Centrifugal Compressor Performance — Report

Calculation summary | PlantCalcKit v1.0

DOCUMENT

Plant / project	**Example Plant**
Equipment tag / system	**K-101**
Calculation / document no.	**CALC-CC-001**
Revision	**0**
Prepared by	**Your name**
Checked by	**—**
Date	**07-Nov-2026**

Calculation basis

Gas: Mixture — Natural gas (typical pipeline) · Method: Schultz real-gas polytropic · Flow: Actual inlet volume flow · Peng–Robinson real-gas states, ideal-gas cp polynomials, aligned with the publicly documented method (ASME PTC 10 / ISO 5389 style)

Status

✓ Inputs OK · ℹ️ 10 default value(s) in use: mechanical loss, expected efficiency, vendor curve: gas molar mass, vendor curve: suction compressibility Z, vendor curve: suction temperature, driver and drive-train efficiency, operating time, energy price, suction-temperature step for the what-if, pressure-ratio step for the what-if

KEY INPUTS

Input	Unit	Value used
Suction pressure	bar a	30.000
Suction temperature	°C	35.00
Discharge pressure	bar a	60.000
Discharge temperature (measured)	°C	102.00
Actual inlet volume flow	m³/h	2,000.0
Shaft power (measured)	kW	1,700.0
Mechanical loss (bearings, seals, gear)	%	1.50
Expected efficiency (design or vendor curve)	%	78.00
Vendor curve: gas molar mass	g/mol	17.589
Vendor curve: suction compressibility Z	—	0.9349
Vendor curve: suction temperature	°C	35.00
Driver and drive-train efficiency	%	95.00
Operating time	h/yr	8,000
Energy price (USD per unit shown)	per MWh	80.00

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COMPOSITION

Component	Mole %	Mass %
Methane	92.000	83.912
Ethane	4.000	6.838
Propane	1.000	2.507
Isobutane	0.200	0.661
Butane	0.200	0.661
Isopentane	0.050	0.205
Pentane	0.050	0.205
Hexane	0.050	0.245
Nitrogen	1.500	2.389
Carbon dioxide	0.950	2.377

RESULTS — OPERATING POINT

Result	Unit	Value
Gas state at suction and discharge	—	no condensation expected
Gas molar mass	g/mol	17.589
Pressure ratio (discharge / suction, absolute)	—	2.0000
Compressibility Z at suction	—	0.9349
Compressibility Z at discharge	—	0.9447
Density at suction	kg/m³	22.028
Density at discharge	kg/m³	35.815
Isentropic exponent at suction (real gas)	—	1.2978
Mass flow	kg/h	44,056.8
Actual inlet volume flow	m³/h	2,000.0
Standard volume flow (15 °C, 1.01325 bar)	Sm³/h	59,056.1

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RESULTS — HEAD, EFFICIENCY AND POWER

Result	Unit	Value
Head (selected method)	kJ/kg	104.853
Efficiency (selected method)	%	76.51
Real-gas enthalpy rise	kJ/kg	137.048
Gas power from the enthalpy rise (ṁ·Δh)	kW	1,677.2
Gas power from the shaft power (shaft − mechanical loss)	kW	1,674.5
Energy balance (enthalpy-rise power / shaft-derived power)	%	100.2
Efficiency from the measured power	%	76.63
Specific shaft power	kJ/kg	138.911
Specific shaft power per standard volume	kWh/1000 Sm³	28.786
Annual energy cost at this point	USD/yr	1,145,263

RESULTS — METHOD COMPARISON

Result	Unit	Value
Schultz: measured volume exponent n	—	1.4262
Schultz correction factor f	—	0.99969
Schultz: polytropic head	kJ/kg	104.853
Schultz: polytropic efficiency	%	76.51
Ideal-gas: polytropic exponent n	—	1.3963
Ideal-gas: polytropic head (average Z)	kJ/kg	104.869
Ideal-gas: polytropic efficiency	%	74.61
Isentropic discharge temperature	°C	88.42
Isentropic head	kJ/kg	102.348
Isentropic efficiency	%	74.68

RESULTS — DISCHARGE-TEMPERATURE CHECK AND VENDOR-CURVE BASIS

Result	Unit	Value
Predicted discharge temperature at the expected efficiency	°C	100.88
Measured discharge temperature	°C	102.00
Measured − predicted	K	+1.12
Measured − expected efficiency	points	-1.49
Equivalent-speed factor c = N_eq / N	—	1.0000
Equivalent inlet flow on the vendor curve	m³/h	2,000.0
Equivalent head on the vendor curve	kJ/kg	104.853

WHAT-IF — SUCTION TEMPERATURE AND PRESSURE RATIO

Case	Level	Pressure ratio	Head	Shaft power	Discharge T	Cost USD/yr	Change USD/yr
Suction -10.0 K	25.0	2.000	101.45	1,644.8	89.8	1,108,097	-37,166
Suction -5.0 K	30.0	2.000	103.15	1,672.4	95.9	1,126,680	-18,583
Now (base case)	**35.0**	**2.000**	**104.85**	**1,700.0**	**102.0**	**1,145,263**	**0**
Suction +5.0 K	40.0	2.000	106.55	1,727.6	108.1	1,163,846	+18,583
Suction +10.0 K	45.0	2.000	108.26	1,755.2	114.2	1,182,429	+37,166
Pressure ratio -10.0 %	54.000	1.800	87.56	1,419.6	90.9	956,333	-188,930
Pressure ratio -5.0 %	57.000	1.900	96.37	1,562.4	96.6	1,052,579	-92,684
Now (base case)	**60.000**	**2.000**	**104.85**	**1,700.0**	**102.0**	**1,145,263**	**0**
Pressure ratio +5.0 %	63.000	2.100	113.04	1,832.7	107.2	1,234,685	+89,422
Pressure ratio +10.0 %	66.000	2.200	120.95	1,961.0	112.3	1,321,107	+175,844

FINDINGS AND RECOMMENDATIONS

◆ **Opportunity**

Cooling the suction gas by 5 K would save about 28 kW of shaft power, about 18,583 USD per year. Check the suction cooler and the inlet piping heat gain.

