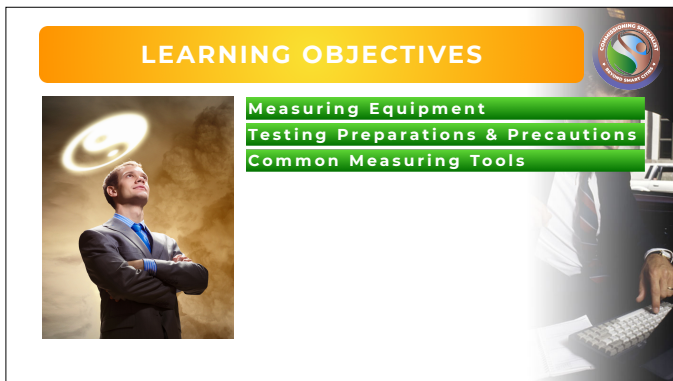




MEASURING EQUIPMENT

Energy management and conservation benefit from energy usage statistics. So, residences, workplaces, and factories need electrical power metres. Energy usage monitors detect the electrical power of individual devices or buildings and can be used to verify energy metrics.

Electricity metres are varied. Power firms install sophisticated utility units to measure energy consumption and prices. Plug-in USB models and whole household devices are available for home energy consumption customization. Certain power metres can be connected to a building's electric box to measure energy, power, and voltage usage. Plug-in units measure specific appliances. There are other power monitoring equipment and apps that measure residential energy use.



MAINTENANCE ECMS

☒ Develop a Preventive Operation & Maintenance Program

⇒ A comprehensive O&M plan for a facility should include PM procedures for periodically reviewing and monitoring the operating sequences, strategies and schedules to ensure that the facility operates as efficiently as possible.

⇒ Preventive maintenance should include activities critical to energy-efficient building operation.

☒ Develop O&M procedures and forms for tracking actual equipment performance against expected performance.



MAINTENANCE ECMS +

☒ Forms may include:

- ⇒ Task description,
- ⇒ Checking method and frequency for each piece of equipment
- ⇒ Reporting formats

⇒ Procedures for addressing non-conformance issues and how to resolve performance deficiencies

☒ Periodically review HVAC and lighting schedules, temperature setpoints and occupant/tenant use requirements so equipment runs only when needed.

☒ Seasonally adjust control strategies. A good strategy for the cooling season is not necessarily optimal for the "swing" season or the heating season.



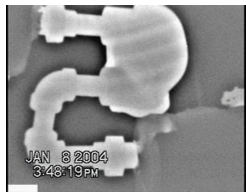
INFRARED PHOTOGRAPHY

- ✓ Maintenance Help from Interesting Technologies
- ✓ Family of non-destructive testing techniques
- ✓ Produces images of heat usually invisible to the human eye
- ✓ Heat in some mechanical situations can be a sign of impending malfunctions
- ✓ Heat in some electrical wiring can be a sign of bad connections and/or phase problems
- ✓ Heat anomalies in steam systems (e.g. traps)
- ✓ Heat loss through building envelope
- ✓ Averted problems can be significant in nature (e.G. Primary transformer fires, etc.)
- ✓ IR operator needs some level of expertise -Attend training - Contract service
- ✓ One major malfunction discovered and infrared program just paid for itself

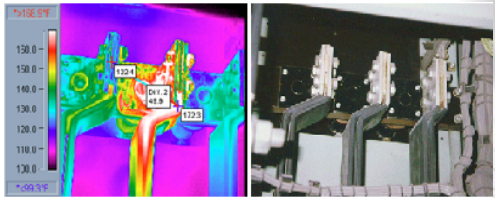




IR PHOTOS OF MALFUNCTIONING STREAM TRAP



EXAMPLE IR PHOTOS



Example IR photo of bad electrical connection - FLIR Systems Inc.

VIBRATION ANALYSIS

Another powerful member of the family of non-destructive testing techniques

Measures vibration signatures of machinery (usually rotating)

Two Main Diagnostic Methods

1.Vibration Signatures (Snap-Shot)

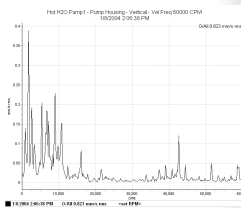
2.Trending (Observation Over Time)

Even more so than infrared photography, training is mandatory (this is a science and an art)

Trending vibration levels over time can remove some of the uncertainty of problems

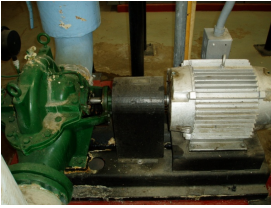
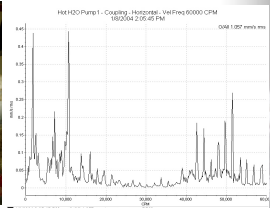
Technique used to spot: Bad Bearings, Bad Gears and Loose Machine Mountings

VIBRATION ANALYSIS EXAMPLES



☑ Water pump with suspicious (noise-floor) vibrations. Attempts to localize problem began. (Okla. State IAC)

VIBRATION ANALYSIS EXAMPLES



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