

Australian Standard™

**Safety valves, other valves, liquid level
gauges and other fittings for boilers and
unfired pressure vessels**



This Australian Standard was prepared by Committee ME-001, Pressure Equipment. It was approved on behalf of the Council of Standards Australia on 30 June 2003. This Standard was published on 18 August 2003.

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STANDARDS AUSTRALIA

RECONFIRMATION

OF

AS 1271—2003

Safety valves, other valves, liquid level gauges, and other fittings for boilers and unfired pressure vessels

RECONFIRMATION NOTICE

Technical Committee ME-001 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.

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Approved for reconfirmation in accordance with Standards Australia procedures for reconfirmation on 13 October 2015.

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NOTES

Australian Standard™

**Safety valves, other valves, liquid level
gauges and other fittings for boilers and
unfired pressure vessels**

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PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee ME-001, Pressure Equipment to supersede AS 1271—1997. 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 (July 2004). 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.

The Committee's intention is to consolidate all valve requirements used for pressure equipment within the Committee's scope into one document. This has been achieved by incorporating some parts of AS 3653—1993, *Boiler—Safety, management, combustion and other ancillary equipment*, into this Standard.

The remainder of AS 3653 will be superseded by a proposed new Standard to cover the areas of unattended, limited attendance and attended boilers and on publication of the new Standard, AS 3653 will be withdrawn.

Other Australian Boiler Standards will reflect these changes as they are revised.

The objective of this Standard is to specify clear, uniform and safe requirements for the design, construction and testing of safety valves, other valves, liquid level gauges, blowdown valves and other fittings for use on boilers and unfired pressure vessels, and their associated piping.

Users of this Standard are reminded that it has no legal authority in its own right but may acquire legal standing in one or more of the following circumstances:

- (a) Adoption by a government or other authority having jurisdiction.
- (b) Adoption by a purchaser as the required standard of construction when placing a contract.
- (c) Adoption where a manufacturer states that a product is in accordance with this Standard.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

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STANDARDS AUSTRALIA

Australian Standard

**Safety valves, other valves, liquid level gauges and other fittings for
boilers and unfired pressure vessels**

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for the design, construction and testing of safety valves, other valves, liquid relief valves, liquid level gauges, blowdown valves and other fittings for use on boilers and unfired pressure vessels, and their associated piping.

1.2 APPLICATION

Each fitting shall comply with the requirements of Section 2 and with the requirements of the following Sections, as appropriate:

- (a) Safety and relief valves..... Section 3.
- (b) Liquid relief valves..... Section 4.
- (c) Liquid level gauges Section 5.
- (d) Blowdown valves Section 6.

1.3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

- | | |
|--------|--|
| 1210 | Pressure vessels |
| 1722 | Pipe threads of Whitworth form |
| 1722.1 | Part 1: Sealing pipe threads |
| 1722.2 | Part 2: Fastening pipe threads |
| 2129 | Flanges for pipes, valves and fittings |
| 2593 | Boilers—Unattended and limited attendance |
| 4037 | Pressure equipment—Examination and testing |
| 4041 | Pressure piping |
| 4942 | Pressure equipment — Glossary of terms |

AS/NZS

- | | |
|------|--------------------|
| 1200 | Pressure equipment |
|------|--------------------|

ANSI

- | | |
|---------|--|
| B1.20.1 | Pipe threads, general purpose |
| B16.5 | Pipe flanges and flanged fittings |
| B16.47 | Large-diameter steel flanges NPS 20 through NPS 60 |
| B16.104 | Control valve seat leakage |

API	
RP520	Sizing, selection and installation of pressure-relieving devices in refineries, Part 1: Sizing and selection
527	Seat tightness of pressure relief valves
598	Valve inspection and testing
BS	
1560	Circular flanges for pipes, valves and fittings (Class designated)
1560.3.1	Section 3.1: Steel, cast iron and copper alloy flanges — Specification for steel flanges
1726	Cylindrical helical springs made from round wire and bar—Guide to methods of specifying tolerances and testing
1726.1	Part 1: Compression springs
3463	Specification for observation and gauge glasses for pressure vessels
3799	Specification for steel pipe fittings, screwed and socket-welding for the petroleum industry
MSS	
SP61	Hydrostatic testing of steel valves

1.4 DEFINITIONS

For the purpose of this Standard the definitions in AS 4942 apply.

