Trade Licensing Program

Steam Engineer & Boiler Fireman License

1. Types of valves found on and around boilers. Describe and tell where they are used.
    1. Gate valves. Rising stem. Rising valve
    2. Globe valves. Rising stem. Rising valve
    3. Non-return valves
    4. Check valves.
    5. Needle valves
    6. Pressure reducing valve. (PRV)
    7. Balanced valves
    8. Plug valves. Pet cocks.
    9. Quick closing valves. "Guillotine like".
    10. Seatless blowdown valves
    11. Ball valves
    12. Motorized valves
    13. Solenoid operated valves.
2. Neatly sketch and label a fire tube boiler showing at least the following parts:
    1. Shell and or drum.
    2. Fire tubes
    3. Furnace
    4. Stays. Through and diagonal
    5. Dampers
    6. Baffles
    7. Breeching
    8. Stack connection.
    9. Safety valve
    10. Boiler stop valve.
    11. Header stop valve.
    12. Feedwater connection. Check Valve. Proper use of globe valve
    13. Vent valve.
    14. Gage glass with valve connections.
    15. Water column
    16. Try cocks.
    17. Gage glass drains.
    18. Water column drain
    19. Bottom boiler blowdown connection
    20. Surface blow. Continuous blow
    21. Steam gauge and test gauge connection with pig tail.
    22. High pressure cut out with manual reset.
    23. High pressure cut out - Recycling
    24. Modulating load control

25. Water level control. Choice of float, Thermostatic, or Vapor pressure types
26. Flame failure device

3. Describe circulation in a steaming boiler to include the following:
    1. The effect on the water level when a normal load is applied to include what is actually taking place with the water and steam generation in the boiler. Take the description step by step from the application of the load, the resultant drop in boiler pressure, the immediate reaction in the boiler and the follow-up action of the combustion controls and feedwater controls to meet the new load demands.
    2. Consider the same steps when the load is dropped.
    3. Describe the danger caused by loading a steaming boiler too rapidly.
    4. Describe the action in the steaming boiler if the feedwater and fuel were shut off immediately - say a power outage or a complete securing of the system.

       Note: In the discussion, describe what is actually physically taking place in the water and steam in the boiler in both the liquid and steam bubble forming parts of the boiler.
4. Discuss the indications of faulty gage glass readings. Tell how the "water bounce in the gage glass" indicates possible pluggage. Give step-by-step procedure to properly clear connections to the gage glass. Discuss what will happen if the top valve to the gage glass is closed. Describe proper procedure to replace a gage glass on a steaming boiler to include safety precautions.
5. Define an interlock and a relay and a sample of their use in boiler controls.
6. List the steps to follow in putting a boiler on the line starting with an empty boiler.
7. Discuss gage pressure, vacuum pressure, furnace draft pressure, and absolute pressure measurements. What are the terms or units and what is their relationship to atmospheric pressure.
8. Describe a water level control to include how the level is determined and how this information gets from the level device to the point of use. The following lists some devices.
    1. Float (McDonnell Miller)
    2. Thermostatic (Copes)
    3. Vapor pressure (Bailey)
    4. Differential pressure (DP Cell)
9. Describe the operation of the following flame failure indicating devices:
    1. Lead sulfide cell. (Fireye)
    2. Flame rod (Rectification by flame)
    3. Ultra Violet Flame (UV Cell)
10. Define the following heat energy terms:
    1. Sensible heat How measured.
    2. Latent heat How measured and relationship to pressure.
    3. British thermal unit (BTU)
    4. Therms
11. Give examples of the following heat transfer terms:
    1. Radiation Convection Conduction

