
TRAINING CATALOGUE · CATEGORY C

# Pressure Relief & Overpressure Protection

Overpressure scenarios, PSV and rupture-disc sizing, flare and vent systems, tank venting and two-phase relief - the last line of protection, designed and documented to code.

**5** COURSES

**6.5** TRAINING DAYS

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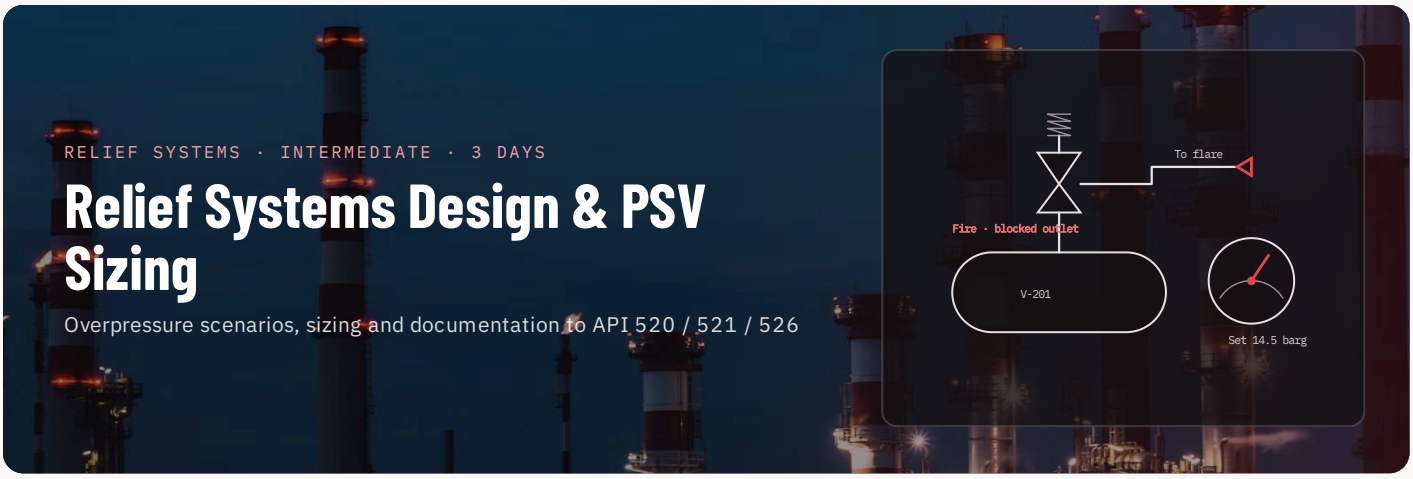
# Category C · Pressure Relief & Overpressure Protection

| CODE | COURSE | DURATION | LEVEL | PRIMARY AUDIENCE |
|---|---|---|---|---|
| **C · Pressure Relief & Overpressure Protection** | | | | |
| TR-C01 | **Relief Systems Design & PSV Sizing**<br>Overpressure scenarios, sizing and documentation to API 520 / 521 / 526 | 3 days | Intermediate | Process engineers responsible for relief design |
| TR-C02 | **PSV Validation and Relief Register Workshop**<br>Checking existing relief devices against current process conditions and building a register that holds up | 1 day | Intermediate | Process and pressure-equipment engineers responsible for the |
| TR-C03 | **Flare and Vent System Design (API 521)**<br>Header hydraulics, knock-out drums, flare tips and radiation for new and modified disposal systems | 1 day | Intermediate | Process and project engineers designing or modifying flare a |
| TR-C04 | **Tank Venting, Blanketing and Emergency Venting (API 2000)**<br>Normal and emergency venting, inert gas blanketing and vacuum protection for atmospheric and low-pressure tanks | ½ day | Foundation | Process |
| TR-C05 | **Two-Phase Relief and Runaway Reactions (DIERS)**<br>Vent sizing for flashing, foaming and reactive systems using the DIERS methodology | 1 day | Advanced | Relief and process safety engineers in petrochemical |




RELIEF SYSTEMS · INTERMEDIATE · 3 DAYS

# Relief Systems Design & PSV Sizing

Overpressure scenarios, sizing and documentation to API 520 / 521 / 526

| DURATION | LEVEL | FORMAT | LANGUAGE | MAX. PARTICIPANTS |
|---|---|---|---|---|
| 3 days | Intermediate | On-site classroom · virtual instructor-led | English | 16 |

**12** sizing exercises

**8** overpressure scenarios covered

**1** relief-register template

## Overview

Every relief valve on the unit is the last line of protection for the equipment behind it. The course works through scenario identification, load calculation and sizing for vapour, liquid, two-phase and fire cases, then the parts most audits find missing: inlet and outlet constraints, installation effects and a relief register that survives management of change.

