

MECHANICAL SPECIFICATIONS

TEST AND BALANCE (MINIMUM REQUIREMENTS)

- 1. TAB FIRM QUALIFICATIONS: ENGAGE A TAB FIRM CERTIFIED BY AABC, NEBB, OR TABB.
2. TAB CONFERENCE: MEET WITH OWNER'S AND/OR OWNERS REPRESENTATIVES ON APPROVAL OF TAB STRATEGIES AND PROCEDURES TO DEVELOP A MUTUAL UNDERSTANDING OF THE DETAILS. ENSURE THE PARTICIPATION OF TAB TEAM MEMBERS, EQUIPMENT MANUFACTURERS' AUTHORIZED SERVICE REPRESENTATIVES, HVAC CONTROL SYSTEMS INSTALLERS, AND OTHER SUPPORT PERSONNEL. PROVIDE SEVEN (7) DAYS' ADVANCE NOTICE OF SCHEDULE MEETING TIMES AND LOCATION.
3. TAB REPORT FORMS: USE STANDARD FORMS FROM SMACNA'S TABB "HVAC SYSTEMS - TESTING, ADJUSTING, AND BALANCING".
4. COORDINATE THE EFFORTS OF FACTORY-AUTHORIZED SERVICE REPRESENTATIVES FOR SYSTEMS AND EQUIPMENT, HVAC CONTROLS INSTALLERS, AND OTHER MECHANICS TO OPERATE HVAC SYSTEMS AND EQUIPMENT TO SUPPORT AND ASSIST TAB ACTIVITIES.
5. PERFORM TAB AFTER LEAKAGE AND PRESSURE TESTS ON AIR AND WATER DISTRIBUTION SYSTEMS HAVE BEEN SATISFACTORILY COMPLETED.
6. COMPLETE SYSTEM READINESS CHECKS AND PREPARE SYSTEM READINESS REPORTS. VERIFY THE FOLLOWING:
- PERMANENT ELECTRICAL POWER WIRING IS COMPLETE.
- HYDRONIC SYSTEMS ARE FILLED, CLEAN, AND FREE OF AIR.
- AUTOMATIC TEMPERATURE-CONTROL SYSTEMS ARE OPERATIONAL.
- EQUIPMENT AND DUCT ACCESS DOORS ARE SECURELY CLOSED.
- BALANCE, SMOKE, AND FIRE DAMPERS ARE OPEN.
- ISOLATING AND BALANCING VALVES ARE OPEN AND CONTROL VALVES ARE OPERATIONAL.
7. PERFORM TESTING AND BALANCING PROCEDURES ON EACH SYSTEM ACCORDING TO THE PROCEDURES CONTAINED IN SMACNA'S TABB "HVAC SYSTEMS - TESTING, ADJUSTING, AND BALANCING".
8. CUT INSULATION, DUCTS, PIPES, AND EQUIPMENT CABINETS FOR INSTALLATION OF TEST PROBES TO THE MINIMUM EXTENT NECESSARY TO ALLOW ADEQUATE PERFORMANCE OF PROCEDURES. AFTER TESTING AND BALANCING, CLOSE PROBE HOLES AND PATCH INSULATION WITH NEW MATERIALS IDENTICAL TO THOSE REMOVED. RESTORE VAPOR BARRIER AND FINISH ACCORDING TO INSULATION SPECIFICATIONS FOR THIS PROJECT.
9. MARK EQUIPMENT AND BALANCING DEVICE SETTINGS WITH PAINT OR OTHER SUITABLE, PERMANENT IDENTIFICATION MATERIAL, INCLUDING DAMPER-CONTROL POSITIONS, VALVE POSITION INDICATORS, FAN-SPEED CONTROL LEVERS, AND SIMILAR CONTROLS AND DEVICES, TO SHOW FINAL SETTING.
10. TAKE AND REPORT TESTING AND BALANCING MEASUREMENTS IN INCH-POUND (IP) UNITS.
11. PREPARE TEST REPORTS FOR BOTH FANS AND OUTLETS. OBTAIN MANUFACTURER'S OUTLET FLOWS AND RECOMMENDED TESTING PROCEDURES. CROSSCHECK THE SUMMATION OF REQUIRED OUTLET VOLUMES WITH REQUIRED FAN VOLUMES.
12. PREPARE SCHEMATIC DIAGRAMS OF SYSTEMS "AS-BUILT" DUCT LAYOUTS.
13. DETERMINE THE BEST LOCATIONS IN MAIN AND BRANCH DUCTS FOR ACCURATE DUCT AIRFLOW MEASUREMENTS.
14. CHECK AIRFLOW PATTERNS FROM THE OUTSIDE-AIR LOUVERS AND DAMPERS AND THE RETURN AND EXHAUST-AIR DAMPERS, THROUGH THE SUPPLY-FAN DISCHARGE AND MIXING DAMPERS.
