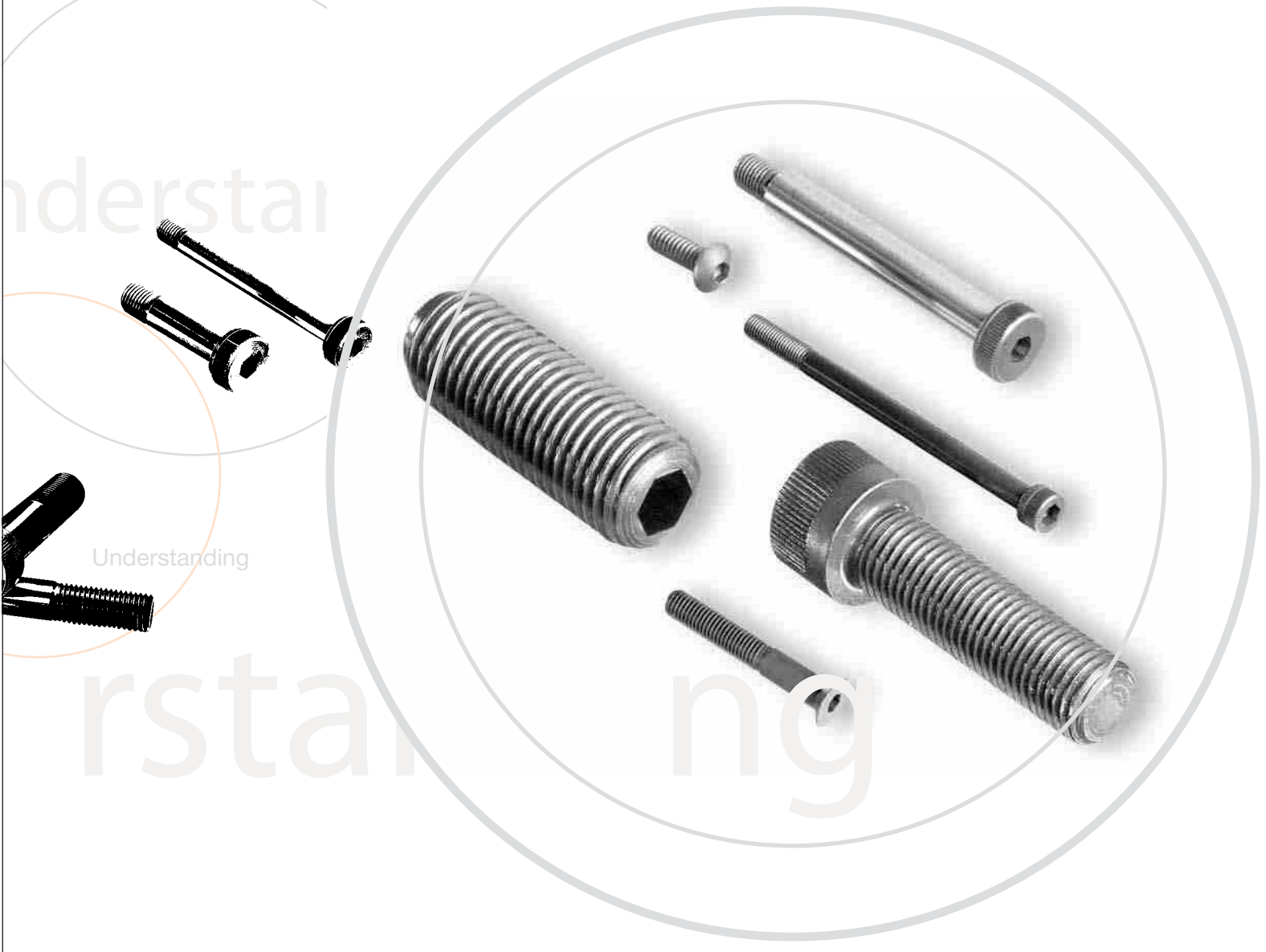
Unbrako®

Understanding

Unbrako

technical brochure



Understanding

UNBRAKO is the world's largest manufacturer of Precision Mechanical Fasteners and has earned a reputation for quality and performance in the production of Hexagon Socket Screws (and Allied Products), Aerospace and Automotive Fasteners. Special Hot and Cold Forged Components as well as significant business in Speciality and Exotic Alloy materials and magnetic products.

UNBRAKO employs over 4,000 people in 5 manufacturing plants and sales offices in 6 countries spread over 4 continents.

Since its founding in 1903, **UNBRAKO** has sought opportunities for growth through product innovation and technological advances. In pioneering work in metallurgy, testing, design and metal working, the company continues to develop unique capabilities for solving its customers industrial problems.

UNBRAKO is involved with quality control at its specialist steel suppliers, enabling **UNBRAKO** to control the production of high grade alloy steels with metallurgical and chemical characteristics specifically to suit **UNBRAKO** Fasteners. It also allows complete control of material from original steel melt to finished product ensuring ultimate fastener reliability.

UNBRAKO In addition to the well known hexagon socket product range (detailed in this catalogue), **UNBRAKO** also manufacturers a wide range of custom designed fasteners for aerospace and other demanding applications. The wide range of Hexagon Wrenches and Wrench Sets are also available.

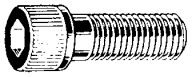
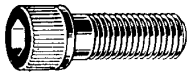
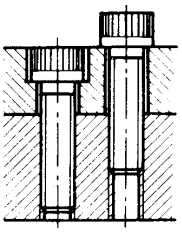
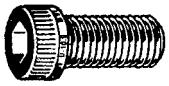
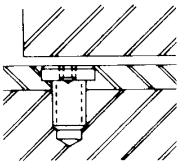
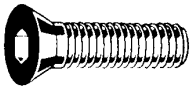
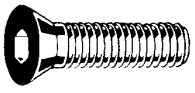
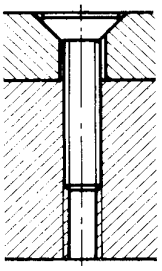
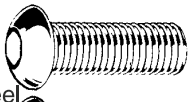
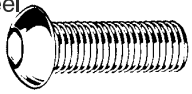
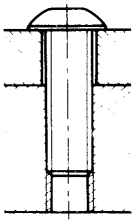
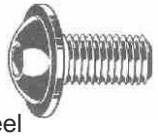
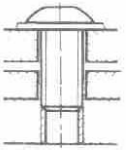
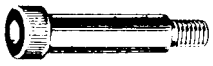
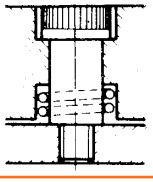
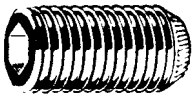
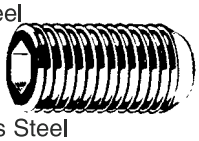
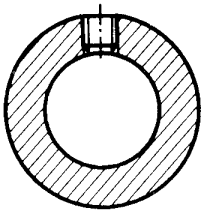
UNBRAKO standard fasteners-"The widest range in the world" are available from Distributors who have the support of trained sales and application engineers who will solve fastening problems in all types of industrial environments. If necessary **UNBRAKO** will design and develop fasteners to suit the specific requirements of any application.

CONTENTS

Due to a continuous policy of research and development Unbrako reserve the right to alter the specification of any product without prior notice.

Performance data listed is for standard production items only. Non stock items may vary due to variables in methods of manufacture. It is recommended that the user verify performance on any non-standard parts for critical applications.

QUICK SELECTION GUIDE

Type	Application	Features
Socket Head Cap Screws  Alloy Steel  Stainless Steel		Suitable for all high tensile applications. Use stainless for corrosive-cryogenic or elevated temperatures.
Socket Low Head Cap Screw  Alloy Steel		Suitable for use in parts too thin for std. SHCS; and for applications with limited clearances.
Countersunk Socket Head Screws  Alloy Steel  Stainless Steel		Controlled angle under the head ensures maximum flushness and sidewall contact. Non-slip Hex socket prevents marring of material. Note: Inclined angle under the head varies as follows: BSW & BSF Threads - 90°C UNC & UNF Threads - 82°C Metric Threads - 90°C Above M20 - 60°C
Button Head Screws  Alloy Steel  Stainless Steel		Low heads streamline design. Use them in materials too thin to countersink: also for non-critical loading requiring heat treated screws.
Flange Button Head Scre ws  Alloy Steel		Allows covering of large diameter holes in sheet metal. Can be used with softer materials.
Shoulder Screws  Alloy Steel		Replaces costly special parts - shafts, pivots, pins, guides, linkages and trunnion mountings. Also standard for tool and die industries.
Socket Set Screws  Alloy Steel  Stainless Steel		Fasten collars, sleeves, gears, knobs on shafts. Locate machine parts Cone, half dog, oval, cup and self locking knurled cup points are standard.

QUICK SELECTION GUIDE

Maximum Operating Temperature Unplated	Material	Corrosion Resistance	Magnetic or Non-Magnetic	Page
300°C	High Grade Unbrako Alloy Steel	Plating Optional	Magnetic	4 to 18
430°C	Austenitic Stainless Steel	Excellent	Non-Magnetic	
300°C	High Grade Unbrako Alloy Steel	Plating Optional	Magnetic	11
300°C	High Grade Unbrako Alloy Steel	Plating Optional	Magnetic	19 to 26
430°C	Austenitic Stainless Steel	Excellent	Non-Magnetic	
300°C	High Grade Unbrako Alloy Steel	Plating Optional	Magnetic	27 to 30
430°C	Austenitic Stainless Steel	Excellent	Non-Magnetic	
300°C	High Grade Unbrako Alloy Steel	Plating Optional	Magnetic	31 to 32
300°C	High Grade Unbrako Alloy Steel	Fair	Magnetic	41 to 44
300°C	High Grade Unbrako Alloy Steel	Plating Optional	Magnetic	31 to 39
430°C	Austenitic Stainless Steel	Excellent	Non-Magnetic	

SOCKET HEAD CAP SCREWS

If you use fasteners, you know their importance in today's technology. Higher pressures, higher stresses and higher speeds demand stronger, more reliable joints, and stronger, more reliable fasteners to hold them together. Parts must stay together. A single failure can destroy valuable equipment or stop an assembly line. Reliability must be total.

This is why industry is using more and more socket head cap screws, the strongest threaded fasteners you buy "off the shelf". They have the extra strength and fatigue resistance required for total reliability in high strength fastening.

Tensile and Fatigue Strength

Unbrako socket head cap screws have the highest levels of strength and fatigue resistance in the industry. They exceed all government and industry standards. Instead of the usual range of 1220 N/mm^2, minimum tensile strength levels of Unbrako cap screws are consistently 1300 N/mm^2. At the same time ductility and fatigue resistance are not sacrificed.

When you buy tension fasteners (which is what socket head cap screws basically are) you're buying clamping force - the ability to hold things together. The additional strength offered by Unbrako screws can save pounds, if you use the screws correctly.

The extra strength of Unbrako screws allows the use of either fewer fasteners of the same size, or the same number of smaller screws to achieve the same clamping force. With fewer fasteners you save on drilling and tapping and have fewer screws to buy and install. If you go the other way, smaller screws generally cost less and permit reduced assembly size, saving space, material and weight.

If you have dynamic stress or varying load conditions, the exceptional fatigue resistance of Unbrako screws gives you an additional bonus of built-in protection against fatigue failure.

Design

One of three major factors in the superiority of Unbrako socket head screws is design. For example, socket depth is carefully controlled. The socket is deep enough for full tightening without reaming and cracking, but not deep enough to weaken the head area and cause failure.

Inspired by our research and development of aerospace fasteners, another major feature on Unbrako socket screws is the Radiused-Root-Runout. The root of the thread runout is also radiused to eliminate the usual sharp 'V' - a major point of weakness in other threads. Fatigue life in this critical area is increased as much as 300% in certain sizes.

Class 4g 6g tolerances are standard, the closest without selective assembly. They combine maximum cross-section with smooth assembly, and assure better mating of parts.

The elliptical fillet at the juncture of head and shank is another aerospace-inspired Unbrako development. This compound curve more than doubles fatigue life in the head area without reduction of critical bearing area. Discontinuity is minimised and stress concentrations are reduced, providing an added margin of safety. Heads are correctly proportioned to screw size, assuring full clamping force without indentation and loss of preload.

Properties

Second major factor in Unbrako socket screw superiority is their physical properties. These are no accident. Consistently higher stress levels area direct result of customised heat treatment. Carbon content of furnace atmospheres is closely controlled, since carburisation (too much carbon) makes screws brittle, while decarburisation (too little carbon) results in soft surface with poor strength and resistance to wear. Every melt of Unbrako steel is pre-tested and its treatment tailored to produce a consistent part.

Manufacturing Control

Closely controlled manufacturing is the third factor. Rigid control of every operation of a socket screw is necessary in order to guarantee performance.

Heads of standard Unbrako socket screws are forged, not machined. Machining cuts metal fibres, breaks flow lines, creates planes of weakness at stress points. Forging, on the other hand, forms metal, produces uniform grain flow, makes heads stronger by compressing the metal. Head bearing area is strictly perpendicular to screw body to avoid strains and misalignment. Fillet areas are precisely controlled, with fillets made glass smooth to eliminate surface irregularities where cracks can start.

Radiused threads of standard Unbrako screws are rolled, not ground or cut. Rolled threads are more uniform and closer tolerances can be maintained because Unbrako thread roll dies and rolling techniques produce smoother surfaces and more accurate size control. High points and planes of weakness are avoided.

Plating

Plating becomes more critical as the demand for plated screws increases. Unbrako socket screws that are to be plated are accurately controlled to be within tolerance after plating. Precision plating thickness brings screws to correct dimensions, while rigid control of the plating process guards against screw failure from hydrogen embrittlement. This is a brittle condition caused by hydrogen diffusing into the base material during cleaning and electroplating. It can cause screw failure long after the screw is tightened, but can be avoided by the extreme care Unbrako take in processing plated socket screws.

Unbrako Socket Screws pay off in Savings

You get extra safety and reliability in Unbrako socket screws, plus significant economies, both in the cost of the fasteners and the cost of their installation. Furthermore, they protect the reputation of your product, which can well depend on the fasteners that hold it together.

These are considerations too important to overlook as production costs continue to rise and reliability requirements become more exacting.

"YOU'RE SAFER WITH UNBRAKO"

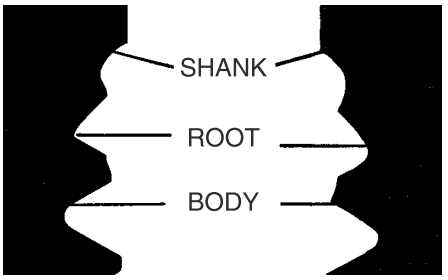
UNBRAKO DEVELOPMENTS MEAN
- Extra Strength Where If Counts

Deep, accurate socket for uniform wrenching power and high maximum torques. Precise knurls for easier handling and quick identification.

Precision forged head for continuous grain flow and maximum strength.

Elliptical head to shank fillet for increased fatigue life.

Radiused-root runout increases fatigue life.

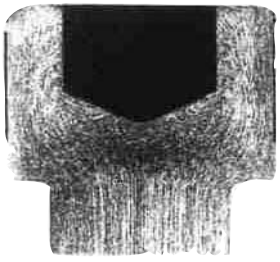


CONVENTIONAL THREAD RUNOUT Note sharp angle at root where high stress concentration can develop cracks in the screw.

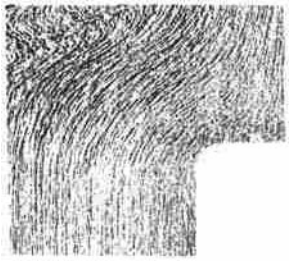
UNBRAKO RADIUSED ROOT RUNOUT THREAD - Controlled radius of runout root provides a smooth form that distributes stress and increases fatigue life of fastener considerably.

Fully formed radiused threads rolled to maintain continuous grain flow for greater tensile and fatigue strength.

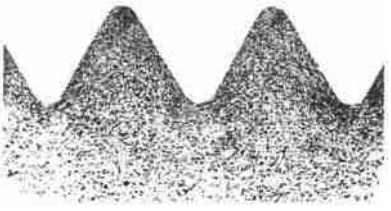
Heat treatment in a controlled atmosphere for maximum uniform strength and surface integrity without brittleness or decarburisation.



