SRI LANKA STANDARD 818 : 1988

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SPECIFICATION FOR

SCREWED STUDS

SRI LANKA STANDARDS INSTITUTION

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SPECIFICATION FOR SCREWED STUDS

SLS 818 : 1988

Gr. 12

SRI LANKA STANDARDS INSTITUTION
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This standard does not purport to include all the necessary provisions of a contract.

SRI LANKA STANDARD
SPECIFICATION FOR SCREWED STUDS

FOREWORD

This Sri Lanka Standard was authorised for adoption and publication by the Council of the Sri Lanka Standards Institution on 1988-04-19, after the draft, finalized by the Drafting Committee on screwed studs, had been approved by the Mechanical Engineering Divisional Committee.

This standard has been drawn up to cover screwed studs for general purpose applications. In the preparation of this standard, note has been taken of the types of studs required by the local market.

All standard values given in this specification are in SI units.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or an analysis, shall be rounded off in accordance with SLS 102. The number of significant figures to be retained in the rounded off value shall be the same as that of the specified value in this standard.

The assistance derived from the publications of the British Standards Institution, Bureau of Indian Standards and the Institute of Fastners, United State of America in the preparation of this standard is gratefully acknowledged.

1 SCOPE

This Sri Lanka Standard specifies the dimensional and mechanical property requirements for plain carbon and low alloy steel, screwed studs with metric threads in diameter from 3 mm to 39 mm inclusive intended for general purpose applications.

The screwed studs covered are of the following types :

Type 1 : Interference

Type 2 : Double end, and

Type 3 : Continuous thread.

The dimensional requirements of this standard shall also apply to non-ferrous and stainless steel screwed studs of the above types, (the mechanical property requirements of these studs are not covered.)

NOTE - Studs shall comply with the requirements in SLS 379 *in respect of the requirements not laid down in this specification.*

2 REFERENCES

SLS 12 Method of tensile testing of steel products other than sheet, strip, wire and tube.

SLS 102 Presentation of numerical values

SLS 122 Vickers hardness test

SLS 145 Rockwell hardness test

SLS 146 Brinell hardness test

SLS 268 Specification for ISO metric screw threads - Part 1-6

SLS 355 Method of Charpy impact test (U-notch) for steel

SLS 379 General requirements and technical supply conditions for bolts, screws and nuts

SLS 428 Random sampling methods

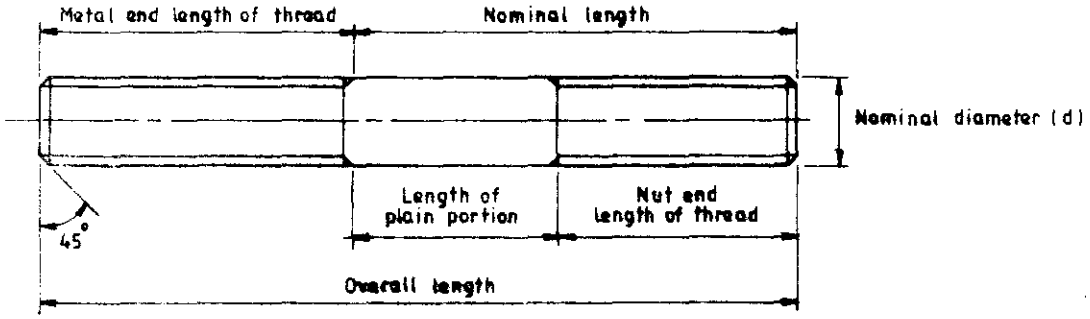
BS 4439 Screwed studs

3 NOMENCLATURE

3.1 **Nominal diameter (d)** : Basic major diameter of thread.

3.2 **Nominal size : Md** (the letter M indicates that the product is ISO metric).

3.3 **Type 1 - Interference Stud**

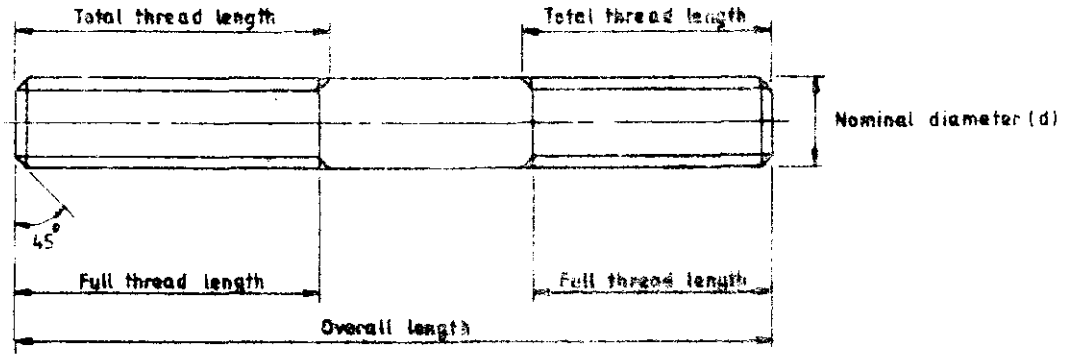


3.3.1 *metal end* : The end of the stud which is screwed into the component.

3.3.2 *nut end* : The end of the stud which is not screwed into the component.

