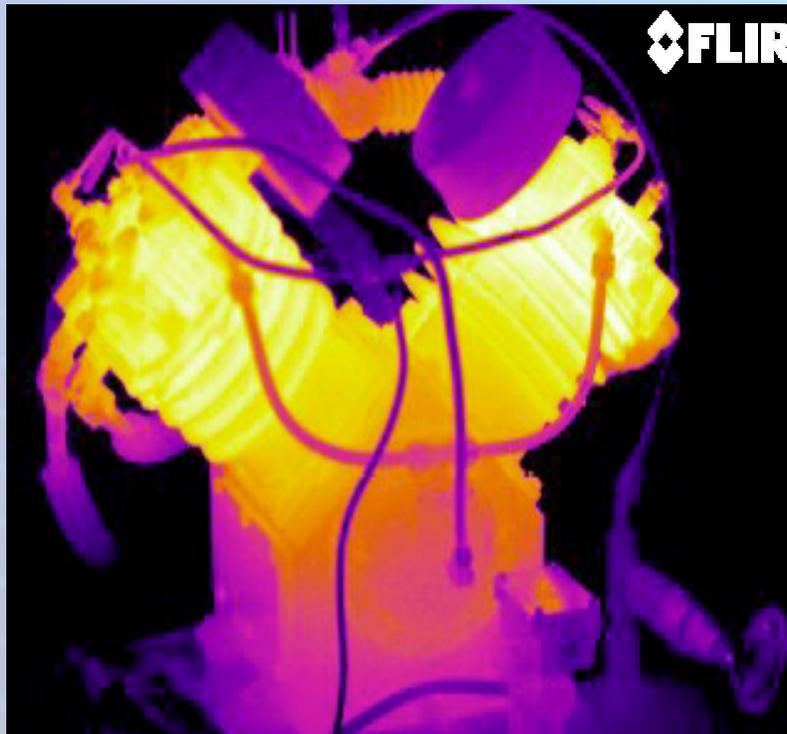


Infrared Applications



Chris Illingworth - **FLIR** Systems, Inc.

Infrared Radiation

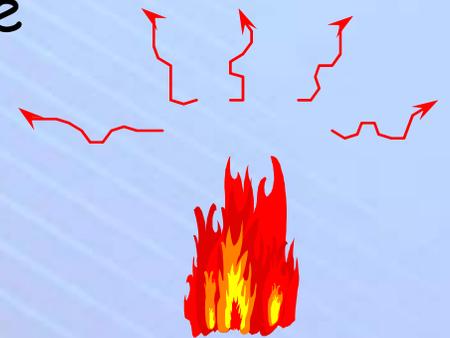
IR is emitted by all objects

IR radiation increases with temperature

IR is generated by the vibration of electrically charged particles

IR travels through space at the speed of light

The difference between light and IR is wavelength



Why does Infrared work for Predictive Maintenance?

Because, when things go bad they HEAT UP!!!

Benefits of IR Thermography:

Helps to prevent unscheduled shutdowns

Allows repairs to be made at a convenient time

Provides improvements in production efficiency

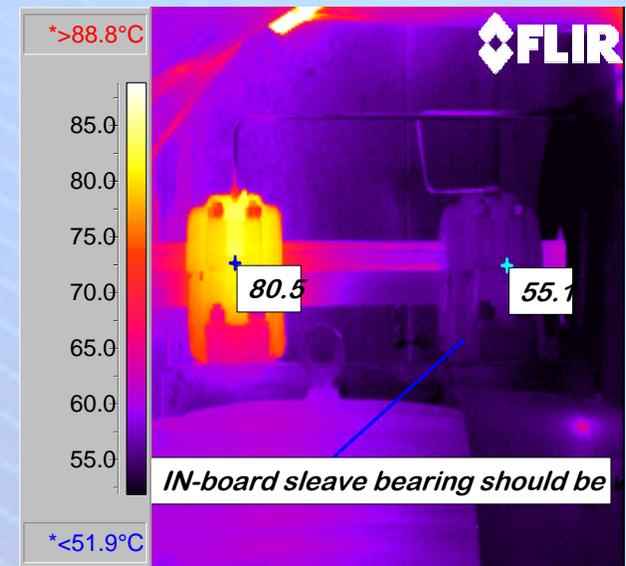
Reduces insurance premium

Maintain Plant Safety

Reduces energy bills

IR Advantages

- ❖ Direct Contact not necessary
 - Remote access--Plants are littered with hard to get at targets
 - Can avoid safety cutouts and view online
 - Efficient viewing of many targets in a short time
- ❖ Thermogram documentation



Overhead Industrial Fan Bearing

Indoor Electrical Inspections

- ❖ Indoor Substations
- ❖ Electrical Panels
- ❖ Fuses
- ❖ Motor Control Centers
- ❖ Bus Ducts/Cable Trays

Typical Causes for Problems

Connection Problems

- Loose bolted connections impede current causing increased temperature.
- Connections potentially too tight.
- Friction connections.

