KNIGHTHAWK TECH NOTES

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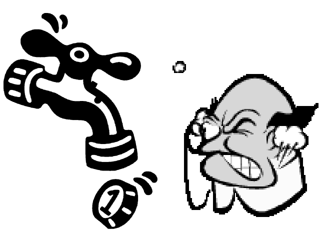
"Don't Let It Leak"

It has been a great week and the plant has been running smooth for a while. Turnarounds are over, spring break is done and now the routine "stuff" starts taking priority again. You just came out of a staff meeting with the plant manager and he reminds everyone how fugitive emissions and environmental releases have to be addressed. Like any engineer, you start going through the list which includes, but is not limited to seals, flanges, packing glands, and so forth. After a brief discussion with the process and environmental departments, some key areas are identified. In your brief frustration, you realize that you did not design or build the plant, but you have to somehow make it work. With the first pass on how to reduce releases and fugitive emissions you have one item on the top of your list — flanges. The problem area has to be the flanges and there are a "gazillion" of these in service in your plant.



What is causing all the leaks? You check with materials engineering and the gaskets are O.K. Mechanical says there are no process problems. Maintenance keeps fixing the leaks and the Plant Manger is shaking his head, venting "steam" at a rate that would probably drive a 100 MW turbine. After a statistical analysis and reduction of the data, it was determined that the high temperature flanges in this particular service are the ones leaking. After "sniffing" the flanges, Maintenance will typically tighten the flanges some more, but it really does not help. Now it is time to find the root cause of the leaking problem. After a rigorous analysis, it was found that thermal cycling of over-torqued flange bolts was the source of the problem.

One approach to "difficult flange leak problems" such as the one described above is as follows:

1. Define the process load conditions that the leaking flanges experience. This includes, but is not limited to steady state, startup, shutdown, and any transient conditions.

2. Develop a heat transfer model to determine the heat distribution through the flanges.

3. Develop a non-linear elastic/plastic model of the flange including the gasket or seal ring.

4. Load the same model through assembly and all process conditions.

5. Evaluate the contact pressure in the seal zone throughout each load cycle.

6. Revise gasket or flange design parameters where necessary.

Look at seal alternatives, for example, a Taper-Lok ® or equivalent. Perform the same analysis on these alternatives.

In critical applications, standard Code calculations and generally accepted methodology may not always address the governing issues in the design. Higher level numerical methodologies have been successfully employed to solve complex seal problems. For any analysis and design, make sure that a professional engineer, competent in flange design, reviews and approves any seal or flange design.

KnightHawk Project Update

- Tower Flow Distribution – Petrochemical
- Flange Leak Finite Element – Petrochemical
- Axial Air Compressor Blade Analysis – Gas Plant
- Reactor Acoustic Vibration – Petrochemical
- Pump Skid Design – Off Shore
- Waste Heat Boiler Failure Analysis – Petrochemical
- Furnace Acoustics – Power
- Critical Pipe Stress – Crack Gas – Petrochemical
- Structural Dynamics – Acoustic – Nuclear
- Level 3 Waste Heat Boiler Fit For Service – Petrochemical
- Rotordynamics – Motor Compressor Train – Refinery
- Polymer Gear Pump Failure Analysis – Petrochemical
- Polymer Heat Exchanger – Petrochemical
- Boiler Failure – Power
- Residual Weld Stress – Non-linear Plastic Analysis - Petrochemical
- Waste Heat Boiler Failure Analysis and Redesign - Petrochemical
- Gas Turbine Ducting and Damper Exhaust Failure Analysis – Off Shore
- Process Transients Field Data Acquisition – Petrochemical
- Reactor Design Optimization – FEA - Petrochemical
- High Pressure Flange Design Riser – FEA – Off Shore
- 10,000 psi Oxygen Valve CFD – NASA
- Heat Exchanger Vibration – Petrochemical
- Compressor Vibration Study - Petrochemical
- Gasifier Reactor Redesign – Petrochemicals
- Non Linear FEA - Petrochemical

Cliff's Notes:

KnightHawk has developed non-linear finite element models of most every type of flange and joint design, including the seal over the last 15 years. Our models have also been tested and proven in the field where it counts. Our specialty is high temperature and high pressure applications. Give us a call and we can show you how we can solve your tough leak applications.

Now, I heard a joke from Joel Osteen the other day that I just had to tell everyone. It goes like this: A burglar was robbing a house. As he reached for a valuable stereo he heard a voice that said "Jesus is watching you". The burglar, startled and amazed, stepped back and started shinning his light around. There sat a parrot in a cage. The parrot looked at the burglar and said, "My name is Moses" and the burglar realized it was the bird that said "Jesus is watching you". The burglar snapped at the parrot and said, "Who in the world would name their parrot Moses?" Moses the parrot said to the burglar … "The one that named me was the same person that named the 150 lb Rottweiler (standing right behind you), Jesus." … Have a great day.

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