KNIGHTHAWK TECH NOTES

PHONE: (281) 282-9200 • FAX: (281) 282-9333
WEBSITE: www.knighthawk.com

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"Acoustical Driven Vibrations—Don't Let it Fail You"

Acoustical driven vibrations can lead to failure and performance problems. Well I am sure the first thought in your mind is what is acoustical driven vibration? Fair question. Every contained volume has an acoustical response. Many times acoustics or noise is welcome like at a concert or event. Acoustics physics and its harmful interactions can be explained as follows:

- ***First there has to be a noise or acoustical source that corresponds to the acoustical natural frequency of a contained volume.***

Now I know this still may not make sense to you, so let's go into more detail. Every contained volume has a set of natural frequencies. You know when you are in some rooms with many people you cannot hear anything while in others you can hear just fine, even with the rooms being the approximate same size and with the same number of people. Well, the difference is the acoustical response, one may have acoustical lagging to change the response and dampen out the noise. Examples in industry of the contained volume may be a building, rotating equipment case, piping, pressure vessels, heat exchangers, tanks or piping.

- ***The acoustical source must drive the contained volume at one or more of its natural frequencies.***

This means that the source must excite the contained volume's acoustic natural frequencies. These excitations cause noise leading to pressure pulsations in the system. Usually exciters are equipment or devices that cause radical changes in the momentum and pressure of the fluid within the contained volume. Usually these conditions lead to some type of fluid pulsations as s primary driver. Unique or complex process dynamics can also drive the acoustics.

Examples of exciters might be:

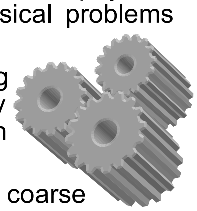
- Reciprocating compressors and pumps.
- Axial, screw, liquid ring, or centrifugal compressors.
- Let down or recycle valves.
- Two phase flow conditions.

- ***The acoustical natural frequencies must correspond to the mechanical natural frequencies.***

Every structure has natural frequencies. If the acoustical natural frequencies and the mechanical natural frequencies correspond, the structure can vibrate.

Now that you know all of this, how do you identify the problem and solve it. Let's first go over a few points regarding these type problems.

1. These problems are frequently complex and have to be diagnosed and calculated precisely.
2. The quick fix rarely works and can make matters worse.
3. The details of the actual physical geometry and fluid physical problems are important.
4. The frequencies causing problems are typically the higher modes with lower amplitudes.



5. Sometimes during the coarse of operation, the vibration will "tune in and out"
6. No shortcuts can be implemented on the typical solutions methodology and be successful.
7. The analysis must match the physical situation.

The solution methodology is as follows:

- Execute a field study with a data acquisition system to evaluate vibration and pressure pulsations.
- Develop a tuned acoustical model to match the physical situation.
- Rework analytically
- Design implementation

Computational Fluid Dynamics and finite element codes are more advanced than ever to aid in addressing complex acoustical problems. KnightHawk has been involved in advanced studies of cavity acoustics i.e. the study of acoustic responses within the rotating equipment enclosures. The result of this work has been able to answer "phenomena" failures that have occurred in open face impeller in compressors.

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KnightHawk Project Update

- Compressor High Vibration – Petrochemical
- Stripper Tower Failure Analysis – Petrochemical
- Waste Remediation Equipment Design – Oil & Gas
- Liquid Ring Compressor Failure – Petrochemical
- CFD of Separator – Petrochemical
- Hydrogen Gas Reformer Design – Oil & Gas
- RCF of Corroded Pipe – Oil & Gas
- Air Compressor Failure – Petrochemical
- Critical Pipe Stress – Petrochemical
- Vertical Cast Transporter Failure – Nuclear Power
- Flue Gas Cooler – Petrochemical
- Compressor Cross Head Failure – Oil & Gas
- Transient Fluid Dynamics – Petrochemical
- API Tanks FFS – Petrochemical
- Structural Analysis – Petrochemical
- Transfer Line Exchanger – Petrochemical
- Flare Design Analysis – Petrochemical
- Fit for Service Analysis – Petrochemical
- Tensile Testing – Manufacturing
- CFD of PSV Systems – Petrochemical
- Motor Shaft Failure – Petrochemical
- Gas Pipeline Coupling Failure – Oil & Gas
- Ultra High Pressure Vessel FFS – Petrochemical
- Reciprocating Compressor Failure – Petrochemical
- Pump Vibration Analysis – Petrochemical
- Corrosion Analysis – Gas Pipeline

Cliff's Notes: KnightHawk has pioneered developments in complex acoustical analysis within the internals of rotating equipment. We are your one stop source for field service, metallurgical, and specialty engineering. Facilities around the world call upon KnightHawk to solve some of industries most challenging problems.

I hope everyone had a great Super Bowl Sunday and your team came out victorious. It's hard to believe January has come to a close and the Winter Olympics are starting up. It is an amazing experience to watch as countries send their best athletes to compete in various events and bring pride to their homeland. For myself, I can't wait to see Shaun White tear it up on the snowboard.

Take care and God Bless.

Cliff Knight

cknight@knighthawk.com