Phase (Load) Imbalance

- Current is not evenly distributed between all phases causing overloading.

Faulty Components

How can infrared electrical scans help me to conserve energy?

Resistance in metals changes in a linear fashion with temperature change.

As the temperature rises, the resistance rises and power consumption is directly proportional to resistance.

Thus, there is increased power usage when the temperature of electrical components increase.

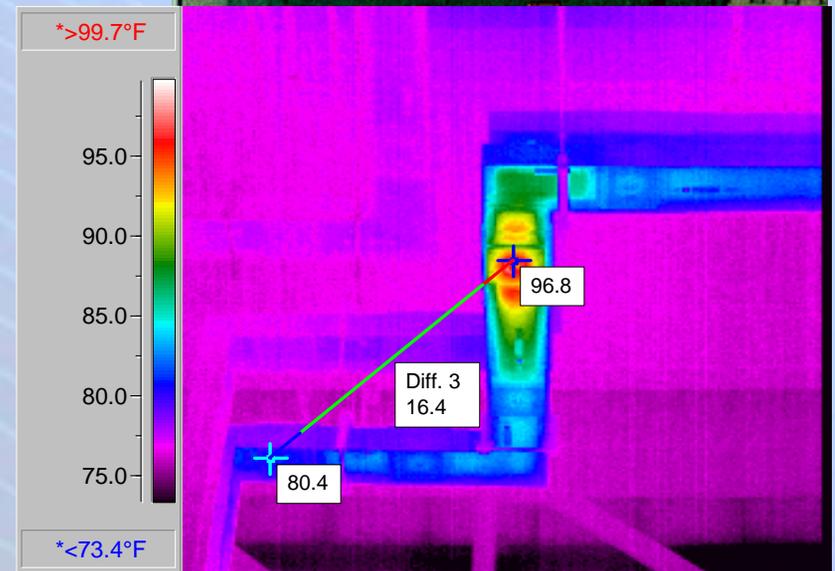
Electrical Distribution Systems

Fuses - Improper load balance, poor connection at "stabs", or bad fuses can cause overheating

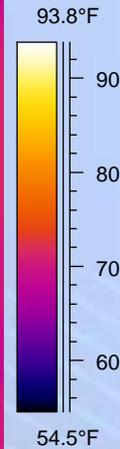


Bus Ducts

➤ Small temperature rises on the outer surface can indicate large temperature rises inside.



Electrical Vaults



ANALYSIS:

Hot Spot Temperature	122.8°F
Reference Temperature	59.3°F
Temperature Rise	63.55 °F

Insert bushing on H1. Repair/Replace ASAP

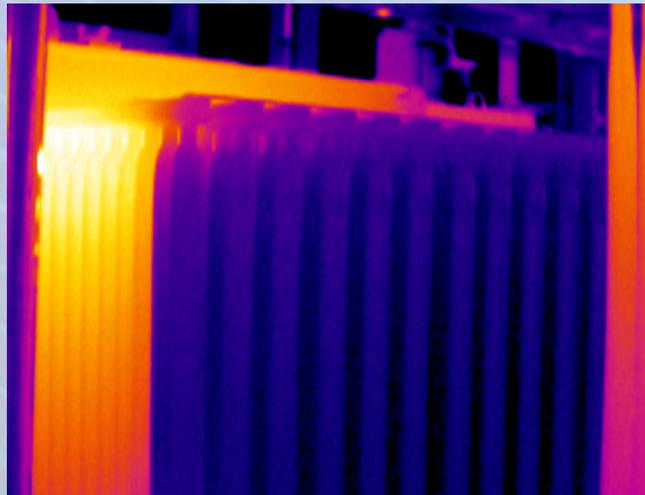
Electrical Applications: Circuit Breakers



Transformers

Plugged Transformer Tubes

A Typical Transformer is designed for a 20 year life. Operating one at 110C over design reduces the life to 6 months



Some Mechanical IR Anomalies

- ❖ Friction
 - Wear
 - Faulty, contaminated or poorly lubricated bearings
- ❖ Misaligned shafts and misuse
- ❖ Cooling degradation, material loss or blockages

