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Michaels Engineering Energy Brief

RULES OF THUMB

SUGGESTIONS...

Do you have certain Energy Efficiency topics you'd like to know more about? Send an email with your suggestion to the author listed below and your topic might become a future Energy Brief!

DID YOU KNOW...

...An extensive rule-of-thumb list is an energy analyst's most useful tool.

...Sometimes when using rules of thumb and worst-case scenarios, decisions to implement projects can be made with no further evaluation.

MEET THE AUTHOR

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RULES OF THUMB

The origin of the commonly used "rule of thumb" phrase is debatable, but the principle underlying the modern rendition is invaluable to quickly screening energy-saving opportunities. Savings can be quickly quantified using parameters such as square footage, typical ventilation rates, fan or pump characteristics, typical equipment efficiencies, and hours of operation. Let's demonstrate with some examples that can be completed in a couple minutes each.

COMPRESSED AIR

Example: A two hundred horsepower compressor operates 6,000 hours per year with an average load of 50%. The compressor has inlet valve control so the minimum power, even at almost no flow is approximately 80%. This is a wasteful scenario. If this compressor were replaced with a compressor with variable frequency drive control the savings could be quickly estimated as follows.

Base case: 90% power x 200 hp x 0.75 kW/hp x 6,000 hours per year ~ 800,000 kWh

Proposed case: 50% power x 200 hp x 0.75 kW/hp x 6,000 hours per year ~ 450,000 kWh

Savings ~ 350,000 kWh, or $21,000 per year at a estimated $0.06 kWh

EXHAUST HEAT RECOVERY

Example: A swimming pool facility has a 100% outside air unit to provide makeup air for exhaust. The pool surface area is approximately 4,000 square feet. Appropriate ventilation levels would be 1 cubic foot per minute per square foot of pool, or 4,000 cfm. Since the space is fairly warm the balance point temperature will be high so assume 6,500 heating degree-days. A heat recovery unit could be installed to recovery 60% of the recoverable heat from the exhaust.

Base case: 4,000 cfm x 1.08 Btu/hr/F x 6,500 degree days x 24 hr/day / 100,000 Btu/therm / 80% heating efficiency ~ 8,400 therms

Proposed case: ~ 8,400 therms x (1-60% recovery effectiveness) = 3,360 therms

Savings ~ 5,000 therms, or roughly $6,000 at $1.20 gas

VARIABLE FREQUENCY DRIVE

Example: A 50 horsepower chilled water pump operates at a constant speed for 5,000 hours per year. Although a throttled pump will use a little less energy than one that runs at full flow, this isn't significant for a rule-of-thumb calculation. The average cooling load and therefore required chilled water flow is most likely less than 50% but to be conservative, that is what we will use. Rule of thumb is that power varies with the cube of percent full speed. I.e. 50% x 50% x 50%, or 12.5%

Base case: 50 hp x 80% estimated load x 0.75 kW/hp / 95% estimated motor efficiency x 5,000 hours ~ 158,000 kWh

Proposed case: ~ 158,000 kWh x 0.53 / .85 (estimated drive loss at 50% speed) = 23,000 kWh

Savings ~ 135,000 kWh, or roughly $8,100 at $0.06 gas

SPEED AND POWER

An extensive rule-of-thumb list is an energy analyst's most useful tool. These rules are used to quickly determine whether someone else's complex analysis is likely to be accurate. They are also used on the front end to quickly cull projects from an identified list of opportunities. Sometimes when using rules of thumb and worst-case scenarios, decisions to implement projects can be made with no further evaluation. However, in most cases a detailed analysis is necessary to make investment decisions.