

AWT Training Seminars

AWT Training Seminars

WELCOME TO THE AWT REGIONAL TRAINING PROGRAM

2014 – Las Vegas and Indianapolis

AWT Training Seminars

Course Schedule – Day 2

8:00 a.m. *Time & Relationship Management*
 9:00 a.m. *Filtration & Pretreatment*
 10:00 a.m. **BREAK**
 10:15 a.m. *Boiler Types & Operation*
 12:00 p.m. **LUNCH**
 1:00 p.m. *Boiler Treatment Programs*
 3:00 p.m. **BREAK**
 3:15 p.m. *Testing*
 5:00 p.m. *Testing Workshop*
 6:00 p.m. **CLOSING – DAY 2**



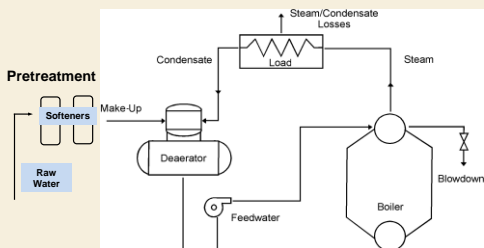
2014 Service Technician Training Program

Boiler Types & Operation

Mr. Chris Golden –
Taylor Technologies



Boiler System Layout





Boiler System Components

- Pretreatment
 - Filters
 - Softener
 - Dealkalizer
 - Reverse Osmosis
 - Other Systems (Demineralization, EDI, ...)



Boiler System Components

- Feedwater System
 - Feedwater Tank
 - Deaerator
 - Condensate Tank

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Boiler System Components

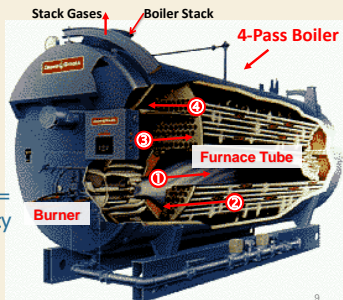
- Boiler Types
 - Firetube
 - Watertube
 - Cast Iron Sectional
 - Steam Generators
 - Aluminum Boilers
- Blowdown Heat Exchangers

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Firetube Boilers

- Bulk boiler water surrounds the fire in the tubes
- Great differences in efficiency
- Increased passes = increased efficiency

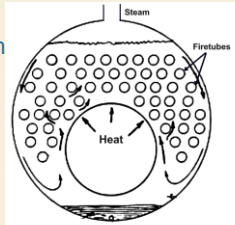


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Firetube Boilers

- Package units
- Steam bubbles produced on the top half of the tubes
- Large water volume vs. steam output
- Rated in horsepower
 - 1 HP \approx 34.5 lb./hr. steam at 212°F
 - Limited by shipping size
- Up to 1,500 HP and 300 psig

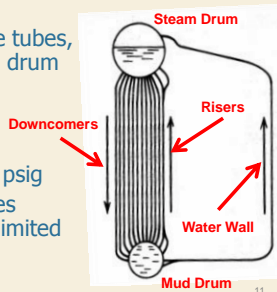


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Watertube Boilers

- Water contained in the tubes, steam drum, and mud drum
- Rapid steaming capabilities
- Rated in lb./hr.
- Pressures up to 3,200 psig
- Higher steam capacities because they are not limited in size



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Cast Iron Sectional

- Gasket or push nipple
- Poor circulation
- Needs low hardness water
- Gasketed units – no free hydroxide alkalinity
- Sulfite



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Cast Iron Sectional

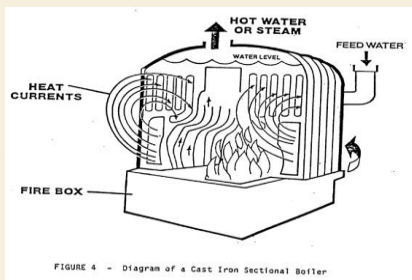
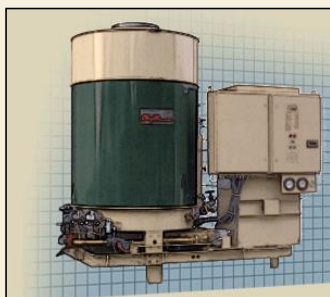


FIGURE 4 - Diagram of a Cast Iron Sectional Boiler

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Steam Generator

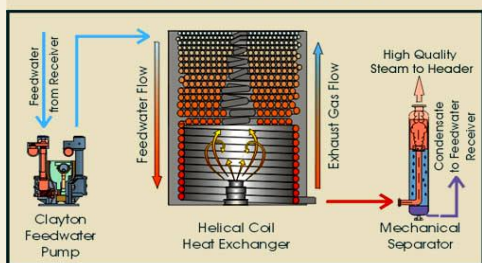


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Steam Generator

How We Make Steam



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Aluminum Boilers

Aluminum Metallurgy

- Different than steel or stainless
- Requires pH between 6.0 and 8.5
- Use neutral pre-cleaners
- No nitrite – very reactive and corrosive
- Molybdate-based treatments have pH enhancers – will drive pH >8.5
- Solids detrimental to aluminum - filtration

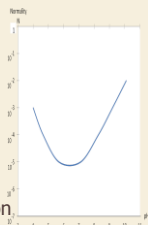


Chart: Vargel, Christian. 2003. "Solubility of Alumina in Water as a Function of pH." *Corrosion of Aluminum*, (p. 319), Elsevier Ltd. Kidlington, Oxford, UK