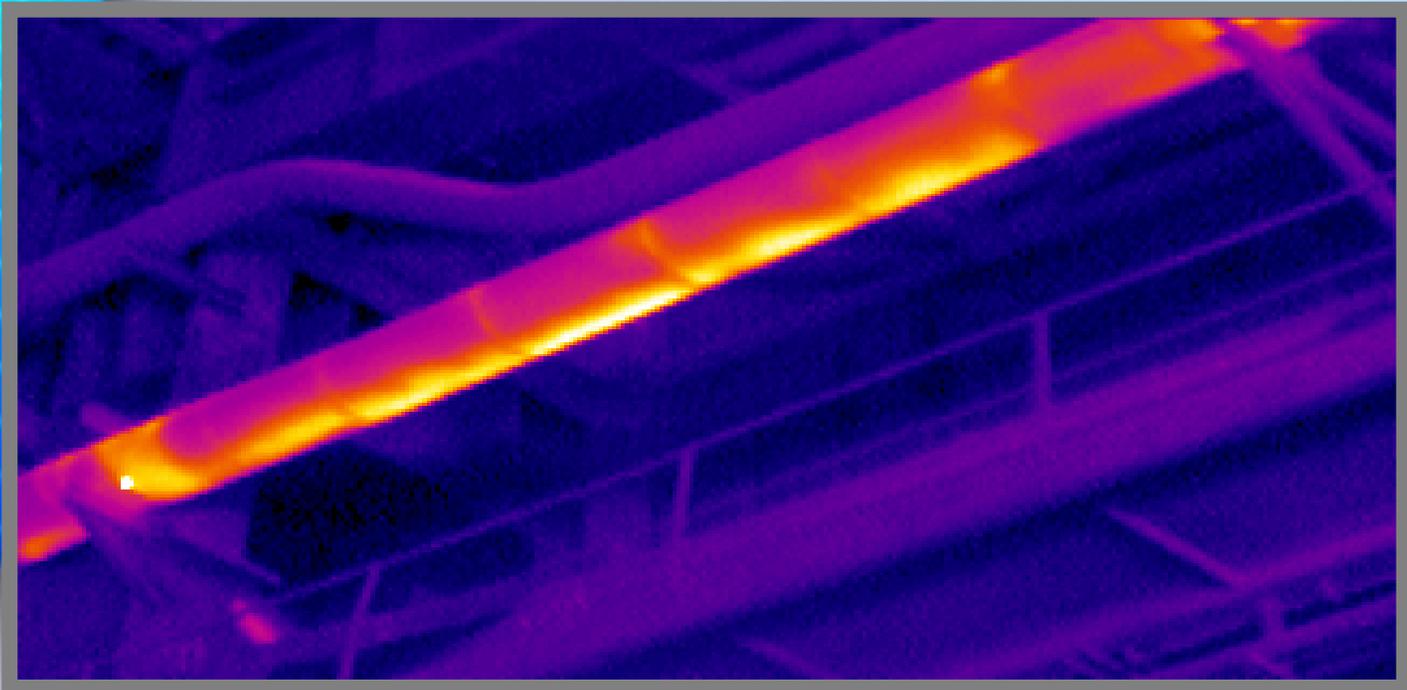
Mechanical applications and symptoms detected

- ❖ Drives/Conveyors, Pillow Blocks, Couplings, Gears, Power Transmission Belts, Pulleys, Shafts.
- ❖ Pumps/Compressors/Fans/Blowers
- ❖ Valves: Shutoff Valves, Relief Valves, Steam Traps
- ❖ Overheated bearings or rollers, misalignment of shaft, pulley or coupling, lubrication failure, uneven pressure.
- ❖ Overheated bearings, high compressor discharge temperature, high oil temperature, and broken or defective valve.
- ❖ Leakage, blockage.

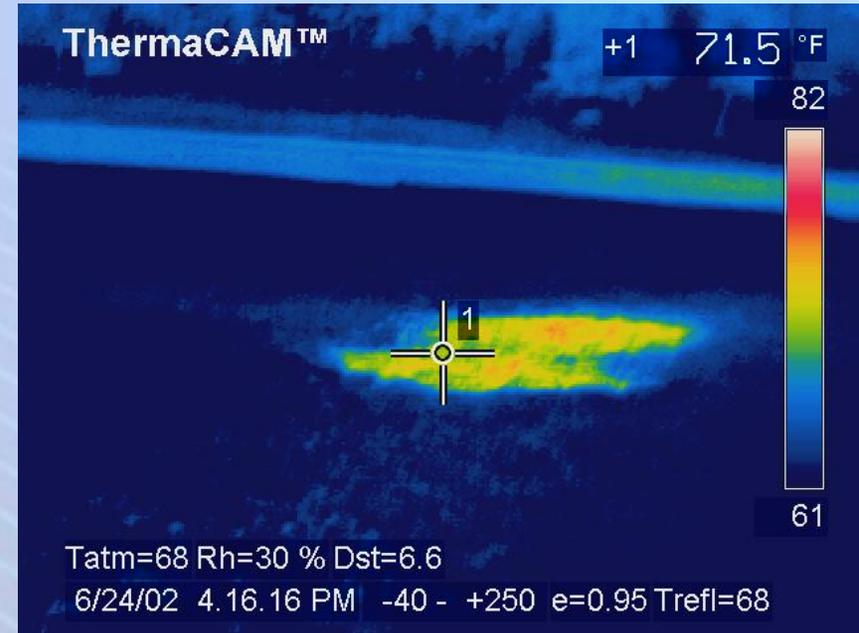
Mechanical applications and symptoms detected