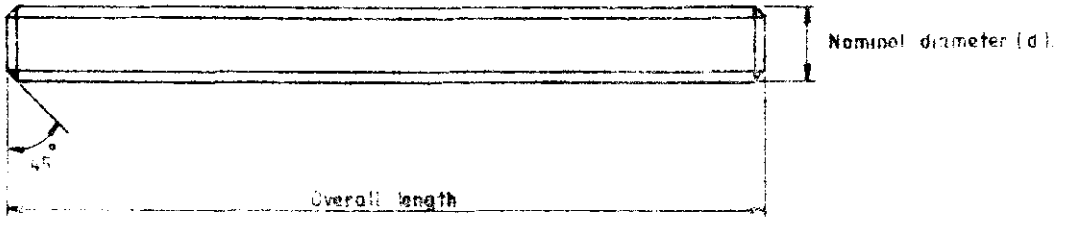
3.3.3 *plain portion* : The unthreaded length of stud.

3.4 Type 2 - Double end stud



NOTE - Both ends of the stud are nut ends.

3.5 Type 3 - Continuous thread stud



4 DESIGNATION

When designating ISO metric screwed studs for the purposes of an enquiry or order, the following information shall be given.

a) General product description, i.e. type of screwed studs and material;
b) The letter 'M' (indicating that the product is ISO metric);
c) The nominal diameter of the product, in millimetres ;
d) Length
   for Type 1 : The nominal length and the metal end length of thread
   for Type 2 : The overall length ;
   for Type 3 : The overall length ;
e) The strength grade symbol (this applies to steel products only) ; and
f) For Type 1 : Thread requirement at metal end of stud i.e. '4h' or 'OS' (oversize). (see 5.2.1.3).

Example

Interference type screwed studs 10 mm diameter, 50 mm nominal length and length of metal end thread of 1½ d, manufactured from steel of strength grade 8.8 with oversize thread to Table 1 would be designated;

Interference type steel screwed stud M10 x 50 (1½ d) 8.8 'OS'

5 REQUIREMENTS

5.1 Material

5.1.1 *Chemical composition of steel screwed studs*

The chemical composition of steels, given in Appendix A, is for guidance only.

Unless the purchaser states in his enquiry or order that a specified composition is required, the choice of steel will be at the discretion of the manufacturer. The steel used shall be such that the finished product possesses the mechanical properties appropriate to the strength grade.

TABLE 1 - Limits and tolerances for alternative oversize 'OS' thread for metal end of Interference type Screwed studs (see 5.2.1.3)

Dimensions in millimetres

Nominal size	Pitch (Coarse pitch series) P	Major diameter			Pitch (effective) diameter			Minor diameter		
		max.	tol.	min.	max.	tol.	min.	max.	tol.	min.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
M3	0.5	3.000	0.067	2.933	2.723	0.048	2.675	2.435	0.084	2.351
M4	0.7	4.000	0.090	3.910	3.601	0.056	3.545	3.197	0.106	3.091
M5	0.8	5.000	0.095	4.905	4.540	0.060	4.480	4.079	0.118	3.961
M6	1.0	6.000	0.112	5.888	5.421	0.071	5.350	4.844	0,143	4.701
M8	1.25	8.000	0.132	7.868	7,263	0.075	7.188	6.542	0.165	6.377
M10	1.5	10.000	0.150	9.850	9.111	0.085	9.026	8.244	0.193	8.051
M12	1,75	12.000	0.170	11.830	10.958	0.095	10.863	9.948	0.221	9.727
(M14)	2.0	14.000	0.180	13.820	12.801	0.100	12.701	11.646	0.244	11.402
M16	2.0	16.000	0.180	15.820	14.801	0.100	14.701	13.646	0.244	13,402
(M18)	2.5	18.000	0.212	17,788	16.482	0.106	16.376	15.039	0.286	14.753
M20	2.5	20.000	0.212	19.788	18.482	0.106	18.376	17.039	0.286	16.753
(M22)	2.5	22.000	0.212	21.788	20.482	0.106	20.376	19.039	0.286	18.753
M24	3.0	24.000	0.236	23.764	22.176	0.125	22.051	20.444	0.341	20.103
(M27)	3.0	27.000	0.236	26.764	25,176	0.125	25.051	23.444	0.341	23.103
M30	3.5	30.000	0.265	29.735	27.859	0.132	27.727	25.838	0.384	25.454
(M33)	3.5	33.000	0.265	32.735	30.859	0.132	30.727	28.838	0.384	28.454
M36	4.0	36.000	0.300	35.700	33.542	0.140	33.402	31.233	0.428	30.805
(M39)	4.0	39.000	0.300	38.700	36.542	0.140	36.402	34.233	0.428	33.805

5.2 Dimensions and tolerances

5.2.1 *Screw threads*

The form of the thread, diameters and associated pitches of standard screwed studs, metric series, shall be in accordance with **SLS 268**.

5.2.1.1 Type 1 : Interference Studs

(i) Nut end

The screw thread on the nut end shall be to the tolerances for Class 6 g (medium fit) as specified in **SLS 268 ; Part 5.**

(ii) Metal end

The screw thread on the metal end shall be either to the standard limits of Tolerance Class 4h (close fit) as specified in **Part 5 and Part 6** of **SLS 268** or alternatively may be oversize on the pitch and minor diameters. Oversize threads shall conform to the limits and tolerances given in Table 1.