1.5 PRESSURES

Pressures referred to in this Standard are gauge pressures unless otherwise noted.

1.6 DESIGNATION

The designation number for valves or fittings manufactured to this Standard shall be as follows:

- (a) For safety valves AS 1271-3.
- (b) For liquid relief valves.....AS 1271-4.
- (c) For liquid level gauges.....AS 1271-5.
- (d) For blowdown valves.....AS 1271-6.
- (e) For fittings (other than listed above) AS 1271-2.

SECTION 2 GENERAL VALVE DESIGN, CONSTRUCTION AND APPLICATION

2.1 MATERIALS

2.1.1 Material standards

Material used in the construction of a valve or fitting shall comply with AS 1210. Alternative materials complying with the requirements of a relevant Specification of the British Standards Institution (BSI), or the American Society for Testing and Materials (ASTM), may be used.

NOTE: The requirements of a Standard which relate to dimensional standardization only and not to performance and safety may be disregarded by agreement between the purchaser and the manufacturer.

2.1.2 Suitability

Materials used in the construction of valves and fittings shall be suitable for the conditions of use, i.e. the material shall be—

- (a) suitable for the temperature and pressure of the fluid being handled under all operating conditions;
- (b) compatible with the fluid and with the material of adjacent components; and
- (c) suitable for the environment in which the valve is installed.

Non-metallic materials shall not be used for pressure parts, with the exception of non-metallic seating components.

2.1.3 Limits of application

A material shall not be used at a pressure or temperature outside the limits specified in the applicable Standards mentioned in Clause 2.1.1.

2.1.4 Castings and forgings

Any casting or forging shall be smooth, sound, and free from cracks or other injurious defects. Variations of thickness at any place shall be gradual and substantial fillets shall be provided.

NOTE: The specific quality standard for castings or forgings may be specified by the purchaser.

2.1.5 Repair of castings

The requirements of the application Standard shall be met, however, any defect in a weldable alloy casting, except grey iron castings and spheroidal graphite iron castings, may be welded by an approved process, including any necessary subsequent heat treatment, provided that such repair does not impair the strength of the casting. Such defect shall be cleaned out to sound metal. The welding filler metal shall be such as will produce a weld having characteristics similar to the parent metal.

2.1.6 Impregnation of castings

Castings that are found to be porous may be reclaimed by impregnation under the following conditions, provided that the porosity is not part of a linear defect:

- (a) The application is one in which failure would not result in an immediate and significant hazard.
- (b) The working temperature is not greater than 150°C.

NOTE: In the event of the manufacturer supplying appropriate test certificates from an accredited test laboratory, this temperature may be increased to 210°C.

- (c) The component is marked to show that it has been impregnated.

2.2 CONSTRUCTION

2.2.1 Bonnet and cover joint

The bonnet or cover of a cast iron valve or fitting shall be of the bolted type.

The bonnet or cover of a valve or fitting larger than DN 40 that is connected directly to a boiler or pressure vessel, or of any other valve or fitting larger than DN 60, shall be of the bolted, pressure-seal, screwed-and-welded, or welded type as appropriate for the operating conditions.

Any screwed bonnet which includes the gland components shall incorporate positive means to prevent the inadvertent unscrewing of the bonnet, e.g. locked with grub screw, split pin, or similar device.

Where the bonnet is used to retain a spring assembly of a safety or relief valve, it shall be arranged so that the disc is free of the seat before the bonnet can be removed.

2.2.2 Stems and stuffing boxes

Additional to the requirements of the application Standard, any valve larger than DN 50, or any valve, irrespective of size, that will be subject to high temperatures or is intended to handle fluid that is likely to be corrosive, erosive, or to contain sediment or other material detrimental to stem screw threads, should be of the outside-screw type, i.e. one in which the actuating thread of the stem is exterior to the bonnet.

No stuffing box shall have an internal thread.

Gland nuts which could possibly be released by operation of a valve stem shall be designed and suitably locked to prevent inadvertent release. The design of the stem and gland arrangement should be such that leakage from an O-ring or other seals will occur before release of the stem. Positive means shall be provided to prevent the stem from being ejected on failure of any component.

