



Power Potential of a One Inch Supercritical CO2 Feed for ORC and Brayton Cycles

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Upper bound power potential for a one inch inside diameter supercritical CO2 feed at fifteen hundred psi and three thousand psi across turbine inlet temperatures of one hundred C, three hundred C, five hundred C, and seven hundred C, with practical expectations for Organic Rankine Cycle and Brayton cycle test carts.



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Scope and assumptions

This is an upper bound, assumption driven sizing intended for a lab cart. Flow is limited by choked conditions at the smallest area, here taken as a smooth one inch inside diameter feed with a short, well contoured run into the test head. For comparability across temperatures, the outlet is assumed to be about one point zero MPa class back pressure. Ideal shaft power is reduced to a practical figure by applying a composite factor for turbine efficiency and header losses.

ORC practical power equals about sixty percent of the ideal isentropic potential.

Brayton practical power equals about fifty percent of the ideal potential, reflecting higher parasitics and generally smaller usable enthalpy drop at similar pressure ratios. Real systems will be heater limited long before they are line size limited. Treat these as ceilings for what the pipe could feed, not as what a small heater cart can actually deliver.

Results at fifteen hundred psi inlet

One inch feed at fifteen hundred psi with turbine inlet temperatures of forty five C, one hundred C, three hundred C, five hundred C, and seven hundred C.

Organic Rankine Cycle practical power

Forty five C about five hundred thirteen kilowatts, about six hundred eighty eight horsepower

One hundred C about one thousand sixty six kilowatts, about one thousand four hundred thirty horsepower

Three hundred C about one thousand two hundred seventy five kilowatts, about one thousand seven hundred nine horsepower

Five hundred C about one thousand six hundred forty six kilowatts, about two thousand two hundred eight horsepower

Seven hundred C about one thousand nine hundred eight kilowatts, about two thousand five hundred forty horsepower

Brayton cycle practical power

Forty five C about four hundred twenty eight kilowatts, about five hundred seventy four horsepower

One hundred C about eight hundred eighty nine kilowatts, about one thousand one hundred ninety two horsepower

Three hundred C about one thousand sixty two kilowatts, about one thousand four hundred twenty five horsepower

Five hundred C about one thousand three hundred seventy two kilowatts, about one thousand eight hundred thirty horsepower

Seven hundred C about one thousand five hundred ninety kilowatts, about two thousand one hundred ninety horsepower

**POWER POTENTIAL OF
SUPERCRITICAL CO₂ TURBINES
AT 2000 PSI**

	PIPE INNER DIAMETER			
TIT (°C)	1/8	1/4	3/8	1 in
45	5,2	20	46	184
100	10,7	42	92	371

300	12,7	49	108	431
700	15,5	61	134	538

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Power Potential of Supercritical CO₂ Turbines at 3000 psi

	Pipe Inner Diameter			
TIT	1/8 in	1/4 in	3/8 in	1 in
45 °C	23 kW	92 kW	206 kW	1650
100 °C	47 kW	189 kW	423 kW	3420

300 °C	56 kW	229 kW	512 kW	4150
700 °C	84 kW	341 kW	762 kW	6180

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