Avon transition duct redesigned to eliminate leakage and extend service life

Retrofit duct has an expansion bellows design with bolted flanges at each end for gas-tight operation

After more than 40 years in service, the Rolls-Royce Avon is still in production for gas pipeline compressor, enhanced oil recovery water injection, oil pump drive, and 50/60-Hz electric power generation applications.

During this long history of operation, the engine design has been upgraded at various times to incorporate advances in technology and engineering improvements developed for new generation gas turbines.

As part of a current technology upgrade, being undertaken by the OEM, Fern Engineering will supply its transition duct design for the Avon (that carries hot gases from the gas generator into the power turbine) to Rolls-Royce Power Engineering in the UK.

Company says it plans to incorporate Fern's design, which was initially installed in 1996, on all new production Avons.

The transition duct will also be offered as a replacement part for existing Avons, giving improved life and reduced hot gas leakage.

Field problems

Fern originally designed the duct for a client to solve a problem with severe hot gas leakage due to excessive distortion of the original OEM transition piece and mating hardware.

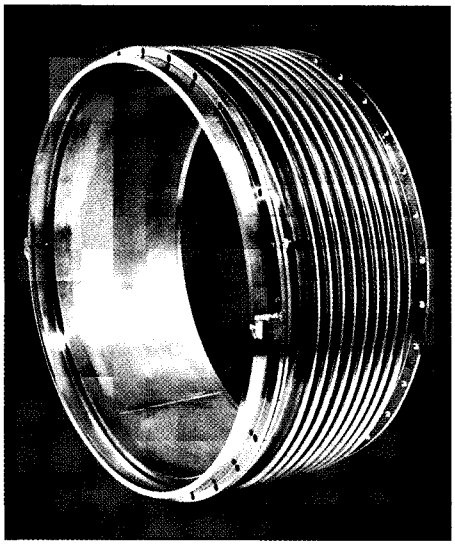
A significant amount of the gas generator exhaust never made it into the power turbine because of leakage. This resulted in a loss of power output and triggered high-temperature enclosure alarms and shutdowns.

A total of twenty-seven replacement ducts have been installed since the first retrofit in 1996. That first duct has been in continuous use for seven years now, says Fern, logging close to 8,000 hours of operation per year without a problem.

Improved design uses fatigue-resistant Inconel 625 nickel base alloy, which provides high creep and stress rupture strength with good resistance to low cycle fatigue, versus stainless steel for the original transition duct design.

Retrofit design

New duct has an expansion bellows design to accommodate the large thermal expansion that occurs during engine start-up. The bellows-style expansion joint has bolted flanges at each end to ensure gas-tight operation.



Redesigned transition. Expansion bellows to accommodate thermal growth loads during startup is made of Inconel 625 nickel based alloy to handle temperature extremes and low cycle fatigue. Retrofit expansion joint is about 12 inches long by 30 inches in diameter, weighs around 80 pounds.

Original Rolls-Royce design uses piston ring seals at each end to handle the thermal expansion, but these rings are also the source of the hot gas leakage experienced by many users.

"An additional advantage to the Fern design," say project engineers, "is that it allows easy access to both the gas generator and power turbine visual inspection and removal or installation procedures.

"After unbolting the flanges, the bellows can be compressed so that the duct can be lifted out of the way – providing ample room for inspection of the exhaust end of the gas generator and the inlet of the power turbine."

With the original duct design, the gas generator assembly must be moved forward before the transition duct can be removed. This requires a lengthy maintenance procedure.

Onsite installation

Retrofit replacement kits include all the hardware that might be needed for a direct field replacement of the existing duct.

No modification of the mating components is required, Fern notes. Work is almost always done by the equipment owner-operator at the site.

As to kit prices, there are several variants depending on packager that affect price, so that both Fern and Rolls are reluctant to quote the cost of a field retrofit – not even for budgeting purposes.

Over the years, the Avon gas generator has been packaged by a number of OEMs, often driving their own power turbine design. However, Rolls-Royce and Cooper Rolls supplied most of the Avon gas turbines in the field.

Rolls-Royce reports that 552 Avon gensets still in service have logged more than 12 million fired hours of operation.

Also 675 mechanical drive Avons still in land-based and offshore platform service have logged over 44 million cumulative fired hours of operation. Presumably, all of those engines that are operational are retrofit candidates.