

# DESIGN GUIDELINES

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March 2017





## **DESIGN GUIDELINES MARCH 2017 REVISION**

### **INTRODUCTION**

HISD Design Guidelines, Version 3.0, were originally published in August 2013. It is HISD's intention to update the Guidelines on a quarterly basis. Revisions typically will include manufacturer updates for listed materials and new items having been approved and added by the Guideline Review Committee.

The revised Design Guidelines will replace the current version on the HISD website. In addition, an email notification will be issued to all active program managers and architects.

### **FORMAT**

Revised sections will be identified in the header as Version 3.0, Revised Month and Year. Sections not revised will indicate only Version 3.0.

Items deleted by the revision will be struck through, ~~ITEM~~ and new items will be underlined, ITEM.

A new Guideline issue will remove struck through items and remove underlines from the previous issue. The new issue will then follow the strike through, underline process listed above.

### **SECTIONS REVISED IN THE MARCH 2017 ISSUE**

- Section 08 71 00 – Door Hardware
- Section 14 24 23 – Hydraulic Elevators
- Section 22 10 00 – Plumbing Piping
- Section 22 30 00 – Plumbing Equipment
- Section 22 40 00 – Plumbing Fixtures
- Section 23 05 13 – Common Motor requirements
- Section 23 21 13 – HVAC Piping and Pumps
- Section 23 23 00 – Refrigerant Piping
- Section 23 37 00 – Air Outlets and Inlets
- Section 23 52 00 – Boilers
- Section 23 64 00 – Packaged Water Chillers
- Section 23 65 00 – Cooling Towers
- Section 23 70 00 – Central HVAC Equipment
- Section 23 81 00 – Decentralized Unitary HVAC Equip
- Section 26 05 00 – Common Work Results For Electrical
- Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables
- Section 26 05 33 – Raceway and Boxes for Electrical Systems
- Section 26 32 13 – Engine Generators
- Section 26 50 00 – Lighting
- Section 26 55 00 – Theatrical Lighting
- Section 27 50 00 – Local Sound Reinforcement and Intercom Public Address System
- Section 28 13 00 – Access Control and Intrusion Detection System
- Section 28 23 00 – Security Camera Systems



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#### CSI MasterFormat

Section No.	Title	Revision Date
<b>DIVISION 3 – CONCRETE</b>		
03 05 00	Concrete Common Work Results	VERSION 3.0
<b>DIVISION 4 – MASONRY</b>		
04 05 00	Masonry Common Work Results	VERSION 3.0
<b>DIVISION 5 – METALS</b>		
05 05 00	Metals Common Work Results	VERSION 3.0
<b>DIVISION 6 – WOOD, PLASTICS &amp; COMPOSITES</b>		
06 05 00	Wood, Plastics & Composites Common Work Results	VERSION 3.0
<b>DIVISION 7 – THERMAL &amp; MOISTURE PROTECTION</b>		
07 05 00	Thermal & Moisture Protection Common Work Results	VERSION 3.0
<b>DIVISION 8 – OPENINGS</b>		
08 05 00	Openings Common Work Results	VERSION 3.0
<b>DIVISION 9 – FINISHES</b>		
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<b>DIVISION 10 – SPECIALTIES</b>		
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<b>DIVISION 11– EQUIPMENT</b>		
11 05 00	Equipment Common Work Results	VERSION 3.0



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**DIVISION 12 – FURNISHINGS**

12 05 00	Furnishings Common Work Results	VERSION 3.0
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**DIVISION 14 – CONVEYING EQUIPMENT**

14 05 00	Conveying Equipment Common Work Results	VERSION 3.0
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**DIVISION 21 – FIRE SUPPRESSION**

21 05 00	Fire Suppression Common Work Results	VERSION 3.0
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**DIVISION 22 – PLUMBING**

22 05 00	Plumbing Common Work Results	VERSION 3.0
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**DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)**

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27 05 00	Communications Common Work Results	VERSION 3.0
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**DIVISION 28 – ELECTRONIC SAFETY AND SECURITY**

28 05 00	Electronic Safety & Security Common Work Results	VERSION 3.0
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**DIVISION 32 – EXTERIOR IMPROVEMENTS**

32 05 00	Exterior Improvements Common Work Results	VERSION 3.0
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**DIVISION 33 – ELECTRONIC SAFETY AND SECURITY**

33 05 00	Utilities Common Work Results	VERSION 3.0
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## 1. INTRODUCTION

### 1.1. THE HISD 2012 FACILITIES CAPITOL (BOND) PROGRAM

On Nov. 6, 2012, Houston voters by a margin of nearly 2-1 approved a \$1.89 billion bond to replace and repair 40 schools across the district, including 29 high schools.

Planning on the new and renovated campuses has already begun with design work slated to begin in 2013 and construction to begin in 2014. The entire project will be spread out over the next six to eight years to help control costs and allow the district to gradually phase in a 4.85-cent property tax rate increase over the next five years.

The bond program also includes work that will benefit students across the district, including \$100 million in technology upgrades, \$44.7 million to replace regional field houses and improve athletic facilities, \$35 million to renovate middle school restrooms and \$17.3 million for safety and security improvements.

“When this work is finished, Houston will boast the most modern portfolio of urban high school campuses in America,” Superintendent Terry Grier said. “For years, HISD has been a national model for other urban school districts that are striving to simultaneously close the achievement gap while raising the level of achievement of all students, including the highest performers. Thanks to Houston’s voters, we will finally have quality campuses to fully support our students’ strong academic progress.”

Projects funded through the bond program include:

**New campuses for 20 high schools:** Austin, Bellaire, Davis, DeBakey, Eastwood, Furr, High School for the Performing and Visual Arts, Jordan, Lamar, Lee, Madison, Milby, North Early College, Sam Houston, Sharpstown, South Early College, Sterling, Washington, Worthing and Yates

**Partially replacing four high schools:** Waltrip, Westbury, Young Men’s College Prep Academy, Young Women’s College Prep Academy

**Renovating four high schools:** Jones, Kashmere, Scarborough, Sharpstown International

**Converting five elementary schools to K-8 campuses:** Garden Oaks Montessori, Mandarin Chinese Language Immersion School, Pilgrim Academy, Wharton Dual Language School, Wilson Montessori

**Building three new elementary campuses:** Askew, Parker, and relief school on the west side

**Replacing/completing two middle school campuses:** Grady (new addition to complete new campus), Dowling (new campus)

The Board of Education has also agreed to rebuild two schools – Condit Elementary and the High School for Law Enforcement and Criminal Justice – either through the sale of surplus district property or by using any potential leftover bond funds.



## 1.2. PURPOSE AND ORGANIZATION OF THE DESIGN GUIDELINES

The purpose of this document is to provide the Houston Independent School District (HISD/Owner) as well as the Design Professional with a cohesive set of standards and guidelines for creating exemplary 21<sup>st</sup> century learning environments and building systems for new and renovated facilities. These Guidelines have been developed to assist the Architect-Engineer in the planning and design of functional, cost effective and durable educational facilities that are attractive and enhance the educational experience. The Guidelines are the minimum performance base requirements of products, systems, and materials.

The design services of the Architect-Engineer are viewed as financial investments made by the HISD to maximize the value of their resources. Because the HISD is a public institution, the resources spent on a school property must be responsibly accounted for during pre-design, design, construction, commissioning, and over the life of the facility. This Guideline will facilitate and guide the work of the Architect-Engineer towards the goal of maximizing the perceived and real value of a school facility by enhancing the educational environment of the students, and realizing the value of the facility as a capital asset.

## 1.3. APPLICATION OF THE DESIGN GUIDELINES

The design, construction, commissioning, operations and maintenance, and renovation/reuse of a school facility is a complex process which occurs over a period of many years. The following are essential design concepts and issues that, in concert, will enhance the educational environment of the students while realizing the value of the facility as a capital asset over time:

### 1. Safe school site and building design.

- a) Integrate Crime Prevention Through Environmental Design (CPTED) fundamentals such as access control, natural and formal surveillance, territoriality, defensible space, and target hardening.
- b) Integrate Health and Life Safety fundamentals such as separation of auto and bus traffic, reduction or elimination of the need for children to cross vehicle circulation, adequate emergency service access to the site and building(s), avoidance of locations near high tension electrical lines, avoidance of locations near hazardous material or process sites (chemicals, noise, etc.), provision of safe playground equipment, separation of appropriate age groups on the playgrounds, adequate circulation corridors and components, safe classrooms and laboratories, and safe support spaces.
- c) Closely follow all fire codes and requirements, especially as it relates to occupancy types. Provide adequate egress, equipment and separations.

### 2. School facility flexibility/adaptability over time.

- a) Accommodate for possible changes in academic philosophy, academic program mix, student population, and community access/use of school facilities.
- b) Accommodate the need to reduce redundant or specialized spaces by creating shared and/or multi-purpose spaces where possible.

### 3. Be attentive to the community's physical/functional perception of, and relationship with, the school.

- a) Does the school facility have a community presence?
- b) Does the community use the facility after school hours?
- c) Does the school facility present a welcoming, character to the community?

### 4. Establish functional and operational zoning of school functions to ensure [1] an effective public to private sequence of spaces (increases security), and [2] appropriate location of similar functional and operational needs.

### 5. Employ multi-duty (integrated) building structures, systems, and materials to reduce material use and costs, and increase constructability.

### 6. Establish appropriate size/scale/proportions perception of the school facility by the students so



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that the built environment appears welcoming and non-threatening.

7. Employ building commissioning as a proactive process to minimize building system deficiencies at turnover, ensure that owner receives a facility that performs as designed and specified, ensures appropriate indoor environment quality (reduced IAQ liability), improves occupant comfort and productivity, and reduces equipment and system maintenance/operations costs and replacements.

These Guidelines incorporate experiences and lessons learned from past building improvement programs and have been organized in accordance with CSI's format. They are not intended to limit or control opportunities for innovative design but rather to assist the Architect-Engineer in understanding certain planning requirements, design criteria, and concern regarding reduction of resource consumption. The Architect-Engineer of record shall not interpret any of the guidelines as relieving them of their professional responsibility for the design of the project. Nevertheless, whenever the design of facilities varies from the requirements and considerations of the Guidelines, the Designer shall obtain prior approval in writing from the Owner. All designs shall meet the requirements of the Texas Accessibility Standards of the Texas Architectural Barriers Act.

Please note that separate Educational Specifications and Building Programs listing detailed space and equipment requirements will be issued for each building project. In event of any conflict between the two, the Education Specifications shall supersede the requirements of the Guidelines.

These Guidelines should be of great benefit to Designers as well as the Owner. The entire design and construction process will be strengthened and less complicated if all concerned utilize the Guidelines at each phase of project design and approval. It is understood that technological advances will occur rapidly and will cause many of the systems and materials included in this document to be outdated in a short period of time. It is the intent of the HISD to make the Design Guidelines a living document that can reflect advances and changes over time. Updates will occur as new systems and materials are investigated through either research or experience. As the Guidelines evolve, your comments and recommendations are invited for future revisions.



## 1.4 CREATING EXEMPLARY 21<sup>ST</sup> CENTURY LEARNING ENVIRONMENTS

Under the 2012 bond, HISD is committed to building schools that provide a solid foundation for modern learning. The goal of the program is to ensure we are designing facilities that reflect the importance of collaboration, creativity, critical thinking and problem-solving.

Some of the key components of 21<sup>st</sup> century schools include:

- **Flexible spaces:** Education must evolve beyond a traditional classroom configuration.
- **Differentiated learning:** Students have individual learning styles, and a “one-size-fits-all” approach does not engender success.
- **Project-based learning:** When a project has real-world application, student engagement increases.
- **Blended learning:** A way to combine instructor-led classroom learning with mobile and online education using such tools as TV, cell phones, tablets and videoconferencing.
- **Commons:** A place considered the physical “heart” of the school that offers a comfortable place to gather, problem-solve and collaborate.

Additional issues to consider include the student's ability to hear and understand classroom discussions. HISD requires compliance with ANSI Standard 12.60 for Classroom Acoustics to address issues of reverberation time and background noise and their effect on speech intelligibility in the classroom.



## 1.5. SUSTAINABILITY

The 2012 Facilities Capital Program is a continuation of HISD's implementation of sustainable design and construction of facilities. In 2005, the HISD Board of Education authorized use of the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED®) rating system. Numerous HISD facilities have now been designed, constructed, and certified under the LEED program at all certification levels.

It is an expectation that all future projects be designed and constructed using sustainable building principals and that success is documented through higher levels of LEED certification. A minimum of SILVER Level in the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) rating is to be achieved. The application of sustainable practices in the design of new facilities must be an overarching philosophy and guide decisions throughout the design and construction process.

It is an expectation that new buildings be designed to minimize use of non-renewable energy sources. HISD has established goals, including Goal 4 - Increase Management Effectiveness and Efficiency. Reducing energy consumption and using energy resources wisely aligns with this goal.

HISD is continuing to find ways to be "green" and to teach sustainability in classrooms. New buildings provide additional opportunities for students, staff, and communities to engage with design teams who are knowledgeable about sustainable practices. The benefits reach new generations to evolve the changes that are necessary.

A list of all attempted LEED credits shall be included in the **Schematic Design** submission for review and approval by the HISD Facilities Design. **Do not include** credits "Under HISD Consideration".

All attempted credits should be selected in keeping with maintaining the overall construction budget and schedule.

### HISD REQUIRED LEED CREDITS CHART

HISD Req'd.	Not allowed by HISD	Under HISD Consideration	Category and Credit
			<b>Sustainable Sites</b>
		✓	Credit 1 – Site Selection
		✓	Credit 2 – Development density and community
		✓	Credit 4.1 – Public transportation access
		✓	Credit 4.2 – Bike Storage and Showers
		✓	Credit 4.3 - Low Emission and Fuel Efficient Vehicles
	✓		Credit 4.4 - Alternative Transportation – Parking Capacity
		✓	Credit 6.1 - Stormwater design – quantity control
		✓	Credit 6.2 - Stormwater design – quality control
		✓	Credit 7.1 - Heat island effect - Nonroof
✓			Credit 7.2 - Heat island effect - roof
✓			Credit 8 - Light pollution reduction
		✓	Credit 9 - Site Master Plan
✓			Credit 10 - Joint use of facilities
			<b>Water Efficiency</b>
		✓	Credit 1 - Water efficient landscaping
		✓	Credit 2 - Innovative wastewater technologies
✓			Credit 3 - Water use reduction (30% reduction)





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			<b>Energy &amp; Atmosphere</b>
✓			Credit 1 - Optimize energy performance (30%)
		✓	Credit 2 – On-site renewable energy
✓			Credit 3 - Enhanced Commissioning
✓			Credit 4 - Enhanced Refrigerant Management
✓			Credit 5 - Measurement and verification
		✓	Credit 6 – Green Power
			<b>Materials &amp; Resources</b>
		✓	Credit 1.1 - Building Reuse - Maintain Existing Walls, Floors & Roof (75% reuse)
		✓	Credit 1.2 - Building Reuse - Maintain interior nonstructural elements
		✓	Credit 2 - Construction waste management
		✓	Credit 3 - Materials reuse
		✓	Credit 4 - Recycled content
		✓	Credit 5 - Regional materials
		✓	Credit 6 - Rapidly renewable materials
✓			Credit 7 - Certified wood
			<b>Indoor Environmental Quality</b>
✓			Credit 1 - Outdoor air delivery monitoring
	✓		Credit 2 - Increased Ventilation
✓			Credit 3.1 - Construction IAQ Management Plan, During Construction
✓			Credit 3.2 - Construction IAQ Management Plan, Before Occupancy
✓			Credit 4 - Low-Emitting Materials
✓			Credit 6.1 - Controllability of systems - lighting
		✓	Credit 7.1 - Thermal comfort - design
✓			Credit 8.1 - Daylight and views – daylight
✓			Credit 8.2 - Daylight and views – views
✓			Credit 10 - Mold Prevention
			<b>Innovation &amp; Design Process</b>
		✓	Credit 1 – Innovation in design
✓			Credit 2 - LEED Accredited Professional
✓			Credit 3- School as a Teaching Tool



## 1.6. DEFINITIONS AND ABBREVIATIONS

### DEFINITIONS

Throughout this guide, mandated requirements are differentiated from recommendations or commentary as follows:

Mandates: Indicated by use of “**shall**”, “**will**”, “**use**”, or “**shall not**”, “**do not**” (in bold type)

Recommendations or commentary: Indicated by words or phrases such as “should”, “may”, “it is Recommended” and the like. Any such words or phrases indicate an option that is to be decided by the Designer.

**COMMISSIONING-** Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent, basis of design, construction documents and Owner's system operational needs. This is achieved by beginning in the design phase, documenting design intent/basis of design and continuing through construction, building acceptance and the warranty period with actual verification of performance. The commissioning process shall coordinate what have traditionally been separate functions of system documentation, equipment startup, control system calibration, testing and balancing and performance testing. During the Warranty Period, commissioning may be necessary to assist the Owner one time per typical issue to help coordinate resolution of any unresolved issues related to equipment/systems function. The Commissioning Authority (Commissioning Authority (CxA) directs and coordinates all commissioning activities.

### COMMISSIONING DEFINITIONS

- A. Adjustment: To change the speed, flow, position, signal, or level of any piece of mechanical equipment.
- B. Owner's Project Requirements (OPR) - a static document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the owner. It addresses the Owner's Performance Requirements (OPR) and operational needs.
- C. Calibration: To check or adjust the graduations of a quantitative measuring instrument against a known standard.
- D. Critical System: a system that is related to life-safety. This includes, shelter-in-place, emergency backup systems (e.g. generator/automatic transfer switch), emergency lighting, fire smoke dampers, duct detectors, call switches, shunt-trip buttons, refrigerant leak detection and associated exhaust fans and alarms.
- E. Non-critical Systems: are those systems not indicated as critical systems.
- F. Data-logging - monitoring flows, currents, status, pressures, etc. of equipment using stand- alone data-loggers separate from the control system.
- G. Deficiency - a condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not comply with the design intent).
- H. BAS (Building Automation System): Other common acronyms are DDC (Direct Digital Controls), BMS (Building Management System), Facility Control System (FCS) or FMS (Facility Management System). This is the system providing automation functions for control of the HVAC and mechanical systems as well as alarming, monitoring, trending and interface/integration to related building systems such as fire alarm, security, card access, electrical switchgear, and stand-alone controls for major equipment such as chillers.  
Functional Performance Testing (FPT): This portion of the Commissioning Process involves dynamic tests that ensure that all mechanical, electrical and life safety systems function in accordance with design intent. The tests are dynamic and on-line and test the systems through all possible modes of operation.
- J. Installation Verification: This initial portion of the Commissioning Process includes observations and punch-lists recorded and performed by the Engineer



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to ensure that all equipment is installed in accordance with the Specifications and Drawings. The Commissioning Authority shall overview this process.

- K. Power Monitoring System (PMS): This is not synonymous with the FCS system. This is the system providing monitoring / trending / logging data as related to the electrical distribution system bundled loads, e.g. lighting, fans, and major equipment such as chillers and air handlers, etc.
- L. Pre-functional checklists (PC): This portion of the Commissioning Process involves primarily the test and balance and startup personnel to ensure that individual pieces of equipment are capable of performing in accordance with the Specifications, Drawings, and manufacturers' requirements. This is documented with a pre-functional checklist provided and completed by the contractor. The Commissioning Authority shall overview this testing.
- M. Statistical Sampling - Functionally testing a statistically representative quantity (i.e. 15%) of identical or near identical pieces of equipment. Subject to 3% failure threshold whereby if there are greater than 3% testing failures of randomly chosen equipment, the testing shall be noted as failed and the Contractor shall re-verify the startup of 100% of the equipment. An additional identical statistically representative quantity of equipment shall again be tested which shall include a retest of 25% of the failed equipment and 75% randomly chosen untested equipment. This shall be repeated until the testing is noted as passing.  
Any proposed statistical sampling shall be identified in the construction phase commissioning plan and approved by the Commissioning Authority (CxA).
- N. Tuning: To adjust for maximum performance.

### ABBREVIATIONS

**Owner:** Houston Independent School District

**HISD:** Houston Independent School District

**Designer:** Design professional registered to practice in Texas. This **shall** be an architect for the design of all-new structures, additions, and renovations or alterations to existing structures. The scope of the architect's services **shall** include the services of professional engineers to design the structural, plumbing, mechanical and electrical portion of the project. The services of the architect may be deleted and comparable services of an engineer or landscape architect may be substituted in lieu of where a project is almost entirely within the design realm of such professionals.

**Program Manager:** Project Manager

**Learning Center:** Classroom

**Science Learning Center/Wet Lab:** Science Classroom

**Learning Commons:** Library or Media Center

**Visual Arts Learning Center:** Fine Arts

**Instrumental Learning Center:** Band or Orchestra

**Vocal Music Learning Center:** Choir or Choral

**Student Dining Commons:** Dining Room or Cafeteria

**Receiving:** Loading Dock

ADA: American's with Disabilities Act

AHERA: Asbestos Hazard Emergency Response Act of 1987

ASHRAE: American Society Heating, Refrigeration, and Air Conditioning Engineers

ASTM: American Society for Testing Materials

AWI: Architectural Woodwork Institute

BOCA: Building Officials and Code Administrators International

CPSC: Consumer Product Safety Council HVAC:

Heating, Ventilation and Air Conditioning

ICBO: International Conference of Building Officials

TSBC and/or State Building Code: Texas State Building Code including the General, Mechanical, Electrical, Handicap and Gas Volumes.

NEMA: National Electrical Manufacturer's Association



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NFPA:	National Fire Protection Association
NRCA:	National Roofing Contractors Association
OSHA:	U.S. Occupational Safety and Health Administration
SMACNA:	Sheet Metal and Air Conditioning Contractors National Association, Inc.
UL:	United Laboratories, Inc.
TDLR:	Texas Department of Licensing and Regulation
BICSI:	Building Industry Construction Service International
PIMA:	Polyisocyanurate Insulation Manufacturer's Association
TIMA:	Thermal Insulation Manufacturer's Association
ARMA:	Asphalt Roofing Manufacturer's Association
BCR:	Building Communication Room
MDF:	Main Domain Facility
FCR:	Floor Communication Rooms



## 2. PROJECT PROCEDURES AND REQUIREMENTS

### 2.1. DRAWING GUIDELINES

**CAD Files provided shall comply with the following criteria:**

1. AutoCAD 2009 or later. Only 2 dimensional, non-propriety, base AutoCAD objects shall be used.
2. Single .DWG file per floor. Use standard fonts, etc. supplied with base AutoCAD. All pages to include a graphic scale (readable on 8 ½ X 11 pages, a north arrow and the name of the facility.
3. Layers:
  - a. Floor plan (walls, windows and door swings)
  - b. Furniture
  - c. Room Name
  - d. Equipment
  - e. HISD Security (cameras, motions, keypads)
  - f. Plumbing (fixtures)
  - g. Graphic Scale readable on 8 1/2 X 11
  - h. North Arrow
  - i. Room Numbers (Template provided by HISD Program Manager)
4. The ability to plot a Composite floor plan (per floor), where room numbers and names can be read easily (down to, and especially 8 ½ x 11)
5. These drawings shall reflect As-Built conditions; no demolition plans (Base Plan ONLY).
6. All drawings should be printed in 8 ½ x 11 and in .PDF electronically, is the end result desired. This will allow printing in 8 ½ x 11, 11 x 17, etc.
7. Color settings for Black on White.





## 2.2. DELIVERABLE REQUIREMENTS

### SCHEMATIC DESIGN DELIVERABLES

#### GENERAL

The Architect/Engineer Agreement, Article 2.2.10, Schematic Design Documents, states that "Based on the mutually agreed-upon Project Scope, Schedule and Construction Budget requirements between A/E and HISD, or its designated representative, the A/E shall prepare, for approval by HISD, and the PM, Schematic Design Documents consisting of drawings and narrative descriptions necessary to describe the concept of the Project. The Schematic Design Documents shall be provided to the PM for review. The PM shall provide recommendations to HISD regarding the documents. The Schematic Design Documents shall be approved in writing by the PM and HISD before being deemed acceptable."

The following outline indicates HISD's expectations of the products to be submitted during the Schematic Design Phase. Revisions to the deliverables can be negotiated with PM and HISD.

#### A. Schematic Design Report

1. Description of project scope and statement of goals and objectives:
  - a. Building/project statistics
  - b. Program summary including area tabulation
  - c. Owner project priorities
  - d. Issues and/or concerns
2. Narrative descriptions of project features and building systems:
  - a. Description of design features
  - b. Reasoning behind the design
3. Description of materials, systems and equipment:
  - a. Conceptual narrative of major building materials, systems, equipment and room finishes.
  - b. Conceptual structural system description and design criteria.
  - c. Preliminary list of equipment furnished by HISD.
4. Narrative descriptions of engineering systems:
  - a. Documentation of applicable laws, regulations and agencies.
  - b. Summary of available utilities.
  - c. Initial contact and summary of agencies, utilities, etc. having a significant influence on the project. (including but not limited to water, gas, electrical, phone and cable)
  - d. Conceptual HVAC design description with design criteria including owner requirements, codes and standards, temperature ranges, air changes, humidity control, etc. Description shall include a minimum of two HVAC systems that appear compatible with loading conditions for subsequent life-cycle costing.
  - e. Conceptual electrical design description with design criteria including owner requirements, codes and standards, voltages, emergency power needs and communication networks.
  - f. Conceptual plumbing design description with design criteria including owner requirements, codes and standards, temperatures, treatment methods, special drain requirements, etc.
  - g. Conceptual fire protection design description with design criteria including owner and underwriter requirements, codes and standards, location for wet and dry pipe systems, available pressure, emergency power, etc.
  - h. Identify any specialty consultants that are required for the project.
5. Project schedule
  - a. Updated design schedule including all review and approval periods.



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- b. Preliminary construction schedule.
6. Statement of Probable Construction Cost: Provide a cost estimate broken down by major components:
  - a. Verify that all elements have been included by crosschecking against the description of materials, systems and equipment for omissions.
  - b. Include any owner purchased construction elements. (OFCl-Owner Furnished, Contractor Installed)
  - c. Exclude any Owner purchased and installed construction elements. (OFOl-Owner Furnished, Owner Installed)
  - d. Exclude any construction elements designated N.I.C-Not in Contract.
  - e. Include a factor for escalation to the mid-point of construction.
  - f. Include any projected cost implications for LEED Strategy alternates, include pay back assumptions and estimate.
7. Preliminary LEED checklist (use LEED 2009 for Schools New Construction and Major Renovation) indicating schematic process considerations of these strategies. Note points most likely to be attained, those not possible to attain, and those either to be determined or stretch goals with appropriate time and funding focus.

### B. Schematic Design Drawings

The A/E shall develop all designs using Building Information Modeling (BIM). The A/E shall select BIM application(s) and software(s) and develop project designs using commonly accepted BIM software that is compatible with the latest International Alliance for Interoperability (IAI) Industry Foundation Class (IFC) standards. A/E shall use 3D graphic model(s) (the "Model") and associated intelligent attribute data ("Facility Data") created by this software to produce accurate project documents. The submitted Model shall be in a native file format, interactive for the user, and the model shall be capable of being converted to a standard platform or interoperable file format like IFCs.

1. Architectural Site Plan: Complete site plan of the project showing location of the following:
  - a. All buildings, roads, parking, paving, and landscape areas.
  - b. Clear delineation of the project limit lines.
  - c. Existing utilities noted per survey, existing drawings or utility company data.
  - d. Proposed utilities, showing services and structures.
  - e. Preliminary site drainage, storm water removal, and retention.
  - f. Identify number of parking spaces per code/zoning requirements.
  - g. Provisions for trash disposal and removal, service access and loading docks, fire truck access, etc.
  - h. Major mechanical equipment.
2. Building/Floor Plans (including small-scale key plan, if required):
  - a. Plans of all floors showing preliminary structural grid, structural elements, vertical circulation elements, core elements, vertical shafts, interior partitions, floor elevations.
  - b. Key dimensions, bay sizes and overall dimensions.
  - c. Plan indicating major extent of materials and any special conditions or equipment.
  - d. Building section cuts, showing locations of building sections.
  - e. Room names and square footage of room.
  - f. Show project limit lines if not otherwise clear on Site Plan.
  - g. Preliminary finish schedule.
  - h. Summary of program space requirements.
  - i. Locate support spaces (telephone rooms, computer rooms, pump rooms, mechanical rooms, elevator equipment rooms, etc.)

### Schematic Design Deliverables



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- j. Indicate setbacks and overhangs.
3. Roof plan:
  - a. Preliminary structural grid.
  - b. Identification of roof system, deck, membrane flashing and drainage technique
  - c. Indicate overall combined heat transfer coefficient for roof/ceiling composite and roof area.
  - d. Major roof-mounted equipment and openings.
4. Building Sections:
  - a. Include major sections through building to show relevant conditions.
  - b. Preliminary Structural grid.
  - c. Floor to floor height.
  - d. Ceiling heights.
  - e. Keys for typical wall sections.
5. Building Elevations:
  - a. All major elevations with extent of glazing and mullion spacing.
  - b. Minor elevations if they contain significant items.
  - c. All materials called out in notes.
  - d. Floor lines, roofline and top of parapets indicated with dimensions.
  - e. Relationship to existing and finished grade clearly shown.
6. Model or Rendering:
  - a. Model to show massing and site development, or;
  - b. Renderings showing massing and exterior treatment with basic colors and materials indicated.
7. Schematic Details:
  - a. Preliminary wall sections of typical conditions.
  - b. Partial interior elevations of unique features and/or specialized spaces indicating materials and details.
8. Structural:
  - a. Preliminary structural systems layout with overall dimensions and floor elevations. Identification of structural system (precast, structural steel with composite deck, structural steel with bar joists, etc.).
  - b. Identification of foundation requirements (fill requirements, piles, caissons, spread, footings, etc.).
9. Mechanical:
  - a. Conceptual drawings to illustrate major equipment locations and space requirements, and space allocations for major distribution of ducting and piping. Indicate mechanical rooms, major shafts and single-line trunk distribution.
  - b. Development of building shafts, heights, interstitial space with Architectural and Structural.
  - c. Energy sources identified and general entrance location.
10. Electrical:
  - a. Single-line distribution drawings to illustrate major equipment locations and space requirements, and space allocation for major distribution of conduits and/or cable trays.
  - b. Incoming feed(s) identified and general entrance location, pad location.
  - c. Coordination of site lighting and egress from electrical rooms.
  - d. Preliminary schedule of major electrical equipment indicating size and Capacity
  - e. Legend showing all symbols used on drawings.
11. Plumbing:
  - a. Conceptual drawings to illustrate major equipment locations and space requirements, and space allocations for major supply and drain piping.
  - b. Incoming supply and discharge locations identified.
12. Mechanical (Fire Protection):
  - a. Coordinate major equipment locations and space requirements, and space



## BUILDING EXCELLENCE

- allocation for major distribution of sprinkler mains, etc. to be shown on architectural.
- b. Incoming water service location identified.
- 13. Specialty Consultants:
  - a. One line plans as appropriate. (kitchen, labs, etc.)
- 14. Graphics: Documents as required by program.
- 15. Furnishings: Generic furniture layout plans.

### C. Supporting Data

(Should be included in Schematic Design Report or in graphic form as part of the Schematic Design Drawings.)

1. Preliminary Building Code Analysis:
  - a. Confirm all applicable codes.
  - b. Occupancy, load and egress capacity calculations.
  - c. Width of protected corridor and travel distance to exit.
  - d. Type of Construction, user group(s), allowable area tabulations, etc.
  - e. Initial reviews for ADA compliance.
  - f. Verify zoning conformance.
  - g. Verify energy performance requirements.
2. Preliminary Engineering calculations:
  - a. Preliminary HVAC block loads, and conceptual design options analysis and recommendations. Tabulate occupancy assumptions for each area or space.
  - b. HVAC studies. (Building orientation and fenestration, smoke evacuation, heat recovery, life cycle cost analysis, ASHRAE, medical isolation, etc.)
  - c. Preliminary electrical load estimate, and conceptual design options analysis and recommendations.
  - d. Electrical studies. (Preliminary, ASHRAE 90, lighting, NFPA 780 calculations, risk management, secondary vs. primary assessments, etc.)
  - e. Preliminary incoming plumbing demand and discharge loads, and conceptual design options analysis and recommendations. Calculate and confirm plumbing fixture counts.
  - f. Plumbing studies. (ASHRAE 90, water treatment, subsoil perimeter/under slab drainage)
  - g. Preliminary water supply demand (flow and pressure) for fire sprinkler system, and conceptual design options analysis and recommendations.
  - h. Overall life cycle cost analysis for the building to identify different options for HVAC, plumbing and electrical systems.
  - i. Preliminary Energy Assessment as applicable (use LEED 2009 for Schools New Construction and Major Renovation)
3. Design criteria, reports, or drawings by specialty consultants.
  - a. Flow Tests.
  - b. Commissioning Report as applicable
4. Project statistics or other applicable data.

### D. Format

1. Submit "Schematic Design Report" as a bound document in 11"x17" format. Larger drawings may be submitted separately as a 24"x36" or 30"x42" set.

**END OF SECTION**



## BUILDING EXCELLENCE

### DESIGN DEVELOPMENT DELIVERABLES

#### GENERAL

The Architect/Engineer Agreement, Article 2.3.1, Design Development Documents, states that "Upon receipt of written authorization to proceed and based on the approved Schematic Design Documents and comments from HISD and the PM and any adjustments authorized by HISD in the Project Scope, Schedule, or Construction Budget, the A/E shall prepare, for approval by HISD and the PM, Design Development Documents consisting of drawings, outline specifications, and other documents to fix and describe the size and character of the Project as to architectural, structural, mechanical, electrical, and plumbing systems, materials and such other elements as may be appropriate. The Design Development Documents shall comply with the requirements of the PPR, Educational Facility Specifications, and HISD Design Standards. The documents shall be provided to the PM and HISD for review. The Design Development Documents must be approved in writing by the PM and HISD before being deemed acceptable."

The following outline indicates HISD's expectations of the products to be submitted during the Design Development Phase:

In addition to the information required for Schematic Design, include the following. Revisions to the deliverables can be negotiated with PM and HISD.

- A. Architectural Drawings:
  - 1. Architectural Site Plans
    - a. Complete site plan including grading, drainage, storm water removal and retention
    - b. Show trees to remain in relation to building
    - c. Show north arrow
    - d. Show seasonal sun angles (altitude and azimuth)
    - e. Landscape elements (lighting, site furnishings, etc.)
    - f. Spot elevations
  - 2. Building/Floor Plans
    - a. Locate all internal partitions and draw to the appropriate thickness dimension.
    - b. Provide area summary.
    - c. Call out all casework (casework will be in Wet Labs only) and other equipment on plans.
    - d. Label OFCI (Owner Furnished, Contractor Installed) items.
    - e. Indicate major mechanical and electrical systems and their requirements including louvers, areaways and utility entrances.
    - f. Show plumbing fixtures.
    - g. Show internal and external dimensions to locate all features.
    - h. Show all room names and numbers.
    - i. Show exterior and interior doors and door numbers.
    - j. Key all typical partition types.
    - k. Key all references: match lines, building sections, enlarged plans, notes, etc.
    - l. Note finish floor elevations.
    - m. Indicate expansion joints.
    - n. Draw building cores to a larger scale (typically 1/4" = 1'-0"), detail and dimension stairs, elevators, toilets, and shafts, etc. with key to larger plans.
    - o. Draw plans and elevations of key areas (lobby, special spaces) to a larger scale (typically 1/4" = 1'-0") with all surfaces shown and materials called out and keyed to larger plans.
    - p. Preliminary development of details and large scale blow-ups.
    - q. Legend showing all symbols used on the drawings.
  - 3. Roof Plan:





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- a. Indicate structural grid.
  - b. Label roof materials, assemblies and slope criteria and directions.
  - c. Indicate drains, overflows, scuppers, etc.
  - d. Indicate and label roof mounted equipment and openings.
  - e. Indicate and label roof accessories; hatches, skylights, lighting, walkways, etc.
  - f. Preliminary development of details.
4. Reflected Ceiling Plan:
  - a. Tie all finished spaces to building grid.
  - b. Show relationship of ceiling to partitions.
  - c. Indicate location of all ceiling materials including exposed structure.
  - d. Locate all soffits and bulkheads.
  - e. Show skylights.
  - f. Indicate all devices that penetrate the ceiling; lighting, speakers, smoke detectors, HVAC diffusers and grilles, sprinklers, etc.
  - g. Locate access panels.
5. Building Elevations:
  - a. Show all building elevations including roof structures.
  - b. Show all fenestration and relation to floor slabs, windows, doors, and storefront.
  - c. Indicate floor levels and note finished floor elevations.
  - d. Show vertical dimensions and overall building heights.
  - e. Show column centerlines.
  - f. Show expansion joints, panel joints, control joints, and reveals.
  - g. Show, locate and dimension exterior mechanical equipment.
  - h. Note all exterior materials; and show extent of each material.
  - i. Detail elevations at a larger scale (typically 1/4" = 1'-0") as necessary to explain intent. Elements that may require detail elevations include building entrances, special brickwork or masonry, building canopy, etc.
  - j. Key all references: match lines, buildings sections, wall profiles.
6. Building Sections and Wall Profiles:
  - a. Include overall building sections through all major portions of the building in sufficient detail to explain the design.
  - b. Include vertical circulation and clearly show relationships to surrounding buildings.
  - c. Show final vertical dimensional relationships, materials and component relationships.
  - d. Show floor lines and column lines.
  - e. Indicate finished grades around the building.
  - f. Key all references: typical wall profiles and detail cuts.
  - g. Exterior wall sections indicating location and size of fenestration and overall thermal transfer value for exterior envelope.
7. Details:
  - a. Typical details of all major exterior wall assemblies; parapets to foundation.
  - b. Foundation and perimeter treatment details.
  - c. Typical window types, and head, jamb and sill conditions.
  - d. Typical interior and exterior columns.
  - e. Key areas shown including stairs, loading docks, shafts and other condition where wall sections reveal the third dimension.
  - f. Casework elevations and millwork profiles.
  - g. Partition Types.
8. Interior elevations:
  - a. All significant interior spaces.
  - b. Ceiling and plenum spaces.
  - c. Ceiling and floor breaks.



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9. Schedules:
    - a. Finish schedule identifying all finishes.
    - b. Door and frame schedules showing final quantity, type and quality levels.
    - c. Hardware schedule.
    - d. Window and glazing schedule.
    - e. Other schedules as required to fully explain project.
  10. Model or Rendering:
    - a. Updated finished color rendering or model.
- B. Civil Drawings:
1. Site Survey: Prepared by HISD's consultant.
  2. Demolition Plan:
    - a. Indicate all elements of the site to be removed including buildings, utilities, landscaping materials, etc.
    - b. Show construction fencing.
    - c. Do not show contour lines.
  3. Site Plan:
    - a. Building tied down dimensionally be critical dimensions with pertinent adjacencies, street line, property lines, required setbacks, easements, rights of way, manholes, sewers, hydrants, light standards, details references, dimension radii, benches, interfaced with the survey.
    - b. Do not show contour lines or paving joint patterns.
  4. Grading Plan:
    - a. Show new contours with heavy, solid lines and existing contours with dashed lines. Indicate construction improvement footprints including paving and building.
    - b. Do not show demolished elements, utilities, landscaping, etc.
  5. Utility Plan:
    - a. Include all existing and new utilities to the building (electrical, water, gas, telephone and cable).
    - b. Include all sanitary and storm laterals from the building to the mains.
    - c. Include all site storm sewers, inlets, manholes, etc.
    - d. Profiles designed, but not drawn. Do not show contour lines. Do not indicate utilities demolished or removed.
  6. Enlarged Plans:
    - a. Provide as required to clearly indicate the design intent.
    - b. Include joint patterns, paving patterns, critical design elements, stairs, ramps, planters, etc.
  7. Sections:
    - a. Include typical driveway, parking area, and sidewalk cross sections.
- C. Landscape Drawings:
1. Plans:
    - a. Indicate types of major plants and trees graphically and label.
    - b. Describe small scale planting beds.
    - c. Indicate all site furnishings elements, benches, grates, paving patterns, etc.
    - d. Locate irrigation controls.
  2. Schedules:
    - a. Preliminary schedule of major plants and trees.
    - b. Indicate diameter and species of proposed trees.
  3. Details:



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- a. Preliminary details of soil preparation and planting concepts.
    - b. Preliminary details of site elements.
  4. Irrigation Plans:
    - a. Describe irrigation coverage, locations and operational system concept.
- D. Structural Drawings:
  1. Plans:
    - a. Foundation plan including interior and exterior perimeter foundation sizes, footings, piles, caissons, wall, beams and grade beams.
    - b. Framing plans for all floors and with all member sizes located and sized; typical and maximum column sizes, and typical reinforcing for concrete. Include all columns, beams, purlins, joists, etc.
  2. Schedules:
    - a. Footing, beam, column and connections schedules
  3. Sections and Details:
    - a. All penetrations of structural elements noted.
    - b. Special conditions noted (shoring, underpinning, etc.)
    - c. All slab openings, pits, tunnels and ramps shown.
    - d. Typical details for connection and reinforcing.
    - e. Expansion joints located and sized.
    - f. Typical edge of slab details for cladding attachment.
    - g. Location of in-floor electrical system.
    - h. Load key sheet and general notes.
    - i. Final building elevations.
- E. Mechanical Drawings:
  1. Prepare conceptual duct and pipe plans to show the following:
    - a. Single-lines indicating routing of supply and return mains, and risers, with preliminary sizes.
    - b. Typical zoning layout showing terminal boxes, heat pumps, exhaust fans, perimeter radiation, cabinet unit heaters, etc.
  2. Prepare conceptual equipment plans to show the following:
    - a. Preliminary equipment room layouts with minimum service clearances, housekeeping pads, duct layout, and utility routing.
    - b. Preliminary major roof top equipment layouts, clearances and penetrations.
    - c. Devices in ceiling located
  3. Typical section view of critical areas to show coordination between structure, MEP, and ceiling construction.
    - a. System or flow diagrams.
    - b. Preliminary equipment schedules to show capacities, weights, and utility requirements.
    - c. Legend showing all symbols used on drawings.
- F. Electrical Drawings:
  1. Prepare power system plans to show the following:
    - a. Panel board locations, major equipment locations including service entrance, main distribution panels, and preliminary pad(s) sizes and locations.
    - b. Major electrical equipment (switch gear, distribution panels, emergency generator, transfer switches, UPS system, etc.) dimensioned and drawn to scale into the space allocated.
  2. Lighting plan indicating fixture types with location of special controls.



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3. Typical receptacle and device layout plans system or flow diagrams.
  4. Typical layout of fire alarm, security, and communication system(s) devices.
  5. Site plans indicating lighting, security concepts, transformers, pull boxes, manholes, etc.
  6. One-line power diagram.
  7. Equipment, light fixture and panel-board schedules with capacities and appropriate design weights (transformers, major fixtures, etc.).
  8. Design concepts for specialty areas such as laboratories, security, acoustical, A/V, and kitchen.
- G. Plumbing Drawings:
1. Prepare conceptual plumbing plans to show the following:
    - a. Fixtures and equipment locations, emergency eyewash stations, storage tank(s) sizes and locations, major utility routing, and locations of risers, with preliminary sizes.
    - b. Proposed routing and sizes of major utilities to 5' outside of building.
    - c. Proposed roof drain and overflow locations and conceptual drops.
  2. Prepare conceptual equipment room plans to show the following:
    - a. Preliminary equipment layouts with minimum service clearances, housekeeping pads, and backflow preventer size and location.
    - b. System or flow diagrams.
    - c. Preliminary equipment schedules to show capacities, weights, and utility requirements.
- H. Mechanical (Fire Protection) Drawings:
1. Prepare conceptual fire protection plans to show the following:
    - a. Areas/zones protected by wet pipe/dry pipe systems and design densities.
    - b. Areas protected by chemical fire suppression systems and design densities.
    - c. Proposed locations for Siamese connections, fire hose cabinets, routing and location of risers and standpipes, with preliminary sizes.
    - d. Proposed location and size of fire suppression agents.
  2. Prepare conceptual equipment room plans to show the following:
    - a. Preliminary equipment layouts with minimum service clearances, housekeeping pads, and backflow preventer size and location.
  3. System or flow diagrams.
  4. Preliminary equipment schedules to show capacities, weights, and utility requirements.
- I. Technology:
1. Finalize all telecommunication rooms, service entrances and identify all backbone pathways. Plans shall include schematic layouts of headend closets, legends and details.
- J. Outline Specification:
1. Include each Construction Specifications Institute's (CSI) "Master Format, 2012 Edition" section to be used for the project.
  2. Use draft specification format with "Part 1 Scope and Standards" and "Part 2 Material and Equipment" and include quality characteristics.
  3. Each section should be followed by prepared Catalog cuts as appropriate.
- K. Statement of Probable Construction Cost: Provide a cost estimate broken down by major components.



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1. Verify that all elements have been included by crosschecking against the description of materials, systems and equipment for omissions.
  2. Include any owner purchased construction elements. (OFCI-Owner Furnished, Contractor Installed)
  3. Exclude any Owner purchased and installed construction elements. (OFOI-Owner Furnished, Owner Installed)
  4. Exclude any construction elements designated N.I.C-Not in Contract.
  5. Include a factor for escalation to the mid-point of construction.
  6. Include any projected cost implications for LEED Strategy alternates, include pay back assumptions and estimate.
- L. Project Schedule Updates:
1. Identify potential long lead items.
- M. Building Code Analysis:
1. Perimeter allowances/compliance.
  2. Fire protection system including standpipes, signaling, detection, etc.
  3. Reviews, variances, etc. established with authorities having jurisdiction (if applicable).
  4. Egress loads at all exits. (Indicate with a directional arrow and quantify load)
  5. All fire rated partitions with rating.
  6. All firewalls and fire/smoke separation walls and ratings.
  7. Perimeter access for emergency equipment.
  8. General standpipe, Siamese connections or other complimentary fire protection locations.
- N. Mechanical, Electrical, Plumbing and Fire Protection Engineering Data:
1. Finalize design criteria and code reviews for all disciplines.
  2. Computerized HVAC load calculations.
  3. Interior electrical load for systems furniture, receptacles, lighting, food service equipment and any other special use equipment.
  4. Plumbing design calculations.
  5. Fire protection design calculations.

**END OF SECTION**





## BUILDING EXCELLENCE

### CONSTRUCTION DOCUMENT DELIVERABLES

#### GENERAL

In the Construction Documents Phase, the A/E Team will produce a complete, fully coordinated, integrated drawing package which will be used to bid, permit, and construct the project. These drawings, together with the project manual plus any addenda issued during the bidding process plus any contract amendments, become the basis for the construction contract.

The term "Drawings" refers to the graphic description of elements included within the scope of the contract documents.

The term "Project Manual" refers to the written portion of the contract documents. All construction documents will be complete and sealed, signed and dated by the architect or engineer of record prior to printing of bid documents.

All corrections to drawings identified during design development and subsequent intermediate contract documents phase reviews will be completed and incorporated into the construction documents prior to issue.

#### CONSTRUCTION DOCUMENTS

The following outline indicates the drawings in addition to the information required for Design Development Phase to be submitted to HISD during the Construction Documents Phase:

A. Architectural Drawings:

Complete all information not included on Design Development Drawings. Finalize all information.

1. Building Floor Plans
2. Demolition Plans (as required)
3. Larger Scale Floor Plans
4. Roof Plan
5. Reflected Ceiling Plan
6. Building Elevation
7. Building Sections and Wall Profiles
8. Details
9. Interior Elevation
10. Schedules

B. Civil Drawings:

Complete all information not included on Design Development Drawings. Finalize all information.

1. Site Survey
2. Demolition Plan (as required)
3. Site Plan
4. Grading Plan
5. Utility Plan and Profiles
6. Enlarged Plans
7. Sections and Details

C. Landscape Drawings:

Complete all information not included on Design Development Drawings. Finalize all information.

1. Plans



## B U I L D I N G   E X C E L L E N C E

2. Schedules
3. Details
4. Irrigation Plans

D. Structural Drawings:

Complete all information not included on Design Development Drawings. Finalize all information.

1. Plans
2. Schedules
3. Sections and Details

E. Mechanical Drawings:

Final duct and pipe plans to show the following:

1. Double line drawings indicating routing of supply and return mains, and risers, with sizes for ductwork and equipment room piping.
2. Other piping may be single line.
3. Show ductwork on separate sheets, not with utilities.
4. Typical zoning layout showing terminal boxes, heat pumps, exhaust fans, perimeter radiation, cabinet unit heaters, etc.
5. Show location of all dampers and valves.
6. Final equipment plans to show the following:
  - a. Equipment room layouts with minimum service clearances, housekeeping pads, duct layout, and utility routing.
  - b. Roof top equipment layouts, clearances and penetrations.
7. All details, cross-sectional and elevation views as required to show coordination between structure, MEP, and ceiling construction.
8. Air and water flow balancing diagrams.
9. Control schematic, pint listing, and sequence of operation diagrams.
10. Final equipment schedules to show capacities, weights, and utility requirements.

F. Electrical Drawings:

1. Final power system plans to show the following:
  - a. Panel-board locations, equipment locations including service entrance, main distribution panels, and pad sizes and locations.
2. Final lighting plan indicating fixture types with location of controls.
3. Receptacle and device layout plans.
4. Final layout of fire alarm, security, and communication system(s) devices.
5. Site plans indicating lighting, security concepts, transformers, pull boxes, manholes, etc.
6. Final equipment, light fixture and panel-board schedules with capacities and design weights.
7. Final design details for specialty areas such as laboratories, security, acoustical, A/V, and kitchen.

G. Plumbing Drawings

1. Final plumbing plans to show the following:
  - a. Fixtures and equipment locations, emergency eyewash stations, storage tank sizes and locations, utility routing, and locations of risers, with sizes.
  - b. Routing and sizes of utilities to 5 feet outside of building.
  - c. Roof drain and overflow locations.
2. Final equipment room plans to show the following:
  - a. Final equipment layouts with minimum service clearances, housekeeping pads, and backflow preventer size and location.
  - b. System or flow diagrams.



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- c. Equipment schedules to show capacities, weights, and utility requirements.
- H. Mechanical (Fire Protection) Drawings:
  - 1. Final fire protection plans to show the following:
    - a. Areas/zones protected by wet pipe/dry pipe systems and design densities.
    - b. Areas protected by chemical fire suppression systems and design densities.
    - c. Locations for Siamese connections, fire hose cabinets, routing and location of risers and standpipes, with preliminary sizes.
    - d. Location and size of fire suppression agents.
  - 2. Final equipment room plans to show the following:
    - a. Equipment layouts with minimum service clearances, housekeeping pads, and backflow preventer size and location.
    - b. System or flow diagrams.
    - c. Equipment schedules to show capacities, weights, and utility requirements.
- I. Technology:
  - 1. Include final plans, pathways, headend room layouts, backbone schematic diagrams and telecommunication specifications.
  - 2. Include final backbone riser diagrams for all intra-building cross connects and inter-building cross connect locations. Also include service entrances and headend room layouts, wall elevations of all communication rooms, rack elevations, grounding busbar, termination boards, conduits, cables trays, floor penetration locations and pull boxes.
  - 3. Detailed room layouts indicating all technology outlets with identification to determine number of drops to each outlet.
- J. Sustainable Performance (LEED) Reports:
  - 1. Include final design and specified LEED checklist when applicable (use LEED for Schools for New Construction and Major Renovation, Version 2009 or appropriate spreadsheet) indicating points/strategies attained and add/alternatives to gain further cost effective sustainable objectives. Note points already attained, those not possible to attain, and those either to be determined or stretch goals with appropriate time and funding focus. List high performance facility strategies that support life cycle cost approach and resource stewardship.
  - 2. Commissioning Agent Pre-Construction Assessment, as applicable.
  - 3. Energy Assessment and Life Cycle Cost Analysis, as applicable (use LEED for Schools for New Construction and Major Renovation, Version 2009 or applicable).
  - 4. Preliminary Day Light Modeling, as applicable.

**END OF SECTION**



B U I L D I N G   E X C E L L E N C E

SECTION 03 05 00

CONCRETE COMMON WORK RESULTS

GENERAL

- 1.1 All concrete placed in the District shall be tested by a District selected Geotechnical Consultant.

HISD's preference for exterior building material is brick veneer masonry or other appropriate exterior finish material that retains its original color and resist water penetration, stains and deterioration over time. Use of exposed concrete (poured-in-place, precast panels and tilt-wall panels) as an exterior "finish" material is discouraged and must have prior written approval from the District.
- 1.2 Use of fly ash, if allowed, shall be carefully described by the structural engineer and reviewed by HISD Project Manager.
- 1.3 Specify Class A underslab vapor retarder under all slabs on grade in accordance with appropriate ASTM.
- 1.4 Concrete structural components:
  - A. Standardize re-bar grades, sizes, and lengths to the fullest extent possible. Reinforcing steel to be new billet steel conforming to ASTM Standards for the material.
  - B. Provide keyways at all construction joints and include continuous water stops wherever subjected to hydrostatic pressures.
  - C. Slope the top of all exposed exterior concrete surfaces and include drip groove underneath all cantilevered leading edges.
  - D. Limit the use of admixtures to only those specified by the concrete design engineer, indicating exact parameters and conditions upon which a particular admixture is acceptable, and in specific quantities. Do not allow the use of any admixture which is not previously approved in writing by the engineer. No exceptions.

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Revision Date

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Polished Concrete Finishing

VERSION 3.0

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Integrally Colored Concrete

VERSION 3.0

[03 52 16](#)

Lightweight Insulating Concrete Deck

VERSION 3.0



## SECTION 03 35 43

### POLISHED CONCRETE FINISHING

#### GENERAL

- 1.1 The architect should use all applicable references, codes and National industry standards and environmental standards to specify and complete work performed in this division.
- 1.2 Require a warranty for the work specified for at least one year, including cost of refinishing, at no cost to Owner.

#### PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.

#### 2.2 MATERIALS

- A. Equipment to be used for grinding/polishing shall be:
  1. Three-head counter rotating variable speed floor grinding machine.
  2. Dust extraction system and pre-separator.
  3. 75kw MQ power generator or equivalent.
- B. Equipment to be used for grinding/polishing shall possess at least 775 lb. of head pressure.
- C. Equipment to be used for edge grinding/polishing shall be a hand grinder with dust extraction equipment.
- D. Diamond grinding segments shall be:
  1. Metal bonds: 40, 60, 80 and 150 grit.
- E. Diamond polishing pads shall be:
  1. Resin bonds: 100, 200, 400, 800, 1500, and 3000 grit.
- F. Grinding pads for edges shall be:
  1. Resin bonds: 40, 60, 80, 100, 200, 400, 800, 1500, and 3000 grit.
- G. Equipment to be used for densifying and cleaning the floor after grinding/polishing procedure has been performed:
  1. Tennant ride-on auto-scrubber or equivalent with a head pressure of 150 lb.
  2. Follow auto-scrubber's manual for cleaning instructions after densifying and conditioning the floor.
  3. Do not allow densifier to remain inside the auto-scrubber after densifying.
- H. Concrete Densifier:
  1. Liquid hardener/densifier shall be LIQUI-HARD as manufactured by W. R. MEADOWS.
- I. Concrete Enhancer:
  1. Water-based, synthetic polymer concrete floor enhancer shall be BELLATRIX as manufactured by W. R. MEADOWS.
- J. Water: Potable water.

#### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.



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- A. Examine surfaces to receive treatment. Notify architect if surfaces are not acceptable. Do not begin application until unacceptable conditions have been corrected.
- B. Final sheen shall be equivalent to that as accepted on the mock-up.
- C. Coordinate polishing operations with other associated work and trades.
- D. Do not use stain or scuff removing agents.
- E. Begin and complete polishing within two weeks prior to possession date.
- F. Utilize machines to the maximum extent practical to achieve optimum efficiency.
- G. Surface Preparation:
  - 1. Protect adjacent surfaces not designated to receive treatment.
  - 2. Clean and prepare surfaces to receive treatment in accordance with manufacturer's instructions, ensuring that all stains, oil, grease, form release agents, dust and dirt are removed prior to application.
  - 3. Ensure concrete is a minimum of 28 days old.
- H. Application:

To obtain high-gloss finish that will look wet and show mirror-like reflections of side and overhead images (INDUROSHINE PDS-3), ensure applicator follows the applicable procedures incorporating grinding plates in the following order.

  - 1. Verify that the floor is clean and dry prior to polishing procedure.
  - 2. Inspect and verify that the floor does not have curled joints, large cracks, spalling or lippage. If lippage or curled joints are present, refer to Section 03 01 00 – Maintenance of Concrete for corrective procedures.
  - 3. Using the 80-grit metal bond grinding segment, grind the floor surface at a rate of 500 ft.<sup>2</sup>/hr. Vacuum the surface to remove loose particulates.
  - 4. Using the 150-grit metal bond grinding segment, grind the floor surface at a rate of 600 ft.<sup>2</sup>/hr. Vacuum the surface to remove loose particulates.
  - 5. Flood surface with LIQUI-HARD concrete densifier and scrub into floor for 45 minutes, ensuring that no puddling of densifier occurs.
  - 6. Squeegee off excess material.
  - 7. Wait 24 hours.
  - 8. Verify that the floor is dry and clear of debris prior to continuation of polishing procedure.
  - 9. Using the 100-grit resin bond polishing segment, grind the floor surface at a rate of 600 ft.<sup>2</sup>/hr. If scratches from the previous grit are still apparent, decrease the rate of grinding by 100 ft.<sup>2</sup> until scratches are removed. Vacuum the surface to remove loose particulates.
  - 10. Using the 200-grit resin bond polishing segment, grind the floor surface at a rate of 700 ft.<sup>2</sup>/hr. If scratches from the previous grit are still apparent, decrease the rate of grinding by 100 ft.<sup>2</sup> until scratches are removed. Vacuum the surface to remove loose particulates.
  - 11. Using the 400-grit resin bond polishing segment, grind the floor surface at a rate of 700 ft.<sup>2</sup>/hr. If scratches from the previous grit are still apparent, decrease the rate of grinding by 100 ft.<sup>2</sup> until scratches are removed. Vacuum the surface to remove loose particulates.
  - 12. Using the 800-grit resin bond polishing segment, grind the floor surface at a rate of 1000 ft.<sup>2</sup>/hr. If scratches from the previous grit are still apparent, decrease the rate of grinding by 100 ft.<sup>2</sup> until scratches are removed. Vacuum the surface to remove loose particulates.
  - 13. Using the 1500-grit resin bond polishing segment, grind the floor surface at a rate of 1500 ft.<sup>2</sup>/hr. If scratches from the previous grit are still apparent, decrease the rate of grinding by 100 ft.<sup>2</sup> until scratches are removed. Vacuum the surface to remove loose particulates.
  - 14. Using the 3000-grit resin bond polishing segment, grind the floor surface at a rate of 2000 ft.<sup>2</sup>/hr. If scratches from the previous grit are still apparent, decrease the rate of grinding by 100 ft.<sup>2</sup> until scratches are removed. Vacuum the surface to remove loose particulates.



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15. Using the auto-scrubber, clean the floor thoroughly as per the manufacturer's instructions with a white non-woven pad. Pads should be replaced approximately every 30,000 ft.<sup>2</sup>.
- I. Concrete Enhancer
  1. Allow 24 hours before proceeding with concrete enhancer application.
  2. Spray concrete enhancer full strength from container using an industrial sprayer delivering 1/10th of a gallon per minute.
  3. Pre-wet micro-fiber applicator with concrete enhancer prior to use.
  4. Uniformly spread concrete enhancer with a micro-fiber applicator, ensuring that the product is not allowed to dry before spreading is complete. Special caution should be taken to not over apply. A monolithic, thin, even film is desired.
  5. For optimum performance, apply a second coat at a 90° (right) angle to the first coat, after the first coat is thoroughly dry.
  6. Allow 24 hours for concrete enhancer to dry.
  7. Burnish with a hogs hair pad at 2000 rpm, or substitute a diamond pad if necessary.
- J. Protection
  1. Keep surface dry for a minimum of 48 hours after application.
  2. Allow 72 hours before heavy traffic.

**END OF SECTION**





**SECTION 03 36 00**

**INTEGRALLY COLORED CONCRETE**

**GENERAL**

- 1.1 The architect should include in this section integrally colored concrete and curing.
  - A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to Work of this Section.
- 1.2 Require a 4'-0" x 4'-0" mock-up at location of project. For accurate color, the quantity of concrete mixed to produce the sample should not be less than 3 cubic yards (or not less than 1/3 the capacity of the mixing drum on the ready-mix truck) and should always be in full cubic yard increments. Include samples of control, construction, and expansion joints in sample panels. Mockup shall be produced by the individual workers who will perform the work for the Project.

**PRODUCTS**

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines and must be approved by HISD project team to be considered.

**2.2 MATERIALS**

- A. Colored Admixture for Integrally Colored Concrete: CHROMIX P<sup>®</sup> Admixture and CHROMIX ML<sup>®</sup>; L. M. SCOFIELD COMPANY.
  1. Admixture shall be a colored, water-reducing, admixture containing no calcium chloride with coloring agents that are limeproof and ultra-violet resistant.
  2. Colored admixture shall conform to the requirements of ACI 303.1, ASTM C979, ASTM C494 and ASSHTO M194.
- B. Curing Compound for Integrally Colored Concrete: Curing compound shall comply with ASTM C309 and be of same manufacturer as colored admixture, for use with integrally colored concrete.
  1. Exterior Integrally Colored Concrete: LITHOCHROME<sup>®</sup> COLORWAX; L. M. SCOFIELD COMPANY. Use to cure exterior flatwork that will be allowed to cure naturally with only occasional maintenance.
  2. Interior Integrally Colored Concrete: COLORCURE<sup>®</sup> (Pigmented) or CEMENTONE<sup>®</sup> (Clear); L. M. SCOFIELD COMPANY. Use to cure interior flatwork that will receive regular maintenance.

**2.3 COLORS**

- A. Concrete Color[s]:
  1. Cement: Color shall be gray or white.
  2. Sand: Color shall selected by architect and approved by HISD Project Manager.
  3. Aggregate: As selected by architect and approved by HISD Project Manager.
  4. Colored Admixture: As selected by architect and approved by HISD Project Manager.

**2.4 CONCRETE MIX DESIGN**

- A. Minimum Cement Content: 5 sacks per cubic yard of concrete.
- B. Slump of concrete shall be consistent throughout Project at 4-inches or less. At no time shall slump exceed 5-inches. [If super plasticizers or mid-range water reducers are allowed, slump shall not exceed 8-inches.]
- C. Do not add calcium chloride to mix as it causes mottling and surface discoloration.
- D. Supplemental admixtures shall not be used unless approved by manufacturer.



- E. Do not add water to the mix in the field.
- F. Add colored admixture to concrete mix according to manufacturer's written instructions.

## EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.

### 3.2 INSTALLATION

- A. Install concrete according to requirements of Division 3 Section "Cast-In-Place Concrete."
- B. Do not add water to concrete mix in the field.
- C. Surfaces shall be finished uniformly with the following finish (if used):
  - 1. Broomed: Pull broom across freshly [floated] [troweled] concrete to produce [fine] [medium] [coarse] texture in [straight] [wavy] lines perpendicular to main line of traffic. Do not dampen brooms.
  - 2. Swirl: Float concrete. Work float flat on surface using pressure in swirling manner to produce series of uniform arcs and twists. [Use aluminum or magnesium float to produce medium texture.] [Use wood float to provide coarse texture.]
  - 3. Trowel: Precautions should be taken to ensure that the surface is uniformly troweled so that it will not be slippery. Do not over-trowel or burnish the surface.
  - 4. Rock Salt: [Float,] [trowel,] [and] [broom] concrete. Then sprinkle salt on concrete and press into surface leaving only tops of salt grains exposed. After 24 hours, wash salt away with water and brush. Allow surface and impressions to dry before applying curing compound.
  - 5. Sandblast: Allow concrete to cure to sufficient strength so that it will not be damaged by blasting but not less than seven days. Use [light] [medium] [heavy] sandblasting to remove cement mortar from surface and expose aggregate to match originally approved [mockup] [field sample].
  - 6. Exposed Aggregate: Finish concrete and apply chemical surface retarder according to manufacturer's written instructions. Wash surface to match originally approved [mockup] [field sample].

### 3.3 CURING

- A. Integrally Colored Concrete: Apply curing compound for integrally colored concrete according to manufacturer's instructions using manufacturer's recommended application techniques. Apply curing compound at consistent time for each pour to maintain close color consistency.
- B. Curing compound shall be same color as the colored concrete and supplied by same manufacturer of the colored admixture.
- C. Precautions shall be taken in hot weather to prevent plastic cracking resulting from excessively rapid drying at surface as described in CIP 5 *Plastic Shrinkage Cracking* published by the National Ready Mixed Concrete Association.
- D. Do not cover concrete with plastic sheeting.

### 3.4 TOLERANCES

- A. Minor variations in appearance of integrally colored concrete, which are similar to natural variations in color and appearance of uncolored concrete, are acceptable.

## END OF SECTION



## SECTION 03 52 16

### LIGHTWEIGHT INSULATING CONCRETE DECK SYSTEM

#### GENERAL

- 1.1 The architect should include in this section the metal decking, lightweight insulating concrete, and EPS roof insulation, and that all Work be performed by the lightweight insulating concrete sub-contractor.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 QUALITY ASSURANCE
  - A. The applicator should be approved in writing by manufacturer to install the lightweight insulating concrete deck system and have been in business for at least five years, is responsible for ensuring positive drainage (No ponding water will be accepted) and must perform a water test prior to application of roof system.
  - B. Provide a lightweight insulating concrete system with a Class A fire resistance rating and is tested by UL in accordance with the procedures of ASTM E119 and listed in the UL "Fire Resistance Directory".
  - C. The lightweight insulating concrete system shall meet wind uplift standards of UL-90 and must be tested by UL in accordance and listed in the UL "Roofing Materials Directory" for wind uplift resistance.
  - D. Test results shall meet or exceed established Standards.
  - E. The Owner will select the Inspection and Testing Laboratory and pay for the cost of tests to determine the dry density and compressive strength.
  - F. Compressive strength shall be determined in accordance with ASTM C495.
  - G. Test cellular concrete in accordance with ASTM C796.
- 1.4 WARRANTY
  - A. Require the lightweight concrete deck manufacturer to warrant the decking and associated Work in conjunction with the roofing manufacturer from the project date of Substantial Completion as follows:
    1. The warranty shall be a NDL "No Dollar Limit" / no penal sum type, with total replacement cost. Refer to roof system specification section for length of warranty period.
    2. The warranty shall provide manufacturer's maximum extended wind rated coverage (up to Hurricane force winds) as defined by the Beaufort Scale.
    3. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
    4. The full system warranty including lightweight insulating concrete deck, roofing insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
  - B. Require the contractor jointly with any subcontractors employed by him, to guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the lightweight insulating concrete deck will be and remain in good condition for a five year warranty period from the date of substantial completion.

#### PRODUCTS

- 2.1 Limit the following products to the named manufacturers listed below. Manufacturers whose products meet or exceed these specifications and who have manufactured and installed roof



## BUILDING EXCELLENCE

deck materials and systems of the type specified here for a minimum of ten years, and maintains a jointly held source of responsibility with the roofing membrane manufacturer may apply for approval to the District.

- A. Elastizell Corp. of America
- B. Siplast, Inc.
- C. Vermiculite Products Inc.
- D. Celcore, Inc.

### 2.2 MATERIALS

- A. Metal Deck: Minimum 24 gauge corrugated steel decking incorporating a pre-applied galvanized coating conforming to ASTM A653, minimum Class G-90 and having slots in flutes equal to a minimum of 0.75 percent of the deck area.
- B. Insulation Board shall be at least 4 inches thick with a minimum thermal value of 20 R.
  - 1. Approved Products/Manufacturers include "Insulperm" by Siplast, "Starrfoam-HB" by Starrfoam Manufacturing, Inc., "Vermaperm" manufactured by Vermiculite Products Inc., and "Holey Board" manufactured by Houston Foam Plastics.
- C. Any one of the following products from a single manufacturer is approved for use on this Project:
  - 1. Vermiculite: Comply with ASTM C332, produced by a current member of VA. Mix shall be 1:6 with 140 (min) psi at 28 days compressive strength; 48 to 60 pcf wet density, and 25 to 32 pcf dry density.
  - 2. Cellular: Mix shall be 1:3 with minimum compressive strength of 140 psi, cast density of 34-42 pcf.
- D. Use Portland Cement, conforming to ASTM C150, Type I or III.
- E. Admixtures include air entraining types and superplasticizer (water reducer) types as recommended by insulating concrete material manufacturer. Admixtures may be injected into material at the plant. The use of calcium chloride is not permitted.
- F. Require potable water that is clean and free of deleterious amounts of acid, alkali, and organic materials – (Drinkable).
- G. Expansion Joint Material shall be one inch thick of type recommended by insulating concrete material supplier for expansion joints in structural system.
- H. Reinforcing shall be a 3/4 inch long, polypropylene fiber, Fibermix as manufactured by Fibermesh Co. for cellular concrete only.
- I. Nailers: Install required thickness of wood to align with specified thickness of lightweight insulating concrete.

## EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.

### 3.2 INSTALLATION

- A. Expansion Joint Material: Install at the following locations: perimeter of deck, changes in direction of roof deck and structural roof penetrations and expansion joints.
- B. Install slurry coat of lightweight insulating concrete over metal deck to minimum thickness of 1/4 inch over top of flutes of metal decking.
- C. Place insulation boards into slurry within 30 minutes of applying lightweight insulating concrete in accordance with manufacturer's instructions.
- D. Walk board into slurry to ensure proper embedding of insulation boards into lightweight insulating concrete and keying with insulation holes. Hold boards back two inches from all penetrations and perimeter. Place boards with staggered joints in running bond pattern.
- E. Fill holes in the insulation boards and place a two inch minimum thickness of lightweight insulating concrete over top of the insulation boards within four hours after installation of



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- insulation boards. Build all crickets and saddles shown with lightweight insulating concrete sloped to drain as indicated on drawings.
- F. Deposit insulating concrete fill and screed (without troweling, rodding, tamping, or vibrating) immediately after mixing. Place on surfaces clean and free of loose matter. Place no concrete when temperature is 40 degrees F or falling.
  - G. All wood blocking for deck penetrations support and low roof deck to rise wall blocking shall be installed one inch higher than designed lightweight fill thickness. Install fill in a two foot tapered edge condition.
  - H. Allow insulating concrete fill to dry as thoroughly as possible before application of roofing, and not less than the minimum time recommended by the manufacturer. Begin roofing when the insulating concrete fill can withstand construction traffic (usually two to three days after placement), verify/confirm with manufacturer's recommendations. Do not leave insulating concrete fill deck surface exposed for longer than ten days. Install no more insulating concrete fill than can be roofed within the ten day time limit.
  - I. Add two pounds of fiber reinforcing per cubic yard of lightweight insulating concrete if cellular concrete is used.

### 3.3 FIELD QUALITY ASSURANCE

- A. The Owner will select the independent inspection and testing laboratory and pay for the cost of tests.
- B. The independent inspection and testing laboratory will randomly sample and verify the following:
  - 1. Mix design compressive strength in accordance with ASTM C495.
  - 2. Mix design wet and dry density range in accordance with ASTM C495.
  - 3. Polystyrene insulation density in accordance with ASTM C578.
  - 4. Base ply fastener pull tests shall be performed three days or more following the installation of the lightweight insulating concrete to ensure a minimum withdrawal resistance of 40 pounds per fastener. Submit test results to Architect.
  - 5. Thermal insulation value in accordance with ASTM C177
- C. Retests for work which fail initial tests or inspections shall be paid by contractor.
- D. Results of all tests will be made available to all concerned parties.
- E. Water Test: The lightweight insulating concrete shall slope to drain and no ponding of water will be accepted. Also, no slopes less than 1/4 inch per foot will be allowed.

**END OF SECTION**



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SECTION 04 05 00

MASONRY COMMON WORK RESULTS

GENERAL

- 1.1 HISD's exterior material preferences are brick, plaster and metal panels and in limited areas: structural glazed tile, cast stone and split-face concrete block. The finish materials should retain their original color and resist water penetration, stains and deterioration over time.
- 1.2 ***To ensure proper flashing and moisture and vapor barrier application, the window system shall be installed prior to the brick veneer.*** At all masonry openings, detail a metal drip between the lintel and the masonry to cause rainwater to drip off masonry rather than draining underneath the opening across the lintel and soffit. A membrane flashing in the wall construction shall catch condensate within the wall and direct moisture onto the metal drip. Weep holes across the masonry opening shall also be utilized.
- 1.3 For building interior, bull nose all exposed exterior CMU corners, except where ceramic wall tile is scheduled.
- 1.4 Do not specify concrete block masonry to be used as an exterior finished surface, unless approved by HISD Project Manager.
- 1.5 All masonry units shall be above grade. All masonry walls shall have expansion/contraction joints as recommended by the Masonry Institute.
  - A. Joints for expansion, contraction, and building movement shall be sealed to prevent weather and water from penetrating to the interior of the building. Refer to Division 7.
  - B. All vertical weeps shall be drained at finish floor or not less than 8 inches above finish grade.
  - C. Through-wall flashing, as recommended by the Masonry Institute, shall be provided at parapet wall caps, window heads, shelf angles and at all brick ledges.
  - D. Masonry anchors to structured steel framed shall be of flexible design, i.e. wire tie strap anchors. Corrugated metal ties are not acceptable.
  - E. Provide appropriate through-wall flashing and install honeycomb-style "weeps" per local Municipal jurisdiction requirements.
  - F. Protect the top of all masonry walls with metal copings to prevent the entry of moisture and the resulting efflorescence.
- 1.6 When face brick is to be used, specify at least two equivalent brick veneer of choice rather than specifying an allowance. Also, consideration should be given to compatibility of the brick with other structures on campus as well as the surrounding neighborhood.
  - A. Durability and availability for current projects and future additions should be considered. When attempting to match an existing brick, the manufacturer and manufacturer's number of the matching brick should be specified. Avoid specifying any type of masonry unit that is non-standard, or has a high possibility of being discontinued or difficult to match, or requires a long lead time for delivery. Specify that open cavities of all walls under construction be covered at day's end - and enforce it.
  - B. Face Brick: Include only a medium hardness clay brick, with moderate water absorption characteristics. Omit "Mexican brick" and extremely hard brick from consideration. A velour or similar faced surface is preferable. Do not use machine textured, slurried, or scratched faced brick, or ones made with highly contrasting color blends.
  - C. HISD must approve brick selection as well as contractor provided mockup required.
  - D. Use a tooled/concave joint on all exterior masonry. Neatness of masonry work and tooling of joints shall extend the full height of masonry, regardless of ceiling requirements.



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E. Always consider large face brick on a wall three stories or higher.

1.7 Use of split-face CMU on interior shall have a clear sealer approved by block manufacturer.

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SECTION 04 20 00

UNIT MASONRY

GENERAL

- 1.1 The architect should include in this section: concrete masonry units (CMU), face brick, including solids and mortar, grout, reinforcement, anchorages, flashing, and accessories shown, specified, or required to complete Work.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 QUALITY ASSURANCE
  - A. Where indicated or required, provide materials and construction which are identical to assemblies whose fire endurance has been determined by testing in compliance with ASTM E119 by U.L.
  - B. Single Source Responsibility:
    1. Obtain masonry units of uniform texture and color, or a uniform blend within the accepted ranges for those characteristics, from one manufacturer.
    2. Brands of cementitious materials and admixtures, and the source of supply of sand and aggregates shall remain the same throughout the Work.
- 1.4 REQUIRED TESTS, INSPECTIONS AND COORDINATION
  - A. Require for the materials and installation of masonry shall be subject to testing and inspection by an independent testing laboratory. Such tests and inspections shall not relieve Contractor of responsibilities for providing materials and procedures which comply with Contract Documents.
  - B. Openings and chases for heating, plumbing, electrical ducts, pipes, and conduits shall be built into masonry walls as required. Provide for installation of bolts, toggles, flashings, beams, anchors, hangers, nailing strips, wall plugs, and frames as required. Consult other trades in advance and make provisions for installation of their work to avoid cutting and patching. Coordinate installation of steel reinforcement for reinforced masonry. Coordinate placement of concrete in masonry beams, lintels, soffits, and pilasters.
  - C. Require coordination with work of Section 07 11 00, Dampproofing above Grade and all Sections of Work built-in, adjacent to, or applied to unit masonry work.
- 1.5 Require a warranty for the work specified for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
  - A. Defects shall include noticeable deterioration of unit or mortar finish, chalking or dusting excessively, changing color in irregular fashion, cracking or spalling, releasing from substrate and staining or discoloring, including efflorescence.

PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of the guidelines. Other approved manufacturers must have supplied a 500,000 brick project in the last 5 years within the purposed project area to be considered.
- 2.2 MATERIALS
  - A. Concrete Masonry Units (CMU/Block):
    1. Type/Sizes:



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- a. Concealed cavity block and interior block, unless otherwise noted shall be regular smooth face units with 8 inch by 16 inch face dimensions as required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
    - b. Exterior exposed block shall be integrally colored face units with 8 inch by 16 inch face dimensions or required, 4 inch, 6 inch, and 8 inch depths as indicated on drawings.
  2. Integral Water Repellant (In exterior exposed CMU) shall be a "Dry-Block Block Admixture" as manufacturer by W.R. Grace & Co., or equal. Require liquid polymeric, integral water-repellant admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
  3. Comply with ASTM C90 (Class D-2 (2 hour) and Class B-4 (4 hour)) block at rated walls) with a type N grade for the highest standard for typical cavity block and interior use. Type S, for exterior exposed masonry walls. Aggregate should be lightweight in accordance with ASTM C331
  4. Curing should be a rotary kiln process.
  5. Provide bullnose units at all outside corners, except where ceramic wall tile is scheduled.
  6. Provide graffiti protection on split faced CMU.
  7. Provide bond beams, control joints, jambs, lintels, soaps, cap blocks, and fillers to match and compliment block units as shown or required.
- B. Face brick, complying with the requirements of ASTM C216 or C652, Grade SW.
  1. Specify brick that has an initial rate of absorption less than 30g/30 sq. in. per minute when tested per ASTM C67.
- C. Mortar:
  1. Mortar, unless stated otherwise in structural drawings, should be made of portland cement: ASTM C150, Type 1, hydrated lime: ASTM C207, TYPE "N", typical (TYPE "S" for load-bearing masonry), aggregate: sand conforming to ASTM C144, and clean and potable water.
    - a. Admixtures For Mortar include spectrum mortar color for face brick and concrete masonry units. In general, do not use calcium chloride.
  2. Mix Design: (Proportions by volume) (Unless stated otherwise on Structural Drawings)
    - a. Typical, Non-load bearing masonry shall comply with ASTM C270, Type "N" with proportions of 1 part cement, 1 part hydrated lime and 6 parts sand to provide a compressive strength of 750 psi in 28 days. Do not use calcium chloride.
    - b. Load bearing structural masonry shall comply with Type: ASTM C270, Type "S" with proportions of 1 part cement, 1/2 part hydrated lime and 4-1/2 parts sand to provide a compressive strength of 1800 psi in 28 days. Do not use calcium chloride.
- D. Grout:
  1. Grout shall be made of hydrated lime: ASTM C207, TYPE "S", Portland cement: ASTM C150, Type 1, clean, potable water and aggregates. Course aggregate shall conform to ASTM C404 and fine aggregate shall conform to ASTM C144.
  2. Mix Design shall comply with ASTM C476 to provide a compressive strength of 2,500 psi in 28 days, unless noted otherwise. Do not use calcium chloride.
    - a. Fine grout conforming to ASTM C476 and consisting of 1 part Portland cement, 0 to 1/10 part lime and 2-1/4 to 3 parts sand by volume.
    - b. Course grout conforming to ASTM C476 and consisting of 1 part Portland cement, 0 to 1/10 part lime and 2-1/4 to 3 parts sand, and 1 to 2 parts course aggregate.
- E. Reinforcement, Anchors and Tie Systems:



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1. Reinforcement shall be used in all wythes shall be galvanized after fabrication in accordance with ASTM A153, Class B-2.
  2. Pre fab corners and tees shall be used at all wall corners and intersections.
  3. Anchors detailed on Structural Drawings supersede.
- F. Block Insulation:
1. Rigid Core Inserts shall be "U" shaped insulation inserts conforming to ASTM C578, replacing Federal Specification (FS) HH-I-524C, Type I, specification for Preformed Cellular Polystyrene Thermal Insulation. Sizes, as required for 6 inch, 8 inch, 10 inch, and 12 inch blocks as shown or required.
  2. Loose Core Fill should be loose perlite or vermiculite insulation conforming to ASTM C332, Standard Specification for Lightweight Aggregates for Lightweight Concrete. Loose fill insulation shall be certified asbestos-free.
  3. Foamed-In Place Block Insulation shall be a two component system consisting of amino-plast resin and a catalyst foaming agent surfactant.
    - a. It should be designed to completely fill irregular or hard-to-reach spaces, can be installed in both new and existing concrete masonry unit construction, have excellent energy and sound insulation values, have no settling or expansion after installation, superior fire and safety performance, no CFC's or HFC's and is safe for the environment.
  4. Sand Fill should be clean, dry sand of type recommended to suit application.
- G. Precast Concrete U-Lintels
1. Concrete Materials are portland cement: ASTM C150 Type I or III, gray color, Aggregates: ASTM C33, potable water and shall contain calcium chloride or chloride ions.
  2. Reinforcing include deformed reinforcement: ASTM A615 Grade 40 or 60 and prestressing strand: ASTM A416 270 ksi LL.
  3. Fabrication, unless specified otherwise, shall conform to PCI MNL-116. U-lintel units 14 feet in overall length and shorter shall be made of concrete with a minimum strength of 3500 psi at 28 days. U-lintel units exceeding 14 feet in overall length shall be made of concrete with a minimum strength of 6000 psi at 28 days and shall be prestressed concrete. Units shall be sand block finish except prestressed, 6 inch wide, and 12 inch wide U-lintels shall be smooth form finished. Tolerances shall be per PCI MNL-116. Minor patching in plant is acceptable provided structural adequacy of units is not impaired
- H. Miscellaneous Materials:
1. Reinforcing Steel: ASTM A615, Grade 60.
  2. Form grade plywood with wood studs and wales as required.
  3. Patented shores of design and manufacture sufficient to safely support imposed loads.
  4. Premolded Filler shall be fibrous mastic strips containing 35 percent to 50 percent asphaltic impregnation, ASTM D1751.
  5. Flashing Cement shall be "Nervaplast" cold setting mastic
  6. Building Felt shall be No. 15 asphalt saturated felt, ASTM D226.
  7. Request 16 gauge galvanized dovetail corrugated masonry anchor, 1 inch x 3-1/2 inch.
  8. Headed Stud Anchor shall be welded by full-fusion process.
  9. Bolts shall comply with ASTM A307. Furnish with carbon steel washers.
  10. Deformed Bar Anchors shall be welded by full-fusion process.
  11. Reinforcing Bars to be welded per ASTM A706.
  12. Cavity Drainage Protection shall be 2 inch thick by 10 inch high by 5 feet long recycled polyester/ polyethylene mesh, trapezoidal-shaped, continuous at foundation, at heads above openings, and shelf angles.
  13. Masonry Color should be an iron oxide pigment conforming to ASTM C979 shall be inert, stable to atmospheric conditions, sunfast, weather resistant, alkali resistant, water insoluble, and free of fillers and extenders.



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14. Weep Hole Vents are injection molded vent made from flexible polyvinyl chloride in an offset "T" shape, inserted in head joints, the slotted leg of the vent allows air to pass in and out allows water to weep out and prevents water from penetrating in. Weep hole vents shall be sized to match masonry (possible custom sizing).

### 2.3 MASONRY CLEANING MATERIALS

- A. Water: Clean, potable, and free of oils, acids, alkalis, salts, and organic matter. Use to rinse masonry surfaces and dilute concentrated cleaners.
- B. Chemical cleaner may be used, verify product use based on masonry color being cleaned as instructed by manufacturer.
- C. Muriatic acid is not permitted.

## EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.

- A. Provide forms and shores sufficiently strong and rigid as required to support soffits, beams, and lintels during construction.
- B. Build forms to conform to shape, line, and dimension of masonry members as detailed, substantial and sufficiently tight to prevent leakage of mortar, grout or concrete. Properly brace or tie together so as to maintain position and shape.
- C. Concrete Masonry Units, where cutting is required, masonry shall be cut with a sharp masonry saw. Ensure concrete masonry units to receive sand fill are ready for filling and cutouts are protected from material spillage.
- D. Dampen brick before laying in a manner consistent with the nature of the brick, the mortar, and the weather conditions.
- E. Mortar and Grout:
  1. Use suitable containers for material measurement. Measuring sand by the shovel is not acceptable. Thoroughly machine mix a min. of five minutes after all materials are in mixer. Consistency will completely fill all spaces intended to receive grout. Use within 2-1/2 hours of initial mixing. Mortar or grout shall not be used if curing has progressed to yield a stiff consistency.
- F. Reinforcement:
  1. Reinforcement shall be free from loose rust and other coatings that would reduce the bond. Cut accurately to length and bend by such methods as will prevent injury to the material. Straighten out kinks or bends.
- G. General:
  1. Do not use chipped or cracked concrete masonry units (CMU) and face brick, where exposed to view.
  2. Use masonry saws to cut and fit exposed units.
  3. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  4. Exposed masonry at exterior corners shall be solid units.
  5. Clean surface of masonry smooth and free from projections which might puncture or otherwise damage flashing material.
  6. Place through-wall flashing as follows:
    - a. Place on bed of mortar and cover with mortar.
    - b. Provide at steel columns and beams in exterior masonry walls and elsewhere as indicated on the drawings or required.
    - c. Install asphalt laminated copper membrane as base flashing at all exterior cavity walls below weep holes.
    - d. Install at material transitions inside exterior cavity walls, roof edge/exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior wall sill/weep conditions, exterior door and



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window frame perimeters, roof deck/exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps or openings to ensure a continuously sealed building envelope.

7. Lay masonry units plumb, true to line, and with level courses accurately spaced within allowable tolerances.
  8. Do not furrow bed joints.
  9. Stop off horizontal run by racking back in each course; toothing is not permitted.
  10. Adjust units to final position while mortar is soft and plastic.
  11. If units are displaced after mortar has stiffened, remove, clean joints and units and re-lay with fresh motor.
  12. When joining fresh masonry to set or partially set masonry, remove loose masonry units and mortar and clean and lightly wet exposed surface of set masonry prior to laying fresh mortar.
- H. Fill Metal Door jamb frames with solid with mortar. Build in anchors.
- I. For Lintels and Bond Beams, provide reinforced unit type, except where steel lintels are shown. Use reinforcing bars as shown on the drawings. Completely fill in lintel block and bond beams with grout. Provide 8 inch bearing at end of lintels.
- J. Connect corners with No. 9 galvanized wire or corrugated tie using one tie for each 4 inches of nominal wall thickness.
- K. Allow space at top of horizontal spanning walls for compressible joint back-up and sealant as specified in Sealant section. Anchor top of walls to deck or structure.
- L. Mortar Beds:
1. Place mortar in a manner which will result in the development of adequate bond between the masonry and the reinforcement.
  2. Lay units with full mortar coverage on horizontal and vertical joints in all courses.
  3. Provide sufficient mortar on ends of masonry unit to fill head joints.
  4. Rock closures into place with head joints thrown against two adjacent masonry units in place.
  5. Do not pound corners or jambs to fit stretcher units after setting in place.
  6. Where adjustment to corners or jambs must be made after mortar has started to set, remove mortar and replace with fresh mortar.
- M. Mortar Joints and Patterns:
1. Lay CMU in running one-half (1/2) bond pattern, unless noted otherwise.
  2. Lay brick in running one-third (1/3) bond pattern, unless noted otherwise on drawings. Refer to drawings for accent coursing.
  3. Provide flush joints where concealed from view and where dampproofing is scheduled.
  4. Provide standard concave tooled joint where masonry is exposed to view for brick and CMU, typically.
  5. All mortar joints to be of consistent size.
  6. Provide soldier courses where indicated, refer to the elevations.
  7. All horizontal joints shall be concave tooled joint at face of units, unless noted otherwise.
- N. Reinforcement, Anchor and Tie Systems:
1. Completely embedded in mortar or grout.
  2. All reinforcement consisting of bars or wire 1/4 inch or less in diameter embedded in the horizontal mortar joints shall have no less than 5/8 inch mortar coverage from the exposed face.
  3. Where modular brick is used with brick coursing at 16 inches on center, provide ladder reinforcing within each wythe at 16 inches o.c. vertically for exterior wythe and back-up wythe, whether detailed or not.
  4. Veneer anchors at exterior sheathed covered metal stud exterior walls shall be attached on outside face of sheathing using cadmium plated sheet metal screws.





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- Spacing shall be same as stud spacing o.c. horizontally and 16 inches o.c. vertically.
5. Veneer anchors at Interior brick walls with metal stud back-up shall be the same as Paragraph "d" above, except anchors shall be attached directly to metal stud with recommended corrosion resistant fasteners in accordance with manufacturer's recommendations.
  6. At intersection of all perpendicular masonry walls provide two vertical rows of ladder type reinforcing at 16 inches o.c. vertically.
  7. Weld veneer anchors to structural steel in accordance with manufacturer's recommendations. Touch-up steel shop paint and galvanized coating on anchor with proper touch-up paint to match damaged coating in accordance with manufacturer's recommendations.
  8. In cavity walls with CMU back-up, embed truss type horizontal reinforcement with integral adjustable pintle wall ties every 16 inches o.c. vertically.
  9. Splices in reinforcement: Splices may be made only at such points and in such manner that the structural strength of the member will not be reduced. Lapped splices shall be eight inches. Welded or mechanical connection shall develop the strength of the reinforcement.
  10. Corrugated strap ties shall not be used as veneer anchors at exterior or where subject to moisture. Their use in interior, dry conditions are acceptable.
  11. Place joint reinforcement in the first two bed joints above and the first two bed joints below masonry openings. Extend extra reinforcing two feet beyond jambs. Provide masonry ties at floor and roof decks as indicated.
- O. Lay masonry units plumb, level, and true to line with full head and bed joints. Butter ends of masonry with sufficient mortar to fill head joints. Do not furrow bed joints. Slope top of bed joint toward center of wall to minimize amount of mortar forced into grout space. Remove mortar, protruding from joints into grout space, before pouring grout.
- P. Reinforcing Bars:
1. Hold vertical bars in position at top and bottom and at intervals not exceeding eight 8 feet-0 inches with a minimum clearance of 1/4 inch from masonry and not less than one bar diameter between bars.
  2. When a foundation dowel is not in alignment with a vertical block cell or pilaster, slope it not more than one horizontal in six vertical to bring it into proper alignment before grouting.
  3. Place horizontal reinforcing bars in continuous masonry courses, consisting of bond-beam or trough block units, and solidly grout in place.
  4. Use straight reinforcing bars except for bends around corners and where bends or hooks are detailed on plans.
  5. Lap reinforcing steel 40 bar diameters minimum where spliced and wire together.
- Q. Where detailed place grout in reinforced masonry beams, walls, columns, and pilasters. All cells and spaces containing reinforcing bars shall be filled with grout. Wherever possible grouting shall be done from inside face of masonry. Exercise extreme care to prevent grout from staining face of masonry. Immediately remove any spilled grout from face and top of masonry.
1. Prior to grouting clean space so that all spaces to be filled with grout do not contain mortar projections greater than 1/2 inch, mortar droppings or other foreign material. Grout shall be placed so all spaces designated to be grouted shall be filled with grout and grout shall be confined to those specific spaces.
  2. Grout materials and water content shall be controlled to provide adequate fluidity for placement, without segregation of constituents and shall be mixed thoroughly.
  3. Between grout pours a horizontal construction joint shall be formed by stopping all wythes at the same elevation and with grout stopping a minimum of 1-1/2 inches below a mortar joint, except at top of wall. Where bond beams occur, stop grout pour a minimum of 1/2 inch below top of masonry.



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4. Reinforcement shall be placed prior to grouting. Bolts shall be accurately set with templates or equivalent means and held in place to prevent movement.
5. Segregation of grout materials and damage to masonry shall be avoided during the grouting process. Adequately brace masonry to prevent displacement or cracking during grouting operations.
6. Grout shall be consolidated by mechanical vibrator during placing, before loss of plasticity, in a manner to fill grout space. Grout pours greater than 12 inches shall be reconsolidated by mechanical vibration to minimize voids due to water loss. Grout pours 12 inches or less in height shall be mechanically vibrated, or puddled. Grout shall not be handled nor pumped utilizing aluminum equipment.
7. Size and height limitations of grout space or cell shall be as follows:

GROUT TYPE	GROUT POUR MAX. HEIGHT (FEET)	LEAST CLEAR DIMENSIONS		CLEANOUTS REQUIRED
		Width of Grout Space (In.)	CMU Cell Dim. Dims. (In. x In.)	
Fine	1	3/4	1-1/2 x 2	No
Fine	5	1-1/2	1-1/2 x 2	No
Fine	8	1-1/2	1-1/2 x 3	Yes
Coarse	1	1-1/2	1-1/2 x 3	No
Coarse	5	2	2-1/2 x 3	No
Coarse	8	2	3 x 3	Yes

- a. Clear dimension is the cell or grout space width less mortar projections.
  - b. Grout space width shall be increased by the horizontal projection of the diameters of horizontal bars within the cross section of the grout space.
8. Place grout in lifts not exceeding 8 feet-0 inches.
- R. Concreting: Supervise placing of concrete in cores of masonry beams and lintels and over masonry soffits where structural concrete is detailed. Report discrepancies or procedures which may adversely affect performance of masonry work.
- S. Brick Weepholes:
1. Provide weepholes above all thru-wall flashings where weepholes occur at the base of the wall. The mason shall coordinate the location of the thru-wall flashings with the location of the sidewalks on the civil engineering drawings. Both weepholes and thru-wall flashings shall be above the first course of brick above the sidewalks. Pay particular attention to areas near exterior doors.
  2. Ensure cavity drainage protection is properly installed.
  3. Leave head joint free and clean of mortar.
  4. Spacing: 20 inches on center maximum for king sized brick, and 24 inches on center for modular brick and block, unless shown otherwise.
  5. Keep weepholes and area above flashing free of mortar droppings.
  6. Coordinate weep holes to be located above sidewalks and paving.
- T. Sealant Joints:
1. Allow for sealant joints around outside perimeters of exterior doors, window frames and other wall openings. Have a uniform depth of 3/4 inch and a uniform width as shown on the drawings but not less than 1/4 inch.
- U. Movement Joints (Expansion Joints and Control Joints):
1. Locate expansion and control joints as shown on drawings, or if not shown, comply with the following:
    - a. Vertical expansion joints shall be placed in the brick wythe and control joints shall be placed in the concrete masonry wythe, although they do not necessarily have to be aligned.
    - b. Mortar and joint reinforcement shall not bridge brick movement joints.





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- c. Mortar joints which stop at the expansion joint cavity shall be struck flush with the masonry unit, producing a continuous flat surface for the sealant to adhere to.
- d. Vertical Expansion Joints should be located on long straight walls without openings maximum 25 feet-0 inches.
- e. Locate expansion joints at the corner of walls perpendicular to one another. In instances, where the joint is not desired at the corner, the expansion joint shall be located within 10 feet-0 inches of the corner in either wall, but not necessarily both. The spacing of expansion joints around a corner shall not exceed the spacing of expansion joints in a straight wall. For example, if the spacing between expansion joints on a straight wall is 25 feet-0 inches, then the spacing of expansion joints around a corner could be 10 feet-0 inches on one side of the corner and 15 feet-0 inches on the other side. Joint reinforcement may be added around wall corners to provide added tensile strength to the corner, but joint reinforcement shall not bridge the expansion joint.
- f. Offsets and Setback expansion joints shall be located at 10 feet-0 inches maximum on one side of the offset or setback. The spacing of expansion joints around an offset or setback shall not exceed the spacing of expansion joints in a straight wall. See expansion joints at corners of perpendicular walls to one another above for example of spacing.
- g. Openings (Doors and Windows):
  - 1) Locate vertical expansion joints along the edge or jamb of the opening of windows and doors. Single opening windows and doors under 6 feet-0 inches in width shall have expansion joint on one side of the edge or jamb of the opening, unless shown otherwise on drawings. Windows and doors 6 feet-0 inches and over in width shall have expansion joints on both sides of the edge or jamb of the opening.
  - 2) Where masonry above an opening is supported by shelf angles attached to the structure, a vertical expansion joint shall be located alongside the opening, continuing through the horizontal support.
  - 3) Where masonry above the opening is supported by loose lintels (unattached to the structure), special detailing and construction is required. If the expansion joint runs along side the opening, the loose steel lintel shall be allowed to expand independently of the masonry. To accomplish this, form a slip plane with flashing located above and below the angle. A backer rod and sealant shall be installed in front of the toe of the angle, and space shall be left at the end of the angle. Thus, a pocket will be formed which will allow movement of the steel angle within the brickwork. If the joint cannot be built in this manner, then the vertical expansion joint shall not be located alongside the opening, but rather, the joint shall be located halfway between the openings.
- h. Intersections and Junction expansion joints shall be located at intersections of masonry walls and walls which serve different functions. If the masonry is not required to be bonded at the intersection, an expansion joint shall be incorporated. Walls which intersect at other than right angles are also vulnerable to cracking at the intersection. Locate expansion joint to separate adjacent walls of different heights to avoid differential movement, especially if the difference is very large.
- i. All vertical expansion joints shall be carried through the parapets. Additional expansion joints shall be halfway between those running full



## BUILDING EXCELLENCE

height, unless the parapet is reinforced. These additional expansion joints shall continue down to a horizontal expansion joint, or continue to the base of the wall.

- j. Locate horizontal expansion joints at shelf angles supporting brick masonry.
  - k. Locate CMU control joints directly over concrete slab control joints. Whenever possible, lay out CMU so that control joint will coincide with CMU module (25 feet-0 inch maximum spacing between control joints), unless noted otherwise on drawings. Locate control joints at structural columns to isolate movement from continuing or intersecting walls and columns. Install backer rod and sealant in accordance with manufacturer's instructions.
- V. Block Insulation: (As shown or required)
- 1. Rigid Core Inserts: Fill concrete masonry unit cells completely with insulation in accordance with manufacturer's instructions.
  - 2. Loose Core Fill: Fill concrete masonry unit cells shown or required completely with loose core fill. Ensure concrete masonry units to receive loose core fill are ready for filling and cutouts are protected from material spillage. Place signs on filled walls stating "Do Not Cut Openings or Drill In This Wall" once fill is placed.
  - 3. Foamed-In Place Block Insulation: Make sure concrete masonry units to receive foamed in place block insulation are ready for drilling and filling. Drill holes and fill concrete masonry unit cells completely with insulation in accordance with manufacturer's instructions. Plug holes with cement mortar and leave surface smooth in accordance with manufacturer's instructions.
  - 4. Sand Fill: Fill concrete masonry unit cells shown or required completely with sand. Ensure concrete masonry units to receive sand fill are ready for filling and cutouts are protected from material spillage. Place signs on filled walls stating "Do Not Cut Openings or Drill In This Wall" once fill is placed.

### 3.2 ALLOWABLE TOLERANCES

- A. Maximum Variation from Plumb:
  - 1. In lines and surfaces of columns, walls and at rises:
    - a. 1/4 inch in 10 feet (1:480)
    - b. 3/8 inch in 20 feet (maximum)
    - c. 1/2 inch in 40 feet (1:960)
  - 2. For external corners, expansion joints and other conspicuous lines:
    - a. 1/4 inch in 20 feet (maximum)
    - b. 1/2 inch in 40 feet (1:960)
- B. Maximum variation from level:
  - 1. 1/4 inch in any bay or 20 feet
  - 2. 1/2 inch in 40 feet (1:960)

### 3.3 REMOVAL OF FORMS AND SHORES

- A. Do not remove shores and forms under reinforced masonry beams, lintels, and soffits until members have hardened sufficiently to carry their own weight and other super imposed loads. Providing that sufficient curing has taken place, leave forms and shores in place as follows: Beam and lintels: Minimum ten (10) days.
- B. Allow 16 hours to elapse after completion of masonry columns and walls before placing floor or roof construction loads on them. Allow an additional 48 hours before applying concentrated loads such as trusses, girders, and beams.

### 3.4 REPAIRING, POINTING AND CLEANING

- A. All holes in exposed masonry shall be pointed, and defective joints shall be cut out and re-pointed with mortar.



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- B. Before applying any cleaning agent to the entire wall, it shall be applied to a sample wall area of approximately 20 square feet. Sash, metal lintels and other corrodible parts shall be thoroughly protected.
  - 1. Clean all exposed surfaces of new masonry of excess mortar, efflorescence, stains, and job dirt, using materials specified.
  - 2. Clean from bottom up; prevent cleaning materials and rinse water from contacting non-cementitious materials.
  - 3. Clean in accordance with manufacturer's instructions and recommendations, product data, and container label instructions.
  - 4. Mix materials in strict accordance with manufacturers instructions; do not dilute unless permitted by manufacturer.
  - 5. Prevent overspray, wind drift, and splash onto surfaces not to be treated.
  - 6. No high pressure washers are permitted.
  - 7. Low pressure spray for wetting and rinsing is permitted. Pressure should be in the range of 400-1000 psi. Equipment should produce 6-8 gallons of water per minute using a 15-40 degree fan tip (no fan tip less than a 15 degree is allowed).
  - 8. No metal tools or wire brushes are allowed for cleaning of masonry. Use a waste piece of same masonry material for scraping of installed material.
- C. Imperfect or damaged work, or any material damaged or determined to be defective before final completion and acceptance of the entire job, shall be satisfactorily replaced at Contractor's expense and in conformity with all requirements of drawings and specifications. Removal and replacement of masonry work shall be performed in such a manner as not to impair the appearance or strength of the structure in any way.

**END OF SECTION**



B U I L D I N G E X C E L L E N C E

SECTION 05 05 00

METALS COMMON WORK RESULTS

GENERAL

- 1.1 Structural Steel should be coated with a rust inhibiting primer. Exposed structural steel shall be galvanized and receive a paint finish. Where structural steel frame and other members require a fire rating, ***use spray on fireproofing to achieve rated assemblies.***
  - A. Select beams for economy of section, however, maintain web thickness as necessary to facilitate detailing.
  - B. Structural steel sections shall comply with ASTM standards.
- 1.2 Canopies at drop-off lanes to building entry should allow for large number of students to enter in rainy weather.
- 1.3 Entry canopies are required for all exterior doors that are not recessed in an alcove.
- 1.4 Metal Roof Decking
  - A. Hot dip galvanized metal roof decking, with the appropriate gauge for the span, shall be specified (G-90).
  - B. Follow FM loss prevention guidelines for local area and building height, including decreased weld spacing at corners and perimeters.
  - C. Metal decking used for concrete slab forms should be of sufficient gauge to support concrete placement without buckling or deformation from traffic.
  - D. Flutes of metal decking supporting rigid insulation should be of proper size to accommodate the span capability of the specified insulation.
- 1.5 No field painted handrails, bollards, bike racks, etc. Only factory finishes are acceptable.
- 1.6 ***Stairs shall require embedded or mechanically fastened metal nosings that work with specified flooring in lieu of surface applied resilient nosings.***
- 1.7 All handrails shall be anchored to each substrate type with appropriate anchor type and blocking.
- 1.8 All handrails shall meet applicable code requirements.
- 1.9 No interior roof ladder shall be within 10'-0" of exterior wall.

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Metal Fabrications



## BUILDING EXCELLENCE

### SECTION 05 50 00

#### METAL FABRICATIONS

##### GENERAL

- 1.1 The section includes miscellaneous metal items and their related components.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 For off-the-shelf items, request all layouts, sizes, methods of construction and installation, including sizes and types of all fastening devices. For custom fabricated items, submit design calculations for the materials and their connections designed by the Contractor, prior to or with the shop drawings. Calculations shall bear the seal of a Registered Professional Engineer, licensed in the State of Texas.

##### PRODUCTS

###### 2.1 MATERIALS

- A. Structural Steel should comply with ASTM A36. Welding guidelines include Finish #1 for interior handrails and guardrails, Finish #2 for typical ornamentals metals exposed to view and Finish #3 for miscellaneous exposed metals in non-public spaces per NOMMA.
- B. Bolts should comply with ASTM A307 and be sized at 3/4 inch unless otherwise noted.
- C. Expansion bolts include 1/4 inch or less and greater than 1/4 inch. If greater than 1/4 inch, the top shall be 1/2 inch below concrete surface.
- D. Molly screw anchors in walls 1/16 inch to 5/8 inch thick should be "S" length, in walls 5/8 inch to 1/4 inch thick, "L" length, and in walls 1-1/4 inch to 1-3/4 inch thick, "XL": length.
- E. Nelson stud anchors should comply with ASTM A108 and should be headed, low carbon steel, non-threaded, galvanized, and standard ferrule as required.
- F. Any ungalvanized ferrous metal with primer to be shop coated, except for those to receive application of spray-applied fireproofing. Overall application of a brush or spray coat of red oxide primer shall be in accordance with SSPC - Paint 25.
- G. Galvanized Metal should comply with ASTM A123. All steel sections which are fully or partially exposed to weather should be galvanized. Hot-dip galvanization should occur after fabrication. Silicone protective coating shall not be used at galvanized items scheduled to receive paint.
- H. Stainless Steel should comply with ASTM Standards and be Type 302 or 304 with a concealed No. 2D finish.
- I. Aluminum should be type 6061 or 6063 with a mill finish if concealed and a milled, anodized or Kynar finish if exposed.

###### 2.2 MISCELLANEOUS METAL ITEMS

- A. The following is a list of the principal miscellaneous metal items. This list is offered only as a guide. All items exposed to the exterior shall be hot-dip galvanized after fabrication.
  1. Provide hot-dip galvanized steel pipe guard post (bollards) filled with 2,500 PSI in concrete footing.
  2. For Removable Guard Posts, provide a hot-dipped galvanized steel pipe sleeve with a steel angle with hole for lock welded to pipe and place in concrete footing and a smaller hot-dipped galvanized steel pipe insert with a steel angle with a hole for lock welded to pipe. Fill smaller diameter pipe with 2,500 PSI concrete after installation and round off concrete top.
  3. Accessible Parking Sign Posts should be 2 inch by 12 inch galvanized steel tube with integral welded galvanized post cap, painted. The post should have two galvanized stud anchor bolts welded to steel tube front and back.



## BUILDING EXCELLENCE

4. All Steel Pipe Handrails and Brackets shall be Schedule 40 steel pipe rails as required. Brackets shall be wall type and all other components required for finished installation should be included.
5. Aluminum Handrails and Brackets shall be aluminum pipe rails as required. Brackets shall be wall type and all other components required for finished installation should be included.
6. Steel Ladders shall be fabricated from flat bar steel stringer with steel rod rungs let into stringers, welded and ground smooth. Provide all angle supports and anchoring devices for bolting to wall, floor, or structure as required.
7. Steel Ships Ladders shall be fabricated from steel shapes as shown, weld joints and grind smooth. Provide cages where shown.
8. All ladders shall be designed with required wall standoff and meet all OSHA requirements (OSHA 1926.1053)
9. Masonry Anchors (At steel columns shall be fabricated from 5/16 inch dia. steel, field welded to columns, spaced not more than 24 inches o.c. vertically to coincide with horizontal mortar joint elevations.
10. Loose Lintels shall be fabricated from steel shapes, weld joints and grind smooth.
11. Frame Supports shall be constructed above ceiling frame supports for aluminum entrances and storefronts, hollow metal frames of channels and/or tubes, with all anchorage devices as detailed or required.
12. Below and Above-Ceiling Supports shall be constructed of UNISTRUT members with an 1/8 inch accuracy. Provide supports complete with fastenings to structure for overhead equipment.
13. Shelf Angles for Masonry shall be galvanized steel for angles on exterior walls.
14. Provide one 2 foot by 2 foot access door at each restroom plumbing chase wall.
15. Foot scrapers shall be made from steel shapes, weld joints and grind smooth.
16. Condenser Water Pump Base Plate shall be fabricated from a steel plate with holes for anchor bolts as required. Provide stainless steel anchor bolts of size, type, and finish as shown or recommended by fabricator to suit application.
17. Provide stair safety nosings at concrete and steel pan stairs as required.
18. ***Stairs shall require embedded or mechanically fastened metal nosings that work with specified flooring in lieu of surface applied resilient nosings.***
19. Conduit trench pans should be a heavy metal form pan with a 12 inch interior trench width and four inch depth. Covers shall be set 1/8 inch above concrete floor so that the finished top is flush with the finished floor.
20. Provide trench covers and frames at sidewalks where required.
21. Provide cast iron downspout boots conforming to Type DS4 with standard rust inhibitive primer.
22. Bicycle Racks shall consist of unitized welded spreader frame constructed from galvanized steel. All hardware and labor shall be provided to install the units in the concrete sidewalk as required by the manufacturer.
21. Catwalk Structure should be steel. Fabricate the floor from standard metal bar grating with rectangular bearing bars and cross bars of size and spaced as required and recommended by NAAMM. Cross bars shall be welded or fused to bearing bars. Ends of grating shall be banded at supports. Weld grating to supports at bearing bars and banded ends. Align all bars in adjacent panels. Provide attachments and all catwalk accessories and miscellaneous supports as indicated. Weld all joints and grind smooth.
22. Column covers shall be extruded aluminum, .145 thickness with clear anodized finish, fabricated in two vertically divided sections attached with demountable, concealed interlock assembly with sound backing to prevent denting.

## EXECUTION



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- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- A. Separate all dissimilar metals.
  - B. Welded Joint Finishes: Where welding is exposed to view, welds shall be executed neatly then ground smooth. Pits and blemishes are not acceptable. Provide joints as stated above in accordance with NOMMA Guideline 1.
  - C. For manufactured items, adhere to printed manufacturer's installation instructions.
  - D. Refer to painting section for items that are to receive paint.

**END OF SECTION**





B U I L D I N G   E X C E L L E N C E

SECTION 06 05 00

WOOD, PLASTICS & COMPOSITES COMMON WORK RESULTS

GENERAL

- 1.1 Casework in general shall comply with TDLR accessibility requirements
- 1.2 Use laminate finished casework except for utility shelving. Learning Commons shelving shall be all wood construction. Refer to Division 12 Section 12 56 51.
- 1.3 Pay attention to shelf loading. Refer to Section 06 20 00. Shelf thickness shall be appropriate for cabinet width. Consider cabinet mounting to wall – use wall blocking as appropriate for loads.
- 1.4 No shelving shall be wider than 36 inches.
- 1.5 Provide sloping panel at sink knee spaces to hide piping.
- 1.6 Provide combination core for all casework, except as noted. Combination core consists of plywood face veneer laminated to medium density fiber core.
- 1.7 Casework and millwork bases shall be of solid lumber, 2X material.
- 1.8 Countertop core at sink areas shall be of 7/8" marine grade plywood.
- 1.9 ***All carpentry shall meet AWI standards.***
- 1.10 All laboratory casework shall be wood.

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## BUILDING EXCELLENCE

### SECTION 06 10 00

#### ROUGH CARPENTRY

##### GENERAL

- 1.1 The architects should include in this section: all rough carpentry items including wood blocking for support of items supported on or recessed into wood framing or requiring wood blocking for support, wood cants, nailers, curbs, and other items associated with roofing work and miscellaneous framing items and plywood sheathing.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 REQUIRED STANDARDS AND GRADING
  - A. All lumber used structurally shall be graded and marked with grade and trademark of a lumber grading organization, except that a certification of grade from such a grading organization may be accepted in lieu of grade and trademarks. Trademark of manufacturer shall also appear on each piece.
  - B. Each piece of plywood used shall carry the American Plywood Association trademark.
  - C. Grading Rules: Conform with all applicable requirements of American Lumber Standards "Simplified Practice Recommendations R-16" and to grading rules of manufacturer's association under whose rules the lumber is produced.

##### PRODUCTS

- 2.1 MATERIALS
  - A. Lumber should be treated No. 2, S4S Southern Yellow Pine, #1 kiln dried, complying with NWMA Standards. Use for blocking, stripping, grounds, cants and miscellaneous wood items in contact with concrete, roofing, or exposed to the weather.
    1. No. 2, S4S Southern Yellow Pine should be used for framing, blocking, stripping and miscellaneous concealed interior lumber not exposed to concrete, roofing weather or moisture, when FRS lumber is not required by building code.
    2. Fire Retardant No, 2, S4S Southern Pine should be used for framing, plates and blocking in all walls and partitions where required by building code.
  - B. Plywood should comply with APA Standards.
    1. APA A-D, Group 1 Interior shall be used where appearance of only one side is exposed to view for interior locations. Use for wall liner at MDF/IDF closets and telephone boards in mechanical and telephone rooms where shown or required. 3/4 inch thick unless required or shown otherwise.
    2. Exterior plywood shall be Group 1 with an APA rated sheathing. Use where miscellaneous plywood is exposed to concrete, weather, or at roof construction as sheathing.
    3. Fire Retardant Treated Plywood shall be used when required by building code or noted on drawings.
    4. Underlayment, if shown or required, shall be APA rated Sturdi-floor, exterior grade, tongue and groove edges.
  - C. Rough Hardware:
    1. Nails, Spikes, and Staples shall be galvanized for exterior locations, high humidity locations, and treated wood; plain finish for other interior locations: Size and type to suit application. Do not use to resist "pull-out" loads.
    2. Bolts, Nuts, Washers, Lags, and Screws shall be medium carbon steel; size and type to suit application. Galvanize for exterior locations, high humidity locations, and treated wood. Plain finish for other interior locations.
    3. Metal fasteners in contact with preservative treated wood shall be G-90 galvanized, minimum, or stainless steel in accordance with manufacturer's instructions. No uncoated steel shall come in contact with preservative wood.



## BUILDING EXCELLENCE

- D. Wood Treatment:
1. Preservative Treatment (Concealed Conditions):
    - a. Micronized Copper Quaternary (MCQ), a pressure impregnate preservative to net retention of 0.15 lbs./cu.ft., in plant licensed by manufacturer.
    - b. Borate, a pressure impregnate preservative to net retention of 0.28 lbs./cu.ft., in plant licensed by manufacturer in accordance with: Preservative Treatment Standard: AWPAP5, Structural Lumber Treatment Standard: AWPAC31, and Plywood Treatment Standard AWPAC9
    - c. Brush two coats of preservative on bored or sawn surfaces of treated lumber. Provide Quality Mark Stamp or end tag identifying third party inspection agency on treated wood for identification.
    - d. Conditions that are interior, above ground that are not exposed to direct standing water, in contact with natural grade, or exposed to weather.
    - e. ACQ and CCA preservatives not permitted.
  2. Fire Retardant Treatment: Use in locations prescribed and required by codes and authorities having jurisdiction. Typical locations may include roof hatch and skylight blocking, blocking in rated wall or ceiling assemblies, and smoke vents.
    - a. Lumber shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All lumber must be dried following treatment in accordance with AWPAC20.
    - b. Plywood shall be pressure-impregnated with non-combustible fire retardant chemicals in accordance with U.L. FRS Fire Hazard Classification. All plywood must be dried following treatment in accordance with AWPAC27.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.

- A. Wood Framing:
1. Framing and blocking shall be accurately cut and fitted true to line and levels, avoiding shims and wedges.
  2. Spiking and nailing shall be done using largest size spikes and nail practicable.
  3. Unless otherwise shown, use 2 inch by 4 inch wood studs spaced 16 inches o.c. with 4 inch face perpendicular to direction of wall or partition. Provide single bottom plate and double-top plates 2 inches thick by width of studs.
  4. Bolt nailers and blocking to steel, masonry or concrete members with bolts or proportionate strength of members attached from each end, except as otherwise noted on plans.
  5. Provide blocking, bucks and framing as necessary and for other trades as required. Drill lumber accurately for bolts and fit all bolts with suitable washers.
- B. Plywood:
1. Install plywood over framing in accordance with instruction of American Plywood Association Construction Guide Form No. E30C.
  2. Install underlayment plywood as shown in accordance with instructions of American Plywood Association. Space panel joints and edges 1/32 inch. Fill and sand panel edge joints, surface roughness, and damaged or open areas. Nail with 4d ring-shank nails spaced at six inches at edges and eight inches in field each way.

### END OF SECTION



B U I L D I N G   E X C E L L E N C E

SECTION 06 20 00

FINISH CARPENTRY AND MILLWORK

GENERAL

- 1.1 The architect should include in this section: all finish carpentry items including finish carpentry, millwork and cabinetry, plastic laminate, casework hardware, miscellaneous millwork, simulated wood trim, ballet bar, existing door plastic laminate resurfacing, finish hardware and plastic laminate faced wood doors
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 QUALITY ASSURANCE
  - A. Manufacturer shall have a minimum of five years experience in providing manufactured casework systems for similar types of projects, produce evidence of financial stability, bonding capacity, and adequate facilities and personnel required to perform on this project.
  - B. Coordinate the Work of this Section with plumbing work specified in Division 15.
  - C. Coordinate location of blocking in walls for installation and support of wall cabinets.
  - D. Fabricate millwork and cabinetry in accordance with ANSI A161.1, NEMA LD3, and general static load testing performed and certified by an independent testing agency.
- 1.4 Require a warranty for the work specified for five years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
  - A. Defects shall include rough or difficult operation, or loose or missing parts, delamination of surfaces, noticeable deterioration of finish and warped or misaligned surfaces or telegraphing of subsurface imperfections.

PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines, are certified by AWI Quality Certification Program to be considered.
- 2.2 MILLWORK MATERIALS
  - A. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD3, and the following requirements: Exposed doors, finished end panels, and other vertical surfaces shall be GP28 (0.028 inch thick nominal), Horizontal surfaces other than top shall be GP28 (0.028 inch thick nominal), Cabinet Liner shall be CL20 (0.020 inch nominal), white, Work Surfaces and Countertops shall be GP50 (0.050 inch thick nominal) with BK20 (0.20 inch thick) backer sheet, backsplash shall be PH42 (0.042 inch nominal) with nominally balanced backer sheet.
    1. Use a PVA water resistant adhesive. Contact adhesives not permitted.
    2. Pressure Fused Laminate: NEMA LD3 VGL, and NEMA LD3 CLS shall be melamine resin impregnated, 120 gram PSM minimum, thermofused to core under pressure. Closed interiors and underside of wall cabinets should be white. On exposed and Semi-exposed open cabinets the color should match the exterior. Provide balanced construction with same thermofused melamine. Unsurfaced coreboard or simple backers are not allowed.
  - B. Core Material:
    1. Particleboard shall meet ANSI 208.1 with a minimum 45 pcf density, Grade M-3.



## BUILDING EXCELLENCE

2. Plywood shall be shop sanded, exterior grade veneer cored, hardwood faced, any species, with no defects affecting strength or utility. Overlay plywood not permitted. Plywood allowed at countertops and toe-base only.
3. Water resistant treated plywood (marine grade): shall have 24 hour thickness swell factor of five percent or less and 24 hour water absorption factor of ten percent or less; P.S. 51, Type II or better.
4. Cabinet components shall be of the following minimum core thicknesses:
  - a. Cabinet backs, drawer body, and drawer bottoms: 1/2 inch particleboard
  - b. Door and drawer face, base, wall, and tall cabinet tops and bottoms, cabinet sides, drawer spreaders, cabinet back rear hangstrips, structural dividers, and exposed cabinet backs: 3/4 inch particleboard
  - c. Work surfaces and countertops shall be a minimum 1 inch particleboard or plywood, except use water resistant treated plywood core at counters with sinks.
  - d. Shelves shall be 3/4 inch particleboard core for 30 inches long or less, 1 inch thick particleboard core for more than 30 inches long; 14 inch deep, unless otherwise noted. Provide vertical dividers for shelves over 36 inches long.
  - e. Cabinet Toe-Base shall be 3/4 inch plywood. No particleboard within four inches of floor.
- C. Countertops and Backsplashes:
  1. Provide countertops with PVC edge in as long as practical continuous lengths. Provide field glued splines at joints. No joints closer than 24 inches either side of sink cutout.
  2. The backsplash shall be integral to countertop, 4 inch high unless otherwise shown. Fabricate with single continuous sheet of laminate from front counter to top of splash with no joints from horizontal to vertical application. No joints shall occur at sink openings.
  3. At exposed countertop end corners, provide 1 inch radius, or similar safety treatment.
- D. Leave toe spaces unfinished for installation of resilient base, unless otherwise shown.
- E. End Panels and Filler Strips should match adjacent case-piece.
- F. Edging:
  1. Flat Edge PVC edging shall be 0.020 inch. Solid, high-impact, purified, color-thru, acid resistant, machine-applied with hot melt adhesives. 3 mm PVC shall be solid, high-impact, purified, color-thru, acid resistant, pre-lamination primed edging, machine-applied with hot melt adhesives, and machine profiled to 1/8 inch radius

### 2.3 CABINET HARDWARE

- A. All hardware shall meet ANSI A156.9. All keying shall match existing master key system and be approved by the Owner.
- B. Hinges shall be Heavy duty, five-knuckle 2 3/4 inch institutional type hinge shall meet ANSI/BHMA A156.9 Grade 1 requirements and shall be mill ground, hospital tip, Teflon coated tight pin feature with all edges eased. Hinge shall be full wrap around type of tempered steel 0.095 inch thick. Each hinge shall have minimum of 9 screws, #7, 5/8 inch FHMS to assure positive door attachment. One pair per door to 48 inch height. Hinge shall accommodate 13/16 thick laminated door and allow 270 degree swing. The finish should be US26D.
- C. Pulls shall be wire design, 4 inches, chrome with a US26D finish.
- D. Sliding Door Hardware should be frameless 1/4 inch glass sliding doors with double track rolling door assembly. Framed 13/16 inch thick stile and rail sliding doors: top mounted track with dual roller hangers. Vertical adjustment for accurate alignment.
- E. Drawer Slides:



## BUILDING EXCELLENCE

1. Standard Drawers should have a 3/4 extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 100 pound dynamic load rating at full extension.
  2. File Drawers should be full extension, 3-part progressive opening slide, precision steel ball bearing, minimum 100 pound dynamic load rating at full extension, zinc plated or epoxy coated at manufacturer's option.
  3. Provide body mounted molded rails for hanging file system for legal or letter size as indicated by manufacturer's model number. Cutting or machining of drawer body/face not permitted.
  4. Paper Storage Drawers should be full extension, self-closing, white epoxy-coated, lever disconnect, positive in-stop/out-stop, nylon rollers, minimum 150 pound dynamic load rating at full extension.
- F. Catches should have opening resistance in compliance with the ADA. Provide top-mounted magnetic catch for base and wall cabinet door. Provide two at each tall cabinet door.
- G. Adjustable Shelf Supports should be dual-pin design with anti tip-up shelf restraints for both 3/4 inch and 1 inch shelves. Include keel to retard shelf slid-off, and slot for mechanical attachment for shelf to clip. Load rating shall be minimum 300 pounds each support without failure.
- H. Wardrobe Rod should be 1-1/6 inch diameter plated steel rod, with captive sockets.
- I. Coat Hooks can be single or double prong, wall mounted in satin aluminum.
- J. Locks shall be five-disk tumbler cam-style with strike. Locks on cabinets in same room keyed alike. Provide two keys per room where doors and drawers are scheduled to receive locks. Dull chrome finish. Lock core shall be removable with a control key, permitting Owner to change lock arrangements without tools.

### 2.4 SPECIALTY ITEMS

- A. Grommets shall be 2-1/2 inches in diameter with "Flip-Top"™ tab in cap and should be located where electrical, telephone, and computer data wiring need to pass through tops whether shown or not.
- B. Keyboard Drawers to be located at all knee spaces.
- C. Molded Personal Pencil Drawer should be high-impact 100 Polystyrene with in-stop, out-stop, and self-closing features. Provide under top mounted 100 lb self-closing slides. Twelve compartment drawer body, and slides, Black. Provide where indicated on plans.
- D. Mailbox Label Holder shall be Brass and card size 1/2" x 2-3/16", one per opening.

### 2.5 SOLID STOCK

- A. Moisture Content should be in relation to over-dry weight shall be between 8 percent and 13 percent at time of installation.
- B. Natural Finish Hardwood allows for an occasional knot provided it is tight and smooth with a rift-cut grain pattern. The species should be AWI "Premium" Grade, White Oak.
- C. Paint Grade Hardwood shall be any species, including Parana Pine. Do not use Oak, Elm or similar species which have coarse grain.

### 2.6 MISCELLANEOUS

- A. Utility Shelving: AWI "Economy" grade.
- B. Clothes Rod: should be 1-1/2 inch diameter smooth wooden dowel by length required, with end supports and fasteners of type recommended to suit application.
- C. Provide minimum 4 foot by 8 foot by 3/4 inch thick plywood for telephone/data punch down blocks and video equipment.

### 2.7 SIMULATED WOOD TRIM

- A. Lightweight simulated wood trim as follows can be for crown moldings, model 090600 in 6-1/2 inches high x 4-1/2 inch projection x 16 feet length, or model 151200 in 8 inches





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high x 7-3/4 inch projection x 16 feet length. Provide molded units with manufacturer's standard primed finish to receive field applied coating.

1. Fasteners should be used as recommended by molded unit manufacturer, provide trim screws, drywall screws or finishing nails. Pneumatic nail gun permissible for use; staple gun not permissible.
2. Joint Compound should be used as recommended by molded unit manufacturer, provide spackle joint compound, ready-mixed, vinyl type.
3. Use manufacturer recommended adhesive for product installation.

- 2.8 Stationary wall mounted ballet bars shall be made of 1-1/2 inch diameter by length shown on drawings, hand sanded Red Oak rail. The bar shall be cut at the center to allow for shipment. The bar shall be attached to the wall with three plated mounting brackets for each 12'-0" of bar. Provide all anchors and fasteners of type instructed by manufacturer.

### 2.9 MILLWORK FABRICATION

#### A. Detailed Requirements For Cabinet Construction:

1. Toe-Base should be a continuous, ladder type platform with concealed fastening to cabinet bottom, level and secured to floor. Toe-base at exposed cabinet end panels shall be recessed 1/4 inch from face of finished end, for flush installation of finished base material. No cabinet sides-to-floor will be allowed.
2. Cabinet Top and Bottom shall have solid sub-top. At cabinets over 36 inches bottoms and tops shall be mechanically joined by a fixed divider. Assembly devices shall be concealed on bottom side of wall cabinets.
3. Cabinet Sides shall be doweled, and glued under pressure, or attached with fully concealed interlocking mechanical fasteners to sub-top and bottom. Drill holes for adjustable shelves 1-1/4 inches on center.
4. Cabinet Backs shall be side bound, captured in grooves, recessed from cabinet rear, and securely fastened at top and bottom. Hang rails shall be located at rear of cabinet back and fastened to cabinet sides. Provide minimum of two at base, two at wall, and three at tall cabinets as instructed by casework manufacturer. Provide removable back panels and closure panels for plumbing access at all sink cabinets, and where shown on drawings
5. Exposed end corner and face frame attachment shall be butt jointed, glued and finish nailed; or attached with fully concealed interlocked mechanical fasteners.
6. Door and Drawer Fronts:
  - a. Drawer fronts and hinged doors shall overlay the cabinet body. Maintain a maximum 1/8 inch reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.
  - b. Where indicated, provide Stile and Rail doors with full 1/4 inch plate glass, hinged or sliding. Exposed lite-opening edges shall be trimmed and glazed with extruded glazing bead.

#### B. Drawers:

1. Drawer fronts shall be applied to separate drawer body component sub-front.
2. Drawer sides shall be doweled to receive front and back, glued under pressure, machine squared.
3. Drawer bottom shall be set into front and sides, 1/4 inch deep groove with minimum 3/8 inch standing shoulder, continuously glued. Reinforce drawer bottoms with 1/2 inch by 4 inch front-to-back intermediate underbody stiffeners, mechanically fastened. One at 24 inches, two at 36 inches, and over.
4. Paper storage drawers shall be fitted with full width hood at back.
5. Hanging file drawers shall be fabricated to accept letter size hanging folders.

#### C. Vertical and Horizontal Dividers are as required by manufacturer for type and style of component.

#### D. Door/Drawer Front Rail, as required by manufacturer for type and style of component, and hardware placement.





## BUILDING EXCELLENCE

- E. The following special requirements shall be met, where specifically indicated on architectural plans as "ADA". Shall be in compliance with Federal Register Volume 56, No. 144, Rules and Regulations:
  - 1. Countertop height, with or without cabinet below, not to exceed a height of 34 inches Above Finished Floor (A.F.F.), at a surface depth of 24 inches
  - 2. Kneespace clearance must be a minimum of 29 inches A.F.F. at apron, and 30 inches clear span width.
  - 3. 12 inch deep shelving, adjustable or fixed should not to exceed a range from 9 inches A.F.F. to 54 inches A.F.F.
  - 4. Wardrobe cabinets require a rod/shelf adjustable to 48 inches A.F.F. at a maximum 21 inch shelf depth.
  - 5. In addition to above, upper kneespace frontal depth for sink cabinets, shall be no less than 8 inches, and lower toe frontal depth shall be no less than 11 inches, at a point 9 inches A.F.F., and as further described in Volume 56, Section 4.19.
- F. Typical Desk or Counter Height at Kneespace Locations shall be 30" above finished floor.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging the products and adjacent work.
  - B. Anchorage: Attach securely so the products will perform to their maximum ability without damage from inadequate fastenings.
  - C. Fasten tops to frames with concealed clips, screws and glue.
  - D. The supplier will mark each item of hardware for location. Protect the markings until each item is installed. If any item is delivered to the job not properly marked, return it to the supplier for marking before attempting to install it.
  - E. Check markings on hardware for proper location. Install and make necessary adjustments for proper working order. Any hardware damaged by improper adjustment or careless abuse will be replaced by the Contractor at his expense.
  - F. Provide clean, properly sized and accurately placed mortises and drilled holes for all mortise hardware such as locksets and for cylindrical locks where specified only.
  - G. Fit all surface-applied hardware accurately.
  - H. After hardware is installed, protect exposed surfaces by use of heavy paper and masking tape and maintain until job completion.
  - I. Remove all finish hardware except that which is primed for painting before painter's finish is applied. Permanently replace and re-adjust for proper function after painter's finish has dried hard.

### END OF SECTION



SECTION 07 05 00

THERMAL & MOISTURE PROTECTION COMMON WORK RESULTS

GENERAL

- 1.1 HISD preference is to use a fluid applied air and vapor barrier with transition strips at exterior wall assemblies. Ensure continuous coating free of breaks, voids and pinholes- thoroughly covering all cracks, joints and corners.
- 1.2 Rigid extruded polystyrene foam board is the HISD preference exterior thermal exterior cavity insulation. To ensure full coverage, install board insulation with joints tight to veneer wall ties.
- 1.3 Exterior Insulation and Finish Systems (EIFS) shall be limited in use and must be submitted to HISD for approval.
- 1.4 Asphalt shingles shall be limited in use and must be submitted to HISD for approval.
- 1.5 Prefinished standing seam metal roofing with concealed fasteners is the preferred roofing assembly system and shall be installed on solid decking, open frame "purlin" structure must be submitted to HISD for approval. Panels shall be pre-finished galvalum, alternative proposed substitutions shall be submitted to HISD for approval.
- 1.6 Gutters and downspouts may be an exterior design element but should be connected at grade to an underground storm drainage system with an overflow relief outlet just above grade.
- 1.7 Prefinished metal wall panels shall have a minimum 60 mil fully adhered "high temp" waterproof membrane installed behind the panels. No exposed fasteners allowed.
- 1.8 All low-sloped roof assemblies shall be a multi-ply modified bitumen with a "cool roof" finish ply or multi-ply "white" thermoplastic finish ply with a smooth surface Modified Bitumen base. No single-ply systems allowed. Provide interior roof drains.
- 1.9 District preferred roof deck shall be lightweight insulating concrete over minimum 24 gauge, G-90 galvanized slotted metal decking.
- 1.10 Provide internal ladders and roof hatch access to all main building roof areas. External roof ladders at all roof level changes shall be provided to ensure access across entire building. No roof area should be further than 150 feet from a roof hatch or external ladder.
- 1.11 All sheet metal fascias, gutters and downspouts shall be pre-finished aluminum. All metal flashings embedded in roof membrane and in through-wall conditions shall be stainless steel. All removable counter-flashings shall be pre-finished aluminum.
- 1.12 All exterior building joint sealants shall be non-priming one-part sealants with backer rod.
- 1.13 ***See diagram below for preferred typical exterior wall assembly.***
- 1.14 ***District requires spray-on fireproofing for rated floor/ceiling assembly in lieu of rated lay-in ceiling assembly (09 51 00).***



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BUILDING EXCELLENCE

SECTION 07 11 00

DAMPPROOFING ABOVE GRADE

GENERAL

- 1.1 District preference is for Air and Vapor Weather Barriers (see Section 07 25 00), obtain District approval prior to use of this product.
- 1.2 Require a warranty for two full years/continuous without failure

PRODUCTS

- 2.1 Manufacturers listed below whose product meets or exceeds the specifications are approved for use on the Project. Other approved manufacturers must have a minimum of five years experience manufacturing equivalent products to those specified
  1. Henry No. HE789 Fibered Asphalt Emulsion
- 2.2 DESCRIPTION
  - A. Type: Fibered Asphalt Emulsion Coating and Dampproofing.
  - B. Use: Dampproofing on exterior sheathing and CMU in cavity wall and in soffits
  - C. Composition and Materials: Asphaltic resin and clay colloidal emulsifiers.
  - D. Limitations: Apply material when temperature is over 45 degrees F and protect from rain or freezing until completely dry.
- 2.3 TECHNICAL DATA
  - A. Henry Company No. HE789:
    1. Compliance: ASTM D1227 Type II Class I, and ASTM D-1187, Type I.
- 2.4 MISCELLANEOUS MATERIALS
  - A. Provide primers, glass fabric scrim tape, mastic, and other materials not specifically described, but required for a complete and proper installation as instructed by the dampproofing manufacturer or required.

EXECUTION

3.1 INSTALLATION

- A. Require surface preparation (Masonry): Dust, dirt, old loose or scaling coatings should be removed from the surface before coating. Seal cracks, joints, penetrations, and splits, repaired with four inch wide glass fabric scrim tape embedded in Henry #789. Dusty or porous masonry surfaces should be dampened with water. Highly porous masonry must be primed with Henry #792 Penetrating Asphalt Primer or #788 Non-Fibered Asphalt Emulsion Dampproofing which has been thinned with one gallon water per five gallons of #788. Cleaned metal surfaces should also be primed. Require approval of the surface preparation and sealing of cracks, joints and other penetrations prior to the application.
- B. Require surface preparation (Sheathing) including prepping joints and penetrations.
- C. Application with either brush or spray equipment. Apply spray in one coat with a 50% overlap of the spray pattern to obtain a uniform and continuous coating, carrying coating in and around joints, grooves, and slots, following reveals and soffits of windows, and continuing 12 inches out on adjoining partitions and soffits as instructed by manufacturer.
  1. Insure continuous coating free of breaks, voids and pinholes.
  2. Thoroughly cover all cracks, joints, and corners.
- E. Coverage: Minimum 4 gallons per 100 square feet.
- F. Storage: Keep container tightly sealed and protect from freezing in shipping and storage.

3.2 TESTING AND INSPECTING



**B U I L D I N G   E X C E L L E N C E**

- A. Twenty days after completion of this portion of the work, require a demonstration by running water test that the Work will successfully repel water.
  - 1. Require a Notice at least 72 hours in advance, and conduct the test in the Architect's presence.
  - 2. By means of an outrigger, or similar acceptable equipment, place the nozzle of a 3/4 inch garden hose at a point approximately 10 feet-0 inches away from top of wall, aiming the nozzle at slight downward angle to direct full stream of water onto wall.
  - 3. Run water onto wall at full available force for not less than four hours.
  - 4. Upon completion of the four hour period, inspect interior surfaces of wall for evidence of moisture penetration.
- B. If evidence of moisture penetration is discovered, apply an additional coat of approved water repellent to exterior surface, repeating application and testing (at no additional cost to the Owner) until no evidence of moisture penetration is found.

**END OF SECTION**



## SECTION 07 16 14

### BELOW GRADE COLD FLUID-APPLIED WATERPROOFING

#### GENERAL

- 1.1 Require preparation of concrete surfaces to receive waterproofing membrane, proper sealing of cracks and joints, prefabricated drainage composite or protection board at walls that fall below grade (i.e. auditorium, elevator pit, etc.). Use Pre-applied waterproofing system, with joint sealing tape, and other accessories at below grade horizontal surfaces under the slab or elevator pit.
- 1.2 QUALITY ASSURANCE
  - A. Require that applicator shall be experienced in applying the same or similar materials and shall be specifically approved in writing by the membrane system manufacturer.
  - B. Regulatory Requirements: Comply with applicable codes, regulations, ordinances, and laws regarding use and application of products that contain volatile organic compounds (VOC).
- 1.3 DELIVERY, STORAGE, AND HANDLING
  - A. Require delivery of materials job site in original, factory-sealed, unopened containers bearing manufacturer's name and label intact and legible with name of material, stock number and date of manufacture and material safety data sheets
  - B. Require storage and handling in strict compliance with manufacturer's instructions
  - C. Protect from damage from sunlight, weather, excessive temperatures and construction operations.
- 1.4 PROJECT CONDITIONS
  - A. Allow work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.
  - B. Installation shall occur only when substrate construction and preparation work is complete and in condition to receive membrane waterproofing.
  - C. Require coordination of waterproofing work with other trades to ensure adequate illumination, ventilation, and dust-free environment during application and curing of membrane. The applicator shall have sole right of access to the specified areas for the time needed to complete the application and allow the membrane to cure adequately.
  - D. Require protection of adjoining surfaces not to be coated against damage or soiling. Protect plants, vegetation and animals which might be affected by waterproofing operations.
  - E. Warn personnel against breathing of vapors and contact of material with skin or eyes. Wear applicable protective clothing and respiratory protection gear.
  - F. Keep products away from spark or flame. Do not allow the use of spark producing equipment during application and until all vapors have dissipated. Post "NO SMOKING" signs.
  - G. Maintain work area in a neat and orderly condition, removing empty containers, rags, and rubbish daily from the site.
- 1.5 Require a warranty of the work specified herein for two (2) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship

#### PRODUCTS

##### 2.1 FLUID APPLIED WATERPROOFING SYSTEM



## B U I L D I N G   E X C E L L E N C E

- A. Specifications are based on named manufacturer. Other approved manufacturers must have a minimum of five years experience manufacturing equivalent products to those specified to be considered.
1. Carlisle Coatings and Waterproofing Incorporated, Sapulpa, OK (Barricoat)
  2. Grace Construction Products, W. R. Grace & Co.-Conn.
- B. Waterproofing Membrane: Two part, self-curing, synthetic rubber based material meeting or exceeding the performance requirements of ASTM C836 and other ASTM standards as indicated in the following table and conforming to W.R. Grace & Co. "Procor" waterproofing membrane.
- Waterproofing Membrane Physical Properties, minimum:

<b>Property</b>	<b>Test Method</b>	<b>Typical Value</b>
Cured Film Thickness	ASTM D3767 Method A	1.5 mm (0.60 in.) nom
Solids Content	ASTM D1644	100 percent
Flexibility, 180 degree	ASTM D1970	Unaffected
Bend over 25 mm (1 in.)		
Mandrel at 32 degrees C (-25 degrees F)		
Elongation	ASTM D412	500 percent minimum
Peel Adhesion to Concrete	ASTM D903 Modified*	880 N/m (5 lbs./in.)

- C. Accessory Products:
1. Prefabricated Drainage Composite: Shall be designed to promote positive drainage while serving as a protection course.
    - a. Hydroduct<sup>®</sup> 660 Drainage Composite for use on all horizontal surfaces.
    - b. Hydroduct<sup>®</sup> 220 Drainage Composite for use on all vertical surfaces.
  2. Protection Board (Use only where prefabricated drainage composite is not used):
    - a. Asphalt Hardboard: A pre-molded semi-rigid protection board consisting of bitumen, mineral core and reinforcement. Provide 3 mm (0.125 inch) thick hardboard on horizontal surfaces not receiving steel reinforced slab. Where steel reinforcing bars are to be used, apply two layers of 3 mm (0.125 inch) thick hardboard or one layer of 6 mm (0.25 inch) thick hardboard.
    - b. Expanded Polystyrene: 25 mm (1 inch) thick for vertical applications with the following characteristics:
      - Normal Density: 1.0 pcf<sup>3</sup>
      - Thermal Conductivity, K factor: 0.24 at 40 degrees F, 0.26 at 24 75 degrees F
      - Thermal Resistance, R-Value: 4 per 1 inch of thickness.
- D. Locations: Vertical below-grade retaining walls and walls that fall below grade 0'-0" and where shown on drawings.

### 2.2 PRE-APPLIED WATERPROOFING SYSTEM

- A. Specifications are based on named manufacturer. Other approved manufacturers must have a minimum of five years experience manufacturing equivalent products to those specified to be considered.
1. Carlisle Coatings and Waterproofing Incorporated.
  2. Grace Construction Products, W. R. Grace & Co.-Conn.
- B. Waterproofing Membrane: Composite sheet comprising a thick HDPE film, an aggressive pressure sensitive adhesive and a weather resistant protective coating. Membrane provides a continuous seal that resists water ingress and migration between the membrane and the structure. The waterproofing system shall conform to the following products as manufactured by W.R. Grace & Co.:





## BUILDING EXCELLENCE

1. Membrane: Robust membrane for horizontal use below concrete slabs complying with Preprufe 200.
  2. Tape: Self-adhesive 8 inch wide strip applied to the surface of the membrane along the line of all concrete joints (application temperature range minus 25 degrees F to 86 degrees F. Product shall conform to Preprufe CJ Tape LT; or in hot climates (minimum 50 degrees F), use Preprufe CJ Tape HC.
  3. Sealing Membrane: For sealing around penetrations shall conform with Bituthene.
- C. Locations: Below grade horizontal surfaces under the slab, and where shown on drawings.

### EXECUTION

#### 3.1 EXAMINATION

- A. All surfaces to be waterproofed shall be thoroughly examined for all deficiencies. Should deficiencies exist, the Architect shall be notified in writing and corrections made.

#### 3.2 SURFACE PREPARATION

- A. Surfaces to which waterproofing is to be applied shall be thoroughly clean, dry and free from all surface contaminants or cleaning residue that may harmfully affect the adhesion of the membrane.
- B. Repair all cracks in accordance with manufacturer's instructions.

#### 3.3 APPLICATION

- A. Priming: Shall be in accordance with membrane manufacturer's instructions.
- B. Apply waterproofing in accordance with membrane manufacturer's instructions.
- C. Liquid membrane waterproofing on vertical walls shall positively overlap turned up sheet membrane waterproofing from under slab as instructed by the manufacturer.
- D. Where shown or required, install specified perimeter drainage system as the first course of drainage composite immediately after membrane has cured on vertical surfaces. Install manufacturer's recommended drainage composite or protection board/protection course on remainder.

### END OF SECTION



B U I L D I N G   E X C E L L E N C E

SECTION 07 21 00

THERMAL INSULATION

GENERAL

- 1.1 The architects should include in this section: rigid board cavity wall insulation where shown on drawings or required and batt insulation used for thermal and sound insulation in stud walls, above lay-in ceiling panels, and where shown on drawings or required.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.

PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.

2.2 MATERIALS

- A. Rigid Wall Insulation: (In Exterior Cavity Walls)
  1. Extruded Polystyrene Foam Board:
    - a. Specification: ASTM C578, Type IV
    - b. Thermal Resistance: R=5.0 per inch minimum.
    - c. Water Absorption (% by volume): 0.1 maximum
    - d. Water Vapor Permeance (perm): 1.1 per inch
    - e. Compressive Strength: 15 psi minimum
    - f. Thickness: 1-1/2 inches, unless shown otherwise
    - g. Size: 16 inch x 96 inch sheets.
- B. Batt Insulation:
  1. Thermal Insulation:
    - a. Type: ASTM C665, Type 1, unfaced
    - b. Thickness/R-Values (minimum):
      - 1) 3-1/2 inches/R-11 where shown on drawings.
      - 2) 6 inches/R-19 where shown on drawings.
    - c. Surface Burning Characteristics:
      - 1) Flame Spread: 25 or less
      - 2) Smoke Developed: 50 or less
  2. Acoustical (Sound Attenuation) Insulation:
    - a. Type: ASTM C665, Type 1, unfaced
    - b. Surface Burning Characteristics:
      - 1) Flame Spread: 25 or less
      - 2) Smoke Developed: 50 or less
    - c. Thickness/R-Values (minimum):
      - 1) 3-1/2 inches/R-11 where shown on drawings.
      - 2) 6 inches/R-19 above lay-in ceiling specified and where shown on drawings.
- C. Saffing Insulation: As specified in Section 07 84 00, Fire Stopping and Fire Saffing.
- D. Miscellaneous Materials:
  1. Mechanical Fasteners: Impaling clip of [unfinished] [galvanized steel] [plastic] [nylon] with washer retainer and clips, to be adhered or mechanically fastened to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
  2. Adhesive: Type recommended by insulation manufacturer for application.

EXECUTION



**B U I L D I N G   E X C E L L E N C E**

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- A. Furnish acoustical insulation to acoustical lay-in ceiling contractor for laying insulation above lay-in ceiling panel system specified.
  - B. Rigid Board Insulation:
    - 1. Install board insulation at exterior masonry walls in accordance with manufacturer's printed instructions.
    - 2. Cut insulation to fit snugly around obstructions such as vents, pipe or conduit.
    - 3. Install board insulation to back-up wall surface secured by veneer wall ties and mastic.
    - 4. Install board insulation with joints tight to veneer wall ties and to provide full coverage.
  - C. Batt Insulation (Thermal and Sound):
    - 1. Walls:
      - a. Insulation shall be friction fit between studs and provide full coverage where indicated on drawings.
      - b. Insulation shall be tight within spaces in partitions, around cut openings, behind and around electrical and mechanical items within or behind partitions and tight to items passing through partitions.
      - c. Wall areas above ceiling: At side wall insulation in ceiling cavity, install adhesive-mounted impaling devices with metal caps at 2 feet-0 inches vertically and at four (4) inches from each side of blankets horizontally. Install blankets with four (4) foot dimension running vertically on spikes, keeping blankets tight to exterior wall without crushing into each other.
  - D. Safing Insulation: As specified in Section 07 84 00, Fire Stopping and Fire Safing.

**END OF SECTION**



## SECTION 07 26 20

### FLUID APPLIED AIR AND VAPOR BARRIER

#### GENERAL

- 1.1 This Section specifies a water resistant fluid applied air and vapor barrier in exterior wall assemblies.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Material Performance: Provide materials which have an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 in. water (1.57 psf) (0.02 L/m<sup>2</sup> @ 75 Pa.) when tested according to ASTM E 2178.
- B. Assembly Performance: Provide a continuous air and vapor barrier assembly that has an air leakage not to exceed 0.040 cubic feet per square foot per minute under a pressure differential of 0.3 in. water (1.57 psf) (0.20 L/ m<sup>2</sup> @ 75 Pa.) when tested in accordance with ASTM E 2357. Assembly shall perform as a liquid drainage plane flashed to discharge condensation or water penetration to the exterior. Assembly shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air and vapor seal materials at such locations, changes in substrate and perimeter conditions.
  - A. Assembly shall be capable of withstanding combined positive and negative design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure.
  - B. Assembly shall not displace adjacent materials under full load.
  - C. Assembly shall be joined in an airtight and flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations and creep, and anticipated seismic movement
- C. Connections to Adjacent Materials: Provide connections to prevent air leakage and vapor migration at the following locations:
  - 1. Foundation and walls, including penetrations, ties and anchors.
  - 2. Walls, windows, curtain walls, storefronts, louvers or doors.
  - 3. Different wall assemblies, and fixed openings within those assemblies.
  - 4. Wall and roof connections and penetrations.
  - 5. Floors over unconditioned space.
  - 6. Walls, floor and roof across construction, control and expansion joints.
  - 7. Walls, floors and roof to utility, pipe and duct penetrations.
  - 8. Seismic and expansion joints.
  - 9. All other leakage pathways in the building envelope.

#### 1.3 QUALITY ASSURANCE

- A. Manufacturer: Obtain primary materials from a single manufacturer regularly engaged in manufacturing air and vapor barrier membranes. Obtain secondary materials from a source acceptable to the primary materials manufacturer.
- B. VOC Regulations: Provide products which comply with applicable regulations controlling the use of volatile organic compounds for the specific authority having jurisdiction.
- C. Field Quality Assurance: Implement the ABAA Quality Assurance Program requirements. Cooperate with ABAA inspectors and independent testing and inspection agencies engaged by the Owner. Do not cover air and vapor barrier until it has been inspected, tested and accepted.
- D. Mock-Ups: Build mock-up representative of primary exterior wall assemblies and glazing assemblies including backup wall and typical penetrations. Mock-up shall be approximately 8 feet long by 8 feet high and include the materials proposed for use in the



## BUILDING EXCELLENCE

exterior wall assembly. Mock-up shall be suitable for testing as specified in the following paragraph.

- E. Mock-Up Tests for Air and Water Infiltration: Test mock-up for air and water infiltration in accordance with ASTM E 1186 (air leakage location) or ASTM E 783 (air leakage quantification), and ASTM E 1105 (water penetration). Use smoke tracer to locate sources of air leakage. If deficiencies are found, repair or modify mock-up and retest until satisfactory results are obtained. Deficiencies include air leakage beyond values specified, uncontrolled water leakage, unsatisfactory workmanship.
- F. Perform the air leakage tests and water penetration test of mock-up prior to installation of cladding and trim but after installation of all fasteners for cladding and trim and after installation of other penetrating elements. For fasteners which would normally only be installed with cladding, install representative fasteners without cladding; intent is to perform testing with all types of penetrations in place.
- G. Mock-Up Tests for Adhesion: Test mock-up of fluid applied and sheet applied materials for adhesion in accordance with ASTM D 4541 using a Type 1 pull tester except that the disk used shall be 100mm in diameter and the membrane shall be cut through to separate the material attached to the disk from the surrounding material. Perform test after curing period recommended by the manufacturer. Record mode of failure and area which failed in accordance with ASTM D 4541.

### 1.4 WARRANTY

- A. Material Warranty: Provide manufacturer's standard product warranty, for a minimum 3 years from date of Substantial Completion.
- B. Installation Warranty: Provide air barrier subcontractor's 2 year warranty from date of Substantial Completion, including all components of the air and vapor barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of adhesion, loss of cohesion, failure to cure properly.

## PRODUCTS

### 1.5 MATERIALS

- A. Fluid Applied Air and Vapor Barrier: Fluid applied proprietary materials as specified. Use regular or low-temperature formulation depending on site conditions, within temperature ranges specified by manufacturer. Provide related accessories including primer, seam tape, mastic, fluid and sealant recommended by manufacturer. Subject to compliance with requirements, provide one of the following:
  - A. BASF Corporation - Wall Systems:
    - 1. Fluid Applied Air Barrier Membrane: Enershield-I, Senershield-VB, Finestop-VB.
    - 2. Fabric Reinforcement: Sheathing Fabric to be saturated with BASF Fluid Applied Membrane for use at sheathing joints, penetrations and window rough openings.
    - 3. Flashing and Transition Membrane: TF Membrane / WS Flash polyester-faced 30-mil self-adhesive membrane or TF Wrap / WS Wrap polyethylene-faced 20-mil self-adhesive membrane.
    - 4. Water-based Primer for Self-Adhesive Membranes: WS Flashing Primer.
    - 5. Mastics: As recommended by manufacturer.
  - B. Carlisle Coatings & Waterproofing Incorporated
    - 1. Fluid Applied Air and Vapor Barrier: Fire-Resist Barritech NP, 70 to 80 mils thick (wet).
    - 2. Detail Flashing: Fire-Resist 705 FR
    - 3. Counterflashing for Metal Wall Flashings: Fire-Resist 705 FR
    - 4. Water-Based Primer for Detail Flashing: CCW-702 WB
    - 5. Solvent-Based Primer for Detail flashing: CCW-702 or CCW-702 LV
    - 6. Solvent-Based Aerosol Primer for Detail Flashing: CAV-GRIP
    - 7. Reinforcing Fabric: DCH Reinforcing Fabric



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8. Glass Mat: LiquiFiber-W
9. Termination Mastic: SURE-SEAL Lap Sealant
10. Fill Compound: CCW-201 or CCW-703 V
- C. Grace Construction Products:
  1. Fluid Applied Air and Vapor Barrier: Perm-A-Barrier Liquid, 60 mils thick (wet).
  2. Water-Based Primer for Flashing, Transition Strip and Detail Membrane: Perm-A-Barrier WB Primer.
  3. Solvent-Based Primer for Flashing, Transition Strip and Detail Membrane: Bituthene Primer B-2 and Bituthene Primer B2 LVC.
  4. Through Wall Flashings or Shelf Angle Flashings: Perm-A-Barrier Wall Flashing.
  5. Mastics, Adhesives and Tapes: As recommended by Grace Construction Products.
  6. Transition Strip: Perm-A-Barrier Detail Membrane and Perm-A-Barrier Wall Flashing.
  7. Termination Mastic: Bituthene Liquid Membrane and as recommended by Grace Construction Products.
  8. Window Flashing and Detail Membrane: Perm-A-Barrier Detail Membrane and Perm-A-Barrier Wall Flashing.
- D. Henry Company:
  1. Fluid Applied Air and Vapor Barrier, Low VOC: Air Bloc 32MR, 75 to 115 mils thick (wet).
  2. Transition Membrane: Blueskin SA and Blueskin SA LT for low-temperature applications.
  3. Water-Based Primer for Transition Membrane: Aquatec Primer.
  4. Solvent-Based Primer for Transition Membrane: Blueskin Adhesive.
  5. Solvent-Based Aerosol Primer for Transition Membrane: Blueskin Spray Prep.
  6. Counterflashing for Masonry Through-Wall Flashing: Blueskin TWF.
  7. Mastics, Adhesives and Tapes: Henry 570-05 Polybitume.
- E. Protective Coatings Technology, Inc.
  1. Poly-Wall AirLok Flex at 8 - 12 mils thick (dry)
  2. Water-Based Primer: As recommended by manufacturer.
  3. Solvent-Based Primer: Poly-Wall AirLok or AirLok Flex as recommended.
  4. Counterflashing for Masonry Through-Wall Flashings: Poly-Wall CrackGuard.
  5. Mastics, Adhesives and Tapes: As recommended by manufacturer.
- F. W. R. Meadows, Inc.:
  1. Fluid Applied Air and Vapor Barrier: Air-Shield LM and Air-Shield LM All Season (for cold temperature applications), 60 mils (wet), 45 mils (dry).
  2. Detailing Strips: Air-Shield Self-Adhering Air Barrier.
  3. Water-Based Primer: Mel-Prime WB.
  4. Solvent-Based Primer: Mel-Prime VOC and Mel-Prime NE.
  5. Counterflashing for Masonry Through-Wall Flashings: Air-Shield Thru-Wall Flashing.
  6. Mastics, Adhesives and Tapes: Pointing Mastic.

