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Compressor Temperatures

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Temperature F

- Discharge – Temperature measured (or entered) at the discharge line.
- Suction – Temperature measured (or entered) at the suction line

IR Calibration

- IR units @ 4mA - 0 F
- IR units @ 20mA- 1000F
- IR units should be in Fahrenheit

Theoretical Discharge Temperature

- F- This is the calculated theoretical discharge temperature for each cylinder end. It is calculated from user-collected suction temperature, the absolute compression ratio of the toe pressures and the K-value derived from the current gas sample.
- Delta- This is calculated by subtracting the theoretical discharge temperature from the measured discharge temperature.

K-Value

- The ratio of specific heats is a physical property of pure gases and gas mixtures and is known by many other names including: adiabatic exponent, isentropic exponent, and K value. It is used to define basic gas processes including adiabatic and polytropic compression. It also appears in many of the traditional equations commonly used to determine a compressor head, gas discharge temperature, gas power, and polytropic exponent

Compressor Report

Compressor Performance Report

Compressor Cylinder ID	Theo Dis Temp (F)	Theo Dis Temp (delta)	Temp F Dis	Temp F Suc
1> Comp 1H Pressure	217.4	-1.8	215.6	111.6
2> Comp 1C Pressure	218.7	-3.1	215.6	111.6
3> Comp 2H Pressure	220.1	23.6	243.7	97.6
4> Comp 2C Pressure	218.4	25.3	243.7	97.6
5> Comp 3H Pressure	245.1	13.8	258.9	136.7
6> Comp 3C Pressure	244.1	14.8	258.9	136.7

calculated

difference

Measured (from page 1)

The Theoretical discharge temperature is calculated from the measured suction temperature, the compression ratio of the toes and the K-value of the gas.

The delta temperature will elevate as the cylinder leakage rates increase.

The Math

- Theoretical compressor calculations use absolute temperatures (Degree Rankin)
- Absolute temperature (R) =degrees F + 460
- The Standard temperature of gas measurement is 60 degrees F
- (60 degrees F + 460) 520 Degrees Rankin

Theoretical Temperature Example

- T1 = 60 deg F
- R = 200 psia / 100 psia = 2
- K = 1.28
- T2 = ((T1+460) *R^((K-1)/K))-460
- T2 = ((60+460) *2^ ((1.28-1)/1.28))-460
- T2 = (520*2^ (.28/1.28))-460
- T2 = (520*2^ (.21875))-460
- T2 = (520*1.1637)-460
- T2 = (605.124)-460
- T2 = 145 deg F

Temperatures

- Suction Nozzle, Compressor Valves, Discharge Nozzle, Packing Vent, Water In/Out, Oil In/Out.
- Suction Nozzle Temperature is one of the most important temperatures. Why? Because they are the foundation of Theoretical Calculation,

To Gauge or Not To Gauge

- If there are RTD gauges in nozzles then using the panel temperature would be helpful and OK. Also long as they are properly located and properly maintained.
- RTD gauges are the best way to get temperature because they are in the stream of gas flow.

Theoretical

- You can have the theoretical curves on or off. When selecting on here are your options.
- K Based (Adiabatic)
- N Based Theoretical
- Averaged N Based
- Power Cylinder Compression K Model
- Equation of State Model K
- You can change this under Software options/General/Plotting/Theoretical model


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N-Based

- The N compression and N-Expansion values are derived from the actual sloes of the collected indicator card. When the theoretical lines are replotted they will always line up with the actual at the beginning and end of the slope. Do not need a accurate clearance for this to work. Limited Diagnostic value.

Averaged N Based

- The N compression and N-Expansion values are derived from the actual slopes of the collected indicator card and then averaged for each end. When the theoretical lines are replotted they may deviate from the actual at the beginning and end of the slope. Do not need an accurate clearance for this to work. Limited diagnostic value but better than N-Valve only.

K Based

- The K values are derived from the gas analysis and modified by the average gas temperature. An accurate clearance value needs to be in the setup for the current load step. This plot is the best for diagnostic comparison with the collected PV when the Zs and Zd value are relatively close to each other. Use the average GPSA calculated clearance in the load step table if unsure of he actual clearance. Good diagnostic value.

Equation of State Model K

- The K values are derived from the gas analysis and continuously modified by the theoretical gas temperature . An accurate clearance value needs to be in the setup for the current load step. This plot is the best for diagnostic comparison with the collected PV when the Zs and Zd values are significantly different to each other. Use the average GPSA calculated clearance in the load step table if unsure of the actual clearance. Good Diagnostic value.

Isothermal Compression Model

- This model assumes that the compressed gas remains at a constant temperature throughout the compression or expansion process. In this cycle, internal energy is removed from the system as heat at the same rate that it is added by the mechanical work of compression. Isothermal compression or expansion more closely models real lift when the compressor has a large heat exchanging surface, a small gas volume, or a long time scale(ie., a small power level). Compressors that utilize inter-stage cooling between compression stages come closest to achieving perfect isothermal compression. However, with practical devices perfect isothermal compression is not attainable. For example, unless you have a infinite number of compression stages with corresponding intercoolers, you will never achieve perfect isothermal compression.

Adiabatic Compression Model

- Assumes that no heat is transferred to or from the gas during the compression, and all supplied work is added to the internal energy of the gas, resulting in increases of temperature and pressure. Theoretical temperature rise is T2 = T1·Rc(k-1)/k, with T1 and T2 in degrees Rankine or kelvin, and k = ratio of specific heats. R is the compression ratio; being the absolute outlet pressure divided by the absolute inlet pressure. The rise in air and temperature ratio means compression does not follow a simple pressure to volume ratio. This is less efficient, but quick. Adiabatic compression or expansion more closely model real life when a compressor has good insulation, a large gas volume, or a short time scale. In practice there will always be a certain amount of heat flow out of the compressed gas. Making a perfect adiabatic compressor would require perfect heat insulation of all parts of the machine. A bicycle tire pump's metal tube becomes hot as you compress the air

Polytropic Compression Model

- This model takes into account both a rise in temperature in the gas as well as some loss of energy (heat) to the compressor's components. This assumes that heat may enter or leave the system, and that input shaft work can appear as both increased pressure (usually useful work) and increased temperature above adiabatic (usually losses due to cycle efficiency). Compression efficiency is then the ratio of temperature rise at theoretical 100 percent (adiabatic) vs. actual (polytropic).

Compressor Performance Report

- Theoretical temperatures are a good tool to determine, first, if we have properly measured the temperatures. Cylinder temperatures are the most difficult item for us to measure accurately. Many compressors have good instrumentation to measure discharge temperatures, but very few have instrumentation to measure suction temperature. If we start out with a questionable suction temperature, the theoretical temperature calculations will not represent the discharge temperatures at the compressor. The delta temperatures are the difference between the measured temperatures, and the calculated discharge temperatures. If the gas sample is not representative of the gas being compressed, the K value will not be correct and that is an important part of the theoretical calculations. We can use the theoretical temperature calculation to correct for less than perfect temperature gathering for healthy cylinders. The temperature is used to calculate the Z-factors of the gas for the capacity calculations.

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Thank You

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