15. LOCATE START-STOP AND DISCONNECT SWITCHES, ELECTRICAL INTERLOCKS, AND MOTOR STARTERS.
16. VERIFY THAT MOTOR STARTERS ARE EQUIPPED WITH PROPERLY SIZED THERMAL PROTECTION.
17. CHECK DAMPERS FOR PROPER POSITION TO ACHIEVE DESIRED AIRFLOW PATH.
18. CHECK FOR AIRFLOW BLOCKAGE.
19. CHECK CONDENSATE DRAINS FOR PROPER CONNECTIONS AND FUNCTIONING.
20. CHECK FOR PROPER SEALING OF AIR-HANDLING UNIT COMPONENTS.
21. CHECK FOR PROPER SEALING OF AIR DUCT SYSTEM.
22. ADJUST FANS TO DELIVER TOTAL INDICATED AIRFLOW WITHIN THE MAXIMUM ALLOWABLE FAN SPEED LISTED BY FAN MANUFACTURER.
23. MEASURE FAN STATIC PRESSURES TO DETERMINE ACTUAL STATIC PRESSURE AS FOLLOWS:
- MEASURE OUTLET STATIC PRESSURE AS FAR DOWNSTREAM FROM THE FAN AS PRACTICAL AND UPSTREAM
- MEASURE STATIC PRESSURE DIRECTLY AT THE FAN OUTLET OR THROUGH THE FLEXIBLE CONNECTION.
- MEASURE INLET STATIC PRESSURE OF SINGLE-INLET FANS IN THE INLET DUCT AS NEAR THE FAN AS POSSIBLE, UPSTREAM FROM FLEXIBLE CONNECTION AND DOWNSTREAM FROM DUCT RESTRICTIONS.
- MEASURE INLET STATIC PRESSURE OF DOUBLE-INLET FANS THROUGH THE WALL OF THE PLENUM THAT HOUSES THE FAN.
24. MEASURE STATIC PRESSURE ACROSS EACH COMPONENT THAT MAKES UP AN AIR-HANDLING UNIT, ROOFTOP UNIT, AND OTHER AIR-HANDLING AND -TREATING EQUIPMENT.
25. SIMULATE DIRTY FILTER OPERATION AND RECORD THE POINT AT WHICH MAINTENANCE PERSONNEL MUST CHANGE FILTERS.
26. MEASURE STATIC PRESSURES ENTERING AND LEAVING OTHER DEVICES SUCH AS SOUND TRAPS, HEAT RECOVERY EQUIPMENT, AND AIR WASHERS, UNDER FULL-BALANCED CONDITIONS.
27. COMPARE DESIGN DATA WITH INSTALLED CONDITIONS TO DETERMINE VARIATIONS IN DESIGN STATIC PRESSURES VERSUS ACTUAL STATIC PRESSURES. COMPARE ACTUAL SYSTEM EFFECT FACTORS WITH CALCULATED SYSTEM EFFECT FACTORS TO IDENTIFY WHERE VARIATIONS OCCUR. RECOMMEND CORRECTIVE ACTION TO DESIGN AND ACTUAL CONDITIONS.
28. DO NOT MAKE FAN-SPEED ADJUSTMENTS THAT RESULT IN MOTOR OVERLOAD. CONSULT EQUIPMENT MANUFACTURERS ABOUT FAN-SPEED AND SAFETY FACTORS. MODULATE DAMPERS AND MEASURE FAN-MOTOR AMPERAGE TO ENSURE THAT NO OVERLOAD WILL OCCUR. MEASURE AMPERAGE WHILE COOLING, FULL HEATING, ECONOMIZER, AND ANY OTHER OPERATING MODES. DETERMINE THE MAXIMUM REQUIRED BRAKE HORSEPOWER.
29. ADJUST VOLUME DAMPERS FOR MAIN DUCTS, MAIN BRANCH DUCTS, AND MAJOR BRANCH DUCTS TO INDICATED AIRFLOW WITHIN SPECIFIED TOLERANCES.
30. MEASURE STATIC PRESSURE AT A POINT DOWNSTREAM FROM THE BALANCING DAMPER AND ADJUST BALANCING DAMPER WITH THE PROPER STATIC PRESSURE IS ACHIEVED.
31. PREPARE SCHEMATIC DIAGRAMS OF SYSTEMS "AS-BUILT" PIPING LAYOUTS.
32. PREPARE INSTRUMENTATION SYSTEMS FOR TESTING AND BALANCING ACCORDING TO THE FOLLOWING, IN ADDITION TO THE GENERAL PREPARATION PROCEDURES SPECIFIED ABOVE:
- OPERATE ALL MANUAL VALVES FOR MAXIMUM FLOW.
- CHECK EXPANSION TANK LIQUID LEVELS AND SAFETY FACTORS.
- CHECK MAKEUP-WATER-STATION PRESSURE GAGE FOR ADEQUATE PRESSURE FOR HIGHEST VENT.
- CHECK FLOW-CONTROL VALVES FOR SPECIFIED SEQUENCE OF OPERATION AND SET AT INDICATED FLOW.