### 1.6 AUXILIARY MATERIALS

- A. Comply with both air and vapor barrier manufacturer's recommendations and roofing material manufacturer's recommendations.
- B. Provide primers, glass fabric scrim tape, mastic, and other materials not specifically described, but required for a complete and proper installation as instructed by the dampproofing manufacturer or required.

## EXECUTION

- 1.7 The architect should include the following requirements in their specification and include additional directives as necessary for the project.



1.8 Require examination of substrates, areas, and conditions under which air and vapor barrier assemblies will be applied, with Installer present, for compliance with requirements.

- A. Do not proceed with installation until after minimum concrete curing period recommended by air and vapor barrier manufacturer.
- B. Ensure that the following conditions are met:
  - 1. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants
  - 2. Concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions.
  - 3. Masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.
- C. Verify substrate is surface dry. Test for capillary moisture by plastic sheet method according to ASTM D 4263 and take suitable measures until substrate passes moisture test. Surface dry is an acceptable substrate condition if acceptable to the manufacturer.
- D. Verify sealants used in sheathing are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered.

#### 1.9 SURFACE PREPARATION

- A. Require that substrate surfaces are clean, prepared, and treated according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air and vapor barrier application. Mask off adjoining surfaces to prevent overspray and spillage.
- B. Surface Preparation (Masonry): Dust, dirt, old loose or scaling coatings should be removed from the surface before coating. Cracks, joints, penetrations, and splits should be sealed, repaired with four inch wide glass fabric scrim tape embedded in Henry #789, or manufacturers approved equal. Dusty or porous masonry surfaces should be dampened with water. Highly porous masonry should be primed with Henry #792 Penetrating Asphalt Primer or #788 Non-Fibered Asphalt Emulsion Dampproofing which has been thinned with one gallon water per five gallons of #788, or manufacturers approved equal. Cleaned metal surfaces should also be primed. Architect must approve the surface preparation and sealing of cracks, joints and other penetrations prior to the application of the dampproofing.
- C. Surface Preparation (Sheathing): Prep joints and penetrations.
- D. Prime substrate for application of sheet membrane transition strips as recommended by manufacturer and as follows:
  - 1. Prime masonry, concrete substrates with conditioning primer.
  - 2. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.
  - 3. Prime wood, metal, and painted substrates with primer.
  - 4. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air and vapor barrier and at protrusions.
- E. Prime substrate for application of fluid applied air and vapor barrier if recommended by manufacturer based on project conditions and as follows in Installation subsection.

#### 1.10 INSTALLATION

- A. Air and Vapor Barrier Installation: Install transition strip materials and fluid applied air and vapor barrier to provide continuity throughout the building envelope. Install materials in accordance with manufacturer's recommendations and as follows, unless manufacturer recommends other procedures in writing based on project conditions or particular requirements of their recommended materials:
- B. Apply under normal working conditions above 45 degrees F and rising. Do not apply when rain is imminent.
- C. Apply with brush or spray equipment. Soft brushes free from stiff bristles should be used and the material applied in even strokes. When spraying, apply in one coat with a 50% overlap of the spray pattern to obtain a uniform and continuous coating, carrying coating





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- in and around joints, grooves, and slots, following reveals and soffits of windows, and continuing 12 inches out on adjoining partitions and soffits as instructed by manufacturer.
- D. Ensure continuous coating free of breaks, voids and pinholes.
  - E. Thoroughly cover all cracks, joints, and corners.
  - F. Provide fluid applied air and vapor barrier and transition strips in all exterior cavity walls on concrete masonry units, and on all exterior sheathing including, but not limited to, areas above soffits, doors and windows, and behind stucco and plaster.
  - G. Apply primer for transition strips at rate recommended by manufacturer. Allow primer to dry completely before transition strip application. Apply as many coats as necessary for proper adhesion.
  - H. Apply primer for fluid applied air and vapor barrier as recommended by fluid applied air and vapor barrier manufacturer. Based on manufacturer's recommendation, no primer may be required for the fluid applied materials.
  - I. Apply fluid applied air and vapor barrier using equipment and methods recommended by manufacturer, to achieve a dry film thickness as recommended by the manufacturer.
  - J. Apply fluid applied air and vapor barrier and transition strips to shed water naturally without interception by a sheet edge, unless that edge is sealed with permanently flexible termination mastic.
  - K. Position subsequent sheets of transition strips applied above so that membrane overlaps the membrane sheet below by a minimum of 2 inches (50 mm), unless greater overlap is recommended by manufacturer. Roll into place with roller.
  - L. Overlap horizontally adjacent pieces of transition strips a minimum of 2 inches (50 mm), unless greater overlap is recommended by manufacturer. Roll seams with roller.
  - M. Seal around all penetrations with termination mastic, extruded silicone sealant, membrane counterflashing or other procedure in accordance with manufacturer's recommendations.
  - N. Connect air and vapor barrier in exterior wall assembly continuously to the air barrier of the roof, to concrete below-grade structures, to windows, curtain wall, storefront, louvers, exterior doors and other intersection conditions and perform sealing of penetrations, using accessory materials and in accordance with the manufacturer's recommendations.
  - O. At changes in substrate plane, provide transition material (bead of sealant, mastic, extruded silicone sealant, membrane counterflashing or other material recommended by manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
  - P. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to the other. Membrane shall be continuously supported by substrate or as recommended by the manufacturer.
  - Q. At through-wall flashings, provide an additional 6 inch wide strip of manufacturer's recommended membrane counterflashing to seal top of through-wall flashing to membrane or as recommended by manufacturer. Seal exposed top edge of strip with bead of mastic or as recommended by manufacturer.
  - R. At deflection and control joints, provide backup for the membrane to accommodate anticipated movement.
  - S. At expansion and seismic joints provide transition to the joint assemblies.
  - T. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and as recommended by the manufacturer.
  - U. At end of each working day, seal top edge of the self-adhered membrane to substrate with termination mastic.
  - V. Do not allow materials to come in contact with chemically incompatible materials.
  - W. Do not expose membrane to sunlight longer than as recommended by the manufacturer.
  - X. Inspect installation prior to enclosing assembly and repair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by manufacturer.

### 1.11 FIELD QUALITY CONTROL



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B U I L D I N G   E X C E L L E N C E

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- A. Owner's Inspection and Testing/ABAA Audits: Cooperate with Owner's testing agency and ABAA auditors. Allow access to work areas and staging. Notify Owner's testing agency/ABAA auditor in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Daily inspection and testing may be required. Do not cover Work of this Section until testing and inspection is accepted.
- B. Twenty days after completion of this portion of the work, at the discretion of the Architect, demonstrate by running water test that the Work of this Section will successfully repel water.
  - 1. Require a Notice at least 72 hours in advance, and conduct the test in the Architect's presence.
  - 2. By means of an outrigger, or similar acceptable equipment, place the nozzle of a 3/4 inch garden hose at a point approximately 10 feet-0 inches, aiming the nozzle at slight downward angle to direct full stream of water onto wall.
  - 3. Run water onto wall at full available force for not less than four hours.
  - 4. Upon completion of the four hour period, inspect interior surfaces of wall for evidence of moisture penetration.
- C. If evidence of moisture penetration is discovered, apply an additional coat of approved fluid applied air and vapor barrier and/or transition strips to exterior surface, repeating application and testing (at no additional cost to the Owner) until no evidence of moisture penetration is found.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 07 41 13

#### PREFINISHED METAL ROOFING

##### GENERAL

- 1.1 The architect should include in this section: preformed, prefinished metal roof panels, flashings, gutters, downspouts and splash blocks, all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, weathertight, and complete installation.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 QUALITY ASSURANCE
  - A. Manufacturer's Qualifications:
    1. Manufacturer must have a minimum of five years experience manufacturing roof panels of the type specified for this Project. Panels specified in this Section shall be produced in a factory environment or by manufacturer's certified and approved on-site roll forming equipment to assure the highest level of quality control. A letter certifying compliance should accompany the product material submittal.
  - B. Installer's Qualifications:
    1. Installer of the system shall be an approved installer, certified and authorized by the manufacturer as trained and qualified to install the manufacturer's product. Provide a letter of certification from manufacturer that installer has a minimum of three year of metal roof panel installation experience preceding the date upon which work is to commence.
- 1.4 SYSTEM PERFORMANCE REQUIREMENTS
  - A. Windlift requirements: ASCE 7 wind uplift requirements per geographical location and 110 mph 3-second gust wind speed zone, exposure B with an Importance Factor of 1.15 based on IBC requirements. Roof system shall be installed in accordance with Factory Mutual wind uplift requirements and I-49 perimeter flashing requirements.
    1. Zone 1 Field
    2. Zone 2 Perimeter
    3. Zone 3 Corner
  - B. Performance Testing:
    1. Panel system shall have an FM Hail Damage Rating of Class 1-SH (Test 4471).
    2. Panel system shall have a Class "A" Fire Rating in accordance with ASTM E108.
    3. Metal roof system must be installed to resist the roof design pressures calculated in accordance with IBC or authorities having jurisdiction. Determine panel bending and clip-to-clip strength by testing in accordance with ASTM E1592. Capacity for gauge, span or loading other than those tested may be determined by interpolating test results by engineer supplying calculations.
    4. Metal roof system must meet the air infiltration requirements of ASTM E283 when tested with a 6.24 PSF pressure differential with resulting air infiltration of 0.0071 cfm/sq. ft.
    5. Metal roof system must meet the water penetration requirements of ASTM E331 when tested with a 12.00 PSF pressure differential with no uncontrollable water leakage when five gallons per hour of water is sprayed per square foot of roof area.
    6. ICBO Evaluation Services, Inc. Report No. ER-5409 is in compliance with UBC authorities having jurisdiction.
- 1.5 RECOMMENDED SUBMITTALS



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- A. All calculations shall be sealed by a professional engineer licensed in the State of Texas. Engineering calculations defining cladding loads on all roof areas based on specified building codes, allowable clip loads and required number of fasteners to secure the panel clips to the designated substructure. Uplift loads on clip fasteners with full recognition of prying forces and eccentric clip loading. Calculate holding strength of fasteners in accordance with submitted test data provided by fastener manufacturer based on length of embedment and properties of materials.
- B. Certifications:
  - 1. Letter of certification from manufacturer that installer is in compliance and meets specified requirements.
  - 2. Letter of certification from manufacturer that panels have been produced in a factory environment or with certified/approved fixed-base roll forming and leveler equipment.
  - 3. Certified test results by a recognized testing laboratory or manufacturer's laboratory (witnessed by a professional engineer) in accordance with specified performance test methods for each panel system.
  - 4. Manufacturer's affidavit that materials used in project contain no asbestos.
- C. Testing Reports: Showing metal panels have been tested in accordance with specified performance testing requirements.

### 1.6 WARRANTY

- A. Warrant the work specified herein against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials or workmanship. Warranty shall be a "Weather tightness" Warranty. Field Reports are required throughout Project and are to be supplied by a Manufacturer's Approved Technical Inspector. Manufacturer's personnel which are not Quality Control Technicians are not acceptable for inspection.
  - 1. Roof Panels and Finish:
    - a. Durability of the roof panels due to rupture, structural failure or perforation shall be warranted for a period of 20 years by the Manufacturer.
    - b. The exterior color finish for painted roof panels shall be warranted by the Manufacturer for 20 years against chalking, blistering, peeling, cracking, flaking, checking and chipping.
  - 2. Weathertightness:
    - a. The entire roof system including all roof panels, flashings, curbs, interior gutters, etc. shall be warranted by the manufacturer against leaks for a period of 20 years.
    - b. The warranty shall be issued to the Owner by the Manufacturer at time of entire Project Substantial Completion.
    - c. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation.
    - d. The roof system shall include roof insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system by the manufacturer, including materials and labor, shall be done at no cost to the Owner for duration of warranty period.
  - 3. Roofing Contractor: Jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding Company for the first two years and the manufacturer for the remaining three years.



## PRODUCTS

### 2.1 APPROVED MANUFACTURERS

- A. Manufacturers listed who produce products equivalent to those specified are approved for use on the Project. Other manufacturers must have a minimum of ten (10) years experience manufacturing equivalent products to those specified and comply with requirements of Division 1 regarding substitutions to be considered.
  - 1. AEP-Span, Dallas, TX; (214) 827-1740
  - 2. Firestone Unalclad UC-6 Double-Lock Standing Seam
  - 3. Fabral, Grapevine, TX; (800) 477-9066
  - 4. MBCI, Houston, TX; (281) 445-8555
  - 5. CARLISLE SYNTEC INCORPORATED Carlisle, PA 800-479-6832
  - 6. Pac Clad , Tyler Texas 1-800-441-8661
  - 7. Berridge Manufacturing Company; San Antonio, TX; (800) 669-0009
  - 8. McELROY METAL Bossier City, LA 800-950-6531
  - 9. RolCOM, a Centria Company, Frankfort, KY; (888) 647-4084
  - 10. UNA-CLAD Anoka Minnesota 800-426-7737
  - 11. ZIP-RIB Merchant & Evans Inc. 800-257-6215
- B. Specifications are based on SuperLok<sup>®</sup> (Double Lock Seam) architectural structural standing seam metal roof system manufactured by MBCI, Houston, TX; (281) 445-8555.
- C. Roof panels with lap type side joints or those requiring battens or other non-integral sealing means or exposed structural fasteners will not be acceptable.
- D. Roof panels shall be roll formed in the manufacturer's plant to control quality or by certified/calibrated/approved on-site roll-forming equipment only.
- E. Roof panels shall have a 20 year foamable mastic sealant plant-installed sealant for quality control. No solid butyl sealant or extruded rubber will be accepted.

### 2.2 MATERIALS

- A. Metal Roof Panels:
  - 1. Panel Profile: Two inch high by 3/4 inch wide rib by 16 inch wide, striated panel.
  - 2. Metal Roof System: Vertical leg, concealed fastener, standing seam, utilizing male and female rib configurations, with factory applied hot-melt mastic in female rib, continuously locked together by an electrically powered mechanical seaming device during installation.
  - 3. Gauge: Minimum 24 gauge (UL 90 rated)
  - 4. Substrate: Galvalume<sup>®</sup> steel sheet, Grade "D" minimum yield of 50,000 PSI.
  - 5. Clips: Two piece floating clip, 18 gauge base, 24 gauge top, with factory applied mastic, with fasteners to structural.
  - 6. Texture: Striations.
  - 7. Finish: Full strength Kynar 500 or Hylar 5000 Fluoropolymer coating, applied by the manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.70 to 0.90 mil over 0.25 to 0.35 mil prime coat, to provide a total dry film thickness of 0.95 to 1.25 mil. Bottom side shall be coated with primer with a dry film thickness of 0.25 mil. Finish shall conform to tests for adhesion, flexibility, and longevity as specified by the Kynar 500 or Hylar 5000 finish supplier. Color shall be selected by Architect from manufacturer's full range of non-metallic colors. (20 year warranty)
  - 8. Touch-up Paint: Paint burns, scars, welds, and damaged and rusted surfaces with cold galvanizing paint in accordance with ASTM A780. Acceptable Products include ZRC Cold Galvanizing Compound manufactured by ZRC Chemical Products, Quincy, MA; Galvax Zinc-rich Cold Galvanizing Coating manufactured by Alvin Products, Inc., Lawrence, MA; or paint complying with military specification MILP-21035A, Type I or II.



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### 2.3 MISCELLANEOUS MATERIALS

- A. Fasteners: All self-tapping/self-drilling fasteners, bolts, nuts, self-locking rivets and other suitable fasteners shall be designed to withstand specified design loads.
  - 1. Use long life fasteners for all exposed fastener applications.
  - 2. Provide fasteners with a factory applied coating in a color to match metal roof system application.
  - 3. Provide neoprene washers under heads of exposed fasteners.
  - 4. Locate and space all exposed fasteners in a true vertical and horizontal alignment. Use proper torque settings to obtain controlled uniform compression for a positive seal without rupturing the neoprene washer.
  - 5. Fasteners used to attach metal "Z" purlins shall be size and type recommended by manufacturer to achieve FM 1-90 requirements.
- B. Accessories:
  - 1. General: Provide all components required in accordance with the metal roof system manufacturer's approved shop drawings for a complete metal roof system to include panels, panel clips, trim/flashings, fascias, ridge, closures, sealants, fillers, and other required items.
  - 2. Utility Board: Shall be 1/2 inch thick glass mat-embedded, water resistant gypsum core panel conforming to "Dens-Deck Primed" roof board as manufactured by G-P Gypsum Corporation or Architect approved equal.
  - 3. Insulation Board: Three (3.5) inch thick closed cell glass reinforced polyisocyanurate insulation board complying with ASTM C1289, Type I, Class 2 and FS HH-I-1972/1, Class 2.
  - 4. Waterproofing Membrane: 60 mil thick "high temp" SBS modified bituminous product of self-adhering type with non-stick surface conforming to "TAMKO TW-Metal and Tile Underlayment" manufactured by Tamko Roofing Products, Inc. or Architect approved equal.
  - 5. Prefabricated Roof Curbs and Equipment Supports, Roof Jacks, and Rooftop Walkways: Shall be product of manufacturer approved by the metal roof system manufacturer and as specified below. Curbs shall be type recommended by roofing manufacturer to warranty curb and roofing for 20 years.
  - 6. Closures: All outside closures shall be fabricated from Galvalume® sheet steel of the same gauge, finish and color as the panels. Galvanized base is unacceptable.
  - 7. Tape Seal: Shall be a pressure sensitive, 100 percent solids, polyisobutylene compound sealing tape with a release paper backing. Provide permanently elastic, non-sagging, non-toxic, non-staining tape seal approved by the metal roof system manufacturer.
  - 8. Joint Sealant: Shall be a one-part elastomeric polyurethane sealant approved by the metal roof system manufacturer.
  - 9. Splash Blocks: Shall be as specified in Section 07 62 00, Sheet Metal Flashing, Gutters, Downspouts and Trim.

## EXECUTION

### 3.1 INSTALLATION OF METAL ROOFING OVER METAL DECK

- A. Install metal deck to structure to meet ASCE-7 wind uplift requirements.
- B. Install insulation over metal deck in conformance with approved shop drawings and manufacturer's instructions.
- C. Install substrate board over insulation in conformance with approved shop drawings and manufacturer's instructions.
- D. Install waterproofing membrane barrier over substrate board in conformance with approved shop drawings and manufacturer's instructions. Lap and tape seal all joints.





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- E. Remove protective strippable plastic film covering from metal roof panels, trim, and related items in accordance with manufacturer's instructions.
- F. Install metal roof system so that it is weathertight, without waves, warps, buckles, fastening stresses or distortion, allowing for expansion and contraction. Isolate dissimilar metal contact with proper taping and/or coatings.
- G. Install metal roof panels, trim, and related items in accordance with approved samples with approved shop drawings and manufacturer's instructions.
- H. Provide concealed anchors at all panel attachment locations.
- I. Install panels plumb, level and straight with seams and ribs parallel, conforming to design as indicated.
- J. Install roof jacks in accordance with approved shop drawings and manufacturer's instructions.
- K. Install roof curbs in accordance with approved shop drawings and manufacturer's instructions. Anchor curbs securely in place with provisions for thermal and structural movement. Provide prefinished metal cover around all curbs to match color and finish of metal roof panels.
- L. Install gutters and downspouts in accordance with approved samples with approved shop drawings and manufacturer's instructions. Gutter design for required gutter and downspout sizes shall be submitted prior to installation.
- M. Install downspouts plumb and level, attached to columns or wall with straps located at top and bottom of downspout and maximum ten (10) feet on center.
- N. Install splash block under discharge port of downspouts.
- O. Install gutter screen over installed gutter. Secure screen to spacer with self-tapping screw.
- P. Provide expansion joints on ends of gutters spaced maximum 50 feet on center. Install snap-on cover over expansion joint.

**END OF SECTION**





**SECTION 07 52 19**

**MODIFIED BITUMEN "COOL ROOF" MEMBRANE ROOFING SYSTEM**

**GENERAL**

**1.1 SECTION INCLUDES**

- A. Require the contractor to coordinate the work of the entire roofing assembly, including, but not limited to:
  - 1. Tapered edge strips, cant strips, and wood nailers. (Refer to this Section and Section 06 10 00)
  - 2. Curbs, (Refer to Section 07 72 00)
  - 3. Modified bitumen membrane roofing
  - 4. Flashings, including sheet metal perimeter edge (fascia) (Refer this Section and Section 07 62 00)
  - 5. Walkway pads, expansion joints, and other work incidental to, the complete and proper installation of a watertight modified bitumen membrane roofing system as shown on the drawings or specified herein, and in accordance with all applicable requirements of the Contract Documents.
  - 6. Light weight concrete roof deck warranty.
- B. The intent of this Section that the Work shall:
  - 1. provide a watertight facility;
  - 2. conform to all applicable building code requirements and of authorities having jurisdiction;
  - 3. Include Section 07 62 00, Sheet Metal Flashing, Downspouts, Gutters and Trim, and Section 07 72 00, Roof Accessories as part of the Work of this Section.
  - 4. Provide Owner with a single source full system warranty as specified.

- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.

**1.3 INSPECTIONS / TESTS**

- A. The Owner's, Architect's, and Manufacturer's representative shall at all times have access to the job site and work areas. The contractor will provide proper and safe facilities for such access and inspection.
  - 1. Architect Inspections:
    - a. The Architect will be providing periodic inspections throughout the duration of the project. Architect's Representative shall be required to inspect after completion of each major phase of construction for approval.
  - 2. Manufacturer Inspections:
    - a. An inspection shall be made by a representative of the material manufacturer two (2) times per month during performance of Work to ensure that said project is installed in accordance with the manufacturer's specifications and illustrated details. Daily written reports by the manufacturer shall be turned over to the Architect, on each Monday following the prior week.
    - b. The authorized material manufacturer's field representative shall be responsible for:
      - 1) Keeping the Architect's representative informed after periodic inspections as to the progress and quality of the work observed.
      - 2) Calling to the attention of the contractor those matters observed which are considered to be in violation of the contract requirements.



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- 3) Reporting to the Architect's representative, in writing, any failure or refusal of the contractor to correct unacceptable practices called to his attention.
  - 4) Confirming, after completion of the work and based on his observation and test, that he has observed no application procedures in conflict with these specifications. Final payment will not be released until the Architect has received all specified warranties.
- B. Any failure by the Owner's, Architect's or Manufacturer's Representative to detect, pinpoint, or object to any defect or noncompliance of these specifications of work in progress or completed work shall not relieve the contractor, or reduce, or in any way limit, his responsibility of full performance of work required of him under these specifications.
- C. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM standard procedures.
1. Owner will select testing laboratory and will pay for Work required by testing laboratory.
  2. Retests for work which fail initial tests or inspections shall be paid by contractor.

#### 1.4 QUALITY ASSURANCE

- A. Require the following of the Applicator:
1. Applicator shall have approval by manufacturer of accepted roofing system for application and issuance of specified warranty for a minimum of three (3) years. Proof of license agreement dated at least three years prior to date of bid opening.
  2. Applicator shall be an experienced single firm specializing in the type of roofing and sheet metal work specified, with a minimum of five (5) years of previous successful experience on projects similar in size and scope.
  3. No subcontracting of sheet metal fabrication or installation will be accepted. Contractor must have a sheet metal shop on the company premises.
  4. Applicators shall have a competent Superintendent, who is not actually performing roofing work, on site at all time while work is in progress, with full authority to act on behalf of the Contractor as his agent.
- B. Regulatory Requirements:
1. Classification by Underwriters' Laboratories, Inc. as a Class A roof covering.
  2. Roofing system shall be installed in accordance with ASCE-7 wind uplift requirements for geographical location as per IBC requirements.
  3. Follow local, state, and federal regulations of safety standards and codes. Refer to applicable building code or International Building Code for roofing system installation requirements and limitations.
- C. Laboratory Testing and Samples:
1. Require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM procedures.
- D. Require the following Installation procedures:
1. Unless otherwise indicated, the materials to be used in this specification are those specified and denote the type, quality, performance, etc. required. All proposals shall be based upon the use of the specified material.
  2. Install materials in accordance with the manufacturer's current published application procedures and the general recommendations of the National Roofing Contractor's Association.
  3. It will be the contractor's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the contractor shall be responsible for the correctness of it. Any drawings supplied are for reference only.



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4. Contractor shall plan and conduct the operations of the work so that each section started on one day is complete, details installed and thoroughly protected and in watertight condition before the close of work for that day.
5. Materials will be securely fastened in place in a watertight, neat and workmanlike manner. All workmen shall be thoroughly experienced in the particular class of work upon which employed. Work shall be performed in accordance with these specifications and shall meet the approval in the field of the Architect.
6. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust, and shall be deposited at an approved disposal site. At completion, all work areas shall be left broom clean and all contractors' equipment and materials removed from the site.

### 1.5 PERFORMANCE REQUIREMENTS

- A. Windlift requirements: ASCE 7 wind uplift requirements per geographical location and 110 mph 3-second gust windspeed zone, exposure B with an Importance Factor of 1.15 based on IBC requirements. Roof system shall be installed in accordance with Factory Mutual wind uplift requirements and I-49 perimeter flashing requirements.
  1. Zone 1 Field
  2. Zone 2 Perimeter
  3. Zone 3 Corner
- B. Fire Resistance: Meet Underwriter's Laboratory Class "A" fire rating.
- C. Energy Performance: Provide roof materials with Solar Reflectance Index required by the latest edition of the adopted City Codes and when calculated according to ASTM E1980 based on testing identical products by a qualifying testing agency.
- D. Require that base fastener pull out resistance tests on new lightweight insulating concrete fill were performed and approved and coordinated with Roofing Consultant prior to starting roofing application.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's packaging and/or roll plastic are not acceptable for exterior storage. Tarpaulin with grommets shall be accepted minimum for exterior coverings. All stored materials, as mentioned above, shall be minimum of four (4) inches off the substrate and the tarpaulin tied off with rope.
- B. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

### 1.7 WARRANTY/GUARANTEE

- A. Require Warranty of the roofing products and associated Work for 20 years from date of Substantial Completion as follows:
  1. The warranty shall be a NDL "No Dollar Limit" / no penal sum type, with total replacement cost.
  2. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
  3. The roof system including roofing insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
  4. Submit four (4) original executed copies of the Warranty/Guarantee.
- B. Require roofing contractor jointly with any subcontractors employed by him, to guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five (5) year warranty period from date of substantial completion. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding



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Company for the first two (2) years and the manufacturer for the remaining three (3) years.

### PRODUCTS

#### 2.1 APPROVED PRODUCTS/ MANUFACTURERS

- A. Limit the following products to the named manufacturers listed below. Manufacturers whose products meet or exceed these specifications and who have manufactured and installed roof materials and systems of the type specified here for a minimum of ten (10) years, and maintains a single source responsibility for the total roofing system (including the deck) may apply for approval to the District.
- B. Approved Manufactures:
  - 1. Siplast, Inc., Irving, Texas (972) 869-0070
  - 2. Soprema, Wadsworth, OH; (800) 356-3521
  - 3. Firestone Building Products Company, Carmel, IN (800) 428-4442
  - 4. GAF Wayne, NJ (800) 766-3411

#### 2.2 ROOFING SYSTEM ASSEMBLY/PRODUCTS

- A. Modified Base Sheet: A fiberglass reinforced, Styrene-Butadiene-Styrene (SBS) modified asphalt coated sheet, having an average weight of 28 pounds per square.
  - 1. Approved Product:
    - a. Siplast Product: Para Base, base sheet
    - b. Soprema Product: Sopra-G, base sheet
    - c. Firestone Product: SBS Base, base sheet
    - d. GAF: GAFGLAS #75 pound, base sheet
- B. Dry Sheathing Paper: (For use as a slip sheet) Rosin coated, 5 lbs. per 100 sq. ft.

#### 2.3 ROOF MEMBRANE ASSEMBLY

- A. System Description: A roof membrane assembly consisting of two (2) plies of a prefabricated, reinforced, homogeneous polymer modified asphalt membrane, secured to specified insulation or substrate. The assembly shall possess waterproofing capability, such that a phased roof application, with only the modified bitumen base ply in place, can be achieved for prolonged periods of time without detriment to the watertight integrity of the entire roof system. Contractor option to install using hot asphalt "mopped", cold adhesive, torched, or any combination – confirm special membrane types with manufacturer. Provide components of the roof membrane assembly meeting the following physical and mechanical requirements.
  - 1. Modified Bitumen Base Ply: A high performance modified bitumen base ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality modified bitumen and having the following properties:
    - a. Approved Product:
      - 1) Siplast Product: Paradiene 20
      - 2) Soprema Product: Elastophene Sanded
      - 3) Firestone Product: SBS Base
      - 4) GAF: Ruberoid 20
  - 2. Modified Bitumen Finish Ply: A high performance modified bitumen "cool roof" reflective white finish ply consisting of a lightweight random fibrous glass mat impregnated and coated with high quality Styrene-Butadiene-Styrene (SBS) modified bitumen, and having the following properties:
    - a. Approved Product:
      - 1) Siplast Product: Paradiene 30 CR FR TG
      - 2) Soprema Product: Soprastar
      - 3) Firestone Product: UltraWhite
      - 4) GAF: Ruberoid EnergyCap SBS Heat-Weld Plus FR



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3. STRIPPING PLY: Same as roof system base ply.

### 2.4 FLASHING MEMBRANE ASSEMBLY

- A. A flashing membrane assembly consisting of a prefabricated, fiberglass scrim-mat reinforced, block copolymer modified asphalt membrane, with a continuous, channel-embossed metal-foil surfacing. A low softening point asphalt shall be incorporated into the membrane between the metal foil surfacing and the SBS modified bitumen asphalt membrane, at the channels in order to preclude foil delamination during daily thermal cycling. Provide components of the roof flashing assembly meeting the following physical and mechanical requirements:
  1. Metal-Clad Modified Bitumen Flashing Sheet:
    - a. Approved Product:
      - 1) Siplast Product: Veral Aluminum
      - 2) Soprema Product: Sopralast 50 TV "Alu"
      - 3) Firestone Product: SBS Metal Flash AL
      - 4) GAF: Ruberoid Ultraclad
  2. Reinforcing Ply: Same as roof system base ply.

### 2.5 ROOF INSULATION (If Applicable)

- A. Roofing Insulation:
  1. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application with UL and FM Global approval.
  2. Polyisocyanurate Roof Insulation: Shall comply with ASTM C1289 and Federal Specification (FS) HH-I-1972/Gen and HH-I-1972/2, with a 20 psi minimum compressive strength. Insulation shall be surfaced on both sides with a non-asphaltic fiberglass facers. Thickness shall be a minimum of 3.5" over all conditioned air space, see drawings for details.
  3. Recover Board (Unless noted otherwise): Glass-Faced Gypsum Roof Board equal to UL rated Type X "Dens Deck Prime" as produced by Georgia-Pacific. Board sizes shall be 48" x 96" x 1/2" or as indicated on drawings for roof assembly. Provide as required by manufacture recommendation primer for Roof System. Approved substitute, SECUROCK by USG.
  4. Tapered ISO. Insulation: Factory cut 48 inches x 48 inches polyisocyanurate board cut to 1/4 inch per foot slope; thickness varies; ASTM C1289, UL Class A, Factory Mutual Class 1. Provide 1/2 inch recovery board similar to that specified above over tapered polyisocyanurate board insulation if used.
  5. Tapered Edge Strip: 1-1/2 inches to 0 inches (or as required, field verify), 18 inches x 48 inches, install at all expansion joints, curbs, projections, crickets, saddles and base flashings. Approved material shall be as manufactured by Cant Products or pre-approved equal.

### 2.6 ROOFING ACCESSORIES

- A. Roofing Adhesives:
  1. Adhesive, General:
    - a. VOC Content: Not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Mopping Asphalt: An asphalt that has been certified for full compliance with the requirements for Type IV asphalt listed in Table I, ASTM D312. Each container or bulk shipping ticket shall indicate the equiviscous temperature EVT, the finished blowing temperature, FBT, and the flash point, FP.
    - a. Approved Product: PA-100 asphalt manufactured by Siplast.
  3. Cold Process Adhesive: A blend of special adhesive asphalts and safe, high-flash, quick drying solvents that meets or exceeds ASTM D4479, Type II requirements.



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- a. Approved Product: PA-311 Adhesive manufactured by Siplast.
- B. Bituminous Cutback Materials:
  - 1. Primer: A high flash, quick drying, asphalt solvent blend which meets or exceeds ASTM D41 requirements.
    - a. Approved Product: PA-1125 Asphalt Primer manufactured by Siplast.
  - 2. Mastics: An asphalt cutback mastic, reinforced with non-asbestos fibers, used as a base for setting metal flanges and conforming to ASTM D4586 Type II requirements.
    - a. Approved Product: PA-1021 Plastic Cement manufactured by Siplast.
- C. Caulking and Sealants:
  - 1. VOC Content: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Nonmembrane Roof Sealants: 300 g/L; single component, high performance, elastomeric sealants conforming to ASTM C920 requirements.
    - b. Modified Bituminous Sealants: 500 g/L
    - c. Other sealants: 420 g/L
- D. Ceramic Granules: No. 11 Grade Specification Ceramic granules of color scheme matching the granule surfacing of the finish ply.
- E. Metallic Dust: A finely graded metal dust as supplied or approved by the membrane manufacturer, used for covering of bitumen overruns over the foil surfaced membrane.
- F. Fasteners:
  - 1. Shall be Factory Mutual approved and as recommended by the manufacturer for the specific application.
  - 2. Fastener for Brick: Shall be 1/4 inch x 2 inches, stainless steel nail, one piece unit, flat head, as manufactured by Rawl Zamac Nailin, or approved equal.
  - 3. Fastener for Wood: Shall be a #14 Factory Mutual approved fastener, fluorocarbon coated, with CR-10 coating. A minimum 0.200 inch diameter shank and 0.250 inch diameter thread. To be used with Factory Mutual approved, round pressure plates or bar, and having a fluorocarbon CR-10 coating, when subjected to 30 Kesternich cycles (DIN 50018) shows less than ten percent (10%) red rust which surpasses Factory Mutual Approval Standard 4470 as manufactured by Olympic Manufacturing Group, Inc., or pre-approved equal.
  - 4. Lightweight Insulating Concrete Base Sheet Fasteners: Shall be approved by the fastener manufacturer, membrane manufacturer and FM for use with lightweight insulating concrete as follows:
    - a. Fastener shall be a single unit, precision formed, of electro zinc coated steel having a 2.7 inch diameter rib reinforced cap and 1.7 inch long rectangular legs, designed to expand when fully driven into the lightweight insulating concrete. Fasteners for lightweight insulating concrete shall meet FM Standard 4470 requirements for corrosion resistance.
      - 1) Approved Product: "Zono-tite" Base Sheet Fasteners.
  - 5. Roofing Nails: Stainless steel, 316, type, size as required to suite application, minimum 11 gauge with 3/8 inch diameter head, minimum 1-1/2 inches in length.
  - 6. Iron-Lok Toggle: Shall be a toggle bolt with minimum 0.215 inch diameter shank and minimum 20 threads per inch, with a 2-1/2 inch wing span, with wing activated adhesive and pressure plate, as manufactured by Olympic Manufacturing Group, Inc.
- G. Walkway Pads: A prefabricated, puncture resistant polyester core reinforced, polymer modified bitumen sheet material topped with a ceramic-coated granule wearing surface meeting the following physical and mechanical requirements:
  - 1. Thickness: 0.217 inch





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2. Weight: 1.8 lb./ft<sup>2</sup>
3. Width: 30 inches
4. Approved Product: Paratread Roof Protection Material

### 2.7 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Other materials shall be as shown, specified or required and be of the best grade for the proposed use as recommended by the manufacturer.
  1. Expansion Joint: As detailed on drawings and outlined in NRCA and SMACNA manuals.
  2. Low Level expansion joints, as noted on the drawings, to be fabricated similar to Situra Inc. "Red Line" Low level expansion joint details. Install as per manufactures recommendations.
    - a. Approved Substitute Soprema's "Sopra Joint". Install as per manufactures recommendations.
  3. Sealant Backer Rod: Provide compressible rod stock of polyethylene foam, polyurethane foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable, non-absorptive material as recommended by sealant manufacturer for back-up of and compatibility with sealant. Where used with hot-applied sealant, provide heat-resistant type which will not be deteriorated by sealant application temperature as indicated.
  4. Pipe Hangers and Supports: Provide and install all necessary supports for gas lines, conduit, chilled water lines, duct work, condensate lines, etc. Refer to Section 07 72 00, Roof Accessories.
  5. Relief vents, lead and other sheet metal materials shall be as specified in Section 07 62 00, Sheet Metal Flashing, Gutters, Downspouts and Trim.
  6. Cant Strips: Shall be wood fiber where used for non-structural purposes. Shall be treated solid wood where used for structural purposes meeting NRCA, Factory Mutual and Underwriters Laboratory guidelines. If solid wood cant is used where insulation exists, cant is to be toe nailed into treated solid wood nailer the same height as insulation.

## EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project

### 3.2 SITE CONDITIONS

- A. Require installation at times recommended by manufacturer

### 3.3 ROOFING AND FLASHING - GENERAL

- A. Require the minimum on Installation:
  1. Require a three hour firewatch after use of torch. A fire extinguisher shall be present on roof at all times during use of a torch.
  2. Bitumen kettles or tankers shall have a visible thermometer and thermostatic control to provide positive monitoring of the bitumen temperature when it is heated in accordance with manufacturer's instructions. Circulate bituminous materials; do not allow bituminous materials to stand in luggers for long periods. Use insulated hot transport lines and luggers. Kettle shall be kept a minimum of 30 feet away from building, placed so that fumes, odors, and smoke, do not enter building through windows, doors, fresh air vents or similar entrances; are not directed towards freshly painted or anodized surfaces, glass or other glazing materials. Do not place kettle under trees or near vegetation. The assigned kettle man shall remain in close attendance, within 25 feet of ground level, while burners are lit.





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Kettle lids are to remain closed except for loading. Level of bitumen shall be kept within eight inches from top of kettle.

3. Asphalt Moppings: Ensure that all moppings do not exceed a maximum of 25 pounds per square. Mopping shall be total in coverage, leaving no breaks or voids.
4. Membrane Adhesive Application (If applicable): Apply cold adhesive in a smooth, even, continuous layer without breaks or voids at the rate of 1-1/2 gallons per square per ply. (The porosity of some substrates may require a heavier application to ensure full adhesion.) Refer to manufacturer's requirements.
5. All flashings shall be mechanically top-fastened with a termination bar a minimum of six inches on center at the top leading edge, and be a minimum of eight (8) inches in height from finished membrane.
6. On slopes greater than one inch in 12 inches, refer to NRCA and/or manufacturer's guidelines for backnailing procedures and follow the more stringent guidelines for all specified materials.

### 3.4 NAILERS

- A. Wooden nailers shall be installed at perimeter edges or drip edges on outside perimeter of building.
- B. All Construction: Nailers shall be the same height as the new lightweight insulating concrete deck or insulation being installed. Nailers shall be anchored to resist a pull-out force of 175 pounds per foot. Fasteners shall be no less than two (2) per nailer, and be spaced at three (3) feet on center maximum. Provide nailers at all penetrations. Raise all curbs, flashing, etc, a minimum of eight (8) inches above the deck.

### 3.5 APPLICATION OF BASE SHEET

- A. Lightweight concrete deck shall be covered with a base sheet, mechanically fastened as follows:
  1. Install in accordance with manufacturer's current published application instructions and to meet ASCE-7 wind uplift requirements. Fasteners and fastening patterns shall be determined by building height, pull out values from lightweight insulating concrete decks (more stringent applies), location and geographical area of the United States. It is the contractor's responsibility to consult current ASCE-7 publications, literature, and bulletins that are in effect at the time of this project. Submit perimeter, field and corner fastening patterns and cite all ASCE-7 data pertaining to the fastening pattern to the Architect for review.

### 3.6 ROOF ASSEMBLY INSTALLATION

- A. Roofing Application:
  1. Exert sufficient pressure on the roll during application to ensure prevention of air pockets. Lap seams between the base ply layer and the finish ply layer shall not coincide. Stagger the courses to ensure this.
    - a. Apply all layers of roofing perpendicular to the slope of the deck so that water flows over or along lap seams, but never against laps.
    - b. Fully bond the base ply to the base sheet or recover board with cold adhesive, torch, hot asphalt or mechanically attached-(Contractor's option). Each sheet shall have minimum three (3) inch side laps and six (6) inch end laps. Each sheet shall be applied directly behind the adhesive applicator. Stagger end laps a minimum of three (3) feet.
    - c. Fully bond the finish ply to the base ply (Contractor's option). Each sheet shall have a minimum of three (3) inch side and end laps. Each sheet shall be applied directly behind the asphalt applicator. Stagger end laps of the finish ply a minimum of three (3) feet. Stagger side laps of the finish ply a minimum of 12 inches from side laps in the underlying base ply. Stagger



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end laps of the finish ply a minimum of three (3) feet from end laps in the underlying base ply.

- d. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot. The manufacturer shall provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes. Cold process adhesives shall be used on slopes over 1/2 inch per foot up to and including six (6) inches per foot.
- e. Lap Treatment: A 20-pound roller shall be used on all side and end laps, following immediately behind application, apply uniform pressure across lap area to achieve a continuous visible bleed out.

### 3.7 ROOF ASSEMBLY FLASHING INSTALLATION

#### A. Flashing - General:

- 1. Flashings shall be installed using the manufacturer's Veral flashing membrane, with length of run not to exceed manufacturer's recommendations.
- 2. Wooden nailers or curbs shall be installed at all edges and openings in the roof, mechanically fastened to the deck. The nailers should be of exterior grade wolmanized timber, and of the same thickness as any insulation to be used on the roof.
- 3. Cant strips shall be installed at the intersection of the deck and/or all vertical surfaces. Prime all cants.
- 4. The roofing field membrane shall extend up over and to the top of cant strips at all vertical intersections or out to the roof's edge.
- 5. All substrates receiving flashing membrane shall be clean and primed with asphalt primer, prior to application.
- 6. All flashings shall be mechanically fastened with a termination bar a maximum of six (6) inches on center, be a minimum of eight (8) inches above finished roof height, extend a minimum of nine (9) inches onto the field of horizontal roof membrane, and not exceed ten (10) linear feet of run in length.
- 7. Install flashing membrane in accordance with drawings and/or material manufacturer's guarantee requirements, whichever is the most stringent.

- B. Flashing Application - Masonry Surfaces: Flash masonry parapet walls and curbs using the reinforcing sheet and the metal foil flashing membrane. After the base ply has been applied to the top of the cant, fully adhere the reinforcing sheet, utilizing minimum three (3) inch side laps and extend a minimum of three (3) inches onto the base ply surface and three (3) inches up the parapet wall above the cant. After the final roofing ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or by application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three (3) foot widths (cut off the end of roll) always lapping the factory selvage edge. Stagger the laps of the metal foil flashing layer from lap seams in the reinforcing layer. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See manufacturer's schematic for visual interpretation.)

- C. Flashing Application - Wood Surfaces: Flash wood or plywood parapet walls and curbs using the reinforcing sheet and metal foil flashing membrane. The reinforcing sheet shall have minimum three (3) inch side laps and extend a minimum of three (3) inches onto the base ply surface and to the top of the parapet wall, curb, etc. Nail the reinforcing sheet



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through the field of the sheet to the vertical wood surface on 12 inch centers from the top of the cant to top of wall curb, etc. Fully adhere the remainder of flashing reinforcing sheet that extends over the cant and roof level. After the finish ply has been applied to the top of the cant, prepare the surface area that is to receive flashing coverage by torch heating granular surfaces or application of asphalt primer; allowing primer to dry thoroughly. Torch apply the metal foil-faced flashing into place using three (3) foot widths (cut off the end of roll) always lapping the factory selvage edge. Extend the flashing sheet a minimum of four (4) inches beyond the toe of the cant onto the prepared surface of the finished roof and up the wall to the desired flashing height. Exert pressure on the flashing sheet during application to ensure complete contact with the wall/roof surfaces, preventing air pockets; this can be accomplished by using a damp sponge or shop rag. Check and seal all loose laps and edges. Nail the top edge of the flashing on nine (9) inch centers. (See manufacturer's schematic for visual interpretation.)

D. Projection Flashings:

1. Plumbing Vents: Soil vent stack pipes shall receive lead flashings installed in accordance with practices set forth in the NRCA Roofing Manual. The lead shall be carried up and over the top of the stack, and crimped down into the pipe to form a watertight seal. Projections shall be flashed as recommended by the roof membrane manufacturer. Provide tapered edge strips around base. Strip-in flange with specified stripping ply.
2. Square Projections: Strip in all flanges on square projections with specified stripping ply. Prime all flanges prior to setting in a bed of mastic. Install to manufacturer's specifications. Provide tapered edge strips around base. Cricket up-side slope.
3. Round Projections: Strip in all flanges on round projections with specified stripping ply. Prime all metal prior to setting in mastic. Install to manufacturer's specifications. Provide tapered edge strips around base.

E. Wall and Curb Flashings:

1. The flashing substrate shall be free of all dirt and loose material.
2. The underlayment ply or plies shall be brought to the top of the cant strip and adhered.
3. Starting on the roof at least six (6) inches from the roofside edge of the cant strip, adhere two (2) plies of flashing extending over the cant and up the vertical a minimum of eight (8) inches. Each lap of the ply sheet shall be a minimum of three (3) inches.
4. Starting two (2) inches past the flashing plies, install one (1) ply of SBS flashing membrane in hot asphalt. Laps shall not coincide with previously installed plies. The top of the SBS flashing shall be one (1) inch past the previously installed plies above the cant strip.
5. Fasten the top edge of the flashings on six (6) inch centers using approved termination bar and fasteners.
6. An NRCA-approved metal counterflashing shall extend down over the flashing a minimum of four (4) inches.
7. Cricket the up-side slope at all curb projections.

F. Overnight Seal / Water Cut-Off:

1. Over Night Seal: Shall be performed according to accepted roofing practice as outlined in the NRCA Roofing Manual.
2. Water Cut-Off: At the end of day's work or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to resumption of roofing.

### 3.8 ROOF SYSTEM INTERFACE WITH RELATED COMPONENTS



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- A. The following is a list of descriptions for correct installation of components integrated into the roof membrane assembly. In all cases, unless otherwise approved, incorporate flanged components into the system between the application of the base ply and finish ply. The flange must be primed with a uniform coating of approved ASTM D41 asphalt primer and allowed to dry thoroughly; all flanges must be set in approved mastic.
- B. Walkway Pads:
  - 1. Provide around all roof hatches, A/C units (if applicable) and at top and bottom of all roof access ladders.
  - 2. Cut the material into maximum five (5) foot lengths and allow to relax until flat.
  - 3. Adhere the sheet using the specified plastic cement. Apply the specified cement in a 3/8 inch thickness to the back of the product in five (5) inch by five (5) inch spots in accordance with the pattern as supplied by the material manufacturer.
  - 4. Install the walkway pad. Use a minimum spacing of two (2) inches between sheets to allow for proper drainage.
  - 5. Walk-in each sheet after application to ensure proper adhesion.
- C. Sealant: Caulk all exposed finish ply edges at gravel stops, waste stacks, pitch pans, vent stacks, etc., with a smooth continuous bead of approved sealant.
- D. Piping/Conduit: Provide hangers and supports as specified in Section 07 72 00, Roof Accessories. Coordinate locations with Architect.

**END OF SECTION**



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SECTION 07 54 19

MULTI-PLY THERMOPLASTIC MEMBRANE ROOFING SYSTEM

GENERAL

1.1 SECTION INCLUDES

- A. Require the contractor to coordinate the work of the entire roofing assembly, including, but not limited to:
  - 1. Tapered edge strips, cant strips, and wood nailers. (Refer to this Section and Section 06 10 00)
  - 2. Curbs (Refer to Section 07 72 00)
  - 3. Multi-ply fully adhered thermoplastic single-ply membrane roofing
  - 4. Flashings, including sheet metal perimeter edge (fascia) (Refer this Section and Section 07 62 00)
  - 5. Walkway pads, expansion joints, and other work incidental to, the complete and proper installation of a watertight roofing system as shown on the drawings or specified herein, and in accordance with all applicable requirements of the Contract Documents.
  - 6. Light weight concrete roof deck warranty.
- B. It is the intent of this Section that the Work shall:
  - 1. Provide a watertight facility.
  - 2. Conform to all applicable building code requirements and of authorities having jurisdiction.
  - 3. Include Section 07 62 00, Sheet Metal Flashing, Downspouts, Gutters and Trim, and Section 07 72 00, Roof Accessories as part of the Work of this Section.
  - 4. Provide Owner with a single source full system warranty as specified.

- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division

1.3 PERFORMANCE REQUIREMENTS

- A. Windlift requirements: ASCE 7 wind uplift requirements per geographical location and 110 mph 3-second gust windspeed zone, exposure B with an Importance Factor of 1.15 based on IBC requirements. Roof system shall be installed in accordance with Factory Mutual wind uplift requirements and I-49 perimeter flashing requirements.
  - 1. Zone 1 Field
  - 2. Zone 2 Perimeter
  - 3. Zone 3 Corner
- B. Fire Resistance: Meet Underwriter's Laboratory Class "A" fire rating.
- C. Energy Performance: Provide roof materials with Solar Reflectance Index required by the latest edition of the adopted City Codes and when calculated according to ASTM E1980 based on testing identical products by a qualifying testing agency.
- D. Require that base fastener pull out resistance tests on new lightweight insulating concrete fill were performed and approved and coordinated with Roofing Consultant prior to starting roofing application.

1.4 INSPECTIONS / TESTS

- A. The Owner's, Architect's, and Manufacturer's representative shall at all times have access to the job site and work areas. The contractor will provide proper and safe facilities for such access and inspection.
  - 1. Owner/Architect Inspections:
    - a. The Owner/Architect will be providing periodic inspections throughout the duration of the project. Owner's/Architect's Representative shall be required to inspect after completion of each major phase of construction for approval.
  - 2. Manufacturer Inspections:



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- a. An inspection shall be made by a representative of the material manufacturer two (2) times per month during performance of Work and at all major phases of construction, to ensure that said project is installed in accordance with the manufacturer's specifications and illustrated details. Daily written reports by the manufacturer shall be turned over to the Architect, on each Monday following the inspection.
- b. The authorized material manufacturer's field representative shall be responsible for:
  - 1) Keeping the Architect's representative informed after periodic inspections as to the progress and quality of the work observed.
  - 2) Calling to the attention of the contractor those matters observed which are considered to be in violation of the contract requirements.
  - 3) Reporting to the Architect's representative, in writing, any failure or refusal of the contractor to correct unacceptable practices called to his attention.
  - 4) Confirming, after completion of the work and based on his observation and test, that he has observed no application procedures in conflict with these specifications. Final payment will not be released until the Architect has received all specified warranties.
- B. Any failure by the Owner's, Architect's or Manufacturer's Representative to detect, pinpoint, or object to any defect or noncompliance of these specifications of work in progress or completed work shall not relieve the contractor, or reduce, or in any way limit, his responsibility of full performance of work required of him under these specifications.
- C. Architect may require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM standard procedures.
  - 1. Owner will select testing laboratory and will pay for Work required by testing laboratory.
  - 2. Retest for work which fail initial tests or contractor shall pay inspections.

**1.5 QUALITY ASSURANCE**

- A. Require the following of the Applicator:
  - 1. Applicator shall have approval by manufacturer of accepted roofing system for application and issuance of specified warranty for a minimum of three (3) years. Proof of license agreement dated at least three years prior to date of bid opening.
  - 2. Applicator shall be an experienced single firm specializing in the type of roofing and sheet metal work specified, with a minimum of five (5) years of previous successful experience on projects similar in size and scope.
  - 3. No subcontracting of sheet metal fabrication or installation will be accepted. Contractor must have a sheet metal shop on the company premises.
  - 4. Applicators shall have a competent Superintendent, who is not actually performing roofing work, on site at all time while work is in progress, with full authority to act on behalf of the Contractor as his agent.
- B. Regulatory Requirements:
  - 1. Classification by Underwriters' Laboratories, Inc. as a Class A roof covering.
  - 2. Roofing system shall be installed in accordance with ASCE-7 wind uplift requirements for geographical location as per IBC requirements.
  - 3. Follow local, state, and federal regulations of safety standards and codes. Refer to applicable building code or International Building Code for roofing system installation requirements and limitations.
- C. Laboratory Testing and Samples:





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1. Require tests and inspections as necessary to verify quality of roofing materials and workmanship. Laboratory tests will be performed in accordance with ASTM procedures.
- D. Require the following Installation procedures:
  1. Unless otherwise indicated, the materials to be used in this specification are those specified and denote the type, quality, performance, etc. required. All proposals shall be based upon the use of the specified material.
  2. Install materials in accordance with the manufacturer's current published application procedures and the general recommendations of the National Roofing Contractor's Association.
  3. It will be the contractor's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the contractor shall be responsible for the correctness of it. Any drawings supplied are for reference only.
  4. Contractor shall plan and conduct the operations of the work so that each section started on one day is complete, details installed and thoroughly protected and in watertight condition before the close of work for that day.
  5. Materials will be securely fastened in place in a watertight, neat and workmanlike manner. All workmen shall be thoroughly experienced in the particular class of work upon which employed. Work shall be performed in accordance with these specifications and shall meet the approval in the field of the Architect.
  6. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust, and shall be deposited at an approved disposal site. At completion, all work areas shall be left broom clean and all contractors' equipment and materials removed from the site.

### 1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Manufacturer's packaging and/or roll plastic are not acceptable for exterior storage. Tarpaulin with grommets shall be accepted minimum for exterior coverings. All stored materials, as mentioned above, shall be minimum of four (4) inches off the substrate and the tarpaulin tied off with rope.
- B. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day. Any exception must be in written form. Do not place materials or equipment in such a manner as to overload structure.

### 1.7 WARRANTY

- A. Roofing Manufacturer: Warrant the roofing and associated Work for 20 years from date of Substantial Completion as follows:
  1. The warranty shall be a NDL "No Dollar Limit" / no penal sum type, with total replacement cost.
  2. The warranty shall guarantee the entire roof system and associated work against defective materials and workmanship of installation, with NO exclusion for ponding water.
  3. The roof system including light weight insulating concrete, roofing insulation, flashing, metal work, labor, and material shall be guaranteed against failure of workmanship and materials. Repair of the system, including materials and labor, shall be done at no cost to the Owner.
- B. Roofing Contractor: Jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a five (5) year warranty period, after the Architect accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the Contractor, and subcontractors, to make good the requirements of the warranty. The warranty will be held jointly with the Bonding Company for the first two (2) years and the manufacturer for the remaining three (3) years.





## PRODUCTS

### 2.1 GENERAL

- A. The components of the roof system are to be products of a single manufacturer as required providing the specified system warranty.

### 2.2 APPROVED MANUFACTURERS

- A. Specifications are based on multi-ply fully adhered Thermoplastic Fleece back roofing system. Limit the following products to the named manufacturers listed below. Manufacturers whose products meet or exceed these specifications and who have manufactured and installed roof materials and systems of the type specified here for a minimum of 20 years, and maintains a single source responsibility for the total roofing system (including the deck) may apply for approval to the District.
- B. Approved Manufacturers:
  - 1. Johns Manville
  - 2. Carlisle Syn-Tec
  - 3. Flex Membrane International
  - 4. Seaman Corporation -FIBERTITE.
  - 5. GAF- EVERGAURD
  - 6. Sarnafil
  - 7. Firestone

### 2.3 ROOF MEMBRANE ASSEMBLY

- A. Mechanically attached Base Sheet over lightweight insulating roof decks: Shall be a heavy duty (plus) base sheet or venting base as approved by proposed manufacturer.
- B. Modified Bitumen Base Ply: A high performance modified bitumen base ply consisting of a reinforcing mat impregnated and coated with high quality modified bitumen: (Coordinate with manufacturer for special membrane type requirements when installed over insulation.)
  - 1. JM Product: DynaBase
  - 2. GAF: Ruberoid Mop 20
  - 3. Soprema Product: Elastophene Sanded
  - 4. Firestone Product: SBS Base
  - 5. Carlisle, Flex, Fibertite, Sarnafil: Provide modified bitumen base ply equal to membranes listed above to be included in system warranty.
- C. Finish Ply Thermoplastic Sheet: Uniform, flexible sheet formed from polyvinyl chloride, complying with ASTM D 4434-96, of the following type, thickness, and exposed face color:
  - 1. Classification Type II, Grade - I.
  - 2. Thermoplastic Polymer Thickness: 60 mils minimum.
  - 3. ASCE-7 wind uplift criteria.
  - 4. UL Class A.
  - 5. Exposed Face Color: White

### 2.4 FLASHING MEMBRANE ASSEMBLY

- A. A flashing membrane assembly consisting of two (2) plies of reinforced, polymer modified bitumen membrane and a white thermoplastic membrane:
  - 1. Reinforcing PLY: Same as roof system base ply.

### 2.5 ROOF INSULATION

- A. Roofing Insulation (if applicable):
  - 1. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application with UL and FM Global approval.
  - 2. Polyisocyanurate Roof Insulation: Shall comply with ASTM C1289 and Federal Specification (FS) HH-I-1972/Gen and HH-I-1972/2, with a 20 psi minimum



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compressive strength. Insulation shall be surfaced on both sides with a non-asphaltic fiberglass facers. Thickness shall be a minimum of 3" over all conditioned air space, see drawings for details. Approved product shall be Engry 3 as manufactured by Johns Manville or pre-approved equal.

3. Recover Board (Unless noted otherwise): Glass-Faced Gypsum Roof Board equal to UL rated Type X "Dens Deck Prime" as produced by Georgia-Pacific. Board sizes shall be 48" x 96" x 1/2" or as indicated on drawings for roof assembly. Provide as required by manufacture recommendation primer for Roof System. Approved substitute, SECUROCK by USG.
4. Tapered ISO. Insulation (Option No. 1 as required): Factory cut 48 inches x 48 inches polyisocyanurate board cut to 1/4 inch per foot slope; thickness varies; ASTM C1289, UL Class A, Factory Mutual Class 1. Approved product shall be Tapered E'NERG'Y 3 manufactured by Johns Manville or pre-approved equal. Provide 1/2 inch recovery board similar to that specified above over tapered polyisocyanurate board insulation if used.
5. Tapered Perlite Insulation (Option No. 2 as required): Tapered perlite insulation board cut to 1/4 inch per foot slope; thickness varies; conforming to ASTM C728. Approved product shall be Tapered Fesco Board manufactured by Johns Manville or Architect pre-approved equal.
6. Tapered Edge Strip: 1-1/2 inches to 0 inches (or as required, field verify), 18 inches x 48 inches, install at all expansion joints, curbs, projections, crickets, saddles and base flashings. Approved material shall be as manufactured by Cant Products or pre-approved equal.

### 2.6 ACCESSORIES

- A. Roofing Adhesives for membrane and/or insulation:
  1. Mopping Asphalt: Asphalt that has been certified for full compliance with the requirements for Type IV asphalt listed in Table I, ASTM D312. Each container or bulk shipping ticket shall indicate the equiviscous temperature EVT, the finished blowing temperature, FBT, and the flash point, FP.
  2. Bonding Adhesive: As recommended by thermoplastic sheet manufacturer's printed instructions to develop a bond between the membrane and the substrate to which the membrane is to be attached.
- B. Fasteners:
  1. Shall be FM Global approved and as recommended by the manufacturer for the specific application.
  2. Fastener for Brick: Shall be 1/4 inch x 2 inches, stainless steel nail, one piece unit, flat head.
  3. Lightweight Insulating Concrete Base Sheet Fasteners: Shall be approved by the fastener manufacturer, membrane manufacturer and FM for use with lightweight insulating concrete as follows:
    - a. Fastener shall be a single unit, precision formed, of electro zinc coated steel having a 2.7 inch diameter rib reinforced cap and 1.7 inch long rectangular legs, designed to expand when fully driven into the lightweight insulating concrete. Fasteners for lightweight insulating concrete shall meet FM Standard 4470 requirements for corrosion resistance.
  4. Fastener for Insulation (over steel decks): Shall be a #14 Factory Mutual approved fastener, fluorocarbon coated, with CR-10 coating. A minimum 0.200 inch diameter shank and 0.250 inch diameter thread. To be used with Factory Mutual approved, round pressure plates or bar, and having a fluorocarbon CR-10 coating, when subjected to 30 Kesternich cycles (DIN 50018) shows less than ten percent (10%) red rust which surpasses Factory Mutual Approval Standard 4470. Stainless Steel 304 when used with ACQ treated lumber.
  5. Cementitious Fiber Deck Base Sheet Fasteners: Shall be a fastener with self-locking tube nail of the correct length and 2.7 inch smooth secured



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- galvanized disk. Fasteners and washers shall be listed in the Factory Mutual Approval Guide.
- 6. Nails: Stainless Steel ring shank, size as required to suite application, minimum 11 gauge with 3/8 inch diameter head.
- 7. Iron-Lok Toggle: Shall be a toggle bolt with minimum 0.215 inch diameter shank and minimum 20 threads per inch, with a 2-1/2 inch wing span, with wing activated adhesive and pressure plate.
- C. Raised Expansion Joint: As detailed on drawings and outlined in NRCA and SMACNA manuals.
- D. Pipe Hangers and Supports: Provide and install all necessary supports for gas lines, conduit, chilled water lines, duct work, condensate lines, etc.
- E. Cant Strips: Shall be wood fiber where used for non-structural purposes. Shall be treated solid wood where used for structural purposes meeting NRCA, Factory Mutual and Underwriters Laboratory guidelines. If solid wood cant is used where insulation exists, cant is to be toe nailed into treated solid wood nailer the same height as insulation.
- F. Termination Bar: Extruded aluminum bar with lip profile.

### EXECUTION

#### 3.1 PROJECT CONDITIONS

- A. Environmental Requirements:
  - 1. Apply roofing in dry weather.
  - 2. Do not apply roofing when ambient temperature is below 45 degrees F.
  - 3. Refer to manufacturers recommendations.

#### 3.2 NAILERS

- A. Wooden nailers shall be installed at perimeter edges or drip edges on outside perimeter of building.
- B. All Construction: Nailers shall be the same height as the new lightweight insulating concrete deck or insulation being installed or to existing raised roof edge whichever is applicable. Nailers shall be anchored to resist a pullout force of 300 pounds per linear foot per Factory Mutual Data Sheet 1-49. Fasteners shall be no less than two (2) per nailer, and be spaced at three (3) feet on center maximum. Provide nailers at all penetrations. Raise all curbs, flashing, etc, a minimum of eight (8) inches above the deck.

#### 3.3 INSTALLATION OF BASE SHEET

- A. Lightweight concrete deck shall be covered with a base sheet, mechanically fastened as follows:
  - 1. Install in accordance with manufacturer's current published application instructions and to meet ASCE-7 as listed in paragraph 1.7 B2. Fasteners and fastening patterns shall be determined by building height, pull out values from lightweight insulating concrete decks (more stringent applies), location and geographical area of the United States. It is the contractor's responsibility to consult current wind uplift publications, literature, and bulletins that are in effect at the time of this project. Submit perimeter, field and corner fastening patterns and cite all data pertaining to the fastening pattern to the Architect for review.

#### 3.4 INSTALLATION OF BASE PLY MEMBRANE

- A. Apply all layers of roofing free of wrinkles, creases or fishmouths. Exert sufficient pressure on the roll during application to ensure prevention of air pockets. Lap seams between the base ply layer and the finish ply layer shall not coincide. Stagger the courses to ensure this. Apply all layers of roofing so that water flows over or along lap seams, but never against laps.



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1. Fully bond the base ply to the base or recover board with cold adhesive, or hot asphalt. Each sheet shall have minimum three (3) inch side laps and six (6) inch end laps. Each sheet shall be applied directly behind the adhesive applicator. Stagger end laps a minimum of three (3) feet.
2. Maximum sheet lengths and special fastening of the specified roof membrane system may be required at various slope increments where the roof deck slope exceeds 1/2 inch per foot. The manufacturer shall provide acceptable sheet lengths and the required fastening schedule for all roofing sheet applications to applicable roof slopes.
3. Lap Treatment: A 20-pound roller shall be used on all side and end laps, following immediately behind application, apply uniform pressure across lap area to achieve a continuous visible bleed out.

### 3.5 INSTALLATION OF THERMOPLASTIC MEMBRANE

- A. Fully bond the finish ply to the base ply with cold adhesive, or hot asphalt. Each sheet shall have a minimum of three (3) inch side and six (6) end laps. Each sheet shall be applied directly behind the adhesive applicator. Stagger end laps of the finish ply a minimum of three (3) feet. Stagger side laps of the finish ply a minimum of 12 inches from side laps in the underlying base ply. Stagger end laps of the finish ply a minimum of three (3) feet from end laps in the underlying base ply.

### 3.6 SEAM INSTALLATION

- A. Clean seam areas, overlap sheets, and weld side and end laps of sheets and flashings according to manufacturer's written instructions to ensure a watertight seam installation. Weld seam as follows:
  1. Weld Method: Hot Air
- B. Test lap edges with probe to verify seam weld continuity on a daily basis.
- C. Repair tears, voids, and lapped seams in roofing that does not meet requirements.

### 3.7 FLASHING INSTALLATION

- A. Install sheet flashings and performed flashing accessories and adhere to substrate according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with sheet flashing as recommended by manufacturer.
- D. Clean seam areas, overlap seams, and firmly roll flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.
- E. Test lap edges with probe to verify seam weld continuity. Apply lap sealant, if required by roofing manufacturer, and seal exposed edges of sheet flashing terminations per manufacturer's requirements.
- F. Terminate and seal top sheet flashings and mechanically anchor to substrate through termination bars.

### 3.8 OVERNIGHT SEAL / WATER CUT-OFF

- A. Over Night Seal: Shall be performed according to accepted roofing practice as outlined in the NRCA Roofing Manual.
- B. Water Cut-Off: At the end of day's work or when precipitation is imminent, construct a water cut-off at all open edges. Cut-offs can be built using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Cut-offs must be completely removed prior to resumption of roofing.

### 3.9 CLEANING AND PROTECTION

- A. Contractor shall keep the job clean and free from all loose materials and foreign matter. Contractor shall take necessary precautions to keep outside walls clean and shall allow no roofing materials to remain on the outside walls.



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- B. Leave all areas around job site free of trash, debris, roofing materials, equipment, and related items after completion of job.
- C. All bituminous or roofing related materials shall be removed from ladders, stairs, railings, and similar parts of the building.
- D. Remove bitumen stains from walls, walkways, and driveways.

**END OF SECTION**



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ROOF RELATED SHEET METAL

GENERAL

- 1.1 The architect should include in this section: all shop and field formed sheet metal work shown on drawings, specified or required, including, roof penetration sleeves and hood and umbrella counterflashing, metal counterflashing, expansion joint, roof drains, scuppers, metal perimeter edge, gutters, downspouts, splash blocks and splash pans, one-way roof moisture relief vents, metal gravity vents, metal heat exhaust vents, sanitary vent pipes, pipe box and copings, trim and miscellaneous sheet metal accessories.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 QUALITY ASSURANCE
  - A. Single Source Responsibility: Fabricator and installer of roof-related flashing and accessories shall be the same as the membrane roof installer.
  - B. Comply with governing codes and regulations of authorities having jurisdiction.
  - C. ANSI/SPRI ES-1: Fabricate and install sheet metal edge flashings and copings to comply with requirements of ANSI/SPRI ES-1 for 110 MPH wind speed zone and wind resistance loads.
- 1.4 WARRANTIES
  - A. Manufacturer's Product Warranty:
    1. Manufacturer's standard 20 year Kynar 500 or Hylar 5000 Finish warranty signed by the manufacturer, with guarantee covering any failure of the fluoropolymer finish during the warranty period.
    2. Failure is defined to include, but not be limited to:
      - a. Deterioration of finish, such as fading, discoloring, peeling, cracking, corroding, etc.
    3. Correction may include repair or replacement of failed product.
  - B. Roofing Contractor's Warranty:
    1. Contractor shall warrant the sheet metal work and related work to be free from defects in workmanship and materials, and that the metal flashings will be and remain watertight, for a period of five (5) years from date of Substantial Completion.
    2. Defects shall include leaking water or bitumen within building or construction, becoming loose from substrate, loose or missing parts and finish failure as defined above.

PRODUCTS

- 2.1 APPROVED MANUFACTURERS
  - A. Manufacturers named within specification are approved for use on the Project providing:
    1. their products meet or exceed the specifications;
    2. company has a minimum of five (5) years experience manufacturing products of the type specified;
    3. products have been tested in conjunction with roofing membrane system as an assembly and as such has obtained the same approval and rating as the roofing membrane system; and
    4. Products are approved for use by the roofing membrane manufacturer.
- 2.2 SHEET METAL MATERIALS



## BUILDING EXCELLENCE

- A. General Requirements: Roofing sheet metal system shall have been tested in conjunction with roofing membrane system as an assembly and have the same approval and rating as the roofing membrane system.
- B. Prefinished Aluminum Sheet:
  - 1. Precoated type, aluminum conforming to Fed. Spec. QQ-A-250, ASTM B209.
  - 2. Finish: Kynar 500, color as selected by Architect from manufacturer's standard colors.
  - 3. Thickness: Minimum 0.040 inch, except as otherwise indicated.
- C. Sheet Lead:
  - 1. Comply with FS QQ-L-201, Grade B
    - a. Four (4) pound minimum for use at roof drains and soil stacks.
- D. Stainless Steel: ASTM A167, Type 302/304 Soft Temper, No. 2D finish. Minimum thickness 24 gauge, except as otherwise noted.

### 2.3 FASTENERS

- A. Same metal as flashing/sheet metal or other non-corrosive metal or as noted below.
- B. Exposed fasteners shall be self-sealing and gasketed for weathertight installation. (ZAC type)
- C. Match finish of exposed heads with material being fastened.
- D. Mechanical Fasteners:
  - 1. Nails: Ring shank, minimum 1-1/2 inches in length with 1/2 inch diameter head.
  - 2. Washers: Steel washers with bonded rubber sealing gasket.
  - 3. Screws: Self-tapping sheet metal type of stainless steel or compatible with material being fastened, with hooded integral EPDM washers (ZAC type).
  - 4. Rivets: Stainless steel and cadmium plated material, closed end type of sizes recommended by sheet metal manufacturer to suit application.
- E. Continuous Cleat (coping/fascia): Minimum 20 gauge, G-90 galvanized, stainless steel, or aluminum. Match material of coping/fascia and provide one gauge heavier.

### 2.4 RELATED MATERIALS

- A. Solder: ASTM B32, alloy grade 58, 50 percent tin, 50 percent lead.
- B. Flux:
  - 1. Phosphoric acid type, manufacturer's standard.
    - a. For Use with Steel or Copper: Rosin flux
    - b. For Use with Stainless Steel: Acid-chloride type flux, except use rosin flux over tinned surfaces.
- C. Underlayment:
  - 1. 48 mil minimum, non-reinforced, homogeneous, waterproof, impermeable elastomeric sheeting manufactured by Nervastral, Inc. or Lexsuco.
- D. Adhesives: Type recommended by flashing sheet manufacturer seaming and adhesive application of flashing sheet to ensure adhesion and watertightness.
- E. Metal Accessories: Sheet metal clips, straps, anchoring devices, clamps and similar accessories required for the complete installation of work, matching or compatible with material being installed, non-corrosive, size and gauge recommended by installer to suit application and performance.
- F. Sealant:
  - 1. Type A:
    - a. Type: One-part, non-sag, moisture-curing polyurethane sealant.
    - b. Approved Products/Manufacturers: "Chem-Calk 900" manufactured by Bostik Construction Products Division, "Vulkem 921" manufactured by Mameco International, Inc., "Dynatrol I" manufactured by Pecora Corporation, "NP 1" manufactured by Sonneborn Building Products, or approved equal.
  - 2. Type B:





## BUILDING EXCELLENCE

- a. Type: One-part, neutral-curing, medium-modulus silicone sealant for sealing metal to metal surfaces, i.e. metal edge, cover plates, etc.
  - b. Approved Products/Manufacturers: "Chem-Calk 1200" manufactured by Bostik Construction Products Division, "795 Silicone Building Sealant" manufactured by Dow Corning Corporation, "895 Silicone" manufactured by Pecora Corporation, "Omniseal" manufactured by Sonneborn Building Products, "Spectrem 2" manufactured by Tremco Incorporated, or approved equal.
- G. Grout - Pitch Pans:
  - 1. Type: Quick-setting, non-shrink, non-metallic, high strength formula complying with ASTM C1107.
  - 2. Approved Products/Manufacturers: "Sure Grip High Performance Grout" manufactured by Dayton Superior Corporation, "Premier Quick-Trim" manufactured by L & M Construction Chemicals, Inc., "Masterflow" manufactured by Master Builders, Inc., "SonnogROUT 10K" manufactured by Sonneborn Building Products, or approved equal.
- H. Pitch Pan Filler:
  - 1. Type: Pourable polyurethane sealer, approved by roofing system manufacturer.
  - 2. Approved Products/Manufacturers: "Quick Pitch Sealer" manufactured by U.S. Intec, "SPM Pourable Sealer" manufactured by Johns Manville, or approved equal.
- I. Termination Bar:
  - 1. Material: Extruded aluminum bar with flat profile.
  - 2. Size: 1/8 inch thick by one (1) inch wide with factory punched 1/4 inch x 3/8 inch oval holes spaced six (6) inches on center.
  - 3. Approved Product/Manufacturer: "TB 125" manufactured by TruFast Corp., or approved equal.
- J. Splash Blocks: Concrete type, of size and profiles indicated; minimum 3,000 psi compressive strength at 28 days, with minimum five (5) percent air entrainment. Use at locations where roof drainage dumps on ground.
- K. Splash Pans: 22 gauge stainless steel, of size and profiles indicated. Use at locations where roof drainage discharges over adjoining, lower roof level(s).

### 2.5 FABRICATION

- A. Except as otherwise indicated, fabricate work in accordance with SMACNA Architectural Sheet Metal Manual and other recognized industry practices and reviewed shop drawings. Form all flashings, receivers and counterflashings in accordance with standards set forth in the NRCA roofing manual and SMACNA.
- B. Fold back edges on concealed side of exposed edge to form hem.
- C. Unless noted otherwise, lap joints minimum three (3) inch. Lap joints to have sealant installed as per details, to maintain watertight condition, inside and outside corners and elevation changes to be riveted and soldered..
- D. Seams:
  - 1. Wherever possible, fabricate non-moving seams in sheet metal with flat-lock seams and end joints.
  - 2. Tin edges to be seamed, form seams, and solder.
- E. On Kynar 500 or Hylar 5000 pre-finished metal, surface sand metal flanges prior to applying any primers. Prime all metal in contact with bituminous material.
- F. Backpaint all concealed metal surfaces with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.
- G. Expansion Provisions: Where lapped or bayonet type expansion provisions in work cannot be used or would not be sufficiently waterproof or weatherproof, form expansion joints of intermeshing hooked flanges, not less than one (1) inch deep filled with mastic sealant concealed within joints.



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2.6 FABRICATED ITEMS

- A. Through-wall Flashings: (Minimum ten (10') foot lengths)
  - 1. Through wall Receiver Tray: Minimum 24 gauge stainless steel, through wall receivers shall not extend past the face of the exterior veneer more than  $\frac{3}{4}$ ".
  - 2. Removable Counterflashings: Minimum 0.040 inch thick pre-finished aluminum formed in maximum ten (10) foot lengths.
- B. Wind Clips: Minimum 24 gauge stainless steel (or match material of removable counteflashing), one (1) inch wide by length to engage counterflashing a minimum of 1/2 inch.
- C. Roof Penetrations:
  - 1. Umbrella Counterflashing: Two-piece construction of minimum 22 gauge stainless steel, fabricated in accordance with drawings or project requirements.
  - 2. Flashing Pans:
    - a. 24 gauge stainless steel.
    - b. Fabricate to provide installed minimum clear inside perimeter dimension of two (2) inches on each side of penetrating element.
    - c. Fabricate pans to at least six (6) inches above the finished roof membrane and with 1/4 inch hem at top edge and with four (4) inch flanges. Round all corners of flange.
    - d. Fabricate metal bonnets for all pans, NO EXCEPTIONS. Fabricate bonnets with metal compatible with metal to which bonnet is to be attached. On beams and other steel, weld in place bonnets fabricated from 1/4 inch steel plate. Draw band bonnets fabricated from 22 gauge stainless steel may be used on circular projections.
- D. Metal Fascia Edge (Ensure all fabrication and installation is ES-1 certified):
  - 1. Minimum 0.040 inch thick pre-finished aluminum formed in maximum ten (10) foot lengths, with six (6) inch wide cover plates of same profile, four (4) inch flange, maximum seven (7) inch fascia, 3/4 inch gravel stop. Refer to SMACNA Fig. 2-5A
  - 2. Provide expansion slip joints at maximum 20 feet on center.
  - 3. Shop fabricate all interior and exterior corners. Fabricate exterior corners with 18 inch minimum to four (4) foot maximum legs. Lap, rivet, and seal prior to delivery to jobsite.
  - 4. Provide mock-up for Architect's approval prior to fabrication.
  - 5. Pre-engineered ES-1 certified products shall be submitted to District for prior approval.
- E. Continuous Cleats: Continuous strips, same material and profile, minimum one gauge heavier of item which cleats attach.
- F. Vent Hoods, Sleeves, Penetration Flashings, and Accessories: Minimum 24 gauge stainless steel, or as shown or directed otherwise.
- G. Angle Termination Bar: Aluminum pressure bar 1/8 inch x one (1) inch.
- H. Vent Pipe Flashing: Four (4) pound lead. Provide proper size to fold down inside of pipe a minimum of one (1) inch.
- I. Gutters/Downspouts/Collector Heads:
  - 1. Minimum 0.040 inch thick pre-finished aluminum formed in maximum ten (10) foot lengths, with six (6) inch wide cover plates.
  - 2. Verify gutter and downspout meets rainfall data as outlined in SMACNA.
  - 3. Install all anchoring devices as outlined in SMACNA.
  - 4. Expansion Joints: Lap or Butt type per SMACNA, locate every 50 linear feet.
  - 5. Gutter Straps and Supports: Minimum 0.040 inch thick pre-finished (match color) aluminum hemmed around 1/8 inch galvanized bent steel bracket.
  - 6. Downspout straps: Strap type, like metal, match color.
  - 7. Gutter Screen: Stainless steel 1/4 inch diamond wire screen enclosed in a pre-finished steel frame.



## BUILDING EXCELLENCE

8. Collect Heads: Minimum 0.040 inch thick pre-finished (match color) aluminum. As outlined in SMACNA; Refer to Figure 1-25F and Figure 1-28 with alternate Section A-A.

### EXECUTION

#### 3.1 INSTALLATION

- A. Install sheet metal with lines, arises, and angles sharp and true, and plane surfaces free from objectionable wave, warp, or buckle. Exposed edges of sheet metal shall be folded back to form 1/4 inch hem on concealed side from view. Finished work shall be free from water retention and leakage under all weather conditions. Pre-fabricated corners or transitions are required at changes in direction, elevation, or plane and at intersections. Locate field joints not less than 12 inches, nor more than three (3) feet from actual corner. Laps shall be one (1) inch, riveted and soldered at following locations:
  1. Pre-fabricated corners; transitions; changes in direction, elevation, and plane; and at intersections.
- B. Anchor units of work securely in place to prevent damage or distortion from wind or buckling. Provide for thermal expansion of metal units; conceal fasteners wherever possible; and set units true to line and level as indicated. Install work with laps, joints, and seams which are permanently watertight and weatherproof.
- C. Separations: Provide for separation of metal from dissimilar metal or corrosive substrates by coating concealed surfaces with zinc chromate, bituminous coating, or other permanent separation at locations of contact as recommended by manufacturer or fabricator. Do not use materials which are incompatible with roofing system.
- D. Continuous Cleat: At exposed edges of perimeter edge, fascias, cap flashings, and where required, attach continuous cleat at six (6) inches on center with appropriate fasteners. At a distance of 10 feet from each direction of all corners, install fasteners spaced at 3 inches on center. Install cleat so fascia extends a minimum of 1 inch below top of exterior wall finish.
- E. Gravel Guard/Fascia:
  1. Install with expansion joints 10 feet o.c., 1/2 inch expansion leeway, with cover plate.
  2. Set in asphalt mastic and fasten into nailer at 3 inches o.c. staggered.
  3. Buff sand Kynar surface of flange and prime.
  4. Strip in flange with specified stripping plies set in hot bitumen extending 3 inches from outer edge of flange to at least 3 inches inward towards gravel stop. Provide finish stripping ply of modified bitumen base ply in hot bitumen extending 6 inches from the outer edge of the flange and butt base of gravel stop.
- G. Counterflashing:
  1. Do not use surface mount counterflashing except as noted in drawings.
  2. Set in through wall with receiver and spring lock counterflashing, as detailed in drawings and to NRCA roofing manual, SMACNA standards.
  3. Coordinate installation of through-wall flashing with the masonry contractor.
  4. Seal through-wall in conjunction with masonry wall waterproofing.
  5. Install wind clips 30 inches o.c. at all counterflashing over five (5) feet in length.
- H. Pitch Pans, Metal Flanges:
  1. Apply mastic under pitch pan or metal flashing flange at least 1/2 pound per linear foot.
  2. Prime all metal flanges with asphalt primer prior to flashing installation.
  3. Clean all projections enclosed in pitch pans in any manner suitable and coated with a rust inhibitive coating as approved by the Architect. Coating shall be allowed to dry prior to pitch pan fill.
  4. Fill base of pitch pans with grout or cementitious binder and allow to cure.
  5. Top Finish Fill: Self-leveling, one-part urethane; at least two (2) inches to top of pitch pan sides.



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6. Strip in pitch pan flanges with two strips of specified stripping plies set in hot bitumen extending three (3) inches from the outer edge of the flange to at least three (3) inches inward toward base of pitch pan. Provide finish stripping ply of SBS modified bitumen membrane in hot bitumen extending six (6) inches from the outer edge of the flange and butt to base of pitch pan.
- I. Sanitary Vent Stacks:
  1. Prime top and bottom flanges of lead flashing sleeve. Set flange in uniform troweling of plastic roof cement. Prime top side of flange to receive strip-in membrane.
  2. Fold lead sleeve down inside of pipe a minimum of one (1) inch. Apply a continuous bead of sealant on inside of pipe prior to folding lead sleeve.
- J. Gutters/Downspouts:
  1. Install gutters as detailed.
  2. Install downspouts plumb and level, attached to columns or wall with straps located at top and bottom of downspout and maximum ten (10) feet on center.
  3. Install splash pad or block under discharge port of downspouts (if non exist). Install splash pan over a protection (walkway) pad for downspouts located at roof level.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 07 65 10

#### FLEXIBLE FLASHING

##### GENERAL

- 1.1 The architect should include in this section: combination flashing, mortar deflection, and weep as complete one step system. Using this system deletes requirement for mortar deflection devices and may lessen requirements for weep spacing.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 Call for Product Quality & Environmental submittals:
  1. Certificates:
    - a. Indicate materials supplied or installed are asbestos free.
    - b. Indicate recycled content: 90% total recycled material; based on 80% Post Industrial Recycled Content and 10% Post Consumer Recycled Content.
  2. Performance Attributes
    - a. Tensile strength, 31,500 psi minimum
    - b. Puncture Resistance, >500 pounds average
    - c. When tested as manufactured, product resists growth of mold pursuant to test method ASTM-D3273-94.
    - d. Fire Rating: Rated Class B, ASTM E84
- 1.4 QUALITY ASSURANCE
  - A. Qualifications:
    1. Manufacturer: Provide flashing materials by single manufacturer with not less than twenty five years of experience in manufacturing flexible flashing products.
    2. Flashing materials must be able to withstand 300° F temperature without changing the long term performance of the flashing.
    3. All manufacturers of air barrier, insulation and flashing products should provide mutual letters of compatibility for products in combination with each other.
- 1.5 Require the manufacturer provide a warranty for **flexible flashing material for life of the wall**. The warranty should begin at Date of Substantial Completion.

##### PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other manufacturers must have a minimum of five (5) years experience manufacturing products meeting or exceeding the specifications to be considered.
  - A. York as the basis of specification.
- 2.2 MANUFACTURED UNITS
  - A. Flashing and Accessories:
    1. Copper Laminated Flashing:
      - a. Flashing: A full sheet of copper weighing five (5) ounces per square foot coated or bonded on both sides with one (1) of the following:
        - 1) Modified asphalt compound coated.
        - 2) Asphalt saturated, waterproof glass fiber laminated fabric.
      - c. Mastic: manufacturer recommended asphalt troweled mastic for sealing copper laminated flashings
    2. Asphalt-free Copper Fabric Flashing:
      - a. Type: Copper core with polymer fabric laminated to both copper faces with non-asphalt adhesive.



## BUILDING EXCELLENCE

- b. Copper type, ASTM B248-06: CDA Alloy 110, 060 temper.
  - c. Fabric: polymer fabric; laminated back and front face copper core with core weight manufacturer identified on product with color coded laminate or printed on the material.
  - d. Weight: 5 oz copper core, which is color coded with red polymer fabric
  - e. Size: Manufacturer's standard width rolls.
  - f. Polyether sealant: UniverSeal US-100
  - g. Corner and splice material: York Multi-Flash 500 or pre-manufactured corners.
  - h. Mortar deflection: polyester strands that will not degrade and will keep weep vents from clogging with mortar.
    - 1) Weep-Armor
  - i. Polyether sealant: UniverSeal US-100
  - j. Termination bar: rigid PVC or stainless steel termination bar with sealant catch lip. T-96 termination bar
  - k. Glass fabric scrim bonded to a full sheet of copper for general thru-wall flashing as an alternative to asphalt coated copper specified above and where sealant compatibility is required. Provide manufacturers approved seam tape.
- 3. Membrane Flashing:
    - a. Self-Adhered Flexible Flashing: 40-mil, rubberized asphalt adhesive reinforced flashing with a high density cross laminated polyethylene film. Provide compatible substrate primer as instructed by manufacturer.
  - 4. Substrate Primer: as instructed by membrane manufacturer
  - 5. Termination Bar: 1/8 inch thick by 1 inch minimum wide aluminum, w/ pre-punched holes, and self-tapping screws.

## EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Install where indicated, specified, or required in accord with flashing manufacturer's written instructions and as follows.
  - B. Extend flashing 6" minimum beyond opening. Fold flashing ends at end of openings or horizontal flashing terminations to form end dam.
  - C. Flashing width: Width required starting flush with outside face of exterior wythe, extending through cavity, rising height required to extend above lintel steel at least 2".
  - D. Splice end joints by overlapping them 6" and seal with a compatible sealant like UniverSeal US-100.
  - E. Masonry back up:
    - a. Surface apply after dampproofing installation specified in Dampproofing Section in accord with manufacturer's installation instructions.
    - b. Fasten to masonry back-up surface at top by embedding in layer of UniverSeal US-100 polyether sealant or use a non-corrosive T-96 termination bar and fasten it to the backer wall at the top edge of the flashing and seal the top edge with UniverSeal US-100.
  - F. Concrete back up:
    - a. Surface apply after dampproofing installation specified in Dampproofing Section in accord with manufacturer's installation instructions.
    - b. Fasten to concrete surface at top by embedding in layer of UniverSeal US-100 polyether sealant or use a non-corrosive T-96 termination bar and fasten it to the backer wall at the top edge of the flashing and seal the top edge with UniverSeal US-100 or use the York termination clamp, which is embedded in the block back up wall.
  - G. Stud back up with sheathing:
    - a. Fasten to stud back-up at top by embedding in layer of UniverSeal US-100 polyether sealant or use a non-corrosive T-96 termination bar and fasten it to





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the backer wall at the top edge of the flashing and seal the top edge with UniverSeal US-100.

- H. Leave ready for certified compatible building felt or air barrier installation lapping flashing top installed in another Section.
- I. Lay flashing in continuous bead of UniverSeal US-100 polyether sealant on masonry supporting steel.
- J. Fold ends of flashing at end of opening to form dam; seal with UniverSeal US-100 polyether sealant or use purchase manufacturers preformed end dams.
- K. Inside corners: Make in industry accepted manner using corner and splice material or purchase manufactured corners from manufacturer.
- L. Outside corners: Make in industry accepted manner using corner and splice material or purchase manufactured corners from manufacturer.
- M. Cover flashing within a few days of installation to protect it from damage from the different trades, the environment and falling debris. If flashing is left unprotected and it is punctured, torn, or has loose scrim you should contact the manufacturer for repair instructions.
- N. Require the following installation and protection for flexible flashing:
  - 1. Locations: Install in exterior walls to divert moisture within walls to exterior surfaces.
  - 2. Bed Joints: Coordinate work with Division 4, Masonry. Install flashings between two (2) thin layers of masonry mortar without increasing thickness of mortar joint. Keep outer edge of flashing material back from face of masonry.
  - 3. Adjacent Work: Protect work by masking, covering, or other precautionary methods. Remove protection when no longer necessary.
  - 4. Separate copper flashing from dissimilar materials.
  - 5. Protect membrane flashing from overexposure to direct sunlight
  - 6. Follow manufacturer's instructions for mechanically fastened installation with a termination bar.
  - 7. Application Guidelines - Install flashing at the following locations:
    - a. Membrane Flashing: material transitions inside exterior cavity walls, roof edge/exterior wall transitions, masonry joints (control/expansion) inside exterior cavity walls, exterior door and window frame perimeters, roof deck/exterior wall transitions, exterior wall penetrations (i.e. pipe, conduit, ducts, etc.). Provide membrane at all joints, holes, gaps, or openings to ensure a continuously sealed building envelope. Utilize primer on substrates as instructed by manufacturer.
    - b. Copper Flashing: At all horizontal wall flashing, including (but not limited to) exterior wall sill/weep conditions, exterior door and window head/weep conditions, masonry wall cap flashing and masonry wall base flashing.
  - 8. Apply substrate primer as instructed by membrane manufacturer to suit condition.
  - 9. Provide drip edge flashing at weep conditions with membrane flashing. Cut membrane flush with outside edge of brick over top of drip edge flashing to alleviate exposure to UV degradation and deterioration of asphalt membrane.
  - 10. On Horizontal Surfaces: The flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches. Flashing will then be secured in back wall with termination bar.





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11. On Vertical Surfaces: Surfaces receiving the flashing shall be sufficiently spotted with asphalt mastic to hold in place until masonry is set. Secure in back wall with termination bar.
  12. Foundation Sill Dampproofing: The flashing for foundation sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be sloped across the cavity and turned up the wall a minimum of ten (10) inches and secured to back wall with termination bar. Where sill and column meet, flashing shall be brought up a minimum of ten (10) inches up the column.
  13. Thru-Wall Flashing: Shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Carry flashing through the wall, turned up where possible to facilitate drainage through the weepholes, then carried upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secure in back wall with termination bar.
  14. Cavity Wall: Flashing shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise, and secured in the back wall with termination bar. Vertical membrane joints shall be secured with termination bar as instructed by membrane manufacturer.
  15. Heads and Sills: Flashing for heads and sills shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Flashing shall be carried through the wall and upward across the cavity a minimum of six (6) inches, unless noted otherwise. Head flashing shall be carried six (6) inches beyond both end of the steel lintel. Both head and sill flashing shall be turned up at the sides to form a pan. All corners shall be folded, NOT CUT. Install weepholes.
  16. Spandrels: Spandrel flashing shall start from the outside toe of the shelf angle, go up the face of the beam and then through the wall, turned up on the inside not less than two (2) inches. Install weepholes.
  17. Parapet or Coping: Flashing for parapets or coping sills shall be laid in a slurry of fresh mortar and topped with a fresh full bed of mortar. Flashing shall be cut flush with the exterior face of the wall after being left exposed for inspection purposes only. Weepholes shall be installed immediately on top of the flashing.
  18. Install flashings without longitudinal joints within walls, if possible. If required materials are not available in a single width, join by lapping material minimum two (2) inches and seal joint throughout its length with adhesive.
  19. End Joints: Avoid end joints in flashing. When end joints are necessary, lap flashing minimum six (6) inches and seal joint continuously with adhesive.
  20. Penetrations: Where anchors, pipes, and inserts penetrate flashing, make opening in flashing snug and seal with adhesive.
  21. Reglet Termination: Insert wedge into place and seal carefully with adhesive
  22. Install flashing with termination bars in accordance with manufacturer's instructions. Provide 3 coursing at all termination bars, typical.
  23. Top Coat: After flashing material is in place (except in masonry joints where bond and mortar is required) trowel full 1/8 inch protective coating or mastic on all flashing faces.
- O. Locations include: exterior door heads, window heads and sills, storefront heads, horizontal control joints, changes in veneer materials, vertically, other wall openings and other locations indicated.

**END OF SECTION**



B U I L D I N G   E X C E L L E N C E

SECTION 07 72 00

ROOF ACCESSORIES

GENERAL

1.1 INSTALLATION RESPONSIBILITY

- A. Coordinate the Work specified herein with the following Work:
  - 1. Roofing
  - 2. Roofing sheet metal
  - 3. Mechanical equipment
  - 4. Plumbing

- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.

- 1.3 Warranty the Work specified herein for two year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

PRODUCTS

2.1 PREFABRICATED ROOF CURBS

- A. Curbs:
  - 1. Walls: Galvanized steel
  - 2. Wood Nailers: Factory installed.
  - 3. Insulation: 1-1/2 inch thick rigid fiberglass board.
  - 4. Corner Seams: Continuous mitered and welded.
- B. Counterflashing Cap: Stainless steel
- C. Pipe Flashing:

2.2 PIPE SUPPORTS

- A. Gas Pipe Supports:
  - 1. Provide strut and hanger type support with recycled plastics and carbon black for UV protection bases (10 inches x 16 inches x 3 inches; 6 lbs. each); Model Type PP-10 with strut & hanger for lines 2-1/2 inches and smaller, Model Type PS-1-2 with hanger for lines 3 inches and larger.
  - 2. As manufactured by Portable Pipe Hanger, Inc., or approved equal products as manufactured by Miro Industries Inc., MAPA Products or ERICO, Inc
- B. Electrical Conduit / Condensate Lines:
  - 1. Provide strut type support with recycled plastics and carbon black for UV protection bases (10 inches x 16 inches x 3 inches; 6 lbs. each), install with hold clips; Model Type PP-10 with strut.
  - 2. As manufactured by Portable Pipe Hanger, Inc., or approved equal products as manufactured by Miro Industries Inc., MAPA Products or ERICO, Inc.
- C. Chill Water Lines:
  - 1. Provide strut and hanger type support with recycled plastics and carbon black for UV protection bases (size as required); Model Type PS-1-2 and Model Type PSE-2-2 as required.
  - 2. As manufactured by Portable Pipe Hanger, Inc., or approved equal products as manufactured by Miro Industries Inc., MAPA Products or ERICO, Inc
- D. Installation:
  - 1. Locate as indicated by Drawing at no greater than 8 feet-0 inches o.c.
  - 2. Provide protective traffic pads below each support, tacked in place with approved mastic or adhesive.



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- 3. Install hold down clips if indicated on the drawings or required by codes.
- E. Roof Hatch:
  - 1. No roof hatch shall be within 10'-0" of the exterior wall.

**END OF SECTION**



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SECTION 07 81 00

SPRAYED-ON FIREPROOFING

GENERAL

- 1.1 The architect should include in this section: that all labor, materials, equipment and services necessary for, and incidental to, the complete and proper installation of sprayed fire resistive materials and related work as shown on the drawings or where specified herein, and in accordance with all applicable requirements of the Contract Documents. The material and installation shall conform to the applicable building code requirements and the requirements of all authorities having jurisdiction.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 ***District preference is to use spray-on fireproofing for rated ceiling assembly in lieu of rated lay-in ceiling (09 51 00).***
- 1.4 QUALITY ASSURANCE
  - A. Installer: Company specializing in applying the Work of this Section with minimum three (3) years experience and approved by manufacturer.
  - B. Products, execution, and fireproofing thicknesses shall conform to the required fire-resistance ratings requirements of code authorities having jurisdiction.
  - C. Provide certificate of compliance for fireproofing materials to requirements of code authority having jurisdiction indicating approval for use on this Project.
- 1.5 TESTS AND INSPECTIONS
  - A. Architect may require tests and inspections as necessary to verify quality, strength, and thickness of sprayed fireproofing. Laboratory tests of materials for resistance to damage, bond strength, and air erosion will be made in accordance with referenced ASTM standard procedures.
  - B. Owner will select Testing Laboratory and Owner will pay for initial tests of Testing Laboratory. Work which fails initial testing shall be replaced with new materials. Retesting shall be at Contractor's expense until test results are satisfactory to Architect.
- 1.6 PROJECT/SITE CONDITIONS
  - A. When the prevailing outdoor temperature at the building is less than 40 degrees F (4 degrees C), a minimum substrate and ambient temperature of 40 degrees F (4 degrees C) shall be maintained prior to, during and for a minimum of 24 hours after application of the spray-applied fireproofing. If necessary for job progress, Contractor shall provide enclosures with heat to maintain temperatures.
  - B. Provide ventilation to allow proper drying of spray-applied fireproofing during and subsequent to its application.
- 1.7 SEQUENCING AND SCHEDULING
  - A. Sequence and coordinate application of spray-applied fireproofing with work in other sections which would interfere with efficient fireproofing application.
- 1.8 WARRANTY
  - A. Require a warranty of the work specified herein for five (5) years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship. Repair or reinstall failures or damaged fireproofing to achieve required fire resistive ratings at no additional expense to Owner.



## BUILDING EXCELLENCE

- B. Defects shall include non-compliance with specifications, loss of fire resistance rating, cracking, checking, dusting or flaking, spalling or separation from structural substrate and blooming, blistering or peeling.

### PRODUCTS

#### 2.1 ACCEPTABLE PRODUCTS/MANUFACTURERS

- A. Manufacturers named below and their product in parenthesis are approved for use on the project. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications.
  - 1. Concealed Interior Conditions (Low Density):
    - a. Isolatek International, (Cafco Blaze-Shield II – Sealed with Cafco Bond-Seal Topcoat Sealer)
    - b. Isolatek International, (Cafco 300 – Wet Mix)
  - 2. Non-concealed Interior Conditions and Indirect Weather Conditions (Medium Density):
    - a. Isolatek International, (Cafco Blaze-Shield HP – Dry Mix)
    - b. Isolatek International, (Cafco 400 – Wet Mix)

#### 2.2 MATERIALS

- A. Fire Resistance Classification: The spray-applied fireproofing material shall have been tested and reported by Underwriters Laboratories Inc. in accordance with the procedures of ASTM E119 and shall be listed in the UL Fire Resistance Directory.
- B. Require that all Spray-applied fire resistive materials be free of all forms of asbestos, including actinolite, amosite, anthophyllite, chrysotile, crocidolite and tremolite. Material manufacturer shall provide certification of such.
- C. Concealed Interior Conditions:
  - 1. Physical Performance Characteristics: Fireproofing material shall meet the following physical performance standards:
    - a. Deflection: When tested in accordance with ASTM E759, the material shall not crack or delaminate when the non-concrete topped galvanized deck to which it is applied is subjected to a one (1) time vertical centerload resulting in a downward deflection of 1/120th of the span.
    - b. Bond Impact: When tested in accordance with ASTM E760, the material shall not crack or delaminate from the concrete topped galvanized deck to which it is applied.
    - c. Cohesion/Adhesion (Bond Strength): When tested in accordance with ASTM E736, the material applied over uncoated or galvanized steel shall have an average bond strength of 150 psf.
    - d. Air Erosion: When tested in accordance with ASTM E859, the material shall not be subject to losses from the finished application greater than 0.25 grams per square foot.
    - e. Compressive Strength: When tested in accordance with ASTM E761, the material shall not deform more than ten (10) percent when subjected to a crushing force of 750 psf.
    - f. Corrosion Resistance: When tested in accordance with ASTM E937, the material shall not promote corrosion of steel.
    - g. Non-combustibility: When tested in accordance with ASTM E136, the material shall not be combustible.
    - h. Surface Burning Characteristics: When tested in accordance with ASTM E84, the material shall exhibit the following surface burning characteristics:
      - 1) Flame Spread: 0
      - 2) Smoke Developed: 0



## BUILDING EXCELLENCE

- i. Density: When tested in accordance with ASTM E605, the material shall meet the minimum individual and average density values as listed in the appropriate UL design or as required by the authority having jurisdiction, but in no case shall be less than 15 pcf.
- D. Non-concealed Interior Conditions and Indirect Weather Conditions:
  - 1. Non-concealed spaces shall be defined as non-public spaces not requiring concealment of fireproofed structural members but requiring a higher degree of abuse resistance. i.e. parking garages, mechanical rooms, elevator shafts, etc.
  - 2. Physical Performance Characteristics: Fireproofing material shall meet the following physical performance standards:
    - a. Deflection: When tested in accordance with ASTM E759, the material shall not crack or delaminate when the non-concrete topped galvanized deck to which it is applied is subjected to a one (1) time vertical centerload resulting in a downward deflection of 1/120th of the span.
    - b. Bond Impact: When tested in accordance with ASTM E760, the material shall not crack or delaminate from the concrete topped galvanized deck to which it is applied.
    - c. Cohesion/Adhesion (Bond Strength): When tested in accordance with ASTM E736, the material applied over uncoated or galvanized steel shall have an average bond strength of 425 psf.
    - d. Air Erosion: When tested in accordance with ASTM E859, the material shall not be subject to losses from the finished application greater than 0.25 grams per square foot.
    - e. Compressive Strength: When tested in accordance with ASTM E761, the material shall not deform more than ten (10) percent when subjected to a crushing force of 7,300 psf.
    - f. Corrosion Resistance: When tested in accordance with ASTM E937, the material shall not promote corrosion of steel.
    - g. Non-combustibility: When tested in accordance with ASTM E136, the material shall not be combustible.
    - h. Surface Burning Characteristics: When tested in accordance with ASTM E84, the material shall exhibit the following surface burning characteristics:
      - 1) Flame Spread: 0
      - 2) Smoke Developed: 0
    - i. Density: When tested in accordance with ASTM E605, the material shall meet the minimum individual and average density values as listed in the appropriate UL design or as required by the authority having jurisdiction, but in no case shall be less than 22 pcf.
- E. Water: Mixing water shall be clean, fresh, and suitable for domestic consumption and free from such amounts of mineral or organic substances as would affect the set of the fireproofing material. Provide water with sufficient pressure and volume to meet the fireproofing application schedule.
- F. Isolatek Cafco Bond Seal Top Coat (for use over Cafco Blaze-Shield II only): Green tinted sealer for identification.

### 2.3 SOURCE QUALITY CONTROL

- A. Submit evidence that the fireproofing has been tested in accordance with ASTM E119 by UL or other testing agency approved by code authorities having jurisdiction. Include evidence that the fire testing was sponsored by the manufacturer and that the material tested was produced at the manufacturer's facility under the supervision of personnel by said testing agency. Letters documenting classification status are not acceptable evidence of compliance with this Section.

### 2.4 EXTRA PATCHING MATERIAL



BUILDING EXCELLENCE

- A. Installer/subcontractor to provide General Contractor with additional materials for patching of previously applied material damaged by other trades after fireproofing installer has completed work and has left site. Provide material equal to one percent of total project quantity.

## EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Surfaces to receive spray-applied fireproofing shall be provided free of oil, grease, paints/primers, loose mill scale, dirt or other foreign substances which may impair proper adhesion of the fireproofing to the substrate. Where necessary, cleaning or other corrections of surfaces to receive fireproofing shall be the responsibility of the supplier of the incompatible substrate.
  - B. Application of the fireproofing shall not begin until the contractor, applicator and fireproofing testing laboratory (inspector) have examined surfaces to receive fireproofing and determined that the surfaces are acceptable to receive the fireproofing material.
  - C. All surfaces to receive fire protection shall be free of oil, grease, loose mill scale, dirt, paints/primers (other than those listed and tested) or other foreign materials which would impair satisfactory bonding to the surface. Any cleaning of surfaces to receive sprayed fire protection shall be the responsibility of the General Contractor or Steel Erector, as outlined in the structural steel or steel deck section.
  - D. Clips, hangers, supports, sleeves and other attachments to the substrate shall be placed prior to the application of spray-applied fire resistive materials.
  - E. The installation of ducts, piping, conduit or other suspended equipment shall not take place until the application of sprayed fire protection is complete in an area.
  - F. The spray-applied fire resistive material shall only be applied to steel deck which has been constructed in accordance with the criteria set forth by the Steel Deck Institute.
  - G. On roof decks without a concrete cover, complete all roofing applications and roof mounted equipment installation prior to application of the fireproofing to the underside of roof decking and supporting beams and joists. Prohibit all roof traffic upon commencement of the fireproofing and until the fireproofing material is dry.
  - H. Protect permanently exposed walls or floors, or special surfaces which are not scheduled to receive fireproofing.
  - I. Equipment, mixing and application shall be in accordance with the manufacturer's written application instructions.
  - J. The application of spray-applied fire resistive material shall not commence until certification has been received by the General Contractor that surfaces to receive sprayed fire protection have been inspected by the applicator and are acceptable to receive sprayed fire protection.
  - K. All unsuitable substrates must be identified and made known to the General Contractor and corrected prior to the application of the spray-applied fire resistive material.
  - L. Fire protection shall not be applied to steel floor decks prior to the completion of concrete work on that deck, if any.
  - M. The application of sprayed fire protection to the underside of roof deck shall not commence until the roof is completely installed and tight, all penthouses are complete, all mechanical units have been placed, and all roof traffic has ceased.
  - N. Proper temperature and ventilation shall be maintained as specified herein.
  - O. Provide masking, drop cloths or other suitable coverings to prevent overspray from coming in contact with surfaces not intended to be sprayed.
  - P. Bonding materials (adhesives, catch coats, metal lath, mesh, stud pins, etc.) shall be applied in accordance with the appropriate UL fire resistance design and manufacturer's written instructions.
  - Q. Equipment and application procedures for installation of topcoat sealer materials shall conform to the material manufacturer's application instructions.





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- R. Erect appropriate barriers to prevent entry by non-fireproofing workers into the fireproofing spray and mixing areas and other areas exposed to wet fireproofing material.

**3.2 INSPECTION AND TESTING**

- A. The Owner will select, and pay an independent testing laboratory to randomly sample and verify the thickness and the density of the fireproofing in accordance with one (1) of the following procedures:
  - 1. ASTM E605, Standard Test Method for Thickness and Density of Sprayed Fire-Resistive Materials Applied to Structural Members.
  - 2. AWCI, Standard Practice for the Testing and Inspection of Field-Applied Sprayed Fire-Resistive Materials.
  - 3. UBC Standard No. 7-6, Thickness and Density Determination for Spray-Applied Fire Protection.

**END OF SECTION**



B U I L D I N G   E X C E L L E N C E

SECTION 08 05 00

OPENINGS COMMON WORK RESULTS

GENERAL

- 1.1 **All door hardware to be approved by HISD Program Manager and Lock Department.**
- 1.2 Doors at mechanical and electrical equipment rooms shall be fire-rated (at least 20 minutes) as an HISD minimum, even when not required to be rated by code.
- 1.3 Typical interior doors shall be 3'-0" wide x 7'-0" high and 1-3/4" thick made with a high pressure decorative laminate and a bonded particle core. Doors shall receive lock blocking and reinforcements for exit devices.
- 1.4 Overhead rolling fire and counter doors shall be motor operated unless approved by HISD Program Manager.
- 1.5 Skylights are not the preferred method for introduction of daylight to the building interior. **However, to promote creativity and innovation in 21 Century Learning Environments, HISD is open to the use of non-traditional materials and systems. All materials, systems and applications must be presented to the HISD project team and approved before use.**
- 1.6 Skylights with unconventional shapes, problematic flashing requirements or low slopes are not the preferred designs – limit use to avoid leaks.
- 1.7 Lock core keying schedules should be as simple as possible and must fall under the HISD great grand master for all HISD locks.
- 1.8 All exterior glazing shall be double glazed 1" insulated glazing system. **District preference is Solarban® 60 "Solargray" manufactured by PPG Industries, other selections may be submitted to the HISD program manager for review.**
- 1.9 Primary Exterior entry door and frame options are aluminum storefront system and aluminum frames. Secondary entries may be hollow metal doors with glazing panels with hollow metal frames. Finish of aluminum frames may be clear anodized or bronze.
- 1.10 Windows should be visible from adjacent properties to avoid the need for security screens.
- 1.11 Consider shading windows to help prevent solar heat gain. Refer to the local jurisdictional authority for the minimum Solar Heat Gain Coefficient (SHGC) requirements for all exterior glazing.
- 1.12 Refer to Section 08 80 00 for windload and impact resistant design requirements. All glass shall comply with maximum center of glass deflection as required by ASTM.
- 1.13 Interior glazing shall meet code, i.e. tempered, mirror or non-wire fire-rated glass.
- 1.14 Provide phenolic window sills for interior windows.
- 1.15 **Ensure all hollow metal doors are primed and ready for paint.**
- 1.16 **For all major renovations, all existing door hardware should be replaced and should match new construction hardware. The architects should note in their specifications for the contractor to return all existing cores and hardware to HISD Lock Department.**



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- 1.17 *All components of door hardware should be able to be replaced for repair and maintenance.*
- 1.18 *When replacing door hardware in an existing door, provide appropriate repair of door to accommodate new hardware. Patch or cover all holes.*
- 1.19 *To ensure proper core change coordination, a meeting should be scheduled with HISD Program Manager and team.*
- 1.20 *The architect should specify kick plates to both sides of all learning center doors. Require the bottom of the plate to align with the bottom of the door.*

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B U I L D I N G   E X C E L L E N C E

SECTION 08 14 16

FLUSH WOOD DOORS

GENERAL

- 1.1 The architect should include in this section: furnishing and installing interior wood doors, factory fitting to frames and factory preparation for hardware and factory finishing of wood doors.
- 1.2 QUALITY ASSURANCE:
  - A. Comply with the requirements of the following standards unless otherwise specified.
    1. AWI Quality Standard: "Architectural Woodwork Quality Standards" for grade of door, core, construction, finish, and other requirements.
    2. WDMA Quality Standard: WDMA I.S.1-A "Architectural Wood Flush Doors."
  - B. Provide wood doors that comply with NFPA 80, that are labeled and listed for ratings indicated by a testing and inspection agency acceptable to authorities having jurisdiction, based on testing according to building code authorities having jurisdiction. Provide required label on each door and panel.
    1. Provide UL approved 5" deep structural composite lumber top rail reinforcement suitable to hold surface mounted closers with 1-1/2" x No. 12 fully threaded wood screws without the use of through-bolted fasteners.
    2. For door assemblies exceeding sizes of tested assemblies, provide manufacturer's certificate stating that doors conform to all standard construction requirements of tested and labeled fire door assemblies except for size.
    3. At stairwell enclosures, provide doors which have a temperature rise rating of not more than 450° F (232°C) maximum in 30 minutes of fire exposure.
    4. Provide fire-rated doors with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals.
- 1.3 Require manufacturer's written guarantee as specified, agreeing to repair or replace defective doors which have warped (bow, cup, or twist) more than 1/4" in a 42" x 84" section, delaminated, or which show photographing of construction below in face veneers exceeding 0.01" in a 3" span, or do not conform to tolerance limitations of referenced quality standards. The guarantee includes refinishing of defective doors. Guarantee period for solid core interior doors shall be for life of original installation.

PRODUCTS

- 2.1 DOOR CONSTRUCTION, GENERAL
  - A. Adhesives: Do not use adhesives containing urea formaldehyde.
  - B. Use particleboard made with binder containing no urea-formaldehyde resin.
  - C. Doors for Transparent Finish: Comply with the following requirements:
    1. Grade: Premium.
    2. Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.
  - D. All doors shall have structural composite lumber stiles and rails meeting WDMA T.M.-7.
  - E. Vertical Edges: Exposed crossbands not permitted.
- 2.2 FLUSH SOLID CORE WOOD DOORS; WOOD STAVE CORE:
  - A. Bond: Type II water-resistant.



## BUILDING EXCELLENCE

- B. Core: Incombustible mineral. Provide UL approved 5" deep structural composite lumber top rail and lock block reinforcement.
- C. Crossband: Minimum 1/8 inch thick composite board.
- D. Face Panels: Manufacturer's standard 2 or 3-ply face panels.
- E. For transparent finish doors, provide manufacturer's standard thickness face veneers per AWI Grade AA faces, quarter sliced White Oak, to match non-rated doors in the same area. Match for color and grain at veneer joints.
  - 1. Vertical Edges: Same species, cut, and color as face veneer; no finger jointed material permitted.
  - 2. Finish: Shop finished as specified herein.
- F. Ratings: As indicated in Door Schedule found in drawings.

### 2.3 MISCELLANEOUS FABRICATION REQUIREMENTS:

- A. Provide transom and side panels which match quality, rating, and appearance of associated doors.
- B. Factory cut and trim openings. Comply with requirements of referenced standards for each door type.
- C. Provide moldings and glass stops of same species as face veneer at non-fire rated doors and at fire rated doors provide manufacturer's standard wood-veneered steel beads matching veneer species of door faces and accepted for use in doors of fire rating indicated.

### 2.4 PREFITTING AND PREPARATION FOR HARDWARE:

- A. Prefit and premachine wood doors at factory.
- B. Comply with tolerance requirements of WDMA I.S.1-A for prefitting. Machine doors for hardware requiring cutting of doors. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame shop drawings, DHI A115-W series standards, and with hardware templates and other essential information required to ensure proper fit of doors and hardware.

### 2.5 SHOP FINISH:

- A. Prefinish transparent finished wood doors at factory or finishing shop by door manufacturer. Provide manufacturer's finish system with appearance and performance equal to requirements of 3 sealer coats, 2 topcoats, plus stain.
- B. Effect: Filled finish.
- C. Sheen: Satin.
- D. Finish top and bottom edges of doors with 2 coats of sealer plus 1 coat of gloss coating.

## EXECUTION

### 3.1 INSTALLATION:

- A. Condition doors to average prevailing humidity in installation area prior to hanging, and in accordance with referenced standard.
- B. Install wood doors in accordance with manufacturer's instructions and as shown.
- C. Install fire rated doors in corresponding fire rated frames in accordance with the requirements of NFPA Number 80. Provide clearances complying with the limitations of the authority having jurisdiction.
- D. Fit to frames and machine for hardware to whatever extent not previously worked at factory as required for proper fit and uniform clearance at each edge.

**END OF SECTION**



## SECTION 08 14 23

### PLASTIC LAMINATE FACED WOOD DOORS

#### GENERAL

- 1.1 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.2 Require a warranty for the work specified for lifetime replacing, including cost of rehang and refinishing, at no cost to Owner, wood doors exhibiting defects in materials or workmanship including, warp in excess of 1/4 inch as defined by AWI, warp or twist to a degree that door will not operate properly, delamination of face and telegraphing or show through of stiles, rails, or core greater than 0.01 inch in any 3 inch area.

#### PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.

#### 2.2 MATERIALS

- A. The 1-3/4" flush interior non-rated wood door should be made up of 3-ply AWI PC-HPDL-3 High Pressure Decorative Laminate (HPDL), bonded 32lb per cubic foot particle core, bonded 1-3/8" stile and 1-1/8" min. rails abrasively planed as an assembly prior to laminating, factory machine and fit. Structural lumber cores are required at doors with more than 40 percent of door core removed due to light or vent cutouts or doors with exit devices.
- B. Flush interior fire rated wood doors should meet the above requirements and should be scheduled to be fire-rated, receiving the appropriate label, with a 20 minute rated core.
- C. In addition to meeting the above requirements the doors shall receive the appropriate fire-rated label (45, 60, or 90 min), shall contain an asbestos free incombustible mineral core, positive pressure category A, and shall contain 7-inch top-rail blocking, in doors indicated to have closers, 5-inch bottom-rail blocking, in doors indicating armor plates and 5-inch mid-rail and corner blocking, in doors indicated to have exit devices.
- D. Accessories:
  1. Glazing should be factory applied and should be compatible with positive pressure requirements.
  2. Glass stops, where needed, shall be metal type painted to match door frame. Stops prepared for countersink require tamper proof screws.
  3. Adhesive should be type 1, hot pressed
  4. The top, bottom and cut surface of openings should be sealed at the factory with two coats of varnish. Vertical door edges shall be factory painted to match door face. Factory shall supply matching paint and edges shall be touched-up in field.
- E. Fabrication:
  1. Factory machine doors for hardware that is not surface applied complying with hardware schedules, shop drawings, DHI A115-W series standards, and hardware templates. Coordinate with hardware mortises in metal frames.
  2. Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
  3. Provide concealed wiring harness and standardized Molex plug connectors on both ends to accommodate up to twelve wires to doors receiving electrified hardware. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness.



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B U I L D I N G   E X C E L L E N C E

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**EXECUTION**

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- A. Coordinate work with door opening construction, and door and frame hardware installation.
  - B. Clearances:
    - 1. Head and Jambs, meeting edges: 1/8 inch maximum.
    - 2. Sill: 1/2 inch typically, except provide 1/4 inch clearance from top surface of carpeting.
  - C. Verify that frames comply with indicated requirements for type, size, location and swing characteristics and that the frames are installed plumb, level and parallel.
  - D. Coordinate hardware installation for proper door operation. Adjust locks and latches to engage snugly without forcing. Align hardware to function without squeaking, binding, or racking. Mortise as required for automatic door bottoms.
  - E. Protect doors from damage and replace doors that are damaged. Verify that tops and bottoms of doors have been sealed prior to installation, as required for warranty.
  - F. Interior Fire Rated Wood Doors should conform to NFPA 80, UL, and requirements of code, positive pressure rated doors should not contain trim.
  - G. Fire rated door assemblies with gaps in excess of 1/8 inch between door and frame will not comply with NFPA 80
  - H. Do not remove or paint over labels on labeled doors.

**END OF SECTION**





## SECTION 08 33 13

### COILING COUNTER DOORS

#### GENERAL

- 1.1 The architect should include in this section, motor operated steel coiling counter fire door with trim, and accessories as well as electric wiring from disconnect(s) to motor operator.
- 1.2 The company specializing in installing coiling counter doors must have a minimum of five years experience and be approved by manufacturer.
- 1.3 The rolling counter doors shall be designed to a standard maximum of ten cycles per day and an overall maximum of 20,000 operating cycles for the life of the door and shall be constructed in accordance with testing agency requirements and shall bear a rating label in hourly rating as required.
- 1.4 Require a warranty for the work specified for two years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.

#### PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other accepted manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.
  - A. Specifications are based on products of The Cookson Company, Phoenix, AZ.
- 2.2 MOTOR OPERATED COILING COUNTER DOOR
  - A. The door shall be constructed of interconnected strip 22 gauge steel slats conforming to ASTM A653 with either a hot dipped galvanized G-90 coating per ASTM A635 finish, bonderized coating or a factory applied Thermosetting Polyurethane Powder Coating. The bottom bar shall be constructed of tubular extruded aluminum measuring 1-5/16 inch deep by 2-1/4 inch high with a double vinyl astragal on the bottom edge with the same finish as the curtain.
  - B. Require a fusible link.
  - C. Guides shall be constructed of extruded aluminum. At exterior conditions, the curtain capturing channel shall contain wool pile weatherstripping. The finish on the guides shall be the same as indicated for the curtain.
  - D. Brackets shall be constructed of die cast aluminum and shall be the same finish as indicated for the curtain.
  - E. The Barrel shall be steel tubing of not less than four inches in diameter. Oil tempered torsion springs must be capable of correctly counter balancing the weight of the curtain. The barrel shall be designed to limit the maximum deflection to 0.03 inch per foot of opening width. The finish on the barrel shall be one coat of bronze rust-inhibiting prime paint.
  - F. The Hood shall be fabricated from 24 gauge galvanized steel and shall be formed to fit the square brackets. The finish on the hood shall be the same as indicated for the curtain.
  - G. Push-up door operation shall open and close with a maximum of 30 pounds of effort utilizing finger lifts in the bottom bar, not to be used for doors over ten feet wide.
  - H. Push-up doors shall be secured by means of a concealed sliding bolt deadlock in the bottom bar operated by a cylinder lock. Locate one at each jamb, to be operated from inside the door and shall be master keyed to Owner's keying system.
  - I. Upon the activation of a smoke detection system, provide an automatic closing device and governor to control the downward speed of the door. The door shall be operated at a



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- speed of 2/3 foot per second and not more than twenty-four inches per second as indicated in NFPA Bulletin 80. The governor shall be fail-safe, maintenance-free, fully enclosed and warranted for the life time of the door. Once the door has closed, it should be able to be reset by one person on one side of the door only.
- J. The Motor Operator shall operate at a speed of 1/2 foot per second by a totally enclosed electric motor with gear reducer, with geared limit switch and emergency push-up operation, 115 volts single phase, housed in a NEMA 1 housing and include a 24 volt control transformer, 24 volt relays and complete terminal strip to facilitate field wiring, activated by Three Button Push Button Station in a NEMA 1 enclosure.
  - K. Motor operated counter doors shall be secured by means of a concealed sliding bolt deadlock in the bottom bar operated by a cylinder lock, electrically interlocked to prevent the motor from operating when the door is locked. Locate one at each jamb, to be operated from inside the door, master keyed to Owner's keying system.
  - L. The counter door shall include a rolling door safety edge on the bottom bar of the door and shall automatically reverse the door if an obstruction is detected in the downward travel of the door.
    - 1. The safety edge shall consist of a rubber boot attached below the bottom bar with an electrical switch secured to the back of the bottom bar. The Featheredge shall operate with air wave technology and shall not rely on pneumatic pressure or electrical strip contacts to operate properly. The safety edge shall create an air wave that shall be detected and reverse the direction of the rolling door.
    - 2. The operation of the safety edge shall not be subject to interferences by temperature, barometric pressure, water infiltration, or cuts in the rubber boot.
    - 3. The safety edge shall be connected to the motor with a coil cord.
  - M. There should be no electronic links connected directly to building's fire alarm.
    - 1. During installation and subsequent resetting of the fire door, the releasing device's latching mechanism shall hold the door in the set position. Energizing the alarm system shall automatically set the device by releasing the latching mechanism.
    - 2. The device shall hold the fire door in the set position until the alarm or smoke detection system is activated. Upon activation, the device shall mechanically release the fire door after a delay of not more than 10 seconds. If the alarm activation is canceled before the 10 second delay, the device shall automatically reset itself.
    - 3. Provide an integral 4 amp hour battery that is capable of powering the release device and 3 auxiliary devices (smoke detectors, sounder strobes, etc.) for up to 72 hours. During a power outage the device shall automatically switch to battery power. If normal power is resumed within 72 hours, the system shall automatically reset itself and charge the battery. If the power outage is longer than 72 hours, the fire door will be closed mechanically.
  - N. If the door terminates at a countertop, the surface must be a Uniform 1-5/8 inch thickness and have a 1-1/2 hour label.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Coordinate the work with the adjacent work specified in other sections. Provide electrical connections as specified.
  - B. Fit, align, and adjust door assembly level and plumb; provide smooth operation.

### END OF SECTION



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**SECTION 08 45 00**

**INSULATED TRANSLUCENT SANDWICH PANEL ASSEMBLIES**

**GENERAL**

- 1.1 The architect should include in this section: Insulated Translucent Panel Assemblies; battens and perimeter closure system; aluminum structure; flashing; fasteners and accessories.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 Call for structural analysis data and calculations signed and sealed by a professional engineer licensed in the State of Texas responsible for their preparation to certify conformance with project specific design loads and governing code requirements as described herein and indicated on the drawings.
- 1.4 Request installer qualifications: signed by erector, certifying compliance with project qualification requirements.
- 1.5 Certify that system complies with specified performance characteristics and referenced standards.
  - A. U Value: Test report indicating that the complete assembly (Framing and Panel) has been tested in accordance with NFRC 100, and meets requirements of the specification.
  - B. Impact resistance:
    1. Seaward Zones and Inland 1 Zones: Product Evaluation Reports showing that the system has been tested and meets the standards set forth by the Texas Department of Insurance for installations located in the Seaward Zones, and Inland 1 Zones per 2006 IBC/IRC with Texas revisions.
    2. All Other Wind Zones: Repel an impact equal to 60 ft-lbs minimum without fracture or tear when impacted by a 3-1/4 inch diameter, 5 pound free-falling ball.
- 1.6 **SYSTEM REQUIREMENTS**
  - A. General: Conform to ICC Evaluating service acceptance criteria for sandwich panel assemblies and approved plastic panels.
  - B. Engineering Requirements:
    1. Provide self supporting, translucent panel and aluminum structure installed over structural curbs and supports.
    3. Safety factor should be 1.65 for load carrying members and 2.0 for load carrying fasteners.
    4. Allowable deflection (ASTM E72): Structural members: not to exceed L/120 of the clear span and panel assemblies: not to exceed L/60 of the clear span.
      - c. In addition the maximum deflections of the translucent panels shall not exceed the allowable deflection required for long term performance and warranty requirements of the translucent panel system or the requirement of ICC Evaluation Service for the translucent sandwich panels.
  - C. Performance Requirements:
    1. Manufacturer shall configure and fabricate complete translucent panel assembly.
    2. Prepare structural analysis data and calculations to certify conformance with project specific design loads and governing code requirements concerning uplift, positive windload plus dead load, and negative windload plus dead load.

**1.7 QUALITY ASSURANCE**



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- A. Manufacturer shall be specialized in manufacturing translucent panel assemblies of type specified with minimum ten consecutive years experience. Show evidence of materials specified being satisfactorily used on at least three projects of similar size and type.
  - B. Erector's Qualifications: Specialized in installing translucent panel assemblies of type specified with minimum five consecutive years experience and show evidence of satisfactory completion of projects of similar size, scope, and type.
- 1.8 Require a warranty for the work specified against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship
- A. Defects are defined to include uncontrolled leakage of water, abnormal aging or deterioration, loss of structural integrity of panel assembly or face sheet, or delamination of face sheet from core. Warranty shall include all system components, flashing and sealants from 5 years from date of Substantial Completion
  - B. Translucent Facing Material Warranty (Polycarbonate and Fiberglass as applicable): Defects are defined to include fiberbloom (fiber exposure), delamination of coating from exterior sheet, abnormal cracking, abnormal aging, more than 8.0 Delta E units of discoloration, or loss of light transmission greater than 6 percent, as described herein.
    - a. Warranty period: 10 years non-pro rata from Substantial Completion

## PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Pre-finished, factory assembled panel system consisting of flat translucent panel units, battens and perimeter closures, flashing, and related accessories installed over structural curbs and supports.
- B. Physical Properties, testing shall be in accordance with the specified reference standards:
  - 1. Water penetration: ASTM E331- no uncontrolled water penetration at a static air pressure difference equal to 20 percent of the positive design wind pressure with a minimum of 6.24 psf and a maximum of 12 psf.
  - 2. Air infiltration: ASTM E283 - maximum air leakage of 0.06 cfm per square foot of surface when tested at static air pressure difference of 6.24 psf
  - 3. Interior flame spread classification: ASTM E84 - Class A
  - 4. Burn Extent: ASTM D635 – Must meet code requirements according to IBC Section 2606, 2610 and Table 1505.
  - 5. Delamination: IBC 803.2 - Interior face sheets shall not delaminate or become detached when subjected to 200 degrees F for not less than 30 minutes
  - 6. Color stability: ASTM D2244 - Full thickness and unaffected by abrasion or scratching. Color change not to exceed 8.0 Delta E units during 10 years of use.
  - 7. Self-ignition: ASTM D1929 - Greater than 650 degrees F
  - 8. Impact resistance:
    - a. Seaward Zones and Inland 1 Zones: Product Evaluation Reports showing that the system has been tested and meets the standards set forth by the Texas Department of Insurance for installations located in the Seaward Zones, and Inland 1 Zones per 2006 IBC/IRC with revisions.
    - b. All Other Wind Zones: Resist an impact equal to 60 ft-lbs minimum without fracture or tear when impacted by a 3-1/4 inch diameter, 5 pound free-falling ball.

### 2.2 SYSTEM COMPONENTS

- A. Provide one of the following options on the Project: Option No. 1 shall be translucent panel system utilizing glass fiber face sheets as described below. Option No. 2 shall be translucent panel system utilizing polycarbonate face sheets as described below. Mixing systems in a single project not permitted.



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- B. Insulated Translucent Sandwich Panel Units (Option No. 1) shall be architectural grade glass fiber reinforced polymer facings bonded to an aluminum grid core under a controlled process of heat and pressure to form a double-faced, self-supporting, true sandwich panel with a light transmission not less than 18 percent to 24 percent (18% to 24%), a shading Coefficient with a 0.24 minimum and a U-value, panel, tested in accordance with NFRC-100: 0.29 or better.
- C. Metal Materials shall meet ASTM B221, Extruded aluminum alloy 6063-T5/T6 or 6061-T5/T6. Size and shape shall conform to requirements for structural support.
- D. Exposed aluminum shall be clear anodized aluminum meeting the performance requirements of AAMA 611.
- E. Translucent Glass Fiber Assembly (Option No. 1) shall have glass fiber reinforced thermoset resin polymers for facing, formulated specifically for architectural use, a grid size of 12 inch by 24 inch, a shoji grid pattern, a face sheet thickness of 0.045 interior; 0.070 exterior, an exterior face color of crystal and an interior face color of white.
  - 1. Panels shall be self-extinguishing.
  - 2. Weatherability of exterior face sheets, ASTM D1435, shall pass test with and without protective coatings. Results shall be determined by the average of at least three white samples.
  - 4. Fiber blooming, ASTM D4060, the exterior face sheet shall have a permanent erosion barrier.
  - 5. The face sheets shall be uniform in color, free of ridges and wrinkles. Clusters of air bubbles/pinholes are not acceptable. Exterior face sheets shall be smooth, and shall not vary more than plus or minus ten percent in thickness
  - 6. UV Maintenance, if required to maintain warranty, requires the manufacturer to perform routine scheduled inspections, and when required, shall provide recoating of exterior face sheet to maintain performance regarding weatherability and UV protection during the warranty period. Manufacturer shall certify that application of coating does not affect fire resistance.
  - 6. Grid Core shall be aluminum I-beams with direct mechanical interlocking of muntin-mullion and perimeter. Facing material shall have full contact with bonding surface. Ferrous metals are not permitted. Fabricate to prevent variations in alignment at intersections.
  - 7. Adhesives should be factory applied to adhere translucent facing to grid core. Adhesive bonding lines shall be straight with a neat, sharp edge, and shall cover the entire width of the I-beam. White spots at intersections of muntins and mullions shall not exceed four for each 50 square feet of panel, nor shall they be more than 3/64 inch in width.
  - 8. Battens and Perimeter Closure System shall have a screw clamp-tight closure system. Field install aluminum battens and cap plates. The aluminum perimeter frame, including rafters, shall be self-draining of water infiltration and condensation by means of internal gutters which direct moisture to exterior.
- F. Polycarbonate Panel Assembly (Option No. 2):
  - 1. Facing should be tight cell technology extruded polycarbonate. Wide cell technology (cell size exceeding 0.18 inch) not permitted. The panel exterior skins shall be interconnected with supporting continuous ribs, perpendicular to the skins, at a spacing not to exceed 0.18 inch. In addition, the space between the two exterior skins shall be divided by multiple parallel horizontal surfaces, at a spacing not to exceed 0.18 inch. In a cross section, the core shall be constructed of tight honeycomb or rectangular cells not to exceed 0.18 inch by 0.18 inch. Exterior face sheet color shall be clear or white, meeting energy performance requirements, and the interior face sheet color shall be white matte.
  - 2. Panels shall be self-extinguishing.
  - 3. Weatherability:
    - a. Yellowing index shall meet ASTM D1925, not exceeding 10 points Delta Y. Light transmission, ASTM D1003, shall not decrease more than 6 percent over 10 years, or after exposure to temperature of 300 degrees



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- F for 25 minutes (thermal aging).
  - b. The interior and exterior faces shall not change color in excess of 0.75 Delta E by ASTM D2244, and shall not darken more than 0.3 units Delta L by ASTM D2244 and 0.2 units Delta Y (YI) by ASTM D1925, and shall not show cracking or crazing when exposed to 300 degrees F for 25 minutes.
  - c. Panel shall be factory sealed at the sill to restrict dirt ingress.
- 4. Face sheets shall be uniform in color, with a ridged-line texture. Panels shall consist of a polycarbonate resin with a permanent, ultra-violet protective layer, co-extruded by manufacturer during the original extrusion of the panel and shall be a permanent part of the exterior layer. Post-applied coating or films of dissimilar materials are not permitted. The system shall require no scheduled recoating to maintain its performance or for UV protection.
- 5. Translucent Panel Joint System:
  - a. Panel assembly thickness shall be Quadwall, 2.75 or 4 inch (as required by loading) with concealed interlocking H battens
  - b. Extrude panel in one single formable length by width not to exceed 2 feet. Transverse connections are not permitted.
  - c. Provide panels with integrally extruded standing seam upstands which are perpendicular to the panel face and which utilize a dry glazed double tooth grip-lock connection. Welding or gluing of upstands or standing seam, and single tooth locking mechanisms are not acceptable.
  - d. Mullions shall have dry glazed profiles, using no sealant, welding, adhesives or gaskets.
  - e. Concealed stainless steel retention clips, anchors and fasteners shall be used. The use of adhesives, plastic welding or sealant is not permitted. The metal retention clip shall be tested to withstand a wind uplift standard of 90 psf per ASTM E330.
  - f. Free movement of the panels shall be allowed to occur without damage to the weathertightness of the completed system.
  - g. Aluminum perimeter frame, including rafters, shall be self-draining of water infiltration and condensation by means of internal gutters which direct moisture to exterior.
- G. Provide factory installed continuous extruded black rubber gaskets above and below translucent panels.
- H. Insulation should be No. 1 Dry Class glass fiber, in density to achieve specified performance requirements.

### 2.3 ACCESSORIES

- A. Anchors and Fasteners shall be stainless steel, as instructed by manufacturer
- B. Other materials, components are to be use as required for a complete watertight and airtight installation as instructed by manufacturer.

## EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project
  - A. Provide structural framing and support curbs as indicated on the drawings and required by the translucent panel system manufacturer.
  - B. Prepare openings including isolating dissimilar materials from aluminum system which may cause damage by electrolysis.
  - C. Verify acceptability of structural framing and curbs for support of panel system prior to commencement of installation. Commencement indicates acceptance of conditions.
  - D. Erect panel systems in locations indicated on the drawings in accordance with approved shop drawings and manufacturers printed instructions.





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- E. After other trades have completed work on adjacent material, inspect translucent panel installations and make adjustments necessary to insure proper installation.
- F. Install complete system water and air tight. Water Test: Test skylights according to procedures in AAMA 501.2.

**END OF SECTION**





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### SECTION 08 71 00

#### DOOR HARDWARE

##### GENERAL

- 1.1 The architect should include in this section: commercial door hardware for swinging and other doors, cylinders for doors specified in other sections, electrified hardware and products furnished, but not installed, under this Section. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.
- 1.2 RECOMMENDED SUBMITTALS
  - A. Require LEED (Leadership in Energy and Environmental Design) product information and applicable program credits that are available to contribute towards a LEED Certified Level project certification.
    1. Credit MR 4.1 and 4.2: Manufacturer's or fabricator's certificate indicating percentage of post-consumer recycled content by weight and pre-consumer recycled content by weight for each Product specified under this Section.
  - B. Call for details of electrified and access control hardware, indicating the following:
    1. System Block Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Include the following for each unique electrified opening:
      - a. Point-to-point system wiring and riser diagrams.
      - b. Elevation diagram of each door.
      - c. Operational description.
  - C. Request a door hardware schedule prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
    1. Format: Comply with scheduling sequence and vertical format in DHL's "Sequence and Format for the Hardware Schedule."
    2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.
      - a. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3.
    3. Content: Include the following information:
      - a. Type, style, function, size, label, hand, and finish of each door hardware item.
      - b. Manufacturer of each item.
      - c. Fastenings and other pertinent information.
      - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
      - e. Explanation of abbreviations, symbols, and codes contained in schedule.
      - f. Mounting locations for door hardware.
      - g. Door and frame sizes and materials.
      - h. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
        - 1) Sequence of Operation: Include description of component functions including, but not limited to, the following situations: normal secured/unsecured state of door; authorized access; authorized egress; unauthorized access; unauthorized egress; fire alarm and loss of power conditions.
    4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must



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precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

- D. Require a keying schedule prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.
- E. Request maintenance data for each type of door hardware to include in maintenance manuals. Upon completion of construction and building turnover, furnish two (2) complete maintenance manuals to the owner. Manuals to include the following items:
  - 1. Approved hardware schedule, catalog cuts and keying schedule.
  - 2. Provide keying bitting list in paper and electronic format by registered mail directly to facility manager owner.
  - 3. Hardware installation and adjustment instructions.
  - 4. Manufacturer's written warranty information.
  - 5. Wiring diagrams, elevation drawings and operational descriptions for all electronic openings.

### 1.3 REQUIRE QUALITY ASSURANCE

- A. Door Hardware Installer Qualifications: An experienced and factory trained Installer who has completed both standard and electrified builders hardware and integrated access control installations similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Door Hardware Supplier Qualifications: Door hardware supplier with warehousing facilities in Project's vicinity which is not more than a half day of travel from the jobsite and who employs a qualified Architectural Hardware Consultant or equivalent experience available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying. Supplier recognized by manufacturers to be a direct factory-authorized distributor of the specified hardware products. Supplier is required to be available for onsite meetings with one days notice regarding issues that arise with opening functions, installation, keying, on-site warehousing, trouble shooting of products, and final punch out related issues.
  - 1. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- C. Architectural Hardware Consultant Qualifications: A person who is currently certified by the Door and Hardware Institute as an Architectural Hardware Consultant (AHC) and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.
- D. Source Limitations: Obtain each type and variety of aluminum, steel and wood door hardware from the same single source manufacturer and supplier, unless otherwise indicated.
  - 1. Provide electrified door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
  - 2. Provide standard door hardware, electrified door hardware and access control door hardware as a single sourced package from the same qualified supplier.
  - 3. Provide exterior door hardware from the same manufactures as the interior door hardware, HISD Lock department to approve and will be based on the performance of existing hardware.
- E. Regulatory Requirements: Comply with provisions of the following:



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1. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:
  - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
  - b. Door Closers: Comply with the following maximum opening-force requirements indicated:
    - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
    - 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
  - c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
2. NFPA 101: Comply with the following for means of egress doors:
  - a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
  - b. Thresholds: Not more than 1/2 inch high.
3. International Building Code (2003).
- F. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.
  1. Test Pressure: Positive pressure labeling.
- G. Wind Loads: Provide door hardware with hollow metal or aluminum assemblies approved by the Texas Department of Insurance, including anchorage, capable of withstanding windload design pressures which are calculated for this project by a registered architect or engineer and is part of the construction documents per the Texas Department of Insurance, authorities having jurisdiction and the International Building Code Design Loads per section 1609.
- H. Hurricane-Resistance Test Performance: Provide door hardware with hollow metal or aluminum approved assemblies that pass large missile-impact tests, as required by 'Texas Department of Insurance systems' location above grade, and cyclic-pressure tests according to testing requirements of authorities having jurisdiction.
  1. Impact Resistance: Door Hardware approved assemblies must satisfy the Texas Department of Insurance's criteria for protection from windborne debris in both the Inland I zone and the Seaward zone. The assemblies must have passed the large missile impact test (which equates to Missile Level D specified in ASTM E 1996-02). The assemblies may be installed at any height on the structure as long as the design pressure rating for the assemblies is not exceeded. These assemblies will and do not need to be protected with an impact protective system when installed in areas where windborne debris protection is required.

### 1.4 REQUIRE CONTRACTOR TO COORDINATE

- A. Templates: Door Hardware Supplier, ~~in coordination with Stanley Best~~, shall provide and distribute (to the parties involved) templates for doors, frames, and other work specified to be factory prepared for installing standard, electrified and access control door hardware.
- B. to provide and distribute to the parties involved for templating for doors, frames, and other work specified to be factory prepared for installing standard, electrified and access control door hardware.
- C. Access Control and Electrical Connections: Door Hardware supplier with door and frame supplier to coordinate the layout and installation of scheduled electrified door hardware



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with required connections to source power junction boxes, power supplies and security products.

- D. Keying Conference: Door Hardware Supplier to conduct keying Keying conference to incorporate the following criteria into the final keying schedule document:
1. Function of building, purpose of each area and degree of security required.
  2. Plans for existing and future key system expansion.
  3. Review all lock and exit device functions when reviewing keying requirements.
  4. Requirements for key control system.
  5. Installation of permanent keys and cylinder cores.
  6. Address the requirements for delivery of keys.
  7. Address keying and cylinder stamping (identification) as required by owner or owner representative.
  8. Establish method of submitting electronic format of keying systems and diagram and to be produced and provided by Hardware Supplier.

### 1.5 REQUIRED WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of standard, electrified hardware and access control hardware that fails in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
1. Structural failures including excessive deflection, cracking, or breakage.
  2. Faulty operation of the hardware.
  3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- C. Warranty Period: Two year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
1. Five years for cylindrical locksets.
  2. Life of Installation for mortise locks.
  3. Five years for exit devices.
  4. Ten years for manual door closers.
  5. Two years for electromechanical door hardware.
  6. Five years for Thresholds, Door Sweeps, Gasketing, Perimeter Weatherstripping.
- E. Extended Warranty: As requested by the Owner, provide a separate optional extended warranty and maintenance contract is required for the access control system and power assist operated openings. Version upgrades and "fix" releases to the software, beyond the general warranty time period, are available at no extra charge only if the end user is under a valid extended warranty and maintenance contract.
- F. 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.
- G. Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of door hardware and integrated access control systems suppliers and installers. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.



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### PRODUCTS

#### 2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this Section.
  - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated for named products listed in Hardware Sets.
  - 2. Sequence of Operation: Provide electrified and access control hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Schedule.
- C. Finish:
  - 1. Generally BHMA 626 Satin Chromium
  - a. Areas using BHMA 626 to have push plates, pulls, exit devices, vandal trim, and protection plates of BHMA 630 Satin Stainless Steel, unless otherwise noted.
  - 2. Door Closers: Factory powder coated to match other hardware, unless otherwise noted.
  - 3. Aluminum Items: Match predominant adjacent material. Seals to coordinate with frame color.

#### 2.2 HINGES AND PIVOTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Pivot Hinges: NOT ALLOWED.
  - 2. Concealed rods: NOT ALLOWED.
  - 3. Surface Rods: NOT ALLOWED.
  - 4. Hinges: Ives, Hager, McKinney, or Stanley
    - a. Conventional Hinges: Steel or stainless steel pins and concealed ball bearings. Hinge open widths minimum, but of sufficient throw to permit maximum door swing.
    - b. Three hinges per leaf to 7 foot, 6 inch height. Add one hinge for each additional 30 inches in height, or any fraction thereof.
    - c. Extra heavy weight hinges on doors over 3 foot, 5 inches in width.
    - d. Extra heavy weight hinges on doors with panic hardware or fire exit devices.
    - e. Extra heavy weight hinges on restroom, locker, gym, and other high frequency openings.
    - f. Outswinging exterior doors: non-ferrous with non-removable (NRP) pins.
    - g. Non-ferrous material exteriors and at doors subject to corrosive atmospheric conditions.
    - h. Five inch tall hinge at openings over 36 inches in width.
  - 5. Continuous Hinges (Stainless Steel) Hager, Pemko, Ives, McKinney, Stanley or Select.:
    - a. Continuous Hinges: Geared-type aluminum at exteriors.
    - b. Heavy-duty, extra-bearing units for doors over 3 foot, 5 inches in width.
    - c. Heavy-duty, extra-bearing units for doors with panic hardware or fire exit devices.
- B. Standards: BHMA Certified products complying with the following:
  - 1. Butts and Hinges: BHMA A156.1.
  - 2. Continuous Geared Hinges: BHMA A156.26.
  - 3. Template Hinge Dimensions: BHMA A156.7.
  - 4. Self-Closing Hinges: BHMA A156.17.
  - 5. Floor Hinges: BHMA A156.4.



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- C. Quantity: Provide the following, unless otherwise indicated:
1. Two Hinges: For doors with heights up to 60 inches.
  2. Three Hinges: For doors with heights 61 to 90 inches.
  3. Four Hinges: For doors with heights 91 to 120 inches.
  4. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches (of door height greater than 120 inches).
- D. Flush Floor Plates and Thresholds: Provide finish cover plates or thresholds as indicated in door hardware sets for floor hinges. Match door hardware finish, unless otherwise indicated.
- E. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

Maximum Door Size (inches)	Hinge Height (inches)	Metal Thickness (inches)	
		Standard Weight	Heavy Weight
36-in by 86-in by 1-3/4	4-1/2	0.134	0.180
< 36-in by 120-in by 1-3/4	5	0.146	0.190

- F. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
1. Exterior Doors: Heavy weight, non-ferrous, ball bearing hinges.
  2. Interior Doors: Heavy weight, ball bearing hinges unless Hardware Sets indicate standard weight.
- G. Hinge Height Clarifications: Where uneven door leafs occur, the widest door leaf should be used to determine the height of the hinges on the inactive and active door leafs; to ensure equal size hinges on opening.
- H. Hinge Weight Clarification: If heavy weight hinges are specified in hardware sets for aluminum frames then standard weight hinges can be used. If aluminum frame openings are 42 inches and greater then an additional hinge should be used in lieu of heavy weight hinges.
- I. Hinge Options: Comply with the following where indicated in the Door Hardware Schedule or on Drawings:
1. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:
    - a. Out-swinging exterior doors.
    - b. Out-swinging access controlled doors.
  2. Electric Hinges: Provide electric transfer hinges with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
- J. Provide mortar guard enclosure on frames at each electrical hinge location specified.

### 2.3 SCHEDULED DOOR HARDWARE/DOOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Surface Bolts: Flush Bolts and Coordinators
1. McKinney Products (MC).
  2. Rockwood Manufacturing (RO).
  3. Trimco Manufacturing (TR).
  4. Ives
- B. Standards: Comply with the following:
1. Surface Bolts: BHMA A156.16.
  2. Automatic and Self-Latching Flush Bolts: BHMA A156.3.
  3. Manual Flush Bolts: BHMA A156.16.
- C. Surface Bolts and Flush Bolts: BHMA Certified Grade 1.





## B U I L D I N G   E X C E L L E N C E

- D. Provide bolts with top rod of sufficient length to allow bolt location approximately six feet from the floor regardless if detailed as such in hardware sets. Furnish dust proof strikes for bottom bolts. Surface bolts to be 8" in length, unless otherwise noted and U.L. listed for labeled fire doors.
- E. Bolt Throw: Comply with testing requirements for length of bolts to comply with labeled fire door requirements, and as follows:
  - 1. Mortise Flush Bolts: Minimum 3/4-inch throw.

### 2.4 LOCKS AND LATCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Mechanical Mortise Locks and Latches:
    - a. **Sargent Manufacturing (SA) - 8200 Series w/ LNJ Trim, Preferred**
    - b. ~~Schlage (SC) - L9000 Series w/ 03A Trim~~
  - 2. Mechanical Bored Locks and Latches:
    - a. **Best Access Systems (BE) – 93K Series, Preferred**
    - b. ~~Sargent Manufacturing (SA) – 10-Line Series~~
    - c. Schlage (SC) – ND Series
  - 3. Interconnected Locks and Latches:
    - a. **Sargent Manufacturing (SA) - 7500 Series, Preferred**
    - b. Schlage (SC) – H Series/Levon
    - c. Stanley – QCL-200-E
  - 4. Auxiliary Cylindrical Deadbolts:
    - a. Best Access Systems (BE) – T Series
    - b. Sargent Manufacturing (SA) - 480 Series.
    - c. Schlage (SC) – B600 Series
  - 5. Auxiliary Mortise Deadbolts:
    - a. Best Access Systems (BE) – 48H Series
    - b. Sargent Manufacturing (SA) - 4870 Series.
    - c. Schlage (SC) – L400 Series
- B. Standards: Comply with the following:
  - 1. Mortise Locks and Latches: BHMA A156.13.
  - 2. Bored Locks and Latches: BHMA A156.2.
  - 3. Interconnected Locks and Latches: BHMA A156.12.
  - 4. Auxiliary Locks: BHMA A156.5.
- C. Mortise Locks: BHMA Certified Grade 1, Series 1000.
- D. Bored Locks: BHMA Certified Grade 1, Series 4000.
- E. Interconnected Locks: BHMA Certified Grade 1.
- F. Auxiliary Locks: BHMA Certified Grade 1.
- G. Lock Trim: Match the following design style:
  - 1. Levers:
    - a. ~~Best Access System (BE) – 15H/15D~~
    - b. Sargent Manufacturing (SA) – LNL/LL
    - c. Schlage (SC) – 06A/RHO
- H. Lock Functions: Function numbers and descriptions indicated in the Door Hardware Schedule comply with the following:
  - 1. Mortise Locks: BHMA A156.13.
  - 2. Bored Locks: BHMA A156.2.
  - 3. Interconnected Locks: BHMA A156.12.

<u>Lock Function</u>	<u>Lock Type</u>
AB	Entrance Lock or Office
R	Learning Center Function with double lock cylinder and core
D	Storage Function
N	Passage





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- H Hotel w/ indicator at: Single Occupancy Faculty Restrooms
- I. Lock Throw: Comply with testing requirements for length of bolts to comply with labeled fire door requirements, and as follows:
  - 1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
  - 2. Bored Locks: Minimum 1/2-inch latchbolt throw.
  - 3. Deadbolts: Minimum 1-inch bolt throw.
- J. Backset: 2-3/4 inches unless otherwise indicated.

### 2.5 ELECTRIFIED LOCKS

- A. Manufacturers: Subject to same compliance standards and requirements as mechanical locksets, provide products by one of the following:
  - 1. Electromechanical Mortise Locks:
    - a. Best Access Systems (BE) – 45HW EL/EU Secondary.
    - b. Sargent Manufacturing (SA) - 8270 Series, Preferred.
    - c. ~~Schlage (SC) – L90 EL/EU/RX Series, Preferred~~
  - 2. Electromechanical Cylindrical Locks:
    - a. Best Access Systems (BE) – 93K EL/EU Series
    - b. Sargent Manufacturing (SA) - 10G70/71 Series.
    - c. ~~Schlage (SC) – ND DEL/DEU Series.~~
  - 3. Electrified Options: As indicated in hardware sets, provide electrified lock options including: outside door trim control, latchbolt and lock/unlock status monitoring, and request-to-exit signaling. Unless otherwise indicated, provide electrified locksets standard as fail secure.
- ~~B. Keypad Electronic Locks:~~
- ~~C. Self Contained Electronic Locks and Readers: Internal, battery powered, self contained electronic locks consisting of complete lockset, electronically motor driven locking mechanism, stand alone proximity card reader and keypad and specified infrared programming device and accessories. Provide key override, low battery detection and warning, LED status indicators, and ability to program at the lock for the functions indicated.~~
  - 1. ~~Self Contained Electronic Locks:~~
    - a. ~~Best (BE) – Basis “V”.~~
    - b. ~~Sargent Manufacturing (SA) – Profile v.G1.5 Series.~~
    - c. ~~Schlage (SC) – CONGRA series.~~
- ~~D. Computer Managed Software: Provide software, and handheld programmable transmitter, capable of working with Microsoft Windows operating systems (95 or higher), required to program time zone periods, holidays, automatic unlock with first entry, and listing 1,000 event transaction history – unlock, egress activation, entry into programming mode, date, time, user number, and door number.~~
  - 1. ~~Computer Managed Software:~~
    - a. ~~Best (BE) – Basis Software.~~
    - b. ~~Sargent Manufacturing (SA) – SoftLink Plus Software.~~
    - c. ~~Schlage (SC) – LockLink Express Plus Software.~~
- ~~E. Integrated Proximity Card Key Locksets: Wiegand™ compatible electronic access control mortise or bored lockset with integrated proximity card reader included in the trim. Grade 1 lockset consisting of a hard wired, solenoid driven unit allowing locking/unlocking of the lever handle trim, door status switch (mortise lock) monitoring, latchbolt and deadbolt monitoring and request-to-exit signaling. Card reader is HID based technology programmable via panel interface board and third party networked access control software.~~
  - 1. ~~Integrated Proximity Card Key Locksets:~~
    - a. ~~Sargent Manufacturing (SA) – v.N1 Series.~~
    - b. ~~Best (BE) IDH MAX 45HM/93KM Series~~
  - 2. ~~Integrated Proximity Card Key Locksets Sleek and Sophisticated Design:~~



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- a. ~~Sargent Manufacturing (SA) - Harmony Series.~~
- b. ~~Best (BE) IDH-MAX 45HM/93KM Series~~

### 2.6 CYLINDERS AND KEYING

- A. Provide Patented, High, Security cylinders utilizing a unique factory code pattern that is both geographically and time zoned protected. A letter of authorization under the letterhead of the End User must accompany purchases of any products which involve patented cylinders, keys and accessories. Manufacturers of patented security cylinders to allow the ability for both security and conventional cylinders to be used together under the same facility master or grandmaster key system. The End User is required to have the ability for on-site cylinder pinning and original key cutting.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Patented Cylinders:
    - a. Best Access Systems (BE) - CORMAX Patented Cylinders and Cores.
  - 2. Keying Requirements:
    - a. Keying: Lock core keying schedules should be as simple as possible and must fall under the HISD great grand master for all HISD locks. The A/E should confirm the keying plan for each school with the HISD Lock Department and the principal. NOTE TO SPECIFIER: Specifications should indicate that the GC shall contract with Best Access/Stanley to remove all temporary cores and install final cores under direct supervision of HISD representative.
    - b. Key System: Existing small format cylinders with interchangeable core. For estimating purposes use factory GMK charge. Initiate and conduct meeting(s) with Owner to determine system structure and keybow styles.
    - c. Construction Keying: Furnish keyed-alike temporary cores plus 10 operating keys. Temporary cores and keys remain property of hardware supplier.
    - d. Interchangeable Cores: 7-pin solid brass construction. Six-pin should be converted to 7 pin to accept I/C core.
    - e. Permanent Cores: Furnish factory-keyed.
    - f. Match the existing keyway for the school district.
    - g. Permanent Keys and Cores: Use secured shipment direct from point of origination to Owner.
    - h. Biting List: Provide a key-biting schedule. Use secured shipment direct from point of origination to Owner upon completion.
    - i. Key Cabinet: Provide a key cabinet. Confirm mounting location in a secure area..
- C. Standards: Comply with the following:
  - 1. IC Core: BHMA A156.5.
  - 2. Key Control System: BHMA A156.5.
- D. Cylinder Grade: BHMA Certified Grade 1.
- E. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
  - 1. Removable Cores: Core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.
- F. Construction Keying: Comply with the following:
  - 1. Construction Master keying: Provide temporary construction master keyed cores that are replaceable by permanent cores.
- G. Keying System: Unless otherwise indicated, provide for a keying system complying with the following requirements:



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1. New Grand Master Key System: Cylinders are factory keyed operated by a change key, master key, and a grand master key. Conduct keying meeting with End User to define and document keying system instructions and requirements.
- H. Keys: Provide nickel-silver keys complying with the following:
  1. Stamping: Permanently inscribe each key with a visual key control number and as directed by Owner.
  2. Quantity: Supply as designated on HISD key system set up per school level (ES, MS, HS).
    - a. Extra Keyed Permanent Cores: Ten.
    - b. Extra Blank Keys: Fifty.
- I. Key Registration List: Provide keying transcript list to Owner's representative for lock cylinders.
- J. Key Control System: Provide one lockable cabinet for key control and storage for up to 150 percent capacity, type and model to be determined in the keying meeting with the owner. Provide End User with one copy of "Key Wizard" key management software program
- K. Key Cabinets: TelKee, Lund, or Owners Standard.