## Learning outcomes

- Identify and screen overpressure scenarios per API 521
- Calculate relief loads for blocked outlet, fire, control-valve failure, tube rupture and thermal expansion
- Size conventional, balanced-bellows and pilot-operated valves and rupture discs
- Check inlet pressure drop, built-up back pressure and reaction forces
- Handle two-phase and supercritical fluids with the DIERS methods
- Compile a relief register with design basis, calculations and MOC hooks

## Who should attend

Process engineers responsible for relief design, validation and the relief register; inspection engineers

## Course outline

**DAY 1**

Overpressure protection philosophy · code requirements (ASME VIII, API 520/526) · scenario identification workshop · vapour and liquid sizing

**DAY 2**

Fire case and wetted area · heat-exchanger tube rupture · thermal expansion and utility failure · rupture discs and combination devices · installation: inlet/outlet losses, back pressure

**DAY 3**

Two-phase and flashing flow (DIERS/Omega) · flare header and knock-out drum basics · PSV validation on an existing unit · relief register and documentation · CeraVent workshop

## Standards referenced

API 520 Part I & II · API 521 · API 526 / 527 · ASME BPVC Section VIII · ISO 4126 · API 2000

## Tools & exercises

Sizing exercises performed in CeraVent

## What's included

- ✓ Course manual and slide pack
- ✓ Software access for the course
- ✓ Post-course Q&A with the instructor
- ✓ Exercise and case-study pack
- ✓ Competency quiz and certificate
- ✓ Templates used in the exercises

**PREREQUISITES**
Process engineering degree; familiarity with P&IDs and hydraulics

**CERTIFICATION**
Certificate of completion

**INSTRUCTORS**
Practising engineers — TÜV HAZOP Leader, CCPSC and IEC 61511 Functional Safety certified — with 200+ years of cumulative plant experience.

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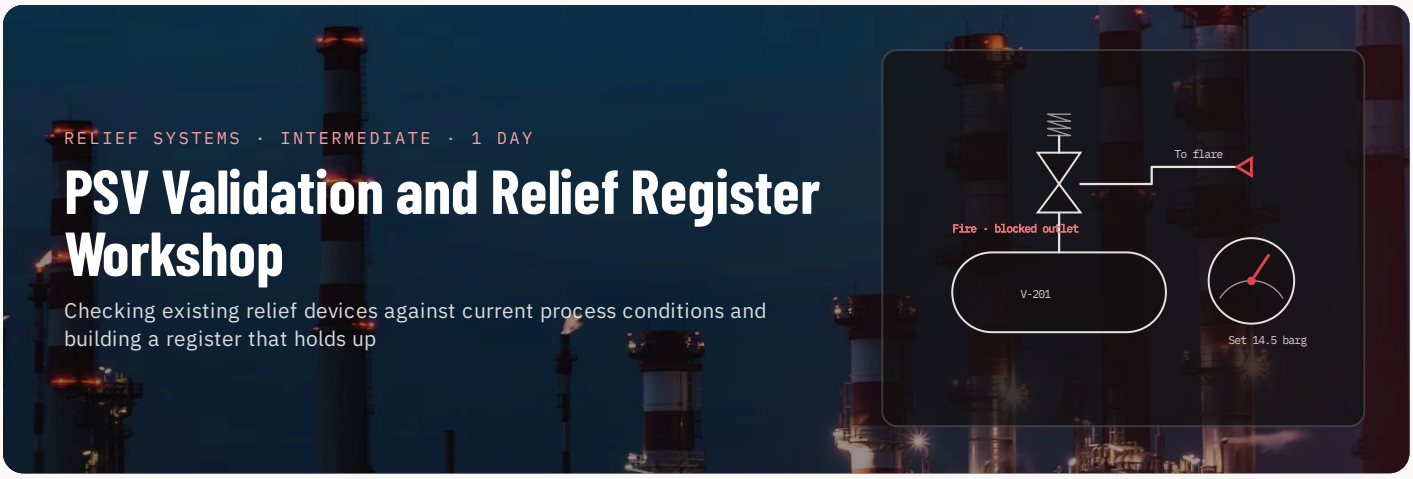


