SECTION 230100
MECHANICAL GENERAL

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Division 21, 22, 23 and 25 and the accompanying drawings cover the provision of all labor, equipment, appliances, and materials and performing all operations in connection with the construction of the air conditioning, ventilating, heating, fire suppression and plumbing systems as specified herein and as shown.

1.2 INTENT OF DRAWINGS AND SPECIFICATIONS

A. The implied and stated intent of the drawings and specifications is to establish minimum acceptable standards for materials, equipment and workmanship, and to provide operable mechanical systems complete in every respect.

B. The engineering drawings are diagrammatic, intended to show general arrangement and sizes of system components, and shall not be scaled. Rather, the architectural and structural drawings shall govern space constraints, dimensions and finishes. All offsets and fittings which will be necessary to accomplish the finished installation shall be provided at no additional cost or increase in the Contract.

1.3 SPACE PRIORITY

A. Ensure optimum use of available space for materials and equipment installed above ceilings. Allocate space in the order of priority as listed below except as otherwise detailed. Items are listed in the order of priority, with items of equal importance listed under a single priority number.
1. Gravity flow piping systems
2. Vent piping systems
3. Recessed lighting fixtures
4. Concealed HVAC terminals and equipment
5. Air duct systems
6. Sprinkler piping systems
7. Pressurized piping systems
8. Electrical conduit, wiring, control air tubing

B. Order of space priority does not dictate installation sequence. Installation sequence shall be as required to install all affected trades.

C. The work of this Division 21, 22, 23 and 25 shall not obstruct access for installation, operation and maintenance of the work of any other Division.

D. All major items of equipment shall be arranged so as to provide a minimum of 28" clear aisle space. Additional space shall be provided between and around equipment for maintenance and proper operation as shown in the equipment manufacturer's literature.

1.4 COORDINATION

A. Coordinate all work under this Division 21, 22, 23 and 25 with work under all other Divisions, providing adjustment as necessary.
B. Coordination of space requirements with respect to Division 26 shall be performed such that:
1. No equipment, piping or ductwork, other than electrical, shall be installed within 42" of switchboards or panelboards.
2. No piping or ductwork which ever operates at a temperature in excess of 120 degrees F. shall be installed within 3" of any electrical conductor.

C. All items mounted in or below the ceiling, and all items penetrating the ceiling, shall be coordinated with the architectural reflected ceiling plans. If any items are not shown on these plans, or any items need to be relocated for coordination purposes, prepare a reflected ceiling plan and submit it to the Architect for approval.

1.5 CODE COMPLIANCE

A. All workmanship and materials provided under this Division 21, 22, 23 and 25 shall comply with all laws, ordinances, codes and regulations of all Federal, State and Local Authorities having jurisdiction.

B. All fire suppression, plumbing, heating, ventilating, and air conditioning materials and workmanship shall comply with the applicable codes and standards as minimum requirements.

C. Secure and pay all fees associated with all permits and licenses required for execution of the Contract. Arrange for all inspections required by city, county, state and other authorities having jurisdiction, and deliver certificates of approval to the Architect.

D. The code requirements are strictly a minimum and shall be met without incurring additions to the Contract. Where requirements of the drawings or specifications exceed the code requirements, the work shall be provided in accordance with these drawings or specifications. In the event of conflict or ambiguity between the various codes, the most stringent requirement shall govern.

1.6 ELECTRICAL REQUIREMENTS AND INTERFACE

A. All electrical equipment and wiring provided under this Division 21, 22, 23 and 25 shall comply with the electrical system characteristics indicated on the electrical drawings and specified in Division 26.

B. Electric controls, contactors, starters, pilot lights, push buttons, etc., shall be provided complete as part of the motor, heater or other equipment which it operates. All electrical components shall be in conformance with the requirements of the National Electrical Code and Division 26. Reference Division 26 and the electrical engineering drawings for those motor starters provided under that Division 26. All starters not shown shall be provided under this Division 21, 22, 23 and 25. Unless specified otherwise under other individual equipment Sections, motor starters shall conform to the following minimum requirements:
1. Starters for motors 1/3 horsepower or smaller shall be manual unless remote or automatic starting is required, in which case the starters shall be magnetic, full voltage, non-reversing, single-speed, unless otherwise indicated. All other starters shall be magnetic.
2. Each starter for a three-phase motor shall be furnished with three (3) overload relays sized for the full load running current of the motor actually provided. Provide an external "HAND-OFF-AUTO" selector switch with red "RUNNING" light. Provide a green pilot light to indicate motor "STOPPED". Each pilot light shall have a legend plate indicating reason for signal.
3. Each overload relay shall have a normally open alarm contact which will close only when actuated by an overload (not to be confused with N.O. or N.C. auxiliary contacts). These contacts shall be properly wired to their respective blue pilot light provided on the starter front cover and having a "TRIPPED" legend plate.
4. Individually mounted motor starters shall be in a NEMA Type 1 general purpose enclosure in unfinished areas and shall be flush mounted in all finished areas. All starters mounted in exterior areas shall have a NEMA 3R enclosure. Each starter shall have a laminated nameplate to indicate equipment unit number, function and circuit number.
5. All motor starters, push buttons and pilot lights shall be of the same manufacturer as the switchboard and shall be General Electric, Square D, Siemens I.T.E., or Westinghouse.