2.2.3 Ball valve, plug cock, or cock

The ported member shall be securely contained within the valve body by means other than the gland. The stem for rotating the ported member should be integral with it, or where this is not practicable, the connection should be sufficiently robust to obviate risk of shearing, and should be designed so that an incorrect angular relationship on reassembly is not possible. The stem shall be made from solid material, with the following exception. Lubrication channels may be drilled.

2.2.4 Moving parts

Moving parts shall be guided efficiently, and shall have sufficient clearance to ensure freedom of movement under all conditions of service. Positive means shall be provided to prevent the valve disc of guided valves, e.g. pintle-guided valves, from being lifted out of its guides while working.

2.3 PRESSURE/TEMPERATURE DESIGN AND RATING

2.3.1 Pressure/temperature rating

The manufacturer shall specify the pressure/temperature combination rating for which the valve or fitting has been designed, and the limiting temperature beyond which it should not be used. Such rating shall allow for moderate shock conditions which may occur in an efficiently designed and operated system, such as a boiler feed system. The manufacturer shall supply on request any additional information relating to the suitability of the valve or fitting for use at other operating pressures or temperatures.

NOTE: Where the use of a valve or fitting for pressure/temperature combinations other than those relating to its original rating is being considered, reference should be made to the manufacturer. If data is not available from this source, reference may be made to Figure E1, Figure E2, or Figure E3 of Appendix E, as applicable. In particular, the operating temperature should not be increased until it has been ascertained that the new conditions remain within the capacity of the valve or fitting.

2.3.2 Modified rating due to connections

Where a valve or fitting incorporates flanges or other methods of connection whose ratings differ from that of the remaining valve or fitting components, the rating of the valve or fitting shall be that of the lowest rated component.

2.3.3 Determination of dimensions

The dimensions of pressure components may be determined by calculation or by proof tests. In no case shall the minimum thickness of a cast iron, sand-cast carbon steel, or copper alloy bonnet or body be less than that given in Tables A1, A2 and A3 of Appendix A, respectively.

Allowance shall be made for loss of wall thickness by corrosion and for manufacturing variations. Material thickness shall take into account external forces that may be applied to the valve or fitting when installed.

The valve manufacturer shall, on request of the purchaser, supply sufficient information to allow evaluation of the effects when expected external loadings are applied to a valve.

2.3.4 Design strength

The design strength of each pressure component shall be in accordance with AS 1210 for the relevant temperature.

2.3.5 Valve and fitting scantlings

The calculations made to determine the dimensions of pressure parts of the valve or fitting shall be based on the relevant design pressure and temperature of the component to which the valve or fitting is to be fitted.

2.3.6 Proof test

Where it is not practicable to calculate the strength of the valve or fitting or a part thereof, with a reasonable degree of accuracy, a full size sample shall be made by the manufacturer and—

- (a) tested to destruction; or
- (b) subjected to strain analysis in accordance with AS 1210 to the satisfaction of the purchaser.

2.3.7 Local reductions

Due account shall be taken of any local reduction in thickness or stress-raising points, e.g. those due to the marking of the valve or fitting of name plates.

2.4 VALVE MOUNTING AND CONNECTIONS

2.4.1 Flanged connections

Bolted flanged connections shall comply with the requirements of AS 1210 or an approved Standard for flanges. Flanges conforming to ANSI B16.47, ANSI B16.5, BS 1560.3.1, or AS 2129 may be used within the size and pressure/temperature rating permitted in the relevant Standard.

2.5.2 Direction of operation

Each directly operated valve shall close by clockwise rotation as seen when facing the hand wheel, handle, or key, and there shall be clear indication thereon (or on an index plate) of the direction of closing. The indication shall be such that its correctness cannot be disturbed by incorrect assembly of component parts of the valve.

A valve fitted with mechanical remote control shall have suitable marking at the operating position to show the extent of the opening and the direction of closure.

2.5.3 Open/shut indicators

Where specified by the purchaser, an indicator to show clearly whether the valve is closed or open shall be fitted.

