BRITISH STANDARD

BS 5351:1986

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Specification for

Steel ball valves for the petroleum, petrochemical and allied industries

UDC 621.646.5-034.14:665.6

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Piping Systems Components Standards Committee (PSE/-) to Technical Committee PSE/7 upon which the following bodies were represented:

Amalgamated Union of Engineering Workers
Associated Offices Technical Committee
Association of Bronze and Brass Founders
Association of Hydraulic Equipment Manufacturers
British Chemical Engineering Contractors' Association
British Compressed Gases Association
British Foundry Association
British Gas Corporation
British Maritime Technology
British Shipbuilders
British Valve Manufacturers' Association Ltd.
Copper Development Association
Copper Tube Fittings Manufacturers' Association
Electricity Supply Industry in England and Wales
Energy Industries Council
Engineering Equipment and Materials Users' Association
GAMBICA (BEAMA Ltd.)
General Council of British Shipping
Greater London Council
Health and Safety Executive
Institute of British Foundrymen
Institution of Chemical Engineers
Institution of Gas Engineers
Institution of Mechanical Engineers
Institution of Water Engineers and Scientists
Society of British Gas Industries
Steel Casting Research and Trade Association
Water Authorities Association
Water Companies Association

This British Standard, having been prepared under the direction of the Piping Systems Components Standards Committee, was published under the authority of the Board of BSI and comes into effect on 31 January 1986

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Contents

Foreword

This British Standard has been prepared under the direction of the Piping Systems Components Standards Committee and constitutes the first revision of BS 5351:1976 which is withdrawn.

The opportunity has been taken in carrying out this revision to introduce internationally agreed pressure/temperature ratings, based on the definition of nominal pressure (PN) given in ISO 7268[1)], covering ratings previously given in German (DIN) and American (ANSI) standards. However, in this revision the use of PN has been limited to valves with flanges designated PN 10, PN 16, PN 25 and PN 40 in accordance with BS 4504-1. For valves with flanges complying with BS 1560-2, class ratings have been retained. This will be reviewed later when BS 1560-2 is revised to introduce flanges having metric bolting and which are designated by the PN system. The designation Class 800 for threaded and socket weld end valves has also been retained as there is no equivalent in the PN system.

This revision also takes account of the latest agreements in ISO/TC 153/SC 1, Valves — Design, construction, marking and testing, and ISO/TC 5/SC 10, Metallic flanges and their joints. On this basis the terminology and definitions in this standard are in accordance with those given in ISO standards and the minimum bore dimensions conform to those agreed in ISO/TC 153/SC 1.

The minimum pressure/temperature seat ratings given in this standard are based on the use of unfilled virgin PTFE for the valve seats, but attention is drawn to the use of alternative seat materials that could give higher pressure/temperature ratings.

Pressure/temperature ratings of the valve are dependent on both the body rating and the pressure capability of the seats. Seat pressure capability will be limited by the strength of the seat material, particularly by the loss of strength which may occur at elevated temperatures. The applicable valve pressure rating at any temperature will, therefore, be limited by either the body rating or the seat rating.

Throughout this British Standard those dimensions shown in parentheses are non-preferred.

Attention is drawn to BS 5159, which specifies valves for less arduous duties than valves covered by this standard and to BS 6683 for guidance on the installation and use of valves.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 22, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

[1)] Published by the International Organization for Standardization (ISO).

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Section 1. General

1 Scope

This British Standard specifies the valve seat and body pressure/temperature ratings, and the design, including materials, dimensions, operation, performance, testing and marking, of straightway steel ball valves having specified wall thickness, an antistatic feature and fire tested design.

It specifies full bore and reduced bore valves of one piece or split body construction with balls which may be seat supported or trunnion supported.

The ranges of valves covered by this standard are given in Table 1 and Table 2 (see also clauses **4** and **5**).

This standard does not cover the installation of ball valves.

NOTE 1 The titles of publications referred to in this standard are listed on page 22 and the inside back cover.
NOTE 2 The information to be supplied by the purchaser at the time of his enquiry/order is given in the form of a data sheet in Appendix A.

2 Definitions

For the purposes of this British Standard, the following definitions apply.

2.1
end-to-end dimension (face-to-face dimension)

the distance between the two planes perpendicular to the body axis located at the extremities of the body ends

2.2
anti-static feature

a feature incorporated in the design of the valve that ensures electrical continuity between the body, ball and stem of the valve

2.3
fire-tested design

a design that is capable of complying with Appendix A of BS 5146-1:1974, as modified by clause **12**

2.4
anti-blow-out stem

a design that ensures the valve stem cannot be blown out of the body in the event of the stem seal retainer, e.g. gland, being removed while the valve is under pressure

2.5
nominal size (DN)

a numerical designation of size which is common to all components in a piping system other than those components designated by outside diameters or by thread size. It is a convenient round number for reference purposes and it is normally only loosely related to manufacturing dimensions

NOTE 1 Nominal size is designated by the letters DN followed by a number.
NOTE 2 This definition is identical with ISO 6708.

2.6
nominal pressure (PN)

a numerical designation which is a convenient rounded number for reference purposes

all equipment of the same nominal size (DN) designated by the same PN number shall have compatible mating dimensions

NOTE 1 The maximum allowable working pressure depends on materials, design and working temperatures, and should be selected from the tables of pressure/temperature ratings given in the appropriate standards.
NOTE 2 Nominal pressure is designated by the letters PN followed by the appropriate reference number.
NOTE 3 This definition is identical with that given in ISO 7268.

3 Valve patterns

Valves shall be full bore or reduced bore (see Figure 1) of short or long pattern, where applicable, as given in Table 6 and BS 2080.

NOTE In certain large PN 10, PN 16 and Class 150 short-pattern valves, the ball in the other than fully open position may protrude beyond the end of the flange faces.

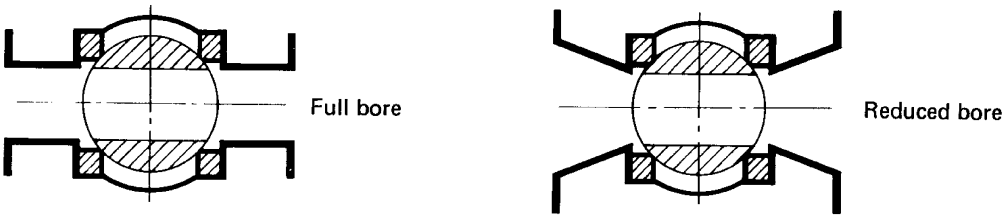


Figure 1 — Valve bore configurations

4 Nominal sizes

Valves shall be of nominal sizes (DN) or (in) or threaded end sizes according to the type of end fitting given in Table 1.

5 Pressure designation

Pressure designations of valves shall be as given in Table 2.

6 Pressure/temperature ratings

Pressure/temperature seat ratings of valves shall be as given in Table 3. With the exception of body seat rings and primary soft seals, all valve components shall be capable of withstanding the pressure/temperature ratings as specified in BS 1560-2, BS 4504-1 or Table 4, as appropriate.

Table 1 — Nominal sizes of valves according to end fitting

Nominal size		**Valve end fittings** (see notes 1 and 2)				
(DN) (see note 3)	(in)	**Flanged end**	**Butt-weld end**	**Socket-weld end**	**Extended-weld end**	**Threaded end size** (see note 4)
8	¼	—	—	—	—	¼
10	⅜	—	—	—	—	⅜
15	½	✓	✓*	✓	✓	½
20	¾	✓	✓*	✓	✓	¾
25	1	✓	✓*	✓	✓	1
(32)	(1¼)	(✓)	(✓)*	(✓)	(✓)	(1¼)
40	1½	✓	✓	✓	✓	1½
50	2	✓	✓	✓	✓	2
(65)	(2½)	(✓)	(✓)	—	—	—
80	3	✓	✓	—	—	—
100	4	✓	✓	—	—	—
150	6	✓	✓	—	—	—
200	8	✓	✓	—	—	—
250	10	✓	✓	—	—	—
300	12	✓	✓	—	—	—
350	14	✓	✓	—	—	—
400	16	✓	✓	—	—	—

NOTE 1 ✓ indicates valve size covered by this standard available both in (DN) and (in) nominal size. ✓* indicates for Class 600 valves only.
NOTE 2 Valve sizes shown in parentheses are non-preferred (see foreword).
NOTE 3 When nominal sizes DN 8 and DN 10 are used in tables, these sizes refer only to valves with threaded end sizes of ¼ and ⅜ respectively.
NOTE 4 Threaded end valves are available only in the sizes given in this column. Designations for sizes are given in ANSI/ASME B1.20.1 or BS 21, as appropriate.

