GENERAL MEP NOTES

COORDINATION

EACH CONTRACTOR SHALL COORDINATE ITS CONSTRUCTION OPERATIONS WITH THOSE OF OTHER CONTRACTORS AND ENTITIES TO ENSURE EFFICIENT AND ORDERLY INSTALLATION OF EACH PART OF THE WORK. EACH CONTRACTOR SHALL COORDINATE ITS OPERATIONS WITH OPERATIONS, INCLUDED IN DIFFERENT SECTIONS, THAT DEPEND ON EACH OTHER FOR PROPER INSTALLATION, CONNECTION, AND OPERATION.

1. SCHEDULE CONSTRUCTION OPERATIONS IN SEQUENCE REQUIRED TO OBTAIN THE BEST RESULTS WHERE INSTALLATION OF ONE PART OF THE WORK DEPENDS ON INSTALLATION OF OTHER COMPONENTS, BEFORE OR AFTER ITS OWN INSTALLATION.
2. COORDINATE INSTALLATION OF DIFFERENT COMPONENTS WITH OTHER CONTRACTORS TO ENSURE MAXIMUM PERFORMANCE AND ACCESSIBILITY FOR REQUIRED MAINTENANCE, SERVICE, AND REPAIR.
3. MAKE ADEQUATE PROVISIONS TO ACCOMMODATE ITEMS SCHEDULED FOR LATER INSTALLATION.
4. VISIT THE SITE PRIOR TO SUBMITTING A BID TO VERIFY THE EXISTING CONDITIONS AND DESIGN CONSTRAINTS. FAILURE TO MEET THIS REQUIREMENT SHALL NOT BE JUSTIFICATION FOR FAULTY INSTALLATION OR ADDITIONAL COSTS.
5. SECURE ALL PERMITS AND INSPECTIONS REQUIRED FOR WORK, AND PAY ALL FEES FOR REQUIRED WORK.
6. COMPLY WITH ALL CURRENT LAWS, BUILDING CODES AND REGULATIONS FEDERAL, STATE AND LOCAL AUTHORITIES HAVING JURISDICTION. IN THE EVENT OF CONFLICT BETWEEN THE CONTRACT DOCUMENTS AND THE LOCAL AUTHORITY HAVING JURISDICTION, THE LATTER SHALL RULE. ANY CHANGES RESULTING SHALL BE MADE WITHOUT ADDITIONAL COST TO THE OWNER OR ARCHITECT/ENGINEER. THE CONTRACTOR SHALL REPORT ANY SUCH MODIFICATIONS TO THE ARCHITECT/ENGINEER AND SECURE HIS APPROVAL BEFORE PROCEEDING. SHOULD THE REQUIREMENTS OF THE CONTRACT DOCUMENTS EXCEED THE REQUIREMENTS OF THE CODES, THE CONTRACT DOCUMENTS SHALL GOVERN, PROVIDED THOSE REQUIREMENTS ARE NOT IN CONFLICT WITH THOSE CODES. ALL ITEMS OF EQUIPMENT AND ALL MATERIALS FOR WHICH APPROVAL STANDARDS HAVE BEEN ESTABLISHED BY UNDERWRITERS' LABORATORIES, INC. (UL), FACTORY MUTUAL (FM), AMERICAN STANDARD CODES, ASME, AGA, AMCA, ASA, ANSI, ASHRAE, AND ARI SHALL BE SO APPROVED AND SHALL BEAR APPROVAL LABELS.
7. PENETRATIONS OF WALLS AND FLOORS OF FIRE-RATED ASSEMBLIES SHALL COMPLY WITH ASTM, U.L., AND THE AUTHORITIES HAVING JURISDICTION.
8. IF THE DRAWINGS AND SPECIFICATIONS ARE IN CONFLICT THE GREATER AMOUNT OF WORK SHALL BE PRICED. BRING THE CONFLICT TO THE ATTENTION OF THE ENGINEER AND REQUEST DIRECTION.
9. DRAWINGS ARE DIAGRAMMATIC AND ARE NOT INTENDED TO SHOW ALL FITTINGS, COMPONENTS AND OFFSETS, ETC. THE CONTRACTOR SHALL PROVIDE ALL FITTINGS, COMPONENTS, OFFSETS OR OTHER FEATURES REQUIRED FOR THE FULL OPERATIONAL CONDITION OF THIS PROJECT.
10. CONFIRM DIMENSIONS AND LOCATIONS IN THE FIELD, DRAWINGS ARE NOT TO BE SCALED AND ARE NOT INTENDED TO SHOW EXACT LOCATIONS BASED ON SCALING DIMENSIONS.
11. GUARANTEE LABOR AND MATERIALS OF ENTIRE INSTALLATION FOR ONE YEAR. WORK BELOW FLOOR OR OVER CORRIDORS SHALL BE PERFORMED AT THE OWNER'S CONVENIENCE AND MAY BE REQUIRED TO BE DONE DURING EVENINGS AND WEEKENDS. DEMOLITION DAMAGE TO EXISTING MATERIALS/EQUIPMENT WILL BE REPAIRED AT NO ADDITIONAL COST TO OWNER. RE-SUPPORT ANY REMAINING PIPING OR DEVICES THAT WERE SUPPORTED BY WALLS BEING REMOVED.
12. ELECTRONIC COPIES OF CAD DRAWINGS OF THE CONTRACT DRAWINGS WILL NOT BE PROVIDED BY THE ENGINEER FOR CONTRACTOR'S USE IN PREPARING SUBMITTALS OR AS-BUILT DRAWINGS

ACOUSTIC TREATMENT

A. IT IS THE INTENT OF THESE DRAWINGS TO SPECIFY AND FOR THE CONTRACTOR TO INSTALL SYSTEMS THAT ARE QUIET AND FREE OF VIBRATION. EQUIPMENT SHALL BE BALANCED AND VIBRATION ISOLATED TO MEET THE REQUIREMENTS SPECIFIED HEREIN FOR BOTH THE EQUIPMENT ITSELF AND CONDITIONS WITHIN OCCUPIED SPACES. THIS CONTRACTOR IS RESPONSIBLE FOR OBTAINING AND INSTALLING EQUIPMENT THAT IS QUIET IN OPERATION AS COMPARED TO OTHER AVAILABLE EQUIPMENT OF ITS SIZE, CAPACITY, AND TYPE.

B. EQUIPMENT NOT MEETING THESE REQUIREMENTS SHALL BE CORRECTED BY THE CONTRACTOR TO AN ACCEPTABLE LEVEL BUT WITHIN THE REQUIREMENTS OF THE SPECIFICATIONS AT NO COST TO THE OWNER, ARCHITECT OR ENGINEER.

C. AIR DISTRIBUTION EQUIPMENT SHALL BE SOUND TESTED AT THE DESIGN OPERATING CONDITIONS AND SHALL NOT EXCEED A MAXIMUM DISCHARGE NC RATING OF 25 OR A RADIATED NC RATING OF 30 AT RATED CFM.

D. UNLESS NOTED OTHERWISE HEREIN OR ON THE DRAWINGS, THE NOISE LEVEL IN ALL OCCUPIED SPACES SHALL NOT EXCEED THE "LOWEST VALUE IN THE RANGE" OF THE NOISE CRITERIA CURVES PUBLISHED IN THE CURRENT FUNDAMENTALS EDITION OF THE ASHRAE GUIDE AND DATA BOOK. THE NOISE CRITERIA CURVES SHALL BE BASED ON ANSI STANDARD S1.6-1967 OCTAVE BANDS AND A SOUND PRESSURE LEVEL IN DECIBELS REFERENCED TO 0.002 MICROBARS. SOUND LEVELS IN OCCUPIED SPACES MUST MEET THE DESIGN CRITERIA WITH ALL CONSTRUCTION IN PLACE.

E. SHOULD A QUESTION ARISE REGARDING THE ACCEPTABLE LEVEL OF NOISE OR VIBRATION IN A PARTICULAR SPACE OR PIECE OF EQUIPMENT, THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING THE SERVICES OF AN APPROVED ACOUSTICAL CONSULTANT TO DETERMINE ACTUAL NOISE/VIBRATION CONDITIONS.

SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. ELECTRONIC COPIES OF CAD DRAWINGS OF THE CONTRACT DRAWINGS WILL NOT BE PROVIDED BY THE ENGINEER FOR CONTRACTOR'S USE IN PREPARING SUBMITTALS OR AS-BUILT DRAWINGS.

B. COORDINATE PREPARATION AND PROCESSING OF SUBMITTALS WITH PERFORMANCE OF CONSTRUCTION ACTIVITIES. COORDINATE EACH SUBMITTAL WITH FABRICATION, PURCHASING, TESTING, DELIVERY, OTHER SUBMITTALS, AND RELATED ACTIVITIES THAT REQUIRE SEQUENTIAL ACTIVITY. SUBMIT ALL ITEMS REQUIRED FOR EACH SPECIFICATION SECTION CONCURRENTLY.

C. ALLOW TIME FOR SUBMITTAL REVIEW, INCLUDING TIME FOR RESUBMITTALS, AS FOLLOWS. TIME FOR REVIEW SHALL COMMENCE ON ENGINEER'S RECEIPT OF SUBMITTAL. NO EXTENSION OF THE CONTRACT TIME WILL BE AUTHORIZED BECAUSE OF FAILURE TO TRANSMIT SUBMITTALS ENOUGH IN ADVANCE OF THE WORK TO PERMIT PROCESSING, INCLUDING RESUBMITTALS.

1. INITIAL REVIEW: ALLOW 7 DAYS FOR INITIAL REVIEW OF EACH SUBMITTAL EXCLUSIVE OF TRAVEL TIME. ALLOW ADDITIONAL TIME IF COORDINATION WITH SUBSEQUENT SUBMITTALS IS REQUIRED.
2. RESUBMITTAL REVIEW: ALLOW 7 DAYS FOR REVIEW OF EACH RESUBMITTAL EXCLUSIVE OF TRAVEL TIME.

D. PLACE A PERMANENT LABEL OR TITLE BLOCK ON EACH PAPER COPY SUBMITTAL ITEM FOR IDENTIFICATION. INDICATE NAME OF FIRM OR ENTITY THAT PREPARED EACH SUBMITTAL ON LABEL OR TITLE BLOCK.

E. INCLUDE THE FOLLOWING INFORMATION FOR PROCESSING AND RECORDING ACTION TAKEN:
1. PROJECT NAME.
2. DATE.
3. NAME OF ARCHITECT.
4. NAME OF ENGINEER.
5. NAME OF CONTRACTOR.
6. NAME OF SUBCONTRACTOR.
7. NAME OF SUPPLIER.
8. NAME OF MANUFACTURER.

F. CONTRACTOR'S REVIEW:
REVIEW EACH SUBMITTAL AND CHECK FOR COORDINATION WITH OTHER WORK OF THE CONTRACT AND FOR COMPLIANCE WITH THE CONTRACT DOCUMENTS. NOTE CORRECTIONS AND FIELD DIMENSIONS. MARK WITH APPROVAL STAMP BEFORE SUBMITTING TO ARCHITECT/ENGINEER.
STAMP EACH SUBMITTAL WITH A UNIFORM, APPROVAL STAMP. PROVIDE A STATEMENT CERTIFYING THAT SUBMITTAL HAS BEEN REVIEWED, CHECKED, AND APPROVED FOR COMPLIANCE WITH THE CONTRACT DOCUMENTS AND THE PHYSICAL SPACE LIMITATIONS AT THE SITE.
PROVIDE A STATEMENT CERTIFYING THAT SUBMITTAL HAS BEEN REVIEWED, CHECKED, AND APPROVED FOR COMPLIANCE WITH THE CONTRACT DOCUMENTS AND THE PHYSICAL SPACE LIMITATIONS AT THE SITE.

IF THE GENERAL CONTRACTOR IS DEFERRING THE ABOVE REQUIREMENTS TO THE SUBCONTRACTOR. THEN THE SUBCONTRACTOR MUST ALSO REVIEW, STAMP AND CERTIFY THE SUBMITTAL.

G. ENGINEER'S ACTION:
ENGINEER WILL NOT REVIEW SUBMITTALS THAT DO NOT BEAR CONTRACTOR'S APPROVAL STAMP AND WILL RETURN THEM.
ENGINEER WILL REVIEW EACH SUBMITTAL, NOTE CORRECTIONS OR MODIFICATIONS REQUIRED, AND RETURN IT. ENGINEER WILL PROVIDE SUBMITTAL WITH AN ACTION SHEET TO INDICATE ACTION.

REQUESTS FOR INFORMATION (RFI)

IMMEDIATELY ON DISCOVERY OF THE NEED FOR ADDITIONAL INFORMATION OR INTERPRETATION OF THE CONTRACT DOCUMENTS, CONTRACTOR SHALL PREPARE AND SUBMIT AN RFI IN THE FORM SPECIFIED.

1. ENGINEER WILL RETURN RFIS SUBMITTED TO ENGINEER BY OTHER ENTITIES CONTROLLED BY CONTRACTOR WITH NO RESPONSE.
2. COORDINATE AND SUBMIT RFIS IN A PROMPT MANNER SO AS TO AVOID DELAYS IN CONTRACTOR'S WORK OR WORK OF SUBCONTRACTORS.
3. INCLUDE A PROPOSED SOLUTION AS WELL AS INCLUDE A DETAILED, LEGIBLE DESCRIPTION OF ITEM NEEDING INFORMATION OR INTERPRETATION. INCLUDE SKETCHES, DESCRIPTIONS, MEASUREMENTS, PHOTOS, PRODUCT DATA, SHOP DRAWINGS, COORDINATION DRAWINGS, AND OTHER INFORMATION NECESSARY TO FULLY DESCRIBE ITEMS NEEDING INTERPRETATION.

RECORD DRAWINGS

A. WITHIN 90 DAYS OF COMPLETION OF THE PROJECT, THE CONTRACTOR SHALL SUBMIT TO THE ENGINEER, A COMPLETE SET OF "AS BUILT" DRAWINGS PORTRAYING ACTUAL SITE CONDITIONS OF THE MECHANICAL, ELECTRICAL, PLUMBING AND FIRE PROTECTION WORK. SUBMISSION SHALL CONSIST OF ONE SET OF PAPER SEPIAS AND ONE SET OF CAD FILES IN AUTOCAD 2007 FORMAT. ENGINEER AND ARCHITECT SEALS AND LOGOS SHALL BE REMOVED FROM THE DRAWINGS AND THEY SHALL BE STAMPED "AS-BUILT DRAWINGS".

B. WITHIN 90 DAYS OF COMPLETION OF THE PROJECT, THE CONTRACTOR SHALL SUBMIT TO THE ENGINEER, A COMPLETE SET OF "O&M MANUALS", EQUIPMENT DATA, HVAC AIR AND WATER BALANCING REPORT, AND LIGHTING CONTROL TESTING REPORT FOR COMPLIANCE WITH CURRENT ENERGY CODE. THE CONTRACTOR SHALL PROVIDE A WRITTEN CERTIFICATION THAT ALL NEW MATERIALS AND COMPONENTS DO NOT CONTAIN ASBESTOS OR PCBS.

REQUIRED SUBMITTALS

A. PROVIDE FOUR BOUND PRODUCT DATA SUBMITTALS FOR THE NEW EQUIPMENT LISTED BELOW TO THE ARCHITECT/ENGINEER. EACH CONTRACTOR RESPONSIBLE FOR THE WORK SHALL REVIEW AND CERTIFY THE SUBMITTAL DATA TO BE IN FULL COMPLIANCE WITH THE CONTRACT DOCUMENTS AND THE PHYSICAL SPACE LIMITATIONS.
1. AIR HANDLING UNITS
2. FAN COIL UNITS
3. AIR DISTRIBUTION DEVICES
4. ELECTRICAL PANELS
5. ELECTRICAL TRANSFORMERS
6. LIGHTING FIXTURES
7. WIRING DEVICES
8. PLUMBING FIXTURES
9. AIR AND WATER BALANCE REPORTS
10. CIRCUIT DIRECTORY CARDS

MECHANICAL AND SERVICE WATER HEATING COMMISSIONING

A. ALL REQUIREMENTS SHALL BE PERFORMED PER THE CURRENTLY ADOPTED ENERGY CONSERVATION CODE IN THE AUTHORITY HAVING JURISDICTION. THE FOLLOWING IS NOT A COMPLETE LISTING.