RELIEF SYSTEMS · INTERMEDIATE · 1 DAY

# PSV Validation and Relief Register Workshop

Checking existing relief devices against current process conditions and building a register that holds up

| DURATION | LEVEL | FORMAT | LANGUAGE | MAX. PARTICIPANTS |
|---|---|---|---|---|
| 1 day | Intermediate | On-site classroom · virtual instructor-led | English | 16 |

**Your** own relief register and PSV data sheets

**10** validation checks per valve

**1** gap list ready for MOC

## Overview

Most relief valves on a mature unit were sized for a process that no longer exists. This workshop takes the participants' own PSV data sheets, P&IDs and current operating envelopes and runs each device through a structured validation: is the governing scenario still the governing scenario, does the installed orifice still pass the load, and do the inlet and outlet lines still meet the code. The output is a gap list with prioritised actions and a register format that an auditor can follow from scenario to calculation.

## Learning outcomes

- Reconstruct the design basis of an existing relief device from drawings, data sheets and operating data
- Re-screen overpressure scenarios after revamps, debottlenecking and set-point changes
- Check installed capacity against recalculated loads for vapour, liquid and fire cases
- Verify the 3 % inlet loss rule, built-up and superimposed back pressure and bellows limits
- Rank findings by risk and route them through MOC and the inspection plan
- Structure a relief register that links PSI, PHA, calculations and inspection history

## Who should attend

Process and pressure-equipment engineers responsible for the relief register; inspection engineers; PSM coordinators covering PSI and mechanical integrity

## Course outline

**MORNING**

Why validation programmes exist: incidents and audit findings · relief register as process safety information · reconstructing the design basis · scenario re-screening on a changed unit · capacity checks in CeraVent

**AFTERNOON**

Inlet and outlet line verification · chattering and back-pressure findings · rupture disc and combination device checks · risk-ranking the gap list · register format, MOC and inspection interface · workshop on participants' own valves

## Standards referenced

API 520 Part I & II · API 521 · API 576 · API 510 · OSHA 29 CFR 1910.119(d) and (j) · ASME BPVC Section VIII

## Tools & exercises

Validation calculations and register templates in CeraVent, working on the participants' own valve data

## What's included

- ✓ Course manual and slide pack
- ✓ Software access for the course
- ✓ Post-course Q&A with the instructor
- ✓ Exercise and case-study pack
- ✓ Competency quiz and certificate
- ✓ Templates used in the exercises

**PREREQUISITES**
Relief sizing basics (TR-C01 or equivalent experience)

**CERTIFICATION**
Certificate of completion

**INSTRUCTORS**
Practising engineers — TÜV HAZOP Leader, CCPSC and IEC 61511 Functional Safety certified — with 200+ years of cumulative plant experience.

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RELIEF SYSTEMS · INTERMEDIATE · 1 DAY

# Flare and Vent System Design (API 521)

Header hydraulics, knock-out drums, flare tips and radiation for new and modified disposal systems

| DURATION | LEVEL | FORMAT | LANGUAGE | MAX. PARTICIPANTS |
|---|---|---|---|---|
| 1 day | Intermediate | On-site classroom · virtual instructor-led | English | 16 |

**1** flare-network case built end to end

**5** global scenarios analysed

**3** radiation and dispersion checks

## Overview

A correctly sized PSV discharging into an undersized header is still an unprotected vessel. This course covers the disposal side of relief: defining global scenarios, building the flare load summary, sizing headers for back-pressure and Mach limits, and designing the knock-out drum, seal, tip and stack so that radiation, noise and dispersion are acceptable. Participants build one complete flare network case from load summary to stack height.

## Learning outcomes

- Define global relieving scenarios (total power failure, cooling water failure, fire zones) and build a load summary
- Size flare and vent headers for allowable back pressure, Mach number and noise
- Design knock-out drums and liquid seals for the governing liquid load
- Select flare tip type and estimate radiation, stack height and sterile radius
- Check flashback, purge, air ingress and low-flow smoking conditions
- Assess the impact of a new tie-in on an existing flare system

## Who should attend

Process and project engineers designing or modifying flare and vent systems; relief engineers moving from single-valve sizing to the collection network

## Course outline

**MORNING**

Disposal system philosophy and API 521 structure · global scenario definition and fire zoning · load summary and simultaneity · header hydraulics: back pressure, Mach, temperature and material limits · segregated wet, dry and acid headers

