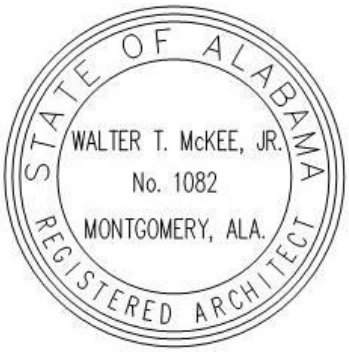
McKEE & ASSOCIATES
ARCHITECTS, INC.

Addendum No. 1
Date: June 23, 2022, 2022



Project:
Eden Elementary School Addition and
Coosa Valley Elementary School Addition
For the Pell City Schools
Pell City, Alabama

MCKEE PROJECT NO. 21.184
ALABAMA DIVISION OF CONSTRUCTION MANAGEMENT NO. 2022173

The following changes and/or substitutions to the plans and specifications are hereby made a part of same and are incorporated in full force as part of the contract.

Bidders shall acknowledge receipt of this Addendum in writing on his Proposal Form.

A1.1 GENERAL MODIFICATIONS:

A. Refer to the **Advertisement for Bids**, **Change** as follows:

1. The sealed proposal as described above shall be received by Dr. James Martin, Superintendent, Pell City Schools, 3105 15th Avenue North, Pell City, Alabama, 35125, Phone: (205) 884-4440 on **Thursday, July 14, 2022**, then opened and read aloud.

   EDEN ELEMENTARY SCHOOL ADDITION – until 2:00 P.M. and

   COOSA VALLEY ELEMENTARY SCHOOL ADDITION – until 2:30 P.M.

B. Refer to **TABLE OF CONTENTS, Revised, dated 6.15.22**, herein.

A1.2 SPECIFICATION MODIFICATIONS:

A. Refer to **Section 04200, Unit Masonry, REVISED, dated 6.22.22**, herein.
B. Refer to **Section 07500, Membrane Roof, REVISED, dated 6.14.22**, herein.
C. Refer to **Section 09800, Acoustical Wall Panels and DELETE in its entirety.**
D. Refer to **Section 09843, Sound Absorbing Wall Panels (AWP)**, herein.
E. Refer to **Section 15000, Heating, Ventilating and Air Conditioning**, herein.

A1.3 DRAWING MODIFICATIONS:

A. See the attached Revised Drawings as follows:

1. **Sheet(s) E3.2, REVISED, dated 6.14.22**, herein.

A1.4 CLARIFICATIONS & RESPONSES:

A. See the following responses to RFI questions received from Contractor's

Question: On Coosa Valley roof framing plan (S3.2B), one section callouts is listed as 18/S3.1B. There is no such detail on S3.1B. However, there is the section detail on 18/S.2B. Is that a typo? In this section, top plate on W8 beam, there is no description and the description of studs are confusing (2-3/8" x 4" x 4") Please advise.

Answer: Section Flag should be S3.2B. Plate sizes are the minimum size that the precast supplier must provide for welding the beam to the hollow core The embeds and Studs will be by precast supplier.

END OF ADDENDUM

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Eden Elementary School Addition and Coosa Valley Elementary School Addition

for

Pell City Schools

Pell City, Alabama

MCKEE PROJECT NO. 21.184

BIDDING REQUIREMENTS

CONTRACT FORMS

- Payment Bond (ABC Form C-7, August 2021)

GENERAL CONDITIONS

- General Conditions of the Contract (DCM Form C-8, August 2021)
- Instructions for Contractor's Insurance Company (Article 37 of DCM Form C-8, August 2021)
- Supplement to General Conditions of the Contract (McKee Form August 2020)
- Application and Certificate for Payment (DCM Form C-10, Revised October 2021)
- Schedule Of Values, (DCM Form C-10SOV, Revised October 2021) Attachment to DCM Form C-10
- Inventory Of Stored Materials, (DCM Form C-10SM, Revised October 2021) Attachment to DCM Form C-10
- Pre-Construction Conference Checklist (DCM Form B-8, November 2021)
- Progress Schedule and Report (DCM Form C-11, August 2021)
- Project Data Form (DCM Form B-9, August 2021)
- Statement Of Field Observations (DCM Form B-10, August 2021)
- Change Order Checklist, (DCM Form B-12, August 2021) For Use With DCM Form C-12
- Contract Change Order (DCM Form C-12 (fully locally-funded K-12 Schools), August 2021)
- Change Order Justification (DCM Form B-11, August 2021) Attachment to DCM Form C-12
- Certification Of Structural Observations (For All New K-12 Public Schools with Tornado Storm Shelters), (DCM Form B-14, Revised August 2021) Attachment to DCM Form C-13.
- Final Payment Checklist (DCM Form B-13, August 2021)
- Certificate of Substantial Completion (DCM Form C-13, August 2021)
- Form of Advertisement for Completion (DCM Form C-14, August 2021)
- Contractor's Affidavit of Payment of Debts and Claims (DCM Form C-18, August 2021)
- Contractor's Affidavit of Release of Liens (DCM Form C-19, August 2021)
- Consent of Surety to Final Payment (DCM Form C-20, August 2021)
- Detail Of Project Sign (DCM Form C-15, August 2021)
- Detail Of Plaque (ABC Form C-16, August 2001)
- General Contractor's Roofing Guarantee (DCM Form C-9, August 2021)

TECHNICAL SPECIFICATIONS

END OF TABLE OF CONTENTS

SECTION 04200 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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 DESCRIPTION OF WORK

A. Extent of each type of masonry work is indicated on drawings and schedule.

B. Types of masonry work required include.

1. Concrete unit masonry.

2. Brick masonry.

1.3 QUALITY ASSURANCE

A. Fire Performance Characteristics: Where indicated, provide materials and construction which are identical to those of assemblies whose fire endurance has been determined by testing in compliance with ASTM E 119 by a recognized testing and inspecting organization or by another means, as acceptable to authority having jurisdiction.

B. Single Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.

C. Single Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

D. Samples: Submit the following samples:

1. Unit masonry samples for each type of exposed masonry unit required; include in each set the full range of exposed color and texture to be expected in completed work.

2. Include size variation data verifying that actual range of sizes for brick falls within ASTM C652 dimension tolerances for brick where modular dimensioning is indicated. The grade shall be SW and the type HBS.

E. Field Constructed Mock-Up Panel: Prepare mock-up panel for the following types of masonry. Purpose of mock-up is further verification of selections made for color and finish under sample submittals and establishing standard of quality for aesthetic effects expected in completed work. Build mock-up panel to comply with the following requirements:

1. Locate mock-up panel on site where directed by the Architect.

2. Build mock-up panel of typical exterior masonry wall, approximately 4’-0” long by 4’-0” high, showing all typical components, connections, attachments to building structure and methods of installation.

3. Retain mock-up panel during construction as standard for judging completed masonry work. When directed, demolish mock-up panel and remove from site.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver masonry materials to project in undamaged condition.

B. Store and handle masonry units to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes. Store masonry units off the ground.

C. Store cementitious materials off the ground, under cover and in dry location.

D. Store aggregates where grading and other required characteristics can be maintained.

E. Store masonry accessories including metal items to prevent deterioration by corrosion and accumulation of dirt.

1.5 PROJECT CONDITIONS

A. Protection of Work: During erection, cover top of walls with waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress.

B. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

C. Do not apply uniform floor or roof loading for at least 24 hours after building masonry walls or columns.

D. Staining: Prevent grout or mortar or soil from staining the face of masonry to be left exposed or painted. Remove immediately grout or mortar in contact with such masonry.

E. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.

F. Protect sills, ledges and projections from droppings of mortar.

G. Environmental Protection:

1. Maintain air temperature and materials to a minimum of 40 degrees F and a maximum of 90 degrees F prior to and during masonry work
2. Do not lay masonry units which are wet or frozen.
3. Remove masonry damaged by freezing conditions.

H. For clay masonry units with initial rates of absorption (suction) which require them to be wetted before laying, comply with the following requirements.

1. For units with surface temperatures above 32°F wet with water heated to above 70°F.
2. For units with surface temperatures below 32°F wet with water heated to above 130°F.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. General: Comply with referenced standards and other requirements indicated below applicable to each form of concrete masonry unit required.

1. Provide special shapes where required for lintels, corners, jambs, sash, control joints, headers, bonding and other special conditions.
2. Provide bullnose units for outside corners, except where indicated as square-edged.

B. Concrete Block: Provide units complying with characteristics indicated below for Grade, Type, face size, exposed face and under each form of block included, for weight classification.

1. Grade N
2. Size: Manufacturer's standard units with nominal face dimensions of 16" long x 8” high x thickness indicated.
3. Type I: moisture-controlled units.
4. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
5. Hollow Loadbearing Block: ASTM C 90 and as follows:
   a. Weight Classification: Lightweight
6. All CMU sills shall be bullnose concrete block, unless another material is indicated on the drawings. If the sills are indicated to receive another material (ie: Solid Surface fabrication, wood, etc.) placed on top of the CMU sill, the CMU sill shall be straight edged concrete block units.

C. **Exterior Colored Smooth and Split-Faced CMU**:

1. Exterior units **MATCH EXISTING SPLIT FACE COLORED BLOCK SIZE, COLOR & TEXTURE.**
2. **Two (2) Colors Total**.
3. Exterior units to be 16" long x 8" high x thickness indicated.
4. Block shall be as manufactured by “Block USA, Jefferson Series or approved equal.
5. Color to be selected by Architect after bid date from Manufacturer Premium Colors. If Architect chooses color of lesser value after Bid Process, Contractor shall issue a deductive Change Order for the difference.
6. Contractor shall erect panel prior to installation for Architects approval. All exterior smooth and split faced block shall be produced by the manufacture in a single run process.
7. Integral Water Repellent Admixture – CMU and Mortar. All exterior units shall be water repellant by using “dry block” integral admix as described below:
   a. Description: An integral liquid polymeric admixture mixed with concrete during production of CMU and mixed with mortar mix, which cross links and becomes permanently locked into the CMU and mortar to provide resistance to water penetration.
   b. Water Permeance: ASTM E 514m achieves Class E rating with no water visible on back of wall above flashing at end of 72 hours, not more than 25 percent of wall area above flashing damp at end of three days, and no leaks (a leak is a flow of water from flashing at a rate equal to or greater than 0.0132 gallons per hour) through wall at end of one day.
   c. Water Vapor Transmission: ASTM E 96, passes. Bond strength: ASTM E 72 and/or ASTM C 1072, minimum equal to bond strength without admixture.
   d. CMU Sampling and Testing: ASTM C 140 surpasses normal and medium weight CMU for compressive strength absorption, weight, moisture content, and dimensional stability.
   e. Water Mixability: fully dispersible in water
   f. Specific Gravity: Minimum 1.0
   g. Manufacturer: Forrer Industries – Dry-Block Water-Repellent Admixture or equal.
8. CMU Sills indicated on drawings are to be solid square edge CMU block in sizes as indicated on drawings.
9. Block Sealer - The Exterior face ONLY (including mortar joints) of all units shall receive two (2) coats of silicone emulsion or RTV Silicone Coating equal to Prosoco Blok-Guard & Graffiti Control or Prosoco Blok-Guard & Graffiti Control II. Contractor must verify that the product used is approved by the block manufacturer. Application shall be as recommended by the sealer manufacturer.

2.2 BRICK MADE FROM CLAY OR SHALE

A. MANUFACTURERES: The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:

1. ACME Brick Company, Montgomery, AL
2. Boral Bricks, Phenix City, Al
3. Henry Brick Company, Selma, AL
4. Equal products of other manufacturers may be used in the work provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

B. General: Comply with referenced standards and other requirements indicated below applicable to each form of brick required.

C. Provide special molded shapes where indicated and for application requiring brick of form, size and finish on exposed surfaces which cannot be produced from standard brick sizes by sawing.

D. For sills, caps and similar applications resulting in exposure of brick surfaces which otherwise would be concealed from view, provide uncored or unfrogged units with all exposed surfaces finished.

E. Facing Brick: Submit samples for approval of equals prior to bids. Eased edge brick shall not be allowed.

2.3 MORTAR AND GROUT MATERIALS

A. MANUFACTURERS: The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:

1. Atlas
2. Citadel
3. Lone Star
4. Magnolia
5. Equal products of other manufacturers may be used in the work provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

B. Masonry Cement: ASTM C 91.

1. Type S for CMU walls
2. Type N for Exterior Face and Accent brick – color pigment.

C. Hydrated Lime: ASTM C 207, Type S.

D. Aggregate for Mortar: ASTM C 144, except for joints less than 1/4" use aggregate graded with 100% passing the No. 16 sieve.

E. Water: Clean and potable.

2.4 JOINT REINFORCEMENT, TIES AND ANCHORING DEVICES

A. MANUFACTURERS: The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:

1. Dur-O-Wall, Inc.
2. Heckman Building Products, Inc.
3. Masonry Reinforcing Corp. of America.
4. National Wire Products Corp.
5. Equal products of other manufacturers may be used in the work provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

B. Materials: Comply with requirements indicated below for basic materials and with requirements indicated under each form of joint reinforcement, tie and anchor for size and other characteristics.

C. Use individual galvanized steel metal ties installed in horizontal joints to bond wythes together

only where wood or metal stud backup occurs. Provide ties as shown, but not less than one metal tie for 4 sq. ft. of wall area spaced not to exceed 24" o.c. horizontally and vertically. Stagger ties in alternate courses. Provide additional ties within 1'-0" of all openings and space not more than 3'-0" apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24" o.c. vertically.

D. Hot-Dip Galvanized Steel Wire: ASTM A 82 for uncoated wire and with ASTM A 123, Class B-2 (1.5 oz. per sq. ft. of wire surface) for zinc coating applied after prefabrication into units.

E. Application: Use where indicated.

F. Joint Reinforcement: Provide truss-type, welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10', with prefabricated corner and tee units, and complying with requirements indicated below:

1. Width: Fabricate joint reinforcement in units with widths of approximately 2" less than nominal width of walls and partitions as required to provide mortar coverage of not less than 5/8" on joint faces exposed to exterior and 1/2" else- where.

2.5 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet.
2. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
5. Fabricate through-wall flashing with drip edge where indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees.
6. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 3/8 inch to form a stop for retaining sealant backer rod.
7. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
8. Metal Drip Edges: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees.
9. Metal Flashing Terminations: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 3/8 inch to form a stop for retaining sealant backer rod.
10. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.

B. Flexible Flashing: For flashing not exposed to the exterior, use one of the following, unless otherwise indicated:

1. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy as follows:
   a. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 inch thick.
   b. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch thick coating of rubberized-asphalt adhesive.
   c. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches from edge.
   d. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
2. EPDM Flashing: Sheet flashing product made from ethylene-propylene-dieneterpolymer, complying with ASTM D 4637, 0.040 inch thick.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

D. MANUFACTURERS: The following manufacturers' products have been used to establish minimum standards for materials, workmanship, and function:

1. Vinyl Sheet Flashing: (Thickness: 20 mils)
    a. Vi-Seal Plastic Flashing; Afco Products, Inc.
    b. BFG Vinyl Water Barrier; B.F. Goodrich Co.
    c. Nuflex; Sandell Manufacturing Co., Inc.
    d. Wascosea"; York Manufacturing, Inc.
    e. Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

2.6 MISCELLANEOUS MASONRY ACCESSORIES

A. See drawings for locations of all required control joints.

B. Non-Metallic Expansion Joint Strips: Pre-molded, flexible cellular neoprene rubber filler strips complying with ASTM D 1056, Grade RE41E1, capable of compression up to 35%, of width and thickness indicated.

C. Premolded Control Joint Strips: Material as indicated below designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

1. Polyvinyl chloride complying with ASTM D 2287, General Purpose Grade, Designation PVC-63506.

D. Bond Breaker Strips: Asphalt-saturated organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mortar Net Solutions; Mortar Net with Insect Barrier or comparable product by one of the following:
    a. Advanced Building Products Inc.
    b. Heckmann Building Products, Inc.
    c. Wire-Bond.
2. Configuration: Provide one of the following:
    a. Strips, full depth of cavity and 10 inches (250 mm) high, with dovetail-shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.

2.7 MASONRY CLEANERS

A. Job-Mixed Detergent Solution: Solution of trisodium phosphate (1/2 cup dry measure) and laundry detergent (1/2 cup dry measure) dissolved in one gallon of water.

2.8 MORTAR AND GROUT MIXES

A. General: Do not add admixtures including air-entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

B. Mixing: Combine and thoroughly mix cementitious, water and aggregates in a mechanical batch mixer; comply with referenced ASTM standards for mixing time and water content.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification, for types of mortar required, unless otherwise indicated.

1. For Exterior Brick, use Type N mortar, equal to Flamingo, Blue Circle or Lehigh.
2. For Other Masonry Units use Type S mortar without coloring pigment.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Wetting Clay Brick: Wet brick made from clay or shale which have ASTM C 67 initial rates of absorption (suction) of more than 30 grams per 30 sq. in. per minute. Use wetting methods which ensure each clay masonry unit being nearly saturated but surface dry when laid.

B. Do not wet concrete masonry units.

C. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.

D. Thickness: Build cavity and composite walls, floors and other masonry construction to the full thickness shown. Build single wythe walls (if any) to the actual thickness of the masonry units, using units of nominal thickness indicated.

E. Build chases and recesses as shown or required for the work of other trades. Provide not less than 8" of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

F. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.

G. Cut masonry units using motor-given saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining work. Use full-size units without cutting where possible.

1. Use wet cutting saws to cut concrete masonry units.

3.2 LAYING MASONRY WALLS

A. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to accurately locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.

B. Coursing and Bonding:

1. **All CMU shall be Stack Bond unless otherwise indicated on structural drawings.**

C. Stopping and Resuming Work: Rack back 1/2-unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.

D. Built-in Work: As the work progresses, build-in items specified under this and other sections of these specifications. Fill in solidly with masonry around built-in items.

1. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.

3.3 MORTAR BEDDING AND JOINTING

A. Lay masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.

B. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

C. Maintain joint width shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8" joints.

D. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials, unless otherwise indicated.

E. Tool all exposed joints, except where otherwise indicated, slightly concave using a jointer larger than joint thickness, unless otherwise indicated.

F. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners or jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

3.4 STRUCTURAL BONDING OF MULTI-WYTHE MASONRY

A. Use continuous horizontal joint reinforcement installed in horizontal mortar joints for bond tie between wythes. Install at not more than 16" o.c. vertically.

B. Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.

1. For horizontally reinforced masonry, provide continuity at corners with prefabricated "L" units, in addition to masonry bonding.

C. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and space as shown below:

1. At juncture of interior partitions and exterior walls, rake and caulk vertical joint.
2. Provide metal ties as shown below.
3. Provide individual metal ties at not more than 16" o.c. vertically.
4. Provide continuity with horizontal joint reinforcement using prefabricated "T" units.

D. Intersecting Load-bearing Walls: If carried up separately, block or tooth vertical joint with 8" maximum offsets and provide rigid steel anchors spaced not more than 4'-0" o.c. vertically, or omit blocking and provide rigid steel anchors at not more than 2'-0" o.c. vertically. Form anchors of galvanized steel not less than 1-1/2" x 1/4" x 2'-0" long with ends turned up not less than 2" or with cross-pins. If used with hollow masonry units, embed ends in mortar-filled cores.

E. Non-bearing Interior Partitions: Build full height of story to underside of roof structure above, unless otherwise shown.

3.5 CAVITY WALLS

A. Keep cavity clean of mortar droppings and other materials during construction. Strike joints facing cavity flush.

B. Tie exterior wythe to new back-up with continuous horizontal joint reinforcing, installed in mortar joints at not more than 16" o.c. vertically.

C. Provide weep holes (Open Head Joints) in exterior wythe of cavity wall located as directed on the drawings, spaced 32" o.c., unless otherwise indicated.

3.6 CAVITY WALL INSULATION

A. On units of plastic insulation, install small pads of adhesive spaced approximately 1'-0" o.c. both ways on inside face. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill all cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.7 HORIZONTAL JOINT REINFORCEMENT

A. General: Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8" on exterior side of walls, 1/2" elsewhere. Lap reinforcing a minimum of 6".

B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Reinforce walls with continuous horizontal joint reinforcing unless specifically noted to be omitted.

D. Reinforce masonry openings greater than 1'-0" wide, with horizontal joint reinforcement placed in 2 horizontal joints approximately 8" apart, immediately above the lintel and immediately below the sill. Extend reinforcement a minimum of 2'-0" beyond jambs of the opening except at control joints.

1. In addition to wall reinforcement, provide additional reinforcement at openings as required to comply with the above.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Provide vertical and horizontal expansion, control and isolation joints in masonry where shown. Build-in related items as the masonry work progresses.

3.9 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and wherever openings of more than 1'-0" for brick size units and 2'-0" for block size units are shown without structural steel or other supporting lintels. Provide formed-in-place masonry lintels. Temporarily support formed-in-place lintels.

C. Provide minimum bearing of 8" at each jamb, unless otherwise indicated.

3.10 FLASHING OF MASONRY WORK

A. General: Provide concealed flashing in masonry work at, or above shelf angles, lintels, ledges and other obstructions to the down- ward flow of water in the wall so as to divert such water to the exterior. Prepare masonry surfaces smooth and free from projections which could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with mastic before covering with mortar. Extend flashings through exterior face of masonry and turn down to form drip.

B. Extend flashing the full length of lintels and shelf angles and minimum of 4" into masonry each end. Extend flashing from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4", and through the inner wythe to within 1/2" of the interior face of the wall in exposed work. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2". At heads and sills turn up ends not less than 2" to form a pan.

C. Interlock end joints of deformed metal flashings by over-lapping deformations not less than 1-1/2" and seal lap with elastic sealant.

D. Install flashing to comply with manufacturer's instructions.

E. Provide weep holes (open head joints) in the head joints of the first course of masonry immediately above concealed flashings. Space weep holes 32" o.c., unless otherwise indicated.

3.11 REPAIR, POINTING AND CLEANING

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point- up all joints including corners, openings and adjacent work to provide a neat, uniform appearance, prepared for application of sealants.

C. Final Cleaning: After mortar is thoroughly set and cured, clean masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave 1/2 panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

3. Protect adjacent non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film or waterproof masking tape.

4. Saturate wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clean water.

5. Use bucket and brush hand cleaning method described in BIA "Technical Note No. 10 Revised" to clean brick masonry made from clay or shale, except use masonry cleaner indicated below.

a. Detergent

6. Clean concrete unit masonry to comply with masonry manufacturer's directions and applicable NCMA "Tek" bulletins.

END OF SECTION

SECTION 07500 - MEMBRANE ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of Contract including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

1.2 DESCRIPTION OF WORK

A. The roofing contractor shall be fully knowledgeable of all requirements of the contract documents and shall make themselves aware of all job site conditions prior to the bid that will affect their work.

B. Provide all labor, material, tools, equipment, and supervision necessary to furnish and install a **60** mil white reinforced TPO (Thermoplastic Polyolefin) or a **60** mil **PVC** (polyvinyl chloride) membrane.

C. **NOTE: PVC (polyvinyl chloride) membrane is required at all Kitchen Roof areas.**

1.3 SUBMITTALS

A. Prior to starting work, the roofing contractor must submit the following:

1. Shop drawings showing layout of insulation, details of construction and identification of materials.
2. Sample of the manufacturer's Membrane System Warranty.
3. Submit a letter of certification from the manufacturer which certifies the roofing contractor is authorized to install the manufacturer's roofing system.
4. Certification of the manufacturer's warranty reserve.