- SET DIFFERENTIAL-PRESSURE CONTROL VALVES AT THE SPECIFIED DIFFERENTIAL PRESSURE. DO NOT SET AT FULLY CLOSED POSITION WHEN PUMP IS POSITIVE-DISPLACEMENT TYPE UNLESS SEVERAL TERMINAL VALVES ARE KEPT OPEN.
- CHECK AIR VENTS FOR A FORCEFUL LIQUID FLOW EXITING FROM VENTS WHEN MANUALLY OPERATED.

- 33. SET CALIBRATED BALANCING VALVES, IF INSTALLED, AT CALCULATED PRESETTINGS.
34. MEASURE FLOW AT ALL STATIONS AND ADJUST, WHERE NECESSARY, TO OBTAIN FIRST BALANCE.
35. SYSTEM COMPONENTS THAT HAVE CV RATING OR AN ACCURATELY CATALOGED FLOW-PRESSURE-DROP RELATIONSHIP MAY BE USED AS A FLOW-INDICATING DEVICE.
36. MEASURE FLOW AT MAIN BALANCING STATION AND SET MAIN BALANCING DEVICE TO ACHIEVE FLOW THAT IS 5 PERCENT GREATER THAN INDICATED FLOW.
37. CHECK THE SETTING AND OPERATION OF AUTOMATIC TEMPERATURE-CONTROL VALVES, SELF-CONTAINED CONTROL VALVES, AND PRESSURE-REDUCING VALVES. RECORD THE FINAL SETTING.
38. VERIFY THAT CONTROLLERS ARE CALIBRATED AND COMMISSIONED.
39. CHECK TRANSMITTER AND CONTROLLER LOCATIONS AND NOTE CONDITIONS THAT WOULD ADVERSELY AFFECT CONTROL FUNCTIONS.
40. RECORD CONTROLLER SETTINGS AND NOTE VARIANCES BETWEEN SET POINTS AND ACTUAL MEASUREMENTS.
41. CHECK THE OPERATION OF LIMITING CONTROLLERS (I.E., HIGH- AND LOW-TEMPERATURE CONTROLLERS).
42. CHECK FREE TRAVEL AND PROPER OPERATION OF CONTROL DEVICES SUCH AS DAMPER AND VALVE OPERATORS.
43. CHECK THE SEQUENCE OF OPERATION OF CONTROL DEVICES. NOTE AIR PRESSURES AND DEVICE POSITIONS AND CORRELATE WITH AIRFLOW AND WATER FLOW MEASUREMENTS. NOTE THE SPEED OF RESPONSE TO INPUT CHANGES.
44. CHECK THE INTERACTION OF ELECTRICALLY OPERATED SWITCH TRANSDUCERS.
45. CHECK THE INTERACTION OF INTERLOCK AND LOCKOUT SYSTEMS.
46. RECORD VOLTAGES OF POWER SUPPLY AND CONTROLLER OUTPUT. DETERMINE WHETHER THE SYSTEM OPERATES ON A GROUNDED OR NONGROUNDED POWER SUPPLY.
47. NOTE OPERATION OF ELECTRIC ACTUATORS USING SPRING RETURN FOR PROPER FAIL-SAFE OPERATIONS.
48. SET HVAC SYSTEM AIRFLOW AND WATER FLOW RATES WITHIN THE FOLLOWING TOLERANCES:
- SUPPLY, RETURN, AND EXHAUST FANS AND EQUIPMENT WITH FANS: PLUS 5 TO PLUS 10 PERCENT.
- AIR OUTLETS AND INLETS: 0 TO MINUS 10 PERCENT.
- HEATING-WATER FLOW RATE: 0 TO MINUS 10 PERCENT.
- COOLING-WATER FLOW RATE: 0 TO MINUS 5 PERCENT.
49. FINAL REPORT SHALL BE TYPEWRITTEN, OR COMPUTER PRINTOUT IN LETTER-QUALITY FONT, ON STANDARD BOND PAPER, IN THREE-RING BINDER, TABULATED AND DIVIDED INTO SECTIONS BY TESTED AND BALANCED SYSTEMS.
50. FINAL REPORT CONTENTS: IN ADDITION TO CERTIFIED FIELD REPORT DATA, INCLUDE THE FOLLOWING:
- FAN CURVES.
- MANUFACTURER'S TEST DATA.
- FIELD TEST REPORTS PREPARED BY SYSTEM AND EQUIPMENT INSTALLERS.
- OTHER INFORMATION RELATIVE TO EQUIPMENT PERFORMANCE, BUT DO NOT INCLUDE SHOP DRAWINGS AND PRODUCT DATA.
51. TEST CONDITIONS FOR FANS AND PUMP PERFORMANCE FORMS INCLUDING THE FOLLOWING:
- SETTINGS FOR OUTSIDE-, RETURN-, AND EXHAUST-AIR DAMPERS.
- CONDITIONS OF FILTERS.
- COOLING COIL, WET- AND DRY-BULB CONDITIONS.
