

SECTION 20 05 00 - MECHANICAL AND PLUMBING GENERAL REQUIREMENTS

1.01 WORK INCLUDED

- A. THE WORK INCLUDED BY THIS DIVISION OF THE SPECIFICATIONS INCLUDES FURNISHING ALL LABOR, MATERIALS, EQUIPMENT, AND SERVICES, INCLUDING MINOR ITEMS OMITTED BUT NECESSARY TO CONSTRUCT AND INSTALL THE COMPLETE SYSTEMS DESCRIBED BY THE CONTRACT DOCUMENTS AND SPECIFIED HEREIN. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE MECHANICAL/PLUMBING CONTRACTOR THE GENERAL CONDITIONS OF THE SPECIFICATIONS APPLY AND ARE INCLUDED IN THIS PART OF THIS SECTION.

1.02 CODES AND REGULATIONS

- A. COMPLY WITH STATE AND LOCAL CODES, AND UTILITY COMPANY REGULATIONS. FINAL INTERPRETATIONS WILL BE MADE BY THE LOCAL INSPECTION AUTHORITY. THE CONTRACTOR TO VERIFY THE GOVERNANCE OF THE FOLLOWING CODES, INCLUDING ANY LOCAL AMENDMENTS AND SUPPLEMENTARY CODES SUCH AS THE NATIONAL FIRE PROTECTION ASSOCIATION:
- | 1. BUILDING CODE: | 2021 MICHIGAN BUILDING CODE |
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| 2. PLUMBING CODE: | 2021 MICHIGAN PLUMBING CODE |
| 3. MECHANICAL CODE: | 2021 MICHIGAN MECHANICAL CODE |
| 4. FIRE CODE: | 2021 INTERNATIONAL FIRE CODE |
| 5. GAS CODE: | 2020 INTERNATIONAL FUEL GAS CODE |
| 6. ENERGY CODE: | 2021 INTERNATIONAL ENERGY CONSERVATION CODE/ ASHRAE 90.1-2019 |
| 7. ELECTRICAL CODE: | 2023 MICHIGAN ELECTRICAL CODE |

1.03 QUALITY ASSURANCE

- A. PERFORM WORK TO AVOID INTERFERENCE WITH THE WORK OF OTHER TRADES. REMOVE AND RELOCATE WORK WHICH IN THE OPINION OF THE OWNER'S REPRESENTATIVES CAUSES INTERFERENCE.
- B. EQUIPMENT AND MATERIALS SHALL BE NEW, UL-LISTED FOR THE USE INTENDED, AND FREE FROM DAMAGE OR DEFECT. THEY SHALL COMPLY WITH THE LATEST INDUSTRY STANDARDS.
- C. PACKAGED EQUIPMENT SHALL BEAR ALL LABELS BY RECOGNIZED NATIONAL TESTING LABORATORY.
- D. PERFORM ALL TESTS AND INSPECTIONS REQUIRED BY AUTHORITIES HAVING JURISDICTION.
- E. ALL EQUIPMENT OR COMPONENTS OF THIS SPECIFICATION SECTION SHALL MEET OR EXCEED THE REQUIREMENTS AND QUALITY OF THE ITEMS HEREIN SPECIFIED, OR AS DEMOTED ON THE DRAWINGS.

1.04 CONTRACT DRAWINGS

- A. ILLUSTRATE THE GENERAL DESIGN AND EXTENT OF PERFORMANCE REQUIRED. ALL DIMENSIONS AND LOCATIONS SHALL BE TAKEN FROM THE ARCHITECTURAL DRAWINGS. CONSULT WITH ARCHITECTURAL PLANS AND LOCATE ALL CEILING EQUIPMENT WHERE INDICATED ON REFLECTED CEILING PLANS.
- B. DEVIATIONS FROM THE DRAWINGS, WITH THE EXCEPTION OF MINOR CHANGES IN ROUTING AND OTHER SUCH INCIDENTAL CHANGES THAT DO NOT AFFECT THE FUNCTIONING OR SERVICEABILITY OF THE SYSTEMS, SHALL NOT BE MADE WITHOUT THE WRITTEN APPROVAL OF THE ARCHITECT/ENGINEER.
- C. THE ARCHITECTURAL AND STRUCTURAL DRAWINGS TAKE PRECEDENCE IN ALL MATTERS PERTAINING TO THE BUILDING STRUCTURE. MECHANICAL DRAWINGS IN ALL MATTERS PERTAINING TO MECHANICAL TRADES AND ELECTRICAL DRAWINGS IN ALL MATTERS PERTAINING TO ELECTRICAL TRADES. WHERE THERE ARE CONFLICTS OR DIFFERENCES BETWEEN THE DRAWINGS FOR THE VARIOUS TRADES, REPORT SUCH CONFLICTS OR DIFFERENCES TO THE ARCHITECT/ENGINEER FOR RESOLUTION.
- D. DRAWINGS ARE NOT INTENDED TO SERVE AS SHOP DRAWINGS. TAKE ALL FIELD MEASUREMENTS REQUIRED TO COMPLETE THE WORK.