C. Motor starters for the following equipment shall be provided under this Division 21, 22 and 23 by the manufacturer of the equipment:
1. Packaged air conditioning equipment
3. Other equipment hereinafter specified in other Sections to be provided with integral starters.

D. Unless otherwise noted or specified in individual Sections, all 3 phase motors shall be standard NEMA continuous duty "B" type, with class B insulation, open drip-proof frame for indoor service, TEFC for outdoor service and a service factor of 1.15. All motors 5 HP and larger shall be U.S. Motors Hi-Efficiency Model or Reliance XE Hi-Efficiency Model.

E. All power wiring and final connections to equipment shall be provided under Division 26.

F. Control components and all interlock and control wiring (24 volt and 120 volt) shall be provided under this Division 21, 22, 23 and 25 as required to achieve the specified control sequences.

G. All control wiring over 30 volts shall be installed by a Licensed Electrician working under this Division 21, 22, 23 and 25.

1.7 SLEEVES, SEALS AND ESCUTCHEONS

A. Sleeves shall be provided through all pipe penetrations of concrete or masonry walls, elevated floors and roofs, except those plumbing piping penetrations for fixtures, vents, etc.

B. Sleeves shall be fabricated from Schedule 40 steel pipe through 10" and Standard Wall steel pipe for sleeve sizes 12" and larger. All sleeves penetrating exterior walls, underground walls, pit or vault walls shall be provided with a 3" x 3/8" thick waterstop ring welded completely to the midpoint of the sleeve.

C. All sleeves penetrating exterior walls, underground walls, pit or vault walls and elevated floors shall be packed and sealed watertight.

E. Sleeves through walls shall be cut and finished flush with each surface of the wall in which they are installed.

F. Sleeves shall be sized to provide a minimum of 1/2" clearance between the inside surface of the sleeve and the outside finished surface of the pipe plus any insulation specified.

G. Fire-stops shall be provided as specified in Section 07270 07841, Firestopping or rating required. All annular spaces between piping and sleeves, which do not require fire-stops, shall be packed with mineral wool and caulked.

H. Provide round, chrome-plated escutcheons on all exposed piping penetrations passing through walls, floors, partitions and ceilings.

1.8 CORE DRILLING

A. Cutting of holes through concrete and masonry shall be by diamond core or concrete saw. Pneumatic hammer, impact electric and hand or manual hammer type drills will not be allowed, except as permitted by the Architect where required by limited working space. Locate holes such that they will not affect structural sections such as ribs or beams. Holes shall be laid out well in advance of the installation. These layout locations shall be approved by the Architect prior to drilling.

PART 2 – PRODUCTS

2.1 BID BASIS AND SUBSTITUTION PROCEDURES

A. Manufacturers names, series and model numbers, as noted or specified, are for the purpose of describing type, capacity, and quality of equipment, materials and products to be used. Unless "or equal" is specifically stated, bids shall be based only on the specified "basis of design" manufacturer. The listing of a particular manufacturer as an "equal" or "acceptable substitute" manufacturer shall not be misconstrued as approving nor allowing the substitution of that manufacturer's standard product in place of the basis of design. No consideration will be given to a product, which would require dimensional, spatial or aesthetic changes to the project. "Acceptable substitute" and "equal" manufacturers shall only bid those products, which exactly match the size and other characteristics of the specified basis of design. Any changes to other disciplines and trades of work required by an "or equal" or "substitute" product shall be duly considered and priced accordingly prior to bidding or pricing. The decision as to whether or not a proposed substitute or "equal" product is actually equal to that specified shall rest solely with the Architect.

B. Requests to provide "equal" products in lieu of those specified shall be submitted to the Architect in writing through the General Contractor in accordance with product options and substitutions, Section 01630 01600.

C. Any "or equal" product or proposed product substitution which will cause a change in the appearance, dimensions or design of any part of the building, it structure, electrical system or any other engineered systems shall be accompanied by a scaled drawing and written description of the required change(s) for approval by the Architect. If deemed necessary by the Architect, design changes shall be signed and sealed by a registered Professional Engineer, currently licensed in this State.

