Air Compressor Specific Power and Efficiency — Report

DOCUMENT

Plant / project	**Example Plant**
Equipment tag / system	**AC-01**
Calculation / document no.	**CALC-PE-200**
Revision	**0**
Prepared by	**Your name**
Checked by	**—**
Date	**07-Nov-2026**
Calculation basis	Compressor: Oil-flooded screw · Control: Load / unload · Flow given as: intake flow (fad at intake conditions) · FAD referred to: ISO 1217: 1 bar a, 20 °C, dry · Power: measured input power · Aligned with the publicly documented ISO 1217 acceptance-test definitions (FAD, specific energy requirement); humid air as an ideal-gas mixture (ASHRAE psychrometrics, IAPWS-IF97 saturation pressure)
Status	**✓ Inputs OK · ℹ️ 10 default value(s) in use: motor and drive efficiency, unrecoverable casing loss, unloaded power, zero-flow power, zero-flow power, variable-speed full-load penalty, operating hours per year, share of the recoverable heat that is used, share of the hours with a heat demand, efficiency of the displaced heating**
Operation and cost	Average load 62.0 % of the full-load flow · 6,000 h/yr · electricity 90.00 USD/MWh · delivered air 38.0 °C · 60 % of the recoverable heat used in 70 % of the hours · displaced heat 35.00 USD/MWh at 85 % efficiency
Allowances used	Motor and drive 93.0 % · casing loss 3.0 % · unloaded power 25 % · zero-flow power 70 % (modulation), 5 % (variable speed) · variable-speed penalty 3.0 % · 10 default value(s) in use

KEY INPUTS (values used; Proposed shows the Actual value where it was left blank)

Input	Unit	Design	Actual	Proposed
Intake air temperature	°C	20.0	30.0	22.0
Ambient (intake) pressure	bar a	1.000	1.006	1.006
Intake relative humidity	%	0.0	55.0	55.0
Discharge pressure (package outlet)	bar g	7.00	7.20	6.50
Displacement (swept volume flow)	m³/min	17.600	17.600	17.600

RESULTS — AIR DELIVERY, SPECIFIC POWER AND EFFICIENCY

Result	Unit	Design	Actual	Proposed	Actual − Design	Proposed − Actual
Free air delivery at the reference conditions	m³/min	16.200	15.204	15.756	-0.996	0.552
Input power at the full-load point	kW	98.00	98.50	93.50	0.50	-5.00
Specific power at the reference conditions	kW/(m³/min)	6.049	6.479	5.934	0.429	-0.544
Isothermal efficiency (on shaft power)	%	61.7	61.5	62.0	-0.2	0.5
Adiabatic efficiency (on shaft power)	%	84.2	84.1	83.7	-0.1	-0.4
Volumetric efficiency	%	92.0	90.9	90.9	-1.1	0.0

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RESULTS — PART LOAD, ENERGY, COST AND HEAT RECOVERY

Result	Unit	Design	Actual	Proposed	Actual − Design	Proposed − Actual
Power at zero flow (selected control)	kW	24.50	24.63	23.38	0.13	-1.25
Average input power at the average load	kW	70.07	70.43	66.85	0.36	-3.58
Specific power at the average load (reference FAD)	kW/(m³/min)	6.976	7.471	6.844	0.495	-0.628
Energy per year (selected control)	MWh/yr	420.4	422.6	401.1	2.1	-21.5
Energy cost per year (selected control)	USD/yr	37,838	38,031	36,100	193	-1,931
Energy per year, load / unload	MWh/yr	420.4	422.6	401.1	2.1	-21.5
Energy per year, modulation	MWh/yr	521.0	523.6	497.0	2.7	-26.6
Energy per year, variable speed	MWh/yr	387.0	389.0	369.2	2.0	-19.7
Cost saved by variable speed against load / unload	USD/yr	3,007	3,023	2,869	15	-153
Cost saved by variable speed against modulation	USD/yr	12,057	12,118	11,503	62	-615
Recoverable heat (coolers, after the casing loss)	kW	82.60	86.37	79.24	3.77	-7.13
Recoverable heat, share of the input power	%	84.3	87.7	84.7	3.4	-2.9
Heat recovered at the share chosen	kW	49.56	51.82	47.54	2.26	-4.28
Heat recovered per year	MWh/yr	148.8	155.6	142.8	6.8	-12.8
Value of the heat recovered per year	USD/yr	6,128	6,408	5,879	280	-529

FINDINGS AND RECOMMENDATIONS

⚠ **Correct soon**

The specific power at the reference conditions is 7.1 % above the design value. Check the intake filter, cooler fouling, separator pressure drop, discharge pressure setting, leakage in the compressor and the control mode.

