

SECTION 15800  
HVAC SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. SECTION INCLUDES

- 1. DUCTWORK
- 2. PIPING
- 3. AIR DISTRIBUTION DEVICES
- 4. EQUIPMENT
- 5. CONTROLS

B. THESE DOCUMENTS ARE SCHEMATIC IN NATURE AND ARE NOT INTENDED TO INDICATE EXACT CONDITIONS. THE DESIGN INDICATES SIZE, GENERAL LOCATIONS AND ROUTING, PERFORMANCE REQUIREMENTS AND OVERALL QUALITY OF CONSTRUCTION. THE DRAWINGS SHALL NOT BE SCALED BY THE CONTRACTOR. THIS CONTRACT INCLUDES ALL MATERIALS, EQUIPMENT AND LABOR NECESSARY TO PROVIDE COMPLETE, FULLY FUNCTIONAL MECHANICAL SYSTEMS AS INDICATED IN THE CONSTRUCTION DOCUMENTS.

C. THE BUILDING ARCHITECTURAL DESIGN AND (WHERE APPLICABLE) EXISTING CONDITIONS INDICATED IN THESE DOCUMENTS ARE APPROXIMATE AND FOR REFERENCE ONLY. THE CONTRACTOR SHALL ADJUST LOCATION AND ROUTING OF EQUIPMENT AND SYSTEMS AS REQUIRED TO ACHIEVE THE DESIGN INTENT.

D. EXCEPT WHERE SPECIFICALLY NOTED, INFORMATION FOR EXISTING WORK (LOCATIONS, CAPACITIES, ETC.) IS TAKEN FROM PREVIOUS DESIGN DRAWINGS AND ARE NOT "AS-BUILT" CONDITIONS. THE CONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS PRIOR TO BID SUBMISSION AND SHALL ADJUST PRICING AS REQUIRED. NO ALLOWANCE WILL BE MADE FOR LACK OF KNOWLEDGE OF THE PROJECT REQUIREMENTS OR OF ACTUAL FIELD CONDITIONS.

E. THE CONTRACTOR SHALL ENSURE THAT CONSTRUCTION DOES NOT CONTAMINATE, HARM OR CAUSE DAMAGE TO ADJACENT TENANTS OR PROPERTY. PROVIDE DUST BARRIERS, TEMPORARY FILTERS (OVER ALL TRANSFER OPENINGS AND EQUIPMENT RA INLETS SERVING THIS SCOPE), ETC. AS REQUIRED FOR DURATION OF PROJECT.

F. COORDINATE INTERRUPTION OF ALL SERVICES (ELECTRICITY, WATER, SEWER, GAS, HVAC SERVICES, ETC.) WITH THE OWNER. COORDINATE ALL ACTIVITY OUTSIDE THE CONSTRUCTION AREA WITH THE OWNER.

1.02 GENERAL

A. ALL CONSTRUCTION SHALL BE WITH NEW, FIRST QUALITY COMPONENTS EXCEPT WHERE SPECIFICALLY NOTED AS EXISTING. ANY EQUIPMENT OR DEVICES TO BE RE-USED SHALL BE THOROUGHLY CLEANED AND SERVICED TO GOOD WORKING CONDITION.

B. ALL NEW EQUIPMENT SHALL BEAR THE LABEL OF THE SPECIFIED LISTING AGENCY.

C. ALL CONSTRUCTION WITHIN HVAC PLENUMS SHALL HAVE A MAXIMUM FLAME SPREAD/SMOKE DEVELOPED RATING OF 25/50 AS REQUIRED BY CODE AND NFPA.

D. HVAC SYSTEM CONSTRUCTION SHALL COMPLY WITH APPLICABLE STANDARDS REFERENCED BY CODE FOR PIPING MATERIAL AND SERVICE.

1.03 QUALITY ASSURANCE

A. PROVIDE PRODUCTS OF MANUFACTURERS REGULARLY ENGAGED IN MANUFACTURE OF SIMILAR PRODUCTS FOR NOT LESS THAN 5 YEARS.

B. ALL PRODUCTS REQUIRING ELECTRICAL CONNECTIONS SHALL BE UL LISTED AND LABELED FOR THE INSTALLED APPLICATION.

C. ALL FANS SHALL BE AMCA LABELED.

D. SUBJECT TO COMPLIANCE WITH THE SPECIFICATIONS AND EQUIPMENT SCHEDULES, THE PRODUCTS OF THE FOLLOWING MANUFACTURERS SHALL BE DEEMED ACCEPTABLE:

1. PACKAGED SYSTEM:	CARRIER, TRANE, YORK.
2. FANS:	COOK, GREENHECK, PENNBARRY
3. AIR DISTRIBUTION DEVICES:	CARNES, METALAIRE, NAILOR, PRICE, TITUS, RUSKIN
4. INSULATION:	3M, ARMSTRONG, CERTAINTED, DOW, JOHNS MANVILLE, KNAUF, NELSON, OWENS CORNING, TRUEBRO

1.04 CODES AND REGULATIONS

A. ALL MECHANICAL SYSTEMS SHALL BE INSTALLED IN ACCORDANCE WITH ALL APPLICABLE CODES AND LAWS (WITH ALL AMENDMENTS ADOPTED BY THE LOCAL AUTHORITY HAVING JURISDICTION), THESE SPECIFICATIONS, DIVISION 1 SPECIFICATIONS, AND OWNER CRITERIA (CONTRACTOR SHALL COORDINATE WITH OWNER). WHERE CONFLICTING REQUIREMENTS OCCUR, THE MORE STRINGENT SHALL GOVERN.