NOTE - It is recommended that tapped holes for the metal end of screwed studs be in accordance with Tolerance Class 4 H as specified in SLS 268 : Part 5. *However, where the class of fit is not critical, holes may be tapped to Tolerance Class 6 H (medium fit).*

5.2.1.2 Type 2 and 3 : Double end studs and Continuous thread studs

The screw threads shall be to the tolerances for Class 6 g (medium fit) as specified in **SLS 268 : Part 5.**

5.2.1.3 If the purchaser requires other classes of fit or fine pitch threads then this shall be the subject of agreement with the manufacturer.

5.2.2 *Diameters of studs*

5.2.2.1 Thread diameter

The form of the thread, diameters and associated pitches of standard screwed studs, metric series, shall be in accordance with **SLS 268.**

5.2.2.2 Plain portion diameter

(i) Type 1 : Interference studs

The diameter of the plain portion shall be equal to the maximum (basic) major diameter of the thread and subject to the tolerances given in Table 3.

(ii) Type 2 : Double end studs

The diameter of the plain portion shall be equal to the maximum (basic) major diameter of the thread and subject to the tolerances given in Table 4.

TABLE 2 - Standard nominal lengths and tolerances - Interference studs

Dimensions in millimetres

Nominal length	Tolerance
12	± 0.35
14	± 0.35
16	± 0.35
(18)	± 0.50
20	± 0.50
(22)	± 0.50
25	± 0.50
(28)	± 0.50
30	± 0.50
(32)	± 0.50
35	± 0.50
(38)	± 0.50
40	± 0.50
45	± 0.50
50	± 0.50
55	± 0.60
60	± 0.60
65	± 0.60
70	± 0.60
75	± 0.60
80	± 0.60
85	± 0.70
90	± 0.70
(95)	± 0.70
100	± 0.70
(105)	± 0.70
110	± 0.70
(115)	± 0.70

Nominal length	Tolerance
120	± 0.70
(125)	± 0.80
130	± 0.80
140	± 0.80
150	± 0.80
160	± 0.80
170	± 0.80
180	± 0.80
190	± 1.0
200	± 1.0
220	± 1.0
240	± 1.0
260	± 1.0
280	± 1.0
300	± 1.0
325	± 1.2
350	± 1.2
375	± 1.2
400	± 1.2
425	± 1.3
450	± 1.3
475	± 1.3
500	± 1.3

NOTE - Lengths shown in brackets are non-preferred.

TABLE 3 - Standard thread lengths and Tolerances - Interference studs

Dimensions in millimetres

Nominal size	Nut end length of thread for nominal length			Tolerance on nut end length of thread - 0 + 2P	Tolerance on metal end length of thread	Tolerance on plain portion diameter
	Up to 125	Over 125 and up to 200	above 200			
	2d + 6	2d + 12	2d + 25			
(1)	(2)	(3)	(4)	(5)	(6)	(7)
M3	12	-	-	- 0 + 1.0	+ 0.40 -	+ 0 - 0.09
M4	14	-	-	- 0 + 1.4		
M5	16	-	-	- 0 + 1.6	+ 0.50 -	+ 0 - 0.12
M6	18	-	-	- 0 + 2.0		
M8	22	-	-	- 0 + 2.5	+ 0.60 -	+ 0 - 0.15
M10	26	32	-	- 0 + 3.0		
M12	30	36	-	- 0 + 3.5		
(M14)	34	40	-	- 0 + 4.0	+ 0.70 -	- 0 - 0.18
(M16)	38	44	57	- 0 + 4.0		
(M18)	42	48	61	- 0 + 5.0		
M20	46	52	65	- 0 + 5.0		
(M22)	50	56	69	- 0 + 5.0	+ 0.80 -	+ 0 - 0.21
M24	54	60	73	- 0 + 6.0		
(M27)	60	66	79	- 0 + 6.0		
M30	66	72	85	- 0 + 7.0		
M33	72	78	91	- 0 + 7.0		
M36	78	84	97	- 0 + 8.0	+ 1.00 -	+ 0 - 0.25
(M39)	84	90	103	- 0 + 8.0		

NOTE - Nominal sizes shown in bracket are non-preferred.

