

Specification for

Pipe supports —

Part 1: Pipe hangers, slider and roller type supports

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Foreword

This British Standard is the metric revision of BS 3974-1, which was originally published in 1966 under the authorization of the Mechanical Engineering Industry Standards Committee and at the request of the Engineering Equipment Users' Association. Previously restricted to requirements for the design (including dimensions) and the manufacture of components for rod-type pipe hangers, this revised edition has been extended to meet the needs of industry and now includes requirements on the design and manufacture of components for slider and roller type supports, for pipes transporting fluids within a temperature range minus 20 °C to 470 °C.

The revised appendices provide recommendations on design considerations, data and formulae for pipework calculations and methods of fixing. To assist the user in the application of pipe supports, many illustrations of typical support assemblies from the Engineering Equipment Users' Association Handbook No. 18 have been included in a separate appendix.

A further Part of this series (BS 3974-2) will deal with pipe attachments to steelwork and masonry structures.

NOTE 1 Information concerning SI units is given in BS 350. "Conversion factors and tables", and in PD 5686 "The use of SI Units".

NOTE 2 Attention is drawn to certification facilities offered by BSI; see the inside back cover of this standard.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 52, 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 Scope

This British Standard specifies requirements for the design (including dimensions) and manufacture of components for pipe hangers, slider and roller type supports for uninsulated and insulated steel and cast iron pipes of nominal size 15 mm to 600 mm, used for transporting fluids within the temperature range $-20\text{ }^{\circ}\text{C}$ to $470\text{ }^{\circ}\text{C}$.

Recommendations on design considerations, data and formulae for pipework calculations, methods of fixing and illustrations of typical pipe support assemblies are given in the appendices.

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

2 Definitions

For the purposes of this British Standard the following definitions apply:

1) anchor

a securing device to maintain in a pipeline a point fixed both in position and direction, under the design condition of temperature and loading

2) cold pull-up (cold draw)

a strain induced in a pipeline during erection to compensate for expansion or contraction under working conditions. This strain may be compressive or tensile depending upon the working temperature being below or above ambient

3) duckfoot

a device for transferring the axial load in a vertical pipeline at its lower extremity to a foundation or other fixtures

4) expansion loop

a device for absorbing the movement due to either temperature change or external force

5) expansion bellows

a device performing a similar function to an expansion loop, but employing a corrugated flexible element inserted in the pipeline

6) fittings

the component parts of a pipeline, other than the pipe. This collective term usually embraces bends, elbows, tees, unions, flanges and similar equipment

7) guide

a device used to restrict pipeline movement to a predetermined direction

8) hanger

a device for suspending a pipeline from a fixed point, and for maintaining the pipeline at a predetermined level, while allowing limited axial and lateral movement

9) loading

the total force on a securing device; it comprises the dead weight of the pipe, working or test fluid, fittings, valves and insulation. It also includes the forces due to thermal expansion or contraction, static and dynamic pressure, impact, wind, snow and ice

10) slider support

a device incorporating two flat or curved surfaces, one of which is attached to the pipe to allow for sliding movement, axially and laterally

11) roller support

a device on which the pipe rests incorporating a rotating member to allow longitudinal movement of the pipeline

12) spherical washer

a component used at the top of a sling rod to allow a limited amount of angular movement

13) Pivot anchor

a type of anchor that permits a pipe to swivel about a fixed point

14) sleeper

a type of support, usually placed on the ground in a pipe track or corridor

15) spring hanger

a type of pipe hanger, designed to adjust itself to changes in position as a result of changes in condition of the pipeline

16) support

a permanent device for retaining a pipeline in a particular manner or position

17) trestle

a framed structure, securely fixed, acting as a support for one or more pipelines elevated above ground

18) turnbuckle

A device using left and right hand screw threads to provide axial adjustments

NOTE See also BS 4429.