B. THE CONTRACTOR SHALL OBTAIN ALL PERMITS, LICENSES, INSPECTIONS, ETC. AND PAY ALL INCIDENTAL FEES, AS REQUIRED BY THE AUTHORITIES HAVING JURISDICTION TO PERFORM ALL ACTIVITIES RELATED TO THIS WORK AND TO OBTAIN A PERMANENT CERTIFICATE OF OCCUPANCY.

1.05 WARRANTY

A. PROVIDE MINIMUM ONE (1) YEAR PARTS AND LABOR WARRANTY FOR ALL NEW EQUIPMENT, MATERIALS AND WORKMANSHIP FROM THE DATE OF BENEFICIAL OCCUPANCY. PROVIDE ADDITIONAL FIVE (5) YEAR PARTS-ONLY WARRANTY FOR COMPRESSORS.

1.06 DESIGN SUMMARY

A. PROJECT LOCATION: BARTOW COUNTY, GEORGIA

B. DESIGN CONDITIONS:

OUTDOOR DESIGN CONDITIONS:	SUMMER: 91.1FDB / 74.5FDB (ASHRAE 1 PERCENT)	WINTER: 18.0FDB (ASHRAE 99 PERCENT)
INDOOR DESIGN CONDITIONS:	SUMMER: 75F MAX, 50%RH	WINTER: 70F MAX

PART 2 PRODUCTS

2.01 DUCTWORK

A. CONCEALED GENERAL SUPPLY, RETURN AND EXHAUST AIR METAL DUCTWORK: 600 GALVANIZED STEEL, LOCK-FORMING QUALITY, FABRICATED AND INSTALLED PER SMACNA AND CODE. DUCTWORK SHALL BE RECTANGULAR OR ROUND PER DRAWINGS -- SIZES INDICATED ON DRAWINGS ARE NET CLEAR INSIDE DIMENSIONS (ADD LINER THICKNESS FOR SHEETMETAL SIZES). ROUND DUCTWORK UP TO 14" DIAMETER SHALL BE SNAP-LOCK PIPE WITH LONGITUDINAL SEAM, LARGER ROUND DUCT AND ALL EXPOSED ROUND DUCT SHALL BE SPIRAL.

1. ALL DUCTWORK SHALL BE METAL -- NO EXCEPTIONS. FIBERGLASS DUCT BOARD MAY NOT BE SUBSTITUTED FOR RECTANGULAR STEEL DUCTWORK. FLEXIBLE DUCT SHALL NOT BE USED ON THIS PROJECT. ALL RUNOUTS AND

FINAL CONNECTIONS TO AIR DISTRIBUTION DEVICES SHALL BE MADE WITH HARD ROUND DUCT ONLY.

B. EXPOSED SUPPLY DUCT: GALVANIZED STEEL DOUBLE WALL SPIRAL DUCT AND FITTINGS WITH 1" THICK INSULATION LAYER FOR CONDENSATION CONTROL. DUCTWORK SHALL BE DEGREASED, PRIMED, AND PAINTED TO MATCH CEILING (COORDINATE FINISH COLOR WITH ARCHITECT).

C. TYPE I KITCHEN HOOD (GREASE) EXHAUST DUCTWORK: CARBON STEEL, MIN 16 GA. WITH LIQUID-TIGHT ALL-WELDED JOINTS AND SEAMS, FABRICATED AND INSTALLED PER NFPA 96 AND CODE; ALL ELBOWS SHALL BE SMOOTH RADIUS WITH INSIDE RADIUS EQUAL TO THE DUCT WIDTH (MITRED ELBOWS ARE NOT ACCEPTABLE); SLOPE MIN 1" PER FOOT TOWARD HOOD; WHERE LOW POINTS ARE REQUIRED IN HORIZONTAL INSTALLATIONS, PROVIDE NFPA COMPLIANT GREASE DRAINS AT ALL LOW POINTS -- ROUTE TO KITCHEN GREASE DRAINAGE SYSTEM; DUCT SHALL BE CONSTRUCTED TO PREVENT ACCUMULATION OF GREASE OR OBSTRUCTION FROM PROPER DRAINAGE -- NO BOLTS, RIVETS, FLANGES, ETC., MAY PROTRUDE INTO DUCT; PROVIDE ACCESS DOORS FOR CLEANING AND INSPECTION OF DUCT SYSTEM AS REQUIRED BY THE LAHJ -- ACCESS DOORS SHALL BE UL LISTED FOR TYPE I KITCHEN EXHAUST SERVICE.

1. WHERE REQUIRED, INSULATE TYPE I EXHAUST DUCT WITH CERAMIC FIBER BLANKET INSULATION SPECIFICALLY DESIGNED AND UL LISTED FOR GREASE EXHAUST DUCT SERVICE AND APPLIED PER MANUFACTURER'S RECOMMENDATIONS FOR 2-HR FIRE RATED ASSEMBLY AND PERMITTING ZERO CLEARANCE TO COMBUSTIBLES; FIBERGLASS REINFORCED ALUMINUM FOIL SCRIM WITH PRODUCT NAME AND UL LISTING PERMANENTLY IMPRINTED ON EXTERIOR; 3M "FIRE BARRIER DUCT WRAP", JOHNS MANVILLE "FIRETEMP", OR VESUVIUS "PYROSCAT".