Table 2 — Pressure designations of valves according to end fitting

Pressure designation	Valve end fittings				
	Flanged end	Butt-weld end	Socket-weld end	Extended-weld end	Threaded end
Nominal pressure (PN)	10 16 25 40	10 16 25 40	— — — —	— — — —	— — — —
Class	150 300 600	150 300 600	800 only[a]	800 only[a]	800 only[a]

[a] Applies to forged or bar stock bodies only.

Table 3 — Minimum pressure/temperature seat ratings for ball valves

Nominal size of valve (DN)		Service temperature (°C)									
		– 30 to 40	50	75	90	100	125	150	175	200	230
Full bore	Reduced bore	Minimum non-shock pressure									
		bar	bar	bar	bar	bar	bar	bar	bar	bar	bar
8 to 20	8 to 25	69	66	56	51	47	38	29	20	11	0
25 to 65	32 to 80	50	49	48	48	47	38	29	20	11	0
80 to 100	100 to 150	42	42	42	42	39	32	24	17	9	0
150	200 to 250	31	31	31	31	29	23	18	12	7	0
200 to 400	300 to 400	21	21	21	21	20	16	12	8	5	0

NOTE 1 The pressure/temperature ratings given in Table 3 are based on seat rings made from PTFE resins without fillers, of virgin material completely free of reclaimed processed material (see **10.3**).
NOTE 2 See Table 1 for equivalent nominal size (in).
NOTE 3 1 bar = 100 kN/m^2 = 100 kPa.

Table 4 — Class 800 body ratings

Body material designation	Grade									
	Carbon steel	5 Cr ½ Mo	1¼ Cr ¼ Mo	2¼ Cr 1 Mo	18/8	18/8 Low C	18/10/2	18/10/2 Low C	18/8 Ti	18/8 Nb
Bar stock bodies	Steel	B5	B11	B22	B304	B304L	B316	B316L	B321	B347
Forged bodies	Steel	F52	F11	F22	F304	F304L	F316	F316L	F321	F347
Service temperature	**Maximum non-shock service pressure**									
°C	bar	bar	bar	bar	bar	bar	bar	bar	bar	bar
– 30 to 38	138	138	138	138	118	98	138	98	138	138
50	137	137	137	137	115	98	137	98	137	137
75	135	135	135	135	110	98	135	98	135	135
100	133	133	133	133	103	98	133	98	133	133
125	132	132	132	132	98.5	97.5	132	97.5	132	132
150	130	130	130	130	94.5	95	130	91.5	130	130
175	129	129	129	129	90.5	89	129	84	129	129
200	128	128	128	128	86.5	82	128	77	128	128
225	125	125	125	125	83.5	76	125	77.5	125	125
250	122	122	122	122	80	70	122	71	122	122
275	116	116	116	116	77.5	66.5	116	68	116	116

Table 5 — Nominal pressure and class ratings and nominal size

1	2	3
Pressure rating		Nominal size range (DN)
PN	Class	
10	150	15 to 400
16	150	15 to 400
25	300	15 to 400
40	300	15 to 400
NOTE See Table 1 for equivalent nominal size (in)		

7 Dimensions

7.1 Flanged-end valves

7.1.1 Flange dimensions shall comply with BS 1560-2 for Class rated valves or BS 4504-1 for PN rated valves.

7.1.2 Face-to-face dimensions shall be in accordance with BS 2080. Valves having flanges complying with BS 4504-1 with nominal pressure (PN) ratings as given in Table 5 shall have the same face-to-face dimensions as valves with flanges of the corresponding class ratings. The applicable nominal size range is also given.

7.2 Butt-weld-end valves

End-to-end dimensions shall be in accordance with:

a) Table 6 for PN 10, PN 16, Class 150 and PN 25, PN 40 and Class 300 valves;

b) BS 2080 for Class 600 valves.

NOTE The details for the weld preparation for butt-weld-end valves are not a requirement of this standard but attention is drawn to Appendix B which gives details of various weld-end preparations and it is incumbent upon the purchaser to specify a particular weld-end preparation, if required (see Figure 3 and Figure 4).

7.3 Socket-weld-end valves

Socket-weld-end dimensions shall be as given in Table 7.

7.4 Extended-weld-end valves

The overall length of weld-end valves when fitted with extended ends shall be 400 ± 1 mm; valves of nominal sizes DN 15 to DN 40 shall have ends square or prepared for welding.

NOTE Valves of nominal size DN 50 should have bevelled ends in accordance with Appendix B which gives details of various weld-end preparations and it is incumbent upon the purchaser to specify a particular weld-end preparation, if required (see Figure 3 and Figure 4).

Table 6 — End-to-end dimensions of butt-weld-end valves

Nominal size (DN)	End-to-end dimensions, mm			
	PN 10, PN 16, Class 150		PN 25, PN 40, Class 300	
	Short pattern	Long pattern	Short pattern	Long pattern
	Reduced bore only	Full or reduced bore	Reduced bore only	Full or reduced bore
40	—	190 ± 2	—	190 ± 2
50	—	216	—	216
(65)	—	273 ± 3	—	241
80	—	310	—	283 ± 3
100	—	350	—	305
150	403 ± 3	457	—	403
200	419	521 ± 4	419 ± 3	502 ± 4
250	457	559	457	568
300	502 ± 4	635	502 ± 4	648
350	572	762	—	762
400	610	838 ± 5	—	838 ± 5
NOTE See Table 1 for equivalent nominal size (in).				

Table 7 — Socket-weld-end details

Nominal size (DN)	Minimum depth of socket	Bore of socket		Outside diameter of body end at weld	
	mm	mm		mm	
15	10	21.8	+0.25 −0	29	+0 −0.25
20	13	27.4		35	
25	13	34.1		43	
(32)	13	42.7		54	
40	13	49.0		58	
50	16	61.0		71	

NOTE See Table 1 for equivalent nominal size (in).

7.5 Threaded-end valves

7.5.1 The outside diameter of the end of threaded-end valves shall be as given in Table 8.

7.5.2 Valve ends shall have internal taper threads in accordance with ANSI/ASME B1.20.1 or BS 21.

Table 8 — Threaded-end details

Threaded-end size	Minimum outside dimension of body end
	mm
¼	22
⅜	26
½	33
¾	38
1	46
(1¼)	56
1½	62
2	75

7.6 Minimum body port diameters

The minimum inside diameters of the body ports for both full and reduced bore valves shall be as given in Table 9.

NOTE The minimum port diameters for lined valves are not covered by this standard.

7.7 Minimum ball port diameters

Minimum ball port diameters shall be as given in Table 9.

7.8 Bolting

Bolting threads shall be in accordance with ISO metric or Unified inch standards. The dimensions and finish of bolting shall comply with the following standards, as appropriate:

metric	inch
BS 3692	BS 1768 (below ½ in)
BS 4168 (cap head)	BS 1769
BS 4190	BS 2470 (cap head UNC)
BS 4439	BS 2693-1
BS 4882	BS 4882

Table 9 — Minimum ball and body port diameters PN 10, PN 16, Class 150, PN 25, PN 40, Class 300, Class 600 and Class 800

Nominal size (DN)	Minimum diameter		
	Reduced bore valves PN 10 up to and including PN 40 and Classes 150 to 800	Full bore valves	
		PN 10 up to and including PN 40 and Classes 150 and 300	Classes 600 and 800
	mm	mm	mm
8	6	6	6
10	6	9	9
15	9.0	12.5	12.5
20	12.5	17	17
25	17	24	24
(32)	23	30	30
40	28	37	37
50	36	49	49
(65)	50	64	64
80	57	75	75
100	75	98	98
150	98	148	148
200	144	198	198
250	187	248	245
300	228	298	295
350	266	335	325
400	305	380	375

NOTE See Table 1 for equivalent nominal size (in).