1.05 SHOP DRAWINGS

- A. SUBMIT PROJECT SPECIFIC SUBMITTALS FOR REVIEW IN COMPLIANCE WITH DIVISION 01.
- B. PREPARE SHOP DRAWINGS TO SCALE FOR THE ARCHITECT/ENGINEER FOR REVIEW. EQUIPMENT AND MATERIAL SUBMITTALS REQUIRED ARE INDICATED ON THE MECHANICAL, FIRE SUPPRESSION, PLUMBING, AND HEATING, VENTILATING AND AIR CONDITIONING SECTIONS.
- C. ALL SUBMITTALS SHALL BE SUBMITTED IN GROUPINGS OF SIMILAR AND/OR RELATED ITEMS.
- D. SHOP DRAWINGS SHALL BE REVIEWED BY THE MECHANICAL CONTRACTOR FOR COMPLETENESS AND ACCURACY PRIOR TO SUBMITTING TO THE ARCHITECT/ENGINEER FOR REVIEW. THE SHOP DRAWINGS SHALL BE DATED AND SIGNED BY THE MECHANICAL CONTRACTOR PRIOR TO SUBMISSION.
- E. SUBMITTALS MUST BE JOB SPECIFIC AND NOT GENERIC IN NATURE.
- F. NO EQUIPMENT SHALL BE SHIPPED FROM STOCK OR FABRICATED UNTIL SHOP DRAWINGS FOR THEM HAVE BEEN REVIEWED BY THE ARCHITECT/ENGINEER.
- G. BY THE REVIEW OF SHOP DRAWINGS, THE ARCHITECT/ENGINEER DOES NOT ASSUME RESPONSIBILITY FOR ACTUAL DIMENSIONS OR FOR THE FIT OF COMPLETED WORK IN POSITION, NOR DOES SUCH REVIEW RELIEVE MECHANICAL TRADES OF FULL RESPONSIBILITY FOR THE PROPER AND CORRECT EXECUTION OF THE WORK REQUIRED.
- H. CONTRACTOR IS RESPONSIBLE FOR:
- DIMENSIONS, WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOB SITE.
 - FABRICATION PROCESSES AND TECHNIQUES OF CONSTRUCTION.
 - QUANTITIES.
 - COORDINATION OF CONTRACTOR'S WORK WITH ALL OTHER TRADES.
 - SATISFACTORY PERFORMANCE OF CONTRACTOR'S WORK.
 - TEMPORARY ASPECTS OF THE CONSTRUCTION PROCESS.
 - PROVIDE DETAILED SHOP DRAWINGS OF PIPING SYSTEMS SHOWING PIPE ROUTING AND TYPES AND LOCATIONS OF ALL PIPE HANGERS.
- I. IF DEVIATIONS (NOT SUBSTITUTIONS) FROM CONTRACT DOCUMENTS ARE DEEMED NECESSARY BY THE CONTRACTOR, DETAILS OF SUCH DEVIATIONS, INCLUDING CHANGES IN RELATED PORTIONS OF THE PROJECT AND THE REASONS THEREFORE, SHALL BE SUBMITTED WITH THE SUBMITTAL FOR APPROVAL.
- J. MANUFACTURERS NOT LISTED MAY SUBMIT FOR ACCEPTANCE AS AN "APPROVED EQUAL." REQUESTS FOR AN "EQUIVALENT" MEANS "APPROVED EQUIVALENT." FOUR COPIES OF SUCH SUBMITTALS MUST BE RECEIVED BY THE ENGINEER SEVEN (7) WORKING DAYS PRIOR TO BID DATE.
- THE TERMS "APPROVED," "APPROVED EQUAL," AND "EQUAL" REFER TO APPROVAL BY THE ARCHITECT OR ENGINEER AS AN ACCEPTABLE ALTERNATE BID. NO SUBSTITUTIONS WILL BE CONSIDERED THAT ARE NOT BID AS AN ALTERNATE. NO MATERIAL SUBSTITUTIONS SHALL BE CONSIDERED FOR APPROVAL PRIOR TO AWARD OF CONTRACT.
 - COORDINATE AND VERIFY WITH OTHER TRADES WHETHER OR NOT THE SUBSTITUTED EQUIPMENT CAN BE INSTALLED AS SHOWN ON THE CONSTRUCTION DRAWINGS WITHOUT MODIFICATION TO ASSOCIATED SYSTEMS OR ARCHITECTURAL OR ENGINEERING DESIGN. INCLUDE ADDITIONAL COSTS FOR ARCHITECTURAL AND ENGINEERING DESIGN FEES IN BID IF DRAWING MODIFICATIONS ARE REQUIRED BECAUSE OF SUBSTITUTED EQUIPMENT.

1.06 WARRANTY

- A. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE SUCCESSFUL OPERATION OF MECHANICAL SYSTEMS, EQUIPMENT, AND MATERIALS INSTALLED UNDER THIS CONTRACT FOR A PERIOD OF ONE YEAR FROM THE DATE OF FINAL ACCEPTANCE UNLESS SPECIFIC ITEMS ARE NOTED TO CARRY A LONGER WARRANTY IN THE CONSTRUCTION DOCUMENTS OR MANUFACTURERS STANDARDS.
- WARRANTY EXCEEDS ONE YEAR - WARRANTY EACH SYSTEM AND EACH ELEMENT THEREOF AGAINST ALL DEFECTS DUE TO FAULTY WORKMANSHIP, DESIGN OR MATERIAL. DEFECTIVE EQUIPMENT OR MATERIALS SHALL BE REPAIRED OR REPLACED AT NO EXPENSE TO THE OWNER. PROVIDE FOUR COMPLETE SERVICE AND MAINTENANCE CALLS SPACED AT EQUAL INTERVALS DURING THE WARRANTY PERIOD.
- WARRANTIES SHALL INCLUDE LABOR AND MATERIAL. MAKE REPAIRS OR REPLACEMENTS WITHOUT ANY ADDITIONAL COSTS TO THE OWNER.
- C. AT THE TIME OF FINAL ACCEPTANCE, DELIVER TO THE OWNER ALL WARRANTIES, IN WRITING AND PROPERLY EXECUTED, INCLUDING TERM LIMITS FOR WARRANTIES EXTENDING BEYOND THE ONE YEAR PERIOD, EACH WARRANTY INSTRUMENT BEING ADDRESSED TO THE OWNER AND STATING THE COMMENCEMENT DATE AND TERM.

1.07 DELIVERY, PRODUCT HANDLING, AND CLEAN UP

- A. DELIVER MATERIALS TO THE SITE IN SUCH A MANNER AS TO PROTECT THE MATERIALS FROM SHIPPING AND HANDLING DAMAGE. PROVIDE MATERIALS ON FACTORY PROVIDED SHIPPING SKIDS AND LIFTING LUGS IF REQUIRED FOR HANDLING. MATERIALS DAMAGED BY THE ELEMENTS SHOULD BE PACKAGED IN SUCH A MANNER THAT THEY COULD WITHSTAND SHORT-TERM EXPOSURE TO THE ELEMENTS DURING TRANSPORTATION.
- B. STORE MATERIALS IN CLEAN, UNDAUNAGED, DRY PLACE AND PROTECT FROM WEATHER AND CONSTRUCTION TRAFFIC. HANDLE CAREFULLY TO AVOID DAMAGE. THE GENERAL CONDITIONS TAKE PRECEDENCE.
- C. USE ALL MEANS NECESSARY TO PROTECT EQUIPMENT BEFORE, DURING, AND AFTER INSTALLATION.
- D. ALL SCRATCHED, DENTED, AND OTHERWISE DAMAGED UNITS SHALL BE REPAIRED OR REPLACED AS DIRECTED BY THE ARCHITECT/ENGINEER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF THE MATERIALS AND EQUIPMENT FROM DAMAGE DURING THE CONSTRUCTION PERIOD.
- E. KEEP JOBSITE CLEAN AND TIDY ALLOWING OTHER TRADES TO CONTINUE WORK.