TABLE 4 - Dimensions and Tolerances-Double end studs

Dimensions in millimetres

Nominal size	Nut Ends				Tolerance on overall length		Tolerance on plain portion diameter
	Length of thread for overall length						
	Up to 150		Over 150		Up to 150	Over 150	
	Full thread length (min.)	Total thread length (max.)	Full thread length (min.)	Total thread length (max.)			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
M6	19.0	22.2	25.4	28.6			$^{+\ 0}_{-\ 0.23}$
M8	22.2	26.2	28.6	32.5			$^{+\ 0}_{-\ 0.25}$
M10	25.4	30.2	31.8	36.5	$\pm$ 0.8	$\pm$ 1.5	$^{+\ 0}_{-\ 0.27}$
M11	28.6	34.1	34,9	40.5			$^{+\ 0}_{-\ 0.30}$
M12	31.8	38.1	38.1	44.5			$^{+\ 0}_{-\ 0.31}$
M14	34.9	42.1	41.3	48.4			$^{+\ 0}_{-\ 0.33}$
M16	38.1	46.0	44.5	52.4			$^{+\ 0}_{-\ 0.35}$
M20	44.5	54.0	50.8	60.3			$^{+\ 0}_{-\ 0.37}$
M22	50.8	61.9	57.2	68.3	$\pm$ 1.5	$\pm$ 2	$^{+\ 0}_{-\ 0.40}$
M25	57.2	69.9	63.5	76.2			$^{+\ 0}_{-\ 0.43}$
M28	63.5	77.8	69.9	84.1			$^{+\ 0}_{-\ 0.47}$
M30	69.9	85.7	76.2	92.1			$^{+\ 0}_{-\ 0.47}$
M35	76.2	93.7	82.6	99.8	$\pm$ 2.3	$\pm$ 3.0	$^{+\ 0}_{-\ 0.52}$
M40	82.6	101.6	88.9	108.0			$^{+\ 0}_{-\ 0.52}$

5.2.3 *Lengths of studs*

5.2.3.1 **Type 1 : Interference studs**

(i) Nominal length

The nominal length of the stud shall be measured from the nut end including the chamber, to the extreme end of the runout of the thread on the metal end. The standard nominal lengths and tolerances are given in Table 2.

(ii) Metal end length of thread

The length of the thread on the metal end of the stud shall include the runout threads and shall be equal to the nominal diameter (d) of the thread or to 1½ d as specified by the purchaser.

The length of thread run-out shall not be less than 2 pitches or more than 2½ pitches.

The tolerances on length of thread shall be as given in Table 3.

(iii) Length of plain portion

The length of the plain portion shall not be less than ½ d and shall be taken to include the run-out threads on the nut end of the studs, but excluding the run-out threads on the metal end.

(iv) Nut end length of thread

The length of thread on the nut end of the stud shall not include the run-out threads and shall be in accordance with Table 3 except in the case of short studs where this would result in a length of plain portion less than ½ d. In such cases a length of plain portion equal to ½ d shall be allowed for, before threading the remainder for the nut end.

The length of thread run-out shall not exceed 2½ pitches. The tolerances on the length of thread shall be plus two pitches on all diameters, as given in Table 3.

5.2.3.2 **Type 2 : Double end studs**

The dimension and tolerances of Double end studs are given in Table 4. Where the overall length is equal to or less than twice the full thread length, continuous thread studs shall be used.

5.2.3.3 **Type 3 : Continuous thread studs**

The tolerances on the overall length shall be as given in Table 5.

TABLE 5 - Tolerances on length of Continuous thread studs

Dimensions in millimetres

Nominal size (1)	Tolerance on overall length	
	Length up to 150 (2)	Length over 150 (3)
M3 to M8	± 0.8	± 1.6
above M8 to M20	± 1.6	± 3.2
above M20 to M32	± 3.2	± 4.8
above M32	± 6.4	± 6.4

5.2.4 *Ends of studs*

The ends of the stud shall be finished with a straight chamfer with a 90^{o} included angle to a depth slightly exceeding the depth of thread.

5.3 **Mechanical properties**

Steel screwed studs shall meet the requirements for mechanical properties given in Table 6.

5.3.1 *Strength grade designation system for steel screwed studs*

Being in accordance with BS : 4439 the strength designation system for steel screwed studs consists of two figures. The first is one hundredth of the minimum tensile strength in N/mm^2, and the second is one tenth of the ratio between the minimum yield stress R_e (or minimum stress at permanent set limit $R_{0.2}$) and the minimum tensile strength, expressed as a percentage. (The figures are rounded off to nearest whole number).

EXAMPLE : for strength grade designation 6.8 in accordance with Table 7.

- 1/100 minimum tensile strength of **588** N/mm^2 gives the symbol '6'.
- 1/10 ratio $\frac{\text{minimum yield stress}}{\text{minimum tensile strength}}$ as a percentage $= \frac{1}{10} \times \frac{471}{588} \times 100$,

  gives the symbol '8'.
- Therefore, strength grade designation is 6.8.
- 10 times, the multiplication of these two figures will give the approximate minimum yield stress.

TABLE 6 - Mechanical properties of steel screwed studs

Mechanical property		Strength grade designation							
		3.6	4.8	5.8	6.8	8.8	10.9	12.9	14.9
Tensile strength R_m	(min) N/mm^2	294	392	490	588	785	981	1177	1373
	(max) N/mm^2 (see Note 1)	400	539	686	785	981	1177	1373	1569
Brinell hardness	(min) HB	75	110	140	170	225	280	330	390
	(max) HB (see Note 1)	135	170	215	245	300	365	425	-
Rockwell hardness	(min) HRB	40	62	77	88	-			
	(min) HRC	-				18	27	34	40
	(max) HRB	70	88	97	102	-			
	(max) HRC (see Note 1)	-				31	38	44	49
Vickers hardness	(min) HV 30	75	110	140	170	225	280	330	400
	(max) HV 30 (see Note 1)	135	170	215	245	300	370	440	510
Yield stress R_e	(min) N/mm^2	200	314	392	471	-			
Stress at permanent set limit $R_{0.2}$	(min) N/mm^2	-				628	883	1059	1236
Stress under proof load (see Note 2)	S_p/R_e and $S_p/R_{0.2}$	0.91	0.91	0.91	0.91	0.91	0.88	0.88	0.88
	S_p N/mm^2	182	286	357	429	571	777	932	1089
Elongation A after fracture	(min) (percent)	22	14	10	8	12	9	8	7
Charpy impact strength (min)	J/cm^2	-				58.8	39.2	29.4	29.4
	kgfm/cm^2	-				6	4	3	3
	ft lbf *	-				22	14	11	11
Decarburization at root of thread Non-decarburized Zone		-				Depth not more than 1/10 of H_1 Depth not more than 2/3 of H_1			

