

Specification for

Pipe supports —

Part 3: Large bore, high temperature, marine and other applications

UDC 621.881:621.643.2

Cooperating organizations

The Mechanical Engineering Standards Committee, under whose direction this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

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	Water-tube Boilermakers' Association

The organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

British Chemical Engineering Contractors' Association	Ductile Iron Pipe Association
British Marine Equipment Council	Heating and Ventilating Contractors' Association
British Ship Research Association	

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Foreword

This Part 3 of BS 3974 has been prepared under the direction of the Mechanical Engineering Standards Committee in cooperation with the Shipbuilding and Marine Standards Committee.

Part 3 specifies requirements for pipe support components for pipe sizes, materials and applications not covered in Parts 1 and 2. Due to particular requirements for certain industries or special material requirements for piping systems, it has been found convenient for presentation purposes to depart from the format previously established in Parts 1 and 2 of this standard and to divide Part 3 into sections, as follows.

- *Section 1: General design and manufacture;*
- *Section 2: General applications;*
- *Section 3: Marine applications.*

Section 3 provides data to meet the specific requirements of shipbuilding pipework installations and is based on a proposal of the British Ship Research Association.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 36, 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.

Section 1. General design and manufacture

1 Scope

Part 3 of this standard specifies design requirements and dimensions for the manufacture of pipe support components that are generally outside the scope of Parts 1 and 2. These are

- a) carbon steel pipe clips, overstraps and U-bolts for large diameter pipes;
- b) alloy steel pipe clips, U-straps and riser clamps;
- c) copper alloy overstraps and hookstraps.

The overall pipe nominal size range is from 10 to 1 200 for pipeline fluid temperatures in the range -196°C to 570°C according to type and material.

The pipe support components specified provide for the supporting of pipes manufactured from carbon and alloy steels, cast iron, ductile iron and grey iron spun pipes, copper and copper alloys.

Section 1 provides design data, material specifications and manufacturing requirements for pipe support components.

Section 2 provides dimensional details and safe working loads (where applicable) for pipe support components on a general application basis.

Section 3 contains additional requirements or restrictions relating to the application to ships' installations of pipe supports detailed in section 2. This includes guidance notes, component details, marine range of working temperatures, safe working loads and material specifications not included in Part 1 and elsewhere in this Part. Typical illustrations of shipboard installations are shown in Figure 12 to Figure 17.

2 References

The titles of the publications referred to in this standard are listed on the inside back cover.

3 Definitions

For the purposes of this British Standard the terminology given in Parts 1 and 2 of this standard, and the following terms and definitions, apply.

3.1

liner

a sheath of protective material inserted between the outside of the pipe and the support clip to protect the pipe from abrasion, electrolytic action, or to limit heat transfer to the clip (see 4.2). Also used to refer to the material inserted between the outside of the pipe and the support clip to distribute the load

3.2

bank

an arrangement of pipelines in close proximity and routed parallel to each other

3.3

seat

a fabricated bracket integral with but auxiliary to the main structure of a ship and provided for the purpose of attachment of a pipe support foot

4 Pipe support design

4.1 The design temperature for pipe clips, U-straps, and riser pipe clamps in direct contact with the pipe shall be that of the fluid in the pipe. Pipe clips, U-straps and riser clamps shall be designed on the basis that they are in direct contact with, but not tightened on to, the pipe.

4.2 Where a pipe clip is in contact with load-bearing insulation, the design temperature shall be that of the outer surface of this insulation. When load bearing insulation is employed between pipe and clip, deformation of the clip is not permitted and therefore the tabulated safe working loads shall be down-rated by 20 %, or alternatively, the width of the clip (dimension *B*) shall be increased by 25 %. Typical insulated pipe clip applications are shown in Figure 12.

4.3 Any dynamic loading to which the pipe clips, U-straps and riser clamps are subjected shall be added to the static load to obtain the total design safe working load. Care shall be taken in calculating both the static and any dynamic loadings.

4.4 High pressure/high temperature pipelines may be constructed using steel tube having a controlled bore and a wide rolling tolerance on the wall thickness, resulting in non-standard outside diameters.

The inside diameters of pipe clips, riser clamps and U-straps specified in this standard have been tabulated to give clearance over standard outside diameter steel tube where the tolerance on the outside diameter is $\pm 1\%$. Where non-standard outside diameter tube is employed the inside diameter of these components shall be varied to suit.

This inside diameter shall be decided by measurement of the outside diameters of a number of tubes from each rolling batch, plus the addition of the clearance between the clip and the pipe as obtained from the tables for similar size tube.