Section 2. Design and materials

8 Design

NOTE Typical ball valve constructions are given in Appendix C.

8.1 General

Bodies shall be of one piece or split construction (see Figure 2(a) and Appendix C). In the case of split body valves, the minimum design strength of the split body joint or joints shall be equivalent to that of the body end flange of a flanged body, or the appropriate equivalent flange for a butt-weld-end, socket-weld-end, or threaded-end body.

Bolted covers shall be provided with not less than four bolts, stud-bolts, studs or socket head cap or hexagon headed screws.

NOTE 1 If the purchaser requires any particular design feature to prevent over-pressurization of the body cavity, e.g. pressure equalizing seats, this should be stated on the enquiry or order (see Appendix A).

NOTE 2 For ball valves designed to relieve pressures above normal working pressure that may build up in trapped cavities due to thermal expansion or evaporation of liquid, provision can be made for a pressure relief hole or passage or other means, e.g. pressure relieving seats, to relieve pressure in the bonnet and body cavities. The means adopted will be determined by the manufacturer unless the purchaser exercises his option in accordance with Appendix A.

8.2 Shell wall thickness

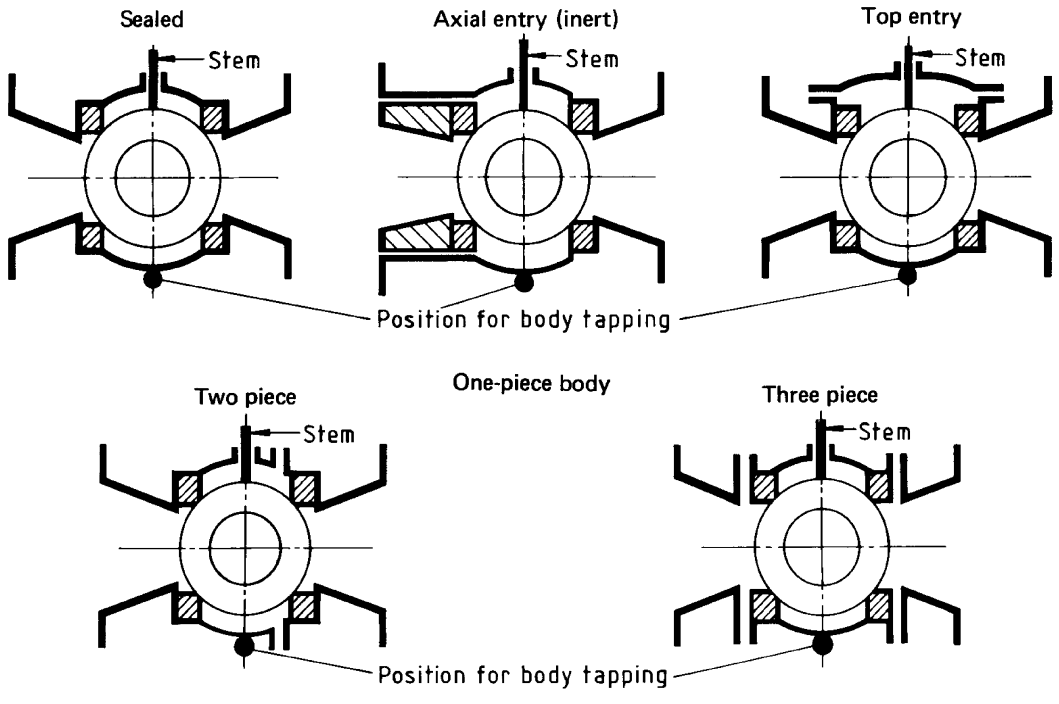
The minimum wall thickness of the pressure-containing shell shall be as given in Table 10. Drilling of, pinning to, or spot welding the wall of a pressure-containing part, e.g. for nameplate fixing, is not permissible where it would reduce the effective thickness below the permitted value.

Table 10 — Shell thickness

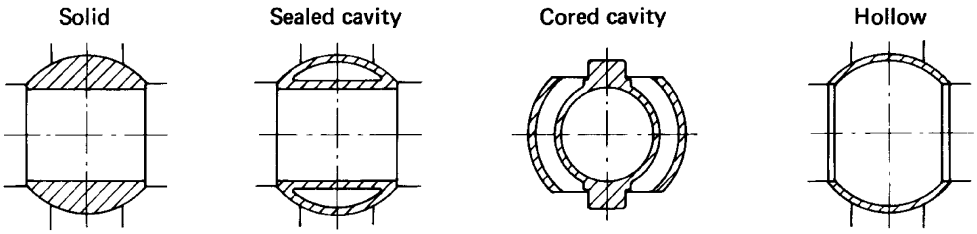
Nominal size	Minimum shell thickness							
(DN)	PN 10	PN 16	Class 150	PN 25	PN 40	Class 300	Class 600	Class 800[a]
	mm	mm	mm	mm	mm	mm	mm	mm
8	—	—	—	—	—	—	—	3.3
10	—	—	—	—	—	—	—	3.5
15	4.0	4.0	4.0	4.0	4.0	4.0	5.0	4.0
20	4.0	4.0	4.0	4.0	4.0	4.0	5.0	4.3
25	5.0	5.0	5.0	5.0	5.0	6.0	6.0	5.0
(32)	6.0	6.0	6.0	6.0	6.0	7.0	7.0	5.6
40	6.0	6.0	6.0	6.0	6.0	7.0	7.0	5.6
50	6.5	6.5	7.0	7.5	8.0	8.0	8.0	6.1
(65)	6.5	7.0	7.0	7.5	8.0	8.0	9.0	—
80	6.5	7.0	7.0	7.5	8.0	9.0	10.0	—
100	7.5	7.5	8.0	8.0	9.0	10.0	12.0	—
150	8.0	9.0	9.0	9.0	11.0	12.0	16.0	—
200	9.0	10.0	10.0	11.0	13.0	14.0	20.0	—
250	9.5	11.0	11.0	12.0	14.0	16.0	23.0	—
300	11.0	12.0	12.0	13.0	16.0	18.0	27.0	—
350	11.0	12.5	13.0	14.0	17.5	20.0	29.0	—
400	12.0	14.0	14.0	16.0	19.0	22.0	32.0	—

NOTE See Table 1 for equivalent nominal size (in).

[a] Applies to forged or bar stock bodies only.

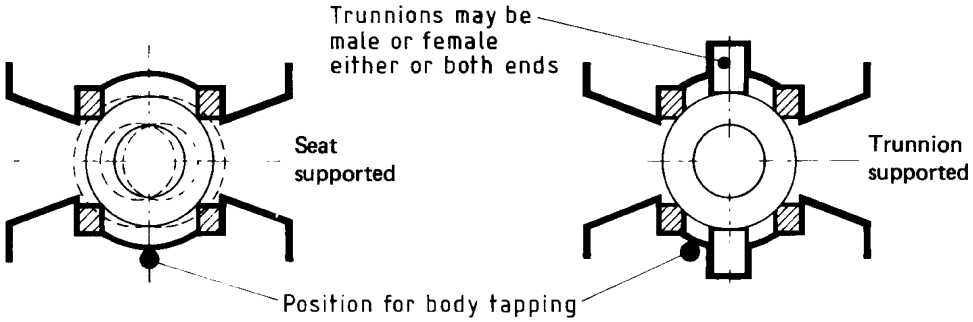


(a) Type of body



NOTE. Solid and cored cavity balls may be of one- or two-piece construction.

(b) Type of ball



(c) Type of ball support

Figure 2 — Typical variations of construction

8.3 Drain tapping

8.3.1 Provision shall be made in the design of valves DN 50 and larger for the incorporation of a drain tapping, the position for which is shown in Figure 2(a).

