

AS 1271—2003
(Incorporating Amendment No. 1)
Reconfirmed 2016

AS 1271—2003

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.

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The remainder of AS 3653 will be superseded by a proposed new Standard to cover the areas of unattended, limited attendance and attended boilers and on publication of the new Standard, AS 3653 will be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

2.4.2 Butt-welded connections

Where a valve or fitting is intended for attachment by butt-welding, the ends shall be prepared in accordance with AS 4041, or other approved Standards provided that the transition slope lies within the limits shown in Figure 1.

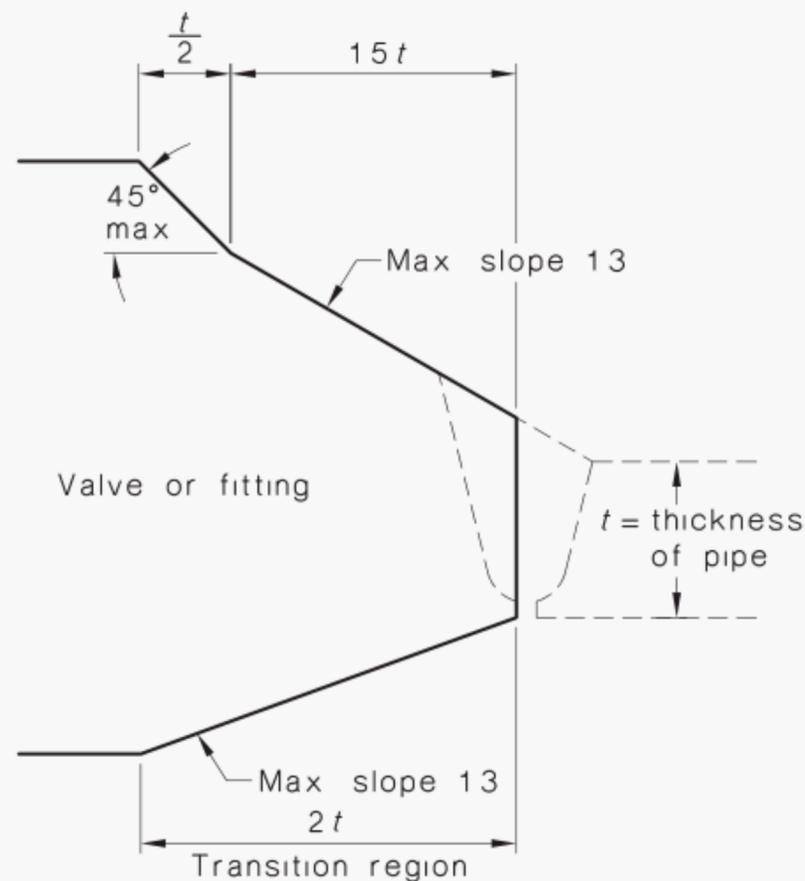


FIGURE 1 TRANSITION SLOPE FOR BUTT-WELD END

2.4.3 Threaded connections

Threads shall be in accordance with AS 1722.1, AS 1722.2, ANSI B1.20.1, or equivalent Standard. Threads shall be right hand. Threads may be taper-to-taper, parallel-to-parallel or taper-to-parallel. Thread shall be true to their full length and depth and shall comply with any gauging requirements of the relevant specification.

2.4.4 Socket-welded connections

Socket welding may be used within the limits of the application Standard. Preparation shall be in accordance with BS 3799, ANSI B16.5, or other relevant Standard.

2.4.5 Other connections

Other methods of connection shall be to a relevant Standard, and in accordance with the application Standard, e.g. AS 4041 for compression or cutting ring couplings.

2.5 MARKING AND DOCUMENTATION

2.5.1 Direction of flow

The direction of flow shall be clearly and permanently indicated on the body of the valve or fitting, except where the valve or fitting is suitable for flow in either direction. The flow indication shall be such that its correctness cannot be disturbed by incorrect assembly of component parts.

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 alloys1.5*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.

3.5.2 Classification

Safety valves shall be classified as follows:

- (a) *Class A* Valves whose ratings have been determined by actual measurement as in Clause 3.5.1(a) or (b).
- (b) *Class B* Valves whose ratings have been determined by calculations as in Clause 3.5.1(c).

NOTE: Reference should be made to the relevant application Standard for the class of valve to be used in a particular application.

3.5.3 Certification

Information which the manufacturer is required to enter in a certificate (see Clause 2.5.6) shall be as follows:

- (a) Operating characteristics determined in accordance with Clause 3.7.
- (b) Flow characteristics determined in accordance with Clause 3.8.
- (c) Rated discharge capacity for the fluid used in the tests and for other fluids determined in accordance with Clause 3.10.
- (d) Rated discharge capacity for overpressure greater than that used for the test determined in accordance with Clause 3.10.

3.5.4 Other certification

Notwithstanding the requirements of Clause 3.6, a certificate that a valve complies with this Standard may be issued on the basis of tests previously conducted, and certification may be given to rate the discharge capacity of valves on the basis of tests conducted outside the Commonwealth of Australia. Certification for approval for such valves shall be supported by documentation of the tests, and sufficient information to prove that the test results being submitted apply to the valves under consideration.

3.6 TESTING FOR OPERATING AND FLOW CHARACTERISTICS FOR SAFETY VALVES USING STEAM, AIR, WATER, OR OTHER GASES OR LIQUIDS OF KNOWN CHARACTERISTICS

3.6.1 Operating and flow characteristics to be tested

The following characteristics shall be tested:

- (a) Set pressure.
- (b) Re-seating pressure.
- (c) Blowdown.
- (d) Reproducibility of valve performance.
- (e) Mechanical characteristics of the valves determined by seeing or hearing such as—
 - (i) ability to re-seat satisfactorily; and
 - (ii) absence or presence of chatter, flutter, sticking, or harmful vibration.
- (f) Relieving pressure.
- (g) Lift.
- (h) Discharge capacity.

3.6.2 Testing of valves

The tests to determine the operating characteristics shall be in accordance with Clause 3.7, and the tests to determine the flow characteristics shall be in accordance with Clause 3.8.

The lift of Class B valves under operating conditions shall be measured in accordance with Clause 3.9.

Where these tests are carried out separately, the parts of the valve which influence fluid flow shall be complete and installed in the valve.

3.6.3 Coefficient of discharge

The theoretical discharge capacity is calculated from the relevant equation in Appendix F, and from this value, together with the actual discharge capacity at relieving pressure, the coefficient of discharge (α) of the safety valve is calculated.

3.6.4 Design changes

Where changes are made in the design of a safety valve in such a manner as to affect the flow path, lift, or performance characteristics of the valve, new tests shall be carried out in accordance with Clauses 3.7 and 3.8.

3.6.5 Records of test

A data sheet shall be completed for each valve submitted for test and shall record the relevant information set out in a form.

NOTE: A suitable form is shown in Appendix B.

3.7 TESTS TO DETERMINE OPERATING CHARACTERISTICS

3.7.1 Test equipment

The error of pressure-measuring equipment used during the test shall be not more than 0.5 percent of full scale reading, with the test pressure within the middle third of the instrument range.

3.7.2 Valves used in the test programme

The safety valves tested shall be representative of the design, pressure, and size range of valves for which operating characteristics are required.

Tests shall be carried out on three sizes unless the size range contains not more than six sizes. In this case the number tested may be reduced to two.

Where the range is extended so that the previously tested safety valves are no longer representative of the range, further tests shall be required.

3.7.3 Test procedure

The tests shall be carried out using three significantly different springs for each size of valve. Where three test pressures are required from one valve size, this may be achieved by testing either one valve with three different springs or three valves of the same size at three significantly different settings. Each test shall be carried out a minimum of three times in order to establish and confirm acceptable reproducibility of performance.

For valves of either novel or special design, or where one size only at one pressure rating is being manufactured, tests at that set pressure are permitted by agreement with the purchaser.

For valves of which one size only at various pressure ratings is being manufactured, tests shall be carried out using four different springs which shall cover the range of pressure for which the valve is to be used.

3.8 TESTS TO DETERMINE FLOW CHARACTERISTICS

3.8.1 Carrying out of tests

After operating characteristics of safety valves for steam service have been satisfactorily established using steam as the test fluid, steam, air, or other gas of known characteristics may be used as the fluid for flow characteristic tests. Further, where discharged quantities are being assessed using fluids other than steam, the valve disc shall be mechanically held at the same lift as that obtained with steam at the same overpressure.

3.8.2 Flow test equipment

The test equipment shall be designed and operated so that the actual test flowing capacity measurement shall be accurate to within ± 2 percent.

3.8.3 Valves used in the test programme

The safety valves tested shall be representative of the design, pressure, and size range of valves for which flow characteristics are required.

The valve configuration shall be the same as that used during the tests for operational characteristics. That is, the lift and, if a blowdown ring(s) is fitted, its position shall be the one(s) established for the particular size and overpressure during operational testing. Average values shall be used where the tolerances of Clause 3.4.2 have been met.

An optional method where curves of capacity versus valve absolute inlet pressure as a function of lift and blowdown ring position may be established. These curves may then be used to obtain the unique value desired based on the results of the operational testing.

3.8.4 Test procedure

The flow characteristic tests for determination of the coefficient of discharge shall be carried out at three different pressures for each of three sizes of a given valve design unless the size range contains not more than six sizes. In this case the number of sizes tested may be reduced to two.

A curve may be established for the coefficient of discharge versus valve lift at a given inlet pressure and, where applicable, the appropriate blowdown ring(s) position. Coefficients of discharge for intermediate positions of lift may be interpolated from this curve. Tests shall be conducted to establish the variation of the coefficient of discharge with inlet pressure and relevant position of blowdown ring(s). If no variation occurs, the curve may be used as described. However, if variation is noted, tests shall be carried out to establish additional curves for these variables.

For valves of either novel or special design of which one size only at various pressure ratings is being manufactured, tests shall be carried out at four different set pressures which shall cover the ranges of pressure for which the valve will be used or as determined by the limits of the test facility. The discharge capacities, as determined by these four tests, shall be plotted against the absolute inlet pressure and a straight line drawn through these four points and zero-zero. If all points do not lie within ± 5 percent of this line, additional testing shall be required until the line is established without ambiguity. For liquids, the capacities determined by the four tests shall be plotted on log-log paper against the differential (inlet pressure minus back pressure) test pressure, and a straight line drawn through these four points.

In all cases, the size and pressure range shall be representative of the design range within limits of the testing facility. In those cases where the size of the valve is greater than can be flow-tested at the test facility, the purchaser may consider the feasibility and opportunity of requiring one confirmatory flow test at the location of the installation.

However, three geometrically similar models of different sizes may be used to determine the coefficient of discharge. The proper function of at least one valve of the design to be certified shall be demonstrated by test.

In all the methods described for flow characteristics testing, all final results shall be within ± 5 percent of the average, or additional testing shall be required, until this criterion is met.

3.8.5 Adjustments during test

No adjustment to the valve shall be made during the test. Following any change or deviation of the test conditions, a sufficient period of time shall be allowed to permit the rate of flow, temperature, and pressure to reach stable conditions before readings are taken.

3.8.6 Records and test results

The test records shall include all observations, measurements, instrument readings and instrument calibration record (if required) for the objective(s) of the test. Original test records shall remain in the custody of the test establishment which conducted the test. Copies of all test records shall be furnished to each of the parties for the test. Corrections and corrected values shall be entered separately in the test record.