- FACE AND BYPASS DAMPER SETTINGS AT COILS.
- FAN DRIVE SETTINGS INCLUDING SETTINGS AND PERCENTAGE OF MAXIMUM PITCH DIAMETER.
- SETTINGS FOR SUPPLY-AIR, STATIC-PRESSURE CONTROLLER.
- OTHER SYSTEM OPERATING CONDITIONS THAT AFFECT PERFORMANCE.
52. SYSTEM DIAGRAMS: INCLUDE SCHEMATIC LAYOUTS OF AIR AND HYDRONIC DISTRIBUTION SYSTEMS. PRESENT EACH SYSTEM WITH SINGLE-LINE DIAGRAM AND INCLUDE THE FOLLOWING:
- QUANTITIES OF OUTSIDE, SUPPLY, RETURN, AND EXHAUST AIR FLOWS.
- WATER AND STEAM FLOW RATES.
- DUCT, OUTLET, AND INLET SIZES.
- PIPE AND VALVE SIZES AND LOCATIONS.
- TERMINAL UNITS.
- BALANCING STATIONS.
- POSITION OF BALANCING DEVICES.
53. AIR-HANDLING UNIT TEST REPORTS: FOR AIR-HANDLING UNITS WITH COILS INCLUDE THE FOLLOWING:
- UNIT IDENTIFICATION.
- LOCATION.
- MAKE AND TYPE.
- MODEL NUMBER AND UNIT SIZE.
- MANUFACTURER'S SERIAL NUMBER.
- UNIT ARRANGEMENT AND TYPE.
- DISCHARGE ARRANGEMENT.
- SHEAVE MAKE, SIZE, INCHES, AND BORE.
- SHEAVE DIMENSIONS, CENTER-TO-CENTER, AND AMOUNT OF ADJUSTMENTS IN INCHES.
- NUMBER OF BELTS, MAKE, AND SIZE.
- NUMBER OF PULLEYS, TYPE, AND SIZE.
- OR DATA.
- MAKE AND SHAPE, TYPE AND SIZE.
- CORSECS FOR ANGLE.
- VOLTS, PHASE, AMPERERTZ.
- FLOW, MAKEUP, LEAKAGE AND SERVICE FACTOR.
- SHEAVE MAKE, SIZE IN INCHES, AND BORE.
- SHEAVE DIMENSIONS, CENTER-TO-CENTER, AND AMOUNT OF ADJUSTMENTS IN INCHES.
TEST DATA (INDICATED AND ACTUAL VALUES):
- TOTAL AIRFLOW RATE IN CFM.
- TOTAL SYSTEM STATIC PRESSURE IN INCHES WG.
- FAN RPM.
- DISCHARGE STATIC PRESSURE IN INCHES WG.
- FILTER STATIC-PRESSURE DIFFERENTIAL IN INCHES WG.
- PREHEAT COIL STATIC-PRESSURE DIFFERENTIAL IN INCHES WG.
- COOLING COIL STATIC-PRESSURE DIFFERENTIAL IN INCHES WG.
- HEATING COIL STATIC-PRESSURE DIFFERENTIAL IN INCHES WG.
- OUTSIDE AIRFLOW IN CFM.
- RETURN AIRFLOW IN CFM.
- OUTSIDE-AIR DAMPER POSITION.
- RETURN-AIR DAMPER POSITION.
- VORTEX DAMPER POSITION.

DUCT INSTALLATION

- 1. DRAWING PLANS, SCHEMATICS, AND DIAGRAMS INDICATE GENERAL LOCATIONS AND ARRANGEMENT OF DUCT SYSTEM, INDICATED DUCT LOCATIONS, CONFIGURATIONS, AND ARRANGEMENTS WERE USED TO SIZE DUCTS AND CALCULATE FRICTION LOSS FOR AIR-HANDLING EQUIPMENT SIZING AND FOR OTHER DESIGN CONSIDERATIONS. INSTALL DUCT SYSTEMS AS INDICATED UNLESS DEVIATIONS TO LAYOUT ARE APPROVED ON SHOP DRAWINGS AND COORDINATION DRAWINGS.
2. INSTALL DUCT ACCORDING TO SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE" UNLESS OTHERWISE INDICATED.
3. INSTALL DUCTS WITH FEWEST POSSIBLE JOINTS.
4. INSTALL FACTORY - OR SHOP-FABRICATED FITTINGS FOR CHANGES IN DIRECTION, SIZE, AND SHAPE AND FOR BRANCH CONNECTIONS.
5. UNLESS OTHERWISE INDICATED, INSTALL DUCTS VERTICALLY AND HORIZONTALLY, AND PARALLEL AND PERPENDICULAR TO BUILDING LINES.
6. INSTALL DUCTS CLOSE TO WALLS, OVERHEAD CONSTRUCTION, COLUMNS, AND OTHER STRUCTURAL AND PERMANENT ENCLOSURE ELEMENTS OF BUILDING.