D. ELBOWS: SMOOTH RADIUS WITH CENTERLINE RADIUS EQUAL TO 1.5 TIMES THE DUCT WIDTH IN PLANE OF TURN. SHORT RADIUS (CENTERLINE RADIUS 1.0 TIMES DUCT WIDTH, MIN. 12" INSIDE RADIUS) OR 90 DEGREE MITRED ELBOWS WITH SINGLE THICKNESS (DOUBLE THICKNESS OVER 30" LENGTH) TURNING VANES MAY BE SUBSTITUTED WHERE SPACE DOES NOT PERMIT INSTALLATION OF FULL-RADIUS ELBOWS.

E. TRANSITIONS: TRANSITIONS SHALL BE MADE WITH MAXIMUM 30 DEGREE DIVERGENCE AND 45 DEGREE CONVERGENCE.

F. TAKE-OFFS FOR ROUND DUCT RUNOUTS: SPIN-IN OR FLANGED FITTING WITH LOCKING MANUAL BALANCING DAMPER (INSTALL WITH DAMPER AXIS PARALLEL TO TRUNK DUCT AXIS) AND NO EXTRACTOR SCOOP. PROVIDE GASK FLOM GASKET FOR FLANGED TAKE-OFF AND SECURE TO TRUNK DUCT WITH SHEETMETAL SCREWS AROUND TAP AT MAX. 6" CENTERS. PROVIDE CONICAL FITTINGS OR 45 DEGREE BOOTS AT TAKE-OFFS IN MEDIUM PRESSURE DUCT SYSTEMS.

G. MANUAL BALANCING DAMPERS: GALVANIZED STEEL; TRIPLE-V BLADES OR ROUND BLADES WITH CRIMPED EDGES RATED FOR 1500 FPM; OPPOSED BLADE ARRANGEMENT WITH LINKAGE OUTSIDE AIRSTREAM; PERMANENTLY LUBRICATED STAINLESS STEEL BEARINGS; MANUAL LEVER WITH QUADRANT LOCK; EXTERNAL DAMPER POSITION INDICATOR; RUSKIN MD35 (RECTANGULAR), MD325 (ROUND) OR APPROVED EQUIVALENT.

H. MOTOR OPERATED DAMPERS: GALVANIZED STEEL; PARALLEL TRIPLE-V BLADES OR SINGLE-THICKNESS ROUND BLADE RATED UP TO 1500 FPM; CLASS I LOW LEAKAGE NEOPRENE SEALS MECHANICALLY LOCKED INTO BLADE (4 CFM/SF @ 1" WG); EXTENDED SHAFT FOR MOTOR ACTUATOR MOUNTING; EXTERNAL DAMPER POSITION INDICATOR; PERMANENTLY LUBRICATED STAINLESS STEEL BEARINGS; RUSKIN CD35 OR APPROVED EQUIVALENT; 120V NORMALLY CLOSED, POWERED OPEN ACTUATOR SIZED PER DAMPER MANUFACTURER'S RECOMMENDATIONS.

I. BACKDRAFT DAMPERS: GALVANIZED STEEL, COUNTER-BALANCED WITH ADJUSTABLE COUNTERWEIGHTS, AND RATED FOR THE DESIGN DUCT VELOCITIES (MIN. AND MAX.) IN WHICH INSTALLED. BO'S INSTALLED AT FAN DISCHARGE SHALL BE ORIENTED WITH BLADES PERPENDICULAR TO FAN AXIS OF ROTATION.

J. FIRE DAMPERS: UL 555 (1-1/2-HR RATED DAMPER FOR ASSEMBLIES UP TO 2-HR; 3-HR RATED FOR ASSEMBLIES OVER 2-HR); DYNAMIC RATED: UP TO 1800 FPM DESIGN SHALL BE 2000 FPM RATED. CERTAIN TYPE FIRE DAMPER WITH TYPE B OR C FRAME (BLADES HOUSED OUTSIDE AIRSTREAM), RUSKIN D100 OR APPROVED EQUIVALENT.

2.02 PIPING

A. CONDENSATE DRAINAGE: PVC PIPING WITH SOLVENT WELD JOINTS. SLOPE AT MINIMUM 1/8" PER FOOT, TERMINATE ON ROOF WITH SPLASH BLOCK ON LOW SIDE OF RTU.

B. REFRIGERANT SUCTION AND LIQUID: ACR COPPER WITH WROUGHT COPPER FITTINGS AND BRAZED JOINTS.

2.03 AIR DISTRIBUTION DEVICES

A. CONTRACTOR SHALL COORDINATE DEVICE BORDER AND MOUNTING FRAME WITH THE SURFACE IN WHICH INSTALLED (REFER TO ARCHITECTURAL DRAWINGS PRIOR TO ORDERING). COORDINATE LAY-IN CEILING GRID SYSTEM TYPE (STANDARD TEE, NARROW TEE, CONCEALED SPLINE, ETC.) SPECIFIED BY ARCHITECT AND PROVIDE APPROPRIATE BORDER AND GASKET. DEVICES IN FINISH SURFACES SHALL BE FREE OF VISIBLE FASTENERS. COORDINATE COLOR AND COLOR WITH THE ARCHITECT.