2.5.4 Data

Each valve or fitting shall be plainly marked by the manufacturer with at least the following data, in such a manner that it will not be obliterated in normal service:

- (a) Manufacturer's name, or trade name or trade mark.
- (b) An identifying symbol, which completely identifies the manufacturer, the model, type, and size of the valve or fitting.
NOTE: The serial number required in Clause 2.5.5(c) is deemed to constitute compliance with this requirement.
- (c) The pressure and relevant temperature at which the manufacturer intends the valve or fitting to be used, stated in the relevant units, or alternatively the valve rating.
- (d) The limiting maximum temperature, in degrees Celsius, followed by the abbreviation 'Max.' where this is less than the rated temperature.

NOTE: The limiting temperature takes account of the operating temperature range of all materials within the valve or fitting.

- (e) Whether there are any other limiting conditions peculiar to the valve (including impregnation).
- (f) The designation number (see Clause 1.6).

NOTES:

- 1 Where the size of fitting precludes the direct marking as specified above, the data may be provided on a securely affixed and durable tag.
- 2 Manufacturers making a statement of compliance with this Australian Standard on a product, or on packaging or promotional material related to that product, are advised to ensure that such compliance is capable of being verified.

2.5.5 Additional marking—safety and relief valves

In addition to the markings required by Clause 2.5.4, the following additional information shall be clearly and permanently marked on safety and relief valves:

- (a) Nominal size (DN) of valve.
- (b) Set pressure, in kilopascals.
- (c) Manufacturer's serial number in accordance with Clause 2.5.6.
- (d) A warning label shall be fitted where the valve is fitted with a test gag or shipping stop. The label shall be of such material and be attached by such means to ensure the label will remain in place and legible after exposure to conditions incident to transport, storage and use. The label shall give instructions for the removal of the gag or stop prior to putting the valve into service.

NOTE: In small relief valves with set pressures not greater than 1400 kPa and with inlet sizes not larger than 10 mm in diameter for air receivers and similar applications, the details shown on the valves may be reduced with approval of the parties concerned.

2.5.6 Records and certification—safety and relief valves

The manufacturer shall allot each safety or relief valve an exclusive serial number, except that, where a batch of valves is such that each could be issued with an identical certificate, each may be allotted the same batch number. The manufacturer shall maintain, for not less than 10 years, sufficient records to provide details of the discharge capacity of the valve.

NOTES:

- 1 A test report data form is shown in Appendix B.
- 2 The manufacturer may provide with each safety valve a certificate worded in the general form set out in Appendix C or Appendix D, as appropriate.

2.6 HYDROSTATIC TESTS

2.6.1 Hydrostatic test fluid

The fluid for all hydrostatic tests shall be water, except where the use of water would be detrimental to the valve or fittings or where contamination with water cannot be tolerated.

2.6.2 Body test

Each valve or fitting shall be subject to a hydrostatic body test without visible evidence of distortion or leakage at pressures not less than—

- (a) for steel and copper alloys 1.5 P , or
- (b) for cast iron or spheroidal graphite iron.....2 P ,

where P is the design pressure.

This hydrostatic test is an integrity test and should be interpreted in accordance with other test procedures and application Standards.

NOTE: The purchaser may specify a higher hydrostatic test pressure to allow for equivalent material strength at ambient temperature.

The test shall be carried out with all the openings blanked off, and the test pressure shall be applied and maintained at the required pressure for a sufficient length of time to permit a visual examination of all surfaces and joints, but in no case for less than the time detailed in Table 1.

Bodies shall be properly vented to remove trapped air.

The blanking shall be made so that it will not exert any significant restraint on the valve or subject it to any external loads. The valve disc or other obturator shall be positioned to ensure full test pressure on all parts of the body, except where the design pressure differs on opposite sides of the obturator. In this case each side may be tested separately to its appropriate body pressure.

A safety valve that is to be installed with a free discharge, or where the only backpressure is built-up backpressure, does not require a hydrostatic test to be applied to that part of the valve on the discharge side of the seat. Where a safety valve is to be subjected to a superimposed backpressure or a valve is to be used on a closed discharge system (closed bonnet valves), a hydrostatic test appropriate to the maximum backpressure on the valve shall be applied to those parts on the discharge side of the seat.

2.6.3 Seat test

Each valve shall be subjected to a seat test at the design pressure to ensure an effective seal *on the seat* in the closed position and with the appropriate side or sides open to atmosphere. Such test may be hydrostatic or pneumatic, but if pneumatic, the valve shall have first been subjected to the hydrostatic test in accordance with Clause 2.6.2 and the precautions of Appendix H shall be observed.

