

Australian Standard[®]

Safety devices for gas cylinders



This Australian Standard® was prepared by Committee ME-002, Gas Cylinders. It was approved on behalf of the Council of Standards Australia on 19 July 2005. This Standard was published on 22 August 2005.

The following are represented on Committee ME-002:

- Air Conditioning and Refrigeration Wholesalers Association
 - Australasian Institute of Engineer Surveyors
 - Australia New Zealand Industrial Gas Association
 - Australian Chamber of Commerce and Industry
 - Australian Industry Group
 - Australian Liquefied Petroleum Gas Association
 - Department for Administrative and Information Services, S.A.
 - Fire Protection Association of Australia
 - Institute of Materials Engineering Australasia
 - International Association for Natural Gas Vehicles
 - Pressure Equipment Association Incorporated
 - The Australian Gas Association
 - Victorian WorkCover Authority
 - Welding Technology Institute of Australia
 - WorkCover New South Wales
-

This Standard was issued in draft form for comment as DR 05025.

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

Keeping Standards up-to-date

Australian Standards® are living documents that reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued.

Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments that may have been published since the Standard was published.

Detailed information about Australian Standards, drafts, amendments and new projects can be found by visiting **www.standards.org.au**

Standards Australia welcomes suggestions for improvements, and encourages readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at **mail@standards.org.au**, or write to Standards Australia, GPO Box 476, Sydney, NSW 2001.

STANDARDS AUSTRALIA

RECONFIRMATION

OF

AS 2613—2005

Safety devices for gas cylinders

RECONFIRMATION NOTICE

Technical Committee ME-002 has reviewed the content of this publication and in accordance with Standards Australia procedures for reconfirmation, it has been determined that the publication is still valid and does not require change.

Certain documents referenced in the publication may have been amended since the original date of publication. Users are advised to ensure that they are using the latest versions of such documents as appropriate, unless advised otherwise in this Reconfirmation Notice.

Approved for reconfirmation in accordance with Standards Australia procedures for reconfirmation on 21 July 2016.

The following are represented on Technical Committee ME-002:

Australasian Fire and Emergency Service Authorities Council
Australia New Zealand Industrial Gas Association
Australian Chamber of Commerce and Industry
Engineers Australia
Environmental Protection Authority New Zealand
Fire Protection Association Australia
Gas Energy Australia
Gas Technical Regulators Committee
International Accreditation New Zealand
National Association of Testing Authorities Australia
SafeWork NSW
The Australian Gas Association
Welding Technology Institute of Australia
Worksafe New Zealand
WorkSafe Victoria

NOTES

Australian Standard[®]

Safety devices for gas cylinders

Originated as AS B281—1969.
Previous edition AS 2613—1989.
Third edition 2005.
Reissued incorporating Amendment No. 1 (October 2007).

COPYRIGHT

© Standards Australia

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher.

Published by Standards Australia, GPO Box 476, Sydney, NSW 2001, Australia

ISBN 0 7337 6826 1

PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee ME-002, Gas Cylinders to supersede AS 2613—1989, *Safety devices for gas cylinders*. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian, rather than an Australian/New Zealand Standard.

This Standard incorporates Amendment No. 1 (October 2007). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

This Standard originated as AS B281—1969 based on the then current version of CGA* Standard S-1.1, *Pressure relief device Standards*, Part 1: *Cylinders for compressed gases*. In 1983 it was revised as AS 2613—1983, when all equations were metricated and minor changes were made. The 1989 revision modified the equations in Clauses 2.2.2 and 2.2.4 to allow for the different flows through an orifice of given area for gases of different densities, in order to obtain approximately equal cylinder emptying times for any gas following device release. This is a unique Australian requirement.

A proposal from the gas cylinder industry was the basis for Appendix D and Appendix H. These Appendices treat pressure-relief valves as a special category of device, and introduce a repeat cycle in the test to show performance after an initial sequence of start-to-discharge, reseal, lift, full discharge, and reseal.

This edition corrects some errors especially in Clauses 2.2.2 and 2.2.4, clarifies some requirements and adds references to suitable materials for safety devices.

Investigations of safety relief of LP Gas fuel vessels for automotive vehicles have confirmed that the effects of any safety device discharge channel can be critical. The requirements for discharge from an automotive LP Gas vessel are set out in AS/NZS 1425, *LP Gas for fuel systems for vehicle engines*. For gas cylinders covered by any Part of AS 2030, *The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases*, safety relief device rating is to take into account the full effects of any discharge channel.

It is recognized that not all types of safety devices for gas cylinders fit into the categories provided by the Standard and it should be noted that certain government departments may have regulations setting different requirements from those in this Standard, e.g. the Navigation Act Classified List of Dangerous Goods and Air Navigation Orders.