19) vapour seal

a barrier, impervious to water vapour, applied to the exterior surface of the insulation of a cold pipe

3 Materials

Components of pipe support assemblies shall be manufactured from the material specified in the schedule below and shall have mechanical properties to satisfy the design requirements specified in clause 4. Other materials may be used providing they have equal or higher mechanical properties.

Schedule of materials

Component	Material reference
Pipe clips	BS 4360:Grade 43A BS 1501–151 Grade 26B BS 1501–161 Grade 26B
Clip bolts and load bolts	BS 4190:Grade 4.6 BS 3692:Grade 8.8
Sling rods, screwed machined eye, weldless eye nut	BS 4360:Grade 43A
Slider members and roller chairs	BS 4-1 BS 4360:Grade 43A
Cast rollers and spherical washers	BS 309 BS 310 BS 1452:Grade 10
Tubular rollers	BS 1387:Medium BS 1775:HFS 13 or HFW 13
Tubular distance pieces	BS 1387:Medium BS 1775:HFS 13 and HFW 13

4 Pipe hanger components

4.1 Components. A pipe hanger is an assembly comprising:

- 1) a pipe clip or one piece strap complete with load and clip bolts, and
- 2) a sling rod having a sling eye at the lower end and a spherical washer and nuts at the top end.

4.2 Pipe clips. Pipe clips are detailed for the full range of sizes and temperature given in clause 1 and are illustrated in Figure 7, Figure 8 and Figure 9, and their dimensions given in Table 7, Table 7a, Table 8 and Table 9.

For pipes up to and including 32 mm nominal size and loads up to 70 kgf, a one piece strap as illustrated in Figure 6 may be used up to a maximum temperature of 100 °C.

4.2.1 Design. For the purposes of this British Standard the design temperature for clips in direct contact with the pipe shall be that of the fluid in the pipe, but, where the clip is in contact with load-bearing insulation, the design temperature shall be that of the outer surface of this insulation.

Pipe clips are detailed in this standard for three temperature ranges designated as follows.

Range A: – 20 °C to 100 °C

Range B: – 20 °C to 400 °C

Range C: above 400 °C to 470 °C

Each range is divided into two load carrying series, light and heavy.

Pipe clips have been designed on the basis that they are in direct contact with the pipe but not tightened on to the pipe. To achieve this, distance pieces are mandatory on clips in Ranges B and C but are optional on Range A (see 4.4).

The method by which pipe clips have been designed is set out in A.3.

The following stress levels have been used in the design.

- Range A: 245 N/mm^{2a}. This stress being equal to yield at room temperature for steel complying with the requirements of BS 4360: Grade 43A.
- Range B: 132 N/mm². This stress being equal to the 0.2 % proof stress at 400 °C for steel complying with the requirements of BS 1501–151 Grade 26B and BS 1501–161 Grade 26B.
- Range C: 50 N/mm². This stress being equal to the mean stress to rupture in 1 000 00 hours at 470 °C divided by a factor of 1.4 for steel complying with the requirements of BS 1501–151 Grade 26B BS 1501–161 Grade 26B.

^a 1 N/mm² = 1 MPa

Clips in Ranges A and B are designed on a factor of unity and on the assumption that the clip is in direct contact with the pipe. Any deformation of the clip will result in a redistribution of stress.

When load-bearing insulation is employed between a pipe and clip, deformation of the clip is not permitted and therefore the tabulated working loads shall be downrated by 20 % or, alternatively, the width of the clip (dimension “B”) shall be increased by 25 %.

When clips are subject to dynamic loading, this loading shall be added to the static load to obtain the total design load.

4.2.2 Manufacture. Dimensions of one piece straps and pipe clips in Range A are given Table 6 and Table 7 respectively. These components shall be made from steel complying with the requirements of BS 4360: Grade 43A.

Dimensions of pipe clips in Ranges B and C are given in Table 8 and Table 9 respectively. These clips shall be manufactured from steel complying with the requirements of BS 1501–151 Grade 26B or BS 1501–161 Grade 26B.