NOTE: The purchaser may specify other seat test requirements.

TABLE 1
MINIMUM DURATION OF HYDROSTATIC TEST

Valve size	Duration, min		
	Equivalent design pressure at atmospheric temperature, MPa		
DN	≤4	>4 ≤6.4	>6.4
>50	2	2	3
>50 ≤65	2	2	4
>65 ≤80	2	3	4
>80 ≤100	2	4	5
>100 ≤125	2	4	6
>125 ≤150	2	5	7
>150 ≤200	3	5	9
>200 ≤250	3	6	11
>250 ≤300	4	7	13
>300 ≤350	4	8	15
>350 ≤400	4	9	17
>400 ≤450	4	9	19
>450 ≤500	5	10	22
>500 ≤600	5	12	24
>600	Pro rata durations		

For any safety valve or relief valve, the test shall be made for seat tightness with the spring in the set position and at a pressure of 90 percent of the set pressure, and shall be carried out after the valve has been lifted and allowed to reseat under the action of the direct loading.

NOTE: The purchaser may specify a higher percentage of the set pressure for the seat tests.

The manufacturers may adopt any approved Standard for the conduct of seat tests appropriate to the type of valve under test, e.g. API 527 for safety valves, API 598 or MSS SP61 for isolating valves, and ANSI B16.104 (FCI-70-2) for control valves. The Standard adopted (where applicable), details of the test, and leakage detected shall be recorded by the manufacturer and shall be made available to the purchaser. Unless otherwise agreed with the purchaser, safety valves for steam service shall be leak-tested with steam at the maximum expected operating pressure not exceeding the reseating pressure of the valve and shall show no audible or visible leakage for one minute.

NOTE: The purchaser may specify test conditions and maximum acceptable leakage.

SECTION 3 SAFETY AND RELIEF VALVES

3.1 GENERAL

3.1.1 Scope of section

This Section specifies requirements for safety and relief valves.

NOTE: Any reference to safety valves includes relief valves.

3.1.2 Fail-safe

Each safety valve shall be designed and constructed so that failure of any part will not obstruct the free and full discharge from the valve.

3.1.3 Stem seals

The stem of a safety valve shall not be fitted with a stuffing box, non-metallic bushing or 'O' ring seal.

3.1.4 Locking of adjustments

Any setting that is adjustable, e.g. blowdown, relieving pressure, and the like, shall be provided with a device that is sufficiently positive to prevent subsequent movement through accident, vibration, or expansion. Means for sealing, locking, or other protection from interference shall be provided as required by the particular application Standard.

3.1.5 Drainage

Application Standards, in general, require that a means of drainage be provided at the lowest point on the discharge side of a safety valve system. Where possible, this should be provided in the body of the valve.

3.1.6 Freedom of operation

The design of safety valves and the choice of their materials of construction shall take into consideration the possible effect on the freedom of the operation of differential expansion and contraction, discharge reaction, icing of external components during discharge, and of gumming or deposits. Valves with plain flat discs without bottom guides shall be used where gumming or deposits are probable on the inside. The valve spring should be protected by a suitable seal, e.g. a bellows, where it is liable to corrosion or blockage due to products discharged, or be suitably shielded where it is liable to corrosion or blockage due to the environment.

3.2 SPRING LOADING

3.2.1 Springs

3.2.1.1 Design

The design calculations for springs shall be to an approved method, e.g. BS 1726-1, for helical compression springs.

3.2.1.2 Workmanship

Each end of a helical compression spring shall present a flat bearing of not less than 75 percent of the circumference at right angles to the axis, so that, when placed on end on a horizontal plane, the spring will be within the tolerances recommended in Appendix A of BS 1726-1 for Class A springs.

NOTE: If it is necessary to specify tolerances closer than those recommended in BS 1726-1, arrangements should be made between the valve manufacturer and the spring manufacturer.

3.2.1.3 *Spacing of coils*

The spacing of the coils shall be such that when the disc is lifted the distance to discharge its rated capacity, a continuous minimum gap of 1 mm shall be maintained between adjacent working coils. The coils shall be uniformly spaced, and the sides of the spring shall be parallel to the axis.

