Chromalox®
PRECISION HEAT AND CONTROL

NISTM
National Institute for
Storage Tank Management

Cost Effective Design Options for Tank Heating

September 11, 2009

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Agenda

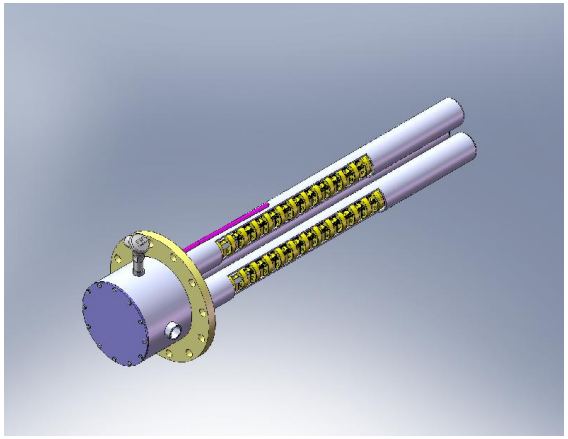
- Tank Heating Options
- Non-Heating Considerations
- Cost Evaluation Methods
- Resources

Tank Heating Products

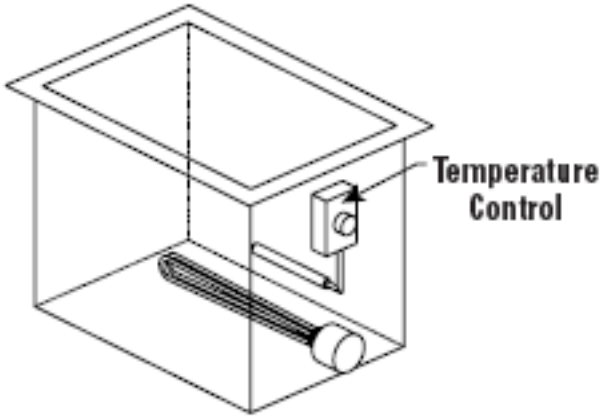
Tank Coils

- Steam or Liquid

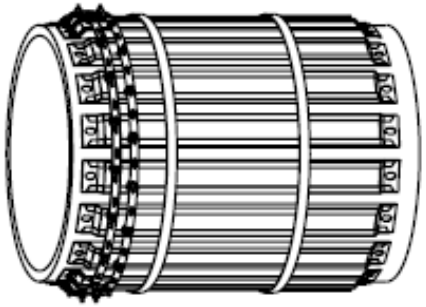
Electric - Replaceable



Electric – Direct Immersion

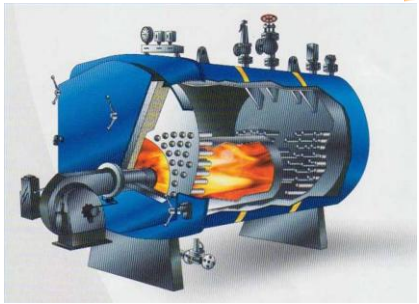


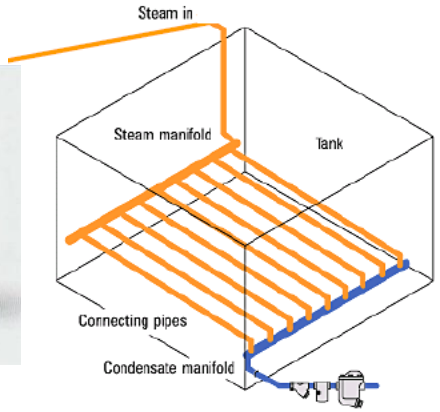
