

CHAPTER 15EHEATING SYSTEMS15E-01 GENERAL

a. This chapter covers material, equipment, and good workmanship practices for the installation of heating systems.

b. The QA Rep should strive to obtain systems in accordance with the contract requirements that are safe, adequate, and neat, and which function properly with a minimum of routine maintenance.

c. In combination heating-cooling systems designed for year-round automatic air conditioning, coordinate material of this section with Section 15F, VENTILATING, AIR SUPPLY AND DISTRIBUTION SYSTEMS, 15G REFRIGERATION AND AIR CONDITIONING, AND SECTION 15C MECHANICAL INSULATION.

15E-02 MATERIALS AND EQUIPMENTa. General

(1) Make sure that each piece of material and each item of equipment has been approved well in advance of its need. When the material and equipment arrive on the job, inspect them very carefully, comparing them with the approved shop drawing and samples. Check and record nameplate data on all equipment.

(2) Determine that there is adequate space in the room for proper functioning and maintenance of all the equipment.

(3) Reject all damaged materials and equipment and have them removed from the site.

(4) Check the electrical features of equipment and coordinate with the mechanical features.

(5) Determine that provisions have been made for access panels.

(6) Check the required controls and valves for compliance with contract requirements.

(7) Check specification provisions for necessary spare parts and tools for all of the equipment.

(8) See that operations and maintenance instructions are with equipment and are posted on the wall upon completion of installation.

(9) Require proper storage and protection of all materials and equipment.

(10) Check the noise level of all equipment.

(11) Verify requirements for the installation of flexible pipe connections and vibration eliminators for equipment.

(12) Check the installation of all equipment for compliance with manufacturer\*s recommendations.

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b. Boilers, Furnaces, and Accessory Equipment

(1) Examine pressure boilers for conformance with the ASME Code.

(2) Check for all necessary connections on the boiler.

(3) Check cast iron boilers, if field assembled, for tightness of joints.

(a) All joints shall be sealed.

(b) Reject cracked section.

(4) Inspect refractory furnaces built up on the job for materials and workmanship.

(a) Require expansion joints to be provided. Piping on both sides of expansion joints should be properly guided.

(b) Insure packing to prevent gas or air leakage.

(c) Reject all cracked, chipped or otherwise damaged brick and tile.

(d) Check plastic refractories for placement, thorough ramming, and consistency.

(a) Require refractories to be kept dry.

(f) Inspect for use of refractory mortar in construction of combustion chamber.

(g) Check for air circulation under the combustion chamber floors.

(5) Inspect the application of insulation after all joints are tightly sealed. Check material, thickness, and finish.

(6) Observe accessory equipment operation such as feedwater controllers, dampers, pressure and draft gages, flow and pressure recorders, soot blowers, water columns and boiler blowdown. Check the pressurestat differential.

(7) Check requirement for expansion joint in floor around boiler.

c. Fuel Burning Equipment

(1) Coal, Hand-Fired. Verify installation of grates and operation of dumping mechanism.

(2) Coal, Stoker-Fired. Confirm capacity and operation of feeder, grates, and ash removal.

(3) Oil burners. Check:

(a) Size and type of burner tips

(b) Location of electrodes to insure spark in oil spray cone

(c) Position of gas or oil pilot

- (d) Clearances for removal of burner from furnace.
- (e) Burner adjustments.
- (f) Carbon dioxide in flue gas.

(4) Inspect gas burners for cleanliness, adjustments, position of pilot flame, and sensing element. Check regulator and controls.

(a) Blow out gas line before connecting to burner or regulator.

- (b) Install regulator in vertical position.
- (c) Pipe gas vents to the outdoors.

d. Draft Fans

(1) Check fans and drivers for anchorage, alignment, and rotation.

(2) Check accessibility of lubrication fittings.

(3) Inspect dampers for operation in compliance with contract requirements.

(4) Inspect bearings for smoothness and overheating.

(5) Check vibration and vibration absorbing mounts.

(6) Inspect insulation application to induced draft fan.

(7) Examine safety control interlocks and sic-flow switches.

e. Oil Storage Tank

(1) Check for Underwriter\*s approval.

(2) Check tank capacity and calibration.

(3) See that tanks have the required openings and the means for proper anchorage.

(4) Check for tank heaters, when required.

(5) Examine paint coating and examine holiday testing.

(6) Check manufacturers instructions for proper installation.

f. Circulating, Condensate and Vacuum Return Pumps

Inspect for capacity and for method of mounting.

g. Miscellaneous Fittings and Equipment

Inspect drips, traps, valves, coils, elements, convectors, radiators, etc., as they are brought on the job, to make sure that they are of the correct capacity and that they have been approved.

