
Piping Stress Engineering Training Course: Thermal Loads, Spans and Anchors

1 – 12 March 2027
Tokyo





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Programme Summary

Piping stress engineering is the subject of this two-week training course for piping, mechanical, stress and project engineers, ending in a stress and support dossier for one piping system. Hot lines, pump and compressor connections and long rack runs fail through overstressed pipe, overloaded nozzles and badly chosen supports, yet checks are often left to late software runs. The programme moves from load cases and code stress limits to modelling, support layout, equipment checks and special cases, applied to a system the participant brings. Mars Training Centre UK delivers this programme on piping stress engineering to mixed-organisation cohorts.

The Business Case

Process plants spend heavily on pipe, supports and rotating equipment that must survive heat-up, shutdown, pressure and vibration for decades. When stress checks start late, designers reroute lines, add loops and change supports after material is ordered or installed. Teams that agree load cases, allowable limits and support philosophy early can resolve conflicts on paper, hand clear loads to civil and equipment colleagues, and defend their choices to clients and reviewers.

- Rework During Construction: Falls as thermal movement and support positions are settled before fabrication.
- Equipment Downtime: Falls as nozzle loads are checked against vendor allowables before start-up.
- Review Cycles: Fall as stress reports follow one structure and one set of stated assumptions.

Principles and Evidence Base

- ASME B31.3 Process Piping: Supplies the stress categories, allowable stress and stress intensification used in Sessions 2, 3 and 4.
- API 610 Centrifugal Pumps: Provides the nozzle load allowables applied to pump connections in Session 7.
- API 617 Axial and Centrifugal Compressors: Provides the allowables applied to compressor connections in Session 7.
- Beam Theory and Thermal Expansion: Underpins the flexibility reasoning behind spans, loops and anchors in Sessions 1 and 5.



Intended Participants

- Piping engineers who route lines and need to know when a stress check is required.
- Stress engineers who build models and report results to design leads.
- Mechanical engineers who own pumps, compressors and vessels with nozzle limits.
- Project engineers who coordinate support design with civil and structural teams.
- Maintenance and integrity engineers who investigate leaks, vibration and support damage.

Typical functions include refining, gas processing, petrochemicals and power generation.

Learning Outcomes

1. Participants will be able to classify piping loads into sustained, occasional and expansion cases.
2. Participants will be able to evaluate calculated stresses against allowable limits.
3. Participants will be able to construct a CAESAR II model that represents supports and boundaries.
4. Participants will be able to prioritise support types, positions and gaps for a given line.
5. Participants will be able to diagnose nozzle overload and flange leakage risks.
6. Participants will be able to justify a stress report to a client reviewer.

Programme Structure

Day 1: Piping Stress Engineering Foundations

Why does a pipe that carries no visible load still become overstressed?

- Pipe Loading Types
- Thermal Expansion Behaviour
- Flexibility Principle
- Stress Screening Criteria
- Stress Report Structure

Day 2: Code Stress Categories

How does the code separate stress that is sustained from stress that relieves itself?

- ASME B31.3 Stress Categories
- Sustained Stress Equation
- Occasional Stress Equation
- Expansion Stress Range
- Allowable Stress Determination

Day 3: Fittings, Intensification and Fatigue

Where do bends, tees and branches concentrate stress and shorten life?



- Stress Intensification Factors
- Flexibility Factors for Bends
- Branch Connection Review
- Cyclic Service Assessment
- Fatigue Cycle Counting

Day 4: Load Case Definition

Which combinations of weight, pressure, temperature and wind govern the design?

- Weight and Pressure Load Cases
- Operating and Design Temperature Cases
- Wind Load Cases
- Seismic Load Cases
- Load Case Combination Table

Day 5: Modelling in CAESAR II

How is a real line turned into a model that can be trusted?

- Node and Element Layout
- Boundary Condition Entry
- Restraint and Gap Modelling
- Model Error Checking
- Result Interpretation Routine

Day 6: Pipe Support Selection

Which support type does each point on the line need, and where does it go?

- Rest Support Selection
- Guide and Line Stop Selection
- Anchor Selection
- Spring Hanger Selection
- Support Span Calculation

Day 7: Equipment Nozzle Checks

Can the pump or compressor nozzle accept the loads the line delivers?

- Vendor Nozzle Allowable Review
- API 610 Pump Allowable Check
- API 617 Compressor Allowable Check
- Vessel Nozzle Load Review
- Flange Leakage Check



Day 8: Dynamic and Special Cases

What changes when the line carries surges, slugs or relief discharge?

- Relief Valve Thrust Load
- Slug Flow Force Estimate
- Fluid Transient Screening
- Vibration Source Review
- Dynamic Restraint Selection

Day 9: Optimising Layout and Supports

How can a failing line be fixed with the fewest changes?

- Expansion Loop Sizing
- Re-routing Trade-off Table
- Support Load Summary for Civil Teams
- Cold Spring Review
- Modification Option Ranking

Day 10: Stress and Support Dossier for One System

Does the analysis of one system hold together from loads to supports?

- Applying the Session 4 Load Case Combination Table
- Testing the Session 5 Result Interpretation Routine
- Reviewing the Session 6 Support Span Calculation
- Checking the Session 7 Vendor Nozzle Allowable Review
- Completing the Stress and Support Dossier

Methodology

The programme uses a structured exercise method built on a shared case of a hot process line running from a heater to a pump and a pipe rack. Participants build each artefact on the case, then on a system from their own plant, receiving written facilitator feedback and comparing results with peers in each session.

- Suggested activity: Classifying the loads on a rack line and computing its expansion stress range.
- Suggested activity: Placing guides, anchors and springs on a drawn line and defending the choice.
- Suggested activity: Presenting a nozzle load check to a mock client reviewer.



Capstone Output

Each participant completes a stress and support dossier for one piping system. It holds a load case table, a stress summary against allowable limits, a support schedule with positions and types, a nozzle check and a list of proposed changes. The dossier is used at work to open design reviews, brief fabrication teams and support requests to equipment suppliers.

Frequently Asked Questions

Is piping stress engineering training suitable for engineers new to stress analysis?

Yes. Piping stress engineering is taught from first principles with worked cases, assuming a degree-level grounding in mechanics or plant experience but no earlier stress software use.

Which standards does piping stress engineering training rest on?

Piping stress engineering training rests on ASME B31.3 for stress limits, API 610 for pump nozzles and API 617 for compressor nozzles, modelled in CAESAR II.

How is the dossier from piping stress engineering training used at work?

You use the stress and support dossier to open design reviews, brief fabricators, agree support loads with civil colleagues and query equipment suppliers.

How does piping stress engineering differ from pipe design and layout training?

Piping stress engineering checks whether a routed line survives loads, temperature and movement, while pipe design and layout training focuses on routing, spacing and drawing production.