- ❖ Motors
 - ❖ Overheating brakes, tires, bearings, pulleys, gears, gear or pulley misalignment, and blockages in hydraulics.
- ❖ Internal Combustion Engines
 - ❖ Valve or injector malfunction, blocked radiator tubes and oil coolers. Thermal distribution, high radiator inlet or outlet temperature.
- ❖ Mechanical Drive Turbines and Small Turbine Generator Units, Gas Turbine, Exhaust Ducts
 - ❖ High lube oil temperature, high bearing temperatures, drain valve blockage, steam trap blockage, faulty stop/control valve operation, uneven metal temperature, leaking shaft seals, gas turbine firing conditions, including deterioration in firing chambers, cross firing tubes

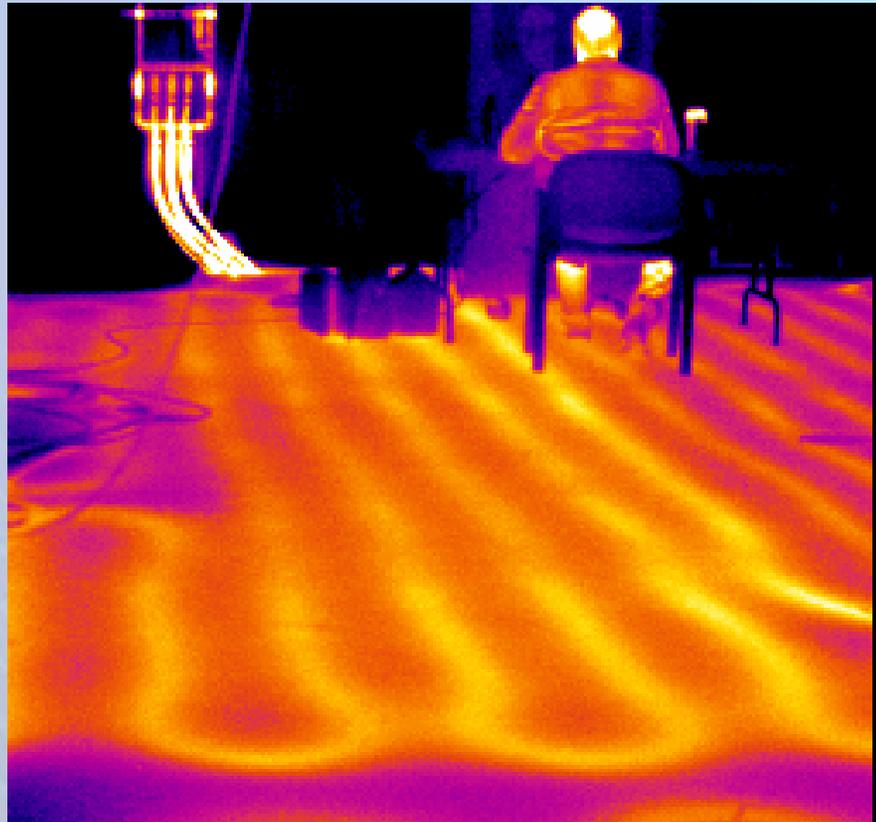
Steam Leaks.