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15E-03 INSPECTION

a. Planning

(1) Check the availability of codes, reference data and manufacturer\*s recommendations.

(2) Check with contractor for his detail layouts of equipment and piping which are normally made to coordinate work of the various trades.

(3) Compare nameplate data, piping markings, etc., with requirements.

(4) provide the proper spacing of equipment to make sure that there is adequate room fur piping, ductwork, accessibility for maintenance and that walls behind ductwork can be finished without duct removal. Check for adequate clearance for removal of air filters and strainers.

(5) verify how the heating system fits into the total job.

(6) Be sure that sleeves of the correct size and material are properly located in floors and walls before they are built.

(7) In spite of all attempts to insure that sleeves, inserts, boxes, and so on, are all in place before concrete is placed, oversights occur, and it becomes necessary to cut concrete. Any such operation should be approved by the supervisor before it is begun. A cut in concrete wall should be made from both sides of the wall to avoid spalling of the far surface.

h. Piping

(1) Compare piping workmanship with the check list of paragraph 15A-03.

(2) Check storage and handling against paragraph 15A-02b.

(3) Inspect for the required type and size of pipe.

(4) Examine the cutting of construction to install piping.

(5) Require provisions for expansion and contraction, and proper anchorage of pipe.

(6) Check the installation of mechanical expansion joints. Do not remove spacers until expansion joints are ready to be installed.

(7) Verify that the pitch of the horizontal runs are correct.

(8) Check the position of branch connections.

(9) Be sure that required valves are installed in the correct positions.

(10) Check the method and procedure of jointing pipes.

(a) On threaded joints, check for the use of tapered threads. See that graphite and oil, or an equivalent, are applied to the threads.

(b) On welded joints, check for compliance with approved welding procedures, inspect for defective welds; check type of material of the welding rod; make sure welders have been qualified and are stamping their welds. See Chapter 5 and Chapter 15A for welding inspection guidance.

(11) See that piping is properly aligned and that there is no strain on joints or on adjacent equipment.

(12) See that proper grade and alignment are maintained and that proper fittings are provided to eliminate air pockets and restrictions.

(13) Check for air valves at all high points and at the ends of mains. Check for drips and traps at low points. Examine the lines to make sure that condensate cannot accumulate in the lines.

(14) Inspect for required floor, wall, and ceiling plates. Check for type, size, material, and finish.

(15) Watch for the use and proper installation of eccentric fittings.

(16) See that interconnecting piping between boilers conforms to shop drawings and ASME Code. Watch for adequate valves and other special fittings. Cutoff valves shall be provided to isolate each boiler from the steam header.

(17) Be sure that lift fittings are provided where the gravity flow of vacuum returns is interrupted by a change to a higher elevation.

(18) Clean all supply and return lines before putting them into operation. Check whether contractor has cleaned all traps and strainers after pipe cleaning and before system operation.

(19) Check safety valve discharge pipe for number of ells (restriction).

(20) Check bent pipe for kinks, wrinkles or other malformations.

#### c. Pipe Insulation

(1) Know locations of pipes required to be insulated.

(2) See that insulation has been approved.

(3) Check width and type of material and the spacing of bands.

(4) Be sure that all fittings except unions and flanges are insulated.

(5) Be sure that insulation is being correctly installed. See section 15C Mechanical Insulation.

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(6) Check for continuity of insulation through walls and floors.

(7) Check that proper thickness of insulation is being applied.

(8) On chilled-water and hot-water combination piping and boiler piping check for vapor seal requirement.

d. Hot Water Systems

(1) Note the installation of balancing valves or orifices in the return connection of each radiator or heating device.

(2) See that contractor balances system as required by plans or specifications.

(3) Insure that threaded openings are provided on converters. See that safety devices and temperature controls are furnished and are in working order. Check coil for tightness and clearance for its removal. Note drain pipe to outside atmosphere or floor drain from blow-off safety valves.

(4) Check for automatic and manual vents.

(5) Examine expansion tanks for size, conformance to code, protective paint coating, insulation, water level gage, drain and air charging valves.

a. High Temperature Hot Water

(1) Check pumps for:

(a) Leveling, alignment, and stability on foundation

(b) Lubrication

(c) Seals for leaks

(d) Packing adjustment and type

(e) Pressure retention

(f) Correct rotation

(g) Seal coolant service installed.