B. SEE DIFFUSERS, REGISTERS, AND GRILLES SCHEDULE SHEET 15100.

2.04 EQUIPMENT

A. ALL EQUIPMENT SHALL MEET THE MINIMUM EFFICIENCY REQUIREMENTS OF ASHRAE 90.1. ALL SMALL GOVERNING ENERGY CLASSES. ALL MOTORS 1HP AND LARGER SHALL BE IEEMA PREMIUM EFFICIENCY.

B. EXCEPT WHERE SPECIFICALLY NOTED OTHERWISE IN THE ELECTRICAL CONSTRUCTION DOCUMENTS, THE MECHANICAL CONTRACTOR SHALL FURNISH ELECTRICAL DISCONNECTS AND STARTERS FOR ALL EQUIPMENT PROVIDED UNDER THIS CONTRACT.

C. ALL EQUIPMENT SHALL BE NEW, FIRST QUALITY, EXCEPT THAT WHICH IS INDICATED AS EXISTING TO REMAIN. CONTRACTOR SHALL TEST AND CERTIFY ALL EXISTING EQUIPMENT FOR PROPER OPERATION AND SHALL REPORT ANY NON-FUNCTIONING EQUIPMENT IN WRITING TO THE OWNER FOR RESOLUTION PRIOR TO START OF NEW MECHANICAL CONSTRUCTION. ALL UNREPORTED EQUIPMENT IS THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL BE REPAIRED OR REPLACED IF NOT FUNCTIONAL AT THE DATE OF BENEFICIAL OCCUPANCY.

D. EXCEPT WHERE SPECIFICALLY NOTED OTHERWISE, SEPARATE COMPONENTS OF A FINISHED SYSTEM AND RELATED CONTROLS SHALL BE BY A SINGLE MANUFACTURER.

2.05 INSULATION

A. INSULATION SYSTEMS, WHERE REQUIRED, SHALL BE CONTINUOUS THROUGH WALL/FLOOR PENETRATIONS, SUPPORTS, VALVES, FITTINGS AND ACCESSORIES (EXCEPTION, AT FIRE DAMPERS). PROVIDE PRE-MOLDED INSULATION ASSEMBLIES FOR PIPING, VALVES AND ACCESSORIES. REPAIR INSULATION AT EXISTING DUCTWORK WHICH HAS BEEN REWORKED. TEARS AND PUNCTURES AT VAPOR BARRIER SHALL BE REPAIRED AND SEALED. ALL DUCTWORK AND PIPING PRESSURE TESTING SHALL BE PERFORMED BEFORE INSULATION IS APPLIED. ALL INSULATION SHALL BE 100% ASBESTOS FREE.

B. SUPPORTS FOR INSULATED PIPING AND DUCTWORK SHALL BE OUTSIDE INSULATION.

C. PROVIDE CONTINUOUS VAPOR BARRIER FOR ALL INSULATED DUCTWORK AND PIPING SYSTEMS. SEAL PER MANUFACTURER'S RECOMMENDATIONS AT ALL JOINTS, SEAMS AND PENETRATIONS BY MECHANICAL SYSTEM APPURTENANCES.

D. INSULATION SYSTEMS: INSULATION SHALL BE MANUFACTURED AND INSTALLED PER NAMA STANDARDS AND MANUFACTURER'S RECOMMENDATIONS FOR INTENDED SERVICE.

17. EXTERNAL DUCT WRAP: FIBERGLASS BLANKET INSULATION; 2" THICK, 1PCF, R-6.0 (WITH 25 PERCENT COMPRESSION), 0-250F SERVICE; FOIL VAPOR BARRIER; FORMALDEHYDE FREE; JOHNS MANVILLE "MICROGLITE XG" OR APPROVED EQUIVALENT.

18. INTERNAL DUCT LINER: FIBERGLASS DUCT LINER; 1" THICK, 1.5 PCF, 0-250F SERVICE, 6000 FPM RATED, 0.7 NRC; NEOPRENE COATING AND AN ANTI-MICROBIAL TREATMENT ON ALL SURFACED EXPOSED TO AIRFLOW; JOHNS MANVILLE "LINACOUSTIC RC" OR APPROVED EQUIVALENT. PROVIDE CONTINUOUS PROTECTION OF LEADING EDGE OF LINER PER MANUFACTURER'S RECOMMENDATIONS.

19. ELASTOMERIC PIPE INSULATION: PREFORMED CLOSED CELL FLEXIBLE ELASTOMERIC FOAM, K=0.28 BTU/HR-SF-F-IN, 0.08 PERM-INCH, 0-220F SERVICE; 25/50 RATED UP TO 1-1/2" THICKNESS; JOINTS AND SEAMS SEALED WITH MANUFACTURER'S LIQUID APPLIED CONTACT SEALANT TO PROVIDE CONTINUOUS VAPOR BARRIER; ARMACELL "AP ARMAFLEX" OR APPROVED EQUIVALENT.

PART 3 EXECUTION

3.01 DELIVERY AND STORAGE

A. NEW EQUIPMENT, AND DEVICES SHALL BE DELIVERED IN MANUFACTURER'S SHIPPING BOXES AND SHALL BE STORED IN CLEAN, DRY ENVIRONMENT ON WOODEN PALLETS AND COVERED WITH 6 MIL PLASTIC WRAP UNTIL READY FOR INSTALLATION.

B. PIPING, DUCTWORK, AND EQUIPMENT CONNECTIONS SHALL BE PROTECTED FROM WATER, DIRT, DEBRIS, SCALE, CORROSION AND DAMAGE DURING CONSTRUCTION. CAP ALL OPEN ENDS UNTIL READY FOR FINAL CONNECTION AND USE.