2.2 MINIMUM STANDARDS

A. Every piece of energy consuming equipment, all fire suppression products and life safety equipment shall comply with the following standards as applicable; especially in regard to prevailing codes:
1. Factory Mutual Laboratories (FM)
2. Industrial Risk Insurers (IRI)
3. Underwriters Laboratories, Inc. (UL)
4. ADC: Air Diffusion Council
5. AGA: American Gas Association
6. AMCA: Air Moving and Conditioning Association, Inc.
7. ANSI: American National Standards Institute
8. API: American Petroleum Institute
9. ARI: American Refrigeration Institute
10. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers
11. ASME: American Society of Mechanical Engineers
12. ASTM: American Society of Testing and Materials
13. AWWA: American Water Works Association
14. IBR: Institute of Boiler and Radiator Manufacturers
15. MSS: Manufacturers Standardization Society
16. NBBPVI: National Board of Boiler and Pressure Vessel Inspectors
17. NEMA: National Electrical Manufacturer's Association
18. OSHA: Occupational Safety & Health Administration
19. PDI: Plumbing Drainage Institute
20. PPI: Plastic Pipe Institute
21. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.

B. All equipment and materials provided under this Section 230100 shall be new and of the best grade commercial quality, shall be of the latest design of the manufacturer, and shall be listed and approved by U.L. and the Underwriter. Materials and equipment manufactured outside of the United States will not be acceptable. All components shall be suitable for the pressures indicated on the flow test.

PART 3 – EXECUTION

3.1 SUBMITTALS

A. Before preparing submittals, study all Contract Drawings and Specifications in detail, obtain manufacturer's recommended instructions, and have submittals prepared based on specific equipment and material proposed for installation. An officer of the contracting firm shall sign all shop drawings (certifying conformance with plans and specifications) before submitting to the Architect or releasing to the field.

B. The submittal process shall not be utilized as an avenue to substitute products after the execution of the contract. Should an unspecified or unequal product be submitted, it will be rejected. If a second attempt at substitution is made during the resubmittal of the same product, then no more reviews of that product will be performed without direct compensation to the Architect being paid for the additional services required for the third review and any further reviews.

C. No more than four (4) copies of submittal data will be reviewed. Any additional copies will be returned unmarked. The responsibility of copying review comments on any additional copies will rest solely with the Contractor.

D. Submittals will not be accepted for review unless they:
1. Comply with the requirements of Division 01, Section 01300, Submittals.
2. Include complete information pertaining to appurtenances and accessories.
3. Are submitted as complete packages which pertain to all related items in Division 21, 22, 23 and 25. Separate packages shall be submitted as follows:
a. All HVAC equipment and components
b. All plumbing equipment, fixtures and components
c. The automatic controls and EMS
4. Are properly marked with equipment, service or function identification as related to the project and are marked with pertinent specification paragraph number.

E. Submit catalog information, factory assembly drawings, field installation drawings and certifications as required for complete explanation and description of all items of equipment. The submittal data shall provide ample, unquestionable compliance with the Contract Documents.

F. Review of submittals shall not be construed as authorizing any deviations from the plans and specifications unless such deviations are clearly identified and separately submitted in the form of a letter that is enclosed with the submittals.

G. Submittals are required on all manufactured equipment, especially energy consuming equipment. Submittals shall include, but are not limited to, the following items of equipment:
1. Insulation
2. Terminal Units
3. Air Distribution Devices
4. Ductwork Shop Drawings
5. Fans
6. Water Source Heat Pumps
7. Makeup Air Units
8. Computer Room Air Conditioning Units

3.3 INSTALLATION REQUIREMENTS

A. All equipment shall be installed in strict conformance with the recommendations of the equipment manufacturer, as indicated on the Drawings and as specified.

B. Provide installation manuals for each piece of equipment. Submit in separately bound volumes after review of submittals.

C. Provide supplementary steel framing and welded steel equipment support stands as required for proper hanging and support of the mechanical systems. Steel angles, channels and tubing utilized for such framing shall be selected for a maximum deflection of 1/360th of the span.

3.4 CLEANING, LUBRICATION AND ADJUSTMENT

A. The exterior surfaces of all mechanical equipment, piping, ductwork, conduit, etc., shall be cleaned and free of all dirt, grease, oil, paint splatter, and other construction debris.

B. Ducts, plenums, and air unit casings shall be cleaned of all debris and either vacuumed or blown free of all rubbish, dirt, and dust before installing grilles, registers or diffusers.

C. Bearings that require lubrication shall be lubricated in strict accordance with the manufacturer's recommendations.

D. All control equipment shall be adjusted to the settings required for the performance specified.

E. Fans shall be adjusted to the speed indicated by the manufacturer to meet the installed final system pressure at the airflows indicated. Any additional sheaves and belts required for final adjustments shall be provided with no increase in the Contract amount.