(2) Insure that radiant heating coils are accurately placed, firmly secured, and absolutely tight under a hydrostatic test pressure of one and one-half times the operating pressure prior to encasement in construction.

f. Steam Systems

(1) Know details of the type of system required.

(2) Check the operation of supply valves to radiator and convactor.

(3) Check radiator run-out for pitch.

g. Hot Air Heating

(1) Insure that contractor follows NFPA criteria for installation of oil or gas equipment.

(2) Be sure that return air has free passage to heater unit.

(3) Note damper setting balance of the flow of air.

(4) Check that flexible connections have been installed between furnace and duct system.

#### h. Heating and Ventilating Units

(1) Require that all component parts operate satisfactorily.

(2) Note access doors for tightness and clearance.

(3) Determine that noise level is within acceptable limits.

(4) Check flexible pipe connections and/or vibration eliminators.

(5) Check rotation.

#### i. Unit Heaters

Check:

(1) Air distribution

(2) Noise level

(3) Controls

(4) Clearances

(5) Rotation

#### j. Controls

Be sure that the controls are provided, as specified, that they are properly hooked up, and that they will perform the required operation.

#### k. Boilers and Boiler Plants

(1) General Requirements:

(a) Before rolling in, check the cleaning of ends of tubes and the surfaces of tube holes in drums and headers. Check to assure that new boilers exposed to weather are covered to prevent corrosion.

(b) See that tube-rolling is done by experienced workmen and that all precautions are taken to prevent either under or over rolling. At this stage of erection request technical assistance.

(c) Insure that the boiler inspector is notified when it is time for the hydrostatic test. Obtain Certificate of Inspection. Do not permit the installation of any baffles or the setting of refractories until after the boiler has passed inspection.

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(d) Affirm that baffles of steel, refractory tile, or monolithic construction are installed gas-tight but with provision for expansion, and that they will resist dislodgment by "puffs".

(e) Insure that boiling-out operations for the removal of grease, oil, and other foreign matter are performed before boiler is placed on-the-line.

(f) Insure that space is provided for tube removal and cleaning and for general maintenance of all equipment.

(g) Check to assure that during periods of operation by contractor chemical treatment and blowdown are provided to prevent scale deposits and corrosion.

## (2) Settings

(a) Be sure that all settings are constructed with provision for expansion and contraction of both the refractories and the pressure parts. See that expansion joints are sealed to prevent passage of air or gases but are flexible enough to maintain their seal under movement of the structure. Check the entire setting for leaks.

(b) Check solid refractory walls for plumb, level courses and dipped joints. Check grades of refractories used. Chipped, cracked, wet or broken refractory materials will be rejected.

(c) Insure that refractory tile and setting casings are constructed to prevent the escape of gases or the infiltration of air, and that they are installed in accordance with the recommendations of the manufacturer.

(d) Insist that all openings through setting walls are accurately located and of proper size. Check temperature of boiler setting surface against room temperature.

(a) Verify that pipe sleeves for draft gages are clean and flush with interior face of wall.

(f) Inspect uptake damper for correct location, bearing material, and freedom of operation when hot.

## (3) Fuel Burning Equipment

(a) Correlate coal stokers with stationary grates for accurate placement and support of the grate bars. See that shaking and dumping mechanism will work freely under operating temperatures.

(b) Evaluate traveling and moving grates for alignment of running parts and guides, tightness of seals, and provision for expansion and contraction.

(c) Note lubrication and protection of motors, gears, and bearings.

(d) Examine all moving parts for operation under temperatures encountered and for loads specified.

(e) Insure that grate design and coal sizing are suitable for each other.

(f) See that stoker feeding mechanism is adjusted to distribute the coat evenly over the grates.

(g) Verify that pulverizers are constructed and installed as nearly dust-tight as possible. Be sure the equipment is firmly secured to foundation. Check units for proper balance and quiet operation at normal operating speeds.

(h) See if pulverizers are adjusted for proper coal fineness. Notice whether heat is applied to the coal in the pulverizer, or that temperatures are obtained prior to entrance of coal to assure satisfactory dryness of coal.

(i) Insure that burners are adjusted for efficient operation, minimum excess air, stable ignition at low rating, and no impingement on furnace walls. Use a boiler test kit when required.

(j) Evaluate the coal feeder for accurate and even operation.

(k) Examine the installation of access and inspection doors.

(l) View magnetic separators for location ahead of pulverizers.

(m) All safety precautions are to be observed in the installation of gas burners and piping. Arrangement of gas valves should be in accordance with ASA Standard Z 21.33.

(n) Burners should be arranged to permit ready inspection and servicing.