B. SYSTEMS ADJUSTING AND BALANCING: HVAC SYSTEMS SHALL BE BALANCED IN ACCORDANCE WITH GENERALLY ACCEPTED ENGINEERING STANDARDS. AIR AND WATER FLOW RATES SHALL BE MEASURED AND ADJUSTED TO DELIVER FINAL FLOW RATES WITHIN TOLERANCES PROVIDED IN THE PRODUCT SPECIFICATIONS. TEST AND BALANCE ACTIVITIES SHALL INCLUDE AIR SYSTEM AND HYDRONIC SYSTEM BALANCING. THE FOLLOWING SYSTEMS ARE EXEMPT:
1. MECHANICAL SYSTEMS AND SERVICE WATER HEATER SYSTEMS IN BUILDINGS WHERE THE TOTAL MECHANICAL EQUIPMENT CAPACITY IS LESS THAN 480,000 BTUH COOLING CAPACITY AND 600,000 BTUH COMBINED SERVICE WATER HEATING AND SPACE HEATING CAPACITY.
2. SYSTEMS THAT SERVE INDIVIDUAL DWELLING UNITS AND SLEEPING UNITS.

C. AIR SYSTEMS BALANCING: EACH SUPPLY AIR OUTLET AND ZONE TERMINAL DEVICE SHALL BE EQUIPPED WITH MEANS FOR AIR BALANCING. DISCHARGE DAMPERS USED FOR AIR SYSTEM BALANCING ARE PROHIBITED ON CONSTANT VOLUME FANS AND VARIABLE VOLUME FANS WITH MOTORS 10HP AND LARGER. AIR SYSTEMS SHALL BE BALANCED IN A MANNER TO FIRST MINIMIZE THROTTLING LOSSES THEN, FOR FANS WITH SYSTEM POWER OF GREATER THAT 1 HP, FAN SPEED SHALL BE ADJUSTED TO MEET DESIGN FLOW CONDITIONS. EXCEPTIONS: FANS WITH MOTORS OF 1 HP OR LESS ARE NOTE REQUIRED TO BE PROVIDED WITH A MEANS FOR AIR BALANCING.

D. HYDRONIC SYSTEM BALANCING: INDIVIDUAL HYDRONIC HEATING AND COOLING COILS SHALL BE EQUIPPED WITH A MEANS FOR BALANCING AND MEASURING FLOW. HYDRONIC SYSTEMS SHALL BE PROPORTIONATELY BALANCED IN A MANNER TO FIRST MINIMIZE THROTTLING LOSSES, THEN THE PUMP IMPELLER SHALL BE TRIMMED OR PUMP SPEED SHALL BE ADJUSTED TO MEET DESIGN FLOW CONDITIONS. EACH HYDRONIC SYSTEM SHALL HAVE EITHER THE CAPABILITY TO MEASURE PRESSURE ACROSS THE PUMP, OR TEST PORTS AT EACH SIDE OF EACH PUMP. THE FOLLOWING EQUIPMENT IS NOT REQUIRED TO BE EQUIPPED WITH A MEANS FOR BALANCING OR MEASURING FLOW:
1. PUMPS WITH PUMP MOTORS OF 5 HP (3.7 KW) OR LESS,
2. WHERE THROTTLING RESULTS IN NO GREATER THAN 5 PERCENT OF THE NAMEPLATE HORSEPOWER DRAW ABOVE THAT REQUIRED IF THE IMPELLER WERE TRIMMED.

E. FUNCTIONAL PERFORMANCE TESTING. FUNCTIONAL PERFORMANCE TESTING SHALL BE CONDUCTED.
1. EQUIPMENT. EQUIPMENT FUNCTIONAL PERFORMANCE TESTING SHALL DEMONSTRATE THE INSTALLATION AND OPERATION OF COMPONENTS, SYSTEMS, AND SYSTEM-TO-SYSTEM INTERFACING RELATIONSHIPS IN ACCORDANCE WITH APPROVED PLANS AND SPECIFICATIONS SUCH THAT OPERATION, FUNCTION, AND MAINTENANCE SERVICEABILITY FOR EACH OF THE COMMISSIONED SYSTEMS IS CONFIRMED. TESTING SHALL INCLUDE ALL MODES AND SEQUENCE OF OPERATION, INCLUDING UNDER FULL-LOAD, PART-LOAD AND THE FOLLOWING EMERGENCY CONDITIONS:
   - 1.1. ALL MODES AS DESCRIBED IN THE SEQUENCE OF OPERATION.
   - 1.2. REDUNDANT OR AUTOMATIC BACK-UP MODE.
   - 1.3. PERFORMANCE OF ALARMS.
   - 1.4. MODE OF OPERATION UPON A LOSS OF POWER AND RESTORATION OF POWER.

EXCEPTION: UNITARY OR PACKAGED HVAC EQUIPMENT THAT DO NOT REQUIRE SUPPLY AIR ECONOMIZERS.

F. CONTROLS. HVAC AND SERVICE WATER-HEATING CONTROL SYSTEMS SHALL BE TESTED TO DOCUMENT THAT CONTROL DEVICES, COMPONENTS, EQUIPMENT AND SYSTEMS ARE CALIBRATED AND ADJUSTED AND OPERATE IN ACCORDANCE WITH APPROVED PLANS AND SPECIFICATIONS. SEQUENCES OF OPERATION SHALL BE FUNCTIONALLY TESTED TO DOCUMENT THEY OPERATE IN ACCORDANCE WITH APPROVED PLANS AND SPECIFICATIONS.

G. ECONOMIZERS. AIR ECONOMIZERS SHALL UNDERGO A FUNCTIONAL TEST TO DETERMINE THAT THEY OPERATE IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.

LIGHTING SYSTEM FUNCTIONAL TESTING

A. ALL REQUIREMENTS SHALL BE PERFORMED PER THE CURRENTLY ADOPTED ENERGY CONSERVATION CODE IN THE AUTHORITY HAVING JURISDICTION. THE FOLLOWING IS NOT A COMPLETE LISTING.

B. OCCUPANT SENSOR CONTROLS. WHERE OCCUPANT SENSOR CONTROLS ARE PROVIDED, THE FOLLOWING PROCEDURES SHALL BE PERFORMED:
1. CERTIFY THAT THE OCCUPANT SENSOR HAS BEEN LOCATED AND AIMED IN ACCORDANCE WITH MANUFACTURER RECOMMENDATIONS.
2. FOR PROJECTS WITH SEVEN OR FEWER OCCUPANT SENSORS, EACH SENSOR SHALL BE TESTED.
3. FOR PROJECTS WITH MORE THAN SEVEN OCCUPANT SENSORS, TESTING SHALL BE DONE FOR EACH UNIQUE COMBINATION OF SENSOR TYPE AND SPACE GEOMETRY. WHERE MULTIPLES OF EACH UNIQUE COMBINATION OF SENSOR TYPE AND SPACE GEOMETRY ARE PROVIDED, NOT LESS THAN 10 PERCENT, BUT IN NO CASE LESS THAN ONE, OF EACH COMBINATION SHALL BE TESTED UNLESS THE CODE OFFICIAL OR DESIGN PROFESSIONAL REQUIRES A HIGHER PERCENTAGE TO BE TESTED. WHERE 30 PERCENT OR MORE OF THE TESTED CONTROLS FAIL, ALL REMAINING IDENTICAL COMBINATIONS SHALL BE TESTED. FOR OCCUPANT SENSOR CONTROLS TO BE TESTED, VERIFY THE FOLLOWING:
   - 3.1. WHERE OCCUPANT SENSOR CONTROLS INCLUDE STATUS INDICATORS, VERIFY CORRECT OPERATION.
   - 3.2. THE CONTROLLED LIGHTS TURN OFF OR DOWN TO THE PERMITTED LEVEL WITHIN THE REQUIRED TIME.
   - 3.3. FOR AUTO-ON OCCUPANT SENSOR CONTROLS, THE LIGHTS TURN ON TO THE PERMITTED LEVEL WHEN AN OCCUPANT ENTERS THE SPACE.
   - 3.4. FOR MANUAL-ON OCCUPANT SENSOR CONTROLS, THE LIGHTS TURN ON ONLY WHEN MANUALLY ACTIVATED.
   - 3.5. THE LIGHTS ARE NOT INCORRECTLY TURNED ON BY MOVEMENT IN ADJACENT AREAS OR BY HVAC OPERATION.