F. Any fans operated during construction shall have temporary filters. Temporary filters shall be changed regularly to minimize contamination of the equipment and duct systems. Permanent filters shall be installed prior to final inspection.

G. All coils shall be thoroughly cleaned and combed prior to final inspection.

3.5 PAINTING

A. All uncoated and uninsulated steel surfaces exposed to sight inside the building, such as piping, equipment hangers and supports which are not provided with factory prime coat or galvanizing, shall be cleaned and painted with one coat of rust inhibiting primer specified in Painting Section. In addition, all surfaces in finished spaces shall also be painted with two coats of finish paint in a color selected by the Architect.

C. Factory painted equipment that has been scratched or marred shall be repainted to match the original factory color.

3.6 DUCTWORK AND PIPING LEAK TESTING

A. Underground, concealed and insulated ductwork and piping shall be tested for leaks in place before backfilling, concealing or covering. Tests shall be conducted in the presence of the Architect or his designated representative.

B. All low pressure ductwork (design operating pressure of 1.0" W.C. E.S.P. or less) shall be tested by the operation of the system to which it is connected.

C. All medium and high pressure ductwork (operating pressure of more than 1.0" W.C. E.S.P.) shall be tested at 1.5 times the design operating pressure of the system to which it is connected, or at the total fan pressure at shut-off, whichever is greater.

D. All visible and audible air leaks from the ductwork systems shall be repaired.

G. Condenser water piping shall be hydrostatically tested at a pressure of 100 psig for a minimum of one hour. No loss in pressure shall be permitted.

H. All refrigerant piping shall be 100% tested with a halide torch leak detector.

I. All leaks shall be repaired by tightening, remaking joints, or replacing pipe and fittings. Caulking of joints shall not be permitted.

3.7 RECORD (AS-BUILT) DRAWINGS

A. At the completion of the project, provide CADD drawings in AutoCad Release 2014 or later and a set of PDFs and hard copies to the Architect and Owner which reflect all changes, deviations and revisions made to the original design documents. Locations of all underground piping and utilities shall be clearly shown and dimensioned from permanent reference points such as building column lines.

3.8 OPERATING AND MAINTENANCE MANUALS AND INSTRUCTIONS

A. Complete operating and maintenance manuals shall be provided to the Owner. Four copies shall be provided. Each copy shall be bound in a separate 3-ring, loose-leaf notebook. Operating instructions shall be provided for each mechanical system, and shall each include a brief system description, a simple schematic and a sequence of operation. Operating and maintenance instructions shall be provided for each piece of equipment. A control system wiring diagram shall be included in each operating and maintenance manual.

B. Prior to final acceptance or beneficial occupancy, provide the services of a competent technician for not less than two (2) days to instruct the Owner in the operation of the mechanical systems.

C. Complete or additional requirements specified in Project Record Documents Section.

3.9 TESTING AND BALANCING

A. Testing and balancing of the HVAC system shall be performed as specified in Section 23 04 30. Note that this work is to be performed under a separate Contract directly under the General Contractor. Submit four (4) copies of the test and balance report directly to the Architect.

3.10WARRANTY

A. All work provided under this Division 21, 22, 23 and 25 shall be subject to a minimum one year warranty. The warranty shall include prompt repair or replacement of equipment or system failures and shall include all parts and labor. In addition, all reciprocating air conditioning compressors shall carry an additional four years parts-only warranty. Extended warranties shall be provided for all other equipment so specified in other Sections.

END OF SECTION 230100

SECTION 230430
HVAC TEST & BALANCE

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section 230430 and the accompanying drawings cover the provision of all labor, equipment, appliances, and materials and performing all operations in connection with the testing and balancing (T&B) of the heating, ventilating and air conditioning (HVAC) systems as specified herein and as shown. These systems include, but are not limited to, the following:
1. Supply distribution systems
2. Return and exhaust air systems
3. Heating, ventilating and air conditioning equipment (all scheduled equipment as a minimum)

1.2 INTENT

A. It is the intent of this Section of the specifications to provide a complete operable and balanced HVAC system as shown and specified, which is airtight, comfortable and free of objectionable noise and vibration.

1.3 SCOPE OF WORK

A. HVAC test and balance shall be performed by an independent agency certified by the Associated Air Balance Council (AABC) under direct contract to the General Contractor. All work performed by this agency shall be performed by qualified technicians under the direct supervision of an AABC or NEBB certified test and balance engineer. The agency shall be independent and shall not be associated in any way with the installing HVAC subcontractor.

B. HVAC test and balance shall be performed in accordance with the AABC National Standards, for Total System Balance.

C. The final T&B report shall serve to substantiate compliance with the intent of the Contract Documents, specifically the HVAC systems.

