

Steam Systems

Training Class Outline

- I. Steam Fundamentals
 - a. Heat Exchange Basics
 - i. Sensible Heat – BTU's
 - ii. Latent Heat – Enthalpy
 - iii. Ts Diagram
 - iv. Liquid to Gas
 - v. Gas to Liquid
 - b. Properties of Saturated Steam
 - i. Chart
 - ii. Steam Temperatures – Determined by steam load demands
 - iii. Low Pressure vs. High Pressure
 - iv. Volume Considerations (steam vs. water / low vs. high pressures)
 - c. Flash Steam
 - i. Calculating Amount of Flash Steam
 - ii. Calculating Wasted Energy
 - iii. Flash Tanks and Capturing Energy
 - iv. Velocities for Water/Steam Separation
 - d. Steam Output
 - i. Air Elimination (low steam performance)
 - ii. Steam Quality (dryness)
- II. Steam Distribution
 - a. Steam Volume vs. Pipe Size
 - i. Pipe Sizing Exercises
 - b. Steam Header
 - i. Piping Configuration
 - ii. Pipe Slope
 - iii. Valves for Supervised Startup
 - iv. Automatic Startup – Condensate Loads
 - v. Vacuum Breakers
 - c. Steam Piping Configurations
 - i. Water/Steam Hammer
 - ii. Steam and Condensate Velocities
 - iii. Intermittent Drip Legs
 - iv. Low Points Require Drip Legs
 - v. Eccentric Fittings and Wye Strainers

III. Pressure Regulation

- a. Types of Regulators
 - i. Direct-Operated
 - ii. Pilot-Operated
- b. High-Pressure to Low-Pressure Limitations
 - i. Pressure Drop (series)
 - ii. Turndown Capacity (Parallel – 1/3 and 2/3 sizing)
- c. Piping Requirements
 - i. Dry Steam (steam separator??)
 - ii. Drip Legs
 - iii. Wye Strainers and Bypass Valves
 - iv. Eccentric and Concentric Fittings
 - v. 10 pipe diameters (before and after)
 - vi. Steam Safety Relief Valves
 - vii. Pipe Sizing Based on Steam Pressure (Larger Pipe on Discharge)
- d. Sizing PRV Stations
 - i. Pressure Pilot Sizing Exercise

IV. Steam Loads

- a. Steam Pressures vs. Temperatures
 - i. Comfort Heating Coils
 - ii. Building Hot Water Conversion (Heat Exchangers)
 - iii. Potable Water Heating (Heat Exchangers)
 - iv. Humidification
 - v. Sterilization
 - vi. Jacketed Cooking Kettles
 - vii. Autoclave Heating
- b. Load Control
 - i. On/Off
 - ii. Modulating
 - iii. Variable Steam Pressures
- c. Load Capacity
 - i. BTU's to LBS/HR
 - ii. GPM to LBS/HR

V. Steam Trapping

- a. What is a Steam Trap?
 - i. Tell the difference between liquid and gas (hot/cold)
 - ii. Keep steam in the process, discharge liquid and cold gases
 - iii. Temperature and Mechanical Operation
- b. Types of Steam Traps
 - i. Thermostatic Traps
 - ii. Float and Thermostatic Traps

- iii. Inverted Bucket Traps
 - iv. Thermodynamic (Disc) Traps
 - v. Pumping Traps ???
 - vi. Orifice Traps
 - c. Selecting the Correct Trap for Your Application
 - i. IHS Trap Selection Chart Examples
 - d. How to Size a Steam Trap
 - i. F&T Trap Sizing Examples
- VI. Condensate Handling
 - a. Flash Steam from Trap Discharge
 - i. How Much? Where Does it Go?
 - ii. Vented Systems
 - iii. Consider Capturing Flash Steam
 - b. Condensate Collection
 - c. Electric Condensate Systems
 - i. 1-Minute NET Storage
 - ii. Pump = 2X Condensate Load
 - iii. Simplex and Duplex with Pump Alternation
 - iv. Control Panels
 - d. Pressure-Powered Pump Systems
 - i. Pressure Powered Pumps
 - ii. Check Valves
 - iii. Receiver Tanks
 - iv. Motive Steam Pressure
 - v. Venting
- VII. Boiler Feed Systems
 - a. Make-Up Water
 - i. Fulton Water Quality Requirements
 - ii. Make-up Water vs. Condensate Return
 - b. Air Elimination (Pre-heat vs. Deaeration)
 - i. Boiler Feed Units
 - ii. Deaerators (Try vs. Spray)
 - iii. Horizontal Tube Boilers vs. Vertical Tube boilers
 - c. Water Treatment
- VIII. Steam Generation
 - a. Heat Transfer
 - i. LMTD with Hot Flue Gases
 - ii. Parallel Flow Heat Exchange
 - iii. Steam Chamber (Steam Separation)
 - b. Types of Boilers
 - i. Horizontal Fire Tube

- ii. Vertical Fire Tube
 - iii. Water Tube
 - iv. Flexible Water Tube
 - v. Cast Iron Sectionals
- c. Near-Boiler Piping
 - i. Steam Quality ("A" Dimension and Velocities)
 - ii. Stop-Check Valves
 - iii. Over-fill Trap and Discharge