7. INSTALL DUCTS WITH A CLEARANCE OF 1 INCH, PLUS ALLOWANCE FOR INSULATION THICKNESS.
8. ROUTE DUCTS TO AVOID PASSING THROUGH TRANSFORMER VAULTS AND ELECTRICAL EQUIPMENT ROOMS AND ENCLOSURES.
9. WHERE DUCTS PASS THROUGH FIRE-RATED INTERIOR PARTITIONS AND EXTERIOR WALLS, INSTALL FIRE DAMPERS.
10. PROTECT DUCT INTERIORS FROM MOISTURE, CONSTRUCTION DEBRIS AND DUST, AND OTHER FOREIGN MATERIALS.
11. PROTECT EXPOSED DUCTS FROM BEING DENTED, SCRATCHED, OR DAMAGED.
12. TRIM DUCT SEALANTS FLUSH WITH METAL. CREATE A SMOOTH AND UNIFORM EXPOSED BEND. DO NOT USE TWO-PART TAPE SEALING SYSTEM.
13. GRIND WELDS TO PROVIDE SMOOTH SURFACE FREE OF BURRS, SHARP EDGES, AND DUST SPRATTER. WHEN WELDING STAINLESS STEEL WITH A NO. 3 OR 4 FINISH, GRIND THE WELDS FLUSH, POLISH THE EXPOSED WELDS, AND TREAT THE WELDS TO REMOVE DISCOLORATION CAUSED BY WELDING.
14. MAINTAIN CONSISTENCY, SYMMETRY, AND UNIFORMITY IN THE ARRANGEMENT AND FABRICATION OF FITTINGS, HANGERS AND SUPPORTS, DUCT ACCESSORIES, AND AIR OUTLETS.
15. REPAIR OR REPLACE DAMAGED SECTIONS AND FINISHED WORK THAT DOES NOT COMPLY WITH THESE REQUIREMENTS.
16. SEAL DUCTS TO THE FOLLOWING SEAL CLASSES ACCORDING TO THE SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE":
- COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE" SEAL CLASS A.
- OUTDOOR, SUPPLY-AIR DUCTS: SEAL CLASS A.
- OUTDOOR, EXHAUST DUCTS: SEAL CLASS A.
- OUTDOOR, RETURN-AIR DUCTS: SEAL CLASS B.
- UNCONDITIONED SPACE, SUPPLY-AIR DUCTS: SEAL CLASS B.
- UNCONDITIONED SPACE, RETURN-AIR DUCTS: SEAL CLASS B.
- UNCONDITIONED SPACE, SUPPLY-AIR DUCTS IN PRESSURE CLASSES HIGHER THAN 2 INCH WG. SEAL CLASS A.
- UNCONDITIONED SPACE, RETURN-AIR DUCTS IN PRESSURE CLASSES HIGHER THAN 2 INCH WG. SEAL CLASS B.
- UNCONDITIONED SPACE, EXHAUST DUCTS: SEAL CLASS B.
- UNCONDITIONED SPACE, RETURN-AIR DUCTS: SEAL CLASS C.
17. THE INSTALLATION OF ALL INSULATION SHALL BE PERFORMED BY AN EXPERIENCED CRAFTSMAN IN A NEAT WORKMANSHIP-LIKE MANNER AND SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S WRITTEN PUBLISHED RECOMMENDATIONS FOR SERVICE INTENDED.
18. CONCEALED INDOOR SUPPLY, RETURN & OUTDOOR AIR DUCTS SHALL BE INSULATED WITH A MINERAL-FIBER BLANKET, 2-INCHES THICK, 1.5-1.8 LB/CU FT. NOMINAL DENSITY.
19. EXPOSED INDOOR SUPPLY & RETURN DUCTS SHALL BE DOUBLE WALL DUCT OF SUFFICIENT CONSTRUCTION TO COMPLY WITH ENERGY CODE AND ASHRAE/IESNA 90.1.
20. EXPOSED OUTDOOR SUPPLY & EXHAUST AIR DUCTS SHALL BE INSULATED WITH A MINERAL-FIBERBOARD, 3-INCHES THICK, 3-LB/CU FT. NOMINAL DENSITY. INSTALL JACKET OVER INSULATION MATERIAL FOR INSULATION WITH FACTORY-APPLIED JACKET. INSTALL THE FIELD-APPLIED JACKET OVER THE FACTORY-APPLIED JACKET. DUCTS AND PLENUMS, EXPOSED, UP TO 48-INCHES IN DIAMETER OR WITH FLAT SURFACES UP TO 72 INCHES: ALUMINUM, SMOOTH MINIMUM 0.020 INCHES THICK.
21. ALL SUPPLY, RETURN & OUTDOOR AIR DUCTS ROUTED IN UNCONDITIONED SPACE SHALL HAVE MINIMUM R11 INSULATION. ALL OTHER INSULATION SHALL BE PER ENERGY CODE UNLESS OTHERWISE NOTED.