1.08 OPERATING AND MAINTENANCE DATA

- A. PROVIDE THE OPERATING AND MAINTENANCE INSTRUCTIONS (FOUR COPIES) REQUIRED FOR OPERATION OF ALL MECHANICAL SYSTEMS. BIND THE WRITTEN INSTRUCTIONS IN A NOTEBOOK. THE GENERAL CONDITIONS TAKE PRECEDENCE. THE MANUALS SHALL INCLUDE THE FOLLOWING ITEMS:
- OPERATING MANUAL AND SPARE PARTS LIST FOR EACH PIECE OF EQUIPMENT.
 - PREVENTIVE MAINTENANCE SCHEDULE FOR LUBRICATING AND CHECKING EACH PIECE OF EQUIPMENT.
 - INSTRUCTIONS ON WHO TO CALL FOR SERVICE DURING THE WARRANTY PERIOD.

1.09 PERMITS

- A. THE CONTRACTOR SHALL PAY FOR ALL FEES, TAXES, SECURE PERMITS, LICENSES, AND INSPECTIONS REQUIRED FOR THE PROJECT.
- B. RULES OF LOCAL UTILITY COMPANIES SHALL BE COMPLIED WITH. CHECK WITH EACH UTILITY COMPANY SUPPLYING SERVICE TO THE INSTALLATION AND DETERMINE ALL DEVICES INCLUDING, BUT NOT LIMITED TO, ALL VALVES, METER BOXES, AND METERS WHICH WILL BE REQUIRED AND INCLUDE THE COST OF ALL SUCH ITEMS IN PROPOSAL.

1.10 TEMPORARY SERVICES

- A. PROVIDE TEMPORARY WATER SERVICE FOR CONSTRUCTION, AS REQUIRED BY THE GENERAL CONTRACTOR.

1.11 COORDINATION

- A. COORDINATE OUTLET DEVICE AND EQUIPMENT LOCATIONS WITH THE ARCHITECTURAL PLANS AND WORK OF OTHER TRADES. LOCATE ON HORIZONTAL AND VERTICAL LINES TO AVOID INTERFERENCE AND TO PROVIDE FUNCTIONAL USE OF ALL EQUIPMENT. VERIFY ELECTRICAL POWER CHARACTERISTICS BEFORE ORDERING EQUIPMENT.
- B. THE GENERAL GUIDELINE FOR THE DIVISION BETWEEN CONTROL (BY MC) WIRING AND POWER WIRING (BY EC) IS THAT POWER WIRING CARRIES THE CURRENT WHICH ENERGIZES A MOTOR, CONTROL, WIRING DOES NOT. CONTROL WIRING MAY BE 120V, WHICH WOULD BE THE RESPONSIBILITY OF THE MC. CONTROL MOTORS ARE WIRED BY THE MC.
- C. FURNISH WIRING DIAGRAMS TO THE ELECTRICAL CONTRACTOR AS REQUIRED FOR PROPER EQUIPMENT HOOKUP. COORDINATE WITH THE ELECTRICAL CONTRACTOR THE ACTUAL WIRE SIZING AMPS FOR MECHANICAL EQUIPMENT (FROM THE EQUIPMENT NAMEPLATE) TO ENSURE PROPER INSTALLATION.
- D. EXAMINE THE SITE AND BECOME AWARE OF EXISTING CONDITIONS, UTILITIES, AND OTHER ISSUES AFFECTING THE SATISFACTORY COMPLETION OF THE PROJECT.
- E. ELECTRICAL WORK PERFORMED BY THIS CONTRACTOR WILL CONFORM TO THE STANDARDS OF DIVISION 26-28. MECHANICAL EQUIPMENT MOTORS AND CONTROLS SHALL BE FURNISHED, SET IN PLACE, AND WIRED ACCORDING WITH THE FOLLOWING SCHEDULE UNLESS OTHERWISE NOTED OR SPECIFIED. MC - DIVISION 21-23 EC - DIVISION 26-28

ITEM	FURN	SET	POWER	CONTROL
COMBINATION STARTERS	MC	EC	EC	MC
EQUIPMENT MOTORS	MC	EC	EC	MC
MOTOR STARTERS & O.L. RELAYS	MC	EC	EC	MC
DISCONNECT SWITCHES	EC	EC	EC	MC
THERMAL OVERLOAD HEATERS (1)	EC	EC	EC	MC
VARIABLE SPEED DRIVES	MC	EC	EC	MC
CONTROL RELAYS/TRANSFORMERS	MC	MC	EC	MC
TEMPERATURE CONTROL PANELS	MC	MC	EC	MC
TEMP. CONTROLS CONTROL WIRING	MC	MC	-	MC
COPPER TUBE AND SOLDER WIRE	MC	MC	-	MC
PUSHBUTTONS & PILOT LIGHTS	MC	MC	-	MC
THERMOSTATS	MC	MC	-	MC
THERMOSTATS: LINE VOLTAGE	EC	EC	EC	-

1.12 ELECTRICAL

- A. LUGS: LUGS FOR WIRING CONNECTIONS SHALL BE RATED FOR COPPER AND ALUMINUM. NAD SHALL HAVE A MINIMUM RATING OF 75C.
- B. ELECTRIC MOTORS: MOTORS SHALL BE RATED FOR THE APPROPRIATE APPLICATION: WET LOCATION (TEFC), SUBMERSIBLE, EXPLOSION PROOF, VFD'S, ETC.
- C. ALL LOW VOLTAGE CONTROL WIRING (24 VOLT) SHALL BE IN CONDUIT AND IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND ALL STATE AND LOCAL CODES AND ORDINANCES AND SHALL BE DONE BY THIS HVAC CONTRACTOR.

1.13 DELIVERY, STORAGE, HANDLING

- A. PROVIDE NECESSARY HANDLING AND HOISTING EQUIPMENT. PROTECT THE MATERIALS OF THIS DIVISION BEFORE, DURING, AND AFTER INSTALLATION.