* *Included to assist with reading of existing impact test equipment.*

NOTES

1. *Only for full size studs.*
2. *The allowed permanent extension is 12.5 micrometres.*

TABLE 7 - Strength grade designations of steel screwed studs

(An extract from Table 6)

Strength grade designation	3.6	4.8	5.8	6.8	8.8	10.9	12.9	14.9
Tensile strength min. N/mm^2	294	392	490	588	785	981	1177	1373
Yield stress R_e min. N/mm^2	200	314	392	471	-	-	-	-
Stress at permanent set limit $R_{0.2}$ min. N/mm^2	-	-	-	-	628	883	1059	1236

5.3.2 *Heat treatment*

Grades designated 8.8, 10.9, 12.9 and 14.9 shall be heat-treated to give the mechanical properties given in Table 6. Other grades may be heat treated if this is necessary to obtain the mechanical properties given in Table 6.

5.3.2.1 Decarburization

For the strength grade designation 8.8, 10.9, 12.9 and 14.9 the depth of the non-decarburized zone shall be not less than two thirds of the depth of the basic thread. In the root of the thread the decarburization shall not exceed one tenth of the depth of the basic thread (see Fig. 1).

For the method of measuring the amount of decarburization, (see B.8 in Appendix B)

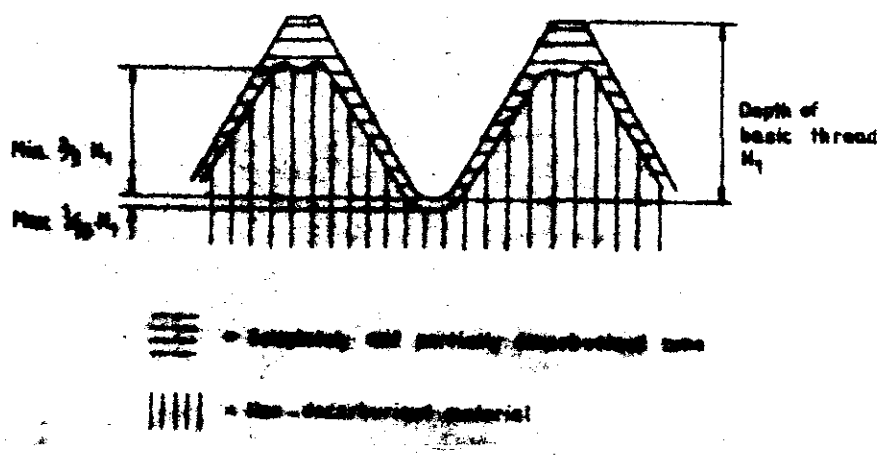


FIGURE 1 - Depth of decarburization on steel screwed studs

6 MARKING

6.1 General

The strength grade marking requirements of this standard are only mandatory for steel screwed studs of 12 mm diameter and larger manufactured to strength grade designation 8.8 or higher.

6.2 The separating full stop in the strength grade designation may be omitted so that the grades may be marked 88, 109, 129 and 149.

6.3 The studs shall be identified as ISO metric by the symbol 'M'.

NOTES :

1. Markings in 6.2 and 6.3 above should be embossed or idented preferably on the nut end in the case of Interference studs.

2. Attention is drawn to Certificate facilities offered by SLSI, see inside back cover of this standard specification.

7 METHODS OF TEST

7.1 Test for mechanical properties shall be in accordance with Appendix B.

7.2 Acceptance tests for steel screwed studs shall be as in Table 8.

The choice of test programme A or B should be agreed (as in Table 8) between the purchaser and the supplier.

The mechanical properties of studs to be decisive for acceptance are shown in Table 8. In table 8 tests are arranged in five groups marked 1 to 5 according to the manner in which the properties being tested are related to one another.

In Table 8 tests marked '@' are decisive for acceptance.

In test Group 1, if the purchaser agrees for simplified acceptance tests, test marked '@' may be replaced by those marked '+'. The purchaser may also demand tests marked '0' to be included in addition.

By special agreement between purchaser and supplier tests marked '0' may be replaced by tests marked '@'. In case of doubt tests marked '@' shall be decisive for acceptance purposes; when it is not possible to carry out these tests due to dimensional reasons (if the studs are too short or too big), tests marked '+' shall be decisive.

The tests shall be carried out in accordance with the requirements given in Appendix B.

8 SAMPLING AND CRITERIA FOR CONFORMITY

The method of sampling and criteria for conformity shall be in accordance with that described in SLS 379.