Jacketed / Indirect Heat

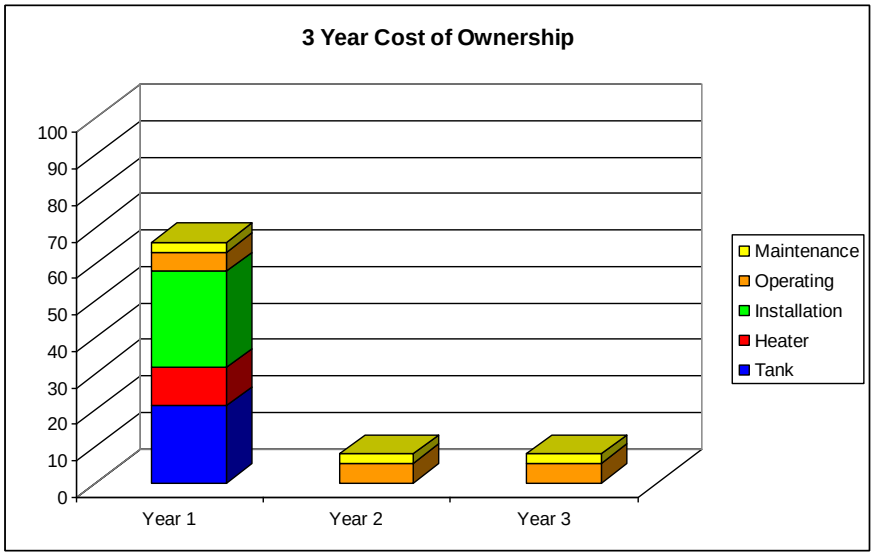


Tank Heating Options

Coils – Plant Steam







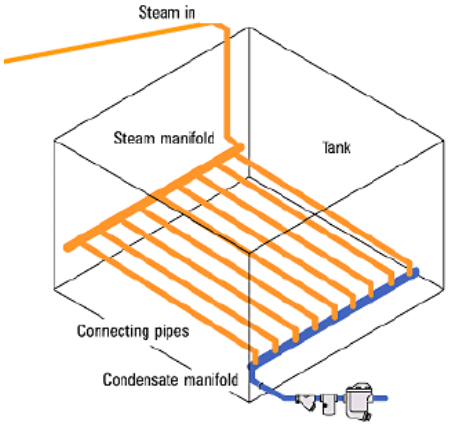
- **Pros**
  - **Low Cost Steam (Already Installed)**
  - **Existing Piping**
  - **Heating Capacity Upgrades**
  - **Good Heat Transfer**
- **Cons**
  - **No Backups**
  - **Heat Trace / Insulate Lines – longer runs**
  - **Ancillary Equipment (Traps, Valves, etc.)**
  - **Potential Internal Interference (Mixer, Quench, etc.)**

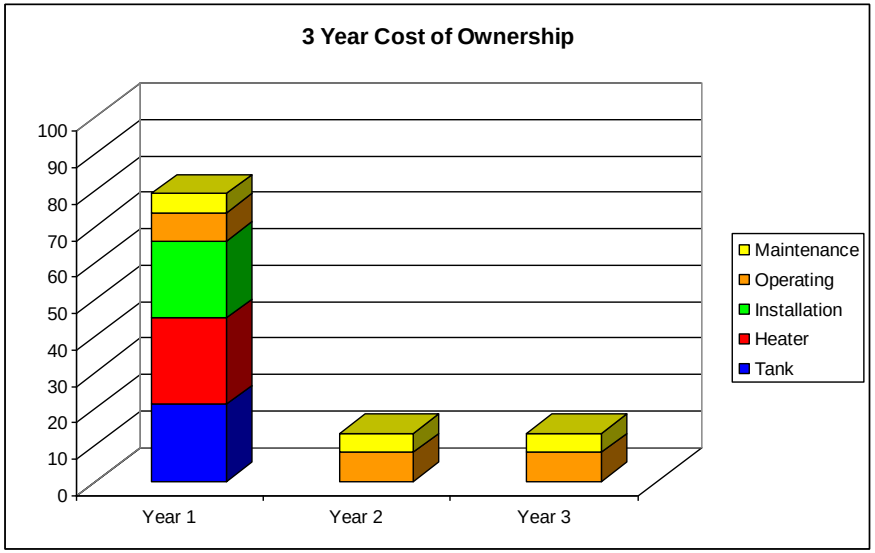
Retrofit Consideration

May require significant rework for coil installation.