◆ **Opportunity**

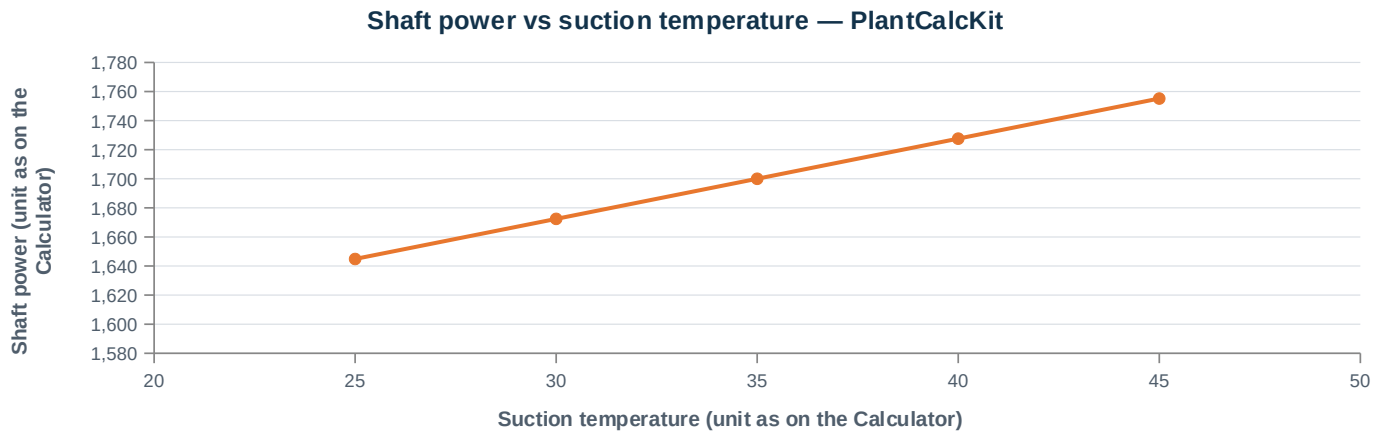
Each 5 % lower pressure ratio saves about 92,684 USD per year: check the discharge-side pressure drop (coolers, check valve, piping) and the suction-side pressure drop.

ℹ️ **Note**

Default values are in use (mechanical loss, expected efficiency, vendor curve: gas molar mass, vendor curve: suction compressibility Z, vendor curve: suction temperature, driver and drive-train efficiency, operating time, energy price, suction-temperature step for the what-if, pressure-ratio step for the what-

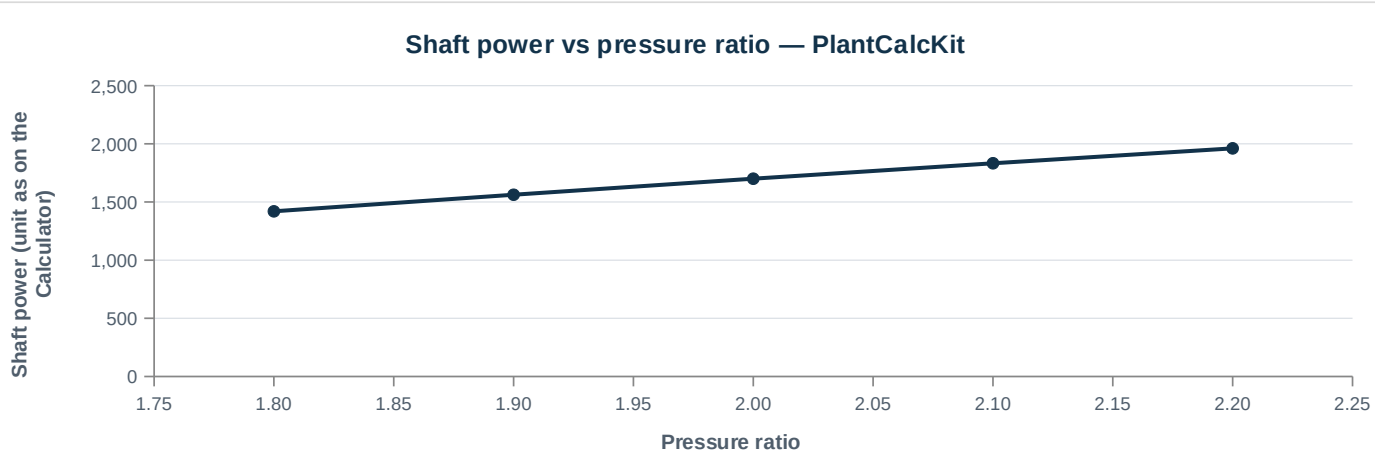
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CHARTS



Observations — suction temperature

[Write your observations here]



Observations — pressure ratio

[Write your observations here]

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