D. HVAC test and balance shall not begin until the systems are substantially complete.

E. Upon the completion of the T&B work, the Agency shall submit four copies of the complete HVAC Test and Balance Report directly to the Architect.

F. The Agency, as a part of its contract with the General Contractor, shall act as an authorized inspection agency, responsible to the General Contractor and the Architect and shall, during the test and balance, list those items which require correction or have not been installed in accordance with the Contract Documents.

G. The Agency shall plainly mark the settings of all valves, dampers and other adjustable devices. If a balancing device is provided with a memory stop, it shall be set, locked and marked.

1.4 SUBMITTALS

A. The name and certification of the Agency, along with the name and certification of the Certified Test and Balance Engineer, shall be submitted to the Architect for review within 30 days after the award of the Contract.

B. The selected Agency shall submit to the Owner:
1. Procedural Manual
2. Report Forms
3. AABC Performance Guaranty
4. Instrument List and Calibration Dates
5. Schedule

C. A reviewed copy of each of the above shall be returned to the Agency before the HVAC Test and Balance begins.

D. If a complete submittal in accordance with these requirements is not received within 60 days from award of the Contract, then the Architect reserves the right to select the Agency.

PART 2 – PRODUCTS

2.1 (Not applicable)

PART 3 – EXECUTION

3.1 GENERAL CONTRACTOR'S DUTIES

A. The General Contractor shall provide the following, within 10 days after his receipt, to the Agency:
1. Contract Drawings
2. Contract applicable specification division 23 (others as applicable)
3. Addenda
4. Change orders
5. Reviewed submittals

B. The Contractor shall start-up and maintain the HVAC systems and shall continue the operation of the HVAC systems during each day of testing and balancing. Start-up and operation shall include, as a minimum, the following:
1. All equipment operable and in safe condition.
2. Temperature control system complete.
3. Proper thermal overload protection in place for electrical equipment.
4. Ductwork leakage rates not exceeding those specified and all duct systems clean of debris.
5. Air transfer systems shall have:
a. Correct fan rotation and RPM.
b. Coil fins cleaned and combed.
c. Filters clean and in place.
d. Access doors closed.
e. All dampers in place and open.
f. All grilles, registers and diffusers installed.

C. Provide sufficient time before final completion date so that testing and balancing can be accomplished. Coordinate the submitted T&B schedule.

D. Provide immediate labor and tools to make required corrections and repairs without undue delay.

E. The General Contractor and his subcontractors shall cooperate fully with the Agency to provide the following:
1. Access to HVAC system components.
2. The right to adjust the systems.

F. Conditions which prevent a proper HVAC Test and Balance shall be reported by the Agency to the General Contractor and Architect within 7 days of their discovery.

G. If it is determined by the Agency and confirmed by the Architect that drive changes or additional balancing dampers are required, the Contractor shall obtain and install all necessary components.

H. The Agency shall cooperate with the Architect and the Contractor and all his subcontractors to perform the work in such a manner as to meet the job schedule.

I. The Agency shall verify that all system components are in place and in proper working order prior to leaving the project.

J. All reported, recorded data shall represent true measured conditions.

END OF SECTION 230430

SECTION 238000
AIR DISTRIBUTION DEVICES

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section 238000 and the accompanying drawings cover the provisions of all labor, equipment, appliances, and materials, and performing all operations in connection with the construction and installation of air distribution devices as specified herein and as shown. These units include, but are not limited to the following:
1. Ceiling Diffusers (CD)
2. Return Air Grilles (RAG)
3. Slot Diffusers (SD)

1.2 INTENT

A. It is the intent of this Section of the specifications to provide complete, operable, adjusted air distribution devices as shown and specified which are free of excessive noise, vibration and airflow fluctuations.

1.3 SELECTION CRITERIA

A. All air distribution devices shall be selected in accordance with the following minimum criteria unless otherwise noted below or on the drawings:
1. Method of mounting shall be compatible with the ceiling, wall or duct surface which it mounts on or in; i.e. lay-in, surface mounting, plaster frame, duct collar, etc. The architectural drawings shall be referenced to determine the mounting method for each device. All flanges on surface mounted devices shall be provided with a gasket.
2. Finish of all ceiling mounted devices shall be selected to match the color of the adjacent ceiling. Finish of all wall mounted devices shall be primer which is compatible with the finish coating specified for the adjacent wall; finish coat will be applied under Division 09.

1.4 BASIS OF DESIGN

A. The basis of design is Titus. Any proposed substitutions shall be proven equal in all respects to the equipment specified as the basis of design. Any modifications to ductwork, controls, ceilings, building structure, etc., that result from any substitution shall be coordinated with all trades. This coordination shall occur before delivery of equipment and any modifications shall be performed without incurring additions to the Contract.