8.3.2 Tapping threads shall be in accordance with BS 21 taper or ANSI/ASME B1.20.1 and of the size given in Table 11.

Table 11 — Drain tapping size

Nominal size (DN)	Pipe tapping size
50, (65), 80, 100	½
150 and 200	¾
250 to 400	1
NOTE See Table 1 for equivalent nominal size (in).	

8.4 Flanged and extended weld ends

End flanges shall be cast or forged integral with the body or end piece of a split body design, or attached by butt welding. The welds of ends attached by butt welding or extended ends attached by socket welding shall comply with BS 2633 or BS 4677, as appropriate. Any heat treatment necessary to ensure that the material is suitable for the full range of service temperature shall be performed.

NOTE Other flange attachment welding methods are outside the scope of this standard.

8.5 Stems, ball shanks, stem extensions

Stems, ball shanks, stem extensions, stem mounted handwheels or other attachments shall be designed to prevent mis-orientation. Permanent marking shall be provided on the end of the stem, to which an operating mechanism could be attached, to indicate the axis of the flow passage through the ball.

NOTE Attention is drawn to the fact that markings such as an engraved line on the end of the stem will only provide an approximate indication of the port position.

8.6 Stem retention

The valve design shall be such that the stem seal retaining fasteners, e.g. packing gland fasteners, alone do not retain the stem. The design shall ensure that the stem shall not be capable of ejection from the valve while the valve is under pressure by the removal of the stem seal retainer, e.g. gland, alone.

8.7 Gland

An internally screwed stuffing box is not permitted. Glands of the screwed cap type (see, for example, item 7 of Figure 6) shall not be used for valves larger than DN 50 or 2 in nominal size. The bolted type shall be of one-piece, one-piece bushed or of two-piece self-aligning type. Vertically split glands shall not be used. Gland bolts shall pass through holes in the gland.

8.8 Body seat rings

Body seat rings or seat ring assemblies shall be designed so as to be renewable except for those valves having a one-piece sealed (welded) body construction.

8.9 Ball

On full bore valves the ball port shall be cylindrical.

NOTE 1 The purchaser should state on his enquiry or order if reduced bore valves are required with balls having cylindrical ports (see Appendix A).

Sealed cavity balls shall be designed to withstand the full hydrostatic body test pressure. Typical types of ball construction are given in Figure 2(b) (see also Appendix C).

NOTE 2 Solid, sealed cavity and two-piece balls are shown with cylindrical ports in Figure 2(b).

8.10 Wrenches and handwheels

When used, wrenches and handwheels shall be designed to withstand a force not less than that given in Table 12 without permanent distortion.

Table 12 — Minimum force for wrenches and handwheels

Valve size	Force
	N
15	350
20	350
25	450
40	600
50	700
80	700
100	700
150	700
200	700
250	700
300	700
350	700
350	700
400	700

8.11 Anti-static design

Valves shall incorporate an anti-static feature that ensures electrical continuity between stem and body of valves DN 50 or smaller, or between ball, stem and body of larger valves.

The use of a conductive stem seal is permitted provided that the seal is not the sole means of achieving the anti-static function.

NOTE Conductive packings are not compatible with certain process fluids (see **10.4** and Appendix A).

8.12 Fire-tested design

All valves shall be of fire-tested design (see clause **12**).

9 Operation

9.1 Valves shall be operated by a handwheel, wrench or actuator (see Appendix A).

NOTE For manually operated valves, clockwise closing will always be supplied unless the purchaser specifically requests anticlockwise closing in accordance with Appendix A.

9.2 The length of the wrench or diameter of the handwheel for direct or gear operated valves shall (after opening and closing a new valve at least three times) be such that a force not exceeding 350 N shall be required to operate the ball from either the open or closed position under the maximum differential pressure recommended by the manufacturer.

9.3 Handwheels shall be marked to indicate the direction of closing.

9.4 Handwheels and wrenches shall be fitted in such a way that whilst held securely, they may be capable of being removed and replaced where necessary.

NOTE On designs where the handwheel retaining nut also compresses the stem packing, removal of the nut could result in leakage from the stem.

9.5 All valves shall be provided with an indicator to show the position of the ball port and the design of the valve shall not permit incorrect assembly. When a wrench is the sole means of indicating port position it shall be arranged so that the wrench lies parallel to the line of flow in the open position.

9.6 Stops shall be provided for both the fully open and fully closed positions of the valve and shall be so designed as to prevent mis-orientation.

9.7 The dimensions of actuator attachment flanges shall comply with BS 5840-1.

10 Materials

10.1 Pressure containing shell

10.1.1 The body, body connector, insert and cover materials shall be selected from BS 1560-2 or BS 4504-1. However for valves smaller than DN 50 and made from bar-stock, the range of materials is supplemented by the materials given in Table 13. For flat covers the range of materials is supplemented by plate complying with BS 1501-1, BS 1501-2 (including Addenda Nos. 1 and 2) and 3, as appropriate. Plate material shall have the same nominal composition as the valve body material.

10.1.2 The carbon content of all pressure-containing parts involved in welding operations shall be restricted as follows:

a) 0.25 % maximum for carbon or carbon molybdenum steels;

b) 0.15 % maximum for 5 Cr ½ Mo steel;

c) $C + \frac{Mn}{6}$ to be not greater than 0.41 %.

10.1.3 The chemical composition of the body drain plug material shall be of the same type as that of the body. Cast iron plugs shall not be used.

Table 13 — Additional materials permitted for use in the manufacture of valves from bar-stock

Material[a]	British Standard	Grade
Carbon steel	970-1	070M20[b]
1 Cr ½ Mo	1502	620–440
2¼ Cr 1 Mo	1502	622
18/8	970-1	304S31
18/8LC	970-1	304S11
18/10/2	970-1	316S31
18/10/2LC	970-1	316S11
18/8/Ti	970-1	321S31
18/8/Nb	970-1	347S31

[a] The materials are in addition to those specified in BS 1560-2 or BS 4504-1.
[b] 070M20 in the normalized condition, or cold drawn from the hot rolled condition.

10.2 Trunnions, ball (or ball and shank), stem and seat ring housings

Trim materials, i.e. trunnions, ball (or ball and shank), stem and seat ring housings, are not a requirement of this standard.

NOTE Trim materials are at the manufacturer's discretion unless specific requirements are stated in the purchaser's order (see Appendix A).

10.3 Body seat rings

The material used for body seat rings shall comply with the minimum pressure/temperature seat ratings given in Table 3.

NOTE 1 Unless otherwise specified by the purchaser, the manufacturer will supply body seat rings made from PTFE resins without fillers and from virgin material completely free of reclaimed processed material.

NOTE 2 The purchaser should state on his enquiry or order if a material other than PTFE, as given in note 1, is required (see Appendix A).

10.4 Stem seals, body seals and gaskets

Materials for stem seals, body seals and gaskets shall be suitable for use at the maximum temperature rating applying to the valve. The minimum corrosion resistance of any metallic part of the gasket shall be equal to the corrosion resistance of the shell.

NOTE The purchaser should specify in the enquiry and/or order any special requirements for seal and gasket materials to ensure compatibility with the process fluid (see Appendix A).

10.5 Bolting

The material of bolting for pressure-containing purposes shall comply with BS 4882. The use of carbon steel bolting is restricted to:

a) a service temperature not exceeding 230 °C;

b) PN 10, PN 16 and Class 150 valves.

10.6 Wrench and handwheel

The wrench or handwheel shall be of steel, malleable cast iron or nodular (spheroidal) graphite cast iron.

10.7 Wrench and handwheel nut

The wrench or handwheel nut material shall have a melting point above 955 °C. If of carbon steel, it shall be protected against atmospheric corrosion.

10.8 Gland

A one-piece gland or any gland flange shall be of steel. The bushing of a one-piece bushed gland or the gland proper of a two-piece gland shall be made of a material having a melting point above 955 °C.

10.9 Identification plates

For valves of nominal size DN 150 and larger, the identification plate shall be of 18/8 Cr Ni steel or nickel alloy, attached to the valve by pins of similar material or by spot welding on carbon steel or austenitic stainless steel valves (see **8.2** and Appendix A).