B. Upon completion of the installed work, submit copies of the manufacturer's final inspection to the specifier prior to the issuance of the manufacturer's warranty.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in the manufacturer's original, unopened containers or wrappings with the manufacturer's name, brand name and installation instructions intact and legible. Deliver in sufficient quantity to permit work to continue without interruption. Comply with the manufacturer's written instructions for proper material storage.

1. Store the **TPO and PVC** membranes in the original undisturbed plastic wrap in a cool, shaded area and cover with light-colored, breathable, waterproof tarpaulins. Thermoplastic membrane that has been exposed to the elements for approximately seven (7) days must be prepared with appropriate cleaner prior to hot air welding.
2. Store curable materials (adhesives and sealants) between 60°F and 80°F in dry areas protected from water and direct sunlight. If exposed to lower temperature, restore to 60°F minimum temperature before using.
3. Store materials containing solvents in dry, well ventilated spaces with proper fire and safety precautions. Keep lids on tight. Use before expiration of their shelf life.
4. Insulation must be on pallets, off the ground and tightly covered with waterproof materials.
5. Any materials, which are found to be damaged, shall be removed and replaced at the applicator's expense.

1.5 WORK SEQUENCE

A. Schedule and execute work to prevent leaks and excessive traffic on completed roof sections. Care should be exercised to provide protection for the interior of the building and to ensure water does not flow beneath any completed sections of the membrane system.

B. Do not disrupt activities in occupied spaces.

1.6 JOB SITE PROTECTION

A. The roofing contractor shall adequately protect building, paved areas, service drives, lawn, shrubs, trees, etc. from damage while performing the required work. Provide all materials as necessary for protection and remove protection material at completion. The contractor shall repair or be responsible for costs to repair all property damaged during the roofing application.

B. If during the roofing contractor's performance of the work the building owner continues to occupy the existing building, the contractor shall take precautions to prevent the spread of dust and debris, particularly where such material may sift into the building. The roofing contractor shall provide labor and materials to construct, maintain and remove necessary temporary enclosures to prevent dust or debris in the construction area(s) from entering the remainder of the building.

C. Do not overload any portion of the building, by either use of or placement of equipment, storage of debris, or storage of materials.

D. Protect against fire and flame spread. Maintain proper and adequate fire extinguishers.

E. Take precautions to prevent drains from clogging during the roofing application.

F. Remove debris at the completion of each day's work and clean drains, if required. At completion, test drains to ensure the system is free running and drains are watertight. Remove strainers and plug drains in areas where work is in progress. Install flags or other telltales on plugs. Remove plugs each night and screen drain.

G. Store moisture susceptible materials above ground and protect with waterproof coverings.

H. Remove all traces of piled bulk materials and return the job site to its original condition upon completion of the work.

1.7 SAFETY

A. The roofing contractor shall be responsible for all means and methods as they relate to safety and shall comply with all applicable local, state, and federal requirements that are safety related. Safety shall be the responsibility of the roofing contractor. All related personnel shall be instructed daily to be mindful of the full time requirement to maintain a safe environment for the facility's occupants including staff, visitors, customers, and the occurrence of the public on or near the site.

1.8 WORKMANSHIP

A. Applicators installing new roof, flashing and related work shall be factory trained and approved by the manufacturer they are representing.

B. All work shall be of highest quality and in strict accordance with the manufacturer's published specifications and to the building owner's satisfaction.

C. There shall be a supervisor on the job site at all times while work is in progress.

1.9 QUALITY ASSURANCE

A. The Contractor shall engage the services of a Professional Roof Consultant. The Consultant must hold a minimum title of Registered Roof Observer (RRO) through the International Institute of Building Enclosure Consultants (IIBEC) and provide evidence of adequate insurance as required below. The Consultant should perform three (3) inspections during the installation of each new roof system type (1 – Start up inspection; 2 – Interim inspection; 3 – Final inspection). The Consultant must document all site visits with photographs and written reports. All reports shall be forwarded to the Architect with documentation of the roofing progress and any deficiencies noted during the inspections. Upon completion of all punch list items, the Consultant should provide a letter of roof completion advising the new roof systems meet and/or exceed the project requirements. ***(Note: Although the contractor will be paying the roof consultant from their proceeds, the roof consultant will be considered an agent of the owner and architect throughout the project and will perform the required inspections on behalf of the owner***

and architect. The above specification shall be applied to individual facilities when multiple site locations are included in the project.)

1. Roof Consultant Insurance Requirements:
    a. Gen. Liability - $1,000,000 each occurrence - $2,000,000 General Aggregate / Auto. Liability - $1,000,000 / Umbrella Liability. - $1,000,000 / Workers Compensation - $1,000,000 per statute / Professional Liability - $1,000,000
2. Approved Roof Consulting Firm:
    a. Roof Asset Management, Inc. | David Lee, RRO, CIT, FAA-107 | 4950 Woodfield Drive, Millbrook, Alabama 36054 | (334) 590-7999.
    b. Substitutions: Roof consulting firms must be pre-approved by the Architect. Requests for a substituting firm must be submitted “In writing” 10 (Ten) days prior to the bid opening**.**

C. The Contractor shall provide signed certification from the Roofing Manufacturer that the roof design provided for this project complies with the performance requirements as set forth by applicable applications in IBC Chapter 15, Section 1504.
    1. The certification shall be attached to the Roof Warranty provided at the close out of the project.
    2. Contractor shall submit a copy of his Manufacturer’s Warranty Notification prior to purchase of materials and start of work.

D. Roof system will meet the requirements of all federal, state and local code bodies having jurisdiction.

E. The TPO or PVC membrane roofing system must achieve a UL Class A and the appropriate FM rating.

F. Unless otherwise noted in this specification, the roofing contractor must strictly comply with the manufacturer's current specifications and details.

G. Impact Resistance: Roof coverings installed on low-slope roofs (roof slope <2:12) shall resist impact damage based on the results of tests conducted in accordance with ASTM D 3746, ASTM D 4272, CGSB 37-GP-52M or the “Resistance to Foot Traffic Test “FM 4470.

H. Drainage:
    1. Provide a roof system with positive drainage where all standing water dissipates within 48 hours after precipitation ends.

I. All roof curbs and penetrations shall have a minimum height of 8” above the completed roof system.

J. Roof curbs shall be installed in accordance with roofing system manufactures instructions.

K. **The roofing system must be installed by an applicator authorized and trained by the manufacturer in compliance with shop drawings as approved by the Architect /owners representative.**

L. Provide adequate number of experienced workers regularly engaged in this type of work who are skilled in the application techniques of the materials specified. Provide at least one thoroughly trained and experienced superintendent on the job at all times roofing work is in progress.

M. There shall be no deviations made from this specification or the approved shop drawings without the prior written approval of the Architect. Any deviation from the manufacturer's installation procedures must be supported by a written certification on the manufacturer's letterhead and presented for the Architects consideration.

N. Upon completion of the installation, the applicator shall arrange for an inspection to be made by a non-sales technical representative of the membrane manufacturer in order to determine whether

corrective work will be required before the warranty will be issued. Notify the Architect and General Contractor seventy-two (72) hours prior to the manufacturer's final inspection.

1.10 JOB CONDITIONS, CAUTIONS, AND WARNINGS

A. Material Safety Data Sheets (MSDS) must be on location at all times during the transportation, storage, and application of materials.

B. When positioning membrane sheets, exercise care to locate all field splices away from low spots and out of drain sumps. All field splices should be shingled to prevent bucking of water.

C. When loading materials onto the roof, the Authorized Roofing Applicator must comply with the requirements of the building owner to prevent overloading and possible disturbance to the building structure.

D. Proceed with roofing work only when weather conditions comply with the manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with the manufacturer's requirements and recommendations.

E. Proceed with work so new roofing materials are not subject to construction traffic. When necessary, new roof sections shall be protected and inspected upon completion for possible damage.

F. Provide protection, such as 3/4 inch thick plywood, for all roof areas exposed to traffic during construction. Plywood must be smooth and free of fasteners and splinters.

G. The surface on which the insulation or roofing membrane is to be applied shall be clean, smooth, dry, and free of projections or contaminants that would prevent proper application of or be incompatible with the new installation, such as fins, sharp edges, foreign materials, oil and grease.

H. New roofing shall be complete and weather tight at the end of the workday.

I. Contaminants such as grease, fats, and oils shall not be allowed to come in direct contact with the roofing membrane.

1.11 WARRANTY

A. Compatibility: Provide products which are recommended by manufacturers to be fully compatible with indicated substrates or provide separation materials as required to eliminate contact between incompatible materials.

B. **Provide manufacturer's 20-year NDL total system warranty covering both labor and material with no dollar limitation and cover all penetrations.**

C. **General Contractor shall provide the General Contractor’s 5-year Roofing Guarantee included in this manual.**

D. Pro-rated system warranties shall not be accepted.

E. Evidence of the manufacturer's warranty reserve shall be included as part of the project submittals for the specifier's approval.

F. All roof warranties shall be provided to the Owner, by the Contractor at the Final Inspection to obtain the Substantial Completion.

G. The roof insulation shall be covered under the roof warranty as required by the manufacturer.

H. ***Standard manufacturer’s roofing guarantees which contain language regarding the governing of the guarantee by any state other than the State of Alabama, must be amended to exclude such language, and substituting the requirement that the Laws of the State of Alabama shall govern all such guarantees.***

I. The roofing manufacturer shall be required to provide documentation certifying that the roof

design provided complies with the performance requirements as set forth in IBC Chapter 15, Section 1504. The documentation shall be attached to the roof warranty at the close out of the project.

PART 2 – PRODUCTS

2.1 GENERAL

A. All components of the specified roofing system shall be products of the manufacturer of the roofing system or accepted by the manufacturer as compatible. All products (including insulation, fasteners, fastening plates and edgings) must be manufactured and supplied by the roofing system manufacturer and covered by the warranty.

B. MANUFACTURERS

1. TPO 60 Mil Manufacturers: The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:
    a. Versico Roofing - Versiweld with Octguard XT (Basis of Design)
    b. GAF – Everguard
    c. Firestone – Ultraply
    d. Johns Manville, Inc.
    e. Carlisle Syntec Systems
2. PVC 60 Mil Manufactures: The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:
    a. Versico Roofing - VersiFlex Roofing (Basis of Design)
    b. DuroLast Roofing
    c. Johns Manville, Inc.
    d. Sarnafil Roof Membrane Roofing
    e. Fibertite Roofing
    f. Carlisle Syntec Systems
4. Walkway Pads: The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:
    a. Roof Trak III Walkway Pads as manufactured by Durolast.
        i. Non-skid, maintenance free walkway protection pad manufactured from recycled membrane and oriented-strand polyester reinforcement. Factory attached, 4 inch wide white membrane skirts for attachment to the field membrane by heat welding (hot-air).
        ii. Size: 30” x 60”.
        iii. Color: White with Safety Yellow skirts.
        iv. Install per manufacturers recommendations.
3. Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

2.2 ADHESIVES AND CLEANERS

A. All products shall be furnished by the roofing manufacturer and specifically formulated for the intended purpose.

1. Bonding Adhesive: **60** Mil: Manufactures recommended Bonding Adhesive
2. Edge Sealant: Cut Edge Sealant
3. Sealer: Water Cut-Off Mastic
4. Pocket Sealant: Manufactures recommended Molded Pocket Sealant
5. Cleaner: Manufactures recommended Membrane Cleaner

B. The Contractor shall be responsible for ensuring all existing curbs / flashings shall be raised as necessary to ensure proper flashing heights.

PART 3 - EXECUTION

3.1 PRE-ROOFING CONFERENCE

A. A pre-roofing conference is required before any roofing materials are installed. This conference shall be conducted by a representative of the Architect. Required attendees include representatives of the Owner, Division of Construction Management Inspector, General Contractor, Roofing Contractor, Sheet Metal Contractor, Roof Deck Manufacturer (if applicable), Roofing Materials Manufacturer (if warranty is required of this manufacturer) and all installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment . ATTENDANCE OF THE CONTRACTOR'S FOREMAN IS MANDITORY. If equipment of substantial size is to be placed on the roof, the Mechanical Contractor must also attend this meeting. Provide at least 72 hours advance notice to participants prior to convening pre-roofing conference.

B. The pre-roofing conference is intended to clarify demolition and application requirements for work to be completed before roofing operations can begin. This would include a detailed review of the specifications, roof plans, roof deck information, flashing details, and approved shop drawings, submittal data, and samples. If conflict exists between the specifications and the Manufacturer's requirements, this shall be resolved. If this pre-roofing conference cannot be satisfactorily concluded without further inspection and investigation by any of the parties present, it shall be reconvened at the earliest possible time to avoid delay of the work. In no case should the work proceed without inspection of all roof deck areas and substantial agreement on all points.

C. The following are to be accomplished during the conference:

1. To review all Factory Mutual and Underwriters Laboratories requirements listed in the specifications and resolve any questions or conflicts that may arise.
2. To establish trade-related job schedules, including the installation of roof mounted mechanical equipment.
3. To establish roofing schedule and work methods that will prevent roof damage.
4. Require that all roof penetrations and walls be in place prior to installing the roof.
5. To establish those areas on the job site that will be designated as work and storage areas for roofing operations.
6. To establish weather and working temperature conditions to which all parties must agree.
7. To establish acceptable methods of protecting the finished roof if any trades must travel across or work on or above any areas of the finished roof.
8. Tour representative areas of roofing substrates (decks); inspect and discuss condition of substrate, penetrations and other preparatory work performed by other trades.
9. Review structural loading limitations of deck and inspect deck for proper installation and fastening as required. Inspect deck for required slope etc.
10. Review roofing system requirements (drawings, specifications and other contract documents). Review required submittals / warranty issues. Verify that the manufacturer's label contains references to specified ASTM standards.

11. Review and finalize construction schedule related to roofing work and verify availability of materials.
12. Review roof application procedures, technique, details and roof specifics. Maintain one copy of manufacturer's application instructions on the project site.
13. Review job specific safety requirements, safety barriers, street blocking, haul routes, building access, site contact, facilities, security, etc.

C. The Architect shall prepare a written report indicating actions taken and decisions made at this pre-roofing conference. This report shall be made a part of the project record and copies furnished the General Contractor, the Owner, the Division of Construction Management, and the Division of Construction Management Inspector.

3.1 INSTALLATION - GENERAL

A. Comply with the manufacturer's published instructions for the installation of the membrane roofing system including proper substrate preparation, jobsite considerations, and weather restrictions.

B. Position sheets to accommodate contours of the roof deck and shingle splices to avoid bucking water.

3.2 EXECUTION – NEW ROOF SYSTEMS

A. Installation of New Roof System as follows:

1. Roof Insulation
   a. Tapered/non-tapered polyisocyanurate insulation.
      i. Refer to Section 07510, Roof Insulation
   b. Cover board
      i. 1/2", 100 psi. ISO HD board
         a) Mechanically Attached
   c. Must maintain a minimum total R value of 25 at any area.
2. Membrane
   a. **60** mil white reinforced **TPO or PVC** membrane
      i. Adhered in accordance with the manufacturer's most current specifications and details.
   b. **60** mil TPO or PVC membrane flashings and associated metal components as required.
3. Warranties
   a. Provide a **20**-year NDL manufacturer's warranty
   b. Provide a **5**-year General Contractor's Roofing Guarantee workmanship warranty found in Contract Forms section of this manual.

3.3 INSULATION PLACEMENT AND ATTACHMENT

A. Install insulation or membrane underlayment over the substrate with boards butted tightly together with no joints or gaps greater than 1/4 inch. Stagger joints both horizontally and vertically if multiple layers are provided.

B. Secure insulation to the substrate with the required fasteners and plates in accordance with manufacturers specifications.

3.4 60 Mil TPO or PVC MEMBRANE PLACEMENT AND ATTACHMENT

A. Unroll and position membrane without stretching. Provide and secure both perimeter and field membrane sheets in accordance with the manufacturer's most current specifications and details.

B. Secure the membrane with the required Fasteners and Plates spaced as required per the manufacturer's requirements to meet the appropriate up-lift at perimeters, curbs, penetrations, drains, etc. with field of sheets fully adhered in the manufacturer's recommended adhesive.

C. Install adjoining membrane sheets in the same manner in accordance with the manufacturer's specifications.

D. Hot air weld the membrane using an Automatic Hot Air Welding Machine or Hot Air Hand Welder in accordance with the manufacturer's specifications. At all splice intersections, roll the seam with a silicone roller prior to membrane seam cooling. All splice intersections shall be overlaid with membrane non-reinforced flashing.

E. Probe all seams once the hot air welds have thoroughly cooled (approximately 30 minutes).

F. Repair all seam deficiencies the same day they are discovered.

G. Apply Cut Edge Sealant on all cut edges of reinforced membrane (where the scrim reinforcement is exposed) after seam probing is complete.

3.5 FLASHING

A. Flashing of parapets, curbs, expansion joints and other parts of the roof must be performed using TPO or PVC reinforced membrane. Non-reinforced membrane can be used for flashing pipe penetrations, Sealant Pockets, scuppers, as well as inside and outside corners when the use of pre-fabricated accessories is not feasible.

B. TPO/PVC Coated Metal Flashings:

1. Install new 24 gauge TPO/PVC coated metal flashings at all locations requiring the new TPO/PVC membrane to lap/weld over the metal flange. Install TPO/PVC metal flashings in lengths no less than 10'-0" unless necessary to fit shorter conditions.

C. Follow manufacturer's typical flashing procedures for all wall, curb, and penetration flashing including metal edging/coping and roof drain applications.

3.6 WALKWAYS

A. Install walkways at all traffic concentration points (such as roof hatches, access doors, rooftop ladders, etc.) and all locations as identified on the drawings.

B. Hot air weld walkway pads to the membrane in accordance with the manufacturer's specifications.

3.7 DAILY SEAL

A. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the workday, a daily seal must be performed to close temporarily the membrane to prevent water infiltration.

B. Complete an acceptable membrane seal in accordance with the manufacturer's requirements.

3.8 CLEAN UP

A. Perform daily clean up to collect all wrappings, empty containers, paper, and other debris from the project site. Upon completion, all debris must be disposed of in a legally acceptable manner.

B. Prior to the manufacturer's inspection for warranty, the applicator must perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

END OF SECTION

SECTION 09843 SOUND-ABSORBING WALL PANELS [AWP]

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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 SECTION INCLUDES

A. Sound-absorbing wall panels, custom-fabricated and fabric-finished. [AWP].

1.3 REFERENCES

A. ASTM International:

1. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
3. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

1.4 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Surface Burning Characteristics (ASTM E84):
   a. Flamespread: 25 maximum.
   b. Smoke Developed: 450 maximum.
   c. Fire ratings for all fabric covered panels is based on testing of the panel wrapped with the standard in-stock fabric, Guilford of Maine, FR 701 Style 2100.

1.5 SUBMITTAL

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit product data sheet, for specified products.

C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including anchorage, accessories, finish colors and textures.

D. Samples: Submit selection and verification samples of finishes, colors and textures.

E. Test Reports: Certified test reports showing compliance with specified performance requirements.

1. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of retesting.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 1 Product Requirements Section.

B. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1.7 PROJECT CONDITIONS

A. Environmental Requirements: Do not install panels until wet work, such as concrete and plastering, is complete; the building is enclosed; and the temperature and relative humidity are stabilized at 60 - 80 degrees F (16 - 27 degrees C) and 35% MINIMUM RH and 55% MAXIMUM RH, respectively. All products constructed with wood or wood fiber content must be stored for at

least 72 hours in the controlled environment specified herein prior to installation to allow the materials to stabilize.

PART 2 - PRODUCTS

2.1 SOUND-ABSORBING WALL PANELS

A. MANUFACTURER

1. Kinetics Noise Control, Inc. (Basis of Design and Quality); PO Box 655, 6300 Irelan Place, Dublin, OH 43017; Telephone: (614) 889-0480; Fax: (614) 889-0540; E-mail: intsales@kineticsnoise.com; Web site: www.kineticsnoise.com.
2. Acoustical Solutions; 2420 Genoble Road, Richmond, VA 23294; Phone:800.782.5742; www.acousticalsolutions.com.
3. Acoustics First; 2247 Tomlyn Street, Richmond, VA 23230-3334; 888.765.2900 or 804.342.2900; www.acousticsfirst.com.
4. MBI Products Company, Inc. | 801 Bond Street, Elyria, OH 44035 | Ph.: 440.322.6500 | www.mbiproducts.com.

2.2 MANUFACTURED UNITS

A. HardSide Panels:

1. Thickness: 2 inches (51 mm) and 4 inches (102 mm).
   Size: As indicated on the drawings up to a maximum 48 inches (1219 mm) x 120 inches (3048 mm) panel.
2. Core: 2 inches (51 mm) and 4 inches (102 mm) thick fiberglass, 6 - 7 pcf (96 - 112 kg/m^3) density.
3. Edge Detail: Square hardened with a Class A hardening solution.
4. Facing: 100% polyester fabric, FR 701 Style 2100 by Guilford of Maine.
   a. Color: As selected by Architect from panel manufacturer's full range of colors.
5. Sound Absorption (ASTM C423): Noise Reduction Coefficient as follows:
   a. 2 inches (51 mm) panel: 1.00, minimum.
   b. 4 inches (102 mm) panel: 1.10, minimum, 125 Hz = 0.65 or greater.
6. Mounting Accessories: HS impaling clips or Z-clips.

B. High Impact HardSide Panels:

1. Thickness: 2 1/8 inches (54 mm).
2. Size: As indicated on the drawings up to a maximum 48 inches (1219 mm) x 120 inches (3048 mm) panel.
3. Core: 2 inches (51 mm) thick fiberglass, 6 - 7 pcf (96 - 112 kg/m^3) density, with bonded facing layer of 10 pcf (192 kg/m^3), 1/8 inch (3.2 mm) thick impact resistant fiberglass.
4. Edge Detail: Square hardened with non-resin, Class A hardening solution.
5. Facing: 100% polyester fabric, FR 701 Style 2100 by Guilford of Maine.

a. Color: As selected by architect from panel manufacturer's full range of colors.

6. Sound Absorption (ASTM C423): Noise Reduction Coefficient as follows:
   a. 2 1/8 inches (54 mm) panel: 1.05, minimum.
7. Mounting Accessories: HS impaling clips or Z-clips.

C. Vinyl Fire Rated Barrier Material:

1. Barrier material shall have a minimum continuous operating temperature range from –40°F to 180°F (-40°C to 82.2°C), be resistant to water, oils, weak acids, alkalies, and fungi, and have weather resistance.
2. Model KNM-100B by Kinetics Noise Control, Inc., Dublin, OH
    a. KNM-100B 1 PSF (4.9 kg/m^2) STC 27, Kinetics limp barrier material, unreinforced and loaded with barium sulphate. Available in black color in 54" x 20 yard (1372 mm x 18.2 m) rolls.

2.3 FABRICATION

A. General: Treat fabric wrapped panels using heat shrink process to develop fully taut facing.

B. Wrap panel edges and return facing fabric 1 - 2 inches (25.4 - 51 mm) on back of panel. Secure fabric with adhesive applied to edges and back of panel only.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

3.2 EXAMINATION

A. Site Verification of Conditions: Verify that substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
    1. Verify that stud spacing is 16 inches (406 mm) o.c., maximum, for panels installed over open studs.
    2. Do not install panels until unsatisfactory conditions are corrected.

3.3 CLEANING

A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as new condition.

