

CHAPTER 15GREFRIGERATION AND AIR CONDITIONING15G-01 GENERAL

This chapter covers Refrigeration and Air Conditioning for both the central and unitary type systems.

Since there is generally a duplication in the requirements for piping and ductwork for this subject and for plumbing and air handling, and since those areas have been covered in previous chapters, it will be necessary for the inspector to be very familiar with the piping area of Chapter 15A and the ductwork section of Chapter 15C.

When the work appears to be beyond the scope of the inspector, technical assistance should be requested promptly.

15G-02 PIPINGa. Refrigerator Piping

- (1) Determine where copper or black steel will be used, and the type required.
- (2) Make sure the piping and fittings have been approved.
- (3) Check the method of installing piping. See Section 15A.
- (4) Make sure piping is stored as prescribed in specifications.

b. Water Piping

- (1) Check the type of piping required for chilled water and condenser water systems. See Section 15A.
- (2) Determine weight and class of piping.
- (3) Make sure the specified and approved piping, fittings and jointing materials are being used.

c. Installation

- (1) Utilize paragraphs 15A-02 and 15A-03 as a check list for fabricating and installing piping. Watch specifically for workmanship, supports, and sleeves.
- (2) Be especially careful to:
 - (a) Make sure the specified solder is used. Check soldering of joints.
 - (b) See that internal valve parts are removed from valves, and that valves are wet wrapped before soldering.
 - (c) See that joints are thoroughly cleaned before soldering.
 - (d) Check on the removal of excess flux and acid after joints are made.

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(3) Make sure the proper type flexible connections are installed in the required locations.

(4) See that unions or flanges are installed at all equipment, at control valves, and at other points that will facilitate maintenance.

(5) Check carefully for the proper slope of all lines. Assure slope of refrigerant lines to provide movement of oil through the system.

(6) Check installation for improper configuration of piping. Make sure the installation conforms with the approved drawing. If there is any question about the requirement for the arrangement of piping and if there is no approved drawing, obtain the drawing before allowing the contractor to proceed.

(7) Make sure air vents are installed at high points in water lines and that drains are installed at low points.

(8) Do not allow gate valves to be installed where globe valves are required.

(9) Be sure balancing cocks are installed as required to permit proper balancing.

(10) Do not install swing check valves in vertical lines with a downward flow of water.

(11) Check for the installation of such required items as pressure gages, thermal elements, thermometer wells, etc.

(12) Provide adequate number and type of hangers. Hangers on uninsulated copper pipe must be electrolytically coated or made of solid compatible non ferrous metals.

(13) Check for the proper installation of oil traps and double risers in refrigerant lines.

(14) Check valves for pressure setting and discharge locations.

(15) Be sure that refrigerant system is evacuated prior to charging and accomplished according to job specifications.

(16) Make sure the system is charged with the required type and amount of refrigerant.

(17) See that the system is completely checked for leaks. Dry nitrogen must be used for pressure tests.

(18) Double check to see that there are no unnecessary oil traps.

(19) Vacuum should be broken by charging the system with dry refrigerant for which the system is designed.

d. Insulation

(1) Determine whether the material on the job has been approved for the particular piping being installed. Make sure insulations, vapor barriers, adhesives and sealers are noncombustible or fire retardant as specified. See Section 15C Mechanical Insulation.

(2) Note that heating water piping is insulated differently from both chilled water piping and combination chilled and heated water piping.

(3) Check thickness of insulation and of vapor barrier finish.

(4) Determine that insulation jackets which are exposed to view are paintable.

(5) Examine the requirements for the insulation of flanges, fittings, and valves, and assure compliance with the specifications.

(6) Check the lap and the sealing at joints.

(7) Be very careful to see that there are no breaks in the vapor barrier. Watch for later damages during construction.

(8) Check specification requirements for extending insulation through sleeves in walls, floors, and ceilings; chilled water lines inside cabinets of fan coil units should be insulated as required to prevent condensate dripping on floor.

(9) Make sure that pipe hangers are installed over insulation. Metal Shields to be provided between hanger ring and insulation. High density insulation insert shall be installed with a length equal to length of metal shield.

(10) Check for the neat termination and seal of insulation at the end of insulation.