3.02 INSTALLATION GENERAL

A. INSTALL CONSTRUCTION PER CODE, MANUFACTURER'S RECOMMENDATIONS, REFERENCED STANDARDS, AND THESE DOCUMENTS. SHOULD CONFLICTING REQUIREMENTS ARISE, THE MORE STRINGENT SHALL GOVERN.

B. CONTRACTOR SHALL REPAIR ANY DAMAGE TO BUILDING STRUCTURE OR FINISHES RESULTING FROM HIS WORK. REPAIR SHALL MATCH SURROUNDING CONSTRUCTION.

C. PROVIDE ACCESS PANELS WHERE REQUIRED IN HARD CEILING AND WALLS TO ALLOW ACCESS FOR MAINTENANCE OF EQUIPMENT AND BALANCING OF SYSTEM. ACCESS PANELS IN FIRE-RATED ASSEMBLIES SHALL BE UL LISTED TO MATCH ASSEMBLY RATING, AND INSTALLED IN COMPLIANCE WITH UL LISTING.

3.03 DUCTWORK INSTALLATION

A. HVAC DUCTWORK SYSTEMS SHALL BE FABRICATED AND INSTALLED PER SMACNA "HVAC DUCT CONSTRUCTION STANDARDS" AND SHALL MEET THE FOLLOWING SMACNA PRESSURE AND SEAL CLASSIFICATIONS:

SUPPLY:	1" WG / A SEAL
RETURN:	1" WG / A SEAL
GENERAL EXHAUST:	1" WG / A SEAL

B. ALL JOINTS AND SEAMS IN GENERAL DUCT SYSTEMS SHALL BE SEALED WITH UL 181 WATER-BASED MASTIC (TAPE IS NOT AN ACCEPTABLE DUCT SEALANT). FLANGED CONNECTIONS SHALL BE SEALED WITH GASKETS AND MECHANICALLY FASTENED. ALL AUDIBLE LEAKS SHALL BE SEALED.

C. INSTALL NEW DUCTWORK AS HIGH AS POSSIBLE, TIGHT TO STRUCTURE ABOVE.

D. RUNOUTS TO DIFFUSERS AND TERMINAL DEVICES SHALL MATCH THE CONNECTION (NECK) SIZE, UNLESS NOTED OTHERWISE.

E. FLEX DUCT SHALL NOT BE USED.

F. RUNOUT CONNECTION TO TRUNK DUCTWORK SHALL BE MIN 5 FT DOWNSTREAM OF EQUIPMENT DISCHARGE AND SHALL BE MIN 3 FT DOWNSTREAM OF ELBOWS OR OTHER TAKE-OFFS.

G. DUCT SIZES INDICATED ARE CLEAR INSIDE REQUIREMENTS FOR AIR FLOW. JUST SHEET METAL SIZE AS REQUIRED FOR DUCT LINER.

H. PROVIDE FIRE DAMPERS AT ALL DUCT PENETRATIONS OF FIRE-RATED PARTITIONS, BARRIERS, FLOORS, AND WALLS. PROVIDE ACCESS DOOR IN DUCTWORK ABOVE EACH FIRE DAMPER, ON ACCESSIBLE SIDE OF FIRE RATED ASSEMBLY, FOR INSPECTION AND MAINTENANCE. PROVIDE ACCESS DOOR IN WALL OR HARD CEILING IF REQUIRED AND COORDINATE LOCATION WITH ARCHITECT.

3.04 PIPING INSTALLATION

A. COOLING COIL CONDENSATE DRAINAGE PIPING SHALL MATCH EQUIPMENT CONNECTION SIZES. PROVIDE P-TRAP AT UNIT (MIN SEAL: 1" GREATER THAN THE SUPPLY FAN TOTAL STATIC PRESSURE). PROVIDE MIN 1/8" PER FOOT SLOPE, FREE OF LOCAL HIGH OR LOW POINTS (PROVIDE CONDENSATE PUMP WHERE REQUIRED TO MAINTAIN MIN SLOPE). TERMINATE ON ROOF WITH SPLASH BLOCK. PROVIDE CLEANOUTS AT ALL CHANGES IN DIRECTION AND AT MINIMUM INTERVALS AS REQUIRED BY CODE IN DRAINAGE PIPING.

B. REFRIGERANT PIPING SHALL BE INSTALLED STRICTLY PER SPLIT SYSTEM MANUFACTURER'S RECOMMENDATIONS.

3.05 AIR DISTRIBUTION DEVICES INSTALLATION

A. COORDINATE LOCATIONS OF ALL NEW AND EXISTING AIR DEVICES TO AVOID CONFLICTS WITH PARTITIONS AND CEILING CONSTRUCTION FEATURES AND DEVICES (LIGHT FIXTURES, SPEAKERS, SPRINKLERS, ETC.) -- COORDINATE WITH ARCHITECTURAL DRAWINGS.

3.06 EQUIPMENT INSTALLATION

A. INSTALL ALL EQUIPMENT PER THESE DOCUMENTS, MANUFACTURER'S RECOMMENDATIONS, AND CODE REQUIREMENTS FOR SPECIFIC APPLICATION.

B. EQUIPMENT ROOF OPENINGS, DUCTWORK, AND PIPING SHALL BE INSTALLED ABOVE WALKWAYS ONLY AND SHALL NOT BE INSTALLED DIRECTLY ABOVE ANY PORTION OF ELECTRICAL EQUIPMENT.