C. TIME-SWITCH CONTROLS. WHERE TIME-SWITCH CONTROLS ARE PROVIDED, THE FOLLOWING PROCEDURES SHALL BE PERFORMED:
1. CONFIRM THAT THE TIME-SWITCH CONTROL IS PROGRAMMED WITH ACCURATE WEEKDAY, WEEKEND AND HOLIDAY SCHEDULES.
2. PROVIDE DOCUMENTATION TO THE OWNER OF TIMESWITCH CONTROLS PROGRAMMING INCLUDING WEEKDAY, WEEKEND, HOLIDAY SCHEDULES, AND SET-UP AND PREFERENCE PROGRAM SETTINGS.
3. VERIFY THE CORRECT TIME AND DATE IN THE TIME SWITCH.
4. VERIFY THAT ANY BATTERY BACK-UP IS INSTALLED AND ENERGIZED.
5. VERIFY THAT THE OVERRIDE TIME LIMIT IS SET TO NOT MORE THAN 2 HOURS.
6. SIMULATE OCCUPIED CONDITION. VERIFY AND DOCUMENT THE FOLLOWING:
   - 6.1. ALL LIGHTS CAN BE TURNED ON AND OFF BY THEIR RESPECTIVE AREA CONTROL SWITCH.
   - 6.2. THE SWITCH ONLY OPERATES LIGHTING IN THE ENCLOSED SPACE IN WHICH THE SWITCH IS LOCATED.
7. SIMULATE UNOCCUPIED CONDITION. VERIFY AND DOCUMENT THE FOLLOWING:
   - 7.1. NONEXEMPT LIGHTING TURNS OFF.
   - 7.2. MANUAL OVERRIDE SWITCH ALLOWS ONLY THE LIGHTS IN THE ENCLOSED SPACE WHERE THE OVERRIDE SWITCH IS LOCATED TO TURN ON OR REMAIN ON UNTIL THE NEXT SCHEDULED SHUTOFF OCCURS.
8. ADDITIONAL TESTING AS SPECIFIED BY THE REGISTERED DESIGN PROFESSIONAL.

D. DAYLIGHT RESPONSIVE CONTROLS. WHERE DAYLIGHT RESPONSIVE CONTROLS ARE PROVIDED, THE FOLLOWING SHALL BE VERIFIED:
1. CONTROL DEVICES HAVE BEEN PROPERLY LOCATED, FIELD CALIBRATED AND SET FOR ACCURATE SETPOINTS AND THRESHOLD LIGHT LEVELS.
2. DAYLIGHT CONTROLLED LIGHTING LOADS ADJUST TO LIGHT LEVEL SET POINTS IN RESPONSE TO AVAILABLE DAYLIGHT.
3. THE LOCATIONS OF CALIBRATION ADJUSTMENT EQUIPMENT ARE READILY ACCESSIBLE ONLY TO AUTHORIZED PERSONNEL.

MECHANICAL SPECIFICATIONS

SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. GENERAL FABRICATION REQUIREMENTS: COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE" BASED ON REQUIRED STATIC-PRESSURE CLASS UNLESS OTHERWISE INDICATED.

B. TRANSVERSE JOINTS: SELECT JOINT TYPES AND FABRICATE ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," FIGURE 2-1, "RECTANGULAR DUCT/TRANSVERSE JOINTS," FOR STATIC-PRESSURE CLASS, APPLICABLE SEALING REQUIREMENTS, MATERIALS INVOLVED, DUCT-SUPPORT INTERVALS, AND OTHER PROVISIONS IN SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE."

C. LONGITUDINAL SEAMS: SELECT SEAM TYPES AND FABRICATE ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," FIGURE 2-2, "RECTANGULAR DUCT/LONGITUDINAL SEAMS," FOR STATIC-PRESSURE CLASS, APPLICABLE SEALING REQUIREMENTS, MATERIALS INVOLVED, DUCT-SUPPORT INTERVALS, AND OTHER PROVISIONS IN SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE."

D. ELBOWS, TRANSITIONS, OFFSETS, BRANCH CONNECTIONS, AND OTHER DUCT CONSTRUCTION: SELECT TYPES AND FABRICATE ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," CHAPTER 4, "FITTINGS AND OTHER CONSTRUCTION," FOR STATIC-PRESSURE CLASS, APPLICABLE SEALING REQUIREMENTS, MATERIALS INVOLVED, DUCT-SUPPORT INTERVALS, AND OTHER PROVISIONS IN SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE."

SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. GENERAL FABRICATION REQUIREMENTS: COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," CHAPTER 3, "ROUND, OVAL, AND FLEXIBLE DUCT," BASED ON INDICATED STATIC-PRESSURE CLASS UNLESS OTHERWISE INDICATED.

B. FLAT-OVAL DUCTS: INDICATED DIMENSIONS ARE THE DUCT WIDTH (MAJOR DIMENSION) AND DIAMETER OF THE ROUND SIDES CONNECTING THE FLAT PORTIONS OF THE DUCT (MINOR DIMENSION).

C. TRANSVERSE JOINTS: SELECT JOINT TYPES AND FABRICATE ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," FIGURE 3-1, "ROUND DUCT TRANSVERSE JOINTS," FOR STATIC-PRESSURE CLASS, APPLICABLE SEALING REQUIREMENTS, MATERIALS INVOLVED, DUCT-SUPPORT INTERVALS, AND OTHER PROVISIONS IN SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE."

D. LONGITUDINAL SEAMS: SELECT SEAM TYPES AND FABRICATE ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," FIGURE 3-2, "ROUND DUCT LONGITUDINAL SEAMS," FOR STATIC-PRESSURE CLASS, APPLICABLE SEALING REQUIREMENTS, MATERIALS INVOLVED, DUCT-SUPPORT INTERVALS, AND OTHER PROVISIONS IN SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE."

E. TEES AND LATERALS: SELECT TYPES AND FABRICATE ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," FIGURE 3-5, "90 DEGREE TEES AND LATERALS," AND FIGURE 3-6, "CONICAL TEES," FOR STATIC-PRESSURE CLASS, APPLICABLE SEALING REQUIREMENTS, MATERIALS INVOLVED, DUCT-SUPPORT INTERVALS, AND OTHER PROVISIONS IN SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE."

SHEET METAL DUCTWORK

A. GENERAL MATERIAL REQUIREMENTS: COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE" FOR ACCEPTABLE MATERIALS, MATERIAL THICKNESSES, AND DUCT CONSTRUCTION METHODS UNLESS OTHERWISE INDICATED. SHEET METAL MATERIALS SHALL BE FREE OF PITTING, SEAM MARKS, ROLLER MARKS, STAINS, DISCOLORATIONS, AND OTHER IMPERFECTIONS.

B. GALVANIZED SHEET STEEL: COMPLY WITH ASTM A 653/A 653M.

C. SUPPLY AND RETURN DUCTWORK SHALL BE EXTERNALLY INSULATED WITH EXTERNAL BLANKET INSULATION. DUCTWORK SHALL BE INTERNALLY LINED ONLY WHERE SPECIFICALLY INDICATED.

D. DUCTWORK SHALL BE SEALED AS REQUIRED BY THE AUTHORITIES HAVING JURISDICTION AND AS REQUIRED TO LIMIT LEAKAGE. LEAKAGE IN EXCESS OF 5% SHALL NOT BE ACCEPTABLE.

E. DUCT DIMENSIONS ARE INSIDE CLEAR DIMENSIONS.

F. THE INTERIOR SURFACE OF ALL DUCTWORK SHALL BE SMOOTH WITH NO SHEETMETAL OR OTHER PARTS PROJECTING INTO THE AIR STREAM. ALL SEAMS AND JOINTS SHALL BE EXTERNAL. THE INSIDE OF ALL DUCTWORK SHALL BE THOROUGHLY CLEANED AND ALL FANS OPERATED TO REMOVE ANY DEBRIS PRIOR TO CONNECTION OF AIR DISTRIBUTION DEVICES.