3.2.1.4 *Height/diameter ratio*

The ratio of unloaded height to external diameter of any helical compression spring shall not exceed 4:1.

3.2.1.5 *Finish*

Springs may be either hot-formed or cold-formed. Each spring shall have a smooth surface free from fins, burrs, scratches, or other imperfections which could interfere with the spring function or impair its service life.

3.2.1.6 *Marking*

Each spring shall be marked or tagged with a number which identifies its characteristics in a manner which is not detrimental to the life or action of the spring.

NOTES:

- 1 Such number should be included in the certificate in accordance with Appendix C or Appendix D.
- 2 Where because of size limitation on small serially produced valves the above requirement is impracticable, special arrangements should be made with the purchaser.

3.2.2 **Range of application**

The spring in a safety and relief valve shall not be set for any pressure more than 5 percent above or below that for which the valve is marked, unless the setting is within the spring design range established by the valve manufacturer, or is determined to be acceptable to the valve manufacturer.

3.2.3 **Prevention to alteration of set pressure**

All safety valves shall be sealed by the manufacturer, or the manufacturer's representative.

Unauthorized interference with the load on the spring after the safety valve has been adjusted shall be prevented by —

- (a) the fitting of a ferrule under the adjusting screw collar;
- (b) the fitting of a compression ring under the adjusting screw collar; or
- (c) the locking of the adjusting screw.

3.3 **EASING GEAR**

3.3.1 **Provision of easing gear**

The object of easing gear is to check that binding or sticking of the disc is not occurring. The action of the easing gear shall ease the spring loading and allow the pressure of the fluid to lift the disc.

Easing gear will normally be specified on safety valves intended for use on steam, air, or those fluids which promote sticking of the valve disc but do not create a hazard when released. Unless leakage of the fluid is prevented at all places other than through the discharge piping, easing gear shall not be provided on valves intended for use with fluids whose discharge could create a hazard.

NOTE: The purchaser should specify requirements for easing gear.

3.3.2 Lifting pressure

The combination of fluid pressure on the disc and the unloading action of the easing gear shall allow the disc to positively lift off its seat when the valve is subjected to the greater of 75 percent of its set pressure and its set pressure minus 0.75 MPa.

3.4 OPERATION

3.4.1 Smooth operation

A safety valve shall operate without chatter, flutter, sticking, or harmful vibration.

3.4.2 Tolerances and limits on valve characteristics

The tolerances and limits as applicable on valve characteristics shall be as follows:

- (a) *Set pressure* ± 3 percent of the set pressure or ± 0.015 MPa, whichever is the greater.
- (b) *Lift* Not lower than the value as stated by the manufacturer.
- (c) *Limits of adjustable blowdown* Minimum 2.5 percent of set pressure, maximum 7 percent of set pressure, except for valves having—
 - (i) diameter of valve throat less than 15 mm for which the maximum limit of blowdown shall be 15 percent of set pressure; or
 - (ii) values of set pressure less than 300 kPa for which the blowdown shall be not more than 30 kPa.
- (d) *Limits for valves with non-adjustable blowdown* Maximum 15 percent of set pressure.
- (e) *Limits of blowdown for incompressible fluids* Maximum 20 percent of set pressure. For values of set pressure less than 300 kPa, the blowdown shall be a maximum of 60 kPa.

Notwithstanding the content of Items (a) to (e), the application Standard shall be met.

3.5 CAPACITY RATING, CLASSIFICATION, AND CERTIFICATION

3.5.1 Method of rating

The rated discharge capacity of a safety valve shall be determined by one of the following methods:

- (a) A physical measurement of the discharge rate, conducted on the actual valve, at the pressure and temperature, and using the fluid for which certification is sought.
- (b) Physical measurements of the discharge rate of a valve of known dimensions, using a fluid of known characteristics, at a known pressure and temperature, followed by a calculation to establish what the discharge capacity would be if any one of, or any combination of, the following were varied:
 - (i) Fluid.
 - (ii) Pressure.
 - (iii) Temperature.
 - (iv) Area through the valve.
- (c) A determination, by calculation only, by applying a discharge capacity equation incorporating established discharge coefficients to the known area through the valve; this area having been established by tests to determine the lift of the valve.