(11) Know the special requirements for insulation and jacketing of piping exposed to weather.

(12) Check the installation, the width, and the spacing of the bands used on pipe jacketing.

15G-03 EQUIPMENT

a. General

(1) All equipment should be checked to see that it is approved before it is needed on the job. When equipment arrives on the job, it should be checked against shop drawing. During installation, the contractor*s work should be checked against the contract plans and specifications, the approved shop drawing, and the manufacturer*s recommendations.

(2) Be sure that no damaged equipment is installed.

(3) See that equipment is stored in a manner that will insure that the equipment be like new when installed.

(4) Be sure that all refrigeration equipment is installed strictly in accordance with the safety code for mechanical refrigeration.

(5) Check on space requirements for equipment. Obtain an equipment room layout drawing and make sure that adequate clearances are provided for maintenance and operation.

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(6) Determine the need for access panels. A common error is the failure to provide the means for pulling condenser and chiller tubes.

(7) Make sure that all rotating parts, such as belts, chains, sheaves, shaft couplings, etc. are covered to protect personnel.

(8) Check the type of motors on equipment, the type of motor starter, heaters in the motor starters, and voltage of motor.

(9) Make sure all equipment is lubricated according to manufacturer*s recommendations. This includes motor bearings.

b. Condensers

(1) See that air flow is not obstructed and that wind deflectors are installed, if required, in air cooled condensers.

(2) Inspect water cooled condensers for leaks and proper flow.

(3) Check evaporative condensers for:

(a) Spray coverage.

(b) Float valve operation without chatter.

(c) Water level.

(d) Fan rotation and speed.

(e) Pump suction strainer.

(f) Liquid discharge line carried full size to first elbow, with a 12-inch to 18-inch drop to receiver.

(g) Mesh size of inlet screens.

(h) Pan, casing, eliminators, fan corrosion protection, and complete drainage.

(i) Provision for and adjustment of constant bleeding.

(4) For all season air cooled condensers manufacturers recommended installation should be adhered to. Check project plans, specifications, and manufacturers recommended installation to see if condenser flooding or air volume control is required.

c. Reciprocating Compressors

Check for:

(1) Oil, suction, and discharge pressures.

(2) Shaft alignment on direct-driven machines.

(3) Operation of high pressurestat, low pressurestat, and oil pressure failure switch.

(4) Proper level viscosity of oil.

- (5) Installation of required gages.
- (6) Amount, correct type, and dryness of refrigerant charge.
- (7) Pressure holding ability upon pump-down.
- (8) Isolator deflection and compressor vibration.
- (9) Suction strainer screen mesh, and removal of startup belts.
- (10) Unloader action.
- (11) Compressor speed.
- (12) Belt tension and alignment.
- (13) Motor amperage under maximum load.
- (14) Refrigerant flood back and oil foaming.
- (15) Cylinder head overheating.
- (16) Rotation.
- (17) Automatic oil heater in crank case. Heater should work during shutdown.
- (18) Loops in refrigerant piping as loops will permit oil to be trapped.
- (19) Damage of equipment compressor - should not be run during vacuum tests.

d. Centrifugal Compressors

Check for:

- (1) Alignment of compressor, drive and gear box.
- (2) Suction damper or inlet vane operation.
- (3) Safety control circuit operation.
- (4) Purge compressor operation.
- (5) Float valve operation, if furnished.
- (6) Oil pump and cooler operation.
- (7) Noise and vibration.
- (8) Required gages.

e. Receivers

Check for:

- (1) Location, if installed on the outside of the building. Do not place in direct rays of sun.
- (2) Relief valves are adequate size.

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(3) ASME Stamp.

(4) Drain, purge valve, liquid level indication, and shut-off valves.

f. Water Chillers

(1) Examine water drains, vents, and correct pass arrangement in direct expansion type chillers.

(2) Inspect for freeze protection safety devices.

(3) Check strength of liquid bleed-off at bottom of flooded chillers. Check adjustment of level control.

(4) Check tubes and shell in brine chiller for type of material.

g. Evaporative Coolers

Inspect for adequate spray coverage, non sagging media, water carry-through, correct water level in sump, and lack of float valve "chatter.

h. Unit Coolers

Check:

(1) For corrosion-protected pan and casing.