B. Keep site free from accumulation of waste and debris.

END OF SECTION

SECTION 15700

HEATING, VENTILATING AND AIR CONDITIONING

PART 1. GENERAL

1.1. **General Provisions:** Section 15010 is applicable in full hereto. No materials or products that contain asbestos, formaldehyde, polychlorinated biphenyl (PCB), lead or mercury, in excess of limits mandated and defined by OSHA, LEED and the EPA, shall be utilized.

Manufacturers not named in the specifications require prior approval, seven (7) days prior to bid date. Follow procedures set forth in Division 1 of the specifications. All prior approvals shall be submitted through the Architect.

1.2. **Qualifications of Subcontractor:** Shall be properly licensed and established as a Heating and Air Conditioning Contractor at location of the work. He shall have had previous experience in the satisfactory installation of at least six (6) systems of this type, size and scope. The Sub-Contractor shall have an adequate service facility to provide complete service and maintenance of the facility within 100 miles of the installation.

1.3. **General Scope:** Include all equipment, material, and labor required for complete and proper installation and operation of HVAC systems, even though not every item involved is indicated. Do not attach any items to other trades' assemblies. Items shall be attached to building structural system. Advisory provisions listed in all Codes referenced in the Contract Documents are mandatory. Where conflicts occur between a Code, Standard, the contract drawings or specifications, the most stringent requirements shall govern and be applied. Refer to other sections of this specification and Section 15010 for additional information and requirements.

1.4. **Site Visits:** It is the contractor's responsibility to have the job ready for site visits when they are scheduled. If the project is not ready for the requested site visit and the Architect, any governmental agency or any other entity requires an additional site visit with the Engineer present, the contractor shall pay Zgouvas, Eiring & Associates a re-visit fee of $1,500. The payment shall be made directly to Zgouvas, Eiring & Associates 5 days prior to the scheduled site visit.

The Contractor is urged to carefully review the extensive requirements of Paragraph "Identification" in Section 15010 of the specifications and note that certain identification is required to be completed before certain site visits. **There are specific identification requirements prior to the above ceiling and final site visits, respectively, that are mandatory. The State of Alabama Department of Construction Management (DCM) will cancel, on-site, the site visit if not completed as specified. Failure to comply with this provision will be cause for cancellation of the site visit, and a fee imposed for the additional site visit, with all costs of the additional site visit to be borne by the respective Contractor responsible.**

1.5. **Miscellaneous:** The Contractor shall carefully examine the contract documents during the bidding phase. Any missing information in the contract documents that is required for obtaining accurate pricing shall be brought to the attention of the Architect, **prior to bid date**, so all may be clarified and/or corrected. Failure to identify and resolve the issues prior to bid shall require the Contractor to provide said items, complete, without additional cost to the Owner or the Owner's Project Design

Professionals, using materials and methods specified by, and as directed by, the Owner's Design Professionals.

1.6. **Identification:** The Contractor is urged to carefully review the extensive requirements of Paragraph "Identification" in Section 15010 of the specifications and note that certain identification is required to be completed before certain site visits**. There are specific identification requirements prior to the above ceiling and final site visits, respectively, that are mandatory. The State of Alabama Department of Construction Management (DCM) will cancel, on-site, the site visit if not completed as specified. Failure to comply with this provision will be cause for cancellation of the site visit, and a fee imposed for the additional site visit, with all costs of the additional site visit to be borne by the respective Contractor responsible.**

1.7. **Painting and Colors:** Furnish to the Architect, color cards for standard and premium colors available. **The Architect shall select color where choices exist**. Refer to Architectural Painting Section of the specifications for additional requirements.

1.8. **Safety Provisions:** Provide covers or guards on all hot, moving and projecting items that may be deemed by the Engineer, Architect or Owner to be a hazard to occupants of the building or to service personnel.

1.9. **Spare Parts:** Manufacturer of any equipment specified shall have a wholesale outlet for readily available replacement parts in the nearest major USA city.

1.10. **Submittals:** Refer to Section 15010 for **strict** submittal requirements, and especially as it applies to Project cost constraints, addendums or Value Engineering (VE) items.

1.11. **Firestopping:** Refer to Section 15010 for requirements. **Note that Division 15 firestopping specifications require firestopping of all penetrations regardless of wall/ceiling/floor construction. Refer to Division 1 for additional requirements.** Where there is a conflict between Division 1 specifications and Division 15 specifications, the most stringent requirements shall govern, be applicable and shall be provided.

1.12. **Service, Charges, Grease, Filters, etc.**: Furnish complete first charges of refrigerant, grease, oils, etc., and be responsible for such full charges for the guarantee period. Provide service and maintenance for all equipment and systems during the guarantee period. As a minimum, quarterly service calls and reports are required. Make last service call two weeks prior to year-end site visit. All quarterly service shall include lubrication of all motors, bearings, calibration and adjustment of all controls and equipment, full refrigerant charge, new filters, belts, etc. **The Contractor is responsible for quarterly filter changes during the guarantee period and shall inscribe onto the filters' casing the date filters were installed/replaced.** The Contractor shall furnish to the Architect and the Owner individual written service reports for all work done under this warranty. Failure to provide the Architect with the Owner's written acknowledgement of service calls shall be construed to mean that the service calls have not been accomplished and are still required.

1.13. **Field Instructions:** The Contractor shall operate all systems for a period of six (6) days after completion of the work. During this time, provide competent personnel to thoroughly instruct representatives of the Owner in the proper operation and care of all equipment and control systems. Secure written acknowledgement of such training from the Owner. Failure to provide the Architect with the Owner's written

acknowledgement of this training shall be construed to mean that the instructions have not been accomplished and are still required.

1.14. **<u>Bound and Framed Instructions</u>: Two weeks before the final site visit**, furnish three complete sets of operating and maintenance instructions, bound in hard cover, indexed and tabbed.

a. The first sheet in the bound instructions shall be a listing of: The Owner/Project Title, Architect, Engineer, General Contractor and Subcontractor.
b. Second page shall be a Table of Contents listing all products numbers in the order which they appear in the specifications and label the tab accordingly.
c. All warranty information shall be filled in by the Mechanical Contractor (Serial numbers, Model Numbers and all other information required by the Equipment Manufacturer).
d. Provide copies of all filled in warranty cards.
e. Provide a summary page that lists each item with its respective warranty listed.
f. Provide a copy of the Contractor's Warranty
g. Local source of supply for parts and replacement, including names and telephone numbers of parts suppliers
h. Provide wiring and control diagrams with explanatory data; control sequences of operation, start-up, operation and shutdown; operating and maintenance instructions for each piece of equipment; manufacturer's bulletins and catalog data; parts list and recommended spare parts. Fold in large sheets of drawings and enclose.
i. A general maintenance summary section shall be included. Provide a list of each piece of equipment using equipment designations as shown on the plans, and the routine maintenance procedures based on the respective manufacturer's recommended intervals. As a minimum, maintenance shall be grouped and individually tabbed to indicate maintenance operations required:

    1. Once a month
    2. Quarterly
    3. Once every six months
    4. Once a year

j. Provide drawings of system control and wiring diagrams, condensed operating instructions, and lubricating schedule and include in binder. All components shall be numbered and identified on diagram. Place in the binder. Also, frame under glass or plastic and mount in each mechanical room in an optimally viewed location.
k. Record drawings of the HVAC drawings, including HVAC Controls drawings, in hard copy and PDF format on CD. Refer to Section 15010, Part 1, General, Paragraph, Record Drawings for additional requirements.
l. Copy of Test and Balance Report to include testing of fire dampers, etc. as specified.
m. Copies of all Site Visit Reports including Contractor's written response that items listed were corrected.
n. Provide copy of results of all tests specified.
o. Provide copy of all start-up reports specified.
p. Provide Owner's letter certifying training of Owner's personnel in the operations of the HVAC systems has been accomplished.

Additionally, the Contractor shall provide all of the aforementioned information, in digital Adobe Acrobat PDF format, on a CD-R CD. The PDF file shall be provided with an embedded index for each item specified. It shall appear in the left hand

window of the opened document so that the Owner or his maintenance personnel can “click” on the indexed item and move immediately to that specific item.

1.15. **Warranty:** Guarantee work as set forth in Section 15010 and Division 1. Guarantee in writing to make good without cost any defects in materials and workmanship for one year following the date of substantial completion of the project, as determined by the Architect, and unless specified otherwise a 5-year warranty on all air conditioning compressors. Provide free maintenance and service during the guarantee period to **include furnishing and replacing of filters.** Refer to other parts for additional requirements and extended warranty requirements.

PART 2. ELECTRICAL WORK AND EQUIPMENT

2.1. **Power:** All power wiring required for installation of equipment is specified under Electrical Division. Electrical equipment shall be compatible with the current shown on electrical drawings. **Verify voltage and power requirements with Electrical Contractor and Electrical plans prior to ordering equipment.**

2.2. **Motors:** All motors furnished shall be designed, manufactured, and tested in accordance with the current applicable standards of NEMA, ANSI, IEEE, and ASTM. As a minimum requirement, all motors shall conform to the current applicable sections of NEMA Standard No. MG-1, Part 3. Motors must meet or exceed The Consortium for Energy Efficiency (CEE) Premium Efficiency™ full load efficiencies. All motors 5 HP and over shall be premium efficiency.

All motors shall be listed under UL recognized component file as applicable. All motors shall be suitable for installation according to the requirements of NEC. Motors shall be wound for the specified voltage and a 1.5 service factor, 1750-RPM open drip proof construction and minimum of Class “F” insulation unless otherwise shown or specified.

The bearings shall have a rated fatigue life of B-10 of 150,000 hours for direct-coupled applications and 50,000 hours for belted applications minimum. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG 1. Load on motors shall not exceed 100% nominal horsepower. Routine factory testing shall be conducted in accordance with Method B of IEEE 112 (current edition), Standard Test Procedure for Polyphase Induction Motors and Generators and shall be as described in Article 12.55 of NEMA MG1, Motors and Generators. **Premium efficient motors shall be warranted for 36 months from date of substantial completion of the project as determined by the Architect.**

Where shown, specified or required, furnish increment wound motors for two-step starting. All motors shall be provided with overload protection and phase protection on all legs. Do not run motors until correct overload elements are installed in starters. Trading overload elements for elements of correct size for motors actually furnished shall be included in this Section.

All motors serving outdoor equipment exposed to weather shall have TEFC motors meeting the requirements set forth previously.

Motors shall be by Allis Chalmers, General Electric Goulds, Louis Allis, Westinghouse or approved equivalent.

2.3. **Fusing:** Provide factory installed fuses in all equipment requiring fusing for branch circuit protection.

2.4. **Motor Starters:** To be furnished under this Section; installation thereof is specified under Electrical Division, except for those which are specified to be factory assembled. Starters shall be Cutler-Hammer, Allen-Bradley, Square D or General Electric. Starters shall be U.L. and NEMA approved. Where required for interlocks provide built-in step down transformer. Motors for VFD drives shall be designed for NEMA MG-1, Part 30.

Motor starters shall be mounted on wall at accessible height standing from floor. Equipment mounted or Uni-strut type frame mounting is not acceptable.

Provide for each motor or group of motors requiring a single control (and not controlled from a motor-control center), a suitable controller and devices that will function as specified for the respective motors.

Provide overload protection for each ungrounded conductor to each motor 1/8 HP or larger (manual reset type unless indicated otherwise). The overload-protection device shall be integral with the motor or controller. Unless indicated otherwise, furnish pilot lights with all remote starters. Where auxiliary control devices are connected into control circuit, these devices shall not bypass safety controls (motor-overload protective devices, high-pressure cutouts, low pressure cutouts, etc.). Provide "Hand - Off - Auto" switches, auxiliary contacts, etc. for all starters.

2.5. **Phase Protection:** All fan motors, indoor units, outdoor units, condensing units, packaged units, etc., shall be provided with surge protection and phase protection to insure against voltage unbalance, over/under voltage, phase loss, reversal, incorrect sequencing and rapid short cycling. Protection shall be provided for all 3-phase equipment utilizing ICM Controls Model 450 or equivalent. All single phase equipment with horsepower greater than or equal to 1/8 HP shall be provided with protection utilizing ICM Controls Model ICM 492 or equivalent. The Contractor shall consult with the Owner's maintenance personnel and set up all programmable options based on the Owner's requirements, within the device's capabilities. Phase protection is not required on equipment being controlled via a variable speed frequency drive; if the specified protection is inherent with the variable speed drive furnished.

2.6. **Controls:** All control cables and wiring shall be in EMT conduit (no “whips”). Do not route control wiring through sleeves containing piping. All control wiring penetrating any exterior wall, interior partition, floor, and similar construction shall be in EMT conduit. EMT control conduit shall be as specified in the Electrical Division of the specifications and/or as shown on electrical drawings. Minimum HVAC Controls conduit size shall be 3/4” in size. All control conduit, power wiring, relays, contactors, transformers and wiring required for a complete functional system as specified, shown on the plans, or as required to accomplish the specified sequences of operation, which is not shown or specified by the Electrical Division, shall be furnished and installed by the HVAC Controls Contractor. This shall include all interlock control wiring between the various components of the air conditioning system, lighting interlocks and all smoke detection system electrical wiring. Electrical work performed under this Section shall conform to requirements set forth in the Electrical Division of the specifications. All wiring shall be in accordance with the National Electrical Code, and all State and local codes. Coordinate all requirements with the Electrical Sub-Contractor prior to bid and provide all as required.

All thermostat and humidistat boxes shall be mounted 46” A.F.F. to the center of the box (ADA height). Where wall mounted CO_2 Sensors are indicated, they shall be mounted 58” A.F.F to the center of the box. Electrical work performed under this

Section shall conform to requirements set forth in the Electrical Division of the specifications. All wall-mounted devices shall be provided with hinged, locking metal covers with rounded edges.

All work shall be done by an approved, independent HVAC Controls Subcontractor whose primary business is the installation and servicing of HVAC controls systems.

2.7. **Controls and Instrumentation Cable:** Instrumentation cable shall be minimum AWG as recommended by the equipment Manufacturer or the HVAC controls system Manufacturer. The most stringent shall be provided. All wiring, cabling, conduit, connections, etc., shall be plenum rated and rated for use at temperatures and conditions expected in the location of mounting

2.8. **Wiring Diagrams:** Furnish to the Electrical Contractor for the specific makes and models of electric-motor operated equipment to be installed. **Verify voltage and power requirements with Electrical Contractor and Electrical plans prior to ordering equipment.**

2.9. **Modifications:** The cost of any modifications of the electrical power wiring, breakers, and/or control wiring conduit, etc. that is required for any items specified in this Section 15700, or controls having electrical power requirements differing from that shown on the electrical drawings and/or as specified, shall be the responsibility of the Mechanical Contractor. **Verify voltage and power requirements with Electrical Contractor and Electrical plans prior to ordering equipment.**

PART 3. VIBRATION AND NOISE CONTROL

3.1. **General:** Elimination of objectionable vibration and noise is the responsibility of the Contractor, who must provide all foundations, isolators, flexible connections, air chambers, curbs, etc. required thereby. Pay special attention to vibration problems at year end site visit and correct all deficiencies noted.

All items of mechanical equipment including air handling equipment, air cooled condensers, condensing units, pumps, piping, indoor cassette units and fans shall be properly isolated from the structure by means of the Engineer's approved vibration absorbing accessories, foundations or supports. Each foundation shall include an adequate number of standard isolation units. Foundations for each piece of equipment shall be submitted for approval.

Manufacturer shall be TR Finn and Co., Inc. "Finn flex" steel spring vibration mountings or equal product by Amber-Booth, Consolidated Kinetics, Korfund Dynamics, Mason Industries or Vibro-Acoustics.

3.2. **Vibration Isolation Pads - Indoor Units:** One layer of 3/4" thick, fire/heat resistant, continuous neoprene pad. Coordinate with details on plans.

3.3. **Sound Levels:** Sound levels caused by operation of pumps, fans, air handling systems, etc., whether generated within rooms or transmitted to rooms through ducts, walls or floors, pipes, etc., shall not exceed specified NC rating at any point within room not more than 6 feet from an air outlet in accordance with ASHRAE octave band method. Offices, classrooms, conference rooms and similar spaces shall have maximum NC-32; corridors, and lobbies, NC-40; toilets, NC-45.

PART 4. TESTING, START-UP, BALANCING, ETC.

4.1. **General:** Conduct tests upon completion of the heating, ventilation and air conditioning installations, and at times as designated by the Architect. Furnish written reports to the Architect of all tests results. Provide copies of all test results in the Bound and Framed Instructions specified hereinbefore. Furnish all necessary personnel, test instruments, power, fuel, etc., as required to complete the specified requirements.

4.2. **Refrigerant Piping:** Test with CO_2 gas and prove tight. Test high and low side of system at 500 psi. After evacuating the system and charging with refrigerant, test piping with a halide torch and prove tight under actual operating conditions.

4.3. **Ductwork for Systems Less Than 2,000 CFM:** Test all supply, return, relief and outside air, exhaust ducts, plenums and casings and make substantially airtight before covering with external insulation or concealing masonry. Substantially airtight shall be construed to mean that no air leakage is noticeable to the senses of touch or sound at joints.

4.4. **Ductwork for Systems 2,000 CFM or Greater:** Test all supply, return, relief and outside air, exhaust ducts, plenums and casings and make airtight before covering with external insulation or concealing in masonry. Test supply ductwork under the positive pressure for the respective system. Test return and exhaust ducts, plenum and casing under a positive pressure of 0.75“WG. Maximum allowable leakage shall be 10%. Vacuum clean ducts, plenums, casings and coils. Demonstrate operation of fire dampers before testing and starting. Check that flexible connections are installed in folds (not pulled tight) and not transmitting vibration.

4.5. **Testing of all Fire Dampers:** The Mechanical Contractor and the Testing and Balancing Contractor shall test all fire dampers and verify installation of access panels to each damper. Test all fire dampers by releasing holding mechanism. Certify in writing that all dampers have been checked and perform correctly. Notify the Architect one week prior to final testing.

4.6. **Domestic Water Circulating System:** Test and adjust domestic water recirculation system to ensure hot water circulation in all mains. Provide flow rate of pump and determined head.

4.7. **Performance Tests:** After cleaning, balancing, and testing are completed as specified, test each system as a whole to see that all items perform as integral parts of the system, and that temperatures and conditions are evenly controlled throughout the building. Verify all sequences of operation and report. Make corrections and adjustments as necessary to produce the indicated conditions. All work shall be performed by an independent test and balancing agency whose primary business is the testing and balancing of heating and air conditioning systems and its related components.

The Test and Balancing Contractor shall hold a current NEBB, NBC or AABC certification. **Proof of certification shall be provided at the submittal stage.** The test shall cover a period of not less than three days and shall demonstrate that the entire system is functioning properly. Provide the following:

Date of testing, space temperature and humidity, outdoor air temperature (DB & WB), air temperature entering condenser coil; refrigerant suction temperature and pressure at compressor evaporator coil; condensing temperature and pressure and load amperes for all motors. Also, provide CFM readings at all

grilles, registers and diffusers and entering and leaving air temperatures at each evaporator coil.

Provide typed list indicating job setting of all automatic controls. Include settings of thermostats, humidity controls, CO_2 sensors, safety controls, minimum damper settings, fire-safety thermostats, pressure controls, temperature controls, and other similar items. Tabulate to show type of control, location, setting and function. Verify that all safety settings and limits are appropriate and comply with current safety Codes and Regulations for the respective system.

After building is occupied, make adjustments as requested by Owner.

4.8. **Balancing:** Check airflow at all supply, return and exhaust grilles, all diffusers and outside air intakes with a recently calibrated direct-reading velocity instrument. Adjust systems to deliver, supply air, return air, outside air or exhaust air quantities to within 10 percent of the indicated amounts. Provide instruments and otherwise assist Architect in checking balancing at final site visit.

4.9. **Phase Protection Verification:** The Test and Balance Contractor, with cooperation from the Mechanical Contractor, shall verify that all phase protection specified has been installed where specified, and installed per the Manufacturer's requirements. The verification of this requirement shall be furnished in tabular form with findings included in the test and balance report. The summary shall list all equipment specified to have the protection, verification that the device is installed per the Manufacturer's recommendation and has been programmed to the Owner's requirements.

4.10. **Test Data:** Submit typewritten report as specified above. Include schedules of readings taken during the testing and balancing operations and a line diagram or plan of the system indicating specified quantities and final balanced quantities **two weeks prior to final site visit**. **No final site visit will be made without this data.** Report the required or specified reading, the first reading taken, and final balanced reading for the following items:

Fans: Size, type, speeding rpm, outlet velocity in fpm, static pressure inches water, air quantity in cfm, and motor load in amperes.

Air Handling Equipment: Size, type, fan speed in rpm, outlet velocity in fpm, external static pressure inches water, total static pressure inches water, air quantity cfm, and motor load in amperes.

All Air Outlets and Inlets: Size, velocity in fpm, and air quantity in cfm.

Coils: CFM, size, face velocity in fpm; air temperature entering coil and air temperature leaving coil, wet-bulb and dry-bulb degrees F.

Refrigerant Hot Gas Reheat Coil: Adjust humidistat so that valve opens. Verify modulation of the coil valve. Provide coil size, face velocity in fpm; air temperature entering coil and air temperature leaving coil, wet-bulb and dry-bulb degrees F.

Ducts: Size, velocity in fpm, and air quantity in cfm.

Indoor Heat Pump Units Auxiliary Heaters: Provide heater capacity (KW), number of stages of heat and/or verify SCR control as applicable, and load amperes.

Air Cooled Condensing Units: Air temperature entering condenser coil; refrigerant suction temperature and pressure at compressor and evaporator coil; condensing temperature and pressure and load amperes for all motors.

4.11. **Control Settings:** In cooperation with the HVAC Controls subcontractor or the mechanical subcontractor as applicable, calibrate, adjust, and verify sequences of operation and the control systems, including the refrigerant hot gas reheat coils, to show that the requirements of these specifications have been met.

Verify all specified sequences of operation and provide report. Provide a tabulation of setting on all controls indicating set point and throttling range, etc. after controls and systems have been finally adjusted. Include settings on safety controls and cutouts. Verify that all safety settings and limits are appropriate and comply with current safety Codes and Regulations for the respective system. Provide typed list indicating job setting of all automatic controls. Include settings of thermostats, humidity controls, CO_2 sensors, safety controls, minimum damper settings, fire-safety thermostats, pressure controls, temperature controls, and other similar items. Tabulate to show type of control, location, setting and function. Verify that all safety settings and limits are appropriate and comply with current safety Codes and Regulations for the respective system.

4.12. **Notification:** Notify the Architect one week prior to all testing. The Contractor shall provide all testing equipment and shall furnish written reports to Architect of all tests results. Additionally, provide copies in the Bound and Framed Instructions specified hereinbefore.

PART 5. SHEET METAL DUCT WORK (LOW VELOCITY 2" S.P.)

5.1. **General Scope:** Provide as shown and as required for the air conditioning, heating and ventilation systems. Make changes in dimensions, offsets or crossovers as necessary to clear piping, lights and structural members, and to maintain scheduled headroom. Provide all accessories required. Refer to architectural drawings and specifications.

Ductwork visible through all grilles, registers, diffusers, ceilings, etc. shall be painted flat black with paint having a fire hazard rating not to exceed 25 for flame spread and 50 for fuel contributed and smoke developed as determined by ASTM E84.