TABLE 8 - Acceptance tests for steel screwed studs (see 7.2)

Test Group	Mechanical property	Reference to Appendix B	Test Method	Test programme A (for machined test pieces)								Test programme B (for full size studs)							
				Strength grade								Strength grade							
(1)	(2)	(3)	(4)	(5)								(6)							
				3.6	4.8	5.8	6.8	8.8	10.9	12.9	14.9	3.6	4.8	5.8	6.8	8.8	10.9	12.9	14.9
1	Tensile strength R_m	B.1	Tensile test	@	@	@	@	@	@	@	@								
	Tensile strength R_m	B.2	Tensile test									@	@	@	@	@	@	@	@
	Brinell hardness HB	B.3	Brinell hardness test	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	Rockwell hardness HR	B.4	Rockwell hardness test	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vickers hardness HV	B.5	Vickers hardness test	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Yield stress R_e	B.1	Tensile test	@	@	@	@												
	Stress at permanent set limit $R_{0.2}$	B.1	Tensile test					@	@	@	@								
	Stress under proof load	B.6	Proof load test									@	@	@	@	@	@	@	@
3	Percentage elongation after fracture A	B.1	Tensile test	@	@	@	@	@	@	@	@								
4	Impact strength	B.7	Impact test					@	@	@	@								
5	Decarburization	B.8	Decarburization					@	@	@	@					@	@	@	@

@
+
0 } See clause 7.2

APPENDIX A

SELECTION OF STEELS FOR STEEL SCREWED STUDS (5.1.1)

A.1 The chemical compositions given in Table (10) are to be used as a guide only in selecting suitable steels for studs. Unless the purchaser states in his enquiry or order that a specified composition is required, the choice of steel will be at the discretion of the manufacturer. The steel used shall be such that the finish product possesses the mechanical properties appropriate to the strength grade. Table 9 illustrates the general property requirements.

TABLE 9 - Property requirements of steel screwed studs (see Table 6)