C. PROVIDE START-UP, PROGRAMMING AND ADJUSTMENT FOR ALL NEW EQUIPMENT BY A FACTORY-AUTHORIZED AGENT TRAINED AND CERTIFIED BY THE MANUFACTURER TO PROVIDE START-UP SERVICE FOR THE SPECIFIC EQUIPMENT.

D. INSTALL ALL NEW EQUIPMENT TO PROVIDE MINIMUM REQUIRED CLEARANCES FOR OPERATION, MAINTENANCE AND INSPECTION.

E. THERMOSTATS AND SPACE SENSORS SHALL BE LOCATED PER THE PANEL AND AS FOLLOWS. WALL-MOUNTED TSTATS SHALL BE MOUNTED PER ALL REQUIREMENTS FOR WHEELCHAIR ACCESS (54" OFF FLOOR FACE ACCESS, 48" AFF FOR FRONT FACE ACCESS ONLY). DO NOT LOCATE THERMOSTATS THE SAME WALL STUD SPACE AS DIMMERS AND THERMOSTATS (COORDINATE WITH ELECTRICAL) OR WHERE OPERATION ACCESS BE BLOCKED BY FURNITURE (COORDINATE WITH ARCHITECTURAL). THERMOSTATS SHALL NOT BE LOCATED IN THE DIRECT THEATRE OF ANY DEVICE.

F. PROVIDE TESTING, TUNING, AND BALANCING (TAB) SERVICES PERFORMED BY AN INDEPENDENT TAB OR AEC ENGINEERING AGENCY WHICH HAS BEEN IN BUSINESS AS AN INDEPENDENT TAB AGENCY FOR A MINIMUM OF 5 YEARS. PROVIDE COMPLETE TAB REPORT FOR THE PROJECT. REPORT FORMAT AND CONTENT SHALL BE PER AEC OR TAB STANDARDS AND SHALL INCLUDE, AT THE MINIMUM, THE FOLLOWING INFORMATION (BOTH DESIGN AND BALANCED QUANTITIES): EQUIPMENT CONNECTION AND FACE SIZES; PERFORMANCE (FLOW, PRESSURE, TEMPERATURE RISE/DROP, ETC.); MOTOR RPM AND HP; FAN/PUMP RPM AND VERIFICATION OF PROPER ROTATION; ELECTRICAL CHARACTERISTICS (W/PH/A); VERIFICATION OF PROPER RESPONSE OF SYSTEM TO CONTROLS; MANUFACTURER'S OPERATING SEQUENCES AND AS SPECIFIED HEREIN; TAB REPORTS SHALL BE LEGIBLE (TYPEWRITTEN OR PRINTED HANDWRITING IS NOT ACCEPTABLE) AND SHALL CLEARLY INDICATE ALL REQUIRED INFORMATION. INCOMPLETE OR ILLEGIBLE REPORTS WILL BE REJECTED WITHOUT REVIEW. TEST AND BALANCE ALL SYSTEMS PER PROCEDURES OUTLINED BY LICENSING AGENCY, AND AS SPECIFIED BELOW:

- 1. TEST ALL EQUIPMENT FOR PROPER OPERATION. TEST CONTROLS FOR PROPER RESPONSE TO ALL SEQUENCES AND OPERATING SCHEDULES. RECALIBRATE EXISTING CONTROLLERS SERVING SPACES UNDER THIS CONTRACT TO ENSURE PROPER OPERATION.
- 2. EXCEPT WHERE SPECIFICALLY NOTED OTHERWISE, ALL SYSTEM FLOWRATES SHALL BE BALANCED TO WITHIN 95-105 PERCENT OF DESIGN, WHERE FINAL BALANCED CONDITIONS ARE OUTSIDE THIS RANGE, MEASURE AND REPORT DIAGNOSTIC INFORMATION AND POSSIBLE PROBLEMS.

3.07 COORDINATION

A. THE BASIS-OF-DESIGN PRODUCTS WERE USED TO DETERMINE DIMENSIONS, INSTALLATION AND ACCESS CLEARANCES, SUPPORTS, ELECTRICAL SERVICE, CONNECTION ARRANGEMENTS, ETC. WHERE ALTERNATE PRODUCTS ARE PROVIDED, IT IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR TO COORDINATE ALL REQUIREMENTS AND RECTIFY ANY CONFLICTS AT NO ADDITIONAL COST TO THE OWNER.

B. MECHANICAL CONSTRUCTION SHALL BE COORDINATED WITH ALL OTHER TRADES PRIOR TO INSTALLATION TO AVOID CONFLICTS. CONFLICTS WHICH ARISE DUE TO LACK OF COORDINATION SHALL BE RESOLVED BY THE CONTRACTOR AT NO ADDITIONAL COST.

C. COORDINATE WITH ALL ARCHITECTURAL ELEMENTS, INCLUDING (BUT NOT LIMITED TO): CEILING ASSEMBLIES, LIGHTING, PROJECTORS AND SCREENS, OVERHEAD PAGING SYSTEM, MOVABLE PARTITION ASSEMBLIES, RATED AND NON-RATED PARTITIONS, ETC. -- REFER TO ARCHITECTURAL DOCUMENTS.