5.2. **Protection of Interior of Duct from Debris:** ALL open portions of ductwork shall be covered with a self-adhesive film or airtight sheet metal caps to prevent the intrusion of contaminates. All duct taps, duct take-offs, etc., shall be protected immediately after the tap, take-off, etc. has been fabricated in the field. When sections of sheet metal are delivered to the facility for fabrication in the field, which cannot be protected with the specified material, the sheet metal shall be covered with Visqueen. Prior to erecting same, ductwork shall be manually cleaned to remove all dust, dirt and construction debris. All ductwork shall be erected clean. After each section of ductwork is erected, immediately protect all openings as specified herein before. In effect, there shall be no ductwork opening that is exposed to the ambient air. The material shall be a minimum of 3-mil thickness and have a minimum tensile strength of 10 psi. It shall be UV resistant, waterproof and recyclable. Material shall be DuroDyne Dyn-O-Wrap or approved equivalent. **Any ductwork discovered to be unprotected as specified is subject to immediate rejection for use on this project.**

5.3. **Protection of Interior of Ductwork When Any Air Moving Equipment is Operating During Construction and Prior to Owner's Occupancy:** If air moving

equipment must be used during construction, temporary filtration media with a Minimum Efficiency Reporting Value (MERV) of 8, as determined by ASHRAE 52.2 and shall be installed at each return air grille, return air register, exhaust grille, exhaust register, and unit return air inlet. The General Contractor shall provide a written request to the Architect for permission to temporarily operate any HVAC equipment during construction. The request shall be provided a minimum of seven (7) days prior to the desired date of the interruption. Do not operate any equipment without the Architect's written approval.

5.4. **Sizes:** Take measurements at job and fit work into available space. Report to the Architect any unworkable conditions encountered and alter layout or duct sizes as directed without additional cost to the Owner or the Owner's Project Design Professionals. Unless otherwise approved, conform to dimensions indicated. Duct dimensions shown indicate NET FREE AREA after installation of duct liner; increase sizes indicated to allow, therefore.

5.5. **Sheet Metal:** ARMCO, or equal, prime quality, G-90 galvanized sheet steel. Unless indicated otherwise on the plans, gauges shall be as recommended in the current edition of current SMACNA "Duct Construction Standards" **but in no case shall be less than listed in the table below for the respective duct largest dimension or diameter**.

Up to 30 inches	24 ga.
31 to 54 inches	22 ga.
55 to 84 inches	20 ga.
85 to 96 inches	18 ga.

5.6. **General Fabrication:** Construct and erect in a skillful manner, meeting requirement of the current SMACNA "Duct Construction Standards" for 2" static pressure unless noted or specified otherwise. **Where conflicts occur between current SMACNA requirements and the contract drawings or specifications, the most stringent requirements shall apply. In general, the heaviest gauge metal and the strictest installation/fabrication methods shall be provided.** Form straight and smooth on the inside, with joints neatly finished. Make up in sections of such length that mechanic can reach thru open end to seal insulation at previous joint. Assemble and anchor to be completely free from vibration and drumming under all conditions of operation. Make takeoffs at round ducts with prefabricated round-to-rectangular and rectangular-to-round transitions.

Where ductwork penetrates non-rated partitions above the ceiling or insulation support/attic air barriers, draft stops and similar partitions, the openings shall be sized as required for duct and insulation, plus 1". Provide duct supports as specified within 12" of each side of the partition penetrated. **DO NOT ALLOW DUCT TO REST ON PARTITION WALLS**. Openings shall be saw cut or properly blocked out and present a neat appearance. Where penetration occurs at rated assemblies, provide appropriate fire damper and install as specified and detailed. Where penetration occurs at non-rated assemblies, fill void between assembly and duct with fire retardant mineral wool insulation and seal with fire stopping material to prevent the passage of smoke and fire. After closing and filling the annular space, provide 4" wide, 16 gauge galvanized steel closure plates around the penetration, completely covering the opening. Closure plates shall fit snugly to duct, shall be secured to assembly and sealed airtight.

Provide additional supports to raise ductwork off any metallic piping. Wherever any bare metallic piping is in contact with externally insulated duct or bare sheet metal duct, there shall be dielectric separation provided. The Contractor shall provide 1"

thickness, **unslit** AP Armaflex insulation of sufficient inside tubular diameter to snuggly and completely cover the respective piping. The insulation shall extend the full length of the affected area plus 6" on both sides. Refer to Part "Pipe and Miscellaneous Insulation Work" in this division for AP Armaflex material specification. The use of Rubatex insulation between piping and the ductwork shall only be allowed when providing the proper supports is not an option.

Refer to Paragraph "Hangers and Supports" for additional requirements.

5.7. **Branch Ducts to Diffusers:** Round runouts to diffusers, up to and including 14" round, shall be 24 ga., G-60 galvanized, DuctMate Series GreenSeam +Snap Lock pipe with factory sealed longitudinal and transverse gaskets. Gasket for GreenSeam +Snap Lock pipe shall contain antioxidants, fungicides, adhesion promoters, zero VOCs and shall meet or exceed ASTM E-84 test requirements. 16" round to 20" round runouts shall be 24 ga. and equal to DuctMate Series Reeves Lock Pipe, G-60 galvanized pipe.

5.8. **Return Air Platforms:** Return air platforms shall be constructed with 1-1/2"x1-1/2"x1/4" steel angle iron frame and 18 ga. G-90 galvanized steel all sides, top and bottom, then sealed airtight. Insulate all sheet metal sides, top and bottoms with 2" thickness, 1.5 lb. density, unfaced duct liner, same as internally lined ductwork. Provide angle iron supplemental supports and pedestal type pipe columns to support the units and allow individuals to stand on the platform without platform deformation or failure. Platforms shall be a minimum of 24" tall, or as space permits. **No combustibles are allowed in the return air plenum.**

5.9. **Cross-Joints, Seams and Stiffening:** Join and stiffen with combination of joint types and structural angles as recommended in current SMACNA "Duct Construction Standards". **Cross break all flat areas over 35 inches wide.** Install internal ends of slip joints in the direction of flow.

All transverse joints with long dimension over 24" shall be made with all metal DuctMate joints system as manufactured by DuctMate Industries, Inc., Quikduc Transverse Duct Connection Systems or Dyn-O-Mate with roll-formed flanges, corner pieces, gasket, and cleat. System used shall be installed in strict accordance with current SMACNA and manufacturer's recommendations and instructions.

Make all cross joints and all branch, grille and diffuser take-offs, except DuctMate joints, air tight by applying fibrated, low VOC, LEED IEQ 4.1 compliant duct sealer. Sealer shall meet and pass ASTM D-2202, ASTM C-731 and EPA regulations. Sealer shall meet the requirements for the pressure classification of the ductwork installed. Sealer shall be Hardcast Iron Grip 601 with 10-year or equivalent by Foster or Childers.

5.10. **Turns and Transitions:** Fabricate turns with an inside radius equal to width of duct. At 90-degree turns, Contractor may substitute square elbows, with standard factory-made, multiple, double-blade constructed vanes. Vanes shall be a double wall, true airfoil contour with smoothly rounded entry nose with extended trailing edge. Vanes shall be formed from a single piece of 26 ga., hot dipped galvanized steel and shall be 3" radiused vanes on 2.4" centers. Vanes shall be provided with two (2) tie rods and continuous internal tubes for stiffening and rigidity. Maximum pressure drop shall be .06" W.G. at 1500 FPM. Generated sound power level shall not exceed 54 decibels in band 4 at 2000 FPM (24"x24" duct size). **Single wall turning vanes are not allowed.** Vanes shall be as manufactured by Aero/Dyne Series HEP, Duro Dyne HTV/DHV, Hamlin Sheetmetal or approved equivalent by DuctMate. Avoid abrupt changes in shape, with a slope of 4:1 the minimum allowed.

5.11. **Branch Duct Take-Off:** Provide at all points where branch ducts take off from trunks, and where ducts divide. Refer to details on the drawings. Damper shall be minimum 22 Ga., G-90 Galvanized steel with 2" build out. Body shall be a minimum of 24 Ga., G-90, galvanized steel with 4" W.G. construction. Fitting shall have 1" flange with corner clips, pre-punched mounting holes and adhesive coated gasket. Take-off shall be Flexmaster LDS, BO3, GSI HETO (high efficiency take-off) HTS2, Elgen HET or approved equivalent.

5.12. **Fire Dampers:** Provide as shown on drawings and in each duct passing through firewalls, floors, and other fire barriers in accordance with NFPA Code 90A. Install in such manner that fusible links can be replaced. Employ UL listed links rated at 165 degrees F (212 degrees where within 10 feet of a heating coil).

Typical dampers shall be UL labeled, minimum 1-1/2 hour rated, (higher where required), equal to Prefco #5500, with Type B, 21 gauge galvanized steel wrap around low resistance frame, 21 gauge galvanized steel blades and 16 ga. factory sleeves. Equivalent products by Air Balance, Ruskin, Pottorff or Airstream Products will be accepted. Where damper is installed behind wall grilles or registers use No. 5500-E6-LPB.

Install in accordance with all applicable conditions of the UL listing, for which data sheets must be submitted for approval. At typical ducts, provide 16 ga. sleeves secured in opening with 1-1/2" x 1-1/2" x 14 ga. (min.) angles, bolt angles and damper sleeve with galvanized bolts. **Fire dampers indicated for use in storm/tornado/safe areas shall have 10 ga. sleeves and angles. Fire dampers at floor penetrations shall have 12 ga. sleeves and angles.** Size structural openings so that space between sleeve and masonry is not less than 1/8" per linear foot of duct or more than 1/2". Secure ducts to sleeve per detail and current SMACNA requirements. After installation release holding mechanism and verify proper closure of each damper.

Ductwork in fire-rated floor-ceiling or roof-ceiling assembly system with air ducts that pierce the ceiling of the assembly shall be constructed in conformance with designs in UL Fire Resistance Directory. In general, ducts shall be encased in fire rated material.

At internally insulated ducts, size dampers for gross duct size, so that liner butts into damper frame surround.

5.13. **Volume Dampers Used with Automatic Controls:** See Controls at end of Section 15700.

5.14. **Volume Dampers:** For round ducts less than 12" diameter and rectangular ducts less than 12" in height in either dimension: Single leaf, constructed with 18-gauge galvanized metal with locking type control quadrant, single center U-bolt and pivot rod extending through opposite side of duct with brass bushing at both ends.

5.15. **Volume Dampers:** For round ducts greater than or equal to 12" diameter or rectangular ducts greater than or equal to 12" height in either direction, provide opposed blade, airfoil blades of 16 ga.-galvanized steel mounted in steel frames by 3/8" steel trunnions riding in brass bushing with dual U-bolts. Blade width shall not exceed 10 inches and individual blade length shall not exceed 48 inches. Extend one trunnion to permit operation from outside the duct. Provide manually operated dampers with cadmium plated steel locking quadrant. Dampers opening to the

outside shall have felted edges.

5.16. **Stand-Off Mounting Brackets:** Locking-type quadrant operators for dampers, when installed on ducts to be externally insulated, shall be provided with standoff mounting brackets, bases or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Standoff mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

5.17. **Access Panels/Doors:** Provide double wall access door in the side of the duct for each fire damper, motorized damper, on each side of duct mounted coils and duct heaters, smoke detectors and elsewhere indicated, specified or required for proper maintenance. Size and position to provide maximum access to all items. Typical doors shall be double metal faced, 22 ga. steel door panels and 22 ga. frame, internally insulated same as duct (1" minimum) fiberglass insulation, neoprene gasket seal and full length plated steel piano hinges with cam lock. Provide access panels/doors with cam locks only, where hinged access panels/doors cannot be completely opened without obstruction. When access panels/doors are provided with cam locks only, they shall be provided with a safety chain. Access panels/doors shall be rated for the anticipated duct pressure, plus 1".

For ducts 10" round and smaller, provide a removable section of duct to provide required access. Refer to other sections for access doors required in kitchen hood exhaust ducts, moisture-laden ductwork, etc.

Hinged access doors shall be Ruskin Series ADH22. Removable access doors/panels with cam locks shall be Ruskin Series ADC22 with minimum of two cam locks and safety chain. Nailor Industries Model 08SCL/Model 08SH, Kees ADH/ADC or Pottorff Series HAD/CAD will be acceptable.

Hinged access doors for round ductwork shall be flush mounted, flat oval, 1" insulated, low leakage, 22 ga. steel door panels and frame, except with two large hand knobs or cam locks with safety chain, and equivalent to Ruskin Model ADR2 for round ducts 10" round, up to and including, 16" round duct. Nailor Series 0800 or Pottorff Series DMR will be acceptable.

Refer to Section 15010 for additional access door/panel requirements including identification.

5.18. **Duct Instrument Test Holes:** Provide for each system four test holes (two in supply duct and two in return air plenum) at opposite ends near air handling units with screwed caps. In addition, at duct mounted coils and electric duct heaters provide one on either side of the coil or duct heater.

5.19. **Flexible Connections and Bonding Jumpers:** Install so that the cloth is in folds (not drawn tight). Connect all ducts to air handling units and fans, excepting dome type fans, with preassembled flexible connection. Fabric width shall be 6" for all air handling equipment. Ceiling mounted exhaust fans may be 4" width.

Connectors for all air handling equipment shall be a factory fabricated and assembled unit with 6" dual fabric, heavy duty, 20 oz/sq. yd polyester/polyester fabric with flame resistant coating and mildew resistant per ASTM G-21. The assembly shall comply with NFPA 701, NFPA 90A, NFPA 90B and ASTM E-84. The unit shall be constructed of minimum 24 ga. galvanized steel meeting ASTM A-653-94-G60. Metal to fabric connectors shall be double locked, airtight and waterproof to 10" W.C. positive pressure and 10" W.C. negative pressure. Assembly shall be DuctMate PROflex with power lock connection or approved equivalent by DuroDyne.

Flexible connections for ceiling exhaust fans shall be preassembled flexible connection of 29 ounce fire-resistant, neoprene coated glass fiber cloth equal to Ventfabrics “Ventglas” (4” fabric width), as manufactured by Ventfabrics, Wiremold or Thermaflex.

Provide preassembled flexible connections for all ducts that cross building expansion joints. Flexible connections shall be 6” in width as specified hereinbefore. Coordinate requirement with Architectural plans and provide as required.

Externally insulate all flexible connectors to prevent condensation with 2” thickness external duct insulation as specified later in this section. **Do not insulate flexible connectors until installation of the below specified bonding jumper has been verified.**

Provide copper jumpers across all flexible connectors taking care that jumpers do not bind flexible connections. Provide compression lug and grounding connector screwed into the duct with two (2) screws, on both side of the flexible connector. Bonding wire shall be shielded 12 AWG.

5.20. **Register and Grille Connections:** Where take-offs are in side of a duct, clinch lock short tee sections onto trunk. Install collars with slip joints and 3/4” flange at outlet end. At sheetrock and other hard surfaces, set collars exactly flush with surface.

Install boots above lay-in ceilings simultaneously with ceiling work.

At return air, relief air and exhaust air grilles 48” or more in either dimension, collars shall be 1” x 2” x 1/8 inch steel angle frames with corners mitered, welded and ground smooth. Frames in ceiling shall be independently suspended from the ceiling structure, or the duct shall have special reinforcing to prevent sagging of the boot. Interior of ductwork visible through grilles and diffusers shall be painted flat black with paint having a fire hazard rating not to exceed 25 for flame spread and 50 for fuel contributed and smoke developed as determined by ASTM E84.

5.21. **Hangers and Supports:** **Duct hangers shall NOT penetrate the external insulation vapor barrier. All duct hanger materials shall be external of the insulation materials, insulation jacket and vapor barriers. All vapor barriers shall be continuous and without penetrations. Refer to plan details for supports required within the storm shelter/safe area.**

“Sammy” bolts are prohibited. Contractor shall provide supplemental steel between structural purloins, bar joists, etc., for duct support as required to meet support spacing specified. Supplemental steel shall be welded in place as directed and specified by the Structural Engineer. Support small (less than 40 united (w+h) inches) horizontal ducts without external insulation with 1-1/4” x 20 ga. band hangers. Provide in pairs close to each transverse joint and in no case more than six feet apart. Bands shall be turned 3” under the lower corner of ductwork and fastened with two (2) self-tapping screws into the bottom of the duct surface. Bands shall be attached up the sides of the ductwork at a maximum of 6” intervals and in the bottom of the duct. Seal all screws with duct sealer as specified for ductwork.

All 14” or less concealed round ducts with external insulation shall be provided with band hangers and saddles. Suspend ducts, at six (6) foot intervals with 8” long, 3” wide, 22 gauge galvanized metal saddles hung from structure with 22 gauge, 1” wide straps. Bands shall pass completely under and around round ducts. Loop strap under duct and attach to strap with two (2) galvanized bolts. Thereafter, loop top end of

hanger over steel structural members above and fasten with two (2) galvanized bolts. Where concrete joists occur overhead, secure straps to side of joist with galvanized expansion or ramset bolts. Where flat concrete surface occurs overhead, secure with ramset or expansion bolt fasteners. See other Specification Sections in the Contract Documents for limitations on use of power driven fasteners.

All concealed and externally insulated rigid round metal ducts greater than or equal to 16", all externally insulated rectangular ductwork, all externally insulated square ductwork and all externally insulated flat oval ductwork that is specified to have external insulation with a vapor sealed facing **shall be supported with trapeze hangers consisting of Unistrut, threaded rods and inserts or clamps as required to accommodate overhead construction.** Threaded rods shall be of size required to provide support of three (3) times the anticipated load of the assembly. Trapeze hanger assembly spacing shall not exceed 8 feet.

Where ducts are specified to have external insulation with a vapor sealed facing, support duct on trapeze hangers consisting of a Unistrut assembly with threaded rods.

On externally insulated ducts, install 3/4" thickness, **unslit** AP Armaflex insulation of sufficient inside tubular diameter to slide over the Unistrut support, completely cover and snuggly fit to the bottom horizontal Unistrut duct support. The insulation shall extend the full width of the duct plus a minimum of 6", each side. Where channel shapes are used, orient the open side, down. Refer to Part Pipe and Miscellaneous Insulation Work for AP Armaflex material specification. Space hangers a minimum of 6" (maximum of 12") from the sides of the duct to permit the duct to be placed within the trapeze hangers.

All concealed internally insulated round ducts shall be supported as specified above for externally insulated ductwork except without saddle. Coordinate exposed duct support requirements with plan details.

Support all non-externally insulated horizontal ducts larger than or equal to 50 united (w + h) inches on trapeze type hanger assembly same as specified above for externally insulated duct except without Armaflex surround on the Unistrut. Install inserts or clamps as required to accommodate overhead construction. Spacing shall not exceed 6 feet.

Support small vertical runs with 1/8" steel bands screwed to three sides of duct and expansion bolted to adjacent structural elements; spacing shall not exceed 10 feet. Support vertical runs larger than 40 united (w + h) inches with structural brackets with welded joints.

Where ducts pass through floors, seal as specified hereinbefore, support duct and close opening with minimum 2"x2"x1/8" steel angles on all sides and, secured to both floor and duct. At plenums and risers just above the floor, provide suitable chair assemblies of welded structural shapes.

Where horizontal ducts with standing joints exceed 72 inches in width they shall be provided with additional hangers at the mid-point of their width, consisting of a support bolted to an interior 1/8 x 1-1/2 inch strap that shall, in turn, be bolted to the duct. Internal straps and hangers shall be spaced one for each duct section.

Where trapeze type hangers or DuctMate is used to support exposed ductwork in finished areas, the width of the support shall not exceed the duct width by more than six (6) inches on either side of the duct.

5.22. **Roof Intake and Relief Hoods:** Greenheck Model FGI/FGR or approved equivalent by Loren-Cook, aluminum or galvanized steel construction unit with welded joints, complete with 1/2" aluminum bird screen, rain gutter, weather baffle, 10" high (exhaust/relief) or 14" high (intake) height NRCA approved roof curb with built-in cant strip, integral fiberglass insulation and wood nailer. Hood sizes smaller than 24"x24" shall be hinged type. All intakes, relief or exhaust vents greater than 12x12 shall be 125 MPH rated. Maximum intake throat velocity of 250/500 FPM and .05" WC maximum pressure drop. Maximum relief throat velocity of 600 FPM and .05" WC maximum pressure drop. Hood, throat and curb cap shall be minimum 18ga.

Roof curbs shall be painted with two coats of non-reflective paint. Paint type and color as selected by Architect. All roof curbs furnished shall adhere to the roofing manufacturer's requirements so as not to void the roofing warranty. The top of all roof curbs shall be level with pitch built into curb when deck slopes 3/8 of an inch per foot or more. Coordinate with architectural and structural plans for required slope. Coordinate roof curb and interface in the building roofing system and verify minimum net height to be as required by code or as required by Architect. Refer to architectural specification and plans for additional requirements. All roof curbs interfacing shall comply with the Architectural requirements. Coordinate prior to bid and provide as required.

5.23. **Flexible Air Ducts:** Flexible duct for connections shall be Thermaflex M-KE, GreenGuard Level 4 certified, ATCO UPC #031 or Flexmaster. Duct shall be rated for a maximum pressure of 16" (4-10 in. ID) or 10" (12-16 in. ID) water column positive and 2" water column maximum negative pressure and 5000 FPM maximum velocity and Listed by Underwriters Laboratories, Inc., under UL Standard 181 as a Class 1 air duct and complying with NFPA Standards 90A and 90B. Duct shall have a maximum flame spread of 25 and a maximum smoke developed rating of 50. Flexible air duct shall be factory made and composed of an inner duct of woven and coated fiberglass providing an air seal and permanently bonded to coated steel wire helix, a fiberglass insulating blanket and low permeability outer vapor barrier of fiberglass reinforced metallized film laminate. R-value shall be a minimum R=8 per ASTM C-518.

Flexible duct length shall not exceed six (6) feet. Supply each duct with **stainless steel worm gear driver and stainless steel band** at take-off fitting and supply fixture connections. Zip tying is not allowed. Suspend ducts, at three (3) foot intervals with 8" long, 3" wide, 22 gauge galvanized metal saddles hung from structure with 22 gauge 1" wide straps. Loop strap under duct and attach to strap with two (2) galvanized bolts. Thereafter, loop top end of hanger over steel structural members above and fasten with two (2) galvanized bolts. Branch duct connectors for connecting round low velocity branches to rectangular low velocity trunks shall be rectangular to round take-off fittings as detailed on the drawings with damper and standoff mounting bracket.

Provide a full size radiused, galvanized sheet metal elbow transition piece from flexible duct connection to each diffuser boot. Elbow gauge shall be as specified hereinbefore in Part, "Sheet Metal Ductwork" for respective duct size.

PART 6. DUCT INSULATION WORK (EXTERNAL)

6.1. **General:** **All work by Insulating Sub-Contractor whose primary business is the installation of insulation materials** with experienced applicators in accordance with manufacturer's recommendations. Duct must be clean, dry and pressure tested

before covering is applied. Cover flexible connections with insulation material as hereinafter specified to same thickness as adjacent duct. All insulation materials (coatings and mastics) shall be fire resistive per NFPA Pamphlet No. 90, ASTM C 411, shall be UL listed and shall have a fire hazard rating not to exceed 25 for flame spread and 50 for fuel contributed and smoke developed as determined by ASTM E84, NFPA No. 255 or UL 723. Finished insulation system shall provide complete thermal barrier throughout the equipment and air distribution system, including effective and durable vapor barriers and vapor stops for any system or condition potentially subject to condensation. Insulation system shall be provided to prevent condensation or potential thereof, to prevent transmission of water vapor into the insulation system (vapor barriers), and to prevent transmission of water vapor within the insulation system should vapor barrier compromises occur during operation and/or maintenance of the building (vapor stops).

Refer to Section Sheet Metal Ductwork, Paragraph Hangers and Supports, for miscellaneous insulating requirements for externally insulated ductwork.