Tank Heating Options

Coils – Localized Steam





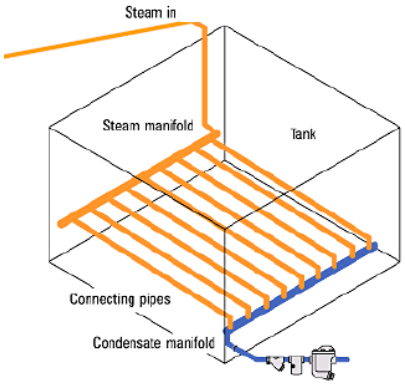
- **Pros**
  - **Local Control**
  - **Efficient Energy Use**
  - **Fossil Fuels or Electric (+/-)**
- **Cons**
  - **Higher Heating Equipment Costs**
  - **Limited Capacity**
  - **Additional Footprint requirements**

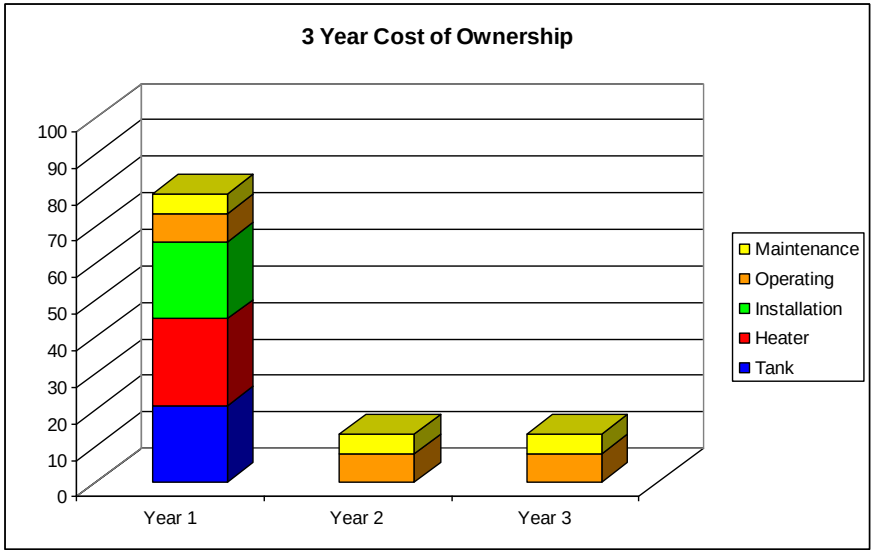
Retrofit Consideration

- Smaller tanks may use over-the-side coils

Tank Heating Options

Water / Oil Exchanger





- **Pros**
  - **Low pressure piping**
  - **Even Heat Distribution**
  - **Controlled Max. fluid temperatures**
- **Cons**
  - **Water Treatment / Oil Maintenance**
  - **Pump Maintenance**
  - **Lowered Transfer Rates = More Surface Area Required (Diameter / Length in Piping)**

Retrofit Consideration

- May require significant rework for coil installation.