### 2.7 STRIKES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Electric Strikes: BHMA Certified Grade 1.
    - a. ~~Folger Adam EDC (FO) – 300, 700 Series.~~
    - b. Hanchett Entry Systems (HE) – 1000, 5900, 9600 Series.
    - c. Trine 4800 Series
    - d. ~~Adams Rite 7100 Series; 7400 Series~~
- B. Standards: Comply with the following:
  1. Strikes for Bored Locks and Latches: BHMA A156.2.
  2. Strikes for Mortise Locks and Latches: BHMA A156.13.
  3. Strikes for Interconnected Locks and Latches: BHMA A156.12.
  4. Strikes for Auxiliary Deadlocks: BHMA A156.5.
  5. Dustproof Strikes: BHMA A156.16.
  6. Electric Strikes: BHMA A156.5.
- C. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
  1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
  3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
- D. Provide electrified products with an in-line power controller that enables the hardware to operate from 12 to 32 volts. On board safety features shall include an in-line fuse to protect the hardware and host system from any possible reverse current surges. The controller shall regulate current to provide continuous duty operation without the typical head build up. Adding the in-line power controller with electrified products provides unlimited lifetime warranty of electrified products.

### 2.8 EXIT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Exit Devices:
    - a. **Sargent Manufacturing (SA) - 80 Series, Preferred**
    - b. Von Duprin (VO) – 35A/98 Series.



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- c. Stanley Manufacturing (SA) – Precision Apex Series
  - 2. Exit Device Trim, Pull/Lever:
    - a. Corbin Russwin Hardware (CR) – T13/N9M
    - b. Sargent Manufacturing (SA) – FSW/ETL
    - c. Von Duprin (VO) – 697/994L
  - 3. Electrified Options: As indicated in hardware sets, provide electrified exit device options including: electric latch retraction, electric dogging, outside door trim control, exit alarm, delayed egress, latchbolt monitoring, lock/unlock status monitoring, touchbar monitoring and request-to-exit signaling. Unless otherwise indicated, provide electrified exit devices standard as fail secure.
- B. Standard: BHMA A156.3.
- C. Exit Devices: BHMA Certified Grade 1.
- D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- E. Fire Exit Devices: Complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
- ~~F. Self-Contained Electronic Exit Trim: Internal, battery-powered, self-contained electronic exit device consisting of complete door trim unit with electronically motor driven locking mechanism, stand-alone proximity card reader and keypad and specified infrared programming device and accessories. Provide key override, low battery detection and warning, LED status indicators, and ability to program at the device for the functions indicated.~~
  - 1. ~~Self-Contained Electronic Exit Trim:~~
    - ~~a. Sargent Manufacturing (SA) – Profile v.G1.5 Series.~~
    - ~~b. Von Duprin (VO) – CM Series.~~
- ~~G. Integrated Proximity Card Key Exit Trim: Wiegand™ compatible electronic access control exit device with integrated proximity card reader included in the exit trim. Device consists of a hard wired, solenoid driven unit allowing locking/unlocking of the exit trim, door status switch monitoring, latchbolt and touchbar monitoring and request-to-exit signaling. Card reader is HID based technology programmable via panel interface board and third party networked access control software.~~
  - 1. ~~Integrated Proximity Card Key Exit Trim:~~
    - ~~a. Sargent Manufacturing (SA) – v.N1 Series.~~
  - 2. ~~Integrated Proximity Card Key Locksets Sleek and Sophisticated Design:~~
    - ~~a. Sargent Manufacturing (SA) – Harmony Series.~~
- H. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
- I. Outside Trim: Match design for locksets and latchsets, unless otherwise indicated.
- J. Through Bolt Installation: For exit devices and trim as required for fire rated wood doors.

### 2.9 ACCESSORIES FOR PAIRS OF DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Coordinators:
    - a. McKinney Products (MC).
    - b. Rockwood Manufacturing (RO).
    - c. Ives
    - d. Trimco
  - 2. Keyed Removable Mullions:
    - a. Sargent Manufacturing (SA) L980 Series.
    - b. Von Duprin (VO) KR4954 Series.
    - c. Precision KR 822
- B. Standards: Comply with the following:
  - 1. Coordinators: BHMA A156.3.



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2. Removable Mullions: BHMA A156.3.
- C. Fire-Exit Removable Mullions: Provide keyed removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions shall be used only with exit devices for which they have been tested.

### 2.10 CLOSERS and POWER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one the following:
  1. Surface-Mounted Closers (Heavy Duty): BHMA Certified Grade 1.
    - a. LCN Door Closers (LC) – 4040XP Series with heavy duty arms.
    - b. Norton Door Controls (NO) - 7500 Series with heavy duty arms.
    - c. Sargent Manufacturing (SA) - 351 Series with heavy duty arms.
    - d. Stanley - D4550 Series
  2. Surface-Mounted Closers (Standard Duty): BHMA Certified Grade 1.
    - a. LCN Door Closers (LC) – 1461 Series.
    - b. Norton Door Controls (NO) - 8501 BF Series.
    - c. Sargent Manufacturing (SA) - 1431 Series.
    - d. Stanley – D3550 Series
  3. Closer Holder Release (Detector) Devices: BHMA Certified Grade 1.
    - a. LCN Door Closers (LC) – 4040SE Series
    - b. Norton Door Controls (NO) - 7700PT(D) Series.
    - c. Sargent Manufacturing (SA) -351 EHT(D) Series
  4. Power Assist Operators: BHMA Certified Grade 1.
    - a. Besam Manufacturing (BM) – SW-100 Series.
    - b. LCN Door Closers (LC) – 4640 Series.
    - c. Norton Door Controls (NO) – Norton 5900 X-in Series.
    - d. Sargent Manufacturing (SA) - MPower 4000 Series.
    - e. Stanley (ST) – Magic Force Series.
- B. Standards: Comply with the following:
  1. Closers: BHMA A156.4.
  2. Power Operators: BHMA A156.19. Power operators to comply with TAS 404.3.
- C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide non-handed, factory-sized closers adjustable to meet field conditions and requirements for opening force.
- D. Closer Options: As indicated in hardware sets, provide door closer options including: delayed action, hold open arms, extra duty parallel arms, positive stop/hold open arms, compression stop/hold open arms, special mounting brackets, spacers and drop plates. Through bolt type mounting is required as indicated in the door hardware sets.
- E. Power assist operators as surface mounted, electric low energy type conforming to ANSI A156.19 requirements and capable of meeting ANSI A117.1 guidelines. Outputs and relays required to be on board in the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.
  1. Outputs and relays on board the operator allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.
  2. Electronic Controls to be microprocessor controlled unit shall control the operation and switching of the swing power operator. The electronic control provides low voltage power supply for all means of actuation. Electronic encoder to determine absolute open and close position.
  3. **All electrified locks should be fail secure.**



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### 2.11 OPERATING and PROTECTIVE TRIM UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Metal Protective Trim Units:
    - a. McKinney Products (MC).
    - b. Rockwood Manufacturing (RO).
    - c. Ives
    - d. Trimco (TR)
- B. Standard: Comply with BHMA A156.6.
- C. Materials: Fabricate protection plates from the following:
  - 1. Brass/Bronze and Stainless Steel: .050 inches thick, beveled four sides (B4E) with countersunk screw holes.
- D. Push-Pull Design: 1" Round with 10" Centers. Provide 90 degree offset pulls at exterior openings.
- E. Fasteners: Provide manufacturer's designated fastener type as indicated in door hardware sets.
- F. Furnish protection plates sized 1 1/2 inches less than door width (LDW) on push side and 1 inch less door width on pull side by height specified in door hardware sets.

### 2.12 STOPS AND HOLDERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Stops and Holders:
    - a. McKinney Products (MC).
    - b. Rockwood Manufacturing (RO).
    - c. Hager
    - d. Trimco Manufacturing (TR) 1201, 1209, & 1277.
    - e. Ives FS448, FS18S, & 407B
- B. Standards: Comply with the following:
  - 1. Stops and Bumpers: BHMA A156.16.
  - 2. Electromagnetic Door Holders: BHMA A156.15.
  - 3. Combination Overhead Holders and Stops: BHMA A156.8.
  - 4. Door Silencers: BHMA A156.16.
- C. Stops and Bumpers: BHMA Certified Grade 1.
- D. Electromagnetic Door Holders for Labeled Fire Door Assemblies: Coordinate with fire detectors and interface with fire alarm system. Magnetic door holders shall meet or exceed ANSI A156.15 and be UL listed 228 for Door Closer and Holders, with or without integral smoke detectors. Holding force shall be 25 to 40 pounds and shall be fail-safe. Pushpin release that eliminates residual magnetism shall be standard. Provide magnetic hold-opens with triple-voltage coil that can receive 12 VDC, 24 VAC/DC, or 120VAC; or coordinate required voltage with electrical. Subject to compliance with requirements, provide products by one of the following:
  - 1. Rixson Hardware (RX) - 980 Series.
  - 2. Sargent Manufacturing (SA) - 1560 Series.
  - 3. LCN (LC) – SEM7800 Series.
- E. Combination Overhead Stops and Holders: Certified BHMA Grade 1.
  - 1. Glynn-Johnson (GJ) – 100 Concealed and 90 Surface Series
  - 2. ABH.
  - 3. Sargent Hardware (SA) – 600 Concealed and 500 Surface Series.
- F. Floor Stops: For doors, unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic.
  - 1. Where floor or wall stops are not appropriate, provide overhead stops.





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- G. Silencers for Metal Door Frames: BHMA Grade 1; neoprene or rubber, minimum diameter 1/2 inch fabricated for drilled-in application to frame. Provide (3) per single door and (2) per paired door frame if applied gasketing is not specified in Hardware Sets.

### 2.13 DOOR THRESHOLDS, WEATHERSTRIPPING AND GASKETING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Door Thresholds, Weatherstripping and Gasket Seals:
    - a. McKinney Weatherstripping Products (MW).
    - b. NGP Manufacturing (NG)
    - c. Pemko Manufacturing (PE).
    - d. Reese
- B. Standard: Comply with BHMA A156.22.
- C. General: Provide continuous weatherstrip seal on exterior doors and smoke, light, or sound gasketing on interior doors where specified. Provide non-corrosive fasteners for exterior applications.
  - 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame. Install header seal before mounting door closer arms.
  - 2. Meeting Stile Astragals: Fasten to meeting stiles, forming seal when doors are closed.
  - 3. Door Sweep: Apply to bottom of door, forming seal with threshold when door is closed.
- D. Basic Sound Seal Requirement: Whether indicated on the drawings or not, provide gasketing MCKS88BL at sound rated wall types and at the following areas for limiting of sound transmission: private offices, exams, conference, private toilets, corridor openings, rooms and similar sound sensitive area.
- E. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
  - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- F. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
  - 1. Intumescent Seals and Gasketing: Provide concealed, Category A type gasketing systems on assemblies where an intumescent seal is required to meet IBC and UL-10C positive pressure labeling.

### 2.14 SLIDING DOOR HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. P. C. Henderson, Inc. (PC).
  - 2. Haefele Manufacturing (HF).
  - 3. Hager Manufacturing (HA).
  - 4. Richards-Wilcox, Inc. (RW).
- B. Standard: Comply with BHMA A156.14.
- C. Sliding Bi-Passing Pocket Door Hardware: Provide complete sets consisting of track, hangers, stops, bumpers, floor channel, guides, and accessories indicated.
- D. Bi-folding Door Hardware: Rated for door panels weighing up to 125 lb.
- E. Pocket Sliding Door Hardware: Rated for doors weighing up to 200 lb.

### 2.15 POWER SUPPLIES

- A. Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Modular unit in NEMA ICS 6, Type 4 enclosure. Provide the least number of units, at the appropriate





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amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment. Third party listed and labeled for use with fire alarm systems. Power supply shall be furnished with a minimum of four (4) 4 Amp/hour batteries providing battery back up. An integral battery charging circuit shall be standard. Provide key locking cover to prevent tampering. Provide all control boards and relay panels to sufficiently operate the opening as described and intended per hardware sets. Subject to compliance with requirements, provide products by one of the following:

1. Boxed Power Supplies:
  - a. Securitron Door Controls (SE) - BPS Series.
  - b. Folger Adam EDC (FO) - FABPS Series.
  - c. Locknetics (LO) – 505-EIR Series.

### 2.16 ELECTRIC DOOR CORDS

- A. Electric Door Hardware Cords: Furnish electric transfer wiring with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and another one for hinge to junction box above the opening. Wire nut connections are not acceptable at low voltage electrified hardware. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified door:
  1. McKinney: Inner Door Cord 3 inches: QC-C003P
  2. McKinney: Inner Door Cord 3 foot door: QC-C206P
  3. McKinney: Inner Door Cord 4 foot door: QC-C306P
  4. McKinney: Inner Door Cord 15 feet: QC-C1500P
  5. McKinney: Hinge to Junction Panel 15 feet: QC-C1500P
  6. Provide one each of the following tools as part of the base bid contract:
    - a. McKinney: Electrical Connecting Kit: QC-R001
    - b. McKinney: Hand Tool for Connectors: QC-R003

### 2.17 ELECTRIC WALL MOUNT KEYSWITCHES

- A. Keyswitches shall be furnished on a stainless steel single gang face plate with a 12/24VDC bi-color LED and an integral backing bracket that shall permit integration with any 1.25" or 1.125" mortise cylinder. Keyswitches shall be available for momentary or maintained action and in narrow stile designs. Subject to compliance with requirements, provide products by one of the following:
  1. Electric Wall Mount Keyswitches
    - a. Securitron Door Controls (SE) – MK Series
    - b. Folger Adam EDC (FO) - FAMKSeries.
    - c. Locknetics (LO) – 650 Series.

### 2.18 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

### 2.19 FINISHES

- A. Standard: Comply with BHMA A156.18.
- 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. Protect mechanical finishes on exposed surfaces from damage by applying a strippable and temporary protective covering before shipping to jobsite.



## BUILDING EXCELLENCE

- D. Finishes on locksets, latchsets and exit devices to incorporate an FDA recognized antimicrobial coating (MicroShield™) listed for use on medical and food preparation equipment that will suppress the growth and spread of a broad range of bacteria, algae, fungus, mold and mildew.
- E. Provide clear powder coat finish at exit devices located on exterior openings such as gates and at pool exit doors.
- F. BHMA Designations: Comply with base material and finish requirements indicated by the following:
  - 1. BHMA 626: Satin chromium plated over nickel, over brass or bronze base metal.
  - 2. BHMA 630: Satin stainless steel, over stainless-steel base metal.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- 3.2 ***The architect should coordinate with the lock department upon substantial completion a core installation and keying meeting. Lock department to participate in walk through and sign off on lock hardware and lock core install.***

#### 3.3 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical source power to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.4 PREPARATION

- A. Steel Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.
- C. Electrified Openings: Provide steel doors and frames and wood doors prepared to receive electrified hardware connections specified in Door Hardware Sets without additional modification.

#### 3.5 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  - 2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
  - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Provide and coordinate concealed wood blocking for wall mount stops as detailed in Door Hardware Schedule.
- C. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

#### 3.6 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier and Door Hardware Manufacturer will perform a final inspection of installed door hardware and state in report whether work complies with or



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deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

1. Access Control System Consultant will inspect integrated electronic and access control hardware and state in report whether installed work complies with or deviates from requirements, including whether electronic and access control hardware is properly installed and performing according to system operational descriptions.
  - a. Inspection: Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.
  - b. Pre-testing: Program and adjust the system and pretest all components, wiring, and functions to verify they conform to specified requirements. Replace malfunctioning or damaged items with new items.
  - c. Acceptance Test Schedule: Schedule tests after pre-testing has been successfully completed and system has been in normal functional operation for at least 2 weeks.
  - d. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

### 3.7 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
  1. Door Closers: Adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- B. Six-Month Adjustment: Approximately six months after date of Substantial Completion, Installer shall perform the following:
  1. Examine and readjust each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.
  2. Consult with and instruct Owner's personnel on recommended maintenance procedures.
  3. Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation of door hardware units.

### END OF SECTION



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SECTION 08 80 00

GLAZED SYSTEMS

GENERAL

- 1.1 The architect should include in this section: exterior and interior glass, glazing sealant, aluminum framing systems, including storefront and curtainwall system, aluminum and glass entry doors, glazing of hollow metal doors, glazing of plastic laminate faced wood doors, aluminum horizontal sliding window, aluminum sunshades and operable windows.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 Require Engineer's calculations of performance requirements.
- 1.4 QUALITY ASSURANCE
  - A. Furnish a valid AAMA "Notice of Product Certification" indicating that the windows for the project conform to AAMA/NWWDA 101/I.S.2-97.
  - B. A manufacturer capable of providing aluminum framed storefront system that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.
  - C. Obtain aluminum framed storefront system from a single manufacturer.
- 1.5 Verify actual dimensions of aluminum framed storefront openings by field measurements before fabrication and indicate field measurements on Shop Drawings.
- 1.6 Require a warranty for the work specified for two years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship such as distortion or waves.

PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.
  - A. Sub-Contractors and Installers shall be certified from the manufacturer of the system being provided. Window and curtain wall systems shall be provided from manufacturer to the project site and shall not be assembled from raw extrusions or product material stock.
- 2.2 PERFORMANCE SPECIFICATIONS
  - A. Require the following simultaneously through the most adverse conditions of each exterior application.
    1. Design system to withstand positive and negative windloads normal to the plane of the wall in excess of 20 psf.
    2. Provide for noiseless expansion and contraction of all materials and assemblies due to temperature changes in a range between 10 degrees F and 180 degrees F without detriment to appearance or performance.
    3. Drain water entering at joints and condensation occurring within the wall construction to the exterior face of the wall. Allow no uncontrolled water other than condensation on the interior face of the wall.
    4. Limit air leakage to maximum 0.06 cfm per square foot of wall projected area. (Storefront at 8 lb./sq.ft.)
  - B. Require the following simultaneously through the most adverse conditions of each exterior application. Aluminum Window Requirements Conformance to specifications in



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AAMA/NWWDA 101/I.S.2 when tests are performed on the prescribed 8'0" x 5'0" minimum test size with the following test results:

1. Air Infiltration should be a maximum of .07 cfm/square foot when tested per ASTM E 283 at a static air pressure difference of 1.57 psf.
2. There should be no uncontrolled water leakage when tested per ASTM E 547 and ASTM E 331 at a static air pressure difference of 10 psf
3. The window should be operable with a maximum .4% permanent deformation per member when tested at a static air pressure difference of 67.5 psf.

### 2.3 MATERIALS

#### A. Aluminum:

1. Aluminum Alloys should comply with the standards and designations of the Aluminum Association and the following Standards: Sheet and Plate (ASTM B209), Extruded Bars, Rods, Shapes, and Tubes (ASTM B221), Bars, Rods, and Wire (ASTM B211), Standard Structural Shapes (ASTM B308), Drawn Seamless Tube (ASTM B210), Extruded Structural Pipe and Tubes (ASTM B429), and Welding Rods and Bare Electrodes (AWS Code).
2. Aluminum Finish, as selected by HISD Program Manager, should conform to AAMA 2604 for applied finishes or AAMA 661 for anodized finishes and have a five-stage; zinc chromate conversion coating pretreatment. The finish shall be applied with electrostatic spray and oven bake by approved applicator. The dry film thickness must be a minimum 1.2 mils on exposed surfaces, except inside corners and channels.

#### B. Steel:

1. For Carbon Steel, provide structural reinforcement as required.
2. Stainless Steel Fasteners should meet ASTM A167, type 302/304 and have a No. 4 satin finish where exposed.
3. Require galvanized or stainless steel for shims. Galvanized steel shall meet (ASTM A36 or ASTM A283) and stainless steel shall meet (300 Series). Do not use aluminum or plastic shims.
4. For Exposed Cladding, Trim and Panels, provide cladding elements with formed edge flanges and backside stiffener members as required to maintain such flatness that when measured at room temperature the maximum slope of the surface at any point, measured from the nominal plane of the surface in its final installed position shall not exceed 1.25 degrees.
5. Materials used as permanent or temporary protection for metals shall conform with the following standards:
  - a. Bituminous Paint: FS TT-C-494 or MIL-P-6883A.
  - b. Mastic Bulk Compound: FS SS-C-153, Type I or Type II.
  - c. Preformed Mastic Tape: NAAMM Specifications for Non-Shrinking, Non-Resilient Performed Sealing Compound
  - d. Zinc Rich Paint: MIL-P-38 336.

#### C. Glazing Materials at Hollow Metal Frames:

1. Use glazing compounds and preformed glazing sealants approved for the application, conforming to Glazing Materials portion of FGMA Glazing Manual.
2. Sealant should be one part acrylic polymer sealant conforming to FS TT-S-00230 or silicone, FS TT-S-0023-C. Use for glazing of all fixed glass. Include primer as recommended by manufacturer. All sealants shall be compatible with adjacent material per manufacturer's instruction.
3. Setting Blocks should be hard rubber or clean grain softwood.
4. Back-up material should be foamed polyethylene or polystyrene rodstock, sizes as required by joint condition, and compatible with sealant.
5. Glazing Tape should be DAP #1202 or as approved.
6. Glazing Gaskets are extruded neoprene, free of porosity, surface defects, dimensional irregularities and conforming to physical properties of ASTM C509.



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7. Use of metal sash putty will not be permitted, but compound conforming to FS T-G-410 will be permitted. The use of nonskinning compounds, nonresilient type preformed sealers, and preformed impregnated type gasket will not be permitted.
- D. Glazing Materials at Aluminum Framing include extruded neoprene glazing gaskets and sealant complying with Federal Spec. TT-S-00230.
  1. Glass: Glass shall meet the requirements of ASTM C1036.
  2. Care shall be taken to minimize the tong marks and, unless indicated otherwise, the tong marks shall occur at the bottom of the glass (after installation).
  3. All glass shall be heat strengthened unless noted otherwise.
  4. Color of tinted glass shall be as selected by HISD Program Manager
  5. **Safety Glazing** is subject to compliance with requirements, obtain safety glazing products permanently marked on each individual glass lite with certification label of manufacturer acceptable to authorities having jurisdiction. Safety glazing shall conform to ANSI Z97.1, Safety Performance Specification, and ANSI Z97.1, Safety Glass Code., and IBC 2406.1 as applicable.
  6. **Bullet resistant glass**, where specified, is subject to compliance with requirements with authorities having jurisdiction. The glass shall be 1-3/16 inch thick, Class I for use with and supplied loose by window manufacturer.
  7. **No IG unit shall be larger than 48" x 48" and laminated or tempered glass should not be larger than 48" x 72". All other sizes will need to be approved by HISD Project Manager and HISD Facility Maintenance Department.**
  8. **All glazing shall be center set inside glazed.**
  9. All exterior glazing shall be 1" insulated glazing systems.
  10. Interior glazing shall meet code, i.e. tempered or wire/fire.
  11. Exterior Glass shall be 1 inch thick insulating glass units comprised of a 1/4 inch thick glazing quality Low-e tinted tempered float glass exterior lite with a 1/4 inch thick glazing quality clear tempered float glass interior lite, separated by a 1/2 inch air space. **District preference is Solarban® 60 "Solargray" manufactured by PPG Industries, other selections may be submitted to the HISD Program Manager for review.** Glass shall have the following properties:
    - 1) Visible Light Transmittance (%): 35
    - 2) Winter Night-time U-value: .29
    - 3) Shading Coefficient: 0.28
    - 4) Solar Heat Gain Coefficient (SHGC): 0.24
  12. Acoustical Glass consisting of one lite of 1/4 inch thick tempered glass and one lite of 3/8 inch thick laminated clear float glass comprised of two 3/16 inch thick glazing quality clear float glass lites, laminated to each side of a clear 0.030 inch thick polyvinyl butyral (PVB) interlayer. Install in sound retardant doors.
  13. **NO LEXAN**
- E. Aluminum and Glass Entrance Doors shall be Wide Stile Swing Door Standard Entrance or equivalent product from list of approved manufacturers.
  1. Doors shall be 1-23/32 inch thick, consisting of 5 inch vertical stile, 5 inch top rail and 6-1/2 inch bottom rail aluminum tubular sections with 0.125 inch thick nominal wall thickness.
  2. Provide bolted and welded connections, fit to a hairline joint. Provide reinforcing at bolted attachments. Tapped aluminum is not permitted. Require concealed screws, nuts, bolts, and anchors, except hardware screws on butt of door, of non-corrosive metal.
  3. Require same glass type at all exterior locations. Deliver doors to job pre-glazed.
  4. Use manufacturer's recommended glazing gaskets for flush glazing (color: Black).
  5. Provide mullion stabilizer as required at double acting doors with removable mullion.





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- F. Aluminum Storefront/Entrance Framing System shall be 2 inch by 4-1/2 inch flush glazed type (typical) with mullion reinforcement, if necessary, to achieve structural requirements. Glass Pockets shall be sized to accept specified glass. Provide sill receptors with end dams (At all sill conditions). One operable window per classroom: project out hopper in storefront system.
- G. Aluminum Curtain Wall System:
  - 1. Structural Properties:
    - a. Limit the dead load deflection of horizontal members supporting glass to 1/175 of the clear span with a 1/8 inch maximum deflection.
    - b. Limit the deflection of any member in a direction parallel to the plane of the wall and of any corner mullion in both parallel and perpendicular directions to a maximum of 25 percent of the glass bite dimension and maintain a minimum of 1/8 inch clearance between the member and the edge of the glass, panel, or other component.
    - c. Limit the wind load deflection of any member to 1/240 plus 1/4 inch of the clear span, based on "pinned" ends.
    - d. Limit the wind load deflection of corner mullions to the span as specified above, with the specified pressure acting on one face of the building with no pressure acting on the adjacent face, or 1/2 the specified pressure acting on one face of the building with 1/2 the specified suction acting on the adjacent face, whichever is the greatest.
    - e. No wall element shall sustain permanent deflection of glass breakage under maximum design load.
    - f. The panels and their connections shall accommodate movements of the structure resulting from lateral forces. Provide connections with sufficient ductility to preclude brittle failure, at or near, welds.
    - g. Framing Sizes: 2-1/2 inches x 6-3/4 inches (**OR 7-1/2 for required windloads or impact resistant**) where indicated on the drawings. Miter ends of horizontals to form segmented curve at commons.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Obtain hardware templates from finish hardware supplier.
  - B. Inspect each piece of glass immediately prior to start of installation. Do not install items which are improperly sized, have damaged edges, or are scratched, abraded, or damaged in any other manner. Do not remove labels from glass.
    - 1. Install glass so distortion waves, if present, run in the horizontal direction.
  - C. Locate setting blocks at sills one quarter of the width of the glass in from each end of the glass, unless otherwise recommended by the glass manufacturer.
  - D. Install all glass, gasket, aluminum framing, aluminum horizontal sliding window in accordance with manufacturer's printed instructions. Installed windows units shall conform to AAMA 502 minimum requirements for air and water infiltration.
  - E. Caulk joints where indicated to meet performance specifications
  - F. Erection Tolerances:
    - 1. Maximum deviation from vertical is 1/8 inch in any story and 1/4 inch in any 45 foot run.
    - 2. Maximum deviation from horizontal is 1/8 inch in any 30 foot run.
    - 3. Maximum deviation from true alignment is 1/32 inch for any two abutting units. Allow no edge projections.
    - 4. Maximum joint gap is 1/32 inch.
    - 5. Maximum openings between movable glazing stop and adjacent member is 1/32 inch.





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- G. Protect glass from breakage after installation by promptly installing streamers or ribbons, suitably attached to the framing and held free from glass. Do not apply warning markings, streamers, ribbons, or other items directly to the glass.
- H. Adjust windows as necessary for smooth and weather tight operation, and leave windows clean and free of construction debris.

**END OF SECTION**



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SECTION 09 05 00

FINISHES COMMON WORK RESULTS

GENERAL

- 1.1 ***To promote creativity and innovation in 21 Century Learning Environments, HISD is open to the use of non-traditional materials and systems. All materials, systems and applications must be presented to the HISD project team and approved before use.***
- 1.2 Wall finishes are matched to specific projects, so consider grade levels and the level of wear and tear expected.
- 1.3 Provide corner guards at all painted gypsum board outside corners.
- 1.4 ***District requires spray-on fireproofing for rated ceiling assembly in lieu of rated lay-in ceiling (09 51 00).***
- 1.5 Vinyl micro-vented wall covering over gypsum board may be used as a tackable wall surface.
- 1.6 Floor finishes are matched to specific types of use (reference Education Specification). Verify recommendations with HISD Project Manager.
- 1.7 All color selections shall be reviewed by HISD Program Manager.
- 1.8 Materials and products should be durable- built to withstand constant use and should be easy to clean and maintain.
- 1.9 In accordance with LEED guidelines, specify floor mats to be installed at each public entrance to the building. The mat should be the width of the opening, by a minimum of 6' long. If the arrangement includes a small vestibule, the depth of mat should extend the full depth of the vestibule.
- 1.10 Schedule wall tile in restrooms to extend full height floor to ceiling. Floor to wall shall be coved. Exterior corners shall be bullnosed. All restrooms to receive epoxy grout.
- 1.11 Tile Floors in restrooms, kitchens, or other areas where water is subject to discharge to the floor, shall be sloped to floor drains. Slope should be uniform and continuous to perimeter of area. Ensure that the floor slopes do not exceed 2% in any direction as applicable under the Texas Accessibility Standards.
- 1.12 Specify a vapor barrier to cover entire concrete floor and extending up the perimeter wall as required by manufacturer and installer for flooring installation.
- 1.13 Require contractor to conduct slab moisture test. The moisture shall not exceed maximum allowable moisture content as allowed by flooring manufacturer.
- 1.14 ***Stair shall have embedded or mechanically fastened metal nosings that work with the specified flooring.***
- 1.15 Specify that the ceiling contractor shall be responsible for support wires for the ceiling, independent of any other installation, including, but not necessarily limited to mechanical ductwork, plumbing piping, or lighting fixtures.



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- 1.16 Specify that the ceiling contractor shall be responsible for installation of one support wire at each corner of each lighting fixture.
- 1.17 Specify that the ceiling contractor shall be responsible for inspection of the ceiling installation upon completion, to ascertain that neither the ceiling tile, nor the grid, is supporting any other product or material.
- 1.18 For resilient flooring, all surfaces shall be scheduled to receive base, including cabinets, shelving, or other fixed equipment.
- 1.19 Require resilient flooring under all permanently installed casework.
- 1.20 Specify final cleaning to be performed by contractor and coordinated to allow application of protective finishes by Houston ISD Maintenance Department if required. Protection thereafter, until final acceptance by HISD shall be the responsibility of the contractor. Intermittent cleaning by the contractor, during finish work shall be done under the supervision of the Custodial Services Department, with cleaning materials stipulated by HISD Maintenance Department.
- 1.21 ***Design learning centers to comply with ANSI Standard S 12.60 for acoustic performance. The standard addresses the issue of both reverberation time and background noise and their effect on speech intelligibility.***

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## BUILDING EXCELLENCE

### SECTION 09 21 16

#### GYPSUM WALLBOARD SYSTEMS

##### GENERAL

- 1.1 The architect should include in this section: metal wall and ceiling framing for gypsum board construction, Exterior Sheathing, Gypsum Wallboard, Gypsum Shaft Liner, Abuse Resistant Gypsum Panels, Impact Resistant Gypsum Panels, Cement Tile Backer Board, Moisture Resistant Tile Backer Board and Taped, filled and sanded joint treatment.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 Require a warranty for the work specified for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
  - A. Exterior sheathing weathering warranty covering in-place exposure damage to exterior sheathing for twelve months. Exterior sheathing warranty against manufacturing defects for five years. Abuse Resistant Panel weathering warranty covering in-place exposure damage to sheathing for six months. Abuse Resistant Panel warranty against manufacturing defects for three years. Glass-mat sheathing weathering warranty covering in-place exposure damage to sheathing for three months. Glass-mat sheathing warranty against manufacturing defects for three years. Tile backer board warranty against manufacturing defects for 20 years.

##### PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered. All gypsum wallboard must be U.S. produced.

##### 2.2 MATERIALS

- A. Metal Framing System:
  1. Studs, meeting ASTM C645-08, shall be C-channel, roll-formed from hot-dipped galvanized steel with corrosion resistant coating. Channel type screw studs shall be roll formed from gauge as galvanized steel, unless noted otherwise, 20 gauge (1/360) galvanized steel at walls to receive tile. The section modules for studs shall be S = 0.135 for 3-5/8 inch studs, and S = 0.082 for 2-1/2 inch studs.
  2. Tracks, meeting requirements of ASTM C645-08 shall also be C-channel, roll-formed from hot-dipped galvanized steel.
    - a. Use deflection track at non-rated walls extending to structure to allow for 3/4 inch movement in either direction. Do not fasten studs directly to Deflection Track.
    - b. Contractor shall use a deflection track and firestop system at heads of fire rated partitions. System shall use "Shadowline" deflection track, mineral fiber, sealant, clips, and accessories required to achieve fire ratings shown or required. System shall comply with deflection track and Firestop System.
    - c. Channel Bridging and Bracing: U-Channel Assembly; Base metal thickness of .0538 inch (1.37mm) and minimum 1/2 inch wide flanges.
    - d. The galvanized sheet steel flat strap and backing plate for blocking and bracing in length and width is subject to compliance with requirements.
- B. Wall and Ceiling Materials:



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1. Exterior Sheathing, meeting ASTM C1177, shall be 1/2 inch thick water resistant treated gypsum core with front and back glass mats faced or embedded in core, contain a weather resistant surface, zero flame spread, and zero smoke. Use as exterior sheathing in metal stud framed construction behind face brick in cavity wall construction, and behind plaster.
2. Gypsum Wallboard shall be 5/8 inch thick, tapered-edged, and conform to ASTM C1396, Type X. Sizes shall be 4 feet-0 inches wide by longest practical length to minimize joints. Moisture Resistant gypsum board is also 5/8 inch thick with moisture resistance, is green faced, with a tapered-edged. Sizes shall be 4 feet-0 inches wide by longest practical length to minimize joints. Provide fire rated core where required to maintain fire rating of adjacent assembly.
3. Abuse resistant gypsum panel (Moderate Duty) is 5/8 inch thick, Type X, with a tapered edge.
4. Impact resistant gypsum panel (Heavy Duty) is 5/8 inch thick, Type X, with a tapered edge. Use in all common spaces including stud framed stair enclosures and the cafeteria. Use up to 8'-0" at all school corridors.
5. Gypsum Shaft Liner is made of a gypsum core for added fire resistance and multi-layered green paper facings that are treated to resist moisture penetration.
6. Cement Tile Backer Board, used in wet/humid areas, is 1/2 inch thick and is used as sheathing at shower areas and restrooms, or as scheduled on walls to receive ceramic tile. Use greatest width by longest practical length to minimize joints. Use joint reinforcement and fasteners in accordance with manufacturer's instructions. For fiber and cement backer boards, provide waterproof membrane behind backer board per TCA W244. Coated glass-mat water-resistant gypsum board does not require waterproofing membrane per TCA W245.
7. Moisture Resistant Tile Backer Board (Dry areas) shall be 1/2 inch thick.
8. Channels shall be gauge designed by manufacturer in cold formed steel channels with hot dip galvanized finish. Use for suspended ceilings.
9. Galvanized sheet metal furring channels are 2-3/4 inches wide and 7/8 inch deep.
10. Corner Beads are made from 28 gauge galvanized steel with 1-1/4 inch legs and should be used at all exterior corners.
11. Joint Compound is typically by gypsum manufacturer for intended use. Fire rated type must be used on fireproof systems. Perlite and other additives not permitted.
12. Laminating Adhesives should be recommended by manufacturer of product to be laminated.
13. Use single component, non-skinning, non-hardening synthetic rubber for the acoustical sealing of gypsum board partitions. STC rating in accordance with manufacturer's instructions.
14. Call for 9-gauge galvanized hanger wire and 16 gauge tie wire.
15. Screws shall be 1 inch and 1-5/8 inch long self drilling, self tapping cadmium plated bugle head type.
16. Resilient Clips should be used in accordance with wallboard manufacturer's recommendations.
17. Control Joints shall be metal with 1/4 inch open joint and perforated flanges for floating in place.
18. Wall Fixture Reinforcement should be 6 inches from 14 gauge cold formed steel galvanized channels.
19. Glass-fiber Mesh Tape shall be a minimum of 2 inch wide self-adhering glass-fiber type with 10X10 threads per inch.
20. Silicone Joint Sealant, meeting ASTM C920, Type S, grade NS, shall be compatible with exterior sheathing tape and sheathing, instructed by tape and sheathing manufacturers for use with glass-fiber mesh sheathing tape and for covering exposed fasteners.



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21. Waterproof membrane under cementitious/fiber tile backer board shall be minimum 15-pound building felt or 4-mil polyethylene film.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Install sheathing without openings, gaps, cracks, or holes.
  - B. Attach sheathing to metal framing with gold side out and with screws spaced eight inches on center at perimeter where there are framing supports and eight inches on center along intermediate framing in field.
  - C. Drive fasteners to bear tight against and flush with surface of sheathing. Do not countersink.
  - D. Locate fasteners minimum 3/8 inch from edges and ends of sheathing panels.
- 3.2 INTERIOR METAL FRAMING INSTALLATION
  - A. Attach floor track to floor at 24 inches maximum centers with shoot-in pins or concrete nails.
  - B. Fasten ceiling track at 24 inch intervals, staggered. Where shown or required to extend above ceiling, brace to the structure at intervals not exceeding 4 feet-0 inches.
  - C. Drywall Suspension System: Use at gypsum drywall suspended ceilings, where required.
  - D. Metal Studs should be single lengths positioned vertically straight and plumb in the runners, spaced 16 inches on center, unless noted otherwise.
  - E. Anchor all studs located adjacent to door and window frames, partitions intersections and corners to runner flanges by positive screw engagement through each stud flange and runner flange. Position all studs vertically with the open side facing in the same direction, engaging the floor and ceiling runners.
    1. Use positive screw attachments with 3/8 inch or 1/2 inch Type "S" or "S-12" pan head screws through each stud flange and runner flange.
  - F. Provide solid bridging spanning between wall studs at all wall mounted fixtures, finish hardware, toilet partitions, accessories and equipment.
- 3.3 GYPSUM WALLBOARD INSTALLATION
  - A. Apply all ceiling boards first, cut boards so that they slip easily into place, butt all joints loosely, and place tapered or wrapped edges next to one another.
  - B. Select the maximum practical length to minimize end joints. All end joints shall be neatly fitted and staggered. Joints on opposite sides of partition shall be so arranged as to occur on different studs.
  - C. Wherever possible, apply boards perpendicular to framing and in lengths that will span ceilings and walls without creating end (butt) joints. If butt joints do occur, stagger and locate them as far from the center of walls and ceilings as possible.
  - D. Support all ends and edges of gypsum board on framing, except long edges at right angles to framing and where end joints are to be floated between frame members and back-blocked.
  - E. Install metal corner bead at external corners. Where length of the corner does not exceed standard stock lengths, use a single length.
  - F. Install gypsum board 1/2 inch above surface of slab to prevent wicking of moisture.
  - G. Install metal trim where indicated.
  - H. To insure level surfaces at joints, arrange board application so that the leading edge of each board is attached to the open or unsupported edge of a steel stud flange.
  - I. The leading edge of gypsum board shall not be attached to the web edge of a flange.
  - J. Fasten wallboard at 12 inches on center except at the edges/joints which shall be at 8 inches on center.
  - K. Position edge-grip clips on the back of the panels and drive prongs into panel edges. Space clips 16 inches on center Screw-attach clip to framing, furring or wall surface.



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- L. Apply at least two coats of joint compound over beads, screw heads and trim, and each coat shall be feathered out onto panel faces. Float out and sand joints to make joints invisible when painted with non-texture paint.
- M. Caulk around pipes, ducts, structure or similar items which penetrate drywall systems.
- N. Provide acoustical sealant at walls in accordance with manufacturer's instructions.
- O. Control joints shall be located 30 feet-0 inches on center maximum and along building expansion joints, unless noted otherwise. Locations shall be reviewed prior to placement.

### 3.4 CEMENT TILE BACKER BOARD INSTALLATION – WET AREAS

- A. Install tile backer on walls vertically or horizontally.
- B. Coated Glass Mat Backer Boards: Install tile backer directly on metal stud framing system in showers and other wet areas in accordance with manufacturer's recommendations and TCA, Methods W245 at walls and B420 for shower installations.
- C. Cementitious/Fiber Backer Boards: Install tile backer on approved waterproof membrane in showers and other wet areas in accordance with manufacturer's recommendations and TCA, Methods W244 at walls and B419 for shower installations.
- D. Substrate for tile: Apply clear silicone sealant to corners and board joints. Apply glass mesh joint tape over joints. Embed tape in setting material specified for tile finishes. Seal penetrations with setting material or silicone sealant.

### 3.5 MOISTURE RESISTANT TILE BACKER BOARD INSTALLATION – DRY AREAS

- A. Install tile backer on walls vertically or horizontally.
- B. Install tile backer on walls in accordance with manufacturer and TCA, Method W245.
- C. Substrate for tile: Apply glass mesh joint tape over joints. Embed tape in setting material specified for tile finishes. Allow joints to dry prior to installing tile systems.

### 3.6 CEILING FRAMING INSTALLATION

- A. Main Runners: 9-gauge hanger wires shall be spaced not over 4 feet-0 inches in the direction of 1-1/2 inch main runner channels and not over 4 feet-0 inches in the direction of right angles to the main runners, and within 6 inches of the ends of main runners and of boundary walls, girders or similar interruptions of ceiling continuity. Main runners shall be spaced not over 4 feet-0 inches on center.
- B. Cross tees shall be spaced in accordance with manufacturer's recommendations or in conformance with UL Fire Resistance Directory.
- C. Furring Channels: Space 16 inches on center, and saddle-tie with two strands of 16-gauge tie wire to main runners or main support members. Do not let into or come in contact with abutting masonry walls. End splices shall be provided by nesting channels or studs no less than 8 inches and securely wire-tie.
- D. Drywall Suspension System: Install in accordance with manufacturer's instructions.
- E. Provide control joints in ceiling at maximum 30 feet on center and, if possible, to coincide with expansion joints in the roof above.

### 3.7 CEILING BOARD INSTALLATION

- A. Apply gypsum board of maximum practical length with the long dimension at right angles to the furring channel and fastened with one inch drywall screws spaced 12 inches on center in the field of the board and along abutting ends.
- B. Align abutting end or edge joints over the web surface of the furring channel. Tie neatly and accurately with end joints staggered.
- C. Install gypsum board ceiling panels in drywall suspension system.

### 3.8 WORKMANSHIP TOLERANCES

- A. Correct any nicks, bumps, out-of-level or out-of-plumb areas detectable to the naked eye.
- B. Walls: 3/8 inch maximum deviation from vertical.
- C. Bumps in Boards: Maximum 1/8 inch in 24 inches.
- D. Corners: Maximum out-of-square 1/8 inch in 16 inches.





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- E. Float solid between corner beads less than 36 inches apart. Surfaces that appear concave are not acceptable.
- F. Provide "J" mold and continuous 1/4 inch reveal wherever gypsum board directly abutts other material or when end is exposed.
- G. Float Control Joints flush with wall surface so that ceiling wall mold specified separately will align with wall surface flat and straight.
- H. Interior gypsum wallboard and ceiling board installation may not commence until all exterior dampproofing and roofing are completed and roof top equipment is fully installed and flashed and exterior wall openings are protected.

**END OF SECTION**



## SECTION 09 30 13

### CERAMIC TILING

#### GENERAL

- 1.1 The architect should include in this section: thin set glazed wall and floor tile, base and necessary trim shapes, mortar and grout, expansion joints, sealants, transition strips, and accessories shown or required to complete work.
- 1.2 The architect should specify epoxy grout for all tile applications.
- 1.3 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.4 Require a warranty for the work specified for lifetime replacing, including cost of rehang and refinishing, at no cost to Owner, wood doors exhibiting defects in materials or workmanship including, warp in excess of 1/4 inch as defined by AWI, warp or twist to a degree that door will not operate properly, delamination of face and telegraphing or show through of stiles, rails, or core greater than 0.01 inch in any 3 inch area.

#### PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.

#### 2.2 MATERIALS

- A. Ceramic Tile:
  1. Floor Tile:
    - a. Type/Size: Non-glazed ceramic mosaic tile, with cushion edge.
    - b. Base: Cove type to match floor tile type and size.
    - c. Colors: As selected by Architect from manufacturer's available colors.
  2. Wall Tile:
    - a. Type/Size: Bright or matte glazed ceramic tile, with cushion edge.
    - b. Shapes: Provide necessary trim shapes to terminate tile with a bullnose edge and rounded external corners. Provide square internal vertical corners and ceiling - wall joints. Provide built-up cove base at showers as shown or required.
- B. Epoxy Grout: Use 100 percent solids epoxy grout in accordance with ANSI A118.3. No substitutions. Color shall be as selected by Architect from manufacturer's full line of available colors.
- C. Crack Isolation Membrane: Provide shower pan waterproofing in accordance with Section 07 13 00.
- D. Expansion Joints
  1. Expansion Joint Filler: Flexible and compressible, closed-cell type, rounded at surface to contact sealant as instructed by sealant manufacturer to suit intended use.
  2. Silicone compound sealant over filler. ASTM C920, Uses M and A, single component, mildew resistant. Sanded to match grout. Provide at all wall corners, ceilings, control joints and changes in materials, where floor tile abuts perimeter walls, curbs, columns, and pipes; and 24 feet to 36 feet elsewhere.
- E. Miscellaneous Metals



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1. Cement-based Floor Leveling Material: Self-Leveling Underlayment Concrete Gypsum-based products are prohibited.
  2. Transition Strips: Of type and size recommended to suit application. Color shall be as selected by Architect from manufacturer's standard colors.
- F. Extra Tile
1. Deliver one unopened box of each type and color of wall and floor tile to the Owner in accordance with Section 01 77 00, Closeout Procedures.

**EXECUTION**

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- A. Examination: Examine substrates for expansion joints and defects which may affect the work. Do not start work until defects have been corrected. Ensure that surfaces are:
    1. Dry, clean, free of oily or waxy films, free of curing compounds.
    2. Firm and level within specified tolerances.
    3. Minimum of 40 degrees and rising.
  - B. Tile contractor shall examine preparatory work by others and notify Architect of any imperfections which would affect a satisfactory completion of this tile work. Verify that slab is free of cracks, waxy or oily films, and is well cured. Absence of such notification shall constitute acceptance of responsibility by tile contractor.
  - C. Installation
    1. Align joints (no staggering)
    2. Set interior floor tile and grout in accordance with TCA F113 and shower floor in accordance with TCA B415. Set marble thresholds in accordance with TCA TR611 and manufacturer's instructions.
    3. Set interior wall tile and grout in accordance with TCA W244 on tile backer cement board at wet areas, showers, and restrooms, TCA W243 on tile backer gypsum board at dry areas not exposed to water or moisture, and TCA W202 on concrete masonry unit (CMU) substrates.
    4. Allow minimum of 24 hours after tile is set before grouting.
    5. Lay out tile so that the minimum size tile used is 1/2 size.
    6. Form internal angles square.
    7. Install expansion joints in accordance with TCA publication EJ171.
    8. Slope tile within three foot diameter of a floor drain, unless otherwise noted.
    9. Damp cure grout in accordance with manufacturer's recommendations.
  - D. Cleaning and Protection
    1. Clean work at completion of installation, remove excess grout from tile surfaces. Clean tile and grout surfaces prior to installation of plumbing fixtures.
    2. Wipe all tile with a clean damp cloth, and buff lightly, leaving tile surfaces clean and ready to use.
    3. Remove grout from adjacent finish surfaces.
    4. Protect finished installation until final acceptance.

**END OF SECTION**



## SECTION 09 30 16

### QUARRY TILE

#### GENERAL

- 1.1 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.2 Require a warranty for the work specified for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship. Defects shall include, but not be limited to, the following:
  1. Damaged tile, including broken or chipped edges.
  2. Loose or missing tile.
  3. Noticeable deterioration or discoloring of tile or grout.

#### PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.

#### 2.2 MATERIALS

- A. Quarry Tile:
  1. Size: 6 inches by 6 inches by 1/2 inch thick.
  2. Finish: Manufacturer's skid inhibiting textured surface.
  3. Colors: Architect will select colors from manufacturer's product color line.
  4. Base: 6 inch high by 6 inches long, with cove bottom and round top typically, except at ceramic tile finish.
  5. Patterns: Borders and patterns in colors as indicated or directed by Architect.
- B. Mortar Adhesive: Use one of the following. No substitutions.
  1. FlexBond Premium Flexible Bonding Mortar manufactured by Custom Building Products.
  2. 1300 Universal Bonding Mortar as manufactured Dal-Tile Corp.
  3. LATICRETE® 254 Platinum Thin-Set Mortar manufactured by Laticrete International, Inc.
- C. Epoxy Grout: Use 100 percent solids epoxy grout in accordance with ANSI A118.3. No substitutions. Color shall be as selected by Architect from manufacturer's full line of available colors. (sealer not required)
- D. Expansion Joints: Polysulfide sealant over filler. ASTM C920, Grade P, Class 25, Uses T and M. Polyspec Thiokol, or Architect approved equal. Self-leveling and flexible sealant over filler of type instructed by tile manufacturer to suit application. Sealant shall match grout color. Expansion joints shall conform to TCA EJ171.
- E. Tile Sealer: "Sealers Choice 15 Gold"
- F. Transition Strips: Of type and size recommended to suit application. Color shall be as selected by Architect from manufacturer's standard colors.
- G. Cement-based Floor Leveling Material: Self-Leveling Underlayment Concrete Gypsum-based products are prohibited.
- H. EXTRA TILE: Deliver one unopened box of tile of each size and color of the same tile production run to the Owner at Substantial Completion.

#### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Coordinate:



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1. Level substrate surfaces to acceptable flatness by installing latex floor leveling material in accordance with manufacturer's instructions and/or slab grinding.
  2. Protect surrounding work from damage or disfiguration.
  3. Vacuum clean and damp clean existing substrate surfaces.
  4. Examine preparatory work by others and notify Architect of any imperfections which would affect a satisfactory completion of this tile work.
  5. Examine substrates for expansion joints and defects which may affect the work. Do not start work until defects have been corrected. Ensure that surfaces are:
    - a. Free of cracks, dry, clean, free of oily or waxy films, free of curing compounds.
    - b. Well cured, firm and level within TCA specified tolerances.
    - c. Sloped to drain where floor drains occur.
    - d. Minimum of 40 degrees F and rising.
  6. Absence of such notification shall constitute acceptance of responsibility by tile contractor.
- B. Installation:
1. Install tile and base with aligned joints (no staggering), 1/8 inch to 3/16 inch joint width.
  2. Install tile in accordance with manufacturer's instructions.
  3. Set tile and base in accordance with TCA F115 and ANSI A108.5 in patterns as shown or directed by Architect.
  4. Do not use damaged tile, including tile with broken or cracked edges.
  5. Lay out all work so that, where possible, no tiles less than half size occur.
  6. Slope tile within three (3) foot diameter of a floor drain.
  7. Install epoxy grout in accordance with ANSI A108.6 and manufacturer's instructions.
  8. Damp cure grout in accordance with manufacturer's recommendations. Clean all tile surfaces upon completion. Protect finish tile work from damage.
  9. Clean expansion joints of dirt and debris and install in accordance with TCA EJ171 and install filler and sealant in accordance with manufacturer's instructions. Coordinate expansion joints with joints in the concrete slab.
  10. Install transition strips at locations where floor tile meet other flooring materials.
  11. Apply two (2) coats tile sealer in accordance with manufacturer's instructions and application rates. Do not allow sealer to come in contact with any non-recommended surfaces.
- C. Cleaning and Protection
1. Clean work at completion of installation, remove excess grout from tile surfaces.
  2. Remove grout from adjacent finish surfaces.
  3. Seal all quarry tile with specified sealer in accordance with manufacturer's instructions.
  4. Protect finished installation until final acceptance.
  5. Do not permit traffic over finished floor surface.
- D. Repair
1. Repair or replace damaged floors, including those with broken or cracked edges at no expense to Owner.

**END OF SECTION**



B U I L D I N G   E X C E L L E N C E

SECTION 09 30 19

PORCELAIN TILE

GENERAL

- 1.1 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.2 Require a warranty for the work specified for one year.
- 1.3 The architect should specify epoxy grout for all tile applications.

PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.

2.2 MATERIALS

- A. 5/16 inch thick through body porcelain tile with cushioned edge and manufacturer's standard slip resistant finish to meet coefficient of friction code requirements.
  1. Color: To be selected by Architect from manufacturer's full color line
  2. Finish: Unpolished and polished finish as directed.
  3. Locations: Each type shall be as shown on drawings.
  4. Base: Porcelain tile base to match porcelain tile.
- B. Mortar Adhesive: LATICRETE® 254 Platinum Thin-Set Mortar as manufactured by Laticrete International, FlexBond Premium Flexible Bonding Mortar as manufactured by Custom Building Products or 1300 Universal Bonding Mortar as manufactured Dal-Tile Corp., Ultraflex 3 as manufactured by Mapei Americas. No substitutions.
- C. Epoxy Grout (used at all interior tile installations) Use 100 percent solids epoxy grout in accordance with ANSI A118.3. No substitutions. Color shall be as selected by Architect from manufacturer's full line of available colors.
- D. Crack Isolation Membrane:
  1. Sheet membrane used to eliminate transmission of substrate cracks.
  2. Liquid membrane with fiberglass mesh in accordance with ANSI A118.12.
- E. Expansion Joint:
  1. Filler: Flexible and compressible, closed-cell type, rounded at surface to contact sealant as instructed by sealant manufacturer to suit intended use.
  2. Typical Conditions except as specified below: Silicone compound sealant over filler. ASTM C920, Uses M and A, single component, mildew resistant. Sanded to match grout. Provide at all wall corners, ceilings, control joints and changes in materials, where floor tile abuts perimeter walls, curbs, columns, and pipes; and 24 feet to 36 feet elsewhere.
  3. Conditions exposed to chemicals, food processing, etc.: Polysulfide sealant over filler. ASTM C920, Grade P, Class 25, Uses T and M. Polyspec Thiokol, or Architect approved equal. Self-leveling and flexible sealant over filler of type instructed by manufacturer to suit application. Sealant shall match grout color. Expansion joints shall conform to TCA EJ171.
- F. Latex Floor Leveling Material: ARDEX K-15 Self-Leveling Underlayment Concrete manufactured by ARDEX ENGINEERED CEMENTS. No substitutions.
- G. Edge Protection and Transition Strips:
  1. Porcelain Tile to Gyp. Bd.: Schluter® - QUADec transition strips in aluminum finish at all porcelain tile wainscot to gyp board transition locations.



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2. Porcelain Tile to Porcelain Tile: Schluter® - QUADEC transition strips in aluminum finish at all porcelain tile wall outside corner locations.
  3. Porcelain Tile to Carpet: Schluter® - SCHIENE transition strips in aluminum finish at porcelain tile to carpet transition locations.
  4. Porcelain Tile to Sealed Concrete: Schluter® - RENO-U edge protection in satin aluminum finish at porcelain tile to sealed concrete.
  5. Stair nosing: Schluter® - TREP-S GS 10 S, aluminum support with thermoplastic rubber insert.
  6. Provide all corners and connectors as required for a complete and detailed finished installation.
- H. EXTRA TILE: Deliver four unopened boxes of tile of each color tile and base from the same tile production run to the Owner at Substantial Completion.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- A. Coordinate:
    1. Protect surrounding work from damage or disfiguration.
    2. Vacuum clean and damp clean existing substrate surfaces.
    3. Examine preparatory work by others and notify Architect of any imperfections which would affect a satisfactory completion of this tile work.
    4. Examine substrates defects which may affect the work. Do not start work until defects have been corrected. Ensure that surfaces are:
      - a. Free of cracks, dry, clean, free of oily or waxy films, free of curing compounds.
      - b. Well cured, firm and level within TCA specified tolerances.
      - c. Minimum of 40 degrees F and rising.
    5. Absence of such notification shall constitute acceptance of responsibility by tile contractor.
  - B. Installation:
    1. Crack Isolation Membrane:
      - a. Install crack isolation membrane under tile over building control joints and substrate cracks up to 1/8 inch. Apply a 30 inch wide strip centered on control joint or crack. Install in accordance with TCA F125 and manufacturer's instructions.
      - b. Install joint sealant in joint of first tile on both sides of control joint and crack.
      - c. Install membrane with products or methods approved by membrane manufacturer when joining, sealing, fastening, or adhering sheet membranes.
    2. Install porcelain wall tile and porcelain pavers with aligned joints (no staggering), 1/8 inch to 3/16 inch joint width.
    3. Install porcelain pavers over crack isolation membrane in locations shown on drawings in accordance with TCA F125 and ANSI A108.5 recommendations and manufacturer's instructions.
    4. Do not use damaged porcelain tile, including those with broken or cracked edges.
    5. Lay out all work so that, where possible, no tiles less than half size occur.
    6. Install expansion joints in accordance with TCA publication EJ171. Install porcelain tile joints aligned with floor joints.
    7. Install grout in accordance with ANSI A108.10 and manufacturer's instructions.
    8. Install edge protection and transition strips in accordance with manufacturer's instructions.





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9. Damp cure grout in accordance with manufacturer's recommendations. Clean all porcelain tile surfaces upon completion. Protect finish porcelain tile work from damage.
- C. Cleaning and Protection
  1. Clean work at completion of installation, remove excess grout from porcelain tile surfaces. Wipe all tile with a clean damp cloth, and buff lightly, leaving tile surfaces clean and ready to use.
  2. Remove grout from adjacent finish surfaces.
  3. Protect finished installation until final acceptance.
  4. Do not permit traffic over finished floor surface.
- D. Repair
  1. Repair or replace damaged porcelain tile, including those with broken or cracked edges at no expense to Owner.

**END OF SECTION**



B U I L D I N G   E X C E L L E N C E

SECTION 09 51 00

ACOUSTICAL LAY-IN CEILING

GENERAL

- 1.1 The architects shall include in this section: Suspension system (Grid) and accessories, Acoustical lay-in panels: standard, *fire rated*, and sag resistant, Vinyl faced, sag resistant, scrubbable lay-in panels and *Hold down clips*, spacing clips, moldings, and accessories.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 ***District requires spray-on fireproofing for rated ceiling assembly in lieu of rated lay-in ceiling (09 51 00).***
- 1.4 Require a warranty for the following:
  - A. Require warranty for standard ceiling panels to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects for a period of one year from the date of Substantial Completion.
  - B. Require warranty for sag resistant ceiling panels to be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects for a period of ten years from the date of Substantial Completion.
  - C. Require a warranty for standard suspension systems to be free from defects in material or factory workmanship and shall not incur 50 percent red rust for a period of ten years from the date of Substantial Completion.
  - D. Suspension System / Ceiling Panels: Require a manufacturers standard 15 year warranty for suspension systems when used in combination with same manufacturers sag resistant ceiling panels. Ceiling panels should be free from sagging, warping, shrinking, buckling, or delaminating as a result of manufacturing defects. Suspension systems shall not incur 50 percent red rust during the period of the warranty.

PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines and must be approved by HISD project team to be considered.
  - A. Suspension System (Grid) and Acoustical Lay-in Panels: Armstrong World Industries, Inc. (Basis of Specification)

2.2 MATERIALS

- A. The 15/16" Suspension System (Grid), meeting ASTM C635, shall be intermediate duty commercial quality cold rolled steel with galvanized coating with exposed T and components die cut and interlocking.
  1. Accessories include Perimeter moldings, *Hold down clips* and an Aluminum cap for use over steel grid in kitchen areas or where required. White color.
  2. Hanger Wire shall be made from soft tempered, prestretched galvanized carbon steel in accordance with ASTM A641, with a yield stress load of at least three (3) times the design load, but not less than 12 gauge in diameter.
    - a. Each light fixture shall have wire hangers at each corner (4 total). This includes existing lights for renovations.
- B. Standard wet-formed mineral fiber lay-in panels shall be 24 inches by 24 inches by 5/8 inch thick with a square lay-in trim and an NRC of 0.55 - 0.65 in accordance with ASTM C423. The fire rating and UL should be determined by building type and code requirements.



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- C. Sag resistant, anti-microbial panels are made from a wet-formed mineral fiber, shall have the square lay-in trim and shall be 24 inches by 24 inches by 5/8 inch thick. The NRC should be 0.55 - 0.65 in accordance with ASTM C423. The fire rating and UL should be determined by building type and code requirements. The tile requires a manufactures anti-microbial treatment in accordance with ASTM D3273.
- D. Vinyl-faced, wet-formed mineral fiber tiles shall be sag resistant, 24 inches by 24 inches by 5/8 inch thick, have a square lay-in trim with an NRC of 0.10 - 0.15 minimum in accordance with ASTM C423. The fire rating and UL should be determined by building type and code requirements. The tile contains a scrubbable factory applied white vinyl plastic paint with manufactures anti-microbial treatment in accordance with ASTM D3273.
- E. Fiberglass tiles shall be square lay-in, 24 inches by 24 inches by 1 inch thick and contain a factory-applied vinyl latex paint on woven, glass cloth scrim with an NRC of 0.95. The fire rating and UL should be determined by building type and code requirements.
- F. High Impact tile shall be made from wet-formed high density mineral fiber, impact and scratch resistant in a square-cut lay-in tile at 24 inches by 24 inches by 3/4 inch thick with an NRC of 0.50 minimum in accordance with ASTM C423. The surface of the tile includes a factory applied scrubbable white vinyl plastic paint.
- G. LEED Compliant tiles shall be wet-formed high density mineral fiber, square-cut and 24 inches x 24 inches x 3/4 inch thick with an NRC of 0.70 minimum in accordance with ASTM E1264. The fire rating and UL should be determined by building type and code requirements. The tile recycled content shall be a minimum of 50 percent.
- H. Accessories:
  - 1. Shadow molding shall be at all locations (whether detailed or not) where an acoustical lay-in ceiling abuts a gypsum board ceiling in the same plane, provide a "W" shaped reveal or "shadow" molding.
  - 2. *Fire Resistance Rating* to provide required ceiling assembly rating as scheduled. Located at fixtures being reinstalled in new fire rated ceiling assemblies.

- 2.3 At completion of work, require not less than three unopened cartons of acoustical ceiling materials and one unopened box of suspension system material.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- A. Install acoustical ceiling systems to comply with manufacturer's instructions and CISCA "Ceiling Systems Handbook" and ASTM C636.
  - B. Typically install system so that panels are centered in the space in both directions to limit small cut pieces to minimum of three inches on any side, or so that light fixtures are centered in areas
  - C. Suspend main beams from structure (but not bridging) above by means of 12 gauge galvanized wire, spaced at 4 feet-0 inches on center, both directions, wrapped tightly at least three full turns. Powder actuated devices in metal deck are not permitted. Join cross tees to main beam with a positive interlock. Pop rivets will not be permitted for field splices.
  - D. Align beams or tees with angle molding at corners.
  - E. At perimeter areas, secure angle molding to vertical surfaces, ends of tees to rest on bottom flange of molding. Attachment of cross tees to wall angles with pop rivets will not be permitted. Hanger wire at 45 degree approximately ten inches long may be used to tie the grid to the wall above the ceiling to prevent eventual disengagement of the two components.
  - F. Refer to UL Assemblies Drawings for Fire Rating requirements of ceiling materials at rated floor and roof assemblies.

### END OF SECTION



BUILDING EXCELLENCE

SECTION 09 62 33

WEIGHT ROOM FLOORING

GENERAL

- 1.1 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.2 Require a warranty for the work specified for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship. Defects shall include, but not be limited to:
  - a. Delamination from substrate.
  - b. Deterioration or fading.

PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.

2.2 MATERIALS

- A. Prefabricated homogeneous rubber tile flooring shall be composed of 100 percent synthetic rubber (styrene butadiene), mineral aggregates, organic stabilizing agents and fade resistant pigmentation. The material shall be 1/8 inch thick by 39-3/8 inch square tile with slate finish, with color to be selected by Architect from manufactures full line of colors.
- B. Physical properties of the flooring shall conform to the following minimum standards:

<u>Physical Properties</u>	<u>Standard</u>	<u>Specification</u>
Hardness Shore A	ASTM D2240	92
Smoke Density	ASTM E662	< 450, Class 1
Static Load Limit	ASTM F970	0.00 inches
Fungal Resistance Test	ASTM G21-90	No Growth
Coefficient of Friction	ASTM D2047	Dry 0.66, Wet 0.69

- C. Adhesive: As instructed by flooring manufacturer for adhering rubber tile flooring material.
- D. Patching Compound: Type supplied, approved, or recommended by flooring manufacturer to suit application.
- E. Reducer Strips: Type and size recommended by flooring manufacturer at edges of juncture with adjacent floor surfaces.
- F. Resilient Base: Furnished under Section 09 65 19.

EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Surface Conditions
    1. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
    2. Ensure that substrates are dry and exhibit neutral alkalinity. Conduct moisture test in accordance with ASTM F1869 - maximum allowable amount of moisture



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emission from floor shall not exceed maximum allowable moisture content as allowed by flooring manufacturer.

B. Preparation:

1. Subfloors:

- a. Ensure proper vapor barrier is installed under concrete slab.
- b. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with patching compound.
- c. Clean floor and apply and float filler to leave smooth, flat, hard surface. Prohibit traffic until filler is cured.
- d. Verify that substrate is smooth, level, at required finish elevation.
- e. Prior to laying materials, broom clean or vacuum the surfaces to be covered, and inspect the subfloors.
- f. Subfloor shall be prepared in accordance with flooring manufacturer's recommendations.

C. Installation

1. Rubber sport surface to be unrolled, precisely fitted and working cut, and left in final position, prior to adherence, a suitable time to permit stress relief. Remove adjacent to final position immediately prior to application of adhesive.
2. Mix two part polyurethane adhesive in accordance with formulator's instructions. Use 1/8 inch notched trowel to spread adhesive over application area.
3. Install rubber sport surface onto freshly applied adhesive.
4. Roll installed sheet goods with suitable weight steel roller prior to set of adhesive to remove entrapped air. Use care to avoid displacement of unconfined sheet goods. Clean joints and surfaces of sheet goods where adhesive is extruded by rolling. Use wood alcohol or other solvent, each as approved by the prefabricated sport surface manufacturer.
5. Hold all seams in place with sandbags or suitable weight a minimum of 12 hours after installation of sheet goods.
6. Paint all lines, if any, in accordance with manufacturer's recommendations.

### END OF SECTION



**SECTION 09 64 00**

**WOOD GYMNASIUM FLOORING**

**GENERAL**

- 1.1 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.2 Require a warranty for the work specified for three years signed by Manufacturer, Installer, and Contractor, agreeing to repair or replace wood flooring that shrinks, warps, cracks, or otherwise deteriorates excessively, or which breaks its anchorage or bond with substrate or otherwise fails to perform as required, due to failures of materials or workmanship not due to unusual exposure to moisture or other abusive forces or elements not anticipated for application.

**PRODUCTS**

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.
  - A. Wood Flooring: High School- Aacer Flooring LLC, ("AacerFlex" with BioPower resilient pads). (Basis of Specification)
  - B. Wood Flooring: Middle School/High School- Aacer Flooring LLC, ("AacerCush II" with AacerCush resilient pads).(Basis of Specification)
- 2.2 WOOD FLOORING MATERIALS
  - A. Strip and plank flooring shall be kiln-dried, No. 2 common plain sawn 3/4 inch red oak with a face width of 2-1/4 inches. The tongue and groove floor should be end matched and come in random-length strips and shall be channeled (kerfed) for stress relief. The oak shall be unfinished to receive specified finish in field.
  - B. The urethane finish system is water-based and is recommended by the flooring and finish manufacturer to achieve color and finish specified. The stain should be penetrating and nonfading, pliable and formulated for multicoat application on wood flooring.
  - C. Wood Filler is formulated to fill and repair seams, defects, and open-grain hardwood floors, compatible with finish system components and recommended by filler and finish manufacturer to suit application. Provide pigmented filler to match.
  - D. Wood Screeds should be made from 2 x preservative treated wood. Preservative treatment shall be product suitable for interior installation and which after treatment can be dried to a moisture content of 12 percent or less, if saturation with water is involved.
  - E. Plywood subfloor is made from 3/4 inch preservative treated APA rated plywood sheathing.
  - F. The vapor barrier is made from a 6 mil polyethylene, to cover entire concrete floor under wood flooring, extending up wall at perimeter. Seams lapped and sealed with tape.
  - G. The felt underlayment shall comply with ASTM D226, Type I, No. 15, asphalt-saturated felt.
  - H. Tape shall be 2 inch wide duct tape or type recommended by tape manufacturer for sealing vapor retarder and felt underlayment laps, seams and edges.
  - I. Mastic is recommended as a wood flooring adhesive by flooring and adhesive manufacturers to suit application.
  - J. Fasteners for wood screeds, plywood subfloor, and flooring shall be machine-driven of type, size and finish recommended by flooring manufacturer, but not less than those in NOFMA.
  - K. Wood Trim (If shown or required) shall be 2 inches wide, tapered on one side, and in thickness matching flooring.
  - L. Cleaning Solvent shall be a degreaser of type recommended by solvent and flooring manufacturer to suit application.



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- 2.3 Require at completion of work not less than two percent of the quantity of each wood flooring material installed.

**EXECUTION**

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- A. Installer must have a minimum of five years experience in installation of type of wood flooring specified. Flooring contractor shall be a member in good standing of the Maple Flooring Manufacturers Association (MFMA).
  - B. Verify moisture content of all materials prior to installation and finishing. At time of delivery, limit average moisture content of all wood framing members and subflooring should be below 12 percent-14 percent before delivery of the flooring. In general, wood or plywood subfloors should not exceed 14 percent moisture content, or 4 percent moisture content difference between wood flooring and subfloor. In regions with constant high humidity moisture content shall not exceed ten percent.
  - C. Do not proceed with installation of wood flooring until spaces have been enclosed and are at approximate humidity condition planned for occupancy. Condition wood for five days prior to start of installation by placing in spaces to receive flooring and maintaining ambient temperature between; 60 degrees F and 75 degrees F and 35 to 55 percent relative humidity for 14 days before, during, and after installation.
  - D. Inspect concrete slab for proper tolerance and dryness, and report discrepancies.
  - E. Provide smooth troweled and level concrete subfloor to a tolerance of 1/8 inch in a 10 feet-0 inch radius. Provide concrete subfloor in acceptable condition by grinding down high areas and filling low areas with approved leveling compound.
  - F. Install sleepers end-to-end at right angles to the direction of finish flooring with end joints staggered. Space sleepers and provide expansion voids at the perimeter and at all vertical obstructions in accordance with manufacturer's instructions.
  - G. Install one layer of specified vapor retarder over concrete subfloor with edges overlapped and taped with specified tape in accordance with flooring manufacturer's instructions.
  - H. Attach plywood to the sleepers at 45 degree or 90 degree angles to direction of finish flooring, 1/4 inch spacing all edges and breaking joints at four feet. Provide expansion voids at the perimeter and at all vertical obstructions and attach in to subfloor accordance with flooring manufacturer's instructions.
  - I. Cover plywood subfloor with felt, lapping edges and sealing laps with tape in accordance with flooring manufacturer's instructions.
  - J. Install finish flooring in accordance with NOFMA and manufacturer's instructions. Machine blind nail finish flooring at right angles to sleepers and through subfloor at each sleeper crossing. End joints must be properly driven up and proper spacing provided for the humidity conditions of the area as recommended by the installer. Provide expansion voids at the perimeter and at all vertical obstructions as recommended by flooring manufacturer.
  - K. Machine-sand to remove offsets, ridges, cups, and sanding-machine marks that would be noticeable after finishing.
  - L. Apply finish in number of coats recommended by finish manufacturer for application intended, but not less than three finish coats.

**END OF SECTION**





## SECTION 09 65 16

### RESILIENT SHEET FLOORING AND BASE

#### GENERAL

- 1.1 The architect should include in this section: resilient vinyl sheet flooring and adhesive attached with accessories and resilient base and attached adhesive.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 Require a warranty for the work specified herein for five years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
  - A. Defects shall include delamination from substrate and deterioration or fading.

#### PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.
- 2.2 MATERIALS - ALL MATERIALS SHALL BE ASBESTOS FREE
  - A. Vinyl Sheets, complying with ASTM F1303 come in 6 foot rolls and have a thickness of 0.08 inches. Pattern and color to be selected from manufacturers full line of colors. Dark colors in limited areas for accent only.
  - B. Rubber Base, complying with ASTM F1861, shall be made of vulcanized Type TS, Group 1 Style A & B rubber. Vinyl base and type TP are not acceptable. The topset cove base should be 4 inches and come in 48" lengths, 0.125 inches thick.
  - C. The latex floor leveling material, as required, shall be a self-leveling underlayment concrete or SDF (feather finish) self-drying. No substitutions.
  - D. Joining and edge finish moldings are used for flooring terminations with other flooring. The rubber or vinyl moldings are tapered or bullnosed as required per the type of flooring and one inch wide by 1/8 inch thick.
  - E. Flooring adhesive should be clear set and should be the same brand as flooring or as instructed by manufacturer.
  - F. Base adhesive should be the same brand as base or as instructed by base manufacturer.
- 2.3 At the completion of the project require four percent or one unopened carton of each color and pattern of flooring and base selected, whichever is greater. One gallon container of each type adhesive used for flooring and base.

#### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Prepare concrete floors to receive flooring in accordance with ASTM F710.
  - B. Verify substrates are smooth, level, at required finish elevation, and without more than 1/8 inch in 10 feet-0 inch variation from level or slopes shown on the drawings.
  - C. Level substrates by grinding high spots or filling low spots with latex cementitious subfloor filler as required. Verify substrates are smooth, level, at required finish elevation, and are ready to receive resilient tile flooring and base



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- D. Conduct moisture test in accordance with ASTM F1869 - maximum allowable amount of moisture emission from floor is 3.0 pounds per 1,000 square feet in 24 hour period, and shall not exceed maximum allowable moisture content as allowed by flooring manufacturer.
- E. Install materials after finishing operations, including painting, have been completed and after permanent heating and cooling system is operating. Verify that moisture content of concrete slabs, building air temperature, and relative humidity are within the limits recommended by the manufacturers of the materials used.
- F. Installing Resilient Flooring:
  - 1. Butt units tightly to vertical surfaces, nosings, edgings, and thresholds.
  - 2. Scribe as necessary around obstructions and to produce neat joints.
  - 3. Place rolls tightly laid, even, and in straight parallel lines.
  - 4. Extend units into toe spaces, door reveals, and in closets.
  - 5. Lay units from center marks established with principal walls, discounting minor offsets, so that units at opposite edges of the room are of equal width.
    - a. Adjust as necessary to avoid use of cut widths less than 3 inches wide at edge of space.
    - b. Lay units square to axes of the room or space.
  - 6. Match units for color and pattern by using materials from cartons in the same sequence as manufactured and packaged.
  - 7. Place joining and edge finish mouldings, including reducer strips tightly butted to units and secured with adhesive, providing at all unprotected edges unless otherwise shown.
- G. Installing Base:
  - 1. Use factory-preformed exterior corners, and factory preformed or job-mitered interior corners.
- H. Remove excess adhesive and other blemishes from exposed surfaces, using neutral cleaner recommended by the manufacturer of the resilient materials.

**END OF SECTION**



## SECTION 09 65 19

### RESILIENT TILE FLOORING AND BASE

#### GENERAL

- 1.1 In this section architects should include: resilient (vinyl composition (VCT)) tile flooring adhesive attached with accessories, resilient (rubber) base attached adhesive, and resilient (rubber) stair stringer skirting.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.

#### PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.
- 2.2 MATERIALS - ALL MATERIALS MUST BE ASBESTOS FREE
  - A. Vinyl Composition Tile (VCT), complying with ASTM F1066, may be 12 inches by 12 inches, or approved size by HISD Program Manager, by 1/8 inch thick with patterns and colors selected from manufacturers standards. The static load limit is 150 PSI (ASTM F970).
  - B. Rubber Base, complying with ASTM F1861, shall be made of vulcanized Type TS, Group 1 Style A & B rubber. Vinyl base and type TP are not acceptable. The topset cove base should be 4 inches and 0.125 inches thick.
  - C. Stair Stringer Skirting shall comply with ASTM F2169 Type TS and be made of 10 or 12 inch rubber in 72 inch lengths and 0.08 inches thick.
  - D. Stair Treads and Risers are made of 0.20 thick compression molded, high grade rubber with color throughout, with raised radial pattern on tread with integral riser, ASTM F2169 Type TS. ***Stairs shall require embedded or mechanically fastened metal nosings that work with specified flooring in lieu of surface applied resilient nosings.***
  - E. Joining and edge finish moldings are used for flooring terminations with other flooring. The rubber or vinyl moldings are tapered or bullnosed as required per the type of flooring and one inch wide by 1/8 inch thick.
  - F. Flooring adhesive should be clear set and should be the same brand as flooring or as instructed by manufacturer.
  - G. Base adhesive should be the same brand as base or as instructed by base manufacturer.
- 2.3 At the completion of the project require four percent or one unopened carton of each color and pattern of tile, base and stair stringer skirting, stair treads/risers material selected whichever is greater. One gallon container of each type adhesive used for flooring, base, and stringer skirting.

#### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Prepare concrete floors to receive flooring in accordance with ASTM F710.
  - B. Verify substrates are smooth, level, at required finish elevation, and without more than 1/8 inch in 10 feet-0 inch variation from level or slopes shown on the drawings.



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- C. Level substrates by grinding high spots or filling low spots with latex cementitious subfloor filler as required. Verify substrates are smooth, level, at required finish elevation, and are ready to receive resilient tile flooring and base.
- D. Conduct moisture test in accordance with ASTM F1869 - maximum allowable amount of moisture emission from floor is 3.0 pounds per 1,000 square feet in 24 hour period, and shall not exceed maximum allowable moisture content as allowed by flooring manufacturer.
- E. Install materials only after finishing operations, including painting, have been completed and after permanent heating and cooling system is operating. Verify that moisture content of concrete slabs, building air temperature, and relative humidity are within the limits recommended by the manufacturers of the materials used.
- F. Installing Resilient Tiles:
  - 1. Butt units tightly to vertical surfaces, nosings, edgings, and thresholds.
  - 2. Scribe as necessary around obstructions and to produce neat joints.
  - 3. Place tiles tightly laid, even, and in straight parallel lines.
  - 4. Extend units into toe spaces, door reveals, and in closets and similar spaces.
  - 5. Lay units from center marks established with principal walls, discounting minor offsets, so that units at opposite edges of the room are of equal width.
    - a. Adjust as necessary to avoid use of cut widths less than 3 inches wide at edge of space.
    - b. Lay units square to axes of the room or space.
  - 6. Match units for color and pattern by using materials from cartons in the same sequence as manufactured and packaged.
  - 7. Lay in alternating pattern with grain in all units running 90 degrees from adjacent unit.
  - 8. Place joining and edge finish mouldings, including reducer strips tightly butted to units and secured with adhesive, providing at all unprotected edges unless otherwise shown.
- G. Installing Base:
  - 1. Use factory-preformed exterior corners, and factory preformed or job-mitered interior corners.
- H. Installing Stair Stringer Skirting Material:
  - 1. Cut to fit and match tread and riser profile and to meet height of base material at stair landings.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 09 65 66

#### RESILIENT ATHLETIC FLOORING

##### GENERAL

- 1.1 Architects to include in this section heat welded, multipurpose gymnasium sport flooring.
- 1.2 Require a warranty for the work specified herein for 15 years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.
  - A. Defects shall include shrinking, cracking, or otherwise deteriorating excessively, becoming loose from substrate, and failure due to unusual exposure to moisture or other abusive forces or elements.

##### PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.
  - A. Specifications are based on:
    1. Athletic Resilient- Robbins Sport Surfaces "Pulastic 2000" polyurethane surfacing over polyurethane/rubber granulate base in total thickness of 7/16."
    2. Athletic Rubber- Tuflex Rubber Products "Spartus" 3/8" thick recycled rubber tiles using 100% recycled elastomeres.

##### 2.2 MATERIALS

- A. Leveling Compound should be approved by manufacturer to correct minor subfloor deviations.
- B. The flooring contains a homogenous vinyl wear-layer combined with a closed-cell foam cushioned backing, reinforced with a fiber glass mesh interlayer. Total thickness: 7mm, minimum.
  1. The physical properties include:
    - a. Coefficient of Friction: 0.4 - 0.48, DIN 18032-2
    - b. Ball Bounce: greater than 90 percent, DIN 18032-2
    - c. Area Deflection: 0 percent. DIN 18032-2
    - d. Fire Rating: Class I, ASTM E648
    - e. Resistance to Rolling Load: 1000N minimum, DIN 18032-2
    - f. Shock Absorption: 33 percent minimum, DIN 18032-2
- C. Require an antifungal and antibacterial treatment throughout the thickness of the surface as well as a factory applied photo reticulated, UV cured polyurethane, anti-dirt treatment. The color should be selected from the manufacturers full line of available colors, including wood grain and solid colors.

##### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Installation temperature shall be at least 65 degrees F or maximum of 86 degrees F and the moisture content of the slab three (3) pounds per 1,000 square feet per 24 hours or lower, according to RMA testing method and in accordance with ASTM F1869.
  - B. All gymnasium sport flooring products shall be ISO 9001 certified. Installation of gymnasium sport flooring products shall be performed by a qualified flooring contractor approved by the gymnasium sport flooring manufacturer.
  - C. Flooring shall be DIN Certified according to DIN 18032-2.



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- D. Environmental Requirements: The building shall be dry and enclosed. Permanent heat, light and ventilation shall be installed and operable. Flooring installation shall not begin until the installer is familiar with existing subfloor conditions. All work which would cause damage, dirt, dust or interruption of normal installation pace shall be completed at least one (1) week prior to and during installation the room temperature must be maintained at a minimum of 65 degrees F. The installation area shall be closed to all traffic and activity for a period to be set by the flooring contractor.
- E. Verify that the concrete subfloor, on or below grade, is adequately vaporproofed beneath the slab and along the perimeter with suitable, approved vaporproofing system. The vapor barrier must be placed in contact with the concrete slab and installed in strict accordance with the vapor barrier manufacturer's instructions. Verify that adequate perimeter drainage is provided.
- F. Before beginning installation, verify that the subfloor is properly cured, clean and dry, usually 60 days or more are necessary depending on water content and atmospheric conditions.
- G. Verify with the contractor, and by visual inspection that no curing compounds or sealers have been applied to the concrete without prior approval of the sports flooring manufacturer.
- H. Verify that there are no variations in the concrete slab that exceed plus or minus 1/8 inch in a ten (10) feet radius.
- I. Fill cracks, grooves, voids and/or construction joints with leveling compound as approved by sports flooring manufacturer. High spots on the floor shall be removed by grinding.
- J. Use adhesives approved by the sports flooring manufacturer.
- K. Install sports flooring and seaming of joints (heat welding method) in accordance with written instructions provided by the manufacturer.
- L. Game Lines: apply using compounded polyurethane paint as instructed by the sports flooring manufacturer. Colors to be selected from the sports flooring manufacturer's full line of available colors.

**END OF SECTION**



SECTION 09 66 13

PORTLAND CEMENT TERRAZZO

GENERAL

- 1.1 The architect should include in this section: terrazzo floor and base, divider strips and perimeter edging and curing, grinding, and sealing.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 Require a mockup of ten square feet of terrazzo flooring and three lineal feet of base, curb, and border, as applicable. When accepted, mockup will demonstrate minimum standard for the Work. Mockup may remain as part of the Work.

PRODUCTS

2.1 MATERIALS

- A. Portland Cement, complying with ASTM C150, shall be Type 1 normal; white color for topping mix; grey color for underbed; modified to NTMA higher compressive strength requirements; cement for topping mix and obtained from single source. The color topping pigments shall be non-fading. The sand shall comply with ASTM C33 and be sharp, coarse, clean, screened, and free of deleterious material. Potable water should be used with the cement.
- B. The surface aggregate should be crushed marble, No. 0 - 1 size in accordance with NTMA chip size for standard gradation and uniform coloration.
- C. When required, non-slip aggregate of aluminum oxide of size and color to match surface aggregate chips should be used.

2.2 ACCESSORIES

- A. Reinforcing Mesh should comply with ASTM A185 and shall be 2 x 2 inch x 16 gauge, galvanized.
- B. Divider strips are 1/8 inch wide heavy top zinc, full depth of terrazzo, with anchoring features.
- C. Control Joint Strips are 1/4 inch nominal width zinc strip, 1/8 inch wide neoprene filler strip between vertical strips, with anchoring features to suit terrazzo thickness.
- D. Match divider strips with projecting base of 1/2 inch.
- E. Foam Filler shall be closed cell urethane foam, capable of compression to 50 percent of its thickness with full recovery as recommended by manufacturer.
- F. Isolation membrane, complying with ASTM D2103, shall be a six mil polyethylene sheet or type recommended by manufacturer.
- G. Use Brass non-slip inserts, 3/8 x 3/8 inches x 20 gauge dove-tail shaped channels, with anchors; filled with aluminum oxide as non-slip filler.
- H. Curing Compound: ASTM C309.
- I. The Cleaner should be a neutralizing liquid type as recommended by manufacturer.
- J. The Sealer should be a colorless, penetrating liquid type to completely seal cementitious matrix surface; not detrimental to terrazzo components, and recommended by the manufacturer.
- K. Wax should be a colorless liquid or paste type as recommended by manufacturer.
- L. Subfloor filler shall be latex as recommended by manufacturer.

2.3 MIXES

- A. The Underbed is made up of one part Portland cement to four parts sand by volume. Add water to produce low slump mix.





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- B. The Floor and Base are made up of white Portland cement, aggregate, exposed divider and accessory strips.

2.4 This section describes HISD's standards for the use of sand cushioned terrazzo. Other installations such as bonded and monolithic may be presented to the HISD project team for approval.

### EXECUTION

3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.

- A. Installer's Qualifications: A company having skilled mechanics with not fewer than three years of satisfactory experience in installation of portland cement terrazzo flooring.
  - 1. Furnish a list of similar flooring projects installed within the previous three years. Include project name, area of terrazzo flooring actually installed, and contact information.
  - 2. Furnish resumes of key project personnel, detailing relevant experience.
- B. Do not install wet mixed terrazzo when temperature is below 50 degrees F or above 90 degrees F. Maintain temperature range, 24 hours before, during, and 72 hours after installation of terrazzo.
- C. Do not begin terrazzo work until concrete substrate has cured 28 days, minimum.
- D. Place sand cover over structural floor substrate to a nominal thickness of 1/2 inch, compact and roll smooth.
- E. Place isolation membrane over sand bed surface, lap edges and ends 6 inches. Extend isolation membrane up perimeter vertical surfaces to height of base. Secure in place.
- F. Place cementitious underbed over isolation membrane to nominal thickness of 1-3/4 inches. Broom finish top surface.
- G. Place reinforcement into lower third of underbed. Discontinue reinforcement at control joint and joint separations of underbed. Lap reinforcement joints 6 inches minimum.
- H. Saw cut underbed to install divider and control joint strips. Place strips into semi-plastic uncured underbed.
- I. Locate control joints to frequency required by 400 sq. ft. maximum underbed panel size, and more frequent where structural sub-floor deflects easily.
- J. Place divider and control joints to locations indicated. Install straight and level.
- K. Slope strips to achieve floor surface slope to drains.
- L. Install non-slip inserts where shown or required.
- M. Install recess frames where shown or required.
- N. Install base, border, and curb divider and control strips, as applicable, to match floor pattern. Install terminating cap strip to top of base; attach securely to wall substrate.
- O. Place terrazzo topping mix over prepared underbed to a nominal thickness of 5/8 inch.
- P. Apply non-slip aggregate at rate of 25 pounds per 100 sq. ft. to surfaces where shown or required.
- Q. Flush Vertical Base: 3/8 inch minimum topping on underbed bonded to wall substrate, with cove transition between horizontal and vertical surfaces. Total minimum thickness of 3/4 inch.
- R. Projecting Vertical Base: 3/8 inch minimum topping on underbed bonded to wall substrate, projecting 1/4 inch from finish wall surface, with cove transition between horizontal and vertical surfaces; shape base in accordance with drawings.
- S. Terrazzo Stairs and Landings: Minimum 5/8 inch topping on treads and minimum 3/8 inch topping on risers. Total minimum thickness of 1-1/2 inches for treads and one inch for risers.
- T. Terrazzo Treads and Landings in Metal Pans: 5/8 inch terrazzo topping on reinforced underbed. Total minimum thickness of two inches.
- U. Cure terrazzo topping by method in accordance with NTMA instructions.
- V. Barricade area to allow undisturbed curing.



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- W. Brush apply terrazzo topping mix slurry to topping surface.
- X. Finish terrazzo to NTMA instructions.
- Y. Produce terrazzo finish surface to match approved mockup or sample, with 70 percent chips exposed.
- Z. Grind terrazzo surface with power disc machine; sequence with coarse to fine grit abrasive, using a wet method.
- AA. Apply grout mix to match matrix over ground surfaces to fill honeycomb exposed during grinding.
- BB. After grout has sufficiently cured, grind, using a fine grit abrasive.
- CC. Hand grind base, cove, and curb, as applicable, similarly.
- DD. Maximum Variation from Flat Surface: 1/8 inch in 10 feet.
- EE. Maximum Variation from Level (Except Surfaces Sloping to Drain): 1/8 inch.
- FF. Scrub and clean terrazzo surfaces with cleaner in accordance with NTMA instructions. Let dry.
- GG. Immediately when dry, apply sealer in accordance with NTMA and manufacturer's instructions.
- HH. Wax and polish surfaces in accordance with NTMA and manufacturer's instructions.

**END OF SECTION**



**SECTION 09 67 23**

**RESINOUS FLOORING- HISD Master**

**GENERAL**

- 1.1 The architects should include in this section: preparation of concrete surfaces, epoxy resin composition flooring and integral base and expansion control.
- 1.2 Require a warranty for the work specified for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
  - A. Any and all product failures associated with issues arising from an existing slab need to be covered under the one year warranty above.

**PRODUCTS**

- 2.1 The resinous flooring is a troweled, seamless, anti-microbial flooring system consisting of a primer and 3/16 inch thick epoxy resin base incorporating suitable chemical resistant aggregates with integral coved base.
- 2.2 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines be considered.
  - A. Specifications are based on epoxy resin flooring Dex-O-Tex Cheminert "K", manufactured by Crossfield Products Corp., Rancho Dominguez, CA.

**2.3 MATERIALS**

- A. Epoxy resin flooring shall have a primer with bond coat solids by volume at 95%, a pot life @ 77 deg of 60 min and a viscosity @ 77 deg of 500 cps (mixed). The body shall be made of conforming epoxy resin with a slip resistant top coat as recommended by the manufacturer. A decorative medium quarts may be added as a slip resistance measure.
- B. A waterproofing membrane, where specified, should be recommended or produced by the epoxy resin manufacturer. An anti-microbial chemical additive may also be included to prevent bacteria growth.
- C. Expansion Joints are recommended by manufacturer to suit application.
- D. Sealants are a two component, polysulfide, 100 percent solids, elastomeric product that has a minimum polymer content of 35 percent and elongation of minimum 500 percent as instructed by epoxy flooring manufacturer.

**2.4 PROPERTIES**

- A. Require the flooring system meet or exceed the minimum physical property requirements when tested according to the referenced standard test method. The floor's 9,200 psi compressive strength shall comply with ASTM C579, while the tensile strength, ASTM D-638, shall be 1650 psi with a modulus of elasticity of 4,000psi per ASTM D-790.
- B. The impact resistance should not be more than 0.024 inches due to the 85-90 Durometer "D" surface hardness and should have an abrasion resistance of 0.0 gr (ASTM D1044).
- C. Water Absorption should be a maximum of 0.3 percent (MIL D-3134).
- D. Adhesion should be 400 psi (A.C.I. Comm. No. 503.1) (100% failure in concrete).

**EXECUTION**

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.



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- A. Engage a certified installer or applicator who has specialized in installing resinous flooring and who is acceptable to manufacturer of primary materials.
- B. Obtain epoxy resin composition flooring materials, including primers, resins, hardening agents, and finish or sealing coats, from a single manufacturer.
- C. Permanent lighting will be in place and working before installing resinous flooring.
- D. Concrete should be either water cured or cured using sodium silicate curing compounds only. Other types of curing compounds are generally not acceptable. Concrete should be cured for a minimum of 28 days.
- E. Concrete subfloors on or below grade shall be adequately waterproofed beneath and at the perimeter of the slab and on the earth side of below grade walls. Sand-poly-sand slab construction is not an acceptable construction. Provide under slab vapor retarder membrane per section 03 30 00 – Cast-in-place Concrete.
- F. Conduct moisture test - maximum allowable amount of moisture emission from floor is 3.0 pounds per 1,000 sq. ft. in 24 hour period.
- G. Shot-blast, acid etch or power scarify as required as instructed by epoxy resin flooring manufacturer to obtain optimum bond of flooring to concrete. Remove sufficient material to provide a sound surface free of laitance, glaze, efflorescence, and any bond-inhibiting curing compounds or form release agents. Remove grease, oil, and other penetrating contaminants. Repair damaged and deteriorated concrete to acceptable condition. Leave surface free of dust, dirt, laitance, and efflorescence.
- H. Apply primer over prepared substrate at rate as instructed by manufacturer, approximately 5-8 mils.
- I. Apply base coating approximately 20 mils thick, and then broadcast “beaching” with color quartz aggregate while coating is still wet. Apply aggregate to complete refusal. Aggregate must “free fall” onto the coating; do not throw down upon or across surface.
- J. Allow to cure and then vacuum off excess aggregate. After excess aggregate is removed, “stone” the surface lightly with a coarse stone or steel trowel to remove imperfections and vacuum again.
- K. Second Broadcast: Apply second coating approximately 20 mils thick.
- L. Apply seal coat of epoxy coating to produce finish matching approved sample, in spreading rates as instructed by manufacturer to attain the desired slip-resistant texture.
- M. Fill joints that are to receive expansion joints with temporary spacer strips or mask. Remove temporary spacer strips after the resin flooring is applied and seal with compatible sealant as instructed by manufacturer.
- N. Mix resin hardener and aggregate when required, and prepare materials according to flooring system manufacturer's instructions.
- O. Over waterproof membrane, trowel apply epoxy mortar mix at nominal 3/16 inch thickness; hand or power trowel. When cured, sand or grind if necessary to remove trowel marks and roughness.
- P. After body coat has cured sufficiently, apply grout and finish coats of type recommended by flooring manufacturer to produce finish matching approved sample and in number of coats and spreading rates recommended by manufacturer.
  - 1. Finished floor shall be 1/4 inch thick maximum, uniform in color and free of trowel marks.
- Q. Apply cove base mix to wall surfaces at locations shown to form cove base height of 4 inches unless otherwise indicated. Follow manufacturer's printed instructions and details including taping, mixing, priming, troweling, sanding, and top-coating of cove base. Cove base should be applied prior to the application of the base coat and top coat.
- R. Fill joints that are to receive expansion joints with temporary spacer strips or mask. Remove temporary spacer strips after the resin flooring is applied and seal with compatible sealant as instructed by manufacturer.
- S. Cure epoxy resin composition flooring materials according to manufacturer's directions, taking care to prevent contamination during application stages and before completing curing process. Close application area for a minimum of 24 hours.

**END OF SECTION**



## SECTION 09 68 00

### CARPET

#### GENERAL

- 1.1 The architect should include in this section: carpet, carpet accessories, adhesive, and resilient base at carpeted areas.
- 1.2 REQUIRED WARRANTY
  - A. Require warranty for the carpeting for 25 years non-prorated against defects including dimensional stability including curling, edge ravel, delamination of backing, wear in excess of 10 percent by weight and zippering.
  - B. The warranty shall state that the static electricity shall not exceed 3.5 KV at 70 degrees F at 20 percent RH for 25 years non-prorated.

#### PRODUCTS

- 2.1 MATERIALS
  - A. Provide carpet free of any irregularities in weave or materials, and each color of one dye lot. Moth and vermin-proof and pre-shrink carpet.
  - B. Basis of Specification: Tandus Applause III with ER3 Modular or PowerBond ER3 Cushion RS Backing
  - C. Carpet tile shall be a symtex 24"x24" tile with 12 pile units per inch. The Dynex SD/Nylon should be 50% solution/50% yarn dyed with an ensure soil/stain protection.
    1. The primary backing system should be made from 50.2% Pre-Consumer and 40.2% Post-Consumer recycled content. The secondary backing should be 100% Recycled Content with a Tru Bloc barrier system. The total weight should be 134.9 oz per square yard.
  - D. Cementitious latex floor leveling material may be recommended to suit application in addition to the recommended adhesive.
- 2.2 At the completion of the carpet installation require the carpet subcontractor to provide an additional three percent of total yards installed of each carpet specified to the Owner for future carpet replacement that may be required. This extra stock is to be unused rolls, tiles, and mats and does not include scraps.

#### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. By General Contractor:
    1. Verify substrates are smooth, level, at required finish elevation, and without more than 1/8 inch in 10 feet-0 inch variation from level.
    2. Level substrates by grinding high spots or filling low spots with a portland based latex floor leveling material as required.
    3. Fill cracks and holes with latex emulsion filler compatible with carpet adhesive.
  - B. By Flooring Contractor:
    1. Verify substrates are smooth, level, at required finish elevation, and are ready to receive carpet and base.
    2. Conduct moisture test - maximum allowable amount of moisture emission from floor is 3.0 pounds per 1,000 sq. ft. in 24 hour period.
  - C. General:
    1. Installer must be a certified installer with a minimum of five years experience installing products.



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2. Prime subfloor prior to Power Bond RS installation.
  3. Adhere directly to subfloor using no pad and no foam. Roll carpet with a roller to insure maximum contact at the pressure recommended by the manufacturer.
  4. Scribe carpet accurately to all vertical surfaces.
  5. Align lines of carpet as tufted, using no fill strips less than six inches (15 cm) in width, laying all carpet in same direction unless specifically directed.
- D. Seams:
1. Fabricate seams by the double cut method, overlapping material two to three inches and properly seal. Do not stretch seams.
  2. Roll out air bubbles toward seam using 100 pound roller.
  3. Carefully apply a bead seam sealer to the cut edge at proper height to seal edges. Do not use floor adhesive to bead cut edge. Use seam sealer.
- E. Spillage of adhesive on the face of the carpet shall be removed immediately with a clean-up solvent recommended by the manufacturer.
- F. Close areas to traffic for at least 12 hours after installation.
- G. Provide traffic areas with Kraft paper or "Visqueen" to protect against damage and soiling.
- H. The carpet installer shall be required to re-lay carpet that does not provide an attractive wrinkle-free appearance and shall correct conditions due to faulty installation which may appear for a period of one year from date of Substantial Completion at no expense to Owner.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 09 72 16

#### DRY ERASE WALL COVERING

##### GENERAL

- 1.1 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.2 Require a warranty for the work specified for one year.

##### PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.
- 2.2 MATERIALS
  - A. Primer and Adhesive. Use primer and adhesive that are specifically recommended by the manufacturer. Provide mildew resistant and non-staining materials.
  - B. Media Projection Marker Wall Covering: Smooth low gloss vinyl surface for projection and dry erase markers.
    1. ER60: 60-inch width, 17 ounces per square yard, non-woven backing.
      - a. Adhesives: Heavy-duty clear premixed vinyl adhesive or clay based adhesive.
      - b. Substrate Primer/Sealer: White pigmented acrylic base primer/sealer specifically formulated for use with vinyl wallcoverings.
      - c. Map Rail: MAP1: 2 inch Map Rail with tac•wall™ Insert.
      - d. Presentation Starter Kits: Provide one Walltalkers starter kit containing eight dry erase markers, two erasers, 10 cleaning towels, and one 8 ounce bottle liquid surface cleaning solution for each room installed with dry erase wallcovering.
        1. RSK1: Presentation starter kit for regular dry erase surfaces.
      - e. Approved Product/Manufacturer: Walltalkers Erase Rite Wallcoverings manufactured by RJF International Corporation.

##### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Coordinate:
    1. Do not begin until all walls are smooth and free of surface imperfections.
    2. Commencement of work will be an indication that the wall covering subcontractor accepts the scheduled walls as being free of imperfections.
    3. Apply one coat of primer in accordance with the printed instructions of manufacturer.
    4. Before beginning application of vinyl wall covering, confirm products for uniform color, texture and quality.
    5. Apply vinyl wall covering vertically in lot and roll number sequence.
    6. Use butt joints only (no overlapping).
    7. Trim vinyl wall covering to within 3/4 inch of top of scheduled base.
    8. Cleaning: At completion of job, clean all paste residue and matter from surfaces.
      - a. Assure that all joints have achieved continuous lamination.

#### END OF SECTION





## BUILDING EXCELLENCE

### SECTION 09 22 16

#### TACKABLE WALL COVERING

##### GENERAL

- 1.1 The architect should include in this section: Uni-color, linoleum resilient homogeneous tackable surface consisting of linseed oil, granulated cork, rosin binders and dry pigments calendared onto natural burlap backing. Color shall extend through thickness of material.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 Require a warranty for the work specified for five years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship. effects shall include, but not be limited to, the following:
  - a. Delamination.
  - b. Noticeable deterioration or discoloring

##### PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.
- 2.2 MATERIALS
  - A. Vinyl Wall Covering:
    1. Physical Properties:
      - a. Width: 48 inches
      - b. Gauge: 1/4 inch
      - c. Backing: Burlap
      - d. Facing: Linoleum, self-healing
      - e. Bacteria Resistance: Provide manufacturers standard anti-microbial additive.
  - B. Use solvent-free adhesive as specifically instructed by the wallcovering manufacturer.

##### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Do not begin until all walls are smooth and free of surface imperfections.
  - B. Commencement of work will be an indication that the wall covering subcontractor accepts the scheduled walls as being free of imperfections.
  - C. Apply adhesive in accordance with the printed instructions of manufacturer. Remove adhesive residue immediately.
  - D. Before beginning application of wall covering, confirm products for uniform color, texture and quality.
  - E. Apply wall covering from top to bottom, then side to side. Roll sheet firmly into adhesive to remove air bubbles.
  - F. Butt joints.
  - G. Trim vinyl wall covering to within 3/4 inch of top of scheduled base.
  - H. Cleaning: At completion of job, clean all paste residue and matter from surfaces with a neutral pH cleaning solution. Do not use abrasive cleaners.
    1. Assure that all joints have achieved continuous lamination.

#### END OF SECTION



BUILDING EXCELLENCE

SECTION 09 72 16

VINYL WALL COVERING

GENERAL

- 1.1 Wall covering must carry the maximum UL Fire Hazard classification when tested in accordance with ASTM E84. Wall covering must meet Federal Specification (FS) CCC-W-408A.

PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered the basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.
  - A. Specifications are based on "Desert Sand" pattern as manufactured by Koroseal Wallcoverings.

2.2 MATERIALS

- A. Vinyl Wall Covering:
  1. Physical Properties:
    - a. Federal Specifications (FS): CCC-W-408A, Type II, Teflon treated.
    - b. Width: 53/54 inches
    - c. Total Weight: 20 - 21 ounces per linear yard
    - d. Vinyl Weight: 11 - 12 ounces per square yard
    - e. Fabric Weight: 2.0 ounces per square yard.
    - f. Fabric Type: Osnaburg
    - g. Fire Resistance: Class A (ASTM E84)
    - h. Color(s): As selected by Architect from manufacturer's full range of colors.
    - i. Patterns: Allow for patterns and stripes as required by Architect. No additional cost will be allowed for digital design work or laser cutting.
- B. Primer and Adhesive. Use primer and adhesive that are specifically recommended by the manufacturer. Provide mildew resistant and non-staining materials.

EXECUTION

3.1 APPLICATION

- A. Do not begin until all walls are smooth and free of surface imperfections.
- B. Commencement of work will be an indication that the wall covering subcontractor accepts the scheduled walls as being free of imperfections.
- C. Apply one coat of primer in accordance with the printed instructions of manufacturer.
- D. Before beginning application of vinyl wall covering, confirm products for uniform color, texture and quality.
- E. Apply vinyl wall covering vertically in lot and roll number sequence.
- F. Use butt joints only (no overlapping).
- G. Trim vinyl wall covering to within 3/4 inch of top of scheduled base.

3.2 CLEANING

- A. At completion of job, clean all paste residue and matter from surfaces.
- B. Assure that all joints have achieved continuous lamination.

END OF SECTION



## SECTION 09 91 00

### PAINTING AND STAINING

#### GENERAL

- 1.1 Architects should include in this section: surface preparation and field application of paints and stains on interior/exterior substrates where shown or required.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 Require coordination of the work specified. Request information to preceding trades for proper preparation of substrate. Require substrate inspection before proceeding to verify proper preparation and ask for notification for any item to receive paint which may not be covered by a scheduled finish type.
- 1.4 Require an extra stock equaling ten percent or a minimum of one gallon, whichever is greater, of each color, type, and gloss of paint used in the work, tightly sealing each container and clearly labeling contents and location where used.
- 1.5 Require a warranty for the work specified for two years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
  - A. Defects may include discoloring noticeably by yellowing, streaking, blooming, changing color or darkening, mildewing, peeling, cracking, blistering, alligating or releasing from the substrate, chalking or dusting excessively, changing sheen in irregular fashion, softening or becoming tacky and bubbling. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to the Owner.

#### PRODUCTS

- 2.1 All paint materials selected for coating systems for each type of surface shall be the product of a single manufacturer and shall, as a system, have flame spread, fuel contribution, and smoke density test results less than 25.
  - A. Paint materials listed as the basis of specification herein, unless otherwise designated in the "Painting Schedule", are the products of The Sherwin-Williams Company, Cleveland, OH and require no further approval as to manufacturer or catalogue number.
- 2.2 MATERIALS
  - A. Paint and coatings should be ready mixed, except for field catalyzed coatings; having good flow and brushing properties and consistent drying or curing behavior, free of sags and streaks.
  - B. For architectural paints, coatings, and primers applied to interior walls and ceilings, do not exceed the VOC content limits established in Green Seal Standard GS-11. Flat paints should have 50 g/L and non-Flats 150 g/L.
    1. For anti-corrosive and anti-rust paints applied to interior ferrous metal substrates, do not exceed the VOC content limit of 250 g/L established in Green Seal Standard GC-03, Anti-Corrosive Paints.
    2. For clear wood finishes, floor coatings, stains, sealers, and shellacs applied to interior elements, do not exceed the VOC content limits established in South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings. Clear wood finish should be varnish 350 g/L or lacquer 550 g/L. Floor coatings should be 100 g/L and sealers should be 250 g/L for waterproofing and 275 g/L for sanding. Stains shall be 250 g/L.



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- C. Accessory materials include linseed oil, turpentine, and paint thinners as recommended by paint and coatings manufacturer as necessary to achieve finishes specified.
- D. Patching and surface prep are typically latex fillers as recommended by manufacturer.

## EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- A. Verify that shop applied primers are compatible with specified finish coats.
  - B. Measure moisture content of surfaces using an electronic moisture meter. Do not begin application of coatings unless moisture content of surfaces is below the maximum values: gypsum soffits (12 percent), plaster (12 percent), Masonry (12 percent), wood (15 percent), vertical concrete (12 percent) and horizontal concrete (8 percent).
  - C. Spray equipment shall be the type recommended for the application and shall be maintained clean and in proper working order and shall be operated by person(s) or entity specializing in application of paints and coatings of types specified with minimum five years experience.
  - D. Number of coats of each of several finishes shall be in accordance with detailed specifications, which will produce first quality finish if properly applied.
  - E. Temperature in the storage area shall be between 40 and 110 degrees F. Open and mix all materials in the storage area. Apply water-base paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 degrees F, unless otherwise permitted by paint manufacturer's printed instructions.
  - F. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 F, unless otherwise permitted by paint manufacturer's printed instructions.
  - G. Do not paint in snow, rain, fog or mist, or when relative humidity exceeds 85 percent, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.
  - H. Surface must be clean to insure adhesion. Remove oil and grease with paint thinner. Wash off dirt with warm soapy water and rinse with clean water. Remove rust by wire brushing or sanding. Wall surfaces must be dry before painting. Verify moisture.
  - I. Unfinished Surfaces
    - 1. Wood: Sand smooth and apply one coat of Primer Undercoat. After primer has dried overnight, putty nail holes and cracks, then spot-prime putty with primer. Again, allow the primer to dry over- night, sand lightly and topcoat.
    - 2. Masonry and Concrete: Remove efflorescence or cement dust on masonry and concrete by etching with a 10 percent solution of muriatic (Hydrochloric) acid. Flush off surface after etching with clean water, and paint while still damp. On surface where muriatic acid cannot be used to neutralize the efflorescence, remove the efflorescence by sanding, scraping or wire brushing and apply a coat of Masonry Conditioner before painting. If efflorescence is not present, no primer is necessary on concrete and masonry surfaces. Fill voids and pores in concrete and haydite blocks with Latex Block Filler and allow to dry overnight before topcoating.
    - 3. Iron and Steel should be primed with metal primer and allowed to dry overnight.
    - 4. Galvanized metal should be primed with galvanized metal primer and allow to dry overnight before topcoating.
  - J. Paint Thickness: Provide the following minimum dry film thickness per coat unless noted otherwise: enamels on metal: 1 mil, latex paints: 1 mil, metal primers: 1.5 mils, undercoats: 1.5 mils, oil paints: 1.5 mils, and epoxy coating: 2.0 mils  
Thickness test: Use observation gauge that measures "V" shape scratch.



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- K. Allow exterior paints to dry 72 hours between coats and interior paint to dry 24 hours between coats. Allow all enamels and varnishes to dry 24 hours between coats. If enamel and varnishes are tacky after 24 hours, allow additional time until finish is dry.
- L. Leveling: Apply with proper consistency and quality so paint flows out to a level surface free of brush and roller marks, bubbles, dust, runs, sags, and holidays. Spread evenly.
- M. First coat shall be white, unless otherwise specified.
- N. Keep project premises free of painting-related debris. Collect material that may constitute a fire hazard, place in closed metal containers, and remove daily from site.
- O. Exterior surfaces are divided into two (2) different categories, based upon color and level of graffiti resistance required. System 1 will be used when standard earthtone colors or neutral colors are specified, and System 2 will be used when bright colors (primary reds, yellows, and oranges) are specified and/or when a graffiti resistant coating is required.
  - 1. Galvanized Metal:
    - a. Surface Preparation: Acid etch galvanized surfaces that have not weathered at least six months prior to beginning painting operations.
    - b. Primer: One coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
    - c. Finish: Two coats Sher-Cryl HPA High Performance Acrylic (B66W300)
  - 2. Un-galvanized Metal:
    - a. Primer: One coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
    - b. Finish: Two coats Sher-Cryl HPA High Performance Acrylic (B66W300)
  - 3. Concrete and CMU:
    - a. Primer/Finish: Two coats Loxon XP Exterior Waterproofing System, 14-18 mils wet, 6.4 – 8.3 mils dry per coat
  - 4. Wood (Includes plywood siding and wooden trim):
    - a. Primer: One coat A-100 Latex Wood Primer (B42W41)
    - b. Finish: Two coats A-100 Acrylic Gloss (A8 ser.)
  - 5. Fiber-Cement Materials:
    - a. Primer: One coat Loxon Masonry Primer (A24W300)
    - b. Finish: Two coats A-100 Acrylic Gloss (A8 Series)
  - 6. Parking Line and Driveway Paint: Setfast Waterborne Yellow (TM225) (meets Federal Specification (FS) TTP-1952-B)
  - 7. All piping in mechanical rooms shall be painted in their entirety, in colors: Gas lines (Orange), domestic cold water (White), domestic hot water (Pink), heating hot water (Red), condenser water (Green) and chilled water (Blue).
- P. Interior Surfaces:
  - 1. Galvanized Metal:
    - a. Primer: One coat Pro-Cryl Pro Industrial Universal Primer (B66W310)
    - b. Finish: Two coats Pro Industrial 0 VOC Acrylic Semi-Gloss
  - 2. Gypsum Wallboard:
    - a. Primer: One coat ProGreen 200 Latex Primer (B28W600)
    - b. Finish: Two (2) coats ProGreen 200 Latex Egg-Shell (B20W200 Series)
  - 3. Concrete and CMU: (Enamel)
    - a. Primer: One coat ProMar Block Filler (B25W25)
    - b. Finish: Two coats ProGreen 200 Latex Semi-Gloss (B31-600 Series)
  - 4. Wood: (Painted)
    - a. Primer: ProMar Classic Latex Primer (B28W8111)
    - b. Finish: ProClassic Waterborne Semi-Gloss (B31 Series)
  - 5. Wood: (Stained)
    - a. Stain: SherWood BAC Wiping Stain (S64 Series)
    - b. Finish (First Coat): Wood Classics Polyurethane Varnish (A67 Series)
    - c. Finish (Second Coat): Wood Classics Polyurethane Varnish (A67 Series)
  - 6. Gypsum Wallboard: (Epoxy) – Kitchens, bathrooms, laboratories, etc.
    - a. Primer: One coat Pro Green 200 Latex Primer (B28W600)
    - b. Finish: Two coats Water-Based Catalyzed Epoxy (B70/B60)



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7. CMU: (Epoxy) - Kitchens, bathrooms, laboratories, etc.
  - a. Primer: Two coats Pro Mar Block Filler (B25W25)
  - b. Finish: Two coats Water-Based Catalyzed Epoxy (B70/B60)

**END OF SECTION**



BUILDING EXCELLENCE

SECTION 10 01 00

MISCELLANEOUS SPECIALTIES

GENERAL

- 1.1 The architect shall include in this section the following items by the contractor. Possible items include: Manual Projection Screens, Kilns, Kiln vents, Drying Cabinets, TV Mounting Brackets, Motorized Projection Screens, Floor Safes, Burglary/Fire Safes, Curtains and Tracks, Corner Guards, Electric Chain Hoists, Protective Wall Padding, Learning Commons Security Systems, Ice Machines, Hydraulic Tables, Hydrotherapy Whirlpools, Swimsuit dryers, Storage Cabinets, Rapid Entry Systems (Fireman's Lock Box), Barrier Free Lift Systems, Depressible Book Trucks and Scoreboards.

PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications and must be approved by HISD project team to be considered.

2.2 MATERIALS

- A. The kiln should be automatic firing with firemate controls with a temperature of 2350 F. Electrical requirements include 208 volts, 3-phase, 52 amps and the dimensions should be 30-1/2 inches by 39-1/2 inches by 48 inches H. Other features may include: Delay fire and memory timer, Two layer heat shield with insulation to keep switch cool, Premium insulating firebrick heavy-duty elements, Dropped recessed brick grooves, Lock-in lid support, Fall away Prop-R-Vents for easy two-stage firing, Tapered peepholes, Dust free coating, Full firing capacity, Reversible brick bottom, Wide ventilated switch box, Long life electrical system, Heavy amperage cord set, Heavy galvanized steel base, Stainless steel case, Sturdy kiln stand, and Furniture Kit.
- B. The kiln vent should have a 1/8 hp motor, 120 V / 60 Hz / single phase, two-speed, 500 CFM blower, with negative pressure kit, pulleys, flexible exhaust hose and exterior louver. The venting diameter should be 44 inches and there should be one vent per kiln.
- C. The kiln room drying cabinet should be 48 inches wide x 24-1/4 inches deep x 84 inches tall with two hinged doors with louvers, five perforated shelves and one drip pan.
- D. TV Mounting Brackets:
  1. Wall Brackets contain a TV bracket with support tray, wall arm, wall support plates, fasteners, safety straps and security accessories required to complete work. It should be capable of securely holding a 27 inch television as furnished by Owner with a 30 degree adjustable tilt.
  2. Ceiling Brackets contain a TV bracket with support tray, ceiling suspension kit, fasteners, safety straps and security accessories required to complete work and should be capable of securely holding a 27 inch television as furnished by Owner with a 30 degree adjustable tilt.
- E. Plasma/LCD Monitor Mounting Brackets:
  1. Wall Mounted Brackets for mounting on wood studs or masonry wall include a universal adapter plate, pull-out swivel with up to 45° rotation, is 3.4" deep in closed position and up to 11.9" fully extended, has 0°, 5° or 10° lockable incremental tilt, an installation tool securing arms for screen installation, mounts to 16" wood studs, concrete, cinder block, includes hardware is capable of securely holding a 32-58 inch television.
  2. Ceiling Mounted Brackets contain 0° to 20° adjustable tilt and 360° swivel, the screen mounts vertically or horizontally, uses standard 1 1/2" – 11.5 NPT





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- schedule 40 pipe, theft-resistant security fasteners secure the screen to the mount and is capable of securely holding a 32-71 inch television.
- F. Manual Projection Screens are pull-down ceiling mounted made from a heavy 22 gauge octagonal steel case with baked enamel finish and fitted with end caps concealing roller ends with integral bearing surface to support roller and integral brackets for wall mounting by means of slotted screw holes. Bottom of fabric shall be mounted into a metal strip in a tubular steel slat finished in baked enamel. Ends of slat shall be protected by plastic caps. Plated steel slat pull shall be attached to slat with screws.
1. Screen should have a Matte White surface with masking borders on flame retardant and mildew resistant seamless fabric. Fabric shall be mounted into a metal strip in a metal Camlok roller system without tape, glue, staples or cords so that fabric may be easily replaced yet cannot be pulled from roller.
- G. Motorized Projection Screens are electrically operated 120 volt (60 Hz), 2.1 amp, with a quick connect male plug-in connector on the motor. Motor shall be mounted inside the roller, to be three wire with ground, quick reversal type, oiled for life, with automatic thermal overload cutout, integral gears, capacitor and an electric brake to prevent coasting. To have preset but accessible limit switches to automatically stop picture surface in the "up" and "down" positions
1. The roller is rigid metal, at least 5.75 inches in diameter and mounted on two heavy duty brackets equipped with self-aligning bearings.
  2. The Screen Fabric should be flame retardant and mildew resistant, Matt White picture surface with black masking borders.
  3. The case should be made of extruded aluminum powder coated white. End caps to be of heavy gauge steel, powder coated white. Bottom of case to have a removable access door. Door to be of extruded aluminum powder coated white. Bottom of case to be self-trimming, with a built-in flange around the case bottom.
  4. Controls should have three position control switch in box with cover plate.
- H. The floor safe should have outside dimensions of 12-3/4 inches H x 14-1/8 inches W x 11-3/4 inches D and weight 100 lbs. The 3/4 inch solid steel door has quick-release hinges that are 3/8 inches in diameter. The oversized floor plate ensures strong installation in concrete.
- I. Corner Guards should have a tensile strength of 300 ft. lbs./sq. in., a Rockwell hardness of 70 (ASTM D785), IZOD and a 16 ft. lbs./in. (ASTM D256). The corner guards may be made from Lexan, Polycarbonate Resin with 1/8 inch nominal thickness in four foot lengths and should be attached with chrome plated screws to fit counter-sunk pre-drilled holes.
- J. Electric Chain Hoist shall be a single speed with a lift speed of 16 FPM and a one ton capacity. The single phase motor has a one HP power rating and requires 208 volts. The chain lift is 20 feet, control cord is 16 feet and the minimum distance between hooks shall be 18 inches.
- K. Protective Wall Padding shall be constructed of two inch thick Bonded Foam Filler (firm), with a 6 lb. density, cemented to 3/8 inch thick Backing Board and covered with Flame Retardant, vinyl-coated polyester folded and stapled securely to back of oriented strand board. A one inch nailing margin shall be provided to top and bottom for securing panels to the wall.
- L. Learning Commons Security System helps ensure that no materials, which are sensitized leave the Learning Commons without being checked out. It is safe for magnetic media, and has audible and visible alarms. (to be installed at each Learning Commons door) Detection system equipment may include models 3800, 3500 and 3900.
- M. Commercial Ice Machine, indoor, air cooled shall have a capacity of 340 pounds daily ice production with storage for 210 pounds of ice. The stainless steel exterior with corrosion-free base shall be 59-1/2 inches high by 22 inches wide by 34 inches deep. The ambient temperature ranges from 35 - 110 degrees F.
1. The Ice Machine Electric voltage is 120/60/1 with a minimum circuit ampacity of 11.3 and maximum at 20.



## BUILDING EXCELLENCE

2. Require a warranty of five year parts and five year labor for the evaporator, five year parts and three year labor for the compressor and three years for all other parts and labor.
- N. Commercial Ice Machine, large capacity, water cooled shall have a capacity of 500 pounds daily ice production with storage for 430 pounds of ice. The stainless steel exterior with corrosion-free base shall be 76-1/2 inches high by 30 inches wide by 34 inches deep. The 16,000- 22,000 BTU/hr machine shall have an ambient temperature range: 40 degrees - 110 degrees F.
  1. The Ice Machine Electric voltage is 208/60/1 with a minimum circuit ampacity of 12.6 and maximum of 20 amps.
  2. Require a warranty of five year parts and five year labor for the evaporator, five year parts and three year labor for the compressor and three years for all other parts and labor.
- O. A Hydraulic Table includes features such as fully adjustable leg sections, with a range of up to 75 degrees vertical, a fully adjustable head section from 40 degrees up, to 90 degrees down, cam operated gas struts actuates both head and leg sections, a 27 inch wide center section, with a slight taper at head and leg section to make accessibility easier, lifting cams are CAD designed and laser cut to tight precision tolerances, a 120 volt silent Hanning motor, a height range of 20 inches low to 38 inches high, and should include a five year warranty.
- P. Hydrotherapy Whirlpools include full body Lo-Boy Stationery Whirlpools that have a capacity of 105 gallons and are 66 inches long x 24 inches wide x 18 inches deep with a thermostatic mixing valve: MXT1 (15 gal/min) or MXT2 (25 gal/min).
- Q. Hydrotherapy Whirlpools include a Slant Back Mobile Whirlpool that has a 100 gallon capacity and is 76 inches long by 40 inches wide by 26 inches deep with electrical requirements of 115 V, 60 Hertz, 3 pole GFI receptacle, 1/2 HP pump motor, 8 amps.
- R. Hydrotherapy Whirlpools include a Sports Series Mobile Whirlpool with a 110 gallon capacity and a size of 56 inches long by 24 inches wide by 25 inches deep with same electrical requirements as above.
- S. The Swimsuit Dryer should have a manual self-start and self-stop, no-heat high-speed spinning water extractor made of rust-resistant stainless steel and plastic.
- T. Storage Cabinets should be constructed of heavy-gauge steel throughout for maximum rigidity and trouble free performance and feature double satin chrome handle, one fixed and one with key lock, 16-gauge steel frame construction, Four knuckle hinges, Louvered backs for ventilation, Leveling screws for easy opening doors, Dual reinforced doors ensure quiet operation, Built-in shelf support tabs, no bolts or clips needed, Raised bases to protect doors from damaged by mops during cleaning, Shelf loads to 200 lbs. and Nylon lock bar guide for quiet operation.
- U. Rapid Entry System (Fireman's Lock Box)
- V. Barrier Free Lift Systems:
  1. Lift System "1" is a 400lb portable ceiling lift with 3-90 degree curves, 3-45 degree curves, 2 long rollers, Universal Sling with head support, installation hardware for all thread suspension.
  2. Lift System "2" is a transverse system with model V4 (400lb) portable unit, ceiling lift, 110 feet of straight track, 32 feet of reinforced track, transverse rollers, 2 long rollers for portable unit, installation hardware with threaded rod suspension, one Universal sling with head support.
- W. Depressible Book Truck should be 27 inch W by 27 inch H by 22 inch D with a 3/4 inch multi-ply veneer core plywood banded with solid oak and a 3/4 inch solid oak handle. The book truck should be mobile using 4 - 3 inch casters on roller bearing swivel mounts.

## EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.



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B U I L D I N G   E X C E L L E N C E

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- A. Verify utility requirements, where applicable, are installed and ready for connection.
- B. Verify items fastened to walls have proper blocking or support items installed.
- C. Bolt fasten floor safe securely in location indicated on drawings.
- D. Fasten curtain track securely in straight and level position, mounted as detailed.
- E. Fasten corner guards in place with screws with bottom of corner guard at top of scheduled base at all field applied vinyl wall covering.
- F. Install wall padding panels with minimum amount of wrinkles in fabric.
- G. Install projection screen housing in conjunction with ceiling system. After interior construction is essentially complete, install viewing surface and operating mechanism in housing. Install screens securely to supporting substrate so that screens are level and back of case is plumb. Provide required brackets, hanger rods, and fasteners.

**END OF SECTION**



## SECTION 10 05 00

### SPECIALTIES COMMON WORK RESULTS

#### GENERAL

- 1.1 ***To promote creativity and innovation in 21 Century Learning Environments, HISD is open to the use of non-traditional materials and systems. All materials, systems and applications must be presented to the HISD project team and approved before use.***
- 1.2 Visual display surfaces should be only factory-assembled units with mounting clips for installation without adhesive. Locate in room according to teaching arrangement. Verify location of each board during Design Development staff review.
- 1.3 Materials and products should be durable- built to withstand constant use and should be easy to clean and maintain.
- 1.4 Provide all welded metal lockers with pad lock "hasp" hardware and sloped top surfaces. Sloped tops shall be continuous pieces of matching metal in maximum practical lengths. Athletic Lockers shall be heavy mesh welded lockers to meet ventilation requirements.
- 1.5 Locker rooms should have no wood benches.
- 1.6 Toilet partitions shall be solid polymer, floor mounted and overhead braced. Pilasters shall have stainless steel shoes. Provide continuous hinges on doors. No integral hinges allowed as well as no zamac coated hardware. Partitions between urinals and lavatories shall have floor mounted pilasters
- 1.7 Specify solid wood blocking in cavity for mounting all toilet accessories on stud walls. Specify butterfly bolts, or other substantial mounting for accessories on masonry walls. Plastic expansion anchors are not acceptable
- 1.8 Hand Dryer: SUPPLIED AND INSTALLED BY CONTRACTOR – Electrical circuit and conduit shall be sufficient to provide 120 volt service at 16 amps. Location of hand dryers to be coordinated with Architect.
- 1.9 All marquee signs must be totally enclosed with exhaust fan and a breather for heat dissipation. The front and back paneling should have a cover in between to prevent any bird nest or access from outsiders. Ensure that the required conduit for the exterior marquis sign is included in contractor's scope of work for future installation of exterior marquee sign.
- 1.10 Mounting heights for bottom edge of markerboards/tackboards
 

2'-0" A.F.F.	Pre-K and K
2'-6" A.F.F.	Grades 1 and 2
2'-10" A.F.F.	Grades 3 – 5
3'-0" A.F.F.	Grades 6-12 and adult

Mounting heights for Bottom edge of electronic white boards	
2'-0" A.F.F.	Pre-K and K
2'-6" A.F.F.	Grades 1 and 2
2'-10" A.F.F.	Grades 3 – 5
3'-0" A.F.F.	Grades 6-12 and adult
4'-0" A.F.F.	Middle school and high school science classrooms/laboratories

NOTE: In classrooms that are used by multiple grade levels, mounting height for bottom edge of markerboards/tackboards should be at 2'-10" A.F.F.

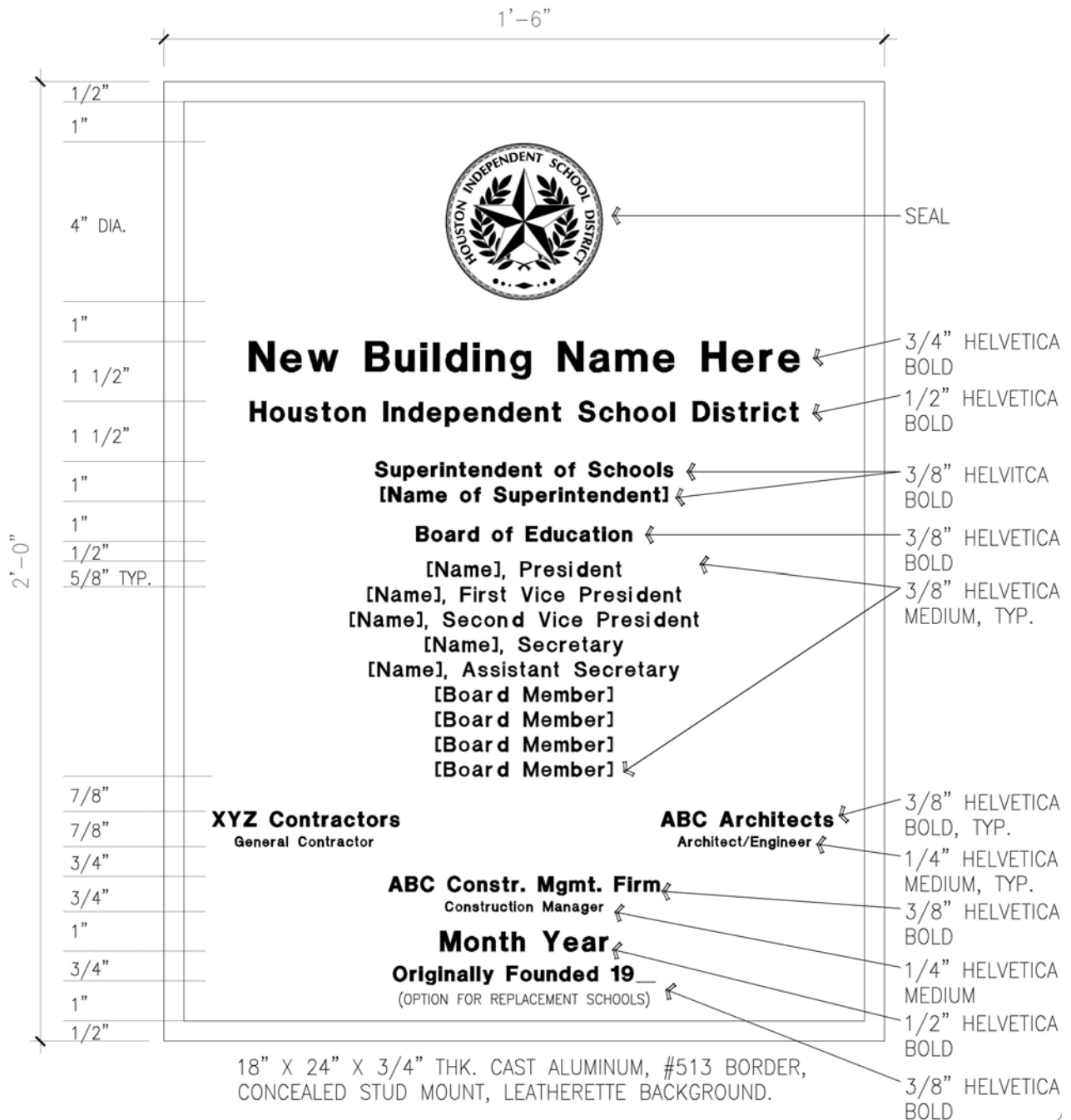


- 1.11 Provide job site signage and dedication plaque per attached drawings.
- 1.12 The architect should consult with the HISD Program Manager for job site information and requirements.

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## DEDICATION PLAQUE

Consult with HISD Program Manager for Board Member and date information.



B U I L D I N G   E X C E L L E N C E

SECTION 10 11 00

MARKERBOARD AND TACKBOARD

GENERAL

- 1.1 Require a warranty for the work against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship for the following terms:
  - A. Markerboards: Minimum of 50 years or for the life of the installation.
  - B. Tackboards: Minimum five years.

PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.
  - A. Specifications are based on products of Claridge Products and Equipment, Inc.
- 2.2 Markerboards (MB) shall be a 24 gauge porcelain enamel steel similar to "Liquid Chalk Surfaces (LCS-II)" with the ability to use liquid chalk writing system markers and magnets, mounted on 7/16 inch 2-ply hardboard, with 0.015 inch aluminum foil backing sheet (1/2 inch total thickness) measuring four feet high and in No. 92 Standard Gloss White.
  - A. The marker trough shall be similar to No. 371A marker trough with extended rear flange and endcaps under all markerboards.
  - B. Edge trim shall be extruded snap on aluminum similar to No. 273A in dull satin anodized.
  - C. The map rail, similar to No. 275A, shall run across top of markerboard and 4 map clips, similar to No. 76M shall be included with no adhesive.
  - D. Concealed mounting clips, Similar to No. 277, are located at top and sides.
  - E. Specify two flag holders and flags, No. 76 F.H., per board and markings such as rectangular grid, polar grid and/or music staff shall be applied at appropriate rooms. No more than two flag holders per learning center.
- 2.3 Tackboard (TB) should be similar to "Fabricork" 1380 with an extruded aluminum snap on frame, similar to No. 273A in dull satin anodized.
  - A. Concealed mounting clips, similar to No. 277, are located at top and sides.
- 2.4 Accessories include four #76M display hooks per board, one set #76RB roller brackets for each board and termination caps for all aluminum end sections.

EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Rigidly anchor to backup materials to withstand 200 plf load. Set without mastic on gypsum board partitions.
  - B. Install trim plumb with joints closely fitted and corners mitered. Secure trim with fasteners spaced 16 inches on centers maximum. Provide screws in lead shield on concrete and masonry walls and direct attachment to studs or metal backing on drywall construction. Use concealed fasteners.
  - C. Markerboard: Secure marker trough to backup materials with concealed fasteners through rear flange. Slip marker board into carrier slot. Then, install side and top ground clips and trim in accordance with manufacturer's printed instructions.
  - D. Provide all grounds, brackets, anchors, trim, and accessories for a complete installation.

END OF SECTION





**B U I L D I N G   E X C E L L E N C E**

**SECTION 10 12 00**

**DISPLAY CASES**

**GENERAL**

- 1.1 Require a warranty for the work specified for herein for 1 year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.

**PRODUCTS**

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.
  - A. Specifications are based on named products manufactured by Poblocki Sign Company.

**2.2 MATERIALS**

- A. Interior Display Cases should be complete cases, no visible fasteners or knock-down cases allowed. The factory assembled clear anodized aluminum cabinet should have 3/4 inch plywood backing with recessed mountings. The two sliding doors should contain "H" bars on the top and bottom. Framed glass doors required for cases over 66 inches tall. A manufacturers lock should be provided.
  1. Top mounted T-8 H.O. fluorescent lighting should be provided with dual voltage 120/277 volt ballast with egg crate diffusers.
  2. Shelving should be made of 1/4 inch polished clear tempered glass.
  3. Standards should be surface mounted (Cee) with regular brackets with cam lock levers.
  4. Specifications are based on Model "G".
- B. Poster Cases should have recessed mountings with a clear anodized aluminum finish and 1/4 inch clear glass, horizontally tempered. Trim style based on 'AA.' The background shall be vinyl over 1/4
  1. Specifications are based on Model "B", 2 inch deep.

**EXECUTION**

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Coordinate dimensional and electrical requirements prior to fabrication.
  - B. Install display cases at locations scheduled or noted on the drawings.
  - C. Install display cases in accordance with manufacturer's installation procedures.

**END OF SECTION**



B U I L D I N G   E X C E L L E N C E

SECTION 10 14 00

GRAPHICS

GENERAL

- 1.1 The architect should include in this section: exterior wall mounted school name, dedication plaque, room identification signage, traffic signage, including, but not limited to accessibility (Handicapped) parking signs, brackets, clips, posts, fasteners, concrete footings, and all accessories required for proper installation of signage and post and panel sign for site directory / directional signage.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.

PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.

2.2 MATERIALS

- A. Cast Metal Dedication Plaque: Aluminum
  1. The casting shall be of virgin ingots of F-214 Aluminum Alloy and shall be free of pits and gas holes and all letters shall be sharp and hand tooled with a single line standard border design.
    - a. Lettering shall be Helvetica Medium in both upper and lower case letters, unless shown otherwise.
    - b. The border and letters should have a satin finish with a leatherette texture sprayed background with Gun Metal Gray acrylic lacquer.
    - c. The plaque shall be chemically cleaned and etched and treated with alodine and once complete, shall be sprayed with two coats of clear acrylic lacquer.
  2. Concealed fasteners and hardware of size and type recommended by manufacturer shall be provided for attachment of plaque on brick wall.
- B. Cast Metal Dedication Plaque: Bronze
  1. The casting shall be of prime bronze ingots of Alloy 220 Commercial bronze free of pits and gas holes and all letters shall be sharp and hand tooled with single line standard border design.
    - a. Lettering shall be Helvetica Medium in both upper and lower case letters, unless shown otherwise.
    - b. The border and letters should have a satin finish on a black baked acrylic coated background.
    - c. The plaque shall be chemically cleaned and upon completion shall be sprayed with two coats of clear hardened acrylic polyurethane.
  2. Concealed fasteners and hardware of size and type recommended by manufacturer shall be provided for attachment of plaque on brick.
- C. Cast Metal Letters:
  1. Casting shall be of 319 aluminum alloy with satin polished faces and matte sides. Letters shall be finished in clear anodized finish and shall be 12 inch high in Helvetica Medium upper case letters, unless shown otherwise.
  2. Concealed fasteners and hardware of size and type recommended by manufacturer shall be provided for attachment of plaque on brick.
- D. Room Identification Signage:



## BUILDING EXCELLENCE

1. Signage should be constructed of one or two high pressure laminates, laminated to a 1/8 inch thick acrylic back with a radius or square corners with square-cut edges painted.
  2. Room Numbers, Symbols, and Restroom Copy shall be matte finished acrylic, raised 1/32 inch, of color contrasting to the face laminate. Characters and pictograms shall be chemically welded to the acrylic backing, through the face laminate, to assure permanent adhesion. Room numbers and restroom copy shall be accompanied by Grade II braille by means of "VisiTouch Duradot System". Glass or metallic "Durodots" shall have 0.059 inch surface diameter with body of sphere pressure secured below face laminate. Routed boxes or glued on dots are not acceptable.
  3. Lower or secondary copy must be a minimum of 5/8 inch high incised sans serif style, (Helvetica, Optima, Futura), all caps, paint-filled in a color.
  4. Restroom pictograms shall appear on a minimum six inch square, unobstructed field.
  5. Window (Slotted) Signs are open on both ends for an owner insert, window shall be a non-glare acrylic window with an exposed color laminate behind in color.
  6. Fasteners are 1/8 inch thick, double-sided foam tape of type recommended to suit application and commercial grade silicone sealant. Back-up plates shall be supplied, where shown or required, for signage mounted on glass.
- E. Traffic Signs:
1. Signage is made of 0.080 inch thick aluminum or galvanized steel sign with 1-1/2 inch silk screen upper case letters, copy and border. Signs shall have 1-1/2 inch radius at corners typically.
  2. Accessibility ("Handicapped Parking") signs with lettering and graphics shall comply with local codes.
  3. "Stop", "No Parking" and "One Way" signs with lettering and graphics shall comply with local codes.
  4. Provide galvanized steel sign mounting hardware as instructed by manufacturer. Provide concrete footings of 3,000 psi compressive strength at 28 days, unless noted or directed otherwise.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- A. Cast Metal Dedication Plaque:
    1. Install in accordance with manufacturer's instructions, as located on drawings with concealed fasteners of threaded bolt screwed into back of plaque and inserted into hole drilled in brick at an angle and filled with cement.
  - B. Cast Metal Letters:
    1. Install in accordance with manufacturer's instructions, as located on drawings, with concealed fasteners in flush mounting or projected mounting.
  - C. Room Identification Signs:
    1. Install in accordance with manufacturer's instructions, as located on drawings, with double-sided foam tape and a bed of silicone sealant.
    2. Where shown or required, mount signs on glass using back-up plates.
  - D. Traffic Signs:
    1. Install sign posts in concrete footings, with signs set to heights as shown on drawings and in accordance with manufacturer's instructions.
  - E. Post and Panel Sign for Site Directory / Directional Signage:
    1. Install signposts in concrete footings, with signs set to heights as shown on drawings and in accordance with manufacturer's instructions.

### END OF SECTION



## SECTION 10 14 11

### INTERIOR SIGNAGE AND WAYFINDING

#### GENERAL

- 1.1 Provide uniformity in signage on each campus to aide in utilization of sign information.
- 1.2 Establish consistency in signage guidelines among all HISD campuses and demonstrate sensitivity to the wide range of ages and sizes found among school building users and create a signage system that will be effective for all building users.

#### PRODUCTS

- 2.1 Wayfinding: Directional signs should be used to help students, staff and visitors find their way.
  - A. Building directory
    1. Locate in an area immediately visible from the primary building entry.
    2. Directory should be flush or recessed, rather than projecting.
    3. Letters and numbers should be simple in style.
  - B. "You are here" maps
    1. "You are here" maps are a useful orientation and wayfinding device. They should be located at all areas where a building user is likely to need help deciding how to proceed.
    2. Care should be taken to orient the drawing correctly in relation to the building and the viewer.
    3. A simple drawing is more useful than one that is too cluttered with graphic symbols and complex color coding. Target the complexity of the drawing to the age level of the users.
  - C. Direction to a particular destination
    1. Directional signs may be wall-mounted or professionally executed graphics directly applied to the wall surface.
    2. If pedestrian traffic is heavy, signs should not be obstructed by pedestrian flow.
- 2.2 Identification: Each area or room requires individual identification. Examples include:
  - A. Room number
  - B. Restrooms
  - C. Stairs
  - D. Mechanical
  - E. Electrical
  - F. Custodial
- 2.3 Emergency and Regulatory: Codes require signage that informs the user population of prohibited activities and safety requirements. Examples include:
  - A. Fire exits
  - B. Handicapped accessibility
  - C. Environmental health

#### EXECUTION

- 3.1 All signage shall comply with most current ADA and Building Code requirements. Changes in legal requirements subsequent to release of this document by HISD are the responsibility of consultants.
  - A. Additional requirements include:
    1. Size
      - a. Signs should be of consistent size and proportion and must be large enough to convey necessary information.



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- b. Signs with numbers only should as small as possible but meet code requirements.
    - 2. Construction
      - a. The sign plaque should be manufactured with integral raised features.
      - b. For economy, general purpose signs should be frameless and one piece construction. Avoid any add-on features that peel off, slide out or pop off.
      - c. Generally speaking, use signs with fixed numbers and removable inserts. Only rooms that cannot conceivably be used for a different purpose shall have permanently affixed name. Examples include Boys Restroom, Student Dining Commons, Gymnasium. Offices, storage rooms, Learning Centers, Instrumental Learning Centers could all be repurposed in the future and therefore the signage shall NOT include a permanent name for the space. Abbreviations shall not be used.
    - 3. Methods of attachment
      - a. Signs must be securely attached.
      - b. Use concealed fasteners or vandal-proof exposed fasteners and caulk the edges of each sign to the supporting wall.
  - B. Nomenclature
    - 1. Room designation
      - a. All spaces shall receive a number. On signs that include a name or window for an insert, the number should appear first.
      - b. The room number on each room's sign shall be consistent with the designation of that room on any energy management software, electrical panel directories, etc.
      - c. Two spaces shall not receive the same number even though they may be connected by a doorway.
      - d. If a single space has multiple doors, all doors should receive the same number.
      - e. Number rooms in each area of the building to aid in wayfinding. For example, the Entry /Administrative/Guidance area could be 100-199, Kindergarten/First Grade team could be 200-299, Second/Third Grade area 300-399, etc. For a second story, the numbers above those wings would be 2100-2199, 2200-2299, 2300-2399, etc. The designation ending in "00" would be the corridor of each wing.
    - 2. Number of digits
      - a. Room numbers should not exceed four digits except where there may be spaces within a space. This may be a combination of letters and numbers. Place letters after the numbers. Example: 1200A.
    - 3. Rooms on primary corridors
      - a. Number odd numbers consecutively along one side of a corridor with even numbers on the opposite side. This is typically done using the building floor plan, but it is imperative to consider the space in three dimensions. Angles and viewing distance are critical.
    - 4. Rooms on secondary corridors or suites
      - a. Use a similar model to aid in wayfinding.
  - C. Allowance
    - 1. Provide an allowance in the budget for signs to be prepared at the principal's direction. For example, signs are used to designate corridors that are off-limits during lunch.



## SECTION 10 21 13.19

### SOLID POLYMER SHOWER COMPARTMENTS

#### GENERAL

- 1.1 The architect should include in this section: solid polymer, shower compartments fabricated of non-corrosive High Density Polyethylene (HDPE) materials with hardware, fasteners, and accessories.
- 1.2 Require a warranty for the work specified for herein for 15 years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.

#### MATERIALS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.

#### 2.2 SHOWER COMPARTMENTS

##### A. Materials:

1. Compartments shall be floor mounted, overhead braced, with non-corrosive panels and pilasters of solid polymer and in the dimensions and arrangements indicated on the drawings.
2. Panels and pilasters shall be fabricated from Polymer resins under high pressure forming a single component section which is waterproof, non-absorbent and have a self-lubricating surface that resists marking with pens, pencils or other writing utensils.

##### B. Construction and Fabrication:

1. Panels and pilasters shall be one inch thick with all edges machined to a radius of 0.250 inch and all exposed edges to be free of saw marks.
2. Dividing Panels are 54 inches high and shall be mounted at 14-1/2 inches above the finished floor with continuous aluminum corner brackets
3. Pilasters are 76 inches high with continuous aluminum corner brackets.
4. Panels and pilasters shall be equal to "Plasti-Glaze 280" in color selected from manufacturer's colors.
5. Edging strips are aluminum fastened to the bottom edge of panels utilizing vandal-proof stainless steel fasteners.

##### C. Equipment:

1. Curtain Rod/Head Rails shall be aluminum with anti-grip (Two per compartment)
2. Provide chrome plated steel hooks for heavy duty, 8 gauge vinyl shower curtains (Two per compartment/dressing & shower)
3. Provide a chrome plated soap dish.
4. Provide a solid polymer one inch thick by 9-1/2 inch wide seat for each compartment.
5. Provide two sets of one inch thick polymer pilasters- one set between the dressing and shower compartments and the second set at the end of the dressing compartments. Headrail with integral curtain track shall be mounted continuously at the tops of each pilaster set.
6. Provide clothes hooks at panels in dressing compartments.



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**EXECUTION**

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- A. Provide blocking/anchoring devices to secure to wall. Anchoring devices must be compatible to wall type to ensure adequate strength.
  - B. Pilaster shoes shall be anchored to the floor with No. 5 plastic anchors and No. 14 stainless steel philips head screws.
  - C. Attachment of brackets to adjacent wall construction shall be accomplished by one theft proof Zamac mushroom nail in head anchor directly behind the vertical edge of panels and pilasters at every 12 inches along the length of bracket and two No. 5 plastic anchors and No. 14 x 1-1/4 inch stainless steel philips head screws at each 12 inch interval alternately spaced between anchor connections.
  - D. No evidence of drilling, cutting or patching shall be visible in the finished work. Defaced finish will not be permitted. Damaged, scratched or marred defective materials will be rejected and shall be replaced with new materials.

**END OF SECTION**





## SECTION 10 21 13.19

### SOLID POLYMER TOILET PARTITIONS AND SHOWER COMPARTMENTS

#### GENERAL

- 1.1 The architect should include in this section: solid polymer, floor mounted, overhead braced, toilet partitions and shower compartments fabricated of non-corrosive High Density Polyethylene (HDPE) materials with hardware, fasteners, and accessories.
- 1.2 Require a warranty for the work specified for fifteen years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship

#### PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.

#### 2.2 TOILET PARTITIONS

- A. All toilet partitions shall be floor mounted, overhead braced, with non-corrosive panel doors and pilasters of solid polymer and in the dimensions and arrangements indicated on the drawings. Partitions between urinals and lavatories shall have floor mounted pilasters. Panels, doors and pilasters shall be fabricated from Polymer resins under high pressure forming a single component section which is waterproof, non-absorbent and has a self-lubricating surface that resists marking with pens, pencils or other writing utensils. The panel should have a manufacturer applied texture similar or equal to EX from Scranton Products.
- B. Construction and Fabrication:
  1. Doors, Panels, and Pilasters shall be one inch thick and all edges machined to a radius of 0.250 inch and all exposed edges to be free of saw marks made of HDPE (High Density Polyethylene), fabricated from polymer resins compounded under high pressure.
  2. The panels should be waterproof and nonabsorbent, with self-lubricating surface, resistant to marks by pens, pencils, markers and other writing instruments.
  3. Dividing Panels and doors shall be 55 inches high and shall be mounted at 14 inches above the finished floor.
  4. Pilasters shall be 82 inches high.
  5. Urinal Screens are 24 inches deep x 60 inches high and shall be mounted 12 inches above finished floor.
  6. Doors, panels, urinal screens, and pilasters shall be equal to "Plasti-Glaze 280" in manufacturer's selected color.
  7. Edging Strips are aluminum fastened to the bottom edge of all doors and panels utilizing vandal-proof stainless steel fasteners.
  8. Door hardware shall be as follows:
    - a. Require full length continuous adjustable helix hinge in brushed finish surface manufactured from 14 gauge, 304 Stainless Steel, with stainless steel pin welded and ground. Both hinges shall be fastened with 3/4 inch long #14 stainless steel screws.
    - b. Each door requires one coat hook/bumper with rubber bumper. No Zamac coated hardware.
    - c. Handicapped doors also include one door pull and one wall stop.
    - d. Door Strike and keeper are fabricated from heavy aluminum extrusion (6463-T5 Alloy) with clear anodized finish with wrap around flange,



## BUILDING EXCELLENCE

- surface mounted and thru-bolted to pilaster with one-way sex bolts. Size of strike shall be six inches.
- e. Door Latch Housing shall be fabricated from heavy aluminum extrusion (6463-T5 Alloy) with clear anodized finish, surface mounted and thru-bolted to door with one-way sex bolts. Slide bolt and button shall be heavy aluminum with similar or equal to "Tuff-Coat Black" finish.
- 9. Pilaster Shoes shall be 3 inch high 20 gauge stainless steel shoes with theft proof sex bolts.
  - 10. Provide full length continuous wall brackets (6463-T5 Alloy) with mill finish weighing not less than 1.685 lbs. per linear foot similar or equal to section #58992 shall be used for all panels to pilaster, pilaster to wall, and panel to wall connections. Manufacturer to predrill holes spaced every six inches along full length of brackets. Thru-bolt to panels and pilasters with one-way sex bolts.
  - 11. Headrail to be fabricated from heavy aluminum extrusion (6463-T5 Alloy) with mill finish in anti-grip configuration weighing not less than 1.188 lbs. per linear foot similar or equal to section #58993. Fasten to tops of pilasters and headrail brackets by thru-bolting with one-way sex bolts.
  - 12. Headrail Brackets are 16 gauge stainless steel.

### 2.3 SHOWER COMPARTMENTS

- A. All shower compartments shall be fabricated of same solid polymer material as toilet partitions above, floor mounted, overhead braced, with vandal proof stainless steel fasteners, and be in the dimensions and arrangements indicated on the drawings.
- B. Equipment:
  - 1. Curtain Rod/Head Rails shall be aluminum with anti-grip (Two per compartment)
  - 2. Provide chrome plated steel hooks for heavy duty, 8 gauge vinyl curtains (Two per compartment/dressing & shower)
  - 3. Require a chrome plated soap dish.
  - 4. Seats are HDPE 1-3/8 inch thick x 9-1/2 inch wide (each compartment)
  - 5. Provide two sets of one inch thick polymer pilasters- one set between the dressing and shower compartments and the second set at the end of the dressing compartments. Headrail with integral curtain track shall be mounted continuously at the tops of each pilaster set.
  - 6. Provide clothes hooks at panels in dressing compartments.

## EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project
  - A. Provide blocking/anchoring devices to secure to wall. Anchoring devices must be compatible to wall type to ensure adequate strength.
  - B. Install partitions and compartments in substantial manner, straight, plumb, and true in accordance with manufacturer's instructions.
  - C. Install all partitions and compartments where indicated on the drawings, and as indicated on the shop drawings, anchoring all components firmly in place for a long life under hard use and in complete accordance with the manufacturer's recommendations.
  - D. Pilaster shoes shall be anchored to the floor with No. 5 plastic anchors and No. 14 stainless steel philips head screws.
  - E. Attachment of brackets to adjacent wall construction shall be accomplished by one theft proof mushroom nail in head anchor directly behind the vertical edge of panels and pilasters at every 12 inches along the length of bracket and two No. 5 plastic anchors and No. 14 x 1-1/4 inch stainless steel phillips head screws at each 12 inch interval alternately spaced between anchor connections.
  - F. No evidence of drilling, cutting or patching shall be visible in the finished work. Defaced finish will not be permitted. Damaged, scratched or marred defective materials will be rejected and shall be replaced with new materials.