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Aluminum Boilers

Treatment recommendations

- Follow manufacturer's recommendations for warranty
- Inhibited glycol with inhibitors specifically for aluminum
- Aluminum more noble than iron and copper – isolate aluminum with di-electric unions

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Boiler System Components

Steam System

- Heat Exchangers
- Process Equipment
- Steam Turbines
- Flash Tanks

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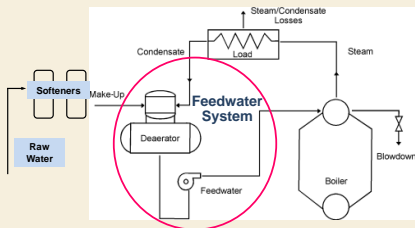


Boiler System Components

- Condensate Return System
 - Traps
 - Lines
 - Return Tanks



Boiler System Layout





Importance of Oxygen Removal

Oxygen causes severe pitting-type corrosion.



Oxygen Pitting in a Standby Boiler



Tubercles Covering Oxygen Pits

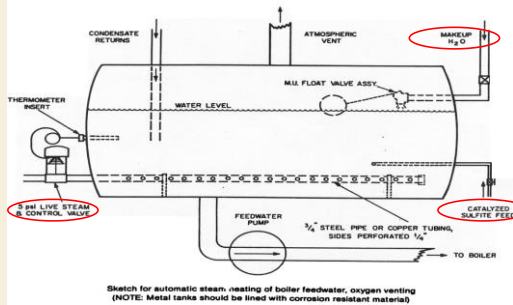


Feedwater Tanks and Deaerators

- Reduce bulk of dissolved oxygen mechanically
- Remove other gases
- Chemically remove residual oxygen



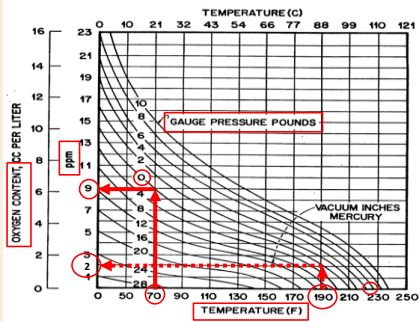
OPEN FEEDWATER TANK HEATING

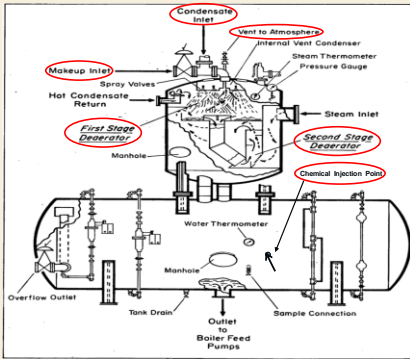


Sketch for automatic steam heating of boiler feedwater, oxygen venting
(NOTE: Metal tanks should be lined with corrosion resistant material)



SOLUBILITY OF DISSOLVED OXYGEN AT VARIOUS PRESSURE/TEMPERATURE CONDITIONS





Spray-type Deaerator

Testing Feedwater

- Conductivity*
- Chloride
- pH
- Total Alkalinity*
- Silica*

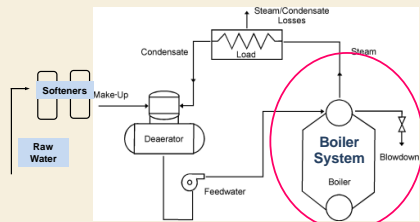
*Run these tests to determine the limiting factor for cycles of concentration.

Testing Feedwater

- Hardness:
≤0.30 ppm as CaCO₃ for boilers <300 psig
- Iron:
≤0.100 ppm as Fe for boilers <300 psig
- Copper:
≤0.050 ppm for boilers <300 psig
- Dissolved Oxygen:
0.007 ppm as O₂ with oxygen scavenger



Boiler System Layout





Boiler Blowdown

- Continuous or surface
- Bottom
- Water column



All Boilers

- Produce clean steam
- Maximize fuel efficiencies
- Can form scale
- Need to be blown down

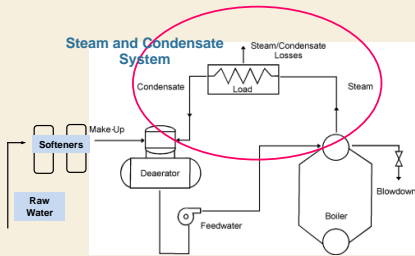


Testing Boiler Water

- Discussed in "Boiler Treatment Programs" section



Boiler System Layout





Steam System Equipment

- Air Handlers
- Heat Exchangers
- Process Vessels
- Humidifiers
- Steam Turbines



Steam Quality

- Dry
- Very low in solids
- Silica <20 ppb (0.020 ppm)

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What Does Steam Look Like in a Boiler?



Video by Spirax Sarco, Inc., used with permission.

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Condensate System Equipment

- Steam Traps
- Condensate Receiver
- Condensate Return Pump
- Condensate Return Line

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Condensate Quality

- Very low in solids (low conductivity)
- Silica <20 ppb (<0.020 ppm)
- Inhibit corrosion (carbonic acid and oxygen)
- Low in iron and copper
- High in heat value

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Testing Condensate

- pH (>8.3)
- Iron (≤ 0.100) and Copper (0.050 ppm)
- Conductivity
- Hardness (<0.2 ppm)
- Silica (if steam-driven equipment is on-site, <0.020 ppm)

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