⚠ **Correct soon**

The free air delivery at the reference conditions is 6.2 % below the design value. Check the intake filter and valve, internal leakage or wear, the valves of a reciprocating machine and the flow measurement.

◆ **Opportunity**

At 62 % average load a variable-speed machine would use 34 MWh/yr less than load / unload (3,023 USD/yr, 7.9 %). Compare with the extra cost of the drive.

◆ **Opportunity**

About 86 kW of heat (88 % of the input power) can be taken from the coolers; at the share and hours entered 156 MWh/yr could be recovered, worth 6,408 USD/yr.

◆ **Opportunity**

Lowering the discharge pressure by 100 kPa would save about 8.1 % of the compressor power (34 MWh/yr). Check the real pressure needed at the points of use and the pressure drop in the treatment equipment.

◆ **Opportunity**

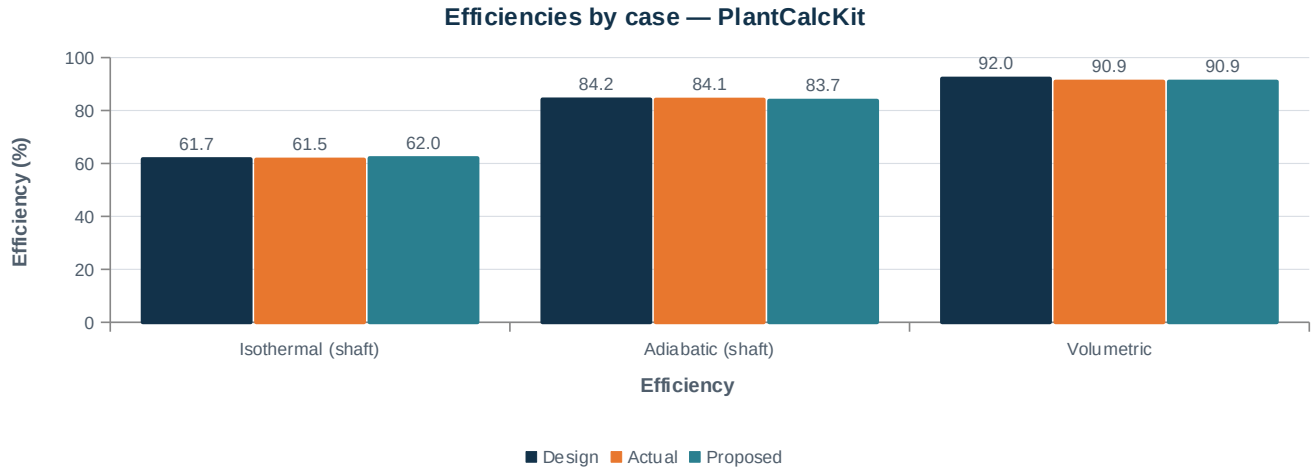
The intake air is 10 K warmer than the reference temperature: the specific power per unit of reference flow is about 3.4 % higher than at the reference intake. Ducting cooler outside air to the intake saves about 1 % per 3 K.

◆ **Opportunity**

The proposed case changes the annual energy by -21 MWh (-5.1 %) and the specific power at the reference conditions by -8.4 %.