Accurate control of socket depth gives more wrench engagement than other screws, permitting full tightening without cracking or reaming the socket, yet maintaining ample metal in the crucial fillet area for maximum head strength.



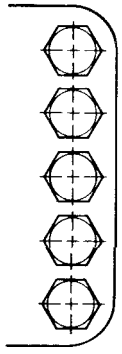
Controlled head forging forms uniform grain flow with unbroken flow lines, makes heads stronger, prevents failure in vital fillet area and adds to fatigue strength of the screw.



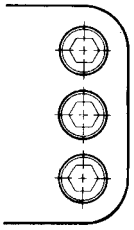
Cross-section of radiused fully formed threads. Contour following flow lines provide extra shear strength in threads, resist stripping and provide high fatigue resistance. Note the large root radius, an Unbrako socket screw development that increases fatigue life of the threads.

APPLICATIONS

FEWER HOLES TO DRILL AND TAP



Three screws do the work of five



Old Method

5 - M10 Screws
@ 800 N/mm² tensile

640 N/mm² yield =
5 x 640 x 58 =
186 kN max. load

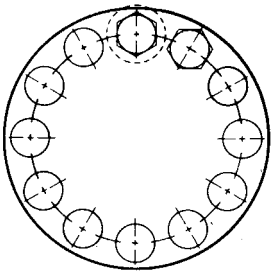
Unbrako Method

3 - M10 Screws
@ 1300 N/mm² tensile

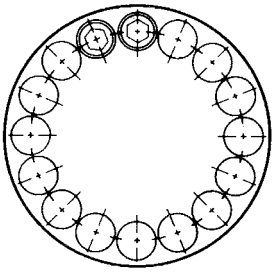
1170 N/mm² yield =
3 x 1170 x 58 =
204 kN max. load

COMPACT SPACING

Clearance for socket wrench



No wrench clearance necessary



Old Method

12 - M16 Hexagon Head Screws
@ 800 N/mm²
tensile strength

Total strength = 1206 kN

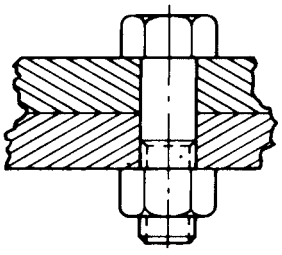
Unbrako Method

16 - M16 Socket Head Cap Screws
@ 1300 N/mm²
tensile strength

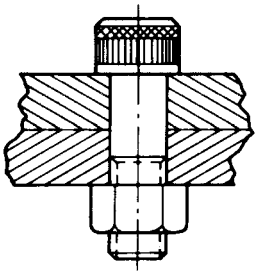
Total strength = 2940 kN

HIGH TENSILE AND YIELD STRENGTH

Ordinary Bolts



Socket Head Cap Screws



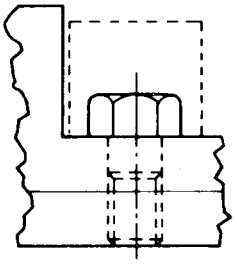
Old Method
800 N/mm² M12 Bolt
tensile = 67 kN
yield = 54 kN

Unbrako Method
1300 N/mm² M12 Unbrako Bolt
tensile = 110 kN
yield = 99 kN

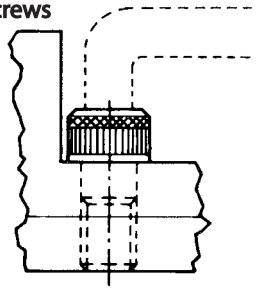
Extra Unbrako Joint Strength:
tensile = 64% Increase
yield = 83% Increase

HIGH SHEAR STRENGTH

Ordinary Bolts



Socket Head Cap Screws

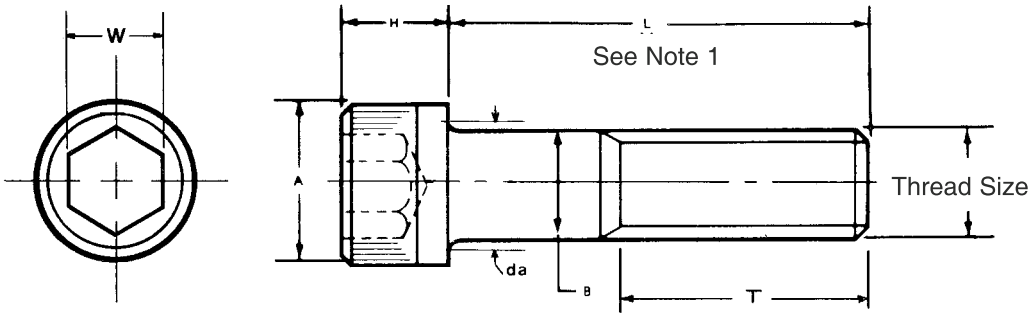


Old Method
800 N/mm² M12 Bolt
Shear Strength = 40 kN

Unbrako Method
1300 N/mm² M12 Unbrako Bolt
Shear Strength = 66 kN
Extra Unbrako Shear Strength = 26 kN less wrenching space needed

Example (shown above) - against adjacent machine parts Unbrako Screw requires 50% less space for clearance. In counterbored screw application Unbrako Screws require minimum counterbore since no wrench clearance is necessary.

SOCKET HEAD CAP SCREWS - ISO Metric



Applicable or Similar Specifications:

Product	BS 4168		
	DIN 912		
	ISO 4762		
Grade	BS 6104	Grade	12.9
	ISO 898/1	Grade	12.9

DIMENSIONS AND TIGHTENING TORQUES - ISO Metric Threads

Thread Size (B Max.)	Pitch	A Max.	da Max.	H Max.	W Nom.	SEE NOTE 2 L	Length of Thread T (Ref)	Maximum Tightening Torques Unplated Plated Nm	Unplated Plated lbf.in.	Induced Load Nm	Induced Load lbf.in.	kN	lbf.
M3	0.50	5.50	3.60	3.00	2.5	20	18	2.1	18.6	1.6	14.2	3.99	890
M4	0.70	7.00	4.70	4.00	3.0	25	20	4.6	40.7	3.5	31.0	6.75	1510
M5	0.80	8.50	5.70	5.00	4.0	25	22	9.5	84.1	7.1	62.8	11.10	2480
M6	1.00	10.00	6.80	6.00	5.0	30	24	16.0	142.0	12.0	106.0	15.60	3480
M8	1.25	13.00	9.20	8.00	6.0	35	28	39.0	345.0	29.0	257.0	28.70	6400
M10	1.50	16.00	11.20	10.00	8.0	40	32	77.0	682.0	58.0	513.0	45.70	10200
M12	1.75	18.00	13.70	12.00	10.0	50	36	135.0	1200.0	101.0	894.0	66.70	14900
(M14)	2.00	21.00	15.70	14.00	12.0	55	40	215.0	1900.0	161.0	1420.0	91.30	20400
M16	2.00	24.00	17.70	16.00	14.0	60	44	330.0	2920.0	248.0	2190.0	126.00	28100
(M18)	2.50	27.00	20.20	18.00	14.0	65	48	455.0	4030.0	341.0	3020.0	153.00	34100
M20	2.50	30.00	22.40	20.00	17.0	70	52	650.0	5750.0	488.0	4320.0	197.00	44000
(M22)	2.50	33.00	24.40	22.00	17.0	70	56	870.0	7700.0	652.0	5770.0	245.00	54700
M24	3.00	36.00	26.40	24.00	19.0	80	60	1100.0	9740.0	825.0	7300.0	284.00	63400
M27	3.00	40.00	30.40	27.00	19.0	90	66	1650.0	14600.0	1238.0	11000.0	374.00	83400
M30	3.50	45.00	33.40	30.00	22.0	100	72	2250.0	19900.0	1688.0	15000.0	454.00	101000
M33	3.50	50.00	36.40	33.00	24.0	100	78	3050.0	27000.0	2287.0	20200.0	550.00	123000
M36	4.00	54.00	39.40	36.00	27.0	110	84	3850.0	34100.0	2888.0	25000.0	664.00	148000
M42	4.50	63.00	45.60	42.00	32.0	130	96	6270.0	55500.0	4700.0	41600.0	889.00	198000

ALL DIMENSIONS IN MILLIMETRES. SIZES IN BRACKETS ARE NON-PREFERRED STANDARDS.

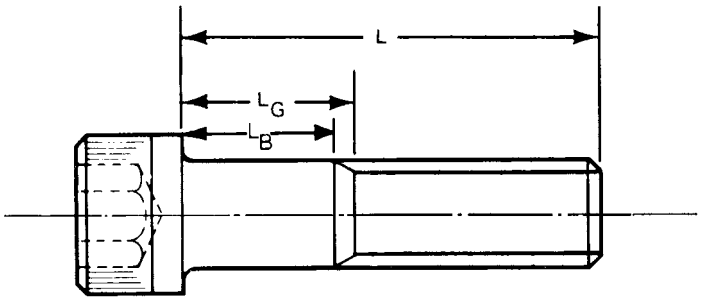
MECHANICAL PROPERTIES

Material	Unbrako High Grade Alloy Steel	
Heat Treatment	Rc 40-43	
Screw Size	≤M16	>M16
Tensile Strength	1300 N/mm²	1250 N/mm²
Yield Strength	1170 N/mm²	1124 N/mm²
Shear Strength	780 N/mm²	750 N/mm²
Min. Elongation	9%	9%

NOTES:

1. Thread and Grip Lengths are shown on Pages 8 & 9.
2. Screws with lengths equal or shorter than listed in column 'L' will be threaded to head.
3. **Thread Class:** 4g 6g
4. **da:** Transition Diameter
5. **Working Temperature:** -50°C +300°C
6. Torques calculated in accordance with VDI 2230 "Systematic calculation of high duty bolted joints" with σ 0.2 = 1080 N/mm² and μ = 0.125 for plain finish and μ = 0.094 for plated.

SOCKET HEAD CAP SCREWS - ISO Metric

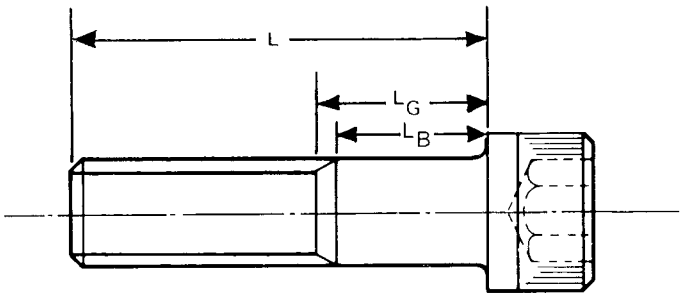


BODY AND GRIP LENGTHS - ISO Metric Threads

Thread Size	Body and Grip Lengths	Length 'L'											
		20	25	30	35	40	45	50	55	60	65	70	80
M3	LB. Min.	To Head	4.5	9.5									
	LG. Max.		7.0	12.0									
M4	LB. Min.	→	To Head	6.5	11.5	16.50							
	LG. Max.			10.0	15.0	20.00							
M5	LB. Min.	→	To Head	4.0	9.0	14.00	19.00	24.00					
	LG. Max.			8.0	13.0	18.00	23.00	28.00					
M6	LB. Min.	→	→	To Head	6.0	11.00	16.00	21.00	26.00	31.00			
	LG. Max.				11.00	16.00	21.00	26.00	31.00	36.00			
M8	LB. Min.	→	→	→	To Head	5.75	10.75	15.75	20.75	25.75	30.75	35.75	45.75
	LG. Max.					12.00	17.00	22.00	27.00	32.00	37.00	42.00	52.00
M10	LB. Min.	→	→	→	→	To Head	5.50	10.50	15.50	20.50	25.50	30.50	40.50
	LG. Max.						13.00	18.00	23.00	28.00	33.00	38.00	48.00
M12	LB. Min.	→	→	→	→	→	To Head	10.25	15.25	20.25	25.25	35.25	
	LG. Max.							19.00	24.00	29.00	34.00	44.00	
(M14)	LB. Min.	→	→	→	→	→	→	To Head	10.00	15.00	20.00	30.00	
	LG. Max.								20.00	25.00	30.00	40.00	
M16	LB. Min.	→	→	→	→	→	→	→	To Head	11.00	16.00	26.00	
	LG. Max.									21.00	26.00	36.00	
(M18)	LB. Min.	→	→	→	→	→	→	→	→	To Head	9.50	19.50	
	LG. Max.										22.00	32.00	
M20	LB. Min.	→	→	→	→	→	→	→	→	→	To Head	15.50	
	LG. Max.											28.00	
(M22)	LB. Min.	→	→	→	→	→	→	→	→	→	To Head	11.50	
	LG. Max.											24.00	
M24	LB. Min.	→	→	→	→	→	→	→	→	→	→	To Head	
	LG. Max.												
M27	LB. Min.	→	→	→	→	→	→	→	→	→	→	→	
	LG. Max.												
M30	LB. Min.	→	→	→	→	→	→	→	→	→	→	→	
	LG. Max.												
M33	LB. Min.	→	→	→	→	→	→	→	→	→	→	→	
	LG. Max.												
M36	LB. Min.	→	→	→	→	→	→	→	→	→	→	→	
	LG. Max.												
M42	LB. Min.	→	→	→	→	→	→	→	→	→	→	→	
	LG. Max.												

ALL DIMENSIONS IN MILLIMETRES

SOCKET HEAD CAP SCREWS - ISO Metric



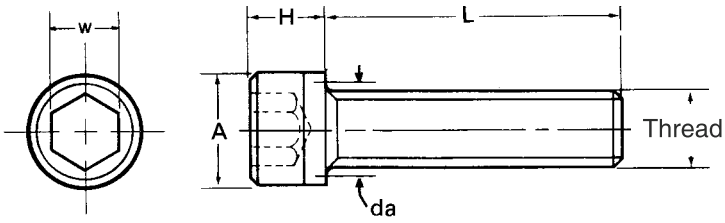
90	100	110	120	130	140	150	160	180	200	220	240	260	280
50.50	60.50												
58.00	68.00												
45.25	55.25	65.25	75.25										
54.00	64.00	74.00	84.00										
40.00	50.00	60.00	70.00	80.0	9.0								
50.00	60.00	70.00	80.00	90.0	100.0								
36.00	46.00	56.00	66.00	76.0	86.0	96.0	106.0						
46.00	56.00	66.00	76.00	86.0	96.0	106.0	116.0						
29.50	39.50	49.50	59.50	69.5	79.5	89.5	99.5	119.5					
42.00	52.00	62.00	72.00	82.0	92.0	102.0	112.0	132.0					
25.50	35.50	45.50	55.50	65.5	75.5	85.5	95.5	115.5	135.5				
38.00	48.00	58.00	68.00	78.0	88.0	98.0	108.0	128.0	148.0				
21.50	31.50	41.50	51.50	61.5	71.5	81.5	91.5	111.5	131.5	151.5			
34.00	44.00	54.00	64.00	74.0	84.0	94.0	104.0	124.0	144.0	164.0			
15.00	25.00	35.00	45.00	55.0	65.0	75.0	85.0	105.0	125.0	145.0	165.0		
30.00	40.00	50.00	60.00	70.0	80.0	90.0	100.0	120.0	140.0	160.0	180.0		
To Head	19.00	29.00	39.00	49.0	59.0	69.0	79.0	99.0	119.0	139.0	159.0	179.0	
	34.00	44.00	54.00	64.0	74.0	84.0	94.0	114.0	134.0	154.0	174.0	194.0	
→	To Head	20.50	30.50	40.5	50.5	60.5	70.5	90.5	110.5	130.5	150.5	170.5	190.5
		38.00	48.00	58.0	68.0	78.0	88.0	108.0	128.0	148.0	168.0	188.0	208.0
→	To Head	14.50	24.50	34.5	44.5	54.5	64.5	84.5	104.5	124.5	144.5	164.5	184.5
		32.00	42.00	52.0	62.0	72.0	82.0	102.0	122.0	142.0	162.0	182.0	202.0
→	To Head	16.00	26.0	36.0	46.0	56.0	76.0	96.0	116.0	136.0	156.0	176.0	
		36.00	46.0	56.0	66.0	76.0	96.0	116.0	136.0	156.0	176.0	196.0	
→	To Head	21.5	31.5	41.5	61.5	81.5	101.5	121.5	141.5	161.5			
		44.0	54.0	64.0	84.0	104.0	124.0	144.0	164.0	184.0			

Length 'L' Tolerance (mm)		
Screws Over	Up to and including	Tolerance
-	50	±0.25
50	80	±0.50
80	120	±0.70
120	250	±0.80
250	-	±1.00

NOTES:

1. Dimensional and tightening information for standard metric cap screws on Page 7 and metric low head on Page 11.
2. Dimensions for LB and LG are calculated from the following formula:
   - T Ref = (2x Nominal Dia) plus 12mm.
   - LG max = Nominal length "L" minus "T"
   - LB min = Nominal length "L" minus (T + 5 pitches)
3. Screws ordered to an intermediate length shall have a grip length equal to that of the screw of the next shortest length.