D. ELECTRICAL REQUIREMENTS SHALL BE COORDINATED WITH THE DIVISION 16000 CONTRACTOR, INCLUDING (BUT NOT LIMITED TO): SERVICE (VOLTS, PHASE, CYCLE), MINIMUM CIRCUIT AMPS, MAXIMUM OVER CURRENT PROTECTION, STARTERS (WHERE NOT PROVIDED WITH PACKAGED EQUIPMENT), DISCONNECTS, ETC. UNLESS SPECIFICALLY NOTED OTHERWISE, ALL ELECTRICAL DISCONNECTS SHALL BE FURNISHED BY THE EQUIPMENT PROVIDER.

E. OPENINGS REQUIRED IN BUILDING STRUCTURE, SLABS, FLOORS, EXTERIOR WALLS AND ROOFS SHALL BE COORDINATED WITH THE ARCHITECT, OWNER AND STRUCTURAL ENGINEER. ALL CUTTING AND PATCHING REQUIRED SHALL BE PROVIDED BY THE CONTRACTOR.

F. EQUIPMENT WEIGHTS AND PROPOSED SUPPORTING METHODS SHALL BE COORDINATED WITH THE STRUCTURAL ENGINEER FOR ALL EQUIPMENT AND ASSEMBLIES WHICH ARE SUPPORTED BY THE BUILDING STRUCTURE.

G. UTILITY AND METERING REQUIREMENTS (ELECTRICITY, WATER, SEWER, FIRE PROTECTION WATER, GAS, ETC.) SHALL BE COORDINATED WITH THE APPROPRIATE AGENCIES.

3.08 HANGERS AND SUPPORTS

A. SUPPORT ALL PIPING AS REQUIRED BY CODE AND IN ACCORDANCE WITH MSS SP-69, PER SPECIFIC REQUIREMENTS FOR PIPING MATERIALS, SERVICE TEMPERATURE, AND INSULATION.

B. SUPPORTS SHALL BE ANCHORED TO SUBSTANTIAL BUILDING STRUCTURE ONLY. DO NOT SUPPORT FROM OTHER PIPING, DUCTWORK, CEILING SYSTEM, CONDUIT, ETC. SUPPORT SYSTEMS (HANGERS, FRAMES, ANCHORS, ETC.) SHALL BE RATED FOR MINIMUM 200% OF THE TOTAL SUPPORTED WEIGHT (EQUIPMENT, PIPING, DUCTWORK, INSULATION, WORKING FLUIDS, ETC.) FOR THE SPECIFIC INSTALLATION CONDITIONS.

C. PROVIDE ROOF CURB FOR ALL ROOF-MOUNTED FANS AND ROOFTOP UNIT. CURB SHALL BE MINIMUM 14" HIGH, SIZED TO MATCH WEIGHT AND SIZE OF SUPPORTED EQUIPMENT, SUITABLE FOR ROOF SYSTEM, MATED TO ROOF SLOPE TO PROVIDE LEVEL EQUIPMENT MOUNTING SURFACE, AND MANUFACTURED TO APPLICABLE NRCA STANDARDS AND EQUIPMENT MANUFACTURER'S REQUIREMENTS. FLASH AND SEAL WEATHERTIGHT TO ROOF.

D. PROVIDE VIBRATION ISOLATION AT ALL EQUIPMENT WITH ROTATING OR RECIPROCATING PARTS. INSTALL AND ADJUST VIBRATION ISOLATORS IN ACCORDANCE WITH THE (EQUIPMENT AND ISOLATOR) MANUFACTURER'S

RECOMMENDATIONS. NOMINAL STATIC DEFLECTION SHALL BE AS RECOMMENDED BY ISOLATOR MANUFACTURER FOR SPECIFIC APPLICATION.

SPRING/NEOPRENE HANGERS, EQUAL TO MASON 30N, FOR SUSPENDED EQUIPMENT AND 5/16" WAFFLE PADS, EQUAL TO MASON W, FOR FLOOR-MOUNTED EQUIPMENT.

3.09 WALL, FLOOR AND ROOF PENETRATIONS

A. PROVIDE SLEEVES FOR ALL WALL AND FLOOR PENETRATIONS. PROVIDE UL LISTED FIRESTOP SYSTEM AT ALL PENETRATIONS OF FIRE RATED ASSEMBLIES. PROVIDE FREESTONECHONS FOR ALL VISIBLE WALL AND CEILING PENETRATIONS.

B. ALL EXTERIOR WALL AND ROOF PENETRATIONS SHALL BE FLASHED AND SEALED WEATHERTIGHT. PROVIDE 12" ROOF CURB WITH INSULATED WEATHERTIGHT CAP. FOR ALL PIPING PENETRATIONS OF ROOF. PIPING SHALL PENETRATE THROUGH SIDE WALL OF CURB, NOT THROUGH TOP, AND SHALL SLOPE AWAY FROM CURB FOR POSITIVE DRAINAGE. STANDARD PIPING WEATHER BOOTS AND "PITCH POCKETS" ARE NOT ACCEPTABLE.

3.10 IDENTIFICATION

A. EQUIPMENT AND CONTROLS: LABEL EQUIPMENT WITH PERMANENT LABEL (EMBOSSED METAL, ENGRAVED PLASTIC OR SOLID HANDWRITTEN MARKER IS NOT ACCEPTABLE) INDICATING DESIGNATION. LABEL ALL THERMOSTATS AND CONTROL DEVICES WITH PERMANENTLY PRINTED HANDWRITING IS NOT ACCEPTABLE) LABEL INDICATING DESIGNATION OF CONTROLLED EQUIPMENT. LABELS SHALL NOT COVER NAMEPLATES OR OPERATING INSTRUCTIONS.