(2) Water defrost units for spray coverage with no carryover.

(3) Electric defrost units, for cycle timing in accordance with the job conditions.

(4) Hot gas defrost, for suction pressures and refrigerant charge in accordance with manufacturer*s recommendations.

(5) Drainage during defrost cycle.

(6) Cycle timing.

(7) That drain lines are properly trapped on the warm end.

i. Refrigeration Specialties

Check:

(1) Superheat setting of expansion valves and that bulb and equalizer position is in accordance with the manufacturer*s recommendations.

(2) Solenoid valve for vertical stem, correct direction of refrigerant flow, and manual opener disengaged.

(3) Unobstructed view of sight glass.

(4) Operation of evaporator pressure regulator under light load.

(5) Operation of hold-back value upon start-up.

(6) Float valves or switches mounted level and at a height which will insure correct liquid level in the evapoess before opening of refrigerant drier canisters.

(7) Airtightness before opening of refrigerant drier canisters.

(8) Drier; if it is the replaceable type, piping will be arranged to facilitate replacement - 3 valve bypass.

(9) Piping connections of liquid-suction heat exchanger.

(10) That direct expansion coils are installed as recommended by manufacturer.

(11) That pans of fan-coil units are protected against corrosion.

(12) That drain pans are installed under all units, or as needed, to collect condensate.

j. Package-Type Air Conditioners

Check the following:

(1) High-pressure cutout setting.

(2) Compressor hold-down bolts (for shipping) removed.

(3) Drip pan should be watertight and connected to open drain.

(4) Water regulator valve operation, if used.

(5) Installation of air filters and strainers.

(6) Operation of thermostat.

(7) Suction and discharge pressures of refrigeration compressors.

k. Washers

(1) Check the following features of the spray-type air washers:

(a) All nozzles discharging water spray.

(b) No water should carry over from eliminators.

(c) Eliminators must not rattle, and they must be removable for maintenance.

(d) Float valve should not "chatter" on opening or closing.

(2) Check the following features of the capillary-type washers:

(a) Media should not sag in frames.

(b) Wetting of all media.

(c) Water level is at correct height.

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1. Humidifiers and Dehumidifiers

(1) Examine the humidifiers for supported coil and corrosion-protected pan.

(2) Check refrigeration type dehumidifiers for frosting of cooling coil and for water carry-over.

(3) Check absorption type dehumidifiers for the following:

(a) Solution level and temperature controls.

(b) No solution should carry over from eliminators.

(c) Regenerator duct must be drained of specified material, and correctly sealed.

(d) Damper operation, cycle timing, evidence of "dusting" of the desiccant, and regenerative temperatures.

m. Absorption Refrigeration Machine

Check the following:

(1) Cleanliness of all parts during erection.

(2) Proper materials.

(3) Access for removing tubes from absorber-evaporator and generator-condenser.

(4) Control operation, especially high and low-limit temperature cutouts or condenser water pump interlock.

(5) Operation of purge system.

(6) Unit to be fully charged with water and a nontoxic absorber after installation.

(7) Services of a factory representative for charging, testing, starting the plant, and providing instruction.

n. Cooling Towers and Ponds

(1) Check mechanical-draft cooling towers for unobstructed air intake, fan rotation and speed, belt tension, stacked fill, and weather protection of motor. (Do not allow open fan motors when totally enclosed motors are specified.) Insure that water-flow through outlet does not form a vortex which draws air in with the water. Check operation of water temperature control and drainage devices.

(2) Observe spray ponds for evenness of sprays and for water drift.

(3) Insure provision for an adjustment of constant bleed.

(4) See that mist eliminators are installed when specified.

(5) Insure the installation of over-flow and drain piping.

(6) See that the water is at adequate level after operation, and that spray-pump operates.

(7) Check belt alignment and tension.

o. Pumps

(1) Assure that manufacturer*s name-plates, equipment, serial numbers, or code stamps are not covered or hidden from view after installation.

(2) Check for anchorage of pump in compliance with contract.

(3) Check alignment of pump with motor and piping.

(4) Make sure that all gages and meters are provided.

