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# Australian Standard 2129–1978

# FLANGES AND BOLTING FOR PIPES, VALVES AND FITTINGS

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STANDARDS ASSOCIATION OF AUSTRALIA
*Incorporated by Royal Charter*

THE FOLLOWING SCIENTIFIC, INDUSTRIAL AND GOVERNMENTAL ORGANIZATIONS were officially represented on the committee entrusted with the preparation of this standard:

Aluminium Development Council
Associated Chambers of Manufactures of Australia
Australian Chamber of Commerce
Australian Compressed Air Institute
Australian Institute of Metals
Australian Institute for Non-destructive Testing
Australian Liquefied Petroleum Gas Association
Australian Mines and Metals Association
Australian Valve Manufacturers Association
Australian Welding Institute
Australian Welding Research Association
Boiler and Pressure Vessel Manufacturers Association of Australia
Bureau of Steel Manufacturers of Australia
Department of Defence
Department of Labour Relations and Consumer Affairs, Queensland
Department of Northern Australia
Department of the Capital Territory
Departments of Labour and Industry
Electricity Supply Association of Australia
Institution of Engineers, Australia
Insurance Council of Australia
Metal Trades Industry Association of Australia
Petroleum Refining Engineers Advisory Committee
Queensland Society of Sugar Cane Technologists
Railways of Australia Committee
Society of Mechanical Engineers of Australia
Universities and Technical Colleges

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This standard, prepared by Committee ME/1, Boilers and Unfired Pressure Vessels, was approved on behalf of the Council of the Standards Association on 1 November 1977, and was published on 1 March 1978.

In order to keep abreast of progress in industry, Australian standards are regularly reviewed. Suggestions for improvement to published standards, addressed to the head office of the Association, are welcomed.

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*This standard was issued in draft form for public review as DR 76084.*

AUSTRALIAN STANDARD

# FLANGES AND BOLTING FOR PIPES, VALVES AND FITTINGS

## AS 2129–1978


| | |
|---|---|
| First published (as AS B52) (endorsement of BS 10, Parts 1, 2 and 3) | 1931 |
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# PREFACE

This standard was prepared by the Association's Committee on Boilers and Unfired Pressure Vessels as a revision and metrication of AS B52—1971, which it accordingly supersedes.

In 1971, AS B52, which had previously been the endorsement of BS 10, was published as a self-contained Australian standard but was basically a reprinting of BS 10:1962. With the introduction of metrication, it has been necessary to phase out imperial standards and to publish metric standards. Consequently, a conference was held to determine the course of action to be adopted in Australia, with particular reference to flanges and bolting.

In 1971, the British Standards Institution stated that 'BS 10 would not be metricated and eventually all standard flanges will be designed to BS 4504 or BS 1560. However, it is realized that BS 10 must remain in existence for many years to come.'

BS 4504 specifies a modification of the German DIN flange and relates to existing pipe sizes; screwed flanges employ BSP threads and metric bolts are specified. BS 4504 does not comply with any published International standard but relates to two associated draft International standards, viz ISO DIS 2084, Pipeline Flanges for General Use — Mating Dimensions, and ISO DIS 2441, Pipeline Flanges for General Use — Shapes and Dimensions of Pressure-tight Surfaces. It should be noted that these drafts mainly cover some aspects of flanges, whereas BS 4504 comprises specifications for a full flange.

Australia abstained from voting on these draft standards on the grounds that it was not certain that hard metrication would proceed in this direction because there is no internationally accepted hard metric series of pipes and at that time ISO 336 (or BS 3600) had not been published.

BS 1560, Part 2 is the British version of the American standard ANSI B16.5 and the equivalent International standard is ISO 2229. These cover steel flanges ½ in to 24 in; above this size, MSS SP.48 is used. Screwed flanges employ American threads and imperial bolts are used. A group of three ISO committees is investigating the use of metric bolts for the flanges which are used by the petroleum and natural gas industries.

Australian pipeline and piping codes specify BS 1560, Part 2 as an alternative to AS B52.

ISO and CEN (the European Committee for Standardization) have set up working groups to study a proposal originating in the U.K. which favours the use of BS 4504 for all diameters and up to 4 MPa, and ISO 2229 for all diameters to 24 in above 4 MPa, as it is considered that for lower pressures the ANSI flange is too thick. Australia does not support this move as it considers that an international flange, rather than a national flange, should be standard.

Because AS B52 is used almost exclusively by the water authorities in Australia (where interchangeability of flanges is essential) as well as by the boiler and pressure vessel industry, the Standards Association decided that AS B52 be soft metricated.

As Table C flanges are still widely used by the water supply industries, they have been reintroduced. Leakage is often a problem with the larger AS B52 flanges and to overcome this problem O-ring flanges have been included in this standard.

Metric fasteners have been introduced and all flanges have been checked to ensure that adequate bolting capacity is retained, the strength of the flange joint is not impaired and interchangeability with existing flanges is preserved. Pitch circle diameters have been rounded to the nearest millimetre and flange overall diameters have also been appropriately rounded.