6.2. **Material:** Provide GreenGuard certified glass fiber duct insulation with reinforced foil kraft laminate jacket, formaldehyde-free.

All **supply air and return air ducts** located in the attic, mechanical mezzanine or outside the building insulation envelope shall be provided with a total of 3.5" thickness external insulation, in addition to the specified acoustical liner. The first layer shall be **1.5" thickness, 0.75 lb. density, without reinforced foil kraft laminate jacket** and with characteristics specified above. The second layer shall be **2" thickness, 1.5 lb. density, with reinforced foil kraft laminate jacket** and with characteristics specified below.

OPTION: In lieu of providing two layers of insulation for supply and return air ducts as specified above, the Contractor may substitute one layer of 4.25" thickness, 0.75 lb. density **with reinforced foil kraft laminate jacket** with characteristics specified below.

All **supply air** and **return air** ductwork located above the ceiling within the building insulation envelope, in chases and other similar areas, but not in the attic or a mechanical mezzanine, shall be provided with **2" thickness, 1.5lb. density, duct wrap with reinforced foil kraft laminate jacket** as specified below. Note that this requirement does not apply to ductwork that is exposed to view in finished areas. Refer to internal duct insulation requirements for duct exposed to view in finished areas.

All **outside air** and **exhaust air** ductwork shall be provided with **1.0" thickness, .75lb. density, with reinforced foil kraft laminate jacket** as specified below. Note that this requirement does not apply to ductwork that is exposed to view in finished areas. Refer to internal duct insulation requirements for duct exposed to view in finished areas.

Thermal conductivity for **1.0" thickness** per ASTM C-518, **0.75 lb. density** shall be not less than k=0.27 BTU·in/(hr·ft²·°F) and minimum installed R=3.0 at 75°F mean temperature with test based on material thickness compressed 25%.

Thermal conductivity for **1.5" thickness** per ASTM C-518, **0.75 lb. density** shall be not less than k=0.27 BTU·in/(hr·ft²·°F) and minimum installed R=4.2 at 75°F mean temperature with test based on material thickness compressed 25%.

Thermal conductivity for **2" thickness** per ASTM C-518, at its rated thickness, and **1.5 lb. density** shall be not less than k=0.24 BTU·in/(hr·ft²·°F) and minimum installed R=6.3 at 75°F mean temperature with test based on material thickness compressed 25%.

Thermal conductivity for **4.25" thickness** per ASTM C-518, **0.75 lb. density** shall be not less than k=0.27 BTU·in/(hr·ft²·°F) and minimum installed R=12.0 at 75°F mean temperature with test based on material thickness compressed 25%.

See "Duct Insulation (Internal)" for internal acoustical insulation required in addition to the external insulation specified hereinbefore.

Supply air, return air, relief air and outside air ducts within enclosed mechanical rooms do not require flexible, external, duct insulation. Instead, supply air, return air, relief air and outside air ducts in all mechanical rooms shall be insulated with 1" thickness, 3.0 lb. density, rigid glass fiber duct insulation to a point above the ceiling of the adjacent conditioned space. Facing shall be aluminum foil reinforced with fiberglass yarn and laminated with fire resistant adhesive to Kraft paper. Thermal conductivity value shall be per ASTM C-612, Type 1B, at its specified thickness, shall be not less than k=0.24 BTU·in/ (hr·ft²·°F) at 75°F mean temperature. Insulation shall meet or exceed the requirements of ASTM E 84, UL 723, ASTM C 1136-Type II, NFPA 90A, NFPA 90B, FHC 25/50 and ASTM C 795. Moisture sorption shall be less than 5% by weight and maximum moisture vapor transmission of 0.02 perms. Insulation shall be Owens-Corning Series 1400 FR Spin-Glas Board or equal material by Knauf, Schuller, Owens-Corning or CertainTeed. Note that rigid board insulation is not required in the attic or mechanical mezzanine.

6.3. **Thickness:** Toilet/shower and janitor closet/housekeeping exhaust ducts, backs of ceiling diffuser panels and outside air ducts: 1.0" thickness, 3/4 lb. density with reinforced foil kraft laminate jacket. All other locations: Minimum 2.0" thickness and density specified above with reinforced foil kraft laminate jacket. Coordinate with variations specified above for additional layers or 4.25" thickness and provide as required.

Where 2" internal acoustical insulation is specified for ductwork located above the ceiling within the building insulation envelope, in chases and other similar areas, but not in the attic or a mechanical mezzanine, the respective external insulation may be reduced by 1" total thickness with respective density previously specified. **No reduction in insulation thickness shall be taken for any ductwork located in the attic, mechanical mezzanine or outside of the building insulation envelope**. See limits of acoustical insulation in Part Duct Insulation Work (Internal) below. Where duct board is specified within the mechanical rooms, external duct wrap insulation is not required.

6.4. **Manufacturer:** Johns-Manville Micro-Lite EQ, Type 150 or Type 75 with thickness and density as specified above. Equivalent material by Knauf, Schuller, Owens Corning or CertainTeed will be accepted.

6.5. **Ducts to be Insulated Externally:** Supply air and return air ducts including ducts with acoustical liner, outside air ducts, make-up air ducts, toilet//housekeeping/janitor closet areas exhaust ducts, short branch duct collar connections to grilles, registers and diffusers, all flexible canvas connectors exterior rim/cone of all ceiling diffusers. **Do not externally insulate flexible canvas connectors until installation of the specified bonding jumper has been verified by the Engineer or the Authority having jurisdiction.** See Part "Duct Insulation Work (Internal)" for sound attenuating insulation requirements of externally insulated ductwork.

6.6. **Application:** Sheet metal duct shall be clean, dry and tightly sealed at all joints and seams before applying duct wrap. Adhere insulation to metal with 4" strips of Foster 85-60, ITW Miracle-Kingco M595 Ultratack or Childers CP-127, low VOC insulation bonding adhesive meeting ASTM C916 at 8" on center on circumferential joints. Wrap insulation tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2". The 2" flange of the facing shall be secured using 9/16" flare-door staples applied 6" on center and taped as specified hereinafter. On longitudinal joints, the overlap shall be secured using 9/16" flare-door staples applied 6" on center and taped as specified hereinafter. For rectangular ducts wider than 23", additionally support insulation with weld pins and speed clips 18" on center. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping. Insulate standing seams and stiffeners that protrude through the insulation with 2" thick, faced, flexible blanket insulation. Cover with reinforcing mesh and coat with vapor barrier finish coating. Vapor seal all seams, joints, pin penetrations, other breaks, circumferential and longitudinal joints with reinforcing mesh and coat with vapor barrier facing. Mesh shall be **4" wide pre-sized glass cloth** adhered and finished with two (2) coats of a white vapor barrier coating, Foster 30-33, Vimasco 749 or Childers CP-33. **No FSK tape will be allowed.** Fiberglass cloth shall be Great Lakes Textiles Style GL1658, 20x10 thread count per square inch, 0.004-inch thickness and 1.60 oz. /sq. yd., Childers Chil Glas #10 glass mesh, Foster Mast-A-Fab polyester mesh or equivalent product by 3M.

Any externally insulated duct with metallic vapor barrier that is in contact with sprinkler piping or metallic conduits shall be provided with a section of Rubatex insulation between ductwork and piping/conduits. Rubatex shall be 3/4" thickness, AP Armaflex insulation of sufficient inside tubular diameter to slide over, completely cover and snuggly fit the contacted pipe. The insulation shall extend the full width of the duct plus a minimum of 6", each side of the duct. Refer to Part Pipe and Miscellaneous Insulation Work for AP Armaflex material specification. Slit Armaflex may be used in lieu of unslit. If slit Armaflex is used, glue the longitudinal joint and butt joint with Armaflex glue and follow with 3" wide, 1/8" thickness Armaflex across all glued joints. The use of Rubatex insulation between piping and the ductwork shall only be allowed when raising the effected duct is not an option.

6.7. **Insulation Pins and Washers:** **The use of adhesives for attaching pins and washers to the ductwork is prohibited.** Pins shall be cupped-head, capacitor-discharge-weld pins, zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135 inch diameter shank, length to suit depth of insulation specified with integral 1-1/2 inch galvanized carbon-steel washer. Insulation retaining washers shall be self-locking type formed from 0.016-inch thick galvanized steel with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

6.8. **Hot Gas Reheat Coil and Cabinet:** Where hot gas reheat coils are specified and the coil is not within the insulated Heat Pump or Air Handling Unit equipment cabinet, externally insulate the hot gas reheat coil cabinet with 1.5" thickness duct board equal to Owens Corning 800 FR. Protect external insulation with open weave glass or polyester cloth by Johns-Manville Duramesh, Childers Chil Glas #10 or Foster Mast-A-Fab, embedded between two 1/8" coats of Foster 60-91 (gray) Monolar Mastic or Childers Encacel X-1 (gray). Coordinate coil requirements with Mechanical Contractor prior to bid and provide as required.

PART 7. DUCT INSULATION WORK (INTERNAL)

7.1. **General:** All work by experienced applicators in accordance with manufacturer's recommendations. Duct liner, mastics and materials shall comply with all requirements and other building code requirements. All insulation materials (coatings and mastics) shall be fire resistive per NFPA Pamphlet No. 90A and 90B and shall be UL listed and shall have a fire hazard rating not to exceed 25 for flame spread and 50 for fuel contributed and smoke developed as determined by ASTM E84. Liner materials shall conform to the performance based ASTM C1071, which includes ASTM C518 Thermal Conductivity, ASTM C411 Temperature Resistance, ASTM C665 Corrosiveness, ASTM E84 Surface Burning Characteristics, ASTM C1338 Fungi Resistance, ASTM C1304 Odor Emissions and ASTM C1104 Moisture Vapor Sorption.

7.2. **Material:** Liner shall be a GreenGuard certified, low VOC, Type I liner as defined by ASTM C1071 and characteristics complying with ASTM E 84, UL 723, NFPA 255, NFPA 259 and ASHRAE 62. It shall have an acrylic coating formulated with an immobilized, EPA registered, protective agent to protect against growth of fungi and bacteria as required by ASTM C1071 and tests conducted in accordance with ASTM C 1338, ASTM G21 and ASTM G 22. It shall not support microbial growth and have glass fibers bonded with a thermosetting resin. The airstream surface shall be protected with a reinforced coating with flexible glass cloth reinforcement. The liner shall have a reinforced factory applied edge coating and operate in an environment of a maximum of 250°F and maximum of 6,000 fpm air velocity. Thermal conductivity per ASTM C-518, at its rated thickness, shall be not less than k=0.16 BTU·in/(hr·ft²·°F) and R=6.3 at 75 F mean temperature in accordance with ASTM C18. Sound absorption coefficients for the liner shall be per ASTM C 423 and ASTM E 795 test methods and the table below. **Furnish sound characteristics for approval with the material submittal.**

Sound Absorption Coefficient at Frequency

Thickness	(Cycles per Second)						
(In)	**125**	**250**	**500**	**1000**	**2000**	**4000**	**NRC**
1.5	0.10	0.47	0.85	1.01	1.02	0.99	0.80
2.0	0.25	0.66	1.00	1.05	1.02	1.01	0.95

7.3. **Manufacturer:** Shall be Johns Manville Linacoustic RC or equivalent material by Schuller, Knauf, Pittsburgh, CSG, Owens Corning or CertainTeed.

7.4. **Thickness:** 1.5 inches thickness. Return air platforms/plenums 2.0” thickness.

7.5. **Ducts and Equipment to be Insulated Internally:** Exposed supply air, exposed return air and exposed outside air ducts in areas without ceilings, return air plenums/platforms, transfer air (jumper and ATD) ducts and relief air ducts.

7.6. **Acoustical Duct Lining:** Line the first ten (10) linear feet of all single wall, supply and return air ducts downstream of all heat pumps, storm shelter supply air fans and transfer air (jumper and ATD) ducts with insulation equal to Johns Manville Linacoustic RC and **2.0” thickness.** Sound absorption characteristics shall be as specified above.

Provide metal nosing as specified below when transitioning from 2” thickness to 1.5” thickness internal liner. See detail on plans.

7.7. **Application:** Adhere insulation to the entire surface of the sheet metal with fire resistive, low VOC, UL labeled, fire resistive, water based, ASTM C 916, Type II compliant adhesive before the metal is broken. Adhesive shall be Foster 85-60 or Childers CP-127. Secure all sheets wider than 24 inches with sheet metal screws and washers or stud pins and clips 16 inches on center, each way. Joints shall be straight and smooth and shall be buttered with adhesive to prevent erosion and improve airflow. Product shall have factory applied edge coating to assure sealing of transverse edges per current SMACNA and NAIMA installation standards.

Damage to the liner shall be repaired using Johns Manville SuperSeal products as required or equivalent materials by other manufacturers with their specific equivalent products.

7.8. **Metal Nosings: All exposed leading and trailing edges shall be secured with sheet metal nosings to protect insulation edges**. Metal nosings shall be securely installed over all transversely oriented liner edges facing the airstream at forward and rear discharge towards coils, dampers, ducts, plenums, changes of insulation thicknesses of adjoining insulation, any exposed insulation ends and at any point where lined duct is preceded by unlined duct. See detail on the plans. All remaining miscellaneous exposed edges shall be sealed/coated. There shall be no exposed fiberglass ends in the airstream.

PART 8. REGISTERS, GRILLES AND DIFFUSERS

8.1. **General:** All grilles, registers and diffusers shall be product of a single manufacturer; shall baked enamel finish with color as selected by the Architect. Architect may require painting of the diffusers, grilles, registers, etc., in the field. Where field painting is required, diffusers, grilles and registers shall be factory primed for painting in the field. Refer to Architectural Section “Painting”, coordinate requirements and provide finish as required. Where lay-in type panels and frames are specified, check ceiling suspension system and coordinate interfacing. All grilles, registers and diffusers not in integral lay-in metal panels shall be mounted with aluminum-countersunk screws with finish to match respective items.

All ceiling diffusers back panels shall be insulated with 1” thickness, foil backed insulation and securely attached. Contractor has the option of insulating manually or furnishing the diffuser with factory furnished insulation from the diffuser manufacturer. Factory provided insulation shall be attached as shown on the plan details.

All grilles, registers and diffusers shall be ADC or approved equivalent Agency certified.

All ceiling diffusers, ceiling grilles and ceiling registers located within a designated storm shelter or safe area shall be provided with earthquake/hurricane tabs/clip and required accessories for securely supporting from the structure above with minimum 12 ga. galvanized ceiling suspension system wire.

8.2. **Square Ceiling Diffusers with Round Neck:** Titus Model TMSA-AA, Price ASCDA, removable core type, aluminum construction, with baked enamel finish color selected by the Architect, designed for four-way diffusion complete with Titus AG-85, Price VCR8E steel butterfly blade damper. Diffuser face shall be 24” x 24” with type frame to interface with ceiling system. Use lay-in type frame where lay-in ceilings occur.

8.3. **Square and Rectangular Neck Ceiling Diffusers:** Titus Model TDCA-AA 6-95-125-25, Price Model AMDA-6-3LAL, removable core type, extruded aluminum construction, with baked enamel finish color selected by the Architect, designed for one, two, three and four-way diffusion as indicated on plans, complete with AG-95 aluminum opposed blade damper, AG-125 Dua-Trol and adjustable vanes. Where lay-in ceiling occurs, diffusers shall have integral 2' x 2' or 2' x 4' aluminum modular lay-in ceiling panel with finish to match diffuser.

8.4. **Wall Supply Air Registers:** Titus Model 300 FS-5-D-65, Price 620DAL-F-S-D-A-SW all aluminum adjustable 4-way deflection type. Provide with AG 35B aluminum opposed blade damper with worm gear, Allen Key operators and AG-225 extractors with No. 1 operator, auxiliary mounting frame and baked enamel finish color selected by the Architect.

8.5. **Wall Return Air Registers:** Titus Model 33R-PF, Price Model 91-L-D-A-VCS3 gymnasium heavy duty steel register with 38 degree deflection 14 ga. blades, support bars on 6" centers Allen key operated aluminum opposed blade damper and auxiliary mounting frame all finished with baked enamel finish color to be selected by the Architect.

8.6. **Ceiling Mounted Exhaust Air and Return Air Registers:** Titus Model 50-F-0-5-D-25, Price Model 80DAL-F-SW-A all-aluminum fabricated egg-crate type with baked enamel finish color to be selected by the Architect, Allen key operated aluminum opposed blade damper and lay-in type frame. Where lay-in ceilings occur, each register shall have integral 2' x 2' or 2' x 4' aluminum modular lay-in ceiling panel with finish to match diffuser.

8.7. **Ceiling Mounted Return Air or Relief Air Grilles and Air Transfer (Jumper Duct) Grilles:** Same as return air registers except without dampers.

8.8. **Expanded Metal Grilles:** Provide metal grille equal to McNichols Co., flattened expanded metal, galvanized, hot dipped, 3/4, #16 flattened, minimum 70% open (free) area with U-Edging to protect occupants from injury. Grille shall be factory primed for painting in the field as directed by the Architect.

8.9. **Equal Products:** By Titus, Price, Krueger and Metalaire will be accepted.

PART 9. FEMA LOUVERS

9.1. **FEMA Louvers:** Louvers indicated to be in outside/perimeter wall shall be furnished and installed by the General Contractor. See Architectural specifications for requirements. Louvers indicated to be within the storm shelter in various ductwork and partitions associated with Mechanical work shall be furnished and installed by the Mechanical Contractor.

Louvers shall be FEMA 361 or FEMA 320 compliant as applicable. Coordinate requirements with FEMA notes on the structural plans and provide accordingly. Louvers shall be AMCA 540 and 550 certified and labeled as required. The louver shall be a U.L. Classified Wind-Storm rated assembly in accordance with FEMA Guidelines P-320, P-361, and ICC 500 for static and cyclical design pressures of positive/negative 250 PSF and debris impact of a 15 pound 2"x4" traveling at 100 MPH. The louver shall be AMCA certified and bear a metal U.L. Label. **Stick-on type U.L. labels are not allowed.** Louver depth shall be as required for the assembly it is mounted in. Louver shall be Greenheck or equivalent by Reliable, Ruskin, Carnes or Airolite.

PART 10. CONDENSATE DRAINAGE PIPING

10.1. **General:** Cut accurately to measurements established at site and work into place without springing or forcing, properly clearing all building features. Arrange and install piping systems sizes as shown, as close as practical, straight, properly supported and run as directly as possible forming right angles or running parallel with building lines, true to line and grade, free of sags and bends. Route through previously built-in sleeves and avoid cutting or other weakening of the structure. Make changes in direction and size with fittings (no bushings will be allowed). Cap or plug open pipe ends during installation to keep out foreign material.

Before installation, piping shall be checked, upended, swabbed, and all dirt from storage or from lying on the ground shall be removed. Any installed dirty piping shall be cleaned. All piping shall be clean when it is installed.

Make all connections to equipment using screwed unions. Install unions in all piping connections to each piece of equipment, including traps, pumps, coils, etc..

All piping shall be concealed within walls, chases, above ceilings, etc., unless specifically noted otherwise.

10.2. **Condensate Drain Piping and Drain Pipe from Drip Pans to Floor Drains, Hub Drains and Miscellaneous Condensate Receivers:** Type M hard copper tubing with wrot copper solder joint fittings with 45° or 90° offset fittings. ProPress or similar type fittings/joints are not allowed.

Provide a trap in each drain line with capped or plugged cleanout tees. Trap depth shall be as required by the equipment Manufacturer. In absence of the equipment Manufacturer's trap requirements, traps shall be equal to the total system pressure plus one inch. Provide an electric switch, conforming to UL 508, to shut down the unit should the line become obstructed.

10.3. **Copper Joints:** Make assemblies with tin-antimony (95-5) solder and non-corrosive flux (this does not apply to refrigerant piping). Clean and polish the tube and the inside of the fittings, using No. 60 steel wool. Apply flux and place fitting on the tube. Heat joint evenly, but take care not to overheat fitting. Apply solder until a solder line shows completely around the joint. Remove surplus solder and allow joint to cool. ProPress or similar type fittings/joints are not allowed.

10.4. **Escutcheons:** Provide all pipes passing through the floors, walls or ceilings of finished rooms with chrome plated brass escutcheon plates securely fastened in place with round head set screws.

10.5. **Unions:** Unions shall be of the following types:

Copper Lines: Ground joint, copper to copper.

Dielectric Unions: Provide where copper pipe joins to steel pipe, EPCO or approved equivalent. Contractor shall provide a globe valve on each side of each dielectric union to allow for replacement of the union.

Expansion: Provide for expansion and contraction of all piping and make proper provisions so that there will be no undue strain on any pipe or equipment.

10.6. **Sleeves:** Refer to Section 15010, Para. B. 4. Pipe Sleeves.

PART 11. REFRIGERANT PIPING AND ACCESSORIES

11.1. **General:** Cut accurately to measurements established at site and work into place without springing or forcing, properly clearing all building features. Arrange and install piping systems, as close as practical, straight, properly supported and run as directly as possible forming right angles or running parallel with building lines, true to line and grade, free of sags and bends. Locate piping as high as practical and in parallel groups as close together as practical. Route through previously built-in sleeves and avoid cutting or other weakening of the structure.

All refrigerant piping, including mini-split piping, shall be Type L hard drawn, ACR copper refrigerant tubing with wrot copper solder joint fittings. **Coiled copper and precharged line sets are NOT allowed unless specifically noted or specified.** All offsets and changes in direction shall be made with 90º or 45° elbows as required. System shall be complete and sized to conform to current ACRMA standards, except that refrigerant suction risers shall be sized for a gas velocity not less than 2000 fpm.

Where refrigerant piping is shown rising in the wall cavity and requires modifications to the block wall due to the size of the piping and insulated assembly, the block shall be neatly saw cut. Provide reinforcing to the affected portions of the wall as indicated on the structural drawings and details, the same as required at window and door openings. See the structural drawings for specifics. Extreme coordination is required prior to the erection of the structural slab and wall. Coordinate with the General Contractor.

Refer to Section 15010 and provide wall sleeves and escutcheons as specified for typical piping. Sleeves for pipe passing through exterior walls that contain refrigerant piping shall be Schedule 80, ASTM D1785 PVC pipe, 1/2" larger in diameter than piping and piping covering. Refer to Section 15010, Sleeves and Firestopping for additional requirements. **Taping or zip tying of liquid lines to suction lines is not allowed.** Refer to Section 15010 and below for requirements. Coordinate wall sleeve sizes required for refrigerant piping with insulation and aluminum jacket requirements. Piping within wall cavities shall be seamless type with no joints.

11.2. **Joints:** Brazed joints only. Flare joints are not allowed. Make up with high temperature silver solder suitable for twice (2x) the working pressure, at maximum capacity, of the system. Pass dry nitrogen gas through pipe while joints are brazed. No joints shall be allowed within any masonry walls or any other inaccessible area. Solder shall be Sil-Fos 15 or approved equivalent. All soldering or brazing, materials and methods used shall be as recommended by the unit manufacturer. Piping within wall cavities and other inaccessible areas shall be seamless type with no joints.

11.3. **Piping Diagram:** Various manufacturers of heat pumps and mini-split systems have different reasons for the use of loops, traps, accumulators, receivers, etc., in piping arrangements, therefore, submit for approval, the air conditioning equipment Manufacturer's recommended, dimensioned plan view and isometric piping diagram proposed for use for each system, showing all valves, loops, pipe sizes and all appurtenances, required for the proper operation of the respective system. Secure approval of compressor and air conditioning unit manufacturer before submitting. **Failure to provide a manufacturer approved diagram will make the contractor responsible for all required changes to the piping system without additional cost to the Owner or his Design Professionals.** Submit catalog data and

manufacturer's ratings for all valves, catch-alls, etc. with diagram for each system. Identify all items for respective system and list capacities, pressure drops, etc.