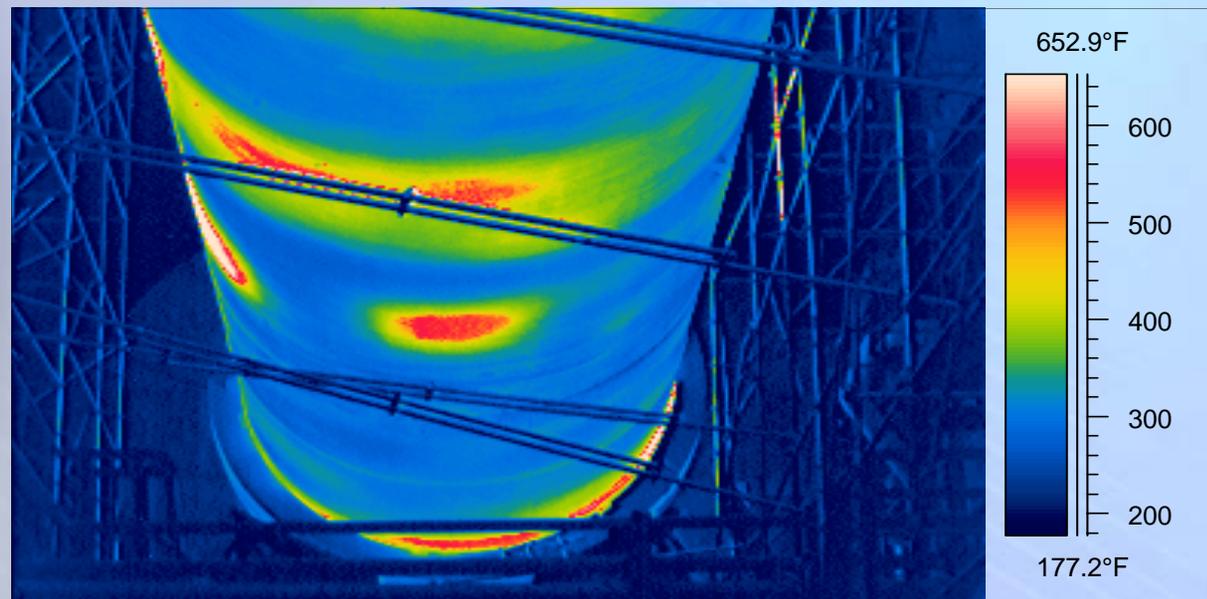
Underground Steam Leaks



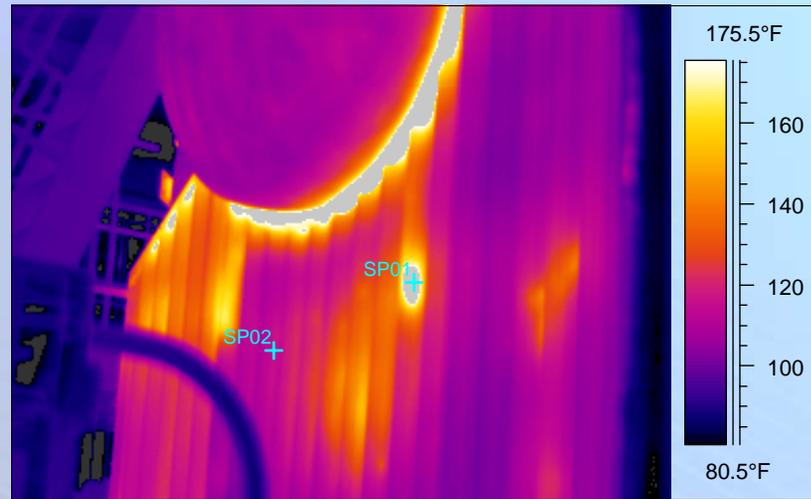
Verify location and performance
subsurface heat sources...



Rotary kiln-refractory issues

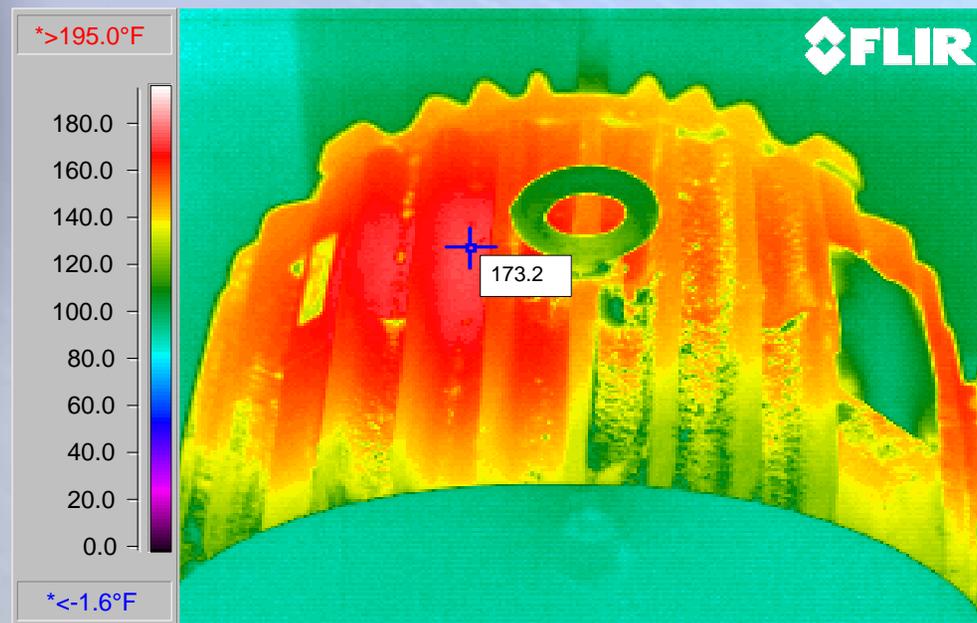


Boiler Insulation, Hot Spot



Electric Motors

- ❖ Electric Motors represent over 70% of US manufacturing's 36 billion dollar annual electric bill*
- ❖ *5/1 998 FORTUNE Magazine





