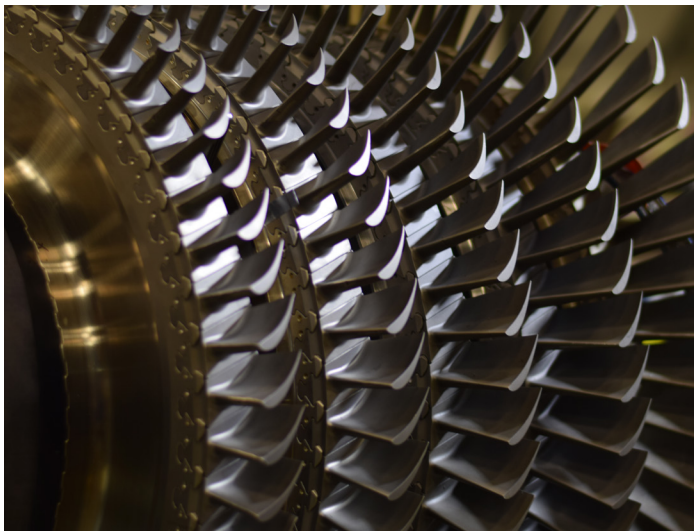


I-R NITRIC ACID EXPANDERS-REBUILT TO RUN!

By Robert Klova, P.E.

As many end users will attest, Ingersoll-Rand E-5XX nitric acid (tail gas) expanders are notoriously finicky pieces of turbomachinery. There are a number of reasons for this; one is the basic configuration of the machine. Having a beam-style rotor suspended between two bearing housings that are supposed to remain aligned to each other through a hot casing is a tall order. There are other factors as well. Chief among them is a rotor design that relies on Curvic Couplings to locate and transmit torque between disks. The Curvic design originally selected does not allow for relative growth between disks, yet the rotor uses high expansion alloy disks for the first two stages and a low expansion alloy for the cooler last three disks – a basic incompatibility that highly stresses the Curvics.

Finally, because of the high inlet pressure, a long, very tight clearance HP seal is used. While it is a honeycomb design, its locational control in the casing is inadequate, so frequent rubs combined with the large surface area can induce significant rotor vibration.



So what can be done? Short of a complete redesign (any takers?), it is a situation that must be managed through proven modifications, and extremely careful build techniques. Rotating Machinery Services is staffed with engineers, designers, and shop personnel that have been making these machines run for nearly 30 years. Over the years, we have developed upgrades and build techniques that minimize the potential

for vibration and other operating problems. These modifications can be summarized as follows:

Stabilize the Rotor: We use special balancing procedures, rotor construction techniques, and extremely tight acceptance criteria on Curvic tooth condition and rotor runouts to maximize the chances of the rotor remaining straight and balanced at speed and temperature. We also offer material and geometry upgrades to reduce rotor internal stresses and increase positional control.

Stabilize the HP Seal: We modify the HP seal to assure that the honeycomb remains concentric to the mounting fit area. We also modify the mounting fit geometry for better locational stability.

Special Journal Bearing Design: Based upon extensive rotor dynamics analysis, we offer a unique journal bearing design to maximize rotor stability and tolerate misalignment between bearings.

Keep the Inlet Scroll Concentric: Using a series of modifications to maintain the inlet scroll concentric to the rotor, we minimize the chances of the inlet scroll placing loads on the HP Seal, which can push it into the rotor.

Proven Cold Alignment Recommendations: E-5XX expanders can be sensitive to misalignment. We recommend cold alignment settings based upon field measurements and proven by experience that minimize hot misalignment when these units are at operating temperatures.

RMS has more in-house engineering experience with these expanders than any other supplier in the world. This experience will help your expander run smoother, but we will also apply it to optimize your expander's power output and solve other reliability issues such as joint and flange leaks, blade tip rubs, and bearing housing oil leaks. We would be happy to discuss any issues that you may have, and recommend a proven solution. A site survey by one of our engineers is always a good first step.

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