Pipe clips may be formed either hot or cold but consideration shall be given to the need to carry out heat treatment on cold formed clips of thickness 10 mm and over.

Where material for the manufacture of clips is cut from plate, the cut edges are to be ground smooth prior to forming.

4.3 Clip and load bolts. One piece straps and Range A and Range B pipe clips shall have clip and load bolts complying with the requirements of BS 4190, Grade 4.6 material.

Range C pipe clips shall have clip and load bolts complying with the requirements of BS 3692: Grade 8.8 material.

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

4.4 Distance pieces Distance pieces for use in pipe clips (see 4.2.1) shall be manufactured from steel tube (see clause 3) of suitable bore to be a free fit on the clip bolt with ends cut square.

The length of the distance piece required for use with clips illustrated in Figure 7 shall be equal to the width of the sling rod eye and, for clips illustrated in Figure 8 and Figure 9, shall be equal to the width of the sling rod eye plus 3 mm.

4.5 Sling rods and sling rod eyes. Dimensions of sling rods and sling rod eyes shall be as given in Table 1, Table 2, Table 3 and Table 4.

Four types of eye, all of which are suitable for the temperature range specified in clause 1, are illustrated as listed below.

Screwed machined eye	Figure 1
Weldless eye nut	Figure 2
Integral forged eye	Figure 3
Hot formed eye	Figure 4

The length of sling rods and the extent to which they are threaded at the top shall be such as to suit the individual pipe hanger requirements.

The top of each sling rod shall be fitted with 2 nuts and a spherical washer (see 4.6).

Turnbuckles may be used for joining lengths of sling rod together and to provide a convenient method of adjusting the length of the sling rod.

4.5.1 Design. The safe working loads given in Table 1, Table 2 and Table 3 have been obtained by using a safety factor of 6.25 relative to the tensile strength of the material; the area taken is that at the root of the thread as defined in BS 3643-2.

The safe working loads given in Table 4 are based on a fibre stress of approximately 200 N/mm^2 in the loop and it should be noted that the safe working loads are considerably reduced.

Where the sling rods and sling rod eyes illustrated in Figure 1, Figure 2 and Figure 3 are used with pipe clips in Ranges A, B and C, the safe working load of the complete hanger shall be that given for the pipe clip. Where the sling rods with hot formed eyes illustrated in Figure 4 are used with pipe clips in Ranges A, B and C, the safe working load of the complete hanger shall be that given for the hot formed eye.

4.5.2 Manufacture. Sling rods and sling rod eyes shall be manufactured from the materials specified in clause 3. All threads shall comply with the requirements of BS 3643-2, Classes 7H or 8g.

Sling rod eyes shall be manufactured by either:

- 1) making the eye separately from square bar (Figure 1), or a forging (Figure 2), and attaching to the rod by screwing and tack weld, or
- 2) forging the end of the rod into an integral eye (Figure 3), or
- 3) hot forming the end of the rod into a loop (Figure 4).

4.6 Spherical washers. Spherical washers are in general use and for this reason are included in the standard, but experience has shown that in a substantial number of cases, due to corrosion, dirt and paint, these components have failed to function.

4.6.1 Manufacture. Spherical washers shall be manufactured from good commercial quality steel or malleable cast iron as specified in clause 3.

4.6.2 Dimensions. The dimensions of spherical washers shall be as given in Table 5.

4.7 Load bearing insulation

4.7.1 Various forms of load bearing insulants are available, examples being those based on asbestos, low temperature rubbers and hardwood. Consideration can be given to other synthetic materials. Advice should generally be sought from the manufacturers, particularly in respect of high and low temperature applications together with associated load bearing properties.

In the case of hardwood, cognizance should be taken of the corrosive interaction between wood and ferrous pipe, dependent on the acid and moisture content of the wood used.

