INTERNATIONAL STANDARD

**ISO 4126-10**

First edition
2010-10-01

# Safety devices for protection against excessive pressure —

## Part 10: Sizing of safety valves for gas/liquid two-phase flow

*Dispositifs de sécurité pour protection contre les pressions excessives —*

*Partie 10: Dimensionnement des soupapes de sûreté pour les débits diphasiques gaz/liquide*

Reference number
ISO 4126-10:2010(E)



ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

 

# Contents

Page

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 4126-10 was prepared by Technical Committee ISO/TC 185, *Safety devices for protection against excessive pressure*.

ISO 4126 consists of the following parts, under the general title *Safety devices for protection against excessive pressure*:

— *Part 1: Safety valves*

— *Part 2: Bursting disc safety devices*

— *Part 3: Safety valves and bursting disc safety devices in combination*

— *Part 4: Pilot-operated safety valves*

— *Part 5: Controlled safety pressure-relief systems (CSPRS)*

— *Part 6: Application, selection and installation of bursting disc safety devices*

— *Part 7: Common data*

— *Part 9: Application and installation of safety devices excluding stand-alone bursting disc safety devices*

— *Part 10: Sizing of safety valves for gas/liquid two-phase flow*



 

# Introduction

Well-established recommendations exist for the sizing of safety devices and the connected inlet and outlet lines for steady-state, single-phase gas/vapour or liquid flow. However, in the case of a two-phase vapour/liquid flow, the required relieving area to protect a system from overpressure is larger than that required for single-phase flow when the same vessel condition and heat release are considered. The requirement for a larger relief area results from the fact that, in two-phase flow, the liquid partially blocks the relieving area for the vapour flow, by which most of the energy is removed by evaporation from the vessel.

This part of ISO 4126 includes a widely usable engineering tool for the sizing of the most typical safety valves in fluid services encountered in various industrial fields. It is based on the omega parameter method, which is extended by a thermodynamic non-equilibrium parameter. Without this extension for considering non-equilibrium, the proposed method is in accordance with API RP 520. A balance is attempted between the accuracy of the method and the unavoidable uncertainties in the input and property data under the actual sizing conditions. There are other sizing methods available, which are referred to in this part of ISO 4126.

In case of two-phase flow, the fluid state and, hence, the mass flow rate required to be discharged are dependent on the size of the safety valve. Furthermore, the two-phase mass flow rate through a safety valve essentially depends on the mass flow quality (mass fraction of vapour) of the fluid at the inlet of the valve. Because these parameters are, in most cases, not readily at hand during the design procedure of a relief device, this part of ISO 4126 also includes a comprehensive procedure that covers the determination of the fluid-phase composition at the safety valve inlet. This fluid-phase composition depends on a scenario that leads to the pressure increase. Therefore, the recommended sizing procedure starts with the definition of the sizing case and includes a method for the prediction of the mass flow rate required to be discharged and the resulting mass flow quality at the inlet of the safety valve.

If flow is confirmed to be single-phase up to the narrowest flow cross-section, it is appropriate to use ISO 4126-1. The equations of ISO 4126-1 are also included in this part of ISO 4126, modified to SI units, to calculate the flow rates at the limiting conditions of single-phase flow.

# Safety devices for protection against excessive pressure —

# Part 10:
# Sizing of safety valves for gas/liquid two-phase flow



## 1 Scope

This part of ISO 4126 specifies the sizing of safety valves for gas/liquid two-phase flow in pressurized systems such as reactors, storage tanks, columns, heat exchangers, piping systems or transportation tanks/containers. The possible fluid states at the safety valve inlet that can result in two-phase flow are given in Table 1.

NOTE The expression “safety valve” is a synonym for valves as described in ISO 4126-1, ISO 4126-4 and ISO 4126-5.

**Table 1 — Possible fluid state at the inlet of the safety valve that can result in two-phase flow**

| Fluid state at valve inlet | Cases | Examples |
|---|---|---|
| liquid | subcooled (possibly flashing in the safety valve) | cold water |
| | saturated | boiling water |
| | with dissolved gas | $CO_2$/water |
| gas/vapour | near saturated vapour (possibly condensing in the safety valve) | steam |
| gas/liquid | vapour/liquid | steam/water |
| | non-evaporating liquid and non-condensable gas (constant quality) | air/water |
| | gas/liquid mixture, when gas is desorbed or produced | |

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4126-1, *Safety devices for protection against excessive pressure — Part 1: Safety valves*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4126-1 and the following apply.

**3.1**
**pressurized system**
equipment such as reactors, storage tanks, columns, heat exchangers, piping systems and transport tanks/containers being protected against impermissible pressure accumulation by a safety valve