11.4. **Solenoid Valves (Where Required):** Install in liquid refrigerant connection to the evaporators. Valves shall be designed for the operating pressure and capacity as listed in manufacturer's catalog with a pressure drop not exceeding 2 psi, and shall be sufficient for the requirements of the installation. Install in horizontal runs with body vertical.

11.5. **Expansion Valves (Where Required):** Properly sized diaphragm or bellows type, with external superheat adjustment set for 10 degrees F. superheat. Install in the liquid refrigerant supply lines to the evaporators. Expansion valves up to and including 7-1/2 tons capacity shall be Sporlan Type "S" or approved equivalent. Expansion valves over 7-1/2 ton capacity shall be Sporlan Type "O" or approved equivalent. Install Sporlan full size catch-all filter-drier ahead of valve.

11.6. **Refrigerant Service Valves:** Provide for the proper servicing of the equipment. All refrigerant circuit access ports located outdoors shall be fitted with color coated, all brass, and locking type tamper resistant caps. The locking caps shall be color coded for the refrigerant used. Caps shall be Novent Series 8668 for R-410 refrigerant with 86698 NV Multikey unlocking mechanism for R-410 refrigerant or equivalent by JB Industries Series Shield and DiversiTech Series Sentry. Provide owner with minimum of six (6) spare keys.

11.7. **Refrigerant Filter Drier (Catch-all):** Install in refrigerant line on the inlet side of each thermostatic expansion valve a Sporlan, three desiccants type filter drier. Filter driers up to and including 10-ton capacity shall be sealed type. Filter driers over 10-ton capacity shall be replaceable core type. Units shall have minimum surface filtering area and capacity not less than that shown in Sporlan Valve Company Bulletin 40 10 under sizes for "field replacement or field built up sizes". Careful attention must be given to providing the correct type of filter drier as it pertains to type of refrigerant used in the respective system.

11.8. **Pipe Sleeves:** See Section 15010 for requirements.

PART 12. PIPE HANGERS AND SUPPORTS

12.1. **General:** Refer to Section 15010.

12.2. **Painting of Hangers and Supports:** All non-galvanized exposed ferrous metal parts of hangers, Unistrut and other assemblies used for supporting of ducts (except hanger straps and threaded rods), piping and plumbing related items in mechanical rooms, crawl space, above ceilings, etc., including black steel pipe, uncoated cast iron pipe, hangers, brackets, etc. shall be coated. All exposed ferrous metal parts of hangers, Unistrut and other assemblies used for supporting of ducts (except hanger rods, duct straps/band hangers), piping and related items in mechanical rooms, crawl space, above ceilings, etc. Include black steel pipe, uncoated cast iron pipe, hangers, brackets, etc. All finishes and coatings shall have a fire hazard rating not to exceed 25 for flame spread and 50 for fuel contributed and smoke developed as determined by ASTM E84. Also, see specification section, "Identification" for additional requirements. Refer to Section 15010 for additional requirements.

PART 13. PIPE AND MISCELLANEOUS INSULATION WORK

13.1. **General Provisions:** All work by experienced applicators in accordance with manufacturer's recommendations. Installation shall be as recommended by the Manufacturer. Where specified installation conflicts with the Manufacturers recommendations, the strictest application shall be provided. Piping must be clean, dry and pressure tested before covering is applied. Size pipe hangers to fit over insulated pipe size. **Hangers shall not be in contact with bare pipe and shall not penetrate the vapor barrier**. See hangers and supports for requirements. Cover fittings, valves and flanges with insulation material as hereinafter specified to same thickness as adjacent pipe covering except screwed unions in hot and chilled piping and other specifically named items. Neatly bevel covering edges adjacent to unions and other points of termination or provide factory fabricated beveled insulation fitting. All insulation materials including coatings and mastics shall have a composite rating for insulation, jacket or facing, including adhesives, not to exceed 25 flame spread and 50 for fuel contributed and smoke developed as determined by ASTM E-84, NFPA 255 and UL 723.

13.2. **Refrigerant Suction Lines and All Hot Gas Reheat Coils' Hot Gas Lines, Various Liquid Lines and Mini-Split System Liquid Lines:** Insulate with UL fire and smoke rated unslit, black, flexible foamed, elastomeric, closed cell pipe insulation by AP Armaflex or equivalent by K-Flex or Aerocel AC EPDM. It shall be GreenGuard certified tubular insulation with Microban antimicrobial protection. Insulation shall have a 'k' factor of not more than 0.256 at 90°F mean temperature, water absorption percent by volume of 0.2 and a water vapor transmission rate of 0.05 perm-inches or less. Slip insulation onto pipe prior to installation. **Longitudinal cutting of the insulation is prohibited.**

Refrigerant piping and hot gas reheat coil refrigerant supply line insulation shall be 1" thickness.

Note that Various Manufacturers of mini-split systems require the insulating of refrigerant liquid lines. When required by the Manufacturer, they shall be insulated using materials specified above and in thickness required by the respective Manufacturer. Where the mini-split system Manufacturer requires less than 1" insulation, install thickness recommended with materials specified above using methods specified below. **Preinsulated refrigerant piping is not allowed unless insulation meets the requirements specified above. Note also that coiled refrigerant piping is not allowed unless specifically noted. Refer to other portions of this specification for refrigerant piping requirements.**

Slip insulation onto pipe prior to erecting. **Longitudinal cutting of the insulation is prohibited. Do not stretch or bend insulation at any turn, nor slide insulation over sweat fittings.** Insulate sweat fittings and elbows with miter-cut pieces of insulation or prefabricated fittings as recommended in Armaflex installation instructions, the same size as on adjacent piping. Fitting cover shall be long enough to overlap the pipe insulation by a minimum of one inch on each side. Glue the 1" overlap and seal to the adjacent pipe insulation with same adhesive and tape specified hereinbefore. Seal all butt joints with Armaflex BLV, Black, low VOC, air-drying contact adhesive. After gluing joints, wrap joint with 3" wide, 1/8" thick AP/Armaflex self-adhering tape.

All insulated piping shall be continuous without cutting at clamp/support assemblies. All refrigerant liquid lines which are not associated with a hot gas reheat coil or liquid lines NOT required to be insulated by the equipment

Manufacturer shall not be insulated except, they shall be provided with insulated insert at clamps to Unistrut assemble as specified below.

13.3. **Refrigerant Pipe Supports:** **Do not use clevis hangers for refrigerant piping.** All refrigerant piping, regardless of size, shall be supported with Unistrut assemblies. Provide Unistrut assembly, supporting horizontal refrigerant piping on intervals not exceeding 10 feet. Provide dielectric separation between dissimilar metals. Support piping so that no vibration will be transmitted to the building structure.

Provide an insulated piping clamp assembly at each Unistrut hanger, including the liquid line and any bare copper line attached to the assembly. The insulated clamp shall provide a crush resistant airtight seal and shall consist of a rigid, closed cell, foam insulation to support tubing and absorb vibration. The outer cover shall consist of a rubber coating that seals the cushion completely after installation to prevent condensation. **Plastic inserts/connectors between insulation joints are prohibited**. Clamps shall be steel with electrodichromate finish. Rated assembly temperature range shall be -50ºF to +250ºF. It shall be self-extinguishing as tested under ASTM D 635. after installing device, tape each joint with 3" width insulating Armaflex tape as specified hereinbefore. Insulated lines shall use ZSi Series Cush-A-Therm, ArmaFix Eco Light or approved equivalent.

For units on concrete pad, support piping on concrete pad with rustproof-coated 1-1/2" x 1-1/2" x 1/8" galvanized steel angle supports anchored to pad with steel base plate and bolts. See Part "Hangers and Supports" for coating requirements of Unistrut assembly.

13.4. **Refrigerant Piping and Condensate Drainage Piping Aluminum Jacket:** Do not install aluminum jacket until refrigerant piping insulation installation has been inspected by the Engineer. All insulated exterior refrigerant piping, insulated exterior hot gas reheat coils hot gas piping and all insulated condensate drainage piping terminating in janitor sink, floor sink and hub drains in finished areas and any location that would subject the piping insulation to damage shall be covered with an aluminum jacket.

Where refrigerant piping rises within the wall cavity to above the ceiling, attic or similar space, the aluminum jacket shall terminate within the exterior wall cavity and sealed weather tight to the sleeve in the wall. Where the refrigerant piping extends from the outside, directly into the mechanical room, the aluminum jacket shall terminate a minimum of 8" into the space and sealed weather tight on both sides of the wall and sleeve.

The aluminum jacket shall be 20 mil (.02") thick, smooth finish, 3003 and 3105 series aluminum conforming to ASTM B-209 standards. Fittings shall be 20-mil (.02") thick, die shaped, and smooth finish, Type 1100 aluminum jacket meeting ASTM C585. Provide 1/2" wide, 20-mil (.02") thick, Type 3003 aluminum bands on maximum 24" centers but not less than two bands per jacket section. **Venture Clad or similar product is prohibited.**

13.5. **Condensate Drain Lines:** To include discharge lines on all equipment specified with or provided with air conditioning condensate drainage pumps. Insulate using same methods and materials as specified for refrigerant piping except 1/2" thickness.

13.6. **Painting and Identifying:** Paint and identify after installation is completed as specified in Section 15010. Where piping is specified with an aluminum jacket, painting is not required.

13.7. **Submittal Data:** Submit for approval complete data on materials and application methods proposed.

13.8. **Manufacturers:** Approved equivalents by Pittsburgh Corning, CertainTeed, Baldwin-Ehret-Hill, Manville, Owens Corning, Armstrong Childers and 3M Company will be accepted.

PART 14. VENTILATION

14.1. **General:** Provide all fans complete with ducts, grilles, curbs and required accessories. Provide for all fans to be interlocked with air handling units a "hand" – "auto" – "off" switch. All fans shall be AMCA certified in accordance with Standards #210 and 300. Fans wheels shall be balanced in accordance with AMCA Standard 204-05. Fans shall be UL 705 listed and shall bear the UL Label. Furnish for approval capacity and sound power ratings. All motors 1/2 HP and smaller shall have built-in overload protection. All motors shall also be premium efficiency type. Refer to Section Motors for additional requirements. Scheduled static pressures are external to sound curbs

14.2. **Ceiling Mounted Cabinet Fans:** Penn Ventilator Company Model Zephyr, Series Z-3H thru Z-15H with RA right angle arrangement or TDA arrangement as shown on the plans, or approved equivalent, complete with all accessories, including unit mounted solid state speed control switch, factory baked enamel white metal ceiling grille, metal flanged inlet and outlet connections, acoustically insulated metal housing, direct driven, internally isolated centrifugal fan, integral backdraft damper and terminal cap, cast aluminum brick vent or soffit grille as shown on the plans. Fan wheel shall be steel. Provide aluminum wheel where fan exhausts shower areas. Fan shall be supported from the structure with 1/4" hanger rods, rubber in shear vibration isolators and Manufacturer furnished bracket for attaching rods to the fan and structure above.

14.3. **Cabinet In-Line Centrifugal Fans (SAF):** Loren-Cook Series "SQ" in-line centrifugal type fan as shown on the fans schedule. Fan shall have 18 ga. galvanized steel cabinet with integral duct collars, bolted access doors on 3-sides which are sealed with closed cell neoprene gasketing, disconnect switch, centrifugal, backward inclined extruded aluminum fan wheel and cast aluminum hub, supports for ceiling suspension, permanently lubricated drip proof motor, and gravity type discharge damper and Manufacturer furnished VFD (NOT a speed controller) if indicated or specified. Bearings shall be heavy duty, L50 life in excess of 200,000 hours at maximum cataloged operating speed. Bearings shall be regreaseable ball type with extended fittings in a pillow block cast iron housing. Coordinate fan arrangement required (top, side and bottom) at the site, prior to ordering fan. Contractor shall provide fan with filter frame and 1" thick metal washable filters if access to filter section requires removal of the fan housing panel. Do not provide Manufacturer provided filter frame unless it is external to the unit and is provided with thumbscrew access. **Filter access requiring the removal of the fan housing is prohibited. The Contractor is responsible for quarterly filter cleaning during the guarantee period.**

14.4. **Acceptable Manufacturers:** Cook, Acme, Greenheck, Penn Barry.

PART 15. SPLIT SYSTEM HEAT PUMP UNITS

15.1. **General:** Furnish and install split system heat pump systems as manufactured by the Trane Company. All equipment (condenser/compressors) scheduled cooling capacities are based on 95°F ambient temperature. Indoor units shall be Series TEM6 for units with scheduled cooling capacity of 48MBH or less. Indoor units with scheduled cooling capacities of greater than or equal to 54 MBH shall be Trane Odyssey Series TWE. Outdoor units shall be Trane series TWA. Equivalent units/systems by Carrier or Lennox will be considered.

Each unit shall be completely factory assembled and tested, and shall include hermetic compressor, outdoor condenser coil, indoor evaporator coil, condensate switch to shut unit down should condensate drain line become obstructed, fan and high static ECM motor drives (Series TEM6) or belt drive motor with variable pitch pulley, high static drive and permanently lubricated ball bearing motor (Series TWE), interconnecting wiring, low voltage control transformer, prewired control panel and other necessary components mounted in weather resistant steel cabinet with baked on enamel finish. The unit shall be UL or ARL (Applied Research Labs) listed and labeled accordingly. The heat pump shall be sound rated per ARI Standard 270 and operation sound level shall not exceed acceptable limits. Heating and cooling capacities shall not be less than those indicated on the drawings. Indoor unit shall be provided with single point power connections (fan and heater). **Verify voltage and power requirements with Electrical Contractor and Electrical plans prior to ordering equipment.**

15.2. **Special Considerations:** The equipment manufacturer shall size the refrigerant piping for all the units and shall furnish all accessories and auxiliaries required for a complete and proper installation for the specific application shown on the drawings and the specified sequence of operation. Refer to Section Refrigerant Piping and Accessories for additional requirements.

15.3. **Cabinet:** Heavy duty plastic (1-ton through 5-tons) and heavy gauge galvanized steel cabinet with weather resistant baked enamel finish for all other units. Access to the electrical controls and compressor shall be made by removing two service panels.

15.4. **Compressor System:** The unit shall contain a hermetic compressor. The compressor shall have high and low pressure protection, sump heat and compressor overload protection. Refrigerant circuit shall include service valves, pressure tap ports, check valves, switch over valve, refrigerant line filter-driers, and factory furnished holding charge of R-410a. All units with scheduled cooling capacity greater than 60 MBH shall be provided with multiple compressors or 2-stage compressors as required by ASHRAE 90.1.

All refrigerant circuit access ports located outdoors shall be fitted with color coated, all brass locking type tamper resistant caps. The locking caps shall be color coded for the refrigerant used. Caps shall be Novent Series 8668 for R-410 refrigerant with 86698 NV Multikey unlocking mechanism for R-410 refrigerant or equivalent by JB Industries Series Shield and DiversiTech Series Sentry. Provide owner with minimum of six (6) spare keys.

Compressor shall be designed, manufactured and warranted for five years by the air conditioning unit manufacturer.

15.5. **Outdoor Coil:** The outdoor coils shall be constructed of aluminum fins or Spine Fin mechanically bonded to seamless aluminum or copper tube and shall be protected by a unit manufacturer furnished, heavy-duty metal hail guard. The outdoor coil shall

have expansion valve refrigerant control during heating operation, and automatic time and temperature actuated defrost control system. Unit shall, as factory shipped, cycle fan motor on outdoor thermostat for low ambient cooling down to 45°F outdoor temperature. Provide heavy-duty metal condenser coil hail guard.

15.6. **Controls:** Controls shall be factory wired and readily accessible. Compressor shall have overload protection; high and low pressure cutouts, 24-volt control transformer and magnetic contactor.

15.7. **Air Handler:** Air handler cabinet shall be constructed of heavy gauge steel with baked enamel finish and be internally lined with foil laced fiberglass insulation. The indoor coil shall be constructed of aluminum plate fins mechanically bonded to seamless copper tubes. The indoor (evaporator) coil shall have expansion valve control and be equipped with defrost control and provided with stainless steel drain pan. Air handler shall be provided with low voltage terminal board and fan motor relay. Refer to drawings for specific drive requirements.

15.8. **Electric Heaters:** Provide electric heater with a total heating output not less than indicated on the drawings. Heater assembly shall include power supply fusing, automatic resetting limit switches and heat limiters for thermal protection. Heater shall be provided with factory disconnect switch and fusing all per National Electrical Code and UL. The auxiliary heater cabinet shall be factory-sealed air tight and insulated to prevent condensation.

Units with a specified cooling capacity of less than 40 MBH shall use the auxiliary resistance heater for reheat. Where the auxiliary resistance heater is specified for maintaining space temperature during dehumidification, the auxiliary resistance heater shall be provided in a minimum of two stages.

15.9. **Hot Gas Reheat Coil:** Each unit with scheduled cooling capacity greater than or equal to 40 MBH shall be provided with a refrigerant hot gas heating coil in the reheat position for humidity control. The coil shall be of sufficient size to reheat all of the supply air. Provide, complete, with all necessary valves, controls, etc., as required for a complete and properly functioning installation. Provide manual isolation valves for each hot gas and liquid lines. Furnish for approval air conditioning equipment manufacturer approved refrigerant piping and controls diagram, and statement by the air conditioning manufacturer on company letterhead that use of the hot gas reheat coil with the equipment is acceptable to the manufacturer and does not affect any warranty or guarantee. **Equipment submittal will not be reviewed without a manufacturers' approved diagram and referenced statement**. Minimum reheat capacity for supply air shall be 10ºF. Maximum coil pressure drop is 0.10” static pressure.

15.10. **Indoor Thermostat:** Manufacturer shall provide a combination 7-day programmable, two-stage heating manual changeover heat pump thermostat. Thermostat shall have outdoor thermistor to compensate for thermostat droop, emergency heat switch with indicator light and auxiliary heat light. Thermostat shall have sub-base fan switch for “On-Auto” selection and manual “Heat-Cool” switch. Thermostat shall be hardwired and be provided with battery backup. Coordinate thermostat with specified sequence of operation and provide as required. Provide hinged metal guard with rounded corners, lock and key for each thermostat.

15.11. **Outdoor Thermostat:** Provide mounting box. Provide one outdoor thermostat for control of second stage of electrical heaters.

15.12. **Factory Start-up Service:** The Contractor shall provide a factory-trained technician, employed by the unit manufacturer and not a sales representative, to check out all equipment with scheduled cooling capacity greater than or equal to 60,000 Btuh and/or are provided with hot gas reheat coils or UV-C lights, and furnish written report indicating equipment is installed in strict accordance with manufacturer's recommendations. Also, provide temperature, pressure and amp readings taken during testing to substantiate unit performance including the range of the refrigerant hot gas reheat coil as applicable.

15.13. **Power Wiring:** Unit shall be factory wired for power supply indicated on the electrical drawings. Any variation will be the responsibility of the contractor.

15.14. **Filter Frame and Filters:** Provide 2" thick, MERV 11, pleated filters equal to 30/30/ Farr Series. All filters shall be common industry standard size filters that are readily available and do not have to be fabricated. Cutting and taping of filter segments to make a proper filter is prohibited. Where indoor section sits on R.A. platform or is horizontally mounted in an attic space and the manufacturer does not provide a filter access with thumbscrew access in the bottom of the unit, provide a filter frame that is designed to mount to the bottom (R.A. inlet) of the air unit. Frame shall be hinged and have thumbscrews or wing nuts to open the access door. Filter frame shall be as manufactured by E-Z Filter Base Mfg., Inc. or approved equivalent. **The Contractor is responsible for quarterly filter changes during the guarantee period and shall inscribe onto the filters' casing the date filters were installed/replaced.**

15.15. **Ultraviolet (UV-C) Lights:** Mechanical Contractor is responsible for wiring the devices and providing power for the UV-C lights if not shown by the Electrical plans. Devices shall be hardwired, and UL labeled for the installation. Plug-in devices are not allowed.

Comply with UL / C-UL or ETL for Ultraviolet Fixturing. Store UV-C Fixturing in a clean, dry place and protect from weather and construction traffic. UV-C products supplier shall provide proof of 100% inbound and outbound testing of equipment. The UV-C Power supply shall have been tested, listed and labeled as compliant with UL, CSA and CE. Plenum wiring loom shall meet UL Subject 13 and UL 1581, Article 725 of the NEC and meet UL VW-1 material ratings. There shall be a metallic Loom cladding and it shall be UL recognized DXUZ2 and constructed of flexible galvanized steel and cover the entire Loom. Each lamp shall contain no more than 5 milligrams of mercury consistent with current environmental practices. Lamp Watts shall be printed on all lamps, no exceptions. Lamps shall not produce ozone and shall be hermetically sealed within a layer of UV-C transmissible FEP to protect against lamp breakage and to contain lamp contents should breakage occur.

Power supply and fixturing shall be warranted to be free from defects for a period of five (5) years. Lamps shall be warranted to be free from defects for a period of one (1) year.

Lamps shall be installed in sufficient quantity and in such a manner to provide an equal distribution of UV-C energy. When installed, the UV-C energy produced shall be of the lowest possible reflected and shadowed-losses and shall produce 360-degree UV-C irradiance from the lamps within the UV cavity. Lamp Watts shall be printed on all lamps, no exceptions. Each lamp shall contain less than 5 milligrams of mercury, consistent with current environmental practices. Lamp useful life shall be a minimum of 9,000 hours with no more than a 15% output loss at the end of the lamps life (12 months of continuous use). Lamps shall be constructed with UV-C resistant bases and shall not produce ozone. Lamps shall produce the specified output in

moving air of up to 1000 fpm and temperatures of 0-200°F. Lamps shall be hermetically sealed within a layer of UV-C transmissible FEP to provide protection against lamp breakage and to ensure Lamp contents from a broken Lamp, are contained.

Fixture modeling shall be included in the submittal and must contain the necessary calculations to demonstrate that a minimum of 6 lamp watts, as recommended by ASHRAE, are distributed equally to each square foot of coil surface area to achieve a minimum of 100 microwatts per square centimeter equally distributed to the surfaces at the plenum sides, top and bottom. All calculations are to be at 55 degrees F and 500 fpm air velocity, no exceptions.

The power supply housing shall be capable of installation within or outside of the air stream, secondary compartment or NEMA enclosure. Lamps shall be mounted to irradiate the intended surfaces as well as all of the available line of sight airstream through proper placement, 360° irradiation and incident angle reflection.

To protect personnel, all access panels and doors to the UV-C assembly and/or within view of the UV-C assembly shall include mechanical interlock switches to ensure that the UV-C assembly will be de-energized when any of these accesses are opened. A redundant disconnect service switch shall be installed on the unit exterior, next to the unit access door, in plain sight to provide a method to more specifically de-energize the UV-C lamp circuits prior to entering the lamp plenum.

15.16. **Phase Protection:** All indoor and outdoor equipment shall also be provided with surge protection and phase protection to insure against voltage unbalance, over/under voltage, phase loss, reversal, incorrect sequencing and rapid short cycling. Protection shall be provided for all 3-phase equipment utilizing ICM Controls Model 450 or equivalent. All single phase equipment with horsepower greater than or equal to 1/8 HP shall be provided with protection utilizing ICM Controls Model ICM 492 or equivalent. Where phase protection device cannot be mounted within the respective equipment, provide a NEMA 4x or NEMA enclosure appropriate for the installation. The Contractor shall consult with the Owner's maintenance personnel and set up all programmable options based on the Owner's requirements, within the device's capabilities.

