



**Gulf Coast Center
of Excellence**



Session 05: Instrumentation for Energy Assessments

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This session will discuss common measurement equipment used for industrial energy assessments:

- **Personal Protective Equipment (PPE)**
- **Basic Equipment**
 - Many common energy auditing tasks can be accomplished with basic items
- **Advanced Equipment**
 - Equipment-specific instrumentation
 - Dataloggers and portable sensors



- This presentation includes images, part numbers, and approximate prices for equipment.
 - The information presented here should NOT be taken as an endorsement of a particular brand or model.
 - Prices are approximate and likely to change.
 - The authors strive to respect the image copyright of equipment manufacturers, and images are included only as a general representation of a particular type of equipment.



Personal Protective Equipment (PPE)

PPE Recommendations

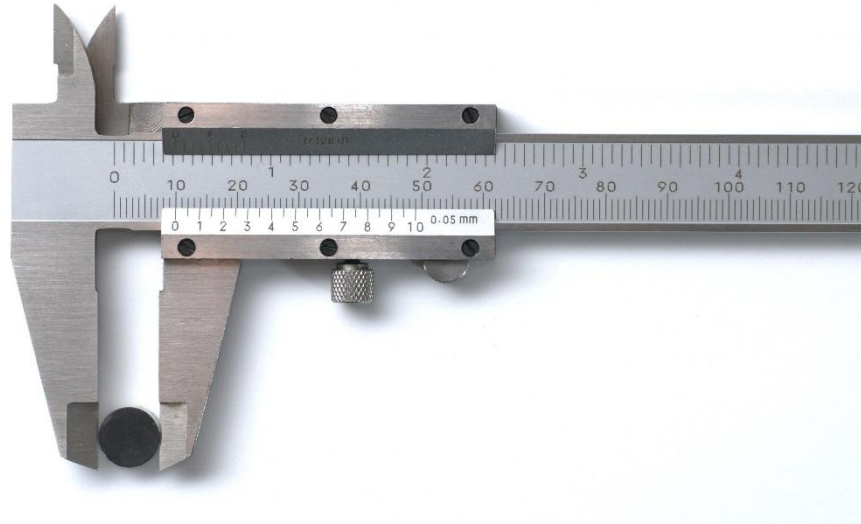
- Steel-toed Shoes
- Safety Glasses and Case
- Hearing Protection
- Reflective Vests
- Head Protection





Basic Equipment

Let's talk about specific instrumentation...



- What basic tools do you need for a typical energy audit?

Most important tools are simple

- Notepad



- Stopwatch



- Gloves



- Camera



- Rag and/or brush



- Measuring Tape



- Flashlight



- Pressure Gauge



Length Measurement

- Measuring Tape (\$5-10)
- Diameter Tape (\$5-10)
 - For fast measurement of pipe diameters
- Measuring Wheel (\$35-40)
- Laser Distance Sensor (\$80-100)
 - Effective for quickly measuring large distances, roof heights, etc.





Specific Sensing Equipment

Lighting Measurement

- Light Level Meter (\$150-200)
 - Measure in the dominant visual direction
 - Common uses
 - Use IES standards for appropriate light levels
 - Reduce total number of lamps
 - Reduce wattage of individual lamps
 - Lower fixtures
 - Determine appropriate skylighting
- Ballast Discriminator (\$80-100)
 - Determine electronic/magnetic ballast and associated ballast factor



Temperature Measurement

- Thermocouple Reader (\$150-400)
 - Measure surface / air / water temperatures



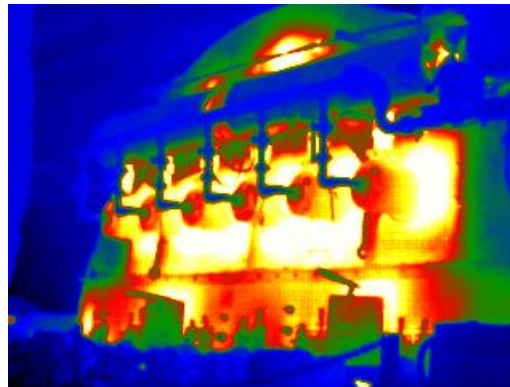
Temperature Measurement

- Infrared Thermometer (\$100-300)
 - Calibration can be subjective (emissivity parameters)



Temperature Measurement

- Infrared Camera (\$200-2000)
 - Calibration can be subjective (emissivity parameters)
 - Effective communication tool (convincing pictures)
 - Great for identify insulation needs (hot & cold)



Combustion Measurement

- Combustion Analyzer (\$700-4000)
 - Boiler combustion efficiency rarely checked by plant personnel
 - Best system is one of continuous monitoring and evaluation



Air Flow Measurement

- Anemometer (\$50-400)
 - Economical
 - Useful for estimating average air flow rate
- Pitot Tube Flow Sensor (\$300-1500)
- HVAC probe flow sensors (\$1,500-2,000)
 - Accurate flow with articulated probes
 - Specific for HVAC flow



Ultrasonic Sensor

- For Compressed Air Systems
 - Identify leak locations
 - Calibrated tests allow for rough estimates of leak rate



UE Ultraprobe
(\$5,000)



Synergys
(\$4,000)



Fluke
(\$28,000)

Ultrasonic Sensor

- For Steam Systems
 - Identify failed steam traps. Failure rate in unmaintained areas is high
 - Listen for characteristic sound of leaking steam, trap function



UE Ultraprobe
(\$5,000)



Synergys
(\$4,000)



Electrical Measurement

- Current Clamp and Voltmeter (\$100-400)
 - Ask plant electrician to perform measurements



Vibration Measurement

- Vibrometer (\$500-14,000)
 - Measure motor health
 - Built in ISO standard criteria for evaluation



Test Products
Intl
(\$500-1100)



Fluke
(\$3,200)



Fluke
(\$14,000)



Dataloggers and Sensors

- Effective for characterizing actual operational patterns

- **Lighting/Occupancy:** quantifying potential for occupancy based lighting controls
- **Temperature/Humidity:** quantifying cooling loads, programmatic failures, etc.
- **Motor Duty Factors:** for accurate calculation of motor energy consumption
- **Electrical Current:** monitoring transient power consumption
- **Pressure:** monitoring air compressor performance
- **Air Velocity:** monitoring air flow rate
- NOTE: Use Bluetooth tags if you leave equipment with client!





Final Recommendations

A few final recommendations...

- Start with simple tools, and then invest in advanced (i.e. costly) equipment
 - Industrial facilities are a tough environment
 - Consider the life-time of equipment
- Use high-quality storage cases
 - Protect the equipment
 - Portability is an important consideration
- Batteries
 - Always have spares
 - ...and the screwdrivers needed to install them



A few final recommendations...

- Some facilities will not allow laptops, mobile phones, etc.



- Always have paper notebooks



- Have alternatives for tasks commonly done with phone apps



- Specific facilities will have further restrictions
 - Some chemical facilities will prohibit any spark-source
 - Some food facilities will require you to use their specialized pens (i.e. metallic pens that will show up on x-rays)



Questions