1.5 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers are Price, Carnes, and Metal Aire, provided that their units, performance, appearance and physical characteristics are equal in all respects for this specific project.

PART 2 – PRODUCTS

2.1 DESCRIPTION

A. Ceiling Diffuser (CD)
1. **Ceiling diffusers shall match base building;** perforated face diffusers equipped with fully adjustable pattern controls, capable of providing one-way, two-way, two-way corner, three-way, and four-way air patterns; Titus PAS. Diffuser performance data shall be in accordance with ADC equipment test code 162R4. The perforated face shall be latched for easy access to pattern controls and duct accessories. The maximum NC level at design airflow shall not exceed 35 when measured in a direct field 5'-0" from the face of the device.

B. Return Air Grilles (RAG)
1. **Return air grilles shall match base building;** Titus PAR perforated face, lay-in type, selected to match the CDs; Performance data shall be in accordance with ADC 1062R4. All other characteristics shall be equal to the ceiling diffusers.

C. Slot Diffuser
1. Supply (SD)
a. **New slot diffusers shall be selected to match existing base building standard perimeter slots; TBDI-80, 24" long with two (2) parallel slots and white frame.** The diffuser shall be constructed of 24 gauge galvanized steel. Each SD shall be provided with a lined steel plenum with tappings for round duct connections as indicated. Maximum NC level shall not exceed 35 at design airflow. Liner shall conform to NFPA 90A 25/50 requirements.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Air distribution devices shall be installed as indicated and in conformance with the manufacturer's recommendations. The color frame and border types shall be coordinated with architectural requirements and shall be selected to install in the finished surface indicated.

3.2 ADJUSTMENT

A. Grilles, registers and diffusers shall be tested and adjusted to provide the scheduled airflow capacities.

B. All adjustable air distribution devices located within three feet of any wall shall be set to blow directly away from, or parallel to, the wall.

C. In all continuous perimeter slot applications, the inactive sections of the slot shall be finished with perforated steel, painted flat black selected to match the CDs. These sections shall be open to the plenum as a return air path.

END OF SECTION 238000

SECTION 238400
DUCTWORK

PART 1 – GENERAL

1.1 DESCRIPTION

A. All work specified in this Section is governed by the Mechanical General Section 230100.

B. This Section 238400 and the accompanying drawings cover the provisions of all labor, equipment, appliances, and materials and performing all operations in connection with the construction of the ductwork systems as specified herein and as shown. These systems include, but are not limited to, the following:
1. Supply air ductwork
2. Return, transfer and relief air ductwork
3. Exhaust ductwork

1.2 INTENT

A. It is the intent of this Section of the specifications to provide a complete operable duct system as shown and specified which is reasonably airtight, free of noise, vibration and sweating, and fabricated so as to fit into the space allotted and to exhibit a minimum resistance to airflow.

1.3 DESIGN AND CONSTRUCTION

A. Ductwork shall be provided in strict accordance with the first edition 1985 – of the SMACNA HVAC Duct Construction Standards – Metal and Flexible, NFPA No. 90A, 90B, 91 and 96, and UL 181.

B. Ductwork dimensions shown are net, clear, inside dimensions with no allowance shown for duct liner. All ductwork specified to be lined shall be 2" larger than shown in each dimension to compensate for the liner. Ductwork shall be square, rectangular, round, spiral or flat oval as noted. Conversion of duct shapes and sizes shown shall be accomplished without increasing air velocities or friction losses and is subject to prior approval by the Architect.

C. Elbows shall be either full radius type (inside radius equal to duct width), five-gore radius, flat-oval type or, in low pressure systems only, squared with double thickness turning vanes.

D. Abrupt changes in duct sizes and shapes shall not be permitted. The total angle of diverging transitions shall be not more than 15 degrees; converging transitions shall be not more than 30 degrees unless otherwise noted or required due to structural constraints.

E. Offsets, transitions, rises and drops are not individually called out on the design drawings. They shall be provided as required to fit the ductwork into the allocated spaces.

F. Transition rectangular ductwork on bottom and sides. Maintain top of ductwork level and as high as possible.

G. All ductwork between the VAV air-handling unit and the terminal units, outside ductwork and toilet exhaust ductwork shall be constructed for 3" WC static pressure class at 4000 FPM velocity with Class A seals and is herein defined as "medium-pressure" ductwork. All other ductwork shall be constructed for standard 1" WC static pressure class at 2500 FPM with Class C seals and is herein defined as "low pressure ductwork."

H. Provide the following types of ductwork material for the services indicated:

TYPE OF MATERIAL	SERVICE
1. Galvanized sheetmetal	Supply, return, exhaust and relief of comfort conditioned and outside air.

