Benefiting government, industry and the public through innovative science and technology

Acoustically Induced Vibration Testing and Analysis

Acoustically induced vibration is a high-cycle fatigue phenomenon that has been shown to cause failures at welded connections in piping systems downstream of high-pressure-drop devices. Southwest Research Institute® (SwRI®) provides a full range of experimental and computational services for protecting piping systems from acoustically induced vibration (AIV) fatigue failures, employing state-of-the-art analysis techniques and full-scale testing capabilities.

80 MMSCFD of nitrogen gas is exhausted out of a 20-inch test header.

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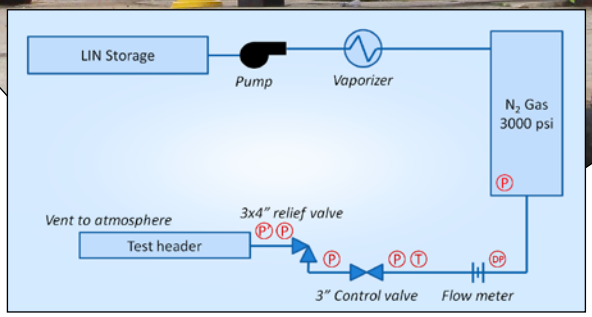

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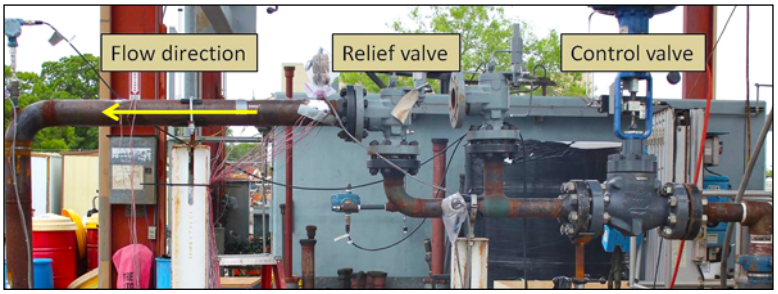
Liquid nitrogen is pumped to 3000 psi through a vaporizer into a large reservoir, providing 30–60 seconds of high flow through a valve assembly and test header, venting to the atmosphere.

Facility

SwRI's valve test facility is capable of:

- Nitrogen gas flow rates up to 80 MMSCFD (32 kg/s) through a full-scale blowdown header assembly (flow rates over 200 MMSCFD (80 kg/s) are possible for other configurations)
- Liquid nitrogen pumped to 3,000 psi through a vaporizer into a large reservoir, providing 30–60 seconds of high flow through a valve assembly and test header, venting to the atmosphere
- Valve sound power levels of over 170 dB, calculated by the Carucci-Mueller method (power levels up to 179 dB are possible)
- Testing of custom piping geometries, configurations, and AIV mitigation techniques



Flow is modulated by a 3-inch control valve and passes through a 3x4-inch relief valve, the primary excitation source.

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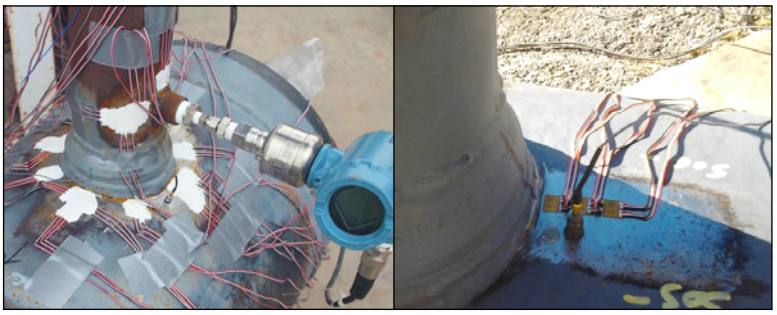
Instrumentation

AIV instrumentation is available for:

- Static and dynamic pressure
- Interior and exterior noise
- Vibration
- Flow
- Temperature
- Dynamic strain



Triaxial strain gauges are placed at several locations around the welded branch connection.

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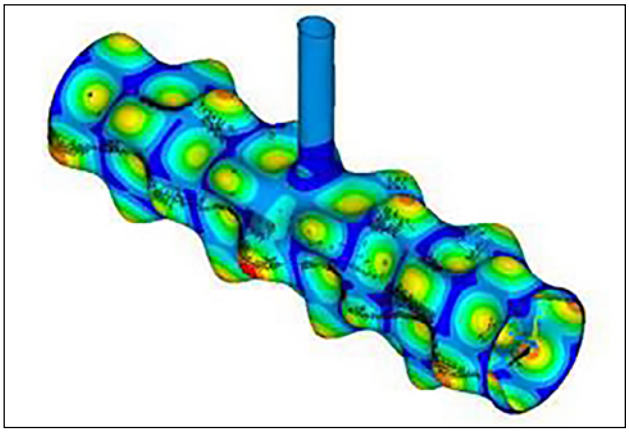
Analysis

SwRI has developed finite element analysis (FEA) models capable of predicting stress reductions for various piping geometries and AIV remedies. These models account for the complex modal interactions of main line and branch piping, as well as stress concentrations associated with welded connections.



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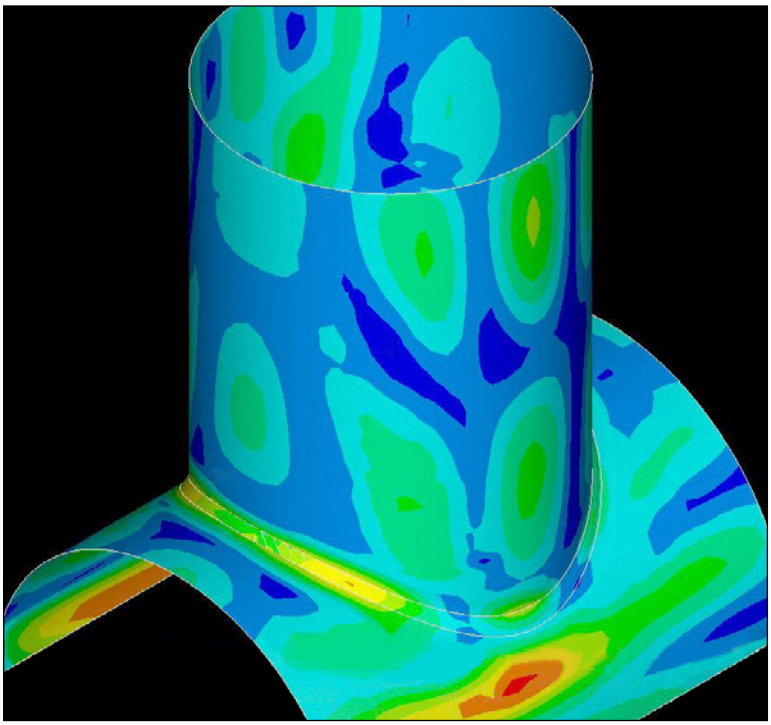
Example of high-frequency shell mode with six nodal diameters



D019596

Finite element model showing stress concentrations near a welded branch connection

We welcome your inquiries.

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Southwest Research Institute is an independent, nonprofit, applied engineering and physical sciences research and development organization using multidisciplinary approaches to problem solving. The Institute occupies 1,200 acres in San Antonio, Texas, and provides more than 2 million square feet of laboratories, test facilities, workshops, and offices for nearly 3,000 employees who perform contract work for industry and government clients.

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