SOCKET HEAD CAP SCREWS
- ISO Metric Micro Screws



Applicable or Similar Specifications:

Product	BS 4168		
	DIN 912		
	ISO 4762		
Grade	BS 6104	Grade	12.9
	ISO 898/1	Grade	12.9

DIMENSIONS AND TIGHTENING TORQUES - ISO Metric Threads

Thread Size	Pitch				Length L		W Nom.	Maximum Tightening Torques				Induced Load	
								Unplated		Plated			
					Min.	Max.		Nm	lbf.in.	Nm	lbf.in.	N	lbf.
M1.4	0.30	2.6	1.8	1.4	3	6	1.27	0.20	1.8	0.15	1.3	733	164
M1.6	0.35	3.0	2.0	1.6	3	6	1.50	0.29	2.6	0.22	2.0	930	208
(M1.7)	0.35	3.0	2.1	1.7	3	6	1.50	0.35	3.1	0.26	2.3	1100	246
M1.8	0.35	3.4	2.3	1.8	3	6	1.50	0.44	3.9	0.33	2.9	1300	291
M2	0.40	3.8	2.6	2.0	3	12	1.50	0.60	5.3	0.45	4.0	1550	347
(M2.3)	0.40	4.0	2.9	2.3	4	15	2.00	0.95	8.4	0.71	6.3	2230	500
M2.5	0.45	4.5	3.1	2.5	4	15	2.00	1.21	10.7	0.90	8.0	2590	580
(M2.6)	0.45	4.5	3.2	2.6	4	15	2.00	1.37	12.1	1.03	9.1	2860	640

ALL DIMENSIONS IN MILLIMETRES. SIZES IN BRACKETS ARE NON-PREFERRED STANDARDS.

MECHANICAL PROPERTIES

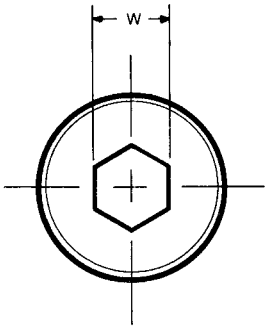
Material	Unbrako High Grade Alloy Steel
Heat Treatment	Rc 40-43
Tensile Strength	1300 N/mm²
Yield Strength	1170 N/mm²
Shear Strength	780 N/mm²
Min. Elongation	9%

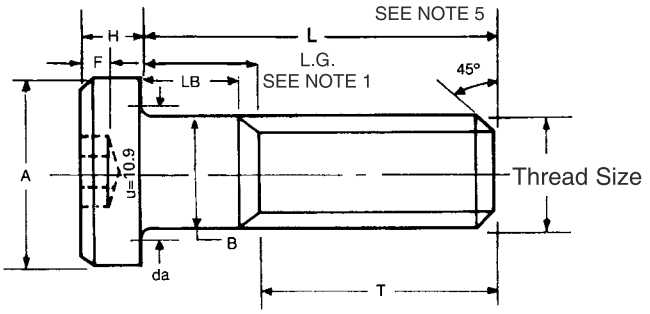
NOTES:

1. **Thread Class:** 4g 6g
2. **da:** Transition Diameter
3. **Working Temperature:** -50°C +300°C
4. Torques calculated in accordance with VDI 2230 "Systematic calculation of high duty bolted joints" with σ 0.2 = 1080 N/mm² and μ = 0.125 for plain finish and μ = 0.094 for plated.

Length 'L' Tolerance (mm)		
Screws Over	Up to and including	Tolerance
-	3.0	±0.20
3.0	6.0	±0.24
6.0	-	±0.25

SOCKET HEAD CAP SCREWS
- Low Head ISO Metric





Applicable or Similar Specifications:

Grade	BS 6104	Grade	10.9
	ISO 898/1	Grade	10.9

DIMENSIONS and TIGHTENING TORQUES - ISO Metric Threads

Thread Size (B max.)								Maximum Tightening Torques				Induced Load	
								Unplated		Plated			
								Nm	lbf.in.	Nm	lbf.in.	kN	lbf.
M4		7.0	4.7	1.48	2.8	20	3	3.8	33.6	2.9	25.7	5.65	1270
M5		8.5	5.7	1.85	3.5	22	4	8.0	70.8	6.0	53.1	9.20	2068
M6		10.0	6.8	2.09	4.0	24	5	13.0	115.0	9.8	86.7	13.00	2920
M8		13.0	9.2	2.48	5.0	28	6	32.0	283.0	24.0	212.0	23.90	5370
M10		16.0	11.2	3.36	6.5	32	8	64.0	566.0	48.0	425.0	38.00	8540
M12		18.0	14.2	4.26	8.0	36	10	110.0	974.0	83.0	735.0	55.50	12470
M16		24.0	18.2	4.76	10.0	44	12	275.0	2434.0	206.0	1820.0	105.00	23600
M20		30.0	22.4	6.07	12.5	52	14	550.0	4870.0	405.0	3585.0	164.00	36800

ALL DIMENSIONS IN MILLIMETRES.

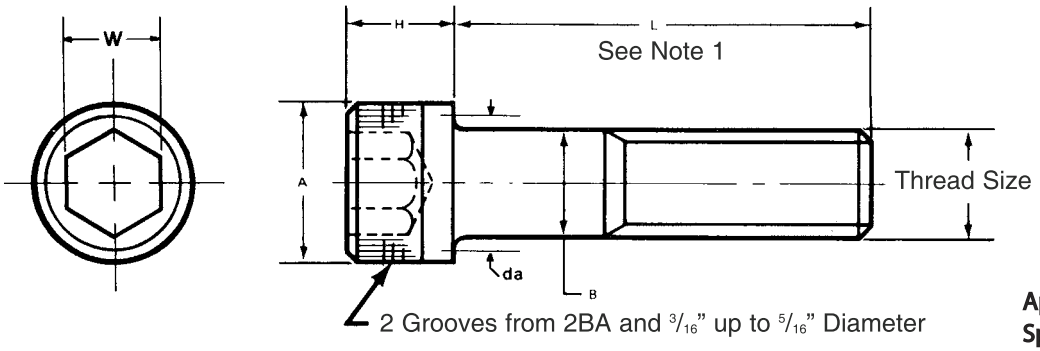
MECHANICAL PROPERTIES

Material	Unbrako High Grade Alloy Steel
Heat Treatment	Rc 33-39
Tensile Strength	1040 N/mm²
Yield Strength	940 N/mm²
Shear Strength	624 N/mm²
Min. Elongation	9%

NOTES:

1. Thread and Grip Lengths are shown on Pages 8 & 9.
2. **Thread Class:** 4g 6g
3. **da:** Transition Diameter
4. **Working Temperature:** -50°C +300°C
5. See Page 9 for Length Tolerance.
6. Sizes M5 and larger are stamped U 10.9. Torques calculated in accordance with VDI 2230 "Systematic calculation of high duty bolted joints" with σ 0.2 = 900 N/mm² and μ = 0.125 for plain finish and μ = 0.094 for plated.

SOCKET HEAD CAP SCREWS
- 1936 Series BA, BSW and BSF Threads



Applicable Specifications
BS 2470

DIMENSIONS AND TIGHTENING TORQUES - BA, BSW and BSF Threads

Thread Size	Threads Per Inch BA		A Max.	B Max.	da Max.	H Max.	W Nom.	Maximum Tightening Torques lbf. in. Unplated BA		Maximum Tightening Torques lbf. in. Plated BA		Induced Load lbf.	
8BA	59.1		0.140	0.0866	0.1026	0.087	1/16	5.0		4		359	
7BA	52.9		0.161	0.0984	0.1144	0.098	1/16	8.5		6		467	
6BA	47.9		0.187	0.1102	0.1282	0.110	5/64	12.0		9		589	
5BA	43.1		0.219	0.1260	0.1460	0.126	3/32	19.0		15		779	
4BA	38.5		0.219	0.1417	0.1617	0.142	3/32	24.0		18		991	
3BA	34.8		0.250	0.1614	0.1854	0.161	1/8	35.0		27		1297	
2BA	31.4		0.312	0.1850	0.2130	0.187	5/32	49.0		37		1729	
1BA	28.2		0.312	0.2087	0.2367	0.209	5/32	80.0		60		2210	
0BA	25.4		0.375	0.2362	0.2642	0.236	3/16	144.0		108		2849	
	BSW	BSF						BSW	BSF	BSW	BSF	BSW	BSF
1/8	40	-	0.219	0.1250	0.1460	0.125	3/32	14	-	11	-	721	-
3/16	24	32	0.312	0.1875	0.2155	0.187	5/32	44	50	33	38	1538	1753
1/4	20	26	0.375	0.2500	0.2780	0.250	3/16	108	144	81	108	2772	2951
		lbf.ft.											
5/16	18	22	0.437	0.3125	0.3465	0.312	7/32	23	23	18	18	4588	4956
3/8	16	20	0.562	0.3750	0.4150	0.375	5/16	44	49	33	37	6813	7364
7/16	14	18	0.625	0.4375	0.4835	0.437	5/16	68	74	51	55	9365	10180
1/2	12	16	0.750	0.5000	0.5520	0.500	3/8	101	111	76	83	12140	13390
9/16	12	16	0.812	0.5625	0.6225	0.562	3/8	154	169	116	124	16452	17847
5/8	11	14	0.875	0.6250	0.6890	0.625	1/2	184	193	138	145	20020	21470
3/4	10	12	1.000	0.7500	0.8280	0.750	9/16	297	308	223	231	29680	30480
7/8	9	11	1.125	0.8750	0.9630	0.875	9/16	518	488	389	366	41030	43180
1	8	10	1.312	1.0000	1.1000	1.000	5/8	758	789	569	592	53890	56920
1 1/8	7	9	1.500	1.1250	1.2350	1.125	3/4	934	993	700	744	49820	52890
1 1/4	7	9	1.750	1.2500	1.3700	1.250	3/4	1318	1390	988	1043	63230	66760
1 3/8	6	8	1.875	1.3750	1.5050	1.375	3/4	1330	1418	997	1063	57990	61880
1 1/2	6	8	2.000	1.5000	1.6400	1.500	1	2291	2430	1717	1823	91640	97230
1 5/8	5	8	2.250	1.6250	1.7500	1.625	1	-	3132	-	2349	-	115600
1 3/4	5	7	2.500	1.7500	1.9100	1.750	1 1/4	3610	3874	2708	2905	123800	132800
2	4 1/2	7	2.750	2.0000	2.1800	2.000	1 3/8	5425	5907	4073	4430	162900	177200

ALL DIMENSIONS IN INCHES.

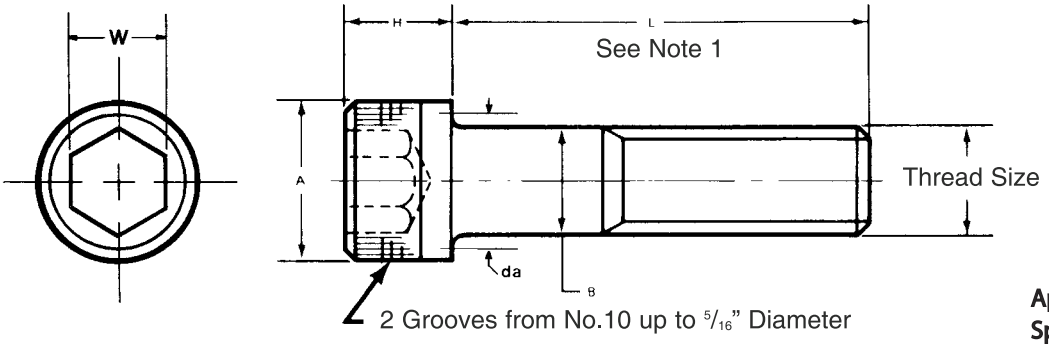
MECHANICAL PROPERTIES

Material	Unbrako High Grade Alloy Steel	
Heat Treatment	Rc 39-43	
Screw Size	≤0.500	>0.500
Tensile Strength	190,000 lbf/in²	180,000 lbf/in²
Yield Strength	170,000 lbf/in²	162,000 lbf/in²
Shear Strength	114,000 lbf/in²	108,000 lbf/in²
Min. Elongation	9%	9%

NOTES:

1. For body and thread lengths see pages 14 & 15.
2. **Thread Class:** BA - Close; BSW and BSF - Medium
3. **da:** Transition Diameter
4. **Working Temperature:** -50°C +300°C

SOCKET HEAD CAP SCREWS
- 1936 Series UNC and UNF Threads



Applicable Specifications
BS 2470

DIMENSIONS AND TIGHTENING TORQUES - UNC and UNF Threads

Thread Size	Threads Per Inch		A Max.	B Max.	da Max.	H Max.	W Nom.	Maximum Tightening Torques lbf. in.				Induced Load lbf.	
								Unplated		Plated			
	UNC	UNF						UNC	UNF	UNC	UNF	UNC	UNF
No.4	40	48	0.183	0.1120	0.1300	0.112	5/64	13.2	14.5	9.9	10.9	640	720
No.5	40	44	0.205	0.1250	0.1450	0.125	3/32	19.6	20.5	14.7	15.4	860	920
No.6	32	40	0.226	0.1380	0.1580	0.138	3/32	24.5	27.6	18.4	20.7	960	1120
No.8	32	36	0.270	0.1640	0.1880	0.164	1/8	45.5	48.0	34.1	36.0	1540	1640
No.10	24	32	0.312	0.1900	0.2180	0.190	5/32	65.4	75.5	49.1	56.6	1880	2240
No.12	24	28	0.343	0.2160	0.2440	0.216	5/32	102.0	109.0	76.5	81.8	2650	2890
1/4	20	28	0.375	0.2500	0.2780	0.250	1/16	153	176.0	115.0	132.0	3470	4150
								lbf.ft.					
5/16	18	24	0.437	0.3125	0.3465	0.312	7/32	26.3	29.3	19.7	22.0	5830	6680
3/8	16	24	0.562	0.3750	0.4150	0.375	5/16	46.8	53.2	35.1	39.9	8700	10300
7/16	14	20	0.625	0.4375	0.4835	0.437	5/16	75.0	84.0	56.3	63.0	12000	13900
1/2	13	20	0.750	0.5000	0.5520	0.500	3/8	115.0	129.0	86.3	96.8	16100	18800
9/16	12	18	0.812	0.5625	0.6225	0.562	3/8	165.0	185.0	124.0	139.0	20800	23900
5/8	11	18	0.875	0.6250	0.6890	0.625	1/2	228.0	258.0	171.0	194.0	25800	30400
3/4	10	16	1.000	0.7500	0.8280	0.750	9/16	363.0	405.0	273.0	304.0	34600	39900
7/8	9	14	1.125	0.8750	0.9630	0.875	9/16	575.0	510.0	430.0	380.0	47100	48600
1	8	12	1.312	1.0000	1.1100	1.000	5/8	788.0	700.0	590.0	525.0	56600	58200
1 1/8	7	12	1.500	1.1250	1.2350	1.125	3/4	1250.0	1115.0	935.0	835.0	76320	85580
1 1/4	7	12	1.750	1.2500	1.3700	1.250	3/4	1750.0	1560.0	1310.0	1170.0	96990	107300
1 3/8	6	12	1.875	1.3750	1.5050	1.375	3/4	2320.0	2070.0	1740.0	1550.0	115500	131500
1 1/2	6	12	2.000	1.5000	1.6400	1.500	1	3040.0	2710.0	2280.0	2030.0	132000	137000
1 3/4	5	12	2.500	1.7500	1.9100	1.750	1 1/4	4990.0	4450.0	3740.0	3335.0	186000	194000
2	4	12	2.750	2.0000	2.1800	2.000	1 3/8	7490.0	6680.0	5615.0	5010.0	216500	227000

ALL DIMENSIONS IN INCHES.