Where the inside diameter thus obtained is different from the pipe outside diameters tabulated in this standard then the dimensions, clearances and sections of the next larger size shall be used except that dimension *P* on pipe clips and dimension *B* on riser clamps shall be reduced pro rata.

4.5 In the case of U-bolts, overstraps and hookstraps, these are primarily intended as retaining type, non-load bearing supports, consequently no safe working loads are specified. If these components are used as load bearing supports it is the responsibility of the user to ascertain that the loads are compatible within the yield strength of the materials of components and fasteners.

4.6 When overstraps are bolted on to a vertical surface so that the weight of the pipe is acting on one half of the overstrap, it is recommended that support ribs are fitted between the palm and the side of the overstrap. In certain instances, lateral strengthening ribs may also be necessary for overstraps fitted in the normal manner to restrain transverse forces on the pipeline.

5 Temperature ranges for pipe supports

5.1 The pipe clips, U-straps and riser clamps specified in this Part 3 are designated by letter reference according to working temperature range as follows.

Temperature ranges

Designation	Working temperature range	Remarks
	°C	
Range A	– 20 to 100	—
Range B	– 20 to 300	For copper and copper alloy tubes only
Range C	above 400 up to and including 470	See note 1
Range D	– 20 to 570	See note 2
NOTE 1 The application of range C pipe clips is not defined in this Part 3 and reference should be made to Part 1 for design, application and dimensional details.		
NOTE 2 Because of different material sections, specifications and temperature applications for range D pipe clips these have been sub-divided into ranges D1, D1(M), D2, D3 and D3(M) within the overall temperature range given above. Specific temperature applications are specified in the appropriate sections 2 and 3. The suffix (M) denotes marine application in section 3.		

5.2 Except where otherwise specified in section 3, the application of U-bolts, overstraps and hookstraps specified in this standard shall be within the temperature range – 20 °C to 250 °C.

6 Materials

6.1 The preferred materials from which components of pipe support assemblies shall be manufactured are given in the following schedule of material specifications. Other materials may be used provided that they have equal or higher physical properties.

6.2 Lining materials for support components used on copper/copper alloy tubes shall be suitable for the limiting temperature of the pipeline. Also, care shall be taken in the choice of materials to be used in direct contact with the copper/copper alloy tubes since in certain environmental conditions, galvanic action may take place.

7 Manufacture and heat treatment

7.1 Where material for the manufacture of pipe clips, U-straps, riser clamps, overstraps and hookstraps is cut from plate, the cut edges shall be ground smooth prior to forming.

7.2 Carbon steel pipe clips, overstraps and hookstraps may be formed either hot or cold but consideration should be given to the need for heat treatment on cold formed clips of thickness of 10 mm and over.

Schedule of materials

Component		Material	Material reference	
			BS no.	Designation
(a) Pipe clips Clips	Range A Range B	Carbon steel	BS 4360 BS 1501-1	Grade 43A 151 or 161: grade 26B
	Range D1, D1(M), D2 Range D3, D3(M)	Alloy steel	BS 1501-2 BS 1501-2	620 grade 27B 622 grade 31B
All bolts and studbolts	Range A, B	Carbon steel	BS 4190	Grade 4.6
	Range D1, D1(M), D2 Range D3, D3(M)	Alloy steel	BS 4882 BS 4882	661 grade B16 1 % Cr Mo V boron grade B16A
All nuts	Range A, B	Carbon steel	BS 4190	Grade 4
	Range D1, D1(M), D2 Range D3, D3(M)	Alloy steel	BS 4882 BS 4882	240 grade 4 621 grade 7
Distance-pieces	All ranges	Carbon steel	BS 1387	Medium or heavy
(b) U-straps Strap	Range D1, D2 Range D3	Alloy steel	BS 1501-2 BS 1501-2	620 grade 27B 622 grade 31B
Steady plate	Range D1, D2, D3	Alloy steel	BS 1501-2	620 grade 27A or 27B
Yoke, end and hanger plates	Ranges D1, D2, D3	Carbon steel	BS 4360	Grade 43A
All bolts All nuts	Ranges D1, D2, D3	Carbon steel	BS 3692 BS 3692	Grade 8.8 Grade 8
(c) Riser clamps Clamp and gusset	Range D1, D2 Range D3	Alloy steel	BS 1501-2 BS 1501-2	620 grade 27B 622 grade 31B
All bolts	Range D1, D2 Range D3	Alloy steel	BS 4882 BS 4882	661 grade B16 1 % Cr Mo V boron grade B16A
All nuts	Range D1, D2 Range D3	Alloy steel	BS 4882 BS 4882	240 grade 4 621 grade 7
Distance-pieces	Range D1 Range D2, D3	Carbon steel Alloy steel	BS 1387 BS 3604	Medium or heavy 620
(d) Sling rods Rods Nuts	All components All ranges All ranges	Carbon steel	BS 4360 BS 4190	Grade 43A Grade 4 or 6
(e) Pipe overstraps and U-bolts		Carbon steel	BS 4360	Grade 43A
		Low temperature steel	See Table 12 in section 3	
(f) Pipe overstraps and hookstraps		Copper alloy	BS 2870	CZ 110
		Stainless steel	BS 1449-2	17 % min. Cr content