EQUIPMENT INSTALLATION - COMMON REQUIREMENTS
1. INSTALL EQUIPMENT LEVEL AND PLUMB, PARALLEL AND PERPENDICULAR TO OTHER BUILDING SYSTEMS AND COMPONENTS IN EXPOSED INTERIOR SPACES, UNLESS OTHERWISE INDICATED.
2. INSTALL HVAC EQUIPMENT TO FACILITATE SERVICE, MAINTENANCE, AND REPAIR OR REPLACEMENT OF COMPONENTS. CONNECT EQUIPMENT FOR EASE OF DISCONNECTING, WITH MINIMUM INTERFERENCE TO OTHER INSTALLATIONS. EXTEND GREASE FITTING TO ACCESSIBLE LOCATIONS.
3. INSTALL EQUIPMENT TO ALLOW RIGHT OF WAY FOR PIPING INSTALLED AT REQUIRED SLOPE.
4. DAMAGE AND TOUCHUP: REPAIR MARRED AND DAMAGED FACTORY-PAINTED FINISHES WITH MATERIALS AND PROCEDURES TO MATCH ORIGINAL FACTORY FINISH.
METAL DUCT
1. DUCT CONSTRUCTION, INCLUDING SHEET METAL THICKNESSES SEAM AND JOINT CONSTRUCTION, REINFORCEMENT, AND HANGERS AND SUPPORTS, SHALL COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE" AND DESIGN CRITERIA INDICATED IN "DUCT SCHEDULE" ARTICLE.
2. STRUCTURAL PERFORMANCE: DUCT HANGERS AND SUPPORTS SHALL WITHSTAND THE EFFECT OF GRAVITY LOADS AND STRESSES WITHIN LIMITS AND UNDER CONDITIONS DESCRIBED IN SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE".
3. AIR/STEAM SURFACES: SURFACES IN CONTACT WITH THE AIRSTREAM SHALL COMPLY WITH REQUIREMENTS IN ASHRAE 62.1-2004.

DUCT HANGER AND SUPPORT INSTALLATION

- 1. COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," CHAPTER 4, "HANGERS AND SUPPORTS."
2. HANGER SPACING: COMPLY WITH SMACNA'S "HVAC DUCT CONSTRUCTION STANDARDS - METAL AND FLEXIBLE," TABLE 4-1, "RECTANGULAR DUCT HANGER MINIMUM SIZE," AND TABLE 4-2, "MINIMUM HANGER SIZES FOUR ROUND DUCT;" FOR MAXIMUM HANGER SPACING; INSTALL HANGERS AND SUPPORTS WITHIN 24 INCHES OF EACH ELBOW AND WITHIN 48 INCHES OF EACH BRANCH INTERSECTION.
3. HANGERS EXPOSED TO VIEW: THREADED ROD AND ANGLE OR CHANNEL SUPPORTS.
4. SUPPORT VERTICAL DUCTS WITH STEEL ANGLES OR CHANNEL SECURED TO THE SIDES OF THE DUCT WITH WELDS, BOLTS, SHEET METAL SCREWS, OR BLIND RIVETS; SUPPORTED LOADS AND BUILDING MATERIALS WHERE USED.
REFRIGERANT SYSTEM CHARGING
CHARGING SYSTEM USING THE FOLLOWING PROCEDURES:
1. INSTALL CORE IN FILTER DRYERS AFTER LEAK TEST BUT BEFORE EVACUATION.
2. EVACUATE ENTIRE REFRIGERANT SYSTEM WITH A VACUUM PUMP TO 500 MICROMETERS. IF VACUUM HOLDS FOR 12 HOURS, SYSTEM IS READY FOR CHARGING.
3. BREAK VACUUM WITH REFRIGERANT GAS, ALLOWING PRESSURE TO BUILD UP TO 2 PSIG.
4. CHARGE SYSTEM WITH A NEW FILTER-DRYER CORE IN CHARGE LINE.
REFRIGERANT PIPING INSTALLATION
1. DRAWING PLANS, SCHEMATICS, AND DIAGRAMS INDICATE GENERAL LOCATION AND ARRANGEMENT OF PIPING SYSTEMS; INDICATED LOCATIONS AND ARRANGEMENTS WERE USED TO SIZE PIPES AND CALCULATE FRICTION LOSS, EXPANSION JOINT SIZING, AND OTHER DESIGN CONSIDERATIONS. INSTALL PIPING AS INDICATED UNLESS DEVIATIONS TO LAYOUT ARE APPROVED ON SHOP DRAWINGS.
2. INSTALL REFRIGERANT PIPING ACCORDING TO ASHRAE 15.
3. INSTALL PIPING IN CONCEALED LOCATIONS UNLESS OTHERWISE INDICATED AND EXCEPT FOR EQUIPMENT ROOMS AND SERVICES AREAS.
4. INSTALL PIPING INDICATED TO BE EXPOSED AND PIPING IN EQUIPMENT ROOMS AND SERVICE AREAS AT RIGHT ANGLES OR PARALLEL TO BUILDING WALLS. DIAGONAL RUNS ARE PROHIBITED UNLESS SPECIFICALLY INDICATED OTHERWISE.