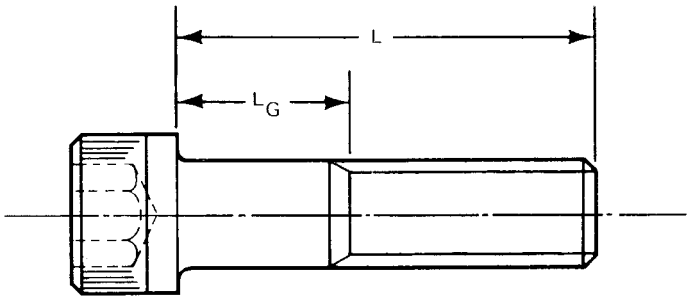
MECHANICAL PROPERTIES

Material	Unbrako High Grade Alloy Steel	
Heat Treatment	Rc 39-43	
Screw Size	≤0.500	>0.500
Tensile Strength	190,000 lbf/in²	180,000 lbf/in²
Yield Strength	170,000 lbf/in²	162,000 lbf/in²
Shear Strength	114,000 lbf/in²	108,000 lbf/in²
Min. Elongation	9%	9%

NOTES:

1. For body and thread lengths see pages 16 & 17.
2. **Thread Class:** #0 through 1" dia. - 3A; over 1" dia. - 2A
3. **da:** Transition Diameter
4. **Working Temperature:** -50°C +300°C
5. Torques calculated in accordance with VDI 2230 "Systematic calculation of high duty bolted joints" with σ 0.2 = 155 K.S.I. and μ = 0.125 for plain finish and μ = 0.094 for plated. Above 0.625" dia. σ 0.2 = 140 K.S.I.

SOCKET HEAD CAP SCREWS
- 1936 Series BA, BSW and BSF Threads



GRIP LENGTH - BA, BSW and BSF Threads

Thread Size	Basic Thread Length See Note 2 (Page15)	Length 'L'																				
		3/4	7/8	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4	4 1/4	4 1/2	4 3/4	5	5 1/4	5 1/2	5 3/4
		Grip Length 'L_G'																					
8BA	.625		.250	.250	.625	.875	1.125																
7BA	.625		.250	.250	.625	.875	1.125	1.375															
6BA	.750			.250	.250	.750	.750	1.250	1.250														
5BA	.750			.250	.250	.750	.750	1.250	1.250	1.750													
4BA	.750				.500	.500	1.000	1.000	1.500	1.500	2.000												
3BA	.875				.375	.375	.875	.875	1.375	1.375	1.875	1.875	2.375										
2BA	.875				.375	.375	.875	.875	1.375	1.375	1.875	1.875	2.375	2.375	2.875	2.875							
1BA	1.000					.500	.500	1.000	1.000	1.500	1.500	2.000	2.000	2.500	2.500	3.000	3.000	3.500	3.500	4.000			
0BA	1.000					.500	.500	1.000	1.000	1.500	1.500	2.000	2.000	2.500	2.500	3.000	3.000	3.500	3.500	4.000			
1/8	.750			.250	.250	.750	.750	1.250	1.250	1.750													
3/16	.875				.375	.375	.875	.875	1.375	1.375	1.875	1.875	2.375	2.375	2.875	2.875							
1/4	1.000					.500	.500	1.000	1.000	1.500	1.500	2.000	2.000	2.500	2.500	3.000	3.000	3.500	3.500	4.000			
5/16	1.125						.625	.625	1.125	1.125	1.625	1.625	2.125	2.125	2.625	2.625	3.125	3.125	3.625	3.625	4.125	4.125	4.625
3/8	1.250						.500	.500	1.000	1.000	1.500	1.500	2.000	2.000	2.500	2.500	3.000	3.000	3.500	3.500	4.000	4.000	4.500
7/16	1.375							.625	.625	1.125	1.125	1.625	1.625	2.125	2.125	2.625	2.625	3.125	3.125	3.625	3.625	4.125	4.125
1/2	1.500								.750	.750	.750	1.500	1.500	1.500	2.250	2.250	2.250	3.000	3.000	3.000	3.750	3.750	3.750
9/16	1.625									.875	.875	.875	1.625	1.625	1.625	2.375	2.375	2.375	3.125	3.125	3.125	3.875	3.875
5/8	1.750									.750	.750	.750	1.500	1.500	1.500	2.250	2.250	2.250	3.000	3.000	3.000	3.750	3.750
3/4	2.000											1.000	1.000	1.000	1.000	2.000	2.000	2.000	2.000	3.000	3.000	3.000	3.000
7/8	2.250												1.000	1.000	1.000	1.000	2.000	2.000	2.000	2.000	3.000	3.000	3.000
1	2.500													1.000	1.000	1.000	1.000	2.000	2.000	2.000	2.000	3.000	3.000

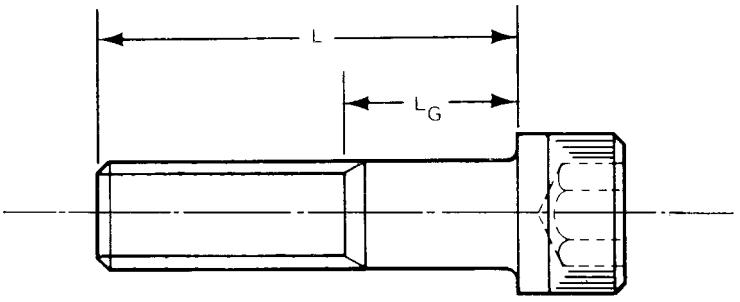
Sizes to the left of the heavy lines will be threaded to head.

ALL DIMENSIONS IN INCHES.

BSW and BSW Thread Lengths of Large Diameter Screws

Thread Size	Length 'L'							
	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2 and over
	Thread Length							
1 1/8			2.812					
1 1/4			3.125					
1 3/8	Sizes to the left of the heavy lines will be threaded to head.			3.437				
1 1/2					3.750			
1 5/8						4.062		
1 3/4						4.375		
2								5.000

SOCKET HEAD CAP SCREWS
- 1936 Series BA, BSW and BSF Threads



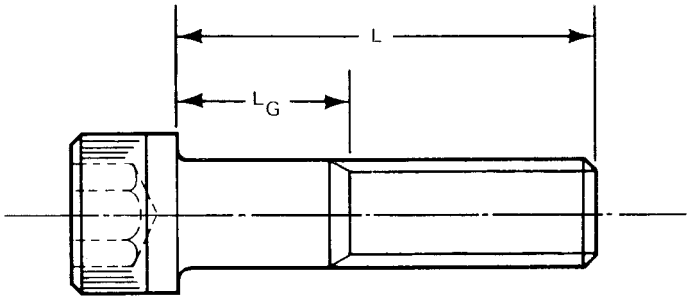
6	6 1/4	6 1/2	6 3/4	7	7 1/4	7 1/2	7 3/4	8	8 1/2	9	9 1/2	10	11	12	13	14	15	16	17	18	19	20
							For sizes longer than shown between heavy lines see Note 2.															
4.625	5.125																					
4.500	5.000	5.000	5.500	5.500	6.000	6.000																
4.625	4.625	5.125	5.125	5.625	5.625	6.125	6.125	6.625	7.125	7.625												
4.500	4.500	4.500	5.250	5.250	5.250	6.000	6.000	6.000	7.000	7.000	8.000	8.000										
3.875	4.625	4.625	4.625	5.375	5.375	5.375	6.125	6.125	6.875	6.875	7.875	7.875										
3.750	4.500	4.500	4.500	5.250	5.250	5.250	6.000	6.000	6.750	6.750	7.750	7.750	9.250	10.250								
4.000	4.000	4.000	4.000	5.000	5.000	5.000	5.000	6.000	6.000	7.000	7.000	8.000	9.000	10.000	11.000	12.000	13.000					
3.000	4.000	4.000	4.000	4.000	5.000	5.000	5.000	5.000	6.000	6.000	7.000	7.000	8.000	9.000	10.000	11.000	12.000	13.000	14.000	15.000		
3.000	3.000	4.000	4.000	4.000	4.000	5.000	5.000	5.000	6.000	6.000	7.000	7.000	8.000	9.000	10.000	11.000	12.000	13.000	14.000	15.000	16.000	17.000

Length 'L' Tolerance		
Screws Over	Up to and including	Tolerance
-	1"	±0.016"
1"	6"	±0.031"
6"	16"	±0.062"
16"	-	±0.125"

NOTES:

1. Dimensional and tightening information on Page 12.
2. Sizes longer than those between the heavy lines shall have a grip length calculated thus - L_G = L - Basic Thread Length.
3. Tolerance on the grip length shall be +0 - 2½ pitches.
4. Tolerance on the thread length shall be +2½ pitches - 0.
5. Screws up to and including 1" dia. ordered to an intermediate length between the heavy lines shall have a grip length equal to that of the screw of the next shorter length.

SOCKET HEAD CAP SCREWS
- 1936-1960 Series UNC and UNF Threads



GRIP LENGTH - UNC and UNF Threads

Thread Size	Basic Thread Length See Note 2	Length 'L'																				
		3/4	7/8	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4	4 1/4	4 1/2	4 3/4	5	5 1/4	5 1/2	5 3/4
		Grip Length 'L_G'																					
No. 0*	.500	.250	.250	.500	.750																		
No. 1*	.625		.250	.250	.625	.875																	
No. 2*	.625		.250	.250	.625	.875	1.125																
No. 3*	.625		.250	.250	.625	.875	1.125	1.375															
No. 4	.750			.250	.250	.750	.750	1.250	1.250														
No. 5	.750			.250	.250	.750	.750	1.250	1.250	1.750													
No. 6	.750				.500	.500	1.000	1.000	1.500	1.500	2.000												
No. 8	.875				.375	.375	.875	.875	1.375	1.375	1.875	1.875	2.375										
No. 10	.875				.375	.375	.875	.875	1.375	1.375	1.875	1.875	2.375	2.375	2.875	2.875							
No. 12	.875				.375	.375	.875	.875	1.375	1.375	1.875	1.875	2.375	2.375	2.875	2.875							
1/4	1.000					.500	.500	1.000	1.000	1.500	1.500	2.000	2.000	2.500	2.500	3.000	3.000	3.500	3.500	4.000			
5/16	1.125						.625	.625	1.125	1.125	1.625	1.625	2.125	2.125	2.625	2.625	3.125	3.125	3.625	3.625	4.125	4.125	4.625
3/8	1.250						.500	.500	1.000	1.000	1.500	1.500	2.000	2.000	2.500	2.500	3.000	3.000	3.500	3.500	4.000	4.000	4.500
7/16	1.375							.625	.625	1.125	1.125	1.625	1.625	2.125	2.125	2.625	2.625	3.125	3.125	3.625	3.625	4.125	4.125
1/2	1.500								.750	.750	.750	1.500	1.500	1.500	2.250	2.250	2.250	3.000	3.000	3.000	3.750	3.750	3.750
9/16	1.625									.875	.875	.875	1.625	1.625	1.625	2.375	2.375	2.375	3.125	3.125	3.125	3.875	3.875
5/8	1.750									.750	.750	.750	1.500	1.500	1.500	2.250	2.250	2.250	3.000	3.000	3.000	3.750	3.750
3/4	2.000											1.000	1.000	1.000	1.000	2.000	2.000	2.000	2.000	3.000	3.000	3.000	3.000
7/8	2.250												1.000	1.000	1.000	1.000	2.000	2.000	2.000	2.000	3.000	3.000	3.000
1	2.500													1.000	1.000	1.000	1.000	2.000	2.000	2.000	2.000	3.000	3.000

Sizes to the left of the heavy lines will be threaded to head.

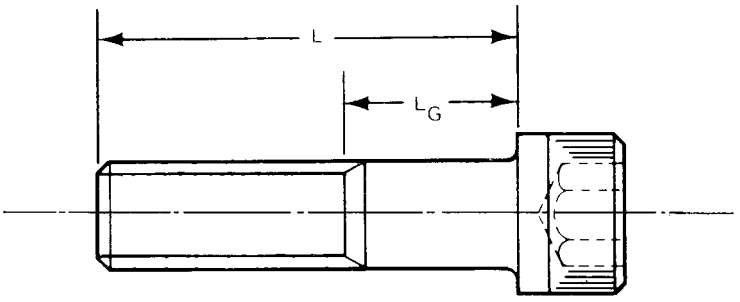
ALL DIMENSIONS IN INCHES.

*Available in 1960 Series only.

UNC and UNF Thread Lengths of Large Diameter Screws

Thread Size	Length 'L'							
	3	3 1/2	4		5		6	6 1/2 and over
	Thread Length							
1 1/8 UNF		2.812						
1 1/8 UNC			2.812					
1 1/4 UNF			3.125					
1 1/4 UNC			3.125					
1 3/8 UNF			3.437					
1 3/8 UNC				3.437				
1 1/2 UNF				3.750				
1 1/2 UNC	Sizes to the left of the heavy lines will be threaded to head.				3.750			
1 3/4 UNF						4.375		
2 UNC								5.000

SOCKET HEAD CAP SCREWS
- 1936-1960 Series UNC and UNF Threads



6	6 1/4	6 1/2	6 3/4	7	7 1/4	7 1/2	7 3/4	8	8 1/2	9	9 1/2	10	11	12	13	14	15	16	17	18	19	20
							For sizes longer than shown between heavy lines see Note 2.															
4.625	5.125																					
4.500	5.000	5.000	5.500	5.500	6.000	6.000																
4.625	4.625	5.125	5.125	5.625	5.625	6.125	6.125	6.625	7.125	7.625												
4.500	4.500	4.500	5.250	5.250	5.250	6.000	6.000	6.000	7.000	7.000	8.000	8.000										
3.875	4.625	4.625	4.625	5.375	5.375	5.375	6.125	6.125	6.875	6.875	7.875	7.875										
3.750	4.500	4.500	4.500	5.250	5.250	5.250	6.000	6.000	6.750	6.750	7.750	7.750	9.250	10.250								
4.000	4.000	4.000	4.000	5.000	5.000	5.000	5.000	6.000	6.000	7.000	7.000	8.000	9.000	10.000	11.000	12.000	13.000					
3.000	4.000	4.000	4.000	4.000	5.000	5.000	5.000	5.000	6.000	6.000	7.000	7.000	8.000	9.000	10.000	11.000	12.000	13.000	14.000	15.000		
3.000	3.000	4.000	4.000	4.000	4.000	5.000	5.000	5.000	6.000	6.000	7.000	7.000	8.000	9.000	10.000	11.000	12.000	13.000	14.000	15.000	16.000	17.000

1936 SERIES

Length 'L' Tolerance		
-	1"	±.016"
1"	6"	±.031"
6"	16"	±.062"
16"	-	±0.125"

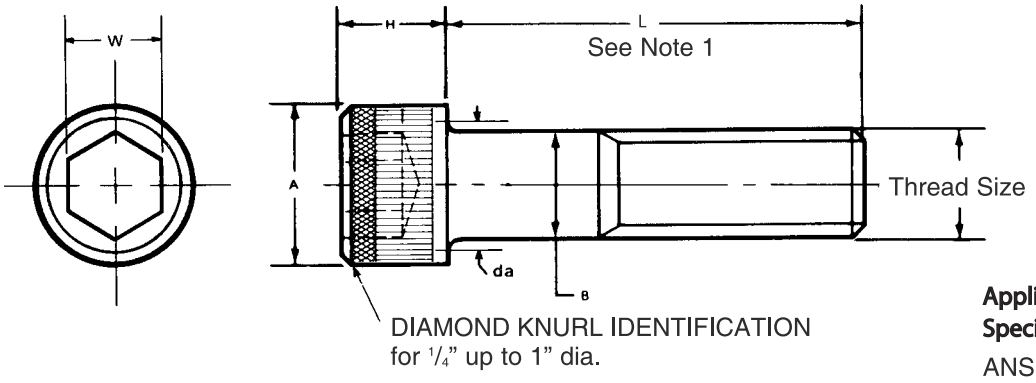
1960 SERIES

Length 'L' Tolerance				
	Length			
	Up to 1" Incl.	Over 1" to 2 1/2"	Over 2 1/2" to 6"	Over 6"
Nº 0 - 3/8"	-0.030"	-0.040"	-0.060"	-0.120"
7/16" - 3/4"	-0.030"	-0.060"	-0.080"	-0.120"
7/8" - 1 1/2"	-0.030"	-0.100"	-0.140"	-0.200"
Over 1 1/2"	-	-0.180"	-0.200"	-0.240"

NOTES:

1. Dimensional and tightening information for 1960 Series on Page 18 and 1936 Series on Page 13.
2. Sizes longer than those between the heavy lines shall have a grip length calculated thus - $L_G = L$ - Basic Thread Length.
3. Tolerance on the grip length shall be +0 - 2 1/2 pitches.
4. Tolerance on the thread length shall be +2 1/2 pitches - 0.
5. Screws up to and including 1" dia. ordered to an intermediate length between the heavy lines shall have a grip length equal to that of the screw of the next shorter length.