(o) Note location of pilot flame. Provision shall be made to facilitate manual lighting of pilot flame. Hand torch and receptacle should be provided for each boiler.

(p) See that mixing dampers or valves are adjusted to proportion air and fuel for the most efficient combustion with minimum excess air and stable operation of low rating, with no impingement on furnace walls.

(q) Compare all dimensions of the combustion chamber during construction for agreement with manufacturer\*s approved shop drawings. Check all materials of construction for compliance with specifications and approved shop drawing. Take physical samples of all tile, insulating plastic, firebrick, etc., for future reference.

(r) Check type and capacity of heaters for grade of oil.

(s) Check relief of excess pressure in pumps.

(t) Test oil piping for leaks.

(4) Draft Fans and Ductwork

(a) See that induced draft fans are provided with cleanout doors.

(b) Verify the operation of dampers at high flue gas temperatures.

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(5) Blow Down System

- (a) Insist that work conforms to applicable codes.
- (b) Observe location of vent and discharge lines.
- (c) Require that piping provides for expansion and contraction.

(6) Combustion Controls

- (a) Inspect equipment for type, capacity, installation, and operation.
- (b) Be sure that operating devices are firmly secured to floor, foundations, or other supports and that they operate freely. They should have sufficient power to easily perform their duties.
- (c) Check the location and stability of sleeves in setting walls, ducts or breechings for draft piping, thermometers and gages.
- (d) Pipe, tubing, and wiring should run neatly and parallel to the lines of building or structure. They should be firmly secured and have proper pitch. See that draft piping is provided with means for removing accumulations of ash and soot.
- (e) Verify the operation of safety controls.
- (f) Check that flame-sensing device is installed in position to sense both pilot and main flame.
- (g) Determine that instrument panels are firmly anchored and set plumb. Be sure that wiring, tubing, and piping are neatly arranged in rear of panel. See that nameplates, indicating the function of each instrument, are mounted on the face of the pane.
- (h) Secure a written statement from manufacturer\*s representative to the effect that all equipment of the control system is properly installed and in perfect operating condition before acceptance.

(7) Economizers and Air Heaters

Check for tightness of tubes or plates and for evidence of erosion or corrosion whether integral with the boiler or separate units. Observe performance.

(8) Fly Ash Collectors

Check:

- (a) Inspection and cleanout doors for location and adequacy
- (b) Dampers for free operation under all temperature conditions.
- (c) Discharge grates for leakage of either ash or air.

## (9) Boiler specialties

(a) Verify all trimmings such as water column, steam gage, safety valves, blowoff valves, nonreturn valves, stop and check feed valves and vent valves for type and size. Inspect for installation and setting.

(b) Check that safety valve discharge piping is anchored so that it does not impose a strain on valve.

## (10) Soot Blowers

(a) Determine operating pressure of steam operated unite.

(b) Note materials of elements and bearings.

(c) See that wall boxes are accurately and firmly set and that the operating heads are securely fastened. Insure that each element operates freely and that it may be removed without disturbing tubes or setting.

(d) Check clearance for the removal of soot blowers.

(e) Insure that drainage is provided to prevent moisture from being blown into the furnace.

(11) Check for correct location and installation of test holes in breechings and stacks to allow for periodic measurement of fly ash and other particulate matter for air pollution control.

(a) Inspect breechings for gage (thickness) of metal, supports, and insulation.

(b) Examine cleanout doors for tightness, location, and size.

(c) Check expansion joints for tightness and location.

(d) Check caulked joint at opening around breaching entering masonry chimneys.

(e) Check guys, bracing or other supports.

(f) Reject damaged or unsuitable brick and radial block. See that all courses are brought up together and bonded.

(g) In reinforcement operation inspect materials and accuracy of placement. Observe especially the lapping of bars.

(h) Evaluate the material and the setting of embedded items for securing ladders, platforms, cables, lights, doors, or other equipment.

(i) Check openings and locations of test holes in breaching. Check cleanout door for size and location.

(j) Check closing and latching of cleanout doors.

(k) See that firebrick lining covers the chimney area and that weep holes are provided at bottom.

(l) Check continuous-pour type concrete chimneys for a smooth, jointless exterior finish.

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(m) Determine if ladders are sturdy, securely anchored, and provided with safety cages where required.

(n) Verify that metal vent cap, when required, is firmly secured and coated for prevention of corrosion.

(o) Identify requirement for obstruction lights and lightning protection. Check access to them for servicing.

(p) Insure that chimney is plumb, concentric, and has uniform taper from top to bottom.

(12) Boiler Feedwater

Check:

(a) Type of water treatment for:

- Water available.