4.7.2 Care shall be taken not to exceed the permitted compressive stress on the insulating material. The maximum calculated load shall be designed on the load area of the ring which is the curved area at the bottom of the pipe outside diameter contained by an angle of 90° (i.e. 45° on each side of the vertical centre line).

The total width shall be equal to that of the pipe clip. Where it is necessary to achieve this by the use of more than one layer of material, the layers shall be longitudinally bolted together. Where segmental rings are used, they shall be securely bolted together to give a total width equal to that of the pipe clip.

The bore diameter of the insulation shall be within 1 mm of the outside diameter of the pipe. The outside diameter of the insulation shall be equal to the specified bore diameter plus two radial thicknesses within a tolerance of $\pm 1.5 \text{ mm}$.

The pipe clip shall remain exposed and shall not be covered.

4.8 Constant effort supports (see A.2.2.2). The deviation in supporting effort, including friction, of constant effort supports shall not exceed $\pm 5 \%$ of the specified load at any point in the travel required. Reduced deviation, where required, shall be agreed between the purchaser and the manufacturer but shall not be specified less than $\pm 2.5 \%$.

Deviation is the sum of the kinematic friction and a manufacturing tolerance factor. It is determined by a load test machine and shall be calculated by the equations:

$$\text{Deviation (+)} = \frac{\text{maximum load moving down} - \text{specified load}}{\text{specified load}} \times 100 \%$$

$$\text{Deviation (-)} = \frac{\text{maximum load moving down} - \text{specified load}}{\text{specified load}} \times 100 \%$$

All deviation tests shall be carried out with the constant effort unit supported in a similar manner to which it will be used in service.

Constant effort supports shall have provision for one site adjustment of a minimum of $\pm 20 \%$ of the specified load. The specified load is that load which the purchaser requires the unit to be preset by the support manufacturer before dispatch from his works.

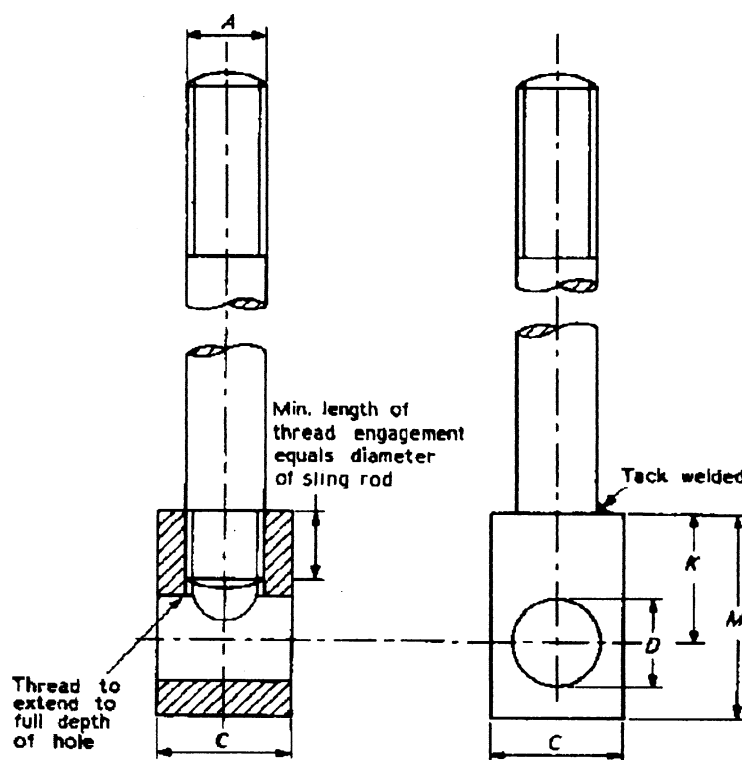


Figure 1 — Sling rod with screwed machined eye

Table 1 — Dimensions of sling rod with screwed machined eye

sling rod dia. <i>A</i>	<i>C</i>	<i>K</i>	<i>M</i>	<i>D</i> dia.	Safe working load
mm	mm	mm	mm	mm	kgf
8	22	16	25	10	230
10	22	19	30	12	360
12	22	22	35	14	530
16	28	28	45	18	1 010
20	32	35	55	22	1 580
24	38	40	65	26	2 280
30	50	52	85	33	3 650
36	55	60	95	39	5 340
42	70	70	110	45	7 400