SOCKET HEAD CAP SCREWS
- 1960 Series UNC and UNF Threads



Applicable Specifications
ANSI B 18.3

DIMENSIONS AND TIGHTENING TORQUES - UNC and UNF Threads

Thread Size	Threads Per Inch		A Max.	B Max.	da Max.	H Max.	W Nom.	Maximum Tightening Torques lbf. in.				Induced Load lb. f.	
								Unplated		Plated			
	UNC	UNF						UNC	UNF	UNC	UNF	UNC	UNF
No.0	-	80	0.096	0.060	0.074	0.060	0.050	-	2.1	-	1.6	-	190
No.1	64	72	0.118	0.073	0.087	0.073	1/16	3.7	3.9	2.7	2.9	280	300
No.2	56	64	0.140	0.0860	0.1020	0.086	5/16	6.2	6.7	4.6	5.0	400	430
No.3	48	56	0.161	0.0990	0.1150	0.099	5/16	9.3	10.2	7.0	7.6	520	580
No.4	40	48	0.183	0.1120	0.1300	0.112	3/32	13.2	14.5	9.9	10.9	640	720
No.5	40	44	0.205	0.1250	0.1450	0.125	3/32	19.6	20.5	14.7	15.4	860	920
No.6	32	40	0.226	0.1380	0.1580	0.138	3/32	24.5	27.6	18.4	20.7	960	1120
No.8	32	36	0.270	0.1640	0.1880	0.164	1/8	45.5	48.0	34.1	36.0	1540	1640
No.10	24	32	0.312	0.1900	0.2180	0.190	5/32	65.4	75.5	49.1	56.6	1880	2240
No.12	24	28	0.343	0.2160	0.2440	0.216	5/32	102.0	109.0	76.5	81.8	2650	2890
1/4	20	28	0.375	0.2500	0.2780	0.250	1/16	153.0	176.0	115.0	132.0	3470	4150
								lbf.ft.					
5/16	18	24	0.468	0.3125	0.3465	0.312	1/4	26.3	29.3	19.7	22.0	5830	6680
3/8	16	24	0.562	0.3750	0.4150	0.375	5/16	46.8	53.2	35.1	39.9	8700	10300
7/16	14	20	0.625	0.4375	0.4835	0.437	3/8	75.0	84.0	56.3	63.0	12000	13900
1/2	13	20	0.750	0.5000	0.5520	0.500	3/8	115.0	129.0	86.3	96.8	16100	18800
9/16	12	18	0.843	0.5625	0.6225	0.562	7/16	165.0	185.0	124.0	139.0	20800	23900
5/8	11	18	0.937	0.6250	0.6890	0.625	1/2	228.0	258.0	171.0	194.0	25800	30400
3/4	10	16	1.125	0.7500	0.8280	0.750	5/8	363.0	405.0	273.0	304.0	34600	39900
7/8	9	14	1.312	0.8750	0.9630	0.875	3/4	586.0	646.0	440.0	485.0	48000	54600
1	8	12	1.500	1.0000	1.1100	1.000	3/4	879.0	962.0	660.0	722.0	63100	71000
1 1/8	7	12	1.687	1.1250	1.2350	1.125	7/8	1250.0	1400.0	938.0	1050.0	79500	92200
1 1/4	7	12	1.875	1.2500	1.3700	1.250	7/8	1760.0	1825.0	1320.0	1460.0	102000	109000
1 3/8	6	12	2.062	1.3750	1.5050	1.375	1	2320.0	2620.0	1730.0	1970.0	120000	143000
1 1/2	6	12	2.250	1.5000	1.6400	1.500	1	2730.0	2730.0	2300.0	2580.0	132000	137000
1 3/4	5	12	2.625	1.7500	1.9100	1.750	1 1/4	4990.0	4490.0	3630.0	4155.0	186000	194000
2	4 1/2	12	3.000	2.0000	2.1800	2.000	1 3/8	7270.0	7750.0	5450.0	6270.0	264000	295000

ALL DIMENSIONS IN INCHES.

MECHANICAL PROPERTIES

Material	Unbrako High Grade Alloy Steel	
Heat Treatment	Rc 39-43	
Screw Size	≤0.500	>0.500
Tensile Strength	190,000 lbf/in²	180,000 lbf/in²
Yield Strength	170,000 lbf/in²	162,000 lbf/in²
Shear Strength	114,000 lbf/in²	108,000 lbf/in²
Min. Elongation	9%	9%

NOTES:

1. For body and thread lengths see pages 16 & 17.
2. **Thread Class:** #0 through 1" dia. - 3A
   over 1" dia. - 2A
3. **da:** Transition Diameter
4. **Working Temperature:** -50°C +300°C
5. Torques calculated in accordance with VDI 2230 "Systematic calculation of high duty bolted joints" with σ 0.2 = 155 K.S.I. and μ = 0.125 for plain finish and μ = 0.094 for plated. Above 0.625" dia. σ 0.2 = 140 K.S.I.

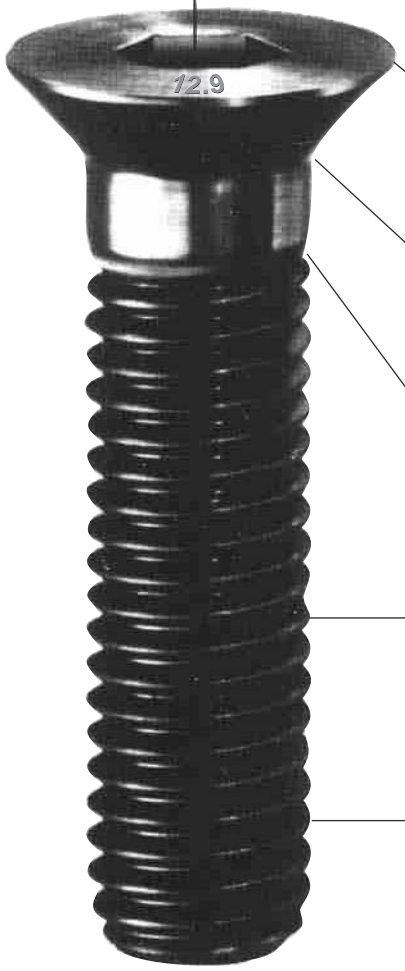
COUNTERSUNK SOCKET HEAD SCREWS

Modern equipment and machinery requires stronger more reliable joints to hold their parts together - and stronger more reliable fasteners. The requirement for dependability also holds true for fasteners used to hold thin section metals together in applications that also require a neat smooth surface.

That's why Unbrako countersunk screws are so widely used for fastening of plates, strips, mouldings, and other thin section parts. Unbrako countersunk screws provide reliable fastening and a smooth, attractive, flush mounting that enhances the appearance of the product on which they are used.

Unbrako countersunk screws provide more clamping force because they are manufactured from high grade alloy steel, and held to exacting tolerances to ensure the highest degree of dimensional uniformity. The closely controlled head angle assures flush seating, and close all-round head contact by initially contacting at the upper portion of the head bearing area in the countersunk hole. Closely controlled threads mean tighter and more secure fits, and stronger assemblies. Deep accurate non-slip sockets provide maximum key engagement for full tightening without marring the surrounding surface.

Unbrako countersunk screws are available with either plain or plated finish. Stainless steel screws are also available.



Deep, accurate socket for uniform wrenching power and high maximum torques.

Precision forged head for continuous grain flow and maximum strength.

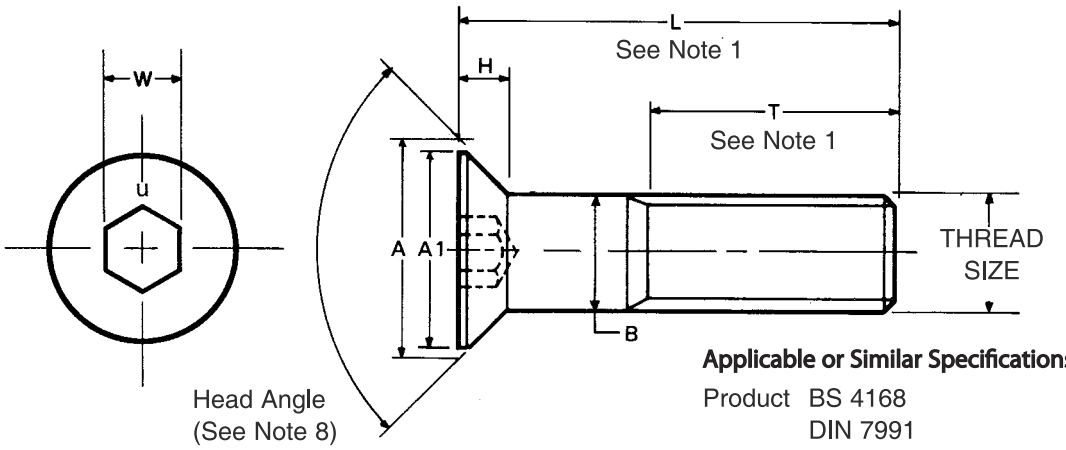
Uniform under-head angle gives maximum contact with side walls.

Radiused-root runout increases fatigue life.

Fully formed radiused threads rolled to maintain continuous grain flow for greater tensile and fatigue strength.

Heat treatment in a controlled atmosphere for maximum uniform strength and surface integrity without brittleness or decarburisation.

COUNTERSUNK SOCKET HEAD SCREWS - ISO Metric



Manufacturer's optional machined socket.

Applicable or Similar Specifications:

Product	BS 4168		
	DIN 7991		
Grade	BS 6104	Grade	12.9
	ISO 898/1	Grade	12.9

DIMENSIONS AND TIGHTENING TORQUES - ISO Metric Threads

Thread Size (B Max.)	Pitch	A Max. (See Note 2)	A1 Max. (See Note 3)	B Max.	H Ref.	W Nom.	Maximum Tightening Torques				Tensile Load
							Unplated		Plated		
							Nm	lbf.in.	Nm	lbf.in.	kN
M3	0.50	6.72	5.82	2.98	1.86	2.0	1.4	12	1.1	9	5.28
M4	0.70	8.96	7.80	3.98	2.48	2.5	3.4	30	2.6	22	9.22
M5	0.80	11.2	9.78	4.98	3.10	3.0	6.8	60	5.1	45	14.90
M6	1.00	13.44	11.73	5.97	3.72	4.0	11.0	97	8.3	73	21.10
M8	1.25	17.92	15.73	7.97	4.96	5.0	28.0	248	21.0	186	38.40
M10	1.50	22.40	19.67	9.97	6.20	6.0	55.0	486	41.0	365	60.90
M12	1.75	26.88	23.67	11.97	7.44	8.0	95.0	840	71.0	630	88.50
(M14)	2.00	30.24	26.67	13.96	8.12	10.0	150.0	1330	112.0	990	121.00
M16	2.00	33.60	29.67	15.96	8.80	10.0	237.0	2100	177.0	1570	165.00
(M18)	2.50	36.96	32.61	17.96	9.48	12.0	340.0	3000	255.0	2250	202.00
M20	2.50	40.32	35.61	19.96	10.11	12.0	480.0	4250	360.0	3190	257.00
(M22)	2.50	37.38	35.61	21.96	13.32	14.0	637.0	5640	477.0	4220	318.00
M24	3.00	40.42	38.61	23.96	14.22	14.0	746.0	6600	585.0	5180	371.00

ALL DIMENSIONS IN MILLIMETRES. SIZES IN BRACKETS ARE NON-PREFERRED STANDARDS.

MECHANICAL PROPERTIES

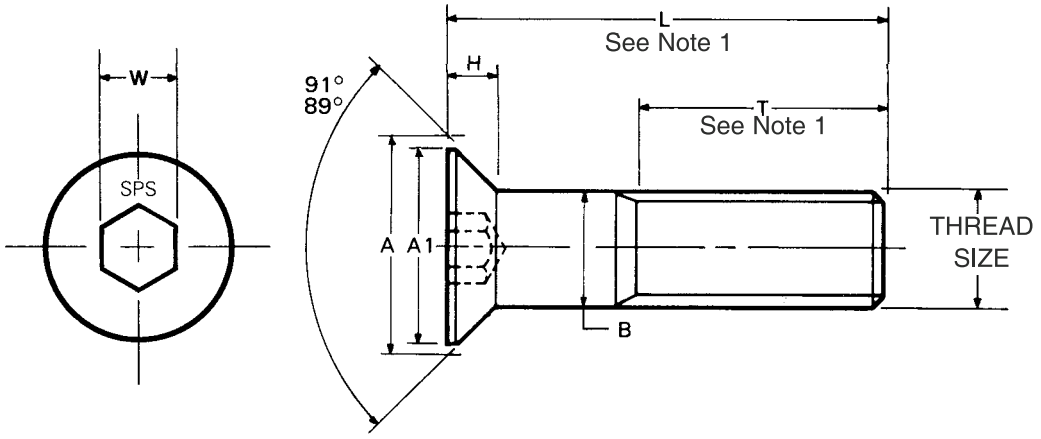
Material	Unbrako High Grade Alloy Steel
Heat Treatment	Rc 39-44
Shear Strength	630 N/mm²
Min. Elongation	9%

NOTES:

1. For overall and thread lengths see pages 22 & 23.
2. A - Maximum theoretical sharp corner.
3. A1 - Absolute minimum head diameter.
4. G - Transition diameter.
5. **Thread Class:** 4g 6g
6. **Working Temperature:** -50°C +300°C
7. Torques calculated in accordance with VDI 2230 "Systematic calculation of high duty bolted joints" with σ 0.2 = 720 N/mm² and μ = 0.125 for plain finish and μ = 0.094 for plated.
8. For sizes up to and including M20 Head Angle shall be 92°/90°, over M20 Head Angle be 62°/60°.

N.B. Because of their head configurations, countersunk head screws may not meet the minimum ultimate tensile load for property class 12.9, specified in table 6 OF BS 6104: Part 1: 1981. They are nevertheless required to meet the other material and property requirements for property class 12.9 in BS 6104: Part 1.

COUNTERSUNK SOCKET HEAD SCREWS
- BA, BSW and BSF Threads



DIMENSIONS AND TIGHTENING TORQUES - BA, BSW and BSF Threads

Thread Size	Threads Per Inch BA		A Max. (See Note 2)	A1 Max. (See Note 3)	B Max.	H Ref.	W Nom.	Maximum Tightening Torques lbf. in Unplated BA		Maximum Tightening Torques lbf. in Plated BA		Tensile Load lbf. BA	
8BA	59.1		.164	.147	.0866	.038	.050	2.0		1.5		638	
6BA	47.9		.211	.189	.1102	.050	.050	4.0		3.0		1050	
5BA	43.1		.239	.215	.1260	.056	1/16	6.0		5.0		1390	
4BA	38.5		.269	.243	.1417	.063	1/16	8.5		6.5		1760	
3BA	34.8		.307	.277	.1614	.072	5/64	14.0		10.5		2310	
2BA	31.4		.351	.319	.1850	.083	3/32	32.0		24.0		3070	
1BA	28.2		.396	.360	.2087	.093	3/32	35.0		26.0		3929	
0BA	25.4		.449	.408	.2362	.106	1/8	72.0		54.0		5070	
	BSW	BSF						BSW	BSF	BSW	BSF	BSW	BSF
1/8	40	-	.239	.215	.1250	.057	1/16	9.0	-	7.0	-	1280	-
3/16	24	32	.356	.323	.1875	.084	3/32	27.5	32	20.5	24	2730	3120
1/4	20	26	.475	.432	.2500	.112	5/32	95.0	98	71.0	74	5130	5710
5/16	18	22	.594	.542	.3125	.140	3/16	217.0	232	163.0	174	8440	9080
								lbf.ft.					
3/8	16	20	.712	.651	.3750	.168	7/32	26.0	32	19.5	24	12500	13400
7/16	14	18	.831	.761	.4375	.196	1/4	39.0	42	29.0	32	17100	18500
1/2	12	16	.950	.870	.5000	.225	5/16	72.0	85	54.0	64	22200	24300
9/16	12	16	1.069	.979	.5625	.253	5/16	103.0	112	771.0	837	29300	31700
5/8	11	14	1.187	1.089	.6250	.281	3/8	136.0	138	102.0	104	36400	38900
3/4	10	12	1.425	1.308	.7500	.337	3/8	138.0	140	104.0	105	53700	56400
7/8	9	11	1.662	1.526	.8750	.393	1/2	338.0	356	253.0	266	74200	77800
1	8	10	1.900	1.745	1.0000	.450	9/16	506.0	535	380.0	401	97300	102700
1 1/8	7	9	2.138	1.964	1.1250	.506	5/8	718.0	763	537.0	572	122500	130200
1 1/4	7	9	2.375	2.183	1.2500	.562	5/8	1013.0	1070	760.0	802	155600	164300

ALL DIMENSIONS IN INCHES.