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- G. Clearance of vertical edges of doors shall be uniform top to bottom and shall not exceed 3/16 inch.
- H. Except for toilet partitions for the handicapped, adjust doors to remain at a uniformly open position when unlocked.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 10 22 26

#### OPERABLE PARTITIONS

##### GENERAL

- 1.1 The architect should include in this section: manual operable walls as shown on drawings.
- 1.2 Require a warranty for the work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials and workmanship.

##### PRODUCTS

- 2.1 Manufacturers must have a minimum of five years experience manufacturing equivalent products to those specified and comply with Division 1 requirements regarding substitutions to be considered.
- 2.2 MATERIALS
  - A. Operation: Top supported, manually operated, hinged in pairs, center stacked.
  - B. Panel Construction: 4 inch thick maximum, nominal 48 inches wide consisting of structural acoustical material, mounted in a steel reinforced full perimeter frame. Panel faces shall be removable and replaceable at site.
  - C. Panel Finish: Class A rated in accordance with ASTM E84, reinforced finish bonded to acoustical material.
  - D. Hanging Weight: Panel hanging weight shall not exceed eight (8) lbs./ft<sup>2</sup>
  - E. Acoustical Rating: Minimum STC rating of 47 in accordance with ASTM.
  - F. Sound Seals:
    1. Vertical seals between panels shall consist of tongue and groove airlock. When engaged, each pair of panels shall result in a single straight unit.
    2. Horizontal Top Seal: continuous contact extruded vinyl shapes.
    3. Horizontal Bottom Seal: 1-1/2 inch clearance, automatically actuated by the movement of one panel-pair against the other. Seals shall not contact floor during movement. Fixed sweep bottom is not recommended.
  - G. Suspension System: Shall be heavy duty aluminum Type 7/8 track. Track shall be supported by adjustable by adjustable steel hanger rods. Panels shall be supported by trolley assemblies of radial type nylon tired or carbon fiber filled tired, steel ball-bearing wheels. Trolleys shall be attached to the panels with adjustable steel pendant bolts with locks to prevent panel misalignment.
  - H. Panels that are hinged together shall be hinged with manufacturer's standard butt-type hinges.

##### EXECUTION

- 3.1 EXAMINATION
  - A. Before commencing installation, examine the opening. Surfaces shall be clean and dry. Concrete surfaces shall be free of excess mortar and lumps. Wood surfaces shall be well nailed and/or glued, nail heads driven flush, and wood free of voids. Metal surfaces shall be free of grease, oil, dirt, rust, corrosion and welding slag, without sharp edges.
  - B. Verify that rough opening is correct and had been prepared by others to conform to ASTM E557.
- 3.2 PREPARATION
  - A. Open containers and verify that all required parts are available and undamaged before disposing of containers.



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- B. Arrange materials in proper sequence to conform to manufacturer's information and installation instructions.

3.3 INSTALLATION

- A. Install operable walls in accordance with manufacturer's instructions using qualified factory trained installers.
- B. Lubricate all bearing and sliding parts and adjust for smooth and easy operation.
- C. Apply perimeter caulking and trim as required.
- D. Adjust hardware for accurate fit and smooth, easy operation.

3.4 DEMONSTRATION

- A. After all adjustments, lubrications and clean-up, the installer shall demonstrate and instruct the proper operation, function and maintenance procedures for the operable walls.
- B. Deliver operation and maintenance manuals to the Owner.

**END OF SECTION**



## SECTION 10 28 13

### TOILET ROOM ACCESSORIES

#### GENERAL

- 1.1 The architect should include in this section: Toilet accessories; shower accessories; and utility room accessories.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 Coordinate the Work with placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.
- 1.4 Require a warranty for the work specified herein for three years, or provide manufacturer's standard warranty for specified products, against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
  - A. Defects shall include, but not be limited to: delamination or deterioration of finish, noisy, rough or difficult operation, and failure to meet specified quality assurance requirements.

#### PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.
  - A. Specifications are based on products of Bobrick Washroom Equipment, Inc.

#### 2.2 COMPONENTS

- A. Accessories shall be shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation. Grind welded joints smooth and fabricate units made of metal sheet of seamless sheets, with flat surfaces.
- B. Stainless Steel sheets shall meet ASTM A666 Type 302 or 304 and stainless steel tubing shall meet ASTM A269. Both shall have a No. 4 satin, unless otherwise specified, finish and a 22 US stainless gauge minimum thickness.
- C. Chromium Plating shall be over nickel and comply with ASTM C456, Type SC 2
- D. Framed mirrors shall be 1/4 inch thick with an electrolytic copper backing and shall be FS DD-G-451-C, silvering quality No. 1 float or plate.
  1. Require warranty of fifteen years against silver spoilage.
- E. Fasteners, Screws, and Bolts shall be hot dip galvanized, tamper-proof.
- F. Expansion Shields shall be fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.
- G. Concealed backing to comply with local codes and as required for substrate conditions; or manufacturers standard mounting kits.

#### 2.3 FINISHING

- A. Baked Enamel coatings require pretreating to clean condition, application of one coat primer and minimum two coats vitreous enamel.
- B. Chrome/Nickel Plating should have a satin finish.
- C. Shop Primed Ferrous Metals requires pretreating, spray apply one coat primer and bake.
- D. Back paint components where contact is made with building finishes to prevent electrolysis.



## BUILDING EXCELLENCE

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project
- A. Comply with ADA and TAS requirements for mounting locations. Refer to drawings. When not shown, submit supplier's recommendations for locations and mounting height before proceeding.
  - B. Contractor shall be responsible for supplying all opening, blocking, and other components necessary for installation of all toilet accessories.
  - C. Use approved theft-resistant type fasteners.
  - D. As a quality standard, Model Numbers shown are products of Bobrick Washroom Equipment, Inc.

#### WASHROOM EQUIPMENT

1. Soap Dispensers should be surface mounted and provided at each lavatory. The **owner will provide** dispenser. Symmetry B.9010001
2. Mirrors are surface mounted, 24 inches x 36 inches, unless shown otherwise and require one at each lavatory. Model No.: B-290. **The mirrors should be mounted away from the sink.**
3. Toilet Paper Dispenser shall be surface mounted and located at each water closet. The **owner will provide** Georgia Pacific 59209.
4. Grab Bars shall be 1-1/2 inch diameter satin finish stainless steel with a 1-1/2 inch clearance between rail and wall. Attach bars with concealed mounting and parallel to the floor at each accessible stall with one 36 inch behind toilet, and one 42 inch long bar at side of toilet. Refer to drawings. Model No.: B-6806.
5. Sanitary Napkin Dispenser shall be surface mounted in each women's toilet room with single coin / double coin - (25/50 cents) operation and capacity of 20 Napkins/ 30 Tampons. Model No.: B-2706
6. Sanitary Napkin Disposals shall be surface mounted and be located at each women's toilet room. Model No.: B-270
7. Mop and Broom Holder shall be surface mounted with a capacity of four hooks and three mop holders and be located above mop sinks at each custodial room. Model No.: B-239 x 34
8. Grab Bars should be surface mounted at each accessible shower stall. Model: B-6861 modified (24 x 16)
9. Folding Bench shall be surface mounted and located at each accessible shower stall. Models: B-5181 (Use Bradley No. 9561 at elementary schools 15" seat height)
10. Clothes Hooks shall be surface mounted and one should be located at each single toilet room inside the door and at each shower location if not included in partition package. Model No.: B-6717; or equivalent.
11. Shower Curtains, Rods and Hooks:
  - a. Model Nos.:
    - 1) Rods: B-6047 (36 inches or as indicated)
    - 2) Curtains: 204-2 (42 inches x 72 inches or as required)
    - 3) Hooks: 204-1 (Seven hooks per curtain or as required)
    - 4) Mounting/Location: One at each accessible shower.
12. Electric Hand Dryers should be high speed, energy efficient, electric hand dryers and internally grounded. Require a 5 year warranty. Operational sound should be less than 80 dB. Motor and blower 5/8 HP, 20,000 RPM. Air flow rate: 19,000 linear feet per minute. The controls should be completely sealed with automatic operations activated by infrared optical sensors. The unit should be recessed in an ADA compliant 22 GA 304 stainless steel #4 satin finished mount. The mounting kit should be all welded construction measuring 16-3/8" wide x 26" high x 3-3/8" deep.





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13. Paper Towel Dispenser / Trash Receptacle Combination should be surface mounted. Model No.: B-3949
14. Roll Paper Towel Dispensers: ***The owner will provide*** SCA 5510282.
15. Horizontal Diaper Changing Stations should be 35 inches long by 22 inches high by 4 inches deep and be FDA approved injection-molded polypropylene with steel-on-steel hinge system. Fabricate to withstand static loads over 400 pounds.
  - a. Include child protection straps with snap-lock fasteners, built in diaper bag hooks, sanitary liner dispensers (Liners shall be 3-ply, biodegradable), premium gas spring mechanisms, molded usage and safety instructions in six languages and Braille and shall be anti-fungal to comply with ASTM standards and ADA compatible.

**END OF SECTION**



## SECTION 10 44 13

### FIRE EXTINGUISHER AND CABINETS

#### GENERAL

- 1.1 Require manufacturer's specifications and technical data to indicate specification compliance and installation instructions.

#### PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.
  - A. Ambassador 2107S21 Series (Non-Rated) and Ambassador 2017SFX with fire-fx fire rated tube as basis for specification.

#### 2.2 MATERIALS

- A. Fire Extinguisher Cabinets (FEC) shall have a 27 inches x 12 inches x 7-3/4 inches inside tub dimension with a 22 gauge min. steel with baked acrylic enamel interior finish. The FEC should be semi-recessed with 2-1/2 inch return trim rolled edge; ADA compliant.
  1. The Door and Frame shall be 18 gauge min. 304 stainless steel door and frame with vertical decal lettering "FIRE EXTINGUISHER" in red color, unless directed otherwise with no glazing.
  2. Hardware consists of a continuous concealed piano hinge constructed of material which matches door and trim material, and a satin finish pull handle with cam cylinder lock with safety pull designed to release upon firm pull on handle.
  3. The cabinet should have a #4 stainless steel finished exterior.
  4. Provide a fire rated cabinet, as needed, for one or two hour rated conditions as indicated or required by specific location. Cabinet shall be tested and approved by Warnock Hersey to ASTM E-814, and shall bear the Warnock Hersey label.
- B. Fire Extinguishers (F.E):
  1. The extinguisher should contain a multipurpose dry chemical with 10 lbs. capacity and UL 4A-80B:C rating conforming to MP10 Series and be mounted with eye brackets for direct wall mounting to hook and for mounting in Fire Extinguisher cabinets.
  3. Provide initial inspection tag for each extinguisher.

#### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Install fire extinguisher cabinets in openings prepared by others in accordance with manufacturer's printed instructions. Install fire extinguisher cabinets in locations required by governing code and as directed by Owner.

#### END OF SECTION



## SECTION 10 51 13

### METAL LOCKERS

#### GENERAL

- 1.1 Require a warranty for the work specified against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
  - A. Defects shall include, but not be limited to rapid deterioration of finish, loose or missing parts, non-functioning components and mechanisms, and rust, delamination, warp, rot or breakage.

#### PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.

#### 2.2 MATERIALS AND FABRICATION

- A. All-Welded Lockers shall be primed, high grade Class I mild annealed, cold-rolled steel. Lockers are pre-assembled with welded seams and joints. Bolts, screws or rivets used in the assembly of the locker bodies are not permitted. The body is 16 gauge, flanged with 18 gauge backs and 16 gauge door frames with continuous door strike. Multiple tiered assemblies shall have intermediate cross frame welded to vertical framing members.
  1. The 14 gauge formed door shall be constructed of single piece cold rolled steel. Full channel shaped on lock side, formed channel formation on hinge side, right angle shaped on horizontal sides with six louvers per door, top and bottom, for a minimum of 7 percent ventilation.
  2. Lockers require two inches high minimum, five knuckle, full loop, tight pin hinges, welded to the door and frame. Two per door for lockers 42 inches high or less and three per door for lockers over 42 inches high.
  3. Latching is made of one-piece, pre-lubricated spring steel, completely contained within the lock bar under tension to provide rattle-free operation. Provide three latching points for lockers over 42 inches in height and two latching points on for all tiered lockers 42 inches and under in height.
  4. Lockers shall be equipped with a positive automatic pre-locking device whereby the locker may be locked while the door is open and then closed without unlocking and without damaging the locking mechanism.
  5. Handles shall be recessed and made of stainless steel with non-protruding lifting trigger.
  6. Number Plates are aluminum with etched figures at least 3/8 inches high, attached near top of door with two aluminum rivets. Number plates shall be in order.
  7. Lockers have a baked enamel finish with colors from the manufacturer's standard colors. Lockers shall be painted inside and outside with the same color.
  8. Provide fasteners and anchors of type, size and finish as recommended by manufacturer for attaching or anchoring lockers to walls and floor.
  9. For Free-Standing Lockers, provide front and end closed bases.
  10. Lockers shall rest on bases as detailed on drawings.
  11. Lockers contain master lock built-in combination locks with five master / control keys and metal dial.
  12. Top Closures, Closure Strips, and Fillers shall be provided where shown, factory fabricated and finished to match lockers, unless noted otherwise.



## BUILDING EXCELLENCE

- B. Handicap lockers shall have recessed handles and shall be single tier or the lower opening of a double tier locker. Locker bottom shall be a minimum of 15 inches off the floor, or an extra shelf placed 15 inches off the floor with bottom or shelf turned down to close resultant opening.

### 2.3 LOCKER TYPES

- A. Type 'A' Student Lockers shall be 12 inches wide by 12 inches deep by 72 inches high, double tier (36 inches high for each tier), with interior hooks, louvered door, solid back, dividers, ends, fillers, sloped tops, and four inch high concrete base. Colors shall from manufacturer's standard colors.
- B. Type 'B' Lockers shall be 12 inches wide by 15 inches deep by 72 inches high, double tier (36 inches high for each tier), with interior hooks, louvered door, solid back, dividers, ends, fillers, sloped tops, and four inch high concrete base. Colors shall be from manufacturer's standard colors.
- C. Type 'C' Lockers shall be 15 inches wide by 15 inches deep by 60 inches high, four tier (15 inches high for each tier), with interior hooks, louvered door, solid back, dividers, ends, fillers, sloped tops, and four inch high concrete base. Colors shall be from manufacturer's standard colors.
- D. Type 'D' Lockers shall be used for physical education and shall be 12" wide by 18" deep and 60 inches high and adjacent to 6 lockers that are 12" wide by 15 inches high with interior hooks, louvered doors, solid back and concrete base. Colors shall be from manufacturer's standard colors.

### 2.4 LOCKER ROOM BENCHES

- A. Benches shall have a 1-1/2 inch (39 mm) thick HDPE plastic, 30 percent recycled material, with matte texture finish top with a black anodized aluminum pedestal with welded aluminum flanges top and bottom. The total bench height is 18-1/2 inches.
- B. Pedestal Attachment requires screw fasteners for attaching each pedestal to bottom of bench and two suitable anchors per pedestal for anchoring pedestals to floor.
- C. Wall Attachment requires fasteners and anchors for attaching bench to wall.

## EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project
  - A. Assemble and install lockers plumb, level, and flush in the locations shown on the drawings in accordance with the manufacturer's instructions. Lockers shall have no sharp metal edges.
  - B. Install and anchor lockers to the floor and wall as instructed by the manufacturer.
  - C. Install sloping hoods, metal fillers, end panels and trim to close openings, and accessories where shown on drawings or required to complete installation. Install using concealed fasteners. Provide flush hairline joints against adjacent surfaces.
  - D. Provide other materials, not specifically described but required for a complete and proper locker and bench installation.
  - E. Adjust doors and latches to operate without binding and positive latching and automatic locking.
  - F. Touch up marred finishes on lockers with manufacturer's supplied paint.

## END OF SECTION



**B U I L D I N G   E X C E L L E N C E**

**SECTION 10 56 13**

**INDUSTRIAL METAL SHELVING**

**GENERAL**

- 1.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.

**PRODUCTS**

2.1 MATERIALS

- A. The adjustable 18 gauge heavy duty open shelves shall have a shelf capacity of 400 lbs. (minimum uniformly distributed load). The edge is made from full box flange construction at front and rear. The shelves are 85 inches high x 18 inches deep and 36 inches wide.
- B. Shelf Unit Components include seven shelves, two pairs of side sway braces per unit and one pair of back sway braces per unit.
- C. Shelves come in the standard factory applied paint in color(s).

**EXECUTION**

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- A. Install shelving units secure to walls in accordance with manufacturer's printed instructions in locations shown on drawings.

**END OF SECTION**



**SECTION 10 73 26**

**ALUMINUM WALKWAY COVER**

**GENERAL**

- 1.1 The architect should include in this section: prefabricated aluminum canopy or canopies.
- 1.2 Require design calculations or letter indicating design certification sealed by a registered professional engineer licensed in the state in which the job site is located.
- 1.3 Require a warranty for the work specified for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship
  - A. Defects shall include loose or missing parts, delamination or deterioration of finish and scratched, dented, and damaged surfaces.

**PRODUCTS**

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.
  - A. Specifications are based on products of Avadek Walkway Cover Systems & Canopies; Houston, TX.

**2.2 MATERIALS**

- A. All aluminum shapes shall be sized and connections designed to meet or exceed specific project design load requirements, and as indicated in the drawings.
- B. Aluminum components shall be 6063-T6 Alloy Extruded aluminum.
- C. Structure shall be designed by the manufacturer to withstand walking on top, heavy hail, and winds in the configurations shown on drawings.
- D. Provide concealed drainage from deck into columns.
- E. Flashing shall be 0.040 inch aluminum fabricated to prevent leakage of water between canopy and adjacent structures, where applicable.
- F. The Roof Deck shall be of size and depth recommended by the manufacturer to suit application, intended use, requirements of building code authorities having jurisdiction, and shall interlock in a homogeneous structural unit, with joint designed and fabricated into a structurally rigid shape which is self flashing.
- G. Provide expansion joints as required. Expansion joints shall have no metal to metal contact.
- H. Horizontal U-Beams and vertical tube columns shall be sizes recommended by the manufacturer to suit application, intended use, and requirements of building code authorities having jurisdiction, and shall be attached with concealed fasteners.
- I. Finish to be selected from manufacturers standard colors.

**EXECUTION**

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Installer's Qualifications: Company with a minimum of five years experience in installing aluminum canopies of the type specified for this Project and approved by steel canopy manufacturer to install their canopies in accordance with their instructions.
  - B. As a performance specification, the criteria for the solution of structurally sound aluminum walkway cover indicated on the Drawings or specified herein are the sole purpose of defining the design intent and performance requirements. The details shown



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are intended to emphasize the acceptable profiles and performance requirements for this Project. To avoid any misunderstanding or lack of interpretation, the Contractor is hereby advised that the responsibility for the aluminum walkway cover is totally his and that designs and resolutions proposed in the Contractor's shop drawings, structural calculations, and related documentation shall be demonstrated throughout the Work and warranty period specified or required.

- C. Design proposal submissions which follow exactly the details indicated on the Drawings for the aluminum walkway cover, will not relieve the Contractor of his responsibility for the design, fabrication, erection, or performance of the Work of this Section.
- D. Coordinate dimensional requirements prior to fabrication.
- E. Canopy erection drawings to be furnished at time of shipment. Piece marks included for field identification of all major parts.
- F. Erection shall be in accordance with manufacturer's recommendations using erectors approved by manufacturer.
- G. Erect canopy after all concrete and masonry in vicinity is complete and washed down.
- H. Column sleeves shall be furnished by the manufacturer and installed by the General Contractor to elevations and dimensions on approved shop drawings.
- I. Install all columns and beams straight and true. Protect columns with heavy plastic sheeting.
- J. Install raincaps over draining sections of the deck. Downspouts columns shall be filled with grout to the discharge level to prevent standing water. Downspout deflectors shall be installed after grouting.
- K. Install all flashing required at the juncture of deck sections.

**END OF SECTION**





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**SECTION 10 73 33**

**MARQUEE SIGN**

**GENERAL**

- 1.1 Require a warranty for the work specified for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- A. Defects shall include deterioration of any material or finish and noisy, rough or difficult operation.

**PRODUCTS**

**2.1 MARQUEE**

- A. The marquee shall include shading, additional text effects and increased memory capacity.
- B. Technical Specifications:
1. The character height shall be 9 or 10 inches (seven pixel font) with min. 3 lines of text with a resolution of 34mm, 82 pixels per square foot.
  2. The Pixel Pitch shall be 0.78 inch center to center.
  3. The Color Capability shall include 4,096 shades of red and amber available. Confirm red or amber with HISD Program Manager.
  4. One red or two amber LEDs are included per pixel with an estimated LED lifetime of 100,000+ hours.
  5. The Horizontal Viewing Angle is 90 degrees (45 degrees left and right) with a vertical viewing angle of 40 degrees (20 degrees up and down)
  6. Contrast Enhancement is made of non-reflective black louvers.
  7. The cabinet should have front access and be ventilated.
  8. The Graphic Capability shall allow for multiple types of text, graphics, logos, basic animation, and multiple font styles and sizes.
  9. Control Software shall be Venus® 1500.
  10. The marquee requires 120/240 VAC single phase power.
  11. Provide 64 levels of display dimming (automatic or manual control).
  12. Matrix Size shall be 48 x 112
  13. Cabinet Size shall be 3'-10" high x 7'-10" wide x 8" deep and weigh 300 lbs. per single face.
  14. Minimum viewing distance: 76'
  15. Maximum Watts per Face (Red): 760
  16. Approved Model: AF-3500 Monochrome Outdoor Full-Matrix Display manufactured by Daktronics Inc.

**EXECUTION**

**3.1 INSTALLATION**

- A. Sign installer shall provide licenses or permits required for the installation of this sign including approval of all authorities having jurisdiction.

**END OF SECTION**



B U I L D I N G   E X C E L L E N C E

SECTION 10 75 00

ALUMINUM FLAGPOLE

GENERAL

- 1.1 The architect should include in this section: aluminum flagpole, with all fittings, accessories, bases and anchorage devices required for a complete installation.

PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.
  - A. Specifications are based on products of Concord Industries, Inc.

2.2 FLAGPOLE

- A. The flagpole shall be fabricated from seamless extruded aluminum tubing complying with ASTM B241, alloy 6063-T6, tensile strength not less than 30,000 psi and a yield point of 25,000 psi. Heat-treat and age hardened after fabrication with a No. 80 grit clear anodized finish.
- B. The commercial ground set cone-tapered flagpole shall be 38 feet- 6inches (20 feet tapered and 18 feet-6 inches straight) with an exposed height of 35 feet-0 inches above ground. The butt diameter is 7 inches with a top diameter of 3.5 inches and a total wall thickness of no more than 0.156 inches.

2.3 FLAGPOLE MOUNTING

- A. The ground mount foundation tube sleeve shall be fabricated from 16 gauge galvanized steel, with a steel base plate whose square dimension shall be at least four inches larger than the inside diameter of the sleeve. The setting plate shall be six inch square steel plate securely welded to the ground spike that is 3/4 inch diameter steel rod not less than 18 inches. The flash collar shall be spun aluminum conforming to Type FC-11 finished to match flagpole shaft with diameter at least one inch larger than sleeve.

2.4 OWNER PROVIDED FLAG

2.5 FITTINGS

- A. Finial shall be a six inch diameter aluminum ball in color to match flagpole shaft.
- B. The Truck shall be cast aluminum revolving and non-fouling, complete with stainless steel ball bearings and two 2-3/8 inch diameter cast nylon sheaves.
- C. Halyards shall be braided polypropylene with locking cover.
- D. Provide two 9 inch cast alum. cleats, with stainless steel socket-head bolts with a cleat cover complete with key operated cylinder lock and shall completely cover cleat when closed. Cover finish shall match flagpole shaft.

- 2.6 Setting material shall be concrete composed of not less than five sacks of Portland cement conforming to ASTM C150, per cubic yard of wet concrete combined with fine aggregate, clean water, and mixed in proportions to attain minimum 28 day compressive strength of not less than 3,000 psi.

2.7 ACCESSORY MATERIALS

- A. Bituminous paint recommended by manufacturer to paint portion of flagpole below ground. Sand, wedges and sealant should all be recommended by manufacturer.



**B U I L D I N G   E X C E L L E N C E**

**EXECUTION**

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- A. Provide each flagpole as a complete unit produced by a single manufacturer, including fittings, accessories, bases and anchorage devices.
  - B. Provide flagpole and installation constructed to withstand a 144 mph windspeed unflagged, and a 120 mph windspeed when flying a 6 feet-0 inch x 10 feet-0 inch flag.
  - C. Pole Construction: Construct pole and ship to site in one piece if possible. If more than one piece is necessary, provide snug-fitting precision joints with self aligning, internal splicing sleeve arrangement for weather-tight, hairline field joints.
  - D. Spiral wrap flagpole with heavy Kraft paper or other protective wrapping, and prepare for shipment in hard fiber tubes or other protective container.
  - E. Deliver flagpole and accessories completely identified for installation procedure. Avoid soiling or damage, and store flagpole unwrapped to avoid staining from wrappings.
  - F. Excavate for foundation concrete to neat clean lines in undisturbed soil. Provide forms where required due to unstable soil conditions. Remove wood, loose soil, rubbish and other foreign matter from excavation, and moisten earth before placing concrete.
  - G. Place concrete immediately after mixing. Place concrete to avoid segregation of mix. Compact concrete in place by use of vibrators to consolidate. Moist cure exposed concrete for not less than seven days or use non-staining curing compound in freezing weather. Finish trowel exposed concrete surface to a smooth, dense surface. Provide positive slope for water runoff to base perimeter.
  - H. Paint below ground portions of flagpole with heavy coat of bituminous paint.
  - I. Install flagpole, with fittings and accessories straight and true in location shown on drawings in accordance with manufacturer's instructions and approved shop drawings.
  - J. Provide positive lightning ground.

**END OF SECTION**



## SECTION 11 05 00

### EQUIPMENT COMMON WORK RESULTS

#### GENERAL

- 1.1 Verify all foodservice specifications, equipment and sample floor plan requirements with HISD food service and facilities staff. Coordinate number of serving stations with the amount of students at each lunch hour as indicated by HISD Food Service and school personnel.
- 1.2 Where applicable, drainage from hot food counter serving line shall be tied under the equipment and routed to adjacent floor drains. (No buckets allowed) All service counters to be on 6" stainless steel legs. No Casters
- 1.3 Coordinate electrical requirements with equipment specifications.
- 1.4 Coordinate conduit for data lines to point of sales at serving lines with HISD food and service technology under floor to avoid power pole installation.
- 1.5 Gas piping for kitchen area should be exposed, not contained within walls.
- 1.6 Learning Commons shelving shall be all wood construction. Height and width of Learning Commons shelving for appropriate age groups shall be reviewed by HISD Learning Commons Services.
- 1.7 Stage curtain material fabric must be permanently and inherently fire resistive. No other fabric types are allowed.
- 1.8 Play equipment shall comply with the most recent ADA requirements with Consumer Products Safety Commission guidelines (CPSC), ASTM and IPEMA.
- 1.9 ***The architect shall specify where possible pre-manufactured casework over custom-built units.***
- 1.10 ***The HISD Program Manager will supply the architect with the approved list of kitchen equipment for campus as needed.***
- 1.11 ***The architect should coordinate defibrillator quantities and locations with HISD Program Manager. The units should be fully recessed and are 13" x13-1/2x 7". The units will be furnished by HISD and installed by the contractor.***

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B U I L D I N G   E X C E L L E N C E

SECTION 11 23 26

LAUNDRY SYSTEMS

GENERAL

- 1.1 The architect should include in this section: commercial washer-extractors and drying tumblers.

PRODUCTS

2.1 APPROVED EQUIPMENT AND MANUFACTURERS

A. Washer-Extractors:

1. The 33-3/8 inch (W) x 55-1/2 inch (H) x 43-5/8 inch (D) washers should be made of a 304 or equal stainless steel cylinder, tub and cover panels with a dry weight capacity of 35 lbs and a wash cylinder volume of 5.76 cu. ft. minimum.
  2. The input voltage should be 208/60/3 3 wire plus ground. The four water supply inlet valves should be 3/4 inch, with 3/4NH male connections. Provide shut-off valves at each inlet with one at 2-3/8 inch drain outlet. Overflow is internally plumbed.
  3. The washer should have eight cylinder speeds, including 1/2 wash speed for processing delicate items. The G-force at highest extract speed is 180 G's.
    - a. The chemical supply system is either a manual filled five compartment dry chemical dispensing system, or an automatic flushing and contain connections for five external supply lines and control signals for eight external supplies.
    - b. The control system includes a programmable microprocessor, 30 programmable cycles, shall be capable of precise temperature controlled fills, contain a thermal cooldown, overnight soak, overflow flush and a drain valve that automatically opens in event of power failure.
  4. The stainless steel trough shall be six feet long with pull out lint screen and three inch no hub.
3. Approved Product/Manufacturer: UniMac Model UWN060T3V

B. Drying Tumblers: Gas

1. The 38-5/8 inch (W) x 53 inch (D) x 76-5/8 inch (H) dryer has a maximum capacity of 75 lbs with a cylinder volume of 22.40 cu. ft.
2. Provide a 3/4 HP (fan) and 1/3 HP (cylinder).
3. The air outlet diameter shall be 8 inches in diameter with an air flow of 920 cfm.
4. The heat source shall be gas, 1/2 inch NPT. Energy requirements include [120 volt single phase] [208 volt, 3-phase].
5. The control system includes eight automatic drying cycles, variable temperature settings, 2-1/2 minute wrinkle free cycle.
6. The lint filter shall be 576 square inches, self cleaning, depositing lint to storage area at bottom of tumbler.
7. Approved Product/Manufacturer: UniMac Model UTO75NQT drying tumbler.

C. Provide three ten bushel yellow glosstex laundry carts.

EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project
- A. Install equipment in accordance with manufacturer's printed instructions.
  - B. Level and adjust for proper operation.

END OF SECTION



B U I L D I N G   E X C E L L E N C E

SECTION 11 31 00

RESIDENTIAL APPLIANCES

GENERAL

- 1.1 The architect should include in this section the following residential appliances: Slide-In Electric Range / Oven, Drop-In Electric Range / Oven, Freestanding Electric Range / Oven, Built-In Electric Cooktop, Vent Hood (30 inch), Vent Hood (30 Inch, ducted), Vent Hood (36 inch), Combination Vent Hood/Microwave Oven, Microwave Oven, Dishwasher, Side by Side Refrigerator/Freezer with Icemaker, Refrigerator with Icemaker, Refrigerator with Top Freezer, Explosion Proof Refrigerator/Freezer, Laundry Equipment (Clothes Washer and Clothes Dryer), Stackable Washer/Dryer, Stackable Laundry Equipment, Undercounter Ice Maker, Undercounter Refrigerator, Freestanding Ice Maker and Ice Bin, Residential Range Fire Suppression System, Undercounter Trash Compactor and Garbage Disposer.

PRODUCTS

2.1 APPLIANCES AND MANUFACTURERS

- A. Slide-In Electric Range should be 36-1/4 inches (H) x 26-5/8 inches (D) x 31-1/4 inches (W) with overhanging porcelain-enameled cooktop, self-cleaning oven and two 8 inch and two 6 inch Plug-In Calrod® Heating Elements.
- B. Drop-in Electric Range / Oven should be 27 inches high x 28-1/4 inches deep x 31-1/4 inches wide with a porcelain-enameled lift-up overhanging cooktop, two 8 inch and two 6 inch plug-in heating elements, removable one-piece drip bowls and is self-cleaning.
- C. Freestanding Electric Range / Oven shall be 30 inches, unless noted otherwise with features such as a 5.3 Cu. Ft. oven capacity, self-cleaning, one-piece patterned glass-ceramic upswept cooktop, two 6 inch (with Warming Option) and one 6 inch/9 inch heating element and one 9-1/2 inch heating element with a TrueTemp™ system with QuickSet V Controls and Six-Pass Power Bake Element
- D. Built-In Electric Cooktop shall be ADA compliant, 3-1/4 inches (H) x 21-3/8 inches (D) x 29-3/4 inches (W) and feature electronic touch controls, no pulse elements, a ceramic glass cooktop, pan presence and size sensor and ribbon heating elements.
- E. Vent Hood shall be 30 inches, unless noted otherwise and non-vented, re-circulating.
- F. Vent Hood shall be 30 inches wide by 20 inches deep and have a height of three inches. The standard features include two 50 watt cleanable halogen light fixtures with High, Medium and Low settings recessed and visible only under the hood and a ducted three speed air mover.
  - 1. The standard duct size is 3-1/4 in. x ten in., or seven in round with a 330 sq. in.filter.
  - 2. The maximum connected load shall be 1.4 amps, 120 volts.
- G. Vent Hood shall be 4-3/4 inches high x 35-7/8 inches wide x 20 inches deep
- H. Combination Vent Hood/Microwave Oven shall have a capacity of 1.5 cu. ft. oven capacity, recirculating vent and 950 watts.
  - 1. Electrical Input – 120V Amperage: 15.
- I. Microwave Oven shall have a capacity of 2.0 Cu. Ft. and shall be 1200 Watts.
  - 1. Require a warranty for one year for the product and a limited ten (10) yr. magnetron warranty.
  - 2. Electrical Input 120V Amperage is 13.9.
- J. Dishwasher shall have a stainless steel interior, be ADA and energy star compliant and have dimensions of 32-7/20 inches (H) x 24 inches (D) x 24 inches (W) with 120v; 60 Hz; 9.1 A.
- K. Side-by-Side Refrigerator/Freezer with Icemaker has a 25.0 cu. ft. capacity (Fresh Food 15.46 cu ft/Freezer 9.56 cu ft), is Energy Star® Qualified and is 120V ; 60Hz ; 15A.
- L. Refrigerator with Top Freezer is a top mount no-frost refrigerator with optional icemaker. The refrigerator has a 21.7 cu. ft. Capacity (Fresh Food 15.35 cu. ft. / Freezer 6.35 cu.





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- ft.). The electrical requirements are 120v; 60Hz; 15A. Special Feature: Provide locks on doors of units shown on drawings as being "lockable".
- N. Refrigerator with Top Freezer/Icemaker shall have a 21 cu. ft. capacity (Fresh Food 14.9 cu ft/Freezer 6.1 cu ft) with Power requirements of 120V; 60 Hz, 15A.
- O. Explosion Proof Refrigerator/Freezer shall have a key On/Off Switch: For secure operation, a highly visible and accurate displaying degree C scale in tenths of a degree.
1. Cabinet Walls should be constructed of 22 gauge cold roll steel (exterior) and 26 gauge galvanized steel (interior) for lasting durability. Both surfaces finished with high luster baked-enamel coatings.
  2. Insulation shall be 2-3/8 inches foamed-in-place urethane (CFC-Free) and have solid urethane foam insulated doors, with sturdy cam-lift hinges with "lock-open" feature for "hands-free" access to stored material.
- P. Laundry Equipment:
1. Clothes Washer should have a capacity of 3.5 cubic feet with multiple wash cycles and have approximate dimensions of 42 inches high x 25-1/2 inches deep x 27 inches wide.
  2. Clothes Dryer (Electric) should have a cubic capacity of 7.0 cubic feet with a deluxe dryer rack. The dryer should have rotary electronic controls and requires 208 V, 4,400W, 22A, 60 Hz.
- Q. Stackable Washer/Dryer Combo is approximately (H x D x W): 71-7/8 inches x 27-1/2 inches x 27 inches with a washer capacity of 3.34 cubic feet and a dryer capacity of 6 cubic feet.
- R. Stackable Laundry Equipment:
1. Clothes Washer should be 2.2 cubic feet with stainless steel basket and a 1400 RPM spin speed
  2. Clothes Dryer (Electric) should have a 4.0 cubic feet capacity.
- S. Undercounter Ice Maker shall be a self-contained undercounter design, ADA accessible height, air cooled with an ice cube storage capacity of 27 pounds and an ice production capacity (per day) of 55 pounds.
- T. Undercounter Refrigerator shall have a capacity of 4.3 cu. ft. capacity (Fresh Food 3.89 cu. ft. / Freezer 0.42 cu. ft.) with a nominal size of 32-3/4 inches (H), 21 inches (D) and 20-1/2 inches (W).
- U. Freestanding Ice Maker and Ice Bin:
1. Ice Maker: Top mount air-cooled shall be 18-7/8 inches wide by 20-3/4 inches deep by 17 inches high and shall be able to produce 400 pounds of ice per day.
  2. Ice Storage Bin shall have a cubic volume of 20.8 cubic feet with a maximum bin capacity of 660 pounds.
- V. Residential Range Fire Suppression System shall have an automatic shutdown of cooktop, while exhaust fan keeps operating with an Ansulox Low pH wet agent. The operating pressure is 100psi at 70° F.
- W. Undercounter Trash Compactor should have a capacity of 1.4 cu. ft.
- X. Garbage Disposers:

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- A. Examine areas where appliances are to be installed to ensure proper opening sizes and that areas are ready to receive appliance installation.
  - B. Ensure that proper utilities are in place.
  - C. Install all appliances and equipment in accordance with manufacturer's printed instructions.
  - D. Adjust appliances and equipment for proper operation.

### END OF SECTION



## SECTION 11 51 23

### LEARNING COMMONS SHELVING

#### GENERAL

#### PRODUCTS

##### 2.1 MATERIALS

- A. The basis of the specification is for Tesco Industries. Catalog description for indicated model number constitutes requirements, unless otherwise specified.
- B. Wood Species:
  - 1. All wood used in the construction of furniture and cabinets shall be northern grown red oak and shall be selected from seasoned, kiln-dried materials free from structural imperfections. The moisture content at time of fabrication shall range from 5 percent to 7 percent. All woods shall be selected for uniformity of grain and color. All selected wood used for internal parts shall be structurally sound.
  - 2. All plywood used shall be of quality as specified by the American Plywood Association. All facing materials shall be no less than 1/28 inch thickness after sanding. Face veneers (i.e. veneers facing an exterior surface) shall be select, plain sliced, slip matched, to selected species.
- C. Wood Finishes:
  - 1. In the manufacturing process after parts are cut and ready to finish, all solid oak panels and shelves are dipped in Nelsonite 15B02 wood stabilizer. Prior to assembly, parts pass through a 5 head wide belt sander which has 100, 120, 150, 180, and 220 grit sand paper. Parts are then inspected, filled and hand sanded as necessary until thoroughly cleaned.
    - a. After sanding, the parts are roll coated with 100 percent solid U.V. stain, wiped, U.V. oven cured and then pass through a deburring station.
    - b. Then parts are roll coated with a 100 percent solid U.V. sealer, U.V. oven cured, then passed through a final deburring station.
    - c. Next parts are roll coated with a final 100 percent U.V. clear top coat and then U.V. oven cured.
    - d. All sealers and finishes must be U.V. and applied by a flat line roll coat system to insure a uniform and environmentally safe finish.

##### 2.2 CONSTRUCTION

- A. Shelving:
  - 1. All vertical uprights of learning commons shelving shall be a minimum of 1 inch thick, kiln dried solid oak, glued up in strips no less than 1-1/2 inches and no more than 4 inches, and free of all imperfections. Veneered plywood of any type and / or uprights of less than 1 inch thickness will not be acceptable.
  - 2. The 2 inch canopy cornice shall be constructed of an oak plywood top with solid oak facia strips which are machine applied to front and back edges. Bolting cleats are attached by means of wood screws and glued construction. All 84 inch single face shelving shall have a 1/4 inch finished top cap.
  - 3. Continuous top shelving shall have a 2 inch deep dovetailed top frame provided with countersunk holes for screwing down a continuous top made of solid core with standard (Statesman) internal straight solid oak edge bands. Bases shall be of solid hardwood 3-1/2 inches in height with dovetail joints.
  - 4. Shelving units shall be standard with back panels on single faced shelving and divider panels on double faced units. Backs shall be 1/4 inch thick oak plywood and finished on one side for single faced units and both sides for double faced units. Backs shall be recessed in a dado on all sides. End panels shall be joined



## BUILDING EXCELLENCE

to cornice and base by means of metal ferrules embedded in the end panels with 5/16 inch hex head bolts passing through the cleats on the cornice and the sides of the base and engaging the ferrules. Filler and corner units shall be supplied as needed to complete shelving runs as shown on the plan.

5. Shelves shall be a minimum of 3/4 inch thick, edge glued, solid oak strips no less than 1-1/2 inches wide nor more than 4 inches wide. The underside of all shelves shall be neatly routed to receive the metal supporting pins. Adjustment of shelves shall be of pin hole style construction with adjustments at 1-1/4 inch increments, which provides for a cleaner less conspicuous installation. Shelving units should be no wider than 36 inches.
6. Adder shelving units shall be joined by means of 5/16 inch hex head bolts passing through both bases and the intermediate upright, both cleats on the cornices and the intermediate upright, and then secured with washers and nuts.
7. All lower shelving shall be on casters. All shelving 72 inches and higher will have a 2 inch wood veneer canopy top to match shelving unit. The canopy top shall be finished on the top and bottom if these cabinets are visible from the second floor overlook of the Learning Commons.
8. When shelving is located along Learning Commons perimeter walls, coordinate with shelving to provide outlets in the back of units.
9. Shelf arrangements per face shall be as follows:

<u>Height</u>	<u>Base</u>	<u>Adjustable</u>	<u>Total</u>
36 inches	1	1	2
42 inches	1	2	3
48 inches	1	2 (3 available)	3 (or 4)
60 inches	1	4	5
72 inches	1	5	6
84 inches	1	6	7
96 inches	1	7	8

10. Units may be ordered with sloped magazine shelves, or picture book shelves. The Number of adjustable shelves will vary when optional shelf styles are ordered.
- B. Book Truck: Buckstaff Model No. 9127-000, Descending Platform Book Truck 992, Modified to 21 inches, to be verified in field.

### EXECUTION

#### 3.1 INSTALLATION

- A. Install shelving under factory supervision. Provide all bolts, blocking, miscellaneous items necessary for a complete installation.
- B. Installation shall be plumb and level, properly aligned between sections and neatly finished at walls and doors.
- C. After completion leave installation clean and adjusted. Remove all debris.

### END OF SECTION



B U I L D I N G   E X C E L L E N C E

SECTION 11 61 43

CURTAINS AT STAGE

GENERAL

- 1.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.

PRODUCTS

2.1 MATERIALS

- A. The Valance, front curtain, and tormentor legs shall be "Memorable" velour finish fabric, flameproofed, 25 ounce. Color from manufacturer's full line of available colors.
  - 1. Side Cyclorama Legs, Rear Cyclorama, and Borders: "Princess" velour fabric, flameproofed, 16 oz. Color from manufacturer's full line of available colors.
  - 2. Black box Curtains: (Floor to Pipe Batten): "Princess" velour finish fabric, flameproofed, 16 oz. Color from manufacturer's full line of available colors.
- B. Curtain Tracks:
  - 1. The front curtain track should be a #400 Heavy Duty Straight Complete.
  - 2. The rear cyclorama tracks shall be a #101 Walkalong.
  - 3. The side leg and tracks shall have #110S Track with #10 Pivot Device.
- C. Side Legs Valance and Border Pipes shall have one inch diameter pipes and should be 7 feet long.

EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- A. Fabricate curtains using multiple widths of 54 inch wide velour without splicing within any panel.
  - B. Curtains shall be 50 percent fullness. Curtains shall be on top attached to 3-1/2 inch nine lb. jute webbing with no less than two rows of stitching. Pleats shall be 12 inches on center.
  - C. Curtains shall have #3 brass grommets with "S" hooks or tie line for attachment.
  - D. Curtain hem shall be five inches with chain pocket and 2/9 chain. Outside hems shall be four inches. Border hems shall be four inches.
  - E. All seams shall be five thread serge with all salvage material removed.
  - F. Center hem of front and concert curtains shall be one foot.
  - G. All equipment shall be installed securely by hanging from structural members. Provide all necessary steel members, hangers and supports for the support chains, if required.
  - H. Curtains shall be finished properly in the best manner and method of the industry; and after hanging, adjust for smooth quiet operation, thoroughly brushed to remove all dust, loose threads, loose fabric lint, etc. Wrinkles shall be allowed to fall out naturally.

END OF SECTION



## BUILDING EXCELLENCE

### SECTION 11 66 23

#### GYMNASIUM EQUIPMENT

##### GENERAL

- 1.1 The architect should include in this section: basketball backstop supports, basketball backstops, volleyball equipment, wall pads (mats), roll-up divider curtain, and walk-along draw curtain.
- 1.2 Require a warranty for the work specified for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
  - A. Defects shall include rough or difficult operation, noisy operation, loose or missing parts, and noticeable deterioration of finish.

##### PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.

##### 2.2 MATERIALS

- A. There should be six Basketball Backstops, Goals, and Winches in the Gymnasium.
  1. Backstops should be forward fold pipe construction with 6-5/8 inch OD suspension support. Sway Braces and Stiffeners shall be 2-3/8 inch OD pipe and 1-7/8 inch OD additional sway braces.
  2. The gym should have two adjustable- No. 00224-000 1/2 inch tempered glass backboards set in continuous vinyl rubber cushioned aluminum frame and safety pad and four- No. 00211-200 Rectangular Fiberglass Bank with Safety Pad.
- B. The gymnasium should have six Backstop Winches
  1. Winch shall be worm gear type designed to hold backstop at any position when raising or lowering. The winch shall be supported by a heavy formed steel main frame for ease of mounting. Worm gear shall be a special forged bronze alloy providing a 30 to 1 ratio. Thrust of the worm shall be absorbed by a hardened steel ball bearing mounted in cast high tensile aluminum support housing. Input worm shall be machined from high carbon steel with hardened contact surfaces. Input shaft shall not extend beyond winch cover to reduce the possibility of injury from an extended type shaft. Input shaft shall be a 3/4 inch square for use with special socket type handle provided with each pair of backstops or with portable electric winch operator specified elsewhere. Cast iron cable storage drum shall be provided with a machined hole and set screw arrangement for securing cable to drum. Winch housing shall be finished in a medium gray enamel. Winch shall be provided for wall mounting with a 2 inch x 10 inch x 2 feet-6 inch long yellow pine wood pad for mounting to walls where required. Pad shall have chamfered edges and shall be finished with two coats of clear natural gloss lacquer.
  2. Provide one winch located for each backstop in Gymnasium.
- C. Provide one Backstop Winch Operator, like Porter No. 706, with key switch operation with 1/2 HP, 60 HZ, 120V and single phase.
- D. Design two Volleyball courts per gymnasium four end uprights. Use S1 carbon poles provided by Sports Imports. The nets should be like model HM-50 and there should be one net per court. The four floor plates and sleeves are similar to Model KA25. Provide four required volleyball post pads.



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## BUILDING EXCELLENCE

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- E. Badminton Equipment includes five end uprights, four nets, four floor plates and sleeves and five badminton post pads.
- F. Wall Padding (Wainscot) consists of two inch thick panels located at walls behind each competition basketball backstop. Each pad shall be 2 feet wide x 6 feet high, unless noted. Panels shall be constructed of two inch thick Bonded Foam Filler (firm), with a 6 lb. density, cemented to 3/8 inch thick Backing Board and covered with Flame Retardant, vinyl-coated polyester folded and stapled securely to back of oriented strand board. A one inch nailing margin shall be provided to top and bottom for securing panels to the wall.
  - 1. Cover material shall have a tear strength of 100 P.S.I. and shall be mildew and rot resistant and fortified with an infection combating fungicide.
  - 2. All cutouts for electrical, if any, shall be made in the field to fit job conditions.
  - 3. Provide six pads behind each basketball goal for a total length of 12 feet, unless indicated otherwise.
- G. Roll-Up Divider Curtain:
  - 1. For the lower 2/3 of height of curtain shall be "Flexivide II" heavy vinyl coated polyester (solid), 22 oz. per square yard material in a manufacturer's standard color and the top 1/3 of curtain shall be "Flexinet" special PVC coated mesh designed for air transfer in dividers, with an approximate 80 percent to 85 percent open, air breathing area.
  - 2. Curtain Support includes a 3-1/2 inch diameter batten, supported by five inch wide, heavy duty commercial grade polyester belts located on 20 feet maximum centers. Belts shall roll up smoothly and wrap precisely due to sturdy and adjustable belt tensioning/tracking guides.
  - 3. The line shaft shall be driven by a heavy duty motor furnished with automatic overload protection of horsepower and type recommended by manufacturer to suit intended use. Gear reducer shall be filled with oil and equipped with high quality Buna-M lip seals for long life and maintenance free service. Special rotary counting limit switches shall be an integral part of the operator. Operator shall be pre-wired with a 54 inch long rubber covered cable with polarized plug attached; matching flange type receptacle shall be mounted in a four inch square box cover (box by electrical contractor). Key switch shall be furnished complete with a stainless steel cover plate for mounting into a four inch square by 3-1/2 inch deep wall junction box which is to be provided by the electrical contractor. For safety, key switch shall be located so that the operator has full view of the curtain while being operated
  - 4. Examine existing support devices to determine if they are adequate to support the new curtain. If they are not, provide overhead support devices and fasteners as recommended by the curtain manufacturer.
- H. The Divider Curtain can either be :
  - 1. Located between basketball practice courts, should be bi-parting; height to vary from floor to top of free standing bleachers and made from a solid "Flexivide" 18 oz. vinyl fabric. The track should be an enclosed formed channel, heavy duty type, 16 gauge Galvanized Steel. Provide strap to secure to wall-mounted screw eye.
  - 2. Divider Curtain should be bi-parting, walk-draw, with equal sections. The lower section shall be 8'-0" high above finish floor and shall be "Flexivide" 19 ounce vinyl fabric. The upper section shall be "Fleximesh" material shall be 7-ounce per square yard open polyester interlocking grid weave coated with PVC with 45 percent to 50 percent open area (45% to 50%).
    - a. The track is an enclosed formed channel, heavy duty type, 16 gauge galvanized steel suspended from building structure, and 4-wheel ball bearing swivel type master carriers with dual nylon rollers with swivel type hook for attachment to welded twist line coil chain and S-hooks.





## BUILDING EXCELLENCE

Bottom of curtain shall contain chain weight affixed at each end of curtain.

- I. Wrestling Mat Lift
  1. Mat Lifter construction shall consist of a welded steel frame, with all drive and lifting mechanism enclosed in a sheet metal housing. Unit shall be a two cable system to assure balanced operation. Cables shall be attached to the welded frame and pass through sheave blocks attached to a load bar, which shall be connected to a fabric sling. Standard unit, load bar, and sling shall be capable of supporting two standard 42' x 42' wrestling mat (weighing approximately 1 lb./sq. ft.) with a 5 to 1 safety ratio. Each unit shall consist of a 210:1 ratio double reduction worm-worm attached to an instantly reversing 2 HP motor, operating with 208/230/460 volts in 3-phase, including a 6 lb. per foot electric safety brake. Lifting and lowering speed shall be approximately 5 feet per minute. Lifting drums shall be machine synchronized for cable wrap and driven by a 210:1 ratio gearbox. Drum shaft shall be 1-7/16" diameter cold-finished steel.
  2. Two steel lift cables shall be 5/16" 6-strand, 37 wires per strand, fiber core. Cables shall be rated at 1704 lbs. each at a 5-to-1-safety factor. Load bar shall be connected to two 22 oz. per square yard vinyl fabric slings with heavy-duty straps and fasteners. Standard sling color is black; other colors are available by special request. Fabric sling incorporates safety straps that wrap completely around mats. Safety straps prevent mat from falling should fabric sling become torn. For safety purposes, sling capacity shall govern the lift capacity of the system. Motor, drive assembly, and all control mechanisms shall be encased in a fireproof safety cover. Movement control shall be by surface mounted control enclosure with limit switches. Approximate unit weight shall be 1,900 lb.
  3. Structural support members and wall connections by others to meet building and unit requirements

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Furnish volleyball post sleeves to concrete contractor for setting in concrete footings.
  - B. Inspect overhead structure to ensure safe and stable installation of ceiling suspended units.
  - C. Verify clearances for folding units prior to installation.
  - D. Verify volleyball net and badminton net post sleeves are properly set in concrete footings.
  - E. Attach backstops securely to structure in accordance with manufacturer's printed instructions. Locate manual hoists as shown.
  - F. Make final adjustment after installation and clean all support piping of dirt and other substances which may affect final finish.

### END OF SECTION





## BUILDING EXCELLENCE

### SECTION 11 66 43

#### INDOOR SCOREBOARDS

##### GENERAL

- 1.1 The architect should include in this section: combination basketball, volleyball, and wrestling scoreboards.
- 1.2 Require a warranty for the work specified for five years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship. LED digits shall be guaranteed for ten years against defects in materials.
  - A. Defects shall include, loose or missing parts, severe deterioration of finish, and faulty operation, including, but not limited to burned out LED lamps.

##### PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.
  - A. Specifications are based on products of The Spectrum Corporation, Houston, Texas.
  - B. Acceptable manufactures include Nevco.
- 2.2 BASKETBALL / VOLLEYBALL / WRESTLING SCOREBOARDS
  - A. The home and visitor score shall be incremented by one from 0 to 199 and the board shall contain possession indicators for each team. Score may also be instantly cleared and reset by keypad entry to any score 0 to 199.
  - B. Clock shall display time remaining up to 99:59. Clock shall be capable of counting up or down, and clock may be instantly reset to any desired time when clock is turned off. Fractional seconds feature shows to 1/100 of a second, the time left in a period.
  - C. Quarters, 1-4, shall be displayed using a numeral lampbank.
  - D. Face-Mounted Horn shall sound manually when clock is turned off and can sound automatically at end of period.
  - E. Automatic substitution feature shall allow the operator to program the horn to sound automatically the next time the clock is turned off thus altering officials of substitution.
  - F. Time-out timer shall display time remaining in the time-out. A very short horn blast shall warn of there being 15 seconds remaining in the time-out. The control box speaker shall signal the end of the time-out.
  - G. Player's number who just committed a foul and his number of fouls shall be instantly posted using a keypad number entry. Team fouls shall be displayed from 0 to 99 for both home and visiting teams. Bonus shall start automatically at the preprogrammed 5th or 7th team foul.
  - H. Dimensions: Scoreboard shall be ten feet in length by five feet in height by five inches in depth and shall weigh 175 lbs. Clock and score numeral displays shall be 14 inches high. Period, Fouls (won), (bout), Player number (game), (weight) numeral displays shall be ten inches high.
  - I. Scoreboard face and scoreboard cabinet shall be made of 0.080 inch thick aluminum with premium urethane finish. Colors shall be from manufacturer's standard color chart.
  - J. LED Digits (Light Emitting Diode): Digits shall utilize superbright LED lamps to form 14 inch amber Score digits and 14 inch red Clock digits. Bonus indicators are red LED, Possession indicators, colon and decimal are amber LED. Digits and indicators average 100,000 hours of lamp life (11 years at 24 hours per day) and provide a maintenance-



## BUILDING EXCELLENCE

- free, energy efficient alternative to incandescent light bulbs. LED digits are covered with 1/8 inch Lexan shields to protect and absorb ball impacts.
- K. All electronic components shall be solid state. Component module shall be accessible from the front of the scoreboard.
  - L. Operator's control console shall not require 120 VAC electrical power. The low voltage control console shall be housed in a protective, weather resistant carry case. A single ten feet long, three wire, low voltage control cable shall unplug and store inside the carrying case. Furnish two control consoles with carrying cases.
  - M. Switching shall be accomplished by solid state membrane switching technology; each switch having a life of at least five million operations. All switches shall be "splash proof" and environmentally sealed by a combination of layers of a velvet grain, highly durable, polycarbonate and glossy polyester. All switches are defined by the 0.020 inch thick black velvet grain polycarbonate "switch locator" overlay. The numeric keypad, clock on-off, and score switches shall give "tactile feedback" to recognition. Sound shall be emitted by all switches to let the operator know a switch has occurred. The clock on-off switch shall be environmentally sealed "bat type" toggle switch. Visual feedback shall be accomplished by LED indicators (green) for the clock and other selected switches (red.) This gives three methods of feedback to the operator: Tactile (feel), Audio (sound), LED/Coding (sight).
  - N. The control panel switch functions shall be changed (depending on the type of scoreboard being used; i.e., basketball, volleyball, football, soccer, wrestling, etc.) by removing a single switch label insert from under the overlay and re-inserting the appropriate switch label insert. The insert shall slide in and out and is locked in place. (This allows a single control to operate multiple scoreboards of different sports). Each sport has a single switch label insert.
  - O. Scoreboard shall require not more than 2.5 amperes at 120 VAC, 60 Hz.
  - P. Provide two scoreboards in the main gym and one basketball scoreboard in the Auxiliary Gymnasium opposite bleachers.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Install each scoreboard on framing and supports as indicated on drawings. Refer to Section 03 30 00, Cast-In-Place Concrete for concrete footings of scoreboard posts as shown or required. Refer to Section 05 50 00, Miscellaneous Metals for steel items incidental to framing and support of scoreboards as shown or required.
  - B. Provide remote locations for additional controller hook-ups as indicated.

### END OF SECTION



## SECTION 11 68 13

### PLAYGROUND EQUIPMENT

#### GENERAL

- 1.1 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.2 All Playstructures and/or equipment shall conform in kind and quality to the specifications set forth in these specifications and will be free of defects in manufacturing and material. As a further indication of quality the following warranties shall be standard for the product:
  - A. 100-Year Limited Warranty for all aluminum posts, clamps, beams and caps, against structural failure due to corrosion/natural deterioration or manufacturing defects. This warranty does not include any cosmetic issues or wear and tear from normal use.
  - B. 15-Year Limited Warranty for all plastic and steel components, including plastic border materials, against structural failure due to corrosion/natural deterioration or manufacturing defects. This warranty does not include any cosmetic issues or wear and tear from normal use.
  - C. 15-Year Limited Warranty for all PVC-coating against structural failure due to natural deterioration or manufacturing defects. This warranty does not include any cosmetic issues or wear and tear from normal use.
  - D. Three Year Limited Warranty for all other parts, ie: Moving parts, Swing seats and hangers; Track ride trolleys and bumpers; all rocking equipment, etc. against failure due to corrosion/natural deterioration or manufacturing defects. This warranty does not include any cosmetic issues or wear and tear from normal use.

#### PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.
- 2.2 MATERIALS AND COMPONENTS
  - A. Playstructures shall be structurally sound and suitable for safe play. Durability shall be ensured on all steel parts by the use of time-tested coatings such as zinc plating, zinc-nickel plating, powdercoating, PVC-coating, etc.
  - B. Primary Fasteners shall be socketed and pinned tamperproof in design, stainless steel (SST) in accordance with ASTM F-879, unless otherwise indicated. All primary fasteners shall include a locking patch type material that will meet the minimum torque requirements of IFI-125. Manufacturer to provide special tools for pinned hex fasteners.
  - C. All metal components to receive PVC-Coating shall be thoroughly cleaned in a hot phosphatizing pressure washer, then primed with a clear acrylic thermosetting solution. Primed parts shall be preheated prior to dipping in U.V. stabilized, liquid poly vinyl chloride, then salt cured at approximately 400 degrees. The finished coating shall be approximately 0.080 +/- 0.020 inch thick at an 85 durometer hardness and shall have a matte finish selected from manufacturer's standard colors.
  - D. All metal components to be powdercoated shall be free of excess weld and spatter. Parts shall be thoroughly cleaned in a 6-Stage Pretreatment system (4 or 5 stage pretreatment is not acceptable) with a hot phosphatizing bath and a non-chrome seal for corrosion resistance, and then thoroughly dried. Powdercoating shall be electrostatically applied and oven cured at 350 degrees F. Average thickness of 0.004 inch shall be Super Surable TGIC (Standard TGIC polyester powdercoat or any other finish is not acceptable). Super Durable TGIC polyester powder shall be specially formulated for optimum U.V. stability and glossiness and shall meet or exceed ASTM Standards for:



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- Adhesion (D-3359B), Hardness (D-3363), Impact (D-2794), Salt Spray resistance (B-117), and paint Line shall employ a "checkered" adhesion test daily.
- E. The decks shall be of modular design and have 5/16 inch diameter holes on the standing surface. There shall be four slots in each face to accommodate face mounting of components. Decks shall be manufactured from a single piece of low carbon 12 GA (0.105 inch) sheet steel (expanded metal decks and sheet steel thinner than 12 GA will not be accepted) conforming to ASTM A-569. The sheet shall be perforated then flanged formed and reinforced as necessary to ensure structural integrity. The unit shall then be PVC-coated brown only. Decks shall be designed so that all sides are flush with the outside edge of the supporting posts.
- F. Rotationally Molded Poly Parts shall be molded using prime compounded linear low-density polyethylene (high density polyethylene is not acceptable) with a tensile strength of 2500 psi in accordance with ASTM D-638 and with color and UV-stabilizing additives. Wall thickness varies by product from 0.187 inch (3/16 inch) to 0.312 inch (5/16 inch).
- G. Polyethylene Parts shall be manufactured from high-density polyethylene that has been specially formulated for optimum U.V. stability and color retention. Products shall meet or exceed density of 0.933 G/cc in accordance with ASTM D-1505, tensile strength of 2400 PSI in accordance with ASTM D-638. Some Polyethylene parts shall available in a two-color product with two 0.125 inch thick exterior layers over a 0.500 inch interior core of a contrasting color. Colors will be selected from manufacturer's standard colors.
- H. Unless otherwise specified, the bury on all footings shall be 34 inches below Finished Grade (FG) on all in-ground play events/posts. Other types of anchoring are available upon request.
- I. Post length shall vary depending upon the intended use and shall be a minimum of 42 inches above the deck height. All posts shall be powdercoated with Super Durable Powdercoat to from standard available colors. All posts shall have a "finished grade marker" positioned on the post identifying the 34 inch bury line required for correct installation and the top of the loose fill protective surfacing. Top caps for posts shall be aluminum die cast (plastic caps are not acceptable) from 369.1 alloy and powdercoated with Super Durable Powdercoat to match the post color. All caps shall be factory installed and secured in place with three self-sealing rivets. A molded low-density polyethylene cap, with drain holes, shall be pressed onto the bottom end of the post to increase the footing area. Crushed, dimpled or uncapped bottom posts ends are not acceptable.
- J. Arch Posts shall be aluminum and shall be manufactured from 6005-T5 alloy. The arch shall be formed to a 21 inch centerline radius to complement the 42 inch center-to-center module. The arch shall be of one continuous piece construction. There shall be no welds or additional pieces mechanically fastened to manufacture the arch. Each arch shall be designed to provide a minimum of 90-1/2 inches clear span from the deck to the inside of the arch at the radius peak. Arches shall be powdercoated from standard colors.
- K. All clamps, unless otherwise noted, shall be die cast using a 369.1 aluminum alloy and have the following mechanical properties: Ultimate Tensile: 47,000 PSI, Yield Strength: 28,000 PSI, Elongation: 7% in two inches, Shear Strength: 29,000 PSI, and an Endurance Limit: 20,000 PSI. Each functional clamp assembly shall have an appropriate number of half clamps and shall be fastened to mating parts with (2) 3/8 inch x 1-1/8 inch hex-pin cap screws (SST) and two stainless steel (SST) recessed "T" nuts. A 1/4 inch aluminum drive rivet w/stainless steel pin is used to insure a secure fit to the post. Hinged clamps, mounting systems bolted into one wall of the support pipe and steel clamps are not acceptable.
1. Clamps shall have three functional applications: as an offset hanger, deck hanger and Hanger clamp assembly.
- L. Slides shall be rotomolded from ldppe as specified and shall have full hoods with integrated handhold and sliding footers. Slides without sliding footers and using bars or pipes for hoods or having full hoods without integrated hand holds will not be accepted. All slides shall mount to the deck face. Slides mounting to the top of the deck are not acceptable. All 72 inch spyro slides shall be one piece with a one-piece full hood.



## BUILDING EXCELLENCE

- M. Activity Panels shall be 3/4 inch thick high-density polyethylene with color throughout the thickness of the product. All graphics on activity panels shall be routed in to expose the middle color of the sandwiched two-color polyethylene. Decals are not acceptable for graphics on activity panels. All activity panels shall be mounted to the post with a clamp system as specified and to the face of the deck with vandal proof hex pin cap screws and hex pin flange nuts. Hex pin bolts and hex nuts are not acceptable.
- N. Climbers shall have 3/4 inch thick high-density polyethylene handholds when required to limit opening from deck to 15 inch width as required by ASTM. Pipe handholds or arches will not be accepted.
- O. Shade Canopy shall be four layered, triangular panels of breathable Shadesure fabric blocking up to 90% of the sun's harmful rays and keeps area up to 30 degrees F cooler. The posts are from the manufacturer and are designed for attachment of shade canopy fabric. The size should be 18 feet x 18 feet x 8 feet high.
- P. The Roof Structure is one-piece pyramid shaped polyethylene with a manufacturer's poly "cupola" style cap and is 94 inches square.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project
  - A. Installer's Qualification: Manufacturer or company specializing in and having minimum of three years experience installing products of type specified.
  - B. Fit, align, and adjust assemblies level and plumb; provide smooth operation.
  - C. Clean assemblies of dirt and grease.

### END OF SECTION



**B U I L D I N G   E X C E L L E N C E**

**SECTION 11 68 23.13**

**OUTDOOR BASKETBALL EQUIPMENT**

**GENERAL**

- 1.1 Require a warranty for the work specified for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.

**PRODUCTS**

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.
- 2.2 MATERIALS AND COMPONENTS
  - A. Basketball Backstops are adjustable from approximately 7'-0" to 10'-0" height (adjustable in 4 inch increments) and are made from a 3-1/2 inch O.D. heavy-wall steel vertical support tube. Pivoting steel tube extensions shall extend from and pivot on each side of the support tube and counterweight assembly, secured with pin connection with hole for padlock.
  - B. The molded fiberglass fan backboard shall be official size (54 inches by 39 inches) and shape. Perimeter flange and structural rib pattern shall be 1-1/2 inch deep. Tensile strength of board shall be 8,900 to 11,700 psi with 23 percent to 27 percent fiberglass content by weight. Threaded inserts shall be molded into backside of backboard at standard mounting centers. Backside of backboard shall be steel reinforced to transfer goal impact loading directly to structure.
  - C. The goal shall be fabricated from 5/8 inch diameter cold drawn alloy steel round formed to an 18 inch inside diameter ring. Inside of ring shall be positioned 6 inches from face of backboard by heavy, L-shaped, formed steel mounting plate with 4 inch by 3 inch mounting hole centers. Goal shall be rigidly braced by means of a 1/2 inch diameter cold drawn alloy steel round formed and welded in position for maximum support. Rim shall be provided with twelve "no-tie" net attachment clips for net attachment. Goal shall be finished in a durable official orange enamel finish. Goal shall be furnished with high quality white nylon net and plated mounting hardware.
  - D. Protective goal padding for each basketball backstop and an in-ground sleeve, set in 3000 psi at 28 days concrete as instructed by manufacturer.

**EXECUTION**

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project
  - A. Install rubber mats over concrete as recommend by manufacturer.
  - B. Care shall be taken to prevent damage. Damaged components will not be accepted.
  - C. Thoroughly clean all completed work and protect surfaces until accepted.

**END OF SECTION**





## BUILDING EXCELLENCE

### SECTION 11 68 23.33

#### TENNIS EQUIPMENT

##### GENERAL

- 1.1 The architect should include in this section: tennis court net posts, nets, with center straps, windscreens, practice walls (beat walls), players benches and umpire stands.
- 1.2 Require a warranty for the work specified for three years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship

##### PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.
- 2.2 NET POSTS AND NETS
  - A. Tennis Nets shall be 1-3/4 inch square galvanized chain link mesh, or fabric mesh as indicated on drawings. Provide net tie cables with a center tie down, double grommets on top binding and a 47 inch by 7/32 inch vinyl coated steel cable.
  - B. Tennis Posts shall be 4-1/2 inch O. D. galvanized pipe 6'-6" long for official 3'-6" above and 3 foot below ground level.
- 2.3 TENNIS COURT WINDSCREENS
  - A. Windscreens are custom made 100 percent leno polypropylene open mesh fabric with an 80 percent windbreak. The fabric weight is 6 ounces per square yard with a tensile strength of 299 x 204. Extra strength hems are constructed with 28 ounce vinyl inserts double sewn to 1-1/2 inches wide and include #2 brass grommets spaced at 18 inch intervals. The green, unless otherwise noted, screens have a dimensional tolerance of 1/2 inch.
- 2.4 PRACTICE WALLS (BEAT WALLS)
  - A. Practice walls shall be made of 4 feet x 8 feet x 3/4 inch thick APA Medium Density Overlay (MDO) board and S4S Grade 2 Wolmanized CCA-4 Southern Pine. The rails shall be made of 1-5/8 inch diameter Schedule 40 galvanized pipe with 5/16 inch diameter x 5 inch long galvanized bolts with two 5/16 inch x 1-1/2 inch galvanized cut washers and 5/16 inch nut per bolt. Nails shall be 8d hot dipped galvanized spiral or ring shank nails and plywood screws shall be exterior decking screws #8 x 2 inch coarse thread Dacrotized screws.
  - B. The walls shall receive a primer coat of oil base exterior wood primer paint (green color), followed by two finish coats of acrylic latex flat exterior finish paint. The net line receives two coats of acrylic latex semi-gloss exterior finish paint in white.
- 2.5 The players bench is a heavy duty aluminum with galvanized steel pedestal
- 2.6 The umpire stand is made from natural wood and steel tubing. Well built with wheels for easy moving and padded feet to protect court finish. Includes a writing desk resting on armrests.

##### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project





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B U I L D I N G   E X C E L L E N C E

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- A. The Contractor shall furnish tennis court net post ground sleeves to contractor performing work of post tensioned concrete tennis courts for timely and proper insertion in work.
- B. Net Post Sleeves and Foundations: Net post sleeves and foundation shall be set prior to post tension concrete slab placement. Post foundation shall have minimum dimensions as shown on the drawings. Set top of sleeve flush with finish concrete surface. Sleeve to set plumb so net post will be true and plumb and support a net 42 inches above the court surface.
- C. Center Strap Anchor: Set center strap anchor where centerline of the court meets centerline of the net. Foundation shall have minimum dimensions as shown on the drawings. Set tubular anchor plumb and flush with finish concrete.
- D. Install windscreens in accordance with manufacturer's instructions.
- E. Install practice walls (Beat Walls) in accordance with manufacturer's instructions.

**END OF SECTION**



## SECTION 11 68 33

### OUTDOOR ATHLETIC EQUIPMENT

#### GENERAL

- 1.1 The architect should include in this section: football goal posts, pole vault boxes, discus cages, toe boards, players benches, and soccer goals.
- 1.2 Require a warranty for the work specified for three years against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship

#### PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.
- 2.2 FOOTBALL GOAL POSTS
  - A. Competition Field Football Goal Posts main standard shall be 10 feet high by five inch diameter, crossbar shall be 23 feet-4 inches by five inch diameter, uprights shall be 20 feet high by four inch diameter. Goal post shall be set in eight inch diameter galvanized steel pipe sleeve and secured with stainless steel hardware. Provide safety pads as instructed by goal post manufacturer to suit application.
  - B. Practice Fields Football Goal Posts shall be straight double posts meeting "NCAA" and "National High School Rules Specifications". Vertical top uprights spaced 23'-4" apart clear and constructed of 4-1/2" inch O.D. galvanized steel. Crossbar construction with 2 inch O.D. galvanized steel with welded bridge truss. Bottom uprights space at 24'-0" apart clear and constructed of 2-3/8 inch galvanized steel. Provide 1-5/16 inch O.D. galvanized soccer back stays. Include four 24-inch long ground sleeves with aluminum top caps for semi-permanent installation. Uprights shall be 20 feet tall above ground and set into three feet concrete footings. Provide safety pads as recommended by goal post manufacturer to suit application.
- 2.3 Pole vault boxes shall be cast aluminum with 105 degree angle between bottom of box and the stopboard. The angle between the side and the bottom is 120 degrees. The front buttress is a trapezoid with six inch and 16.1 inch parallel bases. The length of the box is 42.66 inches.
- 2.4 The discus cage should be installed to meet National Track Federation requirement. Provide six 2 inch diameter by 16 gauge square tubing by 12 feet long with a 45 degree bend at 12 inches from the top end, set in 16 inch deep permanent ground sleeves. Netting shall be 21 gage nylon treated for weather proofing and bordered with 1/2 inch treated nylon rope. Provide removable metal caps for ground sleeves. Extend concrete discus ring to minimum 3 feet beyond netting system.
- 2.5 Provide aluminum shot put toe board for depressed pad. Shot put- Sector shall be 6" red dog c (or approved equal) with perimeter concrete curb
- 2.6 Players shall have a 14 seat standard players bench that is 21'-0" in length. The seat should be a clear anodized aluminum and the pedestal should contain a galvanized frame and legs, permanent footing mounted.
- 2.7 SOCCER GOALS



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- A. Soccer Goals should be made from 4-1/2 inch O.D. galvanized pipe- 8'-0" high by 18'-0" long for girls and 24'-0" long for boys with standard backsway and semi-permanent mounting as recommended by manufacturer. Provide concrete footings for semi-permanent mountings and provide one net per goal.

**EXECUTION**

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Football Goal Posts: Goal posts and foundations shall be installed and assembled in accordance with manufacturer's requirements.
  - B. Pole Vault Boxes: Vault boxes shall be set to alignment and grade shown on drawings so that the finish facility will meet National Collegiate Amateur Association requirements. Grade is a critical factor and shall be treated with precision by the Contractor. Contractor shall devise an anchoring system to hold the vault box while pouring concrete such that vault box will not float.
  - C. Discus Cage: Eight pipe sleeves two inches in diameter shall be embedded in ground with concrete at specified distances around discus pad to meet National Track Federation Ruling (Section 3 ARI.6). Install as instructed by the manufacturer.
  - D. Install aluminum toe board to concrete shot put pad as instructed by the manufacturer.
  - E. Players Bench pedestal should be set in 3000 psi concrete as instructed by manufacturer.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 11 68 43

#### OUTDOOR SCOREBOARDS

##### GENERAL

- 1.1 The architect should include in this section: basketball scoreboards, football scoreboards, baseball scoreboards and softball scoreboards.
- 1.2 Require a warranty for the work specified for five years against defects in materials and LED digits are guaranteed for a period of ten years against defects in materials. First year service includes cost of labor and parts when returned prepaid to manufacturer. Remaining four years cover parts only, when returned insured, prepaid to manufacturer. No charge for time or materials used by others in making repairs will be paid by manufacturer.
  - A. Defects shall include loose parts, severe deterioration of finish and faulty operation of moving parts.

##### PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications and must be approved by HISD project team to be considered.
  - A. Specifications are based on products of The Spectrum Corporation, Houston, Texas.
  - B. Acceptable manufactures include Nevco.

##### 2.2 SCOREBOARD MATERIALS AND COMPONENTS

- A. Basketball / Volleyball / Wrestling Scoreboards: Provide three basketball scoreboards, Model No. SP-5242-UC3, the home and visitor score shall be incremented by one from 0 to 199 and the board shall contain possession indicators for each team. Score may also be instantly cleared and reset by keypad entry to any score 0 to 199.
  1. Clock shall display time remaining up to 99:59. Clock shall be capable of counting up or down, and clock may be instantly reset to any desired time when clock is turned off. Fractional seconds feature shows to 1/100 of a second, the time left in a period.
  2. Quarters, 1-4, shall be displayed using a numeral lampbank.
  3. Face-Mounted Horn shall sound manually when clock is turned off can sound automatically at end of period.
  4. Automatic substitution feature shall allow the operator to program the horn to sound automatically the next time the clock is turned off thus altering officials of substitution.
  5. Time-out timer shall display time remaining in the time-out. A very short horn blast shall warn of there being 15 seconds remaining in the time-out. The control box speaker shall signal the end of the time-out.
  6. Player's number who just committed a foul and his number of fouls shall be instantly posted using a keypad number entry. Team fouls shall be displayed from 0 to 99 for both home and visiting teams. Bonus shall start automatically at the preprogrammed 5th or 7th team foul.
  7. Dimensions: Scoreboard shall be ten feet in length by five feet in height by five inches in depth and shall weigh 175 lbs. Clock and score numeral displays shall be 14 inches high. Period, Fouls (won), (bout), Player number (game), (weight) numeral displays shall be ten inches high.
  8. Scoreboard face and scoreboard cabinet shall be made of 0.080 inch thick aluminum with premium urethane finish. Colors shall be from manufacturer's standard color chart.



## BUILDING EXCELLENCE

9. LED Digits (Light Emitting Diode): Digits shall utilize superbright LED lamps to form 14 inch amber Score digits and 14 inch red Clock digits. Bonus indicators are red LED, Possession indicators, colon and decimal are amber LED. Digits and indicators average 100,000 hours of lamp life (11 years at 24 hours per day) and provide a maintenance-free, energy efficient alternative to incandescent light bulbs. LED digits are covered with 1/8 inch Lexan shields to protect and absorb ball impacts.
  10. All electronic components shall be solid state. Component module shall be accessible from the front of the scoreboard.
  11. Operator's control console shall not require 120 VAC electrical power. The low voltage control console shall be housed in a protective, weather resistant carry case. A single ten feet long, three wire, low voltage control cable shall unplug and store inside the carrying case. Furnish two control consoles with carrying cases.
  12. Switching shall be accomplished by solid state membrane switching technology; each switch having a life of at least five million operations. All switches shall be "splash proof" and environmentally sealed by a combination of layers of a velvet grain, highly durable, polycarbonate and glossy polyester. All switches are defined by the 0.020 inch thick black velvet grain polycarbonate "switch locator" overlay. The numeric keypad, clock on-off, and score switches shall give "tactile feedback" to recognition. Sound shall be emitted by all switches to let the operator know a switch has occurred. The clock on-off switch shall be environmentally sealed "bat type" toggle switch. Visual feedback shall be accomplished by LED indicators (green) for the clock and other selected switches (red.) This gives three methods of feedback to the operator: Tactile (feel), Audio (sound), LED/Coding (sight).
  13. The control panel switch functions shall be changed (depending on the type of scoreboard being used; i.e., basketball, volleyball, football, soccer, wrestling, etc.) by removing a single switch label insert from under the overlay and re-inserting the appropriate switch label insert. The insert shall slide in and out and is locked in place. (This allows a single control to operate multiple scoreboards of different sports). Each sport has a single switch label insert.
  14. Scoreboard shall require not more than 2.5 amperes at 120 VAC, 60 Hz.
- C. Varsity Baseball Scoreboard / Softball: Provide one baseball and one softball scoreboard Model No. SP-9928-PR3.
1. The information display includes home and visitor scores registering 0 thru 99, innings 0 thru 19, balls, strikes, outs, hits and errors (indicate using bullseye type display). All numerical height shall be 24 inches. The size should be 28 feet-0 inches x 12 feet-0 inches, weighing 500 pounds; or equivalent by listed manufacturer.
  2. The sign shall have the school and mascot name embossed above scoreboard on porcelain. (3 feet-0 inches H x 16 feet-0 inches W)
  3. Board power requirements are 20 amp, 120 volts ac, 60 hz, for each scoreboard.
  4. Provide Spectrum SP-9 control cables with necessary accessories and two Multi-Sport controllers with carrying cases.
- D. Football Scoreboard: Provide one football scoreboard Model SP-11120-PR4 with information display
1. Information Display should show home score and visitor score to 99, 99 minute up/down counting clock with 1/10 and 1/100 second track feature, quarter, down, yards to go. The board should be 20 feet long x 8 feet high, weighing 687 pounds; or equivalent by listed manufacturer.
  2. Numeral Height of the clock shall be 24 inches. All other numbers shall be 21 inches.



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## B U I L D I N G   E X C E L L E N C E

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3. The sign shall have the school and mascot name embossed above scoreboard on porcelain (20 feet-0 inches x 3 feet-0 inches).
4. Provide SP-3 control cable with necessary accessories and one Multi-Sport 500 controller with carrying case.
5. Power Requirements include two 30 amp, 120 volts A.C., 60 Hertz, circuits at the scoreboard.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project
  - A. Install specified units in accordance with manufacturer's printed instructions. Erect units plumb and level, with power supply coordinated with the electrical Division.
  - B. Adjust each scoreboard for proper function. Replace broken lamps, faulty control elements, and damaged parts.
  - C. Provide controller hook-ups in first riser of telescoping bleachers specified in Section 12 66 13 or as indicated.

### END OF SECTION



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SECTION 12 05 00

FURNISHINGS COMMON WORK RESULTS

GENERAL

- 1.1 Architect to coordinate location of proposed furnishings with HISD Program Manager. All learning center furnishings shall be in accordance with applicable HISD standard design practices and procured through awarded HISD bid vendors.
- 1.2 All cabinet locks within a single room shall be keyed alike.
- 1.3 District preference is to install premanufactured casework in place of custom millwork. All furnishings to be AWI custom manufacturing level.
- 1.4 Provide window coverings for all exterior windows with approval by HISD Program Manager.
- 1.5 Learning Commons shelving should be solid wood. HISD standard height for elementary learning commons shelving is 48" high, even at perimeter wall locations. Height and width of learning commons shelving for appropriate age groups shall be reviewed by HISD Learning Commons Services.
- 1.6 All other units to be plastic laminate clad. For durability of these plastic laminate units, the use, if any, of particle board is limited to side or divider vertical components and backs at upper cabinets only. All other components should be specified as plywood, including cabinet doors, shelves and all lower cabinet back and dividers. At areas around sinks, specify moisture resistant plywood.
- 1.7 Multiple adjustable shelf cabinets 84 inches high and wider than 36 inches to have a fixed center shelf.
- 1.8 Sink cabinets to have a removable back panel located 12-22 inches A.F.F. for plumbing access.

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## BUILDING EXCELLENCE

### SECTION 12 24 00

#### WINDOW SHADES

##### GENERAL

- 1.1 The architect should include in this section: Manually operated room-darkening shades and electrically operated double-roller sunscreen and room-darkening shades.
- 1.2 Roller Shades should come from a single manufacturer with a minimum of twenty years experience in installing products comparable to those specified in this section.
- 1.3 Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, ATCC9645
- 1.4 Require warranty:
  - A. Roller Shade Hardware, Chain and Shadecloth: Manufacturer's standard non-depreciating twenty-five year limited warranty.
  - B. Roller Shade Motors and Motor Control Systems: Manufacturer's standard non-depreciating five-year warranty.
  - C. Roller Shade Installation: One year from date of Substantial Completion, not including scaffolding, lifts or other means to reach inaccessible areas.

##### PRODUCTS

###### 2.1 SHADE CLOTH

- A. Visually Transparent Single-Fabric Shadecloth: Single thickness non-raveling 0.030-inch thick vinyl fabric, woven from 0.018-inch diameter extruded vinyl yarn comprising of 21 percent polyester and 79 percent reinforced vinyl, in colors selected from manufacturer's available range.
  1. Weave patterns: as selected by Architect
  2. Color: Selected from manufacturer's standard colors.
- B. Vinyl Room Darkening Shadecloth (Single-Fabric): Blackout material, washable and colorfast laminated and embossed vinyl coated fabric, 0.012 inches thick (0.30 mm) blackout material and weighing 0.81 lbs. per square yard, with a minimum of 62 threads per square inch in colors selected from manufacturer's available range.
- C. Color: Selected from manufacturer's standard colors.  
Room darkening (PVC Free) Shadecloth with opaque acrylic backing: .008 inches thick blackout material and weighing .94 lbs. per square yard, comprising of 53% fiberglass, 45% acrylic, 2% poly finish.
  1. Color: Selected from manufacturer's standard colors.

###### 2.2 COMPONENTS

- A. Access and Material Requirements:
  1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
  2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.
  3. Use only engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics, and /or polyester, or reinforced polyester will not be acceptable.
- B. Motorized Shade Hardware and Shade Brackets:



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1. Provide shade hardware constructed of minimum 1/8-inch thick plated steel, or heavier, thicker, as required to support 150 percent of the full weight of each shade.
  2. Provide shade hardware system that allows for field adjustment of motor or replacement of any operable hardware component without requiring removal of brackets, regardless of mounting position (inside, or outside mount).
  3. Provide shade hardware system that allows for operation of multiple shade bands offset by a maximum of 8-45 degrees from the motor axis between shade bands (4-22.5 degrees) on each side of the radial line, by a single shade motor (multi-banded shade, subject to manufacturer's design criteria).
- C. Manual Operated Chain Drive Hardware and Brackets:
1. Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.
  2. Provide hardware capable for installation of a removable fascia, for both regular and/or reverse roll, which shall be installed without exposed fastening devices of any kind.
  3. Provide shade hardware system that allows for removable regular and/or reverse roll fascias to be mounted continuously across two or more shade bands without requiring exposed fasteners of any kind.
  4. Provide shade hardware system that allows for operation of multiple shade bands (multi-banded shades) by a single chain operator, subject to manufacturer's design criteria. Connectors shall be offset to assure alignment from the first to the last shade band.
  5. Provide shade hardware system that allows multi-banded manually operated shades to be capable of smooth operation when the axis is offset a maximum of 6 degrees on each side of the plane perpendicular to the radial line of the curve, for a 12 degrees total offset.
  6. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable
  7. Provide shade hardware constructed of minimum 1/8-inch thick plated steel or heavier as required to support 150 percent of the full weight of each shade.
  8. Drive Bracket / Brake Assembly:
    - a. Drive Bracket model M5 shall be fully integrated with all accessories, including, but not limited to: SnapLoc fascia, room darkening side / sill channels, center supports and connectors for multi-banded shades.
    - b. M5 drive sprocket and brake assembly shall rotate and be supported on a welded 3/8 inch steel pin.
    - c. The brake shall be a clutch design which disengages to 90 percent during the raising and lowering of a shade. The brake shall withstand a pull force of 50 lbs. in the stopped position.
    - d. The braking mechanism shall be applied to an oil-impregnated hub on to which the brake system is mounted. The oil impregnated hub design includes an articulated brake assembly, which assures a smooth, non-jerky operation in raising and lowering the shades. The assembly shall be permanently lubricated. Products that require externally applied lubrication and or not permanently lubricated are not acceptable.
    - e. The entire M5 assembly shall be fully mounted on the steel support bracket, and fully independent of the shade tube assembly, which may be removed and reinstalled without effecting the roller shade limit adjustments.
- D. Drive Chain: #10 qualified stainless steel chain rated to 90 lb. minimum breaking strength. Nickel plate chain shall not be accepted.



## BUILDING EXCELLENCE

### 2.3 SHADE MOTOR DRIVE SYSTEM

- A. Shade Motors:
  - 1. Tubular, asynchronous (non-synchronous) motors, with built-in reversible capacitor operating at 110v AC (60hz), single phase, temperature Class A, thermally protected, totally enclosed, maintenance free with line voltage power supply equipped with locking disconnect plug assembly furnished with each motor.
  - 2. Conceal motors inside shade roller tube.
  - 3. Maximum current draw for each shade motor of 2.3 amps.
  - 4. Use motors rated at the same nominal speed for all shades in the same room.
- B. Total hanging weight of shade band shall not exceed 80 percent of the rated lifting capacity of the shade motor and tube assembly.

### 2.4 MOTOR CONTROL SYSTEMS

- A. IQ/MLC: Specifications and design of shade motors and motor control system are based on the IQ/MLC motor logic control system. Other systems may be acceptable provide that all of the following performance capabilities are provided. Motor logic control systems not in complete compliance with these performance criteria shall not be accepted as equal systems.

## EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- 3.2 INSTALLATION
  - A. Install intermediate support and extension brackets as needed to prevent deflection in headrail.
  - B. Install shades with adequate clearance to permit smooth operation of shades and any sash operators. Hold shades 1/4 inch clear from each side of window opening on inside mount, unless other clearance is indicated.

## END OF SECTION



## SECTION 12 35 50

### EDUCATIONAL CASEWORK

#### GENERAL

- 1.1 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.2 Acceptable manufacturers must have experience manufacturing products meeting or exceeding the specifications shall have a minimum of five years experience in providing manufactured casework systems for similar types of projects.
- 1.3 Require a warranty for the work specified for five year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
  - A. Defects shall include rough or difficult operation, or loose or missing parts, delamination of surfaces, noticeable deterioration of finish and warped or misaligned surfaces or telegraphing of subsurface imperfections.

#### PRODUCTS

##### 2.1 MATERIALS

- A. There are two general categories of casework: (1) solid wood (red oak) and (2) plastic laminate clad. Some of the solid wood units have inset plastic laminate at the top work surface, as described under casework types. All exposed surfaces (interior and outside) of all casework are required to be finished. Some cabinet doors and drawers are indicated under the casework description to have locks. These are cabinet locks, not cam-locks or locks keyed with the building door hardware. All cabinet locks within a single room should be keyed alike. However, cabinet locks shall be different for each room.
- B. All other units are plastic laminate clad. For durability of these plastic laminate units, the use, if any, of particle board is limited to side or divider vertical components and backs at upper cabinets only. All other components should be specified as plywood, including cabinet doors, shelves, and all lower cabinet backs and dividers. At areas around sinks, specify moisture resistant plywood.
- C. Use casework detailing that increases durability. Eliminate sharp edges by easing corners with curved or 45° transitions. At work stations, angle vertical supports back away from the front of the unit to minimize potential damage from chairs and floor maintenance equipment. The selection of edge trim and edge details should be based on endurance under high use.
- D. All plastic laminate casework specifications, standards and construction shall be based on Environments L44 Series manufactured by LSI Corporation of America (custom manufacturing level).
- E. Wheatboard casework may be considered for applicable LEED credits. It is manufactured with rapidly renewable raw material, shall contain a minimum of 90% post-industrial recycled content and is fabricated without added urea formaldehyde.
- F. No-added-urea formaldehyde MDI adhesive shall be permitted.

##### 2.2 Decorative Plastic Laminate should be high-pressure complying with NEMA LD3, and the following requirements:

- A. Provide chemical resistant plastic laminate at all exterior cabinet faces and exposed end panels at all Science Learning Center/Wet Labs, Prep Rooms Art Rooms and Art Storage Rooms if laboratory casework specification is not used.
- B. Require PVA water resistant adhesive. Contact adhesives are not permitted.



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- C. Provide balanced construction. Unsurfaced coreboard or simple backers are not allowed.
- 2.3 Core Material:
- A. Particleboard shall meet ANSI 208.1, minimum 45 pcf density, Grade M-3 and is made with a binder containing no urea-formaldehyde resin.
  - B. Plywood should be shop sanded, exterior grade veneer cored, hardwood faced, any species, with no defects affecting strength or utility complying with HPVA HP-1, made without urea-formaldehyde adhesive. Overlay plywood is not permitted. Plywood is allowed at countertops.
  - C. Water resistant treated plywood shall have 24 hour thickness swell factor of 5 percent or less and 24 hour water absorption factor of ten percent or less; P.S. 51, Type II or better.
  - D. Cabinet components shall be of the following minimum core thicknesses:
    - 1. Cabinet backs, drawer body and bottoms should be 1/2 inch particleboard.
    - 2. Door and drawer face, base, wall, and tall cabinet tops and bottoms, cabinet sides, drawer spreaders, cabinet back rear hangstrips, structural dividers, and exposed cabinet backs should be 3/4 inch particleboard.
    - 3. Work surfaces and countertops should be a minimum of 1 inch particleboard or plywood, except use water resistant treated plywood core at counters with sinks.
    - 4. Shelves should have a 3/4 inch particleboard core for 30 inches long or less, 1 inch thick particleboard core for more than 30 inches long; 14 inch deep, unless otherwise noted. Provide vertical dividers for shelves over 36 inches long.
    - 5. Cabinet Toe-Base should have blum leg levelers with toe kick brackets, adjustable, with 2"x 4" x 3/4" Hardiboard toe board surface on all open sides. All connections shall be fastened by screws.
- 2.4 Countertops and Backsplashes:
- A. Provide countertops with PVC edge in as long as practical continuous lengths. Provide field glued splines at joints. No joints closer than 24 inches either side of sink cutout.
  - B. Backsplash should be 4 inches high unless otherwise shown. No joint shall occur at sink openings. Provide backsplash set in full bead of sealant.
  - C. At exposed countertop end corners, provide 1 inch radius, or similar safety treatment.
- 2.5 Provide 3 mm PVC, solid, high-impact, purified, color-thru, acid resistant, pre-lamination primed edging, machine-applied with hot melt adhesives, and machine profiled to 1/8 inch radius.
- 2.6 All hardware shall meet ANSI A156.9. All keying shall match existing master key system and be approved by HISD.
- 2.7 Hinges should be heavy duty, five-knuckle 2 3/4 inch institutional type hinge shall meet ANSI/BHMA A156.9 Grade 1 requirements with a US26D finish. They should be mill ground, hospital tipped, and contain a Teflon coated tight pin feature with all edges eased. Hinge shall be full wrap around type of tempered steel 0.095 inch thick. Each hinge shall have minimum of 9 screws, #7, 5/8 inch FHMS to assure positive door attachment.
- 2.8 Pulls should be wire design, 4 inches, Chrome, US26D finish.
- 2.9 Drawer Slides:
- A. Standard and File Drawers should have a full extension, 3-part progressive opening slide, precision steel ball bearing, minimum 100 pound dynamic load rating at full extension, and should be zinc plated or epoxy coated at manufacturer's option.
  - B. Provide body mounted molded rails for hanging file system for legal or letter size as indicated by manufacturer's model number. Cutting or machining of drawer body/face not permitted.



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- 2.10 Locks shall be five-disk tumbler cam-style with strikes. Provide two keys per room where doors and drawers are scheduled to receive locks. Cylinder face and keys to be engraved with matching numbers. Dull chrome finish. Lock core shall be removable with a control key, permitting Owner to change lock arrangements without tools. Locks shall operate off of one master key.
- 2.11 Grommets should be 2-1/2 inches diameter with "Flip-Top"™ tab in cap and be used where electrical, telephone, and computer data wiring need to pass through tops or bulkheads.
- 2.12 Keyboard Drawers (At all knee spaces) should be articulating
- 2.13 Molded Personal Pencil Drawer should be made of high-impact 100 Polystyrene with in-stop, out-stop, and self-closing features. Provide under top mounted 100 lb self-closing slides. Twelve compartment drawer body, and slides, Black. Provide at all knee spaces.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Plumbing and electrical items not specified in this Section shall be furnished under separate division. The casework supplier shall be responsible for all cutouts necessary to receive plumbing items. Provide 'J' clamps to secure sinks to countertops.
  - B. Environmental Requirements: do not allow installation of casework until permanent HVAC systems are operating and temperature and humidity have been stabilized for at least one week.
  - C. Installation of work furnished by the various trades shall be coordinated to assure properly functioning equipment at the completion of the job.
  - D. Provide matching fillers and scribes to fit cabinets to partitions, equipment, and columns.
  - E. Provide closure panels at top and bottom of wall hung cabinets at corner intersections.

### END OF SECTION



B U I L D I N G      E X C E L L E N C E

SECTION 12 35 53

LABORATORY CASEWORK

GENERAL

- 1.1 The architects should include in this section wood casework, fume hoods, epoxy resin work surfaces, epoxy resin sinks, drain outlets, service fittings and accessory items as specified.
- 1.2 The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 Require manufacturer's qualifications: Modern plant with proper tools, dies, fixtures and skilled production staff to produce high quality laboratory casework and fume hoods, and shall meet the following minimum requirements:
  1. Minimum of ten years experience in manufacture of wood laboratory casework and fume hoods.
  2. Ten installations of equal or larger size.
- A. Manufacturer to provide load test results certified by an independent testing laboratory for drawers, doors, suspension slides and unit shelving.
- B. Casework construction and performance characteristics shall be in full compliance with SEFA 8 standards. At the Owner's request, independent, third part testing must be submitted validating compliance and adheres to the architectural specifications.
- 1.4 Require a warranty for the casework against becoming unserviceable or causing an objectionable appearance resulting from defects in materials and workmanship, including workmanship of installation. Materials provided by Casework Manufacturer shall carry a warranty for five years from date of Substantial Completion. Other materials and equipment shall carry warranty by the product manufacturer.
- A. Defects shall include discoloration of finish, missing or loose parts, noisy or hard operation of moving parts, and failure to meet specifications.

PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.
- A. Specifications are based on products manufactured by Fisher Hamilton LLC, Two Rivers, WI.
- 2.2 CASEWORK DESIGN
- A. Door and Drawer Design should have a partial overlay design with 3/8 inch reveals between door or drawer and frame, door to door, door to drawer, drawer to drawer; 7/16 inch vertical reveal between doors/drawers and cabinet ends and a standard vertical grain pattern on end panels.
- B. Grain pattern on cabinet fronts should be a horizontal grain on drawer fronts and a vertical grain on door fronts.
- C. Cabinet end panels exposed to view after installation shall be specified as a "finished end" panel. All end panels not exposed to view after installation shall be as listed under "unexposed" plywood.
- D. Cabinets to be rigid, self-supporting design for use in assembly or as single, interchangeable stand-alone units. Surface mounted bottoms and offsets caused by front face frames which interfere with ease of cleaning are not acceptable.





## BUILDING EXCELLENCE

- E. Joinery should be a 32mm doweled system glued, clamped and screwed. Dowels are to be hardwood, laterally fluted with chamfered ends and a minimum diameter of 8mm.

### 2.3 CASEWORK MATERIALS

- A. Hardwood lumber should be clean and free of defects, kiln-dried to uniform moisture content of six percent and shall conform to ANSI/HPVA HP-1 product standards. Exposed material should be Grade I min. Red Oak and semi-exposed material shall be select hardwood. Unexposed material should be sound hardwood of species suitable for the intended purpose.
- B. Plywood should be 7-ply (3/4 inch thick) and 9-ply (one inch thick) veneer core plywood with cross and face plies bonded with Type II water-resistant glue; drawers are 9-ply, 1/2 inch thick and shall conform to ANSI/HPVA HP-1 product standards.
  - 1. Face veneer for exposed surfaces should be plain-sliced red oak veneer, grade A, selected for golden wheat color and narrow hearts, where semi-exposed should be the same as exposed but shall be grade 2. Unexposed is the same species as above but at the grade as recommended by the manufacturer.
- C. Tempered welded fiber shall be wood fibers and natural resin binding agent compressed into dense homogeneous sheets. Sheets are impregnated with a special tempering compound polymerized by baking to give exceptional strength, and shall conform to ANSI/AHA A135.4 Basic Hardboard for Class 1 tempered grade.
- D. Glass shall be 7/32 inch for tall cases and unframed wall and upper case doors, 1/8 inch for framed wall and upper case doors, without imperfections or marred surfaces of clear float glass.
- E. Glue shall be used for laminating - Type II water-resistant; assembly - Type III water-resistant.
- F. Edge banding shall be 3mm hardwood of same species as exposed face veneers.
- G. The finish should be highly chemical-resistant modified acrylic urethane finish with built in U.V. blocker or equal finish applied over stain of selected color. Finish shall meet performance characteristics of TR-5, Section 1500, AWI Architectural Woodwork Quality Standards (latest edition).

### 2.4 CASEWORK FABRICATION

- A. Base Units:
  - 1. Cabinet ends should be 3/4 inch thick plywood with 3mm hardwood banding on front edges. Bore interior faces, as appropriate, for security panels, rails, and provide four rows of shelf support holes.
  - 2. Require four metal corner gusset levelers with threaded adjustment screws and floor pad on all base cabinets.
  - 3. The full top frame consists of a horizontal front top rail that is one inch x three inch solid hardwood, a vertical back top rail that is 3/4 inch x 3-3/4 inch hardwood both attached to cabinet ends with glued 8mm dowel joinery and screws and a top side rail made of 3/4 inch x 1-1/2 inch hardwood between front horizontal and back vertical rails, glued and screwed in place.
  - 4. The front horizontal intermediate rail is 3/4 inch x 1-1/2 inch exposed hardwood and should be provided between doors and drawers, secure to cabinet end panels with glued 8mm dowel joinery.
  - 5. The Toe space rail is 3-3/4 inch x 3/4 inch hardwood or 7-ply veneer core plywood, mounted between end panels with glued 8mm dowel joinery and metal fasteners, forming a 4 inch high x 2-1/2 inch deep toe space, closed to cupboard bottom.
  - 6. The bottom of the base cabinet shall be 3/4 inch thick plywood, set flush and joined to cabinet end panels with glued 8mm dowels on 96mm spacing and metal fasteners. The front edge should be banded with 3mm hardwood banding.



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7. Backs: The back of cupboard units should be made of one-piece 3/16 inch thick hardboard, rabbetted into rear top rail for easy removal from inside of cabinet. Drawer units have an open back and sink units are half-height 3/16 inch thick hardboard, rabbetted into rear rail for easy removal from inside of cabinet.
  8. Vertical dividers in combination cabinets shall be a 1-1/2 inch thick plywood panel (frames not permitted) glued and screwed in place, top and bottom, with 3mm hardwood banding on front edge.
  9. Base unit shelves should be veneer core plywood, 3mm hardwood banded on front edge, adjustable on 32mm centers, be the full depth of the shelf (17-3/4 inches), should be 3/4 inch thick up to and including 30 inches wide and one inch thick for all shelves over 30 inches wide.
    - a. For spill containments, shelves should have a 1/2 inch wide x 1/2 inch high raised lip on all four sides.
  10. Drawer construction:
    - a. The four-sided drawer box with back, front and sides of 12mm (1/2 inch nominal) 9-ply Birch plywood with chemical-resistant finish and finished top edges has sides shall be joined by Lock joint, glued and pinned.
    - b. The drawer bottom is a nominal 1/4 inch, inset into all four sides of drawer box and sealed with hot melt glue process around entire drawer bottom perimeter. Material to be white melamine-clad tempered hardboard.
  11. Door and removable drawer front construction shall be 3 ply 3/4 inch thick (door) and 1/2 inch thick (drawer), particleboard core, hardwood framed all four sides, face veneer on both surfaces with a radiused edge on all four sides and doors to be routed on inside perimeter to allow 1/4 inch inset into door opening.
- B. Hardware:
1. Drawer suspension is made of a 3/4 extension, open roller, 75 lb. dynamic load, self-closing epoxy-coated Blum 230 series or equal on all drawers except file drawers. All file drawers to have full extension with overtravel, ball-bearing roller, 150 lb. dynamic load, zinc-plated Accuride 4034 series.
  2. Drawer and hinged door pulls shall be satin chrome wire pulls.
  3. Require two hinges (5-knuckle, institutional stainless steel) for doors up to 48 inches high and three hinges on doors over 48 inches high. Notch for proper fit.
  4. The shelf supports should be a metal pin and socket system.
  5. Door catches should be adjustable with a spring-actuated nylon roller. Elbow catches should be a spring type with strike.
  6. Locks, where indicated on drawings, should be 5-pin tumbler keyed alike and master keyed to Owner's keying system.
- 2.5 Epoxy end sinks should be center types, Model 952C0730, and consist of 52L48100 Epoxy Sink, 520C0180 Leg Assembly, and 952C073A Frame Assembly.
- 2.6 MECHANICAL SERVICE FITTINGS
- A. Fittings shall be by Chicago Faucet Co. or equal and should be vandal resistant.
  - B. Laboratory Service Fittings shall be laboratory grade, and water faucets and valve bodies shall be cast red brass alloy or bronze forgings, with a minimum content of 85%. All fittings shall be chromium plated unless specified otherwise.
  - C. Water Fittings shall be provided with a renewable unit containing all operating parts which are subject to wear. The renewable unit shall contain an integral volume control device and all faucets shall be capable of being readily converted from compression to self-closing, without disturbing the faucet body proper. Four arm forge brass handles shall contain plastic screw-on type colored service index buttons.
  - D. Ground Key Valve Hose Cocks shall have forged body with 10 serration hose end.



## BUILDING EXCELLENCE

- Handle plug shall be forged brass, long, tapered type with screw-on colored service index button. Valves shall be individually ground, lapped and sealed.
- E. Needle Valve Hose Cocks shall have a stainless steel replaceable floating cone that is precision finished and self-centering. Cone locates against a stainless steel seat, easily removable and replaced with a socket wrench. Valve shall have "Teflon" impregnated packing and designed so unit can be repacked while under pressure.
  - F. Gooseneck Type Outlets shall have a separate brazed coupling to provide a full thread attachment of anti-splash, serrated tip or filter pump fittings.
  - G. Remote Control Valves shall be as previously specified, but shall be complete with brass extension rods, escutcheon plates, brass forged handles and screw-on type colored service index button.
  - H. Tank Nipples shall be provided with locking nut and washer for all fixtures where fittings are anchored to equipment.
  - I. Service Indexes: Fittings shall be identified with service indexes in the following color coding:
 

Hot Water .....	Red
Cold Water .....	Dark Green
Gas .....	Dark Blue
Air .....	Orange
Vacuum .....	Yellow
Distilled Water .....	White
Steam .....	Black
Nitrogen .....	Gray
Oxygen .....	Light Green
Hydrogen .....	Pink
Special Gases .....	Light Blue
  - J. Electrical Fittings shall contain 20 Amp., 125 Volt AC, 3-wire polarized grounded receptacles, unless otherwise specified. Pedestal and line-type boxes shall be of aluminum, metallic finish with stainless steel flush plates. Receptacle boxes shall be of plated steel. All electrical or conduit fittings called for or to be furnished under these specifications shall meet the requirements of the National Electrical Code.
  - K. Sink Outlets for other than stainless steel sinks shall be Molded Epoxy Resin, with integral cross bars, tapered for overflow and be complete with gasket and lock nut with 1-1/2 inch I.P.S. male straight thread outlet. Overflows shall not be furnished for sink outlets unless specifically noted.
  - L. Crumb Cup Strainers shall be stainless steel or chromium plated brass, as specified and shall be furnished for stainless steel sinks, and be complete with gasket, lock nut and 4 inch long unthreaded tailpiece outlet in 1-1/2 inch size.
  - M. Vacuum Breakers, when specified, shall be the 'Nidel or Watts' type unless specified to be an integral part of gooseneck fixture with a renewable seat and fine flow control.
  - N. Aerator Outlets shall be furnished for all gooseneck water faucets nor furnished with serrated hose connectors.
- 2.7 Factory molded epoxy resin tops shall be a uniform mixture throughout the one inch thickness. Color shall be non-glare black, cast surfaces shall be very smooth, with factory cutouts for sinks and drip grooves with plain butt type joints assembled with epoxy adhesive.
- 2.8 FOUR-STUDENT LAB CENTERS
- A. The center should accommodate up to four students.
  - B. The top surface should be one inch thick by length and width black epoxy resin.
  - C. Accessories include two sets of upright rods with metal crossbars, four double AC outlets and two combination cold water gooseneck faucets modified to have four ground-key cocks.



## B U I L D I N G      E X C E L L E N C E

- 2.9 The mobile science demonstration/project table shall have three height adjustments of 30 inches, 32-1/4 inches, and 36 inches with a one inch thick by length and width black epoxy resin top. Accessories include two adjustable shelves in cupboard area and a 25' extension cord.
- 2.10 Provide an emergency drench shower and eye wash combinations with floor drain- mechanical room and laboratory and science learning center/wet lab.
- 2.11 Provide an emergency eye wash in Science Prep Room.
- 2.12 ACID STORAGE UNIT
- A. The cabinet shall be constructed of one inch thick plywood with interior completely lined with polypropylene (floor, interior walls, interior top and top tray) with exterior dimensions of 36-1/2 inches high x 31 inches wide x 20 inches deep and interior dimensions of 28-1/2 inches high x 29 inches wide x 17-1/4 inches deep. Bottle capacity is 30 x 2.5 L or 90 x 500 mL.
  - B. Cabinet features include recessed wooden door handles, the word "ACID" printed on cabinet with six inch red letters, all wooden hinges and four leveling feet.
- 2.13 Safety goggle compartment cases must be located near a safety duplex outlet, 28-1/2 inches H x 26-1/4 inches W x 10-1/4 inches D, shall include a 15 minute timer and have fasteners as recommended by the manufacturer.
- 2.14 Fire blankets, 66 inches wide x 72 inches long, should be stored in a metal container that easily mounts to wall. The drop hinge door allows for quick and easy access. One should be mounted in each Lab.
- 2.15 The flammable storage cabinet should be wood with exterior dimensions of 23-7/8 inches wide x 23-7/8 inches deep x 36-5/6 inches high with interior dimensions of 21-7/8 inches wide x 21 inches deep x 34 inches high. The total bottle capacity is 18 gallons. The cabinet has two doors, a two inch floor spill retention trough, one adjustable shelf and it must meet NFPA and OSHA standards.
- 2.16 Instructor and Demonstration Bench
- A. The top surface should be one inch thick by length and width black epoxy resin.
  - B. Accessories include one set of upright rods with metal crossbars, two double AC outlets and one combination cold water gooseneck faucet.
- 2.17 Laboratory Pegboard and Drying Rack
- 2.18 J-FRAME SUPPORT SYSTEMS
- A. The 'J'-frame support structure shall consist of vertical (inverted 'J') support members and horizontal tubular frames. Vertical 'J' support members shall be 16 gauge, 1-1/4 inch square Type 304 stainless steel seamless tubing, heliarc welded where required, ground smooth at all joints and given a satin finish. Each vertical support shall have a 1 inch height adjustment for handling various floor conditions and be so designed as to maintain a fixed position on the floor. A concealed 'hold-down' angle or other means will be acceptable. Molded vinyl tapered leg shoes shall be furnished at each support leg to conceal the adjustment device and/or 'hold-down' angle. Each support shall have two 5/16 inch - 18 stud bolts supplied for each side for securing the horizontal frames. Cap nuts shall be furnished for all exposed studs.
  - C. All horizontal frames shall have a 1-1/4 inch square tubing front and rear members.



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Horizontal frames shall be 16 gauge, Type 304 stainless steel, heliarc welded throughout ground smooth at all joints and given a satin finish.

- D. The support structure shall be designed for heavy-duty laboratory usage, and when a wall table is completely assembled with work top and cabinets in place, it shall support a 7 foot long wall table assembly with 4 foot and 3 foot modular spacing shall support a load of 1,500 lbs. uniformly distributed over the work top area.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- A. Do not deliver or install wood product until the following conditions are met:
1. Windows and doors are installed and the building is secure and weathertight.
  2. Ceiling, overhead ductwork and lighting are installed.
  3. All painting is completed and floor tile is installed.
  4. Interior building temperature to be between 65 degrees F and 80 degrees F, and ambient relative humidity maintained between 25 percent and 55 percent prior to delivery, and during and after installation. Frequent and/or excessive changes in temperature and/or humidity levels during casework installation, or once casework is installed, shall be avoided to prevent damage to materials.
- B. Field measurements shall be taken to verify that the equipment will fit into the designated space. Entryways, corridors and door openings shall be verified to ensure that the equipment be manufactured in a manner to permit it to be moved through properly into place.
- C. Casework installation:
1. Set casework components plumb, square, and straight with no distortion and securely anchored to building structure. Shim as required using concealed shims.
  2. Fasten continuous cabinets together with joints flush, tight and uniform, with alignment of adjacent units within 1/16 inch tolerance.
  3. Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board. Blocking in wall by rough carpentry as specified in Section 06 10 00.
  4. Abut top edge surfaces in one true plane. Provide flush joints not to exceed 1/8 inch between top units.
- D. Do not deliver or install wood product until the following conditions are met:
1. Where required due to field conditions, scribe or caulk to abutting surfaces.
  2. Secure joints in the field, where practicable, in the same manner as in factory, with dowels, adhesive or fasteners recommended by manufacturer.
  3. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.
- E. Do not deliver or install wood product until the following conditions are met:  
Sink installation: Sinks shall be set in chemical-resistant sealing compound, secured and supported per manufacturer's recommendations.
- F. Accessory installation: Install accessories and fittings in accordance with manufacturer's recommendations. Turn screws to seat flat; do not drive.
- G. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.
- H. Provide necessary protective measures to prevent damage of casework and equipment from exposure to other construction activity.
- I. Advise contractor of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

### END OF SECTION



## SECTION 12 56 51

### LEARNING COMMONS FURNITURE

#### GENERAL

- 1.1 Request shop drawings indicating size, material and finish.

#### PRODUCTS

- 2.1 Where products are named in the specifications, they are considered basis of specification. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the specifications to be considered.

- A. Specifications are based on products manufactured by Tesco Industries, LP, Bellville, TX.

#### 2.2 MATERIALS

- A. Wood Species:

1. All wood used in the construction of furniture and cabinets shall be northern grown red oak and shall be selected from seasoned, kiln-dried materials free from structural imperfections. The moisture content at time of fabrication shall range from 5% to 7%. All woods shall be selected for uniformity of grain and color. Wood used for internal parts shall be selected and structurally sound.
    2. All plywood used shall be of quality as specified by the American Plywood Association. All facing materials shall be no less than 1/28 inch thickness after sanding. Face veneers (i.e. veneers facing an exterior surface) shall be select, plain sliced, slip matched, to selected species.

- B. Wood Finishes:

1. In the manufacturing process after parts are cut and ready to finish, all solid oak panels and shelves are dipped in Nelsonite 15B02 wood stabilizer (shall be U.V. stabilized). All sealers and finishes shall be U.V. stabilized and applied by a flat line roll coat system to insure a uniform and environmentally safe finish.

- C. Shelving:

1. All vertical uprights of learning commons shelving shall be a minimum of 1 inch thick, kiln dried solid oak, glued up in strips no less than 1-1/2 inch and no more than 4 inch, and free of all imperfections. Veneered plywood of any type and / or uprights of less than 1 inch thickness will not be acceptable. The 2 inch canopy cornice shall be constructed of an oak plywood top with solid oak bullnose fascia strips which are machine applied to front and back edges. Attach bolting cleats by means of wood screws and glued construction. Continuous top shelving shall have a 2 inch deep dovetailed top frame provided with countersunk holes for screwing down a continuous top made of solid core with standard internal straight solid oak edge bands or as specified in the equipment list. Bases shall be of solid hardwood 3-1/2 inch in height with dovetail joints. Shelving units shall be standard with back panels on single faced shelving and divider panels on double faced units. Backs shall be 1/4 inch thick oak plywood and finished on one side for single faced units and both sides for double faced units. Backs shall be recessed in a dado on all sides. End panels shall be joined to cornice and base. Filler and corner units shall be supplied as needed to complete shelving runs as shown on the plan. 36 inch high shelving tops shall extend to adjacent window sill. Shelves shall be a minimum of 3/4 inch thick, edge glued, solid oak strips no less than 1-1/2 inch wide nor more than 4 inch wide. The underside of all shelves shall be neatly routed to receive the metal supporting pins. Adjustment of shelves shall be of pin hole style construction with adjustments at 1-1/4 inch increments.  
Shelving shall have a 2 inch wood veneer canopy top to match shelving unit.  
Shelf arrangements per face shall be as follows:





## BUILDING EXCELLENCE

<u>Height</u>	<u>Base</u>	<u>Adjustable</u>	<u>Total</u>
36 inch	1	1	2
42 inch	1	2	3
48 inch	1	2 (3 available)	3 (or 4)
60 inch	1	4	5
72 inch	1	5	6
84 inch	1	6	7
96 inch	1	7	8

Units shall be provided with sloped magazine shelves, picture book shelves, or newspaper inserts. The Number of adjustable shelves will vary.

2. Standard Elementary Books Shelving units are nominal 48" high, 36" wide and 12" deep, anchored to the floor, with each unit having a ¼" oak plywood back; base shelf and 2 adjustable shelves. All exposed surfaces shall be stained and sealed. Units are constructed of solid wood (red oak) glued in strips no less than 1½" wide. The wood strips shall be matched in wood tone. Units shall have 1" thick end panels. Bases shall be solid hardwood 3½" in height.
3. Shelves shall be 1" thick with solid oak edge band on outside edge. Shelves are adjustable and are supported with metal shelf pins in pinholes. The underside of the shelves shall be routed to receive pins. 2" deep tops shall be continuous over adjacent units and have inset plastic laminate at top and bottom surfaces and solid oak edge band.
4. Provide graphics holders at end panels.
5. Note: The HISD standard height for elementary learning commons shelving is 48" high, even at perimeter wall locations, since younger children cannot reach the top shelves of shelving units above 48".

### D. Circulation Desk

1. Circulation Desk – Model No. 4400 Decorative Front (Modified)  
Circulation Desks shall be designed using a modular concept with a continuous top. Modules shall be available in 32 inch, 36 inch, 39 inch, or 42 inch high units as specified on equipment list. Each module shall be 36 inch wide x 26 3/4 inch deep with a 30 inch deep continuous top. A pair of finished end panels is required at the end of each circulation desk configuration. Facing materials shall be 3/4 inch thick, 7-ply plywood with oak veneer facing, with 3 solid oak bullnose trim and HPL inserts and solid oak edges. The modules shall be as shown in the design specifications. All components shall be manufactured using oak plywood with matching solid oak framing. All exterior materials used shall be 3/4 inch thick, 7-ply oak plywood with face veneers 1/28 inch thick, matched for color and grain uniformity and with a solid oak edge. The top shall be 2 inch wood veneer canopy top to match shelving unit. Drawer fronts shall be made of 3/4 inch thick solid red oak lumber, edge glued forming a continuous solid wood drawer front. Drawer sides and parts shall be 1/2 inch thick solid oak with dovetail joints and a 1/4 inch bottom recessed on all four sides. Drawer fronts shall be removable. Drawers shall be equipped with side-mounted, full-extension drawer slides as manufactured by Accuride C3832-A 100# capacity. Drawer pulls shall be wire pulls furnished in a brass matt finish. Doors, end panels, and shelves shall be 3/4 inch thick 7-ply plywood with an oak face veneer of 1/28 inch thick, matched for color and grain with a solid oak edge to match. Doors shall be hung with two commercial grade, European, concealed, self closing hinges (91A6600) and shall be flush insert style. Shelves shall adjust by means of pin holes. KV strips shall not be acceptable. All framing materials shall be of kiln dried oak selected for structural soundness and shall be a minimum of 3/4 inch thick.
2. Finished end panels are required at each end unit of a circulation desk and shall be of 3/4 inch thick oak plywood with solid oak edge banding.
3. No. 4445 - Depressible Book Truck shall be constructed of 3/4 inch thick oak plywood sides and bottom with matching oak edge banding. The truck shall be provided with four 3 inch diameter swivel casters. Unit shall have a floating shelf





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surface which shall be covered in a neutral colored high pressure plastic laminate and shall be supported by a spring action depressing mechanism that lowers with the weight of the books. Rubber bumpers may be ordered as an option.

E. Technical Furniture

1. Atlas Stand shall be constructed the same as tables. Cabinet ends and front shall be 3/4 inch 7-ply oak veneer plywood with solid oak edge bands. Case shall house shelves constructed of 3/4 inch oak plywood with solid oak retainer strip on front edge. Shelves to slide on full extension slides. Top shall be 1-1/4 inch thick constructed of 1-1/8 inch solid core, .050 inch plastic laminate, .030 inch phenolic backer, and solid oak edge bands. Edge bands shall be the same as on the tables for the project. Legs are attached with 4 - 14 ga. steel vertical corner leg brackets. The leg base unit is attached to the atlas cabinet body. The apron rail which is mounted between the legs shall be constructed of 3/4 inch x 3-1/2 inch solid oak and attached to the top with countersunk screws.
2. Dictionary Stand construction to be the same as Tables. Cabinets ends and front shall be 3/4 inch 7-ply oak veneer plywood with solid oak edge bands. Case shall house one adjustable shelf constructed of 3/4 inch oak plywood. Top shall be 1-1/4 inch thick constructed of 1-1/8 inch solid core, .050 inch plastic laminate, .030 inch phenolic backer, and solid oak edge bands. Edge bands shall be the same as on the tables for the project. Legs are attached with 4 - 14 ga. steel vertical corner leg brackets. The apron rail which is mounted between the legs shall be constructed of 3/4 inch x 3-1/2 inch solid oak and attached to the top with countersunk screws.
3. Card Catalog: Sides of the drawer cabinet shall be 3/4 inch thick, 7-ply oak plywood with solid oak edge bands. Framing shall be solid oak. The unit is supported with four vertical 2-3/8 inch solid red oak legs which are a permanent portion of the unit base frame and are attached with 14 gauge steel vertical corner leg brace (EA7) in construction with its perimeter style apron rail design. Each leg is attached by means of two 5/16 inch x 18 inch x 3 inch long hanger bolts per leg for frame corner rigidity. Top of unit shall be 1-1/4 inch thick and constructed from solid core with .050 inch high pressure laminate top surface and .030z' phenolic backer. Edge bands on top shall match those of tables used on the project. Drawer fronts shall be 3/4 inch thick solid oak and finished to match. Drawer fronts shall have two compartment bronze finish pulls fastened to the drawer with concealed screws. Card trays are 5-5/8 inchw x 16 inchd x 2 inchh and are constructed of beige colored high density ABS plastic. Each tray shall be equipped with and adjustable, positive locking metal follower operating in a plastic channel. Rods shall have a metal knob and shall engage in a concealed spring loaded latch to permit the removal or replacement of the cards. Drawers shall slide on solid hardwood slides.

F. Computer Stations:

Full Panel Computer Carrels are available as either double face or single face units and in starter/adder configurations. Standard single face size is 36 inch wide by 48 inch high by 30 inch deep, double face size is 36 inch wide by 48 inch high by 48 inch deep. The carrel work surface shall 2 inch wood veneer canopy top to match shelving unit.. The work surface is attached to side and back panels with 6 inch by 1-1/4 inch by 1-1/4 inch metal brackets which are screwed into the underside of the top surface and bolted into the end panels. Brackets are attached to the back and side panels with metal bolts threaded into metal inserts embedded in the plywood panels. Brackets are then screwed into the underside of the top. Side and back panels shall constructed of 3/4 inch 7-ply veneer core oak plywood with solid oak edge bands. Side panels are attached to the back panel with concealed metal to metal fasteners. The bottom of the side panels shall be equipped with 1 inch adjustable glides.

## EXECUTION

### END OF SECTION



## BUILDING EXCELLENCE

### SECTION 14 05 00

#### CONVEYING EQUIPMENT COMMON WORK RESULTS

##### GENERAL

- 1.1 Review elevator specifications with HISD Program Manager for acceptable manufacturer. Selection of elevator manufacturer should be reviewed for proprietary maintenance agreements that may be needed in the future.
- 1.2 Use of limited use limited access (LULA) elevators and platform lifts shall be required to be approved by HISD Program Manager at the design phase.
- 1.3 Elevator controls shall comply with the local Municipal jurisdiction code, and all applicable State of Texas and Federal Codes.
- 1.4 Elevator should be connected to fire alarm system and shall return to the first floor in the case of activation. If the elevator is not tied to an emergency generator, specify a battery lowering device.
- 1.5 Provide commercial, standard pre-engineered hydraulic or traction passenger elevator with keyed lock operators.
- 1.6 An emergency telephone, with a dedicated line, shall be provided in the elevator cab, with a telephone junction box provided in the elevator machine room.

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## BUILDING EXCELLENCE

### SECTION 14 21 00

#### TRACTION ELEVATOR

##### GENERAL

- 1.1. The architect should include in this section: commercial, standard pre-engineered traction passenger elevators, elevator car enclosures, hoistway entrances and signal equipment, jacks, operation and control systems, accessibility provisions for physically disabled persons, equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity and materials and accessories as required to complete the elevator installation.
- 1.2. The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3. Require a warranty for the work specified for two year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
  - Defects shall include deterioration of finishes, loose or missing parts, non-functioning components and mechanisms and rough or noisy operation.

##### PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.
  - A. Basis of Design Product: "Gen2 Elevator System" manufactured by Otis Elevator.
  - B. Supplier requesting approval shall have a minimum of five years experience in the installation of similar equipment and have a maintenance representative in the area with a stock of parts.
  - C. Acceptable manufacturers: Otis Elevators, ThyssenKrupp, Schindler

##### 2.2 MATERIALS

- A. Power supply for the elevator apparatus will be as shown on the Electrical Drawings.
- B. Elevator shall be electric traction.
- C. Attributes shall include:
  1. The elevator shall have a 2,500 lbs. capacity, or as code and use requires, exclusive of weight of car, Class A. The 2,500 lb elevator has a speed of 150 feet per minute and a clear car dimension of 6'-6" wide x 4'-3" deep.
  2. The elevator entrance is 3 feet-6 inches wide x 7 feet-0 inches high with a single- slide opening with factory-finished enamel.
  3. The elevator has stainless steel cab fronts with swing panel, stainless steel car door with kick plate, vandal resistant telephone compartment, car position indicator, emergency light and alarm bell, VCT floor, oil line shutoff valve, jack cylinder wrapped with corrosion-resistant protective tape, sound isolation couplings, silencer, NEMA 1 (fully enclosed) controller cabinet. Emergency Service in accordance with the Safety Code for Elevators and Escalators (ANSI/ASME A17.1) is included. Provide flat light center light recessed fluorescent cab light, and recessed fan.
  4. Elevator dimensions, location of car operating station, controls, signals, telephone compartment and handrail comply with the requirements of ANSI A117.1 ADA, TAS, and Building Code officials having jurisdiction for use by



## BUILDING EXCELLENCE

the physically handicapped. Other features that may be required by Texas state and local elevator codes shall be included, such as electronic door sensing device, visual and audible signals, hall lanterns, gongs, handicapped signal and control package, and tactile markings.

5. Electrical requirements include 408 Volt/3 Phase/20 HP/60 Hz.
6. Provide a pit ladder and keyed lock operators.

### 2.3 MAINTENANCE

- A. In addition to the required maintenance and protection during construction, provide maintenance on the entire Work of this Section for a period of two years commencing on the day of Substantial Completion. Maintenance shall include, but not necessarily be limited to:
  - Systematic examination, adjustment, and lubrication of all elevator equipment.
  - Repair or replacement of electrical and mechanical parts of the elevator installation as required, using only the genuine standard parts approved for the original installation.
  - Maintenance work as required during regular working hours and regular working days, but with emergency callback service available at all times during this maintenance period.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to the proper and timely completion of the work. Do not proceed until satisfactory conditions have been corrected.
  - B. Install the Work of this Section in strict accordance with the approved shop drawings, the original design, and all pertinent regulations and codes, anchoring all components firmly into position for long life under hard use.
  - C. Upon completion of the installation, and as a condition of its acceptance, provide all necessary equipment and personnel and perform all tests required. Secure all required approvals from agencies having jurisdiction.
  - D. All drawings and schematics Shall be bound in a three-ring binder and placed in a wall mounted cabinet in the elevator machine room. All elevator test documents shall be in a separate binder placed in the cabinet.
  - E. Do not use the elevator during construction without the Owner's permission.

### END OF SECTION



## BUILDING EXCELLENCE

### SECTION 14 24 23

#### HYDRAULIC ELEVATOR

##### GENERAL

- 1.1. The architect should include in this section: commercial, standard pre-engineered hydraulic passenger elevators, elevator car enclosures, hoistway entrances and signal equipment, jacks, operation and control systems, accessibility provisions for physically disabled persons, equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity and materials and accessories as required to complete the elevator installation.
- 1.2. The architect should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3. Require a warranty for the work specified for two year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
  - Defects shall include deterioration of finishes, loose or missing parts, non-functioning components and mechanisms and rough or noisy operation.

##### PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.
  - A. Basis of Design Product: "Endura MRL" manufactured by ThyssenKrupp Elevator.
  - B. Supplier requesting approval shall have a minimum of five years experience in the installation of similar equipment and have a maintenance representative in the area with a stock of parts.
  - C. Acceptable manufacturers: EMR Elevators

##### 2.2 MATERIALS

- A. Power supply for the elevator apparatus will be as shown on the Electrical Drawings.
- B. Elevator shall be traction/hydraulic with direct acting plunger, pumping unit, storage tank, magnetic control valves, and the following:
  1. Pumping units and associated control equipment shall be located in a machine room remote from the hoistways.
  2. Pumps shall deliver oil directly into the cylinders at the necessary pressure and in sufficient quantity to lift the fully loaded elevator at the specified speed. Operating fluid shall be oil.
  3. The tank shall act as a storage tank only, and the oil shall be pumped from the tank into the cylinder on the up trip, returned to the tank on the down trip.
- C. Attributes shall include:
  1. The elevator shall have a 2,500 lbs. capacity, or as code and use requires, exclusive of weight of car and plunger, Class A. The 2,500 lb elevator has a speed of 100 feet per minute and a clear car dimension of 6'-8" wide x 4'-3" deep.
  2. The elevator entrance is 3 feet-6 inches wide x 7 feet-0 inches high with a single- slide opening with factory-finished enamel.
  3. The elevator has stainless steel cab fronts with swing panel, stainless steel car door with kick plate, vandal resistant telephone compartment, car



## BUILDING EXCELLENCE

position indicator, emergency light and alarm bell, VCT floor, oil line shutoff valve, jack cylinder wrapped with corrosion-resistant protective tape, sound isolation couplings, silencer, NEMA 1 (fully enclosed) controller cabinet. Emergency Service in accordance with the Safety Code for Elevators and Escalators (ANSI/ASME A17.1) is included. Provide flat light center light recessed fluorescent cab light, and recessed fan.

4. Elevator dimensions, location of car operating station, controls, signals, telephone compartment and handrail comply with the requirements of ANSI A117.1 ADA, TAS, and Building Code officials having jurisdiction for use by the physically handicapped. Other features that may be required by Texas state and local elevator codes shall be included, such as electronic door sensing device, visual and audible signals, hall lanterns, gongs, handicapped signal and control package, and tactile markings.
5. Electrical requirements include 408 Volt/3 Phase/20 HP/60 Hz.
6. Provide a pit ladder and keyed lock operators.

### 2.3 MAINTENANCE

- A. In addition to the required maintenance and protection during construction, provide maintenance on the entire Work of this Section for a period of two years commencing on the day of Substantial Completion. Maintenance shall include, but not necessarily be limited to:
  - Systematic examination, adjustment, and lubrication of all elevator equipment.
  - Repair or replacement of electrical and mechanical parts of the elevator installation as required, using only the genuine standard parts approved for the original installation.
  - Maintenance work as required during regular working hours and regular working days, but with emergency callback service available at all times during this maintenance period.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to the proper and timely completion of the work. Do not proceed until satisfactory conditions have been corrected.
  - B. Install the Work of this Section in strict accordance with the approved shop drawings, the original design, and all pertinent regulations and codes, anchoring all components firmly into position for long life under hard use.
  - C. Upon completion of the installation, and as a condition of its acceptance, provide all necessary equipment and personnel and perform all tests required. Secure all required approvals from agencies having jurisdiction.
  - D. All drawings and schematics Shall be bound in a three-ring binder and placed in a wall mounted cabinet in the elevator machine room. All elevator test documents shall be in a separate binder placed in the cabinet.
  - E. Do not use the elevator during construction without the Owner's permission.

### END OF SECTION



B U I L D I N G E X C E L L E N C E

SECTION 21 05 00

FIRE SUPPRESSION COMMON WORK RESULTS

GENERAL

- 1.1 At completion of project, the architect should provide a full-sized laminated set of record drawings to be located near the fire risers and fire alarm panel.
- 1.2 Provide a 10% attic stock of sprinkler heads and wrenches for maintenance.
- 1.3 The architect/engineer should specify a main drain when risers are located in mechanical rooms.
- 1.4 Require a sprinkler zoning diagram to be located near fire alarm panel. The diagram shall have the physical address and FDC (fire department connection).
- 1.5 A full-sized laminate copy of all drawings, documentation and reports shall be given to HISD Program Manager for the fire closet.
- 1.6 All mechanical rooms, gymnasiums and spaces with exposed ceilings and high impact shall have wire guards on all sprinkler heads.
- 1.7 In freezers, provide a glycol fire sprinkler system.
- 1.8 The building shall have a wet sprinkler system in accordance with NFPA requirements. Siamese fire department connections and post indicator valves shall be wall mounted or free standing.

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## BUILDING EXCELLENCE

### SECTION 21 11 00

#### FIRE SUPPRESSION SYSTEMS

##### GENERAL

###### 1.1 WORK INCLUDED

- A. All buildings shall have a complete fire suppression (sprinkler) system throughout in accordance with NFPA requirements. Siamese fire department connections shall be wall mounted or free standing. Available static water pressure, residual pressure, and water flow must be evaluated as a part of this determination.
  - 1. Provide stand pipes at legitimate stages and buildings three stories and above.
  - 2. Provide dry pipe systems in areas subject to freezing.
  - 3. Provide clean agent systems in data centers and network operation centers.
- B. Installation of a water storage system along with the fire pump installation may be required where insufficient water, flow, and pressure are present.
- C. A backflow preventer shall be included on all incoming systems.
- D. The contractor shall provide the following as a part of the Operation and Maintenance Manual.
  - 1. Permit and inspection reports for the fire suppression system.
  - 2. Backflow test results on the fire suppression system.
- E. Identification for Fire-Suppression Piping and Equipment:
  - 1. Data/Name plates shall be installed in accordance to Fire Prevention Bureau Standards.
  - 2. Piping shall be identified in mechanical rooms, unfinished spaces without ceilings, above suspended lay-in acoustical ceilings, and crawl spaces for the type of service and direction of flow. Equipment shall be identified with data/name plates.

###### 1.2 RELATED DOCUMENTS

- A. The Authority Having Jurisdiction requirements and NFPA 13.

###### 1.3 REFERENCES

- A. The current editions of NFPA Standards No. 13, 14, 20, 24, 25.
- B. Underwriters' Laboratories
- C. Applicable Codes and Regulations.
- D. Authorities Having Jurisdiction.

###### 1.4 DESIGN CRITERIA

- A. Design Densities:
  - 1. Public Spaces, Offices, and Learning Centers: Wet pipe system with 0.10 gpm per square foot over the most remote 1,500 square feet area.
  - 2. Mechanical rooms, Storage, and Service Areas: Wet pipe system with 0.15 gpm per square foot over 1,500 sq.ft.

- 1.5 All piping valves and fittings shall be made in USA and shall be stamped/stenciled "made in USA."

##### PRODUCTS

###### 2.1 Fire Suppression Water Service Piping

- A. Piping:
  - 1. Black and hot-dipped zinc coated pipe, ASTM A795
  - 2. Welded and seamless steel pipe, ANSI/ASTM A 53
  - 3. Wrought steel pipe, ANSI B 36.10M



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4. Electric resistance welded steel pipe, ASTM A 135
  - B. Fittings:
    1. Cast iron threaded, Class 125 and 250, ANSI B16.4
    2. Cast iron pipe flanges and fittings, ANSI B16.1
    3. Malleable iron threaded, Class 150 and 300, ANSI B16.3
    4. Factory-made wrought steel butt weld, ANSI B16.9
    5. Buttwelding ends for pipe, valves, flanges, and fittings, ANSI B16.25
    6. Steel pipe flanges and flanged fittings, ANSI B16.11
    7. Forged steel fittings, socket welded and threaded, ANSI B16.11
  - C. Foreign Materials:
    1. Piping, valves and fittings from a foreign manufacturer shall not be acceptable.
- 2.2 Fire Suppression Standpipes
- A. Piping:
    1. Ferrous piping – ductile-iron pipe, centrifugally cast for water, AWW C151
    2. Electric-resistance welded steel pipe – standard specification for electric. Resistance-welded steel pipe, ASTM A 135
    3. Welded and seamless steel pipe – standard specification for black and hot-dipped zinc-coated welded and seamless steel pipe for fire protection, ASTM A 53
  - B. Valves
    1. Valves shall be UL listed and FM approved
  - C. Foreign Materials:
    1. Piping, valves and fittings from a foreign manufacturer shall not be acceptable.
    2. Couplings: Victaulic, Grinnell Valves: Nibco, Grinnell, Victaulic
    3. Accessories: Potter–Roemer, Elkhart Brass, Reliable
- 2.3 Wet-Pipe Sprinkler System Heads, Valves and Fire Department Connection
- A. Piping and fittings
    1. Refer to section 21 11 00 – Facility Fire-Suppression Water-Service Piping
  - B. Sprinkler Heads
    1. Shall be UL listed and FM approved
    2. Sprinkler heads with “O” ring design shall not be acceptable
    3. ***Recessed sprinkler heads shall be used in all areas that receive a ceiling. All heads shall be centered in lay-in ceiling tile.***
    4. ***Upright brass sprinkler heads shall be provided where heads are exposed.***
  - C. Valves
    1. Valves shall be UL listed and FM approved
  - D. Fire Department connection:
    1. Fire department connections shall be UL listed and FM approved
- 2.4 Dry-Pipe Sprinkler System
- A. This system shall be used in areas to freezing; same guidelines as Wet Pipe Sprinkler System.
- 2.5 Clean Agent Fire-Extinguishing Systems
- A. Acceptable Manufacturers: DuPont FE-25, DuPont FM-200
- 2.6 Fire Pumps
- A. Pumps
    1. Acceptable Manufacturers: Aurora, Peerless, Fairbanks-Morse
  - B. Controllers
    1. Acceptable Manufacturers: Metron, Master



## EXECUTION

### 3.1 INSTALLATION

- A. Provide tracer wire on all pipe installed below slab outside building; locate leads in accessible location for future use in trouble shooting.
- B. Provide placards on all control valves, alarm lines, alarm test lines, floor control valves, area control valves, inspector test valves and auxiliary drain locations. Valves, etc. above ceiling or in walls to be provided direct access and the location conspicuously noted by a permanent placard indicating the type of device and the zone it covers. Provide a zone map, mounted in an extruded metal frame with protective plexi-glass cover mounted at the sprinkler zone valve header. Map shall indicate which zone valve controls which portion of the building as well as the location of all system drain and test valves. Label each valve with lamacoid, printed signs ("Inspector's test", "Main Drain", etc.). Map shall reflect the actual room numbers indicated in the final approved graphics package.
- C. Provide basket type metal guards over sprinkler heads to protect them from damage in mechanical rooms, main electrical and telephone equipment, storage rooms and all unfinished areas where the head is less than 7 feet-6 inches above finished floor.
- D. Fire Alarm System: Coordinate with Division 26 to provide connections to all supervised devices and flow switches as well as any other items requiring connection to the fire alarm system, provide all wiring and equipment.
- E. Stages: At each side of each stage provide a complete Authorities having Jurisdiction and NFPA compliant class III standpipe system with 1.5" and 2.5" fire department hose connections. Mount hose connections in Potter-Romer lockable, clear glass front cabinet. Coordinate exact location of standpipes with stage equipment.

### 3.2 DEMONSTRATION

- F. Testing of the completed sprinkler system for acceptance shall be witnessed by an Owner's representative. Testing should be coordinated with the Authority Having Jurisdiction.

## END OF SECTION



B U I L D I N G E X C E L L E N C E

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

GENERAL

1.1 SUMMARY

- A. Design a complete plumbing system including all sanitary, waste and vent piping, storm piping, gas piping and all equipment necessary for a complete system and ***in accordance with all local jurisdictions and codes.***
- B. All materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture.
- D. Provide hot and cold and tempered water isolation valves at every supply pipe to each restroom or restroom bank.
- E. Isolation valves shall be accessible in all restrooms. The contractor shall provide a minimum of 2 feet accessible pipe chase for maintenance.
- F. All cleanouts shall be accessible.
- G. Any room that has a plumbing fixture shall have an accessible isolation valve.
- H. A record shall be kept of all permits and inspections and submitted to the Master Plumber. In addition, a list of all equipment and devices will be provided.

1.2 PLUMBING SYSTEM CRITERIA FOR NEW WORK

- A. The design shall include a freeze proof wall hydrant (cold water only) with vacuum breaker in the following areas: Central Plant Mechanical rooms and in the service yard near the kitchen service door.
- B. The building shall have a wet sprinkler system in accordance with NFPA requirements. Siamese fire department connections shall be included.
- C. Lift stations shall not be used unless express written consent by HISD is received.
- D. Domestic hot water temperature shall be limited to 105° F. except for water supplied to kitchen. Kitchens shall have a water supply temperature of 140° F.
- E. The building shall have a wet sprinkler system in accordance with NFPA requirements. Siamese fire department connections and post indicator valves shall be wall mounted or free standing.
- F. Gas piping on roofs shall be supported by manufactured free standing pipe supports.
- G. Size underground domestic water, sanitary, and storm drainage piping to accommodate future additions of 15%.
- H. Water and gas lines under drives and walkways shall be sleeved with schedule 40 PVC, at least two pipe sizes larger than the supply line.
- I. Domestic Hot Water: Domestic water heaters shall be provided to supply hot water to plumbing fixtures according to Table V.C.1.
- J. \*The design of the roof drainage systems shall incorporate roof drains and overflows. The overflow system shall be piped independently and connected vertically to the roof drain down spout. The overflows shall be located in locations readily visible. (\*Discharge overflow above grade if required by local Authority having jurisdiction).
- K. The building domestic hot water systems shall consist of central and point of use water heaters, depending on location and usage. The kitchen shall have a standalone domestic water heater.
- L. Lavatories serving students shall have single, self closing faucets. Learning Center sinks shall have single faucets with goose necks. All sinks to include cold, tempered and hot water not to exceed 105° F
- M. In each science learning center/wet lab, provide a red emergency shut off button to shutdown water, gas and electricity in event of an emergency. Locate this button in the teacher's workstation and away from exit door.



## BUILDING EXCELLENCE

### 1.3 Stadium/Sports Facilities

- A. The building domestic hot water systems shall consist of central and point of use water heaters, depending on location and usage.
- B. All shower facilities shall have hot and cold water with standard fixtures. The shower valves shall be anti-scalding type.
- C. The Domestic hot water temperature shall be limited to 105° F. except for water supplying clothes washing machines, which shall be supplied with 140° F water.
- D. Provide a lint trap for facilities with commercial washing machines, sized per governing code.

### 1.4 PLUMBING FOR KITCHENS

- A. Hot water for dish rinsing system shall be 180 °F (provided by booster heater).
- B. Hot water for kitchen facilities other than dish rinsing shall be 140 °F.
- C. Water heater for kitchen shall be a standalone system.
- D. The hood fire protection system should be included with the hood, with any Interconnecting piping provided by the HVAC contractor.
- E. Coordinate installation of an automatic gas shut off valve for gas cooking equipment with food service consultant.
- F. Provide a grease trap, sized per governing code.

### 1.5 PLUMBING SYSTEM CRITERIA FOR RENOVATION/ADDITIONS WORK

Scope of Inspection: The intent of the following is to provide minimum levels of required inspection by the designing engineer prior to and in conjunction with the renovation/addition design.

- A. Pre-Inspection Meeting
- B. Maintenance staff
  - 1. Review existing equipment history
  - 2. Discuss any accessibility issues
  - 3. Discuss any maintenance issues
  - 4. Review suggested/requested work to be done
- C. Maintenance staff Engineer's Walk Through
  - 1. Check fixtures for cracks.
  - 2. Check piping, faucets, angle stop valves, flush valves and other plumbing brass for leaks. Note signs of water damage
  - 3. Inspect drains and any sump pumps
  - 4. Inspect concealed (above ceiling) systems: Piping, Insulation
- D. Submit Engineer's Evaluation including changes in budget and scope.
- E. The specifications shall state that all drain lines (roof, sanitary, and condensate) shall be flow-tested prior to the contractor obtaining a notice of substantial completion.

### 1.6 PLUMBING SPECIALTIES

- A. Acceptable Manufacturers:
  - 1. Roof and floor drains: Interceptors, Cleanouts, Water hammer arrestors: MFGR, J.R. Smith, Zurn, Josam, Wade, Precision Plumbing Products.
  - 2. All restrooms, clinics, planting areas, custodial rooms, mech. rooms, and emergency shower and eye wash areas shall have a 3" floor drain installed.
  - 3. Back flow preventers: Watts, Febco, Wilkins.
  - 4. Thermostatic mixing valves: Lawler, Powers, Symmons.
  - 5. Hose bib hydrants: Chicago, Josam, Woodford, Zurn, J.R. Smith, Wade.

### 1.7 INTERFERENCE DRAWINGS

- A. Where field conditions prohibit the installation of the plumbing system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8 inch scale, clearly depicting the conflict along with an alternate installation



## BUILDING EXCELLENCE

arrangement that satisfies the design intent of the documents without incurring additional cost.

- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

### 1.8 GENERAL ELECTRICAL REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with plumbing equipment specified in Division 22.
- B. Electrical materials and work provided shall be in accordance with Division 26.

### 1.9 SWIMMING POOL PLUMBING SYSTEMS

- A. Acceptable Manufacturers: Neptune, Benson, Swimquip
- B. Pool heater Acceptable Manufacturers: Ray Pak, Laars, Lochinvar
- C. Filters shall be sand type
- D. System shall be installed indoors

### 1.10 *Install test T valves for annual gas tests.*

### 1.11 *Provide HISD Program Manager with a copy of all rough and final tests.*

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<a href="#"><u>22 30 00</u></a>	Plumbing Equipment	VERSION 3.0
<a href="#"><u>22 40 00</u></a>	Plumbing Fixtures	VERSION 3.0

## EXECUTION

### 3.1 OWNER INSTRUCTION – GENERAL

- A. Provide on-site Owner training for all new equipment by factory trained specialists.
- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.
- D. Refer to individual equipment specifications for additional training requirements.

**END OF SECTION**



B U I L D I N G   E X C E L L E N C E

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

GENERAL

1.1 SUMMARY

- A. Design a complete plumbing system including all sanitary, waste and vent piping, storm piping, gas piping and all equipment necessary for a complete system and ***in accordance with all local jurisdictions and codes.***
- B. All materials and distribution, and utilization equipment shall be UL Listed.
- C. All equipment and materials shall be new, unused and of United States Domestic manufacture.
- D. Provide hot and cold and tempered water isolation valves at every supply pipe to each restroom or restroom bank.
- E. Isolation valves shall be accessible in all restrooms. The contractor shall provide 24" clear space inside the chase between piping and carriers.
- F. All cleanouts shall be accessible.
- G. Any room that has a plumbing fixture shall have an accessible isolation valve.
- H. A record shall be kept of all permits and inspections and submitted to the Master Plumber. In addition, a list of all equipment and devices will be provided.

1.2 PLUMBING SYSTEM CRITERIA FOR NEW WORK

- A. The design shall include a freeze proof wall hydrant (cold water only) with vacuum breaker in the following areas: Central Plant Mechanical rooms and in the service yard near the kitchen service door.
- B. The building shall have a wet sprinkler system in accordance with NFPA requirements. Siamese fire department connections shall be included.
- C. Lift stations shall not be used unless express written consent by HISD is received.
- D. Domestic hot water temperature shall be limited to 105° F. except for water supplied to kitchen. Kitchens shall have a water supply temperature of 140° F.
- E. The building shall have a wet sprinkler system in accordance with NFPA requirements. Siamese fire department connections and post indicator valves shall be wall mounted or free standing.
- F. Gas piping on roofs shall be supported by manufactured free standing pipe supports.
- G. Size underground domestic water, sanitary, and storm drainage piping to accommodate future additions of 15%.
- H. Water and gas lines under drives and walkways shall be sleeved with schedule to PVC, at least two pipe sizes larger than the supply line.
- I. Domestic Hot Water: Domestic water heaters shall be provided to supply hot water to plumbing fixtures according to Table V.C.1.
- J. \*The design of the roof drainage systems shall incorporate roof drains and overflows. The overflow system shall be piped independently and connected vertically to the roof drain down spout. The overflows shall be located in locations readily visible. (\*Discharge overflow above grade if required by local Authority having jurisdiction).
- K. The building domestic hot water systems shall consist of central and point of use water heaters, depending on location and usage. The kitchen shall have a standalone domestic water heater.
- L. Lavatories serving students shall have single, self closing faucets. Learning Center sinks shall have single faucets with goose necks. All sinks to include cold, tempered and hot water not to exceed 105° F
- M. In each science learning center/wet lab, provide a red emergency shut off button to shutdown water, gas and electricity in event of an emergency. Locate this button in the teacher's workstation and away from exit door.





## BUILDING EXCELLENCE

### 1.3 Stadium/Sports Facilities

- A. The building domestic hot water systems shall consist of central and point of use water heaters, depending on location and usage.
- B. All shower facilities shall have hot and cold water with standard fixtures. The shower valves shall be anti-scalding type.
- C. The Domestic hot water temperature shall be limited to 105° F. except for water supplying clothes washing machines, which shall be supplied with 140° F water.
- D. Provide a lint trap for facilities with commercial washing machines, sized per governing code.

### 1.4 PLUMBING FOR KITCHENS

- A. Hot water for dish rinsing system shall be 180 °F (provided by booster heater).
- B. Hot water for kitchen facilities other than dish rinsing shall be 140 °F.
- C. Water heater for kitchen shall be a standalone system.
- D. The hood fire protection system should be included with the hood, with any Interconnecting piping provided by the HVAC contractor. Piping or electrical wiring for such systems shall be performed by contractors licensed by the State of Texas to perform such work.
- E. Coordinate installation of an automatic gas shut off valve for gas cooking equipment with food service consultant.
- F. Provide a grease trap, sized per governing code.

### 1.5 PLUMBING SYSTEM CRITERIA FOR RENOVATION/ADDITIONS WORK

Scope of Inspection: The intent of the following is to provide minimum levels of required inspection by the designing engineer prior to and in conjunction with the renovation/addition design.

- A. Pre-Inspection Meeting
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  - 3. Discuss any maintenance issues
  - 4. Review suggested/requested work to be done
- C. Maintenance staff Engineer's Walk Through
  - 1. Check fixtures for cracks.
  - 2. Check piping, faucets, angle stop valves, flush valves and other plumbing brass for leaks. Note signs of water damage
  - 3. Inspect drains and any sump pumps
  - 4. Inspect concealed (above ceiling) systems: Piping, Insulation
- D. Submit Engineer's Evaluation including changes in budget and scope.
- E. The specifications shall state that all drain lines (roof, sanitary, and condensate) shall be flow-tested prior to the contractor obtaining a notice of substantial completion.

### 1.6 PLUMBING SPECIALTIES

- A. Acceptable Manufacturers:
  - 1. Roof and floor drains: Interceptors, Cleanouts, Water hammer arrestors: MFGR, J.R. Smith, Zurn, Josam, Wade, Precision Plumbing Products.
  - 2. All restrooms, clinics, planting areas, custodial rooms, mech. rooms, and emergency shower and eye wash areas shall have a 3" floor drain installed.
  - 3. Back flow preventers: Watts, Febco, Wilkins.
  - 4. Thermostatic mixing valves: Lawler, Powers, Symmons.
  - 5. Hose bib hydrants: Chicago, Josam, Woodford, Zurn, J.R. Smith, Wade.



## BUILDING EXCELLENCE

### 1.7 INTERFERENCE DRAWINGS

Where field conditions prohibit the installation of the plumbing system components within the available space as indicated on drawings, the Contractor shall prepare a sketch to the minimum 1/8 inch scale, clearly depicting the conflict along with an alternate installation arrangement that satisfies the design intent of the documents without incurring additional cost.

- B. Obtain written approval of proposed interference resolution prior to proceeding with alternate installation.

### 1.8 GENERAL ELECTRICAL REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with plumbing equipment specified in Division 22.
- B. Electrical materials and work provided shall be in accordance with Division 26.

### 1.9 SWIMMING POOL PLUMBING SYSTEMS

- A. Acceptable Manufacturers: Neptune, Benson, Swimquip
- B. Pool heater Acceptable Manufacturers: Ray Pak, Laars, Lochinvar
- C. Filters shall be sand type
- D. System shall be installed indoors

### 1.10 *Install test T valves for annual gas tests.*

### 1.11 *Provide HISD Program Manager with a copy of all rough and final tests.*

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## EXECUTION

### 3.1 OWNER INSTRUCTION – GENERAL

- A. Provide on-site Owner training for all new equipment by factory trained specialists.
- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.
- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.
- D. Refer to individual equipment specifications for additional training requirements.

### END OF SECTION



## BUILDING EXCELLENCE

### SECTION 22 10 00

#### PLUMBING PIPING

##### GENERAL

###### 1.1 SUMMARY

- A. Design a complete system of plumbing piping and pumps.

##### PRODUCTS

###### 2.1 MATERIALS

- A. Flexible pipe connectors (Steel and Copper), Expansion joints (bellows type), Flexible couplings, and Accessories.
- B. Acceptable Manufacturers:
  - 1. Amber-Booth, Triplex, Mercer Rubber Company
- C. Supports and Anchors
  - 1. No wood sills allowed.
  - 2. Roof supports compatible with existing roof system shall be portable pipe hangers or approved equal.
  - 3. Provide housekeeping pads for all floor mounted equipment.
- D. All buried piping shall be buried a minimum of 30" below finished grade including domestic water, gas, sewer and storm sewer.
- E. Provide shut-off valve for each battery of fixtures located above ceiling near each bathroom.
- F. Instructional piping (water, gas, air, etc.) in any area used by students, route the supply lines through the storage or prep room and install control valves with remote actuation. A separate set shall be installed for each individual teaching space, accessible only by the teacher.
- G. Drainage piping below slab shall be service weight cast iron bell and spigot or schedule 40 PVC.
- H. Draining piping above grade shall be service weight NO-HUB cast iron.
- I. Domestic water below grade shall be ductile iron-ASHI/AWWA C151, C900 PVC and copper ASTM B88 Type K. Above grade, copper ASTM B88 Type L, hard drawn.  
Acceptable Manufacturers: Viega Pro Press (for 3 inch lines or smaller).
- J. Where buried gas piping and fittings shall be schedule 40 black steel with welded joints, coated with bitumastic and wrapped with asphaltum tape. Buried pipe shall have a minimum depth of 30" and be sloped to prevent pockets. Gas piping with 5 pound working pressure or less may be yellow polyethylene with socket heat fusion joints and fittings. Polyethylene piping shall be SDR 11 or SDR 11.5 per their respective size.
- K. Gas piping 2-1/2" and larger shall have welded connections while piping under 2-1/2" shall have screwed connections.
- L. Locate gas meter in the service yard closest to the facility/mechanical room and protected by bollards.
- M. All piping on roof shall be supported by roof mounted pipe hangers. No wood is allowed.
- N. Valves 2-1/2" and smaller shall be cast brass with stainless steel ball and stem; 3" and larger shall be gate valves.
- O. Butterfly valves are not acceptable for any plumbing applications.