Schedule of materials

Component		Material	Material reference	
			BS no.	Designation
(g) Lining materials for steel pipe clips when used on copper/copper alloy tubes (See 6.2)		Lead sheet	BS 1178	—
		Copper/copper alloy sheet	BS 2870	CZ 110
		Compressed fibre sheet	—	—

7.3 Alloy steel pipe clips, U-straps and riser clamps shall be hot formed within the temperature range 950 °C to 1 100 °C. After forming, heat treatment shall be applied as specified in the following schedule.

Minor rectification work to correct distortion caused by heat treatment may be carried out at a temperature not exceeding 650 °C for 1 % Cr, ½ Mo or 690 °C for 2¼ % Cr, 1 % Mo steel without the need for further heat treatment.

7.4 The welding and the examination of welds for the hanger plates of the U-straps shown in Figure 4 and the gusset plates for the riser clamps shown in Figure 5 shall comply with the requirements specified in BS 2633.

7.5 Distance pieces for use in pipe clips and riser clamps shall be manufactured from carbon steel or alloy steel pipe (see clause 6) with the ends cut square and shall be of suitable bore to be a free fit over the bolt. For range A the length of the optional distance piece shall be equal to the width of the sling rod eye, and for ranges B and D pipe clips, shall be equal to the width of the sling rod eye plus 3 mm. For riser clamps, the minimum length shall be as specified in Table 5(a), Table 5(b) or Table 5(c), or the width of the sling rod eye plus 3 mm, whichever is the greater.

7.6 Locking nuts shall be fitted to all load bolts for ranges B, C and D applications. In addition, it is recommended that locking nuts or locking washers be fitted to all other bolts wherever movement due to expansion contraction, vibration or shock loading is expected.

Where studbolts are used for range D pipe clips and riser clamps, a nut and locking nut shall be fitted on each end.

Schedule of heat treatment

Heat treatment operation		Material	
		BS 1501-2 620 grade 27B (1 % Cr, ½ % Mo)	BS 1501-2 622 grade 31B (2¼ % Cr, 1 % Mo)
Heat rate above 400 °C		Temperature rate	
		220 °C/h for thicknesses not exceeding 25 mm	200 °C/h for thicknesses not exceeding 12 mm
		$\left(220 \times \frac{25}{T}\right)$ °C/h for thicknesses (T) over 25 mm	100 °C/h for thicknesses over 12 mm
Normalizing	Soaking temperature	900 °C to 960 °C	
	Time period	0.5 min per mm of thickness (minimum 30 min)	
On completion of normalizing, components shall be removed from the furnace and allowed to cool in still air to a temperature below 150 °C before tempering.			
Riser clamp gusset plates shall be welded on at this stage; the welding shall comply with the requirements of BS 2633.			
After the welding of any component, tempering/stress relieving shall be carried out as follows.			
Tempering/stress relieving	Soaking temperature	630 °C to 670 °C	680 °C to 720 °C
	Time period	5 min per mm of thickness (minimum of 2 h)	3 h irrespective of thickness
Cooling rate after tempering		Temperature rate	
		275 °C/h for thicknesses not exceeding 25 mm	250 °C/h for thicknesses not exceeding 12 mm
		$\left(275 \times \frac{25}{T}\right)$ °C/h for thicknesses (T) over 25 mm	50 °C/h for thicknesses over 12 mm
		Below 400 °C components may be cooled in still air	

7.7 The dimensions and manufacture of spherical washers, sling rods and sling rod eyes shall be as specified in 4.5 and 4.6 of Part 1:1974 of this standard.

7.8 The necessity for manufacturing tolerances on components, particularly range D supports, shall be taken into consideration. Manufacturing tolerances are not specified in this standard and where specific tolerances are required, they shall be agreed between the purchaser and the manufacturer.

8 Protection

Where steel pipe clips, overstraps and U-bolts are exposed to salt water or other corrosive environment they shall be adequately surface protected as agreed between the purchaser and the manufacturer to suit the particular conditions (see 6.2).