15.17. **Pad Mounted Supports:** Units shown on finished grade shall be anchored to the concrete pad. Concrete pads are specified under Division 2. Where concrete pads are not specified or not shown elsewhere, the Mechanical Contractor shall provide a minimum 4” thickness, 3,000-psi concrete pad with rounded edges and corners. Pad shall extend a minimum of 12” around three (3) sides of the unit and terminate at the building outside wall. Provide a strip of asphalt expansion joint between the concrete pad and the building exterior wall. Expansion joint shall be full width by full depth of concrete pad, 1” thickness, non-absorbing, self-sealing, ASTM D 994 compliant as manufactured by W.R. Meadows Inc. or approved equivalent.

15.18. **Warranty:** General warranties are specified in Section "General Mechanical Provisions". The Contractor and equipment Manufacturer shall provide a non-prorated, total of five years, warranty on the unit compressor(s). The manufacturer's warranty shall provide for the repair and/or replacement of the equipment compressor(s) that become inoperative because of defects in material or workmanship. The Contractor is responsible for any parts and labor not provided by the equipment Manufacturer. The warranty shall include refrigerant and all other costs associated with the compressor(s) removal and replacement, shipment to the Contractor or Facility, installation and returning the equipment to its proper operating condition.

The Contractor shall respond within 24 hours upon notification that a compressor has failed under the terms of the warranty. "Respond" shall mean having a Manufacturer certified technician onsite to evaluate the extent of the needed repairs and ordering of all items required for repair. Shipping of the replacement compressor shall be via maximum of 2-day delivery of the compressor(s) if the unit is inoperable.

The warranty period shall begin on the same date as substantial completion of the installation, as determined by the Architect, and shall continue for the full product warranty period specified above.

PART 16. WALL MOUNTED DUCTLESS SPLIT HEAT PUMP SYSTEM UNIT (DHP)

16.1. **General:** Provide ductless, wall mounted, split system type heat pump unit, equal to Mitsubishi Electric Series MSZ/MUZ for units with specified cooling capacity up to 9 MBH and PKA/PUZ units with specified cooling capacity of 12 MBH to 36 MBH complete with all accessories including wall hung evaporator blower unit, pad mounted outdoor condensing unit with lockable refrigerant charging valves, filter frame, filter, fixed, wall mounted, 7-day programmable, microprocessor electronic thermostat and control module, adjustable discharge louvers, factory installed heavy duty condensate pump (if drainage indicated on plumbing and HVAC plan is not gravity type), alarm for obstructed condensate line, low ambient indoor coil thermistor, low ambient control to 14º F, outdoor microprocessor control, heavy duty metal condenser coil hail guard and other accessories required for a complete functional installation. Unit shall be provided with sensor to shutdown unit and sound alarm if condensate line becomes obstructed. If BAS system is part of the project, provide output contacts to show alarm at BAS system Operator Console. Coordinate with BAS Contractor and provide as required for proper interface. Refrigerant shall be R-410a. Compressors shall be warranted for 5 years.

All refrigerant circuit access ports located outdoors shall be fitted with color-coded, all brass, locking type tamper resistant caps. The locking caps shall be color coded for the refrigerant used. Caps shall be Novent Series 8668 for R-410 refrigerant with 86698 NV Multikey unlocking mechanism for R-410 refrigerant or equivalent by JB Industries Series Shield and DiversiTech Series Sentry. Provide owner with minimum of six (6) spare keys.

16.2. **Refrigerant Piping:** Coiled line sets and preinsulated line sets are not allowed. See other parts of 15700 for piping and insulation requirements. The equipment manufacturer shall size the refrigerant piping for all the units and shall furnish all accessories and auxiliaries required for a complete and proper installation for the specific application shown on the drawings and the specified sequence of operation. Refer to Section Refrigerant Piping and Accessories for additional requirements.

All condensate and refrigerant piping that cannot be concealed in the walls in finished spaces shall be provided with Mitsubishi Line-Hide Linset Cover System. Note that this provision shall not be used to cover piping that can be otherwise concealed

16.3. **Condensate Pump (As Required):** Condensate pumps for all indoor units shall be Blue Diamond, Series MaxiBlue or approved equivalent. Pump shall be thermally protected, up to 3.7 GPH flow rate, 23 ft. head, 15 ft. suction, self-priming, powered by the indoor unit and maximum 21-db sound level. Pump shall be provided with mounting feet, extension cables and multi-tank configuration as required. Mechanical Contractor to coordinate power requirements for pump, prior to bid, and provide as required.

16.4. **Condensate Switch:** Unit shall be provided with sensor to shutdown unit and sound alarm if condensate line becomes obstructed.

16.5. **Pad Mounted Supports:** Concrete pad is specified under Division 2 for all units mounted on grade. Where concrete pads are not specified or shown, the Mechanical Contractor shall provide a minimum 4" thickness, 3,000 psi concrete pad with rounded edges and corners. Pad shall extend a minimum of 12" around three (3) sides of the unit and terminate at the building outside wall. Provide a strip of asphalt expansion joint between the concrete pad and the building exterior wall. Expansion joint shall be 1" thickness, non-absorbing, self-sealing, ASTM D 994 compliant and manufactured by W.R. Meadows Inc or equivalent.

16.6. **Phase Protection:** All indoor and outdoor equipment shall also be provided with surge protection and phase protection to insure against voltage unbalance, over/under voltage, phase loss, reversal, incorrect sequencing and rapid short cycling. Protection shall be provided for all 3-phase equipment utilizing ICM Controls Model 450 or equivalent. All single phase equipment with horsepower greater than or equal to 1/8 HP shall be provided with protection utilizing ICM Controls Model ICM 492 or equivalent. Where phase protection device cannot be mounted within the respective equipment, provide a NEMA 4x or NEMA enclosure appropriate for the installation. The Contractor shall consult with the Owner's maintenance personnel and set up all programmable options based on the Owner's requirements, within the device's capabilities.

16.7. **Warranty:** General warranties are specified in Section "General Mechanical Provisions". The Contractor and equipment Manufacturer shall provide a non-prorated, total of five years, warranty on the unit compressor(s). The Manufacturer's warranty shall provide for the repair and/or replacement of the equipment compressor(s) that become inoperative because of defects in material or workmanship. The Contractor is responsible for any parts and labor not provided by the equipment Manufacturer. The warranty shall include refrigerant and all other costs associated with the compressor(s) removal and replacement, shipment to the Contractor or Facility, installation and returning the equipment to its proper operating condition.

The Contractor shall respond within 24 hours upon notification that a compressor has failed under the terms of the warranty. "Respond" shall mean having a Manufacturer certified technician onsite to evaluate the extent of the needed repairs and ordering of all items required for repair. Shipping of the replacement compressor shall be via maximum of 2-day delivery of the compressor(s) if the unit is inoperable.

The warranty period shall begin on the same date as substantial completion of the installation, as determined by the Architect, and shall continue for the full product warranty period specified above.

16.8. **Manufacturers:** Mitsubishi or equivalent by Trane, Lennox, Samsung or Carrier. **Mitsubishi is the basis of Design.**

PART 17. THRU-THE-WALL HEAT PUMP UNITS (TWHP)

17.1. **General:** Furnish and install where shown on the Drawings packaged through-the-wall heat pump terminal unit. Unit shall be Amana Series DigiAIR PMH or equivalent by GE or Trane.

Each unit shall be complete with cabinet, louvered architectural type aluminum outside grille with flange, unit mounted or remote controlled as shown on the plans, fresh air damper, permanent washable filter, cooling chassis, defrost control, change-over valves, auxiliary electric heat, filter, adjustable discharge grille, factory installed make-up air system with configurable dehumidification, 250 watt preheater for outside air and other accessories required for a complete installation. Unit shall be AHRI certified. Provide condensate and defrost drain system complete with required piping to drain. The use of condensate disposal by discharging onto the condenser coil is not allowed. **Architect shall select Architectural Grille and finish.** Coordinate required wall sleeve depth with the Architectural drawings prior to ordering equipment. Unit manufacturer shall furnish cord with plug and receptacle.

17.2. **Warranty:** General warranties are specified in Section "General Mechanical Provisions". The Contractor and equipment Manufacturer shall provide a non-prorated, total of five years, warranty on the unit compressor(s). The Manufacturer's warranty shall provide for the repair and/or replacement of the equipment compressor(s) that become inoperative because of defects in material or workmanship. The Contractor is responsible for any parts and labor not provided by the equipment Manufacturer. The warranty shall include refrigerant and all other costs associated with the compressor(s) removal and replacement, shipment to the Contractor or Facility, installation and returning the equipment to its proper operating condition.

The Contractor shall respond within 24 hours upon notification that a compressor has failed under the terms of the warranty. "Respond" shall mean having a Manufacturer certified technician onsite to evaluate the extent of the needed repairs and ordering of all items required for repair. Shipping of the replacement compressor shall be via maximum of 2-day delivery of the compressor(s) if the unit is inoperable.

The warranty period shall begin on the same date as substantial completion of the installation, as determined by the Architect, and shall continue for the full product warranty period specified above.

PART 18. SPLIT SYSTEM CASSETTE TYPE HEAT PUMP (CCHP)

18.1. **General:** The heat pump air conditioning system shall be equal to Mitsubishi Electric Series PLA/PUZ split system operating with R-410a refrigerant. The system shall consist of a slim silhouette; compact ceiling mounted packaged evaporator section and matching slim line outdoor unit with **lockable refrigerant charging valves** and wall mounted 7-day programmable thermostat with occupancy sensor override. The units shall be listed by Electrical Laboratories (ETL) and/or Underwriters Lab (UL) and bear the ETL and/or UL label. All wiring in accordance with the National Electrical Code (N.E.C.). The units shall be rated in accordance with ARI Standard 240 and bear the ARI label. All units shall be provided with phase protection.

18.2. **Occupancy Sensor:** Provide ‘I-see Sensor’ occupancy sensor.

18.3. **Refrigerant Piping:** Coiled line sets and preinsulated line sets are not allowed. See other parts of 15700 for refrigerant piping and insulation requirements. The equipment manufacturer shall size the refrigerant piping for all the units and shall furnish all accessories and auxiliaries required for a complete and proper installation for the specific application shown on the drawings and the specified sequence of operation. Refer to Section Refrigerant Piping and Accessories for additional requirements.

All condensate and refrigerant piping that cannot be concealed in the walls in finished spaces shall be provided with Mitsubishi Line-Hide Linset Cover System. Note that this provision shall not be used to cover piping that can be otherwise concealed

18.4. **Description:** Capacities and characteristics shall be as specified on the drawings. The indoor unit shall be factory assembled and wired. The casing shall be galvanized sheet metal with insulation. This unit shall fit in the ceiling. The evaporator fan shall be a high performance, fan direct driven by a single motor. The fan shall be statically and dynamically balanced and run on permanently lubricated bearings. The indoor unit shall have an adjustable air outlet system with 4-way deflection airflow. Return air shall be filtered with factory furnished filter. The coil shall be of nonferrous construction with smooth plate fins bonded to copper tubing. All tube joints shall be brazed with phos-copper or silver alloy. The coil shall be pressure tested at the factory. A condensate pan and auxiliary drain pan shall be provided and extend under the coil and piping. Unit shall be provided with sensor to shutdown unit and sound alarm if condensate line becomes obstructed. If BAS system is part of the project, provide output contacts to show alarm at BAS system Operator Console. Coordinate with BAS Contractor and provide as required for proper interface. The control system shall consist of low voltage room thermostat to control heating and cooling. Provide metal thermostat guard with lock and key.

18.5. **Condensate Switch:** Unit shall be provided with sensor to shutdown unit and sound alarm if condensate line becomes obstructed.

18.6. **Outdoor Unit:** Shall be completely factory assembled, piped, wired and **lockable refrigerant charging valves.** The unit shall be furnished with one (1) direct drive, propeller type fan arranged for horizontal or vertical. The motors shall have inherent protection, be of the permanently lubricated type, and resiliently mounted for quiet operation. The compressor shall be of the high-performance rotary type with crankcase heater, accumulator and internal thermal overloads. The refrigeration system shall be equipped with high-pressure switch. Refrigerant flow from the condenser shall be controlled by means of a capillary tube. The condenser coil shall be of nonferrous construction with smooth plate fins bonded to copper tubing. The coil shall be protected with smooth plate fins bonded to copper tubing. The condenser coil shall be protected with an integral heavy-duty metal hail guard. The unit shall be controlled by the microprocessor located in the indoor matching unit. A built-in, low-ambient controller shall allow cooling to 0 degrees F outdoor temperature.

All refrigerant circuit access ports located outdoors shall be fitted with color-coded, all brass, locking type tamper resistant caps. The locking caps shall be color coded for the refrigerant used. Caps shall be Novent Series 8668 for R-410 refrigerant with 86698 NV Multikey unlocking mechanism for R-410 refrigerant or equivalent by JB Industries Series Shield and DiversiTech Series Sentry. Provide owner with minimum of six (6) spare keys.

18.7. **Power Wiring Connection:** The indoor unit shall be factory wired and fused for single power connection and disconnect switch.

18.8. **Roof/Pad Mounted Supports:** Units mounted on finished grade shall be provided with concrete pad. Concrete pads are specified under Division 2. Where concrete pads are not specified or shown elsewhere, the Mechanical Contractor shall provide a minimum 4” thickness, 3,000-psi concrete pad with rounded edges and corners. Pad shall extend a minimum of 12” around three (3) sides of the unit and terminate at the building outside wall. Provide a strip of asphalt expansion joint between the concrete pad and the building exterior wall. Expansion joint shall be 1” thickness,

non-absorbing, self-sealing, ASTM D 994 compliant and manufactured by W.R. Meadows Inc or equivalent. shall be provided with a 4” thickness concrete pad with rounded edges and corners. Concrete pad is specified under Division 2 for all units mounted on grade.

18.9. **Phase Protection:** All indoor and outdoor equipment shall also be provided with surge protection and phase protection to insure against voltage unbalance, over/under voltage, phase loss, reversal, incorrect sequencing and rapid short cycling. Protection shall be provided for all 3-phase equipment utilizing ICM Controls Model 450 or equivalent. All single phase equipment with horsepower greater than or equal to 1/8 HP shall be provided with protection utilizing ICM Controls Model ICM 492 or equivalent. Where phase protection device cannot be mounted within the respective equipment, provide a NEMA 4x or NEMA enclosure appropriate for the installation. The Contractor shall consult with the Owner's maintenance personnel and set up all programmable options based on the Owner's requirements, within the device's capabilities.

18.10. **Warranty:** General warranties are specified in Section "General Mechanical Provisions". The Contractor and equipment Manufacturer shall provide a non-prorated, total of five years, warranty on the unit compressor(s). The Manufacturer's warranty shall provide for the repair and/or replacement of the equipment compressor(s) that become inoperative because of defects in material or workmanship. The Contractor is responsible for any parts and labor not provided by the equipment Manufacturer. The warranty shall include refrigerant and all other costs associated with the compressor(s) removal and replacement, shipment to the Contractor or Facility, installation and returning the equipment to its proper operating condition.

The Contractor shall respond within 24 hours upon notification that a compressor has failed under the terms of the warranty. "Respond" shall mean having a Manufacturer certified technician onsite to evaluate the extent of the needed repairs and ordering of all items required for repair. Shipping of the replacement compressor shall be via maximum of 2-day delivery of the compressor(s) if the unit is inoperable.

The warranty period shall begin on the same date as substantial completion of the installation, as determined by the Architect, and shall continue for the full product warranty period specified above.

18.11. **Manufacturers:** Mitsubishi or equivalent by Trane, Lennox, Samsung or Carrier. **Mitsubishi is the basis of Design.**

PART 19. AUTOMATIC CONTROLS

19.1. **General:** Furnish and install a complete system of automatic temperature controls, as specified herein, as shown on the Drawings and as required for a complete installation. All temperature control equipment shall be of the electric type. All specified Sequences of Operation are subject to all equipment built-in safety requirements. Equipment safety requirements shall not be overridden.

19.2. **Submittals:** The temperature control contractor shall submit a complete set of temperature control diagrams with written "sequence of operation" and factory-printed specification data sheets covering each control device proposed to be used for Engineer's approval prior to installation of any equipment or part of system. Submittal data shall include a schedule of all devices to be installed.

19.3. **Installation:** By trained and experienced mechanics. All work shall be done by an approved, independent HVAC Controls Subcontractor whose primary business is the installation and servicing of HVAC controls systems. The HVAC Controls Sub-Contractor shall have an adequate service facility to provide complete service and maintenance of the facility within 100 miles of the installation.

19.4. **Identification:** Provide permanent nameplates for all control components and for all motor starters. Nameplates shall be engraved laminated plastic with letters sufficiently large to be legible under normal operating conditions. Refer to Section 15010, Identification for additional requirements, nameplate materials, etc.

19.5. **Conduit, Controls Wiring and Instrumentation Cable:** The HVAC Controls Contractor shall be responsible for the furnishing and installation of a complete and fully functional system as specified, shown on the plans and as required to accomplish the specified sequences of operation.

All control cables and wiring shall be in EMT conduit (no “whips”). EMT control conduit is specified in the Electrical Division of the specifications and/or shown on electrical drawings. Minimum HVAC Controls conduit size shall be 3/4” in size. All control conduit, power wiring, relays, contactors and incidental wiring required for a complete functional system as specified, shown on the plans, or as required to accomplish the specified sequences of operation, which is not shown or specified by the Electrical Division, shall be furnished and installed by the HVAC Controls Contractor. This shall include all interlock control wiring between the various components of the air conditioning system, lighting interlocks and all smoke detection system electrical wiring. Electrical work performed under this Section shall conform to requirements set forth in the Electrical Division of the specifications. All wiring shall be in accordance with the National Electrical Code, and all State and local codes. Coordinate all requirements with the Electrical Sub-Contractor prior to bid and provide all as required.

Instrumentation cable shall be minimum AWG as specified or heavier AWG as recommended by the controls system manufacturer.

All thermostat and humidistat boxes shall be mounted 46” A.F.F. to the center of the box (ADA height). Where wall mounted CO_2 Sensors are indicated, they shall be mounted 58” A.F.F to the center of the box.

19.6. **Space Thermostats:** Furnished by the equipment manufacturer..

Provide hinged metal guard with rounded corners, lock and key for each thermostat. All thermostat boxes shall be mounted 46” A.F.F. to the center of the box (ADA height). All thermostat boxes in walls or partitions shall be sealed/caulked to prevent the passage of air and smoke thru the device.

19.7. **Carbon Dioxide Sensors:** Shall be of the non-dispersive infrared type (NDIR) diffusion sampling, repeatable to +/- 8 PPM with a measurement range 0 – 2000 PPM and be user adjustable. It shall have the following accuracy; from 0-1500 PPM +/- 75 PPM; +/- 5% with an operating range of 32 degrees F to 130 degrees F with a response time of less than 90 seconds.

Sensors shall be provided with all options, inputs and outputs required to control the motorized return air and outside air dampers to accomplish the specified Sequence of Operation. Duct mounted sensors shall be mounted where shown on the plans. Wall mounted sensors shall be mounted 58” A.F.F to the center of the box.

Duct mounted sensors shall be Veris Industries Series CDE or approved equivalent by Johnson Controls or Honeywell. Wall mounted sensors shall be Veris Industries Series CWE or approved equivalent by Johnson Controls or Honeywell.

19.8. **Humidistats:** Heavy-duty industrial type. Provide metal guard as specified for thermostats. All humidistat boxes shall be mounted 46" A.F.F. to the center of the box (ADA height). All humidistat boxes in walls or partitions shall be sealed/caulked to prevent the passage of air and smoke thru the device.

19.9. **Smoke Detectors:** Smoke detectors operating on the ionization principles shall be furnished by the Electrical Contractor and installed where shown on the plans by the Mechanical Subcontractor.

The Mechanical Contractor shall provide an access door/panel, watertight where required, adjacent to each smoke detector to allow for maintenance and visual inspection. Access panels shall be as specified hereinbefore.

19.10. **Condensate Drain Obstruction Alarm:** Provide an electric switch, conforming to UL 508. Upon detection of blockage, the unit shall shutdown.

19.11. **Motorized Dampers:** Equal to Ruskin Series CD-40 with heavy-duty Belimo actuator and 24-volt actuators. Coordinate power requirements with electrical contractor and provide as required. Damper motors shall be located outside the air stream. Provide weatherproof construction for outdoor installation.

19.12. **Typical Split System Heat Pump (HP) Unit Systems with Demand Control Ventilation Sequence of Operation:** Units without demand control ventilation are similar. The control circuit for each unit shall be energized by its respective 7-day programmable thermostat. Occupied and unoccupied schedules shall be programmed by the Controls/Mechanical Sub-Contractor as desired by the Owner.

Thermostat shall be used to control heating and cooling. Provide for each heat pump unit an adjustable outdoor thermostat and wire to control the second stage of the auxiliary electric resistance heater.

Upon a call for the occupied schedule, the outside air damper shall open to its minimum scheduled outside air setpoint and the unit shall start. Upon unit shutdown, the motorized outside air damper shall close.

Upon a call for the unoccupied schedule, the outside air damper shall remain closed and the unit shall start.

A wall mounted or duct mounted CO_2 sensor, monitoring CO_2 levels in the space or return air duct, shall modulate the outside air damper, motorized relief air damper (as applicable) and return air dampers, in sequence, as required to maintain CO_2 levels at a maximum of 700 PPM (adj). Refer to the equipment schedules for the minimum CO_2 scheduled outside air setpoint and the maximum CO_2 scheduled outside air setpoint. Upon satisfaction of the CO_2 sensor, the outside air, relief air and return air dampers shall return to their minimum scheduled setpoint and normal sequence of operation. Refer to the plans for location of the CO2 sensor type required.

Provide a space humidistat to override the cooling thermostat to provide for dehumidification.

During dehumidification, the heat pump unit reversing valve shall be locked out to prevent switching to the heating mode and the compressor shall be commanded on

for cooling. The space thermostat shall then modulate the refrigerant hot gas reheat coil valve or the first stage of the 2-stage heater, as specified below, to maintain the required space temperature.

Where specified or humidistats are indicated on the plans, units with a scheduled cooling capacity greater than or equal to 42 MBH shall utilize the specified hot gas reheat coil for reheat. Units with a specified cooling capacity of less than 42 MBH shall use the auxiliary resistance heater for reheat.

Provide smoke detectors as specified above, and where shown on the plans. Wire the detectors to stop the unit upon smoke detection. Coordinate work with Electrical Subcontractor and provide required interlocks, wiring, relays, etc., as required for shutdown of the unit as specified.

19.13. **Split System Heat Pump HP-A and HP-B Economizer Cycle:** HP-A and HP-B shall be arranged for economizer cycle. Upon a call for the economizer to operate based on the outdoor air thermostat setpoint of 54ºF (adj.), the motorized outside air damper shall open to its 100% open position, the motorized return air damper shall close and the motorized relief air damper shall open, the respective outdoor heat pump unit compressors shall be locked out and the respective indoor unit shall run.

Upon a rise of the outside air temperature to above 63ºF (adj) or the space temperature and humidity setpoint cannot be maintained by the economizer cycle for a period greater than 10 minutes (adj.), the first compressor shall be commanded on to maintain the thermostat/humidity setpoints. If, after energizing the first compressor, the space temperature and humidity setpoints cannot be met after 10 minutes (adj.), the economizer cycle shall be disabled and the system shall revert to its normal sequence of operation.

