

Pipe Stress Analysis: A Critical Step in Performance, Maintenance, Reliability and Safety

In a typical refinery or chemical manufacturing plant, there are hundreds of miles of piping, connections, valves, and equipment. Piping systems convey fluid from one area or piece of equipment to another for a specific use. Piping systems are subjected to system stresses, strains, and displacements including, but not limited to, temperature change, thermal cycling, pipe and fitting weights, static pressure, occasional loads due to wind, seismic, and PSV discharging forces, forces due to vibration, water hammer, slug flow, and end-boundary conditions. Excessive stress levels can result in consequences ranging from poor equipment and piping performance and reliability, failed code compliance, dangerous work environment, and unsafe conditions.

It's critical to have a knowledgeable engineering team be involved during all phases of a project to understand the piping system from a process, materials, and operational basis. This will ensure that performing a Pipe Stress Analysis will result in a code-compliant, reliable, economical, and safe piping system.

Nexus Engineering Group has a talented, multi-discipline team with proven experience troubleshooting piping issues and providing code-compliant piping systems. The experts at Nexus use industry-leading Pipe Stress Analysis software combined with years of experience to provide accurate analyses and economically- and technically-sound solutions.

What is a Pipe Stress Analysis?

A Pipe Stress Analysis is an analytical method of calculating and predicting stresses and displacements in piping systems and reaction loads on structures and equipment such as tanks, pressure vessels, nozzles, pumps, mixers, skids, receivers, exchangers, compressors, and fired heaters in accordance with applicable standards.

In a Pipe Stress Analysis, engineers evaluate the flexibility of piping systems to ensure they're in line with industry piping codes and standards.

Industry Codes Utilized in Pipe Stress Analysis

- ASME B31.1 Power Piping
- ASME B31.3 Process Piping (including Chapter IX)
- ASME B31.4 Pipeline Transportation Systems for Liquids
- ASME B31.5 Refrigeration Piping & Heat Transfer Components
- ASME B31.8 Gas Transmission & Distribution Piping Systems
- ASME B31.9 Building Services Piping
- ASME Section III NC (Class 2)
- ASME Section III ND (Class 3)
- BS7159 Design & Construction of GRP Piping Systems
- BS806 Design & Construction of Ferrous Piping Installations
- CSA Z662 Canadian Oil & Gas Pipeline Systems
- DNV-OS-F101 Submarine Pipeline Systems
- FDBR

When is a Pipe Stress Analysis needed?

Pipe Stress Analysis is recommended for all piping systems subjected to significant temperature and pressure, long spans, large diameter systems, and piping systems connected to sensitive equipment or components. It's also recommended for systems made of steel, stainless steel, fiber-reinforced plastic (FRP), or glass-reinforced epoxy (GRE) and jacketed piping.

If you are experiencing any of the following issues, a Pipe Stress Analysis may be able to properly diagnose the problem:

- Leaking, over-extended, or burst expansion joints
- Leaking pipe or equipment flanges
- Cracked flanges in piping systems or connected equipment
- Visibly deflected, overloaded steel or pipe supports; unengaged or unsupportive steel and/or pipe supports
- Significant pipe sag or deflection that could lead to corrosion due to pocketing of fluid in the pipe
- A burst, strained, or generally distorted pipe or ovalized pipe bends
- Pumps or rotating machinery connected to piping loads that could result in misalignment
- Fixed equipment problems such as distorted nozzles or shell material
- Visibly-corroded piping components
- Visibly-distorted equipment nozzles or shells
- Bottomed- or topped-out variable or constant effort spring hangers or sprung systems with travel stops left in

Nexus Pipe Stress Analysis Options

- Piping Systems in Vibratory Service
- Dynamic Analysis
- Static Analysis
- Piping Design to Withstand PSV Discharge Loads
- Slug Flow
- Analysis to meet ASME, API, or Special Requirements
- Analysis of Underground or Buried Piping Systems
- Fatigue Analysis of High-Pressure Piping
- Various Piping Materials
- Various Piping Codes

What does a Pipe Stress Analysis entail?

Nexus utilizes the piping systems operating modes, temperature, pressure, material, boundary conditions, pipe supports, and other information to perform a Pipe Stress Analysis. In existing facilities where documentation is lacking, Nexus can perform laser scans to obtain system geometries. In conjunction with the analysis, it is sometimes necessary to prove that connected

equipment can withstand the displacements and forces imposed by the piping system.

For such instances, Nexus uses additional software programs to evaluate stresses in line with industry codes and standards.

Through analysis, Nexus will determine the root cause for existing piping and equipment issues and provide recommendations for solutions including a clearly-formatted summary of pertinent data complete with all reference data for your records.

Summary

A Pipe Stress Analysis from Nexus will ensure that pipe systems are engineered to meet industry standards.

Pipe Stress Analysis can help increase piping system life while lowering maintenance costs with fewer unplanned outages and less rework.

Most importantly, Pipe Stress Analysis also ensures piping systems are designed for continued safe and reliable operation.

Nexus can assist with both up-front Pipe Stress Analyses for newly designed systems and existing systems that are experiencing problems.

For more information, contact a piping expert at Nexus by sending an email to info@nexusegroup.com or visiting our website at www.nexusegroup.com.