9 Marking

Pipe clips, U-straps and riser clamps shall be identified by marking in accordance with the requirements specified in BS 5383 as follows.

Range A:	not colour marked
Ranges B and C:	dark grey
Ranges D1, D1(M) and D2:	pink
Ranges D3 and D3(M):	light blue

Section 2. General applications

10 Pipe clip design data

10.1 General. The pipe support components included in this section are, in general, extensions to those contained in Part 1 of this standard, but are augmented by the adaption of Part 1 pipe clips for use on copper alloy pipework and by the inclusion of alloy steel components for high temperature pipework up to 570 °C.

For temperature applications below – 20 °C the information given in clause 16 may be used for guidance purposes.

10.2 Safe working loads. The safe working loads for pipe clips, ranges A, B and D, specified in this section, have been designed on the following.

- Range A: on the yield stress of the material at room temperature.
- Range B: on 0.2 % proof stress of the material at 300 °C.
- Range D: on the mean stress to rupture of the material in 1 00 000 h at the appropriate maximum working temperature, divided by a design factor of 1.4.

10.3 Calculated design stress levels. The calculated design stress levels for pipe clips shall be as given at the foot of the page.

NOTE 1 The design criteria for ranges B, D1, D2 and D3 are derived from BS 5500.

NOTE 2 Information on design considerations for pipework calculations is given in Appendix A of Part 1:1974 of this standard.

11 Summary of pipe support components

The pipe support components specified in section 2 are summarized below. They shall comply with the requirements given in the relevant figures and tables as indicated.

- Range A pipe clips for nominal sizes of steel pipes from 650 to 1 000 inclusive: Figure 1 and Table 1(a).
- Range A pipe clips for nominal sizes of cast iron pipes from 700 to 1 200 inclusive: Figure 1 and Table 1(b).
- Range A pipe clips adapted for outside diameters of copper/copper alloy tubes from 20 mm to 1 016 mm inclusive: Figure 1 and Table 1(c).
- Range A pipe clips adapted for outside diameters of copper/copper alloy tubes from 20 mm to 610 mm: Figure 2 and Table 2.
- Range D pipe clips (incorporating subranges D1, D2 and D3 for nominal sizes of steel or alloy steel pipes from 15 to 600 inclusive: Figure 3 and Table 3.
- Range D1 to D3 U-straps for nominal sizes of alloy steel pipes 200 to 600 inclusive: Figure 4 and Table 4.
- Range D riser clamps (incorporating sub-ranges D1, D2 and D3) for nominal sizes of steel or alloy steel pipes from 200 to 600 inclusive: Figure 5 and Table 5(a), Table 5(b) and Table 5(c).
- U-bolts, to grip pipe, for nominal sizes of steel pipes from 650 to 1 000 inclusive, and for nominal sizes of cast iron pipes from 700 to 1 200 inclusive: Figure 6 and Table 6(a) and Table 6(b).
- Overstraps for nominal sizes of steel pipes from 225 to 1 000 inclusive, and for nominal sizes of cast iron pipes from 80 to 1 200 inclusive: Figure 7 and Figure 8 and Table 7 and Table 8.
- Overstraps and hookstraps for copper/copper alloy tubes and precision steel tubes of outside diameter range 10 mm to 57 mm inclusive: Figure 9 and Table 9.

k) Overstraps for copper/copper alloy tubes of outside diameter range 76.1 mm to 1 016 mm inclusive: Figure 10 and Table 10.

Calculated design stress levels

Range	Material specification		Working temperature range	Design criteria	Design factor	Design stress level
	BS no.	Designation				
A	BS 4360	grade 43A	°C – 20 to 100	Yield stress	1	N/mm ² 245
B	BS 1501-1	151 grade 26B 161 grade 26B	– 20 to 300	0.2 % proof stress	1	145
D1	BS 1501-2	620 grade 27B	– 20 to 510	Mean stress to rupture in 100 000 h	1.4	86
D2			above 510 up to and including 540			47
D3		622 grade 31A	above 540 up to and including 570			36