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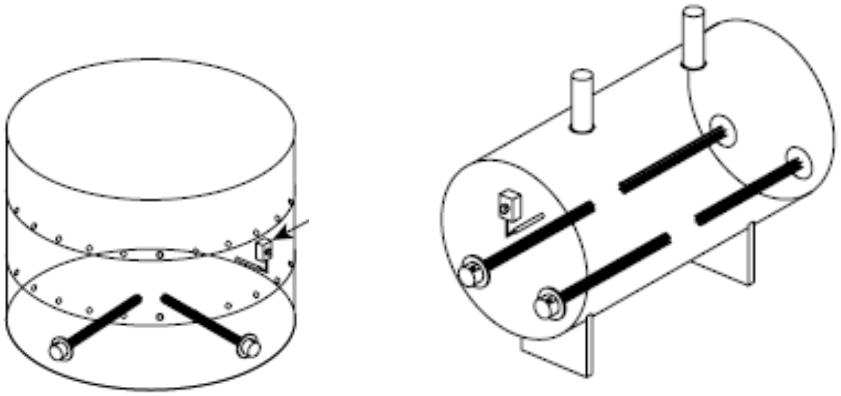
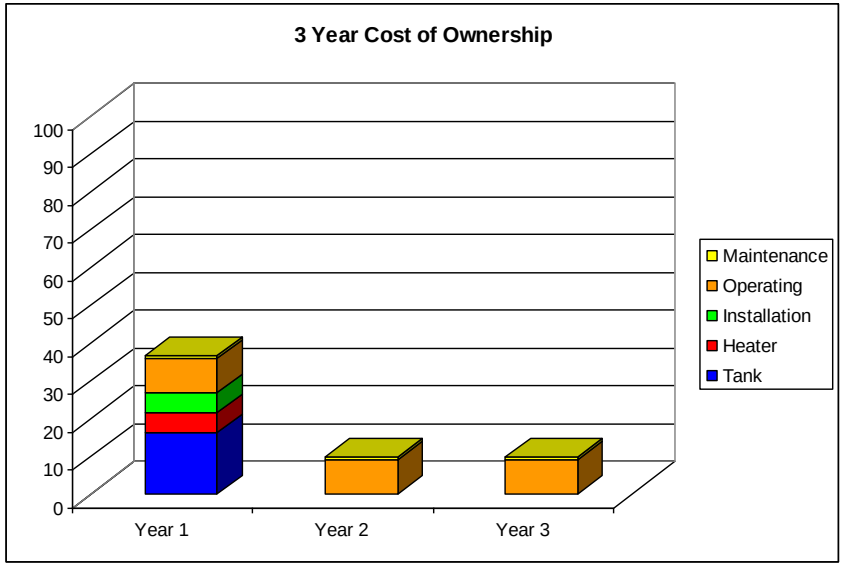
Tank Heating Options

Immersed Electric





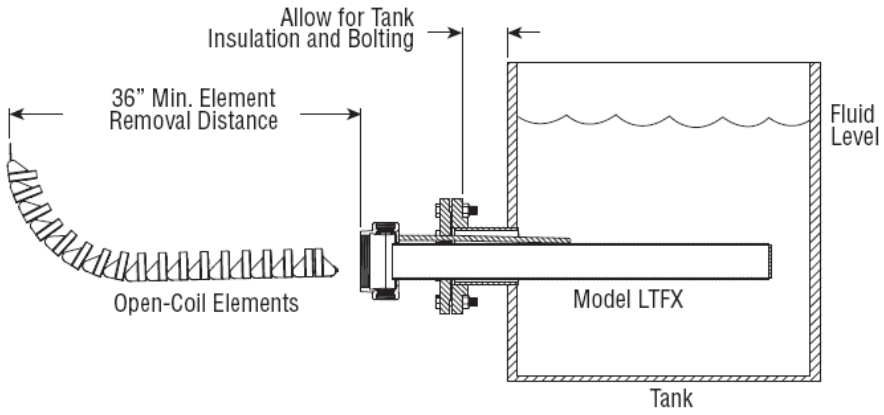
- **Pros**
  - Virtually 100% efficient
  - Quick initial heat up
  - Easy Installation
  - Hazardous Area Rated
- **Cons**
  - Draining Tank for Changes
  - Corrosion consideration
  - Surface Area / Space Consideration
  - Element Support / Protection