(5) See that eccentric reducers, in lieu of concentric reducers, are used in suction piping, and that the flat side is turned up.

(6) Check for adequate support of piping around pump.

(7) Be sure check valve is installed in discharge piping.

(8) Check pump packing. Make sure adequate packing is installed to allow gland take-up.

(9) Check for excess vibration and flexible piping connections if required.

(10) Make sure that the pump motor is weatherproof when specified, and that it is connected to rotate correctly.

(11) Recheck oil sumps after operation, if applicable.

p. Insulation

(1) Check for:

(a) Proper insulation of chilled water pumps.

(b) Insulated converters and expansion tanks.

(c) Insulated condensate drain pans of air handling units.

(d) Protective finish over such items as pumps, converters tanks, fans, etc.

(2) Insure that all insulating materials have been approved and that they are of the specified thickness.

(3) Check the method of attaching insulation to equipment.

(4) Make sure that specified reinforcing is provided in adhesive plaster finish.

(5) See that corner angle beads are installed at the specified corners.

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(6) See that the adhesive finish coat has smooth, pleasing finish.

(7) Check on the application of vapor barriers to see that they effectively seal out all moisture.

15G-04 CONTROLS

a. Review all control installations with approved control shop drawings, to assure that they are being installed in strict conformance with the drawings.

b. See that dampers are mounted securely on rigid supports, and that the correct bearings are provided on the blade axles.

c. Note damper motors while fan is on, and check linkage between damper and motor.

d. Examine valve operations for tight closing.

e. Examine electrical equipment for interlocking.

f. Check on the installation of all required alarm bells.

g. See that freeze-stats are installed as specified.

h. Check for proper electrical current and voltage in the control system. Carefully check the operation of solenoid valves.

i. Check that air compressor location will permit tank drain operation, and check for cycle time with all operating controls.

j. Verify clean elements in humidistats when the system is started.

k. Evaluate pneumatic systems for air-tightness, restrictions caused by flattening of the tubing, and cleanliness of the system.

l. Inspect electronic systems for grounded shielded cable, and location of amplifiers with respect to magnetic fields, such as large transformers.

m. View graphic panels for damaged plastic, dirt between plastic and back plate, lacing of control wires and access for service to all controls.

n. Verify control instructions, including sequence of operations, and control drawing furnished by the contractor when conducting final acceptance test. Check each function of the controls.

15G-05 TESTING

a. Submittals

Be sure the contractor obtains approval of test procedures and other pertinent information prior to testing.

b. Procedures

(1) Make a record of all tests, including such information as who attended, methods and procedures of test, results, and conclusions. Check specifications to determine that contractor is recording sufficient data to comply with requirements.

(2) Before tests are scheduled, see that contractor has proper tools, equipment, and instruments, and gages should be certified and pretested.

(3) See that equipment is thoroughly checked and prepared for tests.

(4) Make sure strainers and filters are clean immediately prior to test.

c. Types

(1) Check the testing of refrigerant piping. See that specified pressure is put on the lines. Make sure all joints are checked, and that leaks are detected, repaired, and retested until found satisfactory. Isolate all items which may be damaged by high pressure.

(2) See that hydrostatic test is performed on all water piping. Carefully check to see if there is a loss in pressure during the test.

(3) See that a performance test on the system is run for the duration specified. Make sure needed corrections and adjustments are made as determined during test. See that the contractor records all data required for the performance test.

(4) After successful tests, install a new oil charge in compressor. Change oil filters and socks, and provide new cartridge in refrigerant drier. (Oil charge is not required for factory sealed units)

15G-06 PAINTING

a. See that equipment is furnished with the correct finish. Watch for abrasions.

b. Watch for miscellaneous ferrous metal items that are not primed.

c. Require touching up, priming, and finish painting as specified.

d. Apply asphaltic varnish on all hangers and other items not to be painted.

e. Require piping identification on coding as specified.

15G-07 OPERATING INSTRUCTIONS AND GUARANTIES

a. See that equipment guaranties, schematic flow diagrams, and instructions for the operation of equipment are furnished and posted.

b. Arrange for future operating personnel to be instructed on the operation of equipment. Make a record of instruction periods, including any complications, instructing personnel, and personnel instructed.