MECHANICAL PROPERTIES

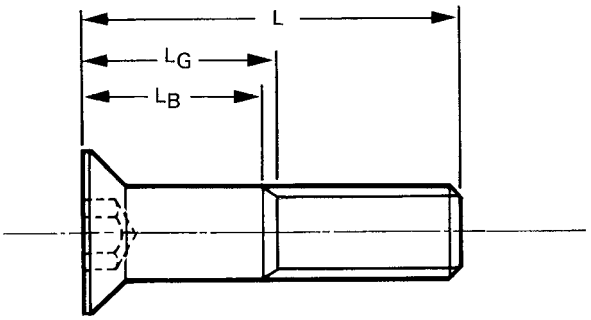
Material	Unbrako High Grade Alloy Steel
Heat Treatment	Rc 39-44
Shear Strength	96,000 lbf/in²
Min. Elongation	**9%**

NOTES:

1. For overall and thread lengths see page 24.
2. A - Maximum theoretical sharp corner.
3. A1 - Absolute minimum head diameter.
4. da - Transition diameter.
5. BSW and BSF - Close / Medium
6. **Working Temperature:** -50°C +300°C

N.B. Because of their head configurations, countersunk head screw tensile loads, are based on 160,000 lbf/in².

COUNTERSUNK SOCKET HEAD SCREWS - ISO Metric

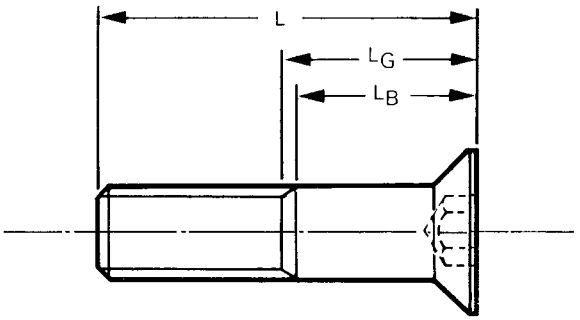


BODY AND GRIP LENGTHS - ISO Metric Threads

Thread Size	Body and Grip Lengths	Length 'L'										
		30	35	40	45	50	55	60	65	70	80	90
M3	LB. Max.	To Head	14.5	19.5	24.5	29.5	34.5					
	LG. Max.		17.0	22.0	27.0	32.0	37.0					
M4	LB. Max.	To Head	11.5	16.5	21.5	26.5	31.5	36.5	41.5	46.5	56.5	
	LG. Max.		15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0	60.0	
M5	LB. Max.	→	To Head	14.0	19.0	24.0	29.0	34.0	39.0	44.0	54.0	64.0
	LG. Max.			18.0	23.0	28.0	33.0	38.0	43.0	48.0	58.0	68.0
M6	LB. Max.	→	→	To Head	16.0	21.0	26.0	31.0	36.0	41.0	51.0	61.0
	LG. Max.				21.0	26.0	31.0	36.0	41.0	46.0	56.0	66.0
M8	LB. Max.	→	→	→	To Head	15.75	20.75	25.75	30.75	35.75	45.75	55.7
	LG. Max.					22.0	27.0	32.0	37.0	42.0	52.0	62.0
M10	LB. Max.	→	→	→	→	→	To Head	20.5	25.5	30.5	40.5	50.5
	LG. Max.							28.0	33.0	38.0	48.0	58.0
M12	LB. Max.	→	→	→	→	→	→	To Head	20.2	25.2	35.2	45.2
	LG. Max.								29.0	34.0	44.0	54.0
M14	LB. Max.	→	→	→	→	→	→	→	To Head	20.0	30.0	40.0
	LG. Max.									30.0	40.0	50.0
M16	LB. Max.	→	→	→	→	→	→	→	→	To Head	26.0	36.0
	LG. Max.										36.0	46.0
M18	LB. Max.	→	→	→	→	→	→	→	→	→	To Head	29.5
	LG. Max.											42.0
M20	LB. Max.	→	→	→	→	→	→	→	→	→	→	→
	LG. Max.											
M22	LB. Max.	→	→	→	→	→	→	→	→	→	→	→
	LG. Max.											
M24	LB. Max.	→	→	→	→	→	→	→	→	→	→	→
	LG. Max.											

ALL DIMENSIONS IN MILLIMETRES.

COUNTERSUNK SOCKET HEAD SCREWS
- ISO Metric



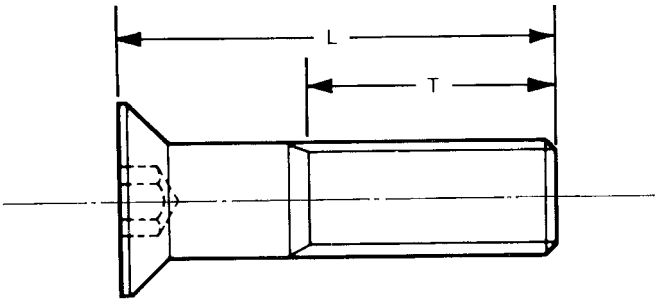
100	110	120	130	140	150	160	180	200	220	240	
74.0											
78.0											
71.0	81.0	91.0									
76.0	86.0	96.0									
65.7	75.7	85.7	95.7	105.7	115.7						
72.0	82.0	92.0	102.0	112.0	122.0						
60.5	70.5	8.05	90.5	100.5	110.5						
68.0	78.0	88.0	98.0	108.0	118.0						
55.2	65.2	75.2	85.2	95.2	105.2						
64.0	74.0	84.0	94.0	104.0	114.0						
50.0	60.0	70.0	80.0	90.0	100.0						
60	70.0	80.0	90.0	100.0	110.0						
46.0	56.0	66.0	76.0	86.0	96.0	106.0	126.0				
56.0	66.0	76.0	86.0	96.0	106.0	116.0	136.0				
39.5	49.5	59.5	69.5	79.5	89.5	99.5	119.5	139.5			
52.0	62.0	72.0	82.0	92.0	102.0	112.0	132.0	156.0			
To Head	45.5	55.5	65.5	75.5	85.5	95.5	115.5	135.5			
	58.0	68.0	78.0	88.0	98.0	108.0	128.0	148.0			
→	To Head	51.5	61.5	71.5	81.5	91.5	111.5	131.5	151.5		
		64.0	74.0	84.0	94.0	104.0	124.0	144.0	164.0		
→		To Head	55.0	65.0	75.0	85.0	105.0	125.0	145.0	165.0	
			70.0	80.0	90.0	100.0	120.0	140.0	160.0	180.0	

Length 'L' Tolerance (mm)		
Screws Over	Up to and Including	Tolerance
-	50	±0.25
50	80	±0.50
80	120	±0.70
120	250	±0.80
250	-	±1.00

NOTES:

1. Dimensions and tightening information on page 20.
2. Dimensions for LB and LG are calculated from the following formula.
   T ref = (2x Nominal Dia.) plus 12mm
   LG. max = Nominal length 'L' minus 'T'
   LB. max = Nominal length 'L' minus ('T' + 5 P)
3. LG is the max. distance from top of the head to the first complete thread. LB is the max. length of unthreaded portion measured from the top of head.
4. Concentricity. - body diameter to thread within 0.1mm per 20mm of body length T.I.R. taken directly under the head when screw is held by the full threads closest to the head of the screw.
5. The axis of the conical bearing surface shall be parallel to the axis of the body within ½°

COUNTERSUNK SOCKET HEAD SCREWS
- BA, BSW and BSF Threads



THREAD LENGTHS FOR STANDARD SCREW DIAMETERS - BA, BSW and BSF Threads

Thread Size	Length 'L'																				
	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4	4 1/4	4 1/2	4 3/4	5	5 1/4	5 1/2	5 3/4	6
	Length of Thread 'T'																				
8BA		1																			
6BA		1	1																		
5BA		1	1																		
4BA		1	1	1	1																
3BA		1	1	1	1																
2BA		1	1	1	1																
1BA		1	1	1	1																
0BA		1	1	1	1	1 1/8	1 1/4	1 3/8	1 1/2												
1/8		1	1																		
3/16		1	1	1																	
1/4			1	1	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2								
5/16			1 1/8	1 1/8	1 1/8	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8							
3/8				1 1/4	1 1/4	1 1/4	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2				
7/16				1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2				
1/2		Sizes shorter than those listed will be threaded to head.					1 1/2	1 1/2	1 1/2	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3
9/16								1 5/8	1 5/8	1 5/8	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3
5/8								1 3/4	1 3/4	1 3/4	1 3/4	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3
3/4									2	2	2	2	2	2 1/8	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3
7/8										2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 3/8	2 1/2	2 5/8	2 3/4	2 7/8	3
1										2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 5/8	2 3/4	2 7/8	3
1 1/8												2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 7/8	3
1 1/4													3	3	3	3	3	3	3	3	3

ALL DIMENSIONS IN INCHES.

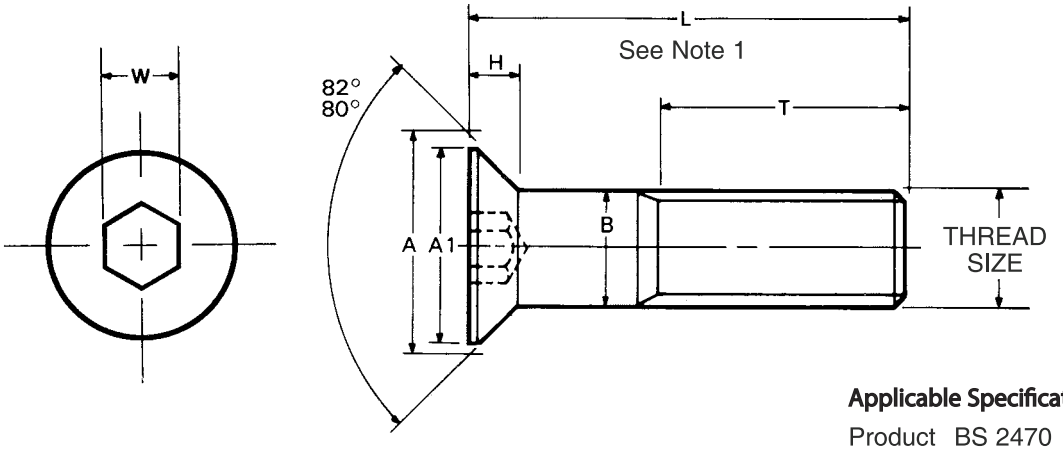
Length 'L' Tolerance		
Screws Over	Up to and including	Tolerance
-	2"	±0.10"
2"	4"	±0.20"
4"	-	±0.30"

Thread Length Tolerance -0 +2 1/2 Pitches

NOTES:

1. Dimensions and tightening information on Page 21.

COUNTERSUNK SOCKET HEAD SCREWS
- UNC and UNF Threads



Applicable Specifications:

Product BS 2470
ANSI B 18.3

DIMENSIONS AND TIGHTENING TORQUES - UNC and UNF Threads

Thread Size	Threads Per Inch		A Max. (See Note 2)	A1 Min. (See Note 3)	B Max.	H Ref.	W Nom.	Typical Tightening Torques lbf. in				Tensile Loads lb. f.	
								Unplated		Plated			
	UNC	UNF						UNC	UNF	UNC	UNF	UNC	UNF
No.0	-	80	.138	.117	.0600	.044	.035	-	1.6	-	1.2	-	265
No.1	64	72	.168	.143	.0730	.054	.050	2.6	2.9	1.9	2.1	390	390
No.2	56	64	.197	.168	.0860	.064	.050	4.4	4.8	3.3	3.6	555	555
No.3	48	56	.226	.193	.0990	.073	1/16	6.7	8.5	5.0	6.3	725	725
No.4	40	48	.255	.218	.1120	.083	1/16	8.9	10.0	6.6	7.5	960	1,040
No.5	40	44	.281	.240	.1250	.090	5/64	13.0	14.0	9.0	10.0	1,260	1,310
No.6	32	40	.307	.263	.1380	.097	5/64	16.0	19.0	12.0	14.0	1,440	1,620
No.8	32	36	.359	.311	.1640	.112	3/32	30.0	32.0	22.0	24.0	2,220	2,240
No.10	24	32	.411	.359	.1900	.127	1/8	44.0	51.0	33.0	38.0	2,780	3,180
1/4	20	28	.531	.480	.2500	.161	5/32	100.0	120.0	75.0	90.0	5,070	5,790
5/16	18	24	.656	.600	.3125	.198	3/16	210.0	240.0	157.0	180.0	8,350	9,250
3/8	16	24	.781	.720	.3750	.234	7/32	380.0	430.0	285.0	322.0	12,400	14,000
7/16	14	20	.844	.781	.4375	.234	1/4	600.0	680.0	450.0	510.0	16,900	18,900
1/2	13	20	.938	.872	.5000	.251	5/16	930.0	1050.0	697.0	787.0	22,800	25,600
5/8	11	18	1.188	1.112	.6250	.324	3/8	1800.0	2000.0	1350.0	1500.0	36,000	40,800
3/4	10	16	1.438	1.355	.7500	.396	1/2	3200.0	3560.0	2400.0	2670.0	53,200	59,300
7/8	9	14	1.688	1.604	.8750	.468	9/16	5400.0	6000.0	4050.0	4500.0	73,500	81,000
1	8	12	1.938	1.841	1.0000	.540	5/8	8200.0	8900.0	6150.0	6675.0	96,300	106,000

ALL DIMENSIONS IN INCHES.

MECHANICAL PROPERTIES

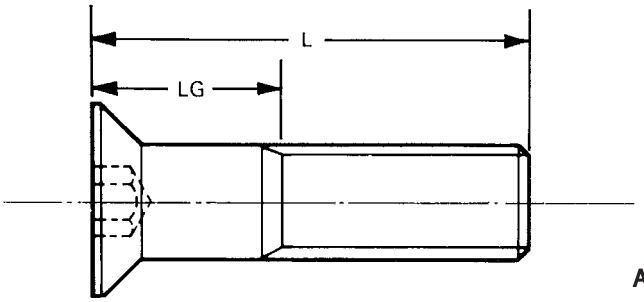
Material	Unbrako High Grade Alloy Steel
Heat Treatment	Rc 39-43
Shear Strength	96,000 lbf/in²
Min. Elongation	**9%**

NOTES:

1. For overall and thread lengths see page 26.
2. A - Maximum theoretical sharp corner.
3. A1 - Absolute minimum head diameter.
4. da - Transition diameter.
5. **Thread Class:** 3A
6. **Working Temperature:** -50°C +300°C
7. Torques calculated in accordance with VDI 2230 "Systematic calculation of high duty bolted joints" with σ 0.2 = 100 K.S.I. and μ = 0.125 for plain finish and μ = 0.094 for plated.

N.B. Because of their head configurations, countersunk head screw tensile loads, are based on 160,000 lbf/in².