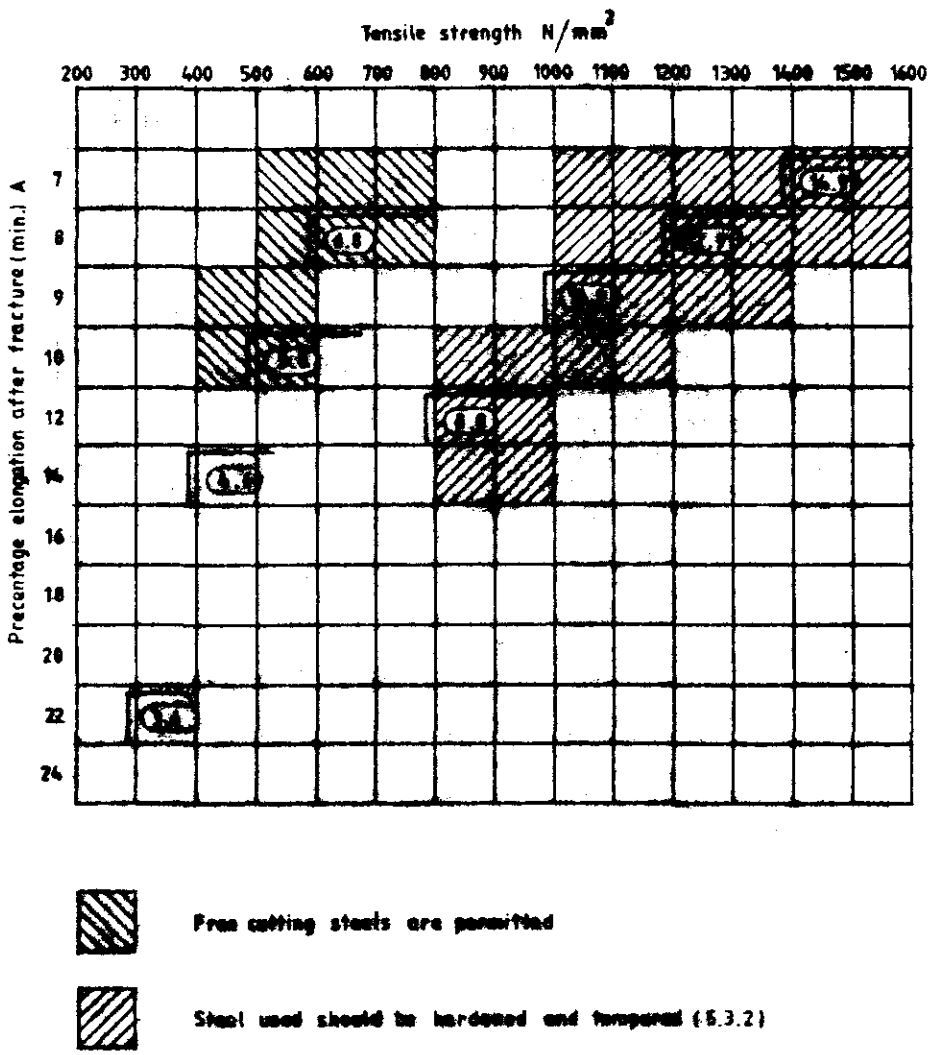


TABLE 10 - Guide lines for selection of steels for screwed studs

Nominal diameter d (mm)		Strength grade				
		3.6 to 6.8	8.8	10.9	12.9	14.9
Above (1)	to (2)	Chemical composition (3)	(4)	(5)	(6)	(7)
3	8	C 0.20/0.53 P 0.06 max. S 0.07 max.	C 0.32/0.50 P 0.04 max. S 0.05 max.	C 0.32/0.50 P 0.04 max. S 0.05 max. (see Note 2)	C 0.19/0.52 P 0.035 max. S 0.035 max. *Total alloy content 0.9 min	C 0.19/0.52 P 0.035 max. S 0.035 max. *Total alloy content 1.5 min. Mo 0.15 min
8	18	Free cutting steels are permitted except for strength grades 3.6 and 4.8 (see Note 3)		P 0.04 max. S 0.04 max. *Total alloy content 0.9 min. (see Note 1)		
18	24				C 0.19/0.52 P 0.035 max. S 0.035 max. *Total alloy content 0.9 min. Mo 0.15 min.	C 0.19/0.52 P 0.035 max. S 0.035 max. *Total alloy content 2.5 min. Mo 0.2 min.
24	39		C 0.032/0.50 P 0.04 max. C 0,04 max. *Total alloy content 0.5 min. (see Note 1)		C 0.19/0.52 P 0.035 max. S 0.035 max. *Total alloy content 1.5 min. Mo 0.15 min.	

**Total alloy content is the sum of the Cr, Ni, Mo and V plus Mn content higher than 0.8%.*
For all classes in the table, a steel of a higher grade may be used providing that the studs produced meet all the requirements of the desired grades.

NOTES

1. *When molybdenum is the only alloying element in Classes 8.8 and 10.9 the minimum permissible content is 0.2 %, In Class 10.9 the use of such a steel is restricted to sizes up to and including stud diameter 1^{O} mm.*
2. *If steel with a carbon content less than 0.3% is used, the minimum manganese content should be greater than 1.3 %.*
3. *When free cutting steels with sulphur and or lead are used the following maximum sulphur, phosphorous and lead contents are permissible : Sulphur 0.34%, Phosphorous 0.1%, Lead 0.15% to 0.35%.*

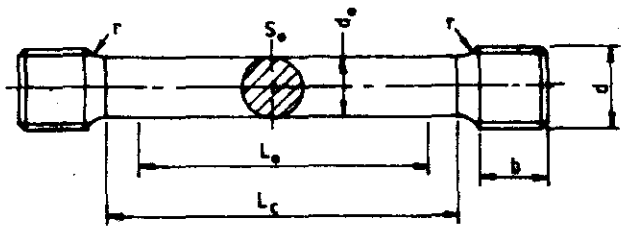
APPENDIX B

TESTING OF MECHANICAL PROPERTIES OF STEEL SCREWED STUDS
(see 5.3 and 7)

B.1 Tensile testing of machined test pieces

Perform the tests in accordance with the requirements of **SLS 12** to determine the following :

B.1.1 *Tensile strength,*
B.1.2 *Yield stress, (grades 3.6 to 6.8)*
B.1.3 *Stress at permanent set limit of 0,2% (grades 8.8 and higher), and*
B.1.4 *Percentage elongation after frecture.*



d = nominal thread diameter
d_o = diameter of test section (less than minor diameter of thread) (see note)
b = length of thread (d min.)
L_o = gauge length $5.65\sqrt{S_o}$
S_o = area of test section
r = radius (4 mm min.)
L_c = length of straight ($L_o + d_o$)

FIGURE 2 - Dimensions of test piece

NOTE - When machining test specimens of heat treated studs over 16 mm nominal diameter, the reduction of diameter shall not exceed 25 per cent of the original diameter (about 44 per cent of the cross sectional area).

B.2 Tensile testing of full size studs

The tensile test shall be carried out on full size products in order to demonstrate ability of the specimen to conform to the requirements of Table 6. The calculation of the tensile strength shall be based on the tensile stress area :

$$\text{Tensile stress area, } A_s = \frac{\pi}{4}\left[\frac{\text{Mean of pitch (effective) diameter + minor diameter}}{2}\right]^2$$

$$= \frac{\pi}{16}\left[\text{pitch (effective) diameter + minor diameter}\right]^2$$

When carrying out the test, a free threaded length equal to the nominal diameter shall be subjected to the tensile load.

B.3 Brinell hardness test

The Brinell hardness tests shall be performed in accordance with the requirements of **SLS 146**. The impression should be applied to the centre position of the end of the stud after approximately 0.4 mm has been removed by grinding.

B.4 Rockwell hardness test

The Rockwell hardness test shall be performed in accordance with the requirements of **SLS 145**. The impression of the ball or cone shall be applied to the centre position of the end of the stud, after approximately 0.4 mm has been removed by grinding.

B.5 Vickers hardness test

The Vickers hardness test shall be performed in accordance with the requirements of **SLS 122**. The impression of the indenter shall be applied to the centre position of the end of the stud after approximately 0.4 mm has been removed by grinding.

B.6 Proof load testing for full size studs

The proof load test consists of applying the proof load, and measuring any permanent extension of the stud. The proof load is applied axially to the stud in a tensile testing machine. The length of free thread shall be between ½ d and d at the nut end of the stud. The test nut at the metal end of the stud shall be screwed up to the thread runout.