* Compressed Gas Association (U.S.A.)

CONTENTS

	<i>Page</i>
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE	4
1.2 REFERENCED DOCUMENTS	4
1.3 DESIGNATION	4
1.4 DEFINITIONS	5
SECTION 2 SELECTION AND PERFORMANCE REQUIREMENTS	
2.1 SELECTION	7
2.2 FLOW RATE	7
2.3 FLOW-RATING PRESSURE OF A PRESSURE-RELIEF VALVE	8
2.4 START-TO-DISCHARGE PRESSURE OF A PRESSURE-RELIEF VALVE	8
2.5 RATED BURSTING PRESSURE OF A BURSTING DISC DEVICE	8
SECTION 3 MATERIALS, DESIGN, AND CONSTRUCTION	
3.1 GENERAL	9
3.2 DESIGN	9
SECTION 4 PERFORMANCE UNDER TEST	
4.1 GENERAL	12
4.2 TYPE TESTS (OF ALL TYPES OF DEVICE)	12
4.3 PRODUCTION TESTS OF PRESSURE-RELIEF VALVES	12
4.4 PRODUCTION TESTS OF SAFETY DEVICES OTHER THAN PRESSURE-RELIEF VALVES	12
4.5 RETESTS	13
4.6 AFTER-SERVICE RETESTS	13
4.7 TEST RECORDS	13
SECTION 5 IDENTIFICATION AND MARKINGS	
5.1 ALL SAFETY DEVICES	14
5.2 INDIVIDUAL COMPONENTS OF BURSTING DISC ASSEMBLIES	14
5.3 FUSIBLE PLUGS	14
5.4 PRESSURE-RELIEF VALVES	15
5.5 COMBINATION SAFETY DEVICES	15
APPENDICES	
A TEST METHOD FOR YIELD TEMPERATURE OF A SEPARATE FUSIBLE PLUG	16
B TEST METHOD FOR YIELD TEMPERATURE OF A FUSIBLE MATERIAL	17
C SUGGESTED SAMPLE SELECTION FOR TEST PURPOSES	18
D TEST METHOD FOR START-TO-DISCHARGE, LIFT, FULL DISCHARGE, AND RESEAL OF LP GAS PRESSURE-RELIEF VALVES	19
E TEST METHOD FOR START-TO-DISCHARGE, LIFT, FULL DISCHARGE, AND RESEAL FOR PRESSURE RELIEF VALVES	22
F TEST METHOD FOR BURSTING PRESSURE OF A BURSTING DISC	23
G TEST METHOD FOR EXTRUSION OF AN UNREINFORCED FUSIBLE OR REINFORCED FUSIBLE PLUG	24
H TEST METHODS FOR FLOW RATING OF GAS SAFETY RELIEF DEVICES	25
I TEST METHOD FOR BURSTING PRESSURE AND YIELD TEMPERATURE OF A COMBINED BURSTING DISC/FUSIBLE PLUG DEVICE	27
J FORMAT OF TEST REPORT TO SUPPORT DEMONSTRATION OF COMPLIANCE OF A SAFETY DEVICE TO THIS STANDARD	28

STANDARDS AUSTRALIA

Australian Standard

Safety devices for gas cylinders

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies the designations, and the requirements for design, construction, testing, and marking of safety devices intended for fitment to gas cylinders.

NOTE: The use, conditions and limitations on the fitment of safety devices to gas cylinders is specified in Standards such as the AS 2030 series and AS/NZS 1425.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

2030 The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases

2030.1 Part 1: Cylinders for compressed gases other than acetylene

2337 Gas cylinder test stations

2337.1 Part 1: General requirements, inspection and tests—Gas cylinders

2360 Measurement of fluid flow in closed conduits

2360.1.4 Part 1.4: Pressure differential methods—Measurement using orifice plates, nozzles or Venturi tubes—Guide to the effect of departure from the conditions specified in Part 1.1

2473 Valves for compressed gas cylinders (threaded outlet)

2527 Cylinders for dissolved acetylene

4955 Transportable gas cylinders—Compatibility of cylinder and valve materials with gas contents

4955.1 Part 1: Metallic materials

4955.2 Part 2: Non-metallic materials (ISO 11114-2:2000, MOD)

ISO

13341 Transportable gas cylinders—Fitting of valves to gas cylinders

1.3 DESIGNATION

Safety devices shall be designated as follows:

- (a) Type BD—Bursting disc.
- (b) Type FP1—Fusible plug or reinforced fusible plug, utilizing a fusible material with yield temperature not more than 77°C nor less than 69°C (74°C nominal).
- (c) Type FP2—Fusible plug or reinforced fusible plug, utilizing a fusible material with yield temperature not more than 104°C nor less than 98°C (100°C nominal).
- (d) Type BD/FP1—Series combination bursting disc/fusible plug, utilizing a fusible material with yield temperature not more than 77°C nor less than 69°C (74°C nominal).