3.9 MEASUREMENT OF LIFT

3.9.1 Carrying out measurement

After the operating characteristics have been established the lift of Class B safety valves shall be measured under dynamic conditions. Steam, air, or other gas of known characteristics may be used as the fluid to achieve the lift of the valve. The lift measured shall correspond to h_L in the appropriate diagram of Figure 2.

3.9.2 Measuring equipment

The equipment used to measure the lift shall be designed so that the actual lift measurement shall be accurate to within ± 2 percent.

3.9.3 Valves used in measurement programme

The safety valves used for measurement of lift shall be representative of the design, pressure and size range of valves for which the discharge capacity is to be calculated.

The valve configuration shall be the same as that used during the tests for operational characteristics.

3.9.4 Measurement procedure

The lift shall be measured at three different relieving pressures for each of three sizes of a given valve design unless the size range contains not more than six sizes. In this case the number of sizes measured may be reduced to two.

For valves of either novel or special design of which one size only at various pressure ratings is being manufactured, tests shall be carried out at four different pressures which shall cover the ranges of pressure for which the valves will be used.

The measurement of lift shall be repeated three times for each pressure and the values shall be within ± 5 percent of the average or additional measurements shall be required.

3.9.5 Records

All values of lift measured and the corresponding relieving pressures shall be recorded, and the original records shall be retained by the test establishment. Copies of all test records shall be furnished to each of the parties for the test. Corrections and corrected values shall be entered separately in the test record.

3.10 RATED DISCHARGE CAPACITY

3.10.1 Class A valves

For Class A valves, the maximum rated discharge capacity which the manufacturer shall enter in the records required by Clause 2.5.6 shall be determined as follows:

- (a) For one valve only for service with the same fluid, set pressure, and overpressure as used in the test 100 percent of the measured capacity.
- (b) For a number of valves all of the same design and size for service with the same fluid, set pressure, and overpressure as used in the test 100 percent of the measured discharge of the valve giving the lowest value.
- (c) For a number of valves of identical design and size for service with the same fluid and at the same overpressure as used in the test, but set at different pressures within the range of pressures covered by the test..... 90 percent of the discharge capacity for the set pressure as obtained from the curve of measured capacities plotted against set pressures provided that such capacities from the test lie on a reasonably smooth curve.
- (d) For a range of valves all of the same geometric design for service with the same fluid and at the same overpressure as used in the test, but of varying sizes and at different set pressures within the range tested.....in accordance with the following procedure:
 - (i) The coefficient of discharge (α) for each of the nine valves tested shall be determined relevant to the test fluid and, from the results, an average value of α determined.
 - (ii) The rated discharge capacity shall be that calculated from the equations in Appendix F using a coefficient of discharge equal to 90 percent of the average value determined in Item (i).

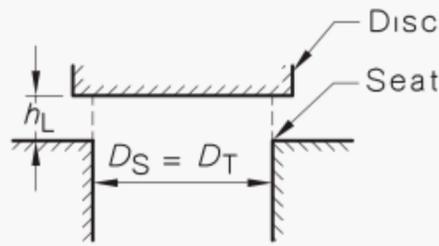
If the size or set pressure of a valve to be rated lies outside the range of sizes or set pressures tested, but the purchaser agrees that the overall results of the tests justify the necessary extrapolation, then the following apply:

- (A) For Item (d), the coefficient of discharge used shall be equal to 90 percent of the lowest value (in lieu of the average value) calculated from the tests.
- (B) For Item (c), and with the approval of the purchaser, a similar procedure to that of Item (d) may be used and applied to the lowest of the coefficients so obtained.

3.10.2 Class B valves

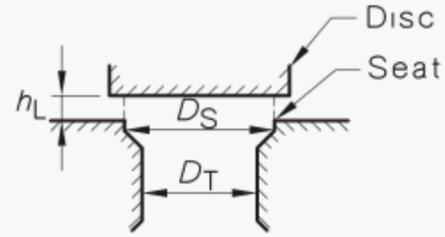
Class B valves, the maximum rated discharge capacity may be determined by the relevant equation in Appendix F using a value for coefficient of discharge (α) of—

- (a) for those valves whose discharge is unobstructed other than through the seat ... 0.5; or
- (b) for those valves which use any form of throttling or change of direction of the fluid to enhance lift0.4, and using a value (A) which is the lesser of the valve throat area and curtain area calculated in accordance with the relevant diagram in Figure 2 based on a value for lift (h_L) obtained by test.



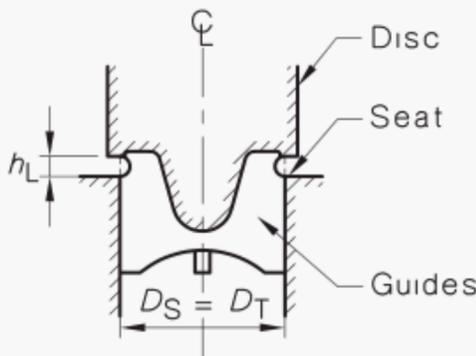
Seat and throat area = $\frac{\pi}{4} D_S^2$
 Curtain area = $\pi D_S h_L$

(a) Flat seat valve



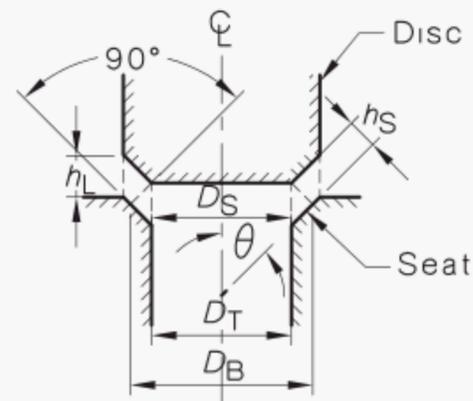
Seat area = $\frac{\pi}{4} D_S^2$
 Throat area = $\frac{\pi}{4} D_T^2$
 Curtain area = $\pi D_S h_L$

(b) Flat seat valve (restricted throat)



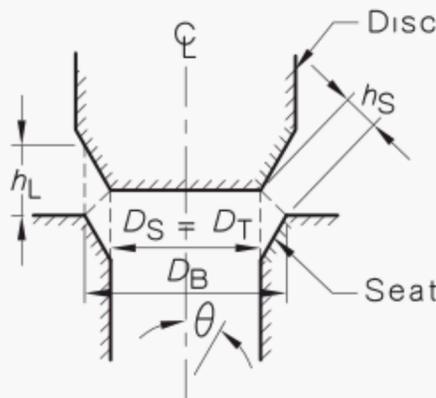
Seat and throat area = $\frac{\pi}{4} D_S^2$ - area obstructed by guides
 Curtain area = $\pi D_S h_L$

(c) Flat seat valves (restricting guides)



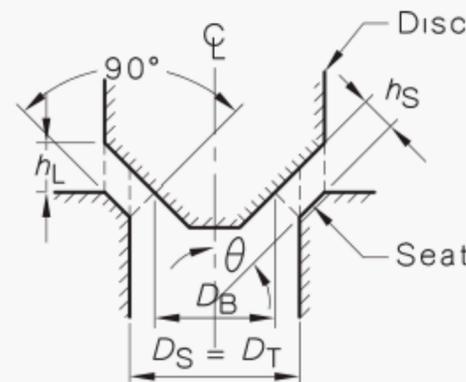
Seat area = $\frac{\pi}{4} D_S^2$
 Throat area = $\frac{\pi}{4} D_T^2$
 Curtain area = $\frac{\pi}{2} (D_S + D_B) h_S$

(d) Bevel seat valve ($D_T < D_S < D_B$)



Seat area = $\frac{\pi}{4} D_S^2$
 Curtain area = $\frac{\pi}{2} (D_S + D_B) h_S$

(e) Bevel seat valve ($D = D_T < D_B$)



Seat area = $\frac{\pi}{4} D_S^2$
 Curtain area = $\frac{\pi}{2} (D_S + D_B) h_S$

(f) Bevel seat valve ($D_B < D_S = D_T$)

LEGEND

- h_L = lift
- D_S = seat diameter, which is the smallest diameter of the disc which touches the seat
- D_T = throat diameter
- D_B = other diameter for determining curtain area
- h_S = slant height for determining curtain area
- θ = bevel seat angle

FIGURE 2 VALVE AREAS

The maximum rated discharge capacity which the manufacturer shall enter in the records required by Clause 2.5.6 shall be determined as follows:

- (i) For one valve only for service with the same fluid, at pressure, and overpressure as used in the test 100 percent of the calculated capacity.
- (ii) For a number of valves all of the same design and size for service with the same fluid, set pressure and overpressure as used in the test 100 percent of the capacity calculated by using the minimum lift (h_L) of the valves under test.
- (iii) For a number of valves of identical design and size where the lifts at the same percentage overpressure and at the various set pressures lie within 5 percent..... 90 percent of the value obtained at the desired set pressure using the average of the lifts of the valves under test.
- (iv) Where the ratio of the lifts to the throat diameters at the same percentage overpressure for the various set pressures and sizes lie within 10 percent and if the size and set pressure of the valve to be rated lies within the range of sizes and set pressures tested 90 percent of the value obtained at the desired set pressure using the average of the ratios of the lifts to the throat diameters.
- (v) If the size or set pressure of any valve to be rated lies outside the range of sizes and set pressures tested, but the purchaser agrees that the overall results of the tests justify the necessary extrapolation..... 90 percent of value obtained at the desired set pressure using the lowest value of the ratios of the lifts to the throat diameters obtained in the tests.

3.10.3 Pilot operation

Where a safety or relief valve incorporates pilot operation or other form of auxiliary assistance to lift, the records required by Clause 2.5.6 shall clearly state whether the rated discharge capacity entered therein is based on the pilot or auxiliary being in operation or not.

NOTE: AS/NZS 1200 provides that only the discharge capacity when the pilot mechanism or auxiliary is inoperative is permitted as part of the required relieving capacity on the protected equipment.

SECTION 4 LIQUID RELIEF VALVES

4.1 GENERAL

A liquid relief valve shall comply with the construction requirements for a safety valve, except that requirements for capacity testing may not apply.

NOTE: The purchaser may specify capacity testing if required.

Safety relief valves shall be used to protect pressurized systems where a liquid is maintained above its atmospheric flash temperature, as in the case of a high pressure hot water heating system.

The inclusion or exclusion of certain features, e.g. easing gear and blowdown rings, may be determined from the relevant application.

4.2 RATED DISCHARGE CAPACITY

The maximum rated discharge capacity, which the manufacturer shall enter in the records required by Clause 3.6.5, shall be either—

- (a) 90 percent of the measured capacity; or
- (b) 90 percent of the calculated capacity using a coefficient of discharge (α) of 0.64.

A coefficient of discharge (α) of 0.62 shall be used for an overpressure of 25%. For lower overpressures correction, factors as provided by the manufacturer shall be applied, or reference made to API RP520, Part 1.

SECTION 5 LIQUID LEVEL GAUGES

5.1 SCOPE OF SECTION

This Section specifies the minimum requirements for direct vision liquid level gauges of the tubular type or plate type fitted to boilers and pressure vessels.

5.2 MOUNTINGS

The mountings of a direct-vision liquid level gauge and its valves shall be of substantial construction with large passageways through them, preferably not less than 6 mm diameter. In addition, they should be of such construction that a cleaning instrument can be passed through the openings.