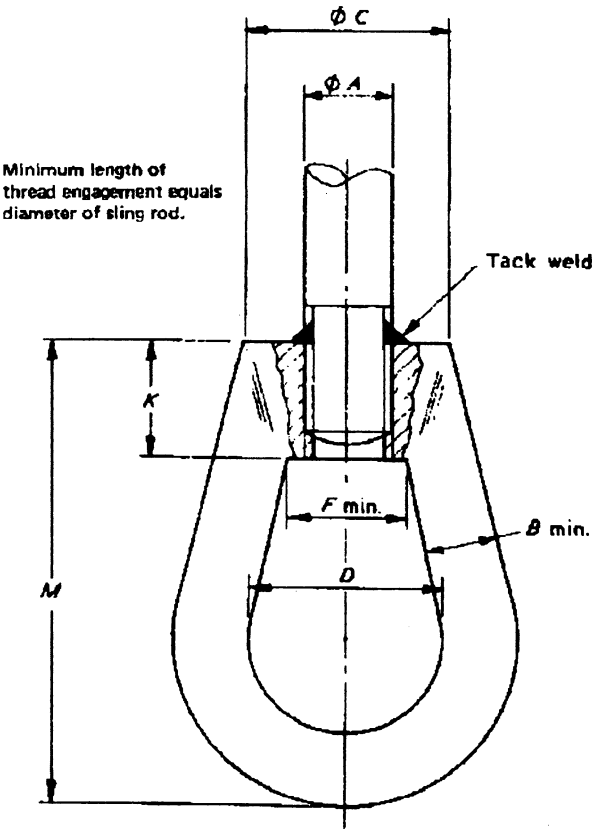


Figure 2 — Sling rod with weldless eye nut

Table 2 — Dimensions of sling rod with weldless eye nut

Sling rod dia. A	D	B min. ($0.7 A$)	C dia.	F min.	K	M	Safe working load
mm	mm	mm	mm	mm	mm	mm	kgf
8	25	6	32	12	16	64	230
10	25	7	32	14	16	64	360
12	30	9	38	16	18	73	530
16	30	12	38	20	18	73	1 010
20	40	14	45	24	25	102	1 580
24	50	17	50	28	28	124	2 280
30	75	21	70	34	38	146	3 650
36	75	26	70	40	38	146	5 340
42	100	30	80	46	45	180	7 400

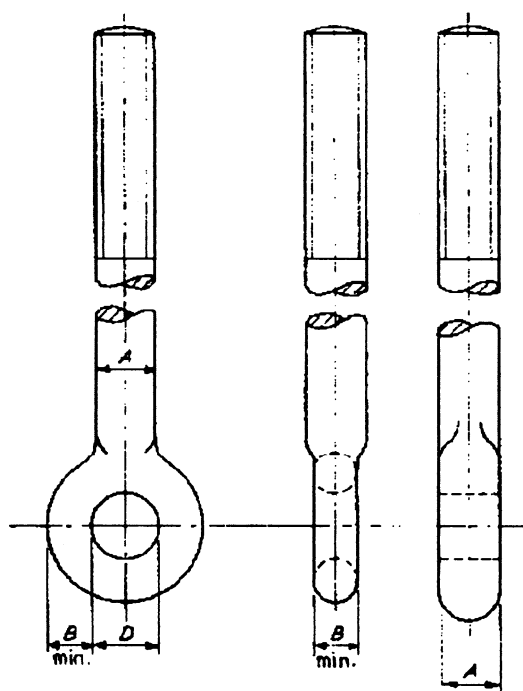
Alternative methods
of manufacture

Figure 3 — Sling rod with integral forged eye

Table 3 — Dimensions of sling rod with integral forged eye

Sling rod dia.A	D dia.	B min. (0.7A)	Safe working load
mm	mm	mm	kgf
8	14	6	230
10	16	7	360
12	18	9	530
16	22	12	1 010
20	26	14	1 580
24	30	17	2 280
30	36	21	3 650
36	42	26	5 340
42	48	30	7 400