- (e) Type BD/FP2—Series combination bursting disc/fusible plug, utilizing material with yield temperature not more than 104°C nor less than 98°C (100°C nominal).
- (f) Type PRV—Pressure-relief valve.
- (g) Type PRV/FP1—Parallel combination pressure-relief valve/fusible plug, utilizing a fusible material with yield temperature not more than 77°C nor less than 69°C (74°C nominal).
- (h) Type PRV/FP2—Parallel combination pressure-relief valve/fusible plug, utilizing a fusible material with yield temperature not more than 104°C nor less than 98°C (100°C nominal).

1.4 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 2030.1 and those below apply.

1.4.1 Bursting disc

An operating part of a safety device in the form of a disc which closes the safety device channel. The disc is intended to burst at a predetermined pressure to permit discharge of fluid.

NOTE: Types of disc include flat, preformed, reinforced, and grooved discs.

1.4.2 Combination bursting disc/fusible plug

A bursting disc in series combination with a low melting point fusible material, intended to prevent the disc bursting at its predetermined bursting pressure unless the temperature also is high enough to cause yielding of the fusible material.

1.4.3 Combination pressure-relief valve/fusible plug

A safety device utilizing a pressure-relief valve in parallel combination with a fusible plug.

NOTE: This combination device may be an integral unit, or separate units installed as an assembly, and is intended to open and close at predetermined pressures or open at a predetermined temperature (or both).

1.4.4 Flow rate

The amount of gas (per unit of time) that can be discharged at the required flow-rating pressure.

1.4.5 Flow-rating pressure

The pressure at which a safety device is rated for flow.

1.4.6 Free air or free gas

Air or gas measured at a pressure of 101.3 kPa (absolute) and a temperature of 15°C.

1.4.7 Fusible plug

A safety device in the form of a plug of suitable low melting point material which closes the safety device channel and is intended to yield at a predetermined temperature to permit discharge of fluid.

1.4.8 Operating part

The part that closes the safety device channel, but, which when moved from this position as a result of the action of heat or pressure or a combination of the two, permits discharge of fluid from the gas cylinder.

1.4.9 Pressure opening

Orifice against which the operating part functions.

1.4.10 Pressure-relief valve

A safety device containing an operating part that is held by a spring force in a position closing the safety device channel, and intended to open and to close at predetermined pressures.

1.4.11 Rated bursting pressure (of a bursting disc)

The maximum pressure at which the bursting disc is designed to burst at the rated temperature when in the pressure opening for which it is designed.

1.4.12 Rated temperature (of a bursting disc)

The temperature at which the rated bursting pressure of a disc is to be determined.

NOTE: Unless otherwise specified, rated temperature is taken as 65°C.

1.4.13 Reinforced fusible plug

A fusible plug consisting of a core of suitable material having a comparatively high yield temperature surrounded by a low melting point fusible material of the required yield temperature.

1.4.14 Resealing pressure (of a pressure-relief valve)

The pressure at which flow becomes less than a nominated quantity when measured through a water seal of not greater than 100 mm on the outlet of the pressure-relief valve.

1.4.15 Safety device

A device, including the approach channel, the operating part, and the discharge channel, intended to protect a gas cylinder against overpressure or bursting.

1.4.16 Safety device approach channel

The parts of the safety device channel on the gas cylinder contents side of the operating part, inclusive of any piping attached to the inlet side of the device.

1.4.17 Safety device channel

The passage or passages through which fluid discharge by operation of the safety device must pass from the gas cylinder to the atmosphere.

1.4.18 Safety device discharge channel

That part of the safety device channel on the gas cylinder atmospheric side of the operating part, including any piping attached to the outlet side of the device.

1.4.19 Start-to-discharge (of a pressure-relief valve)

The pressure at which the first bubble appears through a water seal of not greater than 100 mm on the outlet of the pressure-relief valve.

NOTE: Start-to-discharge is also known as start-to-release pressure.

1.4.20 Test pressure (of gas cylinder)—

The test pressure of the gas cylinder for which the safety device is intended.

1.4.21 Yield temperature (of a fusible plug)

Temperature at which the fusible material will yield.

SECTION 2 SELECTION AND PERFORMANCE REQUIREMENTS

2.1 SELECTION

The selection of a safety device shall be in accordance with the Standard that specifies the application.