5.3 GAUGE GLASSES

No tubular gauge shall be less than 12 mm or more than 20 mm outside diameter, or less than 6 mm inside diameter. All direct-vision liquid level gauges glasses shall comply with BS 3463.

5.4 DRAIN

A drain cock or valve shall be fitted to each direct-vision liquid level gauge.

5.5 COCK HANDLES

Any gauge cock plug shall be plainly marked with a deep line to indicate the direction of the passageway through the plug, and the handle shall lie perpendicular to this line and to the direction of flow. Where a handle is detachable, provision shall be made to prevent incorrect alignment with the plug.

5.6 GUARDS

Each tubular liquid level gauge shall be of such construction that a suitable guard can be fitted to it.

5.7 SAFETY DEVICES

Water level gauges fitted to boilers complying with AS 2593, except where exempted, shall have self-closing safety devices fitted to prevent the escape of both steam and water from a ruptured glass. The following requirements are mandatory:

- (a) The automatic shut-off device shall be of the solid non-corrodible metal ball type to avoid the need for guides.
- (b) The check ball shall open by gravity.
- (c) The check ball shall be not smaller than 12 mm diameter, and the diameter of the circle of contact with the seat shall be not greater than 67 percent of the diameter of the check ball.
- (d) The radial clearance around each ball shall be not less than 3 mm, and the travel movement from the normal resting place to the seat shall be not less than 6 mm.
- (e) The ball seat shall be flat with either a square or a hexagonal opening, or be otherwise arranged so that the steam passage can never be completely closed by the valve.
- (f) The gauge valve in the steam end shall have a projection or other device which holds the ball not less than 6 mm from its seat when the gauge valve is closed.

5.8 CONNECTION TO PRESSURE VESSEL

A liquid level gauge connected to a pressure vessel having a design pressure exceeding 750 kPa shall have a flanged connection to gas or vapour and liquid ends or, for steel fittings, either flanged or welded.

For a design pressure of 750 kPa and below, the connection may be screwed.

SECTION 6 BLOWDOWN VALVES

6.1 DESIGN

A blowdown valve shall be of substantial construction and suitable for handling liquid containing scale or sediment. Grey iron castings or low ductile grades of spheroidal graphite iron castings shall not be used in construction of any blowdown valve.

No blowdown valve shall incorporate an internally screwed stem.

6.2 OPERATION

Each valve shall be fitted with a device which shall indicate clearly its open and closed positions. The key or similar device for operating the valve shall be of such construction that it cannot be removed unless the valve is fully closed.

APPENDIX A
 MINIMUM THICKNESS OF SAND-CAST VALVES
 AND OTHER FITTINGS

(Normative)

TABLE A1
MINIMUM THICKNESS OF CAST IRON VALVES
(SAND-CAST)

Inlet size	Minimum thickness, mm	
	Design pressure ratings at atmospheric temperature, MPa	
mm	≤1.4	>1.4 ≤1.8
≤20	6	6
>20 ≤25	6	8
>25 ≤40	8	10
>40 ≤65	10	11
>65 ≤80	11	12
>80 ≤100	13	13
>100 ≤150	14	16
>150 ≤200	16	17
>200 ≤250	19	21
>250 ≤300	21	22
>300 ≤350	22	25
>350 ≤400	24	27
>400 ≤450	27	32
>450 ≤500	29	35
>500 ≤600	32	38

NOTES:

- 1 Inlet sizes indicated in this Table should not be taken as being a recommended size series.
- 2 Minimum thickness for intermediate inlet sizes may be interpolated.

TABLE A2
MINIMUM THICKNESS OF CARBON STEEL VALVES (SAND-CAST)

Inlet size mm	Minimum thickness, mm							
	Design pressure ratings at atmospheric temperature, MPa							
	≤1.4	>1.4 ≤2	>2 ≤3.5	>3.5 ≤5	>5 ≤6	>6 ≤8	>8 ≤12	>12 ≤21
≤25	6	6	8	8	8	8	10	11
>25 ≤32	6	6	8	8	9	9	10.5	12
>32 ≤40	7	7	8	8	10	10	11	13
>40 ≤50	9	9	10	10	11	11	13	16
>50 ≤65	10	10	11	11	12	12	14	19
>65 ≤80	10.5	10.5	12	12	13	13	16	21
>80 ≤100	11	11	13	13	14	16	19	24
>100 ≤150	12	13	14	16	17	19	22	30
>150 ≤200	13	14	16	17	19	22	28	38
>200 ≤250	14	16	17	19	21	25	33	44
>250 ≤300	16	17	18	21	24	27	38	50
>300 ≤350	17	18	19	22	25	30	41	55
>350 ≤400	17	19	21	22	27	32	44	59
>400 ≤450	18	21	22	25	30	36	50	70
>450 ≤500	20	21	23	27	33	41	57	80
>500 ≤600	21	22	25	30	36	44	64	89

NOTES:

- 1 Inlet sizes indicated in this Table should not be taken as being a recommended size series.
- 2 Minimum thickness for intermediate inlet sizes may be interpolated.

TABLE A3
MINIMUM THICKNESS OF COPPER ALLOY VALVES (SAND-CAST)

1	2	3	4				5			8	9	
			Valve size		Capillary and compression ends		Minimum wall thickness mm					
Flanged ends	Threaded	Inches	mm	PN 16	PN 20	PN 25	PN 32	PN 40	PN 16	PN 25	PN 40	Maximum wall thickness for valves having capillary or compression ends mm
—	1/4	8	1.5	1.6	1.7	1.8	2.0	2.0	—	—	—	1.5
10	3/8	10.12	1.6	1.7	1.8	1.9	2.1	2.1	—	—	—	1.6
15	1/2	15, 16, 18	1.7	1.8	1.9	2.1	2.4	2.4	—	—	—	1.7
20	3/4	20, 22, 25	1.8	2.0	2.1	2.3	2.6	2.6	—	—	—	1.8
25	1	28, 30	2.0	2.1	2.4	2.6	3.0	3.0	—	—	—	2.0
32	1 1/4	35, 38	2.2	2.4	2.6	3.0	3.4	3.4	—	—	—	2.2
40	1 1/2	42	2.3	2.5	2.8	3.2	3.7	3.7	—	—	—	2.3
50	2	54	2.5	2.8	3.2	3.7	4.3	4.3	—	—	—	2.5
65	2 1/2	67	2.8	3.2	3.7	4.3	5.1	5.1	—	—	—	2.8
80	3	—	3.1	3.6	4.1	4.8	5.7	5.7	—	—	—	—
100	4	—	3.5	4.0	4.6	5.4	6.4	6.4	—	—	—	—

NOTES:

- 1 The purpose of Table A3 is to indicate only the minimum wall thickness appropriate to the valve size and pressure designation.
- 2 Minimum thicknesses for intermediate inlet sizes may be determined by interpolation.
- 3 See Clause 2.3.3 for minimum thickness of neck.
- 4 PN reference in Columns 4 to 8 to be considered with pressure class of valve.

APPENDIX B
 PROPOSED TEST REPORT FOR SAFETY VALVE
 (Informative)

Valve identification

- 1 Valve manufacturer's name Address
- 2 Manufacturer's type or style No. Serial No.....

Description of valve under test

- 3 Inlet nominal boremm
 Screwed (..... thread type); Flanged (..... Designation); weld end ()
- 4 Outlet nominal bore..... mm
 Screwed (.....thread type); Flanged (..... Designation); weld end ()
- 5 Nozzle throat diameter mm
- 6 Seat: Inside diameter
 Flat/Bevel (cross out one); Bevel seal angle (deg)
- 7 Spring: Inside/outside diameter mm
- 8 Spring rate..... newton/mm
- 9 Free length mm
- 10 Materials: Body Seat
- Disc Spring.....
- 11 Mass of completely assembled valve (kg)
- 12 Manufacturer's drawing(s) Note(s).....

Description of capacity test

- 13 Place of test Date of test.....
- 14 Test conducted by.....
- 15 Representatives of interested parties.....
- 16 Fluid used in test
- (For steam state if dry or saturated, or percentage of moisture)*
- 17 Flow measured by: weighted condensation/flowmeter (cross out one).

Set pressure tests results

- 18 Pressure set (MPa) Opening..... (MPa) Reseating..... (MPa)
- 19 Blowdown..... (MPa) or (%)

Discharge capacity test results

- 20 Actual discharge capacity by test (kg/h) at (MPa)
-

* If steam is used for tests, it is recommended that it should be dry saturated. However if superheated steam is used, the temperature is to be stated.

21 Is test capacity with pilot valve or another indirect control operation?

(See Clause 3.10.3)

22 Lift (at test discharge capacity)..... (mm)

23 Valve inlet pressure (MPa)

24 Valve inlet temperature (°C)

Computed capacity of valve¹

25 Area through valve: Curtain..... (mm²) Seat..... (mm²) Throat (mm²)

26 Theoretical discharge capacity (kg/h)

27 Coefficient of discharge (α)

Observed mechanical characteristics

28 Does valve chatter? Does valve flutter?.....

29 Does valve stem leak Was valve stem leakage measured?

We declare the above data to be correct and that it complies with all aspects of AS 1271.

Signed:..... Date:.....
 (Manufacturer's representative)

Signed: Date:.....
 (Inspector)

NOTE: Convenient multiples of any unit may be used, provided that the values of the multiples are clearly stated, e.g. pressure may be expressed in kilopascals or megapascals as convenient.

It should be noted that the above form relates to a test on a single valve at a single set pressure and does not itself provide the data for a rated discharge capacity except on the individual valve concerned.

The determination of rated capacity requires the correlation of test results as above on the necessary number of valves or set pressures. A declaration of rated capacity should be set out in accordance with Appendix C.

Should it be desired to adopt Class B certification in accordance with Appendix D, then the above form with the deletion of Items 15 and 18 may be used for tests on the relevant number of valves and set pressures.

APPENDIX C
FORM FOR CERTIFICATE—CLASS A SAFETY VALVES
(Informative)

This safety valve marked:

Maker's name, trade name or trademark

Model No.

Serial No.

is of a design which has been the subject of tests with.....
(fluid)

in accordance with Australian Standard AS 1271 for Class A safety valves, resulting in a coefficient of discharge of for that fluid. When fitted with spring No..... with a spring rate of newton/mm, and a free length of mm, it has a lift of at least mm and a minimum discharge area ofmm², and consequently a rated discharge capacity at a set pressure ofand an overpressure of percent of of at°C.
(quantity) (unit) (fluid)

The set pressure of this valve may be adjusted within the limits of MPa and..... MPa but any such adjustment will invalidate the rated discharge capacity stated above.

Name (Print).....
(Manufacturer's representative)

Signed:..... Date:
(Manufacturer's representative)

NOTE: Where the valve incorporates pilot operations or any form of auxiliary assistance to lift, the following should be added to the certificate:

This valve incorporates (description of such auxiliary equipment) and the rated discharge capacity stated above is based on auxiliary equipment being in operation (or not in operation, as appropriate).

APPENDIX D
FORM FOR CERTIFICATE—CLASS B SAFETY VALVES
(Informative)

This safety valve marked:

Maker's name, trade name or trademark

Model No.

Serial No.

is of a design which has been the subject of tests with
(fluid)

in accordance with Australian Standard AS 1271 for Class B safety valves. When fitted with spring No. with a spring rate of newton/mm and a free length ofmm, it has a lift of at leastmm and a minimum discharge area of mm².