Energy Savings Example=

14,930 (total hp of motors)

X 75% (load factor)

X 8,000 (operating hours)

X 2% (% savings)

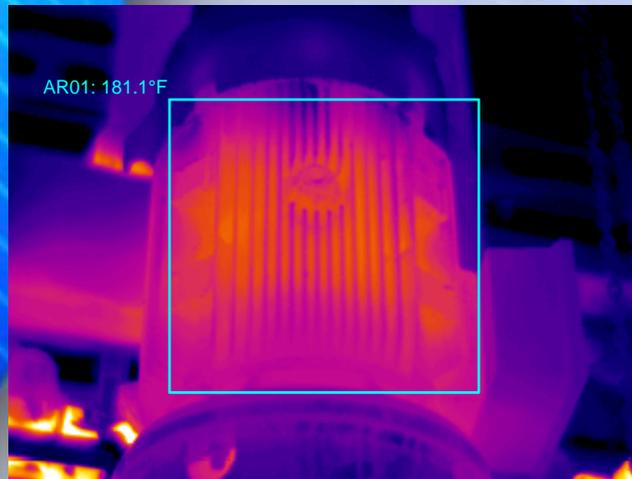
X .746 kW/hp

X .06/kWh (electrical usage costs)

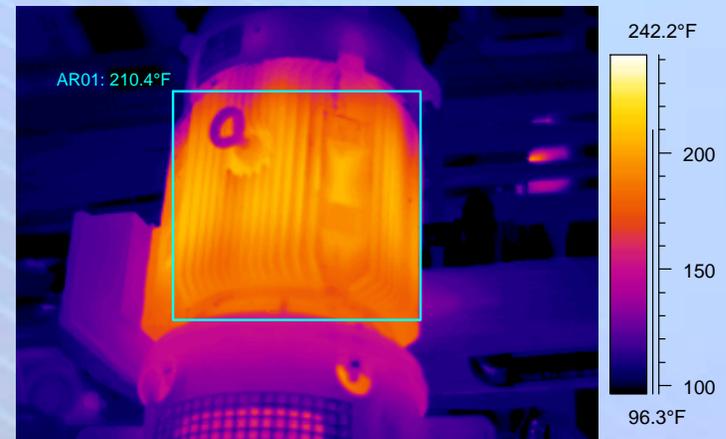
= \$80,192 per year

Electric Motors

Many times motors are overlooked during typical electrical infrared surveys. A typical motor operating at 18 F over design cuts the life of a motor in half.

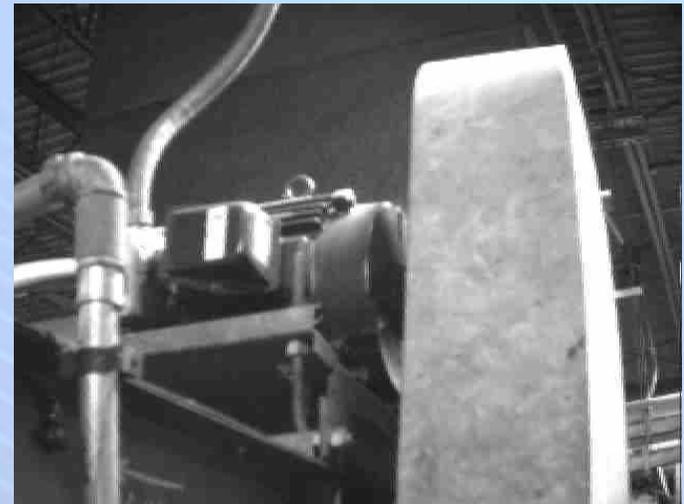
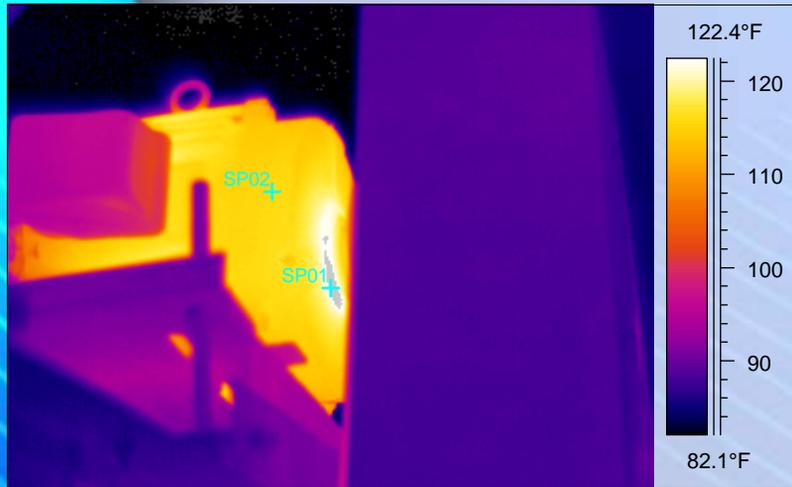