1.14 AS-BUILT DRAWINGS

- A. KEEP A CURRENT SET OF "AS-BUILT" DRAWINGS ON SITE. UPON COMPLETION OF THE WORK, FURNISH ENGINEER WITH A REPRODUCIBLE PRINTS SHOWING THE "AS-BUILT" INSTALLATION.

1.15 PROJECT SITE CONDITIONS

- A. VISIT THE SITE, EXAMINE, AND VERIFY THE CONDITIONS UNDER WHICH THE WORK MUST BE CONDUCTED BEFORE SUBMITTING PROPOSAL. THE SUBMITTING OF A PROPOSAL IMPLIES THAT THE CONTRACTOR HAS VISITED THE SITE AND UNDERSTANDS THE CONDITIONS UNDER WHICH THE WORK MUST BE CONDUCTED. NO ADDITIONAL CHARGES OR TIME EXTENSIONS WILL BE ALLOWED BECAUSE OF FAILURE TO MAKE THIS EXAMINATION OR TO INCLUDE ALL MATERIALS AND LABOR TO COMPLETE THE WORK.

1.16 PLAN VERIFICATION

- A. AFTER COMPLETION OF THE BIDDING AND SELECTION PROCESS, PRIOR TO AWARDING THE CONTRACT, THE CONTRACTOR MUST REVIEW AND VERIFY THE CONTRACT DOCUMENTS IN THEIR ENTIRETY, INCLUDING THOSE OF OTHER TRADES. AT THIS TIME, DISCREPANCIES, CONFLICTS, OMISSIONS, ETC. IN THE CONTRACT DOCUMENTS MUST BE DOCUMENTED. ALTERATIONS TO THE CONTRACT SHALL BE MADE AT THAT TIME TO INCLUDE SUCH ITEMS AS WELL AS OTHER MODIFICATIONS WHICH MIGHT BE MADE BY THE OWNER, AFTER AWARD OF THE CONTRACT, CHANGE ORDERS CAUSED BY DISCREPANCIES, CONFLICTS, OMISSIONS IN THE CONTRACT DOCUMENTS WILL NOT BE ALLOWED.

1.17 INSTRUCTION OF OWNER PERSONNEL

- A. AT A TIME MUTUALLY AGREED UPON BETWEEN THE OWNER AND CONTRACTOR, PROVIDE THE SERVICES OF A FACTORY TRAINED AND AUTHORIZED REPRESENTATIVE TO TRAIN OWNER'S DESIGNATED PERSONNEL ON THE OPERATION AND MAINTENANCE OF THE EQUIPMENT PROVIDED FOR THIS PROJECT. PROVIDE TRAINING TO INCLUDE, BUT NOT BE LIMITED TO, AN OVERVIEW OF THE SYSTEM AND/OR EQUIPMENT AS IT RELATES TO THE FACILITY AS A WHOLE, OPERATION AND MAINTENANCE PROCEDURES AND SCHEDULES RELATED TO STARTUP AND SHUTDOWN, TROUBLESHOOTING, SERVICING, PREVENTIVE MAINTENANCE, AND APPROPRIATE OPERATOR INTERVENTION, AND REVIEW OF DATA INCLUDED IN THE OPERATION AND MAINTENANCE MANUALS.
- B. SUBMIT A CERTIFICATION LETTER TO THE ARCHITECT STATING THAT THE OWNER'S DESIGNATED REPRESENTATIVE HAS BEEN TRAINED AS SPECIFIED HEREIN. LETTER SHALL INCLUDE DATE, TIME, ATTENDEES AND SUBJECT OF TRAINING. THE CONTRACTOR AND THE OWNER'S REPRESENTATIVE SHALL SIGN THE CERTIFICATION LETTER INDICATING AGREEMENT THAT THE TRAINING HAS BEEN PROVIDED.
- C. SCHEDULE OWNER TRAINING WITHIN AT LEAST 7 DAYS ADVANCE NOTICE.

1.18 HVAC USE DURING CONSTRUCTION

- A. HVAC EQUIPMENT SHALL NOT BE USED DURING CONSTRUCTION AS A MEANS TO HEAT OR COOL THE SPACE. UNLESS SPECIFIC APPROVAL IS GIVEN BY THE OWNER. IF SUCH EQUIPMENT IS USED, IT MUST BE COMPLETELY CLEANED AND REPAIRED AS NECESSARY. CLEANING INVOLVES REPLACING ALL FILTERS, CLEANING ALL COILS AND HEAT EXCHANGERS, INSPECTING FANS, PLENUMS, AND DUCTWORK AND CLEANING AS DIRECTED BY THE OWNER.
- B. IF HVAC EQUIPMENT IS USED DURING THE CONSTRUCTION PERIOD, THIS CONTRACTOR SHALL PROVIDE MINIMUM MEV'S FILTERS OR FILTRATION MEDIA OVER ANY RETURN AIR GRILLES AND OPEN RETURN AIR DUCT WORK FOR THE DURATION OF THE CONSTRUCTION PERIOD. CONTRACTOR SHALL PROVIDE ONE SET OF FILTERS WHEN THE UNIT IS STARTED AND REPLACE FILTERS AS NEEDED, BUT NOT LESS THAN EVERY FOUR WEEKS.
- C. ON THE DAY OF SUBSTANTIAL COMPLETION, THE CONTRACTOR SHALL CLEAN THE UNIT AND PROVIDE A NEW SET OF FILTERS IN THE UNIT.

1.19 REFRIGERANT AND OIL

- A. PROVIDE FULL REFRIGERANT AND OIL CHARGE IN NEW AIR CONDITIONING REFRIGERATION SYSTEMS, AND MAINTAIN IT FOR FULL TERM OF THE GUARANTEE.
- B. ALL NEW MECHANICAL EQUIPMENT SHALL UTILIZE R-410A.
- C. DISPOSURE OF RECOVERED REFRIGERANT LEGALLY, IN ACCORDANCE WITH APPLICABLE RULES AND REGULATIONS.

