



Radial-Inflow Turbine Geometry for Supercritical CO₂: From Pressure Ratio and RPM to Bucket Angles and Diameters

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<https://infinityturbine.com/radial-inflow-turbine-geometry-for-sco2-by-infinity-turbine.html>

A practical, FileMaker-ready method to size a supercritical CO₂ radial-inflow turbine stage. Links pressure ratio, temperature, RPM, and mass flow to tip diameter, blade height, and inlet metal angles using CO₂ properties and stage loading and flow coefficients.



This webpage QR code

PDF Version of the webpage (maximum 10 pages)

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Overview

For compact supercritical CO₂ systems, a single radial-inflow turbine stage is common. The goal is to convert a specified total-to-static enthalpy drop into shaft work while keeping inlet Mach numbers and incidence under control. With CO₂'s dense, non-ideal behavior, you should size to the actual inlet state (pressure, temperature, cp, k, compressibility Z, density) rather than air-based rules.

This guide gives a first-cut sizing workflow and a FileMaker Pro calculation that returns the key geometry:

- Tip speed and tip diameter
- Rotor inlet blade height
- Inlet absolute and relative metal angles
- Sanity checks for Mach number

It assumes a radial-inflow turbine with near-zero exit swirl (a common target), high effectiveness recuperation upstream, and a specified overall pressure ratio across the turbine stage.

Design coefficients to choose

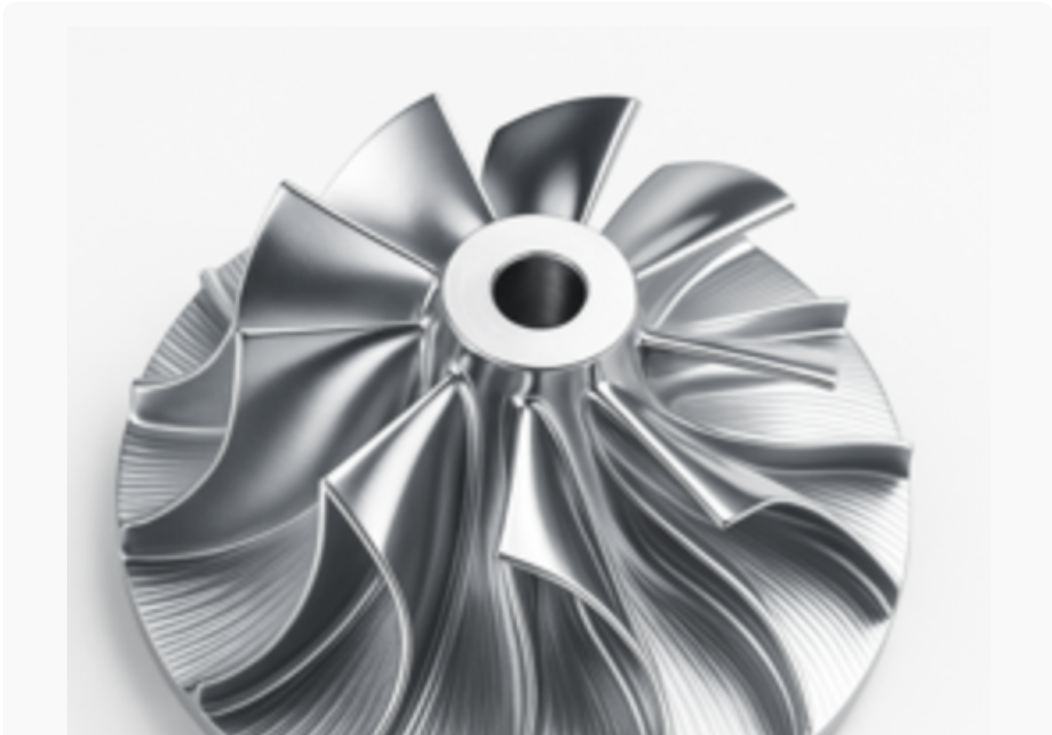
These are typical starting values; adjust during iteration.

- Turbine isentropic efficiency, η_t : 0.80 to 0.90
- Stage loading coefficient, $\psi_t = \Delta h_0 / U_2^2$: 1.0 to 1.6
- Flow coefficient at rotor inlet, $\phi_t = V_{m2} / U_2$: 0.15 to 0.25
- Slip and exit swirl: target V_{w3} approx 0 (zero exit swirl)
- Radius ratio, $r_r = R_3 / R_2$: 0.35 to 0.50 (sets hub exit diameter)
- Inlet relative Mach target: M_{rel2} less than about 1.2

Inputs and CO₂ properties

Provide these as fields or globals in FileMaker. If you do not compute properties in FileMaker, precompute with REFPROP or CoolProp and store them.

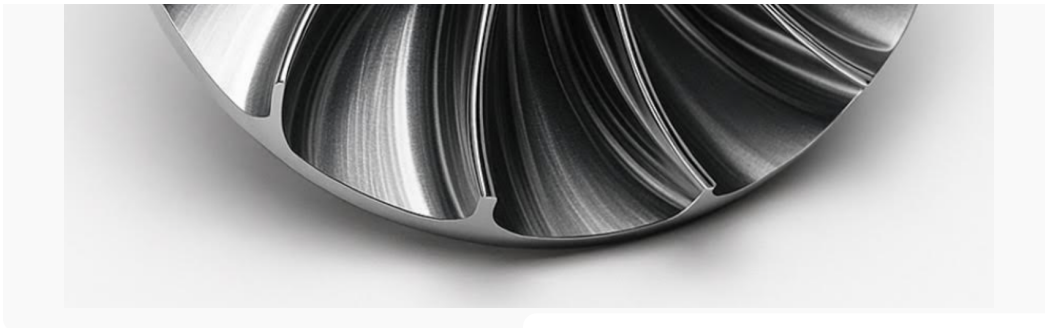
- T3_K turbine inlet total temperature, K
- P3_Pa turbine inlet total pressure, Pa
- PR_t turbine pressure ratio P3 over P4 (total to static target)
- N_rpm shaft speed, rpm
- mdot_kg_s mass flow, kg per s





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