181 F



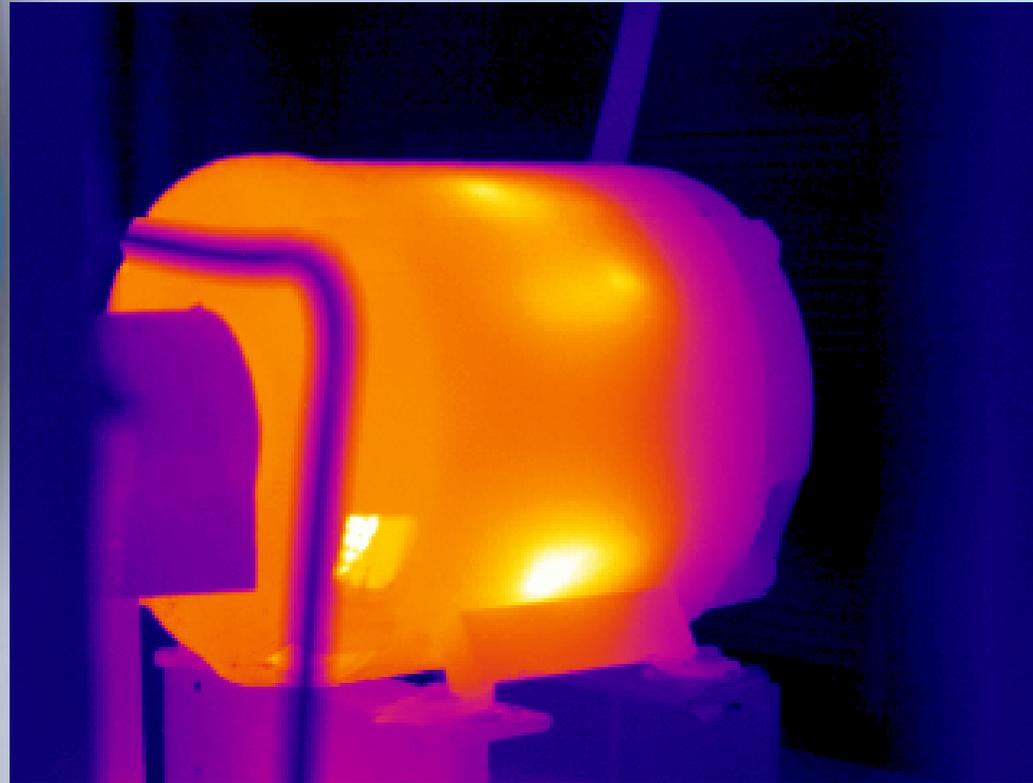
210 F

Motor Bearing on HVAC

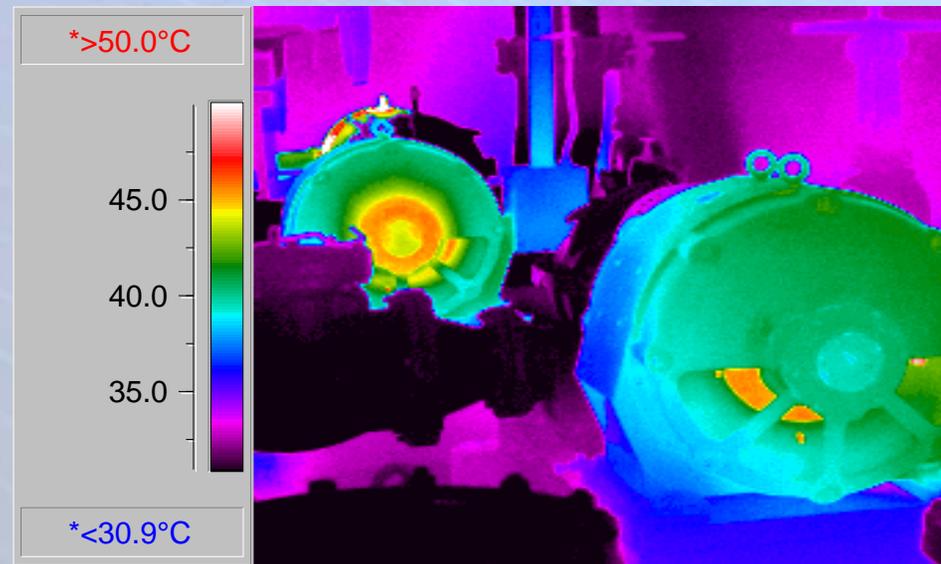


The bearing and motor should be the same temperature.

