ORC Refrigerants at 300 psi: Temperature Limits, Efficiency, and Usage Notes

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https://infinityturbine.com/infinity-turbine-orc-refrigerants-300psi-usage-data.html

Explore Organic Rankine Cycle refrigerants at 300 psi. Learn the associated maximum temperatures, Carnot efficiencies, condenser conditions, and regulatory notes for each fluid.

This webpage QR code

PDF Version of the webpage (maximum 10 pages)

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Note: the standard Infinity Turbine ORC systems are designed for 300 psi operation. If you want higher pressure, then consider our Supercritical CO2 systems.

Introduction

In Organic Rankine Cycle (ORC) systems, the thermodynamic properties of refrigerants determine efficiency, operating conditions, and overall system performance. By comparing refrigerants at a standard pressure of 300 psi (~20.7 bar), we can evaluate how temperature capability, efficiency, and practical use cases differ. This article lists common ORC refrigerants, their temperature at 300 psi, Carnot efficiencies at those temperatures, optimal condenser ranges, and regulatory notes.

R-245fa (Honeywell Genetron)

Temperature at 300 psi (20.7 bar): ~125 °C (257 °F)
Carnot Efficiency (vs 30 °C / 86 °F condenser): ~25 percent
Condenser Temperature: Most effective around 30–35 °C (86–95 °F)
Notes: High global warming potential (GWP ~950). Facing phase-out in the EU under F-Gas Regulation.

R-1233zd(E) (Hydrofluoro-olefin, HFO)

Temperature at 300 psi (20.7 bar): ~155 °C (311 °F)
Carnot Efficiency (vs 30 °C / 86 °F condenser): ~29 percent
Condenser Temperature: Effective in the 25–35 °C (77–95 °F) range
Notes: Very low GWP (~1). No near-term sunset dates. Widely promoted as a sustainable replacement for R-245fa.

R-123 (HCFC, historical use)

Temperature at 300 psi (20.7 bar): ~110 °C (230 °F)
Carnot Efficiency (vs 30 °C / 86 °F condenser): ~23 percent
Condenser Temperature: Best around 25–30 °C (77–86 °F)
Notes: Phased out globally under the Montreal Protocol due to ozone depletion potential. Not viable for new ORC systems.

R-600 (n-Butane)

Temperature at 300 psi (20.7 bar): ~140 °C (284 °F)
Carnot Efficiency (vs 30 °C / 86 °F condenser): ~27 percent
Condenser Temperature: Optimal near 25–30 °C (77–86 °F)
Notes: Low GWP but highly flammable. Regulatory and safety concerns limit adoption in many regions.

R-601 (Pentane)

Temperature at 300 psi (20.7 bar): ~160 °C (320 °F)
Carnot Efficiency (vs 30 °C / 86 °F condenser): ~30 percent

Refrigerant	Max Temp (°C / °F)	Pressure (bar / psi)	Carnot Efficiency (%)	Best Condenser Temp (°C / °F)	Notes
R-245fa	150 / 302	36 / 522	29	30–35 / 86–95	High GWP, EU sunset
R-1233zd(E)	180 / 356	19 / 276	33	25–35 / 77–95	Low GWP HFO, no sunset
R-123	130 / 266	14 / 203	26	25–30 / 77–86	HCFC, phased out
R-600 (Butane)	150 / 302	50 / 725	29	25–30 / 77–86	Low GWP, flammable
R-601 (Pentane)	180 / 356	30 / 435	33	25–30 / 77–86	Low GWP, flammable
R-152a	120 / 248	45 / 653	25	25–30 / 77–86	Moderate GWP, phasedown

Refrigerant	Temp @ 300 psi (°C / °F	Carnot Eff. (%)	Best Condenser Temp (°C
R-245fa	125 / 257	25	30–35 / 86–95
R-1233zd(E)	155 / 311	29	25–35 / 77–95
R-123	110 / 230	23	25–30 / 77–86

Refrigerant	Temp @ 300 psi (°C / °F	Carnot Eff. (%)	Best Condenser Temp (°C
R-600 (Butane)	140 / 284	27	25–30 / 77–86
R-601 (Pentane)	160 / 320	30	25–30 / 77–86
R-152a	100 / 212	21	25–30 / 77–86

Refrigerant	Notes
R-245fa	High GWP HFC; EU F-Gas phase-down
R-1233zd(E)	Low GWP HFO; no sunset date

R-123	HCFC; phased out under Montreal Protocol
R-600 (Butane)	Low GWP; flammable; safety-limited
R-601 (Pentane)	Low GWP; flammable; geothermal use
R-152a	Moderate GWP; EU F-Gas phasedown