Diameter/pitch combinations are specified in AS 1275 (as a coarse-thread series) and in AS 1721 (providing a range of two or three pitches for each diameter). AS 1721 differs from ISO 261 in that the 333 diameter/pitch combinations specified in ISO 261 have been rationalized to 256 diameter/pitch combinations in AS 1721. An Australian standard covering stud bolts has not yet been published (one is in course of preparation) and as an interim measure the diameters and pitches specified in BS 4882 have been adopted in Table 3.14. The following table lists these sizes and the screw thread standards to which each size conforms. Also listed for those sizes which conform only to ISO 261 are the adjacent sizes specified in AS 1721.

| Sizes specified in Tables 3.14 and 3.15 conforming to— | | | Adjacent sizes specified in AS 1721 |
|---|---|---|---|
| AS 1275<br>AS 1721<br>ISO 261 | AS 1721<br>ISO 261 | ISO 261 | |
| M12 × 1·75<br>M16 × 2<br>M20 × 2·5<br>M24 × 3<br>M27 × 3 | | | |
| | | M30 × 3 | M30 × 3·5 and M30 × 2 |
| | | M33 × 3 | M33 × 3·5 and M33 × 2 |
| | M36 × 3<br>M39 × 3 | | |
| | | M45 × 4 | M45 × 4·5 and M45 × 3 |
| | | M52 × 4 | M52 × 5 and M52 × 3 |

Flanges manufactured to this standard can be bolted to flanges manufactured to AS B52 except for the 1400, 1600, 2000, 2200 and 2800 nominal size flanges. New flanges have been introduced for these sizes because no imperial flange of equivalent size exists which could be used without interference between the bolts and the outside diameter of the pipe or fitting.

Flanges to this standard can be used on pipes having diameters shown in AS 1238, Preferred (Soft Metric) Sizes of Steel Pipes, and AS 1579, Arc Welded Steel Pipes for Water and Gas.

The layout of this standard conforms to current Australian standards practice.

As this standard also serves in some degree as an application code, to provide designers with a useful historical record, the following is reprinted from the Foreword of BS 10:1962:

'BS 10 flanges have been in use since 1904 and have been developed continuously to meet the increasing pressure and temperature requirements. At the

time of this (1962) revision, flange joints with carbon steel pipe flanges for high temperatures and pressure to the British Standard Tables have been in service throughout the world for periods equal to the economic life of primary plant. The trend towards the use of ever higher temperatures in thermal cycles, together with the need to conserve resources, necessitated a revision of design theory. Research into the design of flange joints under the auspices of the Institution of Mechanical Engineers made it possible to calculate the effects of high temperatures. The result of this research have been applied in the revision of BS 10 on which this standard is based.

Experience has indicated that where temperatures of 800°F (427°C) and higher have to be withstood, an estimate of the effect of creep becomes essential so that the condition of a joint at any given time, after initial tightening, can be predicted. This has been made possible by methods of analysis developed for application to the British Standard type of flange, and examination of the resulting proportions of these flanges has shown that a complete rationalization of the tables can be obtained by an increase in the thickness of the flange in certain sizes. Apart from Table A sizes 54 in to 72 in, the other basic dimensions i.e. the flange diameter, bolt circle diameter and the number and sizes of the bolts, have not been altered except in the case of Table E where the bolt diameter has been increased from 1 in to $1\frac{1}{8}$ in for the 24 in size flange.

The type of steel flange for which calculations have been made is essentially a flat annular ring, homogenous with the pipe, having a raised jointing face of prescribed diameter and with the gasket substantially covering the full area of the jointing face. The thicknesses of boss and welding neck flanges and of integral flanges — cast or forged — on valves, have not yet been evaluated theoretically. As an interim measure the thickness for boss and welding neck flanges are the same as for plain flanges and the existing thicknesses of integral flanges on valves, which have been used for many years, are given in the tables.

*Development of Analysis.* It has been established that the critical stress in a plain flange is the circumferential stress.

In calculating the external loads on the flange, allowance has been made for the effect of the adjacent pipe which is usually subjected to plastic deformation.

At temperatures where no creep occurs elastic conditions prevail in the flange plate throughout the lifetime of the joint and the elastic theory has been used for these conditions.

Where temperatures are such as to produce creep and consequently plastic conditions in all parts of the joint, the initial stresses relax and the stress distribution is changing throughout its lifetime. In this case the criterion for tightness of the joint has to be satisfied under initial tightening conditions (cold), under operating conditions at the end of its life and at all intermediate times.

To solve completely the problems set by these requirements, the relaxed stresses in the component parts of the joint in service should be known. For carbon steel these stresses were obtained from tests on 8 in bore — Table T flanges; for alloy steel they have been derived from existing designs which have been proven to be reliable in service for many years.