G. ALL DUCTWORK DIMENSIONS ON THE DRAWINGS ARE CLEAR INSIDE

H. INSTALL ALL DUCTWORK TIGHT TO STRUCTURE UNLESS OTHERWISE NOTED. THE MECHANICAL CONTRACTOR SHALL COORDINATE WITH ALL OTHER TRADES PRIOR TO THE CONSTRUCTION OR INSTALLATION OF DUCTWORK.

I. ALL TRANSVERSE JOINTS SHALL BE SEALED WITH A WATER BASE ADHESIVE SEALER DESIGNED FOR USE IN MEDIUM VELOCITY DUCT SYSTEMS. SEALER SHALL BE EFFECTIVE AGAINST BOTH NEGATIVE AND POSITIVE PRESSURE LOSSES. SEALER SHALL HAVE A FLAME SPREAD RATING OF 25 OR LESS AND A SMOKE DEVELOPED RATING OF 50 OR LESS. APPLY UN-THINNED WITH BRUSH, TROWEL OR CAULKING GUN AS PER THE MANUFACTURER'S RECOMMENDATIONS AND ALLOW TO DRY FOR A MINIMUM OF 48 HOURS BEFORE AIR IS APPLIED TO THE SYSTEM. SEALER SHALL BE "IRON GRIP WATER BASE DUCT SEALANT #601" AS MANUFACTURED BY HARDCAST, INC., UNI-GRIP AS MANUFACTURED BY UNITED MCGILL, OR AN APPROVED EQUAL.

J. ALL ROUND TAKE-OFFS SHALL BE MADE WITH A DAMPER EXTRACTOR SPIN-IN COLLAR. SPIN-INS SHALL BE INSTALLED WITH THEIR DAMPER AXIS PARALLEL TO AIR FLOW.

K. ALL DUCTWORK SUPPORTS SHALL BE PER TABLE 5-1 OF THE SMACNA MANUAL WITH ALL SUPPORTS DIRECTLY ANCHORED TO THE BUILDING STRUCTURE. SUPPORTS SHALL BE ON MAXIMUM 8'- 0" CENTERS WITH ADDITIONAL SUPPORTS AS REQUIRED TO PREVENT SAGGING.

L. FLEXIBLE DUCT FABRIC CONNECTIONS SHALL BE INSTALLED ON THE INLET AND OUTLET CONNECTIONS TO ALL POWERED AIR MOVING EQUIPMENT WHICH IS NOT CONNECTED WITH FLEXIBLE DUCT. A MINIMUM OF 1" OF SLACK SHALL BE ALLOWED IN ALL FLEXIBLE CONNECTIONS TO INSURE VIBRATION ISOLATION. FLEXIBLE FABRIC SHALL BE A MINIMUM OF 3 INCHES WIDE WITH "GRIP-LOC" SEAM TO 24 GAUGE GALVANIZED METAL SIDE CONNECTORS A MINIMUM OF 3 INCHES WIDE EACH. FLEXIBLE CONNECTION ARE TO FABRICATED WITH ELGEN "ZIPPERLOCK" #ZLN-4 NEOPRENE COATED 30 OZ. FIBERGLASS WITH 24 GAUGE GALVANIZED IRON SIDE CONNECTORS, OR DURO DYNE EXCELON "METAL-FAB" VINYL COATED 22 OZ. NYLON WITH 24 GAUGE GALVANIZED IRON SIDE CONNECTORS OR "APPROVED EQUAL".

M. INSTALL MANUAL SPLITTER DAMPERS IN BRANCH TAKE-OFFS WHERE SHOWN. SPLITTER DAMPERS SHALL BE MINIMUM 16 GAUGE GALVANIZED SHEET METAL AND SHALL BE 3/4 OF THE WIDTH OF THE SMALLEST TAKE-OFF BUT NO LESS THAN 6" LONG. DAMPERS SHALL HAVE 1/8" OF CLEARANCE TO THE DUCT IN WHICH THEY ARE INSTALLED. SPLITTER DAMPERS SHALL BE CONTROLLED BY ONE OR MORE CONTROL RODS IN ACCORDANCE WITH FIG. 2-5 OF THE SMACNA MANUAL. WHERE SPLITTERS ARE IN CONCEALED INACCESSIBLE LOCATIONS, SUBMIT PROPOSED CONTROL ROD DETAILS FOR APPROVAL.

N. DUCTWORK WHICH IS EXPOSED TO WEATHER SHALL HAVE SOLDERED JOINTS AND SEAMS AND SHALL BE PAINTED WITH A SUITABLE EPOXY COATING.

HVAC FILTRATION AND AIR QUALITY

A. UNO, EACH NEW EQUIPMENT SHALL BE PROVIDED WITH A PRE-FILTER WITH A MINIMUM FILTRATION OF MERV-11. FILTER EFFICIENCY SHALL BE RATED IN ACCORDANCE WITH ASHRAE 52-76. AIRFLOW SHALL NOT BE GREATER THAN 500 FPM.

B. UNO, EACH NEW EQUIPMENT SHALL BE PROVIDED WITH A BI-POLAR IONIZATION DEVICE(S) THAT MUST MEET UL-2998 STANDARD CERTIFICATION (ENVIRONMENTAL CLAIM VALIDATION PROCEDURE (ECVP) FOR ZERO OZONE EMISSIONS FOR AIR CLEANERS). THE DEVICE(S) SHALL BE MOUNTED IN THE DOWN STREAM SUPPLY DUCTWORK OR INSIDE THE EQUIPMENT. UNO, THE POWER TO THE DEVICE(S) SHALL BE COMING FROM THE EQUIPMENT'S POWER SOURCE AND INTERLOCKED WITH THE EQUIPMENT'S OPERATION. THE NUMBER OF THE DEVICES SHALL BE SELECTED AND DESIGNED PER THE MANUFACTURER GUIDELINES TO MEET THE DESIGN AIR FLOW CAPACITY REQUIREMENT AND AREA OF COIL FACE COVERAGE.

FLEXIBLE DUCTWORK

A. FLEXIBLE DUCT SHALL BE USED FOR CONNECTIONS TO AIR DISTRIBUTION DEVICES WHERE SHOWN ON THE DRAWINGS OR SPECIFIED HEREIN. MAXIMUM LENGTH SHALL BE 5'-0" FOR AIR DISTRIBUTION DEVICE CONNECTIONS. WHERE LONGER RUNS ARE REQUIRED, PROVIDE RIGID DUCTWORK.

B. INSULATED FLEXIBLE DUCT SHALL BE A FACTORY FABRICATED ASSEMBLY CONSISTING OF A GALVANIZED STEEL OR SPIRAL ALUMINUM HELIX. STAINLESS INNER LINER SHALL BE COMPOSED OF 3-PLY ALUMINUM FOIL OR HEAVILY COATED FIBERGLASS WITH A MAXIMUM THERMAL CONDUCTANCE OF .23 BTU/HR/SF/°F. THE ASSEMBLY SHALL BE SHEATHED IN A REINFORCED METALIZED VAPOR BARRIER OUTER JACKET.

C. THE FLEXIBLE DUCT ASSEMBLY SHALL BE SUITABLE FOR A MINIMUM OF 6" W.C. WORKING PRESSURE AND SHALL BE LISTED CLASS I BY THE UNDERWRITERS LABORATORY AT A FLAME SPREAD OF NOT OVER 25 AND A SMOKE DEVELOPED RATE OF NOT OVER 50. DUCTS SHALL ALSO COMPLY WITH NFPA STANDARD 90A.

D. FLEXIBLE DUCTS SHALL BE SUPPORTED IN SUCH A MANNER TO PREVENT SAGS AND KINKS. BENDS IN ANY LENGTH OF FLEXIBLE DUCT SHALL NOT EXCEED 90° FOR AIR DISTRIBUTION DEVICE CONNECTIONS.

E. ALL JOINTS AND CONNECTIONS SHALL BE MADE WITH 1/2" WIDE STAINLESS STEEL DUCT CLAMPS OR 100% NYLON SELF-LOCKING CLAMPS MANUFACTURED BY PANDUIT CORPORATION OR AN APPROVED EQUAL.