COUNTERSUNK SOCKET HEAD SCREWS - UNC and UNF Threads



Applicable Specifications:

BS 2470
ANSI B 18.3

THREAD LENGTHS FOR STANDARD SCREW DIAMETERS - UNC and UNF Threads

Thread Size	Length 'L' / Grip Length 'LG'																		
	3/4	7/8	1	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4	4 1/4	4 1/2	4 3/4	5
Nº 0	0.25	0.25	0.50	0.75															
Nº 1		0.25	0.25	0.62	0.88														
Nº 2		0.25	0.25	0.62	0.88	1.12													
Nº 3		0.25	0.25	0.62	0.88	1.12	1.38												
Nº 4				0.50	0.50	1.00	1.00	1.50											
Nº 5				0.50	0.50	1.00	1.00	1.50											
Nº 6				0.50	0.50	1.00	1.00	1.50	1.50	2.00									
Nº 8				0.38	0.38	0.88	0.88	1.38	1.38	1.88	1.88	2.38							
Nº 10					0.62	0.62	1.12	1.12	1.62	1.62	2.12	2.12	2.62	2.62	3.12				
1/4						0.75	0.75	1.25	1.25	1.75	1.75	2.25	2.25	2.75	2.75	3.25	3.25	3.75	3.75
5/16							0.88	0.88	1.38	1.38	1.88	1.88	2.38	2.38	2.88	2.88	3.38	3.38	3.88
3/8								1.00	1.00	1.50	1.50	2.00	2.00	2.50	2.50	3.00	3.00	3.50	3.50
7/16	Sizes shorter than those listed will be threaded to head.								1.12	1.12	1.62	1.62	2.12	2.12	2.62	2.62	3.12	3.12	3.62
1/2									1.00	1.00	1.00	1.75	1.75	1.75	2.50	2.50	2.50	3.25	3.25
5/8												1.50	1.50	1.50	2.25	2.25	2.25	3.00	3.00
3/4													1.50	1.50	1.50	1.50	2.50	2.50	2.50
7/8														1.50	1.50	1.50	1.50	2.50	2.50
1															1.50	1.50	1.50	1.50	2.50

ALL DIMENSIONS IN INCHES.

Length 'L' Tolerance				
	Length			
Thread Size	To 1" inclusive	1" to 2 1/2" inclusive2	1/2" to 6" inclusive	Over 6"
Nº 0 - 3/8"	0.030"	0.040"	0.060"	0.120"
7/16" - 3/4"	0.030"	0.060"	0.080"	0.120"
7/8" - 1"	0.050"	0.100"	0.140"	0.200"

NOTES:

1. Dimensions and tightening information on Page 25.
2. Tolerance on the grip length LG shall be +0 - 2 1/2 pitches.

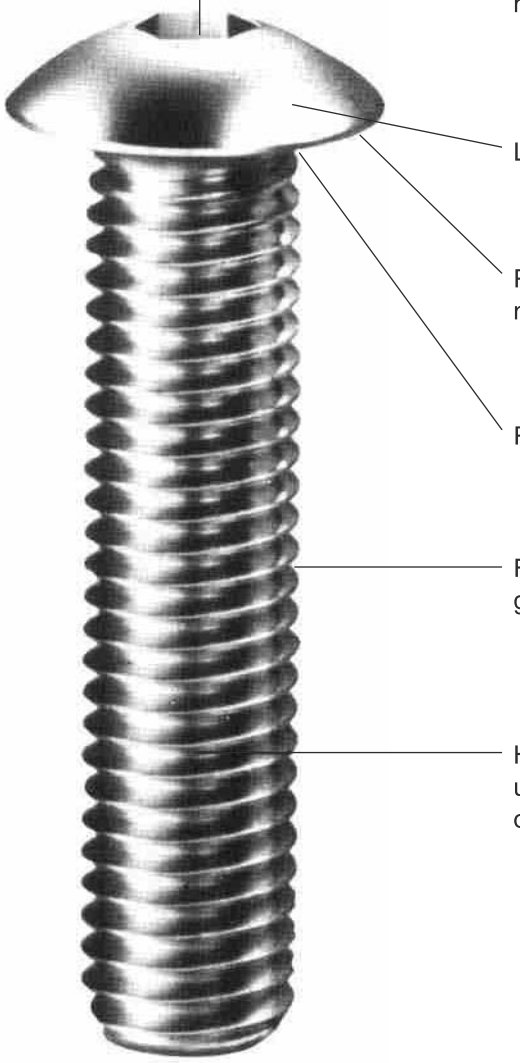
BUTTON HEAD SOCKET SCREWS

Unbrako button head screws are ideally suited for use in materials too thin to countersink and in non-critical loading applications. Their low head profile gives them smooth, aesthetic appearance, and their deep accurate sockets ensure non-slip wrench engagement to prevent marring of the surface in which they are installed.

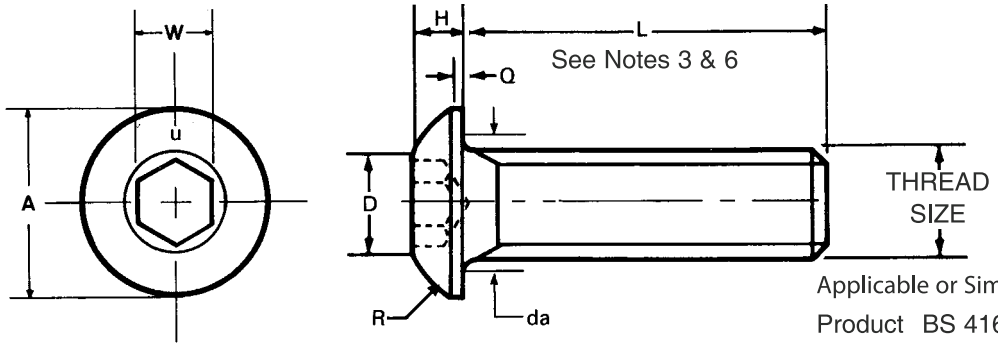
Unbrako button head screws are made from high grade alloy steel and every manufacturing operation is closely controlled. Heads are forged for greater strength and full formed radius-root rolled threads assure close tolerances, maximum strength and superior fatigue resistance. Deep accurate sockets allow full tightening, and customised heat treatment of each heat of steel ensures maximum strength and hardness without brittleness.

Unbrako button head screws are available in plain or plated finishes. Stainless steel screws are also available.

Unbrako flange button head screws in Metric are also available. Please refer to our separate brochure for technical data.



BUTTON HEAD SOCKET SCREWS - ISO Metric



Applicable or Similar Specifications:

Product	BS 4168		
Grade	BS 6104	Grade	12.9
	ISO 898/1	Grade	12.9

DIMENSIONS AND TIGHTENING TORQUES - ISO Metric Threads

Thread Size	Pitch	A Max.	da Max.	D Max.	H Max.	Q Max.	R Ref.	W Nom.	Maximum Tightening Torques				
									Unplated		Plated		
									Nm	lbf.in.	Nm	lbf.in.	kN
M3	0.50	5.70	3.60	3.31	1.65	.38	3.00	2.0	1.4	12	1.1	9	5.28
M4	0.70	7.60	4.70	3.93	2.20	.38	4.20	2.5	3.4	30	2.6	22	9.22
M5	0.80	9.50	5.70	4.50	2.75	.50	5.20	3.0	6.8	60	5.1	45	14.90
M6	1.00	10.50	6.80	5.90	3.30	.80	5.60	4.0	11.0	97	8.3	73	21.10
M8	1.25	14.00	9.20	7.00	4.40	.80	7.50	5.0	28.0	248	21.0	186	38.40
M10	1.50	17.50	11.20	8.20	5.50	.80	10.00	6.0	55.0	486	41.0	363	60.90
M12	1.75	21.00	13.70	10.50	6.60	.80	11.00	8.0	95.0	840	71.0	630	88.50

ALL DIMENSIONS IN MILLIMETRES.

MECHANICAL PROPERTIES

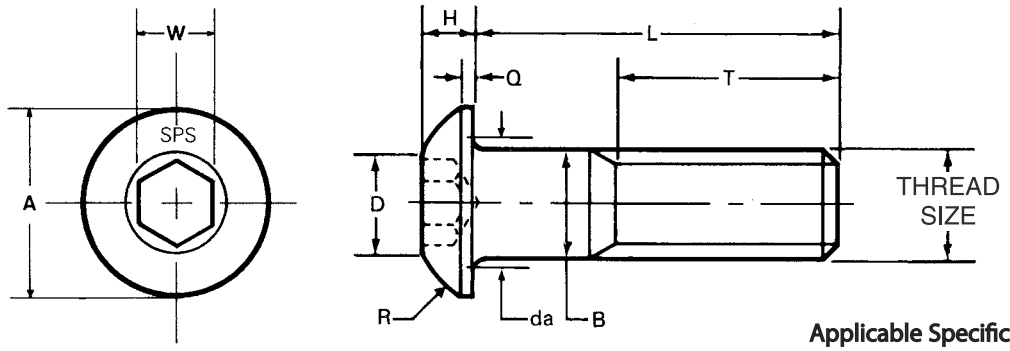
Material	Unbrako High Grade Alloy Steel
Heat Treatment	Rc 39-44
Shear Strength	630 N/mm²
Min. Elongation	**9%**

NOTES:

1. **Thread Class:** 4g 6g
2. **da** - Transition diameter.
3. Full thread length to within 2½ pitches of head.
4. **Working Temperature:** -50°C +300°C
5. Torques calculated in accordance with VDI 2230 "Systematic calculation of high duty bolted joints" with σ 0.2 = 720 N/mm² and μ = 0.125 for plain finish and μ = 0.094 for plated.
6. Length tolerance = ±0.25mm.

N.B. Because of their head configurations, button head screws may not meet the minimum ultimate tensile load for property class 12.9, specified in table 6 OF BS 6104: Part 1: 1981. They are nevertheless required to meet the other material and property requirements for property class 12.9 in BS 6104: Part 1.

BUTTON HEAD SOCKET SCREWS
- BA, BSW and BSF Threads



Applicable Specifications:

Product BS 2470

DIMENSIONS AND TIGHTENING TORQUES - BA, BSW and BSF Threads

Thread Size	Threads Per Inch		A Max.	B Max.	da Max.	D Max.	H Max.	L (See Note 1)	Q Max.	R Ref.	T Min. (See Note 1)	W Nom.	Maximum Tightening Torques lbf. in. Unplated		Maximum Tightening Torques lbf. in. Plated		Tensile Load lb. f.	
	BA												BA		BA		BA	
6BA	47.9		.213	.1102	.1302	.102	.059	.500	.015	.140	.500	1/16	7		5.5		1050	
5BA	43.1		.238	.1260	.1460	.131	.066	.500	.015	.146	.500	5/64	11		8.0		1390	
4BA	38.5		.262	.1417	.1617	.131	.073	.625	.015	.163	.625	5/64	15		12.0		1760	
3BA	34.8		.312	.1614	.1914	.149	.087	.750	.015	.190	.750	3/32	23		17.0		2310	
2BA	31.4		.361	.1850	.2150	.186	.101	1.000	.020	.218	1.000	1/8	35		27.0		3070	
0BA	25.4		.437	.2362	.2762	.232	.132	1.000	.031	.254	1.000	5/32	75		56.0		5070	
	BSW	BSF													BSW	BSF	BSW	BSF
3/16	24	32	.361	.1875	.2175	.186	.101	1.000	.020	.218	1.000	1/8	32	36	24	27	2730	3120
1/4	20	26	.437	.2500	.2900	.232	.132	1.000	.031	.254	1.000	5/32	80	89	60	67	5130	5710
5/16	18	22	.547	.3125	.3520	.268	.166	1.000	.031	.314	1.000	3/16	165	177	124	133	8440	9080
													lbf. ft.					
3/8	16	20	.656	.3750	.4150	.304	.199	1.500	.031	.373	1.500	7/32	24	26	18	19	12500	13400
7/16	14	18	.750	.4375	.4780	.340	.232	1.500	.031	.417	1.500	1/4	39	42	29	31	17100	18500
1/2	12	16	.875	.5000	.5600	.414	.265	2.000	.046	.486	2.000	5/16	58	63	43	47	22200	24300
5/8	11	14	1.000	.6250	.6850	.486	.331	2.000	.062	.528	2.000	3/8	118	126	88	95	36400	38900
3/4	10	12	1.218	.7500	.8100	.613	.398	2.000	.078	.670	2.000	1/2	210	220	157	165	53700	56400

ALL DIMENSIONS IN INCHES.

Length 'L' Tolerance		
Screws Over	Up to and including	Tolerance
-	1"	±0.10"
1"	2"	+0.031" -0.016"
2"	6"	±0.031"
6"	-	±0.062"

MECHANICAL PROPERTIES

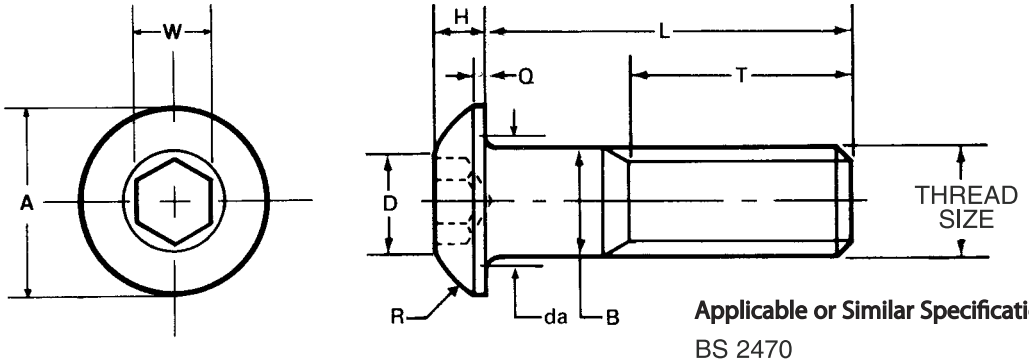
Material	Unbrako High Grade Alloy Steel
Heat Treatment	Rc 39-44
Shear Strength	96,000 lbf/in²
Min. Elongation	**9%**

NOTES:

1. **Thread Length** - Screw lengths equal to or shorter than listed in column 'L' will be threaded to head. For screw lengths longer than 'L', 'T' designates the minimum thread length. The maximum thread length is not specified.
2. **Thread Class:** **BA** - Close
   BSW and BSF - Medium
3. **da** - Transition diameter.
4. **Working Temperature:** -50°C +300°C

N.B. Because of their head configurations, button head screws tensile loads, are based on 160,000 lbf/in².

BUTTON HEAD SOCKET SCREWS
- UNC and UNF Threads



Applicable or Similar Specifications:

BS 2470

ANSI B 18.3

DIMENSIONS AND TIGHTENING TORQUES - UNC and UNF Threads

Thread Size	Threads Per Inch		A Max.	B Max.	da Max.	D Max.	H Max.	L (See Note 1)	Q Max.	R Ref.	T Min. (See Note 1)	W Nom.	Maximum Tightening Torques lbf. in.					
													Unplated		Plated			
	UNC	UNF											UNF	UNC		UNC	UNC	UNF
N°4	40	48	.213	.1120	.1320	.102	.059	.500	.015	.140	.500	1/16	8.9	10	6.6	7.5	960	1040
N°5	40	44	.238	.1250	.1450	.131	.066	.500	.015	.146	.500	5/64	13.0	14	9.7	10.0	1260	1310
N°6	32	40	.262	.1380	.1580	.131	.073	.625	.015	.163	.625	5/64	16.0	19	12.0	14.0	1440	1620
N°8	32	36	.312	.1640	.1940	.149	.087	.750	.015	.190	.750	3/32	30.0	32	22.0	24.0	2220	2240
N°10	24	32	.361	.1900	.2200	.186	.101	1.000	.020	.218	1.000	1/8	44.0	51	33.0	38.0	2780	3180
1/4	20	28	.437	.2500	.2900	.232	.132	1.000	.031	.254	1.000	5/32	100.0	120	75.0	90.0	5070	5790
5/16	18	24	.547	.3125	.3520	.268	.166	1.000	.031	.314	1.000	3/16	210.0	240	157.0	180.0	8350	9250
													lbf.ft.					
3/8	16	24	.656	.3750	.4150	.304	.199	1.250	.031	.373	1.000	7/32	380	430	285	322	12400	14000
7/16	14	20	.750	.4375	.4780	.340	.232	1.500	.031	.417	1.500	1/4	600	680	450	510	16900	18900
1/2	13	20	.875	.5000	.5600	.414	.265	2.000	.046	.486	2.000	5/16	930	1050	697	787	22800	25600
5/8	11	18	1.000	.6250	.6850	.486	.331	2.000	.062	.528	2.000	3/8	1800	2000	1350	1500	36000	40800
3/4	10	16	1.218	.7500	.8100	.613	.398	2.000	.078	.670	2.000	1/2	3200	3560	2400	2670	53200	59300

ALL DIMENSIONS IN INCHES.