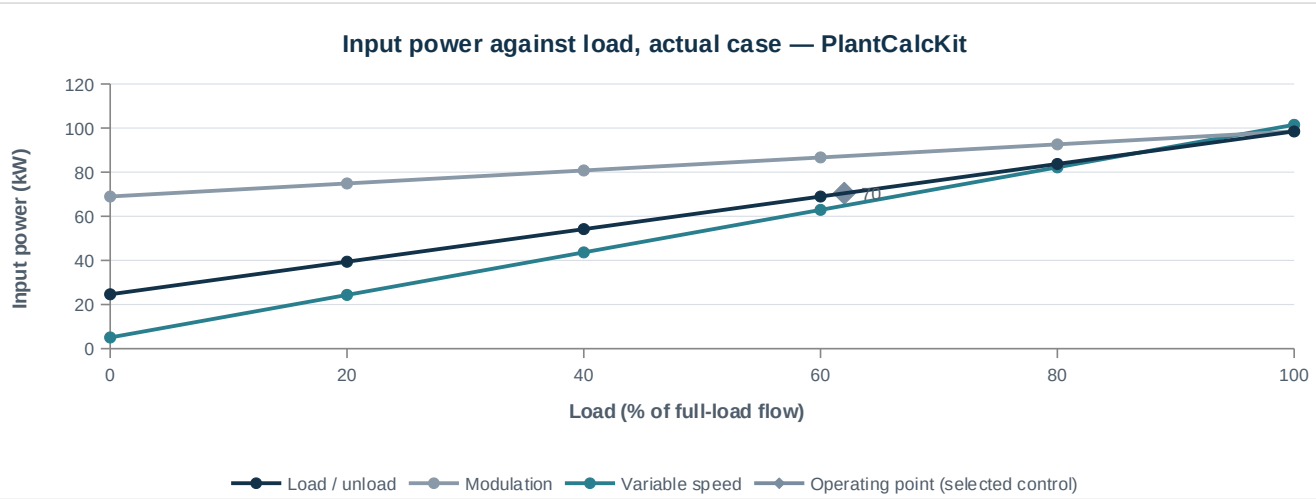
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CHARTS



Observations — efficiencies

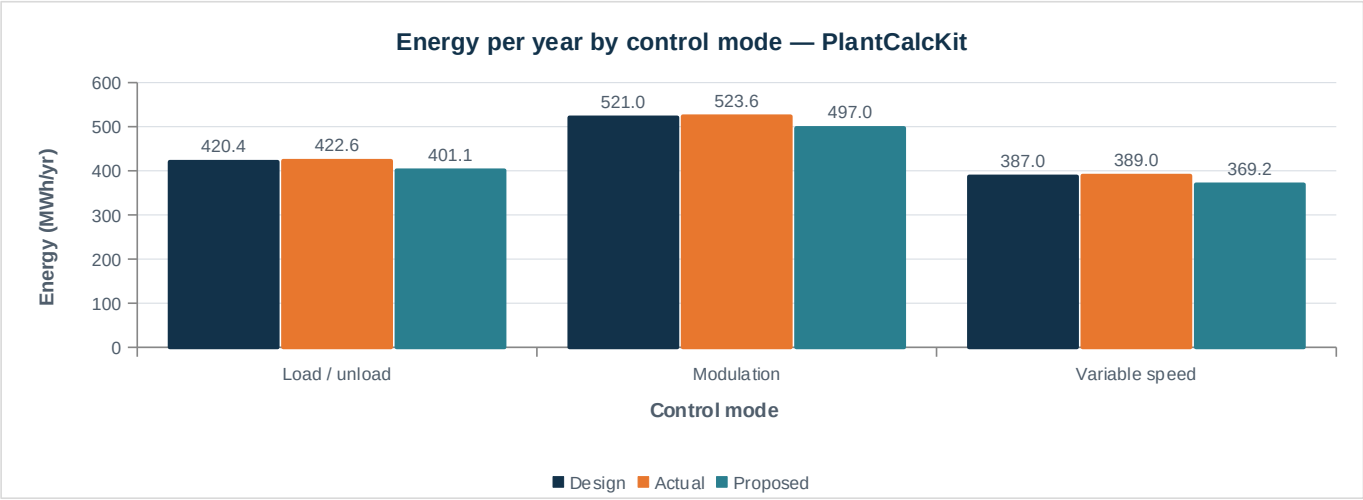
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Observations — part load

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Observations — control modes

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