###### 2.2 CHEMICAL WASTE SYSTEMS

- A. Laundry Waste System
  - 1. Shall have lint trap and sampling wells
- B. Acid Waste System



## BUILDING EXCELLENCE

1. Acceptable Manufacturers: Park Equipment, Rockford, Green Turtle, Ipex, CPVC
  2. Acid resistant piping and fittings shall be schedule 40 PVDF Fusion Joint for above and below grade/slab applications as manufactured by Orion, George Fisher, Enfield and Zurn. Above grade applications shall include PVDF piping with UL listing for use in return air plenums; buried, below grade piping or piping in non-return air plenums need not be plenum rated.
  3. A city/county approved neutralization basin of concrete construction, (\*) epoxy lining outside the building, shall be provided.
- C. Alternative Acid Waste System
1. Acceptable Manufactures: Charlotte Pipe, Spears, Ipex
  2. Special drainage systems for corrosive chemical or acid waste shall be manufactured from CPVC Type IV, ASTM Cell Classification 23447. All pipe, fittings and solvent cement shall be manufactured in accordance with ASTM F 2618 and certified by NSF International for corrosive waste end use. All pipe and molded fittings shall be CAN/ULC S102.2 listed for surface burning characteristics with a flame spread of less than 25 and a smoke development of less than 50 as designated on the original package labeling for fittings and on the pipe print string marking. All pipe markings shall be accompanied by a yellow stripe for identification of CPVC chemical waste system. All fittings shall be CPVC drainage patterns meeting the requirements of ASTM D 3311 and specialty patterns according to the manufacture's specifications. Joining method for pipe and fittings shall be solvent cement welding. Solvent cement shall be a "one-Step" primerless type CPVC cement designated by the system manufacture, specially formulated for resistance to corrosive chemicals and manufactures in accordance with ASTM F 493, as specified in ASTM F 2618. Mechanical connections for special equipment connection or transition to other system materials shall be as specified by the CPVC system manufacture. All pipe, fittings, and cement shall be supplied together as a complete system. Installation shall be in accordance with the manufactures instructions and all applicable codes.
- D. Oil Waste System
1. Shall have prefabricated oil separator and sampling wells
  2. Acceptable Manufacturers: J.R. Smith, Josam, Zurn
- E. Grease Waste System
1. Shall have grease traps and sampling wells
  2. Acceptable Manufacturers: Park Equipment, Rockford, J.R. Smith, Zurn, Josam

## EXECUTION

### 3.1 EXAMINATION

- A. Verify excavations are to required grade, dry, and not over-excavated.

### 3.2 PIPE PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

### 3.3 INSTALLATION – BACKFLOW PREVENTERS

- A. Provide at each make up connection to a hot water boiler, cooling tower, chilled water system kitchen equipment and at each piece of equipment requiring a make-up connection.
- B. Provide at water supply to fire protection system.
- C. Provide a floor drain within six (6) feet of each backflow preventer.
- D. Backflow preventer shall be certified by Contractor.

### 3.4 FIELD QUALITY CONTROL

- A. Pressure test all domestic water piping.
- B. After installation and prior to backfill or cover-up, rinse piping system of particulate contaminants, cap and subject to static water pressure of 125 psig for four (4) hours.
- C. Repair leaks and defects and re-test any portion of piping system that fails.



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- D. Provide written test report including date and time of test, pass or fail indication, summary of remedial work required and date and time of each re-test.
- E. Pressure test all gas piping.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 22 15 00

#### GENERAL SERVICE COMPRESSED-AIR SYSTEMS

##### GENERAL

- 1.1 This Section includes piping and related specialties for general-service compressed-air systems operating at 125 psig and less. Make connections to compressor, dryer, filter, and other related items of equipment and piping accessories, and extend air piping through building to all equipment, fixtures and outlets requiring same.
- 1.2 QUALITY ASSURANCE
  - A. Comply with ASME B31.9, "Building Services Piping", for low-pressure compressed-air piping.

##### PRODUCTS

- 2.1 PIPES, TUBES AND FITTINGS
  - A. Compressed Air Systems
    1. Acceptable Manufacturers: Quincy, Ingersoll-Rand, Champion

##### EXECUTION

- 3.1 Provide quick connect outlets and noses for all shop equipment.
- 3.2 CONNECTIONS
  - A. Drawings indicate general arrangement of piping, fittings, and specialties.
  - B. Install piping adjacent to specialties and equipment to allow service and maintenance.
  - C. Connect piping to air compressors, accessories, and specialties with shutoff valve and union or flanged connection.
- 3.3 FIELD QUALITY CONTROL
  - A. Perform the following field tests and inspections and prepare test reports:
    1. Test and adjust piping safety controls. Replace damaged and malfunctioning safety controls.
    2. Piping Leak Tests: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
    3. Repair leaks and retest until no leaks exist.
    4. Report results in writing.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 22 30 00

#### PLUMBING EQUIPMENT

##### GENERAL

###### 1.1 SUMMARY

- A. Provide a complete installation for each equipment type listed in this section.
- B. Obtain Owner approval prior to the design of any water softener system.

###### 1.2 SUBMITTALS

- A. Product Data: Submit complete manufacturer's specification pages for each piece of equipment. Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Submit electrical characteristics and connection locations.
- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

###### 1.3 EXTRA MATERIALS

- A. Furnish two pump seals.

##### PRODUCTS

###### 2.1 EQUIPMENT

- A. PUMPS – Acceptable Manufacturers: Weil, Chicago, Taco.
  - 1. Pumps: Hot Water Circulator, Bell & Gosset, Taco, Grundfos, PACO, Armstrong
  - 2. Pressure Boosters: Bell & Gosset, Armstrong, NAMCO, Syncroflo
  - 3. Grinder Pumps: ABS, Dorr Oliver, VaughanWeil, Hydromatic
  - 4. Sewage Pumps: Chicago, Weil, Vaughan, Weinman, PACO, Hydromatic
  - 5. Sump Pumps: Barnes, ABS, Vaughan, Weinman, Paco, Weil, Hydromatic
- B. Hot Water Storage Tanks (Domestic Water) – Acceptable Manufacturers: A.O. Smith, Reco, and Lochinvar. Tank shall include the following:
  - 1. Coated Interior
  - 2. Inspection access opening
  - 3. Accessibility for cleaning
  - 4. Drain
- C. Water Filtration Devices – Acceptable Manufacturers: Cuno, Aqua pure.
  - 1. Filters shall remove odor and taste from water.
- D. Water Heaters
  - 1. Storage Type, 5 year warranty against leakage on tank – Acceptable Manufacturers: A.O. Smith, Rheem, State, PVI
  - 2. Non-storage Type – Acceptable Manufacturers: Lochinvar, Ray Pak, Lars
  - 3. Provide circulating return, pumped and controlled by an aquastat, and scheduled by BAS to run only during the occupied mode, on hot water runs in excess of 40 linear feet of pipe length.
  - 4. Point of Use Type – Acceptable Manufacturers: e-Max, Powerstream, Chronomite.
  - 5. ASME rating is not required for water heaters under 120 gallons and 200,000 BTUH in capacity.
- E. Storage Tanks (Surge and Break Tanks)
  - 1. ASME rated.
  - 2. Shall be internally coated if used for domestic water.





## EXECUTION

### 3.1 INSTALLATION

- A. Maintain manufacturer's recommended clearances around and over water heaters.
- B. Install water heater on concrete housekeeping pad, minimum 3-1/2 inches high and six inches larger than water heater base on each side. Refer to Section 03 30 00.
- C. Connect natural gas piping in accordance with NFPA 54.
- D. Provide water heater pan beneath all suspended water heaters with 3/4 inch drain to nearest floor sink.
- E. Connect natural gas piping to water heater, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.
- F. Install piping accessories on all domestic water heaters.
- G. Install the following piping accessories on natural gas piping connections:
  - 1. Strainer.
  - 2. Pressure gage.
  - 3. Shutoff valve.
  - 4. Pressure reducing valve.
- H. Provide factory start-up and demonstration, including operating instructions for all gas-fired water heaters. Schedule training sessions with the Architect and the Owner's representatives. Provide certification letter from manufacturer indicating water heater is installed in accordance with the manufacturer's instructions.
- I. Circulating Pump Installation: Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 22 30 00

#### PLUMBING EQUIPMENT

##### GENERAL

###### 1.1 SUMMARY

- A. Provide a complete installation for each equipment type listed in this section.
- B. Obtain Owner approval prior to the design of any water softener system.
- C. All domestic water heaters to be installed only indoors.

###### 1.2 SUBMITTALS

- A. Product Data: Submit complete manufacturer's specification pages for each piece of equipment. Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Submit electrical characteristics and connection locations.
- B. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

###### 1.3 EXTRA MATERIALS

- A. Furnish two pump seals.

##### PRODUCTS

###### 2.1 EQUIPMENT

- A. PUMPS – Acceptable Manufacturers: Weil, Chicago, Taco.
  - 1. Pumps: Hot Water Circulator, Bell & Gosset, Taco, Grunfos, PACO, Armstrong
  - 2. Pressure Boosters: Bell & Gosset, Armstrong, NAMCO, Syncroflo
  - 3. Grinder Pumps: ABS, Dorr Oliver, VaughanWeil, Hydromatic
  - 4. Sewage Pumps: Chicago, Weil, Vaughan, Weinman, PACO, Hydromatic
  - 5. Sump Pumps: Barnes, ABS, Vaughan, Weinman, Paco, Weil, Hydromatic
- B. Hot Water Storage Tanks (Domestic Water) – Acceptable Manufacturers: A.O. Smith, Reco, and Lochinvar. Tank shall include the following:
  - 1. Coated Interior
  - 2. Inspection access opening
  - 3. Accessibility for cleaning
  - 4. Drain
- C. Water Filtration Devices – Acceptable Manufacturers: Cuno, Aqua pure.
  - 1. Filters shall remove odor and taste from water.
- D. Water Heaters
  - 1. Storage Type, 5 year warranty against leakage on tank – Acceptable Manufacturers: A.O. Smith, Rheem, State, PVI, Bradford White
  - 2. Non-storage Type – Acceptable Manufacturers: Lochinvar, Ray Pak, ~~Lars~~ LAARS, Bradford White
  - 3. Provide circulating return, pumped and controlled by an aquastat, and scheduled by BAS to run only during the occupied mode, on hot water runs in excess of 40 linear feet of pipe length.
  - 4. Point of Use Type – Acceptable Manufacturers: e-Max, Powerstream, Chronomite.
  - 5. ASME rating is not required for water heaters under 120 gallons and 200,000 BTUH in capacity.
- E. Storage Tanks (Surge and Break Tanks)



## BUILDING EXCELLENCE

1. ASME rated.
2. Shall be internally coated if used for domestic water.

### EXECUTION

#### 3.1 INSTALLATION

- A. Maintain manufacturer's recommended clearances around and over water heaters.
- B. Install water heater on concrete housekeeping pad, minimum 3-1/2 inches high and six inches larger than water heater base on each side. Refer to Section 03 30 00.
- C. Connect natural gas piping in accordance with NFPA 54.
- D. Provide water heater pan beneath all suspended water heaters with 3/4 inch drain to nearest floor sink.
- E. Connect natural gas piping to water heater, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.
- F. Install piping accessories on all domestic water heaters.
- G. Install the following piping accessories on natural gas piping connections:
  1. Strainer.
  2. Pressure gage.
  3. Shutoff valve.
  4. Pressure reducing valve.
- H. Provide factory start-up and demonstration, including operating instructions for all gas-fired water heaters. Schedule training sessions with the Architect and the Owner's representatives. Provide certification letter from manufacturer indicating water heater is installed in accordance with the manufacturer's instructions.
- I. Circulating Pump Installation: Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.

### END OF SECTION



## BUILDING EXCELLENCE

### SECTION 22 40 00

#### PLUMBING FIXTURES

##### GENERAL

- 1.1 Provide a complete system of plumbing fixtures and trim.
- 1.2 Ensure fixtures meet all applicable ADA and TAS Accessibility requirements.

##### PRODUCTS

###### 2.1 FIXTURES

- A. Acceptable Manufacturers:
  1. Water closets, urinals and lavatories, ~~and showers~~: American Standard, Kohler, Crane, Sloan, Zurn China.  
Note: Urinals shall be ½ gallon flush in lieu of 1 gallon with ½ gallon flush valves. Lavatory faucets shall be metered, push type: Chicago, Delta, Symmons. Toilet seats shall be solid white plastic, open front, elongated, with sustaining hinge and without cover.
  2. Stainless steel sinks: Elkay, Just, Moen.
- B. Science Learning Center/Wet Labs and art rooms, faculty workroom, main custodial rooms shall be stainless steel.
- C. Middle and high school Science Learning Centers/Wet Labs shall have epoxy sinks and counters.
- D. Mop Sinks – Floor Mounted, Non-Metallic: Sterns-Williams, Fiat.
- E. Shower valves: Symmons, Chicago.
- F. Shower Systems: Bradley, Acorn, Willoughby.
- G. Flush Valves: Automatic, hard wired with true manual override button: Sloan, Zurn.
- H. Drinking fountains: Halsey Taylor, Elkay, Sunroc, Haws, Oasis.
- I. Emergency Fixtures: Bradley, Encon, Haws.
- J. Tepid water, as defined by ANSI standard #2-358, shall be provided for all emergency shower and eye washes.
- K. Food Prep Hand Sinks: Electronic AC Faucet 116.124.AB.1 by Chicago Faucet with dual beam infrared sensor and hardwire transformer 240.631.00.1 or equal.
- L. Thermostatic Mixing Valves – Leonard Valves

##### EXECUTION

###### 3.1 EXAMINATION

- A. Engineer shall oversee preparation and installation of all fixtures prior to wall and ceiling cover-up.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.
- D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

###### 3.2 PREPARATION REQUIREMENTS

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

###### 3.3 INSTALLATION REQUIREMENTS

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key or screwdriver



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## B U I L D I N G   E X C E L L E N C E

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- stops, reducers, and escutcheons.
  - C. Install components level and plumb.
  - D. Install and secure fixtures in place with wall supports wall carriers and bolts.
  - E. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.
  - F. For ADA accessible water closets, install flush valve with handle to wide side of stall.
  - G. Emergency Shower: Provide a floor drain at each shower installation.
  - H. Provide power wiring, including control power transformers as required for all sensor type fixtures.
  - I. Bolt carriers to the floor.
- 3.4 PROTECTION OF INSTALLED CONSTRUCTION
- A. Do not permit use of fixtures before final acceptance.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 23 05 00

#### HVAC COMMON WORK RESULTS

##### GENERAL

- 1.1 Provide all work for mechanical, plumbing and fire protection systems required in the project to be properly installed, tested and performing their intended function.
- 1.2 ***HVAC design should comply with the systems described in Division 23. If the architect/engineering team would like to use alternative systems (geothermal, etc.), they must consult the HISD Program Manager.***
- 1.3 Fabric ducts may be used in spaces such as the gymnasium, natatorium or student dining commons with HISD Program Manager approval.
- 1.4 SUBSTITUTIONS:
  - A. Listed product manufacturers are listed to establish a level of quality on the products. Substitutions may be allowed if the product is equal to or better than what is listed in the design guidelines, as determined by the A/E and Bond office upon submittal of comparison products. No substitutions will be allowed on the following:
    1. Liquid Chilling Machines (chillers)
    2. DDC Controls (Control System) – Use approved vendors only.
    3. Chemical Treatment
    4. Variable Refrigerant Flow Systems
- 1.5 HVAC DESIGN CRITERIA
  - A. Outdoor Environmental Design Criteria
    1. Summer 96/77 °F
    2. Ambient for air cooled equipment 105°F
    3. Winter 20 °F
  - B. Indoor Environmental Design Criteria
    1. Summer 74 °F
    2. Winter 72 °F
    3. Relative Humidity 55% RH (+/- 5%)
    4. O/A Outside Air Systems:
  - C. The HVAC system shall comply with the current versions of the IECC and ASHRAE 62 standards as enforced by the Authority having Jurisdiction.
- 1.6 LEED Requirements.
  - A. Each HISD Project is required to meet the U.S. Green Building Council's "Leadership in Environmental and Energy Design or "LEED" requirements including the preparation of an Energy Performance Model.
  - B. The Engineer of Record shall meet HISD's "Owner's Project Requirements" expressed in part by complying with the Design Guidelines, Educational Specifications and verbal or written instructions from HISD, by incorporating same into the contract documents and specifications.
  - C. Submit Energy Model demonstrating the energy reduction required by LEED to HISD, HISD Program Manager and the Commissioning Authority (CxA) at 60% and 90% Construction Document Review. Ensure the Minimum Energy Load reduction has been met before issuing the contract documents for permitting and bidding.
  - D. The preferred Energy Model programs are Trane Trace, Carrier HAPS or the DOE program. The Engineer of Record shall submit alternate programs to HISD for evaluation and approval prior to proceeding with the Energy Model.
- 1.7 BUILDING COMMISSIONING



## BUILDING EXCELLENCE

- A. Each HISD Project is required to meet the U.S. Green Building Council's "Leadership in Environmental and Energy Design or "LEED" requirements including Enhanced Building Commissioning.
- B. The A/E Design team shall invite the CxA to all Project Team meetings including but not limited to the following:
  - 1. Initial Project Kick Off Meeting – Review Commissioning Requirements.
  - 2. Design Review Meetings – Comply with CxA review comments.
  - 3. Incorporate CxA requirements into the Project Manual prior to issuing for permit of review.
  - 4. Pre-Construction Meeting – Review Commissioning Requirements with the General Contractor and all sub-Contractors.
  - 5. Include CxA in submittal review process for "Owner's Project Requirements" review.
  - 6. Cooperate with General Contractor and CxA as required for Functional Performance Testing coordination.

### 1.8 COORDINATION DRAWINGS

- A. Mechanical room size and location required by design team and to scale. Note: If contractor submits equipment other than that specified, he must also provide detailed shop drawings based on the equipment submitted to demonstrate adequate service clearance with a minimum of 3'-0" around mechanical equipment. Comply with NEC requirements for clearances around electrical gear.
- B. Provide scaled drawings indicating physical sizes, clearances and service access for all equipment, accessories, switchgear, and piping during Design Development, 60% Construction Document and 90% Construction Document review by HISD, HISD Program Managers and the Commissioning Authority. Ensure that all Owner Program Requirements are met.

### 1.9 HVAC SYSTEM CRITERIA FOR NEW WORK

- A. GENERAL REQUIREMENTS
  - 1. Chilled water cooling or Variable Refrigerant Flow systems shall be used for systems above 80 tons. The chillers shall be air cooled or water cooled as further defined herein. Provide equipment with power factor correction capacitors as required to maintain a power factor of 95% at all load conditions. All chillers shall have transient voltage surge suppressors installed on the disconnecting means beside the chiller. Refrigeration equipment shall be free of CFCs.
  - 2. Each chiller shall be provided with a (\*) variable flow, primary chilled water recirculation pump. Upon recommendation of the Engineer of Record and approval by HISD, a primary/secondary chilled water pumping system (variable flow) may be considered to supply the air handling units or other loads at middle and high schools only. Variable frequency drives shall be provided for (\*) both primary and secondary pumps.
    - a. For primary systems only: A combination of 2-way and 3-way control valves and or a pressure differential bypass shall be used (\*) along with variable frequency drives to ensure proper flow and pressure in the hydronic cooling and heating system; the engineer of record shall determine which engineering solution is used.
    - b. For primary/secondary systems only: 2-way control valves with variable frequency drives on the secondary pump and by-pass line (decoupling) shall be used to ensure proper flow and pressure in the hydronic cooling and heating systems.
  - 3. A variable volume outside air system utilizing heat recovery equipment (Sensible/Latent), sized to provide the amount of outside air required by code shall be required in order to meet LEED Energy Performance Requirements. CO2 sensors for demand control ventilation shall be required.
  - 4. DDC controls shall be installed to control the HVAC systems including start and stop of Variable Refrigerant Flow Systems, air handling equipment, exhaust fans,





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pumps, chillers, etc., to control temperature and humidity and to allow for remote monitoring. The system shall be programmed to control occupied, unoccupied and vacant modes. Refer to section 23 09 00 for more details. DDC control contractor shall provide training as per 23 09 00 Part 3. 3.1 Training as well as required Building Commissioning training.

5. All ductwork and hydronic piping shall be installed inside the building. When not possible, obtain approval from HISD before deviating from this requirement. If approved all exterior ductwork shall be run perpendicular or parallel to building orientations to provide a uniform, neat and workman like appearance.
6. All ductwork and hydronic piping shall be concealed wherever possible.
7. Monitoring or control devices in learning centers, public spaces, such as temperature sensors, thermostats, CO<sub>2</sub> sensors, occupancy sensors, etc., shall be tamperproof and installed at an appropriate height to function correctly in compliance with applicable codes and ADA requirements. Devices installed in public or high impact locations shall be provided with protective covers.
8. All mechanical systems shall be designed to minimize the sound levels in occupied spaces and to comply with the USGBC LEED acoustical requirements. The maximum acceptable sound levels shall be as shown in Table V.A.1.10 but in all cases shall comply with the USGBC LEED acoustical requirements:

Type of Space	Maximum Allowable Sound Level Room Criteria Method RC(N)
Auditorium	25
Learning Commons	25
Student Dining Commons	40
Gymnasium	40
Kitchen	40
Elementary Learning Center	30
Middle School Learning Center	35
High School Learning Center	35
All other occupied spaces	35

9. Cooling for learning centers shall be accomplished by utilizing a fan powered VAV air terminal unit with hydronic heat. Every learning center shall be considered a separate zone.
10. Auditoriums, student dining commons, libraries, gymnasiums and other large spaces shall be served by constant volume air handling units utilizing a 4-pipe chilled water and hot water distribution system. Same spaces with ceiling heights less than 15'-0" shall be served by VAV air handling units with chilled water and hot water distribution systems.
11. All mechanical chiller feeders, variable speed drive motor controllers or full voltage non-reversing motor controllers for pumps, air handling units, fans and any other 3 phase HVAC equipment loads shall be equipped with integral phase failure protection, coordinate with electrical drawings to ensure proper equipment specification.
12. Where Bacnet Interface cards are used they shall be installed & started up by the equipment manufacturer. Bacnet cards shall be 76.8 KBPS baud rate. They shall be compatible with Alerton, Andover, Automated Logic & Carrier I-Vu controls and shall be connected as read only. The Engineer of Record shall specify that the Contractor shall coordinate the Work associated with the BACnet cards so the manufacturer and the HVAC controls sub-contractor are present at the same time during programming. No start/stop of equipment is allowed utilizing BACnet interface. Start/stop function shall be hard-wired binary points in all cases.
13. The Engineer of Record shall specify that the BACnet manufacturer and HVAC controls sub-contractor shall provide the service tool, software & training needed



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for HISD service personnel use in replacing failed BACnet cards on the equipment as part of their routine operations and maintenance program.

### 1.10 ELEMENTARY SCHOOLS

- A. The Engineer of Record shall determine the applicability of water cooled versus air cooled chillers or Variable Refrigerant Flow systems and submit a recommendation to HISD for review and approval.
- B. Multiple Air cooled scroll chillers with corresponding pumps shall be provided; each sized for their proportion of the total capacity.
- C. One chilled water pump shall be provided for each chiller.
- D. Packaged air cooled chillers shall not exceed 250 tons in size.
- E. Total Capacity of central plant shall be sized for 130% of the total HVAC load.
- F. Modular variable volume air handling units serving VAV air terminal units or air handling units controlled by variable frequency drives.
- G. Outside air shall be pre-conditioned for VAV and constant volume applications. 100% outside air units shall be ducted to each air handling unit to provide the code required amount of ventilation air for each AHU. Outside air units may serve multiple AHU's. The use of energy recovery systems on these units shall be used and shall be Type 3 desiccant wheels located inside a mechanical room accessed by a floor mounted ladder.
- H. Hydronic boiler(s) shall be provided. Boiler(s) shall be provided with a dedicated hot water pump. Boiler(s) shall be provided with a re-circulation pump or thermostatic control valve to maintain the return water temperature recommended by the manufacturer. Boilers shall comply with low NOX requirements. The use of non-condensing boilers shall be allowed.

### 1.11 MIDDLE SCHOOLS AND HIGH SCHOOLS

- A. Variable Refrigerant Flow Systems or multiple water cooled screw or centrifugal chillers with pumps that installed in a manifold to allow for any pump to support any chiller (chilled water and condenser water) or a combination of the two shall be provided. Water cooled chillers shall not exceed 600 tons in size. Plant capacity to be sized for 130% of the total HVAC load. The chiller plant shall be designed and programmed to run utilizing all chillers in a lead lag manner to equal the run time on each chiller. Bid form shall include a chiller NPLV formula based upon the school's energy model. Formula shall be a weighted average of chiller performance at:
  - 1. Point A – kW/ton at 100% load and 85°F entering condenser water
  - 2. Point B – kW/ton at 75% load and 72°F entering condenser water
  - 3. Point C - kW/ton at 50% load and 65°F entering condenser water
  - 4. Point D - kW/ton at 50% load and 52°F entering condenser water
  - 5. Contractor shall submit a 10 year operating cost for each proposed chilled based upon the chiller's annual ton-hours and a projected electrical cost in \$/kWh.
  - 6. Operating cost = NPLV \* \$/kWh \* Annual ton-hours \* 10 years
- B. The Engineer of Record shall consider specifying a central plant optimization system that ensures the chiller plant always operates at its peak efficiency as follows:
  - 1. Chiller manufacturer shall provide hardware, software and algorithms to optimize chiller plant performance. Algorithms shall select the optimal chiller(s) to run at any given load, based on pre-programmed efficiency profiles of the chillers. Optimization shall determine building load and chilled water flow requirement and select the optimal pump(s) to run to achieve the required flow. Algorithms shall also determine the optimal states and speeds of the condenser water pumps and cooling tower fan cells, while considering the tradeoffs between chiller and tower energy consumption.
- C. To assure that this performance is achieved, provide a web-based measurement & verification dashboard that allows real-time visibility to plant performance, cumulative savings and trending of key temperatures, pressures, flows and power consumption by component. This program shall be integrated into the BAS logic and shall not be a third party stand-alone program.



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- D. The Engineer of Record shall determine the applicability of variable refrigerant flow systems, water cooled versus air cooled chillers and submit a recommendation to HISD for review and approval. Air cooled scroll chillers may be used if it can be shown their use is more applicable to the HVAC load requirements and is economically justifiable. If used, air cooled chillers shall not exceed 250 tons in size. To assure that this performance is achieved, provide a web-based measurement & verification dashboard that allows real-time visibility to plant performance, cumulative savings and trending of key temperatures, pressures, flows and power consumption by component. This program shall be integrated into the BAS logic and shall not be a third party stand-alone program.
- E. One chilled water pump shall be provided for each chiller.
- F. A multi-cell cooling tower shall be provided to serve water cooled chillers. Any condenser water pump shall be able to serve any chiller or cooling tower section. Manual valving is acceptable.
- G. Outside air shall be pre-conditioned for VAV and constant volume applications. 100% outside air units shall be ducted to each air handling unit to provide the code required amount of ventilation air for each AHU. Outside air units may serve multiple AHU's. The use of energy recovery systems on these units shall be used and shall be Type 3 desiccant wheels located inside a mechanical room accessed by a floor mounted ladder.
- H. Minimum two hydronic boilers, each sized for 55% capacity shall be provided. Boiler(s) shall be provided with a dedicated hot water pump. Manual valving shall be provided so either of the hot water pumps can serve either boiler. Each Boiler shall be provided with a re-circulation pump or thermostatic control valve to maintain the return water temperature recommended by the manufacturer. Circulating pumps shall be provided as recommended by manufacturer. Boilers shall comply with low NOX requirements. The use of non-condensing boilers shall be allowed.
- I. Modular variable volume air handling units (AHU) serving multiple zones, with variable frequency drives shall be used.
- J. Each learning center or class area shall be one zone with one box serving that zone.
- K. Outside air shall be pre-conditioned for constant volume applications. 100% outside air units shall be ducted to each air handling unit to provide the code required amount of ventilation air for each AHU. Outside air units may serve multiple AHU's.
- L. In each Science Learning Center/Wet Lab, provide a red emergency shut off button to shutdown water, gas and electricity in event of an emergency. Locate this button in the teacher's workstation and away from exit door.

### 1.12 STUDENT DINING COMMONS/CAFETERIUMS, AUDITORIUMS, GYMNASIUMS, LIBRARIES

- A. Provide constant volume modular AHU's with hot water heat in the reheat position for humidity control.
- B. All units shall be provided with humidity control. This may be achieved with desiccant dehumidification, total energy heat wheels or reheat. If reheat is required, this shall be achieved with hot refrigerant gas or with heat exchange between leaving and entering air. If electric or hot water reheat is used for humidity control, it shall comply with all City of Houston code requirements in force.
- C. Provide an override switch for after-hours use in a locked enclosure. Locate in a suitable and accessible area.
- D. Refer to section 23 09 00 2.12 Field Instrument actions.

### 1.13 STADIUM/SPORTS FACILITIES

- A. For facilities with a total cooling load of less than 80 tons, split DX system or roof top units may be used. For larger systems, one or two air cooled scroll or screw chillers with corresponding pumps shall be provided. If using two chillers, size each for approximately 55% of the total capacity to allow for lead-lag operation.

### 1.14 MDF/IDF ROOMS



## BUILDING EXCELLENCE

- A. Provide 24/7 stand-alone DX HVAC systems for BCR and FCR rooms. Locate units in adjacent space and duct to serve BCR room. Do not locate the fan/evaporator section above the network equipment racks.
- B. Do not tie control of the stand-alone a/c units with building DDC controls. Specify a local thermostat to control this unit but provide a DDC point for status reading.
- C. Provide building a/c in BCR room sized appropriately for the HVAC load. Stand-alone unit shall only operate when main building a/c is unavailable.

### 1.15 NATATORIUMS

- A. Provide packaged DX unit with energy recovery system and remote condenser as manufactured by Dectron or Pool-Pak installed in a service yard to be coordinated with Architect.
- B. The refrigeration system for the building cooling and dehumidification shall be provided with an energy recovery system to use for pool water heating.
- C. A gas fired heater shall be provided for supplementary heating for the pool water.
- D. A gas fired boiler shall be provided to supply hot water to the packaged DX unit for space heating.
- E. Ductwork shall be round, double wall construction, stainless steel or galvanized steel with a corrosion protection coating.
- F. The system shall be able to operate stand alone and will have space temperature status only.

### 1.16 KITCHENS

- A. Constant volume chilled water air handling units.
- B. Provide exhaust/make-up air system per code. The kitchen exhaust hoods shall be short cycle type with heated make-up air supplied inside the hood. A fire detection/suppression system shall be included.
- C. The amount of outside air brought into the kitchen by the air conditioning unit shall be limited to keep the kitchen under negative pressure relative to the main building. The remaining make-up air shall be pulled from the student dining commons.
- D. All kitchen hood exhaust ductwork shall be welded stainless steel.

### 1.17 ADMINISTRATIVE OFFICES

- 1. Provide AHU with DX and chilled water coil for areas serving the administrative suite to allow for after-hours use without using the central plant for cooling or heating.
- 2. Provide override pushbutton for after hours use by DX system, refer to Section 23 09 00 2.12 Field Instrumentation.
- 3. Provide red emergency shut off button to shutdown the entire HVAC system in event of an emergency. Locate this button in the main office near the school secretary.

### 1.18 HVAC SYSTEM CRITERIA FOR RENOVATION/ADDITIONS WORK

- A. The A/E should follow criteria for new construction as described in above wherever practical in renovation projects; however, each renovation project is to be evaluated by the A/E to determine its particular needs. The A/E will recommend design solutions that are cost effective and best meet the unique needs of the school being renovated.
- B. When designing replacement HVAC systems for renovations, the Engineer of Record shall design the system in such a manner to allow the full use of the non-affected areas of the school. The Engineer of Record shall clearly indicate within the contract documents the areas of the school which are to be phased for such construction and further to clearly require the General Contractor to maintain the HVAC system in such a manner to provide good indoor occupant comfort, temperature and humidity control in non-affected areas during construction. Further the Engineer of Record shall clearly indicate within the contract documents the requirement for the General Contractor to have all designated areas of the school served by the new HVAC system to be ready in time for the start of the fall school year as determined by the School Principal and the HISD Program Manager.



B U I L D I N G   E X C E L L E N C E

- C. Scope of Inspection: The intent of the following is to provide minimum levels of required inspection by the designing engineer prior to and in conjunction with the renovation/addition design.
  - 1. Pre-Inspection Meeting:
  - 2. Maintenance staff review of existing conditions and coordination of scope.
    - a. Review consistent hot/cold spots
    - b. Review existing equipment maintenance history
    - c. Identify, review and discuss high humidity issues
    - d. Discuss any accessibility issues
    - e. Discuss any maintenance issues
    - f. Review suggested/requested work to be done
  - 3. Engineer's Walk Through
    - a. Inspect drains and any sump pumps
    - b. Inspect concealed (above ceiling) systems
    - c. Ductwork
    - d. Piping
    - e. Insulation
    - f. Cabling (TV, phone, computer, intercom, etc.)
  - 4. Submit Engineer's Evaluation to Program Manager, HISD Design and Construction and HISD Operations and Maintenance Staff for review and approval prior to commencing design.
- 1.19 ALL HISD FACILITIES – Schools, Administration, Athletics, Maintenance
  - A. Substitute the use of VAV CHW systems as 1<sup>st</sup> choice when design of bldg allows & Variable Refrigerant Volume (VRV) heat pumps as 2<sup>nd</sup> choice with Dedicated Outside Air Units in place of Unit Ventilators whenever possible.
  - B. VRV systems shall have readable BACnet points on their equipment.
  - C. HVAC design for renovations shall incorporate changes due to code requirements into the new design and contract documents.
  - D. When it is deemed not practical to replace Unit Ventilators with VRV Units, the Engineer of Record shall document same in a report and submit to HISD Program Manager, Facilities and Design Staff, Operations and Maintenance Staff for review and approval prior to proceeding with the design documents.
  - E. Systems which do not meet the current energy code or are of a type that are no longer used shall be replaced. If the systems are not identified in the original scope, during the scope to budget, these items shall be identified with the HISD Program Manager.
  - F. Schools with existing 2 pipe chilled water/hot waters unit that are not to be replaced shall incorporate the following:
    - 1. Existing two pipe systems that have HVAC renovations shall add an air cooled heat exchanger to expedite the change over from heating to cooling.
- 1.20 Systems for ADDITIONS shall be designed and installed per the requirements of NEW system guidelines to the extent practical. When tying into an existing system, the type system used shall be compatible with the existing system and shall be installed like RENOVATIONS (see above). If the addition has an independent system it shall meet the requirements for new system, unless the size of the addition makes this impractical.
- 1.21 Survey existing system that shall be modified in order to determine if existing equipment must be upgraded due to code requirements, lack of capacity or equipment no longer working or beyond life expectancy.
- 1.22 Controls shall be DDC systems. Use the following chart to determine if the Controls System "CS" should be tied to the existing system, connected to the centralized monitoring system and/or be installed based on the Section (\*) 23 09 00 BACnet specification.



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Facility Description	Age of Existing Control System	Replace Existing Controls?	Integrate Into the Central Monitoring Center
New Facility	n/a	n/a	Yes
Existing Facility with dial up Proprietary controls.	Any age	Yes	Yes
Existing Facility with Proprietary Control System	> 5, but < 10 years	No	No
Existing Facility with Proprietary Control System	> 10 years	Yes	Yes
Existing Facility with Proprietary Control System, renovation affects less than 25% of the controls	< 10 years	No, add to existing proprietary system	Yes
Existing Facility with Proprietary Control System, renovation affects between 25% to 50% of the controls	< 10 years	No, Add to existing control system to meet current Design Standards	Yes
Existing Facility with Proprietary Control System, renovation affects more than 50% of the controls	any age	Yes	Yes
Existing Facility with no controls	n/a	n/a	n/a
Existing Facility with Bacnet Controls renovation affects < 50% of controls	Any age	No	Yes. Add to existing control system
Existing Facility with Bacnet Controls renovation affects > 50% of controls	Any age	Yes	Yes

\*Proprietary dial up systems need to be changed out ASAP. No matter the age

\*Proprietary control vendors not in the Design Standards can be allowed to install controls on projects with less than 50% renovations with written approval from DDC Dept.

\*No Bacnet Integration between control vendors is allowed.

- A. When replacing unit ventilators or fan coil units in existing buildings include a motorized, modulating outside air damper controlled by a CO<sub>2</sub> sensor located in a protected space in each learning center.
- B. During construction the contractor shall be in charge of HVAC system and be responsible for keeping the areas outside the scope of work in working condition as per the general design criteria as well as maintaining the temperature and humidity level in the area designated as the scope of work. Coordinate with area maintenance.
- C. Mechanical Identification: Provide markers on all piping systems.





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### 1.23 COORDINATION WITH OTHER TRADES

- A. Coordinate the work of this division with all other divisions to ensure that all components of the mechanical, plumbing and fire protection system will be installed at the proper time and fit the available space.
- B. Locate and size all openings in work of other trades required for the proper installation of the mechanical, plumbing and fire protection system components.
- C. Make all mechanical, plumbing and fire protection connections to all equipment furnished by this division and as required by any other division.
- D. Electrical wiring, control equipment and motor starters indicated on the electrical drawings, except items otherwise specifically noted, shall be furnished and installed by the electrical trades. Items of electrical control equipment specifically mentioned to be furnished by the mechanical trades, either in these specifications or on the mechanical drawings, shall be furnished, mounted and wired by this trade unless where otherwise specified in Division 26 or noted on the electrical drawings to be by the electrical trades. All wiring shall be in accordance with all requirements of the electrical Sections of these specifications.
- E. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment. All controllers furnished with mechanical equipment shall have overload protection in all phases. It shall be the responsibility of each subcontractor furnishing motors and devices to advise Electrical Contractor of exact function of systems to assure proper type of starter with correct number auxiliary contacts for proper operation of the system.
- F. The mechanical trades shall coordinate with the electrical to ensure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.
- G. The design of the electrical systems is based on the mechanical equipment specified and scheduled on the drawings. Where changes or substitutions are made that involve additional electrical work (larger-size motors, larger number of motors, additional wiring of equipment, etc.), the mechanical trades shall pay the electrical trades for the cost of the additional work, except for changes by bulletin.
- H. Motor control equipment which is furnished loose under Division 23 shall be delivered to the Electrical Contractor at the site for custody, erection in place, and wiring as specified.
- I. Smoke detection systems will be furnished and installed under Division 26 – electrical. Coordinate locations with Electrical Contractor.

### 1.24 GENERAL ELECTRICAL REQUIREMENTS

- A. Provide electric motors, control panels, certain control and safety devices and control wiring when specified or required for proper operation of electrical systems associated with mechanical equipment specified in Division 23.
- B. Electrical materials and work provided shall be in accordance with Division 26.
- C. Notify Architect/Engineer in writing 14 days before bids are due if it is necessary to increase horsepower of any motors or change any electrical requirements listed or shown. After this period, costs incurred because of changes shall be assumed by the responsible Contractor.
- D. Mechanical equipment with factory assembled and/or attached electric equipment shall be Underwriters' Laboratories (UL) listed as an assembly when such listing is available from UL, and shall meet the latest edition of the National Electrical Code.
- E. Unless otherwise specified, the electrical supply being furnished is a 460 volt, 3 phase, 3 wire 60 hertz source. No neutral connection is available from the 460 volt source. The manufacturer shall include any transformers for equipment requiring other voltages (277volt, 220 volt, 120 volt, 24 volt, etc.).
- F. Electric Motors:
  - A. For each piece of equipment requiring electric drive, provide a motor having starting and running characteristics consistent with torque and speed requirements of the driven machine.
  - B. Manufacturers furnishing motors shall verify motor horsepower with the characteristic power curves of driven equipment on shop drawings.





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- C. Each motor shall be furnished in accordance with Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- D. Contractor shall verify electrical characteristics of each motor with electrical drawings.
- E. Motors which are shipped loose from equipment shall be set by supplying subcontractor.
- F. Alignment of motors factory coupled to equipment and motors field coupled to equipment shall be rechecked by millwright after all connections (belt drives, gear drives, impellers, piping, etc.) have been completed and again after 48 hours of operation in designed service.
- G. Where possible, motors shall be factory mounted.

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<a href="#"><u>23 82 00</u></a>	Heating and Cooling Units	VERSION 3.0

### EXECUTION

#### 3.1 OWNER INSTRUCTION - GENERAL

- A. Provide on-site Owner training for all new equipment by factory trained specialists.
- B. Use Operation and Maintenance manuals and actual equipment installed as basis for instruction.



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- C. At conclusion of on-site training program have Owner personnel sign written certification they have completed training and understand equipment operation. Include copy of training certificates in final Operation and Maintenance manual submission.
- D. Refer to individual equipment specifications for additional training requirements.
- E. All DDC control web portal building graphic room numbers shall match actual architectural graphics package and room number placards actually installed in building.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 23 05 13

#### COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

##### GENERAL

- 1.1 Section includes single and three phase motors.

##### PRODUCTS

###### 2.1 ELECTRIC MOTORS

- A. Acceptable Motor Manufacturers:
  - 1. Baldor/General Electric/MagneTek/Marathon/~~Reliance~~/Siemens/AO Smith
- B. Motor & Motor Controller Requirements:
  - 1. Motors under 1/2 HP shall be 120/1/60
  - 2. Motors 3/4 HP and over shall be 480/3/60, provide integral phase failure relay protection for all three phase motors.
  - 3. All continuously operating motors shall be of high efficiency design.
  - 4. All three phase motors located outside shall be TEFC type.
  - 5. Three phase motors located outside or where they may be subject to physical damage shall have cast iron enclosure.
  - 6. Motors serving condenser fans shall be totally enclosed (TEFC or TEAO) type. Steel enclosure is acceptable.
  - 7. Motors serving air handling units (mounted inside the units) may be open drip proof type.
  - 8. Motors operating with variable frequency drives shall be specially designed for the application.
  - 9. Motors shall be selected so they do not operate into the safety factor.

##### EXECUTION

###### 3.1 INSTALLATION

- A. Provide foundations, supports, and isolators properly adjusted to allow minimum vibration transmission within the building. Refer to Section 23 05 48.
- B. Correct objectionable noise or vibration transmission in order to operate equipment satisfactorily as determined by the Engineer.

#### END OF SECTION



## SECTION 23 05 48

### SOUND AND VIBRATION CONTROL

#### GENERAL

- 1.1 Section Includes: Vibration isolation for building mechanical systems.
- 1.2 PERFORMANCE REQUIREMENTS
  - A. It is the intent of this specification for the engineer to design vibration isolation supports for all equipment, piping and ductwork as may be required to prevent transmission of vibration to the building structure.
- 1.3 Installer: Company specializing in performing Work of this section with minimum three years experience

#### PRODUCTS

- 2.1 VIBRATION ISOLATOR TYPES
  - A. Vibration Control:
    1. Provide vibration isolation for all mechanical equipment. Provide inertia bases for all equipment mounted on upper floors. Acceptable Manufacturers: Amber/Booth Company, Inc., Mason Industries, Inc. Noise Control, Inc.
  - B. NC 35 (refer to table V.A.1.10)
  - C. Sound Attenuators:
    1. Acceptable Manufacturers: Vibro-Acoustic, Rink

#### EXECUTION

- 3.1 INSTALLATION
  - A. Isolators shall be installed as recommended by the manufacturer. Isolate all mechanical equipment 0.5 hp and over.
  - B. Horizontal Pipe Isolation: All pumped water, pumped condensate and refrigerant piping size 1-1/4 inch and larger within mechanical rooms and on pipe size 2 inch and larger outside mechanical rooms shall be isolated.
  - C. Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation or shipment.
  - D. Locate isolation hangers as near the overhead support structure as possible.
  - E. Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of one inch clearance below base will result when supported equipment has been installed and loaded for operation.

**END OF SECTION**



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**SECTION 23 05 93**

**TESTING, ADJUSTING, AND BALANCING FOR HVAC**

**GENERAL**

- 1.1 The engineer should include in this section:
  - A. Testing, adjusting, and balancing of air systems.
  - B. Testing, adjusting, and balancing of Hydronic piping systems
  - C. Testing, adjusting, and balancing of refrigerating systems.
  - D. Measurement of final operating condition of HVAC systems.
  - E. Sound measurement of equipment operating conditions.
  - F. Vibration measurement of equipment operating conditions.
- 1.2 Testing, Adjusting and Balancing (TAB) contractor shall bid work specified under this section direct to school district. TAB contractor shall not be hired by general contractor or any sub-contractor.
  - A. Mechanical contractor is responsible for coordinating work with the TAB Contractor. Mechanical contractor requirements are specified herein.
  - B. TAB Contractors: Engineered Air Balance and Precision Air
- 1.3 SUBMITTALS
  - A. Agency Data: Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.
  - B. Engineer and Technicians Data: Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.
  - C. Procedures and Agenda: Submit a synopsis of the testing, adjusting and balancing procedures and agenda proposed to be used for this project.
  - D. Sample Forms: Submit sample forms, if other than those standard forms, if other than those standard forms prepared by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) are proposed.
  - E. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:
    1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit two complete sets of draft reports. Only one complete set of draft reports will be returned.
    2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit two complete sets of final reports.
    3. Report Contents: Provide the following minimum information, forms and data:
      - a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, the Company, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal name address, telephone number, and signature of the Certified Test and Balance Engineer.



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Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

- b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC or NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
- c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

### 1.4 QUALITY ASSURANCE

- A. Test and Balance Engineer's Qualifications: A Professional Engineers registered in the State in which the services are to be performed, and having at least three years of successful testing, adjusting, and balancing experience on projects with testing and balancing requirements similar to those required for this project.
- B. Agency Qualifications:
  - 1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to the test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
  - 2. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) or by the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB or AABC as a Test and Balance Engineer.
- C. Codes and Standards
  - 1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
  - 2. AABC: "National Standards for Total System Balance."
  - 3. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) ASHRAE Handbook, 1999 HVAC Applications Volume, Chapter 36, Testing, Adjusting, and Balancing.
- D. Pre-Balancing Conference: Prior to beginning of testing, adjusting, and balancing procedures, schedule and conduct a conference with the Engineer and representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of the system operation and readiness for testing, adjusting, and balancing.
- E. Systems shall be fully operational prior to beginning procedures.
- F. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
- G. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within five degrees Fahrenheit wet bulb temperature of maximum summer design condition, and within ten degrees Fahrenheit dry bulb temperature of minimum winter design condition. Take final temperature reading during seasonal operation.
- H. Provide minimum 7 days advanced notice. Include scheduled test dates and times.

### PRODUCTS

Not Used.



## EXECUTION

### 3.1 SERVICES OF THE MECHANICAL CONTRACTOR

- A. Verify systems are complete and operable before commencing work. Verify the following:
  - 1. Systems are started and operating in safe and normal condition.
  - 2. Temperature control systems are installed complete and operable.
  - 3. Proper thermal overload protection is in place for electrical equipment.
  - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - 5. Duct systems are clean of debris.
  - 6. Fans are rotating correctly.
  - 7. Fire and volume dampers are in place and open.
  - 8. Air coil fins are cleaned and combed.
  - 9. Access doors are closed and duct end caps are in place.
  - 10. Air outlets are installed and connected.
  - 11. Duct system leakage is minimized.
  - 12. Hydronic systems are flushed, filled, and vented.
  - 13. Pumps are rotating correctly.
  - 14. Proper strainer baskets are clean and in place or in normal position.
  - 15. Service and balancing valves are open.
  - 16. Re-sheave
- B. Contractor shall provide all volume dampers, balancing dampers, balancing valves, test ports and Pete's plugs as required by the Testing and Balancing Firm. Contractor shall furnish a set of sheet metal shop drawings and HVAC piping drawings to the Testing and Balancing Firm during the submittal phase and incorporate the Testing and Balancing Firm's mark-ups and requests into the project. Contractor shall provide all required equipment to facilitate Testing and Balancing Firm's work. This coordination shall be included in the Contractor's base bid price.
- C. Provide, correct, repair or replace deficient items or conditions found during the testing and balancing.
- D. Provide replacement sheaves as directed by TAB Contractor to achieve scheduled air volumes.
- E. For motors with a variable frequency drive, contractor shall provide belt and sheave adjustment such that units deliver their design cfm when speed drive is at 60 hertz.

### 3.2 SERVICES OF THE TESTING AND BALANCING CONTRACTOR

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- C. Complete system-readiness checks and prepare reports. Verify the following:
  - 1. Permanent electrical-power wiring is complete.
  - 2. Hydronic systems are filled, clean, and free of air.
  - 3. Automatic temperature-control systems are operational.
  - 4. Equipment and duct access doors are securely closed.
  - 5. Balance, smoke, and fire dampers are open.
  - 6. Isolating and balancing valves are open and control valves are operational.
  - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

### 3.3 INSTALLATION TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust fans and Equipment with Fans: +/- 5%
  - 2. Air Outlets and Inlets: +/- 5%
  - 3. Heating-Water Flow Rate: +/- 5%





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4. Cooling-Water Flow Rate: +/- 5%

**3.4 ADJUSTING**

- A. Verify recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- D. Report defects and deficiencies noted during performance of services, preventing system balance.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

**3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.
- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries in clean rooms.

**3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS**

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
  - 2. Measure fan static pressures as follows to determine actual static pressure:
    - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.



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- d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
    3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
      - a. Report the cleanliness status of filters and the time static pressures are measured.
    4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
    5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
    6. Obtain approval from construction manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
    7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
  - B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
    1. Measure airflow of submain and branch ducts.
      - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
    2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
    3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
  - C. Measure air outlets and inlets without making adjustments.
    1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
  - D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
    1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
    2. Adjust patterns of adjustable outlets for proper distribution without drafts.
- 3.7 PROCEDURES FOR DUAL-DUCT SYSTEMS
- A. Verify that the cooling coil is capable of full-system airflow, and set mixing boxes at full-cold airflow position for fan volume.
  - B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
    1. If insufficient static pressure exists, increase airflow at the fan.
  - C. Test and adjust the constant-volume mixing boxes as follows:
    1. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.
    2. Verify sufficient inlet static pressure before making volume adjustments.



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3. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.
- D. Do not over pressurize ducts.
- E. Re-measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.
- F. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

### 3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
  1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
  2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  3. Measure total system airflow. Adjust to within indicated airflow.
  4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
  6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
  7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
  8. Record final fan-performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
  1. Balance variable-air-volume systems the same as described for constant-volume air systems.
  2. Set terminal units and supply fan at full-airflow condition.
  3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  4. Readjust fan airflow for final maximum readings.



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5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
  6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
  7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
  8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
  2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
  3. Set terminal units at full-airflow condition.
  4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  5. Adjust terminal units for minimum airflow.
  6. Measure static pressure at the sensor.
  7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

### 3.9 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Set unit at maximum airflow through the cooling coil.
- B. Adjust each zone's balancing damper to achieve indicated airflow within the zone.

### 3.10 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
  1. Open all manual valves for maximum flow.
  2. Check liquid level in expansion tank.
  3. Check makeup water-station pressure gage for adequate pressure for highest vent.
  4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
  5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
  6. Set system controls so automatic valves are wide open to heat exchangers.
  7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.



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8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

### 3.11 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
  1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
    - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Owner/Engineer and comply with requirements in "Hydronic Pump Specification."
  2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
    - b. Monitor motor performance during procedures and do not operate motors in overload conditions.
  3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
  4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated pre-settings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
  1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
  1. Determine the balancing station with the highest percentage over indicated flow.
  2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
  3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

### 3.12 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

### 3.13 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first and then balance the secondary circuits.



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### 3.14 PROCEDURES FOR HEAT EXCHANGERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.
- E. Check settings and operation of safety and relief valves. Record settings.

### 3.15 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  - 1. Manufacturer's name, model number, and serial number.
  - 2. Motor horsepower rating.
  - 3. Motor rpm.
  - 4. Efficiency rating.
  - 5. Nameplate and measured voltage, each phase.
  - 6. Nameplate and measured amperage, each phase.
  - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

### 3.16 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
  - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
  - 2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
  - 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
  - 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
  - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
  - 6. Capacity: Calculate in tons of cooling.
  - 7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

### 3.17 PROCEDURES FOR COOLING TOWERS

- A. A complete CTI certified test of the cooling tower will be performed by others at the expense of the cooling tower manufacturer. A copy of this test (provided by others) shall be included in the final TAB report. Balance the flow over and through bypass connections of the tower.

### 3.18 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

### 3.19 PROCEDURES FOR BOILERS





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- A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

### 3.20 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
  - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
  - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
  - 3. Check the refrigerant charge.
  - 4. Check the condition of filters.
  - 5. Check the condition of coils.
  - 6. Check the operation of the drain pan and condensate-drain trap.
  - 7. Check bearings and other lubricated parts for proper lubrication.
  - 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
  - 1. New filters are installed.
  - 2. Coils are clean and fins combed.
  - 3. Drain pans are clean.
  - 4. Fans are clean.
  - 5. Bearings and other parts are properly lubricated.
  - 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
  - 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
  - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
  - 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
  - 4. Balance each air outlet.

### 3.21 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Pump curves.
  - 2. Fan curves.
  - 3. Manufacturers' test data.
  - 4. Field test reports prepared by system and equipment installers.
  - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.





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2. Name and address of the TAB contractor.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.
  8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Water and steam flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.
  6. Balancing stations.
  7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    - j. Number, make, and size of belts.
    - k. Number, type, and size of filters.
  2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and rpm.



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- c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  - 3. Test Data (Indicated and Actual Values):
    - a. Total air flow rate in cfm (L/s).
    - b. Total system static pressure in inches wg (Pa).
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg (Pa).
    - e. Filter static-pressure differential in inches wg (Pa).
    - f. Preheat-coil static-pressure differential in inches wg (Pa).
    - g. Cooling-coil static-pressure differential in inches wg (Pa).
    - h. Heating-coil static-pressure differential in inches wg (Pa).
    - i. Outdoor airflow in cfm (L/s).
    - j. Return airflow in cfm (L/s).
    - k. Outdoor-air damper position.
    - l. Return-air damper position.
    - m. Vortex damper position.
- F. Apparatus-Coil Test Reports:
  - 1. Coil Data:
    - a. System identification.
    - b. Location.
    - c. Coil type.
    - d. Number of rows.
    - e. Fin spacing in fins per inch o.c.
    - f. Make and model number.
    - g. Face area in sq. ft
    - h. Tube size in NPS (DN).
    - i. Tube and fin materials.
    - j. Circuiting arrangement.
  - 2. Test Data (Indicated and Actual Values):
    - a. Air flow rate in cfm (L/s).
    - b. Average face velocity in fpm (m/s).
    - c. Air pressure drop in inches wg (Pa).
    - d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
    - e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
    - f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
    - g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
    - h. Water flow rate in gpm (L/s).
    - i. Water pressure differential in feet of head or psig (kPa).
    - j. Entering-water temperature in deg F (deg C).
    - k. Leaving-water temperature in deg F (deg C).
    - l. Refrigerant expansion valve and refrigerant types.
    - m. Refrigerant suction pressure in psig (kPa).
    - n. Refrigerant suction temperature in deg F (deg C).
    - o. Inlet steam pressure in psig (kPa).
- G. Gas Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
  - 1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.



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- f. Fuel type in input data.
    - g. Output capacity in Btu/h (kW).
    - h. Ignition type.
    - i. Burner-control types.
    - j. Motor horsepower and rpm.
    - k. Motor volts, phase, and hertz.
    - l. Motor full-load amperage and service factor.
    - m. Sheave make, size in inches, and bore.
    - n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  - 2. Test Data (Indicated and Actual Values):
    - a. Total air flow rate in cfm (L/s).
    - b. Entering-air temperature in deg F.
    - c. Leaving-air temperature in deg F.
    - d. Air temperature differential in deg F.
    - e. Entering-air static pressure in inches wg (Pa).
    - f. Leaving-air static pressure in inches wg (Pa).
    - g. Air static-pressure differential in inches wg (Pa).
    - h. Low-fire fuel input in Btu/h (kW).
    - i. High-fire fuel input in Btu/h (kW).
    - j. Manifold pressure in psig (kPa).
    - k. High-temperature-limit setting in deg F.
    - l. Operating set point in Btu/h (kW).
    - m. Motor voltage at each connection.
    - n. Motor amperage for each phase.
    - o. Heating value of fuel in Btu/h (kW).
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
  - 1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Coil identification.
    - d. Capacity in Btu/h (kW).
    - e. Number of stages.
    - f. Connected volts, phase, and hertz.
    - g. Rated amperage.
    - h. Air flow rate in cfm.
    - i. Face area in sq. ft.
    - j. Minimum face velocity in fpm.
  - 2. Test Data (Indicated and Actual Values):
    - k. Heat output in Btu/h (kW).
    - l. Air flow rate in cfm.
    - m. Air velocity in fpm.
    - n. Entering-air temperature in deg F.
    - o. Leaving-air temperature in deg F.
    - p. Voltage at each connection.
    - q. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
  - 1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.
    - e. Manufacturer's serial number.
    - f. Arrangement and class.



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- g. Sheave make, size in inches, and bore.
      - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    - 2. Motor Data:
      - i. Motor make, and frame type and size.
      - j. Horsepower and rpm.
      - k. Volts, phase, and hertz.
      - l. Full-load amperage and service factor.
      - m. Sheave make, size in inches, and bore.
      - n. Center-to-center dimensions of sheave, and amount of adjustments in inches .
      - o. Number, make, and size of belts.
    - 3. Test Data (Indicated and Actual Values):
      - p. Total airflow rate in cfm.
      - q. Total system static pressure in inches wg (Pa).
      - r. Fan rpm.
      - s. Discharge static pressure in inches wg (Pa).
      - t. Suction static pressure in inches wg (Pa).
  - J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
    - 1. Report Data:
      - a. System and air-handling-unit number.
      - b. Location and zone.
      - c. Traverse air temperature in deg F.
      - d. Duct static pressure in inches wg (Pa).
      - e. Duct size in inches.
      - f. Duct area in sq. ft..
      - g. Indicated air flow rate in cfm.
      - h. Indicated velocity in fpm.
      - i. Actual air flow rate in cfm.
      - j. Actual average velocity in fpm.
      - k. Barometric pressure in psig (Pa).
  - K. Air-Terminal-Device Reports:
    - 1. Unit Data:
      - a. System and air-handling unit identification.
      - b. Location and zone.
      - c. Apparatus used for test.
      - d. Area served.
      - e. Make.
      - f. Number from system diagram.
      - g. Type and model number.
      - h. Size.
      - i. Effective area in sq. ft.
    - 2. Test Data (Indicated and Actual Values):
      - j. Air flow rate in cfm.
      - k. Air velocity in fpm.
      - l. Preliminary air flow rate as needed in cfm.
      - m. Preliminary velocity as needed in fpm.
      - n. Final air flow rate in cfm.
      - o. Final velocity in fpm.
      - p. Space temperature in deg F.
  - L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
    - 1. Unit Data:
      - a. System and air-handling-unit identification.



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- b. Location and zone.
    - c. Room or riser served.
    - d. Coil make and size.
    - e. Flowmeter type.
  - 2. Test Data (Indicated and Actual Values):
    - a. Air flow rate in cfm (L/s).
    - b. Entering-water temperature in deg F.
    - c. Leaving-water temperature in deg F.
    - d. Water pressure drop in feet of head or psig (kPa).
    - e. Entering-air temperature in deg F.
    - f. Leaving-air temperature in deg F.
- M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
  - 1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Service.
    - d. Make and size.
    - e. Model number and serial number.
    - f. Water flow rate in gpm.
    - g. Water pressure differential in feet of head or psig (kPa).
    - h. Required net positive suction head in feet of head or psig (kPa).
    - i. Pump rpm.
    - j. Impeller diameter in inches.
    - k. Motor make and frame size.
    - l. Motor horsepower and rpm.
    - m. Voltage at each connection.
    - n. Amperage for each phase.
    - o. Full-load amperage and service factor.
    - p. Seal type.
  - 2. Test Data (Indicated and Actual Values):
    - a. Static head in feet of head or psig (kPa).
    - b. Pump shutoff pressure in feet of head or psig (kPa).
    - c. Actual impeller size in inches.
    - d. Full-open flow rate in gpm.
    - e. Full-open pressure in feet of head or psig (kPa).
    - f. Final discharge pressure in feet of head or psig (kPa).
    - g. Final suction pressure in feet of head or psig (kPa).
    - h. Final total pressure in feet of head or psig (kPa).
    - i. Final water flow rate in gpm.
    - j. Voltage at each connection.
    - k. Amperage for each phase.
- N. Vibration Test:
  - 1. Location of points:
    - a. Fan bearing, drive end
    - b. Fan bearing, opposite end
    - c. Motor bearing, center (when applicable)
    - d. Motor bearing, drive end
    - e. Motor bearing, opposite end
    - f. Casing (bottom or top)
    - g. Casing (side)
    - h. Duct after flexible connection (discharge)
    - i. Duct after flexible connection (suction)
  - 2. Test readings:
    - a. Horizontal, velocity and displacement



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- b. Vertical, velocity and displacement
    - c. Axial, velocity and displacement
    - d. Normally acceptable readings, velocity and acceleration
    - e. Unusual conditions at time of test
    - f. Vibration source (when non-complying)
- O. Instrument Calibration Reports:
  - 1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 23 07 13

#### DUCT INSULATION

##### GENERAL

- 1.1 Section Includes: Insulation systems for sheet metal duct conveying cold, hot and grease laden air. Provide duct insulation systems which have been manufactured, fabricated and installed to meet all thermal requirements of mechanical systems. Insulating systems shall be installed in strict accordance with manufacturer's field requirements and the current International Energy Conservation Code.

##### PRODUCTS

- 2.1 ACCEPTABLE MANUFACTURERS
- A. Ductwork Insulation shall comply with IECC 2004.
  - B. Externally wrap all ductwork except for the first fifteen feet from the air handling unit which will be internally lined.
  - C. Acceptable Manufacturers:
    - 1. Glass Fiber: Knauf, Johns Manville, Owens Corning
    - 2. Adhesives: Minnesota Mining, Arabol, Armstrong
    - 3. Ceramic Fiber: Primer Refractories, A.P. Green Refractories
    - 4. Approved Equal: Obtain written approval from HISD for any suggestions.
- 2.2 INSULATION METAL JACKET
- 1. Jacket - .016" x 36" aluminum smooth with moisture barrier jacket.
  - 2. Jacket - .020" x 36" aluminum smooth with moisture barrier jacket (High traffic areas.)
  - 3. Aluminum fasteners – 3/4" bands, 3/4" wing seals .024 elbow covers.
  - 4. T-304 stainless steel fasteners – 1/2" x .020 bands, 1/2" wing seals.
  - 5. Screws are not to be used to secure jacketing.

##### EXECUTION

- 3.1 INSTALLATION
- A. Allow adequate clearance in plenum to ensure duct insulation is not compressed.
  - B. Provide 2 hour enclosure on grease exhaust duct. Enclosure shall extend from kitchen hood to underside of roof deck.
  - C. Insulate all supply, return fresh-air, outside-air, make-up air and exhaust ducts.

**END OF SECTION**





**B U I L D I N G   E X C E L L E N C E**

**SECTION 23 07 16**

**HVAC EQUIPMENT INSULATION**

**GENERAL**

- 1.1 Section Includes: Chilled Water Components and Heating Hot Water Components.
- 1.2 QUALITY ASSURANCE
  - A. Insulation to provide minimum R-Value in accordance with International Energy Conservation Code with Houston Amendment.

**PRODUCTS**

- 2.1 ACCEPTABLE MANUFACTURERS
  - A. Acceptable Manufacturers:
    - 1. Owens Corning, Armstrong, Johns Manville
  - B. Pump Insulation shall match Piping Insulation thickness
  - C. Provide Metal Jacket outdoors
- 2.2 INSULATION METAL JACKET
  - A. Jacket - .016" x 36" aluminum smooth with moisture barrier jacket.
  - B. Jacket - .020" x 36" aluminum smooth with moisture barrier jacket (High traffic areas.)
  - C. Aluminum fasteners – 3/4" bands, 3/4" wing seals .024 elbow covers.
  - D. T-304 stainless steel fasteners – 1/2" x .020 bands, 1/2" wing seals.
  - E. Screws are not to be used to secure jacketing.

**EXECUTION**

- 3.1 INSTALLATION
  - A. Do not insulate boiler or expansion or volume tank manholes, hand holes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.
  - B. Provide metal jacket on all exterior insulated equipment.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 23 07 19

#### HVAC PIPING INSULATION

##### GENERAL

- 1.1 Section Includes: Pipe Insulation
- 1.2 The engineer shall design an insulation system to control condensation and prevent heat loss in all HVAC piping systems.
- 1.3 LEED Submittals:
  - A. "Product Data for Credit IEQ 4.1" Subparagraph below applies to LEED-NC, LEED-CI, and LEED-CS; coordinate with requirements for adhesives and sealants.
  - B. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
  - C. "Laboratory Test Reports for Credit IEQ 4" Subparagraph below applies to LEED for Schools.
  - D. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- 1.4 QUALITY ASSURANCE
  - A. Condensation on any insulated piping system is not acceptable. Replace insulation damaged by condensation at no additional cost.
  - B. All indoor materials shall conform to Composite Surface Burning Characteristics (UL 723, ASTM E84): Flamespread 25 and Smoke developed 50
  - C. All materials shall have U.L. label.

##### PRODUCTS

##### 2.1 ACCEPTABLE MANUFACTURERS

- A. Acceptable Manufacturers:
  - 1. Calcium silicate – Johns Manville
  - 2. Phenolic Foam
  - 3. Metal jacketing – Childers RPR Products
  - 4. Cellular glass – Pittsburgh Corning FOAMGLAS
  - 5. Elastomeric – Armaflex
  - 6. Adhesives – Childers, Foster, Armstrong, (\*) Pittsburgh Corning
- B. All insulation shall comply with IECC 2009.
- C. All chilled water piping insulation shall be cellular glass (FOAMGLAS) or Phenolic Foam.
  - 1. Fittings shall be insulated in a manner similar to that for piping.
  - 2. Application shall be in accordance with Pittsburgh Corning Specifications # I-S-83-07-01 and # I-C-82-07-01.
- D. All interior chilled water piping insulation shall be 2" thickness minimum.
- E. Exterior chilled water pipe insulation shall be a minimum of 2.5" thickness and be a closed cell type with aluminum jacketing.
- F. Provide foam glass insulation at saddles at all support points.
- G. Closed cell insulation shall be applied in two layers with the seams staggered.
- H. Fiberglass insulation is acceptable for hot water piping. FIBERGLASS is UNACCEPTABLE FOR CHILLED WATER PIPE. Armaflex is acceptable for condensate drain pipe, chilled water strainers and valves. Condensate drain piping in non-mechanical rooms shall be protected with a pvc jacket extended to the plumbing trap.
- I. (\*) Apply insulation according to manufacturer recommendations and when pipe is completely dry. (Require piping to be painted with high-zinc content primer [Architect to specify suitable primer] prior to installation of insulation.)



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- J. Paint all un-insulated hydronic piping with high-zinc primer and exterior battleship grade grey finish coat.
- K. Insulation Metal Jacket
  - 1. Jacket - .016" x 36" aluminum smooth with moisture barrier jacket.
  - 2. Jacket - .020" x 36" aluminum smooth with moisture barrier jacket (High traffic areas.)
  - 3. Aluminum fasteners – ¾" bands, ¾" wing seals .024 elbow covers.
  - 4. T-304 stainless steel fasteners – ½" x .020 bands, ½" wing seals.
  - 5. Screws are not to be used to secure jacketing.

### EXECUTION

#### 3.1 INSTALLATION

- A. Ensure that all pipe and fitting surfaces over which insulation is to be installed are clean and dry.
- B. Ensure that insulation is clean, dry and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.
- C. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 23 09 23

#### DIRECT DIGITAL CONTROLS

##### GENERAL

###### 1.1 EXECUTIVE SUMMARY

- A. The Control Systems shall be bid and contracted to the Mechanical Contractor.
- B. All DDC controllers and control system components as described herein shall be provided or furnished by an HISD approved CS manufacturer and integrated into the respective, existing CMCS and shall be capable of receiving global programming modifications from the CMCS. Approved manufacturers are limited to Alerton, Automated Logic and Reliable Controls.
- C. VFD's shall be provided as required under this section for all pump and air handling unit motors. VFD's shall be installed and wired by the Division 26 Electrical Contractor. All VFD's for fan coil units and unit ventilators shall be provided, installed and wired by the equipment manufacturer.
- D. All control valves for applications shall be Belimo pressure independent characterized control valves (PICCV).
- E. Balancing valves are not needed when using pressure independent characterized controls valves (PICCV).
- F. CS design for increased energy efficiency shall be given high priority.
- G. Humidity control will take priority over temperature control when rooms are vacant.
- H. Valves shall be installed on the outside of unit ventilator and fan coil unit cabinets by the Mechanical Contractor.
- I. Panels for UC's shall be mounted on the outside of all unit ventilators and fan coil units with three feet of wall clearance in front of them. No higher than 7 ft to the bottom of panel.
- J. All temperature, humidity and CO2 sensors shall be located across the room from the unit.
- K. Demand ventilation shall be implemented on unit ventilators, fan coil units and air handling units with CO2 sensors and outside air dampers
- L. Dehumidification mode shall only be enabled when both cooling (CHW or DX) and heating (HW or Electric) are enabled and operable.
- M. All inputs (BI's and AI's) and outputs (BO's and AO's) shown on points schedules shall be hardwired to the controllers.
- N. The engineer of record shall only edit sequences and points list as applicable for the designed equipment. Sequences and points lists that do not apply to the project shall be noted as such by engineer for each project.
- O. DDC control vendor shall furnish two laptops or tablets to HISD CFS-DDC controls department at completion of job. Said laptop/tablets shall meet HISD specifications provided by DDC controls department. Provide written verification from DDC control department that they are in receipt of said laptop/tablets.

###### 1.2 DESCRIPTION

- A. General: The control system (CS) shall consist of a high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Management level Ethernet network speed shall be 1Gbps and Automation level MSTP network speed shall be 76.8 Kbps. Each mechanical system and building floor plan shall be depicted on an operator workstation by point-and-click graphics. The preferred CS shall be reliable, easy to operate, easy to maintain, energy efficient and affordable.
- B. Purpose: The purpose of the CS is to operate a building's HVAC system in a manner that provides effective temperature and humidity control while minimizing energy consumption. This means a control strategy that employs reheat for humidity control only



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## BUILDING EXCELLENCE

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- as a last resort.
- C. A single web server with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser from all PC's connected to the network.
  - D. Operators shall be able to operate systems through the web browser interface and all graphical/data representations must appear identical, whether the user is on site or viewing via the web at a remote location. Standard Operator functions such as control point manipulation, manipulation and viewing of trends, schedules and alarms shall be performed through the web browser interface. Advanced technical functions such as DDC programming and network configuration may be performed either through the web browser interface or using an operator's workstation via a VPN connection. Access to these advanced technical features shall be limited to only users with factory certified technical training or those authorized by HISD.
  - E. Contractor shall provide its newest web-based software and software updates required for this project. Additionally the installing contractor shall provide all computer related components (BAS web server – reference specifications for hardware requirements) for the new software platform to function in a peer-to-peer environment. Portable tablets from a variety of different manufacturers shall be able to access the system utilizing one of the browsers specified above for full access and functionality with the system.
  - F. The system shall directly control HVAC equipment as specified in Sequences of Operation. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone.
  - G. Furnish energy conservation features such as optimal start and stop, night setback, request-based logic, and demand level adjustment of set points, (i.e. chilled water, discharge air, etc.) using owner defined parameters during occupied operation. In addition to optimization, the system shall also be able to start and stop primary mechanical equipment based on zone occupancy and/or zone load conditions.
    - 1. System Scheduling. In addition to standard daily, weekly, exception and holiday schedules, the operator shall be able to make a single entry schedule at the highest level of the district, school site and/or building, and, with no further modification, be in control of all equipment within that area (district, school site or building). The intent of this single entry schedule function is to allow district personnel to initiate with little or no notice of a school, community, weather or disaster event, the full operation or full shut down of all building systems with no further operator intervention or local override.
      - a) The operator shall be able to create custom groups and assign equipment and schedules to each group.
    - 2. Automated Demand Response.
      - a) System shall monitor building power consumption from an Electro Industries' Shark Meter. ~~building power meter pulse signals, from building feeder line watt transducer or current transformer, and/or submeter.~~
      - b) In addition, the system shall have the full ability to accept and respond to an automated web services-based signal from a utility, ESCO, and/or Independent System Operator (ISO) as an indication of a high demand condition.
      - c) When power consumption exceeds adjustable predetermined levels adjustable for time of day, or a high demand situation is indicated with the receipt of a web-based signal, the system shall automatically adjust zone setpoints, de-energize low-priority equipment, and take other programmatic actions to reduce demand. When demand drops below predetermined levels, the system shall restore loads as specified.



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- d) Systems only able to provide initial demand response through the shutdown of primary equipment, affecting occupant comfort, air changes and indoor air quality, are unacceptable.
- H. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. Schedules, set points, trends, and alarms specified in Section ~~23 09 00~~ 23 09 23 – 3.7 Sequences of Operation shall be BACnet objects.
- I. System shall be provided with the Utility reporting software and equipment as specified in ~~the sequence of operations~~ Section 23 09 23 – 3.7.
- J. Contractor shall provide as part of bid documentation a listing of specification subsection numbers and paragraphs **with which they DO NOT COMPLY**. Any deviation of any kind from this specification must be CLEARLY addressed in the contractors bid proposal documents allowing the owner/engineer to evaluate all deviations from the desired system features detailed in this specification.

### 1.3 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Division 23 for mechanical equipment.
- C. Division 26 for electrical, lighting, and fire alarm equipment.
- D. The HISD MEP Design Guidelines.
- E. HISD BACnet Six Digit Device Instance and IP Address Allocation Master.

**THE CHILLER SECTION SHALL INCLUDE A BACNET INTERFACE TO BE PROVIDED, INSTALLED AND WIRED BY THE CHILLER MANUFACTURER. THE SWITCHGEAR SECTION SHALL INCLUDE A MODBUS INTERFACE TO BE PROVIDED, INSTALLED AND WIRED BY THE SWITCHGEAR MANUFACTURER. VENDOR SHALL PERFORM CALIBRATION AND PROVIDE EVIDENCE OF SAME WITH CLOSE OUT DOCUMENTATION.**

**THE VARIABLE FREQUENCY DRIVE SECTIONS SHALL BE PROVIDED UNDER THIS SECTION AND INSTALLED BY DIVISION 23 AND WIRED BY DIVISION 26.**

### 1.4 SCOPE OF WORK

- A. Provide a complete Control System (CS) turnkey installation as detailed in this section of these specifications. The CS shall be a native BACnet based system that is stand alone in all aspects except that it shall be remotely monitored and controlled from the HISD Central Monitoring and Control System (CMCS) utilizing the BACnet protocol over the HISD District wide area network. The operator's workstation, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135–2010, BACnet or latest revision. All workstations and controllers, including unitary controllers, shall be native BACnet devices conforming to the latest version of the ASHRAE BACnet standard. System as specified in these documents shall include any and all software and hardware to support at least 50 simultaneous users. All contractors, subcontractors and vendors are to strictly adhere to HISD Design Guidelines. Prior written approval from HISD is required for any deviation from these guidelines.
- B. The CS shall comprise the following components:
  - 1. Communication Control Panels (CCP), based on BACnet standards to interface the School CS to the district wide CMCS.
  - 2. Unitary Controllers (UC), based on BACnet standards.
  - 3. CS Automation Level Network, base on BACnet standards.
  - 4. Field instrumentation.
  - 5. Automatic dampers (not furnished as part of a unit) and valves.



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6. Actuators for automatic valves and dampers.
7. Communication, sequences of operation and optimization software.
8. All power supplies, interlocking and control relays, equipment enclosures, conduit, junction and mounting boxes, cabling and other components, materials and services required for a completed and fully operational turnkey CS installation meeting these specifications.
9. All software necessary for servicing CS controllers and other CS equipment.
- C. Provide the following support for the CS facilities:
  1. Warranty and service during the warranty period.
  2. Submittals, samples and record documentation.
  3. Comprehensive commissioning and testing of the CS.
  4. Training services for the Owner and Operators.
  5. Coordination with other site contractors.
  6. Reporting to the General Contractor, the Architect and Engineer to ensure a well coordinated and timely execution of the Work.
- D. The CS shall be remotely monitored by the HISD district wide CMCS using BACnet over IP through the existing CMCS. The newest version of server and web software shall be provided.
- E. Furnish the following devices for installation by Division 23:
  1. Temperature sensing thermowells.
  2. Automatic dampers.
  3. Pipe tap for insertion flowmeters.
  4. Tapping, piping and 3/8" ball valve, fully installed for all wet differential pressure sensors.
  5. Motorized control valves.
  6. Water pressure sensors and switches with isolation valves.
  7. Companion flanges for inline pipe mounted equipment.
  8. Furnish UC and damper actuators for terminal units and fan coil units to the unit manufacturer for factory mounting. The Mechanical Contractor shall provide access doors, where required, for all control system components to ensure proper maintenance access.
- F. 120 Vac power shall be provided by Division 26 at locations indicated on the Division 26 drawings. Review and verify that these locations are adequate for the proposed CS. Extend power from these locations to all devices, as necessary.

### 1.5 ABBREVIATIONS

AD	-	Automatic Damper
ARCNET	-	Attached Resource Computer Network
ANSI	-	American National Standards Institute
ASHRAE Engineers	-	American Society of Heating, Refrigerating and Air-Conditioning
BIBB	-	BACnet Interoperability Building Block
BBMD	-	BACnet Broadcast Management Device
CS	-	Remote school/building Control System
CCP	-	Communications Control Panel
CMCS	-	Central Monitoring and Control System
CPU	-	Central Processing Unit
DDC	-	Direct Digital Control
ECPAP	-	Expandable Central Plant Application Panel
FAS	-	Fire Alarm System
FCU	-	Fan Coil Unit
FPTU	-	Fan Powered Terminal Unit
FSD	-	Fire / Smoke Damper





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HMI	-	Human Machine Interface
HVAC	-	Heating, Ventilating and Air Conditioning
ICT	-	Information Communication Technology
IEEE	-	Institute of Electrical and Electronics Engineers
I/O	-	Input/Output
IP	-	Internet Protocol
ISA	-	Instrumentation Society of America
ISO	-	International Standards Organization
I/O	-	Input/Output
LAN	-	Local Area Network
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MSTP	-	Master Slave or Token Passing
NEC	-	National Electrical Code
NEMA	-	National Electrical Manufacturers Association
OIW	-	Operator Interface Workstation
PC	-	Personal Computer
PICS	-	Protocol Implementation Conformance Statement
PIM	-	Process Interface Module
POT	-	Portable Operator Terminal
RAM	-	Random Access Memory
ROM	-	Read Only Memory
RFI	-	Radio Frequency Interference
RH	-	Relative Humidity
SD	-	Smoke Damper
SVGA	-	Super Video Graphics Adapter
UC	-	Unitary Controller
UDP	-	User Datagram Protocol
UL	-	Underwriters Laboratory
UV	-	Unit Ventilator
VAV	-	Variable Air Volume
VDU	-	Video Display Unit
WAN	-	Wide Area Network

### 1.6 OVERALL DISTRICT-WIDE CONTROL SYSTEM PHILOSOPHY

- A. The following is a description of the overall CMCS philosophy that shall be applicable to the CMCS and all school CS. It is provided for the purpose of placing the work of the school CS contracts.
- B. For the purpose of describing the CMCS system architecture it shall be divided into three layers:
  1. Management Level:
    - a. A Wide Area Network (the HISD WAN), shall provide a means of interoperable communication between the CMCS and the school CS using BACnet/IP. This WAN is hereafter referred to as the Management Level Network. The Management Level Network shall provide a means by which the building systems throughout the HISD facilities can exchange data in the form of BACnet objects. The Management Level Network shall be BACnet/IP over 1Gbps Ethernet and shall be such that an operator with the required access level shall be able to undertake monitoring and control functions for any of the integrated CS building systems from any PC that communicates as a Thin Client with the terminal servers residing at the Management Level.
    - b. It shall be the responsibility of each CS contractor, to ensure that all



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system data and full English language descriptors for 100% of the hardware and software points is available at the Management Level Network. Each CS contractor shall provide comprehensive and complete documentation regarding the BIBB, address, controller type, databases and other pertinent information. The intent is that the CMCS shall be able to automatically read this data from the network using the BACnet automatic "find new objects" features.

- c. The CMCS architecture shall be Thin Client or equivalent such that all applications software resides at the terminal servers and the entire HISD facilities are covered by a single software license regardless of the number of Personal Computers that are accessing the Management Level Network at any point in time.
- d. CMCS applications software shall run on the terminal servers and software resident at the CMCS Operator Interface Workstations (OIW) shall be minimized. The terminal servers shall be installed at the HISD Central Control Room. The CMCS workstations, including the Portable Operator Workstations (POT), shall be Thin Clients operating through a Virtual Private Network (VPN). It shall be possible to add access from a remote location by modem and/or via the Web.
- e. The Operator Interface Workstations (OIW) that serve the CMCS and CS shall be resident on the Management Level Network, not the CS. If an OIW is required within a school, the CMCS contractor shall provide it under a separate contract.
- f. The Management Level Network communications, without exception, shall be BACnet/IP. It is intended that there be a single point of interface from a school CS and the Management Level Network (HISD WAN). If additional CCP's are required in a school due to Automation Level node quantities or limitations of CCP capabilities, the additional CCP's shall be provided under this contract as an extension of the Management Level Network within the school by the CS Contractor.
- g. The demarcation point between the CMCS and the school CS shall be the CS CCP connection to the WAN data outlet within the school. The CS Contractor shall make the final terminations with supervision from HISD.

2. Automation Level:

- a. The Communication Control Panels (CCP) shall be part of the CS. CCP shall be software programmable with native BACnet/IP to BACnet/MSTP (76.8 Kbps minimum) or BACnet/ARCNET (156Kbps) routers between the Management Level Network and the BACnet controllers on the Automation Level Network.
- b. The Automation Level shall primarily include the DDC controllers that interface with the field sensors and final control elements. It is anticipated that there will be two types of DDC controllers within the CMCS architecture:
  - i. Expandable Central Plant Application panels (ECPAP).
  - ii. Unitary Controllers (UC).
- c. ECPAP controllers shall be fully programmable controllers and shall have the ability to handle major types of equipment such as air handling units, chiller plants, heating plants, etc. The ECPAP shall be native BACnet controllers and shall be interfaced with the Management Level Network via the CCP. ECPAP controllers shall accept up to 8 expansion modules. Expansion modules shall have onboard HOA's and potentiometers.
- d. UC shall be application specific or fully programmable controllers and



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- shall be suitable for the monitoring and control of specific types of smaller equipment such as VAV terminal units and Fan Coil Units. UC shall be native BACnet controllers at the Automation Level.
- e. All controllers shall be BACnet compliant to ANSI/ASHRAE Standard 135–2010 or latest revision.
  - f. The CS Automation Level Networks shall be BACnet using MSTP or ArcNet. No other protocols or network architecture shall be used.
  - g. Where interface to a third party controller is not BACnet compatible, the interface shall be via Modbus. Provide Modbus to BACnet converters as necessary to integrate the third party controller into the Automation Level Network. If Modbus controllers cannot be integrated into the Automation Level, they may be integrated directly to the CCP.
3. Field Level: The Field Level shall include the instrumentation interfaced to the Automation Level DDC controllers such as the temperature, humidity, level, pressure sensors and switches. It shall also include the final control elements such as the valve and damper actuators and the control relays.

### 1.7 WORK OF THE CS CONTRACTOR

- A. The CS Contractor shall provide the mapping, storage, and reporting of the school CS monitoring and control objects into the CMCS and the preparation of data presentation for the CMCS Management Level Network. Provide all necessary documentation, BIBB information, as required for the integration of the CS monitoring and control functions into the CMCS.
- B. The CS Contractor shall assure that device instance, BBMD and UDP assignment and the network design adheres to the HISD BACnet Device Instance and IP Address Allocation Master design standard. CS system shall communicate BACnet Annex J to the CMCS and support network speeds of 100 Mbps. CS system design shall support thermograph floor plans, standard alarms and consist of standard configurations for typical systems. The CS Contractor shall provide the following:
  - 1. Provide and configure in the form of standard BACnet values, the following alarms to be displayed by the CMCS.
    - a. Fan failure
    - b. Smoke alarm (if required)
    - c. Space temperature out of range
    - d. Supply air temperature out of range
    - e. Loss of communication alarm
    - f. HVAC equipment common alarm (i.e.: if any point in a piece of equipment goes into alarm, an HVAC common alarm shall occur)
    - g. Any other alarms as specified elsewhere herein
    - h. HOA switch in hand alarm
  - 2. Provide standard BACnet configuration and access for the following to be displayed by the CMCS using standard BACnet objects and values.
    - a. Schedules
    - b. Trendlogs
    - c. Alarms
    - d. Any other displays as specified elsewhere herein
  - 3. Provide the following data to be displayed and integrated into the BACnet CMCS.
    - a. Space temperature deviation from setpoint
    - b. Current controlling setpoint for each control loop
    - c. HVAC equipment common alarm (i.e.: if any point in a piece of equipment goes into alarm, an HVAC common alarm shall occur)
  - 4. All CS system devices shall comply with BACnet Annex L Standardized Device Profiles for communication to the CMCS BACnet Operator Workstation (B-OWS).



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- Building Controller (B-BC)
  - Advanced Application Controllers (B-AAC)
  - Application Specific Controllers (B-ASC)
  - Smart Sensor (B-SS)
  - Smart Actuators (B-ACT)
5. The CS system shall be designed to provide BACnet data communication per standard BACnet Interoperability Blocks (BIBBs) (Annex K, ASHRAE Standard 135-2010 BACnet). The CS system shall communicate with the CMCS to share data, alarm and notify events, schedule, trend, manage devices and manage the network per the following BIBBs as a minimum.

### Data Sharing

DS-RP-A	Read Property-Client User of Data From Device
DS-RP-B	Read Property- Device Providing Data
DS-RPM-A	Read Property Multiple-Client User of Data From Device
DS-RPM-B	Read Property Multiple- Device Providing Data
DS-WP-A	Write Property-Client User of Data From Device
DS-WP-B	Write Property- Device Providing Data
DS-WPM-A	Write Property-Client User of Data From Device
DS-WPM-B	Write Property- Device Providing Data
DS-COV-B	Change of Value- Device Providing Data

### Alarm and Event Notification

AE-N-A	Notification-Client User of Data From Device
AE-ACK-A	Acknowledge-Client User of Data From Device
AE-INFO-A	Information-Client User of Data From Device
AE-ESUM-A	Event Enrollment Summary-Client User of Data From Device

### Scheduling

SCHED-A	Schedule-Client User of Data From Device
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### Trending

T-VMT-A	Viewing and Modifying Trends-Client User of Data From Device
T-ATR-A	Automated Trend Retrieval-Client User of Data From Device

### Device and Network Management

DM-DDB-A	Dynamic Device Binding-Client User of Data From Device
DM-DDB-B	Dynamic Device Binding - Device Providing Data
DM-DOB-A	Dynamic Object Binding -Client User of Data From Device
DM-DOB-B	Dynamic Object Binding - Device Providing Data
DM-DCC-A	Device Communication Control-Client User of Data From Device
DM-DCC-B	Device Communication Control - Device Providing Data
DM-OCD-A	Write Property-Client User of Data From Device
DM-TS-A	Time Synchronization- Client User of Data From Device
DM-UTC-A	UTC Time Synchronization- Client User of Data From Device
DM-RD-A	Reinitialize Device- Client User of Data From Device
DM-BR-A	Backup and Restore- Client User of Data From Device
DM-PT-A	Private Transfer- Client User of Data From Device



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DM-PT-B	Private Transfer- Device Providing Data
DM-R-A	Restore- Client User of Data From Device
NM-CE-A	Connection Establishment- Client User of Data From Device

6. All standardized BACnet objects and features shall be fully implemented including but not limited to the following:
  - Enter full alphanumeric descriptions of all object descriptions, object names, points and devices in each object, value and point.
  - Each hardware and pseudo point and value in the CS shall be fully BACnet implemented.
  - All alarms shall have full alphanumeric descriptors.
7. CS Contractor shall provide a complete and certified report of all CS network and data information. The report shall provide the following as a minimum.
  - All object descriptors and object names.
  - All device and network addresses and descriptors.
  - All hardware point addresses and descriptors.
  - All analog and binary values and descriptors.
  - All trendlogs and descriptors.
  - All alarms and descriptors.
8. Controllers for each type of controlled equipment shall be configured to one common standard. Therefore, controller point use is consistent and will allow for consistent graphic creation and presentation to the operator.
9. Provide review of the proposed CS, CCP, UC and Automation Level Network for the compatibility and integration capabilities at the shop drawing and submittal stage the project. Report to HISD on any concerns relating to compatibility or integration of the CS into the CMCS.
10. Integrate the CS into the CMCS to include but not limited to the following:
  - a. Point monitoring and control
  - b. Trending
  - c. Alarm configuration and annunciation
  - d. Reporting of real time and historical data
  - e. Equipment scheduling
11. Provide the necessary integration, graphics and interface commissioning of the CS BACnet data into the BACnet CMCS.
12. Create a graphic for each specific piece of equipment, its associated sequence of operation graphic and all menu penetration/summary graphics. This equipment shall include as it pertains to the project the following:
  - a. Chilled Water Systems
  - b. Hot Water Systems
  - c. Air Handling Units
  - d. Dedicated Outside Air Handling Units
  - e. Rooftop Units
  - f. Split Systems
  - g. VAV Terminal Units
  - h. Exhaust Fans
  - i. Lighting Points
  - j. Misc. Points
13. Provide (1) dynamic thermographic floorplan for every facility at the building level. Provide area thermographic floorplans for each floor and section of the building which shall be pick-able from the building level floorplan. These floor plans shall allow an operator to immediately know which zones are deviating from the current setpoint based on color changes on a zone by zone basis. The CS Contractor shall be provided Mechanical and Electrical AutoCad drawings at no additional cost to create floor plans, displaying building, area, or section level



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- floorplans with only the numerical temperature values without dynamic color graphics on the front-end is unacceptable. All thermographs shall be visible via web interface as well as on the LAN.
14. Provide (1) mechanical equipment floor plan for every 4,000 square feet of floor space. This drawing is a second layer that enables the operator to view:
    - a. Mechanical equipment layout including piping and ductwork
    - b. Equipment location
    - c. Wall sensors that display the current space temperature
    - d. VAV boxes and associated space temperature sensors
    - e. Room numbers, etc.
  15. Provide capability for global modification of user definable parameters of all points shall be provided standard to the operation of the system. Global modification is defined as the mass adjustment of user definable parameters and schedules across a defined group, group of groups area, facility, campus, overall district or network. Parameters shall included, but not be limited to temperature setpoint (VAV boxes, AHU Discharge, VAV AHU Static Pressure Setpoints ect), equipment start/stop, equipment status, valve output signal, vfd speed control signal, and damper position signal. User shall be able to lock the definable parameter to a set value, or adjust a setpoint to an operator adjustable value. This function shall be accomplished through the standard graphical user interface/workstation and is to be selectively applicable by the user to all controllers on the network, all controllers in a specific facility or all controllers in a specific zone within a specific facility.
  16. Custom Application Programming. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features:
    - a. Language. Language shall be graphically based or English language oriented. If graphically based, language shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks. If English language oriented, language shall be based on the syntax of BASIC, FORTRAN, C, or PASCAL, and shall allow for free-form programming that is not column-oriented or "fill-in-the-blanks."
    - b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.
    - c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.
    - d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.
    - e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
    - f. Mathematical Functions. Language shall support floating-point addition,





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subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.

- g. Variables: Operator shall be able to use variable values in program conditional statements and mathematical functions.
  - i. Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.
  - ii. System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.

### 1.8 CONTRACTOR QUALIFICATIONS

- A. The CS Contractor shall:
  - 1. Have a local staff in the Houston, Texas area of trained personnel capable of giving instructions and providing routine and emergency maintenance on the CS, all components and software/firmware and all other elements of the CS.
  - 2. Have a proven record of experience in the supply and installation of equivalent BACnet systems over a minimum period of five years. Provide documentation of at least three and no more than six projects of equal or greater size and complexity, if so requested by the General Contractor or Owner.
  - 3. Be a factory certified representative for the native BACnet CS manufacturer for design, installation, and maintenance of the proposed systems.
  - 4. Have comprehensive local service, training and support facilities for the total CS as provided.
  - 5. Maintain local, or have approved local contracted access to, supplies of essential expendable parts.
- B. Subject to their complete compliance with all other provisions of Section ~~23-09-00~~ 23 09 23 of these Contract Documents, the CS Contractor shall be one of the following two local CS companies providing controls from a manufacturer as indicated:
  - 1. ~~Open Tech - Alerten~~
  - 2. ALC/UES - Automated Logic
  - 3. Unify Energy Solutions – Reliable Controls

### 1.9 RELATED WORK IN OTHER SECTIONS

- A. Refer to Division 0 and Division 1 for Allowances and related contractual requirements.
- B. Refer to Section 23 XX XX for General Mechanical Provisions
- C. Refer to Section 23 XX XX for Chiller Control Requirements
- D. Refer to Section 23 XX XX for Air Handling Unit Control Requirements
- E. Refer to Section 23 XX XX for VAV Terminal Unit Control Requirements
- F. Refer to Section 26 XX XX for General Electrical Provisions
- G. Chiller manufacturer shall provide, install and wire a BACnet interface to the chiller.
- H. Division 26 shall provide all conduit and wiring for 120 volts and above, such as power to control panels, 120v valve operators, VAV terminal units, power supplies, etc.
- I. Switchgear manufacturer shall provide Modbus interface to BAS.
- J. Fire alarm manufacturer shall provide contacts within 18 inches of Division ~~23-09-00~~ 23 09 23 control panels for monitoring only of specified fire alarm devices, zones, etc.
- K. CRAC unit manufacturer shall provide Modbus RTU interface to BAS.





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### 1.10 ELECTRICAL POWER PROVISIONS

- A. 120Vac power shall be provided under a separate contract by the Electrical Contractor. Power fed from the normal power circuits will be provided at the following locations:

Power fed from the emergency power circuits will be provided at the following locations:

- B. Normal power shall be provided to the UC serving fan powered terminal units via the control transformer provided with the unit.
- C. Provide the necessary low voltage power to the UC provided that will serve VAV terminal units from the power sources indicated above. Provide step down transformers within panel enclosures. Provide all necessary fuses and circuit protection devices.
- D. Power shall be provided to the dampers interlocked to fans via the control transformer provided with the motor starter.
- E. All components of the CS shall be powered from the sources above. Provide final terminations from the locations indicated on the Division 23 Drawings.
- F. The CS Contractor shall provide any additional power that is required as part of this contract. This shall include all conduit, cabling, circuit breakers, interfaces, etc.

### 1.11 SHOP DRAWINGS

- A. The following information shall be included on the cover page for each shop drawing and equipment documentation submittal:
  - 1. Project name.
  - 2. Date.
  - 3. Submittal number and re-submittal number, as appropriate.
  - 4. Name and address of Consultant.
  - 5. Name and address of General Contractor.
  - 6. Name and address of CS Contractor.
  - 7. Name and address of supplier or vendor, as appropriate.
  - 8. Name of manufacturer.
  - 9. Reference to the applicable Specification Section by name and number.
- B. Shop drawings shall be CAD generated, minimum plot size of 8.5 x 11 inches. Drawings shall include diagrams, mounting instructions, installation procedures, equipment details and software descriptions for all aspects of the system to be installed. At minimum, the shop drawings shall include:
  - 1. CS topology schematic.
  - 2. CCP, UC and other panel layouts, including floor plan location and interconnection drawings.
  - 3. Field instrumentation locations on floor plan drawings.
  - 4. Schematic of systems indicating instrumentation locations.
  - 5. Installation details.
  - 6. Schedule of cabling including details of proposed cable types.
- C. Equipment submittals shall include design, performance and installation details for all aspects of the system to be installed. At minimum, the equipment documentation submittals shall include:
  - 1. Equipment technical data sheets with mounting and installation details.
  - 2. The documentation shall include comprehensive and complete details of the BIBB and Automation Level documentation including address, associated controller type, etc. as required and for the interface to the CMCS.
  - 3. Details of networks/communications equipment, cabling and protocols proposed.
  - 4. Software specifications and descriptions including operating sequences.
  - 5. Field sensor and instrumentation specification sheets.
  - 6. Damper and actuator specification sheets.
  - 7. Valves and actuator specification sheets.
  - 8. Details of piping and/or tubing proposed.



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### 1.12 O&M MANUAL CONTENTS AND FORMAT

- A. Provide O&M Manual with full information to allow matching products under future Contracts to products under this contract, and to allow HISD to operate, maintain and repair (for user-serviceable aspects) products, including trade names, model or type Numbers, color dimensions and other physical characteristics.
- B. Format:
  - 1. Produce on 8-1/2 x 11-inch pages, and bind in 3-ring/D binders with durable plastic covers.
  - 2. Label binder covers with printed title "OPERATION AND MAINTENANCE MANUAL", title of project, and subject matter and "Number \_ of \_" of binder when multiple binders are required.
  - 3. Separate each "Part" with substantial dividers tabbed and titled by Part number.
- C. Contents:
  - 1. Table of Contents for each volume, naming each Part.
  - 2. Part 1: Directory with name, address and telephone number of Designer, Contractor and Subcontractors and Suppliers for each Project Manual section.
  - 3. Part 2: Operation and maintenance instructions, arranged by Project Manual Section number where practical and where not, by system. Include:
    - a. For finish materials, maintenance instructions prepared by manufacturers including recommended cleaning methods and materials and special precautions identifying detrimental agents.
    - b. HVAC, plumbing and electrical products, prepared by product manufacturer, including:
      - i. Product design criteria, functions, normal operating characteristic and limiting conditions.
      - ii. Installation, alignment, adjustment, checking instructions and troubleshooting guide.
      - iii. Operating instructions for start-up, normal operation, regulation and control, normal shutdown and emergency shutdown.
      - iv. Spare parts list for operating products, prepared by manufacturers including detailed drawings giving location of each maintainable part, lists of spares recommended for user-service inventory and nearest source of in-stock spares.
      - v. Outline, cross-section and assembly drawings; engineering data and wiring diagrams
      - vi. Test data and performance curves.

### 1.13 RECORD DOCUMENTATION

- A. Provide Operators' Manuals with, at minimum, the following information:
  - 1. Details of all features and functions available to the Operators.
  - 2. Details of all alarm, diagnostic, error and other messages. Detail the Operator action to be taken for each instance.
  - 3. Detail special programs provided and provide a complete programming instruction manual. Detail operation of all software applications.
  - 4. Detailed list of the database for all installed devices.
  - 5. Details of all data base management functions and features.
  - 6. All details and descriptions shall be in a step by step format such that an Operator/ Manager would be able to undertake the respective actions solely on the basis of information provided in the manuals and drawings.
- B. Provide hardware manuals which shall include, at minimum, the following:
  - 1. Specifications, maintenance requirements and installation requirements for all hardware components.
  - 2. Record drawings and schedules of the completed installation including location



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- of devices, mounting details, cabling details.
- 3. Operating sequences and interlocks.
- 4. Names and addresses of spare parts suppliers.
- C. Record drawings shall be CAD generated and shall include, at minimum, the following:
  - 1. Details required by the shop drawings.
  - 2. Final locations and point ID for each monitored and controlled device.
- D. In addition to the required hardcopies, provide a CD with all of the record documentation in PDF format and a CD(s) containing backup copies of all installed software and graphics.
- E. Online As-built documentation. Contractor shall provide digital replications of as-builts that shall be accessible from each equipment graphic controlled or monitored by the BAS. Electronic documents which shall be accessible include:
  - 1. Module Drawing.
    - a. Provide an electronic wiring diagram of each control module (as shown in submittal documentation). Diagram shall display wiring schematic and terminations to end devices.
    - b. Diagram shall display each input and output terminals and label those that are used for the control application.
    - c. Diagram shall display module type/name and network address.
    - d. The module drawing shall be a separate graphic that is selectable at the applicable location for the control program.
  - 2. Equipment Schematic.
    - a. Provide an electronic equipment schematic for each piece of mechanical equipment. In the event there are multiple quantities of a specific piece of mechanical equipment (i.e. variable volume box) the electronic schematic shall be viewable from each of these instances.
    - b. The schematic shall display all mechanical equipment characterizes including fans, dampers, valves, sensors and other applicable control devices.
    - c. The schematic shall show wiring terminations to each control device as shown in the submittal and as-build documentation.
    - d. Control devices shall be labeled by a symbol that can easily be identified in a bill of material that is shown on this graphic. The bill of material shall show the device symbol, description, manufacture and part number.
  - 3. Sequence of Operations.
    - a. The sequence of operations shall be viewable for each piece of mechanical equipment and be in a text format as shown in the as built documentation.
    - b. The sequence of operations shall be selectable at the applicable location for the control program.
  - 4. Bill of Material.
    - a. Provide a bill of material that indicates specific manufacture, part number, part description and quantity of each device for all system components.

### 1.14 WARRANTY

- A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from completion of system acceptance.
- B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the contractor. The maximum acceptable response time to provide this service at the site shall be 4 hours, during normal working hours.
- C. This warranty shall apply equally to both hardware and software.



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### PRODUCTS

#### 2.1 MANAGEMENT LEVEL NETWORK

- A. Extension of the Management Level Network shall meet, at minimum, the following requirements:
  - 1. Ethernet TCP/IP network.
  - 2. BACnet standards.
  - 3. Cabling shall be Category 6 or higher quality and shall be tested and certified for 1 Gbps data transfer rate.

#### 2.2 CS AUTOMATION LEVEL NETWORK

- A. CS Automation Level LAN shall consist of only the following LAN's:
  - 1. BACnet/MSTP (76.8 Kbps minimum) or BACnet/ARCNET (156Kbps)
  - 2. BACnet.
  - 3. Data transfer rate and data throughput as required to meet the alarm annunciation requirements.
  - 4. Battery backup with lighting and surge protection. 500 VA minimum.
- B. The failure of any node on the Automation Level LAN shall in no way affect the operation of the CS except to inhibit monitoring and control functions at the OIW for that node or any devices served by the failed node.
- C. The failure of any node shall not inhibit the communication between remaining nodes.

#### 2.3 COMMUNICATION CONTROL PANELS (CCP)

- A. CCP shall be software programmable controllers on the primary Management Level Network and shall be a router between the BACnet/IP Management Level Network and the BACnet/MSTP (76.8 Kbps minimum) or BACnet/ARCNET (156Kbps) Automation Level Network.
- B. Provide, at minimum, one CCP.
- C. The CCP shall incorporate software as necessary to provide communications on the Management Level Network.
- D. The failure of any CCP shall be annunciated as an alarm at the CMCS.
- E. Provide a real-time hardware clock at each CCP. The hardware real-time clock shall be used to synchronize all other hardware and software clocks in the CS.
- F. Supply and install surge protection on all power and communication lines.
- G. Install adequate battery back-up.

#### 2.4 EXPANDABLE CENTRAL PLANT APPLICATION CONTROLLERS (ECPAC)

- A. General
  - 1. Expandable application controller shall be capable of implementing control strategies for the system based on information from any or all connected inputs. The program that implements these strategies shall be completely flexible and user definable. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site via simple download are not acceptable. Changing global strategies via firmware changes is also unacceptable. Program execution of controller shall be a minimum of once per second.
  - 2. Programming shall be object-oriented using control program blocks. Controller shall support a minimum of 500 Analog Values and 500 Binary Values. Each and every analog and binary value shall support standard BACnet priority arrays. Programming tool shall be provided with system and shall be the same tool that is used to program the Building Controller. All flowcharts shall be generated and automatically downloaded to controller. No re-entry of database information shall be necessary.
  - 3. Provide means to graphically view inputs and outputs to each program block in



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- real-time as program is executing. This function may be performed via the operator's terminal or field computer.
4. Controller shall have adequate data storage to ensure high performance and data reliability. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative). Battery shall be a field-replaceable (non-rechargeable) lithium type. Unused battery life shall be 10 years.
  5. The onboard, battery-backed real time clock must support schedule operations and trend logs.
  6. Global control algorithms and automated control functions should execute via ~~32~~ 64-bit processor.
  7. Controller shall include both on-board 10BASE-T/100BASE-TX Ethernet BACnet communication over twisted pair cable (UTP) and shall include BACnet IP communication. In addition, controller shall include BACnet PTP connection port.
  8. The base unit of the controller shall host up to 8 expansion modules with various I/O combinations. These inputs and outputs shall include universal 10-bit inputs, binary triac outputs, and 8-bit switch selectable analog outputs (0-10V or 0-20 mA). Inputs shall support 3K and 10K thermistors, 0-5VDC, 0-10VDC, 4-20mA, dry contacts and pulse inputs directly.
  9. All outputs must have onboard Hand-Off-Auto switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position.
  10. The position of each and every HOA switch shall be available system wide as a BACnet object. Expandable Central Plant Controller shall provide up to 176 discreet inputs/outputs per base unit.
- B. BACnet Conformance
1. Central Plant/AHU Controller shall as a minimum support Point-to-Point (PTP), MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Building controller shall be a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:
    - a. Clock Functional Group
    - b. Files Functional Group
    - c. Reinitialize Functional Group
    - d. Device Communications Functional Group
    - e. Event Initiation Functional Group
  2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All necessary tools shall be supplied for working with proprietary information.
  3. Standard BACnet object types supported shall include as a minimum: Analog Input, Binary Input, Analog Output, Binary Output, Analog Value, Binary Value, Device, File, Group, Event Enrollment, Notification Class, Program and Schedule object types. All necessary tools shall be supplied for working with proprietary information.
  4. The Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).
- C. Schedules



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1. Each Central Plant/AHU controller shall support a minimum of 50 BACnetSchedule Objects.
- D. Logging Capabilities
  2. Each controller shall support a minimum of 200 trend logs. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
  3. Controller shall periodically upload trended data to system server for long term archiving if desired.
  4. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.
- E. Alarm Generation
  1. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
  2. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications.
  3. Controller must be able to handle up to 200 alarm setups stored as BACnet event enrollment objects – system destination and actions individually configurable.
  4. Alarm actions shall be made available for assignment by operator.  
Example: Operator will be able to create an action so that chiller alarms will automatically generate email notifications.

### 2.5 UNITARY CONTROLLERS

- A. The CS Contractor shall provide all Unitary Controllers (UC). UC shall be fully programmable or applications specific controllers with pre-packaged operating sequences maintained in EEPROM or flash RAM.
- B. The UC shall be a node on one of the Automation LANs and shall control its own communications so that the failure of any one node, shall not inhibit communications on the network between the remaining nodes.
- C. UC shall be totally independent of other LAN nodes for their monitoring and control functions.
- D. Provide each UC with a battery back-up or EEPROM for the protection of volatile memory for a minimum of 72 hours. Batteries shall be rated for a seven year life.
- E. All associated applications programs shall reside at the UC. UC shall not require communication to any other panel for normal operating sequences other than time scheduled base commands.
- F. Control shall be based on either three term algorithms, i.e. proportional plus integral plus derivative, or two term algorithms, i.e. proportional plus integral, unless specified otherwise.
- G. Provide with each controller the BACnet configuration information including BIBB, address, controller configuration type, etc. to integrate the controller into the CMCS.

### 2.6 UNITARY CONTROLLER - TERMINAL UNITS

- A. The CS Contractor shall provide all UC's required for all terminal units. The number and location of terminal units and air flow rates shall be as indicated on the Mechanical Drawings.
- B. The terminal unit manufacturer shall provide the following components for each fan powered terminal unit for interface and mounting of the UC:
  1. Primary air dampers to be controlled by the UC.
  2. Enclosure to house the UC and associated components including suitable mounting brackets shall be NEMA 1 rating and located outside the terminal unit. The enclosure shall be lockable with the same keys used on the CCP's. Outside





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- equipment shall have NEMA 4X enclosures that are waterproof.
- 3. Multi-point averaging type flow sensor at the primary air inlet to the terminal unit.
- 4. 24 VAC control transformer.
- 5. 24 VAC fan control relay interface.
- 6. 24 VAC heater control relay interface (up to two stages).
- C. The terminal unit manufacturer shall provide the following components for each cooling only VAV terminal unit for interface and mounting of the UC:
  - 1. Primary air dampers to be controlled by the UC.
  - 2. Enclosure to house the UC and associated components or suitable mounting brackets within the terminal unit enclosure.
  - 3. Multi-point averaging type flow sensor at the primary air inlet to the terminal unit.
  - 4. 24 VAC control transformer.
- D. The CS Contractor shall furnish the terminal unit manufacturer the following components for factory installation and wiring for each terminal unit:
  - 1. UC.
  - 2. Damper actuator.
  - 3. Discharge air sensor
- E. The CS Contractor shall field install the following components for each terminal unit:
  - 1. Room temperature sensor
  - 2. Occupancy sensor (As shown on drawings or in points list)
  - 3. CO2 Sensor. (As shown on drawings or in points list)
- F. Provide integral differential pressure transducers for the monitoring of the terminal unit primary air flow rate.
- G. Furnish primary damper actuators, for factory mounting, meeting the following requirements:
  - 1. Direct shaft mounting.
  - 2. Adequate torque, to properly operate the damper from fully open to fully closed without binding.
  - 3. Locking "V" groove or similar means to prevent slippage between actuator and shaft.
- H. The UC shall monitor and control the following parameters for fan powered terminal units:
  - 1. Space temperature.
  - 2. Primary air flow rate.
  - 3. Damper modulation.
  - 4. Heating coil stage control or heating valve control (as applicable).
  - 5. Fan on/off control.
  - 6. Discharge air sensor.
  - 7. Occupancy sensor (As shown on drawings or in points list)
  - 8. CO2 Sensor. (As shown on drawings or in points list)
- I. The UC shall monitor and control the following parameters for VAV terminal units:
  - 1. Space temperature.
  - 2. Primary air flow rate.
  - 3. Damper modulation.
  - 4. Discharge air sensor.
  - 5. Occupancy sensor (As shown on drawings or in points list)
  - 6. CO2 Sensor. (As shown on drawings or in points list)
- J. PID algorithms shall maintain the system operation within + or - 1.0 Deg. F. of the space temperature setpoints.
- K. Following the installation of the terminal unit in the ceiling space the CS Contractor shall undertake the following tasks:
  - 1. Physically connect the UC into the CS Automation Level Network.
  - 2. Install all data into the UC as necessary for the correct operation of the terminal unit.
  - 3. Calibrate the instrumentation associated with the following monitored





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parameters:

- a. Space temperature.
  - b. Primary air flow rate sensor.
  - c. Discharge air sensor
4. Verify that the UC modulates the primary air duct dampers from fully open to fully closed and vice versa within the specified time and verify either visually or by feel that the damper closes fully under UC control.
  5. Verify that each of the heating stages or valve cycles on and off (as applicable).
  6. Verify that the terminal unit-UC is satisfactorily integrated into the Automation Level Network.
  7. Verify that the operating sequences are correct and that there is stable modulation of the primary air damper and staging of the heat.
  8. Assist the Air Balancing Contractor as required for the complete commissioning, calibration and operational verification of the HVAC and terminal unit systems.

### 2.7 UNITARY CONTROLLER – UNIT VENTILATORS (UV) AND FAN COIL UNITS (FCU)

- A. The CS Contractor shall provide all UC's required for all unit ventilators (UV's) and fan coil units (FCU's). The number and location of UV's and FCU's and air flow rates shall be as indicated on the Mechanical Drawings.
- B. Provide an enclosure to house the UC and associated components including suitable mounting brackets shall be NEMA 1 rated and located outside the UV's and FCU's.
- C. The UC shall monitor and control the following parameters for UV's and FCU's:
  1. Space temperature.
  2. Space RH sensor
  3. Cooling coil stage control or cooling valve control (as applicable).
  4. Heating coil stage control or heating valve control (as applicable).
  5. Fan on/off control.
  6. Fan status
  7. Discharge air sensor.
  8. Occupancy sensor
  9. Space CO2 sensor (As shown on drawings or in points list)
- D. PID algorithms shall maintain the system operation within + or - 1.0 Deg. F. of the space temperature setpoints.
- E. Following the installation of the UV's and FCU's in the ceiling space the CS Contractor shall undertake the following tasks:
  1. Physically connect the UC into the CS Automation Level Network.
  2. Install all data into the UC as necessary for the correct operation of the UV's and FCU's
  3. Calibrate the instrumentation associated with the following monitored parameters:
    - a. Space temperature.
    - b. Space RH sensor
    - c. Discharge air sensor
    - d. Space CO2 sensor (As shown on drawings or in points list)
  4. Verify that each of the heating stages or valve cycles on and off (as applicable).
  5. Verify that the UV's and FCU's -UC is satisfactorily integrated into the Automation Level Network.
  6. Assist the Air Balancing Contractor as required for the complete commissioning, calibration and operational verification of the HVAC and UV's and FCU's.

### 2.8 INTERFACE SOFTWARE

- A. Alarms shall be generated by the CS upon the occurrence of one of the following events:
  1. Failure of a CCP, UC, or any other CS hardware components.
  2. Failure of communications of devices on the Automation Level Network.



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3. A monitored status indicates 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 setpoint 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 CS.

Provide configuration of alarming for all monitored and controlled points. Coordinate all alarm limits and definitions with HISD.

### 2.9 ENERGY MANAGEMENT SOFTWARE

- A. An operator with CS configuration software shall be able to define a minimum time delay between successive starts of equipment so that disturbances created on the building electrical system are minimized in frequency and amplitude.
- B. An operator with CS configuration software shall be able to define the minimum time delay between the stopping of a piece of equipment and its subsequent restart. This time delay shall be in effect for motors in the CS software control mode and for motors in the CS manual control mode.
- C. The CS shall not override any hardwired interlocks such as those provided at motor starters for overload protection, damper interlock, pressure interlock, etc. and those provided to facilitate control by the Fire Alarm System regardless of the CS output control mode.
- D. Unless stated otherwise elsewhere in these Specifications, the modulation of final control elements by the CS in the CS software control mode shall be based on a Proportional-Integral-Derivative (PID) control algorithm. The control constants for the PID algorithm shall be definable by the operator. If self-tuning algorithms are provided, it shall still be possible for the operator to manually tune the control loops. The software shall incorporate facilities to enable the bumpless transfer of a modulating output from CS manual control to CS software control and vice versa and the prevention of integral wind-up. PID algorithms shall maintain the system operation within the desired tolerance around the setpoint.
- E. Provide dynamic graphical trending software that emulates, at minimum, a three point strip graphical format. The graphs shall be plotted as the values are sampled in a similar fashion to a chart recorder and when the plot reaches the right hand side of the X-axis, the X-axis shall scroll to the left so as to accommodate newly sampled data.
- F. Provide an energy monitoring software facility to monitor and report electrical energy usage and instantaneous energy demand. This feature shall also store data for recall via the historical data trend package.
- G. Provide run time totalizing software that will accumulate the operating times for motors and unitary equipment as selected by the operator using an interactive procedure. Any piece of equipment that has its status monitored by the CS shall be selectable for inclusion in this feature. It shall be possible to concurrently monitor the accumulated operating time for every item of equipment monitored and/or controlled by the CS.
- H. Provide demand limiting and duty cycle programs that will duty cycle equipment usage in a manner that conserves energy. The cycling of equipment shall be initiated by one of the following means:
  1. Operator defined schedule.
  2. Peak electric demand control software program.
  3. Operator manual command.

The proportion of ON time to OFF time in a single cycle shall either be assigned by the operator using an interactive procedure or the operator may elect to have a variable



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ON/OFF ratio based on other criteria.

- I. Provide a scheduling program that will enable the CS to automatically schedule an item of equipment on and off (occupied) and on and off (unoccupied) based on time to allow the AHU to operate with the outside air dampers closed during non-occupied time periods. The operator shall be able to globally assign a minimum of four start and four stop times to each piece of equipment for each day of the week and for holidays. These schedules shall only be in effect for a piece of equipment when it is in the CS software control mode. The scheduling feature shall conform to the requirements of the CMCS scheduling interface.
- J. Provide equipment fail restart software that will restart equipment shut down as the result of a signal provided by the fire alarm system following the return to normal conditions or a power fail condition.
- K. Provide a night setback software program that shall:
  - 1. Start HVAC equipment after normal hours of scheduled operation to maintain building after hour setpoints, while reducing energy consumption.
  - 2. Night setback temperatures for heating shall be initially set at 55° Deg. F.(adj.) to activate the heating equipment and 60° Deg. F. (adj.) to stop the heating equipment. Once activated, the units involved shall operate as specified in ~~the respective sequence of operation~~ Section 23 09 23 – 3.7. Coordinate the operation of this program with the requirements for terminal unit controls.
  - 3. Night setup temperatures for cooling shall be initially set at 90° Deg. F. (adj.) to activate the cooling equipment and 85° Deg. F. (adj.) to stop the cooling equipment. Once activated, the units involved shall operate as specified in ~~the respective sequence of operation~~ Section 23 09 23 – 3.7. Coordinate the operation of this program with the requirements for terminal unit controls.
  - 4. This feature shall be provided for all HVAC equipment under control of the CS. The operator shall be able to enable/disable this function on a unit by unit basis.
- L. Global modification of user definable parameters of all points shall be provided standard to the operation of the system. Global modification is defined as the mass adjustment of user definable parameters across a defined group, area, facility, campus, or network. Parameters shall included, but not be limited to temperature setpoint (VAV boxes, AHU Discharge, VAV AHU Static Pressure Setpoints ect), equipment start/stop, equipment status, valve output signal, vfd speed control signal, and damper position signal. User shall be able to lock the definable parameter to a set value, or adjust a setpoint to an operator adjustable value. This function shall be accomplished through the standard graphical user interface/workstations.

### 2.10 AUTOMATIC DAMPERS

- A. Furnish automatic dampers (AD) as indicated on the Division 23 Mechanical Drawings for installation by the Division 23 Mechanical Contractor. Refer to Division 23 Drawings.
- B. Provide actuators for all automatic dampers furnished as part of the CS contract. Provide all required actuator mountings, installation, drive arms, linkages and damper end switches. Provide actuators for all dampers provided as part of a factory installation within AHU or unit ventilators.
- C. Dampers and actuators shall be configured for normal and failure positions as indicated in the operating sequences and as indicated in the Division 23 Mechanical Drawings.
- D. The maximum leakage rate for AD shall not exceed 10 cfm per square foot at 4 inches W.C.
- E. Provide electric damper actuators for all AD. Electric actuators shall meet, at minimum, the following requirements:
  - 1. Actuators shall be directly coupled to damper drive blades with no intermediate linkages or shall be rotary type actuators directly coupled to the damper drive shaft.



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2. 120 Vac + or - 10% 60 Hz or 24 Vac power supply.
  3. Actuators shall be motorized/driven in both the open and closed directions. Where required by the sequences of operation, actuators shall have a spring return to the de-energized position upon loss of power. Damper normal and failure positions shall be as identified within the sequences of operation.
- F. Damper actuators shall be Belimo.

### 2.11 CONTROL VALVES

- A. Furnish all valves controlled by the CS as detailed in the Mechanical Documents and as indicated in the Point Sheets. Furnish all shut-off valves for instrumentation. All other valves such as check valves, relief valves, pressure reducing valves, self regulating valves, manually operated valves, etc. shall be furnished and installed by the Mechanical.
- B. Refer to the Division 23 plans and drawings for the design conditions on which to base sizing and ratings of the valves and their actuators.
- C. All chilled water, condenser water, and hot water valves shall meet, at minimum, the following ANSI Class 150 ratings.
- D. Valves 0.5 inch to 2 inches shall have NPT female screwed ends. Valves 2.5 inches and larger shall have flanged ends.
- E. Verify and certify that the materials of construction of the pipe, weld, flange, bolts and valve will not cause any galvanic corrosion.
- F. Where necessary to achieve the required performance and pressure drop a control valve may be down sized up to two nominal sizes below line size. Two position valves shall be full line size.
- G. Valves shall be installed on the outside of unit ventilator and fan coil unit cabinets by the Mechanical 23 Contractor.
- H. Control Valves ½" to 6": The BAS contractor shall furnish all specified motorized control valves and actuators. BAS contractor shall furnish all control wiring to actuators. The Mechanical Contractor shall install all valves. Equal Percentage control characteristic shall be provided for all water coil control valves. Linear valve characteristic is acceptable for 3-way valves 2½ inches and above.
  1. Control Valves: Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
  2. Pressure Independent Characterized Control Valves (PICCV)
    - a. NPS 2 and Smaller: Forged brass body rated at no less than 400 PSI, chrome plated brass ball and stem, female NPT union ends, dual EPDM lubricated O-rings and a brass or TEFZEL characterizing disc.
    - b. NPS 2-1/2 through 6: GG25 cast iron body according to ANSI Class 125, standard class B, stainless steel ball and blowout proof stem, flange to match ANSI 125 with a dual EPDM O-ring packing design, PTFE seats, and a stainless steel flow characterizing disc.
    - c. Accuracy: The control valves shall accurately control the flow from 0 to 100% full rated flow with an operating pressure differential range of 5 to 50 PSID across the valve.
    - d. Flow Characteristics: Equal percentage characteristics.
    - e. Close-Off Pressure Rating: NPS 2 and Smaller, 200psi. NPS 2-1/2 and up, 100psi.
    - f. All actuators shall be capable of being electronically programmed in the field by use of external computer software or a dedicated handheld tool for the adjustment of flow. Programming using actuator mounted switches or multi-turn actuators are not acceptable.
    - g. The manufacturer shall provide a published commissioning procedure that follows the guidelines of the National Environmental Balancing Bureau (NEBB) and the Testing Adjusting Balancing Bureau (TABB).



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- h. The pressure independent control valve shall be provided and delivered from a single manufacturer as a complete assembly. The actuator shall be integrally mounted to the valve at the factory with a single screw on a direct coupled DIN mounting-base.
    - i. The control valve shall require no maintenance and shall not include replaceable cartridges.
    - j. The manufacturer shall warrant all components for a period of 5 years from the date of production, with the first two years unconditional.
    - k. The use of pressure independent valves piped in parallel to achieve the rated coil flow shall be permitted. Actuators shall be electronically programmed to permit sequencing the flow with a single control output point. The use of external devices to permit sequencing is NOT acceptable.
    - l. Valves shall be Belimo or approved equal
  - 3. Globe Valves
    - a. Provide globe valves where a PICCV will not meet the performance requirements of the application.
    - b. Valves 2-1/2 inch (DN65) through 6 inches (DN50) shall be iron body, 125 lb. flanged with Class III (.1%) close-off leakage at 50 psi differential.
    - c. Valves with spring return actuators shall close off against 120% of system psi pressure differential with Class III leakage (.1%).
    - d. Flow type for two-way valves shall be equal percentage. Flow type for three-way valves shall be linear.
    - e. Mixing and diverting valves must be installed specific to the valve design.
    - f. Valves shall be Belimo.
  - I. Provide butterfly valves at the following locations:
    - 1. Cooling tower bypass.
    - 2. Chilled water bypass. The fully modulating chilled water bypass valve shall be sized to accommodate the minimum flow of one chiller in operation. The minimum flow (GPM) of the chiller will be determined by the chiller manufacturer. Chilled water pipe on the entering and leaving side of the bypass valve shall be sized to carry the full GPM of the minimum flow of the chiller. There shall be a minimum of 3' of straight pipe on the entering and leaving side of the bypass valve, not including the distance that the isolation valves takes up. Isolation valves shall be installed on both sides of the bypass valve.
  - J. Butterfly valves shall meet, at minimum, the following requirements:
    - 1. Full lugged type. Semi-lug and wafer valves are not acceptable.
    - 2. Valves shall be full line size.
    - 3. Stem shall be stainless steel and extended for insulation.
    - 4. Valves shall be Belimo.
  - K. Provide electric actuators for all control valves that are furnished as part of the CS contract. Two way and three way control valve actuators shall meet, at minimum, the following requirements:
    - 1. Motor driven type.
    - 2. Gear assembly shall be made of hardened steel. No plastic components shall be acceptable.
    - 3. Actuator shall have an input voltage of 24 VAC or 120 VAC for larger butterfly valves.
    - 4. Exterior housings shall be NEMA-4 rated.
    - 5. Sized to meet the shut-off requirements when operating at the maximum system differential pressure and with the installed system pump operating at shut-off head. Actuators shall control against system maximum working pressures.
    - 6. Normal and failure positions shall be as indicated in the Operating Sequences. Provide spring return actions as necessary.



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7. Visual mechanical position indication, showing valve position.
8. Equipped with an integral position potentiometer to indicate the stem position of the valve if required by the sequence of operation.
9. Manual declutch lever to enable manual operation of the valve. It shall be possible for an operator to manually modulate valves located in mechanical rooms in the event of loss of power.
10. Electric actuators shall be Belimo.

### 2.12 FIELD INSTRUMENTATION

- A. Outside air temperature sensor: Provide outside air temperature sensors as indicated within the Point Schedules. Temperature sensors shall meet, at minimum, the following requirements:
  1. Ventilated white PVC sun shield.
  2. Wall mount weather proof enclosure with conduit fitting.
  3. RTD or thermistor.
  4. CS shall report the monitored temperature with an end-to-end accuracy of  $\pm 0.5$  Deg. F.
- B. Duct mounted temperature sensor: Provide duct mounted, single point temperature sensors as indicated within the Point Schedules. Temperature sensors shall meet, at minimum, the following requirements:
  1. Averaging sensor on air handler applications.
  2. Duct probe sensor on terminal unit and unit ventilator applications.
  3. Stainless steel.
  4. RTD or thermistor.
  5. CS shall report the monitored temperature with an end-to-end accuracy of  $\pm 0.5$  Deg. F.
  6. Provide with a galvanized box. Plastic boxes are not allowed.
- C. Wall mounted space temperature sensor: Provide wall mounted temperature sensors for spaces as indicated within the Point Schedules. Temperature sensors shall meet, at minimum, the following requirements:
  1. Location as shown on the Mechanical Drawings. Sensor location shall be across the room from the unit.
  2. RTD or thermistor.
  3. CS shall report the monitored temperature with an end-to-end accuracy of  $\pm 0.5$  Deg. F.
  4. Mounted 48 inches above finished floor or adjacent to light switch. Mount even with top of light switch across the room from the unit.
  5. Setpoint adjustment slide bar
  6. Provide an editable pushbutton override to each common areas listed. Student Dining Commons, learning commons, gyms, auditorium or multipurpose room & administration office for cooling/heating during after hours activities.
    - a. They shall be housed in a panel installed by CS contractor & shall be locked with a standard key the CS contractor uses on his projects.
    - b. One panel shall be in the administration office for the Student Dining Commons, learning commons, auditorium or multipurpose room & administration office with an editable pushbutton for each area.
    - c. One panel shall be placed in a common area of the gym with an editable pushbutton. The associated locker room for each gym shall be on the gym override. If more than one gym there shall be an editable pushbutton for each one.
    - d. Label pushbutton for each area they serve.
  7. Provide flat plate stainless steel sensors with no local setpoint adjustment in corridors, gymnasiums and common areas.
- D. Thermowell temperature sensor: Provide thermowell mounted temperature sensors as





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indicated within the Point Schedules. Temperature sensors shall meet, at minimum, the following requirements:

1. Rigid stainless steel probe of length which is, at minimum, 20% of the pipe width.
  2. RTD or thermistor.
  3. CS shall report the monitored temperature with an end-to-end accuracy of  $\pm 0.25$  Deg. F. accuracy.
  4. Moisture/waterproof housing with conduit fitting.
  5. Stainless steel thermowell.
  6. Provided with thermal conductivity grease to aid temperature sensing.
  7. Galvanized or plastic boxes are not allowed.
- E. Freezestat: Provide freezestats for all air handling systems that receive untreated outside air. Freezestats shall meet, at minimum, the following requirements:
1. Provide vapor tension elements, which shall serpentine the inlet face on all coils. Provide additional sensors, wired in series, to provide one linear foot per square foot of coil surface area.
  2. Interlock to the associated fan so that fan will shut down when HOA switch is in Hand or Auto position. Provide time delay relays with a 0-10 minute time delay relay duration to minimize nuisance freezestat trips. Time delay relay shall be adjustable at the associated control panel.
  3. Automatic reset. Shall be reset through software.
- F. Outside air relative humidity sensor: Provide outside air relative humidity sensors as indicated within the Point Schedules. Humidity sensors shall meet, at minimum, the following requirements:
1. Non-corroding outdoor shield to minimize wind effects and solar heating. Wall mount weather proof enclosure with conduit fitting.
  2. Two wire, 4-20 mA output proportional to relative humidity range of 0% to 100%.
  3.  $\pm 2\%$  accuracy (5 - 95% RH).
  4. Humidity sensor shall be replaceable.
- G. Interior air relative humidity sensor: Provide wall mounted relative humidity sensors as indicated within the Point Schedules. Humidity sensors shall meet, at minimum, the following requirements:
1. Wall mount enclosure with white cover.
  2. Two wire, 4-20 mA output or digitally communicating proportional to relative humidity range of 0% to 100%.
  3. Humidity sensor shall be replaceable.
  4.  $\pm 2\%$  accuracy (5 - 95% RH).
  5. Mounted 48 inches above floor across the room from the unit.
- H. Duct mounted relative humidity sensor: Provide duct mounted relative humidity sensors as indicated within the Point Schedules. Humidity sensors shall meet, at minimum, the following requirements:
1. Duct mounted moisture resistant enclosure with conduit fitting.
  2. Two wire, 4-20 mA output proportional to relative humidity range of 0% to 100%.
  3. Humidity sensor shall be replaceable.
  4.  $\pm 2\%$  accuracy (5 - 95% RH).
  5. 8 inch probe length.
- I. Wall Mounted Carbon Dioxide Sensor: The CO<sub>2</sub> sensor shall be capable of monitoring CO<sub>2</sub> concentration in a space at an accuracy of  $\pm 30$  parts per million (PPM). The CO<sub>2</sub> sensor shall produce a linear 0-10 VDC signal over the range of 0 to 2000 PPM. The CO<sub>2</sub> sensor shall measure using non-dispersed infrared (NDIR) technology to measure carbon dioxide gas and shall have Automatic Background Calibration (ABC) algorithm to reduce typical zero-drift check maintenance. CO<sub>2</sub> sensors for unit ventilators and fan coil units shall be mounted across the room from the unit beside the wall mounted space sensor. Wall mounted carbon dioxide sensors shall be Honeywell C7632A or Veris CW LSXX.





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- J. Duct Mounted Carbon Dioxide Sensor: The CO<sub>2</sub> sensor shall be capable of monitoring CO<sub>2</sub> concentration in a space at an accuracy of +/- 30 parts per million (PPM). The CO<sub>2</sub> sensor shall produce a linear 0-10 VDC signal over the range of 0 to 2000 PPM. The CO<sub>2</sub> sensor shall measure using non-dispersed infrared (NDIR) technology to measure carbon dioxide gas and shall have Automatic Background Calibration (ABC) algorithm to reduce typical zero-drift check maintenance. CO<sub>2</sub> sensors for duct mounted applications shall be installed in the return air path. Duct mounted carbon dioxide sensors shall be Honeywell C7632B or Veris CW LSXX.
- K. Momentary control relays: Provide momentary control relays as indicated within the Point Schedules and sequences of operation. Relays shall meet, at minimum, the following requirements:
1. Coil ratings of 120 VAC, 50 mA or 10-30 VAC/VDC, 40 mA as suitable for the application.
  2. Provide complete isolation between the control circuit and the digital output.
  3. Located in the UC or other local enclosures.
  4. 10 amp contact rating.
  5. LED status indication.
  6. Pin type terminals.
  7. Latching relays not acceptable.
- L. Duct static pressure sensor: Provide duct mounted static pressure sensors as indicated within the Point Schedules. Static pressure sensors shall meet, at minimum, the following requirements:
1. Input range shall be 0 to 2.0 inches w.g. or as required by the application.
  2. 4-20 mA output proportional to pressure input range.
  3. ± 5% accuracy.
- M. Current sensing relay: Provide current sensing relays as indicated in the Point Schedules for motor status. Current metering transformers and relays shall meet, at minimum, the following specifications:
1. Rated for the applicable load.
  2. The output relay shall have an accessible trip adjustment over its complete operating range. Provide LED indication of relay status.
  3. Split core shall be sized for the application.
  4. Latching relays not acceptable.
- N. Water differential pressure sensor: Provide water differential pressure sensors as indicated in the Point Schedules. Water differential pressure sensors shall meet, at minimum, the following requirements:
1. Cast aluminum NEMA 1 enclosure.
  2. Output of 4-20 mA or 0-10 vdc proportional to the pressure sensed.
  3. Operating range of 0 to 30 psig.
  4. Accuracy of ± 2% of full scale reading.
  5. Valved tapings shall be installed by the Mechanical Contractor.
- O. Air differential pressure switch for fan shutdown: Provide air differential pressure switches as indicated in the Point Schedules to shut down the associated fan in the event of sensing high differential pressure. Air differential pressure switches shall meet, at minimum, the following requirements:
1. Adjustable setpoint with a setpoint range of 0 to 10 inches w.g.
  2. 1/4 inch compression fittings suitable for copper sensing tubing.
  3. Automatic reset. Shall be reset through software.
- P. ~~Photocell: Provide ambient light level sensors as indicated within the Point Schedules. Light level sensor shall meet, at minimum, the following requirements:~~
- ~~1. Non-corroding and weatherproof housing with sensor shield suitable for exterior installations.~~
  - ~~2. 4-20 mA output proportional to the ambient light level.~~
  - ~~3. Mounted on the exterior of a North wall on the roof.~~



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4. ~~Sensor reading from 0 to 750 foot candles.~~
- Q. Occupancy Sensor
1. The ultrasonic occupancy sensors shall be capable of detecting presence in the control area by detecting doppler shifts in transmitted ultrasound.
  2. Sensors shall use patent pending ultrasonic diffusion technology that spreads coverage to a wider area.
  3. Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 KHz. It shall utilize Advance Signal Processing, which automatically adjusts the detection threshold dynamically to compensate for constantly changing levels of activity and airflow throughout controlled space.
  4. To avoid false ON activation and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.
  5. Sensors of varying frequencies shall not be allowed so as to prevent sensors from interfering with each other and to assure compatibility in the event more sensors are added.
  6. Sensors shall operate at 24 VDC/VAC and half-wave rectified.
  7. Detection shall be maintained when a person of average size and weight moves only within or a maximum distance of twelve inches either in a horizontal or vertical manner at the approximate speed of 12 inches per second. The sum of this distance, volume and speed represent the average condition ultrasonic sensors must meet in order for the lights to not go off when a person is reading or writing while seated at a desk.
  8. Sensors shall have a manual on function that is facilitated by installing a momentary switch.
  9. Sensors shall be mounted to the ceiling with a flat, unobtrusive appearance and provide 360° of coverage.
  10. Sensors shall utilize SmartSet technology to optimize time delay and sensitivity settings to fit occupants usage patterns. The use of SmartSet shall be selectable with a DIP switch. Sensor shall have user-adjustable sensitivity setting.
  11. Sensor shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.
  12. Sensors shall cover 360° and up to 2000 square feet of walking motion.
  13. Sensor shall have an additional single-pole, double throw isolated relay with normally open, normally closed, and common outputs. The isolated relay is for use with HVAC control, data logging, and other control options.
  14. Sensors shall have a time delay that is adjusted automatically (with the SmartSet setting) or shall have a fixed time delay of 5 to 30 minutes, set by dipswitch.
  15. Sensors shall feature terminal style wiring, which makes installation easier.
  16. The sensor shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disable for applications that requires less visibility.
  17. To ensure quality and reliability, sensor shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
  18. Sensor shall have standard five year warranty and shall be UL and CUL listed.
- R. Refrigerant leak detection monitoring:
1. Provide refrigerant leak monitoring as identified within the point schedules. Refrigerant leak detection monitors shall meet, at minimum, the following requirements:
    - a. Power consumption: AC - 325 mA, DC - 250 mA.
    - b. Operating temperature range of 0 Deg. C. to 40 Deg. C. (32 Deg. F. to 105 Deg. F.).
    - c. Operating humidity range: 0% to 95% non-condensing.
    - d. Measuring range of 0-1000 ppm proportional to 4 to 20mA output range



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- for each sampling point.
- e. Volt free contacts to indicate an alarm condition.
- f. Refrigerant gas system detection supplier/contractor shall be familiar with standard practices of safety and installation for refrigerant gas detection systems.
- g. Submit details of refrigerant monitors, breathing apparatus, control panel and diagrams as part of the submittal process.
- h. System shall detect the presence of the of the following types of refrigerants regardless of refrigerant type using sequential sampling and multi-point monitoring method:
  - i. CFC
  - ii. HCFC
  - iii. HFC
- i. System shall annunciate to the CS and locally alarm (audible and visual) upon detection of alarm conditions. Provide silencing alarm button at control panel. Provide approved appropriate signage at all entry points to the chiller room. Initial alarm shall comply with recommended Allowable Exposure Level (AEL). Adjustable 3 level alarm for each point shall be supplied with common alarm output contacts. Provide local digital indication of ppm level for a minimum of 1 sample point per chiller. A sample point shall be located close to each chiller and the refrigerant pump out unit location. Location to be approved by the Engineer. Sample point if in alarm shall flash the associated LED. Provide local alarm horns and visual (stroboscopic) beacons at the following locations to activate upon alarm to an approved detail:
  - i. Outside of entrance doors to chiller machine room.
  - ii. Inside rooms without an escape route other than through the chiller room.
  - iii. At each chiller location.
  - iv. At any other location in the chiller room as necessary to ensure that a person at any location in the chiller room and room that can be entered from the chiller room can see the visual alarm and hear the audible alarm and at any other location required to meet the applicable codes.
- j. System shall shut down all electrical equipment (chiller systems and associated pumps, AHU, FCU, etc.) and sequence emergency extract equipment as required to meet regulations. Where combustion equipment is employed, refrigerant vapor monitoring system shall automatically shut down the combustion process in event of refrigerant leakage if other alternative acceptable conditions are not applied. Ventilation system, chiller and associated pumps and other equipment shut down as a result of the refrigerant leak alarm shall return to normal operation when the refrigerant monitoring system is no longer detecting refrigerant levels above setpoints and alarms have been silenced.
- k. System shall have self-diagnostics and supply common malfunction output. Loss of sample flow at either sample or ZERO line and electrical malfunction shall annunciate to the BMS.
- l. Provide two (2) additional particulate filters and zero gas filter cartridges.
- m. Provide self-contained breathing apparatus that is OSHA approved and certified meeting the following requirements:
  - i. Certified for 20 minutes of use.
  - ii. Furnish in clearly marked wall mount metal enclosures to be located inside each room that does not have an escape route apart from through the chiller room, outside one exterior door



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serving the chiller machine room, within the chiller room at locations such that no point in the chiller room is more than 50 feet from an escape door or a SCBA and at all other locations required by the code. Locations of SCBA to be approved by the Engineer.

- n. Provide an emergency shut-off control button outside each chiller plant room entrance/exit door. Button shall be mounted at 1200mm above finished floor adjacent to refrigerant leak detection alarm light. Activation of any one of the buttons shall de-energize all chillers and other electrical equipment within the chiller plant room. Button shall be manually reset.
  - o. Provide RS-485 Modbus interface to CS.
  - p. Provide Vulcain VA301EM Expansion Module, VA301IRFS Infrared Refrigerant Gas Sensors, Strobe/Horns and Emergency Push Buttons.
- S. Water flowmeter — insertion type: Provide water flowmeters as indicated in the Field Point Schedules. Turbine flowmeter shall meet, at minimum, the following requirements:
- 1. Stainless steel insertion probe with non-metallic rotors.
  - 2. 2.0 % accuracy of actual reading from 0.4 to 20 ft/s.
  - 3. Turndown ratio of 30:1.
  - 4. Pulse output proportional to flow rate.
  - 5. Insertion type single turbine on applications with 20 diameters of pipe upstream and 5 diameters of pipe downstream. Insertion type dual turbine flow meters on applications with 10 diameters of pipe upstream and 5 diameters of pipe downstream.
  - 6. Suitable for maximum flow rate in line.
  - 7. Provide valve to allow for removal and re-insertion without disruption to the water service.
  - 8. Provide Onicon or approved equal.
- T. Variable Speed Drives
- 1. General
    - a. VFD's shall be provided as required under this section for all pump and air handling unit motors 10 HP and above. All VFD's for fan coil units and unit ventilators shall be provided, installed and wired by the equipment manufacturer.
  - 2. Acceptable manufacturers of VFD's are:
    - a. ABB, Danfoss
  - 3. Ratings:
    - a. Input 380/415/440/460 VAC +/- 10%, 3 phase, 48-63 Hz or input 200/208/220/230 VAC +/- 10%, 3 phase, 48-63 Hz.
    - b. Output Frequency 0 to 120 Hz
    - c. Environmental operating conditions: 0 to 40°C, 0 to 3300 feet above sea level, less than 95% humidity, non-condensing.
    - d. Enclosure shall be UL Type 1.
    - e. Starting Torque: 175% starting torque shall be available from .5 Hz to 60 Hz.
    - f. Must meet RFI requirements as specified by IEC STD EN 61000-2(-) (2001) for variable frequency drives.
  - 4. Design
    - a. All VFD must be solid state, utilizing Space Vector PWM control for lower motor operating temperature and lower THD on the output. The VFD package as specified herein shall be enclosed in a UL Type 1 enclosure, completely assembled and tested by the manufacturer.
    - b. All VFD shall include a digital display, and keypad, regardless of horsepower rating. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus. The



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- keypad shall be removable, capable of remote mounting, and shall have its own non-volatile memory. The keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFD.
- c. All VFD must have adjustable carrier frequency and up to 4 programmable V/Hz points.
  - d. All VFD's must have BAS (Building Automation System) BACnet protocol and shall reside on the BACnet MSTP network communicating at speeds up to 76.8 Kbps or the BACnet/ARCNET network, communicating at 156 Kbps.
  - e. All VFD shall be selectable as in both Volts/Hertz or Sensorless Vector Control mode regardless of horsepower rating.
  - f. All VFD must have a motor preheat function to prevent moisture accumulation in an idle motor.
  - g. All VFD shall include two independent analog inputs as standard, 0 – 10VDC and 4-20mA. Both analog inputs shall be utilized as speed references, or as PID inputs. The analog inputs shall be programmed as an individual reference at a time, or as a combined reference together. A second PID loop control shall be provided for control of external equipment.
  - h. All VFD shall include a minimum of 8 multi-function input terminals, capable of being programmed to a function on a change of state. These terminals shall provide up to 30 functions, including, but not limited to:
    - i. External Trip
    - ii. Forward
    - iii. Reverse
    - iv. Three Wire Control
    - v. Multi-step Speed Selection
    - vi. Interlock
    - vii. Jog
    - viii. Pre-excite/Motor Preheat
  - i. The VFD shall provide frequency setting resolution of 0.01 Hz when its Digital Reference is utilized below 100 Hz and 0.1 Hz over 100 Hz. The VFD shall provide frequency setting resolution of 0.03 Hz / 60 Hz when Analog Reference is utilized.
  - j. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.
  - k. The VFD shall be capable of both Automatic and Manual Torque Boost function to overcome sudden fluctuation of the load.
  - l. The VFD shall be equipped with Auto-tuning feature for motor data analysis resulting in optimized motor performance.
  - m. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to set-point without safety tripping or component damage (flying start). The VFD shall also be capable of DC injection braking at start to stop a reverse spinning motor prior to ramp.
  - n. The VFD shall be equipped with an automatic extended power loss ride-through circuit, which will utilize the inertia of the load to keep the drive powered. Minimum power loss ride-through shall be one-cycle, based on full load and no inertia. Typical control power loss ride-through for a fan load shall be 2 seconds minimum.
  - o. All VFD shall have 1 analog output (0-10VDC) which can be programmed to function as one of the following: Output Frequency,



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Output Current, Output Voltage, DC Link Voltage. Default is set to Output Frequency.

- p. If the input reference (4-20mA or 0-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, or (3) hold the VFD speed based on the last good reference received. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.
- q. The customer terminal strip shall be isolated from the line and ground.
- r. The drive shall employ current limit circuits to provide "trip-less" operation
- s. The Maximum current limit shall be fixed at 150% (minimum, instantaneous) of the VFD normal duty current rating.
- t. The overload rating of the drive shall be 120% of Rated Current for 1 Min., 150% of Rated Current for 0.5 sec.
- u. The VFD shall have 8 Step Speeds that are preprogrammed via Digital Input Terminals.
- v. The VFD shall have standard Emergency Input and Jog Input Terminals.
- w. The VFD shall provide from 0 to 6000 seconds of Acceleration and Deceleration time setting parameters. Up to 8 Acceleration and 8 Deceleration times shall be programmable.
- x. The VFD shall be optimized for various levels of carrier frequency programmable from 1 to 15 kHz (1 – 3 kHz above 40HP) to reduce motor noise and to provide high system efficiency.
- y. The VFD must have an option to operate multiple motors with single VFD and be able to turn on/off each motors independently as well as simultaneously.
- z. The VFD must have an Energy Saving function in auto and manual mode.
- aa. The VFD must have Bi-directional "Speed search" capability.
- bb. The VFD shall include provisions for multi-motor control as an option or as standard, enabling control of up to 4 motors.
- cc. All VFD include the following programming adjustment capabilities:
  - i. Directional Lock selection to prevent the unexpected motor direction.
  - ii. DC Injection start and stop frequency selection from Minimum output frequency to 60 Hz.
  - iii. Three programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
  - iv. Pre-magnetization selection for the motor to build up an adequate level of flux for enhanced starting torque or programmable Volts/Hertz points selection for flexible Variable and Constant load demand curve and fluctuation.
  - v. VFD Voltage-output to motor adjustment feature enabling the VFD to generate from 40% up to 110% of nominal input voltage to the VFD.
  - vi. Five (5) Fault Histories with detailed description of frequency, current, and other operational status at the time of each fault.
  - vii. Two independently adjustable acceleration and deceleration ramps. These ramp times shall be adjustable from 1 to 6000 seconds.
  - viii. The VFD shall Ramp or Coast to a stop, DC Injection, as selected by the user.





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- dd. The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop and announce the fault condition.
    - i. IGBT overcurrent protection
    - ii. Overcurrent trip on load output
    - iii. DC overvoltage
    - iv. Internal over temperature
    - v. Ground Fault
    - vi. Low Voltage
    - vii. Open output phase
    - viii. Electronic Thermal Protection. The Electronic Thermal Overload protection shall protect the motor based on speed, load curve, and motor parameters.
  - ee. PC software and for parameter upload/download/graphing shall be provided at no additional charge.
5. Additional Features
- a. Three switch Manual Bypass shall be provided on motors 10 HP and up. VFD and bypass components shall be mounted inside a common NEMA 1 enclosure, fully pre-wired, and ready for installation as a single UL listed device. Bypass shall include the following:
    - i. Output, and bypass contactors, to switch power from the VFD to bypass.
    - ii. UL 508E Manual Motor Starter with pad-lockable handle to isolate the drive and protect the motor while operating in the bypass mode.
    - iii. Control and safety circuit terminal strip.
    - iv. Drive/Off/Bypass selector switch and Hand/Off/Auto selector switch.
    - v. Switch selectable smoke purge, auto transfer to bypass and remote transfer functions.
    - vi. Pilot lights (22 mm LEDs) for, "Drive Run" and "Bypass".
    - vii. Hand/Off/Auto selector switch shall provide the following operation:
      - a) Hand Position - The drive is given a start command, and the drive will run at preset speed- user adjustable.
      - b) Off Position - The start command is removed, all speed inputs are ignored, and power is still applied to the drive. If in bypass mode, the motor is stopped.
      - c) Auto Position - The drive is enabled to receive a start command and speed input from a building automation system. If in bypass mode, the motor start/stop is controlled by the building automation system
    - viii. Annunciation contacts for drive run, drive fault, bypass run and motor OL/safety fault.
    - ix. VFD operator/keypad selection, LCD multi-line display.
  - b. Enclosure:
    - i. NEMA 1 extended enclosure, to house additional equipment within the VFD enclosure for VFDs not requiring Bypass.
    - ii. NEMA 12 FVFF (Forced Ventilation inlet Filter and outlet Filter) enclosures with filters and blower.
    - iii. NEMA 3R enclosures for outdoor installations.
  - c. RFI (Radio Frequency Interference) filters to further attenuate possible VFD generated noise shall be provided. Line reactors shall be provided on the input side of the drive for harmonic suppression and input rectifier protection.





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- d. Surge suppression shall be provided to protect the drive from input power disturbances.
    - e. Output reactors shall be provided on the output side of the drive for motor protection in long motor lead length situations when required.
    - f. Serial communication gateway for BACnet shall be provided via an isolated RS485 circuit board to connect to the BACnet MSTP network at 76.8 Kbps or the BACnet/ARCnet network at 156 Kbps.
    - g. Speed potentiometer shall be provided in addition to the digital keypad speed command capabilities.
    - h. Output motor protection (dv/dt) filter shall be provided to accomplish, long motor lead length solutions when required.
    - i. Engraved cabinet nameplates shall be provided.
  - 6. Installation
    - a. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
    - b. Power wiring shall be completed by the electrical contractor. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
- U. AIR FLOW MONITORING STATIONS
  - 1. Air flow monitoring devices shall be provided under this section for all duct and plenum mounted airflow and temperature measurement and fan inlet mounted airflow measurement.
  - 2. ACCEPTABLE MANUFACTURERS
    - a. Subject to compliance with performance and design requirements of this Section, provide products that comply with this specification by one of the following vendors:
      - i. EBTRON, Inc. Models GTx116-PC (basis of design) and GTx116-F
      - ii. Alternatives requesting acceptance as "equals" less than 60 days prior to bid date or products submitted in non-conformance with the requirements of this specification will not be considered.
        - a). For any product to be considered for substitution a written section-by-section detailed exceptions/compliance document shall be submitted to the Engineer before any approval will be considered.
        - b). Any firm submitting a product as an equal shall make available a functioning non-fan powered demonstration sample for review in the specifying engineer's office.
        - c). Or approved equal.
        - d). No honeycomb air flow monitoring stations will be considered.
  - 3. (\*) AIRFLOW/TEMPERATURE MEASUREMENT DEVICES
    - a. Provide airflow/temperature measurement devices (ATMD) where indicated on the plans.
      - i. Fan inlet measurement devices shall not be used unless indicated on drawings or schedules.
    - b. Each ATMD shall consist of one or more sensor probes and a single, remotely mounted, microprocessor-based transmitter capable of independently processing up to 16 independently wired sensor nodes contained in one or more probe assemblies per measurement location.
      - i. Each sensor node shall contain two individually wired, hermetically sealed bead-in-glass thermistors.



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- ii. Thermistors shall be mounted in the sensor node using a marine-grade, waterproof epoxy. Thermistor leads shall be protected and not exposed to the environment. Thermistor leads shall not be fastened to the thermistor semiconductor substrate by weld or solder connections.
- iii. The airflow rate at each sensor node shall be equally weighted and arithmetically averaged by the transmitter prior to output. All integrated circuitry shall be temperature rated as 'industrial-grade'. Submissions containing 'commercial-grade' integrated circuitry are not acceptable.
- iv. The temperature at each sensor node shall be arithmetically averaged or velocity weighted and averaged by the transmitter prior to output, either as field-selected by the contractor or user.
- v. Each transmitter shall have a 16-character alpha-numeric display capable of displaying airflow, temperature, system status, configuration settings and diagnostics.
- vi. Other than the thermistor sensors, no other electronic components shall be located at the sensing node.
- vii. Devices using chip-in-glass, epoxy-coated or diode-case chip thermistors are not acceptable.
- viii. Devices with RJ-45 connections exposed to the environment or having electronic circuitry mounted in or at the sensor node are not acceptable.
- ix. Pitot tubes and arrays are not acceptable.
- x. Vortex shedding devices are not acceptable.
- c. All Sensor Probes
  - i. Each sensor node, consisting of two thermistor-sensors and their structural housing, shall independently determine the airflow rate and temperature at each measurement point.
  - ii. Each sensor node shall be factory calibrated at a minimum of 16 airflow rates and 3 temperatures to standards that are traceable to the National Institute of Standards and Technology (NIST). Thermistor sensor calibrations traceable only to temperature standards are not acceptable.
  - iii. Airflow accuracy shall be +/-2% of Reading over the entire operating airflow range of not less than 0 to 5,000 fpm (25.4 m/s) and not more than 0 to 10,000 fpm (50.8 m/s).
    - a) Devices whose overall performance at the host controller input terminals is the combined accuracy of the transmitter and sensor probes shall demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.
  - iv. Temperature accuracy shall be +/-0.14° F (0.08° C) over the entire operating temperature range of -20° F to 160° F (-28.9° C to 71° C).
  - v. The operating humidity range for each sensor probe shall be 0-99% RH (non-condensing). Product design shall consider direct exposure to or emersion in liquid water and temporary exposure shall not damage the sensing elements.
  - vi. Each sensor or probe assembly shall not require matching to the transmitter in the field.
  - vii. A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter for each measurement location.