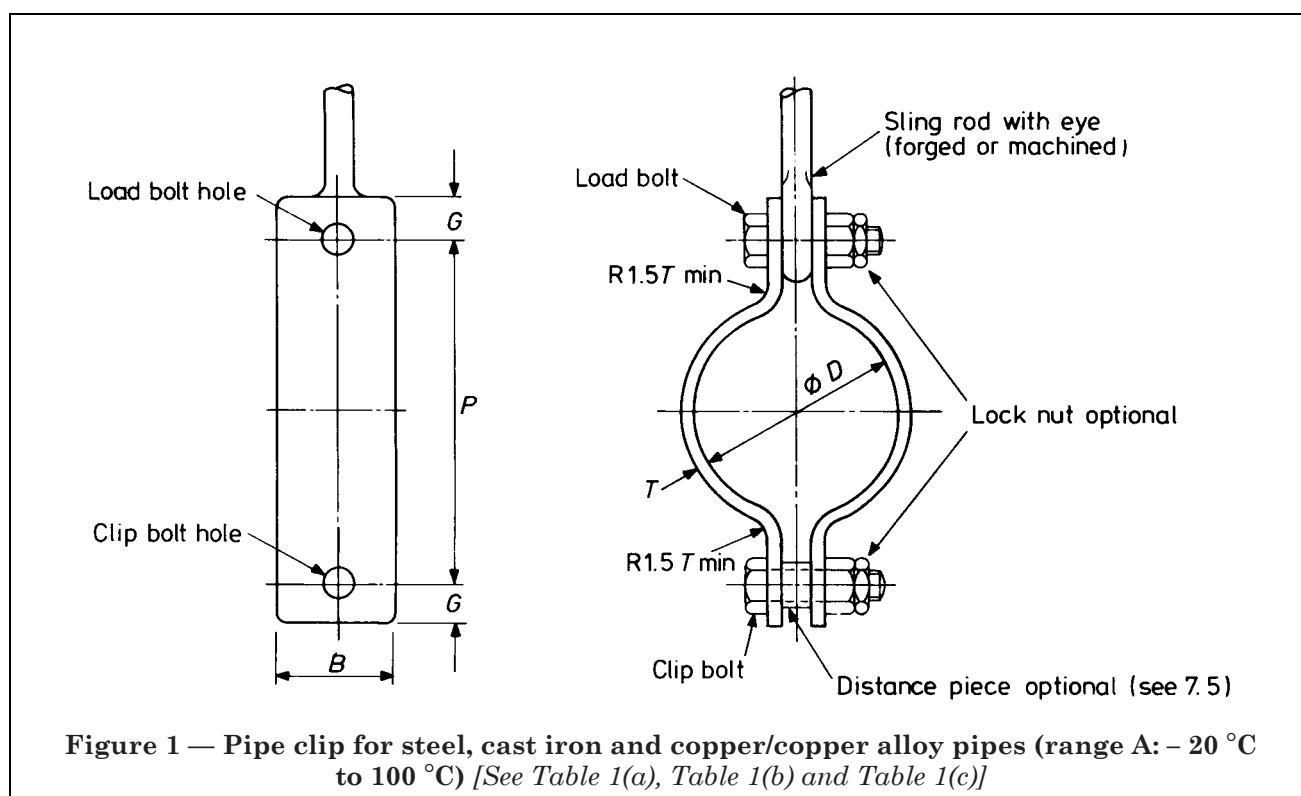


Table 1(a) — Dimensions of pipe clips for steel pipes (range A: – 20 °C to 100 °C)

All dimensions are in millimetres.

Pipe		Sling rod diameter	Clip dimensions			Clip and load bolts		<i>G</i> min.	Safe working load
Nominal size	Outside diameter		<i>D</i> diameter	<i>B</i> × <i>T</i>	<i>P</i>	Bolt size	Hole diameter		
650	660	30	665	80 × 20	830	M30	35	45	kg
700	711	30	716	80 × 20	880	M30	35	45	1 400
750	762	30	765	80 × 20	930	M30	35	45	1 300
800	813	30	816	90 × 25	1 020	M30	35	45	1 200
850	864	30	868	90 × 25	1 070	M30	35	45	2 000
900	914	30	918	90 × 25	1 120	M30	35	45	1 900
1 000	1 016	36	1 020	100 × 30	1 250	M36	42	54	1 800
									2 600

Table 1(b) — Dimensions of pipe clips for cast iron pipes (range A: – 20 °C to 100 °C)

All dimensions are in millimetres.

Pipe		Sling rod diameter	Clip dimensions			Clip and load bolts		<i>G</i> min.	Safe working load
Nominal size	Outside diameter		<i>D</i> diameter	<i>B</i> × <i>T</i>	<i>P</i>	Bolt size	Hole diameter		
700	738	30	740	80 × 20	900	M30	35	45	kg
800	842	30	845	90 × 25	1 040	M30	35	45	1 250
900	945	30	950	90 × 25	1 150	M30	35	45	1 950
1 000	1 048	36	1 050	100 × 30	1 280	M36	42	54	1 750
1 100	1 152	36	1 155	100 × 30	1 380	M36	42	54	2 500
1 200	1 255	36	1 260	100 × 30	1 490	M36	42	54	2 200
									2 000