3.11 INSULATION

A. DUCTWORK SHALL BE INSULATED PER THE FOLLOWING SCHEDULE:

- 1. ALL SUPPLY AND RETURN DUCTWORK WITHIN 15FT OF UNIT CONNECTIONS SHALL BE INTERNALLY LINED WITH 1" FIBERGLASS DUCT LINER FOR SOUND CONTROL.
- 2. ALL CONCEALED, INTERNALLY SUPPLY DUCTWORK SHALL BE EXTERNALLY INSULATED WITH 1" THICK FIBERGLASS DUCT WRAP.
- 3. ALL CONCEALED, UNLINED SUPPLY DUCTWORK SHALL BE EXTERNALLY INSULATED WITH 2" THICK FIBERGLASS DUCT WRAP.
- 4. ALL CONCEALED, UNLINED RETURN DUCTWORK SHALL BE EXTERNALLY INSULATED WITH 1" THICK FIBERGLASS DUCT WRAP.
- 5. TYPE I KITCHEN EXHAUST DUCT SHALL BE INSULATED WITH FIRE-RATED DUCT WRAP WHERE REQUIRED, SEE PARAGRAPH 2.01.C.1.

B. HVAC PIPING SHALL BE INSULATED PER THE FOLLOWING SCHEDULE:

SERVICE	SIZE	TYPE
REFRIGERANT SUCTION	ALL	1" ELASTOMERIC

3.12 EQUIPMENT START-UP AND COMMISSIONING

A. PROVIDE EQUIPMENT START-UP AND COMMISSIONING. EQUIPMENT START-UP SHALL BE PERFORMED BY EQUIPMENT MANUFACTURER'S AUTHORIZED AGENTS ONLY. FOLLOW PROCEDURES OUTLINED BY EQUIPMENT MANUFACTURER'S PUBLISHED INSTALLATION LITERATURE.

B. PROVIDE COMPLETED START-UP CHECKLISTS AND COMMISSIONING REPORTS, SIGNED BY AGENT, IN THE O&M MANUALS.

C. PROVIDE OWNER TRAINING FOR ALL NEW SYSTEMS, EQUIPMENT AND CONTROLS TO BE PROVIDED UNDER THIS CONTRACT.

3.13 SEQUENCE OF OPERATION

A. ALL SYSTEMS PROVIDED UNDER THIS CONTRACT SHALL BE PROVIDED WITH COMPLETE CONTROLS FOR PROPER OPERATION AND PER THE SEQUENCES SPECIFIED. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE ALL CONTROLS ARE COMPATIBLE WITH CONTROLLED EQUIPMENT.

B. AIR CONDITIONING SYSTEMS: SHALL BE CONTROLLED VIA WALL-MOUNTED AUTOMATIC CHANGEOVER, PROGRAMMABLE COMBINATION THERMOSTAT AND HUMIDISTAT. THERMOSTAT SHALL BE ENERGY STAR LABELED AND SHALL HAVE THE MINIMUM FOLLOWING FEATURES: SYSTEM ON/OFF CONTROL, FAN ON/OFF/AUTO CONTROL, BACKLIT LCD SCREEN, TACTILE BUTTON OR TOUCHSCREEN INTERFACE, 7-DAY PROGRAMMING WITH 4 EVENTS PER DAY AND HOLIDAY SCHEDULING, SIMULTANEOUS SETPOINT AND SPACE TEMPERATURE DISPLAY, COMPRESSOR SHORT CYCLE PROTECTION, AUTOMATIC CHANGEOVER WITH SETPOINT CROSSOVER PROTECTION, THERMOSTAT SHUT CONTROL FAN(S), COMPRESSOR(S) AND HEATER(S) PER FACTORY-PROGRAMMED SEQUENCES TO MAINTAIN COOLING, HEATING AND HUMIDITY SETPOINTS.

- 1. SETPOINTS: OCCUPIED 75F COOL / 70F HEAT, UNOCCUPIED 85F COOL / 55F HEAT (ADJUSTABLE).
- 2. SUPPLY FAN: SHALL OPERATE WHEN THERE IS A CALL FOR COOLING, HEATING, OR DEHUMIDIFICATION ONLY, AND SHALL BE OFF AT ALL OTHER TIMES.
- 3. OUTSIDE AIR DAMPER: DURING NORMAL OPERATION, DAMPER SHALL BE OPEN TO NORMAL OA SETTING WHEN FAN IS ON AND CLOSED WHEN FAN IS OFF. DURING MORNING WARM-UP/COOL DOWN MODES, DAMPER SHALL BE CLOSED.
- 4. DEHUMIDIFICATION: CONTINUE COOLING OPERATION UNTIL HUMIDITY SETPOINT (55%RH, ADJUSTABLE) IS SATISFIED, OR UNTIL SPACE TEMPERATURE FALLS 2F (ADJ) BELOW COOLING SETPOINT.

C. EXHAUST FANS SERVING RESTROOMS: INTERLOCK EACH FAN WITH THE LIGHTS OF ALL RESTROOMS SERVED BY THE FAN TO TURN THE FAN ON WHENEVER ANY OF THE LIGHTS ARE ON AND TURN THE FAN OFF WHENEVER ALL OF THE LIGHTS ARE OFF.