The overall length of the stud shall be measured, at its true centre line, with a suitable instrument. The instrument shall be such that the total of inaccuracies due to measuring is less than $\pm$ 5µ mm. The test is considered satisfactory if the measurement, after the proof load has been applied for not less than 10 seconds, shows an extension of not more than 12.5µ mm.

Proof loads for testing coarse pitch series steel screwed studs are given in Table 11.

B.7 Impact testing for machined test pieces

The Charpy U-notch impact test shall be carried out in accordance with **SLS 355**. Take the test piece lengthwise from the stud and as close to the surface as possible. The un-notched side of the best piece is the one nearest to the surface of the stud, the depth of notch being 5 mm in accordance with **SLS 355**.

This test shall be applied only to studs larger than 18 mm diameter.

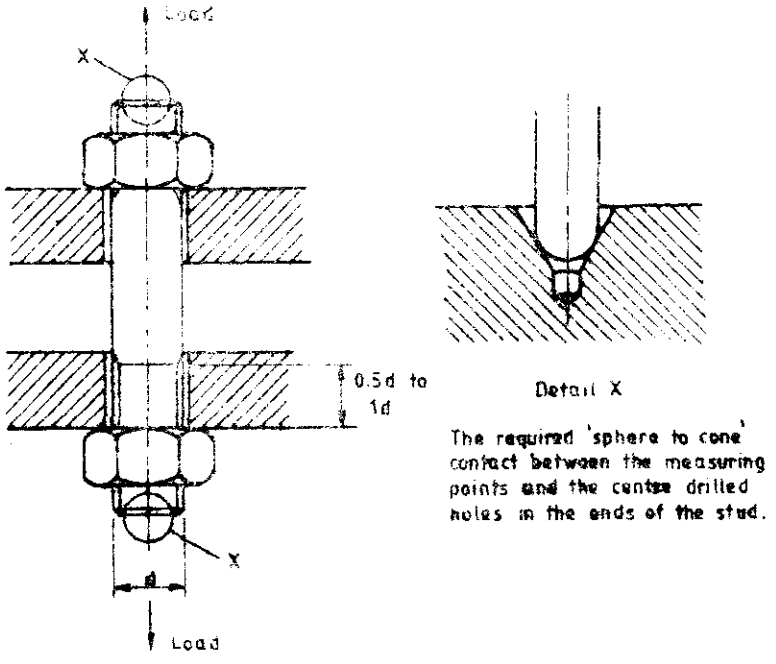


FIGURE 3 - Application of proof load to full size stud

TABLE 11 - Proof loads for steel screwed studs (coarse pitch series)

Nominal size	Tensile stress area mm^2	Strength grade designation							
		3.6	4.8	5.8	6.8	8.8	10.9	12.9	14.9
		Stress under proof load (N/mm^2)							
		182	286	357	429	571	777	932	1089
		Proof load (kN)							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
M3	5.03	0.915	1.44	1.80	2.16	2.87	3.91	4.69	5.48
M4	8.78	1.60	2.51	3.13	3.77	5.01	6.82	8.18	9.56
M5	14.2	2.58	4.06	5.07	6.09	8.11	11.03	13.23	15.46
M6	20.1	3.66	5.75	7.18	8.62	11.48	15.62	18.73	21.89
M7	36.6	6.66	10.47	13.01	15.70	20.90	28.44	34.11	39.86
M10	58.0	10.56	16.59	20.71	24.88	33.12	45.07	54.06	63.16
M12	84.3	15.34	24.11	30.10	36.17	48.14	65.50	78.57	91.80
M14	115	20.93	32.89	41.06	49.34	65.67	89.36	107.18	125.24
M16	157	28.57	44.90	56.05	67.35	89.65	121.99	146.32	170.97
M18	192	34.94	54.91	68.54	82.37	109.63	149.18	178.94	209.09
M20	245	44.59	70.07	87.47	105.11	139.90	190.37	228.34	266.81
M22	303	55.15	86.66	108.17	129.99	173.01	235.43	282.40	329.97
M24	353	64.25	100.96	126.02	151.44	201.56	274.28	329.00	384.27
M27	459	83.54	131.27	163.86	196.91	262.09	356.64	427.79	499.85
M30	561	102.10	160.45	200.28	240.67	320.33	435.90	522.85	610.93
M33	694	126.31	198.48	247.76	297.73	396.27	539.24	646.81	755.77
M36	817	148.69	233.66	291.67	350.49	466.51	634.81	761.44	889.71
M39	976	177.63	279.14	348.43	418.70	557.30	758.35	909.63	1062.86

NOTES

1. $\text{Proof load (kN)} = \dfrac{\text{Stress under proof load } (N/mm^2) \times \text{tensile stress area of stud} / (mm^2)}{1000}$

2. *For stress under proof load, see Table 6.*

8.8 Decarburization test

To determine the amount of decarburization, a longitudinal section shall be taken of the threaded portion, the section plane being within one tenth of the diameter from the stud axis. Mount the section suitably to support the edges of the specimen, polish and etch with an alcoholic solution of nitric acid. Measure the surface decarburization with a micrometer ocular at a magnification of 100. The test piece shall comply with the requirements specified in 5.3.2.1.

In cases of dispute between the purchaser and the supplier the amount of decarburization shall be measured by micro-hardness testing.

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