PART 2 – PRODUCTS

2.1 GALVANIZED SHEETMETAL

A. Galvanized sheetmetal shall be lock-forming grade G90-ASTM A 525 hot dip galvanized steel sheets. Sheetmetal shall be galvanized on each side with not less than 1.25 ounces of zinc per square foot.

2.2 SPIRAL DUCT

A. Spiral duct shall be utilized for all flat-oval and round ductwork in medium and high-pressure systems.

B. Spiral duct shall be the product of United McGill Corporation, R.V. Money or an approved equal.

C. Spiral ribbed duct is not acceptable.

2.3 DAMPERS

A. Manual Volume Dampers
1. Single blade butterfly dampers are acceptable up to 12" round or 12" x 12" square. Dampers larger than these dimensions shall be multi-blade type. Single blade dampers shall be constructed of 16 gauge or heavier galvanized sheetmetal.
2. No multi-blade damper blade shall exceed 8" in width. All multiple blade dampers shall be constructed of 16 gauge galvanized steel or heavier. The damper frame shall be 16 gauge or heavier. The damper action shall be opposed-blade type.
3. Each blade shall pivot on a 1/2" cadmium plated, cold-rolled steel axle which pivots within self-lubricating, oilite bronze bearings.
4. The top and bottom edges of each rectangular damper blade shall be crimped for stiffness.
5. The operating rod for all dampers shall be extended outside the damper frame for attachment of an operator. Each operator shall have a position indicator and locking quadrant.
6. All dampers utilized for introduction of outside air shall have flexible, gasketed edge and end seals. The leakage rate shall be less than 4 CFM per sq. ft. of face area against a 1" W.G. differential pressure, based on a nominal 48" x 48" damper size.
7. Manual volume dampers shall be as manufactured by Louvers & Dampers, Inc. or an approved equal.

B. Control Dampers
1. Control dampers shall be of the same construction as manual volume dampers, except that no manual operator and quadrant is required. The operating rod shall be suitable for operation by an automatic pneumatic or electric operator.

C. Fire Dampers
1. Fire dampers shall be UL-listed and labeled for 1 1/2 hours and shall be provided with 160 degrees F. links. Dampers installed within ducts shall be Type B or Type C with the blades out of the airstream. Areas indicated shall be net, clear, open areas.

D. Smoke Dampers
1. Smoke dampers shall be UL-listed as Class 1 low-leakage smoke dampers with automatic reset and shall be products of Prefco.

2.4 LOW-PRESSURE DUCT BRANCHES

A. Splitter dampers shall be provided at all low-pressure ductwork branches. All low-pressure ductwork branches shall be radiused or 45 degree take-offs; straight taps are unacceptable. The length of the damper blade shall be the same as the width of the widest duct section at the split, but in no case shall blade length be less than 12". Each operator rod shall have a locking swivel joint.

2.5 FLEXIBLE DUCT

A. Flexible ductwork shall be Class 1, UL 181 air duct and meet NFPA 90A and 90B Standards.

B. The internal duct surface shall be acoustically rated, black CPE bonded to a coated steel wire helix. The external jacket shall be a fiberglass, bi-directionally reinforced, metallized vapor barrier with a standing, triple ply seam. Fiberglass insulation shall be provided between the duct surface and the jacket to achieve a maximum thermal conductance of 0.23 BTU/Hr./sq. ft./degree F. at 75 degrees F. mean.

C. Flexible ductwork shall be suitable for 10" W.G. positive pressure and 1" W.G. negative pressure.

D. Flexible ductwork, insulation and insulation cover shall be suitable for ceiling return air plenum installation and shall comply with all applicable codes and standards regarding such ceiling plenum installations.

E. Flexible duct shall be Thermalflex M-KE or an approved equal.

F. The maximum allowable installed length of flexible ductwork shall be as follows:
1. 8'-0" on low-pressure supply air systems limited to short runouts and end of runs connected to round neck supply diffusers and registers.
2. 4'-0" on medium and high-pressure supply air systems limited to the runouts from the sheetmetal ductwork to each terminal unit.
3. 2'-0" on connections from round neck grilles to sheetmetal ductwork on return, exhaust and transfer ductwork.

G. Provide a spin-in fitting with integral scoop and volume damper at all flexible run-out connections in low-pressure supply air ductwork only.

2.6 TERMINAL UNIT RUNOUTS

A. Medium-pressure runouts to terminal units shall be connected to the trunk duct with factory-welded laterals, conical tees or bellmouth fittings; abrupt round or rectangular taps are strictly prohibited and shall be rejected.

2.7 FLEXIBLE CONNECTIONS

A. Provide flexible duct connections at the inlet and outlet of each fan, indoor fan powered induction unit, fan coil unit, air handling unit, etc., and at all other locations indicated. Flexible connections shall be fabricated from a glass fabric coated on both sides with neoprene. Minimum weight shall be 30 oz. per sq. yard.