F. IF IT COMPLIES WITH THESE SPECIFICATIONS, FLEXIBLE DUCTWORK OF THE FOLLOWING TYPES WILL BE ACCEPTABLE:
FLEXMASTER TYPE 8M OR APPROVED EQUAL (EQUIVALENT TO R6).

CONTROLS

PROVIDE ALL TEMPERATURE CONTROLS MODIFICATIONS REQUIRED FOR A COMPLETE AND FUNCTIONING CONTROLS SYSTEM. ALL CONTROLS SHALL MATCH BUILDING STANDARD.

CHILLED WATER / CONDENSATE PIPING

A. STEEL PIPE: ASTM A 53/A 53M, BLACK STEEL WITH PLAIN ENDS.

B. CAST-IRON THREADED FITTINGS: ASME B16.4; CLASSES 125 AND 250.

C. MALLEABLE-IRON THREADED FITTINGS: ASME B16.3, CLASSES 150 AND 300.

D. MALLEABLE-IRON UNIONS: ASME B16.39; CLASSES 150, 250, AND 300.

E. CAST-IRON PIPE FLANGES AND FLANGED FITTINGS: ASME B16.1, CLASSES 25, 125, AND 250; RAISED GROUND FACE, AND BOLT HOLES SPOT FACED.

F. WROUGHT-STEEL FITTINGS: ASTM A 234/A 234M, WALL THICKNESS TO MATCH ADJOINING PIPE.

G. WROUGHT CAST- AND FORGED-STEEL FLANGES AND FLANGED FITTINGS: ASME B16.5, INCLUDING BOLTS, NUTS, AND GASKETS OF THE FOLLOWING MATERIAL GROUP, END CONNECTIONS, AND FACINGS:
1. MATERIAL GROUP: 1.1.
2. END CONNECTIONS: BUTT WELDING.
3. FACINGS: RAISED FACE.

H. GROOVED MECHANICAL-JOINT FITTINGS AND COUPLINGS:
MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE PRODUCTS BY ONE OF THE FOLLOWING:
1. ANVIL INTERNATIONAL, INC.
2. CENTRAL SPRINKLER COMPANY; A DIVISION OF TYCO FIRE & BUILDING PRODUCTS.
3. NATIONAL FITTINGS, INC.
4. S.P. FITTINGS; A DIVISION OF STAR PIPE PRODUCTS.
5. VICTAULIC COMPANY.

JOINT FITTINGS: ASTM A 536, GRADE 65-45-12 DUCTILE IRON; ASTM A 47/A 47M, GRADE 32510 MALLEABLE IRON; ASTM A 53/A 53M, TYPE F, E, OR S, GRADE B FABRICATED STEEL; OR ASTM A 106, GRADE B STEEL FITTINGS WITH GROOVES OR SHOULDERS CONSTRUCTED TO ACCEPT GROOVED-END COUPLINGS; WITH NUTS, BOLTS, LOCKING PIN, LOCKING TOGGLE, OR LUGS TO SECURE GROOVED PIPE AND FITTINGS.
COUPLINGS: DUCTILE- OR MALLEABLE-IRON HOUSING AND SYNTHETIC RUBBER GASKET OF CENTRAL CAVITY PRESSURE-RESPONSIVE DESIGN; WITH NUTS, BOLTS, LOCKING PIN, LOCKING TOGGLE, OR LUGS TO SECURE GROOVED PIPE AND FITTINGS.

I. CHILLED-WATER PIPING, ABOVEGROUND, NPS 2 (DN 50) AND SMALLER, SHALL BE THE FOLLOWING:
1. SCHEDULE 40 STEEL PIPE; CLASS 150, MALLEABLE-IRON, 250, CAST-IRON AND 300, MALLEABLE-IRON FITTINGS; CAST-IRON FLANGES AND FLANGE FITTINGS; AND THREADED JOINTS.

J. CHILLED-WATER PIPING, ABOVEGROUND, NPS 2-1/2 (DN 65) AND LARGER, SHALL BE ANY OF THE FOLLOWING:
1. SCHEDULE 40 STEEL PIPE, WROUGHT-STEEL FITTINGS AND WROUGHT-CAST OR FORGED-STEEL FLANGES AND FLANGE FITTINGS, AND WELDED AND FLANGED JOINTS.
2. SCHEDULE 40 STEEL PIPE; GROOVED, MECHANICAL JOINT COUPLING AND FITTINGS; AND GROOVED, MECHANICAL JOINTS.

K. CONDENSATE-DRAIN PIPING: TYPE M (C) DRAWN-TEMPER COPPER TUBING, WROUGHT-COPPER FITTINGS, AND SOLDERED JOINTS.

L. HANGERS AND SUPPORTS: INSTALL THE FOLLOWING PIPE ATTACHMENTS:
1. ADJUSTABLE STEEL CLEVIS HANGERS FOR INDIVIDUAL HORIZONTAL PIPING LESS THAN 20 FEET (6 M) LONG.
2. ADJUSTABLE ROLLER HANGERS AND SPRING HANGERS FOR INDIVIDUAL HORIZONTAL PIPING 20 FEET (6 M) OR LONGER.
3. PIPE ROLLER: MSS SP-58, TYPE 44 FOR MULTIPLE HORIZONTAL PIPING 20 FEET (6 M) OR LONGER, SUPPORTED ON A TRAPEZE.
4. SPRING HANGERS TO SUPPORT VERTICAL RUNS.
5. PROVIDE COPPER-CLAD HANGERS AND SUPPORTS FOR HANGERS AND SUPPORTS IN DIRECT CONTACT WITH COPPER PIPE.

M. INSTALL HANGERS FOR STEEL PIPING WITH THE FOLLOWING MAXIMUM SPACING AND MINIMUM ROD SIZES:
1. NPS 3/4 (DN 20): MAXIMUM SPAN, 7 FEET (2.1 M); MINIMUM ROD SIZE, 1/4 INCH (6.4 MM).
2. NPS 1 (DN 25): MAXIMUM SPAN, 7 FEET (2.1 M); MINIMUM ROD SIZE, 1/4 INCH (6.4 MM).
3. NPS 1-1/2 (DN 40): MAXIMUM SPAN, 9 FEET (2.7 M); MINIMUM ROD SIZE, 3/8 INCH (10 MM).
4. NPS 2 (DN 50): MAXIMUM SPAN, 10 FEET (3 M); MINIMUM ROD SIZE, 3/8 INCH (10 MM).
5. NPS 2-1/2 (DN 65): MAXIMUM SPAN, 11 FEET (3.4 M); MINIMUM ROD SIZE, 3/8 INCH (10 MM).
6. NPS 3 (DN 80): MAXIMUM SPAN, 12 FEET (3.7 M); MINIMUM ROD SIZE, 3/8 INCH (10 MM).
7. NPS 4 (DN 100): MAXIMUM SPAN, 14 FEET (4.3 M); MINIMUM ROD SIZE, 1/2 INCH (13 MM).
8. NPS 6 (DN 150): MAXIMUM SPAN, 17 FEET (5.2 M); MINIMUM ROD SIZE, 1/2 INCH (13 MM).
9. NPS 8 (DN 200): MAXIMUM SPAN, 19 FEET (5.8 M); MINIMUM ROD SIZE, 5/8 INCH (16 MM).
10. NPS 10 (DN 250): MAXIMUM SPAN, 20 FEET (6.1 M); MINIMUM ROD SIZE, 3/4 INCH (19 MM).
11. NPS 12 (DN 300): MAXIMUM SPAN, 23 FEET (7 M); MINIMUM ROD SIZE, 7/8 INCH (22 MM).
12. NPS 14 (DN 350): MAXIMUM SPAN, 25 FEET (7.6 M); MINIMUM ROD SIZE, 1 INCH (25 MM).