For valves smaller than DN 150, the identification plate material and attachment shall be corrosion resistant.

Section 3. Performance

11 Pressure testing

All valves shall be pressure tested in accordance with BS 6755-1 and for the minimum test durations given in Table 14, and additionally:

a) the shell test shall be a hydrostatic test and there shall be no visually detectable leakage from the valve including the valve stem seals;

b) the seat test shall be either pneumatic or hydrostatic.

NOTE 1 If a particular type of seat test is required, i.e. pneumatic or hydrostatic, the purchaser should state the requirement in the enquiry and/or order (see Appendix A).

NOTE 2 The hydrostatic seat test is an optional test for soft seated ball valves. The purchaser should state any requirement for hydrostatic pressure tests on soft seated ball valves in the enquiry and/or order (see Appendix A).

NOTE 3 It should be noted that soft seated valves, when hydrostatically tested, might have a reduced performance capability in some subsequent services at low differential pressures. In these cases the manufacturer should be consulted.

c) the seat test acceptance level for all valves shall be leakage rate A, i.e. no visually detectable leakage.

If a production pressure test certificate is issued it shall contain a statement by the manufacturer confirming that the valves have been tested in accordance with this standard, and stating the actual pressures and medium used in the tests.

NOTE If a test certificate is required this should be specified by the purchaser on the enquiry and/or order for the valves (see Appendix A).

Table 14 — Pressure test durations

Nominal valve size		Minimum test durations: hydrostatic or pneumatic	
		Shell test	Seat test
(DN)	(in)	minutes	minutes
⩽ 100	⩽ 4	2	2
150 ⩽ 250	6 ⩽ 10	5	5
300 ⩽ 400	12 ⩽ 16	15	5

12 Fire testing

NOTE The text given in **12.1** applies to valves manufactured up to and including 31 July 1990. On 1 August 1990 the text given in **12.2** will apply.

12.1 (Effective up to and including 31 July 1990.)

Valves shall be type-tested in accordance with and comply with the requirements of either:

a) BS 6755-2; or

b) Appendix A of BS 5146-1:1974.

If valves having seats and seals designed to be non-destructible at temperatures up to 600 °C are tested in accordance with **A.1** of BS 5146-1:1974, the requirement for complete decomposition or disintegration of the soft seats and seals given in **A.1.2** b) of BS 5146-1:1974 shall not apply.

NOTE It is recommended that valves submitted for first time fire type testing on or after 1 August 1988 should be tested in accordance with BS 6755-2 only.

12.2 (Effective from 1 August 1990.)

Valves shall be type-tested in accordance with and comply with the requirements of BS 6755-2.

13 Anti-static testing

Valves shall be type-tested, the testing being carried out on new dry "as-built" valves of each type after pressure testing (see clause **11**). The test for electrical continuity shall be carried out after the test valve has been operated at least five times. It shall then be demonstrated that the discharge path between components, as specified in **8.11**, has electrical continuity with a resistance not exceeding 10 Ω from a power source not exceeding 12 V.

Section 4. Marking

14 General

14.1 Introduction

Valves shall be clearly marked in accordance with BS 5418, except as given in **14.2**, **14.3** and **14.4**.

14.2 Body marking

Body marking shall be integral with the body or on a plate securely fixed to the body. The plate (if used) shall be separate and distinct from the identification plate referred to in **14.3** (but see **14.5**).

Body marking shall include the following.

a) Nominal size, expressed as DN or given in inches as appropriate for PN rated or class rated valves respectively.

For reduced bore valves, the nominal size shall be followed by the nearest lower nominal size to which the reduction is effectively made (see Table 9), for example DN 80/65 or 3/2½.

For threaded end valves, the designation used for marking the nominal size shall be in accordance with ANSI/ASME B1.20.1 or BS 21 as appropriate.

b) Nominal pressure, expressed as PN or as class rating as appropriate.

c) Body material designation (see BS 1560-2 or Table 4).

d) Manufacturer's name or trade mark.

e) Melt identification.

f) Arrow to indicate direction of flow (unidirectional flow valves only).

Pipe end flanges grooved for ring joints shall be marked with the ring number (e.g. R25, see BS 1560-2). This identification shall be marked on the rim of both flange edges.

14.3 Identification plate marking

Identification plates shall be marked with the following.

a) The number of this British Standard, i.e. BS 5351.

b) The manufacturer's figure or number identifying the valve in all respects. The same figure or number shall therefore, only be used for valves that are identical in design, detail, dimensions and material, and that have interchangeable parts.

NOTE This identification may be used to determine the precise pressure/temperature rating of the valve from the manufacturer's technical data.

c) Seat material designation.

d) Ball material designation (see Table 15 for typical material symbols).

e) Any pressure or temperature restrictions imposed by the manufacturer due to limitations on materials or design of the closure components. This shall include the pressure differential across the ball at the 20 °C rating if it is lower than that of the body (see clause **6**), and the maximum permissible temperature and its corresponding allowable pressure.

14.4 Additional markings

For those PN 10, PN 16 and Class 150 short-pattern valves where the ball in the other than fully open position protrudes beyond the end of the flange faces, the following marking shall be provided in a prominent position:

"Open before removal".

Paints or inks used for additional markings on stainless steel valves shall comply with BS 5383.

NOTE Other additional markings may be used at the option of the manufacturer or at the request of the purchaser, provided that they do not conflict with any of the markings specified in this standard.

14.5 Omission of markings

On valves smaller than DN 50, it is permissible to omit the body markings in the following order, provided that they are shown on the identification plate:

a) nominal size;

b) manufacturer's name or trade mark;

c) materials designation;

d) nominal pressure rating.

Table 15 — Typical material symbols

Material	Symbol for ball materials
Carbon steel	CS or steel
13 % chromium steel	CR 13
Austenitic stainless steel	18-10-2 18-8 Nb
Nickel copper alloy	NiCu

NOTE For other materials, the manufacturer's designation should be used.

Section 5. Preparation for storage and transportation

15 General

After testing, each valve shall be drained of test liquid, cleared of any extraneous matter and suitably protected in preparation for storage and transportation.

NOTE Painting is not a requirement of this standard but if valves are required to be painted this should be specified by the purchaser in accordance with Appendix A.

16 Body ends

All valves shall have body ends sealed to exclude foreign matter during transit and storage.

Appendix A Information to be specified by purchaser

The following information should be supplied by the purchaser.

Nominal size DN (see clause **4**) . . . . . Pressure designation (see clause **5**) . . . . . .

Valve pattern (see clause **3**)

Full bore . . . . . Reduced bore . . . . . Short . . . . . Long . . . . . .

Body ends (see clause **7**)

Flanged (raised face) . . . . . Flanged (ring joint) . . . . . .

Other flange finish (specify) . . . . . .

Butt-weld-end preparation (see **7.2**) . . . . . .

Socket weld ends (see **7.3**) . . . . . .

Exterior weld ends (see **7.4**) . . . . . .

Threaded ends (see **7.5**) BS 21 (Taper) . . . . . ANSI/ASME B1.20.1 . . . . . .

Shell over pressurization arrangement, if required (see **8.1**)

Type of arrangement . . . . . .

Drain tapping, if required (see **8.3**)

BS 21 (Taper) . . . . . ANSI/ASME B1.20.1 . . . . . .

Ball port (see **8.9**). If through cylindrical bore required . . . . . .

Operation (see **9.1**)

If other than wrench or handwheel (specify) . . . . . .

Operation (see **9.1**)

If anti-clockwise close is required . . . . . .

Materials (see **10.1**)

Pressure containing shell (specify) . . . . . .

Materials (see **8.9** and **10.2**)

Type of ball and where particular material is required, (specify) . . . . . .

Materials (see **10.2**)

Stem, where particular material is required, (specify) . . . . . .

Materials (see **10.3**)

Body seat rings. If other than virgin PTFE is required, (specify) . . . . . .

Materials (see **10.4**)
Any special requirements for stem seals, body seals and gaskets to ensure compatibility with process fluid.

Identification plates (see **10.9**)

If fixing by spot welding is not permitted.