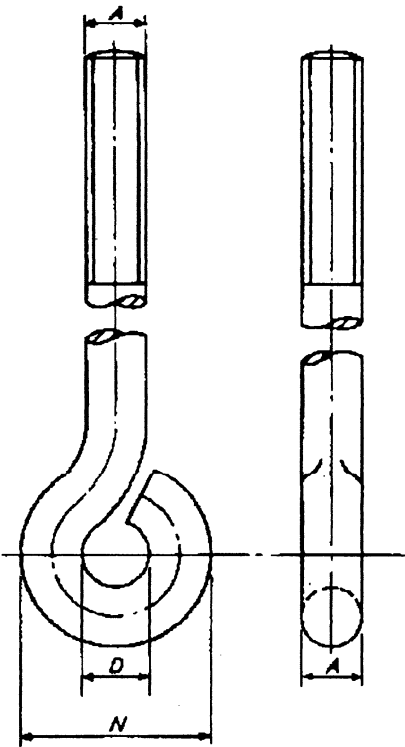


Figure 4 — Sling rod with hot formed eye

Table 4 — Dimensions of sling rod with hot formed eye

Sling rod dia. <i>A</i>	<i>D</i>	<i>N</i>	Safe working load
mm	mm	mm	kgf
8	10	26	70
10	12	32	105
12	15	39	160
16	19	51	285
20	24	64	430
24	28	76	660

NOTE The safe working loads given in Table 4 are those applicable to an open eye. The use of welding to close the eye shall not permit any increase in these working loads.

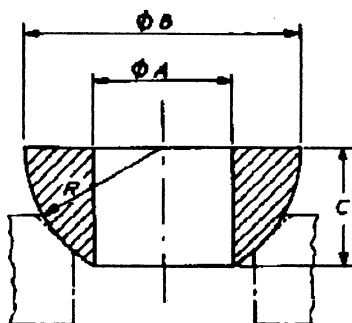


Figure 5 — Spherical washer

Table 5 — Dimensions of spherical washers

All dimensions in millimetres

Sling rod dia.	<i>A</i> dia.	<i>B</i> dia.	<i>C</i>	<i>R rad.</i>
10	12	24	10	12
12	15	30	13	15
16	19	38	16	19
20	24	48	21	24
24	28	56	24	28
30	35	70	30	35
36	42	84	36	42
42	48	96	42	48

