



## Acoustic fatigue assessment

API Standard 521 for pressure relief and blowdown valves.

### What is acoustic fatigue?

During operation of choked-flow gas valves, significant levels of high-frequency noise can be generated, leading to excessive vibration and ultimately, to an acoustic fatigue failure of the associated downstream pipework.

Typical sources of such noise include:

- Pressure relief and safety valves
- Blowdown (orifice plate) valves
- Pressure control valves
- Choke valves
- Gas compressor recycle and anti-surge valves
- Hot-gas bypass valves

The consequences of an acoustic fatigue failure (also known as acoustic induced vibration or AIV) are severe, from both a safety standpoint (gas explosion, sour gas release) and production viewpoint (loss of flare or gas compression system).

### API 521 requirements

API 521 (6th edition, January 2014) requires that “the potential for acoustic fatigue” be evaluated through one of several different methods, with the Energy Institute “Guidelines for the avoidance of vibration induced fatigue failure in process pipework”, in particular being widely employed. This risk-based screening methodology has been used globally for both new design and operational assets.

### Vibration, dynamics and noise expertise

Wood’s engineers have significant experience of carrying out acoustic fatigue assessments for:

- Greenfield and brownfield facilities
- Onshore and offshore facilities
- Upstream, midstream and downstream (refineries and gas transmission pipelines) assets
- Liquefied natural gas plants – EPC stage or operational

### Examples of current and past projects/customers:

- Bechtel - various locations
- Black & Veatch - LNG FPSO
- BP - In Salah Gas + Tuart/ Ha’Py + Ula + Nakika + Schiehallion + Pascagula + Atlantic LNG + In Amenas + SCPX
- Chevron - Wheatstone LNG + Gorgon LNG + Angola LNG + TengizOilCompany + Nemba + Chuangdonbei
- Dubai Supply Authority (DUSUP) – UAE
- Encana – Canada
- ENPPI – Egypt
- Engie - Cygnus
- Kiewit - USA
- Origin - APLNG gas transmission pipeline
- Williams - USA
- Sempra Energy - USA
- SNC Lavalin - ZADCO
- Saudi Aramco
- Shell - Nyhamna
- Total UK - St Fergus + North Alwyn
- Shell - Hasdrubal + Hannibal + Karachagana

## Technical contacts

For further information, or to discuss your acoustic fatigue concerns, email us at [info.VDN@woodplc.com](mailto:info.VDN@woodplc.com), or contact our acoustic fatigue experts directly:

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## Design stage acoustic fatigue assessment

At the design stage, Wood will work with the project team to develop a piping design sufficiently robust that the risk of an acoustic fatigue failure is minimised. The approach is a three-step methodology, based on the industry best practice Energy Institute Guidelines, which members of our vibration, dynamics and noise team co-authored.

### Recommended three-phase methodology:

- Phase 1: Identification of valves or valve groups which generate sufficient noise energy to be of potential acoustic fatigue concern
- Phase 2: Identification of piping connections at significant risk of acoustic fatigue failure, based on the incident noise level and their detailed design
- Phase 3: Identification and evaluation of appropriate noise and vibration control measures, to reduce the risk of acoustic fatigue failures to an acceptable level. This could take the form of simple design changes or detailed finite element analysis to predict the acoustic fatigue life more accurately

## Operational stage acoustic fatigue assessment

For an operational plant, we can provide the following technical services:

- If required, site measurements on the pipework identified as being of concern, for example, vibration, noise and dynamic strain pressure pulsation, using, multi-channel, intrinsically safe monitoring systems
- Screening assessments as per the three-phase methodology outlined for the design stage
- Detailed finite element analysis, where an initial study has already been conducted or a problem has been identified. This can either predict piping stress levels or, if field data is available, accurately predict acoustic fatigue lives and evaluate the effectiveness of long-term modifications

Wood also has a global network of specialist engineering services such as CFD, materials and production chemistry and our teams can call upon these services to support projects, as and when required.

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