



Contra-Rotating Turbine Test Rig

Description

Design and manufacture of a 4 stage, statorless turbine rig for a hypersonic vehicle aero-engine to test aerodynamic feasibility. The rig comprised a two shaft, contra-rotating arrangement, with each 155 kW, two stage turbine independently driving its own dynamometer at each end of the baseplate. Maximum shaft speeds were 2,130 RPM.

The rig used 11.6 kg/s of argon at 5 bar and 80-100 deg C as the working fluid. This is directed into a large plenum through a single inlet, prior to passing through a honeycomb and wire mesh for pre-conditioning of the inlet flow to reduce distortion.

3D CAD blade aerodynamic profiles were provided and converted into complete blade designs for the inlet nozzle, guide van and four rotor stages. All blades were resin injection moulded using a high temperature Polyester / PU material. Rotor 1 & 3 stages were connected on the inner annulus and stages 2 & 4 on the outer annulus, with the outer drive passing through the rotor 4 blades.

Short duration runs allowed the use of sub-critical rotors on large dia grease packed bearings for low cost and simplicity. All casings were GFRP and instrumentation consisted of torque, speed, inlet/outlet temperature and pressure measurement and inter-blading static pressures. LabVIEW was utilised for data acquisition with all the hardware located in a separate DAQ cabinet.

Specification Summary

- Approximately 100 blades / stage
- Turbine output power = 310 kW
- 1000 mm inlet honeycomb & mash
- Skid mounted rig with separate dynamometers
- Interstage pressure instrumentation
- Inlet & outlet total temperature instrumentation
- Inlet & outlet total & static pressure instrumentation



Complete Turbine Rig

Disciplines Used

- Conceptual & mechanical design, CFD, rotordynamics analysis, stress & vibration FEA, LabVIEW DAQ, project management, manufacture, assembly, test & commissioning.