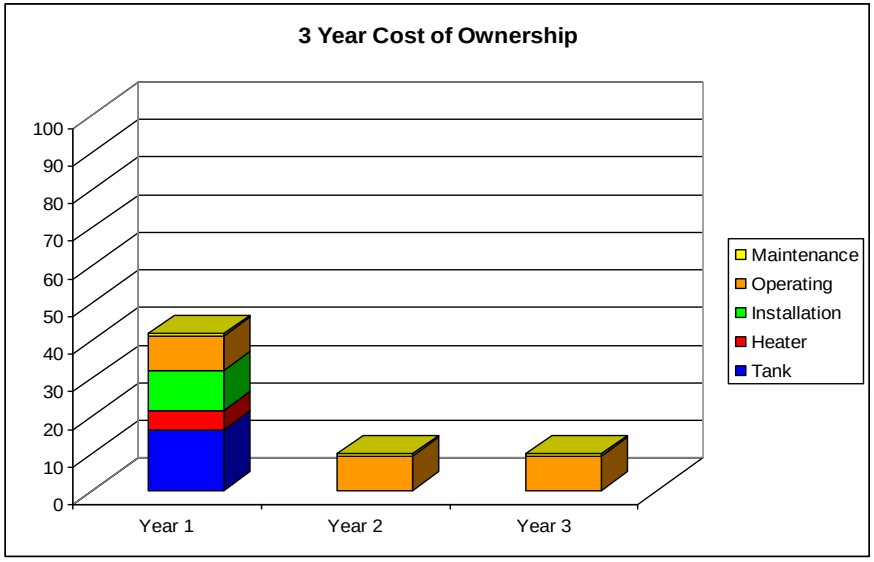
Retrofit Consideration

- Typically External ANSI Flange
- Internal Support for longer units
- Multiple units
- Tank Draining?

Tank Heating Options

Replaceable Electric





- **Pros**
  - **Efficient / Quick Heat Up**
  - **Simple Installation / Easy Replacement**
  - **No Tank Draining for Maintenance**
  - **Hazardous Area Rated**
- **Cons**
  - **Electrical Costs**
  - **Larger Heating Requirements = Higher Amperage / Wire Runs**

Retrofit Consideration

- **May fit existing coils / pipe**
- **Typically External ANSI Flange**
- **Internal Support for longer units**
- **Multiple units**

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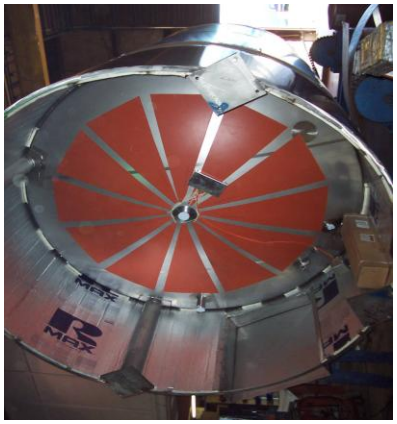
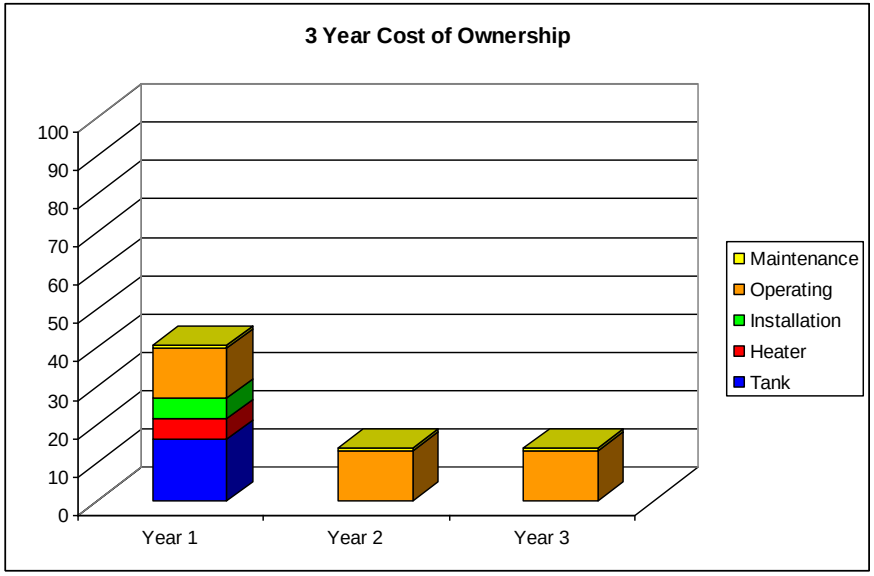
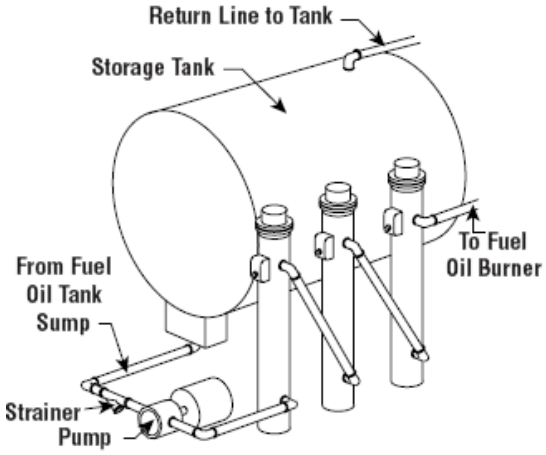
Tank Heating Options