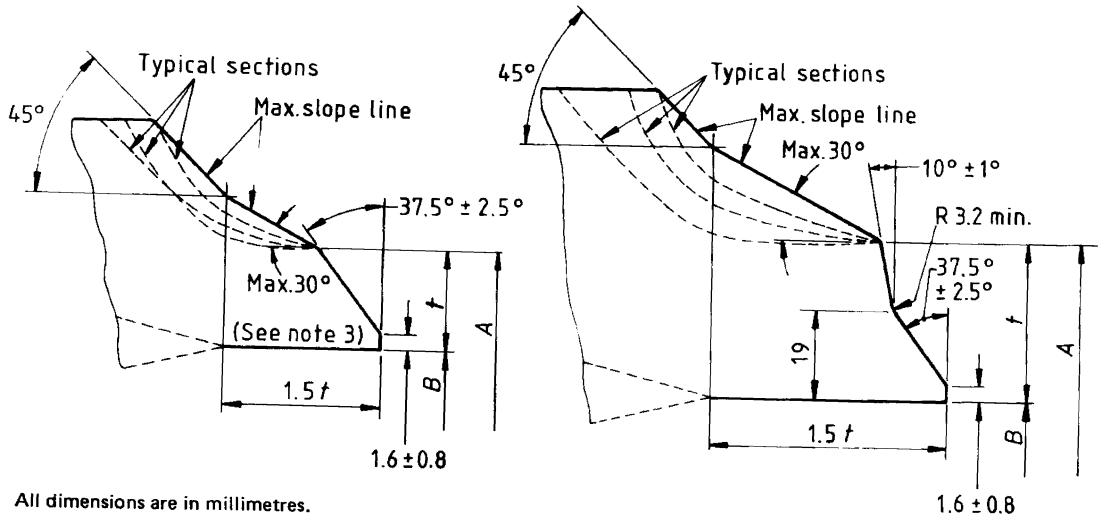
Seat test (see clause **11**)
Whether pneumatic or hydrostatic test is required, (specify) . . . . . .
Whether a test certificate is required, (specify) . . . . . .

Painting (see clause **15**)

If valves are to be painted . . . . . .

Appendix B Weld-end preparations

Typical weld-end preparations are given in Figure 3 and Figure 4.



a) Welding end for connection to pipe of wall thickness t of 22 mm or less

b) Welding end for connection to pipe of wall thickness t greater than 22 mm

NOTE 1 A is the nominal outside diameter of welding end (see table below); B is the nominal inside diameter of pipe (for tolerance on B, see table below); t is the nominal wall thickness of pipe.

NOTE 2 Dotted lines denote maximum envelope for transitions from welding groove.

NOTE 3 The inside and outside surfaces of valve welding ends should be machine finished overall. Contour within the envelope is at the manufacturer's option unless otherwise specifically ordered.

NOTE 4 Intersections should be slightly rounded.

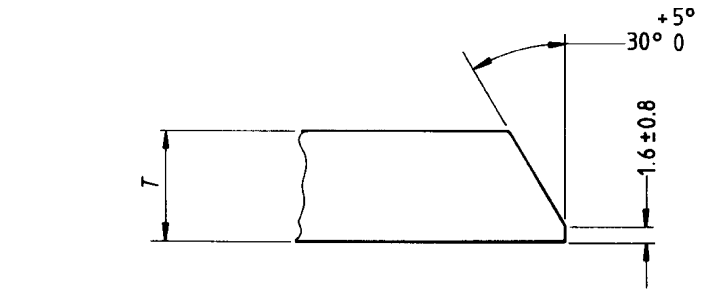
NOTE 5 Valves having nominal wall thickness of 3 mm or less at the weld preparation may have ends cut square or slightly chamfered ends.

NOTE 6 For nominal outside diameters and wall thicknesses of steel pipes, see ANSI B36.10 or BS 1600-2.

NOTE 7 Regardless of tolerances specified for dimensions A and B, the thickness of the weld-end should never be less than 87.5 % of the nominal thickness of the pipe.

Valve nominal size	DN	40	50	65	80	100	150	200	250	300	350	400
A	mm	50	62	75[a]	91	117	172	223	278	329	362	413
Tolerance on A	mm	+ 2.5 − 1					+ 4 − 1					
Tolerance on B	mm	+ 1								+ 2		
[a] A is 78 mm when used with pipe complying with BS 3600.												

Figure 3 — Weld-end preparation

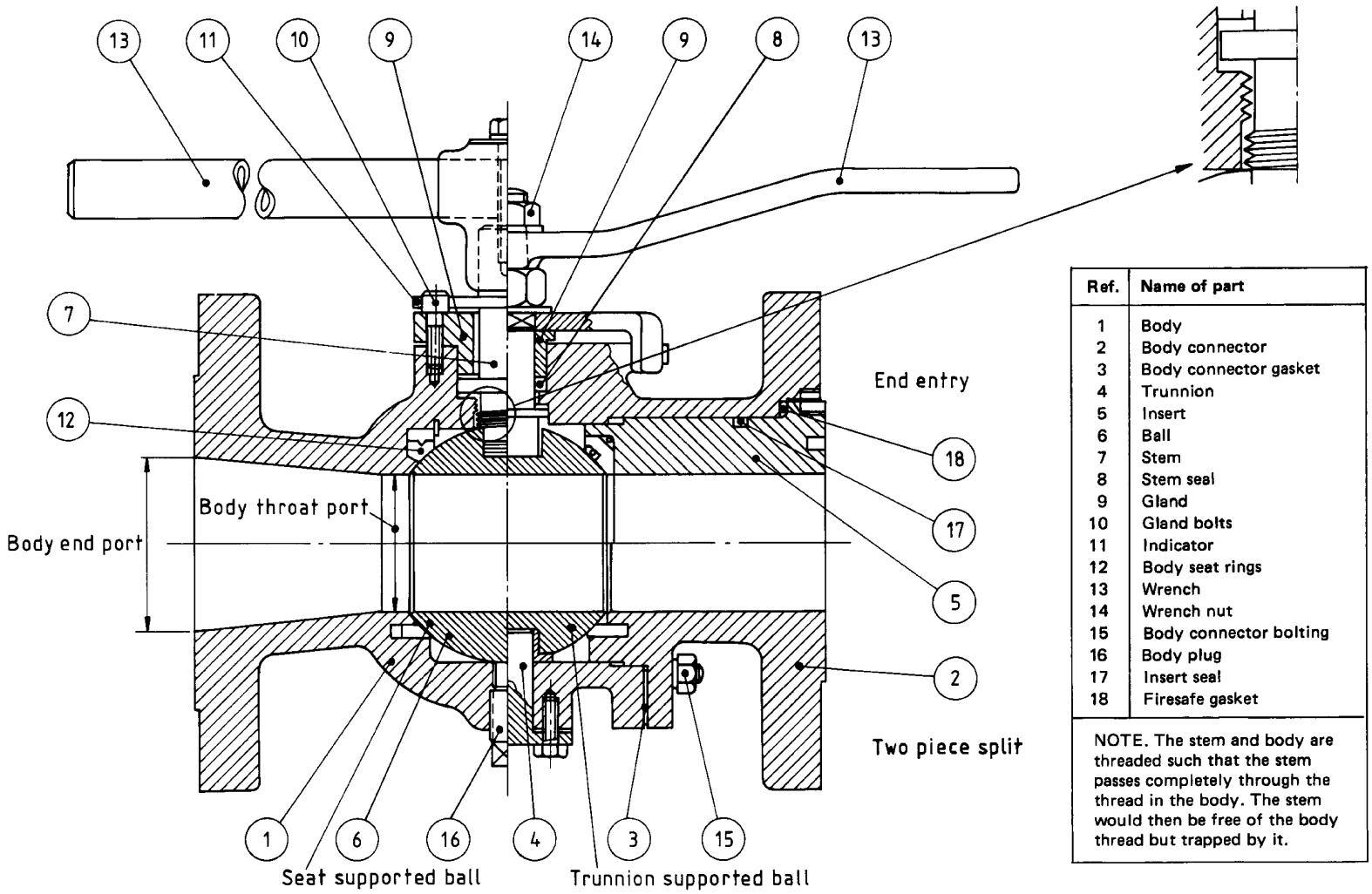


Dimension is in millimetres.