Application of coefficient of discharge of* results in a rated discharge

Capacity at a set pressure ofand an overpressure of %

Of..... of at.....°C.
(quantity) (units) (fluid)

The set pressure of this valve may be adjusted within the limits of MPa and MPa but any such adjustment will invalidate the rated discharge capacity stated above.

Name (Print).....
(Manufacturer's representative)

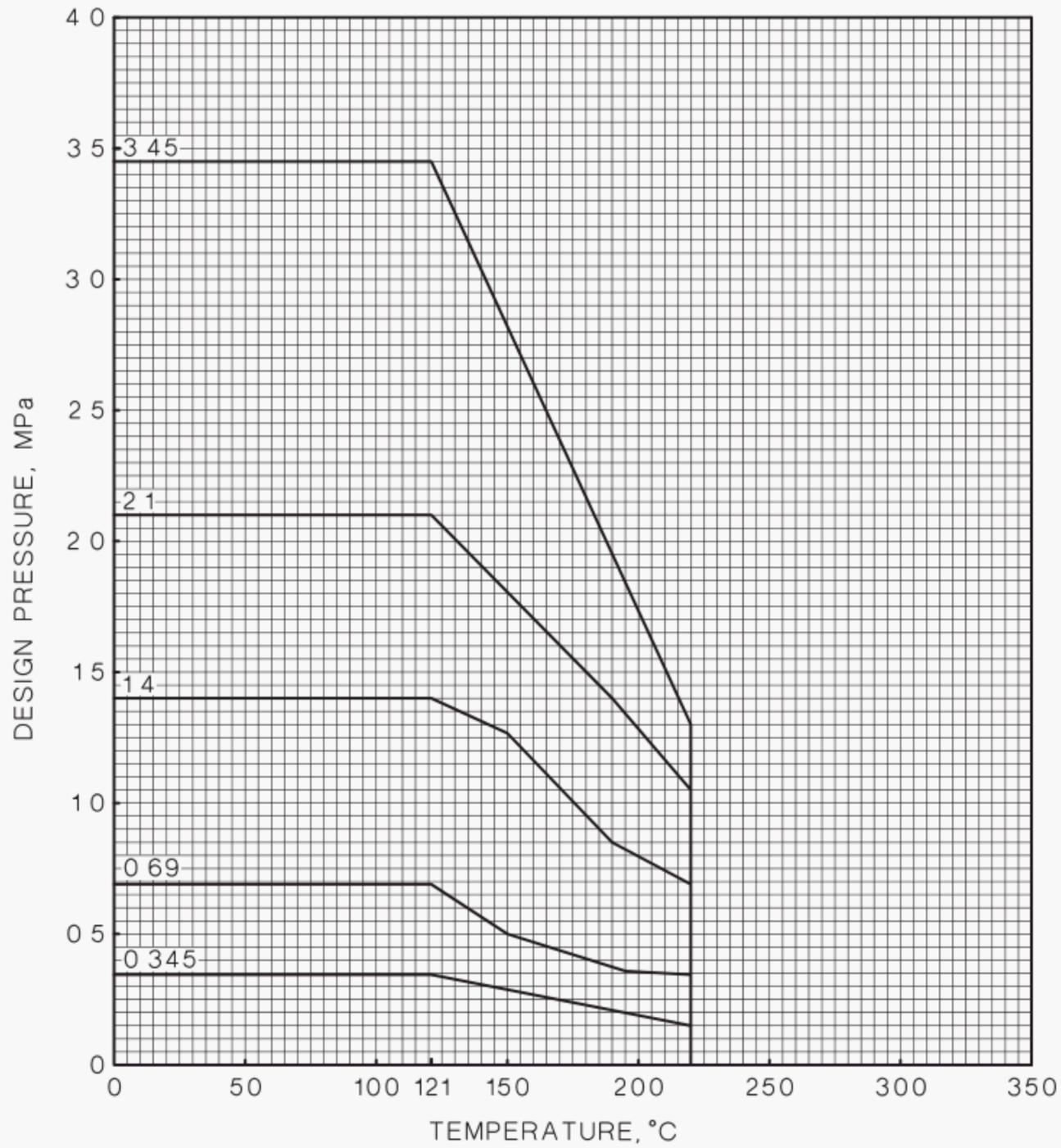
Signed:..... Date:.....
(Manufacturer's representative)

NOTE: Where the valve incorporate pilot operation or any form of auxiliary assistance to lift, the following should be added to the certificate:

This value incorporates (description of such auxiliary equipment) and the rated discharge capacity stated above is based on auxiliary equipment being in operation (or not in operation as appropriate).

* See Clause 3.10.2.

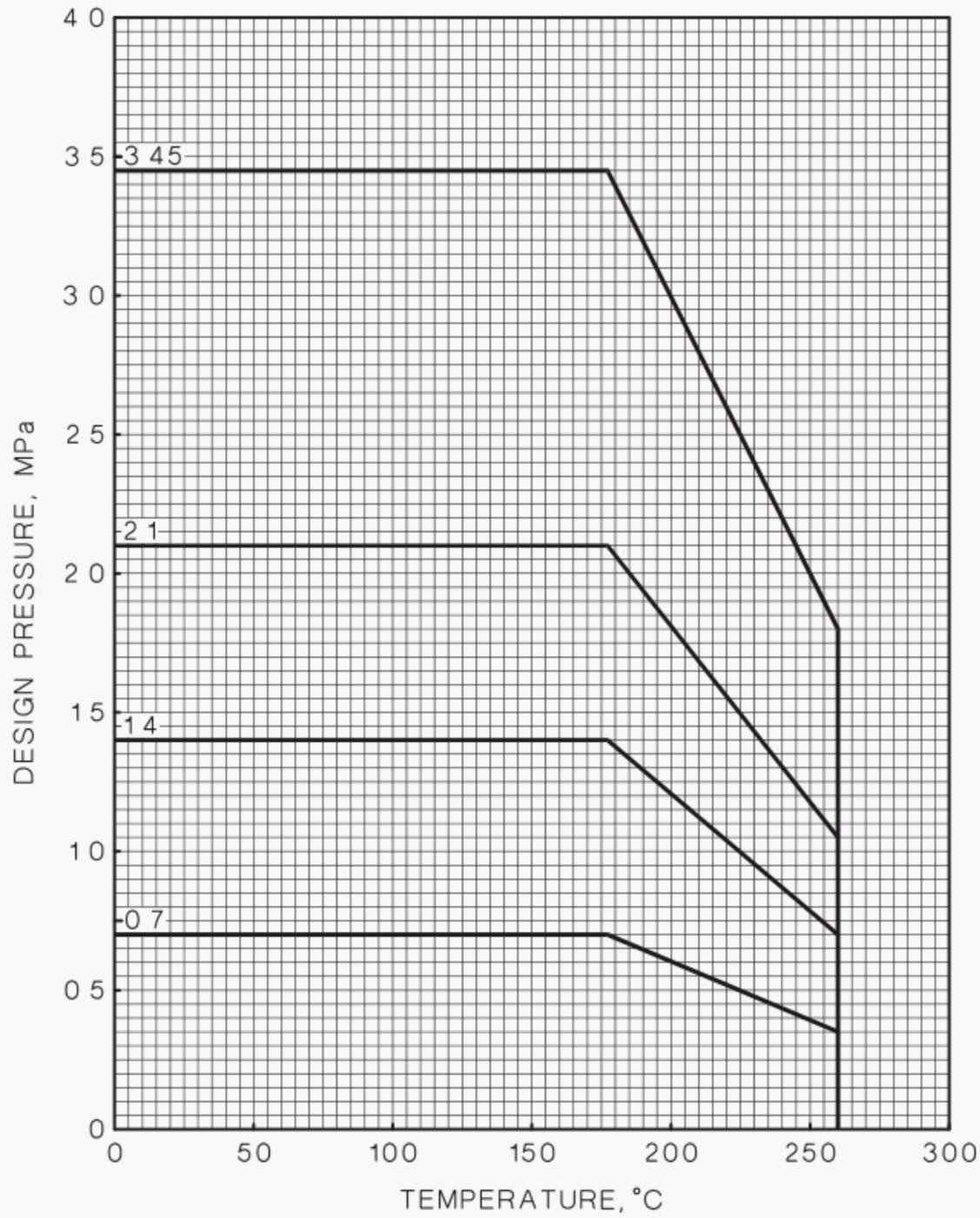
APPENDIX E
PRESSURE/TEMPERATURE TRANSFER CURVE
(Informative)



Example:

A valve which has a rating of 2.1 MPa at atmospheric temperature could (subject to any temperature limitation on body or trim materials) also be used at 220°C by reducing pressure to 1.05 MPa.

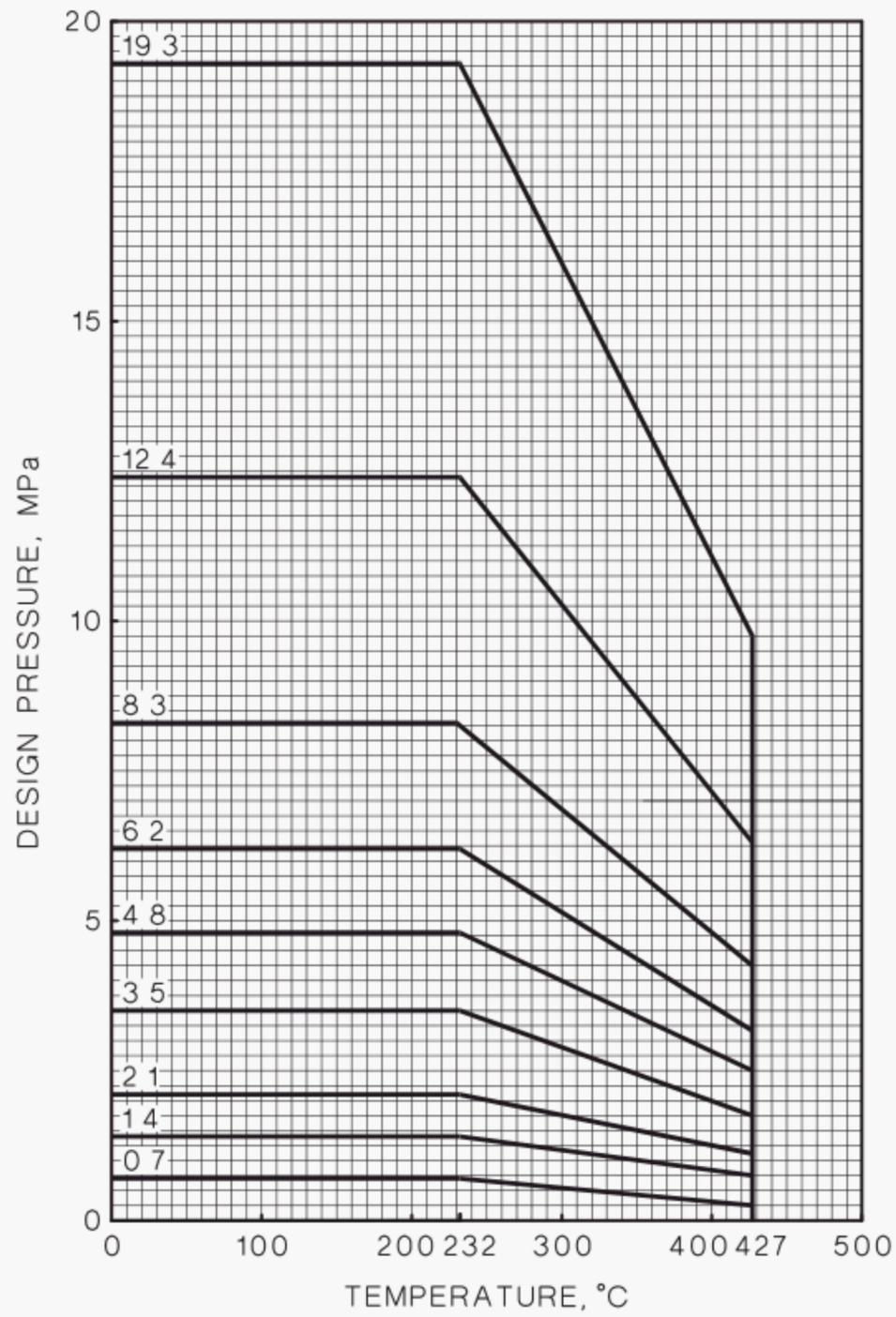
FIGURE E1 PRESSURE/TEMPERATURE TRANSFER CURVES FOR GREY CAST
MALLEABLE CAST IRON



Example:

A valve which has a rating of 2.1 MPa at atmospheric temperature could (subject to any temperature limitation on body or trim materials) also be used at 260°C by reducing pressure to 1.05 MPa.