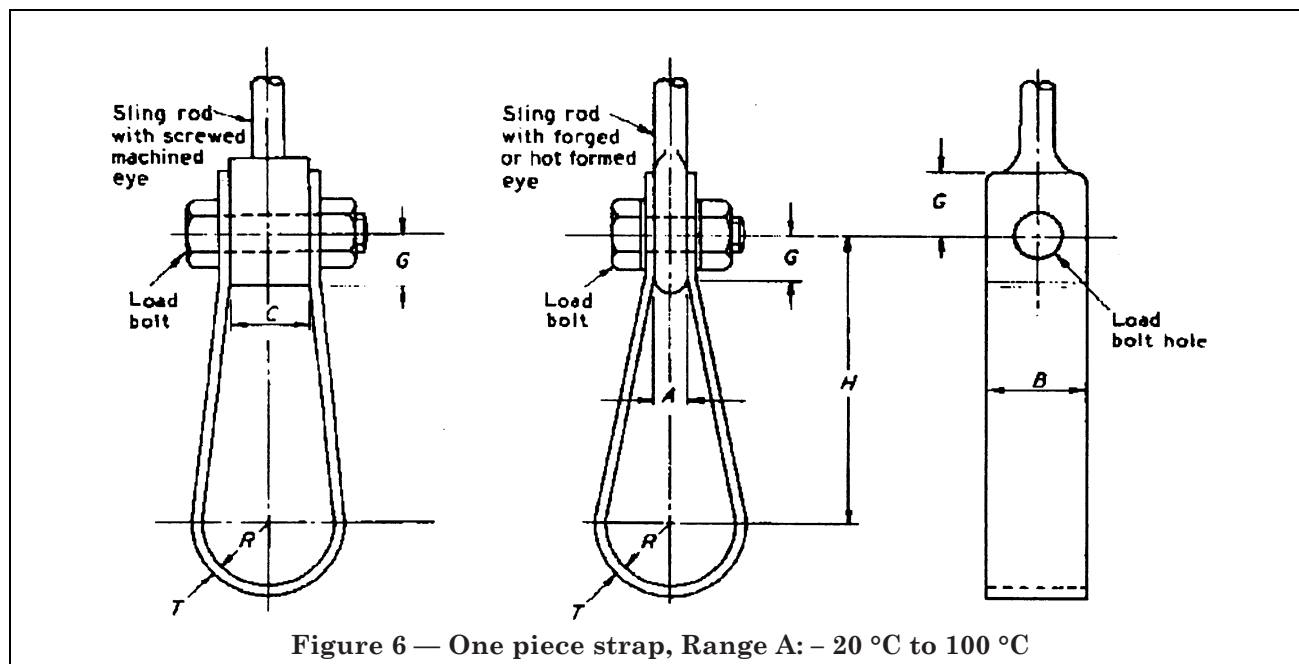


Table 6 — Dimensions of one piece strap (with screwed machined, forged and hot formed eye) for uninsulated steel pipe

Nominal pipe size	Pipe o.d.	Sling rod dia.	C or A	R	B	T	G	H	Load bolt hole	Load bolt	Safe working load
mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	kgf
15	21.3	8	See	12	20	3	17	70	11	M8	70
20	26.9	8	Table 1,	14	20	3	17	75	11	M8	70
25	33.7	8	Table 3 and	17	20	3	17	75	11	M8	70
32	42.4	8	Table 4	22	20	3	17	80	11	M8	70