12. Steam Characteristics
    1. Boiling point temperature. Discuss the effect of pressure.
    2. Steam volume per lb. Discuss the effect of pressure and a comparison with a pound of water under the same conditions.
    3. Note the change in Btu's per pound of steam at different pressures.
    4. Describe superheated steam and discuss reasons for superheating steam.
    5. Define steam quality.
13. Fuel commonly used in Seattle.
    1. Fuel oil grades and Btu's per lb.
    2. Natural gas. Btu's per cu. ft
14. Furnace draft and combustion air. Discuss how it is obtained
    1. Stack
    2. Induced Draft Fan
    3. Forced Draft Fan
    4. Dampers
    5. Balanced draft.
15. Furnace pressure
    1. Describe means for measuring.
    2. Means for controlling
    3. Discuss a negative pressure and a positive pressure furnace.
16. Describe natural gas and fuel oil supply systems.
    1. The reason for maintaining proper fuel air ratio to obtain efficient combustion. The effect of too little air and excess air
    2. Products of combustion. Carbon Monoxide (CO; Carbon Dioxide (CO_2); Water (H_2O); Sulfur Dioxide (SO_2); Sulfur Trioxide (SO_3); Nitrogen Oxides (NO_X); Water (H_2O)
    3. Good combustion requirements:
    1. Time-temperature -turbulence
    2. Means of determining good combustion.
       Stack observation. O_2 Meter. CO_2 Meter. Flame observation Ringleman chart.
17. Means of ignition
    1. Hand torch. High voltage electric spark. Pilot gas
18. Proper boiler and furnace maintenance
    1. Periodic cleaning of water side
        1. Proper feedwater treatment
        2. Bottom blow
        3. Steam drum continuous blow.
    2. Fire side
        1. Brick and baffle maintenance.
        2. Thorough tube cleaning
        3. Proper soot blower adjustment

19. Proper safety procedures to follow:
    1. Describe action in case of boiler over-pressure.
    2. Discuss action to take in case of low water.
    3. Discuss action to take to reduce the chance of a furnace explosion.
    4. Discuss safety valve testing for the boiler.
20. Control system using changes in boiler pressure.
    1. On and off control
    2. Modulating control
        1. Modulating device for sensing boiler pressure changes
        2. Modulating motor controlled by modulating device.
        3. The motor controls the fuel feed and air damper according to demand by means of cams and levers/
21. Discuss the location and use of safety and limiting devices on the boiler / furnace.
    1. Manual reset over pressure sensing device.
    2. Recycling over-pressure control (on-off control)
    3. Modulating boiler pressure sensing load for combustion control
    4. Low water cutout - Recycling
    5. Low water cutout - Manual reset.
    6. Hi-gas pressure shut down with manual reset.
    7. Low-gas pressure shut down with manual reset.
    8. Blower proving sensor / combustion air switch / sail switch, etc.
    9. Furnace pressure sensing for positive furnace pressure
    10. Low fuel oil temperature on some furnaces.
    11. Low fuel oil pressure.
    12. Flame failure
    13. Programmed purge
22. Describe a boiler feedwater cycle including the following:
    1. The hot well and hot well pumps
    2. The deaerating feedwater heaters
    3. The centrifugal pump and include proper starting procedure, proper hook-up and discuss the necessity of a recirculation line.
    4. The basic principle of a duplex and simplex feedwater pump.
23. Miscellaneous.
    1. Discuss water hammer and ways that it can be caused.
    2. Name different types of steam and water traps and where used.
24. Information shown on boiler permit (Certificate of Inspection) and office of issue.
    1. Working pressure of the boiler
    2. Location or address of boiler
    3. Grade of operator license required to operate the boiler.
    4. Kind of boiler
    5. Boiler identifying numbers

25. Knowledge of the City of Seattle "Steam Engineer and Boiler Fireman License Law." and the “Seattle Boiler and Pressure Vessel Code”.
    1. Definitions
    2. License required and expiration.
    3. Exemptions from license requirements
    4. Grades of licenses
    5. Maximum capacity allowable for grades of licenses
    6. Issuance of licenses. Method and requirements
    7. Special license
    8. Department Construction and Land Use, Boiler Section.
    9. Licenses to be posted or carried.
    10. Notice of place of employment
    11. Reporting of defective boilers
    12. Duties of Steam Engineers and Boiler Fireman
    13. Observation and inspection of boilers
    14. Posting of regulations