- Pressures and temperatures to be obtained in boiler.

- Materials and installation.

(b) Scales, proportioning devices, and mixing valves for accuracy and operation.

(c) Installation of tanks and piping for types of material and supports, workmanship, and conformance with contract requirements.

(d) Pressure tanks for conformance with the applicable codes and ASME stamp.

(e) Control apparatus for the installation and operation of all components. Check should be done by the manufacturer's service engineer. Refer to job specifications for necessary tests and reports required, and determine from service engineer the sequence of testing.

(f) Open heaters for the installation of pans, trays, plates, sprays, and other internal parts, as well as for the setting of the control for water level in storage compartment. Be sure that heater vent operates and that the heater reduces the oxygen content in the water to the specified amounts before acceptance. Checking should be done by manufacturer's service engineer.

(g) Closed heaters for compliance with code governing unfired pressure vessels. Assure that clearance is provided for the removal of tubes. Evaluate performance.

(h) Thermometers and gages for accuracy and operation.

(13) Turbines.

(a) Inspect equipment for the pressures and temperatures to be applied. Compare with approved shop drawings.

(b) Examine all drains, drips, leakoffs, relief valves, and other required safety devices for operation.

(c) Insure that turbines are firmly secured to foundation, are accurately aligned with driven equipment, and operate without vibration.

(d) Check that piping is installed to impose no strain on turbine connections.

(e) Verify that provision is made for expansion when aligning couplings.

(f) Be certain that field-assembled turbines are installed by the manufacturer\*s erectors only

(g) Reduction gears must mesh perfectly and operate smoothly and without noise or vibration. Check dwelling after turbines and gears are in perfect alignment.

(h) Evaluate the operation of governors.

(i) Check capacity and steam consumption under various load conditions.

1. Smoke Connections

(1) Examine the size and construction of stacks and flues.

(2) Check the clearance space between stacks, flues, and adjacent building materials.

(3) Inspect the method of supporting and anchoring all smoke connections.

(4) See that cleanout is provided which will allow cleaning of the entire smoke connection without dismantling.

m. Fuel Storage and Conveying

(1) Inspect overhead bunkers for capacity in conformance with specifications. See that all gates are installed dust-tight and that they operate freely. Note the sealing of spaces around top of bunkers and elevators.

(2) Be sure that silos are erected plumb and concentric.

(3) See that courses in tile, brick or block silos are carried up evenly, that horizontal joints are level, and that reinforcement is welded and thoroughly embedded.

(4) Tight joints and reinforcement bands for concrete stave silos must be pulled up tightly.

(5) Check continuous-pour type concrete silo for a smooth, jointless exterior finish.

(6) Determine whether pneumatic conveyers are installed with air and dust-tight joints.

(7) Examine materials and installation of mechanical coal conveyers.

(8) Insure that screw flights do not ride on bottom of trough.

(9) See that bucket, chain, and belt conveyor guides and bearings are carefully aligned.

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(10) Evaluate skip hoists for capacity and proper installation, with particular attention to operation of the top and bottom limit stops.

(11) Make sure that housings for all conveyors and elevators are installed with dust-tight joints.

(12) Access doors and connections with chutes and discharge gates should be tightly fitted.

(13) Observe that chutes are installed with sufficient slope to insure free, gravity flow of coal.

(14) Check weighing lorries for capacity, accuracy of weight, and ease of operation.

(15) Verify that vibrating feeders are accurately positioned and adjusted for specified flow of coal.

(16) Be sure that coal crushers are securely anchored to foundation or supports and that grids are adjusted to proper coal size. Ascertain the direction of rotation.

(17) Check coal scales for accuracy of weight and for operation of component parts.

(18) Track and Truck Hoppers - Insure provision for removing water from pita. Inspect hopper grids for size opening and materials.

(19) Note flow of coal of entire conveying system, from unloading hoppers to boilers.

n. Painting

(1) See that equipment contains the correct finish. Watch for abrasions.

(2) Watch for miscellaneous ferrous metal items that are not primed.

(3) Require finish painting as specified.

(4) Identify all pipe runs as specified.

o. Testing

Witness that all required tests of heating equipment are accurately recorded. See that tests are performed by manufacturer\*s representatives where required. Check tests and verify that tests meet all requirements before acceptance. Report unsatisfactory test results to the supervisor.

p. Operating Instructions and Guaranties

(1) See that equipment guaranties and instructions for the operation of equipment are furnished.

(2) Notify supervisor of the readiness of the construction for test and subsequent operation for instructing personnel.