FIGURE E2 PRESSURE/TEMPERATURE TRANSFER CURVES FOR COPPER AND COPPER ALLOYS



Example:

A valve which has a rating of 4.8 MPa at atmospheric temperature could (subject to any temperature limitation on body or trim materials) also be used at 427°C by reducing pressure to 2.5 MPa.

FIGURE E3 PRESSURE/TEMPERATURE TRANSFER CURVES FOR CAST CARBON STEEL

APPENDIX F
DISCHARGE CAPACITY
(Normative)

F1 SCOPE

This Appendix sets out equations for the calculation of the discharge capacity of a discharge system for single-phase flow.

F2 COEFFICIENT OF DISCHARGE (α)

This coefficient of discharge (α) of a discharge system is the ratio of the measured discharge capacity to the theoretical discharge capacity, i.e:

$$\text{Coefficient of discharge } (\alpha) = \frac{\text{Measured discharge capacity}}{\text{Theoretical discharge}} \quad \dots \text{ (F1)}$$

Where the coefficient of discharge of a discharge system is not known, the value of α to be used in any calculation of discharge capacity may be obtained from the appropriate application Standard or regulations applicable to the system to be protected.

F3 DISCHARGE CAPACITY FOR STEAM

The discharge capacity (q_m) for steam shall be calculated from the following equations:

- (a) *For dry saturated steam* (Dry saturated steam refers to steam with a minimum dryness of 99 percent or a maximum degree of superheat of 10°C):

For applications of 0.1 MPa up to and including 11 MPa:

$$q_m = 5.25 \alpha A p \quad \dots \text{ (F2)}$$

For applications over 11 MPa and up to 22 MPa:

$$q_m = 5.25 \alpha A p \left(\frac{27.644 p - 1000}{33.242 p - 1061} \right) \quad \dots \text{ (F3)}$$

- (b) *For superheated steam* (Superheated steam refers to steam with a degree of superheat greater than 10°C):

For applications of 0.1 MPa up to and including 11 MPa:

$$A1 \quad q_m = 5.25 \alpha A p K_{sh} \quad \dots \text{ (F4)}$$

For applications over 11 MPa and up to 22 MPa:

$$A1 \quad q_m = 5.25 \alpha A p \left(\frac{27.644 p - 1000}{33.242 p - 1061} \right) K_{sh} \quad \dots \text{ (F5)}$$

where

q_m = discharge capacity, in kilograms per hour

α = coefficient of discharge

A1 | p = actual relieving pressure, in megapascals absolute

K_{sh} = superheat correction factor (see Table F1)

A1 | A = minimum flow area through discharge systems, in square millimetres

TABLE F1
SUPERHEAT CORRECTION FACTOR (K_{SH})

Pressure MPa abs.	Saturation temperature °C	Inlet temperature, °C																								
		150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
0.2	120	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89	0.89	0.88	0.87	0.86	0.85	0.84	0.83	0.83
0.3	133	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89	0.89	0.88	0.87	0.86	0.85	0.84	0.84	0.83
0.4	144	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89	0.89	0.88	0.87	0.86	0.85	0.84	0.84	0.83
0.5	152	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89	0.89	0.88	0.87	0.86	0.85	0.84	0.84	0.83
0.6	159	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89	0.89	0.88	0.87	0.86	0.85	0.84	0.84	0.83
0.7	165		1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.92	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.84	0.83
0.8	170		1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99	0.97	0.96	0.95	0.94	0.93	0.92	0.92	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.84	0.83
0.9	175			1.00	1.00	1.00	1.00	0.99	0.98	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.92	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.84	0.83
1.0	180			1.00	1.00	1.00	1.00	0.99	0.98	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.92	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.84	0.83
1.1	184				1.00	1.00	1.00	0.99	0.99	0.99	0.97	0.96	0.95	0.94	0.93	0.92	0.92	0.90	0.89	0.89	0.88	0.87	0.86	0.85	0.84	0.83
1.2	188				1.00	1.00	1.00	0.99	0.99	0.99	0.98	0.97	0.95	0.94	0.93	0.92	0.92	0.90	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.83
1.3	192					1.00	1.00	0.99	0.99	0.99	0.98	0.97	0.96	0.94	0.93	0.92	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.83
1.4	195						1.00	0.99	0.99	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.83
1.5	198							1.00	0.99	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.84
1.6	201								1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.84
1.7	204									1.00	0.99	0.98	0.97	0.96	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.84
1.8	207										1.00	0.99	0.98	0.96	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.84
1.9	210											1.00	0.99	0.98	0.95	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84	0.84
2.0	212												1.00	0.99	0.98	0.95	0.93	0.92	0.91	0.89	0.88	0.87	0.86	0.85	0.84	0.84

(continued)

TABLE F1 (continued)

Pressure MPa abs.	Saturation temperature °C	Inlet temperature, °C																								
		150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
2.1	215									1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.85	0.84
2.2	217									1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.85	0.84
2.3	220									1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84
2.4	222									1.00	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84
2.6	226									1.00	0.99	0.98	0.97	0.95	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.87	0.86	0.85	0.84
2.8	230									1.00	0.99	0.99	0.97	0.96	0.95	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.87	0.86	0.85	0.84
3.0	234										0.99	0.99	0.98	0.96	0.95	0.94	0.93	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.85	0.84
3.2	237										1.00	0.99	0.98	0.96	0.95	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.84
3.4	241										1.00	0.99	0.98	0.97	0.95	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.85	0.84
3.6	244											1.00	0.98	0.97	0.96	0.95	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.86	0.84
3.8	247											1.00	0.99	0.97	0.96	0.95	0.94	0.93	0.91	0.90	0.89	0.88	0.87	0.86	0.85	0.85
4.0	250											1.00	0.99	0.98	0.97	0.95	0.94	0.93	0.92	0.90	0.89	0.88	0.87	0.86	0.85	0.85
4.2	253												0.99	0.98	0.97	0.96	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85
4.4	256												0.99	0.98	0.97	0.96	0.94	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85
4.6	259												1.00	0.99	0.97	0.96	0.95	0.94	0.92	0.91	0.90	0.89	0.88	0.87	0.86	0.85
4.8	261												1.00	0.99	0.98	0.97	0.95	0.94	0.93	0.92	0.90	0.89	0.88	0.87	0.86	0.86
5.0	264													0.99	0.98	0.97	0.95	0.94	0.93	0.92	0.91	0.89	0.88	0.87	0.86	0.86
5.2	266													0.99	0.98	0.97	0.96	0.94	0.93	0.92	0.91	0.90	0.88	0.87	0.86	0.86
5.4	269													1.00	0.99	0.97	0.96	0.95	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.86
5.6	271													1.00	0.99	0.98	0.96	0.95	0.94	0.92	0.91	0.90	0.89	0.88	0.87	0.86
5.8	273														0.99	0.98	0.96	0.95	0.94	0.92	0.91	0.90	0.89	0.88	0.87	0.86

(continued)

TABLE F1 (continued)

Pressure MPa abs.	Saturation temperature °C	Inlet temperature, °C																								
		150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
6.0	276														0.99	0.98	0.97	0.95	0.94	0.93	0.92	0.90	0.89	0.88	0.87	0.86
6.2	278														0.99	0.99	0.97	0.96	0.94	0.93	0.92	0.91	0.90	0.88	0.87	0.87
6.4	280														1.00	0.99	0.97	0.96	0.95	0.94	0.92	0.91	0.90	0.89	0.88	0.87
6.6	282															0.99	0.97	0.96	0.95	0.94	0.92	0.91	0.90	0.89	0.88	0.87
6.8	284															0.99	0.98	0.96	0.95	0.94	0.93	0.91	0.90	0.89	0.88	0.87
7.0	286															0.99	0.98	0.97	0.95	0.94	0.94	0.92	0.90	0.89	0.88	0.87
7.5	290															1.00	0.99	0.97	0.96	0.95	0.94	0.92	0.91	0.90	0.89	0.88
8.0	295																0.99	0.98	0.96	0.96	0.94	0.93	0.91	0.91	0.91	0.88
8.5	299																1.00	0.98	0.97	0.96	0.95	0.93	0.92	0.91	0.90	0.88
9.0	303																	0.99	0.98	0.97	0.96	0.94	0.93	0.91	0.90	0.89
9.5	307																	0.99	0.98	0.97	0.97	0.95	0.93	0.92	0.90	0.89
10.0	311																	1.00	0.99	0.97	0.97	0.96	0.94	0.92	0.91	0.90
10.5	314																		0.99	0.98	0.97	0.97	0.95	0.93	0.92	0.90
11.0	318																		1.00	0.98	0.98	0.97	0.95	0.94	0.92	0.91
11.5	321																		1.00	0.98	0.98	0.97	0.96	0.94	0.92	0.91
12.0	324																			0.99	0.98	0.97	0.96	0.94	0.92	0.91
12.5	327																			0.99	0.98	0.97	0.97	0.95	0.93	0.91
13.0	333																				0.99	0.97	0.96	0.95	0.93	0.91
14.0	336																				0.99	0.97	0.96	0.96	0.93	0.91
14.5	339																				1.00	0.98	0.96	0.96	0.94	0.92
15.0	342																				1.00	0.98	0.96	0.96	0.94	0.92

(continued)

TABLE F1 (continued)

Pressure MPa abs.	Saturation temperature °C	Inlet temperature, °C																								
		150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390
15.5	344																					0.99	0.97	0.96	0.94	0.92
16.0	347																					1.00	0.97	0.95	0.95	0.92
16.5	350																						0.97	0.95	0.95	0.92
17.0	352																						0.97	0.95	0.95	0.92
17.5	354																						0.98	0.95	0.94	0.93
18.0	357																						0.99	0.95	0.94	0.93
18.5	359																						1.00	0.96	0.94	0.93
19.0	361																						1.00	0.96	0.94	0.93
19.5	364																							0.96	0.94	0.92
20.0	366																							0.97	0.93	0.92
20.5	368																							0.98	0.93	0.92
21.0	370																							1.00	0.93	0.91
21.5	372																								0.94	0.91
22.0	374																								0.94	0.94