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d. Duct and Plenum Probes

- i. Probes shall be constructed of extruded, gold anodized, 6063 aluminum tubes or optionally of Type 316 stainless steel tubes. All internal wires within the tube shall be Kynar coated. PVC insulated conductors are not acceptable.
- ii. The number of individual sensor nodes provided for each location shall be as follows:

Duct or Plenum Area (ft <sup>2</sup> )	Total # Nodes / Location	Duct or Plenum Area (m <sup>2</sup> )
<= 1	1 or 2	<= 0.093
>1 to <4	4	>0.093 to < 0.372
4 to < 8	6	0.372 to < 0.743
8 to < 12	8	0.743 to < 1.115
12 to <16	12	1.115 to < 1.486
>=16	16	>= 1.486

- iii. Sensor probe design shall be capable of providing up to 8 sensor nodes per probe.
- iv. The minimum operating airflow range shall be 0 to 5,000 FPM (25.4 m/s) unless otherwise indicated on the plans.
- v. Each ducted sensor probe shall have an integral, U.L. Listed, plenum rated cable. Cable jackets and conductor insulation shall be FEP, Teflon-FEP or Neoflon-FEP. Cables shall include a terminal plug for connection to the remotely mounted transmitter. All terminal plug interconnecting pins shall be gold plated. PVC jacketed cables or PVC insulated conductors are not acceptable with ducted sensor probes.

e. Fan Inlet Probes

- i. Sensor node assemblies shall be mounted on Type 304 stainless steel housings.
- ii. Mounting rods shall be field adjustable to fit the fan inlet and constructed of zinc plated steel.
- iii. Mounting styles required shall be indicated on the plans as either "face mount" or "throat mount."
  - a) Face mounting style shall provide no mechanical fastening in the throat or on the surface of the inlet cone and shall be used on all inlet condition-sensitive plenum-type or plug fans.
- iv. Mounting feet shall be constructed of Type 304 stainless steel.
- v. The minimum operating airflow range shall be 0 to 10,000 FPM (50.8 m/s) unless otherwise indicated on the plans.
- vi. Fan inlet probe cables shall be UL plenum-rated and may be FEP or PVC jacketed.

f. Transmitters

- i. The transmitter shall have an integral LCD display capable of simultaneously displaying airflow and temperature. The LCD display shall be capable of displaying individual airflow and temperature readings of each independent sensor node.
- ii. The transmitter shall be capable of field configuration and diagnostics using an on-board pushbutton interface and LCD display.



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- iii. The transmitter shall have an on-off power switch and operate on 24 VAC. Isolation transformers shall not be required.
  - a) The transmitter shall use a switching power supply, fused and protected from transients and power surges.
  - b) The transmitter shall use “watch-dog” circuitry to assure automatic reset after power disruption, transients and brown-outs.
- iv. All interconnecting pins, headers and connections on the main circuit board, option cards and cable receptacles shall be gold plated.
- v. The operating temperature range for the transmitter shall be -20° F to 120° F (-28.9° C to 48.9° C). The transmitter shall be installed at a location that is protected from weather and water.
- vi. The transmitter shall be capable of communicating with other devices using one of the following interface options:
  - a) Linear analog output signals for airflow and temperature: Field selectable, fuse protected and electrically isolated from all other circuitry, 0-5VDC / 0-10VDC / 4-20mA (4-wire)
  - b) RS-485: Field selectable BACnet-MS/TP, BACnet-ARCNET, Modbus-RTU or Johnson Controls N2-Bus
    - BACnet devices shall provide analog variables for airflow and temperature containing individual sensor airflow rate and temperature data.
  - c) 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, Modbus-TCP and TCP/IP
    - Provide dynamic link libraries and VBA functions to interface Ethernet devices to Microsoft Excel for remote monitoring of airflow and temperature using a MS Windows -based PC.
  - d) LonWorks Free Topology
- vii. The transmitter shall be capable of providing an infra-red interface for manually downloading airflow and temperature data or for uploading transmitter configuration data using a handheld PDA (Palm or Microsoft Windows Mobile operating systems).
  - a) Provide PDA upload/download software for multiple users.
    - Download software shall be capable of displaying and saving individual sensor airflow rates, the average airflow rate, individual sensor temperatures and the average temperature received from the transmitter.
    - Upload software shall be capable of displaying and saving all setup parameters that can be configured using the on-board pushbutton interface and LCD display.
  - b) Provide a Microsoft Excel file capable of creating test and balance reports from PDA data files transferred to a Windows based PC.
  - c) Provide a Microsoft Excel file to create configuration data files that can be transferred from a Windows based PC to a PDA for upload to one or more transmitters.
- viii. The transmitter shall be capable of identifying a ‘damaged’ sensor node, ignore it and continue to operate by correctly



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averaging the remaining sensor nodes.

- g. The ATMD shall carry the CE Mark for European Union shipments, certifying compliance with all applicable compliance testing, regulations and EU directives.
- h. The manufacturer's authorized representative shall review and approve placement and operating airflow rates for each measurement location indicated on the plans.
- i. A written report shall be submitted to the consulting mechanical engineer if any measurement locations do not meet the manufacturer's placement requirements.

### 2.13 PANELS

- A. Provide panels and enclosures for all components of the CS, which are susceptible to physical or environmental damage.
- B. Interior panels and enclosures shall meet be NEMA 1 rated painted steel panels with locking door.
- C. Exterior mounted panels and enclosures shall be NEMA 4 painted steel panels with locking door.
- D. Panels for UC's shall be mounted outside of all unit ventilators and fan coil units with three feet of wall clearance in front of them and no higher than 7 feet to the bottom of the panel.

### 2.14 LABELING and WARNING NOTICES

- A. Provide labeling for all UC panels and enclosures.
- B. Provide labeling of all cables and input/output points at the controller in all wall mounted panels.
- C. Provide high voltage warning notices at all equipment controlled by the CS and at all associated motor starters when used by equipment controller.

### 2.15 TUBING AND PIPING

- A. Provide tubing and piping as required for the field instrumentation.
- B. Tubing within equipment rooms, vertical risers, and penetrations to ductwork shall be either copper pipe or shall be plastic tubing within conduit. Tubing for all water-based instrumentation shall be copper pipe. Identify the type of tubing proposed in the shop drawing submittal.
- C. Provide suitable bulk head fittings for duct and panel penetrations.
- D. Tubing in plenum rated areas shall be plastic tubing. Plastic tubing shall meet, at minimum, the following requirements:
  - 1. Flame retardant.
  - 2. Crack resistant.
  - 3. Polyethylene tubing.
  - 4. 300 psi burst pressure.

### 2.16 CONDUIT AND FITTINGS

- A. Provide all conduit, raceways and fittings for the CS monitoring, communication and control cabling. All work shall meet all applicable codes.
- B. Conduit, where required, shall meet, the requirements specified within Division 26.
- C. Conduit shall be provided whenever one of the following conditions exists:
  - 1. Conduit is required by code.
  - 2. Conduit is indicated on the drawings or specifically required by the specifications.
  - 3. Cabling runs through inaccessible areas such as within partitions/walls, above closed in ceilings, under floor, within trenches on the exterior of the building, when encased in concrete or other material that makes the cable inaccessible or when located such that access to the cable is not readily obtained.



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4. Cable within mechanical, telecommunications and electrical equipment rooms and control rooms shall be enclosed within conduit.
  5. Cable run on the exterior of the building shall be in conduit.
  6. Cable run on an exposed surface shall be in conduit.
  7. Conduit shall be installed, inside wall from sensor box to above the wall, for all wall mounted temperature, humidity and CO2 sensors.
- D. CS monitoring and control cable shall not share conduit with cable carrying voltages in excess of 48 volts.

### 2.17 CABLING

- A. Provide all cables for the CS. Cable shall meet, at minimum, the following requirements:
1. Minimum 98% conductivity stranded copper.
  2. Proper impedance for the application as recommended by the CS component manufacturer.
  3. Monitoring and control cable shall be #18 AWG or larger, dependent on the application. Analog input and output cabling shall be shielded.
  4. Management Level Network cable shall be CAT 6, 24 gauge unshielded.
  5. Automation Level Network cable shall be #24 AWG shielded.
  6. Shield shall be grounded at the CCP, UC, or control panel. Ground at one end only to avoid ground loops.
  7. Identification of each end at the termination point. Identification should be indicated on and correspond to the record drawings.
- B. 120 VAC power wiring shall be of #12 AWG solid conductor or larger as required.
- C. All cable within the building shall be plenum rated cable where required by code. All cable that is not enclosed in conduit shall be plenum rated cable. Plenum rated cable not in conduit shall be routed parallel and perpendicular with the building column lines. Cable may follow ductwork routing and may be fixed to the top or side of the ductwork. If cabling does not follow the ductwork routing, it shall be fixed tight to the structure above. Provide cable bridal rings and beam clamps, at minimum, 15 ft. to support the cabling.
- D. All cable run underground shall be underground or direct burial rated cable.

## EXECUTION

### 3.1 TRAINING

- A. Training: Prior to each project completion, the contractor shall provide 8 hours of initial training to HISD maintenance personnel in a laboratory learning center environment for each project completed. This initial class will be Operator Overview. Thereafter the contractor shall provide training at least for the life of the product to HISD maintenance personnel in a laboratory learning center environment for as long as they are an installing contractor. Training will be done by Factory Certified personnel. Students shall be provided with a dedicated computer workstation utilizing a simulated BAS software platform that is installed for this project. Provide documentation for this requirement in the initial BAS submittal following substantial completion. Training shall include the following: at no cost to the District.
- B. Classes 2 through 6 shall be given when requested by HISD. No more than once yearly. They shall lead to Factory Certification if Tech passes the Certification Test.
1. Operator Overview – General system navigation, scheduling functions, setpoint modifications, scheduling and parameter adjustments.
  2. Advanced Topics Overview – Procedures for detailed analysis of trend setup/configuration, trend historian, alarm setup, alarm actions (email, printing, etc.), point renaming, and detailed analysis of equipment parameters.
  3. Program/Logic Manipulation – Procedures for modifying system programs as needed for additions and modifications.
  4. Graphic Manipulation – How to modify system graphics as needed for additions





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and modifications.

5. Hardware Troubleshooting – Learning center setup shall have HVAC mock-up systems. Operators shall be able to interact with this live system through the BAS utilized for this project. Class will provide students the ability to identify and repair common problems regularly encountered.
6. Software Troubleshooting - Learning center setup shall have HVAC mock-up systems. Operators shall be able to interact with this live system through the BAS utilized for this project. Training will provide students with the ability to identify and repair common issues that are correctable by means of software modifications.
7. Central Plant Operation – At a minimum the instructor shall thoroughly explain different types of central plant equipment and appropriate BAS system modifications that can be made to enhance system performance and energy savings.

### 3.2 INSPECTION DURING INSTALLATION

- A. Prior to acceptance testing, the CS shall be available for use by the Owner. Use by the Owner shall not imply acceptance of any component of the CS or the commencement of the warranty period.
- B. Provide staff to assist the Owner/Engineer with inspections made during the installation period that are required to review the progress and quality of ongoing work. The Owner/Engineer will generate Field Observation Reports on the findings of the inspection. The Owner/Engineer shall advise the CS Contractor during the inspection of any concerns noted with respect to the installation and shall repeat the concerns in writing as soon as possible after the inspection is completed. The CS Contractor shall take corrective action to meet the requirements of the specifications.

### 3.3 COMMISSIONING REQUIREMENTS

- A. Control system shall be set up and checked by factory trained competent technicians skilled in the setting up and adjustment of the BAS equipment used in this project. This technician is to be experienced in the type of HVAC systems associated with this project.
- B. After completion of the commissioning, this contractor will demonstrate the sequence of operations for each system to the mechanical engineer or his representative.
- C. Equipment checkout sheets are to be used by the CS contractor. They shall include a point to point check for each piece of equipment and turned over to the owner and/or mechanical engineer. It shall be signed & dated by CS contractor.
- D. Check all equipment to see that it follows the sequence of operation.
- E. OUTSIDE AHU/ERV
  1. Check all wiring from controller to each end device including any starters, VFDs, and dampers.
  2. Check the controllers for shorts, correct power and change 4-20 jumpers.
  3. Check that the communication jumpers are set properly.
  4. If any safety devices are present, check that they are wired properly. If they are adjustable make sure that they are set to the proper setting before operating any equipment.
  5. Stroke dampers and valves for proper operation.
  6. Set dampers and valves up in the software. Once the damper actuators are set up they are to be marked.
  7. Check and calibrate all temperature sensors. If humidity is present check that it is set up properly in the software.
  8. Start / Stop the unit to check starter or VFD for proper operation. While unit is running check status input.
  9. Check start / stop of any ex-fans associated with the unit.
- F. SINGLE ZONE AHU/FCU





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1. Check all wiring from module can(s) to each end device including any starters, VFDs, and dampers.
  2. Check the module(s) for shorts, correct power and change 4-20 jumpers.
  3. Check that the communication jumpers are set properly.
  4. Install the correct fuses and begin memory download.
  5. If any safety devices are present check that they are wired properly. If they are adjustable make sure that they are set to the proper setting before operating any equipment.
  6. Stroke dampers and valves for proper operation. Set dampers and valves up in the software.
  7. Check and calibrate all temperature sensors. If humidity is present check that it is set up properly in the software.
  8. Start / Stop the unit to check starter or VFD for proper operation. While unit is running check for unit status.
  9. Check start / stop of any ex-fans associated with the unit.
  10. Check all equipment to see that it follows the sequence of operation.
- G. VAV AHU
1. Check all wiring from module can(s) to each end device including any starters, VFDs, and dampers.
  2. Check the module(s) for shorts, correct power and change 4-20 jumpers.
  3. Check that the communication jumpers are set properly.
  4. If any safety devices are present check that they are wired properly. If they are adjustable make sure that they are set to the proper setting before operating any equipment.
  5. Stroke dampers and valves for proper operation. Set dampers and valves up in the software.
  6. Check and calibrate all temperature sensors. If humidity is present check that it is set up properly in the software.
  7. Verify that the VFDs have been set up by the drive start up personal.
  8. Check VAV boxes and make sure that all dampers are open before you start / stop the AHU.
  9. This will keep the ductwork from being damaged.
  10. Start / Stop the unit to check starter or VFD for proper operation. While unit is running check for status.
  11. Check start / stop of any ex-fans associated with the unit.
  12. Check all equipment to see that it follows the sequence of operation.
- H. TERMINAL UNITS
1. Check physical location of box and sensor.
  2. Verify the access to the control cabinet, any obstructions in the ductwork, and the proper tygon tubing has been used and that it is supported properly.
  3. Verify proper address of card, check all wiring with schematic, and box manufacturer wiring schematic. (Proper transformer installed from manufacturer)
  4. Check tubing on airflow cross, verify the high side is connected to the high side and the low side is connected to the low side and, also that caps are installed on the pneumatic tees if installed in the flow cross tubing. The high side is the side of the air flow cross sensor that is facing the inlet or air handler side of the ductwork.
  5. Verify stroke of damper (Clockwise/counterclockwise to close). Check tightness of actuator linkage to shaft. Make sure damper is left in open position.
  6. Verify heat strips energize and time of stages is accurate.
  7. Verify correct flow loop #, configuration, CFMs, damper motor run time, hot water valve run time, etc.
  8. Verify correct damper direction for open and close, input/output addresses and global modify changes.



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9. Under the flow control, zero the terminal unit by inputting the current raw sensor reading into raw sensor reading for zero flow. ALL FANS MUST BE OFF.
10. Turn air handler on and verify airflow reading at each terminal unit.
- I. CHILLER COMMISSIONING
  1. Make sure all flow switches are wired properly before chiller startup is scheduled.
  2. Verify VFD start-up and programming are completed before chiller start-up.
  3. Make sure the freeze protection sequence is working properly to avoid freezing any coils.
  4. Make sure that all devices associated with the chilled water system (i.e. Temps, DPs, flow meters) are clearly marked in the proper location and installed per the manufacture specification. Walk through the locations with the mechanical contractor.
  5. Verify that the mechanical contractor has installed all of the devices in the marked proper locations and per the manufacture specification.
  6. Check all wiring from module can to each device, including temperature sensors, starters, variable frequency drives, refrigerant monitors, valves, and transformers.
  7. Before turning any power on, check the module for shorts, correct power and change the 4-20 jumpers.
  8. Check the communication jumpers and address on the module.
  9. If any safety devices are present, check that they are wired properly. If they are adjustable make sure they are set to the proper settings before starting or turning power on for any equipment.
  10. Stroke all valves isolation, bypass, etc. Ensure proper voltage ranges are set in the software.
  11. Verify the proper personnel have set up any variable frequency drives if applicable.
  12. Calibrate all temperature sensors and differential pressure sensors.
  13. Verify all pump start stops have been set up and status switches are working correctly.
  14. Verify all start stops, alarms, and interlocks including flow switches are working correctly on the chillers.
  15. Check software and equipment to see if it follows the sequence of operation, and that all points are properly functioning when equipment is running.
  16. Verify that the correct pumps are coming on with each chiller.
  17. Are all valves controlling correctly, ISO, bypass etc?
  18. Is VSD tracking and controlling to the voltage signal the program is sending?
  19. Are flow meters reading? Make sure the id tag on meter has correct flow calibration set-up in it from the factory. If not the flow meter calibration kit will be needed to reset these values.
  20. Is chiller reading amps, calibrated properly and set-up in the program correctly?
  21. Test freeze protection by simulating a temperature to the program.
  22. Verify that the graphics reflect the proper piping, associated equipment and device locations.
  23. Set up trends

### 3.4 CONTROL SYSTEM DEMONSTRATION and ACCEPTANCE

- A. Demonstration. Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests specified in Article 4.3 (Commissioning Requirements). Provide Engineer with log documenting completion of startup tests.
  1. Engineer will be present to observe and review system demonstration. Notify Engineer at least 10 days before system demonstration begins.
  2. Demonstration shall follow process submitted and approved under Section ~~23-09~~



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## BUILDING EXCELLENCE

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- ~~00-23-09-23~~ Article 1.11 (Shop Drawings). Complete approved checklists and forms for each system as part of system demonstration.
3. Demonstrate actual field operation of each sequence of operation as specified in ~~Sequence of Operations~~ Section 23-09-23 – 3.7. Provide at least two persons equipped with two-way communication. Demonstrate calibration and response of any input and output points requested by Engineer. Provide and operate test equipment required to prove proper system operation.
  4. Demonstrate compliance with sequences of operation through each operational mode.
  5. Demonstrate complete operation of operator interface.
  6. Demonstrate each of the following.
    - a. DDC loop response. Supply graphical trend data output showing each DDC loop's response to a setpoint change representing an actuator position change of at least 25% of full range. Trend sampling rate shall be from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show setpoint, actuator position, and controlled variable values. Engineer will require further tuning of each loop that displays unreasonably under- or over-damped control.
    - b. Demand limiting. Supply trend data output showing demand-limiting algorithm action. Trend data shall document action sampled each minute over at least a 30-minute period and shall show building kW, demand-limiting setpoint, and status of setpoints and other affected equipment parameters.
    - c. Trend logs for each system. Trend data shall indicate setpoints, operating points, valve positions, and other data as specified in the points list provided with each sequence of operation in Section ~~23-09-00~~ 23-09-23. Each log shall cover three 48-hour periods and shall have a sample frequency not less than 10 minutes or as specified on its points list. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs as specified in Section ~~23-09-00~~ 23-09-23 Article 2.9 Paragraph E. (Dynamic Graphical Trending).
  7. Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.
  8. Prepare a log documenting startup testing of each input and output device, with technician's initials and date certifying each device has been tested and calibrated. This document shall indicate proof that the following functions have been commissioned. Include this information in the as built document
    - a. Short to ground check.
    - b. Trend configuration
    - c. Graphic display
    - d. Point to point
    - e. Lock point on. Equipment reaction.
    - f. Unlock point. Equipment reaction.
    - g. Equipment location correct
    - h. Signal type
    - i. Stroke control valve
    - j. Verify damper actuator operation
    - k. Module address verification
    - l. VAV box crossflow caps verified
    - m. Verify interlocks and shutdowns
  9. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under Section ~~23-09-00~~ 23-09-23.



## BUILDING EXCELLENCE

10. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
11. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.
12. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.
13. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
14. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.
15. Alarms and Interlocks.
  - a. Check each alarm with an appropriate signal at a value that will trip the alarm.
  - b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
  - c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

B. Acceptance.

1. After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.
2. System shall not be accepted until completed demonstration forms and checklists are submitted and approved as required in Section ~~23-09-00~~ 23 09 23 Article 1.11 (Shop Drawings).

### 3.5 HANGING AND SUPPORTING

- A. Install all equipment, devices, materials and components in compliance with the manufacturer's recommendations. Supports shall be suitable for the environment within which the component is to be installed. Coordinate all hanging and supporting of components with all trades.
- B. Provide sleeves for all cable and conduit passing through walls, partitions, structural components, floors and roof

### 3.6 HARDWIRED INTERLOCKS

- A. Provide all required hardwired interlocks between fans, intake and discharge dampers, and motor actuated damper as identified within this specification or the Mechanical Drawings, whether or not furnished under this Section unless the fan is furnished with interlock by fan manufacturer.

### 3.7 SEQUENCES OF OPERATION SOFTWARE

- A. SYSTEM – WATER COOLED CHILLER SYSTEM (TWO CHILLERS WITH DEDICATED PUMPS)
  1. System Off - When the system is off:
    - a. The chilled and condenser water pumps shall be off.
    - b. The chillers shall be disabled.
    - c. The bypass valve shall be open.
  2. Initiation of System Start-Up - The system shall be started:



## BUILDING EXCELLENCE

- a. By an operator manually entered command at the CMCS.
    - b. Automatically by the CS based on time schedule or demand by the AHU.
  3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
    - a. The lead chilled water pump shall start.
    - b. The lead condenser water pump shall start.
    - c. Once flow has been proven through both chiller bundles then the chiller shall start under control of its unit mounted controller.
    - d. After an operator defined time delay, the chilled water bypass valve shall be modulated to maintain the building chilled water differential pressure setpoint to ensure an adequate flow rate.
    - e. If the bypass control valve is fully closed and the building chilled water supply temperature cannot be maintained by the lead chiller for an operator defined period, then the lag pumps and chiller shall be started as described above.
    - f. If the building chilled water supply temperature is at or below the setpoint and the chilled water bypass flow rate is greater than the lag chilled water pump, then the lag chiller and associated pumps shall stop.
    - g. If an emergency plant shutdown button is activated, provide for an orderly shutdown of all equipment within the central plant. Coordinate shutdown sequence of chillers with the chiller manufacturer.
  4. Setpoints - The setpoints for the system shall be determined as follows:
    - a. The chilled water supply temperature setpoint shall be set initially at 44° deg. F (adj.). Allow for adjustable chilled water set point and/or chilled water reset based on outside air temperature.
    - b. The differential setpoint at the plant shall be initially set at 7 psi.
    - c. The operator defined period for chiller and pump staging shall be initially set at 15 minutes during occupied times and 30 minutes during initial staging.
    - d. The period for chilled water bypass control shall be initially set at 5 minutes.
  5. Initiation of System Shutdown - System shutdown shall be initiated:
    - a. By operator entered manual command.
    - b. Automatically by the CS based on a time schedule basis.
    - c. Local emergency power shut off switch is activated.
  6. Freeze Protection
    - a. When outdoor temperatures fall below 35° deg. F(adj.), the chilled water pumps should circulate chilled water with the chillers off and the control valves open to the coils.
  7. Alarm setpoints - The CS shall generate an alarm:
    - a. If the chilled water supply temperature is outside the operator established high alarm limits, which shall be initially set at + 4° Deg. F. around the setpoint.
    - b. If the differential pressure is outside operator established low and high alarm limits, initially set at + or - 3 psi about the setpoint.
    - c. If a pump or chiller fails to start or fails in service.
    - d. If a chiller is operating and there is no flow as indicated by its flow switch.
- B. SYSTEM – WATER COOLED CHILLER SYSTEM (TWO CHILLERS WITH PRIMARY AND SECONDARY PUMPS AND OPEN BYPASS)
  1. System Off - When the system is off:
    - a. The primary chilled and condenser water pumps shall be off.
    - b. The chillers shall be disabled.
    - c. The secondary chilled water pumps shall be off.
  2. Initiation of System Start-Up - The system shall be started:



## BUILDING EXCELLENCE

- a. By an operator manually entered command at the CMCS.
    - b. Automatically by the CS based on time schedule or demand by the AHU.
  3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
    - a. The lead primary chilled water pump shall start.
    - b. The lead condenser water pump shall start.
    - c. Once flow has been proven through both chiller bundles then the chiller shall start under control of its unit mounted controller.
    - d. After an operator defined time delay, the lead secondary chilled water pump shall start. The speed of the pump shall be controlled to maintain the chilled water supply differential pressure setpoint. If the speed of the lead pump is at full speed and the chilled water differential is below setpoint for an operator defined time period, then the lag secondary pump shall start and both pump speeds shall be controlled in unison to maintain the chilled water differential pressure setpoint.
    - e. If the chilled water supply temperature is above setpoint and there is flow in the bypass from the return to the supply, as sensed by the bi-directional flow meter for an operator defined time period, then the lag primary pumps and chillers shall start as described above.
    - f. If the building chilled water supply temperature is at or above the setpoint and there is chilled water flow in the bypass from the supply to the return that is greater than the lag chilled water pump rated flow, then the lag chiller and associated pumps shall stop.
    - g. If an emergency plant shutdown button is activated, provide for an orderly shutdown of all equipment within the central plant. Coordinate shutdown sequence of chillers with the chiller manufacturer.
  4. Setpoints - The setpoints for the system shall be determined as follows:
    - a. The chilled water supply temperature setpoint shall be set initially at 44° deg. F (adj.). Allow for adjustable chilled water set point and/or chilled water reset based on outside air temperature.
    - b. The differential setpoint at the plant shall be initially set at 7 psi.
    - c. The operator defined period for chiller and pump staging shall be initially set at 15 minutes during occupied times and 30 minutes during initial staging.
    - d. The period for chilled water secondary pump lag staging shall be initially set at 10 minutes.
  5. Initiation of System Shutdown - System shutdown shall be initiated:
    - a. By operator entered manual command.
    - b. Automatically by the CS based on a time schedule basis.
    - c. Local emergency power shut off switch is activated.
  6. Freeze Protection
    - a. When outdoor temperatures fall below 35° deg. F(adj.), the chilled water pumps should circulate chilled water with the chillers off and the control valves open to the coils.
  7. Alarm setpoints - The CS shall generate an alarm:
    - a. If the chilled water supply temperature is outside the operator established high alarm limits, which shall be initially set at + 4° Deg. F. around the setpoint.
    - b. If the differential pressure is outside operator established low and high alarm limits, initially set at + or - 3 psi about the setpoint.
    - c. If a pump or chiller fails to start or fails in service.
    - d. If a chiller is operating and there is no flow as indicated by its associated flow switch.
- C. SYSTEM - COOLING TOWERS (TWO TOWERS WITH 2-SPEED MOTORS)





## BUILDING EXCELLENCE

1. System Off - When the system is off:
    - a. The cooling tower fans shall be disabled.
    - b. The bypass valve shall be closed.
  2. Initiation of System Start-Up - The system shall be started:
    - a. By an operator manually entered command at the CMCS.
    - b. Automatically when a chiller is in operation or there is a requirement for condenser water cooling.
  3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
    - a. The lead condenser water pump shall be started as described in the Chilled Water System sequence of operation.
    - b. If the condenser water supply temperature setpoint cannot be maintained with free cooling (tower fans idle), then the tower fans shall start and their speeds shall be modulated in unison to maintain the condenser water supply temperature setpoint.
  4. Setpoints - The setpoints for the system shall be determined as follows:
    - a. Condenser water supply temperature setpoint shall be as scheduled on the Mechanical Documents.
  5. Initiation of System Shutdown - System shutdown shall be initiated:
    - a. By operator entered manual command.
    - b. Automatically by the CS if none of the chilling units are operating or scheduled condenser water is not required.
  6. Freeze Protection
    - a. When outdoor temperatures fall below 35° deg. F (adj.), the condenser water pumps should circulate condenser water to prevent freezing.
  7. Alarm setpoints - The CS shall generate an alarm:
    - a. If the condenser water supply temperature is outside the operator established low and high alarm limits, which shall be initially set at 58° and 89° Deg. F.
- D. SYSTEM – AIR COOLED CHILLER SYSTEM (TWO CHILLERS WITH DEDICATED PUMPS)
1. System Off - When the system is off:
    - a. The chilled water pumps shall be off.
    - b. The chillers shall be disabled.
  2. Initiation of System Start-Up - The system shall be started:
    - a. By an operator manually entered command at the CMCS.
    - b. Automatically by the CS based on time schedule or demand by the AHU.
  3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
    - a. The lead chilled water pump shall start.
    - b. Once flow has been proven through the chiller then the chiller shall start under control of its unit mounted controller.
    - c. After an operator defined time delay, the chilled water bypass valve shall be modulated to maintain the building chilled water differential pressure setpoint to ensure an adequate flow rate.
    - d. If the bypass control valve is fully closed and the building chilled water supply temperature cannot be maintained by the lead chiller for an operator defined period, then the lag pump and chiller shall be started as described above.
    - e. If the building chilled water supply temperature is at or below the chilled water pump, then the lag chiller and associated pump shall stop.
  4. Setpoints - The setpoints for the system shall be determined as follows:
    - a. The chilled water supply temperature setpoint shall be set initially at 44° deg. F (adj.). Allow for adjustable chilled water set point and/or chilled





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- water reset based on outside air temperature.
- b. The differential setpoint at the plant shall be initially set at 7 psi.
  - c. The operator defined period for chiller and pump staging shall be initially set at 15 minutes during occupied times and 30 minutes during initial staging.
  - d. The period for chilled water bypass control shall be initially set at 5 minutes.
5. Initiation of System Shutdown - System shutdown shall be initiated:
- a. By operator entered manual command.
  - b. Automatically by the CS based on a time schedule basis.
6. Freeze Protection
- a. When outdoor temperatures fall below 35° deg. F(adj.), the chilled water pumps should circulate chilled water with the chillers off and the control valves open to the coils. T
7. Alarm setpoints - The CS shall generate an alarm:
- a. If the chilled water supply temperature is outside the operator established high alarm limits, which shall be initially set at + 4° Deg. F. around the setpoint.
  - b. If the differential pressure is outside operator established low and high alarm limits, initially set at + or - 3 psi about the setpoint.
  - c. If a pump or chiller fails to start or fails in service.
  - d. If a chiller is operating and there is no flow as indicated by its associated flow switch.
- E. SYSTEM - HOT WATER SYSTEM (ONE BOILER WITH DEDICATED PUMP)
1. System Off - When the system is off:
    - a. The hot water pumps shall be off.
    - b. The boiler units shall be disabled.
  2. Initiation of System Start-Up - The system shall be started:
    - a. By an operator manually entered command at the CMCS.
    - b. Automatically when there is a requirement for the hot water at the any of the AHU or terminal units after an operator defined time delay.
  3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
    - a. The boiler and associated pump shall be enabled and the boiler unit shall start under control of the unit mounted control panel.
    - b. The differential pressure bypass valve shall be modulated to maintain the hot water differential pressure setpoint.
    - c. The hot water mixing valve shall be modulated to maintain the temperature setpoint shall be reset on a linear reset schedule based on outside air temperature in accordance with the following:
- |                                       |                 |                 |
|---------------------------------------|-----------------|-----------------|
|                                       | 50° Deg. F. OAT | 70° Deg. F. OAT |
| Hot water supply temperature setpoint | 180° Deg. F.    | 100° Deg. F.    |
4. Setpoints - The set points for the system shall be determined as follows:
    - a. The hot water differential pressure setpoint shall be set initially at 8 psig.
    - b. The hot water supply temperature setpoint shall be initially set to 180° Deg. F.
  5. Initiation of System Shutdown - System shutdown shall be initiated:
    - a. By operator entered manual command.
    - b. Automatically by the CS based on a time schedule basis.
  6. Freeze Protection
    - a. When outdoor temperatures fall below 35° deg. F(adj.), the hot water



## BUILDING EXCELLENCE

- pumps should circulate hot water with the boilers off and the control valves open to the coils.
7. Alarms - The CS shall generate an alarm:
    - a. If a boiler is operating without an associate pump operating and vice versa.
    - b. If the hot water differential pressure is outside the operator established low and high alarm limits, which shall be initially set at + or - 3 psig around the current setpoint.
- F. SYSTEM - DEDICATED OUTSIDE AIR PACKAGED ROOFTOP UNIT
1. RTU Mode (Standard Features):
    - a. Occupied: The unit is enabled based on an occupancy schedule when integrated by a Building Automation System (BAS), or from a time clock or mechanical switch/interlock.
    - b. Unoccupied: The unit is placed into standby with the fan off and the outside air damper closed. The fan is capable of cycling on to maintain unoccupied cooling and heating mode set points when monitoring space conditions.
    - c. Heating: Is enabled when the controlled temperature falls below the heating set point and cooling is disabled.
    - d. Cooling: Is enabled when the controlled temperature rises above the cooling set point and free cooling is unavailable.
    - e. Economizer. If outside air temperature is less than the controlled air set point and outside air enthalpy is less than 23 BTU/lb. (adj.) for more than 30 minutes (adj.), the unit is in economizer mode.
  2. Supply Fan Mode:
    - a. Occupied: The fan is commanded to operate continuously. All occupied and night cycle operations are enabled only when the supply fan feedback status is confirmed.
    - b. Unoccupied: The fan is commanded off. The fan can cycle on for unoccupied cooling or heating modes.
  3. Exhaust Fan Mode:
    - a. Occupied: The fan is commanded on when outside air damper is greater than or equal to the outside air damper minimum position and the supply fan is operating. The fan also starts when the heat wheel is operating.
    - b. Unoccupied: The fan is commanded off. The exhaust fan does not night cycle.
  4. Cooling Unoccupied Mode:
    - a. The unit is disabled and the cooling valve is closed.
    - b. If a space temperature sensor is used and the space temperature rises above the unoccupied cooling set point of 80°F (adj.), the unit is enabled. The unit operates with the outside air damper closed and the cooling staged on. When space temperature falls 2°F below set point, the cooling stages off, and four minutes later, the fan stops.
    - c. Cooling is enabled when the space temperature is above the cooling set point of 74°F (adj.), and outside air temperature is above the cooling lockout set point of 50°F (adj.).
    - d. The unit stages on compressors as required to maintain the space temperature set point.
    - e. When outside air enthalpy is below 23 BTU/lb. (adj.) and outside air temperature is below the space temperature set point, cooling is disabled and free cooling, with outside air, becomes the first stage of cooling if required.
  5. Heating Occupied Mode: Space Control:
    - a. Modulating heating is enabled when space temperature falls below the



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- heating set point of 70°F (adj.), and cooling is not operating.
    - b. Modulating heating increases output until the space temperature rises above the heating set point.
    - c. Modulating heating is enabled when discharge temperature falls below the heating set point (adj.), and cooling is not operating.
  - 6. Heating Unoccupied Mode
    - a. Modulating heating is disabled.
    - b. If the space temperature sensor is used and the space temperature falls below the unoccupied heating set point of 65°F (adj.), the fan starts and modulating heating increases its output to 100%. Modulating heating output decreases to 0% when space temperature reaches 2°F above the unoccupied heating set point, and four minutes later, the fan stops.
  - 7. Economizer Occupied Mode: Enthalpy Limit
    - a. If outside air temperature is less than the controlled air set point (adj.), and outside air enthalpy is less than 23 BTU/lb. (adj.) for more than 30 minutes (adj.), the unit will be in the economizer mode.
    - b. Discharge Air Control Option: In the event mixed air temperature falls below 40°F (adj.) during heating mode, the economizer will control to that set point.
    - c. Space Control Option: In the event discharge air temperature fall below 60°F (adj.) during heating mode, the economizer will control to that set point.
    - d. When the unit is not in economizer mode, the outside air damper is set to minimum position, as determined during air balancing.
  - 8. Economizer Unoccupied Mode:
    - a. The outside air damper remains fully closed.
  - 9. Heat Wheel Occupied Mode:
    - a. The heat wheel is enabled whenever the unit is in the occupied mode, and when there is a call for heating or mechanical cooling and the outside air damper is equal to or greater than the minimum outside air position.
    - b. The bypass dampers (interlocked with the heat wheel) are open when the heat wheel is deenergized, and closed when the heat wheel is energized.
    - c. Defrost Control Option: When outside air temperature is below 32°F (adj.), the heat wheel can operate in a defrost mode. When there is a call for the heat wheel, it operates for 30 minutes (adj.) and then stops for two minutes (adj.) to prevent any ice buildup,
  - 10. Heat Wheel Unoccupied Mode:
    - a. The heat wheel is always disabled.
- G. SYSTEM – VAV AIR HANDLING UNITS
  - 1. System Off - When the system is off:
    - a. The unit outside air damper shall be closed.
    - b. The supply air fan shall be off.
    - c. The cooling coil valve shall be closed.
  - 2. Initiation of System Start-Up - System start-up shall be initiated:
    - a. By an operator manually entered command at the CMCS.
    - b. Automatically by the CS based on night setup, time schedule.
  - 3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
    - a. The variable speed supply air fan shall start and the speed shall be modulated to maintain the duct static pressure setpoint.
    - b. Once the unit is operating during normal occupied time periods, the outside air damper shall be modulated open to the maximum position as



## BUILDING EXCELLENCE

- coordinated with the balancing contractor. The sequence shall differentiate between operating time schedules and occupied operating time schedules.
- c. The chilled water control valve shall be modulated to maintain the supply air temperature setpoint **as defined below**.
  - d. If the AHU has been operating for over 60 minutes and the return air CO<sub>2</sub> is below the operator defined high limit, then the outside damper shall be positioned to the 75% of full open position. The CO<sub>2</sub> sensor shall then through a DDC controller, modulate the outside air damper to maintain the CO<sub>2</sub> setpoint.
4. Setpoints - The setpoints for the system shall be determined as follows:
- a. ***The supply air temperature setpoint shall be reset between 53 degrees and 58 degrees based on cooling requests from the zones that the air handler serves. This control algorithm shall optimize the supply air setpoint to allow the highest setpoint possible to maintain the zone with the greatest cooling load. The supply air temperature control shall not be enabled until one zone requests cooling and the outside air temperature is greater than 50 degrees (adj.). All temperature values and the number of requests shall be operator adjustable.***
  - b. The duct static pressure setpoint shall be set by the operator and shall be set initially at 1.25 inches w.g (adj.).
  - c. The setpoint for high static shutdown shall be set initially at 2.5 inches w.g.
  - d. The return air CO<sub>2</sub> reset limit shall be initially set at 800 ppm (adj.).
5. Initiation of System Shutdown - System shutdown shall be initiated:
- a. By operator entered manual command.
  - b. Automatically by the CS when there are no terminal units requiring primary air.
  - c. High static pressure shut down.
6. Alarms - The CS shall generate an alarm:
- a. If the duct static pressure is outside the operator established low and high alarm limits, initially set at 0.5 and 1.5 inches w.g.
  - b. If the supply air temperature is outside the operator established low and high limits, which shall be set at + or - 4 Deg. F. around the current setpoint.
  - c. All alarms shall be inhibited when the supply fan is not operating except the space temperature alarms. The alarms, except the fan failure to start and failure in service alarms and the space temperature alarms, shall remain inhibited following start up of the unit for an operator determined period of time initially set at 2 minutes.
  - d. If the space humidity is above 75 % RH.
  - e. If the return air CO<sub>2</sub> is above the operator established limit, initially set at 1100 ppm (adj).
- H. SYSTEM – VAV OUTSIDE AIR HANDLING UNITS
- 1. System Off - When the system is off:
    - a. The outside air intake damper shall be closed.
    - b. The supply air fan shall be off.
    - c. The cooling coil valve shall be closed.
  - 2. Initiation of System Start-Up - System start-up shall be initiated:
    - a. By an operator manually entered command at the CMCS.
    - b. Automatically by the CS based on night setup, time schedule.
  - 3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:



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- a. The hardwired interlock damper shall open.
  - b. Once the damper is fully open, the variable speed supply air fan shall start and the speed shall be modulated to maintain the duct static pressure setpoint.
  - c. The heating coil valve or electric heater shall be controlled to maintain the heating supply air temperature setpoint.
  - d. The chilled water control valve shall be modulated to maintain the cooling supply air temperature setpoint.
- 4. Setpoints - The setpoints for the system shall be determined as follows:
  - a. The heating and cooling supply air temperature setpoint shall be set manually by the operator and shall be set initially at 50 Deg. F(adj.) and 55 Deg. F(adj.), respectively.
  - b. The duct static pressure setpoint shall be set by the operator and shall be set initially at .75 inches w.g (adj.).
  - c. The setpoint for high static shutdown shall be set initially at 2.5 inches w.g.
  - d. Freezestat setpoint shall be set at the device for 35 Deg. F.
- 5. Initiation of System Shutdown - System shutdown shall be initiated:
  - a. By operator entered manual command.
  - b. Automatically by the CS when there are no terminal units requiring primary air.
  - c. High static pressure shut down.
- 6. Alarms - The CS shall generate an alarm:
  - a. If the duct static pressure is outside the operator established low and high alarm limits, initially set at 0.2 and 1.25 inches w.g.
  - b. If the supply air temperature is outside the operator established low and high limits, which shall be set at + or - 4 Deg. F. around the current setpoint.
  - c. All alarms shall be inhibited when the supply fan is not operating except the space temperature alarms. The alarms, except the fan failure to start and failure in service alarms and the space temperature alarms, shall remain inhibited following start up of the unit for an operator determined period of time initially set at 2 minutes.
- I. SYSTEM - CONSTANT VOLUME AIR HANDLING UNIT
  - 1. General
 

The DDC system shall monitor the outside air dry bulb temperature and relative humidity (RH) and calculate the total enthalpy of the ambient conditions. Additionally using the wall mounted temperature and humidity sensors in each zone the local DDC controller shall calculate the total enthalpy of the conditions in each zone. This shall apply only to 2-pipe systems with electric heat or 4-pipe systems with hot water heat in the reheat position. Demand ventilation shall be implemented on unit ventilators, fan coil units and air handling units with CO2 sensors and outside air dampers whenever possible.

A ceiling mounted occupancy sensor shall distinguish between a Vacant and an Occupied condition with the exception of auditoriums, Student Dining Commons, gymnasiums, libraries and all other large areas.

The operating schedule for the facility shall be based on three unique operating modes: **Unoccupied by Schedule, Vacant by Motion Detector and Occupied by Schedule**. In a typical day these operating modes would occur in the following sequence:

All setpoints thresholds and schedules in each mode shall be operator



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adjustable. Each mode has anti-short cycle feature so that the modes have minimum on and minimum off times to prevent modes from swapping back and forth.

2. Occupied Mode:  
Temperature and Humidity Control

If the room humidity is below 65% RH then run the fan continuously and disable electric reheat unless space temp falls 1 degree below heating set point. If outside air dry bulb temperature and enthalpy are less than room dry bulb temperature and enthalpy and outside air temp is below 65 degrees (Free Cooling condition) then close the CHW control valve and modulate the outside air damper to maintain a 74°F (adj.) space temperature setpoint. If outside air dry bulb temperature and enthalpy are greater than room dry bulb temperature and enthalpy or outside air temperature is above 65 degrees then close the OA damper to minimum position and modulate the CHW control valve to maintain 74°F(adj.).

3. Room Ventilation Control  
General: Room Ventilation Control shall be active during Occupied Mode

If the room CO2 sensor reads below 800 ppm (adj) then the unit outside air (OA) damper shall remain fully closed unless modulated open by Temperature and Humidity Control.

If the room CO2 sensor reads above 800 ppm (adj) and below 1100 ppm (adj) and outside air enthalpy is less than room enthalpy and outside air temp is below 65 degrees then modulate the outside air damper to maintain 800 ppm (adj). If the room CO2 sensor reads between 800 ppm and 1100 ppm and outside air enthalpy is greater than room enthalpy then the unit outside air (OA) damper shall remain fully closed (0% open).

4. Vacant Mode:  
Temperature Control - Increase the current setpoint by 2F (adj.) if in the cooling mode and decrease the current setpoint by 2F (adj.) if in the heating mode. Reset RH threshold to 75%. Shut O/A damper.

5. Unoccupied Mode:  
Temperature and Humidity Control

Same as above. Reset RH threshold to 75% RH and temperature threshold to 85F (adj.) for cooling and 55F (adj.) for heating.

6. Alarms - The CS shall generate an alarm:
  - a. If the space temperature is outside the operator established low and high limits, which shall be set initially at + or - 2 Deg. F. around the setpoint.
  - b. All alarms shall be inhibited when the supply fan is not operating. The alarms, except the fan failure to start and failure in service alarms, shall remain inhibited following start up of the unit for an operator determined period of time initially set at 2 minutes.
  - c. If the space CO2 is above the operator established limit, initially set at 1100 ppm (adj.).

### J. SYSTEM - UNIT VENTILATOR

1. General  
The DDC system shall monitor the outside air dry bulb temperature and relative





## BUILDING EXCELLENCE

humidity (RH) and calculate the total enthalpy of the ambient conditions. Additionally using the wall mounted temperature and humidity sensors in each zone the local DDC controller shall calculate the total enthalpy of the conditions in each zone.

A ceiling mounted occupancy sensor shall distinguish between a Vacant and an Occupied.

The operating schedule for the facility shall be based on three unique operating modes: Unoccupied, Vacant and Occupied. In a typical day these operating modes would occur in the following sequence:

All setpoints thresholds and schedules in each mode shall be operator adjustable. Each mode has anti-short cycle feature so that the modes have minimum on and minimum off times to prevent modes from swapping back and forth.

2. Occupied Mode:  
Temperature and Humidity Control

If the room humidity is below 65% RH then run the fan continuously and disable electric reheat unless space temp falls 1 degree below heating set point. If outside air dry bulb temperature and enthalpy are less than room dry bulb temperature and enthalpy and outside air temp is below 65 degrees (Free Cooling condition) then close the CHW control valve and modulate the outside air damper to maintain a 74°F (adj.) space temperature setpoint. If outside air dry bulb temperature and enthalpy are greater than room dry bulb temperature and enthalpy or outside air temperature is above 65 degrees then close the OA damper to minimum position and modulate the CHW control valve to maintain 74°F(adj.).

3. Room Ventilation Control  
General: Room Ventilation Control shall be active during Occupied Mode

If the room CO2 sensor reads below 800 ppm (adj) then the unit outside air (OA) damper shall remain fully closed unless modulated open by Temperature and Humidity Control.

If the room CO2 sensor reads above 800 ppm (adj) and below 1100 ppm (adj) and outside air enthalpy is less than room enthalpy and outside air temp is below 65 degrees then modulate the outside air damper to maintain 800 ppm (adj). If the room CO2 sensor reads between 800 ppm and 1100 ppm and outside air enthalpy is greater than room enthalpy then the unit outside air (OA) damper shall remain fully closed (0% open).

4. Vacant Mode:  
Temperature Control - Increase the current set point by 2F (adj.) if in the cooling mode and decrease the current set point by 2F (adj.) if in the heating mode. Reset RH threshold to 75%. Shut O/A damper.
5. Unoccupied Mode:  
Temperature and Humidity Control -  
Same as above. Reset RH threshold to 75% RH and temperature threshold to 85F (adj.) for cooling and 55F (adj.) for heating.
6. Alarms - The CS shall generate an alarm:





## BUILDING EXCELLENCE

- a. If the space temperature is outside the operator established low and high limits, which shall be set initially at + or - 2 Deg. F. around the setpoint.
- b. All alarms shall be inhibited when the supply fan is not operating. The alarms, except the fan failure to start and failure in service alarms, shall remain inhibited following start up of the unit for an operator determined period of time initially set at 2 minutes.
- c. If the space CO2 is above the operator established limit, initially set at 1100 ppm (adj.).

### K. SYSTEM – DIRECT EXPANSION ROOFTOP UNIT

#### 1. General

The DDC system shall monitor the space temperature and control the DX cooling coil or the electric heating coil to maintain space temperature.

The operating schedule for the facility shall be based on two unique operating modes: Unoccupied and Occupied. In a typical day these operating modes would occur in the following sequence:

All setpoints thresholds and schedules in each mode shall be operator adjustable. Each mode has anti-short cycle feature so that the modes have minimum on and minimum off times to prevent modes from swapping back and forth.

#### 2. Occupied

##### Temperature Control

If outside air temperature is less than room temperature and outside air temp is below 65 degrees (Free Cooling condition) then stage on the DX controls and open the outside air damper to maintain a 74°F (adj.) space temperature setpoint. If outside air temperature are greater than room temperature and outside air temperature is above 65 degrees then close the OA damper to minimum position and stage on the DX controls to maintain 74°F (adj.).

#### 5. Unoccupied Mode:

Temperature Control - Same as above. Reset temperature threshold to 85F (adj.) for cooling and 55F (adj.) for heating.

#### 6. Alarms - The CS shall generate an alarm:

- a. If the space temperature is outside the operator established low and high limits, which shall be set initially at + or - 2 Deg. F. around the setpoint.
- b. All alarms shall be inhibited when the supply fan is not operating. The alarms, except the fan failure to start and failure in service alarms, shall remain inhibited following start up of the unit for an operator determined period of time initially set at 2 minutes.

### L. SYSTEM – FAN COIL UNIT (HEATING/COOLING)

#### 1. General

The DDC system shall monitor the outside air dry bulb temperature and relative humidity (RH) and calculate the total enthalpy of the ambient conditions. Additionally using the wall mounted temperature and humidity sensors in each zone the local DDC controller shall calculate the total enthalpy of the conditions in each zone. This shall apply only to 2-pipe systems with electric heat or 4-pipe systems with hot water heat in the reheat position. Demand ventilation shall be implemented on unit ventilators, fan coil units and air handling units with CO2 sensors and outside air dampers.

A ceiling mounted occupancy sensor shall distinguish between an **Occupied, Vacant and Unoccupied condition.**



## BUILDING EXCELLENCE

The operating schedule for the facility shall be based on three unique operating modes: **Unoccupied, Vacant and Occupied**. In a typical day these operating modes would occur in the following sequence:

All setpoints thresholds and schedules in each mode shall be operator adjustable. Each mode has anti-short cycle feature so that the modes have minimum on and minimum off times to prevent modes from swapping back and forth.

2. Occupied Mode:  
Temperature and Humidity Control

If the room humidity is below 65% RH then run the fan continuously and disable electric reheat unless space temp falls 1 degree below heating set point. If outside air dry bulb temperature and enthalpy are less than room dry bulb temperature and enthalpy and outside air temp is below 65 degrees (Free Cooling condition) then close the CHW control valve and modulate the outside air damper to maintain a 74°F (adj.) space temperature setpoint. If outside air dry bulb temperature and enthalpy are greater than room dry bulb temperature and enthalpy or outside air temperature is above 65 degrees then close the OA damper to minimum position and modulate the CHW control valve to maintain 74°F(adj.).

3. Room Ventilation Control  
General: Room Ventilation Control shall be active during Occupied Mode

If the room CO2 sensor reads below 800 ppm (adj) then the unit outside air (OA) damper shall remain fully closed unless modulated open by Temperature and Humidity Control.

If the room CO2 sensor reads above 800 ppm (adj) and below 1100 ppm (adj) and outside air enthalpy is less than room enthalpy and outside air temp is below 65 degrees then modulate the outside air damper to maintain 800 ppm (adj). If the room CO2 sensor reads between 800 ppm and 1100 ppm and outside air enthalpy is greater than room enthalpy then the unit outside air (OA) damper shall remain fully closed (0% open).

4. Vacant Mode:  
Temperature Control - Increase the current setpoint by 2F (adj.) if in the cooling mode and decrease the current setpoint by 2F (adj.) if in the heating mode. Reset RH threshold to 75%. Shut O/A damper.

5. Unoccupied Mode:  
Temperature and Humidity Control - Same as above. Reset RH threshold to 75% RH and temperature threshold to 85F (adj.) for cooling and 55F (adj.) for heating.

6. Alarms - The CS shall generate an alarm:

- If the space temperature is outside the operator established low and high limits, which shall be set initially at + or - 2 Deg. F. around the setpoint.
- All alarms shall be inhibited when the supply fan is not operating. The alarms, except the fan failure to start and failure in service alarms, shall remain inhibited following start up of the unit for an operator determined period of time initially set at 2 minutes.
- If the space CO2 is above the operator established limit, initially set at 1100 ppm (adj.).

M. SYSTEM - FAN POWERED VAV TERMINAL UNITS (SERIES FAN)



## BUILDING EXCELLENCE

1. General

The DDC system shall monitor the outside air dry bulb temperature and relative humidity (RH) and calculate the total enthalpy of the ambient conditions. Additionally using the wall mounted temperature sensor in each zone the local DDC controller shall calculate the total enthalpy of the conditions in each zone.

A ceiling mounted occupancy sensor shall distinguish between a Vacant and an occupied condition.

The operating schedule for the facility shall be based on three unique operating modes: Unoccupied, Vacant and Occupied. In a typical day these operating modes would occur in the following sequence:

All setpoints thresholds and schedules in each mode shall be operator adjustable. Each mode has anti-short cycle feature so that the modes have minimum on and minimum off times to prevent modes from swapping back and forth.

2. Occupied Mode: Temperature Control - The primary air damper and the heating coil or heating valve shall be sequenced to maintain a 74°F (adj.) space temperature setpoint. The primary damper shall be modulated between maximum and minimum values as scheduled in the Mechanical Documents.
3. Vacant Mode: Temperature Control - Increase the current setpoint by 2F (adj.) if in the cooling mode and decrease the current setpoint by 2F (adj.) if in the heating mode. The primary damper shall be modulated between maximum and minimum values as scheduled in the Mechanical Documents.
4. Unoccupied Mode: Temperature Control - Reset the temperature threshold to 85F (adj.) for cooling and 55F (adj.) for heating. The fan shall be off and the heating coil shall be off or the heating valve shall be closed.
5. Alarms - The CS shall generate an alarm:
  - a. If the space temperature is outside the operator established low and high limits, which shall be set initially at + or - 2 Deg. F. around the setpoint.
  - b. All alarms shall be inhibited when the supply fan is not operating. The alarms shall remain inhibited following start up of the unit for an operator determined period of time initially set at 2 minutes.

N. SYSTEM - VAV TERMINAL UNITS (COOLING ONLY)

1. General

The DDC system shall monitor the outside air dry bulb temperature and relative humidity (RH) and calculate the total enthalpy of the ambient conditions. Additionally using the wall mounted temperature sensor in each zone the local DDC controller shall calculate the total enthalpy of the conditions in each zone.

A ceiling mounted occupancy sensor shall distinguish between a **Vacant and an Occupied** condition.

The operating schedule for the facility shall be based on three unique operating modes: Unoccupied, Vacant and Occupied. In a typical day these operating modes would occur in the following sequence:

All setpoints thresholds and schedules in each mode shall be operator adjustable. Each mode has anti-short cycle feature so that the modes have minimum on and minimum off times to prevent modes from swapping back and forth.



## BUILDING EXCELLENCE

2. Occupied Mode: Temperature Control - The primary air damper shall be modulated to maintain a 74°F (adj.) space temperature setpoint. The primary damper shall be modulated between maximum and minimum values as scheduled in the Mechanical Documents.
  3. Vacant Mode: Temperature Control - Increase the current setpoint by 2F (adj.) if in the cooling mode and decrease the current setpoint by 2F (adj.) if in the heating mode. The primary damper shall be modulated between maximum and minimum values as scheduled in the Mechanical Documents.
  4. Unoccupied Mode: Temperature Control - Reset the temperature threshold to 85F(adj.) for cooling and 55F(adj.) for heating.
  5. Alarms - The CS shall generate an alarm:
    - a. If the space temperature is outside the operator established low and high limits, which shall be set initially at + or - 2 Deg. F. around the setpoint.
    - b. The alarms shall remain inhibited following start up of the unit for an operator determined period of time initially set at 2 minutes.
- O. SYSTEM – VENTILATION FANS
1. System Off - When the system is off:
    - a. The fan shall be off.
  2. Initiation of System Start-Up - System start-up shall be initiated:
    - a. Manually by a CMCS operator entered command.
    - b. Automatically by the CS base on time schedule.
  3. System Operation - When system start-up has been initiated, the following sequences shall be implemented:
    - a. The fan shall be started.
  4. Initiation of System Shutdown - System shutdown shall be initiated:
    - a. Manually by an operator entered command.
    - b. Automatically by the CS.
  5. Alarms - The CS shall generate an alarm if:
    - a. The fan fails to start or fails in service.
- P. SYSTEM – LIGHTING CONTROL
1. System Off - When the system is off:
    - a. The lights shall be off.
    - b. All control loops shall be disabled.
  2. Initiation of System Start-Up - System start-up shall be initiated:
    - a. By an operator manually entered command at the CMCS.
    - b. Automatically by the CS based on ambient light level.
  3. System Operation:
    - a. Exterior lighting shall be astronomically controlled ~~as follows:~~ with adjustable offset time periods.
      - i. ~~Lighting zones shall be assignable to either an ambient light level start level, time schedule or both.~~
      - ii. ~~Provide programming such that start and stop times can be scheduled based on offset time periods from sunrise / sunset. Utilize the ambient light level sensor to determine sunrise / sunset.~~
    - b. Interior lighting shall be controlled as follows:
      - i. Lighting zones shall be assignable to a time schedule.
        - a) Interior lighting shall be on Motion detectors
        - b) Exterior lighting shall be on photocells and time clocks.
- \* Lighting is under Electrical Division 26
- Q. SYSTEM – EMERGENCY OUTSIDE AIR SHUTDOWN
1. System Off - When the system is off:
    - a. The fans and dampers shall operate under their normal sequences.
  2. Initiation of System Start-Up - System start-up shall be initiated:



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3.
  - a. By an operator manually pushing the shutdown button.
  - System Operation:
    - a. If the shutdown button is pressed, all outside air intake dampers shall close, all 100% outside air units shall shut down and the building exhaust fans shall be shut down.

### 3.8 CS POINT SCHEDULES

- A. The following schedules define the minimum monitoring and control functions to be undertaken by the CS.
- B. The column headed **POINT** provides an English language description of the point to be monitored or controlled.
- C. The column headed **BI** indicates digital input monitoring.
- D. The column headed **BO** indicate digital output control.
- E. The column headed **AI** indicates analog input monitoring.
- F. The column headed **AO** indicates analog output control.
- G. The column headed **HI** indicates hardwired interface.
- H. The column headed **CI** indicates digital communications interface to a third party monitoring or controlling device.

#### POINT SCHEDULE: WATER COOLED CHILLER SYSTEM WITH DEDICATED PUMPS AND DIFFERENTIAL PRESSURE BYPASS

POINT	BI	BO	AI	AO	HI	CI	NOTES
CHILLER CONTROL		X				X	PER CHILLER
CHILLER STATUS	X					X	PER CHILLER
CHILLER ALARM	X					X	PER CHILLER
CURRENT LIMIT				X		X	PER CHILLER
CHILLED WATER SUPPLY TEMPERATURE RESET				X		X	PER CHILLER
CHILLER AMPERAGE			X			X	PER CHILLER
CHILLER PHASE VOLTAGE			X			X	PER CHILLER PER PHASE
CHILLER LOSS OF PHASE	X					X	PER CHILLER
CHILLED WATER RETURN TEMPERATURE			X			X	PER CHILLER
CHILLED WATER SUPPLY TEMPERATURE			X			X	PER CHILLER
CHILLER FLOW STATUS	X				X		PER CHILLER, INTERLOCKED TO CHILLER CONTROL PANEL
CHW PUMP CONTROL		X					PER PUMP
CHW PUMP STATUS	X						PER PUMP
CHILLED WATER BYPASS FLOWRATE			X				
BYPASS VALVE CONTROL				X			



BUILDING EXCELLENCE

POINT	BI	BO	AI	AO	HI	CI	NOTES
REFRIGERANT LEAK ALARM							
REFRIGERANT LEAK SYSTEM ALARM	X						
EMERGENCY PLANT SHUTDOWN SWITCHES	X						ONE PER EXIT DOOR
BUILDING CHILLED WATER RETURN TEMPERATURE			X				DISPLAY THESE VALUES AT ALL AHU'S AS WELL
BUILDING CHILLED WATER SUPPLY TEMPERATURE			X				DISPLAY THESE VALUES AT ALL AHU'S AS WELL
CHILLED WATER SUPPLY FLOW			X				
CHILLED WATER RISER DIFFERENTIAL PRESSURE			X				
REFRIGERANT LEAK ALARM							
REFRIGERANT LEAK SYSTEM ALARM	X						
EMERGENCY PLANT SHUTDOWN SWITCHES	X						ONE PER EXIT DOOR
BUILDING CHILLED WATER RETURN TEMPERATURE			X				
BUILDING CHILLED WATER SUPPLY TEMPERATURE			X				
CHILLED WATER SUPPLY FLOW			X				
CHILLED WATER RISER DIFFERENTIAL PRESSURE			X				

**POINT SCHEDULE: WATER COOLED CHILLER SYSTEM WITH PRIMARY/SECONDARY PUMPS AND OPEN BYPASS**

POINT	BI	BO	AI	AO	HI	CI	NOTES
CHILLER CONTROL		X				X	PER CHILLER



BUILDING EXCELLENCE

POINT	BI	BO	AI	AO	HI	CI	NOTES
CHILLER STATUS	X					X	PER CHILLER
CHILLER ALARM	X					X	PER CHILLER
CURRENT LIMIT				X		X	PER CHILLER
CHILLED WATER SUPPLY TEMPERATURE RESET				X		X	PER CHILLER
CHILLER AMPERAGE			X			X	PER CHILLER
CHILLER PHASE VOLTAGE			X			X	PER CHILLER PER PHASE
CHILLER LOSS OF PHASE	X					X	PER CHILLER
CHILLED WATER RETURN TEMPERATURE			X			X	PER CHILLER
CHILLED WATER SUPPLY TEMPERATURE			X			X	PER CHILLER
CHILLER FLOW STATUS	X				X		PER CHILLER, INTERLOCKED TO CHILLER CONTROL PANEL
PRIMARY CHW PUMP CONTROL		X					PER PUMP
PRIMARY CHW PUMP STATUS	X						PER PUMP
CHILLED WATER BYPASS FLOWRATE			X				BI-DIRECTIONAL
SECONDARY CHW PUMP CONTROL		X				X	PER PUMP
SECONDARY CHW PUMP STATUS	X					X	PER PUMP
SECONDARY CHW PUMP SPEED CONTROL			X			X	PER PUMP
REFRIGERANT LEAK ALARM			X				
REFRIGERANT LEAK SYSTEM ALARM	X						
EMERGENCY PLANT SHUTDOWN SWITCHES	X						ONE PER EXIT DOOR
BUILDING CHILLED WATER RETURN TEMPERATURE			X				DISPLAY THESE VALUES AT ALL AHU'S AS WELL
BUILDING CHILLED WATER SUPPLY TEMPERATURE			X				DISPLAY THESE VALUES AT ALL AHU'S AS WELL
CHILLED WATER SUPPLY FLOW			X				
CHILLED WATER RISER DIFFERENTIAL PRESSURE			X				





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### POINT SCHEDULE:    CONDENSER WATER SYSTEM

POINT	BI	BO	AI	AO	HI	CI	NOTES
TOWER FAN START AND STOP		X				X	PER TOWER
TOWER FAN SPEED CONTROL				X		X	PER TOWER
TOWER FAN STATUS	X					X	PER TOWER
CONDENSER WATER SUPPLY TEMPERATURE			X				
CONDENSER WATER RETURN TEMPERATURE			X				
CONDENSER PUMP CONTROL		X					PER PUMP
CONDENSER PUMP STATUS	X						PER PUMP
CONDENSER WATER BYPASS VALVE CONTROL				X			

### POINT SCHEDULE:                    AIR COOLED CHILLER SYSTEM WITH DEDICATED PUMPS AND DIFFERENTIAL PRESSURE BYPASS

POINT	BI	BO	AI	AO	HI	CI	NOTES
CHILLER CONTROL		X				X	PER CHILLER
CHILLER STATUS	X					X	PER CHILLER
CHILLER ALARM	X					X	PER CHILLER
CURRENT LIMIT				X		X	PER CHILLER
CHILLED WATER RETURN TEMPERATURE			X			X	PER CHILLER
CHILLED WATER SUPPLY TEMPERATURE RESET				X		X	PER CHILLER
CHILLER AMPERAGE			X			X	PER CHILLER
CHILLER PHASE VOLTAGE			X			X	PER CHILLER PER PHASE
CHILLER LOSS OF PHASE	X					X	PER CHILLER
CHILLED WATER SUPPLY TEMPERATURE			X			X	PER CHILLER
CHILLER FLOW STATUS	X				X		PER CHILLER, INTERLOCKED TO CHILLER CONTROL PANEL
CHW PUMP CONTROL		X					PER PUMP
CHW PUMP STATUS	X						PER PUMP
CHILLED WATER BYPASS FLOWRATE			X				
BYPASS VALVE CONTROL				X			
BUILDING CHILLED WATER RETURN TEMPERATURE			X				DISPLAY THESE VALUES AT ALL AHU'S AS WELL



## B U I L D I N G   E X C E L L E N C E

POINT	BI	BO	AI	AO	HI	CI	NOTES
BUILDING CHILLED WATER SUPPLY TEMPERATURE			X				DISPLAY THESE VALUES AT ALL AHU'S AS WELL
CHILLED WATER SUPPLY FLOW			X				
CHILLED WATER RISER DIFFERENTIAL PRESSURE			X				

**POINT SCHEDULE:**

**HEATING HOT WATER SYSTEM WITH  
DIFFERENTIAL PRESSURE BYPASS**

POINT	BI	BO	AI	AO	HI	CI	NOTES
BOILER ENABLE/DISABLE CONTROL		X					PER BOILER
BOILER BURNER STATUS	X						PER BOILER
BOILER LOW WATER ALARM	X						PER BOILER
HEATING HOT WATER SUPPLY TEMPERATURE			X				PER BOILER
HEATING HOT WATER RETURN TEMPERATURE			X				PER BOILER
HEATING HOT WATER PUMP CONTROL		X					PER PUMP
HEATING HOT WATER PUMP STATUS	X						PER PUMP
HOT WATER MIXING VALVE CONTROL				X			
BUILDING HOT WATER SUPPLY TEMPERATURE			X				DOWNSTREAM OF THE MIXING VALVE. DISPLAY THESE VALUES AT ALL AHU'S AS WELL
HOT WATER BYPASS VALVE CONTROL				X			
HEATING HOT WATER BYPASS FLOW RATE			X				
HEATING HOT WATER DIFFERENTIAL PRESSURE			X				

**POINT SCHEDULE:**

**DEDICATED OUTSIDE AIR HANDLING UNITS**

POINT	BI	BO	AI	AO	HI	CI	NOTES
OUTSIDE AIR DAMPER CONTROL				X			
SMOKE DETECTOR	X						
DIRTY FILTER SWITCH	X						
GAS HEATING CONTROL		X					
HOT GAS REHEAT		X					
COOLING CONTROL		X					UP TO 4 STAGES
MODULATING COMPRESSOR CONTROL				X			



## B U I L D I N G   E X C E L L E N C E

POINT	BI	BO	AI	AO	HI	CI	NOTES
SUPPLY FAN CONTROL		X					
SUPPLY FAN STATUS	X						
SUPPLY AIR TEMPERATURE			X				
SUPPLY AIR HUMIDITY			X				

### POINT SCHEDULE: VAV AIR HANDLING UNIT

POINT	BI	BO	AI	AO	HI	CI	NOTES
OUTSIDE AIR DAMPER CONTROL				X			
RETURN AIR CO2			X				
DIRTY FILTER SWITCH	X						
FREEZESTAT	X				X		INTERLOCKED TO SHUT DOWN UNIT UPON ACITIVATION
SUPPLY FAN VSD START AND STOP		X				X	
SUPPLY FAN VSD SPEED CONTROL SIGNAL				X		X	
SUPPLY FAN VSD MOTOR OPERATING STATUS	X					X	
HIGH STATIC SHUTDOWN	X				X		INTERLOCKED TO SHUT DOWN UNIT UPON ACITIVATION
COOLING COIL VALVE CONTROL				X			
SUPPLY AIR TEMPERATURE			X				
SUPPLY STATIC PRESSURE			X				
SPACE HUMIDITY			X				ONE PER AHU

### POINT SCHEDULE:

### VAV OUTSIDE AIR HANDLING UNIT

POINT	BI	BO	AI	AO	HI	CI	NOTES
OUTSIDE AIR DAMPER CONTROL		X					
HEATING VALVE CONTROL			X				
DIRTY FILTER SWITCH	X						
FREEZESTAT	X				X		INTERLOCKED TO SHUT DOWN UNIT UPON ACITIVATION
SUPPLY FAN VSD START AND STOP		X				X	
SUPPLY FAN VSD SPEED CONTROL SIGNAL				X		X	
SUPPLY FAN VSD MOTOR OPERATING STATUS	X					X	
HIGH STATIC SHUTDOWN	X				X		INTERLOCKED TO SHUT DOWN UNIT UPON ACITIVATION
COOLING COIL VALVE CONTROL				X			
SUPPLY AIR TEMPERATURE			X				
SUPPLY STATIC PRESSURE			X				

### POINT SCHEDULE:

### CONSTANT VOLUME AIR HANDLING UNIT



## B U I L D I N G   E X C E L L E N C E

### (HEATING / COOLING)

POINT	BI	BO	AI	AO	HI	CI	NOTES
OUTSIDE AIR DAMPER CONTROL				X			
RETURN AIR CO2			X				
HOT WATER HEATING VALVE CONTROL				X			
DIRTY FILTER SWITCH	X						
ELECTRIC HEATER CONTROL		X					ONE POINT PER STAGE OF CONTROL
FREEZESTAT	X				X		INTERLOCKED TO SHUT DOWN UNIT UPON ACITIVATION
COOLING COIL VALVE CONTROL				X			
SUPPLY FAN CONTROL		X					
SUPPLY FAN STATUS	X						
SPACE TEMPERATURE			X				
SPACE HUMIDITY			X				ONE PER UNIT
SPACE OCCUPANCY	X						NOT REQUIRED IN AUDITORIUMS, STUDENT DINING COMMONS, GYMNASIUMS, LIBRARIES AND OTHER LARGE AREAS

#### POINT SCHEDULE:

#### UNIT VENTILATOR

POINT	BI	BO	AI	AO	HI	CI	NOTES
OUTSIDE AIR DAMPER CONTROL				X			AS SHOWN ON DRAWINGS
COOLING COIL VALVE CONTROL				X			
ELECTRIC HEATER CONTROL		X					AS APPLICABLE
HEATING COIL VALVE CONTROL				X			AS APPLICABLE
FREEZESTAT	X				X		INTERLOCKED TO SHUT DOWN UNIT UPON ACITIVATION
DISCHARGE AIR SENSOR			X				
SUPPLY FAN CONTROL		X					
SUPPLY FAN STATUS	X						
SPACE TEMPERATURE			X				
SPACE HUMIDITY			X				ONE PER UNIT
SPACE CO2 SENSOR			X				
SPACE OCCUPANCY	X						ONE PER ROOM

#### POINT SCHEDULE:

#### DIRECT EXPANSION ROOF TOP UNIT

POINT	BI	BO	AI	AO	HI	CI	NOTES
SUPPLY FAN CONTROL		X					
SUPPLY FAN STATUS	X						
UNIT GENERAL ALARM	X						
SPACE TEMPERATURE			X				
DX COOLING		X					UP TO 2 STAGES



## B U I L D I N G   E X C E L L E N C E

POINT	BI	BO	AI	AO	HI	CI	NOTES
HEAT CONTROL		X					UP TO 2 STAGES

**POINT SCHEDULE: FAN COIL UNIT (HEATING / COOLING)**

POINT	BI	BO	AI	AO	HI	CI	NOTES
OUTSIDE AIR DAMPER CONTROL				X			IF REQUIRED
SPACE CO2 SENSOR			X				IF REQUIRED
ELECTRIC HEATER CONTROL		X					
COOLING COIL VALVE CONTROL				X			
SUPPLY FAN CONTROL		X					
SUPPLY FAN STATUS	X						
SPACE TEMPERATURE			X				
CONDENSATE ALARM	X				X		
SPACE HUMIDITY			X				ONE PER UNIT
SPACE OCCUPANCY	X						ONE PER ROOM

**POINT SCHEDULE: FAN POWERED TERMINAL UNITS**

POINT	BI	BO	AI	AO	HI	CI	NOTES
PRIMARY AIR FLOWRATE			X				
PRIMARY AIR DAMPER CONTROL		X					FLOATING POINT
FAN CONTROL START/STOP		X					
ELECTRIC HEAT CONTROL		X					UP TO TWO STAGES
HEATING VALVE CONTROL		X					FLOATING POINT
SPACE TEMPERATURE			X				
DISCHARGE AIR TEMPERATURE			X				
SPACE OCCUPANCY	X						ONE PER ROOM

**POINT SCHEDULE: VAV TERMINAL UNITS (COOLING ONLY)**

POINT	BI	BO	AI	AO	HI	CI	NOTES
PRIMARY AIR FLOWRATE			X				
PRIMARY AIR DAMPER CONTROL		X					FLOATING POINT
SPACE TEMPERATURE			X				
DISCHARGE AIR TEMPERATURE			X				
SPACE OCCUPANCY	X						ONE PER ROOM

**POINT SCHEDULE: VENTILATION / EXHAUST FANS**

POINT	BI	BO	AI	AO	HI	CI	NOTES
FAN CONTROL START/STOP		X					
FAN STATUS	X						

**POINT SCHEDULE: ELECTRICAL MAIN SWITCHBOARD MONITORING**

POINT	BI	BO	AI	AO	HI	CI	NOTES
KW DEMAND	X					X	
KILOWATT HOUR			X			X	

**POINT SCHEDULE: MISCELLANEOUS**

POINT	BI	BO	AI	AO	HI	CI	NOTES
OUTSIDE AIR TEMPERATURE			X				
OUTSIDE AIR HUMIDITY			X				



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POINT	BI	BO	AI	AO	HI	CI	NOTES
OUTSIDE AIR CO2			X				
KITCHEN FREEZER TEMPERATURE			X				ONE PER FREEZER
KITCHEN COOLER TEMPERATURE			X				ONE PER COOLER
EMERGENCY OUTSIDE AIR SHUTDOWN BUTTON	X						

EDIT RESPONSIBILITY MATRIX BELOW AS NEEDED AND INCLUDE IN THE MECHANICAL AND ELECTRICAL DRAWINGS

**Engineer Shall Post this chart/detail on mechanical bid drawings.**

RESPONSIBILITY MATRIX	EM	MC	EC	CC
PROVISION OF AHU/PUMP VFD				X
INSTALLATION OF AHU/PUMP VFD			X	
WIRING OF VFD AHU/PUMP (LINE VOLTAGE)			X	
WIRING OF AHU/PUMP VFD (LOW VOLTAGE)				X
PROVISION OF UV/FCU VFD	X			
INSTALLATION OF UV/FCU VFD	X			
WIRING OF VFD UV/FCU (LINE VOLTAGE)	X		X	
WIRING OF UV/FCU VFD (LOW VOLTAGE)				X
PROVISION OF CHILLER BACNET INTERFACE	X			
INSTALLATION OF CHILLER BACNET INTERFACE	X			
WIRING OF CHILLER BACNET INTERFACE (LINE VOLTAGE)	X		X	
WIRING OF CHILLER BACNET INTERFACE (COMMUNICATION WIRING)				X
PROVISION OF SWITCHGEAR MODBUS INTERFACE	X			
INSTALLATION OF SWITCHGEAR MODBUS INTERFACE	X			
WIRING OF SWITCHGEAR MODBUS INTERFACE (LINE VOLTAGE)			X	
WIRING OF SWITCHGEAR MODBUS INTERFACE (COMMUNICATION WIRING)				X

EM=EQUIPMENT MANUFACTURER MC=MECHANICAL CONTRACTOR  
EC=ELECTRICAL CONTRACTOR CC=CONTROLS CONTRACTOR

**END OF SECTION**



**B U I L D I N G   E X C E L L E N C E**

**SECTION 23 10 00**

**FACILITY FUEL SYSTEM**

**GENERAL**

- 1.1 Provide a complete natural gas piping system to all gas-burning appliances and all natural connectors.
- 1.2 The architect and engineer should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 Extra Materials: Furnish two packing kits for each type and size valve.

**PRODUCTS**

- 2.1 NATURAL GAS PIPING
  - A. Natural Gas Systems
    1. Above grade natural gas piping to be blacksteel – ASTM53
    2. Galvanized steel piping is not acceptable
    3. Natural gas piping below grade shall be yellow polyethylene – ASTM D2513.

**EXECUTION**

- 3.1 INSTALLATION
  - A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
  - B. Remove scale and dirt, on inside and outside, before assembly.
  - C. Prepare piping connections to equipment with flanges or unions.
  - D. Install plastic ribbon tape continuous over top buried of pipe six inches below finish grade, above pipe line.
  - E. Pressure test all gas pipe, minimum 50 psi for 24 hours.

**END OF SECTION**





## BUILDING EXCELLENCE

### SECTION 23 21 13

#### HVAC PIPING AND PUMPS

##### GENERAL

- 1.1 Section Includes: Pipe and pipe fittings valves and piping specialties for the following systems: Heating water piping, buried, Heating water piping, above ground, Chilled water piping, buried, Chilled water piping, above ground, Condenser water piping, buried, Condenser water piping, above ground, Equipment drains and over flows and Unions, flanges, and couplings.
- 1.2 QUALITY ASSURANCE
  - A. Perform work in accordance with ASME B31.5 code for installation of piping systems and ASME Section IX for welding materials and procedures, welding per ANSI B31.1.
  - B. All grooved joint piping products shall be supplied by a single domestic manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components.
  - C. All pipe and accessories shall be of United States domestic manufacture or Merfish pipe & Supply except China.

##### PRODUCTS

###### 2.1 MATERIALS

- A. Acceptable Manufacturers
  1. Globe Valves: Crane/Mueller/Lunkenheimer/Watts/Nibco/Milwaukee Valves/ Kitz Valves
  2. Ball Valves: Apollo/NibcoWatts/ Milwaukee Valves/ Kitz Valves
  3. Butterfly Valves: Conbraco/Nibco/Watts/Xomox/ Milwaukee Valves/ Kitz Valves
  4. Plug Valves: Dezurik/Xomox/ Milwaukee Valves/ Kitz Valves
  5. Check Valves: Apollo/Crane/Lunkenheimer/Nibco/Val-Matic/Watts/Milwaukee Valves/ Kitz Valves
- B. General Piping Requirements
  1. 2" and smaller shall be NPT screwed
  2. 2-1/2" and larger shall be welded
  3. All piping shall be schedule 40 black steel
  4. Chilled water valves shall have extended stem
  5. Butterfly valves shall be lug type
  6. Chilled water valves shall have extended stem
  7. All balancing valves shall have locking indicator handles unless self-regulating cartridge type
  8. Balancing valves shall be self regulating, maintaining near constant flow over a wide pressure range. The hydronic system will be self balancing. If a flow needs to be changed, the cartridge of the unit will be changed.
  9. Provide blanked off taps at central plant to allow for connection of portable chiller.
  10. Avoid routing piping on roof as much as possible.
- C. Hydronic Specialties
  1. Thermometers and Thermo-wells – for chilled water piping insulate test well and place so condensate does not drip on pipe insulation.
    - a. Chiller inlet/outlet
    - b. Boiler inlet/outlet
    - c. Water cooled condenser inlet/outlet
    - d. Nine inch long, red reading, and ranged per application
  2. Expansion Tanks
    - a. Acceptable Manufacturers: Bell and Gossett, Taco, Wessels Co
    - b. Provide pressure reducer unit
  3. Air Vents
    - a. Acceptable Manufacturers: Armstrong, ITT, Bell and Gossett



## BUILDING EXCELLENCE

- b. Automatic air vents at high points
  4. Air Separators
    - a. Acceptable Manufacturers: Bell and Gossett, McDonald Miller, Taco
  5. Pressure Gauges
    - a. Acceptable Manufacturers: Terice, U.S. Gauge, Taylor
    - b. Install on inlet and outlet of all pumps.
    - c. Gauges shall be at least 3-1/2" and ranged according to the application.
  6. Strainers
    - a. Acceptable Manufacturers: Armstrong, Bell and Gossett, Mueller, Hayward, Hoffman, Process Strainer
  7. Flow Controls
    - a. Acceptable Manufacturers: Bell and Gossett, ITT, Taco, Griswold
    - b. Flow stations at inlet of chiller, condenser, and boiler
  8. Relief Valves
    - a. Acceptable Manufacturers: Bell and Gossett, McDonnell-Miller, Taco
    - b. Block and balance valves at all equipment connections
  9. Glycol Specialties
  10. Taps (Pete's plugs)
    - a. Install Pete's Plugs across all controlled valves, HW and CHW coils.
    - b. Insulate and install so condensate does not drip on the insulation.

### 2.2 HVAC PUMPS

- A. Acceptable Manufacturers: PACO, TACO, Aurora, Bell & Gossett, ~~Patterson~~, Armstrong
- B. Close coupled condenser water only
- C. Base mounted centrifugal
- D. Split case
- E. Radially split (end suction) up to 500 GPM
- F. Axially split 500 GPM and up
- G. Inline pump 3 HP and smaller may be pipe-supported. Larger inline pumps shall be supported from brackets.
- H. Vertical turbine pumps are NOT acceptable

## EXECUTION

### 3.1 INSTALLATION

- A. Ream pipe and tube ends. Remove burrs. Bevel or groove plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges, grooved joint couplings, or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- E. Paint all exposed uninsulated pipe.
- F. Provide all expansion loops, expansion joints, offsets, guides and anchors required to allow for expansion without damage to piping or building and to eliminate objectionable noise.
- G. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
- H. Provide Pete's plugs on suction & discharge of pumps.

## END OF SECTION



## BUILDING EXCELLENCE

### SECTION 23 23 00

#### REFRIGERANT PIPING

##### GENERAL

###### 1.1 SUMMARY

- A. Section Includes: Refrigerant piping, Unions, flanges, and couplings, Refrigerant moisture and liquid indicators, Valves, Refrigerant strainers, Refrigerant pressure regulators, Refrigerant pressure relief valves, Refrigerant filter-driers, Refrigerant solenoid valves, Refrigerant expansion valves, Electronic expansion valves and Refrigerant receivers.

- 1.2 The architect and engineer should use all applicable references, codes and National industry standards to specify and complete work performed in this division.

###### 1.3 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves or equipment.
- C. Provide pipe hangers and supports in accordance with Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment.
- D. Provide receivers sized to accommodate pump down charge.
- E. Flexible Connectors: Use at or near compressors where piping configuration does not absorb vibration.

###### 1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.5 code for installation of refrigerant piping systems.
- B. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.
- C. Perform Work in accordance with ANSI / ASHRAE Standard 15.

###### 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three years experience approved by manufacturer.

- 1.6 Furnish a five year manufacturer warranty for valves excluding packing.

###### 1.7 MAINTENANCE MATERIALS

- A. Furnish two refrigerant oil test kits each containing everything required for conducting one test.

###### 1.8 EXTRA MATERIALS

- A. Furnish two packing kits for each size and valve type.
- B. Furnish two refrigerant filter-dryer cartridges of each type.



## BUILDING EXCELLENCE

### PRODUCTS

#### 2.1 HVAC PUMPS

- A. Acceptable Manufacturers: PACO, TACO, Aurora, Bell, Gossett, and Armstrong
- B. Close coupled condenser water only
- C. Base mounted centrifugal
- D. Split case
- E. Radially split (end suction) up to 500 GPM
- F. Axially split 500 GPM and up
- G. Inline pump 3 HP and smaller may be pipe-supported. Larger inline pumps shall be supported from brackets.
- H. Vertical turbine pumps are NOT acceptable

#### 2.2 REFRIGERANT SPECIALTIES

- A. Use ACR hard drawn copper
- B. L/R fittings
- C. Armaflex insulation with UV protective coating
- D. Insulation shall meet IECC 2004
- E. Supports and hangers shall be same as hydronic piping
- F. Provide petes plugs at units on all chilled water and hot water piping.
- G. Copper piping & soldered copper joints shall only be allowed for refrigerant lines.

### EXECUTION

#### 3.1 INSTALLATION

- A. Limit refrigerant pipe length to 50 feet maximum for split systems.
- B. Insulate suction line and also insulate hot gas & liquid line with ~~3/4"~~ 1" Armaflex. 5/9/13
- C. Metal jacket required for exterior insulation.
- D. Route all refrigerant lines in readily accessible locations.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 23 25 00

#### HVAC WATER TREATMENT

##### GENERAL

- 1.1 The Common Work Results for HVAC, Section 23 05 00, are included as a part of this Section as though written in full in this document.
- 1.2 SCOPE
  - A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.
- 1.3 DESCRIPTION OF WORK
  - A. The service to be provided requires the Bidder to provide complete water analysis, chemicals, testing equipment, training, consulting and technical service in support of the chemical cleaning and treatment of the following systems:
    1. Condenser Water Systems
    2. Hot Water Systems
    3. Chilled Water Systems
  - B. Provide the initial chemical treatment for all systems based on a complete water analysis prior to the equipment installation.
    1. The initial chemical treatment shall be applied after the systems have been cleaned, passivated, and flushed.
    2. The initial treatment supply of chemicals shall be adequate for the start-up and testing period, for the time the system is being operated by the Contractor for temporary cooling and heating, and for a period of (1) year after the systems have been accepted by the Owner. The total time period shall not exceed 1½ years unless specified.
    3. Submit a letter of Certification of Substantial Completion; include final report of specific start-up and testing results and include in OEM Manual.
  - C. The Contractor shall have a qualified Service Representative on site at the facilities to assist with the initial application of the chemicals and training of the Facility personnel.
  - D. Include a 4-hour training session for Owner's designated personnel on all water treatment operations.
- 1.4 ACCEPTABLE MANUFACTURERS
  - A. All materials and systems shall be new and compatible for use in the Owner's Facility (including compatibility with system pressures, temperatures, etc.). Acceptable providers: Nalco Company will be accepted.

##### PRODUCTS

- 2.1 TREATMENT - CLEANING AND PASSIVATION
  - A. Hot & Chilled Water System: Treat each piping system with chemicals to remove and permit flushing of mill scale, oil, grease, and other foreign matter and to promote system passivation. Chemicals shall be equal to Nalco NALPREP 2859 [and shall be compatible with existing water treatment systems, where in use.] Pretreatment shall be accomplished by exposing the system to 500 ppm of NO<sub>2</sub> (2700 ppm as Nalco NALPREP 2859), at a pH of 7.0-8.0 for 24-48 hours. Use sulfuric acid if needed to adjust and maintain system pH. Pretreatment and flushing shall be complete before system treatment is added to the system.
  - B. Condenser Water System: Treat each piping system with chemicals to remove and permit flushing of mill scale, oil, grease, and other foreign matter and to promote system passivation. Chemicals shall be equal to Nalco NALPREP 2578 [and shall be compatible



## BUILDING EXCELLENCE

with existing water treatment systems, where in use.] Pretreatment shall be accomplished by exposing the system to 470 ppm of total inorganic PO<sub>4</sub> (2700 ppm as Nalco NALPREP 2578), at a pH of 6.5-7.5 under no load for 24-48 hours. Use sulfuric acid if needed to adjust and maintain system pH. Pretreatment and flushing shall be complete before system treatment is added to the system.

### 2.2 TREATMENT PROGRAM – CONDENSER WATER SYSTEMS

- A. Provide a single product with scale inhibitors, corrosion inhibitors and biodispersant.
- B. The product shall contain at least PBTC phosphonate for scale inhibition, benzotriazole or tolytriazole as a copper corrosion inhibitor and polymer (i.e. Nalco 23206, 23265).
- C. Cycles of concentration will be maintained in a range of 4-7 for efficient operation and cost effective conservation of water and treatment chemicals. If needed, soft water or acid feed shall be used to maintain this range. If make-up water m-alkalinity exceeds 110 ppm or make-up water calcium exceeds 200 ppm, soft water or acid should be proposed to allow 4-7 cycles. The Contractor is responsible for using the make-up water analysis to make this determination and proving that the proposed chemistry can provide proper system protection given make-up water quality. If acid or soft water is proposed, these costs must be included in the bid. Contractor shall maintain system up to substantial completion.
- D. The condenser water inhibitor furnished shall not contain chromate, molybdate, chlorophenate or sulfuric acid (molybdate is acceptable for soft water programs only).
- E. The Contractor shall provide a biocide consisting of both an oxidizing and a non-oxidizing type biocide. The non-oxidizing biocide must be compatible with the scale and corrosion inhibitor program and be fed at biocidal dosages at least bi-monthly (carbamate is unacceptable). The oxidizing biocide must be a bromine based chemistry. A single drum liquid bromine chemistry is preferred to minimize equipment needed; however, bromine pellets will be acceptable. The Bidder must supply and maintain an appropriately sized brominator driven with make-up water (with a pressure relief valve and rotometer) if pellets are used. A two drum sodium bromide and bleach system and granular or powdered bromine will not be accepted. The biocide program (oxidizing and non-oxidizing) shall be administered from a controller capable of feeding on a programmed time schedule. The controller shall have a pre-bleed and lockout functions for each biocide and be capable of feeding on a 28-day schedule.

### 2.3 TREATMENT – CHILLED AND HOT WATER SYSTEMS

- A. Contractor shall provide a single product treatment. This product shall contain at least tolytriazole as a copper corrosion inhibitor, nitrite and caustic as a ferrous metal inhibitor, and a polymeric dispersant (equivalent to Nalco 2833). Treatment will be maintained at 300-600 ppm Nitrite in Chilled Water Systems and 500-1000 ppm Nitrite in Hot Water Systems.
  - 1. The product furnished shall not contain molybdate as the only ferrous metal inhibitor.
  - 2. The same type of non-oxidizing biocide that is used for the condenser water treatment program shall be used in the event sterilization of the chilled and/or hot water systems is required.

### 2.4 TREATMENT – QUALITY RESULTS ASSURANCE

- A. The condenser water treatment system shall maintain a corrosion rate of less than 2.0 mils per year for mild steel and less than 0.1 mils per year for copper in the cooling water system.
- B. The hot water and chilled water treatment system shall be designed to maintain corrosion rates below 0.5 mils per year for mild steel and 0.1 mils per year for copper.
- C. Condenser water microbiological growth levels shall be maintained below 500,000 cfu's aerobic bacteria and 10 cfu's anaerobic bacteria. These levels shall be determined with aerobic bacteria dipslides and anaerobic bacteria test provided by the Contractor.





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- D. Hot and chilled water microbiological growth levels shall be maintained below 10,000 cfu's aerobic bacteria and 10 cfu's anaerobic bacteria.

2.5 EQUIPMENT

- A. Conductivity/pH/Biocide Controller: A microprocessor based controller manufactured by (Pulsatrol, Lakewood, Walchem) shall be furnished which is capable of controlling conductivity, pH (if needed), and two biocide feeds. The conductivity and pH must have the capability of being transmitted via 4-20 milliamp output to a remote computer or building automation system. The dual biocide feed must include pre-bleed and lock-out capabilities as well as a 28-day schedule. The controller must also sense flow and prevent operation in no-flow conditions. Manual on-off-auto switches must be provided on the controller for conductivity, pH, blowdown, and both biocides. The controller must include visual indications of power, flow, conductivity, pH, alarms, blowdown, and chemical feed. It must also include audible alarm capability.
- B. Inhibitor Controller: A separate controller must be provided for controlling the inhibitor level in the cooling tower systems. Conductivity controllers are not acceptable. The inhibitor must be fed independent of make-up, blowdown, or timers. A computerized monitoring and control system must be furnished by the Contractor that has the capability of controlling the cooling water chemical inhibitor level +5 PPM at all times. Verification of this capability must be submitted with the bid. The unit must provide direct measurement of the chemical inhibitor or tracer and control the chemical level within the control band noted above. The system must also be capable of converting the chemical value to a 4-20 mA output which can be read by the Energy Management system. The system must be capable of producing graphs of the chemical inhibitor levels with a minimum of 24 data points per day. Also, the system must be able to generate a system report on the exact condenser water volume, holding time index, and cooling tower blowdown rates. The following inhibitor controllers will be accepted: Nalco Trasar 3000 or Hach Phosphate Analyzer Cat. #60001-00.
- C. Injectors: All condenser water chemicals must be fed neat into the condenser water system header to allow for proper dilution and mixing and to prevent reaction and precipitation that can occur in a multiple chemical dilution line. All chemicals must be injected into the header via corporation stop injectors (equivalent to Neptune CS75316 or CS100316) to allow for removal without system water loss. The injectors must be constructed of 316 stainless steel unless incompatible with the chemical being fed in which case an acceptable material can be substituted. The injectors must be located at least 16 inches apart on the header. (For high pressure systems, the chemical injectors must be capable of handling system pressure – i.e. high pressure retractable injectors.)
- D. Pumps: Chemical feed pumps, which are compatible with the specified controllers, shall be provided for each liquid condenser water chemical being fed. The pumps shall be sized to deliver adequate dosages in the appropriate time so as not to hinder the performance of the chemical. The pumps shall be manufactured by LMI or Pulsatrol. Liquid bromine pumps shall have automatic degassing heads and be manufactured by Pulsatrol or approved equal for off-gassing chemical. (High pressure systems require pumps manufactured by Milton Roy, Neptune, A & F or approved equal).
- E. Solenoid Valve: Provide an appropriate solenoid valve for system pressure and blowdown flow requirements (manufacturer is ASCO 8211 Series or approved equal).
- F. Totalizing Water Meter: Provide totalizing water meters for condenser water make-up and blowdown lines for determination of evaporation credits. The meters shall be the appropriate size based on make-up and blowdown volume and line size. The meters must also be approved for use by the city or governmental agency providing evaporation credits. The mechanical contractor is responsible for having the meter certified by the governmental agency (i.e. City of Houston).
- G. Pot Feeders: Contractor shall supply pot feeders for each hot and chilled water system. The pot feeders must meet the following: 5-gallon capacity, 200 psi maximum operating pressure, legs, and filter bag assembly.





## BUILDING EXCELLENCE

- H. Corrosion Coupon Racks: One inch PVC corrosion coupon racks with isolation valves, visual 5-21 gpm flow determination, and ports for at least one mild steel and one copper coupon complete with coupons must be provided for each condenser, hot, and chilled water system.

### EXECUTION

#### 3.1 INSTALLATION

- A. Installation will be performed by the mechanical contractor with consultation by the Nalco. Install where shown on the drawings and/or where consulted by Nalco. Follow the manufacturer's installation and start-up instructions.

#### 3.2 RENOVATION PROJECTS

- A. The contractor shall provide the initial cleaning, passivation, and initial treatment for all chilled and hot water systems included in the renovation.
  - 1. The initial chemical cleaning, passivation, and initial treatment shall be applied in accordance with and under the consultation of Nalco Company. Nalco shall also provide pot feeders for all closed loop systems. At the conclusion of the process, the initial treatment will achieve 300-600 ppm Nitrite in Chilled Water Systems and 500-1000 ppm Nitrite in Hot Water Systems.
  - 2. Nalco must conduct system testing prior to the system being placed into operation to confirm proper application of cleaning, passivation, and initial treatment chemicals. A written report must be submitted to HISD/CFS by Nalco verifying proper application prior to the system being placed into operation.
  - 3. Any taps, equipment, plumbing, etc. necessary to facilitate the correct cleaning, passivation, and initial treatment of the systems shall be the responsibility of the mechanical contractor. Cleaning, passivation, and initial treatment of any and all systems and equipment shall be performed prior to tie in with the existing system.

### END OF SECTION



## BUILDING EXCELLENCE

### SECTION 23 31 13

#### HVAC DUCTS AND CASINGS

##### GENERAL

###### 1.1 SUMMARY

- A. Section Includes: Single-wall rectangular ducts and fittings, Single-wall round and Flat Oval ducts and fittings, Double-wall rectangular ducts and fittings, Double-wall round and Flat Oval ducts and fittings, Insulated Flexible Ducts, Sheet metal materials, Sealants and gaskets, and Hangers and supports.

###### 1.2 PERFORMANCE REQUIREMENTS

- A. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

###### 1.3 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code – Aluminum," for aluminum supports, and AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code – Steel," for hangers and supports.
  - 2. AWS D1.2/D1.2M, "Structural Welding Code – Aluminum," for aluminum supports.
  - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 – "Systems and Equipment" and Section 7 – "Construction and System Start-up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 – "HVAC System Construction and Insulation."

##### PRODUCTS

###### 2.1 MATERIALS

- A. Metal Ductwork
  - 1. All ductwork (excluding flex-duct, dish washer and kitchen exhaust) shall be sheet metal, and fabricated and installed per SMACNA. Dish washer exhaust shall be aluminum and kitchen exhaust welded stainless steel or 16 gauge welded black steel insulated as required by code. Provide stainless steel ductwork for science learning center/wet labs and showers.
  - 2. No fiberglass ductwork shall be accepted.
- B. Flexible Ductwork
  - 1. Maximum length of flex duct shall be 8 feet.
- C. Ductwork Hangers and Supports
- D. Dampers
  - 1. Acceptable Manufacturers: Louvers and Dampers, Inc., Ruskin, Nailor Industries, American Warming and Ventilating, Greenheck, Pottorff.
- E. Duct Access Panels and Test Holes
  - 1. Duct access doors shall be hinged and gusseted, equipped with self-tightening latches. Access door for insulated duct shall be double thickness.



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- F. Flexible Duct Connections
  - 1. Acceptable Manufacturers: Metaledge, Ventglass
  - 2. Turning Vanes and Extractors
  - 3. Acceptable Manufacturers: Young Regulator, Titus, Tuttle and Bailey

**EXECUTION**

**3.1 INSTALLATION**

- A. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- B. Do not design ductwork to be outdoors.
- C. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible".
- D. All exposed indoor ductwork shall be double wall with insulation between walls.

**END OF SECTION**



B U I L D I N G   E X C E L L E N C E

SECTION 23 34 00

HVAC FANS

GENERAL

- 1.1 Section Includes: Hooded propeller roof fans, Upblast centrifugal roof fans, Downblast centrifugal roof fans, Upblast centrifugal roof fans – Grease exhaust, Centrifugal filtered supply fans and Inline Fans.
- 1.2 EXTRA MATERIALS
  - A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.
    1. Fan Belts: Two sets for each belt-driven fan.

PRODUCTS

- 2.1 POWER VENTILATORS
  - A. Centrifugal, Axial, Inline.
  - B. Acceptable Manufacturers: Cook, Greenheck, ACME, Penn Barry.
- 2.2 AIR CURTAINS
  - A. Acceptable Manufacturers: Mars, Berner.

EXECUTION

- 3.1 INSTALLATION
  - A. Secure roof fans with cadmium plated steel lag screws to roof curb structure.
  - B. Install dampers in roof curb damper tray.
  - C. Provide hinged curb adapter to permit access to dampers and duct connection.
  - D. Install safety screen where inlet or outlet is exposed.
  - E. Provide sheaves required for final air balance.

END OF SECTION



**B U I L D I N G   E X C E L L E N C E**

**SECTION 23 36 00**

**AIR TERMINAL UNITS**

**GENERAL**

- 1.1 Section Includes: Variable volume terminal units and Series Flow Fan powered terminal units
  - A. Related Sections:
    - 1. Section 23 09 23 – Direct-Digital Control System for HVAC: Controls remote from unit.
- 1.2 QUALITY ASSURANCE
  - A. Test and rate air terminal unit performance for air pressure drop, flow performance, and acoustical performance in accordance with ARI 880 and ARI 885. Attach ARI seal to each terminal unit.
  - B. All electrical components shall be UL Listed and installed in accordance with the National Electric Code. Electrical connections to terminal units shall be single point. The energy terminal shall be UL Listed as a complete assembly.

**PRODUCTS**

- 2.1 AIR TERMINAL UNITS
  - A. Acceptable Manufacturers: Titus, Price, Krueger, Nailor, Trane

**EXECUTION**

- 3.1 INSTALLATION
  - A. Do not install units with filters above gyp. board ceilings or in rooms with a ceiling height greater than 12'-0" A.F.F.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 23 37 00

#### AIR OUTLETS AND INLETS (AIR DISTRIBUTION DEVICES)

##### GENERAL

- 1.1 Section Includes: Air devices.

##### PRODUCTS

###### 2.1 AIR DEVICES

- A. Acceptable Manufacturers: Titus, Nailor, Price, Tuttle & Bailey, Krueger, Pottorff.
  - 1. All inlets and outlets located 8' and lower from the floor shall be heavy duty steel construction; all others shall be aluminum of aluminum construction.
  - 2. All supply outlets shall have pattern adjustment.
- B. Diffusers
  - 1. Square diffusers shall have field adjustable discharge patterns.
  - 2. Intake and Relief ventilators
  - 3. Intake ventilators shall be provided with motorized low leakage damper.
  - 4. Relief ventilators shall be provided with low leakage gravity dampers.
- C. Louvers
  - 1. All louvers shall have drainable blades and shall be provided with a bird screen.

##### EXECUTION

###### 3.1 INSTALLATION

- A. Install diffusers to ductwork with airtight connection.
- B. Install balancing dampers on duct ~~take-off~~ take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly.
- C. Paint visible portion of ductwork behind air outlets and inlets matte black.

**END OF SECTION**



**B U I L D I N G   E X C E L L E N C E**

**SECTION 23 51 00**

**BREECHINGS, CHIMNEYS AND STACKS**

**GENERAL**

- 1.1 Section Includes: Category I Type B double wall metal vents, Category IV Condensing Appliance double wall metal vents, Category III Double wall metal stacks and Double wall engine exhaust.
- 1.2 Design metal stacks that protrude above roof line for wind loading of 110 mph.
- 1.3 Maintain water integrity of roof during and after installation of chimney or vent.

**PRODUCTS**

- 2.1 BREECHINGS, CHIMNEYS AND STACKS
  - A. Acceptable Manufacturers: Metalbestos, American metal Products, AMPCO, Van-Packer, Metal Fab
  - B. Type C
    1. Welded
    2. Insulated
  - C. Type B
    1. Shall have UL/AGA approval
    2. Shall be stainless steel

**EXECUTION**

- 3.1 INSTALLATION
  - A. Locate breechings, chimneys and stacks a minimum of 20 feet horizontal distance from any intake louver, door or window.

**END OF SECTION**





## BUILDING EXCELLENCE

### SECTION 23 52 00

#### BOILERS

##### GENERAL

- 1.1 Section includes: Heating water boilers.
- 1.2 QUALITY ASSURANCE
  - A. Boilers shall comply with International Energy Conservation Code as enforced by the City of Houston.
  - B. All boilers to be installed only indoors.
- 1.3 Installer: Company specializing in performing Work of this section with minimum three years experience.
- 1.4 WARRANTY
  - A. The boiler manufacturer shall warrant each boiler, including boiler, trim, boiler control system, and all related components, accessories, and appurtenances against defects in workmanship and material for a period of eighteen months. Warranty shall begin from date of Certificate of Substantial Completion. Heat exchanger and fuel burner shall be warranted for a period of five years from date of Certificate of Substantial Completion.

##### PRODUCTS

- 2.1 HEATING WATER BOILERS
  - A. Finned Water Tube
    - 1. Acceptable Manufacturers: ~~Lochinvar~~, Teledyne Laars, Ray Pak
    - 2. Low NOX boilers only
    - 3. Low pressure firing
  - B. Fire Tube – Middle School and High Schools only
    - 1. Acceptable Manufacturers: Sellers, Cleaver Brooks, ~~Kewanee~~
    - 2. Low NOX boilers only
    - 3. Low pressure firing
  - C. Thermifac (modular): ~~CAMUS RBL~~ (\*) or approved equal.
  - D. (\*) Condensing cast iron boilers may be used for improved energy efficiency.
  - E. Boiler Accessories
    - 1. Low water cut off
    - 2. High limit
    - 3. Flow proving
    - 4. Pilot safety – 100%
    - 5. Spark ignition
    - 6. Auto relight
    - 7. Time override with manual reset
    - 8. Temperature control based on leaving water

##### EXECUTION

- 3.1 INSTALLATION
  - A. Install boiler on concrete housekeeping pad, minimum four (4) inches high and six (6) inches larger than boiler base on each side.
  - B. Design a natural gas supply system with adequate pressure and volume capabilities for ease of starting with all appliances at full fire.
  - C. Route boiler gas pressure regulator diaphragm relief or force to the building exterior, minimum 18 inches above roof line.



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## B U I L D I N G   E X C E L L E N C E

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- D. Require factory start-up of all boilers.
- E. Coordinate and assist owner in executing a State of Texas boiler inspection upon start up of each boiler.

### 3.2 BOILER INSPECTION



## BUILDING EXCELLENCE

- A. New installations
  - 1. No boiler, except reinstalled boilers and those exempted by the Health and Safety Code, §755.022, shall be installed in this state unless it has been constructed, inspected, and stamped in conformity with the applicable section of the ASME code and registered with the National Board of Boiler and Pressure Vessel Inspectors, and is approved, registered, and inspected in accordance with the requirements of these rules. Cast iron sectional boilers need not be registered with the National Board.
  - 2. A boiler having the standard stamping of another state that has adopted a standard of construction equivalent to the standard of the State of Texas, or a special-designed boiler, may be accepted by the executive director. Any person desiring to install such a boiler shall make application for the installation and shall file with this application the manufacturer's data report covering the construction of the boiler in question.
  - 3. New boilers, including reinstalled boilers, shall be installed in accordance with the requirements of the latest revision of the applicable section of the ASME code and these rules. These boilers shall be inspected within 30 days of the owner or operator notification.
  - 4. Secondhand boilers shall meet all the requirements for new installations, including code construction and stamping requirements.
- B. Existing installations
  - 1. The maximum allowable working pressure for standard boilers shall be determined in accordance with the applicable provisions of the edition of the ASME code under which they were constructed and stamped.
  - 2. In no case shall the maximum allowable working pressure of an existing nonstandard boiler be increased to a greater pressure than would be allowed for a new boiler of same construction.
  - 3. The age limit of any boiler of nonstandard construction installed prior to the date this law became effective shall be 30 years, except that after a thorough internal and external inspection and hydrostatic pressure test of one and one-half times the allowable working pressure, held for a period of at least 30 minutes, during which no distress or leakage develops, any boiler having other than a lap-riveted longitudinal joint may be continued in operation without reduction in working pressure. The age limit of any nonstandard boiler having lap-riveted longitudinal joints and operating at a pressure in excess of 50 psig shall be 20 years; this type of boiler, when removed from the existing setting, shall not be reinstalled for a pressure in excess of 15 psig; and a reasonable time for replacement shall be given at the discretion of the executive director.
  - 4. Shipment of portable or stationary nonstandard boilers into this state for use is prohibited unless application has been made for approval as a portable or stationary nonstandard boiler used for exhibition, instruction, education, show, display, or demonstration. The request to register a portable or stationary nonstandard boiler should include a sufficient description of the materials, methods of construction, drawings, and such other design information as required by the chief inspector to establish the maximum allowable working pressure. As an alternative, the chief inspector may require a proof test of the portable or stationary nonstandard boiler in accordance with the edition of the Code determined to be most applicable for the method of construction.
  - 5. In any case where a boiler is moved and reinstalled, the fittings and appliances must comply with the ASME code.
  - 6. The maximum allowable working pressure on the shell of an existing steam heating boiler shall not exceed 15 psig. For a hot water heating boiler, the working pressure shall not exceed 160 psig or a temperature of 250 degrees Fahrenheit. The maximum allowable working pressure on the shell of an existing



## BUILDING EXCELLENCE

- riveted heating boiler shall be determined in accordance with the National Board Inspection Code covering existing installations for riveted boilers.
- C. Attendance on boilers. A boiler in operation shall be under the supervision of and checked at suitable intervals by a competent attendant, regardless of whether or not it is equipped with automatic feed water regulator, fuel and damper regulator, high-and-low-water alarm, or any other form of automatic control. A competent attendant shall be a person who is familiar with the operation of the boiler and who has been properly instructed in its safe operation.
- D. Care of boiler room
1. The boiler room shall be free from accumulation of rubbish and materials that obstruct access to the boiler, its setting, or firing equipment.
  2. The storage of flammable material or gasoline-powered equipment in the boiler room is prohibited.
  3. The roof over boilers designed for indoor installations shall be free from leaks and maintained in good condition.
  4. Adequate drainage shall be provided.
  5. All exit doors shall open outward. Two or more exits remote from each other should be provided.
  6. It is recommended that the ASME Code, Section VI, covering recommended rules for the care and operation of heating boilers be used as a guide for proper and safe operating practices.
  7. It is recommended that the ASME Code, Section VII, recommended rules for care and operation of power boilers, be used as a guide for proper and safe operating practices.
- E. Foundations and levels.
1. All boilers shall be kept reasonably level and must be provided with a substantial foundation such as steel, concrete, brick, or stone. The boiler mud rim or bottom of a vertical boiler setting shall not be less than six inches from the ground. The locomotive-type boiler mud rim or wet bottom shall have the foundation of its setting not less than 12 inches from the floor or ground. All boiler mud rims shall be accessible to the inspector.
  2. Boilers that are not level and do not have substantial foundations may be removed from service until such provisions are provided.
  3. Supports for boilers shall be masonry or structural steel of sufficient strength and rigidity to safely support the boiler. There shall be no vibration in either the boiler or its connecting piping.
- F. Clearance
1. All boilers and their appurtenances shall be so located that adequate space will be provided for the proper operation, inspection, maintenance, and repair.
  2. A minimum clearance of two feet shall be maintained on all sides of a boiler except portable boilers. A minimum of four feet shall be maintained between top of a boiler and roof joist. A minimum of one foot shall be maintained between the bottom of scotch-type boilers and the foundation or floor.
- G. Safety appliances
1. General. No one shall remove (except temporarily for repair), fail to replace after removal, displace, damage, destroy, carry off, tamper with, or fail to use any safety appliance. When the safety appliance has been removed for repairs and the seal broken, such appliance shall not be replaced on the boiler until it is in proper working order. Such appliance shall not be set at a pressure in excess of the working pressure stated on the certificate of operation. The seal shall be replaced prior to returning the boiler to service.
  2. Dismantled boiler. When a boiler is dismantled or moved, all safety appliances must conform to the requirements governing new installations prior to a return to service.
- H. Preparation for inspection



## BUILDING EXCELLENCE

1. The owner or operator shall prepare a boiler for internal inspection in the following manner.
  - a. Water shall be drawn off and the boiler thoroughly washed.
  - b. All manhole and handhole plates, washout plugs, and plugs in water column connections shall be removed as necessary for complete inspection. The furnace and combustion chambers shall be thoroughly cooled and cleaned.
  - c. All grates of internally fired boilers shall be removed.
  - d. Brickwork shall be removed as required by the inspector in order to determine the condition of the boiler, headers, furnace, supports, or other parts.
  - e. The pressure gage shall be removed for cleaning of the siphon and testing, if necessary.
  - f. The low-water cutoff device shall be dismantled, cleaned, and prepared for inspection.
  - g. Before removing the manhole or handhole covers and entering any part of the boiler connected to a common header with other boilers any leakage of steam or hot water shall be eliminated. The nonreturn and stop valves must be closed, tagged, and preferably padlocked, and drain valves between the two valves opened. The feedwater valves must be closed, tagged, and preferably padlocked. After draining the boiler, the blowdown valves shall be closed and preferably padlocked. Blowdown lines, where practicable, shall be disconnected between pressure parts and valves. All vent and drain lines shall be opened.
2. If the boiler is jacketed so that the seams of shells, drums, or domes cannot be seen, enough of the jacketing, setting wall, or other form of casing or housing shall be removed to permit inspection to determine the safety of the boiler, provided such information cannot be determined by other means.
3. Portable or stationary nonstandard boilers shall be prepared for inspection as described in this section with the following additional requirements.
  - a. External lagging and insulation shall be removed for the first inspection and at five-year intervals for subsequent inspections.
  - b. Ultrasonic thickness measurements or other examinations as required by the chief inspector or deputy inspector shall be performed to determine the condition of the boiler.
  - c. Any other inspections or examinations shall be performed as determined by the chief inspector as a condition for registration.

### END OF SECTION



B U I L D I N G   E X C E L L E N C E

SECTION 23 54 00

FURNACES

GENERAL

- 1.1 Section Includes: Ductable Furnaces and Fuel-fired heaters
- 1.2 Furnish five year manufacturer warranty. Warranty shall begin at date of substantial completion.

PRODUCTS

2.1 GAS FIRED FURNACES

- A. Acceptable Manufacturers: Reznor, Sterling, Modine
- B. Low pressure gas, 7 TO 11 ounces of gas service
- C. Coated alloy heat exchanger
- D. 1600 CFM and under shall be multi-speed direct drive
- E. Above 1600 CFM shall be belt drive and a minimum 2 speed drive
- F. High limit fan delay on/off, 100% pilot spark ignition
- G. Automatic control valve, thermostat controlled

2.2 FUEL FIRED HEATERS

- A. Acceptable Manufactures: Reznor, Sterling, Modine
- B. All units shall be low pressure natural gas and have integral hanger connections
- C. Duct Furnaces: Shall have stainless steel heat exchangers and burners
- D. Gas Fired Unit Heaters: Propeller fan single speed
- E. Radiant Heaters

EXECUTION

3.1 INSTALLATION

- A. Provide regulator outside nearby area served by gas-fired furnaces to reduce pressure from 5 lbs.

END OF SECTION



**SECTION 23 57 00**

**HEAT EXCHANGERS FOR HVAC**

**GENERAL**

- 1.1 Section includes shell and tube type heat exchangers, plate type heat exchangers and accessories and trim.
- 1.2 Furnish five year manufacturer's warranty for heat exchangers
- 1.3 EXTRA MATERIALS
  - A. Furnish two sets of replacement gaskets.
  - B. Furnish one set of wrenches for disassembly of plate type heat exchangers.

**PRODUCTS**

- 2.1 SHELL AND TUBE TYPE HEAT EXCHANGERS
  - A. Acceptable Manufacturers: Alfa-laval, Graham

**EXECUTION**

- 3.1 INSTALLATION
  - A. Layout with clearance to permit removal of tube bundle or plates with minimum disturbance to installed equipment and piping.
  - B. Provide concrete housekeeping pad 4" high and extend 6" beyond equipment on all sides.

**END OF SECTION**





**B U I L D I N G   E X C E L L E N C E**

**SECTION 23 63 00**

**REFRIGERANT CONDENSERS**

**GENERAL**

- 1.1 Section includes refrigerant condenser package, charge of refrigerant and oil, controls and control connections, refrigerant piping and connections, motor starters, electrical power connections.
- 1.2 WARRANTY: FULL 5 YEARS

**PRODUCTS**

- 2.1 CONDENSING UNITS
  - A. Acceptable Manufacturers: Carrier, Trane, York
  - B. Minimum FIN thickness of 6 mil. Anything less than 6 mil must be coated with phenolic epoxy or other approved coating.
  - C. Air cooled systems shall be sized for maximum 25° F. delta T.
  - D. Water cooled systems shall be sized for maximum 10° F. delta T.
  - E. Must be readily accessible for cleaning.
  - F. Single point electrical connection.
  - G. Provide hail-guards.

**EXECUTION**

- 3.1 INSTALLATION
  - A. Install within 50' of DX coils served.
  - B. Route refrigerant lines in readily accessible location

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 23 64 00

#### PACKAGED WATER CHILLERS

##### GENERAL

- 1.1 Section includes chiller package, controls and control connections, chilled water connections, condenser water connections, auxiliary water connections, starters, and electrical power connections.
- 1.2 COORDINATION
  - A. Locate chillers away from instructional spaces.
  - B. Locate air-cooled chillers with adequate free area.
  - C. Locate chillers to comply with copy of Houston noise ordinance.
- 1.3 WARRANTY: FULL 5 YEARS
  - A. The chiller manufacturer shall provide a full machine parts, labor, and refrigerant warranty for a period of five years. Warranty shall begin from date of Certificate of Substantial.
  - B. Provide evaporator tube eddy current testing in the field after installation but prior to start-up. Provide owner a copy of the eddy current test upon completion. Base line eddy current test shall be performed by Texas Eddy Current.
  - C. High pressure refrigerant chillers only.

##### PRODUCTS

- 2.1 MATERIALS
  - A. Acceptable Manufacturers:
    1. Carrier
    2. Trane
    3. York
    4. Smardt
  - B. Minimum FIN thickness of 6 mil. Anything less than 6 mil must be coated with phenolic epoxy or other approved coating.
  - C. R-22 refrigerant is acceptable if the chiller manufacturer guarantees the availability of R-22 at the then current market price throughout the useful life of the chiller or until 2025, whichever occurs first.
  - D. Air cooled chillers shall have an efficiency of 1.3KW/ton or better including condenser fans.
  - E. Water cooled chillers shall have an efficiency of 0.6 KW/ton or better.
  - F. Chillers ~~over 80 tons~~ shall be provided with High/Low Voltage and Loss of Phase cutouts.
  - G. Any system other than that specified in the "HVAC System Criteria" must have economic/efficiency justification and be accepted by HISD.
  - H. Provide single point electrical connection.
  - I. Provide, install and wire a BACnet interface to CS.
  - J. Reciprocating, centrifugal, scroll are acceptable for replacement work only.
  - K. Where Bacnet Interface cards are used they shall be installed & started up by equipment manufacturer's Representative. Bacnet cards shall be 76.8 KBPS baud rate. They shall be compatible with Alerton, Andover, Automated Logic & Carrier I-Vu controls. They shall be connected as read only.

##### EXECUTION

- 3.1 INSTALLATION
  - A. Install chiller on concrete housekeeping pad minimum four inches high and six inches wider than chiller base on each side.
  - B. Install chillers on vibration isolation.
  - C. For indoor chillers provide a dedicated machinery room, refrigerant rupture disc piping to exterior and refrigerant monitor system tied to emergency purge systems.



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B U I L D I N G   E X C E L L E N C E

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END OF SECTION



## BUILDING EXCELLENCE

### SECTION 23 65 00

#### COOLING TOWERS

##### GENERAL

- 1.1 Section includes packaged cooling tower with structure, casing, fill and basin, controls, heaters fans, motors and drive equipment, condensing water inlet and outlet with internal distribution and ladder and handrails.
- 1.2 Utilize cooling towers for projects with water cooled chillers and water to air heat pump systems only.

##### PRODUCTS

###### 2.1 COOLING TOWERS

- A. Acceptable Manufacturers: BAC, Marley, ~~Evapco~~, Ceramic Cooling Tower, REYMSA
- B. Metal towers coated inside and out.
- C. Propeller fan(s)
  1. Bacnet Interface cards shall be installed and started up by equipment manufacturer's representative. BACnet cards shall be 76.8 KBPS baud rate. They shall be compatible with Alerton, Andover, Automated Logic and Carrier I-Vu controls. They shall be connected as read only. The engineer shall specify that the contractor coordinate the work associated with the BACnet cards so the manufacturer and HVAC controls sub-contractor are present at the same time during programming of the cards. No start/stop of the equipment is allowed utilizing the BACnet interface. Start/stop shall be hard-wired binary points in all cases.
- D. Belt drives are preferred but direct drives are acceptable.
- E. Chillers over 80 tons shall be provided with High/Low Voltage and Loss of Phase cutouts.
- F. Variable frequency drives shall be used to control fan speed and temperature.
- G. Drive motor shall be kept out of the water spray.
- H. Basin heaters and associated control devices.
- I. Water make-up and level control devices.
- J. Vibration sensor and interlock to shut down tower as appropriate.

##### EXECUTION

###### 3.1 INSTALLATION

- A. Bypass shall dump directly into basin.
- B. Install make-up water piping with flanged or union connections to tower. Pitch to tower. Do not support piping from tower.
- C. Install overflow, bleed, and drain, to area drain. Coordinate with Plumbing to provide outdoor drain.

###### 3.2 ADJUSTING

- A. Set and balance water flow to each tower inlet.
- B. Adjust water-level control for proper operating level.

###### 3.3 DEMONSTRATION

- A. A factory-authorized service representative shall train Owner's maintenance personnel to adjust, operate, and maintain cooling towers.
- B. Demonstrate system operations and verify specified performance. A functional test of the installed cooling tower control system shall be performed to demonstrate proper



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functioning of all interlocks and protective systems specified or otherwise required. This testing shall be conducted in the presence of the Owner's representative and the Engineer. The Contractor shall submit test procedure for approval by the Engineer prior to testing.

- C. Coordinate testing with Testing and Balancing contractor.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 23 70 00

#### CENTRAL HVAC EQUIPMENT

##### GENERAL

1. SUMMARY
  - A. Section includes modular factory fabricated air-handling units and accessories.
2. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Spare materials shall be provided by equipment manufacturer and not by the installing mechanical contractor.
  - A. Fan Belts: One for each belt-driven fan.
  - B. Filters: One set for each **HVAC** unit.

##### PRODUCTS

##### 2.1 AIR HANDLING UNITS

- A. Acceptable Manufacturers: Carrier, Trane, York, ~~McQuay~~, Aeon, ~~Tentrol~~, Energy Labs, Climate Craft
- B. Performance Data (typical): Provide all data listed in submittal.

Cooling Coil Performance:		Heating Coil Performance:	
Design		Design	
Air Flow (CFM)	20,000	Air Flow (CFM)	20,000
Capacity Total (MBH)	600	Capacity Total (MBH)	300
Capacity Sensible (MBH)	300	Capacity Sensible (MBH)	300
Entering Air to Coil (Db/Wb)	80/67	Entering Air to Coil (Db/Wb)	25
Leaving Air from Coil (Db/Wb)	55/54	Leaving Air from Coil (Db/Wb)	75
Entering/Leaving Water Temp	54/44	Entering/Leaving Water Temp	180/160
Water Flow to Coil (GPM)	150	Water Flow to Coil (GPM)	100
Max. Water Pressure Drop (Ft)	20	Max. Water Pressure Drop (Ft)	20
Max. Face Velocity (FPM)	500	Max. Face Velocity (FPM)	500
Coil Min. Rows/Max. Fins	6/140	Coil Min. Rows/Max. Fins	2/100
Coil Max. Air Pressure Drop	0.75	Coil Max. Air Pressure Drop	0.25

Fan Performance:	
Design	
Air Flow (CFM)	20,000
External Static (In)	2
Motor (BHP)	20
Motor (HP)	25
Motor Voltage	460/60/3
Fan Wheel Type	AF
Fan Wheel RPM	1200
Fan NC Level	85
Fan Control	VFD

*Controllers, valves, actuators and any other DDC control end devices necessary to accomplish the specified sequence of operations shall be provided by controls contractor*



## BUILDING EXCELLENCE

*for field installation under their strict supervision*

B. Equipment Specifications:

1. Casing
  - a. External casing: 18ga galvanized
  - b. Internal casing: 22ga galvanized
  - c. Cooling coil drain pan: 22ga stainless steel
  - d. Insulation (all sections): R 12 foam panels or better.
  - e. Mounting base: 6" full base rail
  - f. Construction type: Post and panel
  - g. Panel type: Removable and cleanable
2. Access section: Between CHW and HC coils (w/door)Cooling Coil
  - a. Copper ½" diameter (.016" wall) or 5/8" diameter (0.020" wall)
  - b. Fins: Aluminum (0.006")
  - c. Max fins per inch 11
  - d. Min rows: 6
  - e. Working pressure: 150 PSIG
  - f. Casing material: Stainless steel
  - g. AHRI 410 certification
3. Heating Coil
  - a. Tubes: Copper ½" diameter (.016" wall) or 5/8" diameter (0.020" wall)
  - b. Fins: Aluminum (0.006")
  - c. Max fins per inch: 11
  - d. Min rows: 2
  - e. Working pressure: 150 PSI
  - f. Casing material: Stainless steel
  - g. AHRI 410 certification
  - h.
4. Fan Section
  - a. Fan Type: Air foil wheel/forward curve
  - b. Fan coatings: Standard paint
  - c. Fan shaft: Solid steel
  - d. Isolation type: 2" spring
  - e. Isolation location: Internal
  - f. Fan sheave: Fixed (2 belt)
  - g. Motor sheave: 1.4 MHP/Adj. (2 belt)
  - h. Fan bearings: 200,000 HR min
  - i. Grease lines: Extended to casing
  - j. Service access: Full height removable door with window
  - k. Fan motor: ODP, E+3 high efficiency, VFD compatible
5. Filter Section
  - a. Configuration: Flat
  - b. Filter type: Replaceable media frames with 2" pads
  - c. Filter efficiency: 30%
  - d. Provide metal filter frames that are removable for replaceable roll media.
6. Miscellaneous Options:
  - a. Factory start up services
  - b. IAQ (fully draining) condensate pans
  - c. CD-60 outside and return air dampers
  - d. Combination filter mixing box
7. Air Coils
  - a. Acceptable manufacturers: same as air handling units
    - 1) Copper tube aluminum fins
    - 2) Stainless steel frame





## BUILDING EXCELLENCE

- b. Double thickness, internally insulated stainless steel drain pan, conforming to the requirements ASHRAE 62.1.
8. Field Confirmation Items:
  - a. Voltage
  - b. Available MCA
  - c. Available space: height, weight and length
  - d. Evaporator connection
  - e. Casing configuration
  - f. External static pressure
  - g. Special dampers or options
  - h. Controls
9. Provide a minimum of 2" filter rack with all units. Do not provide metal frame filters in new schools.
10. The filter section shall be designed for 30% efficiency filter (as defined by ASHRAE 52-76.) The filter rack shall have vertical supports. The filters shall be mechanically compressed to prevent air by-pass.
11. Control modules manufactured by the AHU manufacturer are not acceptable.
12. Where Bacnet Interface cards are used they shall be installed & started up by equipment manufacturer's Representative. Bacnet cards shall be 76.8 KBPS baud rate. They shall be compatible with Alerton, Andover, Automated Logic & Carrier I-Vu controls. They shall be connected as read only.

### 2.2 FILTERS

- A. Filter Box: Section with filter guides, access doors from both sides, for side loading with gaskets and blank-off plates.
- B. Filter Frames: Pad holding frames shall be permanent metal frames designed to contain replaceable filter media pads. Frames shall be constructed of 22 gauge, galvanized steel U channel cell sides, expanded metal support grid, 9 gauge hinged retainer gate, sized to fit in standard universal holding frames, and accept maximum 2" thick media. Acceptable manufacturers: AAF or pre-approved equal.
- C. Replaceable Filter Media: MERV 13 or greater rating in accordance with ASHREA Test Standard 52.2-2007.
- D. High Capacity Angle Filter: Two (2) inch extended area filters. Air quantities as scheduled, clean pressure drop of 0.10 inches wg; dirty pressure drop of 0.75 inches wg.
- E. Filter Area: Max velocity of 350 FPM.
- F. Filter gauges provided for each filter bank. Shall measure static pressure for the filter pressure drop from 0-2".
- G. Acceptable Manufacturers: American Filter Co., Airguard Industries Inc., Camfill Farr.
  1. Any filter that has been tested and rated will be acceptable. If specific manufacturers are listed, the statement above will not apply.
  2. Replaceable media shall meet LEED requirements minimum MERV 13.

### 2.3 HVAC AIR CLEANING DEVICES

- A. Dust Collectors
- B. Acceptable Manufacturers: American Filter Co., Airguard Industries Inc., Camfill Farr.
  1. Any filter that has been tested and rated will be acceptable. If specific manufacturers are listed, the statement above will not apply.
  2. Replaceable media shall **meet LEED requirements minimum MERV 13.**
- C. Catalytic Air Cleaning Systems
  1. Genesis Air

## EXECUTION

### 3.1 INSTALLATION



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## B U I L D I N G   E X C E L L E N C E

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- A. Contractor to provide fixed sheaves required for final air balance as dictated by Test and Balance Contractor.
- B. Provide trapped condensation drain line routed to the nearest floor drain.
- C. Contractor shall comb and vacuum clean coils, inside and outside of unit cabinet as directed by engineer prior to start-up.
- D. Install temporary filters during construction and start-up period. Replace with new set of specified filters at Substantial Completion.
- E. All air units shall remain in manufacturer's protective shipping wrap during construction. Air unit casing openings must remain protected and covered during construction. If protective wrap has been damaged, the contractor shall provide additional protective wrap as directed by engineer.

### 3.2 AIR HANDLING UNIT CONTROLS

- A. Provide a manual damper on all outside air ducts in addition to automatic dampers.
- B. All chilled water and hot water valves shall be installed outside of the unit.
- C. Provide shut-off valves in and out of each unit.
- D. No water balance necessary by Mechanical Contractor when PICCV's are installed.
- E. DEMAND VENTILATION SHALL BE IMPLEMENTED ON UNIT VENTILATORS, FAN COIL UNITS AND AIR HANDLING UNITS WITH CO2 SENSORS AND OUTSIDE AIR DAMPERS SHALL BE IMPLEMENTED.

**END OF SECTION**



B U I L D I N G   E X C E L L E N C E

SECTION 23 72 00

ENERGY RECOVERY EQUIPMENT

GENERAL

- 1.1 Section Includes: Packaged energy recovery unit.
- 1.2 WARRANTY: FULL 5 YEARS

PRODUCTS

- 2.1 ENERGY RECOVERY AIR HANDLING UNITS
- 2.2 Acceptable Manufacturers: Venmar, Cook, Semco, Greenheck, Conserv
- 2.3 Specifications
  - A. Dessicant Wheels
    - 1. The heat wheel media shall be cleanable with low pressure steam, hot water with detergent or compressed air per manufacturer's Instructions, without damage.
    - 2. Must include Type 3 desiccant wheels
    - 3. The cross contamination shall be less than 0.1% of the exhaust air flow.
    - 4. The media shall have a 42 Month warranty with the remaining portion having a 36 Month warranty. Provide a deduct for 12 Month only warranty.
  - B. Controls
    - 1. All controls and devices necessary to accomplish the specified sequence of operations shall be provided and installed by manufacturer.
    - 2. Bacnet Interface Cards shall be used to start/stop the Energy Recovery Equipment. DDC controls will only start/stop by a hard wired contact. Status information received from the equipment will be read from the cards.
    - 3. Bacnet Interface cards shall be used & they shall be installed & started up by equipment manufacturer's representative. Bacnet cards shall be 76.8 KBPS baud rate. They shall be compatible with Alerton, Andover, Automated Logic & Carrier I-Vu controls. They shall be connected as read only.

EXECUTION

- 3.1 CS Interface
  - A. Provide complete operational graphic on DDC web portal indicating dry bulb and dew point discharge information.

END OF SECTION



## BUILDING EXCELLENCE

### SECTION 23 81 00

#### DECENTRALIZED UNITARY HVAC EQUIPMENT

##### GENERAL

###### 1.1 GENERAL REQUIREMENTS

- A. Provide self contained, through the wall room air conditioners factory wired and piped.
- B. Units shall be U.L. listed and AHAM certified.
- C. Units shall be ETL certified for performance.
- D. Provide equipment with electrical characteristics as shown on the Electrical Drawings.

- 1.2 Submit in form similar to the schedule on the Drawings. Show all data listed in schedule, electrical characteristics and accessories being provided.

##### PRODUCTS

###### 2.1 DX HEAT PUMPS

- A. Acceptable Manufacturers: Carrier, Trane, York.
- B. Economic justification required for implementation of heat pumps.
- C. All control end devices necessary to accomplish the specified sequence of operations shall be provided and installed by manufacture.
- D. BACnet Interface cards shall be installed and started up by equipment manufacturer's representative. BACnet cards shall be 76.8 Kbps baud rate. They shall be compatible with Alerton, Andover, Automated Logic and Carrier I-Vu controls. They shall be connected as read only. The engineer shall specify that the contractor coordinate the work associated with the BACnet cards so the manufacturer and HVAC controls sub-contractor are present at the same time during programming of the cards. No start/stop of the equipment is allowed utilizing the BACnet interface. Start/stop shall be hard-wired binary points in all cases.

###### 2.2 VARIABLE REFRIGERANT ~~VOLUME FLOW (VRV)~~ (VRF)

- A. Acceptable Manufacturers: Daikin, Toshiba, LG & ~~Mitsubishi~~.

###### 2.3 PACKAGED AIR CONDITIONING UNITS

- A. Computer Room Air Conditioning Units.
- B. DX split systems may be used.
- C. Acceptable Manufacturers: Carrier, Trane, York.
- D. All control end devices necessary to accomplish the specified sequence of operations shall be provided and installed by manufacture.
- E. BACnet Interface cards shall be installed and started up by equipment manufacturer's representative. BACnet cards shall be 76.8 Kbps baud rate. They shall be compatible with Alerton, Andover, Automated Logic and Carrier I-Vu controls. They shall be connected as read only. The engineer shall specify that the contractor coordinate the work associated with the BACnet cards so the manufacturer and HVAC controls sub-contractor are present at the same time during programming of the cards. No start/stop of the equipment is allowed utilizing the BACnet interface. Start/stop shall be hard-wired binary points in all cases.

###### 2.4 PACKAGED ROOFTOP AIR CONDITIONING UNITS

- A. Acceptable Manufacturers: Carrier, Trane, York, Aeon, ~~Valent, Energy Labs~~, Concepts and Designs Incorporated (CDI)
- B. Curb mounted.
- C. Multiple compressors for units 10 tons and larger.



## BUILDING EXCELLENCE

- D. Integral exhaust with energy recovery system.
- E. DX Unit with hot refrigerant gas re-heat and total energy heat wheel. The unit shall be provided with gas or electric heat.
- F. Total energy heat recovery wheel exhausting spare air, with desiccant unit with DX cooling of the dry air and heat rejection to the regeneration air.
- G. The system shall include:
  - 1. Minimum 2" filter rack
  - 2. Bird screen on intake.
  - 3. For DX unit, hail-guards for condenser section.
  - 4. For DX unit, thermostat and space/supply air cooling/heating temperature controller. Interface to CS shall include enable/disable, status and general alarm.
- H. All control end devices necessary to accomplish the specified sequence of operations shall be provided and installed by manufacture.
- I. BACnet Interface cards shall be installed and started up by equipment manufacturer's representative. BACnet cards shall be 76.8 KBPS baud rate. They shall be compatible with Alerton, Andover, Automated Logic and Carrier I-Vu controls. They shall be connected as read only. The engineer shall specify that the contractor coordinate the work associated with the BACnet cards so the manufacturer and HVAC controls sub-contractor are present at the same time during programming of the cards. No start/stop of the equipment is allowed utilizing the BACnet interface. Start/stop shall be hard-wired binary points in all cases.
- J. Interface to CS shall include enable/disable and general alarm.

### 2.5 PACKAGED ROOFTOP AIR CONDITIONING UNITS – 100% OUTSIDE AIR

- A. Acceptable Manufacturers: Aaon, Addison, Engineered Air, Munters, ATS, Drykor, Daiken, Desertaire, Valent, Petra, Trane
- B. DX or chilled water.
- C. Integral exhaust with energy recovery system.
- D. DX Unit with "modulating" hot refrigerant gas re-heat and total energy heat wheel. The unit shall be provided with gas or electric heat.
- E. Total energy heat recovery wheel exhausting spare air to the outside, with desiccant unit with DX cooling of the dry air and heat rejection to the regeneration air.
  - 1. All-control end devices necessary to accomplish the specified sequence of operations shall be provided & installed by manufacture-
  - 2. Bacnet Interface cards shall be used & they shall be installed & started up by equipment manufacturer's representative. BACnet cards shall be 76.8 KBPS baud rate. They shall be compatible with Alerton, Andover, Automated Logic & Carrier I-Vu controls. They shall be connected as read only.
- F. The system shall include:
  - 1. Minimum 2" filter rack
  - 2. Bird screen on intake.
  - 3. For DX unit, hail-guards for condenser section.
  - 4. Each unit shall have a preheat coil for freeze protection if chilled water.
  - 5. For DX unit, thermostat and space/supply air cooling/heating temperature controller.
- G. Interface to CS shall include enable/disable, status and general alarm.

## EXECUTION

### 3.1 INSTALLATION

- A. Provide gravity flow condensate system.
- B. Provide local disconnect.
- C. Provide connection to CS.

### END OF SECTION



## BUILDING EXCELLENCE

### SECTION 23 82 00

#### HEATING AND COOLING UNITS

##### GENERAL

- 1.1 This section includes constant-volume fan coil units with coils for indoor installations.
- 1.2 QUALITY ASSURANCE
  - A. Obtain fan coil units through one source from a single manufacturer.
  - B. Product Options: Drawings indicate size, profiles, and dimensional requirements of fan coil units and are based on the specific system indicated.
  - C. Coordinate size and location of structural-steel support members.

##### PRODUCTS

- 2.1 MATERIALS
  - A. Fan Coil Units
    - 1. Controls: see DDC Controls Section.
    - 2. Acceptable Manufacturers: Carrier, Trane, International, Enviro-tec, York
    - 3. Provide a manual damper on all outside air ducts in addition to automatic dampers.
    - 4. All chilled water and hot water valves shall be installed outside of the unit.
    - 5. Provide shut-off valves in and out of each unit.
    - 6. Fan motor shall be suitable for ECM/VFD applications.
    - 7. ECM motors to be provided, installed and wired by equipment manufacturer. ECM motors shall be true analog control and not multi speed motors.
    - 8. No water balance necessary by Mechanical Contractor when PICCV's are installed.
    - 9. DEMAND VENTILATION SHALL BE IMPLEMENTED ON UNIT VENTILATORS, FAN COIL UNITS AND AIR HANDLING UNITS WITH CO2 SENSORS AND OUTSIDE AIR DAMPERS.
  - B. Unit Ventilators
    - 1. Controls: See DDC Controls Section.
    - 2. Acceptable Manufacturers: Magic Aire, International, Trane, ~~Herman-Nelson~~, Carrier, Johnson Controls and Temp-spec (Note: Temp-spec units will have all actuators & valves factory installed. They shall be furnished by the controls contractor.)
    - 3. Provide a service switch on the inside of the unit.
    - 4. Provide a manual damper on all outside air ducts in addition to automatic dampers.
    - 5. All chilled water and hot water valves shall be installed outside of the unit.
    - 6. Provide shut-off valves in and out of each unit.
    - 7. Fan motor shall be suitable for ECM/VFD applications.
    - 8. ECM motors to be provided, installed and wired by equipment manufacturer. ECM motors shall be true analog control and not multi speed motors.
    - 9. No water balance necessary by Mechanical Contractor when PICCV's are installed.
    - 10. Any work required beyond this scope of work shall be approved by the Design Standards Committee.
    - 11. DEMAND VENTILATION SHALL BE IMPLEMENTED ON UNIT VENTILATORS, FAN COIL UNITS AND AIR HANDLING UNITS WITH CO2 SENSORS AND



## BUILDING EXCELLENCE

### OUTSIDE AIR DAMPERS.

- C. Casing to be powder coated
  - 1. 14 gauge Front Panels on vertical units
  - 2. Hinged access panels with Cam locks
  - 3. 11" end pockets or larger for piping and controls
  - 4. Removable fan boards
  - 5. ½" insulation (flame spread less than 20)
- D. Fan/Motor
  - 1. Fan motors shall be ECM.
  - 2. The unit controls shall vary the speed in response to variance from set point.
  - 3. Manually adjustable fans are not acceptable.
  - 4. Fan motors shall have unit mounted disconnects.
- E. Coils
  - 1. All units shall have the cooling coil first in air stream followed by a re-heat coil.
  - 2. Coils must be fully accessible for cleaning from access panels.
  - 3. Coils hidden behind un-removable panels are not acceptable.
- F. Filters
  - 1. Filters shall be 1" pleated media with metal frames.
  - 2. Filters shall be removable from front or bottom of units.
  - 3. Acceptable Manufacturers: American Filter Co., Airguard Industries Inc., Camfill Farr.
  - 4. Any filter that has been tested and rated will be acceptable. If specific manufacturers are listed, the statement above will not apply.
  - 5. Replaceable media shall meet LEED requirements minimum MERV 13.
- G. Dampers
  - 1. Dampers shall be provided for outside and return air
  - 2. Dampers shall have rubber edge seals
- H. Certification
  - 1. All units must carry ARI 840 Certification
  - 2. All units must carry ARI 440 or 220 Coil Performance Certification
- I. Controls
  - 1. Controllers, valves, actuators and any other DDC control end devices necessary to accomplish the specified sequence of operations shall be provided by controls contractor for field installation under their strict supervision.
- J. Drain Pans
  - 1. Drain pans shall be ABS plastic or stainless steel
  - 2. Drain pans shall be IAQ fully draining
  - 3. Galvanized drain pans will not be acceptable
  - 4. Drain pans shall be easily removable for cleaning

### EXECUTION

- 3.1 INSTALLATION: LOCATE IN READILY ACCESSIBLE LOCATION FOR EASE OF MACHINARIES

END OF SECTION





## BUILDING EXCELLENCE

### SECTION 26 05 00

#### ELECTRICAL COMMON WORK RESULTS

##### GENERAL

##### 1.1 GENERAL PROVISIONS FOR ELECTRICAL WORK

- A. Electrical Work includes complete systems of electrical service, power distribution, lighting, emergency lighting, lighting control, controllers, cabinets, motor controllers, transformers, circuit breakers, fuses, disconnect switches, surge protection devices, interior and exterior lighting, parking lot lighting, lamps, relay, starters, contactors, wiring, wiring devices, grounding and bonding, lighting protection, equipment wiring system, conduits, raceways, boxes, supporting devices, identification and labeling, fire stopping, testing, training, and commissioning. This includes working clearances, excavating, concrete equipment isolation, access panels, record drawings, installation permits, inspection by governing authorities, cutting and patching work, utility connection coordination, start-up of electrical system and other systems, equipment training of Owner's personnel, operating and maintenance manuals, training videos, housekeeping and cleaning of electrical equipment, Personnel trainings, Test of main circuit breakers, Infrared IR Scans (baseline), Selective Coordination Study, and Commissioning Equipment.
- B. Contractor shall work in conjunction with the Center Point Power Company for the installation of the outdoor pad mounted transformer or overhead. Coordinate the work for the primary of secondary connections, metering, raceways and scheduling of the installation. Service Outlet Location documentation shall be provided to HISD master electrician for records. The HISD Program Manager is responsible to fill out the form for request of new/deletion of meter service and not the contractors. This should be requested 24 days prior to installation/hooking up the power. Once the electrical service is not needed, it is the HISD Program Manager to request for disconnection.
- C. Install primary electrical conduit to a depth not less than 48" deep, in RED CONCRETE ENCASEMENT PLUS TWO RED CAUTION TAPES. Service entrances conduits shall be schedule 80 PVC conduits covered with CAUTION plastic tape, on stand supports and sand pack before backfill. All underground primary conduit and feeders shall be installed per CenterPoint Energy's requirements. All conduits shall be install straight and rigidly securely anchor to the ground on every 6 feet intervals to prevent movement and level conduit throughout the run.
- D. This Division requires the furnishing and installing of items specified or indicated on drawings or reasonably inferred; including every article, device or accessory (whether or not specifically called for by Item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, utilities and as required for complete installation and operation. All work performed under this Section shall be in accordance with the Drawings and HISD MEP Standard Specifications and subject to the terms and conditions of the Contract.
- E. All work shall comply with current addition of all pertinent local and national codes, ordinances, ADA or other regulations, as well as any other authorities that may have lawful jurisdiction pertaining to the work specified. None of the terms or provisions of this Specification shall be construed as waiving any of the rules, regulations or requirements of these authorities.
- F. All work shall be performed in compliance with all applicable and governing safety regulations. All safety lights, guards and signs required for the performance of the work shall be provided by and operated by the Contractor.
- G. Contractor shall comply with safety and occupational health requirements of OSHA and of local authorities. Responsibility for compliance rests solely on the Contractor.



## BUILDING EXCELLENCE

- H. All items of equipment and all materials shall meet standards of and be approved by nationally recognized standards and testing authorities where such standards and testing for materials and equipment are available. All electrical material and equipment used shall be listed, label, approved and Underwriter Laboratory (UL).
- I. All work shall comply with rules and regulations of the latest edition of National Electrical Code, Life Safety Code, City Code, Underwriters' Laboratories, State Fire Insurance Regulatory Body, whether indicated in the Contract Drawings and Specifications or not.
- J. Secure all permits, licenses and inspections required for this work, and shall pay all fees in connection with such permits, licenses and inspections. The electrical contractor shall employ only qualified licenses electricians on in the job-site. The master electrician must be an employee of their company not just leasing the license to perform HISD jobs. The master electrician shall be responsible, supervision, tracking, scheduling, and installation of all electrical equipment, devices, and wiring terminations. The electrical contractor shall install all equipment, wiring, terminations with no defects. The general/electrical shall provide copies of their electrical licenses and City Permits to the master electrician of the District/Owner. Meg all service and feeder conductors to ensure that no short circuits or ground faults before energizing the electrical system. Record all readings on a spreadsheet identifying the service and feeder conductors.
- K. The Contractor shall be responsible for fitting all material and apparatus into the building and shall carefully lay out all work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and hereby to provide an integrated satisfactory operating installation. All work must be coordinated to every crafts to make sure there are no interference with other works. Any violation must be recognized and possible solutions to correct it.
- L. All equipment and materials shall be new (first class) installed in conformance with manufacturer's recommendations and instructions unless in conflict with these Drawings and Specifications. Any conflicts that arise shall be presented to the HISD Program Manager, during the Submittal Process, for resolution.
- M. Conform to specific requirements shown on the Drawings or described elsewhere in these Specifications. All equipment furnished and installed shall be properly secured in place. Follow Manufacturer's recommendations unless otherwise indicated; use vibration isolators where applicable.
- N. Wall-mounted equipment, devices, etc., shall be grouped and install neatly in functionally logical arrangement, and in as aesthetically pleasing a manner as possible. Coordinate work with other trades where their wall-mounted equipment is in close proximity.
- O. Penetrations through walls, ceilings, or floors shall be accomplished neatly. Where visible, penetrations shall be provided with appropriate escushion or trim. Penetrations through exterior walls shall be made weatherproof and insect-proof. Penetrations shall not impair the integrity of the wall, floor, or ceiling; e.g., fire- rated walls, dust-tight walls, soundproof walls, etc. Penetrations must be sleeves unless weatherproof are required. No roof Penetrations shall be done without prior approval by Structural engineer and the Owner.
- P. All walls, ceilings, floors, and underground cover must be verified, field and inspected by the owner Electrical Department, architect and MEP engineer of the project. It is the responsibility of the general contractor to make it happen. Any cost of any corrections and damages, shall fall on the general contractor or parties that approved of the installations.
- Q. The Contractor shall provide the necessary wiring, connections, service switches, poles, wiring protective devices, lighting fixtures, lamps, outlet devices, occupancy sensor s, disconnect switches, etc., required for temporary lighting, single-phase and three-phase power of voltage levels required for the construction of the project. All such equipment shall remain the care of the Contractor while on-site and shall be removed when permanent connections have been completed. No wire, bus or electrical equipment that is part of any of the permanent electrical systems, may be used for temporary electrical



## BUILDING EXCELLENCE

- service for construction operations, unless specifically approved by the HISD. The occupancy sensors and other devices that install on ceiling grid shall be install on octagon/square box on tee-bars. Any unused equipment, wiring, devices, fixtures and apparatus must be turn-in to HISD.
- R. Temporary connection shall be in accordance with the applicable codes. The Contractor shall be responsible for any damage to equipment or and materials, or injury to personnel caused by improperly protected temporary installations. All costs for materials and installation for distribution of temporary electrical facilities shall be at the expense of the Contractor.
  - S. Cutting and patching necessitated by any failure on the part of the Contractor to do this shall be performed at no additional cost to the Owner.
  - T. Verify openings, supports, and space availability shown on plans for use by the Contractor or for installation of all the equipment. If such items are not suitable, notify the Owner immediately.
  - U. Provide roof jacks as required for all equipment and material which is to be installed on the roof. Install the jacks prior to the installation of any conduit, supports or equipment. Any roof work, it shall be the responsibility of the contractor to secure, keep safe the existing conduits in placed. Any breakdown or loose conduit must be fix at once. On existing building where conduits run in the roof must be install on a rack to a 18 inches high from the roof surface. Comply with NEC Table 310.15(B)(2)(a) for Correction Factors.
  - V. Prior to the installation of any devices in the ceiling, the Contractor shall review all Drawings to ascertain if the locations of all devices in the ceilings are such as to create a pattern that is compatible with the reflected ceiling plan and the spacing's of the various electrical devices.
  - W. Short Circuit Analysis: Prior to any electrical submittals being reviewed, the contractor shall perform short-circuit analysis of the specified electrical power distribution such as transformers, panelboards, motors and any other loads. This subjected in the selection of the correct panelboards and equipment.
  - X. All fixtures must be review and verified by HISD prior to submittals and approval. It is the responsibility of the designer to provide this information to the HISD Owner. Do not use recessed can fixtures, and ovation fixtures or similar type of other manufactured. Do not used metal halide on either indoor or outdoor installations. All outdoor lighting applications shall use LED's fixtures with the exceptions of fluorescent on canopies. Provide a photometry in all lighting design. The engineer approved of records must review make recommendations to HISD Owner before to submittals and approval.
  - Y. No lighting fixtures shall be install in stairway and atrium.
  - Z. On the Electrical One-line diagram, the designers shall indicate the length of the conduit and conductor wiring in each service conductors and feeder conductors in the design drawing and as-built blueprint. Provide also the short circuit interrupting rating KAIC, and the brazing KAIC in the One-Line Diagram.
  - AA. All panelboards shall not use an all thread nipple or chase nipple between panelboards. It shall use a close nipple with two locknuts, one in each side for better bonding and grounding. Panelboards shall not be used as raceways, splicing for wiring connections and pull boxes.
  - BB. NO SPLICING ARE ALLOWED ON BRANCH CIRUIT, FEEDERS, SERVICE CONDUCTORS, GROUNDING & EQUIPMENT CONDUCTORS AND INSIDE THE PANELBOARDS.
  - CC. THE SUBSTANTIAL COMPLETION OF A NEW BUILDING OR RENOVATED BUILDING ARE WHEN THE OWNER RECEIVE THE PROPER TRAINING OF THE EQUIPMENT, CORRECTED ALL DEFFECINCIES, PERMITS, O&M MANUALS, DRAWINGS, TRAINING CD'S OR DVD'S, MANUFACTURED DRAWINGS, ARE BEEN FINAL, THE O&M MANUALS ARE TO BE SUBMITTED TO THE OWNER, THEN THE EQUIPMENT



## BUILDING EXCELLENCE

WARRANTY AND BUILDING WARRANTY STARTS NOT WHEN THE EQUIPMENT BARELY INSTALL.

- DD. All walls, ceilings, floors and underground covers, HISD shall be notify within 24 hours in advance for field inspection prior to cover up. Failure to the contractor can be recommend to force to dig, remove all covers for inspections.
- EE. In each Science Learning Center/Wet Lab, provide a red emergency shut off button to shutdown water, gas and electricity in event of an emergency. Locate this button in the teacher's workstation and away from exit door.

### 1.2 GENERAL ELECTRICAL DISTRIBUTION SYSTEMS

- A. Electrical consult shall contact electric utility provider to arrange for new or expanded electrical service. Electrical consultant shall provide utility company with electrical load analysis electrical one-line diagram so the power company can determine the size of the service transformers.
- B. Provide a main circuit breaker for each service. The "Six Main Rule" shall not be used.
- C. Size service conductors and main circuit breaker shall have a spare capacity of 25% for expansion.
  - 1. Minimum service size is as follows: Elementary Schools – 1600 Amps, Middle Schools – 2500 Amps, High Schools – 3000 Amps.
- D. HISD desired service is 277/480 volts, 3 phase, 4 wire, 60 hertz, 65 KAIC RMS and grounded WYE system.
- E. HISD requires the "standard service" design as determined by the utility company. HISD will not pay for a "non-standard" electrical service.
- F. Outdoor Standard Service shall be poured concrete pad mounted underground service or overhead service and meet the power company standards. Poured concrete Pads shall be not less than 12-inches with 5/8 re-bars above and below finished grade and shall meet power company standards.
- G. If overhead service is determine on the standard service calculations, a free-standing bussed electrical service weatherhead shall be installed on W6X6 galvanized I-beams with 2" X 4" galvanized channels welded to the I-beams. A concrete housekeeping pad shall be poured to encompass the free-standing bussed weatherhead and conduit. Provide a minimum of not less than 4 feet minimum working clearance of poured concrete in front of the switchgear, and 3 feet all sides and back for maintenance access. The I-beams shall be buried not less 6 feet depth with poured concrete footing. Note: No wooden poles are allowed. Provide a 4 inch lip welded around the top of the switchboard as transition to bussed weatherhead to keep water from settling. The top cover of the switchboard shall have at least 1 inch sloop from front to the back to drain the water. Indoor Standard Service shall be at least 6 inches height of poured concrete with re-bars. Maintain a working clearance of not less than 3 feet all around between the switchboard and the wall partition, per NEC 110.26.

The switchboard, Motor Control Center and Power Panelboards shall not have any obstruction in front within a distance of 4 feet per NEC 110.26. If available, designer shall attempt to provide more than the minimum space required per NEC 110.26.

For Temporary Building service determine the standard service calculations. A free-standing bussed electrical service weather head shall be installed on W4X6 galvanized I-beams with 2" X 4" galvanized channels welded to the I-beams. Provide a concrete pad below the service location.
- H. Install fencing around the switchgear of at least a minimum 6 feet high with one full access gate at the front and back of equivalent width of the switchgear.
- I. Provide a separate service to maintain all Temporary Buildings (T-buildings). Service equipment shall be rigidly supported by galvanized I-beams. Refer to Letter G above.
- J. In general, electrical equipment shall not be installed in rooms below the finished grade elevation below established flood elevation.