2.07 MATERIALS AND EQUIPMENT

- A. PROVIDE NECESSARY EQUIPMENT, PIPING, DUCTWORK, AND ACCESSORIES THAT ARE NOT PROVIDED BY THE EQUIPMENT SUPPLIER OR OWNER TO COMPLETE INSTALLATION OF EQUIPMENT FURNISHED BY OTHERS' EXISTING EQUIPMENT IN LOCATIONS AS INDICATED ON THE DRAWINGS AND/OR DESCRIBED IN THE GENERAL NOTES TO THIS CONTRACTOR. EQUIPMENT AND ACCESSORIES NOT PROVIDED BY THE EQUIPMENT SUPPLIER MAY INCLUDE CONDENSATE DRAINS, FLUES, VENTS, INTAKES, ASSOCIATED ROOF JACKS AND CAPS TO EXTERIOR, DAMPERS, INLINE FANS, ROOF FANS, CONTROL INTERLOCKS, ETC. AS REQUIRED FOR PROPER OPERATION OF THE COMPLETE SYSTEM IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.
- B. CONTRACTOR SHALL BE RESPONSIBLE FOR CORRECT ROUGH-IN DIMENSIONS AND SHALL VERIFY SAME WITH ARCHITECT AND/OR EQUIPMENT SUPPLIER PRIOR TO SERVICE INSTALLATIONS.
- C. IF AN APPROVED MANUFACTURER IS OTHER THAN THE MANUFACTURER USED AS THE BASIS FOR DESIGN, THE EQUIPMENT OR PRODUCT PROVIDED SHALL BE EQUAL IN SIZE, QUALITY, DURABILITY, APPEARANCE, CAPACITY, AND EFFICIENCY THROUGH ALL RANGES OF OPERATION. SHALL CONFORM WITH ARRANGEMENTS AND SPACE LIMITATIONS OF THE EQUIPMENT SHOWN ON THE PLANS AND/OR SPECIFIED, SHALL BE COMPATIBLE WITH THE OTHER COMPONENTS OF THE SYSTEM AND SHALL COMPLY WITH THE REQUIREMENTS FOR ITEMS REQUIRING PRIOR APPROVAL SPECIFIED IN THE SPECIFICATION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF THE MATERIALS AND EQUIPMENT FROM DAMAGE DURING THE CONSTRUCTION PERIOD.
- D. CHANGES INVOLVING ELECTRICAL WORK: THE DESIGN OF THE MECHANICAL SYSTEMS IS BASED ON THE EQUIPMENT SPECIFIED ON THE DRAWINGS. EQUIPMENT OF HIGHER ELECTRICAL CHARACTERISTICS MAY BE FURNISHED PROVIDED SUCH PROPOSED EQUIPMENT IS APPROVED IN WRITING AND CONNECTING ELECTRICAL SERVICES, CIRCUIT BREAKERS, AND CONDUIT SIZES ARE APPROPRIATELY MODIFIED WITH NO ADDITIONAL COST TO PROJECT. IF MINIMUM ENERGY RATINGS OR EFFICIENCIES ARE NOT MET, THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF THE MATERIALS AND EQUIPMENT FROM DAMAGE DURING THE CONSTRUCTION PERIOD.
- E. WHERE EQUIPMENT CHANGES ARE MADE THAT INVOLVE ADDITIONAL ELECTRICAL WORK (LARGER SIZE MOTOR, ADDITIONAL WIRING OF EQUIPMENT, ETC.) THE MECHANICAL TRADES INVOLVED SHALL COMPENSATE THE ELECTRICAL TRADES FOR THE COST OF THE ADDITIONAL WORK REQUIRED.

SECTION 20 05 10 - MECHANICAL AND PLUMBING BASIC MATERIALS AND METHODS

2.01 GENERAL

- A. COMPLY WITH REQUIREMENTS IN PUBLIC LAW 111-380, "REDUCTION OF LEAD IN DRINKING WATER ACT," ABOUT LEAD CONTENT IN MATERIALS THAT WILL BE IN CONTACT WITH POTABLE WATER FOR HUMAN CONSUMPTION.
- B. COMPLY WITH SECTION 15.01, "PLASTICS PIPING SYSTEM COMPONENTS AND RELATED MATERIALS," FOR PLASTIC, POTABLE DOMESTIC WATER PIPING AND COMPONENTS. INCLUDE MARKING "NSF-PW" ON PIPING.
- C. COMPLY WITH NSF 61, "DRINKING WATER SYSTEM COMPONENTS - HEALTH EFFECTS, SECTIONS 1 THROUGH 9," FOR POTABLE DOMESTIC WATER PIPING AND COMPONENTS.
- D. COMPLY WITH NSF 372, "DRINKING WATER SYSTEM COMPONENTS - LEAD CONTENT" FOR POTABLE DOMESTIC WATER PIPING AND COMPONENTS.
- E. STEEL SUPPORT WELDING: QUALIFY PROCESSES AND OPERATORS ACCORDING TO AWS D1.1, "STRUCTURAL WELDING CODE - STEEL."
- F. STEEL PIPE WELDING: QUALIFY PROCESSES AND OPERATORS ACCORDING TO ASME BOILER AND PRESSURE VESSEL CODE: SECTION IX, "WELDING AND BRAZING QUALIFICATIONS." COMPLY WITH PROVISIONS IN ASME B31 SERIES, "CODE FOR PRESSURE PIPING." CERTIFY THAT EACH WELDER HAS PASSED QUALIFICATION TESTS FOR WELDING PROCESSES INVOLVED AND THAT CERTIFICATION IS CURRENT.
- G. BRAZING: QUALIFY PROCESSES AND OPERATORS ACCORDING TO ASME BOILER AND PRESSURE VESSEL CODE: SECTION IX, "WELDING AND BRAZING QUALIFICATIONS," OR AWS B2.2, "STANDARD FOR BRAZING PROCEDURE AND PERFORMANCE QUALIFICATION."
- H. SOLDERING: QUALIFY PROCESSES AND OPERATORS ACCORDING TO AWS B2.3/2.3M, "SPECIFICATION FOR SOLDERING PROCEDURE AND PERFORMANCE QUALIFICATION."