(continued)

TABLE F1 (continued)

Pressure MPa abs.	Saturation temperature °C	Inlet temperature, °C																									
		400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600	610	620	630	640	
0.2	120	0.82	0.82	0.81	0.80	0.80	0.79	0.79	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
0.3	133	0.82	0.82	0.81	0.80	0.80	0.79	0.79	0.78	0.78	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
0.4	144	0.82	0.82	0.81	0.80	0.80	0.79	0.79	0.78	0.78	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
0.5	152	0.82	0.82	0.81	0.80	0.80	0.79	0.79	0.78	0.78	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
0.6	159	0.82	0.82	0.81	0.80	0.80	0.79	0.79	0.78	0.78	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
0.7	165	0.82	0.82	0.81	0.80	0.80	0.79	0.79	0.78	0.78	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
0.8	170	0.82	0.82	0.81	0.80	0.80	0.79	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
0.9	175	0.83	0.82	0.81	0.80	0.80	0.79	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
1.0	180	0.83	0.82	0.81	0.80	0.80	0.79	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
1.1	184	0.83	0.82	0.81	0.80	0.80	0.79	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
1.2	188	0.83	0.82	0.81	0.81	0.80	0.79	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
1.3	192	0.83	0.82	0.81	0.81	0.80	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
1.4	195	0.83	0.82	0.81	0.81	0.80	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
1.5	198	0.83	0.82	0.81	0.81	0.80	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
1.6	201	0.83	0.82	0.82	0.81	0.80	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
1.7	204	0.83	0.82	0.82	0.81	0.80	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.70	0.70	
1.8	207	0.83	0.82	0.82	0.81	0.80	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.72	0.71	0.71	0.70	0.70
1.9	210	0.83	0.82	0.82	0.81	0.80	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.72	0.71	0.71	0.70	0.70
2.0	212	0.83	0.82	0.82	0.81	0.80	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.72	0.71	0.71	0.70	0.70

(continued)

TABLE F1 (continued)

Pressure MPa abs.	Saturation temperature °C	Inlet temperature, °C																							
		400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600	610	620	630
2.1	215	0.83	0.82	0.82	0.82	0.80	0.80	0.79	0.78	0.78	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.72	0.71	0.71	0.70
2.2	217	0.83	0.83	0.82	0.82	0.80	0.80	0.79	0.78	0.78	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.72	0.71	0.71	0.70
2.3	220	0.84	0.83	0.82	0.82	0.80	0.80	0.79	0.78	0.77	0.77	0.77	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.72	0.71	0.71	0.70
2.4	222	0.84	0.83	0.82	0.82	0.80	0.80	0.79	0.78	0.77	0.77	0.77	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.72	0.71	0.71	0.70
2.6	226	0.84	0.83	0.82	0.82	0.81	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.74	0.74	0.73	0.73	0.73	0.72	0.72	0.71	0.71	0.70
2.8	230	0.84	0.83	0.82	0.82	0.81	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.73	0.73	0.73	0.72	0.72	0.71	0.71	0.70
3.0	234	0.84	0.83	0.82	0.82	0.81	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.73	0.73	0.73	0.72	0.72	0.71	0.71	0.70
3.2	237	0.84	0.83	0.82	0.82	0.81	0.80	0.79	0.79	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.70
3.4	241	0.84	0.83	0.82	0.82	0.81	0.80	0.80	0.79	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.70
3.6	244	0.84	0.83	0.83	0.82	0.81	0.81	0.80	0.79	0.78	0.77	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.70
3.8	247	0.84	0.83	0.83	0.82	0.81	0.81	0.80	0.79	0.78	0.78	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.70
4.0	250	0.84	0.83	0.83	0.82	0.81	0.81	0.80	0.79	0.78	0.78	0.77	0.76	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.70
4.2	253	0.84	0.84	0.83	0.82	0.81	0.81	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
4.4	256	0.84	0.84	0.83	0.82	0.81	0.81	0.80	0.80	0.79	0.78	0.77	0.77	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
4.6	259	0.85	0.84	0.83	0.82	0.82	0.81	0.80	0.80	0.79	0.78	0.77	0.77	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
4.8	261	0.85	0.84	0.83	0.82	0.82	0.81	0.80	0.80	0.79	0.78	0.77	0.77	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
5.0	264	0.85	0.84	0.83	0.83	0.82	0.81	0.80	0.80	0.79	0.79	0.78	0.77	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
5.2	266	0.85	0.84	0.83	0.83	0.82	0.81	0.81	0.80	0.79	0.79	0.78	0.77	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
5.4	269	0.85	0.84	0.84	0.83	0.82	0.81	0.81	0.80	0.79	0.79	0.78	0.77	0.76	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71

(continued)

TABLE F1 (continued)

Pressure MPa abs.	Saturation temperature °C	Inlet temperature, °C																								
		400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600	610	620	630	640
5.6	271	0.85	0.84	0.84	0.83	0.82	0.81	0.81	0.80	0.79	0.79	0.78	0.78	0.77	0.76	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
5.8	273	0.85	0.85	0.84	0.83	0.82	0.82	0.81	0.80	0.79	0.78	0.78	0.77	0.76	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71	0.71
6.0	276	0.85	0.85	0.84	0.83	0.82	0.82	0.81	0.80	0.79	0.78	0.78	0.77	0.76	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71	0.71
6.2	278	0.86	0.85	0.84	0.83	0.82	0.82	0.81	0.80	0.79	0.78	0.78	0.77	0.76	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71	0.71
6.4	280	0.86	0.85	0.84	0.83	0.83	0.82	0.81	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71	0.71
6.6	282	0.86	0.85	0.84	0.84	0.83	0.82	0.81	0.80	0.79	0.78	0.78	0.77	0.77	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71	0.71
6.8	284	0.86	0.85	0.84	0.84	0.83	0.82	0.81	0.81	0.80	0.79	0.79	0.78	0.77	0.76	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
7.0	286	0.86	0.85	0.84	0.84	0.83	0.82	0.81	0.81	0.80	0.79	0.79	0.78	0.77	0.76	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
7.5	290	0.87	0.85	0.85	0.84	0.83	0.82	0.81	0.81	0.80	0.79	0.79	0.78	0.78	0.77	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
8.0	295	0.87	0.86	0.85	0.84	0.83	0.83	0.82	0.81	0.80	0.80	0.79	0.78	0.78	0.77	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
8.5	299	0.87	0.86	0.85	0.84	0.83	0.83	0.82	0.81	0.81	0.80	0.79	0.78	0.78	0.77	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
9.0	303	0.88	0.87	0.86	0.84	0.84	0.83	0.82	0.81	0.81	0.80	0.79	0.78	0.78	0.77	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
9.5	307	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.82	0.81	0.80	0.80	0.79	0.78	0.78	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
10.0	311	0.88	0.87	0.86	0.85	0.85	0.84	0.83	0.82	0.81	0.80	0.80	0.79	0.78	0.78	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
10.5	314	0.89	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.81	0.81	0.80	0.79	0.78	0.78	0.77	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71
11.0	318	0.89	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.81	0.81	0.80	0.79	0.79	0.78	0.77	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71
11.5	321	0.89	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.81	0.81	0.80	0.79	0.78	0.78	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
12.0	324	0.89	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.81	0.81	0.80	0.79	0.78	0.78	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71
12.5	327	0.90	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.81	0.80	0.80	0.79	0.78	0.77	0.76	0.75	0.74	0.74	0.73	0.73	0.72	0.72	0.71	0.71	0.71

(continued)

TABLE F1 (continued)

Pressure MPa abs.	Saturation temperature °C	Inlet temperature, °C																								
		400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600	610	620	630	640
13.0	331	0.90	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.81	0.80	0.79	0.79	0.78	0.77	0.76	0.75	0.75	0.74	0.74	0.74	0.73	0.72	0.72	0.71	0.71
13.5	333	0.90	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.81	0.80	0.79	0.79	0.78	0.77	0.76	0.75	0.75	0.74	0.74	0.74	0.73	0.72	0.71	0.71	0.70
14.0	336	0.90	0.88	0.87	0.86	0.85	0.83	0.82	0.82	0.81	0.80	0.79	0.79	0.78	0.77	0.76	0.75	0.75	0.74	0.74	0.73	0.72	0.71	0.71	0.70	0.70
14.5	339	0.90	0.88	0.87	0.86	0.84	0.83	0.82	0.81	0.80	0.80	0.79	0.78	0.77	0.76	0.75	0.74	0.74	0.73	0.73	0.73	0.72	0.71	0.71	0.70	0.70
15.0	342	0.90	0.88	0.87	0.86	0.84	0.83	0.82	0.81	0.80	0.79	0.78	0.78	0.77	0.76	0.75	0.74	0.74	0.73	0.73	0.73	0.72	0.71	0.71	0.70	0.70
15.5	344	0.90	0.88	0.87	0.86	0.84	0.83	0.82	0.81	0.80	0.79	0.78	0.77	0.77	0.76	0.75	0.74	0.74	0.73	0.73	0.73	0.71	0.71	0.70	0.70	0.69
16.0	347	0.90	0.88	0.87	0.86	0.84	0.83	0.82	0.81	0.80	0.79	0.78	0.77	0.76	0.75	0.74	0.73	0.73	0.72	0.72	0.72	0.71	0.70	0.70	0.69	0.69
16.5	350	0.90	0.88	0.87	0.86	0.84	0.83	0.82	0.80	0.79	0.78	0.78	0.77	0.76	0.75	0.74	0.73	0.73	0.72	0.72	0.72	0.71	0.70	0.70	0.69	0.68
17.0	352	0.90	0.88	0.86	0.86	0.84	0.82	0.81	0.80	0.79	0.78	0.77	0.76	0.76	0.75	0.74	0.73	0.73	0.72	0.71	0.71	0.70	0.70	0.69	0.69	0.68
17.5	354	0.90	0.88	0.86	0.86	0.83	0.82	0.81	0.80	0.79	0.78	0.77	0.76	0.75	0.74	0.73	0.72	0.72	0.71	0.71	0.71	0.70	0.69	0.69	0.68	0.68
18.0	357	0.90	0.88	0.86	0.86	0.83	0.82	0.80	0.79	0.78	0.77	0.76	0.76	0.75	0.74	0.73	0.73	0.72	0.71	0.71	0.71	0.69	0.69	0.68	0.68	0.67
18.5	359	0.90	0.88	0.86	0.85	0.83	0.81	0.80	0.79	0.78	0.77	0.76	0.75	0.74	0.74	0.73	0.72	0.71	0.71	0.70	0.70	0.69	0.68	0.68	0.67	0.67
19.0	361	0.90	0.88	0.86	0.84	0.82	0.81	0.80	0.79	0.78	0.77	0.76	0.75	0.74	0.73	0.73	0.72	0.71	0.70	0.70	0.70	0.68	0.68	0.67	0.67	0.66
19.5	364	0.90	0.87	0.85	0.83	0.82	0.80	0.79	0.79	0.77	0.76	0.75	0.74	0.73	0.72	0.71	0.70	0.70	0.69	0.69	0.69	0.68	0.67	0.67	0.66	0.65
20.0	366	0.90	0.87	0.85	0.83	0.81	0.80	0.79	0.78	0.76	0.75	0.74	0.74	0.73	0.72	0.70	0.70	0.69	0.68	0.68	0.68	0.67	0.67	0.66	0.65	0.65
20.5	368	0.90	0.87	0.85	0.83	0.81	0.79	0.78	0.77	0.76	0.75	0.74	0.73	0.72	0.71	0.70	0.69	0.68	0.68	0.68	0.68	0.66	0.66	0.65	0.64	0.64
21.0	370	0.90	0.87	0.84	0.82	0.80	0.79	0.78	0.76	0.75	0.74	0.73	0.72	0.71	0.70	0.69	0.68	0.68	0.67	0.67	0.67	0.66	0.65	0.64	0.64	0.64
21.5	372	0.89	0.86	0.84	0.82	0.80	0.78	0.77	0.76	0.74	0.73	0.72	0.71	0.71	0.70	0.69	0.68	0.67	0.66	0.66	0.66	0.65	0.64	0.63	0.63	0.63
22.0	374	0.89	0.86	0.83	0.81	0.79	0.78	0.76	0.75	0.74	0.73	0.72	0.71	0.70	0.69	0.68	0.67	0.67	0.66	0.65	0.65	0.64	0.63	0.62	0.62	0.62

F4 DISCHARGE CAPACITY FOR AIR OR ANY GAS OR VAPOUR

F4.1 Critical and subcritical flow

The flow of gas or vapour through an orifice increases as the downstream pressure is decreased until critical flow is achieved. Further decrease in the downstream pressure will not result in any further increase flow.