Figure 4 — Typical bevel for wall thicknesses (*t*) 22 mm or less for pipeline applications

Appendix C Typical ball valve constructions

Typical constructions of ball valves are shown in Figure 5, Figure 6, Figure 7 and Figure 8 which are composite sketches for the purpose of showing some typical variations in individual details. A product utilizing any combination of the details shown in each particular figure (except when such combination may be specifically prohibited in the text) or similar construction will be acceptable provided it complies with this standard in all other respects.



Ref.	Name of part
1	Body
2	Body connector
3	Body connector gasket
4	Trunnion
5	Insert
6	Ball
7	Stem
8	Stem seal
9	Gland
10	Gland bolts
11	Indicator
12	Body seat rings
13	Wrench
14	Wrench nut
15	Body connector bolting
16	Body plug
17	Insert seal
18	Firesafe gasket

NOTE. The stem and body are threaded such that the stem passes completely through the thread in the body. The stem would then be free of the body thread but trapped by it.

Figure 5 — Two-piece split body or one-piece end entry body

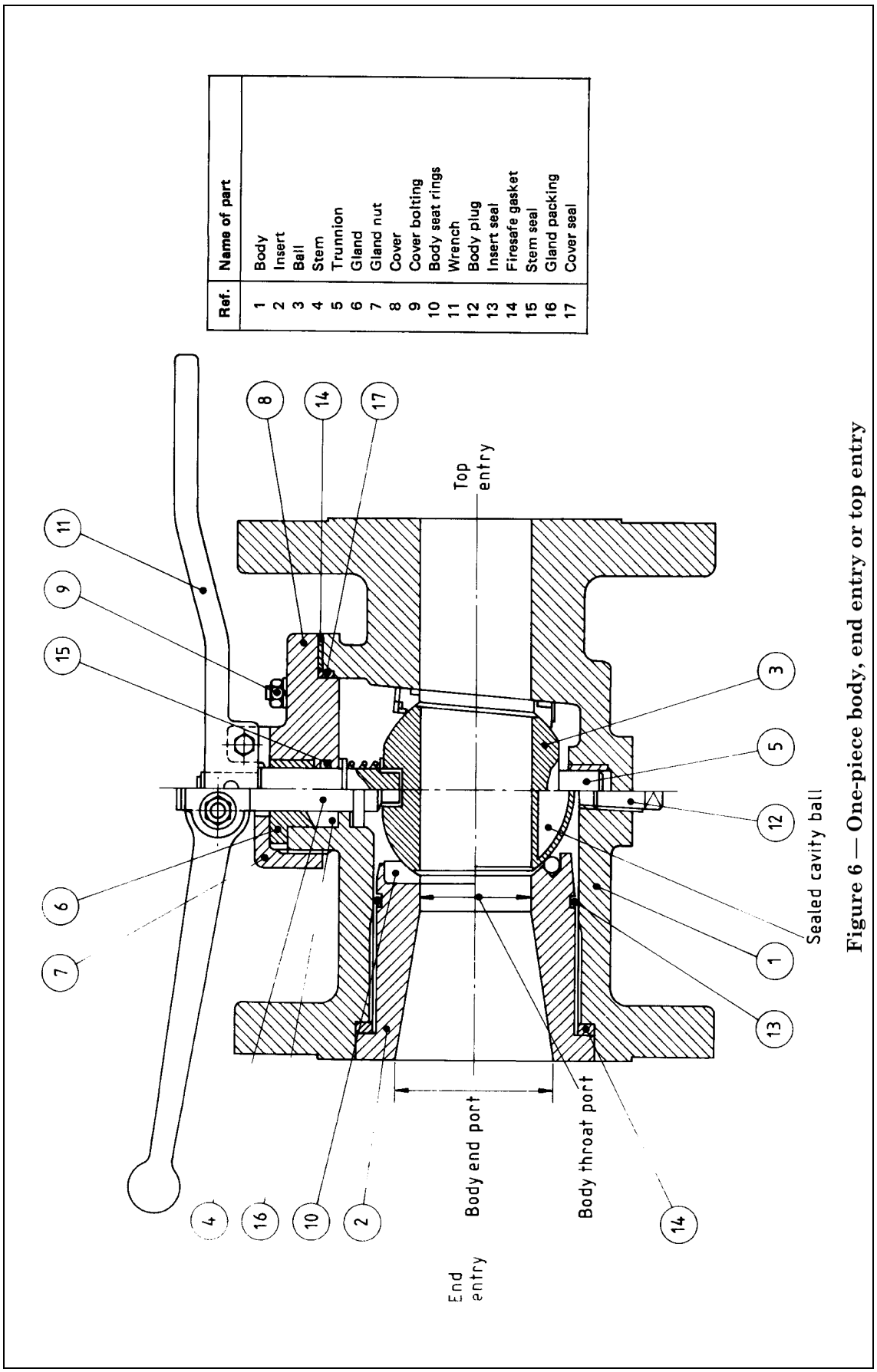


Figure 6 — One-piece body, end entry or top entry

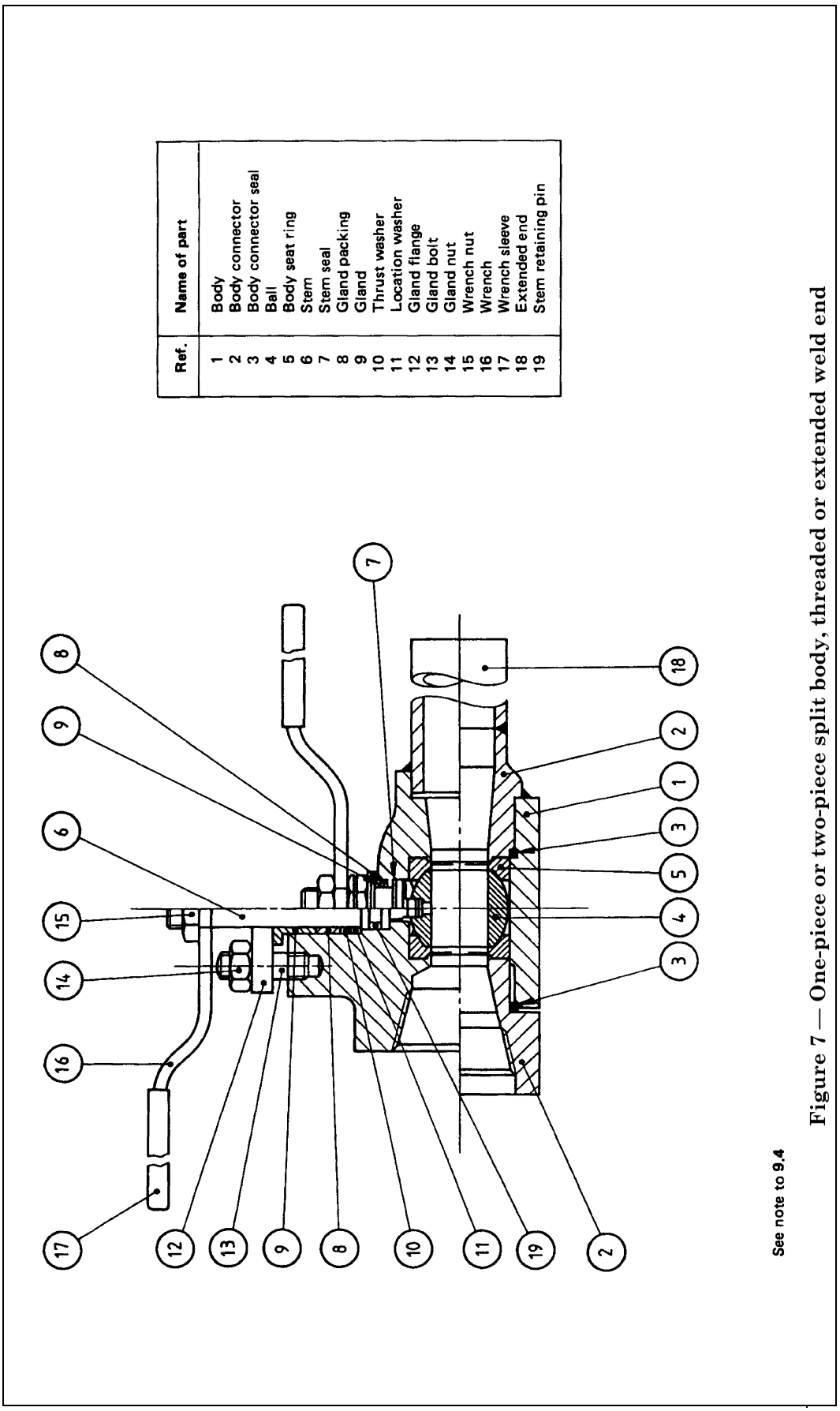


Figure 7 — One-piece or two-piece split body, threaded or extended weld end

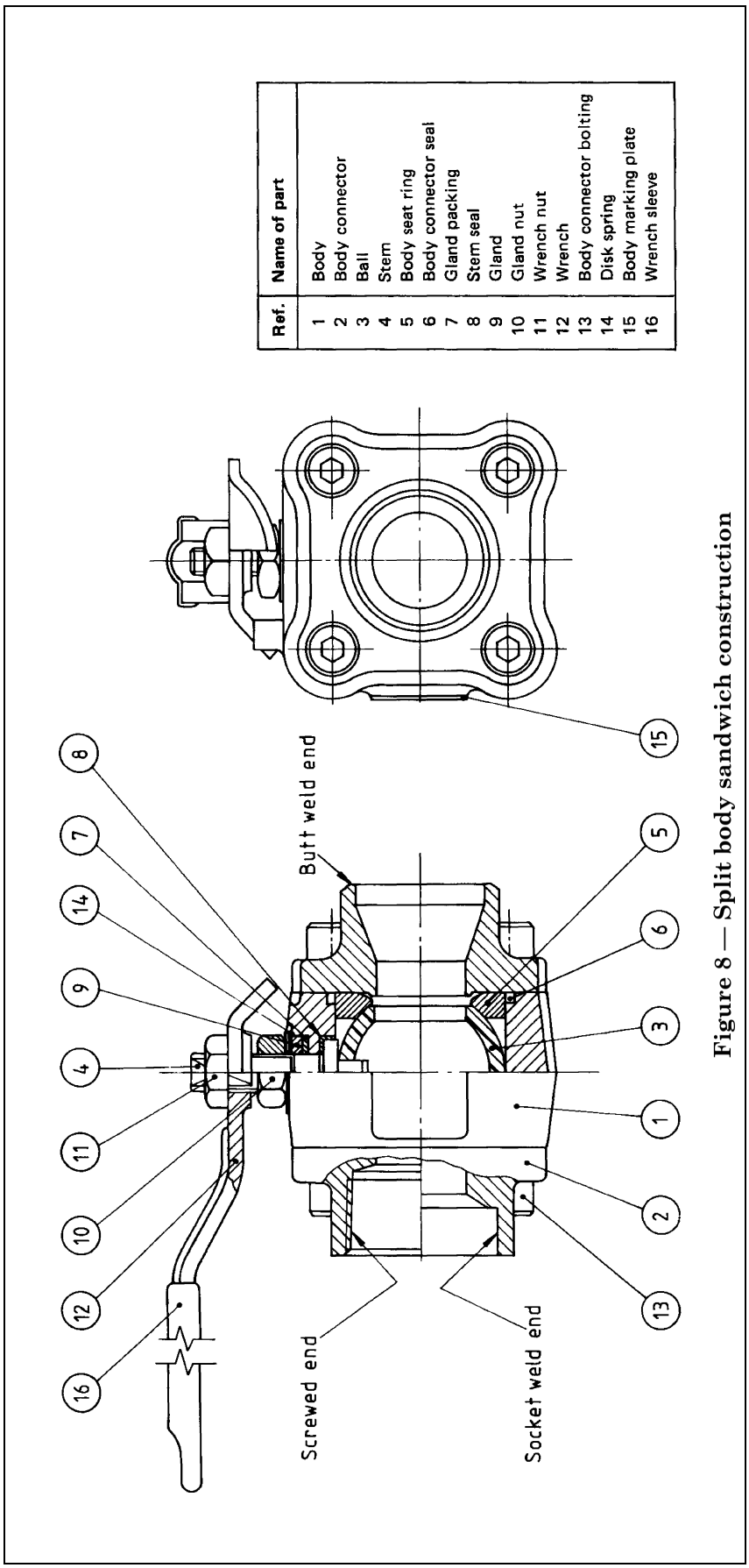


Figure 8 — Split body sandwich construction

Publications referred to

BS 21, *Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads.*

BS 970, *Specification for wrought steels for mechanical and allied engineering purposes.*

BS 970-1, *General inspection and testing procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels.*

BS 1501, *Steels for fired and unfired pressure vessels. Plates.*

BS 1501-1, *Specification for carbon and carbon manganese steels.*

BS 1501-2, *Alloy steels. Imperial units.*

Addendum No. 1 (1973) to BS 1501-2:1970

Addendum No. 2 (1975) to BS 1501-2:1970

BS 1501-3, *Corrosion and heat resisting steel: Imperial units.*

BS 1502, *Specification for steels for fired and unfired pressure vessels: Sections and bars.*

BS 1560, *Steel pipe flanges and flanged fittings (nominal sizes ½ in to 24 in) for the petroleum industry.*

BS 1560-2, *Metric dimensions.*

BS 1600, *Dimensions of steel pipe for the petroleum industry.*

BS 1600-2, *Metric units.*