2.01 JOINING MATERIALS

- A. UNIONS: PIPE SIZE 2 INCHES AND SMALLER:
- FERROUS PIPE: MALLEABLE IRON GROUND JOINT TYPE UNIONS.
 - UNIONS IN GALVANIZED PIPING SYSTEM SHALL BE GALVANIZED.
- B. COPPER TUBE AND SOLDER WIRE: USE COPPER UNIONS WITH SOLDERED JOINTS.
- C. FLANGES: PIPE SIZES 2-1/2 INCH AND LARGER:
- FERROUS PIPE: STANDARD WEIGHT, FORGED STEEL WELD NECK FLANGES.
 - COPPER TUBE AND PIPE: SLIP-ON BRONZE FLANGES.
- D. PIPE-FLANGE GASKET MATERIALS: SUITABLE FOR CHEMICAL AND THERMAL CONDITIONS OF PIPING SYSTEM CONTENTS.
- E. DIELECTRIC CONNECTIONS: UNION WITH GALVANIZED OR PLATED STEEL THREADED END, COPPER SOLDER END, WATER IMPERVIOUS ISOLATION BARRIER, PROVIDE NON-CONDUCTING DIELECTRIC CONNECTIONS WHEREVER JOINING DISSIMILAR METALS.
- F. FLANGE BOLTS AND NUTS: ASME B18.2.1, CARBON STEEL, UNLESS OTHERWISE INDICATED. SQUARE HEAD BOLTS AND NUTS ARE NOT ACCEPTABLE.
- G. FILLER METALS: ASME B9.2, LEAD-FREE, ANTIMONY-FREE, SILVER-BEARING ALLOYS.
- H. INCLUDE WATER-FLUSHABLE FLUX ACCORDING TO ASTM B 813.
- I. BRAZING FILLER METALS: ALLOYS MEETING AWS A5.8.
- USE TYPE BCUP SERIES, SILVER-BEARING, COPPER-PHOSPHORUS ALLOYS FOR JOINING COPPER OR BRASS SOLDER JOINT FITTINGS WITH COPPER PIPE. FLUX IS PROHIBITED UNLESS USED WITH BRONZE FITTINGS.
 - USE TYPE BAG SERIES, CADMIUM-FREE SILVER ALLOYS FOR JOINING COPPER WITH STEEL, STAINLESS STEEL, OR OTHER FERROUS ALLOYS.
- J. WELDING FILLER METALS: COMPLY WITH AWS D12.1/D12.1M FOR WELDING MATERIALS. PROVIDE DRIP PROOF ENCLOSURE FOR LOCAL WELDING TRANSITION: ASTM F 2138.
- K. WELDING MATERIALS: COMPLY WITH SECTION II, PART C, OF ASME BOILER AND PRESSURE VESSEL CODE FOR WELDING MATERIALS APPROPRIATE FOR WALL THICKNESS AND FOR CHEMICAL ANALYSIS OF PIPE BEING WELDED.
- L. SOLVENT CEMENTS FOR JOINING PVC PIPING: ASTM D 2564. INCLUDE PRIMER ACCORDING TO ASTM F 666.
- M. SOLVENT CEMENTS FOR JOINING CPVC PIPING AND TUBING: ASTM F 493.
- N. SOLVENT CEMENTS FOR JOINING ABS PIPING: ASTM D 2208.
- O. SOLVENT CEMENT FOR JOINING PVC WITH ABS PIPING: TRANSITION: ASTM D 2138.
- P. PIPE THREAD COMPOUND FOR NATURAL GAS: USE TETRAFLUOROETHYLENE (TEFLON) TAPE 2 TO 3 MILS THICK.
- Q. PIPE THREAD COMPOUND FOR STEEL PIPE: INORGANIC ZINC-RICH COATINGS OR CORROSION INHIBITED PROPRIETARY COMPOUND.

2.02 MOTORS AND STARTERS

- A. PROVIDE MOTORS AND STARTING EQUIPMENT WHERE NOT FURNISHED WITH THE EQUIPMENT PACKAGE. MOTORS SHALL HAVE COPPER WINDINGS, CLASS B INSULATION, AND STANDARD SQUIRREL CAGE WITH STARTING TORQUE CHARACTERISTICS SUITABLE FOR THE EQUIPMENT SERVED. MOTORS FOR AIR HANDLING EQUIPMENT SHALL BE SELECTED FOR QUIET OPERATION. EACH MOTOR SHALL BE CHECKED FOR PROPER ROTATION AFTER ELECTRICAL CONNECTION HAS BEEN COMPLETED. PROVIDE DRIP-PROOF ENCLOSURE FOR LOCATION PROTECTED FROM WEATHER AND NOT IN AIR STREAM OF FAN AND TOTALLY ENCLOSED FAN-COOLED ENCLOSURE FOR MOTORS EXPOSED TO WEATHER. MOTORS SHALL BE MANUFACTURED BY CENTURY, GENERAL ELECTRIC, WESTINGHOUSE, LOUIS-ALLIS OR APPROVED EQUAL.
- B. QUALITY HANGER SPACING: COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," TABLE 5-1 (TABLE 5-1M), "RECTANGULAR DUCT HANGERS MINIMUM SIZE," AND TABLE 5-2, "MINIMUM HANGER SIZES FOR ROUND DUCT," FOR MAXIMUM HANGER SPACING. INSTALL HANGERS AND SUPPORTS WITHIN 24 INCHES OF EACH ELBOW AND WITHIN 48 INCHES OF EACH BRANCH INTERSECTION.

2.03 ACCESS PANELS

- A. THE MECHANICAL CONTRACTOR SHALL FURNISH AND GENERAL CONTRACTOR SHALL INSTALL. SIZED PANELS WHERE REQUIRED FOR ACCESS TO EQUIPMENT. THE MECHANICAL CONTRACTOR SHALL INCLUDE THE COST OF INSTALLATION IN HIS BID. ACCESS PANELS SHALL BE ADEQUATELY GRESSED, OF A TYPE APPROVED BY THE ARCHITECT AND SHALL BE FIRE OR SMOKE-RATED AS REQUIRED. ACCESS PANELS SHALL BE MINIMUM 18"X18".

2.04 STRUCTURAL STEEL

- A. STRUCTURAL STEEL USED FOR SUPPORT OF EQUIPMENT, DUCTWORK AND PIPING SHALL BE NEW, CLEAN AND CONFORM TO ASTM DESIGNATION A-36.
- B. SUBMIT MECHANICAL COMPONENTS FROM THE BUILDING STRUCTURE. DO NOT SUPPORT MECHANICAL COMPONENTS ON OTHER MECHANICAL OR ELECTRICAL COMPONENTS, NOR OTHER NON-STRUCTURAL ELEMENTS.