**AFTERNOON**

Knock-out drum and seal drum sizing · flare tip selection and radiation calculation · stack height, dispersion and noise · purge, flashback and smokeless operation · adding a new relief source to an existing network · worked case in CeraVent

## Standards referenced

API 521 · API 537 · API 520 Part II · ASME BPVC Section VIII · NFPA 30

## Tools & exercises

Network hydraulics and radiation calculations worked in CeraVent

## What's included

- ✓ Course manual and slide pack
- ✓ Software access for the course
- ✓ Post-course Q&A with the instructor
- ✓ Exercise and case-study pack
- ✓ Competency quiz and certificate
- ✓ Templates used in the exercises

**PREREQUISITES**
Relief sizing basics (TR-C01 or equivalent); familiarity with compressible flow

**CERTIFICATION**
Certificate of completion

**INSTRUCTORS**
Practising engineers — TÜV HAZOP Leader, CCPSC and IEC 61511 Functional Safety certified — with 200+ years of cumulative plant experience.

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RELIEF SYSTEMS · FOUNDATION · ½ DAY

# Tank Venting, Blanketing and Emergency Venting (API 2000)

Normal and emergency venting, inert gas blanketing and vacuum protection for atmospheric and low-pressure tanks

| DURATION | LEVEL | FORMAT | LANGUAGE | MAX. PARTICIPANTS |
|---|---|---|---|---|
| ½ day | Foundation | On-site classroom · virtual instructor-led | English | 16 |

**8** venting calculations worked

**2** tank types: fixed-roof and floating-roof

**1** blanketing case study

## Overview

Storage tanks are protected by a few inches of water column, and they fail when nobody has checked the arithmetic. This half-day course covers thermal in-breathing and out-breathing, pump-in and pump-out rates, fire-case emergency venting and the sizing of pressure/vacuum valves, flame arresters and blanketing regulators to API 2000. It closes with the operating failures that collapse tanks: blocked vents, blanketing gas running out and steam-out without vacuum protection.

## Learning outcomes

- Calculate normal in- and out-breathing for thermal and liquid-movement cases per API 2000
- Size emergency venting for the fire case with and without insulation credit
- Select and size pressure/vacuum relief valves and emergency vents
- Design a nitrogen blanketing system: regulator, set points and gas demand
- Apply flame arrester and detonation arrester requirements correctly
- Recognise the operating scenarios that over-pressure or collapse tanks

## Who should attend

Process, tank-farm and utilities engineers; inspection engineers covering storage tanks; operations staff responsible for tank-farm safe operating limits

## Course outline

**SESSION 1**

Tank types and design pressures (API 650 / API 620) · normal venting: thermal and pump-driven cases · API 2000 methods and the ISO 28300 alignment · fire-case emergency venting and wetted area · PVRV selection and set points

**SESSION 2**

Blanketing systems and regulator sizing · flame and detonation arresters · vent line losses and set-point margin · tank collapse and overfill lessons (Buncefield and others) · sizing exercises in CeraVent

## Standards referenced

API 2000 / ISO 28300 · API 650 · API 620 · API 2350 · NFPA 30

## Tools & exercises

Venting and blanketing calculations worked in CeraVent

## What's included

- ✓ Course manual and slide pack
- ✓ Software access for the course
- ✓ Post-course Q&A with the instructor
- ✓ Exercise and case-study pack
- ✓ Competency quiz and certificate
- ✓ Templates used in the exercises

**PREREQUISITES**
None

**CERTIFICATION**
Certificate of completion

**INSTRUCTORS**
Practising engineers — TÜV HAZOP Leader, CCPSC and IEC 61511 Functional Safety certified — with 200+ years of cumulative plant experience.