5. INSTALL PIPING ABOVE ACCESSIBLE CEILING TO ALLOW SUFFICIENT CLEARANCE FOR CEILING PANEL REMOVAL.
6. INSTALL PIPING ADJACENT TO MACHINES TO ALLOW SERVICE AND MAINTENANCE.
7. INSTALL PIPING FREE OF SAGS AND BENDS.
8. INSTALL FITTING FOR CHANGES IN DIRECTION AND BRANCH CONNECTIONS.
9. SELECT SYSTEM COMPONENTS WITH PRESSURE RATING EQUAL TO OR GREATER THAN SYSTEM OPERATING PRESSURE.
10. INSTALL PIPING AS SHORT AND DIRECT AS POSSIBLE, WITH A MINIMUM NUMBER OF JOINTS, ELBOWS, AND FITTINGS.
11. ARRANGE PIPING TO ALLOW INSPECTION AND SERVICE OF REFRIGERATION EQUIPMENT. INSTALL VALVES AND SPECIALTIES IN ACCESSIBLE LOCATIONS TO ALLOW FOR SERVICE AND INSPECTION. INSTALL ACCESS DOORS OR PANELS AS IF VALVES OR EQUIPMENT REQUIRING MAINTENANCE IS CONCEALED BEHIND FINISHED SURFACES.
12. INSTALL REFRIGERANT PIPING IN PROTECTIVE CONDUIT WHERE INSTALLED BELOW GROUND.
13. INSTALL REFRIGERANT PIPING IN RIGID OR FLEXIBLE CONDUIT IN LOCATIONS WHERE EXPOSED TO MECHANICAL INJURY.
14. SLOPE REFRIGERANT PIPING AS FOLLOWS:
- INSTALL HORIZONTAL HOT-GAS DISCHARGE PIPING WITH A UNIFORM SLOPE DOWNWARD AWAY FROM COMPRESSOR.
- INSTALL HORIZONTAL SUCTION LINES WITH A UNIFORM SLOPE DOWNWARD TO COMPRESSOR.
- INSTALL TRAPS AND DOUBLE RISERS TO ENTRAIN OIL IN VERTICAL RUNS.
- LIQUID LINES MAY BE INSTALLED LEVEL.
15. WHEN BRAZING OR SOLDERING, REMOVE SOLENOID-VALVE COILS AND SIGHT GLASSES; ALSO REMOVE VALVE STEMS, SEATS, AND PACKING, AND ACCESSIBLE INTERNAL PARTS OF REFRIGERANT SPECIALTIES. DO NOT APPLY HEAT NEAR EXPANSION-VALVE BULB.
16. INSTALL PIPING WITH ADEQUATE CLEARANCE BETWEEN PIPE AND ADJACENT WALLS AND HANGERS OR BETWEEN PIPES FOR INSULATION INSTALLATION.
17. INSTALL SLEEVES FOR PIPING PENETRATIONS OF WALLS, CEILING, AND FLOORS.
18. INSTALL SLEEVES SEALS FOR PIPING PENETRATIONS OF CONCRETE WALLS AND SLABS.
19. INSTALL ESCUTCHEONS FOR PIPING PENETRATIONS OF WALLS, CEILINGS, AND FLOORS.

REFRIGERANT PIPE JOINT CONSTRUCTION

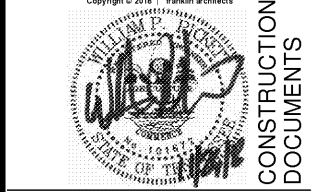
- SOLDERED JOINTS: CONSTRUCT JOINTS ACCORDING TO ASTM B 828 OR CDA'S "COPPER TUBE HANDBOOK."
BRAZED JOINTS: CONSTRUCT JOINTS ACCORDING TO AWS'S "BRAZING HANDBOOK," CHAPTER "PIPE AND TUBE."
- USE TYPE BCUP, COPPER-PHOSPHORUS ALLOY FOR JOINING COPPER SOCKET FITTINGS WITH COPPER PIPE.
- USE TYPE BAG, CADMIUM-FREE SILVER ALLOY FOR JOINING COPPER WITH BRONZE OR STEEL.
REFRIGERANT PIPE HANGERS AND SUPPORTS
PIPING HANGERS AND SUPPORTS MUST ACCOMMODATE EXPANSION AND CONTRACTION, VIBRATION, DEAD LOAD OF PIPING AND ITS CONTENTS, AND SEISMIC-BRACING REQUIREMENTS
1. HANGER, SUPPORT, AND ANCHOR PRODUCTS ARE SPECIFIED IN SECTION 230529 "HANGERS AND SUPPORTS FOR PIPING AND EQUIPMENT."
2. INSTALL THE FOLLOWING PIPE AND SUPPORTS:
- ADJUSTABLE HANGERS, CLEVIS HANGERS FOR INDIVIDUAL HORIZONTAL RUNS AND THREADED HANGERS FOR INDIVIDUAL HORIZONTAL RUNS 20 FEET OR LOWER.