Jacketed / External Heat



- **Pros**
  - No Internal Tank Considerations
  - No Fluid Contact*
  - No Tank Draining
- **Cons**
  - Lowest Efficiency – Tank Material
  - Limits on Surface Area / Temperatures
  - Maintaining Liquid Levels
  - Remove Insulation to Service





Retrofit Consideration

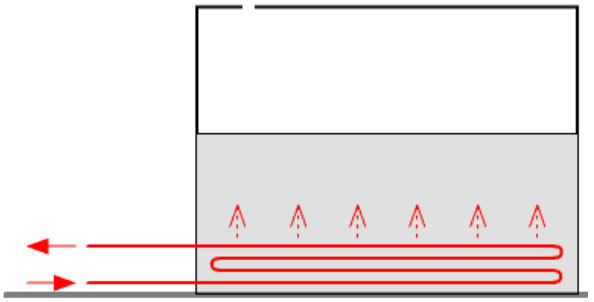
- Good for smaller heating requirement

- Pump w/ heaters for larger needs

Tank Heating Options - Summary

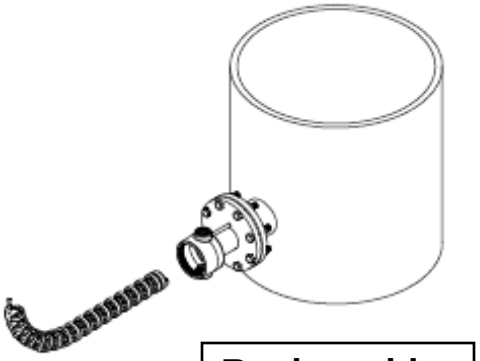
Coil Heating

- **Pros**
  - Lower Operating Costs
  - Largest Heating Tanks
  - Addition of Tanks
- **Cons**
  - Higher Initial Cost for Equipment & Installation
  - More complexity
    - Maintenance Cost
    - Control Systems

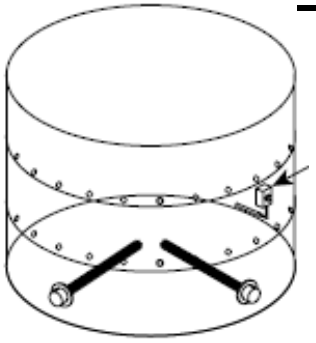


Coils / Heat Exchanger

Non-Coil Heating (Immersion Heaters)