## BUILDING EXCELLENCE

- K. Switchboards and electrical equipment shall be located in dedicated electrical rooms only with panic hardware towards the egress. Switchgear shall not be located in boiler rooms. No overhead sprinkler or other piping inside the electrical room.
- L. Unless site conditions complicate or prohibit underground service, run all service entrance conductors on school property in approved raceway and include one empty conduit of same size and cap properly. Install electrical conduit to a depth prescribed by the NEC and/or authority having jurisdiction but not less than 48" deep, in red concrete encasement plus two red caution tapes.
  - 1. All buried underground electrical conduits shall be installed to a depth prescribed by the NEC and/or authority having jurisdiction but not less than 48" deep from the top of a schedule 40 PVC conduit properly supported anchored to the ground every 6 feet to prevent shifting or movement, sand pack before covered with red concrete. The conduits shall be install straight and level throughout the conduit run. All underground work shall be inspected by HISD representative before cover up. Provide at least 24 hours in advance for inspections.
  - 2. All underground primary feeders shall be installed per electric utility company specifications.
  - 3. Underground distribution feeders and branch circuits shall be installed in schedule 40 PVC conduit with grounding conductor sized per N.E.C. sweep 90° elbows shall be rigid galvanized steel and stub-ups through concrete floor to be PVC coated rigid galvanized steel. Concrete encasement not required under building slab or other paved areas.
- M. All panelboards and distribution panels shall have a neutral and ground bus. All panelboards shall have the box enclosure lip be stabilize so hinged front cover is not out-of-line. The hinged cover to be through and through.
- N. All electrical panelboards and disconnecting means shall not be install behind doors, corridors, stairways, except on designated electrical room only. Panelboards and other equipment mounting on walls shall be mounted on channels struts 1-5/8 x 1-5/8.
- O. Locate panel boards in kitchens and to serve their respective loads. In kitchen area, use stainless steel or NEMA rated for wet/damp locations. No panel boards are allowed to be installed in swimming pool areas or chemical storage rooms. All outdoor panel boards shall be NEMA 3R, except as follows: in areas adjacent to cooling towers, provide NEMA 4X stainless steel equipment.
- P. All mechanical chiller feeders, variable speed drive motor controllers or full voltage non-reversing motor controllers for pumps, air handling units, fans and any other 3 phase hvac equipment loads shall be equipped with integral phase failure protection, unbalance voltage protection and single-phasing protection coordinate with mechanical drawings to ensure proper motor starter/control equipment specification.
- Q. Specify for the manufacturer of the switchgear to provide a coordination study, fault current analysis, arc flash study and test of the main circuit breakers by qualified certified third-party.
- R. All outdoor switchboards shall install fencing at 6 feet in height.
- S. In general, electrical equipment shall not be installed in the rooms below finished grade elevation of basement.
- T. Special Notes about Wiring:
  - 1. Wiring to all non dedicated electrical receptacles and switches are required to utilize parallel circuiting by the use of "pig tails" to each device sot that if an outlet is removed or fails, electrical continuity of the circuit shall not be compromised.
  - 2. All electrical wiring must be properly spliced by twisting the wires together and use of approved and listed compression wire nuts for the application.
  - 3. Do not use end to end butt-splicing connections for any wiring.
- U. Conduit Labeling: Main feeder conduits to each panelboard and distribution panel shall be labeled. Labeling shall be legible and permanent, labeling shall include
  - 1. "Main Feeder to panel (insert panel name)"





## BUILDING EXCELLENCE

2. "Panel(insert panel name) contains breakers or over current device"
- V. All boxes, junction boxes, and pull boxes shall be accessible within reachable. In a areas such as restroom and enclose hard ceiling, junction boxes shall be install outside where are accessible. No extension ring shall be use in any installation. All junction boxes and pull boxes shall be use as pull not for splicing. Splicing is only made when making a 6 feet fixture whip and the devices.
- W. All boxes must be rigidly secure with a screw to a bracket between metal studs. Do not use a movable bracket attach to a box. The face of the box must flush when constructed of a combustible materials and 1/4" back on concrete or masonry. The space on side of the box must at least 1/8 of an inch. No spacing more or less required by Code. All conduits must securely supported every 3 feet of the box not just the support of the box.

### 1.3 GENERAL PROVISION FOR BRANCH CIRCUITS AND GROUNDING

- A. Voltage Ratings
  1. Motors, 1/2 hp and less shall be 120 V single phase
  2. Motors 3/4 hp and above: 480V 3 phase
  3. Heating elements up to 1.8kw: 120 V single phase
  4. Heating elements 1.8kw to 4kw: 277 V single phase
  5. Heating elements above 4kw: 480V 3 phase
  6. Kitchen equipment, hardwired: Verify with kitchen consultant (480/3 preferred)
  7. Fluorescent lighting: 277 V single phase
  8. Any exterior lighting above 22 feet shall be 480 V single phase
  9. Special purpose receptacles: 208 V single-phase (verify for each unit of equipment)
  10. General Purpose receptacles: 120 V single-phase, 20 AMP rated
- B. Branch Circuits
  1. 120 volt receptacles circuits and 277 volt lighting circuits shall be routed in separate raceways with insulated throat.
  2. A grounding conductor shall be provided with all feeders and branch circuits (size based on Article 250, N.E.C.)
  3. Learning Centers shall be served with one-120 volt, 20 amp branch circuit for teacher's receptacles, two- 120 volt, 20 amp branch circuits for computers, one – 120 volt, 20 amp, for smartboards and projectors and 277 volt for lighting.
  4. All branch circuits homeruns serving computers, printers, copiers, fax machines, etc. shall utilize Phase "A", "B", and "C" with a 200% neutral on a 3/4" conduit. It is acceptable to combine with three independent neutral conductors (one for each circuit) in a 3/4" conduit.
  5. All branch circuit conduits shall be routed over head on uniformity runs and junction boxes shall be 8 inches above the ceiling on high ceiling.
  6. All electrical wiring must be properly spliced by twisting the wires together and use of approved and listed compression wire nuts for the application.
  7. Do not use end to end butt-splicing connections for any wiring.
  8. Do not connect two ungrounded conductors to same circuit breaker in any of the panel. Do not make any splicing such as branch circuit conductors inside the panels, safety switches, or non-automatic circuit breakers in separate enclosures. Do not make any splicing on service conductors, and feeder conductors.
  9. Circuit grouping, conduit or cable runs and home runs are indicated with number of conductors shown in each raceway to clarify operation and function of various systems. Comply per NEC Table 310.15(B)(3)(a).
    - a. All wire shall be installed in conduit or raceways but not plastic
    - b. All circuits shall have hot, neutral and green ground wire.



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- c. Provide No. 12 conductors and No. 12 grounding wire minimum to all 20 amp circuit. Calculate the voltage drop over 200 feet for adjustment of conductor size.
    - d. Provide No. 10 conductors and No. 10 grounding wire minimum to all 30 amp circuit. Calculate the voltage drop over 200 feet for adjustment of conductor size.
    - e. Provide No. 10 conductors for 120/208, 20 amp circuits for which the distance from the panelboard to the first device is greater than 100 feet. Calculate the voltage drop over 200 feet for adjustment of conductor size.
    - f. Provide No. 10 conductors for 277/480, 20 amp circuits for which the distance from the panelboard to the first device is greater than 200 feet. Calculate the voltage drop over 200 feet for adjustment of conductor size.
    - g. Do not install wires in conduit until wire entire system of conduit, boxes, and outlet box is permanently in place.
    - h. Exercise care when installing wire in conduit so as to prevent abrasion or damaging the conductor insulation.
  10. Provide proper number of conductors and conduits or cables to provide operative system as indicated. Do not regroup any feeder circuits, branch circuits, and home at any point. Exact circuit numbers are to be determined after installing new breakers in the existing spaces. Comply with the NEC Table 310.15(B)(3)(a) for number of conductors.
  11. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A, and NFPA 70. Perform megging and infrared IR scans and documentation which will turn- in to the HISD Owner.
  12. Seal and make permanently watertight penetrations by electrical raceways or equipment through roofs, ceilings, and walls or floors.
  13. Calculated the voltage drop in each run father than 200 feet in length.
    - a. Service and feeders conductors - 2%
    - b. Branch conductors – 3%
  14. Check for phases rotation and motor rotation and other equipment before energizing the equipment. Follow proper procedures and sequences in energizing electrical equipment.
- C. Grounding
1. Service entrance grounding system: Provide a main bonding jumper between the neutral and ground bus of each switchboard. Provide a separate grounding electrode conductor in conduit with grounding bushings on both conduit ends from the switchboard to the ground rod grid, incoming cold water piping system, and to the "lightning protection system" underground bonding loop. Provide a bonding jumper around the water meter. The grounding electrode conductor shall not be spliced. All grounding conductors shall be install or to enclose steel conduit.
  2. Building steel and piping system: Provide a bonding jumper between building steel and metallic piping systems to bond them to the electrical grounding system.
  3. Neutral: The neutral shall be grounded only at the service entrance and other separately derived systems. The neutral shall be kept separate from the grounding system and shall not be used as a ground.
  4. Transformers: The center point (neutral) of each wye connected transformer shall be bonded to the case and a grounding electrode conductor shall be





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- connected to a ground rod or building steel and cold water pipe. All separately derived systems such as isolation transformers must be grounded at the common point by connecting to a ground rod and building steel. The equipment ground for electrical service shall not be used as a grounding point for any transformers. See Attachment for grounding the transformers.
5. Standby emergency generator: The generator neutral shall be bonded to the generator when a 4 pole switched neutral automatic transfer switch is specified. The frame of the generator must grounded to an earth ground separately.
  6. Grounding conductor: A grounding conductor and metallic conduit system shall bond all equipment served by the electrical system. Provide a flexible bonding jumper for isolated metallic piping and ductwork and around expansion fittings and joints.
  7. Special grounding: Provide a No. 6 AWG copper grounding conductor for each telephone board, television system, etc. Terminate the grounding conductor on ground bus and to the building electrical grounding system.
  8. Theatrical, auditorium, student dining commons/cafetorium sound system, UPS, computers and all electric equipment non linear loads: Specify isolated ground branch circuits, as required.
- D. Learning Center Power Requirements
1. Provide one circuit for no more than four duplex receptacles. (Note: Quad to be counted as two duplex receptacles).
- E. Service Yard Power Requirements: Provide two 20A, 120V, GFCI receptacles with NEMA-3R cover plate mounted in the wall of the building at ADA specified height (recommend 18" above finished grade to centerline of receptacle).
- F. Mechanical Equipment Rooms, Electrical Equipment Rooms and Custodial Rooms Power Requirements: Provide at least one, 20 amp, 120v receptacle in custodial rooms, mechanical or electrical rooms and storage rooms, located on the wall adjacent to the strike side of the door.
- G. Roof Power Requirements: Provide at least one 20A, 120V, GFCI receptacle with NEMA-3R cover plate within 25 feet of roof mounted HVAC equipment, unless the equipment is already provided with such.
- H. Exterior Building Power Requirements: Provide 20A, 120V, GFCI receptacle in weather proof enclosures at ADA specified height (recommend 18" above finished grade to centerline of receptacle), flush mounted in the exterior wall of the building adjacent to each exterior door and at strategic locations. These receptacles shall be for maintenance purposes.
- I. Power Requirements for Miscellaneous Locations
1. Receptacles installed in masonry walls shall be installed on top of a block course, omitting the mortar bed at the box. The purpose of this requirement is to allow the standard device plate to overlap the indentation of the mortar joint.
  2. Corridors shall have receptacles spaced no further apart than 40 feet apart.
  3. Provide power and key operated on/off switch for roll-up overhead grilles at reception areas, corridors, etc.
- J. Clocks: HISD will provide battery powered clocks as part of the furnishings, fixtures and equipment (FFE) budget.
- K. Emergency Power
1. Provide emergency lighting in ALL instructional spaces every Learning Center, every electrical room and every mechanical room. All emergency lighting shall be switched/controlled locally with the fixture group it is associated with and automatically illuminate upon loss of power. For mechanical and electrical rooms do not put on occupancy sensor or any other automatic control: for mechanical and electrical rooms put every fixture in the room on emergency power and control with a local switch, fixtures in these rooms need not come on automatically, intent is for supervisory/service personnel to have total local



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- control of mechanical and electrical room lighting by local switch only but it must be on an emergency power source.
  2. For all schools, provide emergency generator in new and major renovation/addition projects, to sustain life safety loads (major renovation projects include renovating at least 50% of the school).
  3. Emergency generator shall use a natural gas driven engine.
  4. Provide emergency lighting throughout the school using the center lamp of the 2'x4' fixtures or two lamps in a 4 lamp fixture or 2 lamp strip emergency light shall meet the requirements of NFPA 101 including the following:
    - a. All corridors, restrooms, mechanical rooms, electrical room, storage rooms over 25 square feet, kitchen, learning commons, data closets, student dining commons/auditorium, gyms, locker rooms, laundry rooms, stages, auditoriums and instrumental learning center halls. Egress lighting shall not be switched.
    - b. All Learning Centers shall have one emergency light per 900 square feet. The center lamp of the 2 x 4 fixture located by the exit door(s) shall be circuited to the emergency power panel and shall not be switched.
  5. The walk-in refrigerators and freezers in the kitchen shall be circuited to the emergency power panel.
  6. The fire alarm panel and security panel shall be circuited to the emergency power panel. (20A, 120v)
  7. ~~BCR (MDF) BAR and FCR (IDF) FAR~~ room equipment shall be circuited to the emergency power panel. (20A, 120v)
  8. Telephone equipment shall be circuited to the emergency power panel. (20A, 120v)
  9. Submit load calculations using a generator manufacture's software and include 25% spare capacity.
  10. Provide emergency power to designated electrical receptacles for the following:
    - a. Special Education Learning Centers -20A, 120 volt
    - b. Pre-Kindergarten Learning Centers – 20A, 120 volt
    - c. Nurses Clinic -20A, 120 volt
    - d. DDC Panel -20A, 120 volt
  11. If applicable, all exit signs shall be connected to the emergency generator. Exit signs shall be install on a separate circuits from all other loads. All exit and egress lighting shall be installed on a single power source of panelboard. Circuits shall be distributed based on a calculated loads. No other circuits' on this emergency panel. Test all emergency lighting, mapping and Spreadsheet, documentation shall be provided to the HISD master electrician.
- L. Emergency Batteries
1. When an emergency generator is not used, all life safety loads shall use rechargeable batteries for backup power.
  2. Provide 1300 lumen battery ballasts for emergency 2x4 light fixtures.
  3. All wall mounted emergency fixtures shall use nickel-cadmium batteries and contain 2 lamps.
  4. All emergency circuits shall be on a dedicated panelboard only with one main cut-off. No other circuit shall be connected to it. All egress lighting shall only use emergency ballast instead of dual heads mounted on the walls. The exception on dual heads is on the gym area.
- M. ~~THEATRICAL LIGHTING SYSTEM GENERAL REQUIREMENTS~~
1. ~~The fixture shall be supported and secure with a safety chain.~~
  2. ~~The fixture has to be position and aim properly to the needs of the school.~~
  3. ~~Each receptacle shall be twist lock 20A, 125 V, single receptacle and shall be supported properly. Do not use duplex receptacle.~~



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4. ~~Each circuit shall have an independent neutral and grounding wire. The conduits and boxes shall be legibly label/marked with the circuit numbers.~~
  5. ~~The dimmer rack shall be wired neatly in a workmanship manner.~~
  6. ~~The dimmer shall be installed where there is enough air circulation not in a close proximity space.~~
  7. ~~The contractor shall install working lights in the stage area on separate circuit not from the dimmer. The contractor shall provide training to school staff and CFS staff. The manufactured must be present during the commissioning process. The contractor shall contact the representative from CFS 24 hour in advance prior to the training and commissioning. The contractor shall turn in all keys, manufactured drawings, cut sheets, manuals and DVD training.~~
  8. ~~Provide illumination from the front for faces, with the ability to isolate the stage areas left, center, and right.~~
  9. ~~Provide illumination from overhead, with the ability to change the color for variety and affect the mood of the lighting.~~
  10. ~~Provide intuitive graphical color touch screen interface for control of the system. No specialized training shall be required to bring up light fixtures and change color of overhead fixtures. Provide individual control of all fixtures front of house, and grouped controls of each row of fixtures over stage. Provide color picker for graphical color selection of LED color changing fixtures.~~
  11. ~~Additionally, Middle School and High School Proscenium Theatre Stage Spaces shall at a *minimum* comply with the minimum recommended lighting standards of UIL (University Interscholastic League) for the One Act Play Competition. Additional lighting may also be required to support other uses of the stage space such as music and dance performances.~~
    - a. ~~The lighting plot should be laid out in a "standard method," with nine or more acting areas established. If acting areas are larger than 10' in diameter, provide additional fixtures for lighting the area, or break the stage up into additional acting areas.~~
    - b. ~~Each acting area shall have a minimum of two fixtures providing lighting from the front/side, and one fixture from above/back, as well as a color wash fixture.~~
    - c. ~~The use of the three primary colors in light – red, blue and green – as general washes is required for UIL competitions. The color wash lighting shall be individually controlled both by color and area. Border lights are not acceptable. Provide 7 color LED color changing fixtures, a minimum of one per area.~~
    - d. ~~Each acting area and individual fixture shall be independently controllable.~~
  12. ~~Adjustments to the lighting system design guidelines shall be made to accommodate stages of differing sizes and shapes in each category. Any renovation to an existing space shall attempt to best meet these guidelines while taking into account any circumstances that may limit the possible lighting system or may require additional equipment to reach the required functionality.~~
  13. ~~Basis of Design is ETC Fixtures, Rigging, and Dimming Equipment with Paradigm Controls.~~
- N. ~~ELEMENTARY SCHOOL STUDENT DINING COMMONS STAGE LIGHTING~~
1. ~~Front of House: Provide a basic stage wash of eight ETC Source 4 Jr 26 degree fixtures on the front of house pipe, complete with c-clamp, color frame, safety cable, stage pin connector, and Ushio HPL575x/120v long life lamp.~~
  2. ~~Over Stage: Provide an even stage wash of LED fixtures overhead on two pipes: ETC Selador Desire D40 Vivid 7 color mixing. Provide minimum six fixtures (3~~



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per pipe), complete with c-clamp, 75deg lens, safety cables, power cord, pass through powercon cable, and DMX cable. Additional fixtures and lenses of different degree spread may be required to accommodate stages of different sizes and heights.

3. Provide intuitive 7" color touchscreen for everyday control of system and color changing fixtures. Provide multiple pages consisting of fixture controls with faders for intensity control and color picker for color control. Provide individual control of all fixtures front of house, and grouped controls of each row of fixtures over stage.
4. Provide Smartfade ML Control Console for use in dedicated theatrical performances.
5. Provide ETC Unison DRD6 Dimmer Rack with D20 and R20 Dimmer Modules and Paradigm controls.
6. Provide DMX Optosplitter and plug in stations for control of the system LED color changing fixtures.

### O. MIDDLE SCHOOL STUDENT DINING COMMONS STAGE LIGHTING

1. Front of House: Provide a basic stage wash of twelve ETC Source 4 Jr 26 degree fixtures on the front of house pipe, complete with c-clamp, color frame, safety cable, stage pin connector, and Ushio HPL575x/120v long life lamp.
2. Over Stage: Provide an even stage wash of LED fixtures overhead on three pipes: ETC Solador Desire D40 Vivid 7 color mixing. Provide minimum nine fixtures (3 per pipe), complete with c-clamp, 75deg lens, safety cables, power cord, pass through powercon cable, and DMX cable. Additional fixtures and lenses of different degree spread may be required to accommodate stages of different sizes and heights.
3. Provide intuitive 7" color touchscreen for everyday control of system and color changing fixtures. Provide multiple pages consisting of fixture controls with faders for intensity control and color picker for color control. Provide individual control of all fixtures front of house, and grouped controls of each row of fixtures over stage.
4. Provide Smartfade ML Control Console for use in dedicated theatrical performances.
5. Provide ETC Unison DRD12 Dimmer Rack with D20 and R20 Dimmer Modules and Paradigm controls.
6. Provide DMX Optosplitter and plug in stations for control of the system and LED color changing fixtures.
7. Provide Strong Canto 250HR Followspot, with Stand, color boomerang, and 250HR lamp.

### P. MIDDLE SCHOOL/ HIGH SCHOOL AUDITORIUM STAGE LIGHTING

1. Front of House Beam or Overhead Position: Provide a basic stage wash of twenty-four ETC Source 4 19 or 26 degree fixtures, complete with c-clamp, color frame, safety cable, stage pin connector, and Ushio HPL575x/120v long life lamp.
2. If access to the position is not available via a catwalk then the lighting pipe shall be motorized: Provide ETC Prodigy motorized rigging solution.
3. Box Boom Positions, located on the front of house side walls, shall each have six ETC Source 4 26 degree Lustr+ LED 7 color mixing fixtures, complete with c-



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- clamp, wash diffuser, safety cable, power cord, pass through powercon cable, and DMX cable.
4. ~~Over Stage: Provide 4 Electric pipes over stage; all pipes shall be motorized with cable management. Provide ETC Prodigy motorized rigging solution with sufficient switched and dimmable power circuits for all fixtures on each motorized electric.~~
5. ~~First Electric: Provide twelve ETC Source 4 26 degree fixtures, complete with c-clamp, color frame, safety cable, stage pin connector, and Ushio HPL575x/120v long life lamp. Provide six ETC Source 4 PAR fixtures, complete with c-clamp, color frame, safety cable, 4 lens set, stage pin connector, and Ushio HPL575x/120v long life lamp. Provide six ETC Selador Desire D40 Vivid 7 color mixing fixtures, complete with c-clamp, 45 deg lens, safety cables, power cord, pass through powercon cable, and DMX cable.~~
6. ~~Second and Third Electrics: Provide (on each) six ETC Source 4 PAR fixtures, complete with c-clamp, color frame, safety cable, 4 lens set, stage pin connector, and Ushio HPL575x/120v long life lamp. Provide (on each) six ETC Selador Desire D40 Vivid 7 color mixing fixtures, complete with c-clamp, 45 deg lens, safety cables, power cord, pass through powercon cable, and DMX cable.~~
7. ~~Fourth Electric: Provide minimum 6 Altman SpectraCyc 200 LED color changing fixtures, complete with yoke, c-clamp, safety cable, power and pass through cables, and DMX cable. Cyc fixtures are on maximum 8' centers, provide additional fixtures for illumination of area over 42' wide. Provide six ETC Source 4 PAR fixtures, complete with c-clamp, color frame, safety cable, 4 lens set, stage pin connector, and Ushio HPL575x/120v long life lamp. Provide six ETC Selador Desire D40 Vivid 7 color mixing fixtures, complete with c-clamp, 45 deg lens, safety cables, power cord, pass through powercon cable, and DMX cable.~~
8. ~~Additional fixtures and lenses of different degree spread may be required to accommodate stages of different sizes and heights.~~
9. ~~Provide intuitive 7" color touchscreen for everyday control of system and color changing fixtures. Provide multiple pages consisting of fixture controls with faders for intensity control and color picker for color control. Provide individual control of all fixtures front of house, and grouped controls of each row of fixtures over stage. Provide 2 button entry stations at auditorium stage doors for house and work light control.~~
10. ~~Provide ETC Element 40/250 Control Console, complete with two LCD monitors and DMX cable.~~
11. ~~Provide ETC Sensor SR48 Dimmer Rack with D20 and R20 Dimmer Modules and Paradigm controls. Provide solution for Emergency Lighting: ETC Emergency Lighting Transfer Switch and DMX Emergency Bypass Controller.~~
12. ~~Provide DMX network and plug in stations for control of DMX controlled devices.~~
13. ~~Provide Strong Canto 1200 Followspot, with Stand, color boomerang, and 250HR lamp.~~
14. ~~Auditorium HouseLight Fixtures shall be Altman Chalice CDP1003K with DMX Control.~~

### 1.4 THEATRICAL RIGGING GENERAL REQUIREMENTS

- A. ~~Provide safe and secure hanging positions for theatrical lighting.~~



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- B. ~~All positions for portable theatrical fixtures shall be 1½" schedule 40 grade A, seamless pipe fabricated in the largest possible lengths without splices. Battens of greater length shall be spliced by means of .120 x 1 9/16 dia DOM tube 18" long with 9" of tube inserted into each half of the splice. The tight fitting splice tube shall be held in place by a pair of 3/8 x 2 1/2" grade 5 hex bolts on each side of the joint. The bolts shall pass through the pipe at an angle of 90° to each other. There shall be two bolts on each side of the joint spaced 1" and 8" from the joint. Alternatively, one pair of bolts on one side of the joint may be replaced with either plug welds or tight fitting steel rivets. Pipes shall be straight and painted flat black.~~
- C. ~~In order to establish minimum standards of safety, a minimum factor of 8 shall be required for all equipment and hardware used on this project. In addition, the following factors shall be used:~~
1. ~~Cables and fittings 10 Design Factor~~
  2. ~~Cable bending ratio 26 times diameter~~
  3. ~~Max. fleet angle 2 degrees~~
  4. ~~Steel 1/5 of yield~~
  5. ~~Bearings two times required load at full for 2000 hours~~
- D. ~~Provide ETC Prodigy Motorized rigging for any lighting position over 18 feet over the finished floor, or any lighting position over a sloped floor.~~
- E. ~~Provide ETC Prodigy Motorized rigging for Jr High and High School Stage: 4 Electric Pipes over stage.~~
- F. ~~Provide ETC Quick touch rigging controller for operation of rigging systems. Controller shall have a keyswitch, emergency stop, and real time position information displayed on the screen. One preset shall be provided in addition to the high and low trim positions. Locate the rigging controller in sight of the pipes to be operated.~~
- G. ~~Coordinate with the structural engineer to ensure proper structural elements are provided for the full load of all provided equipment.~~
- H. ~~DEAD HUNG RIGGING~~
1. ~~The pipe batten shall be 1½" schedule 40 grade A, seamless pipe fabricated in the largest possible lengths without splices. Battens of greater length shall be spliced by means of .120 x 1 9/16 dia DOM tube 18" long with 9" of tube inserted into each half of the splice. The tight fitting splice tube shall be held in place by a pair of 3/8 x 2 ½" grade 5 hex bolts on each side of the joint. The bolts shall pass through the pipe at an angle of 90° to each other. There shall be two bolts on each side of the joint spaced 1" and 8" from the joint. Alternatively, one pair of bolts on one side of the joint may be replaced with either plug welds or tight fitting steel rivets. Pipes shall be straight and painted flat black.~~
  2. ~~All turnbuckles, clips, tracks, chains and other items of incidental hardware shall be furnished plated or painted. Wire rope shall be galvanized air craft cable. Fasteners, chain, and other miscellaneous hardware shall be either cadmium or zinc plated.~~
  3. ~~All materials used in this project shall be new, unused and of the latest design. Refurbished materials are not permitted.~~
  4. ~~Minimum design load rating for a hang point will be 350 lbs.~~
  5. ~~Top hanging hardware shall be either beam clamp sized for the beam, or 3/16" Proof Coil chain wrap~~





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6. ~~Connections to chain or bottom hanging hardware shall be made with 1/4" screw pin shackle. Pin shall be wired to prevent loosening.~~
7. ~~Batten Clamps shall be sized for the pipe batten. Chain wrapping the batten is not acceptable.~~
- I. ~~MOTORIZED RIGGING~~
  1. ~~Any lighting position over 18' in height or over a sloped floor shall be motorized with cable and data management. Provide ETC Prodigy motorized rigging solution.~~
  2. ~~If access to the Front of House Lighting Position in any auditorium stage is not available via a catwalk then the lighting pipe shall be motorized with cable and data management. Provide ETC Prodigy motorized rigging solution.~~
  3. ~~Auditorium over stage: Provide 4 Electric pipes over stage; all pipes shall be motorized with cable and data management. Provide ETC Prodigy motorized rigging solution with sufficient switched and dimmable power circuits for all fixtures on each motorized electric. Coordinate with theatrical stage lighting requirements to determine the circuit and data needs for each motorized electric.~~
  4. ~~The standard stage electric hoist shall consist of the following major components: 1) Powerhead, 2) Compression Tube with beam clamps, cable management system, loft blocks, liftline and liftline terminations Right Angle Cable Adjuster (RACA), 3) pipe batten and power/control distribution strip~~
  5. ~~The hoist shall include the following features:~~
    - a. ~~A Powerhead containing the following elements: the gearmotor, motor brake, load brake, limit switches operating electronics, load sensor, slack line detector, absolute position sensors, cable drum assembly, and wire rope.~~
    - b. ~~A Compression Tube that prevents hoist system lateral forces from transferring to the building. Hoists or hoisting systems that impose a lateral load on the building shall not be acceptable.~~
    - c. ~~A load sensor shall be built into the Powerhead to create a profile of the actual load on the hoist as it travels through its normal cycle. The profile may be changed by "re-training" the profiling system whenever the suspended load is changed on the batten by activating a key-switch operated training cycle on the hoist controller. The load sensor shall continuously monitor the load when load sensing is turned on.~~
    - d. ~~A position sensing system shall be built into the Powerhead to provide accurate position information. The system shall consist of two absolute sensor types that provide accurate position information for each batten at power-up of the system. Hoisting systems that require re-homing shall not be acceptable. Incremental encoders shall not be acceptable for position readout purposes.~~
    - e. ~~The hoist shall incorporate a built-in slack line sensor. When a slack line condition occurs, it shall cease hoist movement and result in a fault message on the LCD screen on the controller. Movement in the upward direction shall be possible to clear the fault.~~
    - f. ~~The hoist shall include the emergency contactor built into the hoist.~~
    - g. ~~Each wire rope liftline shall adhere to a design factor of 10:1 with an ultimate strength of 4200 pounds. All load path components between the~~





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- ~~building structure and the batten shall exceed the breaking strength of the wire rope. The motor brake shall be rated at least at 125% of the motor torque.~~
- ~~h. Upon energization the control system shall perform an automatic series of diagnostic tests that assure that all system safety functions are working. Should an error in the safety functions be determined, the controller shall report back a fault condition in the LCD display window and shall identify the nature of the fault. Monthly, the system automatically shall perform an additional series of diagnostic tests to determine if there are any problems with any portion of the hoist control system safety features. In the event of a problem, the controller shall report back a fault condition in the LCD display window and shall identify the nature of the fault.~~
6. Each hoist shall be fully tested under full rated load throughout its full travel distance with all its lifelines terminated to the hoist before the hoist is shipped from the manufacturer. Testing shall include:
- ~~a. Hoist operation~~
  - ~~b. Hoist/motor speed~~
  - ~~c. Lifeline terminations under load~~
  - ~~d. Braking and stopping under load~~
  - ~~e. Load cell functions~~
  - ~~f. Slack line detection~~
  - ~~g. Position sensing~~
  - ~~h. Hoist noise~~
7. Only hoists that successfully pass pre-shipment testing shall be sent to any job site. A record of testing and its results shall be available for review at the manufacturers facility for at least one year after testing.
8. The hoist shall be manufactured from UL Listed components and shall be UL Listed and tested as a complete system (not just UL listed parts). All equipment items shall be new and conform to applicable provisions of Underwriters' Laboratories (UL), American Standards Association (ASA), American National Standards Institute (ANSI), National Fire Protection Association (NFPA) Life Safety Code 01, National Electric Code (NEC) and PLASA.
9. Cable Management
- ~~a. The load circuits and control wiring shall be fed to the distribution trough by a built-in cable management system that allows flat feeder cable to fold and store along the top of the connector strip.~~
  - ~~b. At high trim, the entire system shall be stored in 30" of vertical space from the bottom of the mounting steel to the horizontal centerline of the batten. Cable management systems requiring greater vertical storage space shall not be acceptable~~
  - ~~c. Cable management systems that utilize cable cradles, cable reels or locate feeder or data cables outside the off stage edges of the electrics batten shall not be acceptable.~~
  - ~~d. The connector strip shall be built to the length specified with outlets or pigtails located as specified or as shown on the construction drawings. Outlets or plugs shall be 15 amp grounded pin connectors, 15 amp~~



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- twistlock connectors, or 15 amp Edison plugs. The distro trough may also contain connectors for Ethernet and/or DMX connections.
10. All pipe battens shall be fabricated from 1.5" Schedule 40 pipe.
  11. All turnbuckles and cable clips shall be drop forged.
  12. All turnbuckles and clips, tracks, chains and other items of incidental hardware shall be furnished plated or painted. Wire rope shall be galvanized. Fasteners, chain, and other miscellaneous hardware shall be either cadmium or zinc plated.
  13. All materials used in this project shall be new, unused and of the latest design. Refurbished materials are not permitted.
  14. In order to establish minimum standards of safety, a minimum factor of 8 shall be required for all equipment and hardware used on this project. In addition, the following factors shall be used:
    - a. Cables and fittings 10 Design Factor
    - b. Cable bending ratio 26 times diameter
    - c. Max. fleet angle 2 degrees
    - d. Steel 1/5 of yield
    - e. Bearings Two times required load at full for 2000 hours
  15. The entire hoisting system shall be operated by a QuickTouch fixed speed controller or equal. It shall be purpose designed and fabricated to manage and operate hoists specifically designed for overhead lifting. Each system shall incorporate mechanical, electrical and safety features that shall be inherent to this equipment and shall provide an engineered, efficient device to control the equipment. The mechanical, electrical and safety features of this control system shall establish the standard of quality, performance and safety by which hoisting systems of other manufacture shall be evaluated.
  16. The QuickTouch controller shall include the following features:
    - a. Key operated power switch
    - b. LCD display for feedback/operating information
    - c. Key operated hoist load profile training/enable switch
    - d. Latching hoist selection buttons with rear illuminated naming tabs
    - e. Rear illuminated hold-to-operate (deadman) up and down operation buttons
    - f. Dedicated E-stop button
    - g. Outlet for wired remote
    - h. Provide Local Sound Reinforcing System. Refer to Section 27 50 00.
    - i. Keyed switches are required for the following conditions:
      - 1) Operating partitions at stage.
      - 2) Overhead roll up doors or grilles (e.g. concession counter, administration desk, etc.)
      - 3) Corridor lighting
      - 4) Student restroom lighting
      - 5) Corridor gates
      - 6) Gymnasium bleachers backstops & operable dividers
      - 7) Locker or dressing rooms
      - 8) Stadium Lighting
      - 9) Gymnasium Lighting
      - 10) Student dining commons/Auditorium Lighting



## BUILDING EXCELLENCE

- 11) ~~All lighting contractors shall have "H-O-A" control switch.~~
- 17) ~~Substitutions Note: The listed product manufacturers are shown to establish a level of quality. Substitutions may be allowed upon submittal of product data sufficient for HISD to determine the substituted product is equal to or better than that listed above.~~

### 1.5 PARALLEL CIRCUITING

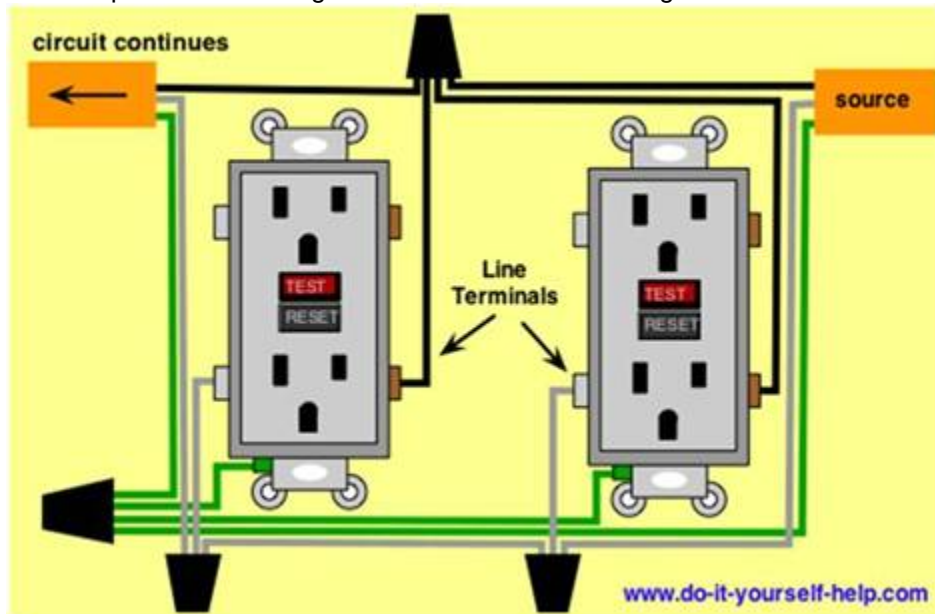
#### A. Definitions:

1. Pigtail: A wire splice is the joining of two or more wires by twisting them together to form a "pigtail". A wire nut is used to insulate and secure the splice. Use wire nuts with metal rather than plastic threads and choose a size appropriate for the gauge wire to be spliced. Splices are usually made inside an outlet or junction box.
2. Multi-wire Branch Circuits - A branch circuit that consists of two or more ungrounded conductors that have a voltage between them, Example Oven or 240V dryer circuit.

#### B. Parallel circuiting ("Pig Tailing")

1. Wiring to all non dedicated electrical receptacles and switches is required to utilize parallel circuiting by the use of "pig tails" to each device so that if an outlet is removed or fails electrical continuity of the circuit will not be compromised.
2. All electrical wiring must be properly spliced by twisting the wires together and use of approved and listed compression wire nuts for the application.
3. Do not use end to end butt-splicing connectors for any wiring.

The receptacles in the diagram are GFCI however wiring should be the same for non-GFCI receptacles.



#### C. Receptacle Circuit Labeling

1. All receptacle plates, light switch plates and outlet boxes shall be permanently labeled with panel and circuit number on outside (or inside) of cover plate and inside of outlet box.
2. Receptacles/Switches: Identify panel board and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.



## BUILDING EXCELLENCE

### 1.6 FACILITY LIGHTNING PROTECTION

- A. Acceptable Manufacturers: Bonded Lighting Protection Systems, Advanced Lighting Technology, Thompson Lighting Protection
- B. Install as required for specs meeting the Code.

### 1.7 CATHODIC PROTECTION

- A. Installation shall not begin until HISD and Engineer of Record approve shop drawings

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## EXECUTION

### 3.1 TESTING REQUIREMENTS

- A. Infrared Inspection of electrical distribution system per NETA Maintenance testing specifications for electrical equipment.
- B. Main service circuit breaker per NETA, Section 7.6.1.2.2.
- C. Emergency lighting per NFPA Standard 101 and compliance with the City Ordinances.

### 3.2 DOCUMENTATION REQUIRED IN OPERATION AND MAINTENANCE MANUAL AND TO THE HISD MASTER ELECTRICIAN

- A. Infrared (BASELINE ) inspection report.
- B. Main service circuit breaker test report.
- C. Emergency (exit & egress) lighting test report.
- D. Selective coordination study report.
- E. Arc Flash study report.
- F. As-built Electrical one-line diagram and riser diagram.
- G. Emergency one-line diagram (Where applicable)
- H. Theatrical lighting control diagram.
- I. Manufacturer drawings of main service switchboard.
- J. Elevator tests & load test report, construction drawing and city permits.
- K. LED's Marquees reports, construction drawings, and city permits.
- L. Lighting controller test reports, and Occupancy sensors settings.
- M. Utility Service Outlet Location of the pad mount or overhead transformers
- N. All City permits.
- O. The manufacturer has to be present in the commissioning and starting process to witness their equipment or product with the commissioning agency and training of personnel at no cost to the District.

### 3.3 DATE OF FINAL ACCEPTANCE



## BUILDING EXCELLENCE

- A. The date of final acceptance shall be the date of Owner occupancy, all punch list items have been completed, as built drawings, O&M Manuals and DVD training videos have been turn-in, training of Owner personnel and Facilities Maintenance and final payment have been received. All documentations shall be documented in writing and signed by the Owner, Architect, MEP Engineer and the Contractor.

### 3.4 TRAININGS

- A. The Contractor shall provide a qualified factory trained personnel to operate and instructions to the Owner's Facilities Personnel. This training shall include the operating of the electrical equipment on personnel safety procedures, operating of the equipment, instructions of operation, calibration, settings, and trip mechanism.

### 3.5 SUBSTITUTIONS

- A. Any substitutions of products and materials shall be approved by the Owner prior to submittals on the design.
- B. Manufactured or representative to provide a cut sheets and sample of the materials or products to be approved.
- C. Any unapproved materials or products install shall be solely the contractor responsibility for any cost, damages, replacement or remove without any cost to the district.

### 3.6 PAINTING AND DAMAGES

- A. The contractor shall protect the finish electrical equipment from damage due to construction until final acceptance of the building.
- B. Any scratch paint must be painted with the same type or ANSI -61 grey color for switchboard, MCC, panelboards, transformers, and etc.
- C. If determined, the equipment is factory defects or abusively damage by the contractor, HISD shall not accept damage equipment. Need new replacement.

### 3.7 ROOM AND SPACE

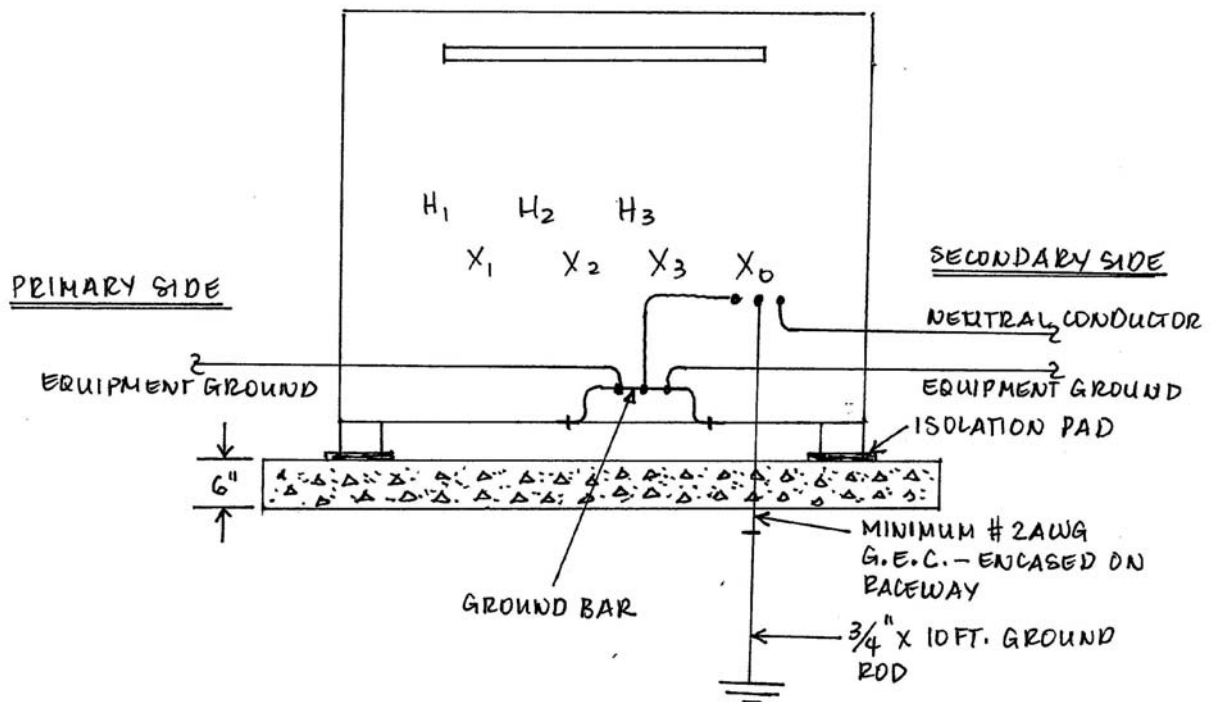
- A. The designer shall provide adequate space for the electrical room, and access doors for egress. The room shall have enough working space for the electrical equipment, and personnel to prevent endangerment in case of emergency.

## END OF SECTION



BUILDING EXCELLENCE

SECTION 26 05 00  
GROUNDING A TRANSFORMER





## BUILDING EXCELLENCE

### SECTION 26 05 19

#### LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

##### GENERAL

- 1.1 Provide a complete system of building wire and cable to all electrical loads.

##### PRODUCTS

2.1 Low Voltage Wire (300V and under)

- A. Acceptable Manufacturers: West Penn, Belden, Alpha.
- B. All low voltage cable shall be rated at 300 volt and be plenum rated. This cable may be routed in plenums in accessible areas without a raceway (Data Cable only). Penetration between walls, cables shall be in enclosed raceway.

2.2 600 Volt or Less Wire and Cable

- A. Acceptable Manufacturers: South wire, General Wire, ~~Essex~~, Encore Wire
- B. All building wire shall be rated at 600 volt, using copper conductors and THHN/THWN insulation. Stranded only. Use 75 degree column in all applications. All motors, chillers, etc. shall require the use of copper conductors only.
- C. No solid wiring is allowed in any application.
- D. ~~Aluminum conductors may ONLY be used for feeders rated for greater than 400 amps or above for non-equipment loads. When aluminum conductors are allowed, the Architectural/Engineering Specifications must clarify minimum installer training and certification requirements. In addition, the Specification must require that the contractor schedule a one year warranty inspection with the Owner. During the inspection, all service connections to panels must be re-tightened and each service cable should have a load test per phase to ensure the limits of the conductor's capabilities are not exceeded. Certification and Training Requirements:~~
  - 1. ~~Installer shall undergo proper trainings and certification in handling proper termination, connections and procedures of aluminum wires.~~
  - 2. ~~Installer shall follow proper manufactured procedures and torqued requirements in terminating the aluminum wires.~~
  - 3. ~~The designers shall identify the proper termination lugs that provide good electrical conductivity and applications.~~
  - 4. ~~The designers shall provide safety procedures, prevention, inspection and maintenance after 18 months.~~
  - 5. ~~The designers shall provide lists on safety, and field inspection during termination, pulling and connecting process. The Owner and A/E shall witness the termination process.~~
  - 6. ~~The designers shall calculate the stretch and stressing of aluminum wires during pulling process.~~
- E. Termination shall use the proper lug, type for the correct conductor size. Do not cut the strands to make the fitting on the lug.

2.3 ~~Conductors and Installations: Copper conductors in all areas, except where Aluminum conductors are allowed per paragraph 2.2, this section.~~

- A. ~~Use stranded conductors for control circuits, branch, feeders, service entrance and final connections to all vibration equipment.~~
- B. ~~Use conductor not smaller than 12 AWG for power and lighting circuits.~~
- C. ~~Use conductor not smaller than 14 AWG for control circuits.~~
- D. ~~Use 10 AWG conductors for 20 ampere, 120-volt branch circuits longer than 100 feet~~
- E. ~~Use 10 AWG conductors for 20 ampere, 277-volt branch circuits longer than 200 feet~~





## BUILDING EXCELLENCE

- F. ~~Install not more 6 conductors per raceway (metallic). See Table 310.15(B)(3)(a)~~
- G. ~~Pull all conductors into raceway at same time.~~
- H. ~~Use approved wire pulling lubricant for all building wire.~~
- I. ~~Neatly train and lace wiring inside boxes, equipment, and panelboards.~~
- J. ~~Clean conductor surfaces before installing lugs and connectors.~~
- K. ~~Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise. Do not cut strands from a conductor.~~
- L. ~~For splices and taps, use only compression connectors for copper conductors splices and taps, 6 AWG and larger. Wrap the uninsulated conductors and connectors with electrical tape to 150 percent of the insulation rating of the conductor.~~
- M. ~~Use conductors rated 90 degrees C, inside a ballast compartment or within 6 inches of any ballast.~~
- N. ~~All No. 6 AWG or smaller conductors, the insulation shall be on a continuous green in color for grounding and continuous white in color for neutral conductor.~~
- O. ~~All service, feeder and branch conductors, the insulation shall be on Continuous color insulation. Electrical tape is not acceptable.~~
- P. ~~(A, B, C, N, G) of its entire length from one end to the other end. No splicing allowed. See Item 19 for Color Code.~~
- Q. ~~Provide identification tags, label or marked on each conductor entering panel, switch, junction box and pull box to identify the circuit conductor.~~
- R. ~~Low voltage wiring shall be routed in separate raceways (metallic) from power wiring systems.~~
- S. ~~The travelers used for 3-way and 4-way switches shall be colored pink.~~
- T. ~~No extension ring is acceptable in any installation. No splicing is allowed to homeruns on either service, feeders, branch circuit conductors except to devices.~~
- U. ~~Conductor (Color Coded). Use continuous length Color on Service and Feeder Conductors. Do not use Black color and identify.~~
  - 1. ~~120/208 volt, 3-phase, 4-wire~~
    - ~~A = Black      B = Red      C = Blue      N = White      G = Green~~
  - 2. ~~277/477 volt, 3-phase, 4-wire~~
    - ~~A = brown      B = purple      C = yellow      N = gray      G = green~~
  - 3. ~~120/240 volt, 3-phase, 4-wire~~
    - ~~A = black      B = orange      C = blue      N = gray      G = green~~

### EXECUTION

#### 3.1 EXAMINATION

- B. Verify raceway installation is complete and supported. Engineer shall provide field observation reports ensuring all wire and cable is properly supported.

#### 3.2 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Do not abandon any existing raceway, conductors or cables in place.

#### 3.3 WIRE COLOR

- A. Comply with the City of Houston and NEC.



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B U I L D I N G   E X C E L L E N C E

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3.4 BALANCING ELECTRICAL SYSTEM

- A. The load on each distribution, power, and lighting panelboards shall be balanced to at least 5% between each phases. Provide documentation of the load calculations.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 26 05 26

#### GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

##### GENERAL

- 1.1 Provide a continuous low-impedance grounding system for the entire electrical wiring system.
- 1.2 The engineer shall use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 Grounding systems use the following elements as grounding electrodes:
  - A. Metal underground water pipe.
  - B. Metal building frame.
  - C. Concrete-encased electrode.
  - D. Rod electrode.
  - E. Plate electrode.
- 1.4 Lightning protection system
  - A. Comply with the lightning installation and recommendation of the industry.
  - B. Must meet all requirements by Local Having Jurisdiction and Lightning Codes.

##### PRODUCTS

- 2.1 EQUIPMENT
  - A. Acceptable Manufacturers: Copper weld, Cad weld, Bundy
  - B. Grounding Electrode: All grounding system on the main electrical service shall be install on building steel, water piping, and earth ground. Use a 3/4 inch x 10 feet ground rod for earth ground or triad system. Drive the ground rod and leave 3 inches above ground.
  - C. Splicing is strictly prohibited in this type of application.
  - D. Raceway/Steel Conduit: All grounding wires shall be enclosed on a steel raceway and use proper lugs, cadweld, and ground clamps.
  - E. Compliance: Comply with the NEC Codes Article 250. Do not use a gas line for grounding purposes.
  - F. Transformers – refer to the transformer grounding and bonding illustration drawing. Use a minimum size No. 2 AWG for GEC and Blackburn clamp to a ground rod.
  - G. Switchboards, panelboards, transformers, disconnecting means and other electrical equipment and devices must be grounded per Article 250. Do not use single lug for two conductors. Panelboards, all grounding equipment shall be install together in a common ground bar and not everywhere in the panelboards.
  - H. Conductors: Use insulated conductors, copper wire for 600 volts unless otherwise required on different voltages. The conductor shall a continuous green in color for the entire length.
  - I. Switchboard: The ground rod shall be install inside the main switchboard with a minimum of 3/0 AWG.
  - J. Connectors: All connectors must listed and labeled by recognized testing laboratory acceptable to Authority. Having Jurisdiction.
  - K. Equipment Grounding: Install insulated equipment grounding conductors will all feeders and branch circuits.
    1. Feeder and branch circuits
    2. Receptacle circuits
    3. Lighting circuits
    4. Single-phase motors and appliance branch circuits
    5. Three-phase motors and appliance branch circuits
    6. Computer and rack mounted electronic equipment circuits



## BUILDING EXCELLENCE

7. Armored and metal clad cable runs
  8. Busway supply circuits
  9. Air duct equipment circuits
  10. Switches circuits
  11. Water Heater circuits
  12. Signal and communication equipment
  13. Marquee LED circuits
  14. Elevator circuits
  15. Metal pole outdoor lighting fixtures. Install No. 6 solid wire below attached to metal pole only.
- L. Bonding:
1. All conduits on feeders and service shall bonded, sized and comply with Article 250
- M. Building Steel Building Structure: Install a driven ground rod at base of each building column

### EXECUTION

- 3.1 An independent agency shall perform to conduct the testing on the grounding system to any facilities to ensure proper continuity and meeting the Code requirements.
- A. Comply with UL 467 for grounding and bonding the materials and equipment.
  - B. This person must have a current certification, work experience, and capability to perform this type testing.
  - C. Tests shall include determining the ground resistance or impedance values.
  - D. Provide a test reports and recommendation.
  - E. Grounding Resistance Values
    1. Substations, Power, Lighting Equipment, Pad Mount Equipment and System capacity more than 1000 kVA is less than 5 ohms
    2. Power distribution Units and Panelboards serving electronic equipment is less than 3 ohms.
    3. Excessive ground resistance must notify the designer/engineer immediately and include recommendations to reduce ground resistance.
- 3.2 TECHNOLOGY CLOSET GROUNDING REQUIREMENTS
- A. Install #3/0 copper bonding conductor installed from service equipment in electrical entrance facility to grounding bus bar in BCR.
  - B. Provide grounding system via 12"x4"x1/4" solid copper bus bar mounted 12" below top of plywood backboard.
- 3.3 IT BCR\FCR GROUNDS
- A. Provide ground copper bus bar in room, by providing a grounding system via 12"x 4" x 1/4" solid copper bus bar mounted 12" below top of plywood backboard.
  - B. Install an equipment grounding conductor from the main electrical system into the isolated ground copper bus bar in BCR\FCR room.
  - C. The copper bus bar shall provide holes for bolt connection. Do not use a machine screw or tap screw for connection.
  - D. Install strap in each side of the cable tray bolted to the frame.

### END OF SECTION



## BUILDING EXCELLENCE

### SECTION 26 05 33

#### RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

##### GENERAL

- 1.1 Section includes conduit and tubing, wireways, outlet boxes, pull and junction boxes, and handholes.
- 1.2 The engineer should use all applicable references, codes and National industry standards to specify and complete work performed in this division.
- 1.3 DESIGN REQUIREMENTS
  - A. Minimum Raceway Size: 3/4 inch with throat plastic bushing or plastic bushing. 1/2 inch conduit allowed for drops to light switches only.
  - B. Rigid Metallic Conduit – ANSI C80.1; Labeled and Listed used commonly outdoor.
  - C. EMT Conduit – ANSI C80.3; Labeled and Listed used for indoor only.
  - D. Liquidtight Flexible Conduit – UL Approved and Listed for equipment connection up to 6 feet only.

##### PRODUCTS

##### 2.1 MATERIALS

- A. Raceways
  1. Acceptable Manufacturers: Allied, Triangle, Republic, Carlen, Wheatland, Centex, Western Tube.
  2. No MC cable or flex conduit allowed. Exception: Flex cable may be used for light fixtures in lengths less than 72" with an equipment grounding wire.
  3. Steel set screw fittings for electrical conduit are allowed only for EMT located in conditioned spaces.
  4. All exterior raceways shall be rigid galvanized steel.
  5. All underground raceways shall be schedule 40 PVC and scotch-wrap resistant on the sweep 90 degree elbow both feeders and service primary duct-bank.
  6. Conduit installed under a canopy shall be rigid galvanized steel.
  7. No PVC or plastic is allowed except on underground. No Intermediate Metallic Conduit (IMC) shall be used.
  8. Comply with the rules in sizing the boxes, and pull boxes NEC Article 314 and, grounding system per NEC Article 250.
  9. Use Steel set screw fittings for electrical conduit are allowed only for EMT located in conditioned spaces.
    - a. Interior raceways shall be electrical metallic tubing (EMT). Except where specify used for rigid metallic conduit such as in pool area, pool storage and kitchen exposed area.
    - b. BX cable conduit is used for fixture whip only up to 6 feet in length. BX cable and MC Cable conduit are not allowed as permanent or temporary wiring.
    - c. On ceiling, conduit must be supported every 10 feet interval. Group multiple conduits neatly on a common trapeze hanger system.
    - d. On wall vertically, conduit must be supported every 6 feet interval.
    - e. On roof, conduit must be supported every 6 feet interval. Maintain clearance from the conduit to the roof surface without derating the conductor ampacity per T310.15(B)(2)(a).
    - f. No plastic conduit allowed on interior application.
    - g. Minimum size conduit as follows:



## BUILDING EXCELLENCE

- 1) 3/4 inch for power and branch circuit wiring, unless indicated otherwise.
    - 2) 3/4 inch for communications cable, unless indicated otherwise.
    - 3) 3/4 inch for low voltage and control cables, unless indicated otherwise.
  - h. Terminations of conduit, with circuitry wire of No. 6 or smaller shall include an insulated bushing.
  - i. Terminations of conduit, with circuitry wire of No. 6 or larger shall include an insulated grounding bushing.
    - 1) Metal conduit outdoor application.
    - 2) Flexible metal conduit motor connections at to 3 feet.
    - 3) Liquid tight metal conduit for transformer application.
    - 4) Electrical metallic tubing for interior used only.
    - 5) Nonmetal conduit low voltage application only.
    - 6) Fittings and conduit bodies.
  - j. Minimum size conduit as follows:
    - 1) 3/4 inch for power and branch circuit wiring, unless indicated otherwise.
    - 2) 3/4 inch for communications cable, unless indicated otherwise.
    - 3) 3/4 inch for low voltage and control cables, unless indicated otherwise.
  - k. Underground distribution feeders and branch circuits shall be installed in schedule 40 PVC conduit with grounding conductors sized per NEC. 90° elbows shall be rigid galvanized steel and stub ups through concrete floor to be PVC coated rigid galvanized steel.
  - l. Conduit types permitted where indicated below:
    - 1. Above Suspended Ceilings: Galvanized or sheradized thick wall Galvanized rigid steel (GRC), or electrical metallic tubing (EMT).
    - 2. Recessed in Metal Stud Walls: Galvanized or sheradized thick wall rigid steel (GRC), or electrical metallic tubing (EMT).
    - 3. Exposed Exterior Areas: Galvanized or sheradized thick wall Galvanized rigid steel (GRC).
    - 4. Underground: PVC schedule 80 with factory sweep made 90° bends of GRC and of above ground.
    - 5. IN CONCRETE SLABS, TO 6" ABOVE CONCRETE FLOORS: Galvanized or sheradized thick wall Galvanized rigid steel (GRC)
    - 6. CAST IN CONCRETE OR SET SOLID IN MASONRY WALLS: Galvanized or sheradized thick wall rigid steel (GRC)
    - 7. CONNECTIONS TO MOTORS AND VIBRATING EQUIPMENT: LIQUIDTIGHT FLEXIBLE METAL CONDUIT (SEALTITE) A MAXIMUM OF 3'.
    - 8. CONNECTIONS BETWEEN JUNCTION BOXES AND LIGHTING FIXTURES SUSPENDED IN LAY-IN CEILINGS: FLEXIBLE METAL CONDUIT (FMC) A MAXIMUM OF 6'.
  - m. Provide expansion fittings in conduits where required to pass expansion joints installed in the building's structure.
  - n. Support all conduits, raceways every six feet between supports, and four feet vertically.
- B. Hangers, Fittings and Supports of Electrical System  
Acceptable Manufacturers: Appleton, Crouse Hinds, Steel City, OOZY. Gender, Carlen, Race
  - 1. All conduits throughout the building shall be supported every 10 feet on centers horizontally and supported 6 feet on centers on vertically. All conduits shall be



## BUILDING EXCELLENCE

- supported on an approved bracket between metal studs and not a clamp or strap directly to the metal studs.
  2. Conduits install on the roof shall be supported every 6 feet intervals either install in jacks or B-line stand with unistrut. Comply per T310.15(B)(2)(a).
  3. All piping, raceways, and equipment suspended from structure shall be supported with hangers designed for the purpose. Use trapeze and install every 8 feet interval, neat, and uniformity not in every direction.
  4. Conduit shall not be supported or fasten to ductwork, piping, or mechanical equipment and conduit.
  5. Do not use spring steel clips and clamps.
  6. Do not use powder-actuated anchors.
  7. Conduits routed along building surfaces shall be supported by means of two hole rigid conduit clamps located 4 feet on center. Two-hole clamps shall be provided where size of conduit and installation conditions warrant.
  8. All supports shall be designed and installed to avoid interference with all other conduits, hangers, ducts, building structures, piping, equipment, etc.
  9. Install surface-mounted cabinets and panelboards with minimum of four anchors.
  10. In wet and damp locations use steel channel supports to stand cabinets and Panelboards one inch off wall.
  11. Use sheet metal channel to bridge studs or 1-5/8 x 1-5/8 unistrut above and below cabinets and panelboards recessed in hollow partitions.
  12. Cabinets
    - a. Hinged door in front cover with flush latch and concealed hinge.
    - b. Metal barriers to separate wiring of different systems and voltage.
  13. IT Backbone and horizontal cabling support systems
- C. Cable Tray Systems
1. Provide continuous cable tray pathway at or within corridors for all data cable. Connect BCR to FCRs for horizontal runs with continuous cable tray. Provide conduit for all fiber connections. Cable tray shall not penetrate walls. Provide 4" conduit sleeves at wall penetrations.
  2. Installed by general contractor on project and needs to be coordinated other building systems installed (ductwork, piping, equipment) in area as well as scheduling of installation during construction.
  3. No power cables allowed in cable tray system.
  4. Basket type tray with U-shaped round wire mesh mounted from wall or inverted "T" mounts. 12"W x 4"H, example: Chalfant WMST412S.
  5. Minimize bends and offsets during installation and provide cable waterfalls at large cable drops from tray system.
  6. Provide 6" clear above and each side of tray from all obstructions.
  7. Install cable tray near corner of room when entering all telecommunication head end closets.
  8. Provide two grounding strap each side of the transition either straight run, 90 degrees, vertical run and T-run.
- D. Conduit Distribution
1. All telecommunication outlets shall receive 1" ID EMT from outlet to accessible ceiling.
  2. Provide bushings on all conduits to protect cabling during installation.
  3. Provide pull-string in all conduits.
  4. For any half-height (pony) walls, contractor shall install a dedicated 1" conduit with pull-string for every two technology boxes installed. Conduits shall route directly from technology boxes up wall in direction of nearest BCR/FCR head end room and terminate above ceiling for the installation of technology cabling.
- E. Telecommunication Outlet Boxes





## BUILDING EXCELLENCE

1. Telecommunication boxes to be 4"x 4" x 2-1/2" boxes mounted at 18" AFF for standard mounting height.
  2. At counter locations with backsplash, mount at 6" above counter surface. At counter locations without backsplash, install at 12" above counter surface.
  3. Do not install boxes back to back.
  4. All video monitor boxes shall be mounted at 84" unless noted otherwise.
  5. Install boxes for wall mounted telephones at 54" AFF.
- F. IT Incoming Service – Raceway Requirement
- A. Install (4)-4" service conduits to be routed underground at minimum depth of 36" from communications hand hold located at property line. Coordinate hand hole location with service companies.
    - a. Provide wide sweeping bends not less than ten times diameter of conduit and no more than two bends (180 degrees total) between pull boxes.
    - b. All bends to be rigid steel conduit.
    - c. Hand holes sizes to be 30"W x 48"L x 48"D installed in 6" deep rock/gravel bottom with ground rod installed in hand hole.
    - d. Stub up conduit to extend 4" above finished floor and contain bushings.
    - e. Slope conduits away from building and seal all conduits after cable installed.
    - f. Service providers to fasten all entrance conduits to building upon installation.

### EXECUTION

#### 3.1 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

#### 3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

#### 3.3 INSTALLATION – RACEWAY

- A. Ground and bond raceway and boxes to ensure a continuous grounding pathway.
- B. Firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.
- C. All conduits shall have ends reamed after cutting or using die.
- D. Used approved tools for specific bends or offsets.
- E. All underground conduits must be secured in place.
- F. Conduit shall be keep dry during construction, and swab out before conductors are pulled. The A/E and Owner must verify all underground run before conductors are pulled.
- G. All conduits shall be store on clean and dry place and not exposed to weather condition.
- H. All bends shall no more than 360 degree or four 90 degree equivalent.
- I. Conduits shall be continuous from outlet to outlets, boxes to boxes, pull boxes to pull boxes and electrically continuous throughout the run before conductors are pulled.
- J. Terminations of all conduits shall be provided with two locknuts one inside and one



## BUILDING EXCELLENCE

- outside, plastic bushing or conduit hubs. Do not use running thread ~~between terminals in~~ all installation or chase nipples between cabinets and enclosures.
- K. Provide ~~and~~ expansion joints on PVC exceeding at 100 feet or follow manufactures recommendations. The A/E and Owner must verify this installation.
  - L. All conduits shall be install, layout in a uniformity, neat installations. Do not run conduit in angle. Conduits shall be run parallel with the wall.
  - M. Do not use other conduits as mean supports or other piping.
  - N. Tighten all connectors and fittings to provide good electrically bonded system.
  - O. Supports and secure all metal studs in place before rough-in.

### 3.4 ABOVE CEILING JUNCTION BOXES

- A. Labeling: Provide label on all above ceiling junction boxes.
  - 1. Provide permanent labeling with indelible black marker, in neat, legible print indicating the panelboard name, branch circuit number(s) and voltage of conductors within the junction box. Junction boxes used for emergency power circuits to be painted red.
  - 2. All boxes, junction and pull boxes shall be approved, listed, and labeled for each used. Conform all outdoor applications, sizing, materials, supports, label, and mounting per National Electrical Code Current Latest Edition and the Local Authority Having Jurisdictions.
  - 3. Do not used switch boxes for any devices.
  - 4. Label all conduits, boxes, junction boxes, pull boxes with designated circuit numbers.

### 3.5 CLEANING AND HOUSEKEEPING

- A. Cleaning:
  - 1. All metal conduits, junction boxes, pull boxes, cabinets, enclosure, auxiliary gutters, wireways, and other electrical equipment shall be free form dust, debris, and dirt.
  - 2. Wipe with clean cloth, use vacuum for cleaning. .

**END OF SECTION**



## SECTION 26 20 00

### ELECTRICAL DISTRIBUTION EQUIPMENT

#### GENERAL

- 1.1 Provide all electrical distribution and motor control equipment and accessories required to distribute electrical power to all motors, outlets and systems requiring power.
- 1.2 QUALITY ASSURANCE
  - A. New: Provide all new equipment.
  - B. Single Manufacturer: All equipment of each type shall be the product of one manufacturer.
  - C. UL: Equipment shall be UL listed. Service entrance equipment shall bear UL Service Entrance label.
  - D. NEC: Equipment and installation shall comply with the Current Edition of National Electrical Code adapted by the Local Authority Having Jurisdiction of City of Houston.
  - E. Wet Locations: Equipment and enclosures installed outdoors and in wet locations shall be approved for the purpose.
  - F. IEEE: Institute of Electrical and Electronics Engineers Standard 1015-1997 (Blue Book) Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
- 1.3 LABELING
  - A. Nameplates and labeling shall be provided in accordance with Section 26 05 53. All feeders shall be labeled at the feeder device and conduits.
- 1.4 FINISHES
  - A. All equipment shall have a factory applied ANSI 61 gray finish applied over a rust inhibiting treatment. Any items which have the finish marred shall be touched up or refinished to a new condition before final acceptance. This shall include, but shall not be limited to, sanding and properly removing rust or other contaminants and completely repainting equipment if damage is extensive. Overall acceptance is subject to approval of the Engineer in writing and the HISD Owner.
- 1.5 OWNER'S INSTRUCTION
  - A. Provide a four hour period of instruction to the Owner's designated personnel upon completion of the main switchboards installation. [Instruction shall include a functional training session on digital metering system operation, system test procedures and safety procedures including PPE.] [Demonstrate the transfer of metered values to the Building Automation System.] Review manufacturer's recommended switchboard maintenance. The Operations and Maintenance Manual shall be complete and on-site at the time of Owner instruction.

#### PRODUCTS

- 2.1 LOW-VOLTAGE TRANSFORMERS
  - A. General Purpose Transformers: Acceptable Manufacturers: Heavy-Duty, General Electric, Square D, Siemens, EATON/Cutler-Hammer, Hammond Power Solutions.
  - B. Harmonic Mitigating Transformers: Acceptable Manufacturers: Heavy-Duty, Power Quality International, Power Smiths, Hammond Power Solutions.
  - C. Install grounding electrode conductor (earth ground) directly to the X0, secondary neutral to the X0, main bonding jumper to the X0 and the other side to transformer case with multiple lugs or ground bar. The primary equipment bonding wire and secondary equipment grounding wire need to be connected to the transformer multiple ground lugs.



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The ground bar or the multiple ground lugs need to be bolted at the bottom of the transformer.

(Do not use individual lugs). No splicing in transformer feeders is acceptable. Comply with Article 250.

- D. In general, transformers shall be 480 volt – 208Y/120 volt 3 phase 4 wire, 60 Hz, WYE system. Transformers serving loads other than 208 volt shall be selected accordingly. Windings shall be copper or electrical grade aluminum terminated on tin-plated or copper bars.
1. Transformers 45kVA and above shall be floor mounted, except when existing conditions do not allow it. Refer to the N.E.C. for additional requirements.
  2. General purpose transformers shall be used in areas such as kitchens, industrial technology areas (woodshops), athletic facilities, or home economics areas or central plants and other areas where computers are not likely or very limited to less than 10% of the calculated load.
  3. Harmonic mitigation or K13 rated transformers shall be used to serve all other areas (i.e. Learning Centers, administrative area, and computer room and computer labs). *Provide 1.73% sized neutral on the secondary side of the transformer.*
    - a. Use a phase shift 0 degree and 30 degree transformers to balance the Total Distortion harmonics (THD).
    - b. The phase shifting transformer are used to improve the harmonics by minimizing the high neutral currents or called harmonics.
    - c. This transformers must be designed and provide the cancellation of the odd numbers.
    - d. The designer shall determine and provide documentation or calculation to show how to improve by eliminating the odd numbers or harmonics.
  4. Transformers shall have an engraved Bakelite name plate. Nameplates shall be white with black letters and show panel designation and be attached with stainless rivets.
  5. Each panelboard shall have a directory card. A type written directory card identifying the load served by each branch circuit in the frame on the panel door under a clear plastic cover. Spares and spaces shall be written with erasable pencil for future use.
  6. Balance loads on all phases in each panel to within 10% of respective phase loads.
  7. All motors 1 HP and greater shall have phase failure protection, under and over voltage protection on all 3 phases.
- E. Transformer shall not be hung in the ceiling without proper approval from a structural engineer.
- F. Transformer shall be set on 6" tall poured concrete isolation pad extending 6" on sides of transformer.
- G. Outdoor transformers shall have a 6 feet fencing with a full access gate in front of the transformer.
- H. Transformers shall use a liquid-tight flexible conduit with an equipment ground install inside and LTFC shall be supported from the wall.
1. Transformers shall be installed on concrete pads not less than 6 inches above finished floor. On outdoor, the poured concrete pads not less than 12 inches above finished grade.
  2. In general, transformers shall be 480 volt – 208Y/120 volt 3 phase 4-wire. Transformers serving loads other than 208 volt shall be selected accordingly.
  3. Transformers 45kVA and above shall be floor mounted, except when existing conditions do not allow it. Refer to the N.E.C. for additional requirements.
  4. General purpose transformers shall be used in areas such as kitchens, industrial technology areas (woodshops), athletic facilities, or home economics areas or central plants and other areas where computers are not likely or very limited to



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- less than 10% of the calculated load.
5. Harmonic mitigating or K13 rated transformers shall be used to serve all other areas (i.e. learning centers, administrative area, and computer room and computer labs). *Provide 1.73% sized neutral on the secondary side of the transformer.*
  6. The main bonding jumper, grounding electrode conductor and equipment conductor must be sized on the current NEC edition. The grounding electrode conductor must not be smaller than No. 2 AWG.
  7. Provide and install a ground bar to where all grounding conductors are to be connected. No individual lugs are allowed. See illustrated diagram for proper grounding.
  8. Delivery, Storage, and Handling
    - a. Transport, handle, store, and protect Products.
    - b. Deliver transformers individually wrapped for protection and mounted on shipping skids.
    - c. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
    - d. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.
    - e. Any defects such as bends, scratch on side covers, top cover and bottom cover must be fix or replace with new transformer. Transformer shall be brand new without defects of any kind.
  9. Coil Conductors
    - a. Continuous windings with terminations brazed or welded. Transformer shall be impregnated with non-hygroscopic and thermosetting varnish. Transformers shall operate at 100% of nameplate kVA rating continuously on a 40 degree C ambient temperature without exceeding the rated average winding temperature rise of the ANSI insulation.
    - b. Isolate core and coil from enclosure using vibration-absorbing mounts.
  10. Installation
    - a. Install transformers in accordance with NECA SI, as indicated on the drawings, and manufacturer's published instructions, at locations and as indicated on the drawings.
      - i. Use manufacturer approved mounting brackets for transformers supported from building structure.
      - ii. Securely anchor transformers to concrete pad for floor mounted transformers.
      - iii. Provide working clearances in conformance with NFPA 70.
      - iv. Provide both primary and secondary protections using fuses or circuit breakers as Indicated on the drawings.
      - v. Transformer must have full length neutral to where all connections are to be made.
      - vi. No single lug used but multiple lugs.
    - b. Set transformers well level in all sides.
    - c. Use minimum 2 foot length flexible conduit for connections to transformer case. Make conduit connections to side panel of enclosure.
    - d. Mount transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
    - e. Provide grounding and bonding as specified in illustrated drawing.
    - f. Furnish and install engraved plastic nameplates.
    - g. field control
      - i. Field testing and inspection.
      - ii. Check for damage and tight connections prior to energizing



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- transformer.
  - iii. Measure primary and secondary voltages and make appropriate tap adjustments. Record all voltages readings.
- 11. Transformers mounted on ceiling mount shall be approved signature by a structural engineer. No Transformer shall be mounted above the ceiling without proper approval from the District.
- 12. Enclosure  
Transformer that are exposed to weather or installed in a sprinkler environment shall have rain shields on all openings. Transformer enclosure shall be cleaned, phosphatized, primed and painted with ANSI-61 gray and baked enamel.
- 13. Maximum sound ratings: Transformers shall have a minimum sound of 40db in all ratings.
- 14. Testing: Prior to energization, contractor shall check transformers windings for continuity and test all insulation resistance. Test shall be made by using a Megger or equivalent test instrument meeting the criteria recommendations. Provide written documentation and be submitted on the O&M manuals.  
Contractor must perform another test after six months after the building occupant and submit to design engineer for review and engineer must submit to Owner final review.
- 15. Enclosure: Each transformers shall have a neutral bus bar to make terminations on X0 terminal.
- 16. Transformers shall be designed to reduce the voltage and current distortion, imbalance on the primary, current crest factor, average and peak phase current, hysteresis losses, eddy current losses, and power factor.

### 2.2 UNINTERRUPTIBLE POWER SUPPLY SYSTEMS

- A. Acceptable Manufacturers: Liebert, PowerWare, Best Power

### 2.3 POWER FACTOR CORRECTION EQUIPMENT

- A. Acceptable Manufacturers: Square D, G.E., Siemens, Cutler-Hammer
- B. Designer shall ensure and demonstrate on the plans that all large motor loads shall be supplied by control equipment designed to maintain a power factor of 95% or better.  
Where this is not possible, power factor correction equipment shall be supplied as required in order to maintain a power factor of 95% or higher at the main electric utility service entrance equipment.
- C. The overcurrent protection, wire sizing and grounding must be size per NEC Article 220, 210, 240, 250 and 460 respectively.

### 2.4 SWITCHBOARDS

- A. Switchboards: Acceptable Manufacturers: General Electric, Square D, Siemens, EATON/Cutler-Hammer.
- B. Minimum physical dimensions for all indoor and outdoor switchboard sections shall be 45"x 45" (width and depth). The end of bus bars on both sides shall have an insulated end cap and insulated fire board installed in the covers. No conduits shall be allowed to enter the top of outdoor switchboards. Outdoor switchboards/switchgear shall be painted with ANSI – 61 grey color after completion. Coordinate with Architect to ensure all indoor switchboards are located in electrical rooms only that have panic hardware in the direction of egress on all doors serving the room, doors must swing out.
- C. Outdoor Applications:
  - 1. Concrete pad, 12 inches above finish grade with 5/16 re-bars piers to the ground in four sides. Maintain a minimum 3 feet of poured concrete pad all around and 4 feet in front the switchboard for working clearance.
  - 2. Install a welded enclosed C-channel form embedded into the concrete at the bottom where the switchboard is going to be set. The C-channel has to maintain to at least 2 inches high from top, of the pour concrete and fill concrete inside the





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3. C-channel to as water will not settle but to drip down to the side.
  4. Grout the sides of the C-channel so water falls on the sides.
  5. Switchboard must be a Dynamic Arc Flash Centuries above 1000 amps.
  6. Nameplate: Provide switchboard with engraved nameplate indicating, designation, voltage, and number of phases. Provide engraved ID tags (Bakelite) for each over current device indicating load served.
  7. Balance Loads: All electrical phases A, B and C on the switchboards must be balanced. Show spreadsheet calculation.
  8. Energization:
    - a. Prior to energization of circuitry, check all accessible connections to manufacturer's torque tightening specifications. Record and submit field test data.
    - b. Prior to energization, check switchboards for electrical continuity (Megger) of circuits and for short-circuits. Record and submit field test data.
    - c. Prior to energization of switchboards, check with an insulation resistance tester, phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled. Record and submit field test data.
  9. Adjusting and Cleaning:
    - a. Set all adjustable trip settings to values provided with Selective Coordination Study.
    - b. Adjust operating mechanisms for free mechanical movement.
    - c. Touch-up scratched or marked surfaces to match original finishes with ANSI-61 Grey color. Do not used latex, oil or other paint.
- D. Indoor Applications:
1. Concrete pad, 6 inches above finish grade with 5/16 re-bars piers in four sides. Maintain a minimum of 8 inches of poured concrete pad all around the switchboard and maintain of at least 3 feet for working clearance at the back and sides of the switchgear, and MCC. No switchboard and MCC shall be install close to the wall.
  2. Switchboard must be a Dynamic Arc Flash Centuries above 1000 amps.
  3. Nameplate: Provide switchboard with engraved nameplate indicating, designation, voltage, and number of phases. Provide engraved ID tags (Bakelite) for each over current device indicating load served.
  4. Balance Loads: All electrical phases A, B and C on the switchboards must be balanced. Show spreadsheet calculation.
  5. Energization:
    - a. Prior to energization of circuitry, check all accessible connections to manufacturer's torque tightening specifications.
    - b. Prior to energization, check switchboards for electrical continuity of circuits and for short-circuits.
    - c. Prior to energization of switchboards, check with an insulation resistance tester, phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled. Record and submit field test
  6. Adjusting and Cleaning:
    - a. Set all adjustable trip settings to values provided.
    - b. Adjust operating mechanisms for free mechanical movement.
    - c. Touch-up scratched or marked surfaces to match original finishes with ANSI-61 Grey color. Do not used latex, oil or other paint.
- E. Switchboards shall have a 0.2% accurate digital meter connected (voltage and amp) to the primary bus after the main circuit breaker. *The digital meter shall provide the following information: volts, amps, kVA, kW, kVARS, Power Factor, kWh, THD amp, Harmonic power flows. Provide an IT address and card to be able to monitor the data/information on computer desktop or laptop.* The manufactured shall demonstrate how to operate the digital meter.





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- F. Locate switchgear of any kind in electric rooms only, not in learning centers, restrooms, corridors, vestibules, offices or other areas where unauthorized access may occur.
- G. Switchboards and switchgear equipment shall be located in electrical rooms only. Sprinkling piping shall be allowed in electric rooms but not positioned directly over the top of electrical panel boards or switchgear.
- H. Switchboard, panelboards, transformers and disconnecting means that are install in a dedicated electrical room only regardless of their Ampacity, the door must be on panic hardware bar.
- I. Install an emergency lighting and must be on a dedicated circuit. No automatic switch installed at this locations. Install wire guard in all lighting fixtures. Maintain at least 10 foot-candle in the area.
- J. Switchboard shall not be located in boiler rooms or mechanical room where water pumps, boilers, chillers are installed.
- K. Switchgear, switchboards, panelboards, transformers, disconnect switches, VFD, pumps, and motor starters shall have a riveted engraved Bakelite nameplate (white background and black lettering). Nameplates shall be white with black letters and show panel designation and be attached with revited to the panel not adhesive.
- L. Switchboards, Motor Control Center (MCC) and panelboards shall be provided with a full hinged front & back covers, full height hinged rear covers, hinged gutter covers.
- M. Switchboards and other electrical equipment shall be installed on a 6 inches poured concrete pad above finished floor and maintain 6 inches extra space around the switchboard.
- N. Switchboards and Motor Control Centers must main 3 feet clearance at the back of the switchboard into the wall.
- O. For switchboards installed outdoors or in unconditioned spaces: Install an electric heater inside the switchboards to prevent for humidity, moisture, and water. The heater shall be on a dedicated circuit.
- P. No conduit shall be installed on top Switchboard on outdoor applications only. Provide an adder cubicle for all conduits.
- Q. DO NOT STAND OR USE THE TOP OF THE SWITCHBOARD AS A WORKING SPACE. ANY ENDS, SCRATCH, ON PART OF THE SWITHCBOARD NEED TO BE FIX OR NEW EQUIPMENT.
- R. On the design one-line diagram, A/E shall provide the short circuit, fault current, distance in length of the conduit/wiring run in each service conductors, feeder conductors, and branch circuit conductors.
- S. Delivery, Storage, and Handling: Store switchboard equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with a watertight wrapping. Do not install damaged equipment; remove damaged equipment from the site and replace with new.
- T. Equipment Switchboard Bus: Provide switchboard busing with sufficient cross-sectional area to fulfill UL 891 pertaining to temperature rise.
  - 1. Bus (copper) shall be continuous rated. Construct through-bus of copper with silver-plated connections, with ampacity rating, and with short-circuit current rating.
  - 2. Provide fully rated copper main bus, full capacity neutral bus, ground bus full length of switchboard, firmly connected to each vertical section of the switchboard.
  - 3. Provide electric heater in each compartment. Electric heater must be protected by a dedicated fuses and circuit conductors.
  - 4. Bus bars of at least 12 inches away from the back hinged cover with insulated fire cardboard. The bus bar ends must be insulated and on the sides with insulated fire cardboard.



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- 5. Surge Protection: Furnish and install internal surge protection unit connected to the switchboard. The surge protection must have an isolation enclosure from the rest of the equipment.
- 6. Do not install a power phase failure relay in the main Switchboard except on the MCC and other motors.
- U. Include metering device (smart meter) to capture kWh energy consumption for chillers, Motor Control Center and kitchen.

### 2.5 PANELBOARDS

- A. Branch Circuit and Distribution: Acceptable Manufacturers: General Electric, Square D, Siemens, Cutler-Hammer. Coordinate with Architect to ensure all indoor panel boards are located in rooms that have panic hardware in the direction of egress on all doors serving the room, doors must swing out. A short-circuit available fault current calculation shall be performed per section 26 20 00, paragraph 2.4(R). For 120/208V panels served by transformers rated 150kVA or less, provide equipment rated at 10 kAIC, or rated to accept the available fault current at the panel per the calculation, whichever is higher. For all other panels, provide equipment rated for 22 kAIC minimum, or rated to accept the available fault current at the panel per the calculation, whichever is higher.
- B. All panelboards and distribution panelboards shall have a stability hinged front cover. The panel box shall have enough lip to hold the weight of the front hinged cover. No bolted front cover is allowed.
- C. Do not use the panelboards for splicing purposes.
- D. All wiring shall be installed neat, orderly, and tie-wrap, label the phases and neutrals circuits, type written hard paper directory.
- E. All grounding wiring shall be installed on a single ground bar. No double lugging.
- F. Neutrals shall be installed on separate neutral bar and no other wiring installed. Remove the manufactured grounding screws to isolate the both grounding bar and neutral bar.
- G. Provide a Bakelite label indicating the panel indication, riveted in front of the panel.
- H. Do not install panelboards or other electrical equipment behind doors. All electrical equipment must be accessible per NEC. Label all conduits including feeders with the circuit numbers and designation.
- I. General panelboard requirements:
  - 1. All panelboards and power panelboards shall have a hinged front cover. No bolted allowed.
  - 2. Each panelboard shall have a hard directory card. A type written directory card identifying the load served by each branch circuit in the frame on the panel door under a clear plastic cover. Spares and spaces shall be written with erasable pencil for future use.
  - 3. Balance loads on all phases in each panel to within 10% of respective phase loads. Perform electrical system testing and inspection as specified in each Specification 26 Section and as specified in this written Section.
  - 4. Label all conduits, dead front cover, conductors (phase and neutral) with the circuit numbers of the load served.
  - 5. All neutral and grounding conductors must be installed on separate ground bars.
  - 6. No splicing is allowed inside the panelboard, cabinets, and pull boxes.
  - 7. All branch circuit conductors, neutral conductors must identify or label with the circuit number of the load served.
  - 8. Install surface-mounted cabinets and panelboards with a minimum of four anchors and must maintain a 1/4 inch clearance from the wall. Use a unistrut as mounting structure.
  - 9. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall. Install a plastic bushing in all conduits.
  - 10. Use copper bus bars in all panelboards.
  - 11. No panelboards, transformers, disconnecting means or other electrical equipment installed behind doors or opening.



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- J. Surge Protection for Distribution Panel Locations (277/480V, 3 phase, 4 wire)
  - 1. For distribution panel applications (400 – 1200 amperes) specify a SPD with a minimum surge current rating of 80kA per protection mode and 160kA per phase.
  - 2. Specified unit shall meet all of the additional requirements listed for the service entrance units.
- K. Surge Protection for Panelboard Locations (120/208V, 3 phase, 4 wire)
  - 1. For lighting and appliance panelboards serving receptacles, specify a SPD with a minimum surge current rating of 65kA per protection mode and 130kA per phase.
  - 2. Specified unit shall meet all of the additional requirements listed for the service entrance units except as noted below:  
SPD shall be life cycle tested to survive 6,000 IEEE Category C3 impulses in each protection mode, with less than 10% degradation.
- L. Emergency Panelboards
  - 1. All emergency lighting shall be installed on a separate panelboard dedicated to emergency lighting branch circuits **only**. This panelboard shut-off with one main circuit breaker.
- M. IT MDF and IDF Panelboards
  - 1. All information technology MDF and IDF branch circuits shall be installed on a separate panelboard dedicated to MDF and IDF loads.
  - 2. Provide a surge protective device on all MDF and IDF panelboards.

## 2.6 MOTOR CONTROL CENTERS

- A. Acceptable Manufacturers: General Electric, Square D, Siemens, Cutler-Hammer
- B. Motor control centers will be set on concrete pads not less than 6" above finished floor and 6 inches in all sides of the MCC.
  - 1. Provide an overload, phase failure power relay and under/over voltage for all three-phase motors.
  - 2. Label all feeder and branch conduits for the load served.
  - 3. Conductors must be installed neat per NEC. Tie-wrap the conductors install and neat inside the compartments.
  - 4. Maintain a working clearance of at least 3 feet in all sides.
  - 5. Provide an insulator protection in all sharp corner edges as not to damage the conductors.
  - 6. Load balance all electrical phases on the switchboards. Perform electrical system testing and inspection as specified in each Specification 26 Section and as specified in this Section.
  - 7. Use copper bus bars in all MCC. Provide flexi-glass in front of the termination lugs. Caution: DANGER HIGH VOLTAGE.
  - 8. Nameplate: Provide motor control center (MCC) with engraved nameplate indicating, designation, voltage, and number of phases. Provide engraved ID tags (Bakelite) for each over current device indicating load served.
  - 9. Grounding:
    - a. Provide equipment grounding connections for motor control center (MCC) as indicated. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.
    - b. Provide an equipment grounding conductor for all three-phase and single-phase motors.
    - c. Test for ground continuity. Test neutral continuity to grounded point of derived system.
    - d. Grounding conductor must be enclosed in a raceway.
  - 10. Energization:
    - a. Prior to energization of circuitry, check all accessible connections to manufacturer's torque tightening specifications.
    - b. Prior to energization, check switchboards for electrical continuity of circuits and for short-circuits.



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- c. Prior to energization of switchboards, check with an insulation resistance tester, phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled. Record and submit field test data.
- C. Adjusting and Cleaning:
  - 1. Set all adjustable trip settings to values provided.
  - 2. Adjust operating mechanisms for free mechanical movement.
  - 3. Touch-up scratched or marred surfaces to match original finishes with ANSI-61 Grey color. Do not use latex, oil or other paint.
- D. Motors
  - 1. Motors are to be wired with a liquid-tight conduit to a minimum of 3 feet.
  - 2. Conduit that comes down from the ceiling to a motor must be rigidly supported.
  - 3. Grounding conductor must be sized accordingly per Article 250.
  - 4. It has to be mounted properly on a 6 inches poured concrete pad with vibration pad.
  - 5. Motors shall be installed per manufactured recommendations.
  - 6. Motors shall be level on either side, and align properly.
  - 7. Motors shall be protected by an overload, unbalance voltage, phase power failure, and over current protection per NEC.
  - 8. Motors shall be energy efficient, free from vibration, soundless.
  - 9. check for motor rotation to prevent from reversing the direction.

### 2.7 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

- A. Automatic Transfer and Isolation: Acceptable Manufacturers: General Electric, Oman, Kohler, ASCO.
- B. Over current Protective Devices – Circuit Breakers and Fuses: Acceptable Manufacturers: General Electric, Square D, Siemens, Cutler-Hammer.
- C. Use heavy duty type disconnects or horsepower rating and switches for all motors and for heavy loads.
- D. Switches and circuit breakers shall have an engraved Bakelite name plate. Nameplates shall be white with black letters and show panel designation and be attached with stainless riveted.

### 2.8 BUS DUCT ASSEMBLIES

- A. Acceptable Manufacturers: General Electric, Square D, Siemens, Cutler-Hammer
- B. No bus duct and cable tray allowed.

### 2.9 ELECTRICITY METERING

- A. Acceptable Manufacturers: General Electric, Square D, Siemens, Cutler - Hammer
- B. Provide a submetering devices to monitor the energy consumption on the daily used. This submetering shall be install in separate compartment attach on the main switchboard of the distribution side.

### 2.10 ENCLOSED CONTROLLERS (CONTACTORS)

- A. Acceptable Manufacturers: Asco, Square D, General Electric, Cutler-Hammer.
- B. Switches and circuit breakers shall have an engraved Bakelite name plate. Nameplates shall be white with black letters and show panel designation and be attached with stainless riveted.

## EXECUTION

### 3.1 DELIVERY, STORAGE AND HANDLING:

- A. General:
  - 1. Store all types of electrical power distribution equipment in a clean, heated building affording appropriate physical protection. Control access to prevent unauthorized



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- tampering with the equipment. However, equipment may be stored in other inside or outside environments under approved conditions.
  - 2. Inspect equipment when received at Project site for shipping damage. Report as required by freight carrier to recover repair or replacement costs from the freight carrier in the event damage was sustained.
  - 3. Covers are required unless indoor, ventilated storage conditions exist. Canvas tarpaulins or the equivalent are preferred over other coverings because they provide better humidity control and enclosure scuff protection. Where exposed to moisture, covers shall be waterproof.
  - 4. The manufacturer's shipping skids shall be left on the equipment to provide structural support until the equipment is set in final resting place.
  - 5. Refer to Section 26 05 00 for additional requirements. Contractor shall furnish new equipment to replace any equipment that is exposed to weather or subjected to other deleterious effects of construction.
- B. Approved Conditions for Equipment Storage:
  - 1. General: Where storage conditions specified above are not available, indoor or outdoor storage shall comply with the following.
  - 2. Switchboards, Motor Control and Other General Distribution and Utilization Equipment:
    - a. Store metal-enclosed equipment in the upright position. Provide good ventilation of the shelter and protection from dirt, moisture and physical damage.
    - b. Space heaters furnished with the equipment shall be connected to a continuous source of power of the proper rating. Where space heaters are supplied from auxiliary power transformers, care shall be taken that low-voltage heater circuits are properly isolated before power source connection to prevent inadvertent energizing of the auxiliary transformer and associated high-voltage primary wiring.
    - c. Ambient conditions may allow condensation inside waterproof covers. If condensation is occurring, temporary heaters or lamp banks shall be provided of sufficient wattage to prevent condensation.
    - d. Contractor shall ensure that equipment stored in shipping cases receives adequate ventilation to avoid mildew and prevent condensation.
- C. Transformer
  - 1. Indoor storage shall be provided for all transformers.

### 3.2 TRANSFORMER VIBRATION ISOLATION:

- A. Floor Mounted Transformers: Install on concrete housekeeping pad with Mason Industries Type WM Neoprene Waffle pad, or equal. Provide Type WM isolation for elevated rack installation.
- B. Wall Mounted Transformers: Install Mason Industries Type WM Neoprene Waffle pad between the wall brackets and the wall.
- C. Suspended Transformers: Install Mason Industries PC30 Pre-compressed spring hanger with neoprene isolator.
- D. Floor Mounted Transformers Greater than 150 kVA: Install on Mason Industries, Inc, or equal, unhoused spring isolators with acoustical pad bonded to bottom. Isolators shall be undamped free-standing spring isolators sized for a minimum of two (2) inches of static deflection. The spring outside diameter shall be no less than 80 percent of the spring operating height. The spring shall have remaining travel to solid of no less than 50 percent of the static deflection. Provide a 1/4 inch neoprene friction pad bonded to the spring base. Bolt each vibration isolator unit to concrete pad, and bolt transformers to the vibration isolator units, using the leveling bolts and nuts provided with the unit.

### 3.3 TRANSFORMER VENTILATION:



## B U I L D I N G E X C E L L E N C E

- A. Transformers with ventilating openings shall be installed so that the ventilating openings are not blocked by walls or other obstructions. The required clearances shall be clearly marked on the transformer.

### 3.4 ELECTRICAL CONTROLS INTERFACE

- A. Provide phase protection for all plant equipment.
- B. Provide Modbus or BACnet interface to switchgear.
- C. Install and wire VFD's provided by the Controls Contractor.

### 3.5 POWER SHUT OFF UNDER KITCHEN HOODS:

- A. NFPA:
  - 1. Comply with NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations. The operation of any extinguishing system shall automatically shut off all sources of fuel and heat to all equipment requiring protection by that extinguishing system.
  - 2. Comply with NFPA 17, Standard for Dry Chemical Extinguishing Systems.
  - 3. Comply with NFPA 17A, Standard for Wet Chemical Extinguishing Systems.
- B. Shunt Trip: All electrical sources located under the ventilating equipment (cooking equipment hood) shall be shut off upon the operation of a wet chemical or water fire extinguishing system. Provide shunt trip accessory on each circuit breaker serving an electrical appliance under the hood. Install control wiring between shunt trips and the hood extinguishing system. coordinate all wiring with supplier of hood fire suppression system for proper selection of shunt trip coil voltage, momentary or maintained-contact closure to activate shunt trip and inter-connections. Operation of a hood extinguishing system shall automatically shunt trip all associated circuit breakers.
- C. Fire Alarm System: The operation of any extinguishing system shall automatically signal the building fire alarm system.

### 3.6 LABELING:

- A. Nametag: Provide a nametag for each piece of distribution equipment.

## END OF SECTION





## BUILDING EXCELLENCE

### SECTION 26 27 26

#### WIRING DEVICES

##### GENERAL

- 1.1 Section includes wall switches; wall dimmers; receptacles; device plates and box covers. All devices shall be installed in outlet boxes of required size and volume.

##### PRODUCTS

###### 2.1 GENERAL

- A. Acceptable Manufacturers: Leviton, Hubbell, Pass and Seymour
1. All devices shall be industrial grade using 302/304 stainless steel cover plates. Specify "toggle" type switches.
- B. Safety Switches: Acceptable Manufacturers: General Electric, Square D, Siemens, Cutler-Hammer
- C. Switches:
- Wall Switch Sensors, Pilot Light Switches, Key Operated Switches, Single-Pole, Double Pole Switches, Three-way Switches, Four-Way Switches, shall rated 20 amp, 125 volt. No 15 amp shall be used. All switches shall be listed, labeled and UL approved. Used one manufactured only.
1. No automatic switches shall be installed in electrical room or dedicated electrical room.
  2. Switches shall be rated 20 amps, 125 volts grounding type.
  3. Wiring to all non dedicated electrical switches are required to utilize parallel circuiting by the use of pigtails.
  4. Wire connection must be installed on the side screw of the switches and not depend on the back of the devices. Provide tape (3M electrical tape) around the terminals or use receptacle with safety covers. .
  5. Grounding conductor must be sized accordingly per Article 250.
  6. Provide type written labels on all switches plates noting the service locations.
  7. Minimum conductor size is No. 12 THWN copper only.
- D. Receptacles
- All receptacles shall be listed, labeled and UL approved. Used one manufactured only. All special receptacles rated more than 20 amp, shall be sized according to load served.
1. Receptacles shall be rated 20 amps, 125 volts grounding type.
  2. ***Use tamper proof receptacle in learning centers where students are 7 years age or younger. Comply with NEC Section 406.2; 406.4(D)(5); 406.14***
  3. Wiring to all non dedicated electrical receptacles are required to utilize parallel circuiting by the use of "pig tails".
  4. Wire connection must be installed on the side screw of the receptacle and not depend on the back of the devices. Provide tape (3M electrical tape) around the terminals or use receptacle with safety covers
  5. Grounding conductor must be sized accordingly per Article 250.
  6. Provide labeling all receptacle plates (front and back cover) with designated circuit and panel indication. The inside of the square boxes need to be marked with the circuit designation number.
  7. Learning center general receptacle shall have a minimum of 3 receptacles per circuit. Each circuit has to have an equipment grounding wire same size as the ungrounded conductors.
  8. Provide tape (3M electrical tape) around the terminals or use receptacle with safety covers
  9. Computer outlets





## BUILDING EXCELLENCE

- a. Each circuit shall be on each own dedicated neutral and equipment grounding wire for three circuits.
  - b. Each circuit shall allow three computer receptacles, quad receptacles and orange type color.
  - c. Provide tape (3M electrical tape) around the terminals or use receptacle with safety covers
10. Calculate for voltage drop for every 200 feet of run
- a. All devices shall be suitable for use intended, and have voltage and current ratings adequate for loads being served.

### EXECUTION

#### 3.1 EXISTING WORK

- A. Disconnect abandoned circuits and remove raceway, wire, and cable. Remove abandoned boxes when connecting wire and cable is abandoned and removed.
- B. Maintain access to existing boxes and wiring connections remaining active and requiring access.
- C. Extend existing circuits using materials and methods compatible with existing electrical installations.

#### D. INSTALLATION

1. Use a torque screwdriver as manufactured recommendations. Tighten unused terminal screws on the devices.
2. Check all devices by pressing the face of the devices. There should be no allowance to move toward in to the wall.
3. There should not more than 1/8 inch in all sides of the boxes of the wall. Repair wall finishes and remount outlet and switches boxes when device paltes do not fit or flush. Do not cover wall opening by using oversized cover plates.
4. Do not cut the strands of the wire. Check all connections and terminations including to avoid neck or cut to the wire strands.
5. Twisting the wires with the right tool before using any of the fittings.
6. All devices meet the ADA compliance and industry standards.
7. Materials are all brand new.
8. Use copper conductors only (Stranded)

#### 3.2 GFCI

- A. Provide ground-fault circuit-interrupter type receptacles for 20 amp receptacles shown on drawings in bathrooms, kitchens and outdoors.
- B. Equipment grounding conductor shall be the same size as the ungrounded conductor.

#### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
  1. Prepare reports that comply with recommendation and use instruments that comply with UL 1436.
  2. The tests shall be diagnostic, including damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new and retest as mention above.

### END OF SECTION



## BUILDING EXCELLENCE

### SECTION 26 32 13

#### ENGINE GENERATORS

##### GENERAL

###### 1.1 SUMMARY

- A. Provide an emergency power system for emergency egress lighting, fire alarm system, emergency elevator operation, and other emergency power loads required.
- B. Power Source: Provide an on-site engine-generator set to generate power for distribution to emergency and standby loads by the emergency power distribution system. Engine-generator set shall be constructed of all-new components.
- C. Transfer: Power to emergency loads shall be automatically transferred from normal utility power to the emergency engine generator upon loss of normal power. Transfer and assumption of load shall occur in ten seconds or less. Loads shall be automatically retransferred upon restoration of normal source.
- D. Distribution System: Distribution equipment devices, and circuits shall be provided as required to distribute power to emergency loads.

- 1.2 Provide a four hour period of instruction to the Owner's designated personnel upon completion of the system installation. Run engine-generator set and review remote annunciator panel for typical readings. Explain operation of generator remote stop switch. Demonstrate complete transfer sequence of utility-generator-utility. Operations & Maintenance Manual shall be complete and on-site for use during Owner's Instruction.

- 1.3 Furnish full parts and labor warranty to cover the entire engine generator package including all accessories for five years from date of acceptance by the Owner not on installation.

###### 1.4 MAINTENANCE

- A. Furnish one set of tools required for preventative maintenance of each engine generator system. Package tools in adequately sized metal tool box.
- B. Provide two spare sets of each oil, and air filter element required for each engine generator system.

##### PRODUCTS

###### 2.1 ENGINE GENERATORS

- A. Acceptable Manufacturers: Onan, Kohler, Caterpillar, Taylor Power, ~~Generac~~
- B. Install as required for the critical used only such as emergency power, computer servers, telephones, fire alarms, elevators and cameras.
- C. Natural Gas only.
- D. Brand new generator

##### EXECUTION

###### 3.1 GENERAL

- A. Provide all work required for complete system testing and checkout. The installation of this system shall comply with the directions and recommendations of authorized factory representatives.

###### 3.2 EMERGENCY DISTRIBUTION SYSTEM

- A. All boxes, and enclosures (including transfer switches, generators, and power panels) for emergency circuits shall be permanently marked so they will be readily identified as a component of an emergency circuit or system. Emergency circuits shall be specially marked and shall be run in raceway separate from normal powered circuits. All



## BUILDING EXCELLENCE

distribution equipment shall be specifically indicated "EMERGENCY" on the equipment nametag. Color code for emergency markings and all nametags shall be RED.

- B. Install one emergency distribution panelboard for the branch circuits and one main circuit breaker to turn-off the entire panelboard.

### 3.3 COMMISSIONING SERVICE

- A. A final inspection and an initial startup of the system shall be rendered by the authorized factory representatives and present the Owner representative.
- B. A letter of certification written by the authorized factory representatives, which states that the system is properly installed and does properly function as recommended by the factory and as described in this specification, shall be submitted to the Architect for his approval.
- C. A test run shall be performed by the authorized factory representative in the presence of the Owner, Architect and Engineer; the time of this test run shall be mutually agreed upon by all persons concerned. This test run may, but is not required to, coincide with other testing requirements described in this section.

### 3.4 INSTALLATION

- A. General: Provide all labor required for a complete installation.
- B. Mounting: Anchor on a four inch concrete pad with bolts and elasto-rib vibration isolators. Pad shall extend a minimum of 18 inches from each side of the generator set skid.
- C. Conductors: Use copper conductors only. Provide an earth ground to the case of the generator. Install an equipment grounding conductor per NEC Article 250.
- D. Circuit Breaker/Fuses: The overcurrent protection shall be size per Article 240, 445, 300, and 310.

### 3.5 TESTING

- A. Factory Testing: The engine generator shall be tested at the factory, demonstrating its performance at full rated load. A certified copy of the test report shall accompany the unit to the field and shall be made available to the building official and copied to the Architect and Engineer.
- B. Field Testing: Conduct tests of the system as required by NEC Article 700 in the presence of the Owner, Architect, Engineer, and Code Authority having jurisdiction. The engine generator set shall demonstrate the actual sequencing of all load onto the generation unit and shall carry the building emergency loads, including any elevator(s), for a minimum period of two (2) hours. Contractor shall insure that all emergency loads are operational before scheduling this test. Test times shall be mutually agreed upon by all persons concerned.
- C. Test shall be perform at full load.
- D. Contractor shall provide full test reports/documentation, manuals, part lists, service number and contact number to the Owner as part of the Commissioning.

### 3.6 SYSTEM GROUNDING

- A. The emergency power system generator output shall be grounded as a separately derived system according to the requirements of the Section titled GROUNDING. Bond the generator neutral to the generator ground.

### 3.7 SIGNS

- A. Service Entrance: A sign shall be placed at the normal power service entrance indicating location of the emergency power engine-generator set.
- B. Generator: Provide a sign arranged to be prominent and legible at the set control panel. Sign shall be an OSHA orange WARNING sign plus text. Sign text shall be "Warning – This equipment starts automatically. Disconnect all sources of supply and load before servicing", or similar approved text.



## BUILDING EXCELLENCE

- C. Fuel Tank: Provide a "Caution - No Smoking" sign on the housing. Sign shall be an OSHA yellow caution sign with text and graphic no-smoking symbol. Provide sign per NFPA 110 Sect. 5.9.7 at both generator gas shut-off valve and building gas shut-off valve to indicate that there is another valve.
- 3.8 REMOTE WIRING
  - A. General: Provide raceway, wiring and control cables from generator control panel to remote points. Underground conduits may be direct buried without concrete encasement if a red plastic warning tape is installed above each conduit.
  - B. Remote Points:
    - 1. Engine-Generator Remote Panel
    - 2. Automatic Transfer Switches
    - 3. Automatic Battery Charger. Provide dc wiring from remote charger to battery rack at engine-generator set. Size wire for maximum 2 percent dc voltage drop at full load.
    - 4. Generator control power 120V branch circuit.
    - 5. Engine water jacket heater branch circuit.
    - 6. Outdoor generator housing: battery rack warming jacket 120V branch circuit.
    - 7. Outdoor generator housing: generator strip heater 120V branch circuit. One circuit may serve both jacket heater and generator heater if total load including voltage drop is less than 80% circuit ampacity.
    - 8. Elevator Controllers; (Signals shall be taken from ATS).
    - 9. Building Automation System (BAS); (BAS wires to the ATS).
    - 10. Building Security System
    - 11. Emergency Lighting Automatic Transfer Switches
- 3.9 EMERGENCY LIGHTING AUTOMATIC TRANSFER SWITCHES
  - A. Provide automatic slave transfer switches where indicated on the drawings for transfer of dimmer branch circuits utilized for emergency lighting.

### END OF SECTION



SECTION 26 43 00

**SURGE PROTECTION DEVICES (SPD's)**

**GENERAL**

- 1.1 Section Includes: Surge Protection Devices, individually mounted and switchboard mounted.  
Switchboards: Surge Protection Device integrated in switchboards.

**PRODUCTS**

2.1 SURGE PROTECTION DEVICES (SPDs)

- A. Acceptable Manufacturers: APT - Advanced Protection Technologies, Current Technologies, Square D, General Electric, Cutler-Hammer and Siemens. Coordinate with Architect to ensure all indoor SPD's equipment is located in rooms that have panic hardware in the direction of egress on all doors serving the room, doors must swing out. Surge Protection Devices equipment shall be installed with the shortest leads possible from the panelboard served, target length is 6 inches shorter straight where possible.
- B. Surge Protection to be used in all main switchboards, all distribution boards and 120/208 lighting panels to control transient voltages. Each surge suppressor must be protected with an over-current protection device and rated for the appropriate short circuit current. SPD's shall also be installed on the disconnecting means beside all chillers.
  - 1. Surge Protection Devices:
    - a. Surge Protection Devices (SPD) shall be used in all main switchboards, all distribution boards and 120/208 lighting panels to control transient voltages. Each surge suppressor must be protected with an over-current protection device and rated for the appropriate short circuit current. SPD's shall also be installed on the disconnecting means beside all chillers.
    - b. Unit shall be UL approved rated for 200,000 AIC and warranted for 10 years with parts and labor.
    - c. SPD units shall be installing as close as possible to the Service Entrance Locations and all panelboards. SPD's shall be cascading from the service entrance to last panelboards.  
Service 3,000 to 4000 Amps – 300 kA per protection mode Phase  
Service 2,000 to less than 3000 Amps – 250 kA per protection mode Phase  
Service 1,000 to less than 2,000 Amps – 150 kA per protection mode Phase  
All others – 100 kA per protection mode Phase
  - 2. For service entrance/main switchboard applications (1200 amperes and larger), specify a SPD with a minimum surge current rating of 125kA per protection mode, and 250kA per phase.
  - 3. Specified units shall meet/exceed the following additional requirements:
    - a. SPD shall be listed and labeled to UL1449 (Third Current Edition) and UL1283.
    - b. SPD shall provide protection in all modes, L-N, L-G, N-G, (where applicable). SPD shall have a Type I designation and a 20 kA I nominal rating.
    - c. UL1449 Suppressed Rating (SVR) Voltage Protection Rating (VPR) shall not exceed the following:



## BUILDING EXCELLENCE

<u>System voltage</u>	<u>Voltage Protection Rating</u>			
L-N	L-N	L-G	N-G	L-L
120/240	700 volts	7000 volts	700 volts	1200 volts
120/208	700 volts	700 volts	700 volts	1200 volts
240	800 volts	1200 volts		1200 volts
277/480	1200 volts	1200 volts	1200 volts	2000 volts
480	1200 volts	1800 volts		1800 volts

- d. SPD UL1449 Short Circuit Rating shall be greater than the fault current at the point of application. In no case should the rating be less than 65kAIC.
- e. SPD shall be life cycle tested to survive 15,000 IEEE Category C3 impulses in each protection mode, with less than 10% degradation.
- f. Documentation of life cycle testing and UL 1449 short circuit rating must be provided.
- g. Documentation of the maximum surge current (single pulse) rating, UL1449 SVR, and noise attenuation must be provided in accordance with NEMA LS-1, 1992.
4. Distribution Panel Locations (277/480V, 3 phase, 4 wire)  
For distribution panel applications (400 – 1200 amperes) specify a SPD with a minimum surge current rating of 80kA per protection mode and 160 kA per phase. Specified unit shall meet all of the additional requirements listed for the service entrance units.
5. Panelboard Locations (120/208V, 3 phase, 4 wire)
  - a. For lighting and appliance panelboards serving receptacles, specify a SPD with a minimum surge current rating of 65kA per protection mode and 130 kA per phase.
  - b. Specified unit shall meet all of the additional requirements listed for the service entrance units except as noted below:  
SPD shall be life cycle tested to survive 5,000 IEEE Category C3 impulses in each protection mode, with less than 10% degradation.
6. All lead length must a minimum of 6 inches per nano-second. Prevent any bends as possible.

### EXECUTION

#### 3.1 EXAMINATION

- A. Verify mounting area is ready for equipment.
- B. Verify circuit rough-ins are at correct location.

#### 3.2 INSTALLATION

- A. Install in accordance with IEEE 1100.
- B. Install service entrance suppressors in switchboard. Suppressors install built-in into the switchboard shall be install in an enclosed panel to isolate from the rest of switchboard components. The suppressor shall be protected with fuses.
- C. Install suppressors for panelboards adjacent to panel as close as possible to the circuit breaker.
- D. Install surge counter in face of switchboard.
- E. Include surge counter for stand-alone SPD.
- F. Install with maximum conductor length of 6 inches. Install suppressor with internal fusing.
- G. Provide 30 amp, 3 pole circuit breaker in panelboards to feed SPD or manufactured recommendation.

### END OF SECTION



## BUILDING EXCELLENCE

### SECTION 26 50 00

#### LIGHTING

##### GENERAL

- 1.1 Section includes interior luminaires, lamps, ballasts, and accessories. Provide all luminaires complete with all new lamps, completely wired, controlled, and securely attached to supports.
- 1.2 Provide extra materials for Owners use. All parts shall be packaged in suitable carton. Provide ten percent spare lamps of each lamp type. Deliver to Owner in original packaging.
- 1.3 All outdoor lighting applications shall be LEDs.
- 1.4 All electrical and luminaires (fixtures) shall be in compliance with the current latest National Electrical Code.

##### PRODUCTS

##### 2.1 LIGHTING REQUIREMENTS

- A. Refer to the Light Level Table this section for lighting levels. Provide a complete point-by-point photometric summary for each room type and each parking lot on each project for HISD Design Development review and written approval. Photometrics shall be shown on 2 feet x 2 feet spacing for indoor locations and 10 feet x 10 feet spacing for outdoor locations. Provide the following ratios of the proposed lighting design:
  1. average maintained footcandle level after 3 years
  2. average maximum to minimum
  3. average to minimum footcandle ratios of the proposed lighting design.
  4. Photometric layout
- B. Obtain HISD written approval of submitted photometrics (light levels) and proposed fixtures prior to proceeding with construction design documents related to lighting. No down lighting and ovation fixture or similar fixtures are to be installing without proper approval to the District/owner. Do not install lighting on a higher ceiling such as corridors, stairwell, atrium or similar other locations. Designer shall provide illumination for all interiors spaces including stairways and atriums but shall take care to position light fixtures so that they are easily accessible for relamping or ballast replacement. Where this is not possible, obtain approval from the HISD Project Manager during the design phase.
- C. Parking lot lighting shall be designed to control light angles to avoid light trespass on adjacent properties.
  1. The minimum wiring that shall be use is No. 8 THWN/THHN copper conductor wire stranded or larger based on 3% calculated voltage drop. Calculate the voltage drop over 200 feet run. In the event of failure, the cost of replacement is the responsibility of the contractor.
  2. At least one fixture in the parking lot shall remain on overnight for safety purposes. This fixture shall be on a dedicated circuit 20 amp with the other fixtures on every pole. All outdoor lighting are LED fixtures. No substitute.
  3. Install rebar in the concrete foundation and allow curing enough before installing the metal pole. Any underground work prior to cover up, HISD electrical department shall make a field inspection. Provide at least 24 hours prior for the inspection.
  4. All parking lot lighting shall be on astronomical time clock tied into the DDC lighting control. Use schedule 40 PVC for parking lot lighting and shall be buried at not less than 24 inches not subject to vehicle traffic. Provide an additional





## B U I L D I N G   E X C E L L E N C E

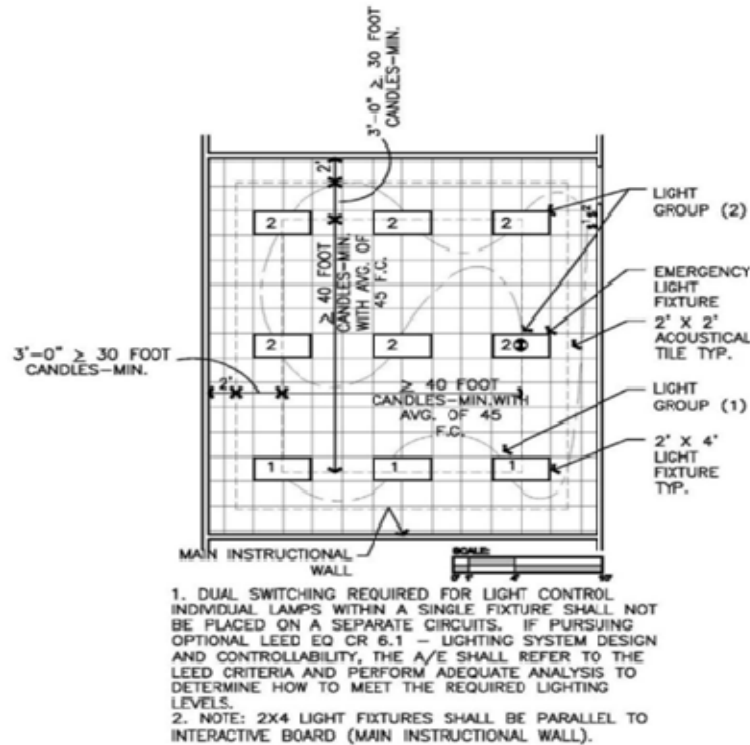
- support so the conduit does not moved.
5. Prefer LED's fixtures use in all outdoor applications except for canopies used in fluorescent fixtures.
  - D. Fluorescent lamps 4 foot shall have a CRI of 82 or better with a Kelvin lamp color temperature rating of 4,100 degrees and a minimum rated lamp life of 24,000 hours.
  - E. Use Super T8 fluorescent ballast shall be electronic, program start less than 10% total harmonic distortion rated at 50,000 starts, greater than .98 power factor for primary lamp, and 0.88 ballast factor. Compact fluorescent ballast shall be electronic, rated at 100,000 starts, program start less than 10% total harmonic distortion when operating at nominal line voltage of primary lamps. When available, all indoor HID ballast shall be pulse start using vertically mounted pulse start lamps.
  - F. Provide 2 feet x 4 feet lay-in luminaries with T8 lamps or Super T8 lamps, and electronic ballast and the body shall be a minimum of 4 inches deep with .125 inch thick acrylic prismatic lens. 2 feet x 4 feet direct luminaries with 2 high output T8 lamps or Super T8 lamps with appropriate ballasts shall be considered for energy savings when they can satisfy photometric light level requirements. With HISD approval individual fixtures less than 4 inches deep may be considered to avoid lowering a ceiling when an unanticipated conflict reduces typical clearances for fixtures. Fixture less than 4 inches shall not be used.
  - G. Each light fixture shall be independently supported with tie-wire from the building structure with four wires; one at each corner. This requirement is separate and apart from ceiling grid wire supports. Also, fixtures shall be secured to the ceiling grid on all four sides by clips to the webs of ceiling grid tees. For renovation projects with ceiling replacements, reinstall existing light fixtures with the same support requirements as new fixtures: wires at each corner to the structure independent of the ceiling grid and with clips to webs of tees on 4 sides.
  - H. For confirmation that lighting design provides the required light levels, a lighting mock up is required during construction. The mock up shall include specified fixtures, wall paint color selections and specified ceiling and flooring. The A/E shall include mock up requirements in project specifications

Light Level Table	
Room Type	Average maintained light level in foot candles at work surface
Learning Center (any instructional space)	Refer to diagram
Computer Labs	Refer to diagram
Kitchens	50
Practice Gymnasiums	50
Varsity Competition Gymnasiums	75
Science Learning Center/Wet Labs	60
Auditorium and Stage House lights	45
Student Dining Commons	40
Mechanical Rooms	45
Corridors	20
Parking Lot Lighting	3-5 with max to min ration of 10 to 1



## BUILDING EXCELLENCE

### Typ. Classroom Reflected Ceiling Plan



- I. Computer Labs: Provide 2'x4' lay-in luminaires with 3-T8 lamps or Super T8 lamps, electronic ballast dual level switching that meets IES RP-24 for VDT use. Body shall not be more than 6" deep.
- J. Service Yards: Service yards shall be provided with fluorescent Luminaires or LED, and wall mounted security lights positioned to eliminate light trespass beyond the service yard area.
- K. Mechanical Equipment Rooms: Mechanical equipment rooms shall be provided with 4 foot, fluorescent strip fixtures with wire-guards. Do not use automatic switching in any electrical rooms or mechanical rooms provide a 2 hour manual twist on timer switch. Install emergency lighting at this locations one at the exit door and others in the critical areas such as equipment.
- L. Exterior Building/Security: Provide wall mounted cut-off security lights using LED or CFL spaced appropriately, around the entire perimeter of the building, over exit doors, and near windows positioned to eliminate light trespass and glare into adjoining properties. Use multiple circuitry like combine one fixture at each pole on one circuit for night light



## BUILDING EXCELLENCE

- purposes. All other fixtures in that one pole with one circuit. Use a lighting contactor controlled by an astronomical time clock.
1. Provide light fixtures with LED or CFL lamps at pedestrian canopies and entrance soffits. Specify recessed fixtures for areas with ceilings, and surface mounted fixtures for areas without ceilings. Specify vandal resistant fixtures.
- M. All exterior lighting shall be controlled by an astronomical time clock  tied into the DDC lighting control.
- N. Parking Lots:
1. Parking lots shall be illuminated
  2. Parking lot light pole standard heights shall be as follows:  
Elementary Schools – 30 feet  
Middle Schools – 30 feet  
High Schools – 40 feet  
Stadium Lots – 50 feet  
Note: Consider the wind load and soil study in the design. Use pedestal footing and determine the depth of the footing.
  3. Fixtures shall utilize cut-off luminaires, which minimize glare. Fixtures close to property lines and adjoining private residences shall utilize a “street side cut-off” device in the fixture to eliminate light trespass on the adjacent property.
  4. Each lighting pole shall have a minimum two fixtures mounted at 180° to one another, wired to separate lighting circuits and separate contactors, to be switched independently of each other and controlled by astronomical time clock. When using exterior LED lighting fixtures they shall be full cut-off, pole mounted fixtures. There will be two fixtures mounted opposite each other per pole. The number of LEDs will be determined by the pole height of 40 feet, the spacing of the adjacent poles, and meeting the 3-5 foot-candle level with a max to min ratio of 10 to 1 or less.
  5. Lighting circuits shall be labeled “Circuit A”, and “Circuit B”. Circuit A shall include: 1) one circuit at each pole, 2) alternating soffit lights at covered walkways and bus loading areas, and 3) soffit lights at all secondary entrances. Circuit B shall include: 1) one lighting circuit at each pole, 2) alternating soffit lights at covered walkways and bus loading areas, and 3) soffit lights at all primary entrances. Specify for the electrical contractor to provide all contactors for the lighting systems. Contactor panels are not acceptable. Provide external mounted contactors at each exterior lighting panelboard permanently labeled for parking lot Circuit A or Circuit B. In lieu of providing two circuits at each pole for individually switching the two fixtures, a single circuit run to each pole will step-dim the two fixtures simultaneously to a 50% lighting level, while obtaining a 55% energy savings.
  6. Each circuit shall be protected by in-line fuses at each lighting standard.
  7. Fixtures shall be mounted on standard poles with arms.
- O. Exit Signs: Exit lighting shall be LED type. Institutional grade, *vandal proof*, wet location, cast aluminum or polycarbonate. Provide nickel-cadmium battery backup when an emergency generator is not used. The circuitry for all exit lights and egress lights shall be on dedicated branch circuits, do not share any conductors with any other building loads.
- P. Swimming Pool Lighting: Underwater lights shall be UL approved metal halide and suitable for such applications. Overhead lighting shall utilize indirect metal halide fixtures designed to eliminate glare on the water surface and provide for ease of maintenance and re-lamping. Provide photometry layout, type of fixture used and there shall be no fixtures above the water area. Provide work light fixtures in the area controlled from a separately switched circuit from the pool lighting. All fixtures must be a rust-resistant
- Q. Marquee Lighting: Shall be LED. Provide electrical circuits for school marquee lighting (freestanding sign) to be controlled by a switch located in the main administration area,



## BUILDING EXCELLENCE

- provide label on switch.
- R. Gymnasium Lighting: Proposed fixture submittals/spec information must be provided for HISD review and approval prior to issue of drawings for bid. Substitutions will not be allowed if the fixtures have not been approved by HISD. Gymnasium fixtures shall be a T5 lamp source. Preferred LED lamp.
- S. Local Indoor Lighting Control
1. All lighting circuits shall be controlled by occupancy sensors by division 26. Every space shall also have a local manual override OFF switch for local control of the lighting.
  2. For new schools, all instructional spaces shall be provided with dual level lighting controls for teaching purposes. The lighting shall be divided and controlled to provide even light distribution suitable for note taking when viewing films or slide presentations.
  3. Provide momentary contact switches to control lighting contactors.
  4. Provide bi-level switching in all public areas (i.e., student dining commons, gym, learning commons, corridor, etc.).
  5. Sports lighting shall have override switches located in a locked room at the stadium.
  6. Provide occupancy sensors to turn off lights when space is unoccupied.
  7. The occupancy sensors shall be dual tech and including photo cell for daylight harvesting.
- T. Lamps
1. Acceptable Manufacturers for T-8 Lamps: General Electric, Osram Sylvania, North American Phillips.
  2. Acceptable Manufacturers for LED Lamps: General Electric, Osram Sylvania, North American Phillips, CREE Lighting
- U. Luminaires
1. Acceptable Manufacturers: Cooper, Hubbell, Kenall, Lithonia, and Phillips. All 2 x 4 luminaires shall be supported by individual metal support wires from the four corners of the fixture directly to the structure above, independent of ceiling grid system.
  2. For outdoor pole mounted luminaires, install a bare No. 6 grounding conductor to the pole base, leave accessible through hand hole. No splicing of pole lighting circuits is allowed.
  3. Clean diffusers/lenses before installing to the fixtures.
- V. Ballasts
1. Acceptable Manufacturers: Advance Transformer Co., Universal Lighting Technology, Osram, Sylvania, General Electric.
  2. The ballasts for parking lot luminaries need to be located 10 feet above grade on the lightning standard as opposed to being mounted inside the luminaire.
- W. LIGHTING CONTROL
1. SYSTEM FUNCTIONALITY REQUIREMENTS
    - a. The lighting control system shall allow the school district to locally or centrally schedule, monitor, and adjust the lighting on a room by room basis via IP address and a standard web browser. The system shall provide real time status and current monitoring of the lighting loads and occupancy state in each room. Centralized control interface is required to provide reporting and trending of actual energy usage and occupancy status, and create alerts to the central district control. Intuitive graphic floor plan screens shall allow the central operator to override lighting and check on status as needed. Systems must integrate with demand response in order to load shed within prescribed time period.



## BUILDING EXCELLENCE

- b. The system shall provide export tables via BACnet IP of occupancy status of each controlled space. This information to be available to DDC controls for temperature setpoint adjustment.
- c. The system shall consist of local room-based controls including digital occupancy sensors, room controllers of 1-3 relays with switching or dimming capability, photosensors, switches, dimmer controls, and plug load controls.
- d. A handheld remote for room configuration shall provide two way infrared (IR) communications to digital devices and allow complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit shall allow send and receive of room variables as well as storage and recall of occupancy sensor settings.
- e. Digital Lighting Management (DLM) local room network: Free topology, plug-in wiring system (Cat 5e) for power and data to room devices. Local room system shall be independently operating, self-configuring, and digitally addressable. Device parameters such as occupancy sensor time delays and sensitivity, astronomical time clock shall be available and adjustable through the network ~~as well as the handheld remote~~. Room configurations shall be stored locally, and shall not be dependent on central network controls for operation. All devices shall be hard wired; no wireless devices shall be permitted.
- f. Network Bridge – provides BACnet MS/TP-compliant digital networked communication between local rooms, panels and the Segment Manager.
- g. Segment Manager – provides web browser-based user interface for system control, scheduling, power monitoring, room device parameter administration and reporting.
- h. Central configuration management software shall be provided with the ability to store, backup and restore all system setting and parameters in networked lighting control spaces. This shall also include the ability to update device firmware from a central location.
- i. Basis of design shall be Wattstopper Digital Lighting Management networked system

### X. SPECIAL SPACE CONTROL REQUIREMENTS

- 1. Provide ceiling mounted occupancy/vacancy sensors with 3 zones of control in all learning center spaces. Provide 50% auto on functionality with digital wall switch for manual override for 100% on. Provide additional control zone for smartboard wall.
- 2. Provide occupancy sensors with automatic on for restrooms, storerooms, corridors, common areas, gymnasiums, and any other applications where hands-free operation is desirable.
- 3. Provide manual on vacancy sensors for any enclosed office, conference room, or meeting room. For larger spaces where line of sight is obstructed, provide ceiling sensor with digital wall switch.
- 4. Provide photosensors where appropriate to take advantage of daylight areas with large window, clerestory, or skylight exposure.
- 5. Minimal exterior building lights required for safety and security shall be on astronomical time clock, Parking lot lighting shall be reduced based on occupancy or schedule.

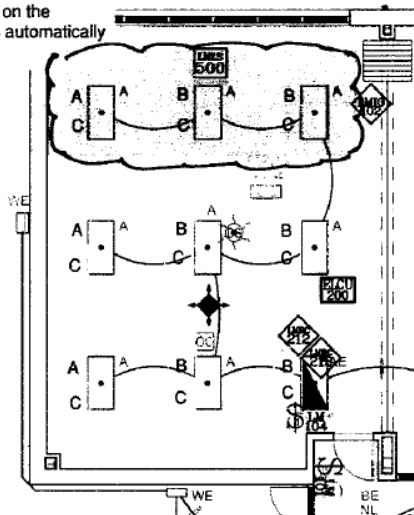
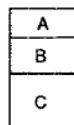


## BUILDING EXCELLENCE

### 6. Bi-Level Switching

All fixtures are bi-level.  
Button A is teaching wall 50%  
Button B is main classroom 50%  
Button C is entire classroom 50%

Daylight zone has dimmable ballast on C zone wired to 0-10v outputs on the ballast. Daylight zone dims automatically and no override is allowed.



### Y. RETROFIT LIGHTING REQUIREMENTS

1. Acceptable Manufacturers: General Electric, Osram Sylvania, North American Phillips.

## EXECUTION

### 3.1 EXISTING WORK

- A. Disconnect and remove abandoned luminaires, lamps, poles and accessories.
- B. Extend existing luminaire installation using materials and methods compatible with existing installation, or as specified.
- C. Clean and repair existing luminaires to remain or to be reinstalled.

### 3.2 INSTALLATION

- A. General: All luminaires shall have proper supports.
- B. Install suspended luminaires using pendants supported from swivel hangers.
- C. Locate recessed ceiling luminaires as indicated on Drawings.
- D. Install surface mounted ceiling luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- E. Chain Hung: Unless otherwise indicated all fluorescent fixtures in Mechanical, Electrical and Elevator Equipment Rooms shall be chain hung. Verify exact mounting height with Architect before installing fixtures. Provide pendant hangers when equipment room has fire-resistive ceiling.
- F. Suspended Ceilings:



## BUILDING EXCELLENCE

1. Provide means of support for luminaires per NEC 410-36. T-bar clips shall be installed on the luminaire and shall be field secured to the inverted ceiling tees so that the luminaire is securely fastened to the ceiling system framing members.
2. Ceiling tiles shall not bear the weight of luminaires. Surface mount luminaires, recessed downlights, light track, exit signs, etc. shall be supported by proper frames or other attachment to main ceiling system grid or building structure above ceiling.
3. Luminaires shall be centered in ceiling tile.
4. Luminaire shall have flange or trim ring for closure of ceiling cutout or opening.
5. Provide four support wires to structure for each 2x4 fixture, one per corner.

### 3.3 LOCATIONS

- A. Coordinate all light fixtures in Mechanical Rooms with the final installed piping and ductwork layouts. Adjust fixture mounting height and location if required so that light output is not obstructed by piping and ductwork.

### 3.4 FIRE INTEGRITY OF CEILING PENETRATIONS

- A. Where ceiling is part of a fire-rated assembly, maintain integrity of that assembly.

### 3.5 AIMING AND ADJUSTMENT

- A. General: All adjustable lighting units shall be aimed, focused, and locked by the Contractor under the supervision of the Architect/Owner. All aiming and adjusting shall be carried out after the entire installation is complete.

### 3.6 CLEANING AND HOUSEKEEPING

- A. All lighting fixtures shall be free from dust, debris and dirt.

**END OF SECTION**





## BUILDING EXCELLENCE

### SECTION 26 55 00

#### THEATRICAL LIGHTING

##### REQUIREMENTS

###### 1.1 GENERAL

###### A. THEATRICAL LIGHTING SYSTEM GENERAL REQUIREMENTS

1. The fixture shall be supported and secure with a safety chain.
2. The fixture has to be position and aim properly to the needs of the school.
3. Each receptacle shall be twist lock 20A, 125 V, single receptacle and shall be supported properly. Do not use duplex receptacle.
4. Each circuit shall have an independent neutral and grounding wire. The conduits and boxes shall be legibly label/marked with the circuit numbers.
5. The dimmer rack shall be wired neatly in a workmanship manner.
6. The dimmer shall be installed where there is enough air circulation not in a close proximity space.
7. The contractor shall install working lights in the stage area on separate circuit not from the dimmer. The contractor shall provide training to school staff and CFS staff. The manufactured must be present during the commissioning process. The contractor shall contact the representative from CFS 24 hour in advance prior to the training and commissioning. The contractor shall turn-in all keys, manufactured drawings, cut-sheets, manuals and DVD training.
8. Provide illumination from the front for faces, with the ability to isolate the stage areas left, center, and right.
9. Provide illumination from overhead, with the ability to change the color for variety and affect the mood of the lighting.
10. Provide intuitive graphical color touch screen interface for control of the system. No specialized training shall be required to bring up light fixtures and change color of overhead fixtures. Provide individual control of all fixtures front of house, and grouped controls of each row of fixtures over stage. Provide color picker for graphical color selection of LED color changing fixtures.
11. Additionally, Middle School and High School Proscenium Theatre Stage Spaces shall *at a minimum* comply with the minimum recommended lighting standards of UIL (University Interscholastic League) for the One-Act Play Competition. Additional lighting may also be required to support other uses of the stage space such as music and dance performances.
  - a. The lighting plot should be laid out in a "standard method," with nine or more acting areas established. If acting areas are larger than 10' in diameter, provide additional fixtures for lighting the area, or break the stage up into additional acting areas.
  - b. Each acting area shall have a minimum of two fixtures providing lighting from the front/side, and one fixture from above/back, as well as a color wash fixture.
  - c. The use of the three primary colors in light - red, blue and green - as general washes is required for UIL competitions. The color wash lighting shall be individually controlled both by color and area. Border lights are not acceptable. Provide 7 color LED color changing fixtures, a minimum of one per area.
  - d. Each acting area and individual fixture shall be independently controllable.
12. Adjustments to the lighting system design guidelines shall be made to accommodate stages of differing sizes and shapes in each category. Any



## BUILDING EXCELLENCE

renovation to an existing space shall attempt to best meet these guidelines while taking into account any circumstances that may limit the possible lighting system or may require additional equipment to reach the required functionality.

13. Basis of Design is ETC Fixtures, Rigging, and Dimming Equipment with Paradigm Controls.

### B. ELEMENTARY SCHOOL STUDENT DINING COMMONS STAGE LIGHTING

1. Front of House: Provide a basic stage wash of eight ETC Source 4 Jr 26 degree fixtures on the front of house pipe, complete with c-clamp, color frame, safety cable, stage pin connector, and Ushio HPL575x/120v long life lamp.
2. Over Stage: Provide an even stage wash of LED fixtures overhead on two pipes: ETC Selador Desire D40 Vivid 7 color mixing. Provide minimum six fixtures (3 per pipe), complete with c-clamp, 75deg lens, safety cables, power cord, pass through powercon cable, and DMX cable. Additional fixtures and lenses of different degree spread may be required to accommodate stages of different sizes and heights.
3. Provide intuitive 7" color touchscreen for everyday control of system and color changing fixtures. Provide multiple pages consisting of fixture controls with faders for intensity control and color picker for color control. Provide individual control of all fixtures front of house, and grouped controls of each row of fixtures over stage.
4. Provide Smartfade ML Control Console for use in dedicated theatrical performances.
5. Provide ETC Unison DRD6 Dimmer Rack with D20 and R20 Dimmer Modules and Paradigm controls.
6. Provide DMX Optosplitter and plug in stations for control of the system LED color changing fixtures.

### C. MIDDLE SCHOOL STUDENT DINING COMMONS STAGE LIGHTING

1. Front of House: Provide a basic stage wash of twelve ETC Source 4 Jr 26 degree fixtures on the front of house pipe, complete with c-clamp, color frame, safety cable, stage pin connector, and Ushio HPL575x/120v long life lamp.
2. Over Stage: Provide an even stage wash of LED fixtures overhead on three pipes: ETC Selador Desire D40 Vivid 7 color mixing. Provide minimum nine fixtures (3 per pipe), complete with c-clamp, 75deg lens, safety cables, power cord, pass through powercon cable, and DMX cable. Additional fixtures and lenses of different degree spread may be required to accommodate stages of different sizes and heights.
3. Provide intuitive 7" color touchscreen for everyday control of system and color changing fixtures. Provide multiple pages consisting of fixture controls with faders for intensity control and color picker for color control. Provide individual control of all fixtures front of house, and grouped controls of each row of fixtures over stage.
4. Provide Smartfade ML Control Console for use in dedicated theatrical performances.
5. Provide ETC Unison DRD12 Dimmer Rack with D20 and R20 Dimmer Modules and Paradigm controls.
6. Provide DMX Optosplitter and plug in stations for control of the system and LED color changing fixtures.
7. Provide Strong Canto 250HR Followspot, with Stand, color boomerang, and 250HR lamp.

### D. MIDDLE SCHOOL/ HIGH SCHOOL AUDITORIUM STAGE LIGHTING

1. Front of House Beam or Overhead Position: Provide a basic stage wash of twenty-four ETC Source 4 19 or 26 degree fixtures, complete with c-clamp, color



## BUILDING EXCELLENCE

- frame, safety cable, stage pin connector, and Ushio HPL575x/120v long life lamp.
2. If access to the position is not available via a catwalk then the lighting pipe shall be motorized: Provide ETC Prodigy motorized rigging solution.
  3. Box Boom Positions, located on the front of house side walls, shall each have six ETC Source 4 26 degree Lustr+ LED 7 color mixing fixtures, complete with c-clamp, wash diffusor, safety cable, power cord, pass through powercon cable, and DMX cable.
  4. Over Stage: Provide 4 Electric pipes over stage; all pipes shall be motorized with cable management. Provide ETC Prodigy motorized rigging solution with sufficient switched and dimmable power circuits for all fixtures on each motorized electric.
  5. First Electric: Provide twelve ETC Source 4 26 degree fixtures, complete with c-clamp, color frame, safety cable, stage pin connector, and Ushio HPL575x/120v long life lamp. Provide six ETC Source 4 PAR fixtures, complete with c-clamp, color frame, safety cable, 4 lens set, stage pin connector, and Ushio HPL575x/120v long life lamp. Provide six ETC Selador Desire D40 Vivid 7 color mixing fixtures, complete with c-clamp, 45 deg lens, safety cables, power cord, pass through powercon cable, and DMX cable.
  6. Second and Third Electrics: Provide (on each) six ETC Source 4 PAR fixtures, complete with c-clamp, color frame, safety cable, 4 lens set, stage pin connector, and Ushio HPL575x/120v long life lamp. Provide (on each) six ETC Selador Desire D40 Vivid 7 color mixing fixtures, complete with c-clamp, 45 deg lens, safety cables, power cord, pass through powercon cable, and DMX cable.
  7. Fourth Electric: Provide minimum 6 Altman SpectraCyc 200 LED color changing fixtures, complete with yoke, c-clamp, safety cable, power and pass through cables, and DMX cable. Cyc fixtures are on maximum 8' centers, provide additional fixtures for illumination of area over 42' wide. Provide six ETC Source 4 PAR fixtures, complete with c-clamp, color frame, safety cable, 4 lens set, stage pin connector, and Ushio HPL575x/120v long life lamp. Provide six ETC Selador Desire D40 Vivid 7 color mixing fixtures, complete with c-clamp, 45 deg lens, safety cables, power cord, pass through powercon cable, and DMX cable.
  8. Additional fixtures and lenses of different degree spread may be required to accommodate stages of different sizes and heights.
  9. Provide intuitive 7" color touchscreen for everyday control of system and color changing fixtures. Provide multiple pages consisting of fixture controls with faders for intensity control and color picker for color control. Provide individual control of all fixtures front of house, and grouped controls of each row of fixtures over stage. Provide 2 button entry stations at auditorium stage doors for house and work light control.
  10. Provide ETC Element 40/250 Control Console, complete with two LCD monitors and DMX cable.
  11. Provide ETC Sensor SR48 Dimmer Rack with D20 and R20 Dimmer Modules and Paradigm controls. Provide solution for Emergency Lighting: ETC Emergency Lighting Transfer Switch and DMX Emergency Bypass Controller.
  12. Provide DMX network and plug in stations for control of DMX controlled devices.
  13. Provide Strong Canto 1200 Followspot, with Stand, color boomerang, and 250HR lamp.



## BUILDING EXCELLENCE

14. Auditorium HouseLight Fixtures shall be Altman Chalice CDP1003K with DMX Control.

### 1.2 THEATRICAL RIGGING GENERAL REQUIREMENTS

- A. Provide safe and secure hanging positions for theatrical lighting.
- B. All positions for portable theatrical fixtures shall be 1½" schedule 40 grade A, seamless pipe fabricated in the largest possible lengths without splices. Battens of greater length shall be spliced by means of .120 x 1 9/16 dia DOM tube 18" long with 9" of tube inserted into each half of the splice. The tight fitting splice tube shall be held in place by a pair of 3/8 x 2 1/2" grade 5 hex bolts on each side of the joint. The bolts shall pass through the pipe at an angle of 90° to each other. There shall be two bolts on each side of the joint spaced 1" and 8" from the joint. Alternatively, one pair of bolts on one side of the joint may be replaced with either plug welds or tight fitting steel rivets. Pipes shall be straight and painted flat black.
- C. In order to establish minimum standards of safety, a minimum factor of 8 shall be required for all equipment and hardware used on this project. In addition, the following factors shall be used:
  - 1. Cables and fittings 10 Design Factor
  - 2. Cable bending ratio 26 times diameter
  - 3. Max. fleet angle 2 degrees
  - 4. Steel 1/5 of yield
  - 5. Bearings two times required load at full for 2000 hours
- D. Provide ETC Prodigy Motorized rigging for any lighting position over 18 feet over the finished floor, or any lighting position over a sloped floor.
- E. Provide ETC Prodigy Motorized rigging for Jr High and High School Stage: 4 Electric Pipes over stage.
- F. Provide ETC Quick touch rigging controller for operation of rigging systems. Controller shall have a keyswitch, emergency stop, and real time position information displayed on the screen. One preset shall be provided in addition to the high and low trim positions. Locate the rigging controller in sight of the pipes to be operated.
- G. Coordinate with the structural engineer to ensure proper structural elements are provided for the full load of all provided equipment.
- H. DEAD HUNG RIGGING
  - 1. The pipe batten shall be 1½" schedule 40 grade A, seamless pipe fabricated in the largest possible lengths without splices. Battens of greater length shall be spliced by means of .120 x 1 9/16 dia DOM tube 18" long with 9" of tube inserted into each half of the splice. The tight fitting splice tube shall be held in place by a pair of 3/8 x 2 1/2" grade 5 hex bolts on each side of the joint. The bolts shall pass through the pipe at an angle of 90° to each other. There shall be two bolts on each side of the joint spaced 1" and 8" from the joint. Alternatively, one pair of bolts on one side of the joint may be replaced with either plug welds or tight fitting steel rivets. Pipes shall be straight and painted flat black.
  - 2. All turnbuckles, clips, tracks, chains and other items of incidental hardware shall be furnished plated or painted. Wire rope shall be galvanized air craft cable. Fasteners, chain, and other miscellaneous hardware shall be either cadmium or zinc plated.
  - 3. All materials used in this project shall be new, unused and of the latest design. Refurbished materials are not permitted.



## BUILDING EXCELLENCE

4. Minimum design load rating for a hang point will be 350 lbs.
5. Top hanging hardware shall be either beam clamp sized for the beam, or 3/16" Proof Coil chain wrap
6. Connections to chain or bottom hanging hardware shall be made with 1/4" screw pin shackle. Pin shall be wired to prevent loosening.
7. Batten Clamps shall be sized for the pipe batten. Chain wrapping the batten is not acceptable.

### I. MOTORIZED RIGGING

1. Any lighting position over 18' in height or over a sloped floor shall be motorized with cable and data management. Provide ETC Prodigy motorized rigging solution.
2. If access to the Front of House Lighting Position in any auditorium stage is not available via a catwalk then the lighting pipe shall be motorized with cable and data management: Provide ETC Prodigy motorized rigging solution.
3. Auditorium over stage: Provide 4 Electric pipes over stage; all pipes shall be motorized with cable and data management. Provide ETC Prodigy motorized rigging solution with sufficient switched and dimmable power circuits for all fixtures on each motorized electric. Coordinate with theatrical stage lighting requirements to determine the circuit and data needs for each motorized electric.
4. The standard stage electric hoist shall consist of the following major components: 1) Powerhead, 2) Compression Tube with beam clamps, cable management system, loft blocks, liftline and liftline terminations Right Angle Cable Adjuster (RACA), 3) pipe batten and power/control distribution strip
5. The hoist shall include the following features:
  - a. A Powerhead containing the following elements: the gearmotor, motor brake, load brake, limit switches operating electronics, load sensor, slack line detector, absolute position sensors, cable drum assembly, and wire rope.
  - b. A Compression Tube that prevents hoist system lateral forces from transferring to the building. Hoists or hoisting systems that impose a lateral load on the building shall not be acceptable.
  - c. A load sensor shall be built into the Powerhead to create a profile of the actual load on the hoist as it travels through its normal cycle. The profile may be changed by "re-training" the profiling system whenever the suspended load is changed on the batten by activating a key-switch operated training cycle on the hoist controller. The load sensor shall continuously monitor the load when load sensing is turned on.
  - d. A position sensing system shall be built into the Powerhead to provide accurate position information. The system shall consist of two absolute sensor types that provide accurate position information for each batten at power-up of the system. Hoisting systems that require re-homing shall not be acceptable. Incremental encoders shall not be acceptable for position readout purposes.
  - e. The hoist shall incorporate a built-in slack line sensor. When a slack line condition occurs, it shall cease hoist movement and result in a fault message on the LCD screen on the controller. Movement in the upward direction shall be possible to clear the fault.
  - f. The hoist shall include the emergency contactor built into the hoist.



## BUILDING EXCELLENCE

- g. Each wire rope lifeline shall adhere to a design factor of 10:1 with an ultimate strength of 4200 pounds. All load path components between the building structure and the batten shall exceed the breaking strength of the wire rope. The motor brake shall be rated at least at 125% of the motor torque.
      - h. Upon energization the control system shall perform an automatic series of diagnostic tests that assure that all system safety functions are working. Should an error in the safety functions be determined, the controller shall report back a fault condition in the LCD display window and shall identify the nature of the fault. Monthly, the system automatically shall perform an additional series of diagnostic tests to determine if there are any problems with any portion of the hoist control system safety features. In the event of a problem, the controller shall report back a fault condition in the LCD display window and shall identify the nature of the fault.
- 6. Each hoist shall be fully tested under full rated load throughout its full travel distance with all its lifelines terminated to the hoist before the hoist is shipped from the manufacturer. Testing shall include:
  - a. Hoist operation
  - b. Hoist/motor speed
  - c. Lifeline terminations under load
  - d. Braking and stopping under load
  - e. Load cell functions
  - f. Slack line detection
  - g. Position sensing
  - h. Hoist noise
- 7. Only hoists that successfully pass pre-shipment testing shall be sent to any job site. A record of testing and its results shall be available for review at the manufacturers facility for at least one year after testing.
- 8. The hoist shall be manufactured from UL Listed components and shall be UL Listed and tested as a complete system (not just UL listed parts). All equipment items shall be new and conform to applicable provisions of Underwriters' Laboratories (UL), American Standards Association (ASA), American National Standards Institute (ANSI), National Fire Protection Association (NFPA) Life Safety Code 01, National Electric Code (NEC) and PLASA.
- 9. Cable Management
  - a. The load circuits and control wiring shall be fed to the distribution trough by a built-in cable management system that allows flat feeder cable to fold and store along the top of the connector strip.
  - b. At high trim, the entire system shall be stored in 30" of vertical space from the bottom of the mounting steel to the horizontal centerline of the batten. Cable management systems requiring greater vertical storage space shall not be acceptable
  - c. Cable management systems that utilize cable cradles, cable reels or locate feeder or data cables outside the off stage edges of the electrics batten shall not be acceptable.
  - d. The connector strip shall be built to the length specified with outlets or pigtails located as specified or as shown on the construction drawings.





## BUILDING EXCELLENCE

Outlets or plugs shall be 15 amp grounded pin connectors, 15 amp twistlock connectors, or 15 amp Edison plugs. The distro trough may also contain connectors for Ethernet and/or DMX connections.

10. All pipe battens shall be fabricated from 1.5" Schedule 40 pipe.
11. All turnbuckles and cable clips shall be drop forged.
12. All turnbuckles and clips, tracks, chains and other items of incidental hardware shall be furnished plated or painted. Wire rope shall be galvanized. Fasteners, chain, and other miscellaneous hardware shall be either cadmium or zinc plated.
13. All materials used in this project shall be new, unused and of the latest design. Refurbished materials are not permitted.
14. In order to establish minimum standards of safety, a minimum factor of 8 shall be required for all equipment and hardware used on this project. In addition, the following factors shall be used:
  - a. Cables and fittings 10 Design Factor
  - b. Cable bending ratio 26 times diameter
  - c. Max. fleet angle 2 degrees
  - d. Steel 1/5 of yield
  - e. Bearings Two times required load at full for 2000 hours
15. The entire hoisting system shall be operated by a QuickTouch fixed speed controller or equal. It shall be purpose-designed and fabricated to manage and operate hoists specifically designed for overhead lifting. Each system shall incorporate mechanical, electrical and safety features that shall be inherent to this equipment and shall provide an engineered, efficient device to control the equipment. The mechanical, electrical and safety features of this control system shall establish the standard of quality, performance and safety by which hoisting systems of other manufacture shall be evaluated.
16. The QuickTouchcontroller shall include the following features:
  - a. Key operated power switch
  - b. LCD display for feedback/operating information
  - c. Key operated hoist load profile training/enable switch
  - d. Latching hoist selection buttons with rear illuminated naming tabs
  - e. Rear illuminated hold-to-operate (deadman) up and down operation buttons
  - f. Dedicated E-stop button
  - g. Outlet for wired remote
  - h. Provide Local Sound Reinforcing System. Refer to Section 27 50 00.
  - i. Keyed switches are required for the following conditions:
    - 1) Operating partitions at stage.
    - 2) Overhead roll up doors or grilles (e.g. concession counter, administration desk, etc.)
    - 3) Corridor lighting
    - 4) Student restroom lighting
    - 5) Corridor gates
    - 6) Gymnasium bleachers backstops & operable dividers
    - 7) Locker or dressing rooms
    - 8) Stadium Lighting
    - 9) Gymnasium Lighting
    - 10) Student dining commons/Auditorium Lighting





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## B U I L D I N G   E X C E L L E N C E

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- 11) All lighting contractors shall have "H-O-A" control switch.
17. Substitutions Note: The listed product manufacturers are shown to establish a level of quality. Substitutions may be allowed upon submittal of product data sufficient for HISD to determine the substituted product is equal to or better than that listed above.

### PRODUCTS

#### 2.1 THEATRICAL LIGHTING CONTROLS

- A. Acceptable Manufacturers: Philip Strand Lighting, Altman Lighting, Lehigh Theatrical

**END OF SECTION**



SECTION 27 05 00

COMMUNICATIONS COMMON WORK RESULTS

GENERAL

1.1 TECHNOLOGY SYSTEM DESIGN REQUIREMENTS

- A. All voice, video and data cabling projects are bid and contracted directly through the Owner and are not part of the general contractor scope of work. The back boxes and raceway needed to support these services are to be included in design and construction documents.
- B. Voice, video and data cabling projects are separate from security, audio visual and building control systems that are not directly associated with the data/voice system:
- C. 100% Schematic Design Milestone Requirements:
  - 1. Locate all telecommunication rooms, service entrances and identify all backbone pathways. Plans shall include schematic layouts of headend closets, legends and details.
- D. 100% Design Development Milestone Requirements:
  - 1. Finalize all telecommunication rooms, service entrances and identify all backbone pathways. Plans shall include schematic layouts of headend closets, legends and details.
- E. 60% Construction Document Milestone Requirements:
  - 1. Include plans, pathways, headend room layouts, backbone schematic diagrams and telecommunication specifications.
- F. 100% Construction Document Milestone Requirements:
  - 1. Include backbone riser diagrams for all intra-building cross connects and inter-building cross connect locations. Also include service entrances and headend room layouts, wall elevations of all communication rooms, rack elevations, grounding busbar, termination boards, conduits, cables trays, floor penetration locations and pull boxes.
  - 2. Detailed room layouts indicating all technology outlets with identification to determine number of drops to each outlet.
- G. ***The HISD Technology Department should review drawings after each design phase.***

1.2 ***The architect shall coordinate all underground conduit to be located adjacent to existing utilities entering the site.***

1.3 ***The architect shall coordinate location of all smart boards and LCD TVs with other equipment in the learning centers, providing each student with proper visibility of the board.***

TABLE OF CONTENTS

CSI MasterFormat

Section No.	Title	Revision Date
<a href="#"><u>27 10 00</u></a>	Telecommunication Room Requirements	VERSION 3.0
<a href="#"><u>27 50 00</u></a>	Local Sound Reinforcement and Public Address System	VERSION 3.0

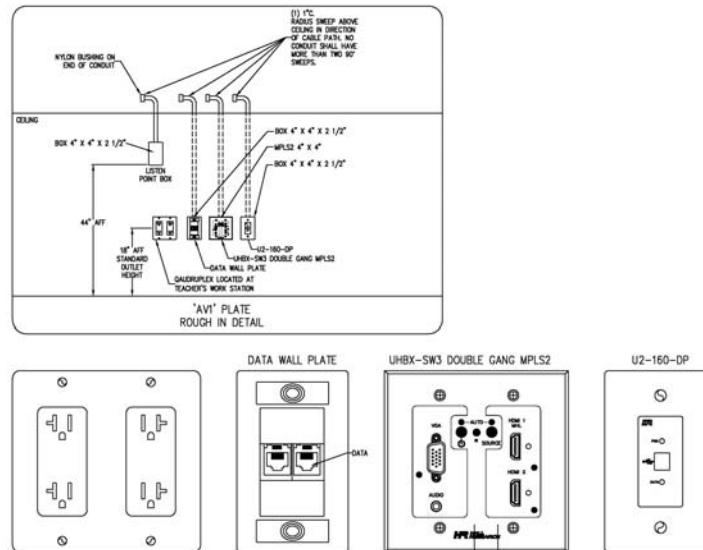
EXECUTION

3.1 TECHNOLOGY SYSTEMS RACEWAY REQUIREMENTS

- A. Provide a complete system of raceway and back boxes for all telecom services, refer to Section 26 05 33 for additional requirements and information.

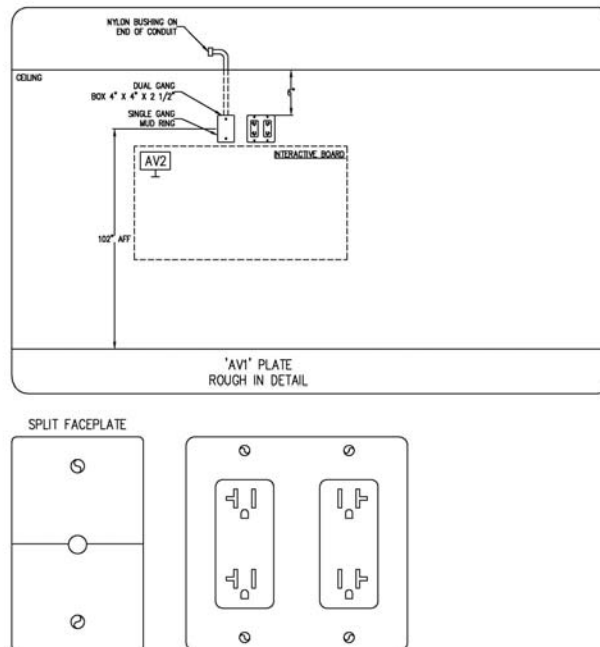
**END OF SECTION**

## Communication Outlet Elevations



(NOTE: ALL 'AV' A/V CABLES ROUTE TO ROOMS WALL MOUNTED PROJECTOR, UNLESS NOTED OTHERWISE. CATEGORY 6 CABLES ROUTE TO THE BDR/FCR SERVING THE ROOM, AND USB EXTENSION CABLES ROUTE TO THE FUTURE INTERACTIVE BOARD LOCATION.