NOTE: This Standard does not specify a method for supporting the demonstration of the compliance of a safety device with its requirements, but Appendix J gives a recommended format for recording the results of testing.

The water capacity and test pressure values used for purposes of selection, calculation, and testing shall be those provided by the owner of the gas cylinder in which the device is to be installed.

A pressure-relief valve shall comply with Clauses 2.2, 2.3, and 2.4.

A bursting disc shall comply with Clauses 2.2 and 2.5.

A fusible plug shall comply with Clause 2.2 and have a yield temperature within the appropriate range of the device designation (see Clause 1.3).

2.2 FLOW RATE

2.2.1 General

The flow rate shall be not less than that established in accordance with Clause 2.2.2, Clause 2.2.3, Clause 2.2.4, or Clause 2.2.5, as appropriate to the type and intended use.

The flow rate requirements of this Clause do not apply to fusible plug devices for acetylene gas cylinders (see Clause 3.2.2).

2.2.2 Device (other than pressure-relief valve) for use with compressed gas

The flow rate of a device (other than a pressure-relief valve) for installation in a non-insulated cylinder for compressed gas shall be calculated from the following equation:

$$q_{v,g} = 0.0517 \frac{m_w}{\sqrt{M}}$$

where

$q_{v,g}$ = flow rate in cubic metres per minute of the free gas which will be protected by the safety device

m_w = water capacity of the cylinder, in kilograms, or 11.3 kg, whichever is the greater

M = molar mass of gas, in kilogram/kilomol.

NOTE: The above equation expresses the flow capacity through a 70% efficient orifice having a cross-sectional area of $0.0319\sqrt{M} \text{ mm}^2$ per kilogram of water capacity, at an upstream pressure of 690 kPa (absolute). The orifice size should be calculated for the highest value of M for which the device is intended.

2.2.3 Device (other than pressure-relief valve) for use with a liquefied gas

The flow rate of a device (other than a pressure-relief valve) for installation in a non-insulated cylinder for liquefied gas shall be calculated from the following equation:

$$q_{v,a} = 0.0192m_w$$

where

$q_{v,a}$ = flow rate, in cubic metres per minute of free air

m_w = water capacity of the cylinder, in kilograms, or 11.3 kg, whichever is the greater.

NOTE: The above equation expresses the flow rate through a 70% efficient orifice having a cross-sectional area of 0.341 mm² per kilogram of water capacity, at an upstream pressure of 690 kPa (absolute).

2.2.4 Pressure-relief valve for use with a compressed gas

The flow rate of a pressure-relief valve for installation in a non-insulated cylinder for compressed gas shall be calculated from the following equation:

$$q_{v,g} = \frac{75.1 \times 10^{-6} p m_w}{\sqrt{M}}$$

where

$q_{v,g}$ = flow rate in cubic metres per minute of the free gas which will be protected by the safety device

p = flow-rating pressure, in kilopascals (absolute)

m_w = water capacity of the cylinder, in kilograms, or 5.7 kg, whichever is the greater

M = molar mass of gas, in kilograms/kilomol.

2.2.5 Pressure-relief valve for use with a liquefied gas

The flow rate of a pressure-relief valve for installation in a non-insulated cylinder for liquefied gas shall be calculated from the following equation:

$$q_{v,a} = 27.89 \times 10^{-6} p m_w$$

where

$q_{v,a}$ = flow rate, in cubic metres per minute of free air

p = flow-rating pressure, in kilopascals (absolute)

m_w = water capacity of the cylinder, in kilograms, or 5.7 kg, whichever is the greater.

2.3 FLOW-RATING PRESSURE OF A PRESSURE-RELIEF VALVE

The flow-rating pressure of a pressure-relief valve shall be not less than 1.25 times the maximum developed pressure of the contained gas, and shall not exceed the test pressure of the cylinder.

2.4 START-TO-DISCHARGE PRESSURE OF A PRESSURE-RELIEF VALVE

The start-to-discharge pressure of a pressure-relief valve shall be not less than 80% of the flow-rating pressure.

2.5 RATED BURSTING PRESSURE OF A BURSTING DISC DEVICE

The rated bursting pressure of a bursting disc device, at a rated temperature of 65°C, shall not exceed the test pressure of the cylinder in which the device is to be used, and shall be not less than 100/(100 – T) times the maximum developed pressure of the contained gas, where T is the manufacturer's guaranteed tolerance, which shall not exceed 15% of the rated bursting pressure.

NOTE: The rated bursting pressure may be lower than the test pressure of the cylinder in which the device is to be used, provided that the conditions in this Clause are satisfied.