Replaceable



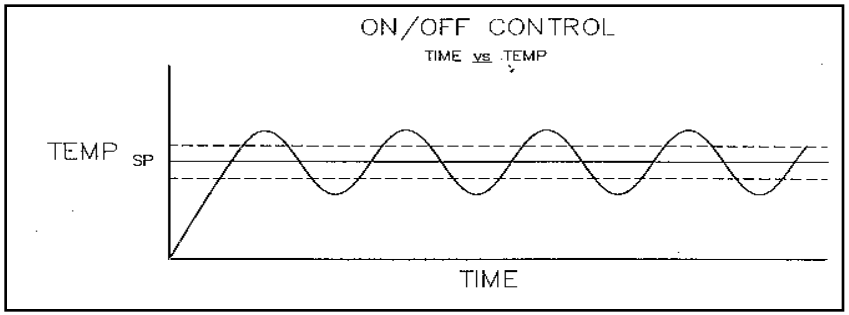
Direct

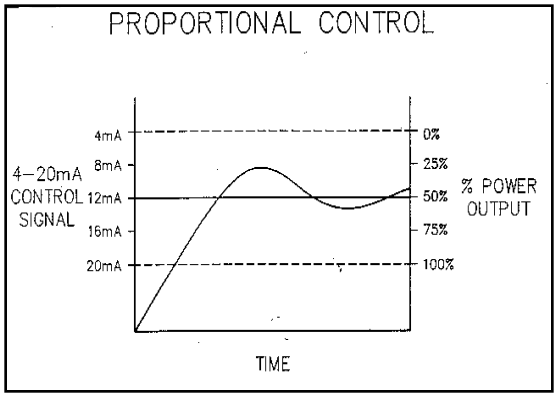
- **Pros**
  - Efficient Power Input & Control
  - Singular Additions
  - Hazardous Locations
- **Cons**
  - Corrosion (direct heating)
  - Electric Rates Review

Non-Heater Considerations

Heater / Temperature Control

- **Control Valve**
  - **Pressure or Flow**
  - **On-Off or Proportional**
- **Direct Connection**
  - **Temperature / Loading Variations**
  - **Turndown ratios / lowered efficiency**
- **SCR or Contactor (Electric Only)**
  - **Contactor – ON / OFF, Less $ - Wider Band**
  - **SCR – 0-100% scale, Higher $ - Tighter Band**
    - **Prolongs Heater Life**
    - **Larger Electrical Enclosure than Contactor**





Heat Up Time vs. KW/BTU requirements for Maintenance

Extended Heat Up times = Increase Efficiency

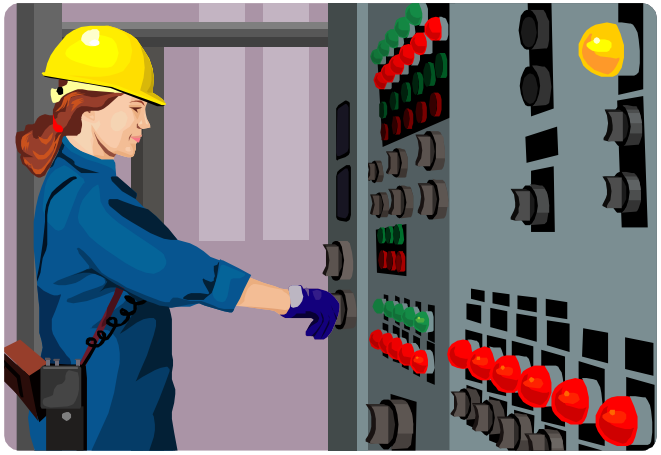
Target Energy level slightly above maintenance temperatures.