Critical flow occurs when —

$$\frac{p_b}{p} \leq \left(\frac{2}{\chi + 1} \right)^{\chi/(\chi - 1)} \quad \dots \text{(F6)}$$

Subcritical flow occurs when —

$$\frac{p_b}{p} > \left(\frac{2}{\chi + 1} \right)^{\chi/(\chi - 1)} \quad \dots \text{(F7)}$$

where

- p = Actual relieving pressure, in megapascals absolute
- p_b = Backpressure, in megapascals absolute
- χ = Isentropic exponent at the relieving inlet conditions (for a perfect gas, χ is the ratio of specific heats)
- = $\frac{\text{specific heat at constant pressure}}{\text{specific heat at constant volume}}$

F4.2 Equations

For discharge capacity at critical flow:

$$q_m = 0.9117C \alpha A \left(\frac{p}{v} \right)^{1/2} \quad \dots \text{(F8)}$$

or

$$q_m = 10C \alpha Ap \left(\frac{M}{TZ} \right)^{1/2} \quad \dots \text{(F9)}$$

For discharge capacity at subcritical flow:

$$q_m = 0.9117CK_b \alpha A \left(\frac{p}{v} \right)^{1/2} \quad \dots \text{(F10)}$$

or

$$q_m = 10CK_b \alpha Ap \left(\frac{M}{TZ} \right)^{1/2} \quad \dots \text{(F11)}$$

where

q_m = Discharge capacity, in kilograms per hour

$$C = 3.948 \left[\chi \left(\frac{2}{\chi + 1} \right)^{(\chi + 1)/(\chi - 1)} \right]^{1/2}$$

K_b = Factor which corrects for the reduction in capacity because of the increase in backpressure (see Table F2)

$$\left[\frac{\frac{2\chi}{(\chi-1)} \left\{ \left(\frac{p_b}{p} \right)^{2/\chi} - \left(\frac{p_b}{p} \right)^{(z+1)/\chi} \right\}}{\chi \left(\frac{2}{\chi+1} \right)^{(z+1)/(\chi-1)}} \right]^{1/2}$$

= 1.0 for critical flow

α = Coefficient of discharge

A = Minimum flow area through discharge systems, in square millimetres

A1 | p = Relieving pressure, in megapascals absolute

ν = Specific volume at relieving pressure and relieving temperature, in cubic metres per kilogram

M = Molar mass, in kilogram per kilomole

T = Relieving temperature, in kelvins

Z = Compressibility factor (see Appendix G)

Where insufficient information is available to determine compressibility factor (Z), a value of 1.0 may be used.

A1 | p_b = backpressure, in megapascals absolute

and where

χ = isentropic exponent at the relieving inlet conditions (for a perfect gas, χ is the ratio of specific heats)

= $\frac{\text{specific heat at constant pressure}}{\text{specific heat at constant volume}}$

For values of C relative to χ , see Table F3.

F4.3 Discharge capacity for real gases

The equations in Paragraph F4.2 for calculating the discharge capacity of a system are based on the assumption that ideal gas laws adequately describe the pressure-volume relationship of the expanding gas and that the expansion process follows an isentropic path.

For a real gas the isentropic exponent and the compressibility factor vary with temperature and pressure through the expansion. Also in general the isentropic exponent does not equal the ratio of specific heats. For a gas which departs significantly from ideal behaviour, the above equations cannot strictly be applied and an iterative calculation is required. However, this is only possible when comprehensive thermodynamic data are available. The most conservative values of the empirically established isentropic exponent and the compressibility factor at either the inlet conditions or the conditions at the orifice (whichever is most conservative) can be used. The predicted conditions at the orifice are established by iteration. In general in situations where departure from ideal behaviour is significant, critical flow conditions occur at the orifice.

If reliable process simulation software, which adequately models the properties of the gas, is available, the critical flow conditions including the flow velocity and density can be established directly by solving Equation F12 along a line of constant entropy from the initial conditions.

$$H + \frac{a^2}{2} = \text{constant} \quad \dots \text{(F12)}$$

where

H = enthalpy of the gas at the particular conditions

a = velocity of sound in the gas at the particular local conditions

The discharge rate can then be calculated using the product gas density, flow area, flow velocity (assumed sonic for critical flow) and the coefficient of discharge.

If detailed thermodynamic data are not available, an appropriately conservative approach shall be adopted.

NOTE: Refer to API 520, Part 1, Appendix B for further information.

TABLE F2
CAPACITY CORRECTION FACTORS (K_b) FOR BACKPRESSURE

pb/p	Capacity correction factor (K_b) for backpressure																			
	Isentropic coefficient (χ)																			
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	
0.45	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.000	0.999	0.999	
0.50	—	—	—	—	—	—	—	—	—	—	—	1.000	1.000	0.999	0.999	0.996	0.994	0.992	0.989	
0.55	—	—	—	—	—	—	—	0.999	0.999	0.999	0.999	0.997	0.994	0.991	0.987	0.983	0.979	0.975	0.971	
0.60	—	—	—	—	—	—	0.999	0.997	0.993	0.989	0.983	0.987	0.987	0.972	0.967	0.961	0.955	0.950	0.945	
0.65	—	—	—	—	—	—	0.995	0.989	0.974	0.967	0.959	0.951	0.944	0.944	0.936	0.929	0.922	0.915	0.909	
0.70	—	—	0.999	0.999	0.993	0.985	0.975	0.964	0.943	0.932	0.922	0.913	0.903	0.903	0.885	0.886	0.879	0.871	0.854	
0.75	—	1.000	0.995	0.983	0.968	0.953	0.938	0.923	0.896	0.884	0.872	0.861	0.851	0.851	0.841	0.832	0.824	0.815	0.808	
0.80	0.999	0.985	0.965	0.942	0.921	0.900	0.881	0.864	0.833	0.819	0.806	0.794	0.783	0.783	0.773	0.764	0.755	0.747	0.739	
0.82	0.992	0.970	0.944	0.918	0.894	0.872	0.852	0.833	0.801	0.787	0.774	0.753	0.752	0.752	0.741	0.732	0.723	0.715	0.707	
0.84	0.979	0.948	0.917	0.888	0.862	0.839	0.818	0.799	0.766	0.752	0.739	0.727	0.727	0.716	0.706	0.697	0.688	0.680	0.672	
0.86	0.957	0.919	0.884	0.852	0.800	0.779	0.759	0.742	0.712	0.700	0.688	0.677	0.667	0.667	0.667	0.658	0.649	0.641	0.634	
0.88	0.924	0.881	0.842	0.809	0.780	0.755	0.733	0.714	0.682	0.668	0.655	0.644	0.633	0.633	0.624	0.615	0.606	0.599	0.592	
0.90	0.880	0.831	0.791	0.757	0.728	0.703	0.681	0.662	0.631	0.617	0.605	0.594	0.584	0.584	0.575	0.566	0.558	0.551	0.544	
0.92	0.820	0.769	0.727	0.693	0.664	0.640	0.619	0.601	0.571	0.559	0.547	0.537	0.527	0.527	0.519	0.511	0.504	0.497	0.490	
0.94	0.739	0.687	0.647	0.614	0.587	0.565	0.545	0.528	0.501	0.489	0.479	0.470	0.461	0.461	0.453	0.446	0.440	0.434	0.428	
0.96	0.628	0.579	0.542	0.513	0.489	0.469	0.452	0.438	0.414	0.404	0.395	0.387	0.380	0.380	0.373	0.367	0.362	0.357	0.352	
0.98	0.426	0.422	0.393	0.371	0.353	0.337	0.325	0.314	0.296	0.289	0.282	0.277	0.271	0.271	0.266	0.262	0.258	0.254	0.251	
1.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

TABLE F3
VALUES OF C RELATIVE TO VALUES OF χ

χ	<i>C</i>	χ	<i>C</i>	χ	<i>C</i>
0.40	1.65	1.04	2.43	1.46	2.74
0.45	1.73	1.06	2.45	1.48	2.76
0.50	1.81	1.08	2.46	1.50	2.77
0.55	1.89	1.10	2.48	1.52	2.78
0.60	1.96	1.12	2.50	1.54	2.79
0.65	2.02	1.14	2.51	1.56	2.80
0.70	2.08	1.16	2.53	1.58	2.82
0.75	2.14	1.18	2.55	1.60	2.83
0.80	2.20	1.20	2.56	1.62	2.84
0.82	2.22	1.22	2.58	1.64	2.85
0.84	2.24	1.24	2.59	1.66	2.86
0.86	2.26	1.26	2.61	1.68	2.87
0.88	2.28	1.28	2.62	1.70	2.89
0.90	2.30	1.30	2.63	1.80	2.94
0.92	2.32	1.32	2.65	1.90	2.99
0.94	2.34	1.34	2.66	2.00	3.04
0.96	2.36	1.36	2.68	2.10	3.09
0.98	2.38	1.38	2.69	2.20	3.13
0.99	2.39	1.40	2.70	—	—
1.00	2.40	1.42	2.72	—	—
1.02	2.41	1.44	2.73	—	—

F4.4 Discharge capacity for incompressible fluids

For incompressible fluids as single phase flow at the inlet and not flashing to vapour (neither partially nor completely) on venting, the following equation applies:

$$q_m = 5.0913Af\mu\alpha(\Delta p\rho)^{1/2} \quad \dots (F13)$$

where

q_m = discharge capacity, in kilograms per hour

A = minimum flow area through discharge system, in square millimetres

ρ = density, in kilograms per cubic metre

Δp = pressure difference between the inlet and the end of discharge system, in megapascals

NOTE: The effect of static head should be considered.

α = coefficient of discharge

$f\mu$ = correction factor for liquid viscosity.

Where the liquid has a viscosity less than or equal to that of water at 20°C, this factor may be taken as 1.0. For greater viscosity the discharge capacity through a given discharge system will be reduced. The factor $f\mu$ is related to Reynolds number and can be obtained from Figure F1. Reynolds number (Re) may be established from the following equation:

$$Re = 0.3134 \left(\frac{q_m}{\mu\sqrt{A}} \right) \quad \dots (F14)$$

where

μ = dynamic viscosity of the liquid, in pascal seconds.