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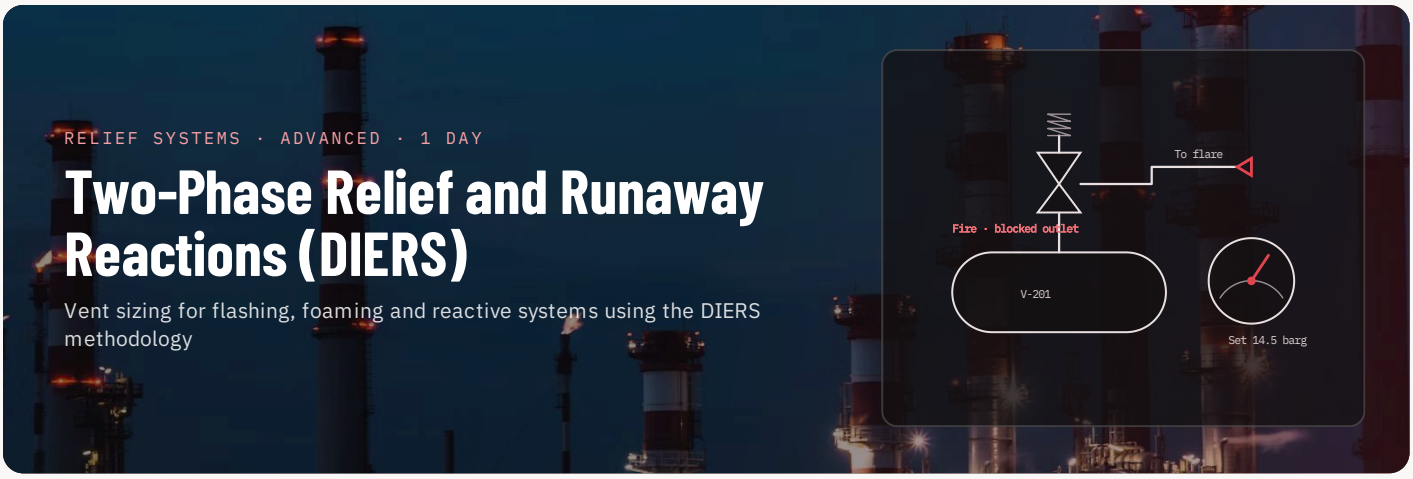


RELIEF SYSTEMS · ADVANCED · 1 DAY

# Two-Phase Relief and Runaway Reactions (DIERS)

Vent sizing for flashing, foaming and reactive systems using the DIERS methodology

| DURATION | LEVEL | FORMAT | LANGUAGE | MAX. PARTICIPANTS |
|---|---|---|---|---|
| 1 day | Advanced | On-site classroom · virtual instructor-led | English | 16 |

**4** reactive systems characterised

**3** two-phase sizing methods compared

**1** runaway-reaction case study

## Overview

Single-phase vapour sizing under-predicts the required area by a factor of several when the vessel swells and vents a two-phase mixture. The course explains when two-phase flow must be assumed, how to characterise a reactive system from calorimetry data, and how to size the vent with the DIERS methods: Omega, homogeneous equilibrium, Leung and the tempered/gassy/hybrid classification. A runaway reaction case study runs from calorimeter trace to vent area and effluent handling.

## Learning outcomes

- Judge when two-phase venting must be assumed: level swell, foaming, reactive and viscous systems
- Interpret adiabatic calorimetry (ARC, VSP2) data for onset, adiabatic temperature rise and pressure rate
- Classify systems as vapour, gassy or hybrid and choose the sizing basis accordingly
- Size vents with the Omega method, HEM and the Leung equation for tempered systems
- Handle flashing and non-flashing flow through valves, discs and inlet lines
- Design effluent handling: catch tanks, quench and separation to avoid a second release

## Who should attend

Relief and process safety engineers in petrochemical, polymer and specialty-chemical plants; engineers responsible for reactor and batch relief design

## Course outline

**MORNING**

Why single-phase sizing fails: incidents and DIERS history · level swell and flow regimes · thermal runaway fundamentals · reading calorimetry data · vapour, gassy and hybrid system classification

**AFTERNOON**

Omega method and HEM · Leung and tempered-system sizing · gassy and hybrid systems · inlet line, disc and valve behaviour in two-phase flow · effluent handling and catch-tank design · runaway case study in CeraVent

## Standards referenced

CCPS Guidelines for Pressure Relief and Effluent Handling Systems · DIERS Project Manual · API 520 Part I · API 521 · ISO 4126-10 · ASME BPVC Section VIII

## Tools & exercises

Two-phase and reactive sizing exercises worked in CeraVent

## What's included

- ✓ Course manual and slide pack
- ✓ Software access for the course
- ✓ Post-course Q&A with the instructor
- ✓ Exercise and case-study pack
- ✓ Competency quiz and certificate
- ✓ Templates used in the exercises

**PREREQUISITES**
Relief sizing basics (TR-C01 or equivalent); chemical engineering degree

**CERTIFICATION**
Certificate of completion

**INSTRUCTORS**
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