BS 1768, *Unified precision hexagon bolts, screws and nuts (UNC and UNF threads). Normal series.*

BS 1769, *Unified black hexagon bolts, screws and nuts (UNC and UNF threads). Heavy series.*

BS 2080, *Face-to-face, centre-to-face, end-to-end and centre-to-end dimensions of flanged and butt-welding end steel valves for the petroleum, petrochemical and allied industries.*

BS 2470, *Hexagon socket screws and wrench keys. Inch series.*

BS 2633, *Class 1 arc welding of ferritic steel pipe work for carrying fluids.*

BS 2693, *Screwed studs.*

BS 2693-1, *General purpose studs.*

BS 3600, *Specification for dimensions and masses per unit length of welded and seamless steel pipes and tubes for pressure purposes.*

BS 3692, *ISO metric precision hexagon bolts, screws and nuts.*

BS 4168, *Hexagon socket screws and wrench keys — metric series.*

BS 4190, *ISO metric black hexagon bolts, screws and nuts.*

BS 4439, *Screwed studs for general purposes.*

BS 4504, *Flanges and bolting for pipes, valves and fittings. Metric series.*

BS 4504-1, *Ferrous.*

BS 4677, *Class 1 arc welding of austenitic stainless steel pipework for carrying fluids.*

BS 4882, *Bolting for flanges and pressure containing purposes.*

BS 5146, *Inspection and test of valves.*

BS 5146-1, *Specification for steel valves for the petroleum, petrochemical and allied industries.*

BS 5159, *Cast iron and carbon steel ball valves for general purposes*[2)].

BS 5383, *Specification for material marking and colour coding of metal pipes and piping system components in steel, nickel alloys and titanium alloys.*

BS 5418, *Specification for marking of general purpose industrial valves.*

BS 5840, *Valve mating details for actuator operation.*

BS 5840-1, *Specification for flange dimensions and characteristics.*

BS 6683, *Guide to installation and use of valves*[2)].

BS 6755, *Testing of valves.*

[2)] Referred to in the foreword only.

BS 6755-1, *Specification for production pressure testing requirements.*
BS 6755-2, *Specification for fire type-testing requirements.*
ISO 6708, *Pipe components — Definition of nominal size.*
ISO 7268, *Pipe components — Definition of nominal pressure.*
ANSI/ASME B1.20.1, *Pipe threads, general purpose (inch).*
ANSI B36.10., *Welded and seamless wrought steel pipe.*

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