- PIPE ROLLER, MSS SP-57 TYPE 44 FOR MULTIPLE HORIZONTAL PIPING 20 FEET OR LONGER.
- SPRING HANGERS TO SUPPORT VERTICAL RUNS.
- COPPER-CLAMP HANGERS AND SUPPORTS FOR HANGERS AND SUPPORTS IN DIRECT CONTACT WITH COPPER PIPE.
3. INSTALL HANGERS FOR COPPER TUBING WITH THE FOLLOWING MAXIMUM SPACING AND MINIMUM ROD SIZES:
- VERIFY ACTUAL SUPPORTED LOADS FOR HANGERS SIZES AND SPACING. CONSULT STRUCTURAL ENGINEER. SPACING AND SIZES IN SUBPARAGRAPHS BELOW ARE FROM THE 2000 ASHRAE HANDBOOK - "HVAC SYSTEMS AND EQUIPMENT."
- NPS 1/2: MAXIMUM SPAN, 60 INCHES; MINIMUM ROD SIZE, 1/4 INCH.
- NPS 3/8: MAXIMUM SPAN, 60 INCHES; MINIMUM ROD SIZE, 1/4 INCH.
- NPS 1/2: MAXIMUM SPAN, 72 INCHES; MINIMUM ROD SIZE, 1/4 INCH.
- NPS 3/4: MAXIMUM SPAN, 96 INCHES; MINIMUM ROD SIZE, 3/8 INCH.
- NPS 1-1/2: MAXIMUM SPAN 96 INCHES; MINIMUM ROD SIZE, 3/8 INCH.
- SUPPORT MULTIFLOOR VERTICAL RUNS AT LEAST AT EACH FLOOR.
REFRIGERANT PIPE FIELD QUALITY CONTROL
1. PERFORM TEST AND INSPECTIONS AND PREPARE TEST REPORTS.
2. TESTS AND INSPECTIONS:
- COMPLY WITH ASME B31.5, CHAPTER VI.
- TEST REFRIGERANT PIPING AND SPECIALTIES, ISOLATE COMPRESSOR, CONDENSER, EVAPORATOR, AND SAFETY DEVICES FROM TEST PRESSURE IF THEY ARE NOT RATED ABOVE THE TEST PRESSURE.
- TEST HIGH- AND LOW-PRESSURE SIDE PIPING OF EACH SYSTEM SEPARATELY AT NOT LESS THAN THE PRESSURES INDICATED IN PART 1 "PERFORMANCE REQUIREMENTS" ARTICLE.
a. FILL SYSTEM WITH NITROGEN TO THE REQUIRED TEST PRESSURE.
b. SYSTEM SHALL MAINTAIN TEST PRESSURE AT THE MANIFOLD GAGE THROUGHOUT DURATION OF TEST.
c. TEST JOINTS AND FITTINGS WITH ELECTRONIC LEAK DETECTOR OR BY BRUSHING A SMALL AMOUNT OF SOAP AND GLYCERIN SOLUTION OVER JOINTS.
d. REMAKE LEAKING JOINTS USING NEW MATERIALS, AND RETEST UNTIL SATISFACTORY RESULTS ARE ACHIEVED.
REFRIGERANT SYSTEM ADJUSTING
1. ADJUST THERMOSTATIC EXPANSION VALVE TO OBTAIN PROPER EVAPORATOR SUPERHEAT.
2. ADJUST HIGH- AND LOW-PRESSURE SWITCH SETTINGS TO AVOID SHORT CYCLING IN RESPONSE TO FLUCTUATING SUCTION PRESSURE.
3. ADJUST SET-POINT TEMPERATURE OF AIR-CONDITIONING OR CHILLED-WATER CONTROLLERS TO THE SYSTEM DESIGN TEMPERATURE.
4. PREFORM THE FOLLOWING ADJUSTMENTS BEFORE OPERATING THE REFRIGERATION SYSTEM, ACCORDING TO MANUFACTURER'S WRITTEN INSTRUCTIONS.
- OPEN SHUTOFF VALVES IN CONDENSER WATER CIRCUIT.
- VERIFY THAT COMPRESSOR OIL LEVEL IS CORRECT.
- OPEN COMPRESSOR SUCTION AND DISCHARGE VALVES.
- OPEN REFRIGERANT VALVES EXCEPT BYPASS VALVES THAT ARE USED FOR OTHER PURPOSES.
- CHECK OPEN COMPRESSOR-MOTOR ALIGNMENT AND VERIFY LUBRICATION FOR MOTORS AND BEARINGS.
5. REPLACE CORE OF REPLACEABLE FILTER DRYER AFTER SYSTEM HAS BEEN ADJUSTED AND AFTER DESIGN FLOW RATES AND PRESSURES ARE ESTABLISHED.

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