2.8 DUCT HARDWARE

A. Duct hardware shall be as manufactured by Young Regulator or an approved equal.

2.9 ACCESS DOORS

A. A duct access door shall be provided at each fire damper. Access doors shall be designed for 1.5 times the pressure of the duct in which they are mounted. Access doors shall be of sufficient size to provide access to the dampers for resetting the blades and replacing the links. Access doors in medium and high-pressure ductwork shall be installed downstream of fire dampers and shall be implosion type. Where access is provided through gypsum board walls or ceilings, furnish access door for installation under Division 9. Each door shall match the fire-rating of the wall or ceiling indicated.

2.10 DUCT LINER

A. Duct liner shall be one inch thick, 1 1/2 lb. density (3 lb. density on medium- and high-pressure supply air systems) fibrous glass with one face coated with a black fire retardant compound. The permanent composite fire and smoke hazard rating of the liner shall be stenciled on the liner face and shall be:
1. Maximum flame spread 25
2. Maximum smoke developed 50

2.11 DUCT INSULATION

A. Duct insulation shall be 2" thick, minimum 3/4 lb. density fiberglass with an FSKL 0.00035" thick aluminum foil jacket, reinforced with fiberglass scrim. Thermal conductivity shall be a maximum of K = 0.24 at 75 degrees F. mean temperature.

B. Insulation adhesive shall be Benjamin Foster 85-20. Tape shall be aluminum foil and shall be SMACNA listed and labeled.

C. The composite NFPA 90A and 90B, ASTM E84, UL rating of the installed insulation shall not exceed 25/50.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Ductwork shall be installed in strict accordance with SMACNA, UL and NFPA standards.

B. Duct liner shall be provided for the following minimum distances or through the first elbow(s) or as otherwise indicated on the drawings, whichever is greater, downstream of each unit indicated below:
1. Terminal unit/WSHP/FCU 5 feet

Duct liner shall also be provided throughout all return air, transfer and plenums.

C. Duct liner shall be cut to provide overlapped and compressed longitudinal corner joints. Liner shall be installed with the coated surface facing the air stream. Duct liner shall be adhered to the ductwork with 100% coverage of the sheet metal surfaces using a fire retardant adhesive applied by spraying. Coat all exposed leading edges and all transverse joints with fire retardant adhesive. The liner shall be additionally secured using metal pins welded to the duct and speed washers. All leading edges shall be secured with sheet metal airfoils.

D. All supply air ductwork shall be insulated. Insulation shall be cut slightly longer than circumference of duct to insure full thickness at corners. All insulation shall be applied with edges tightly banded. Insulation shall be adhered to duct with fire resistant adhesive. Adhesive shall be applied so that insulation conforms to duct surfaces uniformly and firmly. In addition to the adhesive, the insulation shall be additionally secured to the bottom of all ducts 18" or wider by means of welded pins and speed clips. The protruding end of the pins shall be cut off flush after the speed clips have been applied. The vapor-barrier facing shall be thoroughly sealed with tape where the pins have pierced through. All joints shall be sealed with 2" wide SMACNA tape. Any cuts or tears shall be sealed with SMACNA tape.

E. Flexible ducts utilized in the low-pressure ductwork systems shall be installed without kinks or bends which are less than a centerline radius equal to or greater than twice the diameter of the flexible duct being installed. Also, in the runouts from the medium or high-pressure ductwork to the terminal units, the flexible ducts shall be installed with a variance of no more than 1" per foot of installed length off a straight and level line from the centerline of the sheetmetal ductwork runout or tap to the centerline of the terminal unit inlet. The size of the flexible ductwork connected to each terminal unit shall be the equivalent size of the larger of the following:
1. The inlet size of the terminal unit.
2. The runout size indicated on the drawings.

Should the runout size indicated on the drawings differ from the inlet size of the terminal unit or where the inlet to the terminal unit is rectangular, the transition shall be made with sheetmetal and shall occur at the inlet to the terminal unit.

G. All intersections (crossing) of low-pressure and medium-pressure ductwork shall be made with offsets in the low-pressure ductwork only. The medium pressure ductwork shall be installed straight and level.

END OF SECTION 238400

END OF MECHANICAL SPECIFICATIONS

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No.	Date	Description
	01/08/2020	ISSUED/RELEASED FOR CONSTRUCTION

Project Name

FranklinStreet

FRANKLIN STREET
3384 PEACHTREE ROAD
NE, SUITE 650
ATLANTA, GA 30326

ISSUE
ISSUED/RELEASED FOR CONSTRUCTION

MECHANICAL SPECIFATIONS

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GJ Checked	
As indicated Scale	M-0.1
01/08/2020 Date	
142-001-01 Project No.	Drawing Number