As far as present knowledge of creep and relaxation properties allows, the temperatures applicable at corresponding pressures (temperature-pressure applicability) for steel flanges have been ascertained on the basis of ensuring a tight joint for a period of 100 000 hours of continuous service under stable conditions without retightening.'

Listings of relevant standards and specifications referred to in this standard are given in Appendices A and B. Appendix C lists the addresses of Standards organizations.

The Standards Association of Australia wishes to acknowledge the contributions made by the Engineering and Water Supply Department of South Australia in the preparation of the tables listing the dimensions of flanges.

# CONTENTS

STANDARDS ASSOCIATION OF AUSTRALIA

# Australian Standard for FLANGES AND BOLTING FOR PIPES, VALVES AND FITTINGS

## SECTION 1. SCOPE AND GENERAL

**1.1 SCOPE.** This standard gives details for circular, plain, threaded, blank, boss and welding neck flanges manufactured from copper alloy, grey cast iron, malleable cast iron, spheroidal or nodular graphite iron, carbon steel, carbon manganese steel and alloy steel for use with pipes, valves and fittings containing fluid under pressure. Limitations of use of flanges and bolting are included. The types of metric bolting are specified.

**1.2 APPLICATION.** The ranges of temperature and pressure for which the flanges are applicable are as follows:

Temperature: −200°C to 525°C.
Pressure: Up to 19 300 kPa.

The various types of flanges are not necessarily applicable to all temperature pressure and size ranges. References shall be made to the appropriate clauses and tables for details. The allowable pressure may be interpolated between the temperatures. The pressure shown in the flange tables is the maximum allowable non-shock pressure at the temperature shown. When a flange is to be subjected to shock or fatigue, calculations shall be made to ensure that the selected flange is suitable.

Eleven flange tables are provided, viz Tables A, D, C, E, F, H, J, K, R, S and T.

**1.3 DESIGNATION.** A flange shall be designated by the nominal size as given in the first and last columns of the flange table followed by the table letter, e.g. 400E.

**1.4 DEFINITIONS.** For the purposes of this standard the following definitions apply:

**1.4.1 Approved and approval** — approved by, or approval of, the Inspecting Authority.

**1.4.2 Contact surface** — that part of the flange facing upon which the gasket is compressed.

**1.4.3 Flange end** — the reference plane coincident with the front of the flange from which the height of any type of flange facing and also the minimum flange thickness is measured (see Fig. 1.1).

**1.4.4 Flange facing** — the profile of the front of a flange.

**1.4.5 Flange thickness** — the distance from the flange end to the back face of a flange, or, if the bolt holes are spot-faced, from the flange end to the spot facing (see Fig. 1.1).

**1.4.6 Fluid** — any vapour, liquid, gas or mixture thereof.

**1.4.7 Inspecting Authority** — where the flange is to be used in an installation that is subject to statutory jurisdiction, the authority with the powers of inspection. Where this statutory jurisdiction does not exist, the purchaser of the flange or other person or organization named as such has the authority to inspect.

**1.4.8 Integral flange** — a flange which is cast or forged as part of a fitting or the body of a valve.

**1.4.9 Pressure** — the pressure of the fluid on the inside of the pressure-retaining component above ambient pressure, i.e. gauge, unless otherwise specified.

**1.4.10 Shall and Should** — the word 'shall' is to be understood as mandatory and the word 'should' as non-mandatory or recommended.

**1.4.11 Temperature** — the temperature of the fluid inside the pressure-retaining component.

**1.5 STANDARDS AND SPECIFICATIONS.**

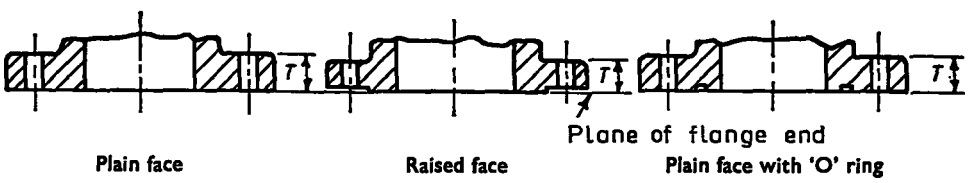
**1.5.1 General.** Where standards or specifications nominated or listed in this standard have not been produced in the metric form, the conversion of values shall be in accordance with Parts 1 to 6 of AS 1377.*

**1.5.2 Nominated Standards.** Standards and specifications nominated for use with this standard are listed in Appendix A.

**1.5.3 Application of Nominated Standards.** Some standards and specifications nominated in Appendix A are supplemented by specific requirements elsewhere in this standard. Users of this standard are advised against attempting direct application of any of these standards without carefully observing the reference to that standard.

**1.5.4 Supplementary Standards.** Standards and specifications which are of a supplementary nature are listed for reference in Appendix B.

* AS 1377, Conversion Tables.




$T$ = minimum flange thickness.

Fig. 1.1. FLANGE END AND MINIMUM FLANGE THICKNESS