2.05 PENETRATIONS AND SLEEVES

- A. SLEEVE SEAL SYSTEMS SHALL INCLUDE MODULAR SEALING-ELEMENT DESIGNED FOR FIELD ASSEMBLY FOR FILLING AN ANNULAR SPACE BETWEEN PIPE AND SLEEVE. SEAL SHALL BE DESIGNED FOR HYDROSTATIC PRESSURE OF 20 PSIG. SEAL SHALL BE MADE OF EPDM-RUBBER WITH INTERLOCKING SANKS AND GROOVES FOR GASKET. PRESSURE PLATES SHALL BE MADE OF STAINLESS STEEL WITH STAINLESS STEEL CONNECTING BOLTS AND NUTS. APPROVED MANUFACTURE ARE METAFLEX, CALPICO, PIPELINE SEAL AND INSULATOR.
- B. PIPE SLEEVES SHALL BE STEEL PIPE IN ACCORDANCE WITH ASTM A 53, TYPE E, GRADE B, SCHEDULE 40 WITH PLAIN ENDS AND INTERIOR WELDED WATERSTOP COLLAR.
- C. SEAL ELEVATED FLOORS, EXTERIOR WALL AND ROOF PENETRATIONS WEATHERTIGHT AND WEATHERTIGHT WITH NON-SHRINK, NON-HARDENING COMMERCIAL SEALANT. PACK WITH MINERAL WOOL AND SEAL BOTH ENDS WITH MINIMUM OF 1/2" OF SEALANT. SEAL AROUND PENETRATIONS OF FIRE-RATED ASSEMBLIES. COORDINATE FIRE RATINGS AND LOCATIONS WITH THE ARCHITECTURAL DRAWINGS. REFER TO STANDARD PENETRATION DETAILS.
- D. INSTALL SLEEVES IN CONCRETE FLOORS, WALLS, ROOFS AS THEY ARE CONSTRUCTED. CUT SLEEVES TO LENGTH FOR MOUNTING FLUSH. EXTEND SLEEVES IN MECHANICAL ROOM FLOORS OR AREAS FIRE IS SUBJECT TO DAMAGE 2 INCHES ABOVE FINISHED FLOOR.

2.06 FIRE STOPPING

- A. SEAL OPENINGS OF FIRE RATED CONSTRUCTION WITH A MATERIAL OR PRODUCT THAT HAS BEEN TESTED AT AN INDEPENDENT TESTING LABORATORY SUCH AS UL OR FM. FIRE STOPPING SHALL CONFORM TO ASTM E-814, UL-1479 OR UL-2079. PRODUCTS SHALL BE SIMILAR TO RECTORSOL METACAUK, 3M BRAND FIRE BARRIER PENETRATION SEALING SYSTEMS, OR HILTI.

2.08 SPARE PARTS

- A. CONTRACTOR SHALL PROVIDE TO THE OWNER, WITH RECEIPT, THE FOLLOWING SPARE PARTS FOR THE EQUIPMENT INSTALLED FOR THIS PROJECT:
- ONE SET OF SPARE FILTERS OF EACH TYPE REQUIRED FOR EACH UNIT. IN ADDITION TO THE SPARE FILTERS, INSTALL NEW FILTERS PRIOR TO TESTING, ADJUSTING AND BALANCING ROLLER FOR ROOF INSTALLATION WITHOUT MEMBRANE PENETRATION.
 - ONE COMPLETE SET OF BELTS FOR EACH FAN.
 - THREE OPERATING KEYS FOR EACH TYPE OF AIR OUTLET AND INLET THAT REQUIRE THEM.

2.09 LOW EMITTING MATERIALS

- A. ALL SEALANTS & ADHESIVES REQUIRED FOR THE INSTALLATION OF MECHANICAL & PLUMBING SYSTEM WITHIN THE BUILDING ENVELOPE SHALL MEET THE REQUIREMENTS FOR LOW EMITTING MATERIALS AS SET FORTH IN THE SOUTHERN CALIFORNIA AIR QUALITY MANAGEMENT DISTRICT (SCAQMD) RULE #118 (OR LATEST NEW CONSTRUCTION REQUIREMENTS), WHICH INCLUDES BUT IS NOT LIMITED TO:
- METAL TO METAL ADHESIVE: VOC LIMIT OF 30G/L
 - FIBERGLASS ADHESIVE: VOC LIMIT OF 80G/L
 - MULTIPURPOSE CONSTRUCTION ADHESIVE: VOC LIMIT OF 70 G/L

3.01 UTILITIES AND PROTECTION OF SERVICES

- A. DO NOT INTERRUPT AND UTILITY OR SERVICE WITHOUT ADEQUATE NOTICE AND SCHEDULE. THE CONTRACTOR SHALL, AT OWNERS EXPENSE, REPAIR, REPLACE, AND MAINTAIN IN SERVICE ANY UTILITIES DAMAGED OR BROKEN OR OTHERWISE RENDERED INOPERATIVE DURING THE COURSE OF CONSTRUCTION.

3.02 PROTECTION DURING CONSTRUCTION

- A. PLUMBING FIXTURES, TRIM AND OTHER EQUIPMENT SHALL BE PROTECTED AGAINST DAMAGE OR INJURY. ALL FIXTURES AND EQUIPMENT DAMAGED BY ANY CAUSE AND ANY TRIM WITH MARRED OR SCRATCHED FINISH SHALL BE REPLACED AT NO ADDITIONAL COST TO THE OWNER. THE FIXTURE PROTECTION SHALL BE REMOVED AT THE COMPLETION OF THE WORK OR FOR FINAL INSPECTION.