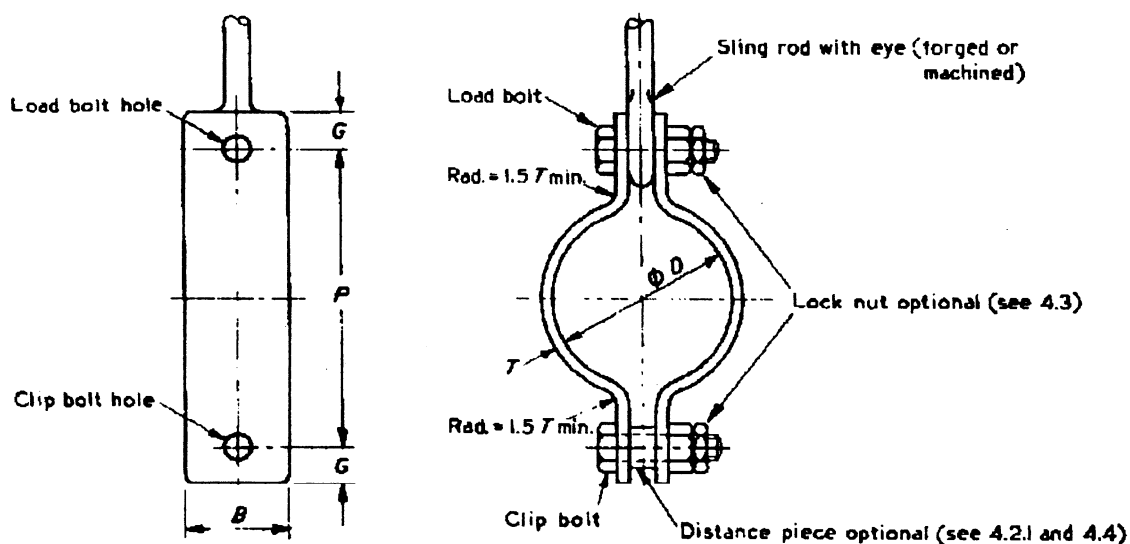


Figure 7 — Pipe clip for steel and cast iron pipes, Range A: -20°C to 100°C
(see Table 7 and Table 7a)

Table 7 — Dimensions of pipe clips for steel pipes, Range A: – 20 °C to 100 °C

Pipe size		Light series								Heavy series							
		Sling rod dia.	<i>D</i> dia.	Clip dimensions <i>B</i> × <i>T</i>	<i>P</i>	Clip and load bolts		<i>G</i> min.	Safe working load	Sling rod dia.	<i>D</i> dia.	Clip dimensions <i>B</i> × <i>T</i>	<i>P</i>	Clip and load bolts		<i>G</i> min.	Safe working load
Nom. size	Outside dia.					Bolt	Hole dia.							Bolt	Hole dia.		
mm	mm	mm	mm	mm	mm	mm	mm	mm	kgf	mm	mm	mm	mm	mm	mm	mm	kgf
15	21.3	USE HEAVY SERIES								10	23	35 × 5	65	M10	12	15	280
20	26.9									10	28	35 × 5	70	M10	12	15	280
25	33.7									10	36	35 × 5	75	M10	12	15	280
32	42.4									12	44	35 × 5	90	M12	15	18	280
40	48.3									12	50	35 × 5	95	M12	15	18	280
50	60.3									12	62	35 × 5	105	M12	15	18	280
65	76.1	12	80	35 × 5	125	M12	15	18	165	16	80	35 × 8	155	M16	19	24	450
80	88.9	12	92	35 × 5	135	M12	15	18	165	16	92	35 × 8	165	M16	19	24	450
100	114.3	12	118	35 × 5	170	M12	15	18	165	16	118	35 × 8	190	M16	19	24	450
125	139.7	16	144	35 × 5	195	M16	19	24	280	16	144	35 × 8	215	M16	19	24	450
150	168.3	16	172	35 × 5	225	M16	19	24	280	16	172	35 × 8	245	M16	19	24	450
175	193.7	16	198	35 × 8	270	M16	19	24	450	16	198	45 × 10	280	M16	19	24	900
200	219.1	16	224	35 × 8	295	M16	19	24	450	16	224	45 × 10	305	M16	19	24	900
225	244.5	16	248	35 × 8	320	M16	19	24	450	20	248	60 × 10	340	M20	24	30	1 350
250	273.0	16	278	35 × 8	350	M16	19	24	450	20	278	60 × 10	365	M20	24	30	1 350
300	323.9	20	330	45 × 10	420	M20	24	30	900	24	330	55 × 15	455	M24	28	36	1 800
350	355.6	24	362	55 × 10	460	M24	28	36	900	30	362	55 × 15	500	M30	35	45	2 250
400	406.4	24	412	60 × 15	535	M24	28	36	1 350	30	412	65 × 20	575	M30	35	45	2 700
450	457.0	30	464	65 × 20	625	M30	35	45	2 250	36	464	80 × 20	635	M36	42	54	3 600
500	508.0	30	516	65 × 20	675	M30	35	45	2 250	36	516	90 × 25	715	M36	42	54	4 500
550	559.0	30	566	65 × 20	725	M30	35	45	2 250	36	566	90 × 25	765	M36	42	54	4 500
600	610.0	30	618	80 × 20	780	M30	35	45	2 700	42	618	110 × 25	830	M42	48	63	5 900