Hot Spots caused by break down in winding insulation that can eventually cause a short

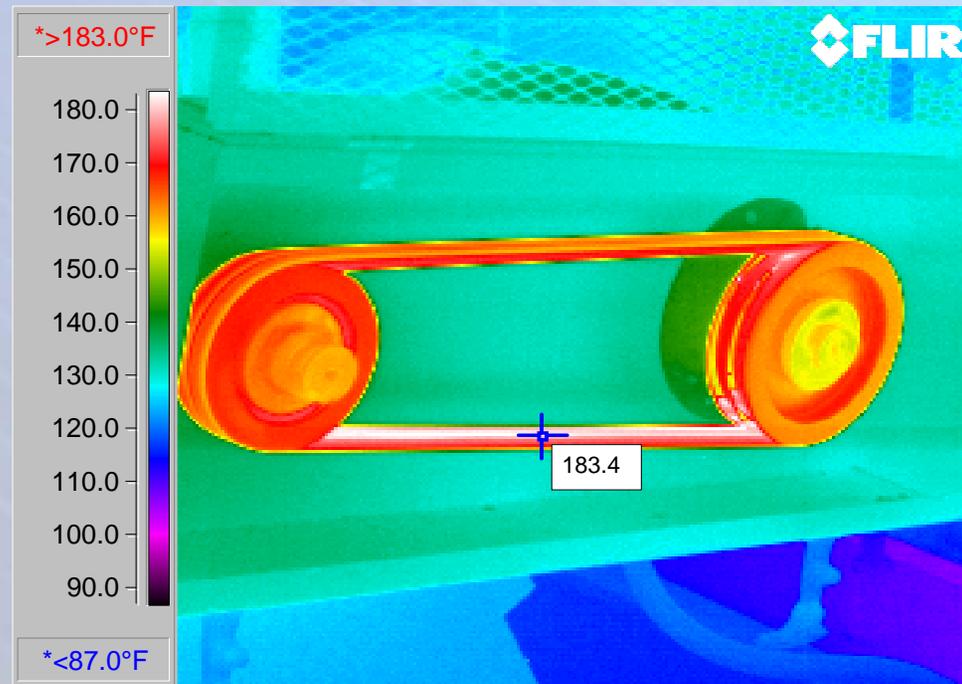


Look at the tail bearings of these motors under identical loads. There is clearly some overheating occurring on the bearing on the left side



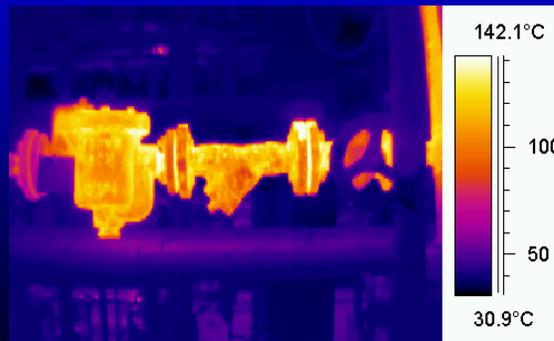
Exhaust Fan Belt Drive System

- ❖ All belt drive systems are subject to over tightening



Steam Traps

Steam Trap
In-operative



FSI

Steam Trap
Operating properly



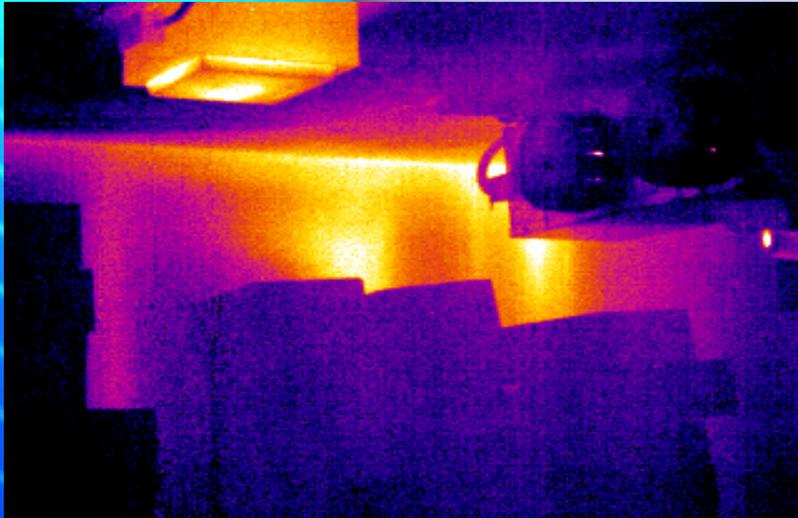
FSI

Roofing and Insulation



Done about 1 hour after sundown.

Insulation analysis



A refrigerator with missing insulation.



Any Questions?