3.03 EXCAVATION AND BACKFILLING

- A. PERFORM EXCAVATION AND BACKFILL REQUIRED FOR INSTALLATION OF UNDERGROUND WORK UNDER THIS CONTRACT. TRENCHES SHALL BE OF SUFFICIENT WIDTH. ORIB OR BRACE TRENCHES TO PREVENT CAVE-IN OR SETTLEMENT. DO NOT EXCAVATE TRENCHES CLOSE TO COLUMNS AND WALLS OF NEW BUILDING WITHOUT PRIOR CONSULTATION WITH THE ARCHITECT. USE PUMPING EQUIPMENT IF REQUIRED TO KEEP TRENCHES FREE OF WATER. BACKFILL TRENCHES IN MAXIMUM 12" LIFTS. EXCAVATION SHALL BE BACKFILLED WITH DRY EARTH IN A MANNER TO PREVENT FUTURE SETTLEMENT.
- B. EXCAVATION AS HEREIN SPECIFIED SHALL BE UNCLASSIFIED. COMMON EXCAVATION SHALL COMPRISE THE SATISFACTORY REMOVAL AND DISPOSITION OF MATERIAL OF WHATEVER SUBSTANCES AND OF EVERY DESCRIPTION ENCOUNTERED, INCLUDING ROCK, IF ANY, WITHIN THE LIMITS OF THE WORK AS SPECIFIED AND SHOWN ON THE DRAWINGS. EXCAVATION SHALL BE PERFORMED TO THE LINES AND GRADES INDICATED ON THE DRAWINGS. EXCAVATED MATERIALS WHICH ARE CONSIDERED UNSUITABLE FOR BACKFILL, AND SURPLUS OF EXCAVATED MATERIAL WHICH IS NOT REQUIRED FOR BACKFILL, SHALL BE DISPOSED OF BY THE CONTRACTOR AT HIS OWN EXPENSE AND RESPONSIBILITY, AND TO THE SATISFACTION OF THE ARCHITECT.

3.04 CUTTING AND REPAIRING

- A. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL CUTTING, DRILLING, WELDING, AND REPAIR OF WALLS, FLOORS, CEILING, ETC. AS REQUIRED FOR TO INSTALL WORK UNDER THIS SECTION. OBTAIN PERMISSION FROM THE ARCHITECT PRIOR TO CUTTING. DO NOT CUT OR DISTURB STRUCTURAL MEMBERS WITHOUT PRIOR APPROVAL FROM THE ARCHITECT. CUT HOLES AS SMALL AS POSSIBLE. GENERAL CONTRACTOR SHALL PATCH WALLS, FLOORS, ETC. AS REQUIRED BY WORK UNDER THIS SECTION. PATCHING SHALL MATCH THE ORIGINAL MATERIAL AND CONSTRUCTION. REPAIR AND REFINISH AREAS DISTURBED BY WORK TO THE CONDITION OF ADJOINING SURFACES IN A MANNER SATISFACTORY TO THE ARCHITECT. THE GENERAL CONDITIONS TAKE PRECEDENCE.

3.05 CONCRETE WORK

- A. NEW FLOOR MOUNTED EQUIPMENT/ FIXTURES SHALL BE CONNECTED TO THE EXISTING SANITARY DRAINAGE SYSTEM AS SHOWN ON THE DRAWINGS OR AS REQUIRED. SAW-CUT EXISTING CONCRETE FLOOR AS REQUIRED TO INSTALL NEW UNDERFLOOR PIPES, AND PATCH TO MATCH EXISTING SUB FLOOR PATCHING REQUIREMENTS.
- B. CONTRACTOR SHALL PROVIDE CONCRETE EQUIPMENT BASES AS SHOWN ON PLANS.

3.06 START-UP PROCEDURES

- A. FOLLOW MANUFACTURER'S RECOMMENDED PROCEDURES IN STARTING UP THE EQUIPMENT. DAMAGE CAUSED DURING START-UP SHALL BE REPLACED AT NO EXPENSE TO THE OWNER.
- B. EQUIPMENT PROVIDER SHALL BE RESPONSIBLE FOR PROVIDING EQUIPMENT START-UP AND, WHEN INSULATION INCLUDING ANY WIRE MESH, REFER TO ARCHITECTURAL SPECIFICATIONS FOR FINISH FLOOR PATCHING REQUIREMENTS.
- C. CONTRACTOR SHALL PROVIDE CONCRETE EQUIPMENT BASES AS SHOWN ON PLANS.

SECTION 20 05 19 - METERS AND GAUGES

2.01 THERMOMETERS

- A. 1/2 INCH LONG DIE-CAST ALUMINUM OR CHROME PLATED BRASS WITH GLASS WINDOW. RED, BLUE, OR GREEN INDICATORS. ADJUSTABLE CONNECTOR WITH 180 DEG VERTICAL PLANE AND 360 DEG HORIZONTAL ORIENTATION. ACCURACY SHALL BE PLUS OR MINUS 1 PERCENT. APPROVED MANUFACTURERS ARE AMETEK, MILUOOD, THERCO, OR WEISS INSTRUMENTS.
- B. THERMOMETER SPACING: COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," TABLE 5-1 (TABLE 5-1M), "RECTANGULAR DUCT HANGERS MINIMUM SIZE," AND TABLE 5-2, "MINIMUM HANGER SIZES FOR ROUND DUCT," FOR MAXIMUM HANGER SPACING. INSTALL HANGERS AND SUPPORTS WITHIN 24 INCHES OF EACH ELBOW AND WITHIN 48 INCHES OF EACH BRANCH INTERSECTION.

SECTION 20 05 29 - HANGERS AND SUPPORTS

1.01 GENERAL

- A. REFER TO DUCT AND PIPING APPLICATION SCHEDULE FOR HANGER, ROD, SPACING, AND TYPES APPROVED FOR DIFFERENT SYSTEMS AND SIZES.
- B. SUPPORT EQUIPMENT, PIPING, DUCTWORK FROM THE STRUCTURE TO PREVENT SAGGING, FLOPPING, SWINGING, AND VIBRATIONS, AND ARRANGED TO PROVIDE FOR EXPANSION AND CONTRACTION. HANGERS SUPPORTING VIBRATING EQUIPMENT SHALL BE PROVIDED WITH SPRING ISOLATORS. CHAIN, PERFORATED IRON OR WIRE HANGERS ARE NOT PERMITTED. SUPPORTS SHALL BE CONNECTED TO THE BUILDING STRUCTURE ONLY. EQUIPMENT, PIPES, DUCTWORK SHALL NOT BE WEIGHTED FROM ONE ANOTHER.
- C. DUCT HANGER SPACING: COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," TABLE 5-1 (TABLE 5-1M), "RECTANGULAR DUCT HANGERS MINIMUM SIZE," AND TABLE 5-2, "MINIMUM HANGER SIZES FOR ROUND DUCT," FOR MAXIMUM HANGER SPACING. INSTALL HANGERS AND SUPPORTS WITHIN 24 INCHES OF EACH ELBOW AND WITHIN 48 INCHES OF EACH BRANCH INTERSECTION.