19.14. **Split System Heat Pump (HP) Unit Economizer Cycle Controls Interface:** Provide Belimo ZIP Economizer or equivalent device by Honeywell or Johnson Controls (JCI) with all modules, temperature and/or enthalpy sensors with required accessories to accomplish the specified sequence of operation.

All damper actuators provided shall be of the same Manufacturer to maintain continuity with devices. i.e., Provide Belimo motorized damper actuators with the Belimo Zip Economizer. Prior to bid, coordinate equipment manufacturer furnished thermostat with economizer controls manufacturer and verify compatibility as required for proper operation.

19.15. **Exhaust Fan (EF) Controls:** Provide interlocks for certain fans as noted on fan schedule, including lighting interlocks if not shown on electrical. Also, provide central HVAC control panel mounted “Hand-Off-Auto” switch for all fans that are interlocked with other equipment to function as follows: With switch in the “Auto” position fan starts with the interlocked equipment. With switch in the “Hand” position, the fan runs continuously.

19.16. **Time Delay Controls:** Provide time delay control systems as required to stage units starting to prevent more than three units from starting at the same time.

19.17. **Miscellaneous Controls:** Provide all other miscellaneous controls, wiring, dampers, valves, etc., as required for a complete functional control system.

19.18. **Service and Guarantee:** After completion of the installation, adjust all control equipment and place the complete system in operation subject to the approval of the Engineer. Guarantee the control system to be free of defects and adequate to

provide required control functions for a period of one year after acceptance of project. Provide free service and maintenance during the guarantee period.

END OF SECTION

GENERAL NOTES:

1. COORDINATE WITH MECHANICAL/PLUMBING DRAWINGS FOR EXACT LOCATIONS OF EQUIPMENT.
2. MOUNT EXTERIOR DISCONNECTS ON EXTERIOR WALLS AT LEAST 18" FROM WINDOWS. LOCATIONS OF DISCONNECTS AND EQUIPMENT ARE SHOWN FOR DRAWING CLARITY PURPOSES ONLY.
3. COORDINATE WITH MECHANICAL/PLUMBING CONTRACTORS TO INSURE OVERCURRENT PROTECTION DEVICES FOR THEIR EQUIPMENT IS SIZED PER MANUFACTURER'S RECOMMENDATIONS. ENGINEER SIZED OVERCURRENT PROTECTION ACCORDING TO MECHANICAL/PLUMBING DRAWINGS AND SPECIFICATIONS, ACTUAL EQUIPMENT SUPPLIED MAY DIFFER. ELECTRICAL CONTRACTOR SHALL WORK WITH OTHER TRADE DISCIPLINES TO INSURE ANY CHANGES WILL BE INSTALLED CORRECTLY AT THE COST OF THE PERSON MAKING THE CHANGES.
4. ALL FLEXIBLE CONNECT TO HVAC UNITS SHALL BE RUN PARALLEL TO HARD SURFACE AND STRAPPED AT LEAST EVERY 2'.
5. CONTRACTOR SHALL PROVIDE CONDUIT FOR MECHANICAL CONTROLS. COORDINATE EXACT LOCATIONS WITH MECHANICAL CONTRACTOR PRIOR TO ROUGH-IN.
6. ALL DISCONNECTS TO HAVE NAMEPLATE AS SHOWN IN DETAIL (3) THIS SHEET, NO EXCEPTIONS.
7. PROVIDE DEDICATED NEUTRALS FOR EACH MULTIWIRE HOMERUN PER NEC.
8. SEE DETAIL (4) THIS SHEET FOR MECHANICAL UNIT CONNECTION DETAIL.
9. SEE GENERAL EQUIPMENT SCHEDULE SHEET E/XX.X.X
10. COORDINATE EXACT LOCATION OF ALL ELECTRICAL WITH MILLWORK PROVIDERS PRIOR TO ROUGH-IN.

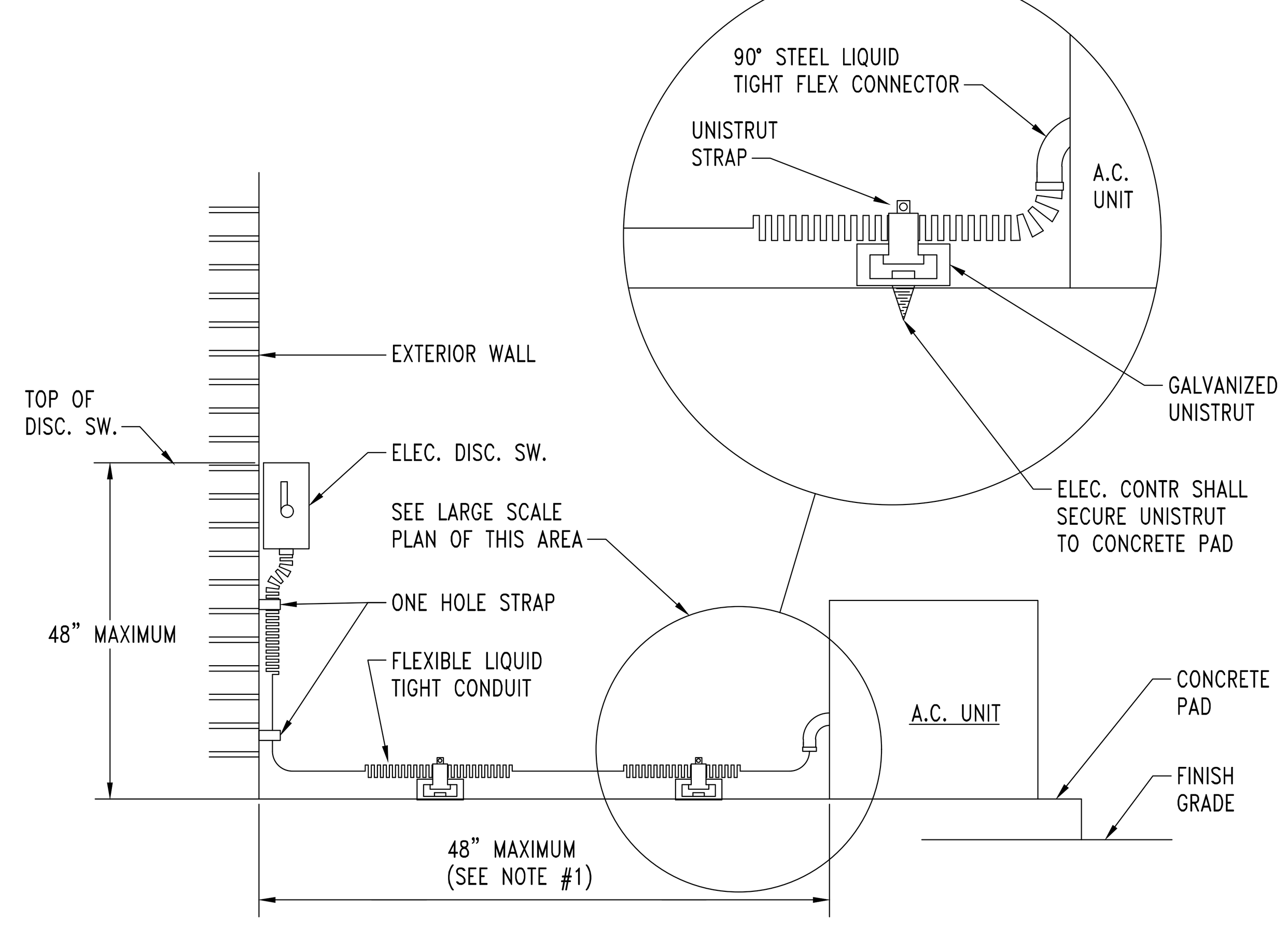
SHEET NOTES:

(1) PROVISIONS FOR ELECTRIC HAND DRYER. MOUNT JUNCTION BOX BEHIND PAPER TOWEL DISPENSER AND WALL BLANK OFF. CIRCUIT BREAKERS FEEDING CIRCUITRY SHALL BE SWITCHED OFF AND WIRE DISCONNECTED.

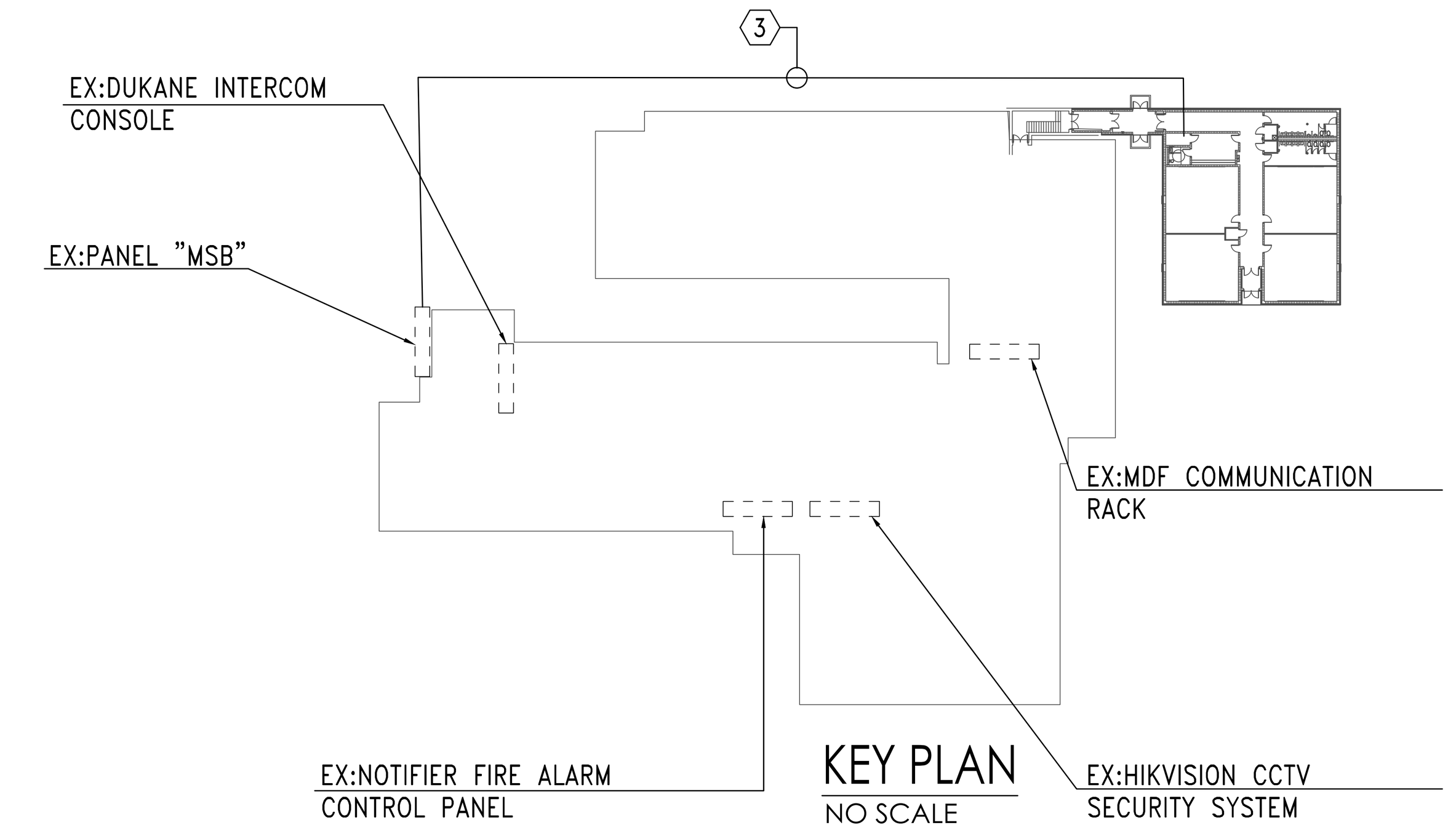
(2) INTERIOR UNIT RECEIVES POWER FROM THE EXTERIOR UNIT. PROVIDE INTERCONNECTING CIRCUITRY AS NEEDED IN CONDUIT TO CONNECT THE INTERIOR UNIT.

(3) CONTRACTOR WILL HAVE TO CUT/PATCH/REPAIR SURFACES AS NEEDED TO BORE THE TWO UNDERGROUND CONDUITS REQUIRED FROM THE EXISTING SWITCHBOARD TO THE NEW PANEL IN THE NEW ADDITION. VISIT SITE PRIOR TO BIDS TO VERIFY ROUTING OF PP1 FEEDER AND BID ACCORDINGLY.

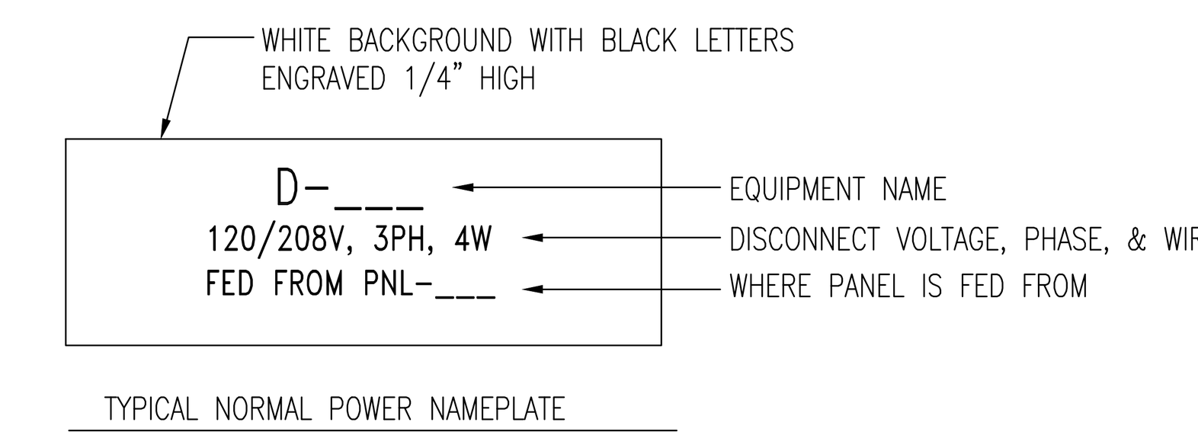
NOTE:
1. FOR DISTANCE GREATER THAN 48" CONDUIT TO BE ROUTED BELOW GRADE WITH 6" OF MECH. UNIT, STUB-UP W/ RIGID ELBOW THRU CONCRETE PAD. PROVIDE FLEXIBLE CONNECTION FROM ELBOW TO MECH. UNIT, W/ CONNECTION MADE AT UNIT AS SHOWN ABOVE.



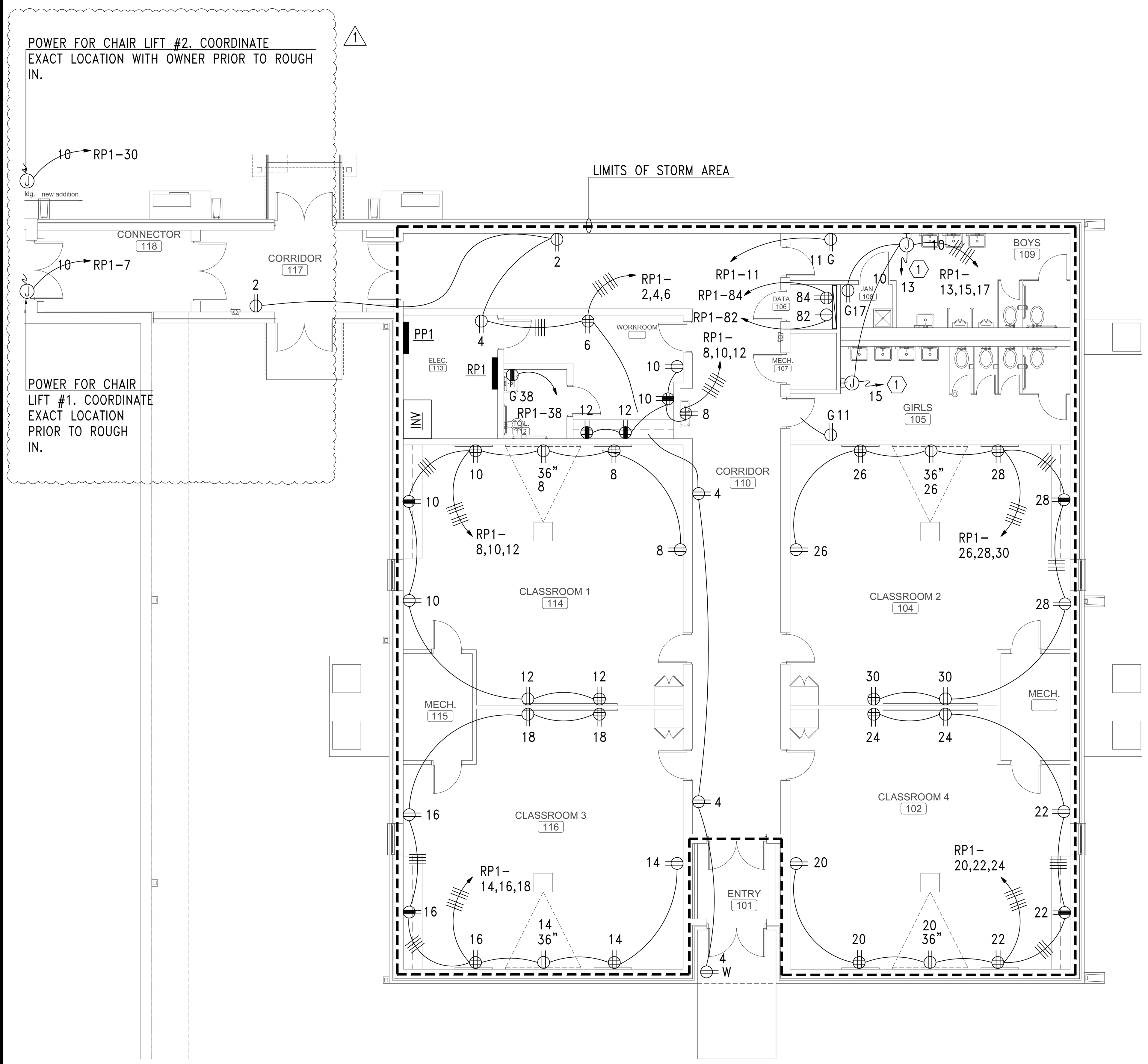
4 E3.1 MECHANICAL UNIT CONNECTION DETIAL
NO SCALE



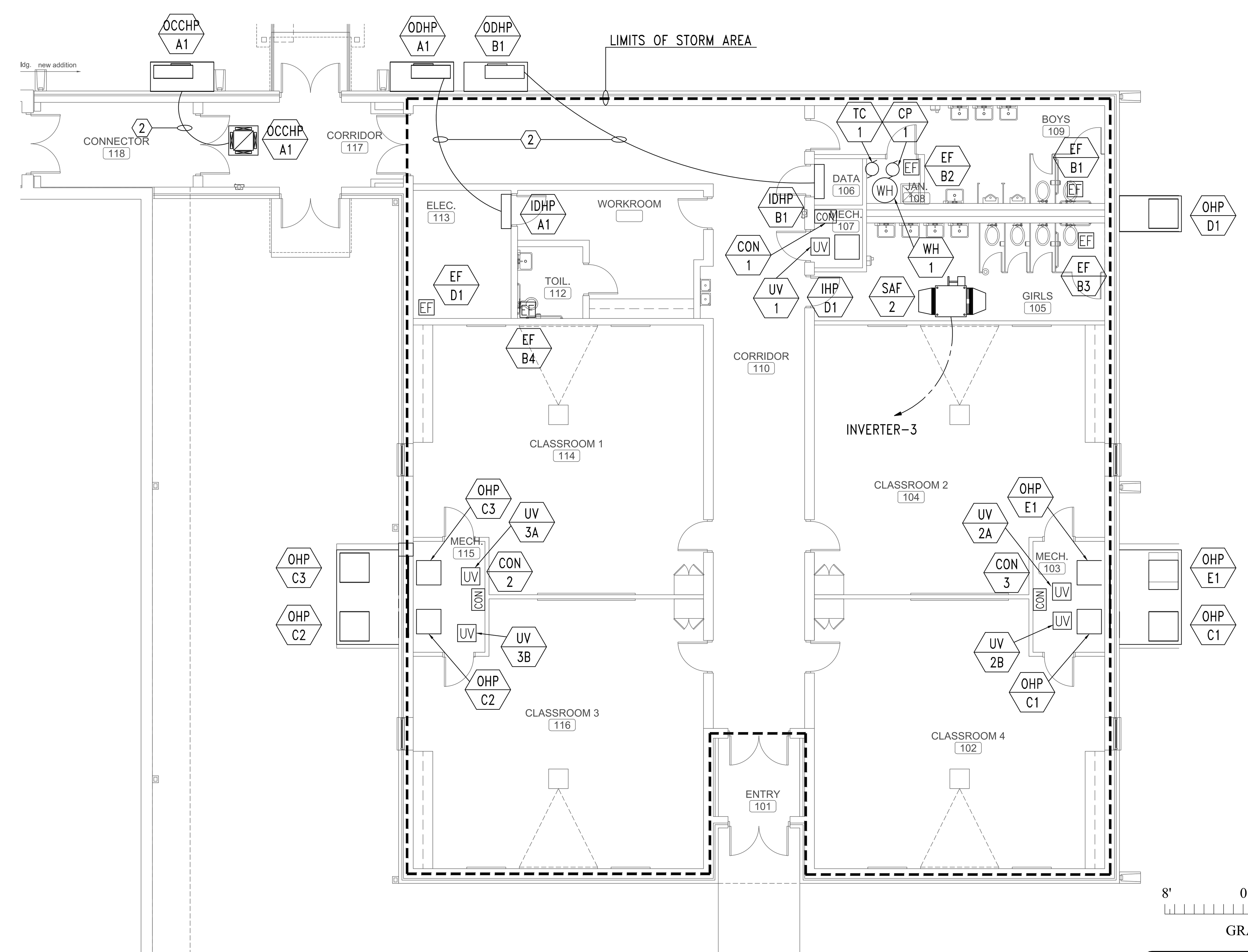
KEY PLAN
NO SCALE



3 E3.1 DETAIL - TYPICAL DISCONNECT NAMEPLATE
NO SCALE



1 E3.2 COOSA VALLEY FLOOR PLAN - POWER
SCALE: 1/8"=1'-0"



2 E3.2 COOSA VALLEY FLOOR PLAN - MECHANICAL POWER
SCALE: 1/8"=1'-0"

1/8" = 1'-0"
8' 0 8 16 FT
GRAPHIC SCALE

Gunn & Associates, P.C.
Consulting Engineers
3102 Highway 14, Millbrook, AL 36054, Tel: 334.285.1273
1200 Providence Park, Suite 200, Birmingham, AL 35242
GA#22-134

EDEN ELEMENTARY ADDITION
AND
COOSA VALLEY ELEMENTARY SCHOOL ADDITION
FOR
PELL CITY SCHOOLS
PELL CITY, ALABAMA

McKEE and ASSOCIATES
ARCHITECTS, INC.
631 SOUTH HULL STREET MONTGOMERY, ALABAMA 36104 (334) 834-9933

SHEET TITLE :	COOSA VALLEY FLOOR PLAN - POWER & MECHANICAL POWER
MCKEE JOB # :	21.184
PSCA # :	
DRAWN BY :	J. TILLERY
DATE:	06.09.2022
REVISED DATE:	06-14-2022 (1)
REVISED DATE:	
REVISED DATE:	

SHEET NO. : E3.2