N. INSTALL HANGERS FOR DRAWN-TEMPER COPPER PIPING WITH THE FOLLOWING MAXIMUM SPACING AND MINIMUM ROD SIZES:
1. NPS 3/4 (DN 20): MAXIMUM SPAN, 5 FEET (1.5 M); MINIMUM ROD SIZE, 1/4 INCH (6.4 MM).
2. NPS 1 (DN 25): MAXIMUM SPAN, 6 FEET (1.8 M); MINIMUM ROD SIZE, 1/4 INCH (6.4 MM).
3. NPS 1-1/2 (DN 40): MAXIMUM SPAN, 8 FEET (2.4 M); MINIMUM ROD SIZE, 3/8 INCH (10 MM).
4. NPS 2 (DN 50): MAXIMUM SPAN, 8 FEET (2.4 M); MINIMUM ROD SIZE, 3/8 INCH (10 MM).
5. NPS 2-1/2 (DN 65): MAXIMUM SPAN, 9 FEET (2.7 M); MINIMUM ROD SIZE, 3/8 INCH (10 MM).
6. NPS 3 (DN 80): MAXIMUM SPAN, 10 FEET (3 M); MINIMUM ROD SIZE, 3/8 INCH (10 MM).

O. CHILLED WATER AND BRINE, ABOVE 40 DEG F (5 DEG C):
1. NPS 12 (DN 300) AND SMALLER: INSULATION SHALL BE THE FOLLOWING: MINERAL-FIBER, PREFORMED PIPE, TYPE I, 1-1/2 INCHES (38 MM) THICK.
2. NPS 14 (DN 350) AND LARGER: INSULATION SHALL BE ONE OF THE FOLLOWING: MINERAL-FIBER PREFORMED PIPE, TYPE I, 1-1/2 INCHES (38 MM) THICK.

P. CONDENSATE AND EQUIPMENT DRAIN WATER BELOW 60 DEG F (16 DEG C):
1. ALL PIPE SIZES: INSULATION SHALL BE ONE OF THE FOLLOWING: MINERAL-FIBER, PREFORMED PIPE INSULATION, TYPE I: 1 INCH (25 MM) THICK.

DUCT INSULATION

A. MINERAL-FIBER BLANKET INSULATION: MINERAL OR GLASS FIBERS BONDED WITH A THERMOSETTING RESIN. COMPLY WITH ASTM C 553, TYPE II AND ASTM C 1290, TYPE III WITH FACTORY-APPLIED FSK JACKET. EQUIVALENT TO R-6. PRODUCTS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE ONE OF THE FOLLOWING:
1. CERTAINTEED CORP.; SOFTTOUCH DUCT WRAP.
2. JOHNS MANVILLE; MICROLITE.
3. KNAUF INSULATION; FRIENDLY FEEL DUCT WRAP.
4. MANSON INSULATION INC.; ALLEY WRAP.
5. OWENS CORNING; SOFTR ALL-SERVICE DUCT WRAP.

B. MINERAL-FIBER ADHESIVE: COMPLY WITH MIL-A-3316C, CLASS 2, GRADE A.
PRODUCTS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE ONE OF THE FOLLOWING:
1. CHILDERS BRAND, SPECIALTY CONSTRUCTION BRANDS, INC., A BUSINESS OF H. B. FULLER COMPANY; CP-127.
2. EAGLE BRIDGES - MARATHON INDUSTRIES; 225.
3. FOSTER BRAND, SPECIALTY CONSTRUCTION BRANDS, INC., A BUSINESS OF H. B. FULLER COMPANY; 85-60/85-70.
4. MON-ECO INDUSTRIES, INC.; 22-25.

FOR INDOOR APPLICATIONS, USE ADHESIVE THAT HAS A VOC CONTENT OF 80 G/L OR LESS WHEN CALCULATED ACCORDING TO 40 CFR 59, SUBPART D (EPA METHOD 24).

C. ASJ ADHESIVE, AND FSK JACKET ADHESIVE: COMPLY WITH MIL-A-3316C, CLASS 2, GRADE A FOR BONDING INSULATION JACKET LAP SEAMS AND JOINTS.
PRODUCTS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE ONE OF THE FOLLOWING:
1. CHILDERS BRAND, SPECIALTY CONSTRUCTION BRANDS, INC., A BUSINESS OF H. B. FULLER COMPANY; CP-82.
2. EAGLE BRIDGES - MARATHON INDUSTRIES; 225.
3. FOSTER BRAND, SPECIALTY CONSTRUCTION BRANDS, INC., A BUSINESS OF H. B. FULLER COMPANY; 85-50.
4. MON-ECO INDUSTRIES, INC.; 22-25.

FOR INDOOR APPLICATIONS, USE ADHESIVE THAT HAS A VOC CONTENT OF 50 G/L OR LESS WHEN CALCULATED ACCORDING TO 40 CFR 59, SUBPART D (EPA METHOD 24).

D. MASTICS
MATERIALS SHALL BE COMPATIBLE WITH INSULATION MATERIALS, JACKETS, AND SUBSTRATES; COMPLY WITH MIL-PRF-19565C, TYPE II.
1. FOR INDOOR APPLICATIONS, USE MASTICS THAT HAVE A VOC CONTENT OF 50 G/L OR LESS WHEN CALCULATED ACCORDING TO 40 CFR 59, SUBPART D (EPA METHOD 24).

E. VAPOR-BARRIER MASTIC: WATER BASED; SUITABLE FOR INDOOR USE ON BELOW AMBIENT SERVICES. PRODUCTS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE ONE OF THE FOLLOWING:
1. FOSTER BRAND, SPECIALTY CONSTRUCTION BRANDS, INC., A BUSINESS OF H. B. FULLER COMPANY; 30-80/30-90.
2. VIMASCO CORPORATION; 749.

WATER-VAPOR PERMEANCE: ASTM E 96/E 96M, PROCEDURE B, 0.013 PERM (0.009 METRIC PERM) AT 43-MIL (1.09-MM) DRY FILM THICKNESS.
SERVICE TEMPERATURE RANGE: MINUS 20 TO PLUS 180 DEG F (MINUS 29 TO PLUS 82 DEG C).
SOLIDS CONTENT: ASTM D 1644, 58 PERCENT BY VOLUME AND 70 PERCENT BY WEIGHT.
COLOR: WHITE.

F. SEALANTS
FSK AND METAL JACKET FLASHING SEALANTS: PRODUCTS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE ONE OF THE FOLLOWING:
1. CHILDERS BRAND, SPECIALTY CONSTRUCTION BRANDS, INC., A BUSINESS OF H. B. FULLER COMPANY; CP-76.
2. EAGLE BRIDGES - MARATHON INDUSTRIES; 405.
3. FOSTER BRAND, SPECIALTY CONSTRUCTION BRANDS, INC., A BUSINESS OF H. B. FULLER COMPANY; 95-44.
4. MON-ECO INDUSTRIES, INC.; 44-05.

MATERIALS SHALL BE COMPATIBLE WITH INSULATION MATERIALS, JACKETS, AND SUBSTRATES.
FIRE- AND WATER-RESISTANT, FLEXIBLE, ELASTOMERIC SEALANT.
SERVICE TEMPERATURE RANGE: MINUS 40 TO PLUS 250 DEG F (MINUS 40 TO PLUS 121 DEG C).
COLOR: ALUMINUM.
FOR INDOOR APPLICATIONS, USE SEALANTS THAT HAVE A VOC CONTENT OF 420 G/L OR LESS WHEN CALCULATED ACCORDING TO 40 CFR 59, SUBPART D (EPA METHOD 24).

G. FSK TAPE: FOIL-FACE, VAPOR-RETARDER TAPE MATCHING FACTORY-APPLIED JACKET WITH ACRYLIC ADHESIVE; COMPLYING WITH ASTM C 1136. PRODUCTS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE ONE OF THE FOLLOWING:
1. ABI, IDEAL TAPE DIVISION; 491 AWF FSK.
2. AVERY DENNISON CORPORATION, SPECIALTY TAPES DIVISION; FASSON 0827.
3. COMPAC CORPORATION; 110 AND 111.
4. VENTURE TAPE; 1525 CW NT, 1528 CW, AND 1528 CW/SQ.

WIDTH: 3 INCHES (75 MM).
THICKNESS: 6.5 MILS (0.16 MM).
ADHESION: 90 OUNCES FORCE/INCH (1.0 N/MM) IN WIDTH.
ELONGATION: 2 PERCENT.
TENSILE STRENGTH: 40 LBF/INCH (7.2 N/MM) IN WIDTH.
FSK TAPE DISKS AND SQUARES: PRECUT DISKS OR SQUARES OF FSK TAPE.