Non-Heater Considerations

Centralized vs. Decentralized Control

- **Local Panel**
  - **Panel, heater, and controls are pre-wired at the factory.**
  - **Temperature and setpoint indication located at the tank.**

- **Integrated Control System - PLC**
  - **Process and overtemperature controllers easily communicate with central control systems.**
  - **Many central PLC or DCS systems have control logic already built-in, so the heater accepts remote setpoints from PLC.**



Non-Heater Considerations

Liquid Level Sensor / Control

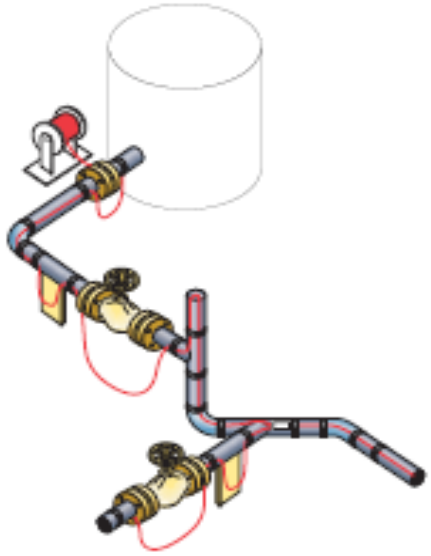
- **Why Liquid Level Control?**
  - **Properly monitor Process Conditions**
    - **Overfilling & Refill Levels**
    - **Daily Usage**
    - **Critical for External Heating**

  - **Protection of Heating System**
    - **Exposed Exchangers / Heating Elements – no heat transfer**
    - **Exposure of temperature sensors – overheating liquid**
    - **Hot Spots on Exchangers / Elements – Coking Fluid**

- **Temperature Sensor - Location**
  - **Outlet Temp – Lag Time**
  - **Bulk - Stratification**
    - **Mixer**

Non-Heater Considerations

Long Piping Runs (Steam / Pumping)

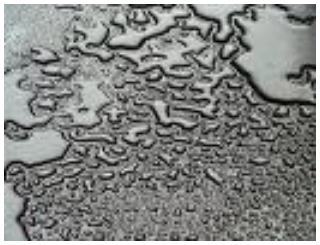


- **Line Tracing**
  - **Steam Tracing (Oil / Water)**
  - **Electrical**
    - **Self Regulating (Freeze Protection, 150 deg. F)**
    - **MI (Metal Sheath, 1100 deg. F)**
  - **What else needs tracing?**
    - **Valves**
    - **Pumps**
    - **Supports**

- **Insulation and Weatherproofing**
  - **No Insulation can equal 10x increase in heat needs**
  - **Decreases Temperature Variation in tank / piping**
  - **Freeze Protecting**
  - **Maintaining desired viscosities for pumping**

Non-Heater Considerations

Hazardous Locations



- **Environmental Conditions**
  - **Indoor**
  - **Outdoor – Coastal (Salt Air) , Seismic, Humidity, etc.**

- **What is the Area Classification?**
  - **Hazardous Rating**
    - **Class, Division, Group**

Class I — Groups A, B, C & D - Division 1 or 2 Temperature Rating T1 - T6

Class II — Groups E, F & G - Division 1 or 2 Temperature Rating T1 - T6

Class III — Division 1 or 2

- **Certification**
  - **Safety Liabilities - Installation**
  - **Insurance requirements**
  - **UL, CSA, ATEX, ASME, etc.**

Total Cost of Ownership

Initial Cost

- **Tank**
  - Coils or None
  - Insulation
- **Heating Equipment**
  - Unit Cost
  - Installation Cost
    - Wiring
    - Piping
      - Valves, Traps
      - Heat Tracing / Insulation
    - Exhaust / Pollution Control
- **Start-up / Commissioning**

Yearly Cost

- **Operating Cost**
  - Raw Fuel Cost
  - Efficiency Rating
  - Piping Losses
- **Maintenance**
  - Cleaning
  - Spare Parts
  - Inspection Visits
    - Local Inspectors
    - Equipment Contract
  - Downtime
- **"X" Factor**
  - What is your facility experience
  - Long Term Growth vs. one time

Resources

Where to Look

- Product Sales / Application Engineers
  - Specific Product Knowledge
- Internet
  - Department of Energy, Trade Associations, Search Engines
- Company Technical Resources
  - Technical Sections, White Papers, Published Articles
- Professional Engineering Firms

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Serving the Process Heating Industry