For sizing for viscous relief, the size is established first for non-viscous relief and the next largest size is selected to calculate Reynolds number. Where the equation shows that the areas assumed to calculate Reynolds number is too small, the calculation is repeated for the next largest size discharge system.

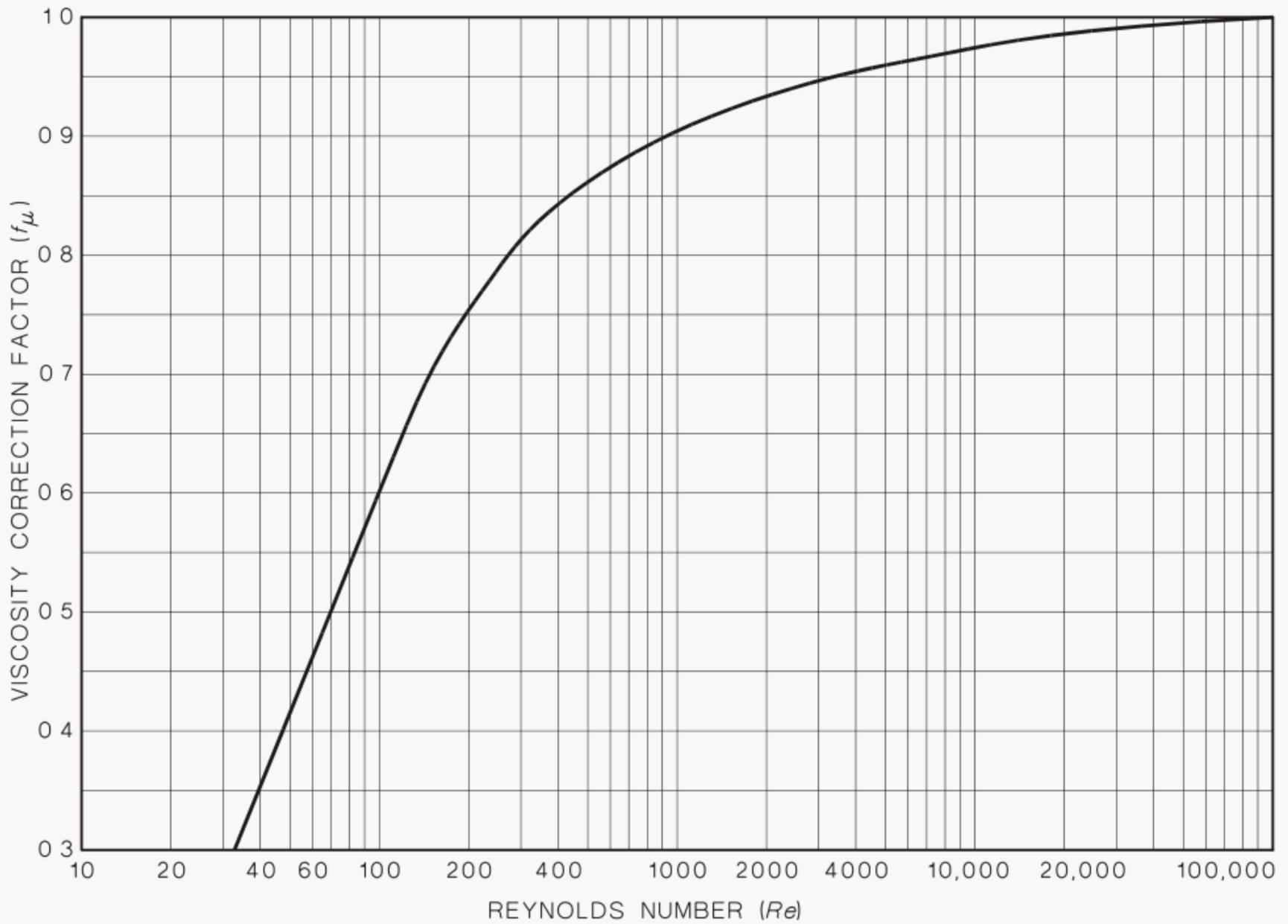


FIGURE F1 CORRECTION FACTOR FOR LIQUID DYNAMIC VISCOSITY

APPENDIX G
DERIVATION OF COMPRESSIBILITY FACTOR
(Normative)

G1 SCOPE

This Appendix sets out a method for the compressibility factor (Z) of a gas at relieving conditions.

G2 EQUATION

The compressibility factor (Z) at relieving conditions may be obtained from accurate pressure, volume, and temperature data for the gas, using following equation:

$$A1 \quad Z = 10^6 \frac{pvM}{RT} \quad \dots (G1)$$

where

- Z = compressibility factor
- p = inlet pressure, in megapascals
- v = specific volume at the inlet, in cubic metres per kilogram
- M = molecular mass, in kilograms per kilomole
- R = universal gas constant, in joules per kilomole kelvin
- T = temperature, in kelvin

In the absence of accurate data, the compressibility factor (Z) may be obtained from Figure G1 from the reduced temperature ($T_r = T/T_c$) and the reduced pressure ($p_r = p/p_c$) of the gas, where T_c and p_c are the critical temperature and the critical pressure of the pure gas.

Example:

To determine the value of the compressibility factor (Z) for a gas relieving through a discharge system with an inlet pressure of 10 MPa and temperature of 70°C.

Inlet pressure (p), in megapascals absolute	= 10 + 0.1
	= 10.1
Temperature (T), in kelvin	= 70 + 273
	= 343
Critical pressure (p_c), in megapascals absolute	= 5.05
Critical temperature, (T_c) in kelvin	= 298

$$p_r = \frac{p}{p_c} = \frac{10.1}{5.05} = 2$$

$$T_r = \frac{T}{T_c} = \frac{343}{298} = 1.15$$

From Figure G1, $Z = 0.5$

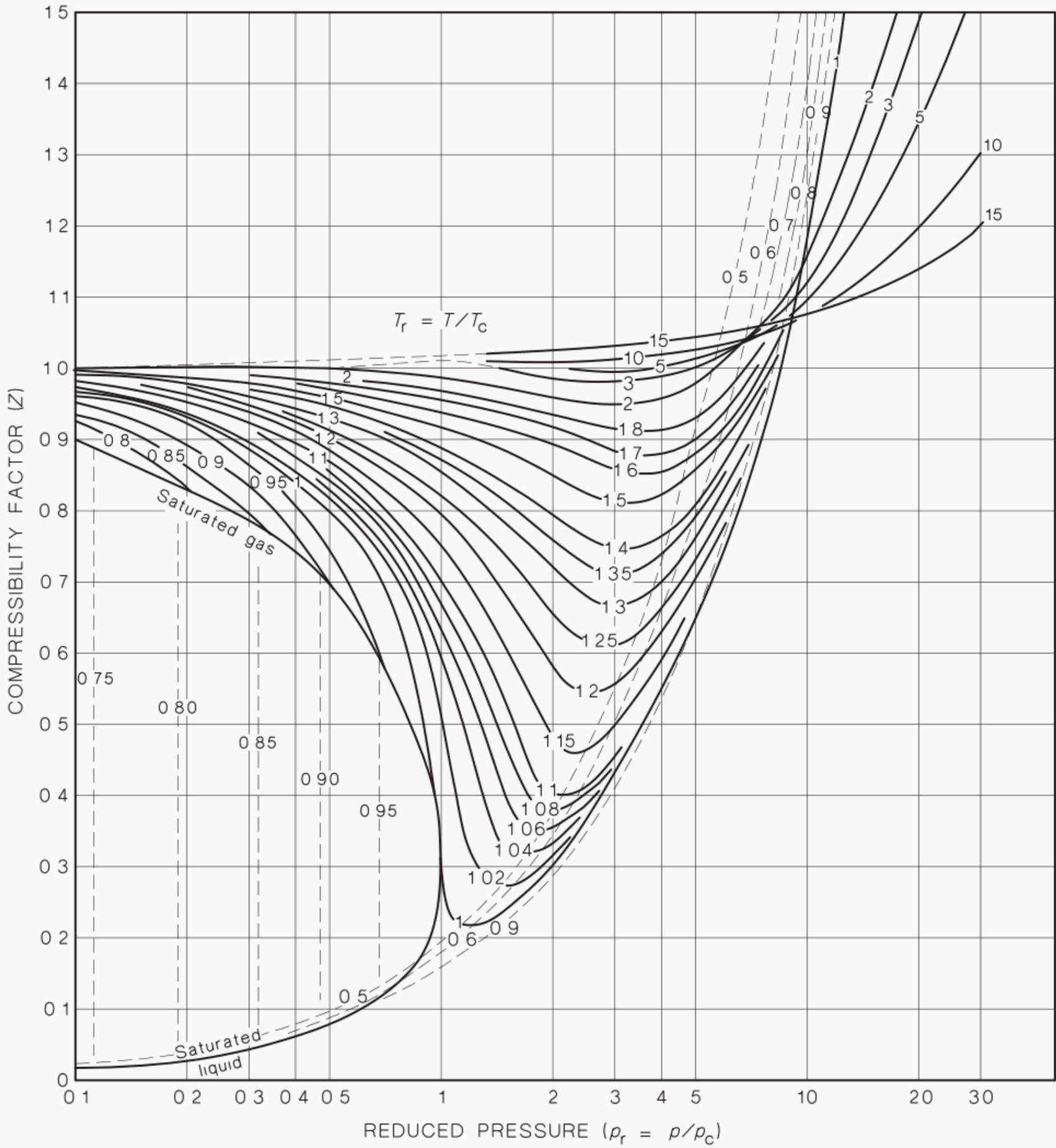


FIGURE G1 COMPRESSIBILITY FACTOR (Z) AS A FUNCTION OF REDUCED PRESSURE AND REDUCED TEMPERATURE

APPENDIX H

PNEUMATIC PRESSURE TESTING SAFETY REQUIREMENTS

(Normative)

The hazards involved in pneumatic pressure testing shall be considered and adequate precautions taken. Attention is drawn to the following:

- (a) If a major rupture of the valve occurs at some stage during the application of pressure, considerable energy will be released, hence no personnel shall be in the immediate vicinity during pressure raising. (For example, a given volume of air contains 200 times the amount of energy that a similar volume of water contains, when both are at the same pressure.)
- (b) The risk of brittle failure under test conditions should have been critically assessed at the design stage. The choice of materials for valves which are to be pneumatically tested shall be such as to avoid the risk of brittle failure during test. This requires an adequate margin between the transition temperature of all parts and the metal temperature during testing.
- (c) If the gas pressure is reduced to the valve under test from high pressure storage, the temperature will fall.
- (d) Valves undergoing pneumatic test shall not be approached for close inspection until after the pressure testing has been completed and the test apparatus de-pressurized.
- (e) No valve undergoing pneumatic test shall be subject to any form of shock loading.
- (f) Precautions shall be taken against pressures generated in excess of test pressure.

For further information on safety requirements, refer to AS 4037.

AMENDMENT CONTROL SHEET**AS 1271—2003**

Amendment No. 1 (2004)

CORRECTION

SUMMARY: This Amendment applies to Appendix F, Paragraphs F3, F4.1 and F4.2 and Appendix G, Paragraph G2.

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NOTES

NOTES

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