H. SECUREMENTS
BANDS:
PRODUCTS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE ONE OF THE FOLLOWING:
1. ITW INSULATION SYSTEMS; GERRARD STRAPPING AND SEALS.
2. RPR PRODUCTS, INC.; INSUL-MATE STRAPPING, SEALS, AND SPRINGS.

ALUMINUM: ASTM B 209 (ASTM B 209M), ALLOY 3003, 3005, 3105, OR 5005; TEMPER H-14, 0.020 INCH (0.51 MM) THICK, 1/2 INCH (13 MM) WIDE WITH WING SEAL OR CLOSED SEAL.

I. INSULATION PINS AND HANGERS:
CAPACITOR-DISCHARGE-WELD PINS: COPPER- OR ZINC-COATED STEEL PIN, FULLY ANNEALED FOR CAPACITOR-DISCHARGE WELDING, 0.106-INCH- (2.6-MM-) DIAMETER SHANK, LENGTH TO SUIT DEPTH OF INSULATION INDICATED. PRODUCTS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE ONE OF THE FOLLOWING:
1. AGM INDUSTRIES, INC.; CWP-1.
2. GEMCO; CD.
3. MIDWEST FASTENERS, INC.; CD.
4. NELSON STUD WELDING; TPA, TPC, AND TPS.

J. INSTALLATION OF MINERAL-FIBER INSULATION:
BLANKET INSULATION INSTALLATION ON DUCTS AND PLENUMS: SECURE WITH ADHESIVE AND INSULATION PINS. APPLY ADHESIVES ACCORDING TO MANUFACTURER'S RECOMMENDED COVERAGE RATES PER UNIT AREA, FOR 100 PERCENT COVERAGE OF DUCT AND PLENUM SURFACES. APPLY ADHESIVE TO ENTIRE CIRCUMFERENCE OF DUCTS AND TO ALL SURFACES OF FITTINGS AND TRANSITIONS. INSTALL EITHER CAPACITOR-DISCHARGE-WELD PINS AND SPEED WASHERS OR CUPPED-HEAD, CAPACITOR-DISCHARGE-WELD PINS ON SIDES AND BOTTOM OF HORIZONTAL DUCTS AND SIDES OF VERTICAL DUCTS AS FOLLOWS:
1. ON DUCT SIDES WITH DIMENSIONS 18 INCHES (450 MM) AND SMALLER, PLACE PINS ALONG LONGITUDINAL CENTERLINE OF DUCT. SPACE 3 INCHES (75 MM) MAXIMUM FROM INSULATION END JOINTS, AND 16 INCHES (400 MM) O.C.
2. ON DUCT SIDES WITH DIMENSIONS LARGER THAN 18 INCHES (450 MM), PLACE PINS 16 INCHES (400 MM) O.C. EACH WAY, AND 3 INCHES (75 MM) MAXIMUM FROM INSULATION JOINTS. INSTALL ADDITIONAL PINS TO HOLD INSULATION TIGHTLY AGAINST SURFACE AT CROSS BRACING.
3. PINS MAY BE OMITTED FROM TOP SURFACE OF HORIZONTAL, RECTANGULAR DUCTS AND PLENUMS.
4. DO NOT OVERCOMPRESS INSULATION DURING INSTALLATION.
5. IMPALE INSULATION OVER PINS AND ATTACH SPEED WASHERS.
6. CUT EXCESS PORTION OF PINS EXTENDING BEYOND SPEED WASHERS OR BEND PARALLEL WITH INSULATION SURFACE. COVER EXPOSED PINS AND WASHERS WITH TAPE MATCHING INSULATION FACING.

FOR DUCTS AND PLENUMS WITH SURFACE TEMPERATURES BELOW AMBIENT, INSTALL A CONTINUOUS UNBROKEN VAPOR BARRIER. CREATE A FACING LAP FOR LONGITUDINAL SEAMS AND END JOINTS WITH INSULATION BY REMOVING 2 INCHES (50 MM) FROM ONE EDGE AND ONE END OF INSULATION SEGMENT. SECURE LAPS TO ADJACENT INSULATION SECTION WITH 1/2-INCH (13-MM) OUTWARD-CLINCHING STAPLES, 1 INCH (25 MM) O.C. INSTALL VAPOR BARRIER CONSISTING OF FACTORY- OR FIELD-APPLIED JACKET, ADHESIVE, VAPOR-BARRIER MASTIC, AND SEALANT AT JOINTS, SEAMS, AND PROTRUSIONS.
1. REPAIR PUNCTURES, TEARS, AND PENETRATIONS WITH TAPE OR MASTIC TO MAINTAIN VAPOR-BARRIER SEAL.
2. INSTALL VAPOR STOPS FOR DUCTWORK AND PLENUMS OPERATING BELOW 50 DEG F (10 DEG C) AT 18-FOOT (5.5-M) INTERVALS. VAPOR STOPS SHALL CONSIST OF VAPOR-BARRIER MASTIC APPLIED IN A Z-SHAPED PATTERN OVER INSULATION FACE, ALONG BUTT END OF INSULATION, AND OVER THE SURFACE. COVER INSULATION FACE AND SURFACE TO BE INSULATED A WIDTH EQUAL TO TWO TIMES THE INSULATION THICKNESS, BUT NOT LESS THAN 3 INCHES (75 MM).

OVERLAP UNFACED BLANKETS A MINIMUM OF 2 INCHES (50 MM) ON LONGITUDINAL SEAMS AND END JOINTS. AT END JOINTS, SECURE WITH STEEL BANDS SPACED A MAXIMUM OF 18 INCHES (450 MM) O.C. INSTALL INSULATION ON RECTANGULAR DUCT ELBOWS AND TRANSITIONS WITH A FULL INSULATION SECTION FOR EACH SURFACE. INSTALL INSULATION ON ROUND AND FLAT-OVAL DUCT ELBOWS WITH INDIVIDUALLY MITERED GORES CUT TO FIT THE ELBOW. INSULATE DUCT STIFFENERS, HANGERS, AND FLANGES THAT PROTRUDE BEYOND INSULATION SURFACE WITH 6-INCH- (150-MM-) WIDE STRIPS OF SAME MATERIAL USED TO INSULATE DUCT. SECURE ON ALTERNATING SIDES OF STIFFENER, HANGER, AND FLANGE WITH PINS SPACED 6 INCHES (150 MM) O.C.

DUCT LINER

A. FIBROUS-GLASS DUCT LINER: COMPLY WITH ASTM C 1071, NFPA 90A, OR NFPA 90B; AND WITH NAIMA AH124, "FIBROUS GLASS DUCT LINER STANDARD."

B. MAXIMUM THERMAL CONDUCTIVITY:
TYPE I, FLEXIBLE: 0.27 BTU X IN./H X SQ. FT. X DEG F (0.039 W/M X K) AT 75 DEG F (24 DEG C) MEAN TEMPERATURE. R6 EQUIVALENT.
TYPE II, RIGID: 0.23 BTU X IN./H X SQ. FT. X DEG F (0.033 W/M X K) - R6 EQUIVALENT.
ANTIMICROBIAL EROSION-RESISTANT COATING: APPLY TO THE SURFACE OF THE LINER THAT WILL FORM THE INTERIOR SURFACE OF THE DUCT TO ACT AS A MOISTURE REPELLENT AND EROSION-RESISTANT COATING. ANTIMICROBIAL COMPOUND SHALL BE TESTED FOR EFFICACY BY AN NRTL AND REGISTERED BY THE EPA FOR USE IN HVAC SYSTEMS.
WATER-BASED LINER ADHESIVE: COMPLY WITH NFPA 90A OR NFPA 90B AND WITH ASTM C 916. FOR INDOOR APPLICATIONS, USE ADHESIVE THAT HAS A VOC CONTENT OF 80 G/L OR LESS WHEN CALCULATED ACCORDING TO 40 CFR 59, SUBPART D (EPA METHOD 24).

C. SHOP APPLICATION OF DUCT LINER: COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," FIGURE 7-11, "FLEXIBLE DUCT LINER INSTALLATION." ADHERE A SINGLE LAYER OF INDICATED THICKNESS OF DUCT LINER WITH 100 PERCENT ADHESIVE COVERAGE AT LINER CONTACT SURFACE AREA. ATTAINING INDICATED THICKNESS WITH MULTIPLE LAYERS OF DUCT LINER IS PROHIBITED.

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