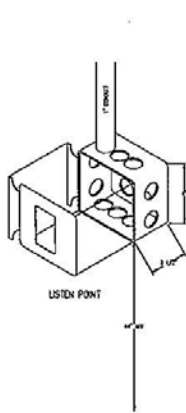
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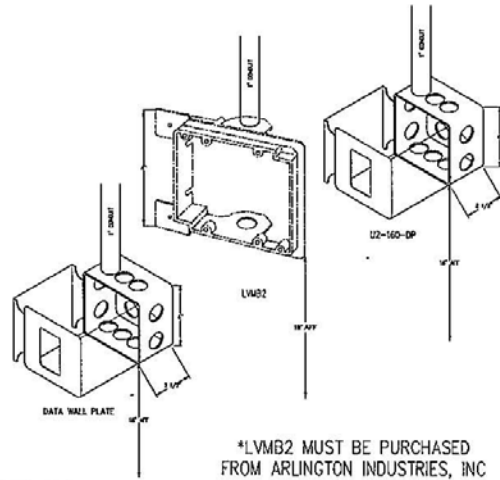
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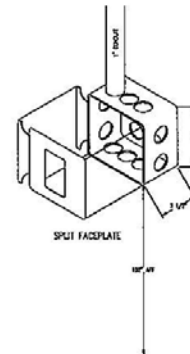
B U I L D I N G   E X C E L L E N C E



DETAIL # 3



DETAIL # 4



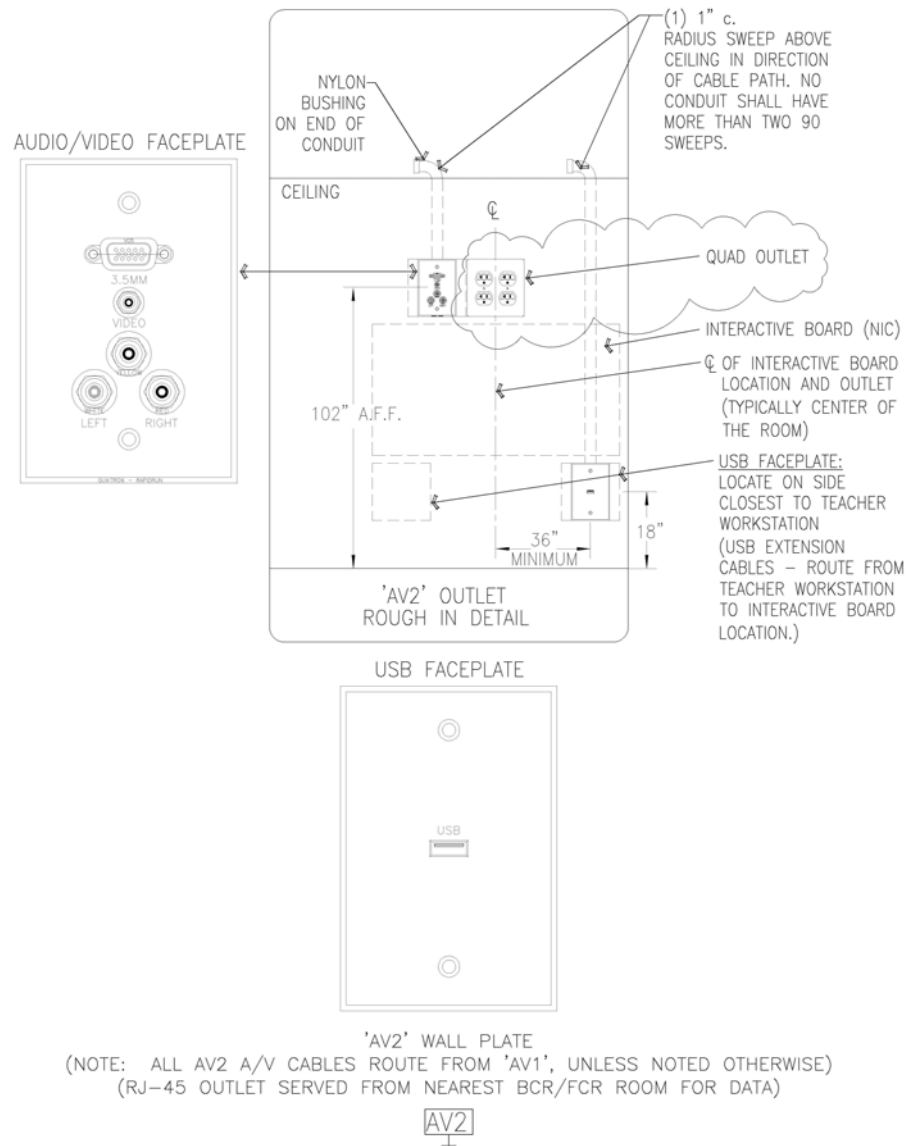
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B U I L D I N G   E X C E L L E N C E

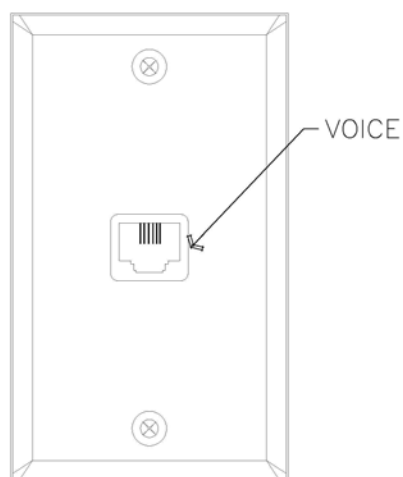
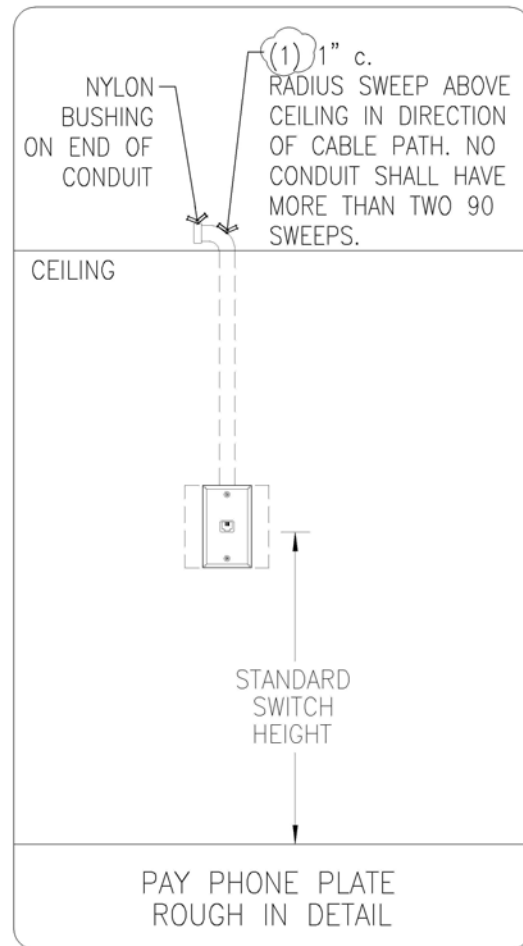
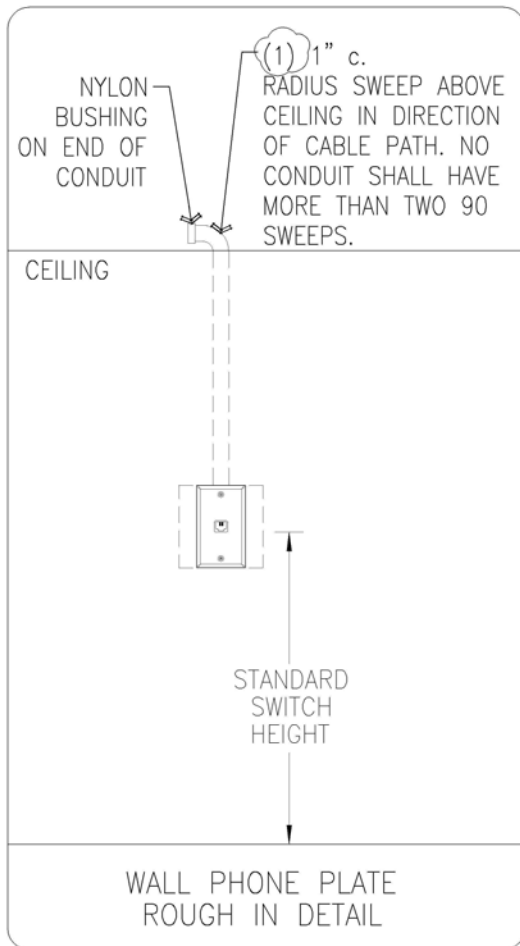
**Communication Outlet Elevations**



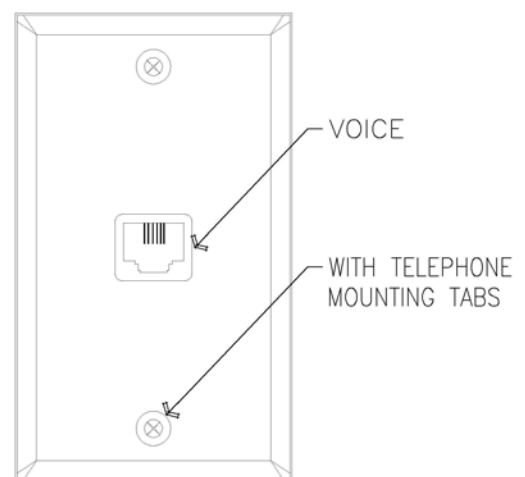


B U I L D I N G   E X C E L L E N C E

**Communication Outlet Elevations**



VW  
▼

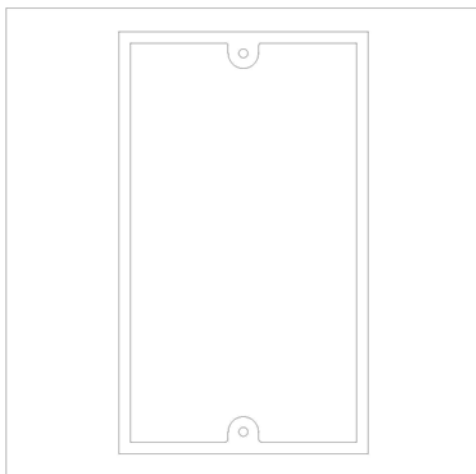
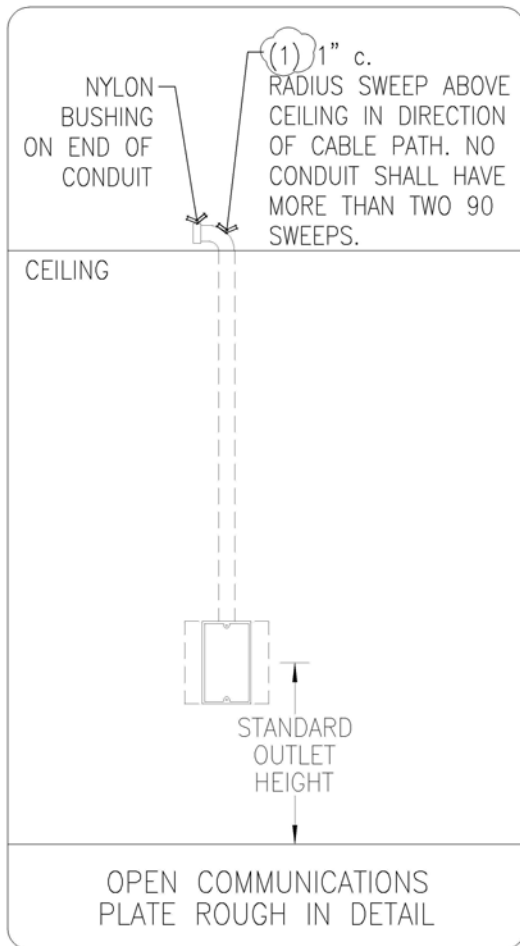


VP  
▼

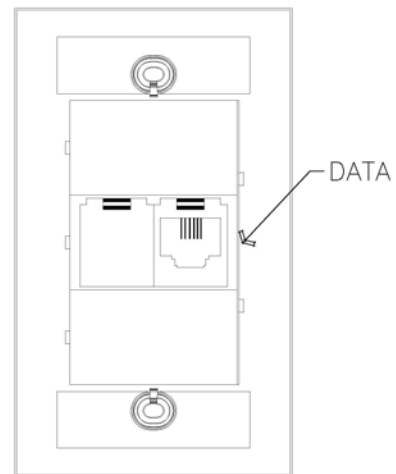
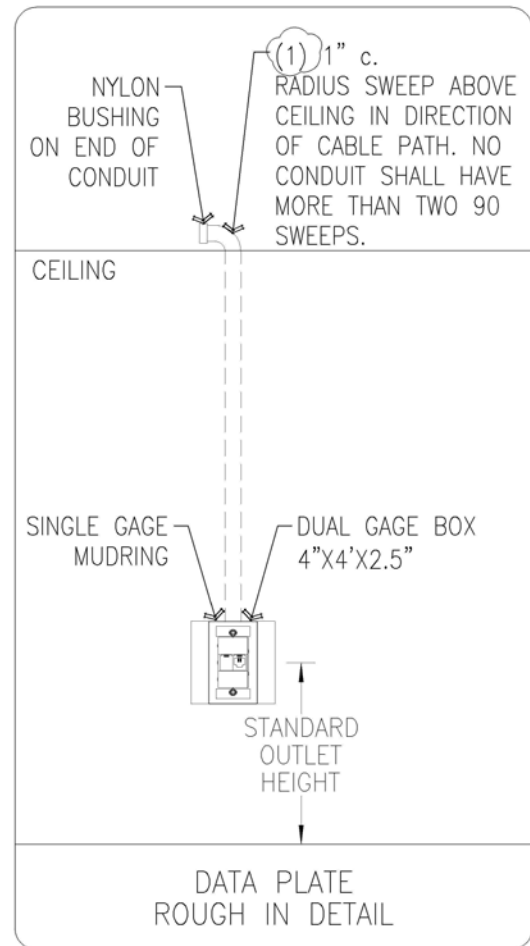


B U I L D I N G   E X C E L L E N C E

**Communication Outlet Elevations**



OPEN  
COMMUNICATIONS  
PLATE  
C  
▽



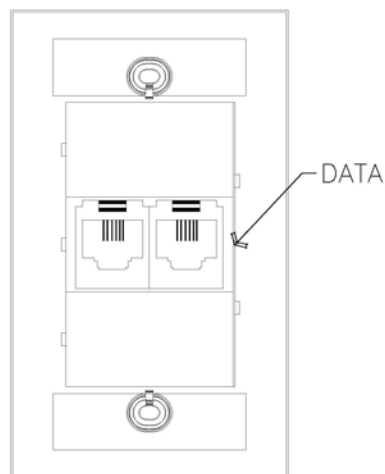
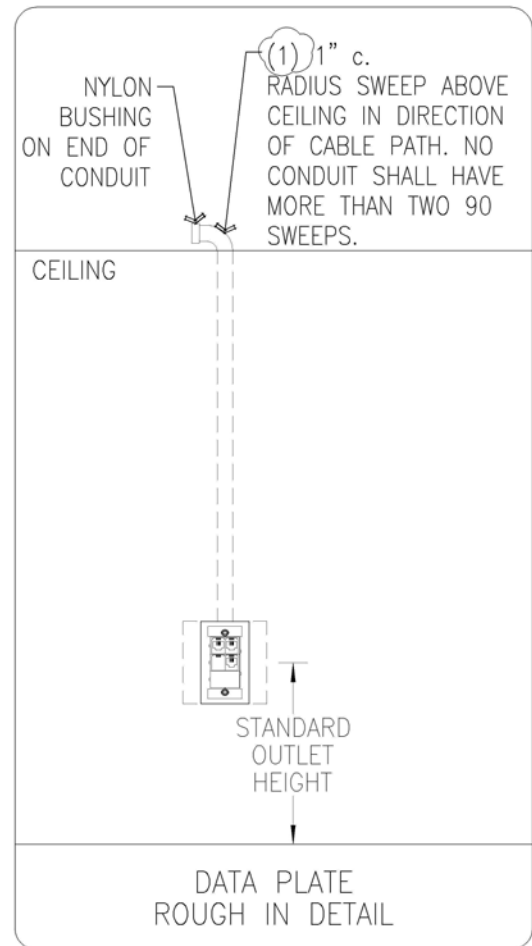
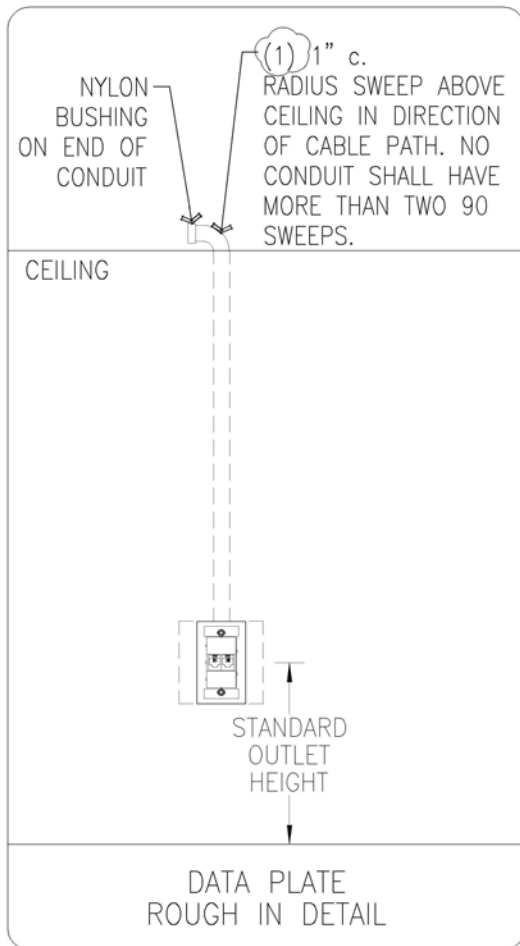
DATA  
WALL PLATE  
D1  
▽



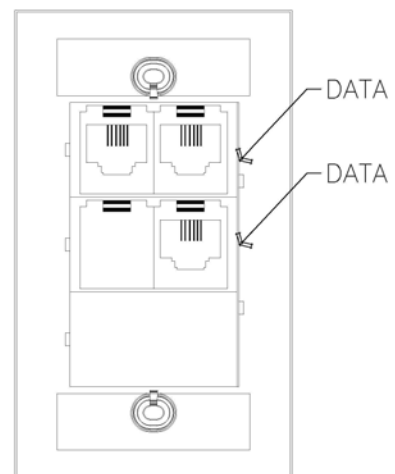


B U I L D I N G   E X C E L L E N C E

**Communication Outlet Elevations**



DATA  
WALL PLATE



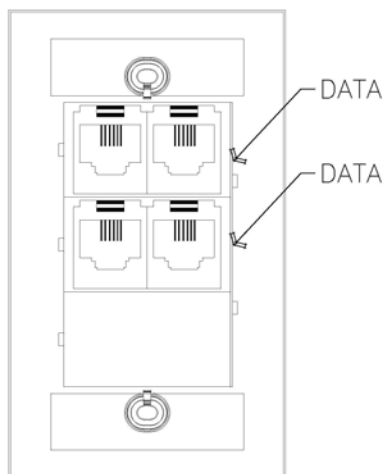
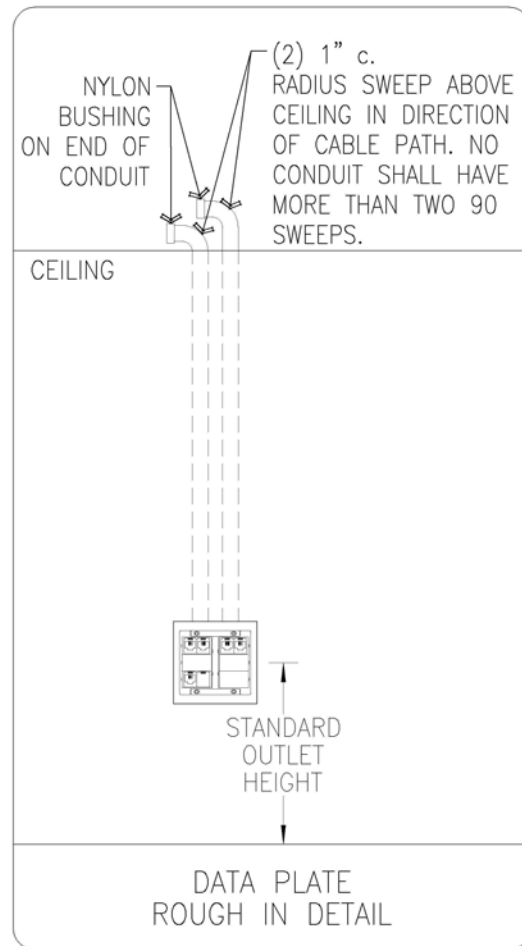
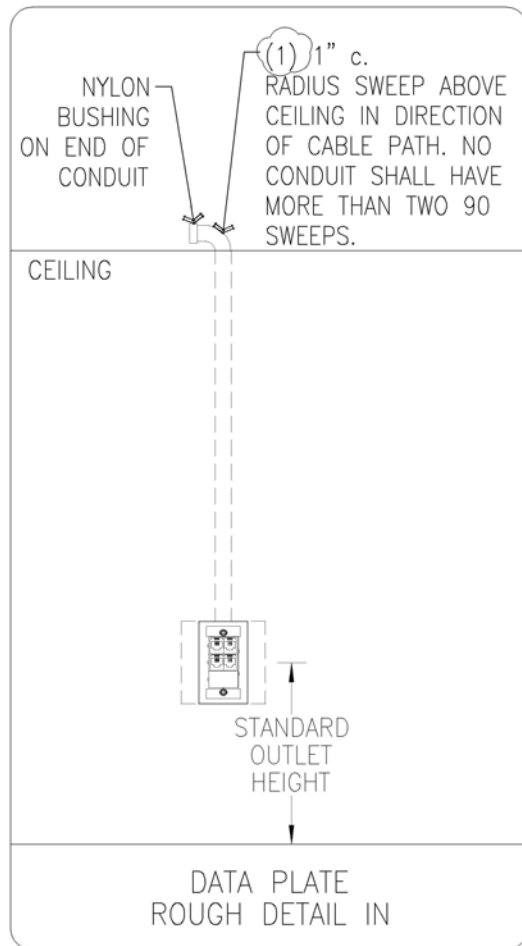
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WALL PLATE





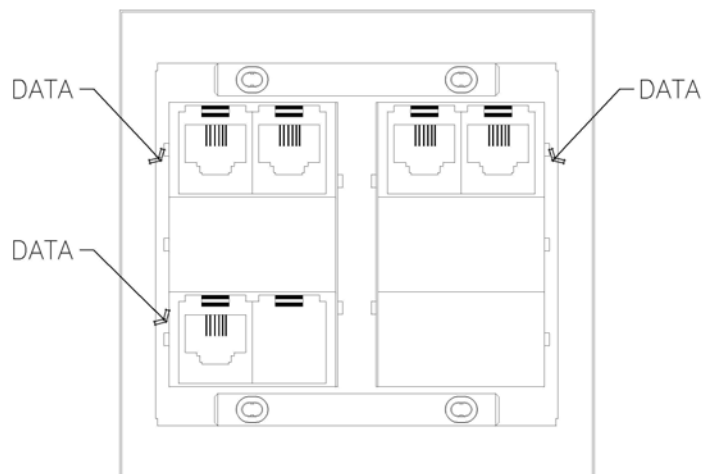
B U I L D I N G   E X C E L L E N C E

**Communication Outlet Elevations**



DATA  
WALL PLATE

D4  
▽



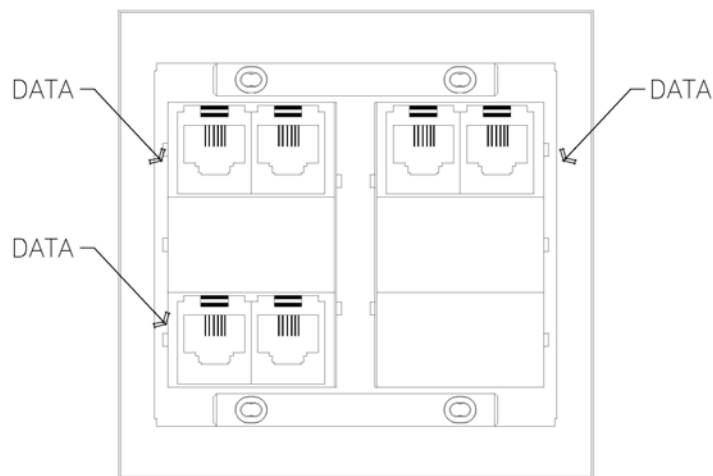
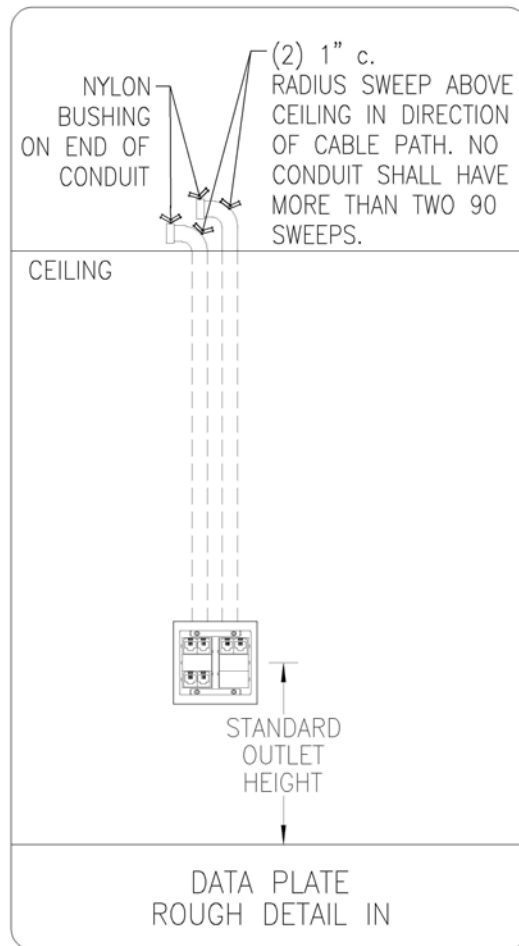
DATA  
WALL PLATE

D5  
▽



B U I L D I N G   E X C E L L E N C E

**Communication Outlet Elevations**



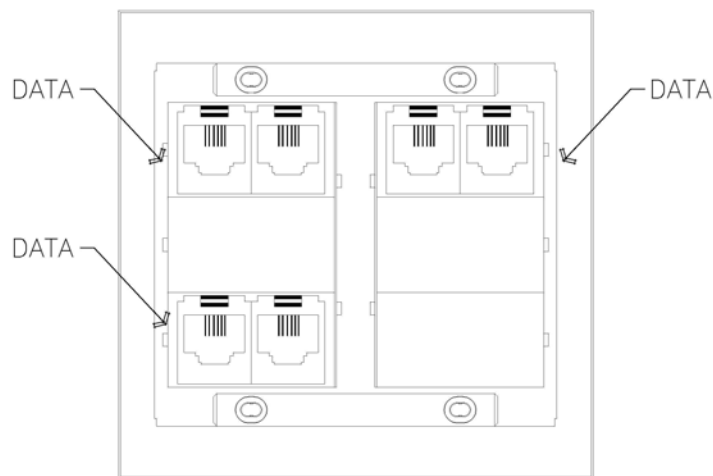
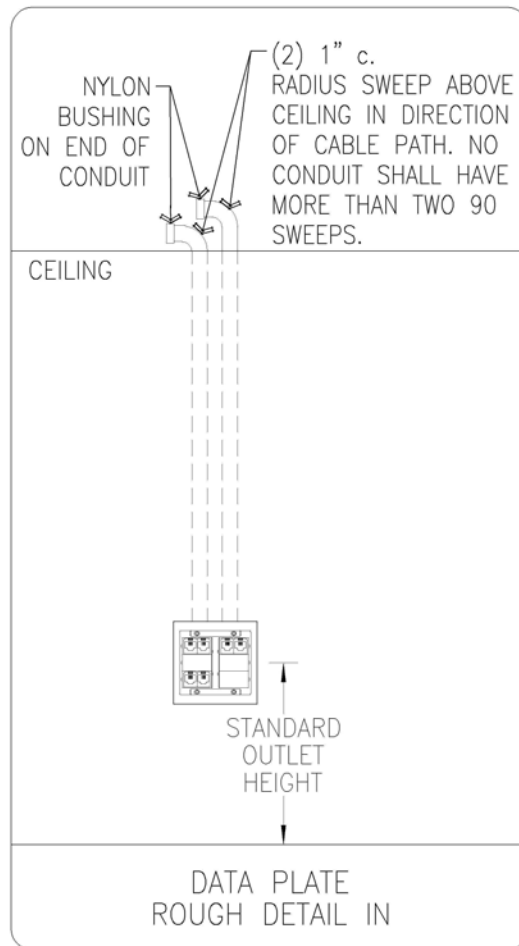
DATA  
WALL PLATE





B U I L D I N G   E X C E L L E N C E

**Communication Outlet Elevations**



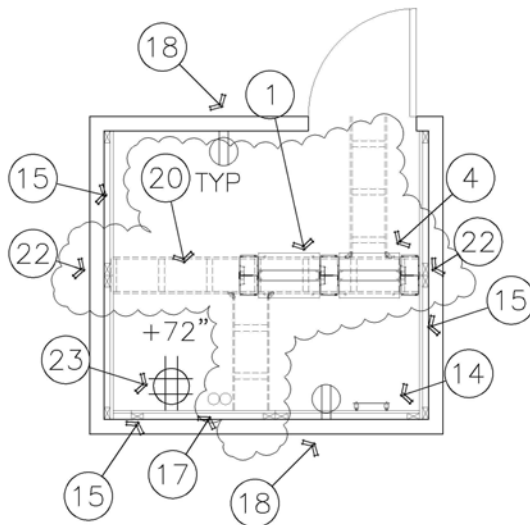
DATA  
WALL PLATE



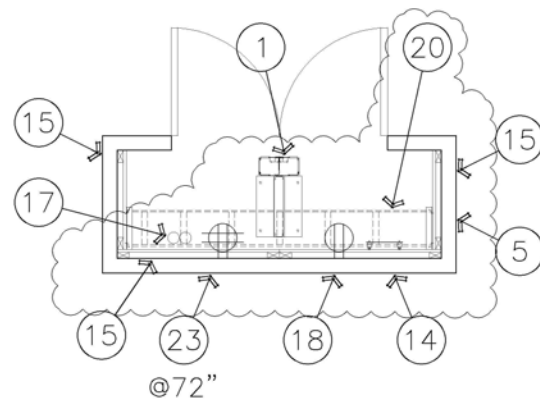


BUILDING EXCELLENCE

**3900-Tech-Floor Communications Room (FCR) 9'x'8'**

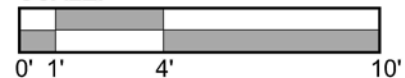


FCR-1  
(8' X 9' ROOM)  
INTERIOR DIMENSIONS



FCR-2  
(3' X 9' ROOM)  
INTERIOR DIMENSIONS

SCALE:



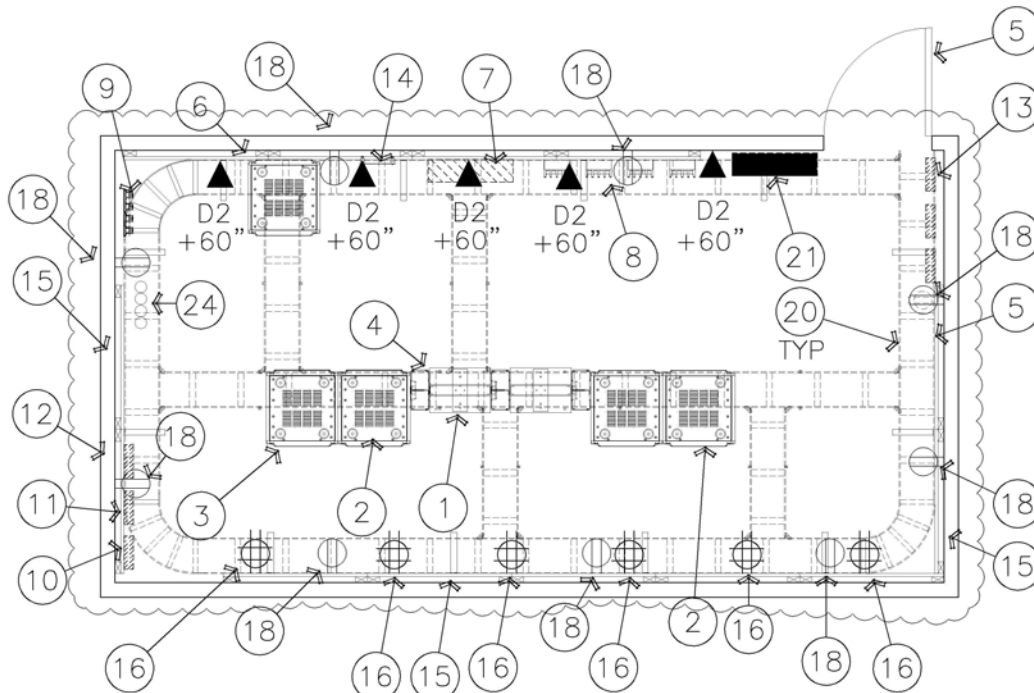
FLOOR PLAN - KEYED NOTES

- |  |  |
|--|--|
| (1) 7'X19' FLOOR MOUNTED RELAY RACK; BLACK (TYP.)      | (13) SPACE ALLOCATED FOR FUTURE EQUIPMENT  |
| (2) 7'X19'X25' FLOOR MOUNTED SERVER RACK; BLACK (TYP.) | (14) WALL MOUNTED GROUND BUSS BAR  |
| (3) VIDEO SURVEILLANCE SYSTEM CABINET                  | (15) 4'X8'X3/4" FIRE RATED PLYWOOD   |
| (4) 7'X6" VERTICAL CABLE TRAY                          | (16) 120VAC/20AMP DEDICATED ELECTRICAL QUAD RECEPTACLE MOUNTED AT +72" AFF. TYPICAL FOR ALL SHOWN.   |
| (5) 12" LADDER TRAY; BLACK (TYP.)                      | (17) 4" CONDUITS   |
| (6) PUBLIC ANNOUNCEMENT HEADEND CABINET                | (18) 120VAC/20AMP DEDICATED ELECTRICAL DUPLEX RECEPTACLE   |
| (7) WALL MOUNTED TELEPHONE SYSTEM                      | (19) NOT USED  |
| (8) 110 STYLE TERMINATION FIELD                        | (20) LADDER TRAY INSIDE BCR/FCR (SHOWN DASHED) BY OTHERS   |
| (9) 66-STYLE TERMINATION FIELD                         | (21) MAIN ALARM PANEL  |
| (10) AT&T COPPER SERVICE                               | (22) LADDER TRAY WALL ANGLE SUPPORT BRACKET (TYP.)   |
| (11) AT&T FIBER OPTIC SERVICE                          | (23) POWER OUTLET (QUAD • 18" U.N.O.)  |
| (12) COMCAST TELEVISION SERVICE                        | (24) (4)-4" UNDERGROUND CONDUIT ROUTING FROM PROPERTY LINE. CONDUITS TO BE LOCATED WITHIN 6" OF WALL SURFACE AND SHALL BE STUBBED UP +6" AFF. RE: SPEC'S |



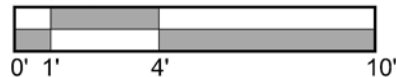
BUILDING EXCELLENCE

**3910-Tech-Building Communications Room (BCR) 12' wide**



BCR  
(12' X 20' ROOM)  
INTERIOR DIMENSIONS

SCALE:



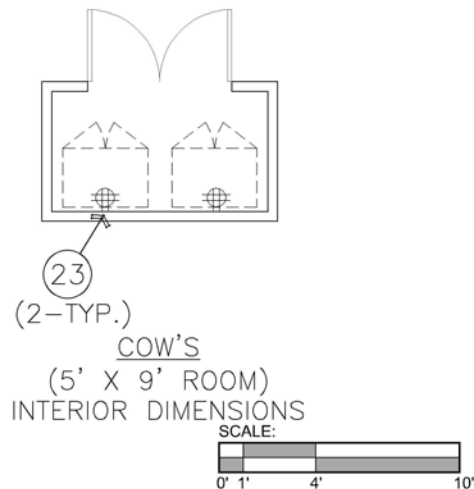
FLOOR PLAN - KEYED NOTES

- |  |  |
|--|--|
| (1) 7'X19' FLOOR MOUNTED RELAY RACK; BLACK (TYP.)      | (13) SPACE ALLOCATED FOR FUTURE EQUIPMENT  |
| (2) 7'X19'X25' FLOOR MOUNTED SERVER RACK; BLACK (TYP.) | (14) WALL MOUNTED GROUND BUSS BAR  |
| (3) VIDEO SURVEILLANCE SYSTEM CABINET                  | (15) 4'X8'X3/4" FIRE RATED PLYWOOD   |
| (4) 7'X6" VERTICAL CABLE TRAY                          | (16) 120VAC/20AMP DEDICATED ELECTRICAL QUAD RECEPTACLE MOUNTED AT +72" AFF. TYPICAL FOR ALL SHOWN.   |
| (5) 12" LADDER TRAY; BLACK (TYP.)                      | (17) 4" CONDUITS   |
| (6) PUBLIC ANNOUNCEMENT HEADEND CABINET                | (18) 120VAC/20AMP DEDICATED ELECTRICAL DUPLEX RECEPTACLE   |
| (7) WALL MOUNTED TELEPHONE SYSTEM                      | (19) NOT USED  |
| (8) 110 STYLE TERMINATION FIELD                        | (20) LADDER TRAY INSIDE BCR/FCR (SHOWN DASHED) BY OTHERS   |
| (9) 66-STYLE TERMINATION FIELD                         | (21) MAIN ALARM PANEL  |
| (10) AT&T COPPER SERVICE                               | (22) LADDER TRAY WALL ANGLE SUPPORT BRACKET (TYP.)   |
| (11) AT&T FIBER OPTIC SERVICE                          | (23) POWER OUTLET (QUAD • 18" U.N.O.)  |
| (12) COMCAST TELEVISION SERVICE                        | (24) (4)-4" UNDERGROUND CONDUIT ROUTING FROM PROPERTY LINE. CONDUITS TO BE LOCATED WITHIN 6" OF WALL SURFACE AND SHALL BE STUBBED UP +6" AFF. RE: SPEC'S |



B U I L D I N G E X C E L L E N C E

## 3920-Tech-Computer on Wheels Storage (COWs)



### FLOOR PLAN - KEYED NOTES

- |  |  |
|--|--|
| (1) 7'X19' FLOOR MOUNTED RELAY RACK; BLACK (TYP.)      | (13) SPACE ALLOCATED FOR FUTURE EQUIPMENT  |
| (2) 7'X19'X25' FLOOR MOUNTED SERVER RACK; BLACK (TYP.) | (14) WALL MOUNTED GROUND BUSS BAR  |
| (3) VIDEO SURVEILLANCE SYSTEM CABINET                  | (15) 4'X8'X3/4" FIRE RATED PLYWOOD   |
| (4) 7'X6" VERTICAL CABLE TRAY                          | (16) 120VAC/20AMP DEDICATED ELECTRICAL QUAD RECEPTACLE MOUNTED AT +72" AFF. TYPICAL FOR ALL SHOWN.   |
| (5) 12" LADDER TRAY; BLACK (TYP.)                      | (17) 4" CONDUITS   |
| (6) PUBLIC ANNOUNCEMENT HEADEND CABINET                | (18) 120VAC/20AMP DEDICATED ELECTRICAL DUPLEX RECEPTACLE   |
| (7) WALL MOUNTED TELEPHONE SYSTEM                      | (19) NOT USED  |
| (8) 110 STYLE TERMINATION FIELD                        | (20) LADDER TRAY INSIDE BCR/FCR (SHOWN DASHED) BY OTHERS   |
| (9) 66-STYLE TERMINATION FIELD                         | (21) MAIN ALARM PANEL  |
| (10) AT&T COPPER SERVICE                               | (22) LADDER TRAY WALL ANGLE SUPPORT BRACKET (TYP.)   |
| (11) AT&T FIBER OPTIC SERVICE                          | (23) POWER OUTLET (QUAD • 18" U.N.O.)  |
| (12) COMCAST TELEVISION SERVICE                        | (24) (4)-4" UNDERGROUND CONDUIT ROUTING FROM PROPERTY LINE. CONDUITS TO BE LOCATED WITHIN 6" OF WALL SURFACE AND SHALL BE STUBBED UP +6" AFF. RE: SPEC'S |





## BUILDING EXCELLENCE

### SECTION 27 10 00

#### TELECOMMUNICATION ROOM REQUIREMENTS

##### GENERAL

###### 1.1 Summary of Work:

- A. Provide a complete and tested cable distribution system for data interconnections (Local Area Network). The data distribution system shall include fully terminated unshielded twisted pair cables, fiber optic cabling, raceways, conduit, UTP termination devices, data communications outlets, fiber enclosures, patch panels, patch cables, network racks, and other incidental and miscellaneous premises wiring system hardware as required for a complete and usable system.

###### 1.2 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. The Data Cable System Installer shall be licensed and shall meet all applicable regulations of the State of Texas and Department of Labor insofar as they apply to this type of system. The proposer shall be a firm normally employed in the low voltage and data cabling industry and shall provide a reference list of ten (10) large-scale projects and contact names confirming successful Category 6 premises wiring system installations.
  - 2. All Data Cable Systems installation shall be performed by a (BICSI) Certified - Registered Telecommunications Technician or under the direct supervision of a (BICSI) Certified - Registered Communications Distribution Designer (RCDD).
  - 3. All Data Cable Systems installation shall be performed by a factory/manufacturer certified installer.

##### PRODUCTS

###### 2.1 GENERAL

- A. Building Demarcation Point (BDP):
  - 1. Main point of service entry for all telephone, fiber and cable building service connection points. Locate on ground floor and locate in Building Communications Room (BCR) is preferred.
  - 2. Not to be used as a route to hold other building systems such as boiler rooms, air exchange rooms, janitorial closets, water heaters, wet sinks or electrical rooms.
  - 3. Provide ground bus bar in room; do not provide a ceiling.
  - 4. For underground ducts and raceway requirements, refer to section 26 06 43 of HISD Design Guidelines.
- B. Building Communications Room (BCR):
  - 1. Primary communications room for the building, also known as MDF. Houses all telephone equipment for building, network equipment, video surveillance, cable television hardware, fire alarm main panel, intercom systems, access control, HVAC building automation, lighting control and district-wide area network equipment.
  - 2. Location and requirements of BCR room:
    - a. Not to be used as a route to hold other building systems such as boiler rooms, air exchange rooms, janitorial closets, water heaters, wet sinks or electrical rooms.
    - b. Locate in central area of building near administration area.
    - c. 12'W minimum x 20'L minimum size for an elementary school, 12'W minimum x 24'L minimum for middle and high schools.
    - d. Provide floor drain in room if risk of water entering facility.



## B U I L D I N G   E X C E L L E N C E

- e. Cover walls with 3/4" plywood, painted with fire retardant paint from 8" aff to 8'-8" aff.
  - f. 10'-0" minimum clearance to structure, no ceiling.
  - g. Locate 3'-0" out swinging door at corner of corridor side of BCR.
  - h. Provide ground bus bar in room
  - i. All conduit stub ups, sleeves, and cores shall be located within 6" of walls.
  - j. Provide detailed locations for all sleeves in wall at BCR and FCR rooms indicating number of sleeves and sizes and detail which sleeve is for which low voltage system such as fire, intercom, security, data or building controls.
- 3. Air conditioning requirements of BCR room:
  - a. Primary cooling for the room to be provided from building air conditioning system. Provide secondary, 24x7x365 backup cooling for room, sized for equipment installed. System shall be separate and independent from building air conditioning system.
  - b. Locate thermostat above light switch at entry door.
  - c. Install evaporator unit with safe plan interlocked with float switch. Route condensate to floor drain and do not use condensate pump.
- 4. Electrical requirements of BCR room:
  - a. Power for telecommunications equipment shall not be on same panel serving convenience receptacles, lighting or HVAC equipment.
  - b. Provide duplex convenience outlet every 10'-0" o.c. along perimeter room wall.
  - c. Each technology / security cabinet/rack shall be served by (1) one dedicated 120v, 20A single pole circuit, locate receptacle at 72" aff behind cabinet/rack.
  - d. For PBX equipment, provide (2) dedicated 208v, 20A single phase double pole circuit on wall behind phone equipment.
  - e. Each rack/cabinet shall contain a horizontal plug strip with 12 foot extension cord rated for 20A receptacle, on/off switch, circuit breaker and minimum six standard outlets.
  - f. For grounding bar requirements, refer to section 26 05 26 of HISD Design Guidelines.
  - g. Bond all incoming conduits, racks, ductwork, piping, cable trays and termination frames with #6 AWG copper strap with termination lugs.
  - h. Tie all Floor Communication Rooms (FCR) together with #3/0 copper conductor.
  - i. Provide 50 foot candles of illumination in room measured at 36" aff.
  - j. Provide dual level switching for fixtures and provide emergency lighting connection as per building emergency lighting standard.
  - k. Do not use fixtures designed for ceiling grids or suspended with wire. Wall mounted fixtures, coordinate locations with equipment.
- C. Floor Communications Rooms (FCR)
  - 1. Space requirements:
    - a. Power and lighting requirements for FCR room to match BCR requirements listed above.
    - b. Dedicated space housing communications equipment serving technology/voice outlets on immediate floor. Also known as IDF closet.
    - c. Stack FCR closets on floors so each closet is directly above / below the other. Install (4)-2" conduits between rooms/floors.
    - d. Minimum size of FCR is 9'x12' for high schools. Minimum size of FCR for elementary or middle schools shall be 9'x8' (standard size).



## BUILDING EXCELLENCE

- e. Provide supply air from building air conditioning system that will maintain temperature from 64 to 75 degrees Fahrenheit, 30%-55% RH. Account for 3000 BTUH per racks for design heat load.
- f. Provide positive air in room.

### EXECUTION

#### 3.1 GENERAL

- A. Fire Wall Penetrations: The contractor shall avoid penetration of fire-rated walls and floors wherever possible. Where penetrations are necessary, they shall be sleeved with metallic conduit and resealed with an Underwriter Laboratories (UL) approved sealant. Contractor shall also seal all floor, ceiling and wall penetrations in fire or smoke barriers and in the wiring closet.
- B. Allowable Cable Bend Radius and Pull Tension: In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation. Refer to the cable manufacturers allowable bend radius and pull tension data for the maximum allowable limits.
- C. Cable Lubricants: After installation, exposed cable and other surfaces must be cleaned free of lubricant residue.
- D. Conduit Fill: Conduit fill shall not exceed 40%.
- E. Damage:
  - 1. The Contractor shall replace or rework cables showing evidence of improper handling including stretches, kinks, short radius bends, over-tightened bindings, loosely twisted and over-twisted pairs at terminals and cable sheath removed too far (over 1-1/2 inches).
  - 2. The Contractor shall replace any damaged ceiling tiles that are broken during cable installation.
- F. Clean Up:

All clean up activity related to work performed will be the responsibility of the Contractor and must be completed daily before leaving the facility.

#### 3.2 DOCUMENTATION

- A. Labels:

The Contractor will label all outlets using permanent/legible typed or machine engraved labels approved by the Owner (no handwritten labels permitted). Label patch panels in the wiring closet to match those on the corresponding data outlets. The font shall be at least on-eighth inch (1/8") in height, block. All labels shall correspond to as-builts and to final test reports.
- B. Floor Plan: A floor plan clearly labeled with all outlet jack numbers shall be included in the as-built plans.

**END OF SECTION**



## BUILDING EXCELLENCE

### SECTION 27 50 00

#### LOCAL SOUND REINFORCEMENT AND PUBLIC ADDRESS SYSTEMS

##### GENERAL

##### 1.1 GENERAL REQUIREMENTS

- A. Provide all equipment specified well as all miscellaneous parts and materials required for the proper installation of each sound system.

##### PRODUCTS

##### 2.1 LOCAL SOUND REINFORCING SYSTEM

- A. Design phase milestone requirements:
  1. 100% Schematic Design Milestone Requirements:
    - a. Locate headend equipment rack locations.
  2. 100% Design Development Milestone Requirements:
    - a. Locate headend equipment racks and preliminary equipment lists
  3. 60% Construction Document Milestone Requirements:
    - a. Finalize headend equipment locations, equipment model numbers, input locations, speakers and identify power requirements.
  4. 100% Construction Document Milestone Requirements:
    - a. Identify all rack locations, speaker locations, provide detailed equipment per headend locations.
    - b. Show all input locations and indicate back box requirements along with conduit requirements.
    - c. Provide riser diagram schematics of system.
    - d. Coordinate power requirements and locations with electrical drawings.
- B. For any product numbers or manufacturers listed have been discontinued and are no longer available, contractor shall provide current model available that is a direct replacement with same or better functionality than original part listed.
- C. Local Sound Reinforcing System: Acceptable Manufacturers: TOA, Bogen, Rauland, Bi-amp, Atlas/Soundolier, Peavey, ~~Sound Tube Sub~~ KDM / Octasound DBX, Tascam, William Sound, Rolls, Shure, Orbit and Crown.
- D. Provide a local sound reinforcing system in all gyms, cafeteriums, student dining commons, auditoriums and sports fields.
  1. Elementary Cafeteriums – Equipment rack shall be a Middle Atlantic rack, model #DWR-24-22 with Plexiglas door. Provide with rack light and 8 power outlet inputs ~~#ACRL-294 sub:~~ PDLT-815 RVA. Provide with powder coated black utility drawer #UD3.
  2. Provide separate commercial grade amplifier with microphone and auxiliary inputs (CD player, tape player, etc.)
  3. Provide rack mounted equipment as listed below for each sound rack on project.
    - a. Crown 2 channel 500 watt @ 4 ohm amp with DSP software, model #CDi1000
    - b. 2 mixers Crown 28M or equal to accommodate at least 12 inputs (2 wall mic inputs, 2 wireless mic inputs, 3 hanging mic inputs, 1 cd/cassette input, 1 projector input, aux input jack for an external source, spare aux input for future use).
    - c. Peavey 31 band equalizer #GME131
    - d. Provide CD/Cassette Deck, Marantz #PMD354 Denon Pro DN-300Z.
  4. Provide separate speakers independent on the paging system.
    - a. Electro Voice #SX300E two way loud speaker (8 ohm) with flying mount kit, MB200 speaker bracket, and Electro Voice #11053031 Neutrik



## BUILDING EXCELLENCE

- Speakon Connector. Provide quantity of 2 unless student dining commons can be split which will then require 2 speakers in each space that can be combined or as separate systems. A power amplifier should also be added for the additional speakers.
- b. Speakers near the stage in the Multipurpose Room should have the capability to be switched on/off independently from the speakers in the other half of the space so that a function can occur at the stage while another function is occurring in the student dining commons.
5. Provide rack mounted equipment as listed below for each sound rack on project. Provide microphones, wireless microphones and hanging microphones.
    - a. Dukane/Shure Cardoid Microphone #SM58S, quantity of 2
    - b. Shure Wireless Microphone System Kit with Handheld/Lav. #SLX124/85/SM58. Quantity of 2.
    - c. Atlas Microphone wall outlet #SG-XLR-F1, quantity of 2.
    - d. Atlas Microphone desk stand #DS-7, quantity of 2.
    - e. Atlas Microphone stand #MS-43E, quantity of 2.
    - f. Dukane/Shure 25' microphone cable #SU-C25J, quantity of 3.
    - g. Shure hanging microphone #EZO/G, or equal, quantity of 3.
  6. Provide rack mounted equipment as listed below for each sound rack on project. Provide assisted listening system PPA 377 Professional.
    - a. Williams Sound, ~~#PPA-375E~~ PPA 377 PRO with 4 receivers, rack mount kit #RPK 005, and antenna #ANT 005.
  7. All wiring shall be at least 18 gauge over all shield and 2C-16AWG plenum for speakers.
  8. All wire labeling shall be on Brady labels, model #PM-1M "Porta-Mark".
  9. Provide auxiliary input at rack to tie in an external source to house system.
  10. Any substitution of equipment or product numbers must be approved by HISD Alarm Communications.
  11. All final walkthrough's of complete installation and delivery of spare or accessory products must be scheduled and signed off by HISD Alarm Communications. All final delivery of products must have a sign off receipt from contractor to HISD Alarm Communications and signed receipt of delivery included in close out documents.

### 2.2 PUBLIC ADDRESS SYSTEM

Performance specification based upon telecor T2/XL systems, other system must meet the minimum criteria specified herein to be considered as equal.

- A. The Public Address System shall consist of the Central Control Unit, Administrative Consoles, PC-Based Graphic User-Interface(GUI) with visual representation of the school, separate web-based programming editor, rack equipment and all other necessary devices that are required to create a complete and operational system such as Speakers, Horns, Amplifiers, and Visual Message Devices, etc. All Public Address main equipment including card cages and all cards, power amplifiers, program sources, etc., shall be rack mounted in the MDF room. All system programming of Public Address and Master Clock features shall be accomplished by an Administrative Console located in the Main Office area or over the LAN/WAN or internet by a browser based software programming tool. The browser based programming tool shall be separate from graphical user interface and shall not be accepted as a substitution of graphical user interface. It shall not be necessary to attend to the main equipment in the Head End for normal day-to-day operation of the system. The system shall be a 25-Volt two-way paging system providing paging zones as indicated and determined by the Owner. The system shall be of modular design utilizing plug-in circuit cards to enable quick on-site replacement or addition of components for system expansion and modification. The system head end equipment shall be rack-mounted in the MDF where shown on the drawings with side panels and stationary platform base. Provide shelves, doors, blank panels, AC power distribution, etc. as required to support all



## BUILDING EXCELLENCE

equipment and fill empty rack space. System shall be comprised of all solid-state electronics, utilizing a microprocessor-based central processor unit, power supplies, audio interface cards, control cards, input/output cards, telephone interface cards, transformers, paging amplifiers, etc., as required for a complete system, to include equipment and installation to interface with the Owner's VoIP telephone system. The interface must comply with loop-start central office (CO) trunk standards in North America as defined by Bellcore and/or industry-standard 2500 analog station ports.

- B. The system must include a Graphical User Interface (GUI) software application that allows for the operation of the System from a Windows®-based PC. Provide networked PC, (coordinate location with Owner), keyboard, mouse, and 21" LCD Monitor. PC shall exceed manufacturer recommended specifications. This software package shall utilize an easy-to-use graphical user interface (GUI), quick graphical access to paging, and program distribution. The software shall also allow easy activation of class change schedules. Emergency operations shall be simplified through this software application by allowing stored audio files and alphanumeric messages for message displays to be activated from the GUI. The GUI shall allow common operations such as daily announcements to become automated (removed), removing multi-step console set ups. (removed) The means for originating voice communications to selected locations must be separate from GUI application and must be provided through the system Administrative Console, Telephone Handset or Microphone. The software must allow the creation of a Custom Operating Screen (s) based on the floor plans of the school facilities. Icons representing Intercom Stations, and Paging, Monitoring and Audio Program Zones shall be incorporated onto the floor plans. The Software GUI shall provide:
1. Simple Routine Call Processing
  2. Emergency Functions
  3. Paging
  4. Audio Program Distribution
  5. Enabling and Disabling of Schedules and Bell Scheduling
  6. Customizable Page Elements
  7. Customizable Operating Screen
  8. Element Library for Emergency Event Icons
- C. The GUI must provide an efficient and reliable method of notifying the occupants of a facility of critical situations. A variety of emergency tone signals that reside within the Intercom/Paging System shall be activated by clicking on pre-programmed buttons on the PC GUI screen, initiating the transmission of tone signals to speakers, and alphanumeric messages to Message Displays/Digital Clocks. A 'lockdown' icon shall be designed as per Owner direction, with owner selecting the appropriate tone.
- D. The system shall be IP based utilizing IP nodes in remote IDF closets. The immediate area around the headend may be wired back to the headend utilizing traditional input/output boards. All nodes must utilize a integrated 30watt amplifier. An external appropriately sized amplifier shall only be used when the 30 watt amplifier is not large enough for the area it is servicing. The IP node shall be 1 Rack Unit high and also provide the clock interface for the area it is serving. If it is set up on the customers LAN it should be partitioned as a VLAN. The node should also be able to function on a redundant network should one be provided.
- E. The main system shall include a Telecor T2/XL head-end, a networked PC with Microsoft Windows XP or Vista running Telecor's Visual Console software, a monitor, data entry keyboard, control console, serial connections to in-house alert systems, UPS power backup, interfaces for network access. A Category 6 plenum rated structured cabling system with C5PPL Patch Panels in IDF's, and all associated system components to provide:





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1. Direct dialing, two-way “amplified voice” communications between all locations equipped with Control Console, Visual Console and/or telephone system handset, and all locations equipped with a public address system speaker; excluding corridor speakers.
2. An Administrative Control Console (located at all symbols) for facilitating all Public Address System announcements and programming, to include but not be limited to: Emergency all-call; paging zone and number assignments; call-in priority levels with tone characteristics; Master Clock event and tone signaling; monitor and reporting on call-in line faults; and manually distribute unique tones to all zones and speakers in the system.
3. The system shall provide a server for network connectivity from authorized PC’s to remotely control or program the T2/XL systems. The server shall provide remote system diagnostics and access to activity log files on the T2/XL system. It also provides support for the GUI program and integrates the functionality of an MCC-300 Administrative Consoles into the framework of a PC. Audio files that are used for daily as well as emergency announcements and music files can be stored in the server for retrieval by the GUI interface and Visual Console. WAV and MP3 files can be stored on the server and called up with Visual Console for play on any event programmed from the bell schedules and played in the appropriate time zones throughout the school. The server also provides for the synchronization of the T2/XL to a master time keeping source. This can be a time source within the facility or an external time server via the Internet.
4. Connection to a local building digital PBX or VoIP telephone system (phone system by Owner), allowing any telephone handset that is part of the telephone system to page and conduct hands-free, open-voice communication with any speaker in the system; the Control Console; GUI or any other classroom telephone. The Connection to the local phone system shall not diminish or restrict any of the capabilities of local telephone system. Public Address System interfaces shall allow any programmed telephone to perform but not be limited to the following intercommunication system functions: all-call; zone call; intercom call to classroom speakers, distribute class change signals, etc.
5. User-programmable zone paging to all classroom and office speakers using microphone, Control Console, Visual Console or telephone. Public address zones shall be software programmable to include 1- and 2-digit numbers. Zone paging shall be independent of time and program zones and shall provide easy access to groups of zones or all-zone pages.
6. Distribution of general announcements over School loudspeakers using a microphone, Control Console, GUI, or telephone handset, on an All-Call basis, pre-selected zone basis, or multiple-zone basis to any paging zone. Speaker assignments to any zones shall be programmable from the Web Editor.
7. Distribution of emergency paging announcements over school loudspeakers using a microphone, Control Console, GUI or telephone handset. Emergency announcements shall have the highest priority over all other system functions, including the Local Audio Systems. Emergency announcements shall automatically disconnect and override all Local Audio Systems. Provide programming source to override local audio systems in Auditorium, Cafe, Fitness Center, Multi-Purpose Building, Lecture Hall and Gym. Coordinate with 27 40 00 contractor.
8. Any individual room station within the system to be designated as a fixed zone by the simple entering of keystroke at the Control Console during a page selection.





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9. Selection and monitoring of individual program sources (Microphone, AM/FM Tuner, Tape or CD) and distribution by the Control Console.
10. Control Console programming of administrative microphone for control and distribution of public announcements, to eliminate the need to go to the central electronics for microphone set up. Keying the microphone shall automatically mute all other audio programs at a lower priority in the system, including Local Audio Systems (emergency pages only). Microphone shall transmit to all rooms or specific speaker zones as programmed in the system software.
11. The capability of multiple open-voice intercom paths. Intercom paths shall be global.
12. Automatic gain-control of intercom speech to assure constant speech level.
13. Automatic sounding of a warning tone over any loudspeaker selected for two-way communications to alert the classroom teacher to an incoming announcement.
14. A minimum of two channels for intercom communications or audio program distribution. The System shall be user-programmable to allocate, upon demand, either of the two channels for intercom or audio program.
15. The ability to monitor the school building either on or off the premises from a single telephone.
16. Audio program distribution to eight different areas of the building selected by the Control Console and Visual Console. Inputs shall be provided for five (5) low-impedance microphones, tuner, tape player and auxiliary source. Program material shall include audio programs from standard AM/FM tuner, tape deck, CD player, or auxiliary source. Control Console and Visual Console shall have the ability to monitor program sources being distributed. Coordinate location of antenna(e) with architect. Locate and install for optimal performance.
17. Audio Source equipment shall have the ability to be located remotely from the main system control electronics, and shall have the ability to distribute two channels of audio simultaneously if so desired. School shall be equipped with (1) rack-mounted AM/FM tuner, (1) rack-mounted cassette tape player, (1) rack-mounted CD player.
18. RS232 Input/Output Interface, Personal Computer, LAN/WAN, Modem, and Printer for monitoring activity within System and for displaying and printing system management information. System shall perform diagnostics, or logging transactions either on or off premises.
19. The ability to interface to the power supplies of door strikes provided by others, to allow remote control of door strike through the paging system.
20. Time Signal tones of an integrated Master Clock System to be distributed throughout zone(s) selected for time signaling over programmed loudspeakers on a manual or automatic basis.
21. Power amplifiers that provide a minimum power capacity of 2 watts per cone speaker location and Door Signaling device plus 15 watts of power per horn type speaker locations.



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22. Cabling that is specified by the manufacturer, which provides shielding of conductors so that the Public Address System does not interfere with the Telephone Systems and Telephone System cabling.
  23. The system must be compatible with a structured cable plant with MDF and IDF and CAT5, CAT5e or CAT6A cabling.
  24. Classroom components (including a speaker, clock and elapsed time controller) may all be connected to the system via a single CAT5, CAT5e or CAT6 cable drop for each classroom/location to either the MDF or IDF in a Networked solution.
  25. Pre-announce tones will alert the listeners of incoming calls with distinct tones for each priority level. To prevent unauthorized monitoring, the tone will sound whenever an area is being monitored, and will repeat at regular intervals. Facilities shall also be provided to defeat the tone repeat function from the administrative console if it is not desired.
  26. Emergency and All Call paging and a minimum of 32 zones of group paging. The paging zones shall be independent of the time tone and audio program distribution zones and a minimum of 8 clock messaging zones and 5 microphone zones. Systems sharing zones for both paging and tone shall not be acceptable.
- F. The system shall be capable of monitoring 32 different sections of the building, either on the premises from a control console, or off premises from a telephone instrument.
  - G. Distribution of paging announcements can be made from any administrative control console, visual console, telephone, or dedicated microphone set-up.
  - H. Emergency announcements shall have the highest priority over any other system function and seize all system loudspeakers regardless of their current mode of operation.
  - I. System shall support general announcements made from a conventional microphone to facilitate reading a script and the participation of multiple announcers. Keying the microphone shall automatically mute all other audio programs at a lower priority in the system and transmit the microphone audio to all buildings or specific speaker zones, as programmed into the system software.
  - J. System will provide Emergency and All Call Paging and a minimum of 32 zones of group paging. The paging zones shall be independent of the tone signal and audio program distribution zones.
  - K. Pre-announce tones will alert zones of incoming pages with distinct tones for each priority level.
  - L. The system must have the capability of distributing audio program sources from any administrative telephone or authorized building telephone. Program distribution shall be accomplished on an all zone, selected zone, or individual zone basis.
  - M. The system shall support the automatic distribution of tone and up to 63 character text signals to all selected areas.
  - N. The system shall support a minimum of 1536 events and 16 schedules. Building zones shall be used to select which areas receive the tone. They must be totally independent from page zones and program zones and clock messaging zones.
  - O. All signal programming shall be accomplished from a PC utilizing a standard web browser. The system shall support running all time schedules concurrently. Selection of appropriate schedule



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for the day shall be accomplished via the Administrative Console or the GUI. Daily default schedule shall be selected during programming.

- P. The duration of the tone, as well as frequency, burst length and output level shall be software programmable from a web browser.
- Q. All system tones shall be user-programmable for the following durations in seconds: 2, 3.5, 5.6, 8, 10, 12.
- R. The system shall be capable of an open-voice intercom path used for monitoring, emergency paging, and intercom.
- S. Corridor speakers, and outside horns in each building shall be combined into groups of owner's preference. There must be 32 independent software paging zones that each circuit may be a part of. Each individual circuit must also have the ability to be paged independent of the software zones.
- T. Station wiring shall be connected to the system using insulation displacement connectors to allow quick disconnection of field cables from the System terminal boards.
- U. All user-programmable data shall be stored in a non-volatile FLASH memory to prevent memory loss during a power failure. Systems that use EEPROM chips for system memory will not be accepted. The CPU must have dual partitioned FLASH memory capable of storing the CURRENT Firmware and allowing for any and all updates to be loaded onto the NEW side of the FLASH memory so as not to lose CURRENT Firmware in the case of a power outage or other situation that may happen during a system Firmware update. The system must also be capable of a system restore to the CURRENT firmware in the case of an incomplete or failed firmware update. The system time clock shall be capable of maintaining correct time for a period of 14 days in the event of a power failure. It shall be possible to return the system programming to the original factory default setting by keying a special code from the Console.
- V. The user shall have the capability to change system programming for all paging functions, bell functions, and clock functions. The Owner shall be provided with the required training, documentation, and software to accomplish these functions.
- W. The system shall be connected to a (owner-provided) Ethernet network port using the TCP/IP protocol. Provide patch cord of sufficient length to connect the head end equipment to the owner provided network switch in the MDF. This must be capable from a direct Ethernet connection on the CPU to the network, if the owner chooses to connect to the network this way.
- X. The user-interface shall support user names and passwords. There shall be multiple levels of access allowed. Some users may have view privileges only while others may edit their site. All editing shall be by means of the Web Editor or programming software. This user-interface must also contain a "one button remove" feature to be able to delete users out of the system with one click of this button on the interface.
- Y. The program shall also serve as part of the documentation process. Page Zones and bell schedules shall support user-definable names and display as pick lists when editing the configuration.
- Z. Diagnostic functions shall be accomplished through any PC connected to the school network and provided with the proper authorization and diagnostic software. Any off-site PC shall have access to the system for diagnostics through the use of the public internet, provided that they have been granted proper authorization and have been provided diagnostic software.



## BUILDING EXCELLENCE

- AA. Although the system is programmed through a PC interface, the system shall not have to rely upon a personal computer for day-to-day operation. All programming information shall be loaded into the XL system allowing independent operation of the system.
- BB. Provide a -1dB balanced audio line-level output from the public address system to each local sound system and provide equipment as required for emergency pages to over-ride the local sound systems. Coordinate with the owner prior to installation during paging zone identification.
- CC. The final copy of the program and the configuration of data files shall be provided to the school in electronic format.
- DD. Provide Microphone for general announcements: unit shall be a hand-held microphone device with a table stand. Contractor shall use XLR type connectors and West Penn 2529 cable or approved equal between the front office location and the Public Address microphone interfaces. Locate microphone and cabling at one of the three A3 faceplates, coordinate location with Owner. Use open ports for VES cabling in A3 faceplate and terminate XLR connector to cable, not faceplate.
- EE. Wire panic button switches (PB symbol on drawings, provided by 28 13 00 contractor) to PA system for contact closure input. Upon contact closure, PA system shall initiate a lockdown sequence, as specified by owner. Coordinate lockdown events with owner (tone, messaging display (removed), etc.) and provide programming to accomplish lockdown procedure which may or may not include integration to owner provided Access Control, CCTV or any other systems as required by owner. Conditions shall also be capable of being actuated by ICON(S) located on the GUI.
- FF. Unspecified Equipment and Material. Any item of equipment or material not specifically addressed on the Drawings or in this Document and required to provide a complete and functional installation shall be provided in a level of quality consistent with other specified items.
- FF. CALL BUTTONS- The system must be capable of utilizing supervised normal and emergency call buttons in all locations shown on the drawings. The system must be capable of displaying shorts or opens on call switch circuits. The trouble indication shall display on the administrative console, be capable of being silenced and annunciate again in 24 hours if problem has not been fixed. This trouble should not be able to be cleared until the wiring issue has been fixed.

### GG. LOUDSPEAKERS, BAFFLES, AND BACKBOXES

1. Speaker/Baffles: Provide backboxes to electrical subcontractor for installation.

- a. As indicated on plans (SP), provide a ceiling mounted round speaker and baffle assembly. The baffle shall be 12-7/8" in diameter and 3/8" deep. The circular design shall match the room ceiling tiles.
- b. Baffle shall be constructed of 22 gauge, cold rolled steel, coated with a baked on white powered epoxy that is resistant to scratches.
- c. Holes in the baffle shall allowing mounting to speaker backbox.
- d. Room speakers must allow hands free talk back when room is paged.
- e. Speakers must meet the following:
  1. Type: Flush mounted 8" cone
  1. Frequency Response: 50 to 18,000 Cycles
  2. Magnet: 6 oz.
  3. Axial Sensitivity 95 dB at 4 ft. with 1-watt input
  4. Telecor STB-11 Speaker/Transformer/Baffle Assembly with T8 Support Bridge and H8 Enclosure as required or equal.



## BUILDING EXCELLENCE

2. Provide Volume attenuators where shown on the drawings (A symbol in a circle) to adjust the volume of the local PA speaker.
3. Horn Speakers: Indoor/Outdoor (External Building PA Speakers (as shown on technology drawings ES (recessed, enclosed), Internal PA Speakers for the Gymnasiums (as shown on technology drawings FS, recessed with protective enclosures)
  - a. Double re-entrant type: flush mount installation.
  - b. Frequency Response: 600 to 14,000 Hz.
  - c. Power Handling: 15 Watts RMS, 30 Watts Peak.
  - d. Variable screw taps, 25 V transformer
  - e. Sound Pressure Level: 110 dB at 1 meter with 1-watt input
  - f. Color: Coordinate with Architect.
  - g. Atlas/Soundolier APF-15T Horn Speaker with 193-8-6 backbox (9-5/8" Sq X 6" Deep) and VP-161APF Speaker Baffle or equal.

### HH. ADMINISTRATIVE PHONE- MCC-300

Administrative phones shall be installed in all locations indicated on the drawings. The administrative phone shall be wired with a single Cat 5 cable and be hot swappable. The administrative phone must have alphanumerical display built in. Administrative phones with optional mounted displays are not acceptable. The system must be able to have a capacity of 32 total administrative phones as a minimum. You must be able to be able to perform programming of the system from the administrative phone without a computer when required.

### JJ. INTERFACE WITH REMOTE SPEAKER SYSTEMS

1. The system will interface and override local use of remote audio systems in the following locations:
  - a. Student Dining
  - b. Gymnasium
  - c. Auditorium Control Room
  - d. PE Alternatives/Fitness Center
  - e. Lecture Hall
  - f. Multi-Purpose Building

### KK. TELEPHONE INTERFACE

1. Contractor must provide system interface and connection to the Owner's telephone system (Provided by Owner). Provide all equipment and cabling necessary to connect and integrate system to the phone system.
2. Each trunk shall be programmable as either incoming, or outgoing, or both.
3. For incoming trunks, system shall be able to direct calls to a user-defined attendant telephone or provide dial tone. For outgoing trunks, system shall provide access to the trunk by dialing 8, 9, or both. If digit 9 is used to access an outgoing trunk, the system shall be able to automatically dial a second 9.
4. Each trunk shall be loop start.
5. Intercom contractor must coordinate telephone interface with Owner's telephone contractor.

## EXECUTION

### 3.1 INSTALLATION

- A. Provide and install Sound Reinforcement System in the Cafetorium and Gymnasium as required. All rack mounted equipment and their controls shall be labeled with 1/4"



## BUILDING EXCELLENCE

lamicoid strips engraved with 1/8" high block letters indicating device operation and level of control function. Verify exact location of equipment racks and remote source control panel with Architect and HISD prior to rough-in.

### 3.2 TESTING AND ACCEPTANCE

#### A. General

1. After completion of installation and start up procedures, commence a verification and testing sequence leading to final acceptance of the owner.
2. Submit for approval, a sample of the form on which the test will be reported.
  - a. Identify project
  - b. Signatures of participants and observers
  - c. Results
  - d. Description of adjustment or corrections of defective components.
  - e. Date
3. Provide schedule of tests. Estimate dates of significant events.
  - a. All testing shall be performed in the presence of the Owner/Architect/Engineer.
4. Test, calibrate and adjust each device in the system
5. Verify operation of all specified functions.
6. Provide documentation of all tests and verifications as specified.

#### B. The following tests and adjustments shall be performed by the Contractor. All equipment required supplied by the Contractor. Follow EIA standards RS-160 and RS-219 in performing tests. Record the results of these tests on project record drawings. Submit written results of tests to Architect prior to scheduled equalization and final inspection date.

1. Measure and record impedance of each speaker line terminating at equipment racks at frequency of 1,000 Hz. with loud speakers connected to their respective lines.
2. Check system to ensure freedom from oscillations or stray RF pickup. Check inputs with no signal and with typical program material driving system to full output. Detect unwanted signals.

### 3.3 INSTRUCTIONS

- #### A.
- Provide 2 hours, 1 hour on each of two days, of instruction to the Owner designated user and maintenance personnel on the use and operation of the system. Instructing personnel shall be a competent engineer or technician familiar with the installed system. Instruction times shall be arranged by the Owner.

### 3.4 ACCEPTANCE BY OWNER

- #### A.
- Upon completion of initial tests and delivery of all documents, diagrams, and project record drawings, notify the Architect in writing that the installation has been completed in accordance with the requirements of the specification and is ready for equalization and inspection by representatives of the Owner.
- #### B.
- Acceptance testing will include operation by the Owner of each major system and other components (microphones, consoles, racks, loud speakers, etc.) deemed necessary. Contractor will assist as necessary in this testing.
- #### C.
- In the event the need for further adjustments or work becomes evident during acceptance testing, the Contractor will continue his work until the system is acceptable, at no additional cost to the Owner.

**END OF SECTION**





**SECTION 28 05 00**

**ELECTRONIC SAFETY AND SECURITY COMMON WORK RESULTS**

**GENERAL**

**1.1 SECURITY SYSTEM DESIGN REQUIREMENTS:**

- A. Security drawings to be on separate plans from any other building systems.
- B. 100% Design Development Milestone Requirements:
  - 1. Locate all room locations that will house security panels and headend equipment.
  - 2. HISD Alarm Communications shall receive pdf versions of floor plans detailing system information, equipment locations and headend closet layouts.
- C. 60% Construction Document Milestone Requirements:
  - 1. Locate all security device locations, door contacts, motion detectors, security cameras with lens information.
  - 2. Locations of all security keypads, control panels, expansion modules and power supplies. Include mounting heights of all devices.
  - 3. Specifications detailing manufacturers and product numbers of devices to be installed.
  - 4. HISD Alarm Communications shall receive pdf versions of floor plans detailing system information, equipment model numbers, equipment locations and headend closet layouts.
- D. 100% Construction Document Milestone Requirements:
  - 1. All device and equipment locations as listed in previous design submissions above.
  - 2. Detailed risers and equipment room layouts for all security equipment to be installed.
  - 3. Complete and detailed specifications indicating product information and installation requirements.
  - 4. HISD Alarm Communications shall receive pdf versions of floor plans detailing system information, equipment model numbers, equipment locations and headend closet layouts.

**1.2 SECURITY CONTRACTOR REQUIREMENTS:**

- A. Intrusion Detection System Contractor Requirements
  - 1. Responsible for complete installation of all security devices, wiring and commissioning of security systems.
  - 2. Provide all programming of security systems and devices.
  - 3. Provide training for all systems installed.
- B. Furnish and install interim monitor at BCR to verify camera views. Contractor is responsible to remove the interim monitor from closet once all camera views have been configured and are complete.
- C. Security Camera Equipment Furnished and Installed by District
  - 1. HISD will furnish and install multiplexer at BCR telecommunication room where DVR equipment will be installed. HISD will provide and install server racks, DVR equipment, DVR recording software, UPS equipment, coax patch cables from DVR to multiplexer, KVM switcher, keyboard/mouse/monitors and all client computers and software required to operate camera system.
- D. Security contractor qualifications:
  - 1. Minimum of five years experience in security industry under current proposer's name.
  - 2. Certified by the manufacturer of all the components they are installing.





## BUILDING EXCELLENCE

3. Submitting contractor must be certified to install products and services for system they are proposing. No subcontract of services will be allowed for any security scope of work.
4. Provide 24 hour support, 7 days a week within 2 hours during normal business days and 4 hours during non-business work hours.
5. Licensed in the state of Texas.
6. Provide a reference of at least three other projects similar in size to current work scope.

### 1.3 SECURITY INSTALLATION REQUIREMENTS:

- A. Cabling Installation
  1. Support wiring every 5'-0" on center, in 4" bridle rings, with no more than 12" cable sag between supports and without over tension of cables.
  2. Label cabling with machine labels 18" of each end of cable keyed to the door, room, or corridor number.
  3. Group cabling according to signal or power levels.
  4. At headend rack, group power cables on one side of rack and coax cables on opposite side of rack.
  5. Provide service loops at all cables and use Velcro tie wraps at all closet locations. Provide tie wraps at 4' intervals maximum and dress in neat orderly fashion.
  6. Do not run cables above red iron joist.
  7. No splices in any cables less than 500' in length.
  8. All exterior exposed coaxial cable shall be contained in waterproof flexible conduit with appropriate fittings.
  9. Provide waterproofing and fireproofing of all sleeves and openings as required.
- B. Security contractor is responsible to coordinate with the project electrical contractor on all power and raceway requirements for project.
  1. Install 3/4" conduit with bushings for all exterior penetrations from device to nearest available above ceiling location.
- C. ***At all corridor doors leading to the building's exterior, provide motion sensors in lieu of door contacts.***
- D. ***At all exterior pole mounted security cameras, provide a clear unobstructed space for maintaining and servicing the devices. No pole shall be above 12'-0".***

### 1.4 ***Add conduit and a tamper switch with a bell for the fire vault.***

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<a href="#"><u>28 13 00</u></a>	Access Control and Intrusion Detection System	VERSION 3.0
<a href="#"><u>28 23 00</u></a>	Security Camera Systems	VERSION 3.0
<a href="#"><u>28 31 00</u></a>	Fire Detection and Alarm	VERSION 3.0

## EXECUTION

### 3.1 RACEWAY AND POWER

- A. Provide a complete raceway system and electrical branch circuits to serve all security system equipment.
- B. Connect all security equipment to emergency generator backed power source.

## END OF SECTION



## BUILDING EXCELLENCE

### SECTION 28 13 00

#### ACCESS CONTROL AND INTRUSION DETECTION SYSTEM

##### GENERAL

###### 1.1 WORK INCLUDED

- A. The Contractor shall furnish and install a complete microprocessor based security alarm system as specified herein. The system shall include, but not be limited to, all control equipment, power supplies, power circuits, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.
- B. Security system devices indicated are for reference and coordination purposes only. The installing contractor shall design and provide a complete system, meeting the requirement of specification. The Contractor shall provide all security system devices required for complete system perimeter coverage acceptable to all governing authorities, Architect and Owner.
- C. The system shall include security for all access into building, including but not limited to doors, roof hatches, windows and interior space motion detection. Card reader access interface must also be provided at locations noted.
  - 1. The Control System shall be Napco Gemini X-255. No Substitute.
  - 2. All cables shall be clearly marked/labeled at each end and identified clearly on as-built drawings.
  - 3. Installation of security panels.
  - 4. Interconnection of security panels.
  - 5. Installation of new security devices.
  - 6. Full coverage of all windows, doors, roof hatches.
  - 7. Preconstruction meeting with Owner's personnel, installing technician and project superintendent.

###### 1.2 Contractor Qualifications:

- A. The installing contractor shall be the authorized representatives of Continental Instruments, Napco Security Group and Salient Systems.
- B. Manufacturer to sell, install, and service Continental Instruments, Napco Security Group and Salient Systems. The installing contractor shall have represented the security alarm and Access control system manufacturer's product for at least two years.
- C. The installing contractor shall provide 24 hour, 365 day per year emergency service with factory trained service technicians.
- D. The installing contractor shall have personnel on their staff that has been actively engaged in the business of designing, selling, installing, and servicing security alarm systems for at least ten years.
- E. All Contractors must submit to the owner prior to starting any work the factory training certificates for all personnel that will be working on the Continental Instruments, Napco Security Group and Salient Systems. No person is allowed to work on the system without proper manufacturer's certification.

##### PRODUCTS

###### 2.1 ACCEPTABLE MANUFACTURERS AND INSTALLERS

- A. For any product numbers or manufacturers listed have been discontinued and are no longer available, Contractor shall submit a list of substitute equipment/parts to HISD Alarm Communications for written approval, prior to installation.
- B. Equipment
  - 1. Access Control System shall be manufactured by Continental Instruments, no exceptions.



## B U I L D I N G   E X C E L L E N C E

2. Security contractor must be licensed security contractor and authorized representative of Continental Instruments and submit copy of current license in submittals.
3. Contractor submitting and installing the work shall be the authorized Continental Instruments contractor, no subcontracting this scope of work.
4. Install main access control panel in BCR. Secondary panels may be installed in FCR if floor plan layout is too large to support system from one location.
5. Use only Turbo Superterm Panels (eight door panel). Owner already has licenses for panels or Accelaterm control panel.
6. Provide minimum of (1) – 8 door intelligent reader control panel, model ~~#CICP2800T~~ ~~#CICP1800T~~. Provide additional 8 door modules per number of card reader controlled doors for project.
7. ~~Provide Lantronix device for remote networking on all new installations.~~
8. Access control contractor will perform any programming necessary to complete system, within HISD Alarm Communication standards.
9. All programming will be completed per campus graphic number package.
10. ~~Access control contractor will provide and install all necessary software on HISD workstation.~~
11. All card readers shall be model #5365EGPOO HID Readers, no exceptions.
12. ~~Provide minimum of (125 per elem, 250 per ms, 400 per hs) Continental Instruments access cards per campus. Contact HISD Alarm Communications for serial number version information before ordering cards.~~
13. Each door setup should contain one door contact, one reader, one door strike, one request to exit motion detector and one junction box with terminal strip at the door to be used as a test point for all devices at that door. Junction box shall be Mier products, #BW108.
14. Use a composite cable from panel to junction box.
15. Use an external power supply at head end, do not use internal power supply on main board for strike power or request to exit motion.
16. Magnetic locks are not to be installed in HISD unless pre-approved by HISD Alarm Communications.
17. Power supplies shall be Altronix, model #AL1024ULACMCV to power door strikes and request to exit motion devices.
18. At power source for control panel, contractor to provide Mier #BW210, beige in color, instrument box over receptacle.
19. Motion to exit devices shall be Bosch, #RTE model #DS160 motion request.
20. Door strikes at exit doors shall be HES #9400 or HES #9600. If electric panic bars are needed, install Sargent Series 80, 24v low current type. Do not use high current electric panic bars which require a power supply at the door location unless pre-approved by HISD Alarm Communications. No Exceptions.
21. Contractor is required to setup and attend a pre-installation meeting between installing contractor and HISD Alarm Communications Dept. Meeting must be held prior to any wiring or installation of security equipment has been started.
22. Card readers are recommended to be installed at the following locations:
  - a. Elementary Campus:
    - a) Main front door entry. Note – additional vestibule doors may be required to receive card access to secure admin area depending on layout.
    - b) Kitchen back door
    - c) Entrance from faculty parking lot
    - d) Entrance from playground area
    - e) BCR headend technology room
    - f) Exterior entrance to main mechanical room in central plant
    - g) Plant operator entrance



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- h) Entrance from site temporary buildings
    - i) Entrance from annex buildings
  - b. Middle School Campus:
    - a) All locations listed for Elementary Campus
    - b) Entrance from athletic fields
    - c) Entrance to main athletics area
  - c. High School Campus:
    - a) All locations listed for Elementary and Middle School Campus
    - b) Entrance to Visual Arts Learning Center area
- 23. Card readers shall be placed on the right side of the door as you enter door from the outside unless placement cannot be made. For all pairs of doors, the right hand door as you face from the outside shall be the door tied to access control system.
- 24. All final walkthru's of complete installation and delivery of spare or accessory products must be scheduled and signed off by HISD Alarm Communications. All final delivery of products must have a sign off receipt from contractor to HISD Alarm Communications and signed receipt of delivery included in close out documents.
- 25. Provide Aiphone, #AX084C Series remote door release system per campus. Provide and install remote release button at Reception Desk, Principal Secretary Desk and Principal Desk. Install Aiphone #AX-DV-P door call station at front entry and faculty entrance location. Aiphone interface to act as card reader interface for selected door. Mounting height shall be 5 feet.
- 26. Provide battery backup on control panels and power supplies.
- 27. All doors shall be installed and configured for "fail secure" operation.

### 2.2 INTRUSION DETECTION SYSTEMS

- A. For any product numbers or manufacturers listed have been discontinued and are no longer available, Contractor shall submit a list of substitute equipment/parts to HISD Alarm Communications for written approval, prior to installation.
- B. System Monitoring and Performance
  - 1. HISD will monitor all panels 24/7 via internet network connections in panels. Secondary monitoring will be provided by HISD via internal radio system and telephone communications as backup monitoring and notification. All panels and termination points of system will be in BCR and FCR rooms along with maintenance rooms as indicated on drawings.
- C. Intrusion Detection System Equipment Door contacts
  - 1. Provide at all roof scuttles, kitchen and pantry doors, band equipment storage doors, exterior roll-up doors, swimming pool doors and all ROTC doors. Provide door contacts on exterior mechanical room and/or electrical room doors that only have outside exterior access.
  - 2. All door contacts shall be recessed in door frame whenever possible and shall match color of door frame.
  - 3. Install Sentrol model #1078-CM for recessed applications.
  - 4. Steel door contacts should be Sentrol #UTC2505AL
  - 5. All doors shall be addressed separately. Double doors to be wired in series and identified as single zone.
  - 6. Provide surface mounted raceway for any exposed security wiring required to connect device.
  - 7. Wiring shall be 22 gauge, two conductor, unshielded stranded cable, white in color, plenum rated. West Penn, General or Coleman are acceptable cable products.
  - 8. Do not exceed 500' from device to intrusion alarm expansion module or alarm control panel. Locate expansion modules in FCR rooms.



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- D. Motion Detectors
1. Napco C-100 STE shall be installed within administration offices, first floor spaces with windows, swimming pool space, ROTC room, all locker rooms, auditoriums, Visual Arts Learning Center and performing arts rooms, science learning center/wet labs and automotive and machine shops, computer labs, art rooms and vocational/specialty learning centers.
  2. Wall mounted on swivel base.
  3. Provide surface mounted raceway for any exposed security wiring required to connect device.
  4. Install Napco #C100STE for standard locations, Protech #SDI-77XL2 for pool area locations, minimum two per pool area.
  5. Corner / wall mount motion detector for 30'x35' range is Napco C100STE. For 50'x45' range, provide Napco C100STLRE model. For long hallways, provide Rokonet #RL17 - 10'x80' range.
  6. ***A motion sensor should be added at all entrances that lead to hall corridors in lieu of door contact.***
- E. Keypads
1. Install in administration office area, plant operator's office, main staff entrance boys/girls coaches offices, instrumental learning center/vocal music learning center rooms, ROTC and swimming pool area.
  2. Install Napco RP1CAE2 at 52" 60" aff, provided with clear Plexiglass vandal proof housing, Stopper #STI-6560 or pre approved equal. Provide clear space in front of keypad for accessibility.
  3. Keypad for the pool area shall be outside of actual pool room area.
  4. Wiring shall be 18 gauge, four conductor, stranded cable, white in color, plenum rated. West Penn, General or Coleman are acceptable cable products.
  5. Do not exceed 500' from device to intrusion alarm expansion module or alarm control panel.
- F. Equipment
1. Alarm controller shall be Napco GEM X255 with Napco GEM X255 enclosure. Tamper switch and bracket shall be Napco GEM X255. Battery shall be a minimum 12volt 8 ah.
    - a. Alphanumeric characters will identify alarm zones. "R" for room, "D" for door and "C" for corridor followed by a dash and the designated alphanumeric character of the building area, followed by the number. (ex: C-by-room 124 is a corridor in building section B and its corridor #124 or simply "Corridor B124".
    - b. Coordinate zone programming of devices with HISD Alarm Communications prior to programming system.
  2. Power supplies shall be Altronix ~~#SMP10PM12P8CB~~ AL600ULACMCB.
  3. Install tamper switch to building Key Safe locations. Wire as zone #1 directly back to main control panel, no splices. Safe provided by Owner and installed by General Contractor.
  4. Install 18 gauge, 6 conductor cable for backbone wiring between panels.
  5. ~~TCP/IP Interface Module shall be Napco NLModul.~~
  6. Zone expansion module shall be Napco GEM3008.
    - a. ~~Install (2) 22/4 wiring from control panel to AES Intellinet module #7650.~~
  7. ~~AES long range radio (7460) interface modules shall be provided to link the Napco GEMX255 control panels to the AES IntelliNet transceivers (transceiver provided by HISD).~~
    - a. Mount below ceiling in Administration area on exterior wall.
    - b. ~~Install (2) 22/4 wiring from control panel to AES Intellinet module #7650.~~



## BUILDING EXCELLENCE

8. All final walkthru's of complete installation and delivery of spare or accessory products must be scheduled and signed off by HISD Alarm Communications. All final delivery of products must have a sign off receipt from contractor to HISD Alarm Communications and signed receipt of delivery included in close out documents.
9. Install battery backup for control panel and power supplies. No glass break detection and all motion sensors shall be corner wall mounted (no exceptions).
10. No ceiling mounted detection sensors shall be installed (no exceptions).

### EXECUTION

#### 3.1 INSTALLATION

- A. All wire shall be UL Listed CL2 for limited energy (300V) applications and shall be installed in conduit. Limited energy MPP wire may be run open in return air ceiling plenums provided such wire is UL Listed for such applications and is of the low smoke producing fluorocarbon type and complies with NEC Article 760 if so approved by the local authority having jurisdiction.
- B. No branch circuit or 120V power wiring or any other wiring shall be run in the same conduit as security alarm wiring.
- C. All wire shall be installed in an approved conduit/raceway system (except where permitted by NEC and the local authority having jurisdiction). Maximum conduit "fill" shall not exceed 40% per NEC.

#### 3.2 TESTING

- A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner, Engineer, Electrical Contractor and performed by the equipment supplier. Final test report must be received and acknowledged by the Owner prior to substantial completion.
- B. Provide instruction as to proper use and operation of system, for the Owner's designated personnel.

#### 3.3 SOFTWARE

- A. Provide two electronic copies of the final programming and program software to the Owner's Security Supervisor after final approval.

### END OF SECTION





## BUILDING EXCELLENCE

### SECTION 28 23 00

#### SECURITY CAMERA SYSTEMS

##### GENERAL

##### 1.1 DESCRIPTION OF WORK

- A. Provide a complete system of surveillance cameras for all HISD facilities.

##### PRODUCTS

##### 2.1 GENERAL

- A. CCTV Field Specifications Security Camera System Equipment
1. Field Hardware Cameras
    - a. Analog Equipment ~~Do not install any IP Cameras or pan/tilt/zoom (PTZ) cameras, fixed only.~~
      - 1) Analog camera
      - 2) Coax cabling (RG59 cable for analog cameras)
      - 3) RG59 patch cable
      - 4) Wall mount coax patch panel (BNC RG59 patch panel for analog cameras)
      - 5) Wall mount patch panel swing arm rack (for BNC RG59 patch panel)
      - 6) Coax patch cable (BNC RG59 patch cable for analog cameras)
    - b. IP Equipment ~~Indoor cameras vandal proof SPEC0 HT649H NUV CT-2M-D21-BH with NUVWMB CA-WP100-B or CA-WM100-B-EA-WM300 SPEC0 INTWM wall mount and outdoor cameras SPEC0 HT672H NUVCAOM SPEC0 INTWM EA-WM200 shall be NUVICO Domes with IR illuminators or pre-approved equal.~~
      - 1) IP Camera
      - 2) Altronix IP over coax transceiver – 1 camera
      - 3) Category 6 patch cable
    - c. ~~All cameras mounted less than 9'-0" shall be installed in vandal resistant housings and wall mounted.~~
    - d. ~~All office areas to receive dome ceiling mounted cameras.~~
    - e. ~~Stairs, elevators and multi-purpose rooms shall use NUVICO NUVCVSD2INL with NUV CAOM bracket vandal resistant domes.~~
  - B. Security Camera System Equipment
    1. Cameras
      - a. Do not install any IP Cameras or pan/tilt/zoom (PTZ) cameras, fixed only.
      - b. Indoor cameras shall be vandal proof Interlogix Truvision: TVD4404.(Indoor Dome), TVD4406 (Outdoor Dome), TVD-M2-WM (Wall Mount).  
Avycon: AVC-DT92VLT (Indoor Dome), AVC-VT92VLT (Outdoor Dome)
      - c. Parking lot cameras shall be Avycon: AVC-VA92SVLT50 (outdoor Dome).
      - d. All cameras mounted less than 9'-0" shall be installed in vandal resistant housings and wall mounted.
      - e. All office areas to receive dome ceiling mounted cameras.
      - f. Stairs, elevators and multi-purpose rooms shall use NUVICO NUVCVSD2INL with NUV CAOM bracket vandal resistant domes.





## BUILDING EXCELLENCE

2. Camera Power Supplies shall be 24v AC to support 16 cameras and be installed in BCR room location, Altronix AL624.
  3. HISD will provide and install digital video recording equipment-remote PC-based.
  4. Local DVR looping shall be mounted in BCR as standard and can be mounted in FCR locations with approval from HISD to reduce cabling distances. Mount DVR in standard 19" rack. Final patching from local DVR to remote DVR will be done by HISD.
  5. HISD will provide and install UPS equipment.
  6. The installation of a weatherproof surface mounted single gang service box is required on all outside cameras (installed below camera) and on the inside cameras (installed above camera) where there is not a dropped ceiling. This service box is for testing of video and power cables.
  7. ***For all canopy and exterior cameras and cabling, use outdoor-rated cables in conduit.***
- C. Typical Camera Quantities (based on building design and layout) per Building Type
1. Numbers listed below are the typical number of cameras based on school type. ***Specific number of cameras should be designed for specific site conditions and are deemed necessary by HISD Program Manager.*** Design of camera layout must comply with areas of coverage listed below and depend on overall school layout and function of campus. Review placement and number of cameras with Owner prior to project being issued.
  2. Elementary and Pre-Kindergarten Centers – ~~32~~ 64 cameras.
  3. Middle Schools – ~~64~~ 96 cameras.
  4. High Schools – ~~96~~ 180 cameras.
- D. Areas Requiring Video Surveillance
1. All Building entrances from exterior into corridors, provide interior camera near entrance to focus on face of person entering, with additional corridor camera viewing door and length of corridor from a distance.
  2. Corridors to be covered with camera layout overlapping 75' maximum per camera.
  3. Student Dining Commons and Multi-Purpose Rooms area shall receive two (2) cameras minimum in tamper resistant housing.
  4. Restroom entrance/exits shall be covered from both sides of corridor longitudinally to view faces of persons entering or exiting restrooms.
  5. Computer labs to receive cameras to monitor equipment in case of theft.
  6. Video Conferencing Lab to receive camera to monitor workstation, podium and related A/V equipment.
  7. Gymnasiums shall receive two (2) cameras minimum, one (1) on each end, installed in opposite corners of gym.
  8. Provide camera in the main reception area.
  9. Learning Commons shall receive cameras to view circulation desk, entry/exit to Learning Commons and media area.
  10. Exterior cameras to monitor parking areas, playground areas, bus loading/unloading and kitchen delivery entrance.
  11. Each campus shall be allowed to select placement of 10% of the total camera count to address specific items related to that campus.
- E. Security Camera Cabling- ***verify with HISD the latest cabling technology to be installed.***
1. ~~CAT 6 UTP for video cabling to camera for runs over 500 feet and Standard RG cabling up to 500~~ 1000 feet. ~~Violet in color and plenum rated.~~ Berk-tek and Draka acceptable manufacturers. No. Cat 6 cabling. White cable is acceptable and plenum rated.



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2. Camera power cable shall be 18 gauge, 2 conductor unshielded stranded plenum rated white in color. West Penn, General and Coleman are acceptable manufacturers.
  3. Contractor to provide and install coax patch cables from multiplexers to DVR equipment (both sets).
  4. Terminate all camera coax cables at BCR on wall mounted patch panel behind camera DVR rack at 64" aff.
  5. Within 10'-0 of each end of security video cabling, contractor to install plenum rated, RG59 white in color to convert UTP device to coaxial connection. Install BNC connectors on each end.
  6. In cases where cat 5 cabling is used, provide individual videobalun (BL4865 or BL3265) at camera and at head end.
- F. All final walkthrough's of complete installation and delivery of spare or accessory products must be scheduled and signed off by HISD Alarm Communications. All final delivery of products must have a sign off receipt from contractor to HISD Alarm Communications and signed receipt of delivery included in the close out documents.

### EXECUTION

#### 3.1 INSTALLATION

- A. Cable Support: all wire not installed inside conduit or a designated cable tray system shall be installed in a dedicated cable support system for the entire run of each cable.
- B. Do not install wall mounted cameras into metal fascia. Ensure they are mounted into brick, and sealed top and sides (not bottom).
- C. Cabling between wiring closet and camera locations shall be made as individual home runs. No intermediate splices may be installed or utilized between the wiring closet and the camera location.
- D. Cameras routed to an FCR w/RG59 coaxial cable, then routed from the same FCR to the BCR must be transitioned using a 25-pair cable w/ video baluns.
- E. All camera servers will be located inside of the BCR and not the FCR.
- F. Contractor is responsible to run and connect cable to DMR.
- G. All video cables shall be run to a BNC wall bracket before connecting to DMR.

#### 3.2 CABLE TESTING – BY MANUFACTURER'S REQUIREMENTS

- A. Notification: The Owner/Architect/Engineer shall be notified one week prior to any testing so that the testing may be witnessed.
- B. Final Acceptance: Before requesting a final acceptance, the Contractor shall perform a series of end-to-end installation performance tests. The Contractor shall submit for approval a proposal describing the test procedures, test result forms and time table for all copper and fiber optic cabling.
- C. Procedures: Trained personnel shall perform all testing. Acceptance of the test procedures discussed below is predicated on the Contractor's use of the recommended products and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation shall be evaluated in the context of each of these factors.
- D. Errors: When errors are found, the source of each error shall be determined, corrected and the cable retested. All defective components shall be replaced and retested. Retest results must be entered on the test results form. All corrections shall be made prior to final acceptance test.

### END OF SECTION



## SECTION 28 31 00

### FIRE DETECTION AND ALARM

#### GENERAL

##### 1.1 SUMMARY

- A. The contractor shall Design, furnish and install a complete distributed microprocessor based 24VDC, electrically supervised, Silent Knight IFP-1000 fire alarm system as specified herein. The system shall include, but not be limited to, all control equipment, remote transponders, power supplies, signal initiating and signaling devices, conduit, wire, fittings, and all other accessories required to provide a complete and operable system.
- B. The system shall operate as a non-coded, continuous ringing system which will sound alarm devices until manually silenced, as herein specified.
- C. The system shall be wired as a Class B and style 4 supervised system for all circuits.
- D. System shall have a minimum of two loops and wired to allow expansion of each loop.
- E. Contractor shall provide a backup copy of the installed program database (on 3.5" floppy disk) upon completion of the project. They shall also provide the current version of VeriFire-TCD for the panel provided.

##### 1.2 CONTRACTOR QUALIFICATIONS

- A. The installing contractor shall be the authorized representative of the Fire Alarm Manufacturer to sell, install, and service the proposed manufacturer's equipment. The installing contractor shall have represented the fire alarm manufacturer's product for at least two years.
- B. The installing contractor shall be licensed by the State Fire Marshall to sell, install, and service fire alarm systems as required by Article 5.43-2 of the Texas Insurance Code.
- C. The installing contractor shall have on his staff an installation technician licensed by the State Fire Marshall's office for such purpose and under whose supervision installation, final connections, and check out will take place as required by the Texas Insurance Code.
- D. The installing contractor or equipment supplier shall have on staff a minimum of two (2) certified NICET Level III state licensed fire alarm planning superintendents under whose supervision system design shall take place. In lieu of an alarm planning superintendent, the contractor may provide design supervision by a registered professional engineer.
- E. The installing contractor shall provide 24 hour, 365 days per year emergency service with factory trained, state licensed service technicians.
- F. The installing contractor shall have been actively engaged in the business of selling, installing, and servicing fire alarm systems in the surrounding area for at least ten (10) years.

#### PRODUCTS

##### 2.1 SYSTEM FUNCTIONAL OPERATION

- A. Fire alarm contractor shall hold current certification to install and support Farenhyt fire alarm systems by Silent Knight.
- B. The required fire alarm and evacuation system providing a system with the following functions and operation:
  - 1. Locate main fire alarm panel in BCR room.
  - 2. Provide a lightening protection kit.
  - 3. Performance Requirements:
    - a. The automatic battery charger shall be capable of charging a fully discharged battery to 70% capacity in 12 hours.



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- b. The fire alarm control panel shall be Silent Knight IFP-1000. All sub-panels shall be analog addressable (i.e. Power Booster) Silent Knight Model #5895XL.
    - 4. All control panel and power booster batteries shall be 12 volt 18 amp or higher, no exceptions shall obtain its primary operating power from a 120 BAC single-phase 60 Hz supply provided with a dedicated and secured disconnect switch.
    - 5. The fire alarm and evacuation system shall comply with NFPA 72 and all applicable local codes. Provide horn/strobe and smoke detectors at all Pre-K and Kindergarten learning centers.
    - 6. All Control panel batteries shall be 12Volt 18amp hour or greater. Installation dates should be clearly marked on batteries.
    - 7. All wiring shall be non-power, unlimited power supply or plenum rated.
    - 8. Panel programming shall include device descriptions and zoning per floor per building (i.e. zone 1= main building first floor Administrative Suite, zone 2= main building first floor corridor east, zone 3=main building learning centers). Panel programming shall be supplied to owner via a hardcopy and electronic.
- C. Installation
  - 1. All wiring shall be in compliance with NEC, local building codes and Article 760 of NFPA Standard 70.
    - a. Fire Alarm wiring shall be U.L.L. approved and not less than #18 gauge.
    - b. Wiring conduits should not be used for any purpose other than fire alarm wiring. (No Exceptions)
    - c. All wiring shall be color coated and marked at each termination or junction box indicating the circuit served (i.e. power supply).
    - d. All sub-panels shall be located in the BCR, FCR, electrical closet or mechanical rooms only.
    - e. All junction boxes including the cover are to be painted red in color for identification purposes.
    - f. All wiring or use plenum rated cable installed in conduit – EMT for indoors and IMC for outdoors.
    - g. All sensors shall be photo detection. All duct detectors shall be analog addressable ionization.
    - h. Horn/Strobe wiring shall be four wiring conductor cable to separate the strobe from the horn and ANSI purposes.
  - 2. All control panels and sub panels shall clearly indicate electrical breaker location, including room number, panel number and breaker number.
  - 3. All horn strobes, speaker strobes or strobes only shall be wall mounted. Do not mount in ceiling unless approved by HISD Alarm Communications.
  - 4. All final programming shall be completed using final room number graphics plan.
  - 5. Provide annunciator panel in front office area.
- D. Test and Reports
  - 1. A trained technical representative of the equipment supplier shall supervise the final control panel connections and testing of the system. Upon completion of the acceptance test the Houston ISD Maintenance Department will be instructed in the proper operation of the system.
  - 2. The installation contractor shall functionally test each and every device in the entire system for purposes of operation and response. Written certification shall be provided upon completion of the test.
- E. Contractor shall be made responsible for maintaining existing fire alarm operational throughout construction duration. In certain cases, the existing fire alarm equipment is currently under warranty from the initial installation. If the contractor requires the temporary or permanent relocation of fire alarm devices in order to complete contractor's work, then contractor will be responsible for disconnecting, removing, securing, protecting, reinstalling, re-testing and re-certifying such equipment or system. The installing vendor listed below must perform any alteration to the existing fire alarm



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system. Contractor is responsible for all costs and coordination of any disconnection, removal, shunting, reconnection, testing, and re-certification of the fire alarm system required to accomplish the renovation work and receive certificates of certification from the City of Houston Fire Department.

### EXECUTION

#### 3.1 FUNCTIONS

##### A. Alarm System Automatic Functions:

1. Upon the operation on any sprinkler flow switch, manual pull station, or detector:
  - a. Signal the Fire Alarm Control Panel. Identify the addressable point at the Fire Alarm Control Panel and the remote fire alarm annunciator.
  - b. Sound a distinctive evacuation signal throughout the entire building.
  - c. Simultaneously activate all flashing visual alarm assemblies associated with audible indicators.
  - d. Shut down all mechanical equipment rated 2000 cfm or greater that circulate air for that floor. This equipment shall include, but shall not be limited to, air handling units, ventilation fans, fan powered boxes, and side pocket boxes. Coordinate with Division 15 Specification Section Air Conditioning Controls as required for passive smoke control.
  - e. Close all smoke control dampers. Provide control relay within three (3) feet of each damper or power supply for motor drives or fail-safe dampers. When fail-safe smoke dampers are powered in parallel from a common power circuit then fire alarm relay may be provided to interrupt common power circuit; separate relay not necessary at every such damper. Install supervised fire alarm wiring from relay to fire alarm control panel. Resetting fire alarm system shall include opening smoke control dampers.
  - f. Activate and automatic telephone dialer and alarm contact closure for use with approved central station monitoring service. Owner provides NFPA 71 central station connection and maintains that service.
  - g. Release all fire and smoke control doors on hold-open devices so that doors may close.
  - h. Kitchen:
    - a) Operation of any kitchen hood fire suppression system shall initiate the alarm building fire alarm control panel. Building fire alarm system shall sound alarm over appropriate notification appliance circuits as required by NFPA 72 sect. 3-8.8.1. Comply with NFPA 96 Standard for Commercial Cooking Operations, sect. 7-3.1.4. Actuation of a dry chemical shall cause building fire alarm per NFPA 17 sect. 3-7.4. Actuation of a wet chemical system shall cause building fire alarm per NFPA 17 sect. 3-2.1.5
  - i. Sprinkler System:
    - a) Operation of any sprinkler system water flow switch shall activate the sprinkler alarm belt.
  - j. All alarm signals shall continue sounding and annunciator(s) shall remain lighted until the alarm acknowledged switch is depressed. The alarm signals shall then stop, but the annunciator shall remain lighted until the system is rest.
  - k. Acknowledging of any alarm signal shall interfere with the re-activating of the alarm signals upon an alarm from another zone.
  - l. Alarm Verification:
    - a) Provide UL listed alarm verification feature.
    - b) Alarm verification shall be per addressable, open area smoke detector. Alarm verification shall be field programmable on an



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individual detector basis. Global or Dydte, alarm verification will be unacceptable.

- c) If an alarm condition is detected by an automatic smoke detector programmed for ALARM VERIFICATION, an alarm verification sequence shall be initiated. Upon receipt of the initial alarm condition, start the verification sequence as prescribed by UL 864. The system shall rest the alarmed zone/device within the UL prescribed window of 60 seconds maximum. If the alarm condition does not confirm within 60 seconds of the reset signal, the programmed alarm outputs shall be canceled and the system returned to the normal mode. If the alarm condition re-occurs within the designated verification cycle or a non-verified device or zone activates, the programmed events listed above shall immediately occur for the confirmed alarm condition.
- d) Alarm verification shall not be used for any spaces programmed to required two smoke detectors to initiate an alarm response (ex. elevator lobbies), per NFPA 72-1993 Sect. 3-8.2.5.

### 3.2 WALK TEST

- A. Notify the Owner, Architect and Engineer when system is 100 percent operational. Schedule walk-through of the entire facility and verify that each initiating and each indicating device is operating properly.
- B. Provide report at conclusion of walk through certifying all fire alarm devices are working.
- C. Walk test shall include a representative from owner maintenance department.
- D. Walk test to show in a printed report all AHU shutdown, Sprinkler Tamper Report, Sprinkler Flow switch, strobes/horns, and smoke detectors. Report shall list all devices by approximate location to rooms, and device number. All duct detectors shall include flow differential at the detector as measured by a manometer. Manometer reading shall match manufacturer's specification for duct detector used.

### 3.3 SOFTWARE

- A. Installer shall provide a backup copy of the installed program database (on 3.5" floppy disk and CD) upon completion of the project. They shall also provide the current version of VeriFire-TCD (CD Software) for the panel provided.

## END OF SECTION





B U I L D I N G   E X C E L L E N C E

SECTION 32 05 00

EXTERIOR IMPROVEMENTS COMMON WORK RESULTS

GENERAL

- 1.1 *The architect should provide proper coordination of all fire lanes with the Fire Marshall.*
- 1.2 Accessible loading zones shall be marked to comply with TDLR and other applicable codes and regulations.
- 1.3 Permeable paving shall be an accepted form of site detention and shall be coordinated with the civil engineer.
- 1.4 At a minimum, all curbs located between approved Fire Lane - Tow-Away Zone signs shall be painted RED or a RED stripe shall be placed along the pavement where there is no curb. These curbs shall also be conspicuously and legibly marked with the warning **"FIRE LANE - TOW AWAY ZONE"** in WHITE letters at least three inches in height, at intervals not exceeding fifty feet.  
  
Any color other than red may be used in **"NO PARKING"** areas that are not approved Fire Lanes. RED colored curbs, pavement striping or wheel stops shall be used only to designated approved Fire Lanes except where authorized by the Code Official. Additional areas may be required by code and/or Fire marshal reviews. Field verify fire lane locations with City of Houston School Team Fire Marshall.
- 1.5 The ground floor elevation should be established with as much foresight as possible, considering the capacity of major off site drainage ways, potential for increased development in the area, and the historical high water levels in the neighborhood. This may result in a first floor elevation higher than the code required elevation.
- 1.6 An irrigation system is to be included for each area that is landscaped since past experience indicates that this is necessary for plant survival. Irrigation of trees throughout a campus beyond the practical extent for a full irrigation system should be accomplished with stream bubblers.
- 1.7 Foundation planting along the base of the building is discouraged due to high maintenance and water penetration. Landscaping should be established with as much foresight as possible, considering amount of irrigation required, drought conditions and location to the proposed construction. Ensure that new landscaping is not planted too close to the building foundation that will cause future structural issues.
- 1.8 Planting improvements should reinforce an environment conducive to learning and high self-esteem. Simplicity in design and maintenance is encouraged. The creation of tall screening in the landscape that prohibits visual surveillance of the campus is discouraged. Improvements should emphasize trees and lawns, but will also entail proportionately small amounts of ground covers, low shrubs, vines and perennials. Indigenous and native materials are encouraged.
- 1.9 All construction projects should include topsoil, fertilization and seeding (type depends on season) with a full stand of grass being the point of transfer of responsibility from contractor to Owner.
- 1.10 Drainage line discharge outlets exceeding 12" diameter require a grating or other device to prevent entrance by small children. Area drain gratings shall have narrow-slot openings of maximum 3/4" width, and shall be "heavy-duty" grade at all locations.





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- 1.11 Provide a one-way bus drop-off lane at a canopy connecting to a building entry, separate from other traffic access, including automobile drop-off; canopy is not required to extend over the drive lane. If new canopy provided, then canopy shall fully extend over new passenger curb ramp provided at bus drop off.
- 1.12 Provide a one-way automobile drop-off access at a canopy connecting to a building entry, separate from other traffic access, including bus drop-off; canopy is not required to extend over the drive lane. If new canopy provided, then canopy shall fully extend over new passenger curb ramp provided at parent drop off zone.
- 1.13 All driveways and parking shall be concrete paving. No asphalt will be allowed except for patching and topping of existing asphalt and with HISD Program Manager approval only.
- 1.14 Paving for service areas should be designed for heavy truck loading and have storm drainage inlets.
- 1.15 No completely enclosed exterior courtyards are allowed. Courtyards, if any, must be open at one side, such as U-shaped; and the open side, if fenced, must have a gate that complies with exit requirements, including exit hardware.
- 1.16 For site ramps and stairs, provide handrails that are of simple design, galvanized and painted, not aluminum or custom detailed.
- 1.17 Service access and service drives shall be separated from other vehicular access.
- 1.18 Playground equipment shall be placed in such a location that will afford maximum security and maintain site lines within the school perimeter.
- 1.19 Finish grading shall have a tolerance of plus or minus ½”.
- 1.20 Speed bumps shall be per City of Houston standard detail for Speed Humps 02741-02 and 02741-03.
- 1.21 All retaining walls with a height of 5'-0” or greater or walls subjected to surcharge loading shall be designed by a professional engineer and the drawings shall be sealed accordingly. Consideration must be given to the need for guardrails for fall protection. Provide railing and guardrails where needed for safety and protection.
- 1.22 Planting
  - A. The following guidelines establish standard for planting and related appurtenances, but are not complete technical specifications. The Consultant is encouraged to consider these a basis for design, documentation, and specifications, but shall also assure their compatibility to the specific site.
  - B. Use native, drought-tolerant plantings that can tolerate periods of saturation.
  - C. Any landscaping beyond code requirements should be minimized. Do not design large planting beds which are a maintenance problem.
  - D. Foundation planting is discouraged. Flowering trees away from the building is preferred.
  - E. HISD written approval is required to include any plant material not covered by an automatic irrigation system other than large play fields and lawns.
  - F. Due to cost, large lawn areas should be hydromulched and not sodded. Exceptions should be reviewed with HISD and may involve time of year and construction schedules.
  - G. Edging is required in each location between a planting bed and lawn areas. Edging can be steel or recycled plastic.



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- H. Side slope so storm water detention areas should be carefully considered and specifications should include establishing a lawn, not just an application of hydromulch. To establish lawn may require topsoil, erosion control, sodding, and irrigation.
- I. Obtain approved plant list from HISD project manger before any plant selections are determined.
- J. Provide a growth period for plant, sod and hydromulch establishment as recommended by the Landscape Architect

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**EXECUTION**

**END OF SECTION**



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SECTION 32 12 16

ASPHALT PAVING

GENERAL

- 1.1 Asphalt Paving shall be only used for resurfacing existing asphalt paving only. All new paving shall be concrete
- 1.2 Require a warranty for the work against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship
  - A. Defects shall include, but not be limited to the following:
    1. "Fatty" or "Lean" areas that show surface failure.
    2. Areas that puddle water in excess of 1/2 inch deep where the designed slope is at least 1/4 inch per foot.
    3. Becoming tacky.

PRODUCTS

- 2.1 Tack coat: RC-2, Texas Department of Transportation Item 300.
- 2.2 Hot-Mix Asphalt Paving: Texas Department of Transportation Item 340, Type D. The paving mixtures shall consist of a uniform mixture of aggregate, hot asphalt cement, and additives if allowed or required. The mix shall be designed in accordance with TXDOT Construction Bulletin C-14 and Test Method Tex-204-F. The mixture shall be designed to produce an acceptable mixture at an optimum density of 96.0 percent, when tested in accordance with Text Method Tex-207-F and Text Method Tex-227-F.
- 2.3 The operating range for control of laboratory density during production shall be optimum density plus or minus 1.5 percent. The materials used in the mixture design shall produce a mixture with a stability value of at least 35, unless otherwise shown on the Drawings, when tested in accordance with Text Method Tex-208-F.
- 2.4 Pavement Markings
  - A. Type: Latex, water based paint intended for use in marking parking lots and roads and complying with FS TT-P-1952B. Apply at manufacturers recommended rates to provide minimum 12 to 15 mils dry thickness
  - B. Stripe Size: Four inches wide for traffic and parking lanes, unless noted otherwise.
  - C. Colors: Traffic and Parking Striping: Yellow or white as selected by Architect and HISD Program Manager.
  - D. Fire lane, accessible parking and access aisles shall be determined by the Architect.

EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- 3.2 Placing Topping:
  - A. Temperature: Provide mix at minimum 225 degrees F., when dumped from mixer.
  - B. Clean Base: Remove loose material, dust, dirt and other foreign materials from the base course.
  - C. Tack Coat: Apply 0.05 to 0.2 gal. per sq. yd.
  - D. Compaction: Compact topping to 95 percent by on-site Hveem test. Stability shall be 35-40 percent by Hveem test.
  - E. Thickness of Topping After Compaction - 1-1/2 inches, unless shown otherwise. Adjust as



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required to obtain grade for drainage.

3.3 Field Quality Control

- A. Surface: Smooth, hard and well cemented to base course.
- B. Grades: Conform to those shown.
- C. Accuracy: Free of puddles deeper than 1/2 inch where designed for a slope of at least 1/4 inch per foot.

**END OF SECTION**



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SECTION 32 13 13

CONCRETE PAVING

GENERAL

- 1.1 All new paving shall be concrete designed per "AASHTO Guide for Design of Pavement Structures" utilizing "Low-Volume Road Design".
- 1.2 Require a warranty for the work against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship
- 1.3 Concrete paving, including, but not limited to parking lots, aprons, sidewalks, curbs, handicapped accessible ramps, approaches, and miscellaneous exterior concrete
- 1.4 Require broom finish on exterior sidewalks
- 1.5 Include a minimum of 5-foot wide paved access to and around the flagpole, accessible by the handicapped.
- 1.6 Exterior walk and paving joints shall have pourable grade two-part polysulfide or urethane sealant. Require prepared joint to be wire brushed and air blasted to thoroughly clean joint before installing sealant.
- 1.7 Concrete shall slope at 1% minimum unless approved by HISD program manager
- 1.8 Standard parking spaces shall be 9' X 20'. Use compact parking spaces (8' X 16') only if recommended by a traffic impact study.
- 1.9 Drive isles shall be 24' minimum wide for car traffic and 30' wide minimum for bus traffic.

PRODUCTS

- 2.1 Metal Reinforcement:
  - A. Bars: Conform to ACI 315, latest edition. Comply with ASTM A615, Grade 60, deformed billet steel bars, unfinished, except Number 3 bars shall comply with ASTM A615, Grade 40, deformed billet steel bars, unfinished.
- 2.2 Tie Wire: 16 gauge annealed.
- 2.3 Concrete Materials (Other than concrete for extruded curbs, unless noted otherwise)
  - A. Cement: Type 1, ASTM C150, unless approved otherwise by Architect. Use one brand of cement for entire project.
  - B. Concrete Admixtures: Provide admixtures produced and serviced by established, reputable manufacturer and used in compliance with manufacturer's recommendations.
  - C. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.
  - D. Water-Reducing Admixture: ASTM C494, Type A, and containing not more than 0.05 percent chloride ions.
  - E. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or Type G and containing not more than 0.05 percent chloride ions.
  - F. Do not allow Calcium chloride, thiocyanates or admixtures containing more than 0.05 percent chloride ions.



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- G. Integral Color Pigment (Required for new concrete handicapped accessibility ramps): Mineral oxide, lightfast, lime-proof, water-resistant type conforming to ASTM C979. Color(s) shall be as selected by Architect from manufacturer's standard color line.
- H. Aggregates: Comply with ASTM C33 with Maximum size not larger than 1/5 of narrowest dimension between forms of the member for which concrete is to be used. Not larger than 3/4 of minimum clear spacing between reinforcing bars. 1-1/2 inch maximum in paving slabs.
- I. Strengths: Five sack (shall contain no less than 5 sacks of Portland cement)/3,500 psi/28 days. Strength recommendations on Drawings supersede when they are greater than specified
- J. Water - Cement Ratio (lb water per lb of Portland cement):3,500 psi concrete:
  - 1. 0.58 maximum
  - 2. 0.46 maximum for air-entrainment
- K. Slump shall be 4 inches plus or minus 1 inch, unless specifically noted otherwise.
- L. Expansion Joints: Fiber Joint Filler/Expansion Joints: Premolded asphalt impregnated rigid fiber board. Comply with AASHTO M-213. Use 3/4 inch thick at expansion joints adjacent to extruded curbs, 1/2 inch thick at perimeter of footings for ground-set items such as bollards and fence posts where such footings are incorporated into slabs; elsewhere as shown.
- M. Wood Joint Filler/Expansion Joints: Where indicated in the drawing, provide construction clear heart grade redwood joints conforming to AASHTO M-90. Provide sizes indicated on drawings. Do not install adjacent to curbs
- N. Load Transfer Units:
  - 1. Light Duty (sidewalk): 3/4 inch thick construction clear heart redwood expansion joint form with minimum one inch deep removable top strip, 1/2 inch by 10 inch smooth steel reinforcing bars at 12 inches o.c. with bond breaker sleeve on one side, and 3/32 inch thick steel bar-support plates each side. Provide custom size as required for full depth of paving and sealant depth as required by sealant manufacturer.
  - 2. Medium Duty (Auto) / Heavy Duty (truck/bus traffic): 3/4 inch thick redwood expansion joint form with minimum one inch deep removable top strip, 3/4 inch by 18 inch steel reinforcing bars at 12 inches o.c. with bond-breaker sleeve on one side and 3/16 inch steel bar-support plates each side. Provide custom size as required for full depth of paving and sealant depth as required by sealant manufacturer.
- O. Transverse/Longitudinal Construction Joints: 18 gauge preformed galvanized keyway with removable strip.
- P. Chairs and Spacers: Heavy-duty plastic-type sized to support all reinforcing steel to proper height directly on properly prepared and compacted subgrade. No sand cushion pads will be permitted. Provide chairs and spacers Series "B" by W.H.C. Products, Inc., E-Z Chair by Aztec Concrete Accessories, Inc., MEDCO PC-4 by Meadow Burke, a Division of MMI Products, GTI Bar Chair by General Technologies, Inc., or approved equivalent. Maximum spacing of chairs shall be 36-inches on center each way.
- Q. Epoxy Adhesive: ASTM C881, two component, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces.
- R. Curing Compound: The compound shall conform to ASTM C309-1315, Type II (A.I.M. Regulations - VOC Compliant).

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- 3.2 Coverage of Reinforcement: The metal reinforcement shall be protected by the thickness of concrete indicated on the plans.
  - A. Three inches: Concrete deposited against ground without use of forms.



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- B. Two inches: Bars more than 5/8 inch diameter where concrete is exposed to the weather, or exposed to the ground but placed in forms.
- C. 1-1/2 inches: Bars 5/8 inch diameter where concrete is exposed to the weather, or exposed to the ground but placed in forms.
- D. Two inches: In slabs and walks on grade.
- E. 1-1/2 inches-1-3/4 inches from top for paving

**3.3 Concrete Placement, General:**

- A. Place concrete in compliance with practices and recommendations of ACI 304, and as specified herein.
- B. Do not deposit concrete on concrete which has hardened sufficiently to form seams or planes of weakness within the section.
- C. Sections between expansion joints and construction joints shall be placed in continuous pours; construction joints in paving and walks other than at formed joint locations will not be permitted.
- D. Place concrete at such a rate that concrete which is being integrated with fresh concrete is still plastic.
- E. Deposit concrete as nearly as practicable in its final location to avoid segregation due to rehandling and flowing. Do not subject concrete to any procedure which might cause segregation.
- F. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming and grouting.
- G. Do not use concrete which becomes nonplastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials.

**3.4 Slab Placement:**

- A. Moisten subgrade the evening before and immediately prior to placement of all paving slabs.
- B. Deposit and consolidate concrete slabs in a continuous operation, within the limits of all expansion joints, until the placing of a panel or section is completed using vibrating bridge screeds, roller pipe screeds or other methods acceptable to Architect.
- C. Consolidate concrete during placement by use of the specified equipment, preferably with power driven floats of impact type, thoroughly working concrete around reinforcement and into corners.
- D. Bring slab surfaces to correct level with a straight edge, and then strike off.
- E. Use bullfloats or darbies to smooth the surface, leaving it free from bumps and hollows.
- F. Do not sprinkle water on the plastic surface; do not disturb the slab surfaces prior to start of finishing operations.

**END OF SECTION**





## BUILDING EXCELLENCE

### SECTION 32 18 00

#### ATHLETIC AND RECREATIONAL SURFACING

##### GENERAL

- 1.1 Verify the areas of all new synthetic turf surface and shock absorbing pad designed for athletic and recreational use.

##### PRODUCTS

- 2.1 Synthetic Grass
  - A. Design team shall detail out section including stabilized sub grade, 20 w/PJC liner, Sub drains, 8" free drainage stone base
  - B. Provide Monofilament at the stadiums- Rubber/ Sand in filled minimum 45 oz, 2.5" pile height monofilament fiber turf
  - C. Provide Slit film at the high schools- Rubber/ Sand in filled
- 2.2 Field Surfacing
  - A. Warning tracks- 4" red dog cinder or app'd equivalent
  - B. Bull pens- Pitching area to be mound clay; bull pen to be 5" concrete pad w/ knitted nylon synthetic turf over a 5mm pad glued to concrete, Astroturf system 5 or approved equal
- 2.3 Natural grass type and root zone- Tif 419.6" root zone being 91% sand and 10% silt/clay
- 2.4 Running tracks
  - A. Surfacing shall be a minimum of 10mm full pour
  - B. High school and competition tracks shall be 8 lane 400 meter per IAAF at high schools. Basis of design for High School tracks is Beynon Sports BSS 1000.
  - C. Coordinate the design of middle school tracks with the HISD Project Manager. Basis of design for Middle School tracks is Beynon Sports BSS 300.
- 2.5 For outdoor concrete basketball courts incorporate an integral coloring to reduce reflectivity
- 2.6 Tennis court
  - A. Post tensioned concrete with tennis court surfacing- Tennis courts surface and coating shall be plexipave, laycold or approved equivalent

##### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- 3.2 Require that synthetic turf system is installed in the field by crews employed by the turf supplier and under the direction and supervision of the manufacturer.
- 3.3 Require that synthetic turf system adhered to a special reinforcing tape as recommended by the manufacturer. No cross or head seams will be permitted.
- 3.4 Require that synthetic turf system is installed in accordance with manufacturer's instructions.
- 3.5 No installation shall be attempted at temperatures below 50 degrees F or under wet conditions.



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- 3.6 Decorations and Field Markings: All decorations and field markings shall be painted.

**END OF SECTION**



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**SECTION 32 18 16**

**PLAYGROUND SURFACING**

**GENERAL**

- 1.1 Provide engineered wood fiber system to a compacted depth as specified below over a 100 percent polyester, non-woven geotextile fabric and drainage system
- 1.2 Require a warranty for the work against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship

**PRODUCTS**

- 2.1 Surfacing System: Fibar System 300,
- 2.2 Surfacing Material: Shall be a mix of random-sized, IPEMA certified, engineered wood fibers in accordance with ASTM F1292 to a compacted depth of 12 inches. Surfacing system shall be accessible in accordance with ASTM F1951.
- 2.3 Permanent Edging Components:
  - A. Edging Material: Shall be 4 feet long x 12 inches high x 4 inches wide made of high-density polyethylene with UV stabilizer.
  - B. Stakes: Shall be 30 inch long galvanized steel stakes to hold edging lengths together and anchor edging.

**EXECUTION**

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
  - A. Verify that areas are ready for installation of all items
- 3.2 Install drainage system over entire play area, unless noted otherwise.
- 3.3 Install geotextile fabric over drainage system, unless noted otherwise.
- 3.4 Install surfacing fibers to compacted thickness specified above, unless noted otherwise.

**END OF SECTION**



BUILDING EXCELLENCE

SECTION 32 31 13

CHAINLINK FENCE AND GATES

GENERAL

- 1.1 Provide chain link fabric shall have the PVC thermally fused to the galvanized steel core wire. Extruded or bonded and glued chain link fence fabric will not be accepted
- 1.2 Fence framework shall have the PVC thermally fused in compliance with ASTM F1234
- 1.3 Provide 8'-0" gate to all open grassed areas to allow for mower access.
- 1.4 Provide 12'-0" double gate as required to access the transformer.
- 1.5 Use an ornamental fence at the front of the site.

PRODUCTS

- 2.1 Fence Fabric:
  - A. PVC coating thermally fused to zinc-coated or zinc-5 percent aluminum-mischmetal alloy-coated steel core wire: ASTM F668 Class 2b, 7 mil thickness thermally fused. Core wire tensile strength 75,000 psi.
  - B. Size: Helically wound and woven to height of six feet with two inch diamond mesh, with core wire diameter of 0.148 inch (9 gauge) and a breakload of 1290 lbf. Color shall be black and comply with ASTM F934
  - C. Selvage of fabric shall be knuckled at top and knuckled at bottom.
- 2.2 Fence Framing:
  - A. Steel pipe - Type I: ASTM F1083, standard weight schedule 40; minimum yield strength of 25,000 psi; sizes as indicated below. Hot-dipped galvanized with minimum average 2.0 oz/ft<sup>2</sup> of coated surface area.
    1. Line posts: 1.90 inch o.d. up to 6 feet on center; 2.375 inch o.d. up to 10 feet on center.
    2. Terminal, End, Corner, and Pull posts: 3.0 inch o.d. up to 6 feet on center; 2.975 inch o.d. up to 10 feet on center
    3. Rails and Braces: 1.660 inch o.d.
    4. PVC finish: In accordance with ASTM F1043, apply supplemental color coating of 10 to 15 mils thermally fused PVC in color to match fabric.
- 2.3 Gate frames: Fabricate chain link swing gates in accordance with ASTM F900 using galvanized steel tubular members, 2 inches square, weighing 2.60 lb/ft. Fusion or stainless steel welded connections forming rigid one-piece unit. Vinyl coated frames thermally fused with 10 to 15 mils of PVC in accordance with ASTM 1043. PVC color to match fence.
  - A. Chain link fence fabric: PVC thermally fused to metallic coated steel wire, ASTM F668, Class 2b, in color, mesh, and gauge to match fence. Install fabric with hook bolts and tension bars at all four sides. Attach to gate frame at not more than 15 inches on center.
  - B. Hardware materials: Hot dipped galvanized steel or malleable iron shapes to suit gate size. Field coat moveable parts (i.e. hinges, latch, keeper, and drop bar) with PVC touch up paint, provided by manufacturer, to match adjacent finishes.
  - C. Hinges: Structurally capable of supporting gate leaf and allow opening and closing without binding. Non-lift-off type hinge design shall permit gate to swing 180 degrees inward.
  - D. Latch: Forked type capable of retaining gate in closed position and have provision for padlock. Latch shall permit operation from either side of gate.



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- E. Keeper: Provide keeper for each gate leaf over five feet wide. Gate keeper shall consist of mechanical device for securing free end of gate when in full open position.
- F. Double gates: Provide drop rod to hold inactive leaf. Provide gate stop pipe to engage center drop rod. Provide locking device and padlock eyes as an integral part of latch, requiring one padlock for locking both gate leaves.
- G. Gate posts: Steel pipe, ASTM F1083, standard weight schedule 40; minimum yield strength of 25,000 psi, 2.875 inches in diameter. Hot-dipped galvanized with minimum 1.8 oz/ft<sup>2</sup> of zinc or respective material finished in accordance with ASTM F1043. PVC color to match fence.

### EXECUTION

- 3.1 Require installation of chain link fence in accordance with ASTM F567 and manufacturer's instructions.
- 3.2 Locate terminal post at each fence termination and change in horizontal or vertical direction of 30 degrees or more.
- 3.3 Space line posts uniformly at 10 feet on center.
- 3.4 Concrete fence post footings shall be set in 3000 psi concrete at 28 days:
  - A. Drill holes in firm, undisturbed or compacted soil. Excavate deeper than specified below as required for adequate support in soft and loose soils, and for posts with heavy lateral loads.
  - B. Line posts shall be set in 9 inch minimum diameter concrete piers, with a minimum of 33 inches of post embedment in concrete with an additional 3 inch concrete cover at bottom.
  - C. All end, corner, and pull posts shall be set in minimum 12 inch minimum diameter concrete piers, with a minimum of 33 inches of post embedment in concrete with an additional 3 inch concrete cover at bottom.
  - D. Place concrete around posts in a continuous pour.
  - E. Trowel finish around post. Slope to direct water away from posts.
- 3.5 Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.
- 3.6 Bracing: Install horizontal pipe brace at mid-height for fences six (6) and over, on each side of terminal posts. Firmly attach with fittings. Install diagonal truss rods at these points. Adjust truss rod, ensuring posts remain plumb.
- 3.7 Tension wire: Provide tension wire at bottom of fabric. Install tension wire before stretching fabric and attach to each post with ties. Secure tension wire to fabric with 12-1/2 gauge hog rings 24 inches on center.
- 3.8 Top rail: Install lengths, 21 feet. Connect joints with sleeves for rigid connections for expansion/contraction.
- 3.9 Install gate posts in accordance with manufacturer's instructions.
  - A. Drill holes in firm, undisturbed or compacted soil. Excavate deeper than specified below as required for adequate support in soft and loose soils, and for posts with heavy lateral loads.
  - B. All gate posts shall be set in minimum 12 inch minimum diameter concrete piers, with a minimum of 33 inches of post embedment in concrete with an additional 3 inch concrete cover at bottom.
  - C. Place concrete around posts in a continuous pour.
  - D. Trowel finish around post. Slope to direct water away from posts.



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- E. Gate posts and hardware: Set keeper, stops, sleeves into concrete. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.

**END OF SECTION**



BUILDING EXCELLENCE

SECTION 32 31 19

ORNAMENTAL FENCE AND GATES

GENERAL

- 1.1 The architect should include in this section: Ornamental picket fencing, gates and accessories, including related footings for posts.
- 1.2 Require a warranty for 15 years against becoming unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship. Defects shall include, but not limited to, the following: cracking, peeling, blistering, corroding or failure of mechanical parts or assemblies.

PRODUCTS

- 2.1 Where products are named in the design guidelines, they are considered the basis of design. Other approved manufacturers must have a minimum of five years experience manufacturing products meeting or exceeding the guidelines to be considered.
  - A. Specifications for fence are based on "Estate N" and for double gates are based on "Estate A-1" manufactured by Monumental Iron Works/Master Halco Inc.
  - B. Field fabrication of ornamental fences and gates meeting the specified requirements is acceptable.
- 2.2 ORNAMENTAL PICKET FENCE
  - A. Pickets: Galvanized square steel tubular members manufactured in accordance with ASTM A787, having a 45,000 psi yield strength and G90 zinc coating, 0.90 oz/ft<sup>2</sup>. Size pickets 3/4 inch by minimum wall thickness 18 gauge. Space pickets 3-15/16 inch maximum face to face. Attach each picket to each rail with 1/4 inch #4 industrial drive rivets.
  - B. Rails: 1-1/2 inch x 1-3/8 inch x 1-1/2 inch, 11 gauge thick galvanized steel "U" channel in accordance with ASTM A653 or ASTM A1008, having a 50,000 psi yield strength and G90 zinc coating, 0.90 oz/ft<sup>2</sup>. Punch rails to receive pickets and rivets and attach rails to rail brackets with two each, 1/4 inch #4 industrial drive rivets. Steel for rail produced under ASTM A653.
  - C. Posts: Galvanized square steel tubular members manufactured in accordance with ASTM A787 having 45,000 psi yield strength and G90 zinc coating, 0.90 oz/ft<sup>2</sup>). Zinc coating is inside and outside. Posts which are zinc coated outside and painted inside, are unacceptable. Minimum post size three inches, having 12 gauge wall thickness, weighing 4.286 lb./ft.
  - D. Accessories: Assembled panels with ornamental accessories attached using industrial drive rivets to prevent removal and vandalism.
  - E. Finish: All pickets, channels, posts, fittings and accessories shall be polyester coated individually after drilling and layout, to ensure maximum corrosion protection. All components are given a four stage "Power Wash" pre-treatment process that cleans and prepares the galvanized surface to assure complete adhesion of the finish coat. All metal is then given a polyester resin based power coating applied by the electrostatic spray process, to a thickness 2.5 mils. The finish is then baked in a 450 degrees F (metal temperature) oven for 20 minutes.
- 2.3 ORNAMENTAL PICKET SWING GATES
  - A. Gate Frames: Fabricate ornamental picket swing gate using galvanized steel members, ASTM A283, structural quality steel, 45,000 psi tensile strength, with galvanized G90 coating. Frame members welded using stainless steel welded to form rigid one-piece





## BUILDING EXCELLENCE

- unit. (no substitution) Minimum size vertical uprights, two inches square 13 gauge wall thickness.
- B. Ornamental Picket Infill: "U" channel rails, formed from hot rolled, structural steel, 1-3/8 inch wide x 1-1/2 inches deep, 11 gauge wall thickness. Punch rails to receive pickets, and weld inside gate frame. Pickets, galvanized steel, 3/4 inch square tube of gauge, spacing, and with accessories to match fence. Attach pickets to "U" rails by 1/4 inch industrial drive rivets, size #4.
  - C. Bracing: Provide diagonal adjustable length truss rods on gates to prevent sag.
  - D. Hardware Materials: Galvanized steel or malleable iron shapes to suit gate size.
  - E. Hinges: Structurally capable of supporting gate leaf and allow opening and closing without binding. Non-lift-off type hinge design shall permit gate to swing 180 degrees.
  - F. Latch: Capable of retaining gate in closed position and have provision for padlock.
  - G. Keeper: Provide keeper for each gate leaf over 5 feet wide. Gate keeper shall consist of mechanical device for securing free end of gate when in full open position.
  - H. Double Gates: Provide drop rod to hold inactive leaf. Provide gate stop pipe to engage center drop rod. Provide locking device and padlock eyes as an integral part of latch, requiring one padlock for locking both gate leaves.
  - I. Gate Posts: Square members, ASTM A787, structural quality steel 45,000 psi tensile strength, with galvanized G90 coating; size as indicated below:

<u>Gate Leaf Single Width</u>	<u>Post Size (square)</u>	<u>Post Depth</u>
3 ft to 4 ft	3 inches	36 inches
4 ft to 8 ft	4 inches	42 inches
12 ft. to 18 ft.	6 inches	48 inches

- J. Polyester Powder Coat Finish: After components have been galvanized to provide maximum corrosion resistance, pre-treat, clean, and prepare galvanized surface to assure complete adhesion of finish coat. Apply 2.5 mil thickness of polyester resin based powder coating by electrostatic spray process. Bake finish for 20 minutes at 450 degrees F, metal temperature. Color shall match ornamental picket fence.

### 2.4 ACCESSORIES

- A. Rail Attachment Brackets - Die cast of zinc (ZAMAK #3 Alloy) in accordance with ASTM B86-83Z 33521. Ball and socket design capable of 30° swivel (up/down-left/right). Bracket to fully encapsulate rail end for complete security. (no substitution)
- B. Industrial Drive Rivets: Of sufficient length to attach items in a secure non-rattling position. Rivet to have a minimum of 1100 lbs. holding power and a shear strength of 1500 lbs.
- C. Ornamental Picket Fence Accessories: Provide indicated items required to complete fence system. Galvanize each ferrous metal item in accordance with ASTM B695 and finish to match framing.
- D. Post Caps: Formed steel, cast of malleable iron or aluminum alloy, weathertight closure cap. Provide one ball style post cap for each post.
- E. Rings: Cast aluminum. Attach ring to top rail by inserting mounting blocks into top rail and riveting through side of rail using 1/4 inch industrial drive rivet. Hold bottom of ring in place by dowel that protrudes from ring through pre-drilled hole in bottom rail.
- F. Picket Tops: Flat tops extending above rail.

### 2.5 SETTING MATERIAL

- A. Concrete: Minimum 28 day compressive strength of 3000 psi.
- B. Flanged Posts: Provide flange type base plates with 4 holes for surface mounting of posts where indicated.

## EXECUTION



## BUILDING EXCELLENCE

- 3.1 Verify areas to receive fencing are completed to final grades and elevations. Ensure property lines and legal boundaries of work are clearly established

### 3.2 FENCE INSTALLATION

- A. Fence height shall be 8 feet-0 inches high, unless indicated otherwise.
- B. Install fence in accordance with manufacturer's instructions.
- C. Space posts uniformly at 7 feet-8-3/4 inches maximum face to face, unless otherwise indicated.
- D. Concrete Set Posts: Drill hole in firm undisturbed or compacted soil. Holes shall have diameter four times greater than nominal outside dimension of post, and depths approximately 6 inches deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom below surface when in firm, undisturbed soil to depth as indicated in table above. Place concrete around post in a continuous pour. Trowel finish around posts and slope to direct water away from posts.
  - 1. Gate Posts and Hardware: Set keepers, stops, sleeves and other accessories into concrete. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.
- E. Surface mount (wall mount) posts with mounting plates where indicated. Fasten with lag bolts and shields.
- F. Check each post for vertical and top alignment, and maintain in position during placement and finishing operation.
- G. Align fence panels between posts. Firmly attach rail brackets to posts with 1/4" (6 mm) bolt and lock nut, ensuring panels and posts remain plumb.

### 3.3 ORNAMENTAL PICKET GATE FRAMING INSTALLATION

- A. Install gate posts in accordance with manufacturer's instructions.
- B. Concrete Set Gate Posts: Drill holes in firm, undisturbed or compacted soil. Holes shall have diameter four times greater than outside dimension of post, and depths approximately 6 inches deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom 36 inches below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour. Trowel finish around post and slope to direct water away from posts.
  - 1. Gate Posts and Hardware: Set keepers, stops, sleeves into concrete. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.

### 3.4 GATE INSTALLATION

- A. Gate height shall be as indicated on drawings.
- B. Install gates plumb, level, and secure for full opening without interference.
- C. Attach hardware by means which will prevent unauthorized removal.
- D. Adjust hardware for smooth operation.

- 3.5 Install post caps and other accessories to complete fence.

### 3.6 CLEANING AND ADJUSTING

- A. Clean up debris and unused material, and remove from site.
- B. Post hole excavation material shall be scattered uniformly away from the posts or removed as directed by Architect.
- C. Concrete splatter shall be cleaned from exposed surfaces of posts.
- D. Adjust gates for level, smooth, quiet operation.

**END OF SECTION**



**B U I L D I N G   E X C E L L E N C E**

**SECTION 33 05 00**

**UTILITIES COMMON WORK RESULTS**

**GENERAL**

- 1.1    Fiberglass or brick structures shall not be utilized for storm or sanitary sewer structures.

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**EXECUTION**

**END OF SECTION**



BUILDING EXCELLENCE

SECTION 33 10 00

WATER UTILITIES

GENERAL

- 1.1 All pipe shall be new and made in the United States. All plastic pipe must also bear the National Sanitation Foundation Seal of Approval (NSF-PW), and have an ASTM design pressure rating of at least 150 psi or a standard dimension ratio of 26 or less. Water Distribution Lines must be installed in accordance with the manufacturer's instructions. All water Line materials and appurtenances shall comply with Section 290.44(b) of the Texas Natural Resource Conservation Commission Rules and Regulations for Public Water Systems regarding lead banned from piping and joints.
- 1.2 Require a warranty for the work against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship

PRODUCTS

- 2.1 Waterlines 4" and greater
  - A. C-900 DR-18 PVC
  - B. Ductile iron fittings with mechanical joints,
  - C. Conform to all requirements of ASTM C900 - DR 18, Class 150.
- 2.2 Waterlines 3" and smaller
  - A. Schedule 80 PVC
  - B. Schedule 80 fittings
  - C. Conform to all requirements of ASTM D 2241 for PVC pipe and be pressure rated at 200 psi with a standard dimension ratio (SDR) of 21 for Class 200 for both barrel and bell dimensions.
- 2.3 All 3/4", 1", 1-1/2" and 2" copper tubes for underground service shall Be Type "K" soft annealed with the proper bending temper. All 3/4" And 1" tubes shall be furnished in coils, each containing 60 feet; FLAT coils are preferred. Other diameters of tubes shall be furnished in straight lengths of 20 feet.
- 2.4 The design of the distribution system shall incorporate a RPZ backflow preventer downstream from the meter adjacent to the right-of-way.
- 2.5 All gate valves shall be designed for a cold hydrostatic working pressure of 175 pounds per square inch for valves with diameters of 3-12 inches, inclusive with shop test of 300 pounds per square inch and a working pressure of 150 pounds per square inch for valves with diameters of 16-48 inches, inclusive with shop test to 300 pounds per square inch. All gate valves shall conform to the requirements of AWWA C500-86 Specification. Valves will be equipped with O-ring stem seals.
- 2.6 Fire hydrants shall be Mueller Super Centurion or an approved equivalent. Each hydrant shall be factory tested to a hydrostatic pressure of 300 psi with valve in both the open and closed positions. The direction of opening nut shall be counterclockwise and shall be cast on the head of the hydrant. Hose nozzles shall be bronze or non-corrosive metal and threads shall be national standard. The main valve opening shall be either five and one-fourth (5-1/4) inches in diameter or six and one-fourth caps shall be provided with gaskets. Bury length shall be three and one-half (3-1/2) feet unless otherwise noted on the plans. Hydrants shall be provided with "dry top" which prevents stem threads from contacting water, and "break-off" type barrel and stem. Hydrants shall be painted with shop coating in accordance with AWWA C502



## BUILDING EXCELLENCE

specification. Final coats of paint will be applied by Contractor in accordance with fire department requirements.

- 2.7 Water meters shall conform to the requirements of AWWA C700, latest revision and shall be of the displacement type. Case shall be bronze and the register shall be sealed. Accuracy shall be at least 100% plus or minus 1.5% of actual thruput. Maximum operating pressure shall be 150 psi. Unless noted otherwise, meters shall be as manufactured by Sensus Technologies, Inc. or a preapproved equivalent.

### EXECUTION

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- 3.2 Avoid the entrance of dirt, water or other substances by the use of tight bulkheads or plugs.
- 3.3 At such street crossings and other intermediate points, the trenches shall be bridged in such proper and secure manner as to prevent any serious interruption of travel upon the roadway and sidewalks.
- 3.4 Require the sterilization of new water lines shall be done in accordance with AWWA C651-86 specification.
- 3.5 Require all necessary equipment and perform all work required in connection with the hydrostatic tests. All pressure pipe installations shall be tested for leakage in the presence of the Engineer. The Engineer shall be given a minimum of 24 hours notice for each and every test. Tests that are not performed in the presence of the Engineer will not be accepted.
- 3.6 Require that the test pressure be 1.5 times the maximum force main design pressure or 150 pounds per square inch gauge, whichever is greater. The test shall be held for a period of four hours. The new system shall be tested in sections between valves. The length of test sections shall not exceed 2,000 feet unless authorized by the Engineer. Each test section shall be slowly filled with water, care taken to expel all air from the pipe. If necessary, the pipes shall be tapped at high points to vent the air.
- 3.7 At the end of the test period, the amount of leakage shall be determined by the quantity of water that must be supplied into the pipe, or any valved section thereof, to maintain pressure within five pounds per square inch of the specified test pressure, after the air in the pipe has been expelled. The maximum allowable leakage shall be calculated using the following formula.
  - A.  $L = SD((P)^{1/2})/133,200$ , where L = leakage in gal/hr
  - B. S = length of pipe in feet
  - C. D = inside diameter of pipe in inches
  - D. P = pressure in pounds per square inch

### END OF SECTION



BUILDING EXCELLENCE

SECTION 33 33 00

SANITARY SEWAGE UTILITIES

GENERAL

- 1.1 All pipe shall be new and made in the United States.
- 1.2 Require a warranty for the work against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship

PRODUCTS

- 2.1 Polyvinyl Chloride (PVC) Pipe for Pressure Rated Lines shall be of the best quality, push-on type, with factory premolded gasketed joints. Pipe shall conform to ASTM D-2241 for PVC pipe. PVC pipe for gravity sewer should be of the best quality, bell and spigot, with factory premolded gasketed joints. Pipe shall conform to ASTM D-3034, SDR 26, for PVC pipe, unless otherwise noted on the plans. All PVC pipe shall be manufactured from Cell Class 12454B in accordance with ASTM D-1784.
- 2.2 Ductile Iron Pipe shall be designed in accordance with ANSI Standard A21.50 (AWWA C-151), or the latest revision thereof. Ductile iron pipe shall be thickness Class 50, pressure rated for 150 PSI unless otherwise indicated on the plans or in the Special Provisions of the Specifications. Pipe and fittings shall be lined with 20 mils of epoxy. Extend lining from plain or beveled end to rear of gasket socket. The exterior of the pipe shall have a bituminous coating approximately one mil in thickness. Polyethylene encasement for use on ductile iron pipe and fittings shall be eight mils thick and conform to the latest revision of ANSI Specification A21.5 (AWWA C-105). All pipe, fittings and appurtenances shall be Polyethylene encased. Polyethylene encasement shall be installed in accordance with the latest revision of ANSI 21.5 (AWWA C-105) standard and shall prevent contact between the buried pipe and appurtenances and the surrounding backfill and bedding material but is not intended to be a completely air and water tight enclosure. Overlaps shall be secured by use of adhesive polyethylene tape, plastic string, binder twine or any other material capable of holding the encasement in place until the backfilling operations are completed.
- 2.3 Centrifugally Cast Fiber Glass Pipe, joints and fittings supplied under this specification shall, as a minimum, conform to the requirements of AWWA C950-81, AWWA Standard for Glass-Fiber Reinforced Thermosetting-Resin Pressure Pipe and ASTM D3517, Standard Specification for Reinforced Plastic Mortar Pressure Pipe, in the case of pressure pipes, and ASTM D3262, Standard Specification for Reinforced Plastic Mortar Sewer Pipe, in the case of gravity sewer pipes. Prior to manufacturing, the pipe supplier shall provide the Engineer with independent laboratory test reports certifying that the pipe has been tested in accordance with and exceeds all minimum requirements of ASTM D-2992 and ASTM D-3681. Manufacturer's "in house" test reports will not be acceptable as a substitute for independent laboratory testing. The Manufacturer shall use only approved polyester resin systems for which he can provide a proven history of performance in this particular application. The historical data shall have been acquired from a composite material of similar construction and composition as the proposed product. The reinforcing glass fibers used to manufacture the components shall be of highest quality commercial grade of glass filaments with binder and sizing compatible with impregnating resins.
- 2.4 All manholes shall be constructed, complete with covers. Manholes shall be constructed of solid precast curved segmental concrete units, circular sections specially cast for use in manhole construction. Fiberglass or brick structures shall not be utilized. Conform to latest ASTM Standards.



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- 2.5 Sanitary sewer lift stations shall only be utilized as approved by the HISD Program Manager. When sanitary sewer lift stations are utilized they shall incorporate as a minimum and auto-dialer, horn and flashing light to indicate alarm conditions.

**EXECUTION**

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- 3.2 Design the maximum earth load on flexible pipe (PVC pipe) results from the consolidated prism of earth directly over the width of the pipe. If design load on the pipe is calculated based on embankment conditions (prism), the trench may be excavated to a width which is as wide as is dictated by practical and economical construction.
- 3.3 Require testing on service connections, pipe installations, manholes and force mains.
- 3.4 All manhole covers shall have designations indicating type of service cover.

**END OF SECTION**





**B U I L D I N G   E X C E L L E N C E**

**SECTION 33 40 00**

**STORM DRAINAGE UTILITIES**

**GENERAL**

- 1.1 All pipe shall be new and made in the United States.
- 1.2 This section covers storm sewers, culverts, manholes, headwalls, inlets, junction boxes and miscellaneous items indicated in connection with the storm sewer system.
- 1.3 Require a warranty for the work against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.
- 1.4 Fiberglass or brick structures shall not be utilized.

**PRODUCTS**

- 2.1 Only precast concrete structures shall be used. Precast structures shall be traffic duty. Concrete for precast structures shall have a design strength of 4500 psi at 28 days. Precast structures shall be monolithic in design. Reinforcing steel shall be Grade 60 and shall meet ASTM A615.
- 2.2 All downspouts and roof leaders shall be connected to underground storm drainage system.
- 2.3 Pipe for storm drains and culverts shall be reinforced concrete pipe (RCP), ASTM C 76, Class III, unless otherwise indicated. Where HDPE (High-Density Polyethylene) is specified, the joints shall meet ASTM F477 and ASTM D3212 (water tight joints). All pipes shall have a smooth interior.
- 2.4 Cast iron shall conform to ASTM Standard Specification A 48, latest edition, for Class 20 gray cast iron. For student safety, openings in drain inlet cover grates should be no larger than the sizes listed
  - A. Inlets near the building or at sidewalks – Vulcan V-8880 ADA Compliant (1.5 inches x 6 inches) or approved equal.
  - B. Inlets in parking lots and open areas – Vulcan V-8880-3 (1.625 inches x 6 inches) or approved equal.
- 2.5 Inlets with a cast in frame shall be utilized in all areas not to receive paving.

**EXECUTION**

- 3.1 The architect should include the following requirements in their specification and include additional directives as necessary for the project.
- 3.2 Piping shall be constructed of the materials specified in this section, and in the manner indicated by Engineer. Pipe shall be laid true to the grades required. Any line in which opening or faulting of the joints occurs during backfill or before final inspection and acceptance, such that infiltration of material or a change in flow characteristics results, must be repaired or replaced to the satisfaction of the Engineer. Under no circumstances shall pipe be laid on unsuitable soft material, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Full responsibility for the diversion of drainage and dewatering of trenches during construction shall be borne by the Contractor. Any section of the pipe already laid that is found to be defective or damaged shall be taken up and re-laid or replaced as directed by the Engineer.



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- 3.3 Manhole installation shall be in strict compliance with the manufacturer's recommended installation procedures. Excavation shall be adequate to accommodate the concrete foundation slab and to provide working room around the manhole.
- 3.4 Stubs shall be provided in manholes at the locations shown required by Engineer. Stubs shall be not less than 2.0 feet long and shall terminate in a bell and plug.
- 3.5 Construct chimneys using precast concrete rings to bring manholes to finish grade. Seal both the top and the bottom faces of concrete rings with "Ramneck" rope type mastic sealant.
- 3.6 Cast iron for manhole frames and covers shall conform to the dimensions required and shall be clean, and free from defects. Manhole covers and Inlet Grates shall include all graphics, logos, and verbiage required by all regulatory agencies having jurisdiction over the project. Holes in cover must be free from plugs or burrs. Bearing surfaces of frames and covers are to be machined so that even bearing occurs when covers are seated in the frame.
- 3.7 No parking allowed for detention use, detention pond must have top soil, hydro, erosion control and temp watering.
- 3.8 Detention pond side slopes shall be steeper than 3'H : 1'V without sloe protection.
- 3.9 Utilize Flexterra for stabilization of slopes equal to or greater than 5'H : 1'V
- 3.10 Inlets with a cast in frame shall be utilized in all areas not to receive paving.

**END OF SECTION**