Length 'L' Tolerance		
Screws Over	Up to and including	Tolerance
-	1"	±0.16"
1"	2"	+0.031" -0.016"
2"	6"	±0.031"
6"	-	±0.062"

MECHANICAL PROPERTIES

Material	Unbrako High Grade Alloy Steel
Heat Treatment	Rc 39-44
Shear Strength	96,000 lbf/in²
Min. Elongation	9%

NOTES:

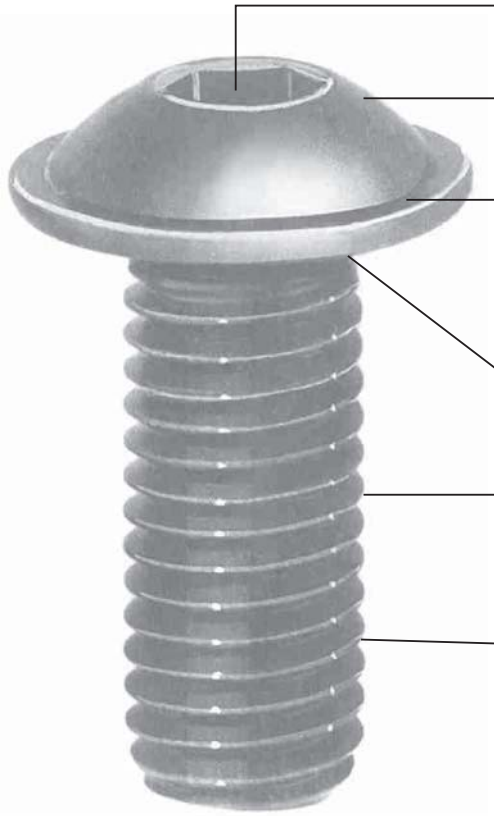
1. **Thread Length** - Screw lengths equal to or shorter than listed in column 'L' will be threaded to head. For screw lengths longer than 'L', 'T' designates the minimum thread length. The maximum thread length is not specified.
2. **Thread Class: 3A**
3. **da** - Transition diameter.
4. **Max. Working Temperature:** -50°C +300°C
5. Torques calculated in accordance with VDI 2230 "Systematic calculation of high duty bolted joints" with σ 0.2 = 100 K.S.I. and μ = 0.125 for plain finish and μ = 0.094 for plated.

N.B. Because of their head configurations, button head screws tensile loads, are based on 160,000 lbf/in².

FLANGE BUTTON HEAD SOCKET SCREWS

Unbrako flange button head screws allow the covering of large diameter holes in sheet metal. As the large underhead surface pressure by area is low, this fastener can also be used with softer materials without harm or damage.
Flange button heads ideal to fix strips, cover plates and sheet metal housings.

The redius on the button head presents a streamlined profile, virtually eliminating the sharp edges which could occur with a bolt and washer assembly.
Unbrako flange button head scews are available with metric threads and



Deep, accurate socket for uniform wrenching power and high maximum torques.

Flange facilities greater load spread and streamlined appearance

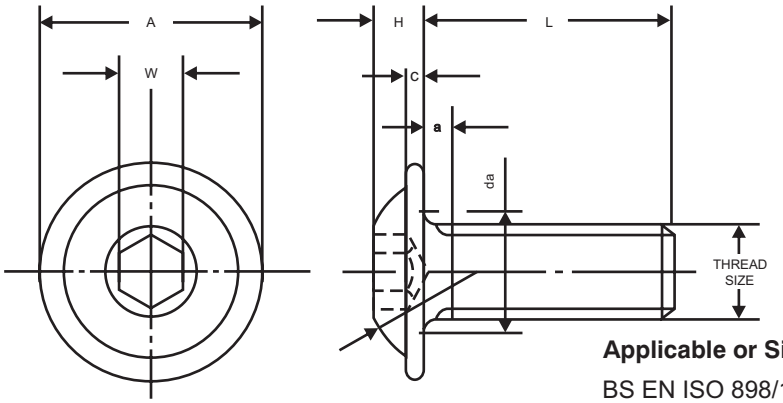
Precision forged head for continuous grain flow and maximum strength

Rediused root runout increases fatigue life

Fully formed radiused threads rolled to maintain continuous grain flow for greater tensile and fatigue strength

Heat treated in a controlled atmosphere for maximum uniform strength and surface integrity without brittleness or decarburisation

FLANGE BUTTON HEAD SOCKET SCREWS - ISO Metric



Applicable or Similar Specifications:

BS EN ISO 898/1 Grade 12.9

DIMENSIONS AND TIGHTENING TORQUES - ISO Metric Threads

Thread Size	Pitch	A Max.	da Max.	C Max.	H Max.	R Ref.	W Nom.	Recommended Tightening Torques Unplated		Tensile Loads
								Nm	lbf. in.	kN
M3	0.50	7.12	3.60	0.70	1.65	3.00	2.00	1.96	18	5.23
M4	0.70	9.29	4.70	0.80	2.20	4.20	2.50	4.52	40	9.13
M5	0.80	11.40	5.70	0.90	2.75	5.20	3.00	9.08	80	14.77
M6	1.00	13.59	6.80	1.20	3.30	5.60	4.00	15.40	138	20.90
M8	1.25	17.00	9.20	1.30	4.40	7.50	5.00	36.80	330	38.06
M10	1.50	20.80	11.20	1.75	5.50	10.00	6.00	72.30	650	60.32
M12	1.75	24.69	13.70	2.40	6.60	11.00	8.00	126.00	1134	87.67

ALL DIMENSIONS IN MILLIMETERS.

Length 'L' Tolerance		
Screws Over	Up to and including	Tolerance
-	1"	±0.16"
1"	2"	+0.031" -0.016"
2"	6"	±0.031"
6"	-	±0.062"

NOTES:

1. **Thread Class: 4g 6g**
2. **da** = Transition diameter.
3. Full thread length to within 2½ pitches of head.
4. **Working Temperature:** -50°C +300°C
5. Length tolerance =±0.25mm.
6. Torques calculated in accordance with VDI 2230 "Systematic calculation of high duty bolted joints with $\sigma 0.2 = 720$ N/mm^2 and $\mu = 0.125$ for plain finish.

MECHANICAL PROPERTIES

Material Unbrako High Grade Alloy Steel
Heat Treatment Rc 39-44

N.B. Because of their head configurations, flange button head screws may not meet the minimum ultimate tensile load for property class 12.9 specified in table 6 of BS EN ISO 898/1. They are nevertheless required to meet the other material and property requirements for property class 12.9 in BS EN ISO 898/1.

SOCKET SET SCREWS

In contrast to other types of fasteners, set screws are primarily used in compression. They must hold fast against three types of forces, torsional (rotational), axial (lateral movement) and vibrational. To be effective, socket set screws should produce a strong clamping action which resists the relative motion between the assembled parts, because of the compression developed by tightening the set screw. Since holding power is proportional to seating torque, the tighter you can seat the screw, the higher the compression force will be.

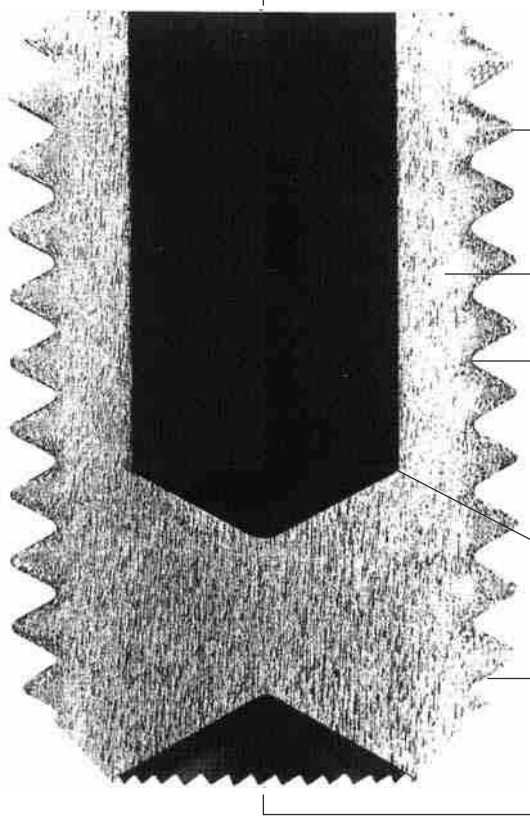
But there is a limit to how much you can tighten the average set screw. If you're not careful, you'll ream or crack the socket, or strip the threads. So you're never sure if the screw is tight enough, and whether it will stay tight.

But you can be sure that Unbrako set screws will 'stay put' because you can tighten them until the key twists off, with no damage to the screws. Unbrako recommend tightening torques as much as 40% higher than other set screws, giving you extra holding power and additional safety and reliability.

Unbrako socket set screws hold tighter because they are stronger than other set screws. The superior strength and dimensional uniformity of Unbrako set screws permit use of consistently higher seating torques than with other set screws. Consequently you can often save money because you can reduce the size or the number of set screws you require in your assembly.

Here are some of the reasons why Unbrako set screws are so strong and stay tight. Unbrako set screws are made of high grade alloy steel and heat treated to a minimum hardness of Rc 45. (Stainless steel set screws are available). Deep accurate sockets give more key engagement for extra wrenching areas. Radiused socket corners minimise points of weakness where cracks may start. Distribute stresses. Fully formed rolled threads provide greater strength and resistance to stripping. Controlled heat treatment assures uniform hardness without brittleness.

Unbrako socket set screws are available in knurled cup, cone, half dog, flat and plain cup point styles in plain or plated finishes. Stainless steel set screws are available in plain cup points only.



Accurate control of socket depth gives you more wrench engagement than other screws; permits full tightening without reaming or cracking the socket.

Threads are formed with the closest possible fit without selective assembly; give maximum cross-section for strength.

Heat treated alloy steel for maximum strength without brittleness or decarburisation.

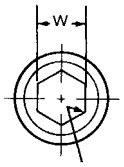
Controlled root radius doubles fatigue life of threads by reducing stress concentrations and avoiding sharp corners where failures may start. Contour following flow lines of rolled threads provide extra strength and preventing stripping.

Radiused socket corners prevent cracking as Unbrako socket set screws develop high tightening torques.

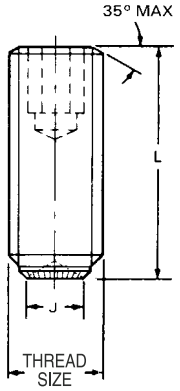
Accurate plating, when required, insures precision fit and maximum corrosion protection.

Counterbore knurled cup point - exclusive Unbrako self-locking point provides greater vibrational holding power than other knurled points.

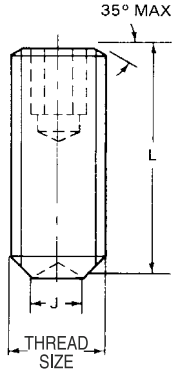
SOCKET SET SCREWS - ISO Metric



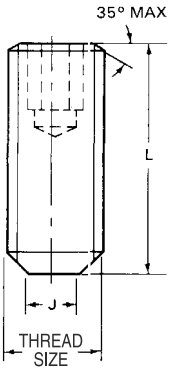
See Note 1



Knurled Cup Point



Plain Cup Point



Flat Point

DIMENSIONS AND TIGHTENING TORQUES - ISO Metric Threads

			Knurled Cup Point		Plain Cup		Flat Point	
Thread Size	Pitch	W Nom.	J Max.	L Minimum Preferred	J Max.	L Minimum Preferred	J Max.	L Minimum Preferred
M3	0.50	1.5	1.30	3.0	1.4	3.0	2.0	3.0
M4	0.70	2.0	2.10	3.0	2.0	3.0	2.5	3.0
M5	0.80	2.5	2.40	4.0	2.5	4.0	3.5	4.0
M6	1.00	3.0	3.30	5.0	3.0	4.0	4.0	4.0
M8	1.25	4.0	4.30	6.0	5.0	5.0	5.5	5.0
M10	1.50	5.0	5.25	8.0	6.0	6.0	7.0	6.0
M12	1.75	6.0	6.60	10.0	8.0	8.0	8.5	8.0
(M14)	2.00	6.0	8.10	12.0	9.0	10.0	10.0	10.0
M16	2.00	8.0	9.10	14.0	10.0	12.0	12.0	12.0
(M18)	2.50	10.0	10.30	16.0	12.0	14.0	13.0	12.0
M20	2.50	10.0	11.50	18.0	14.0	16.0	15.0	14.0
(M22)	2.50	12.0	12.65	20.0	16.0	18.0	17.0	16.0
M24	3.00	12.0	14.65	20.0	16.0	20.0	18.0	20.0

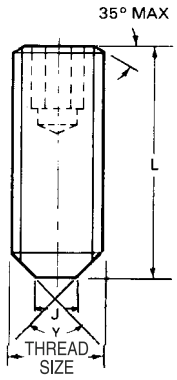
ALL DIMENSIONS IN MILLIMETRES. SIZES IN BRACKETS ARE NON-PREFERRED STANDARDS.

MECHANICAL PROPERTIES

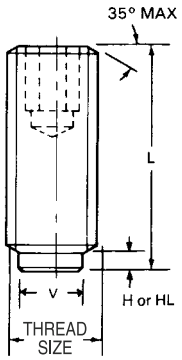
Material Unbrako High Grade Alloy Steel
Hardness Rc 45 Minimum

NOTES:

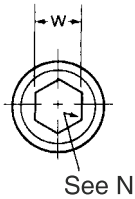
1. Corner of recess must have fillets to minimise stress concentrations.
2. **Thread Class:** 4g 6g
3. **Working Temperature:** -50°C +300°C
4. Screws with length L or below will have half dog point H. Screws with lengths above L will have full dog point HL.
5. Torques calculated at 75% of the torsional shear strength of the respective Unbrako wrenches.
6. For torque and axial holding power see pages 36 and 37.
7. Micro size Plain Cup Point are shown on page 38.



Cone Point



Dog Point

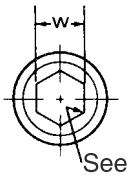


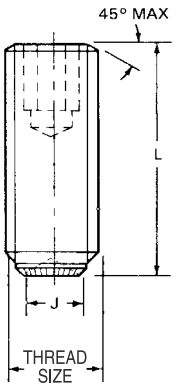
	Cone Point		Dog Point				Maximum Tightening Torque	
J Max.	L Minimum Preferred	y° ± 2° 90° for these Lengths and Over; and 120° Under	L (See Note 4)	H Half Dog Max.	HL Full Dog Max.	V Max.	Nm	lbf.in.
Sharp	4.0	4.00	5.00	1.00	1.75	2.00	0.87	7.7
Sharp	4.0	5.00	6.00	1.25	2.25	2.50	2.20	19.5
Sharp	5.0	6.00	6.00	1.50	2.75	3.50	4.60	41.0
1.5	6.0	8.00	8.00	1.75	3.25	4.00	7.80	69.0
2.0	6.0	10.00	10.00	2.25	4.30	5.50	18.00	160.0
2.5	8.0	12.00	12.00	2.75	5.30	7.00	36.00	320.0
3.0	10.0	14.00	16.00	3.25	6.30	8.50	62.00	550.0
4.0	12.0	14.00	20.00	3.80	7.36	10.00	62.00	550.0
4.0	14.0	18.00	20.00	4.30	8.36	12.00	150.00	1330.0
5.0	16.0	20.00	25.00	4.80	9.36	13.00	290.00	2570.0
5.0	18.0	22.00	25.00	5.30	10.36	15.00	290.00	2570.0
6.0	20.0	28.00	30.00	5.80	11.43	17.00	475.00	4200.0
6.0	20.0	28.00	30.00	6.30	12.43	18.00	475.00	4200.0

Length 'L' Tolerance		
Screws Over	Up to and including	Tolerance
-	Screw Diameter	+0.25 -0.00
Screw Diameter	50	±0.25
50	80	±0.50
80	120	±0.70
120	250	±0.80

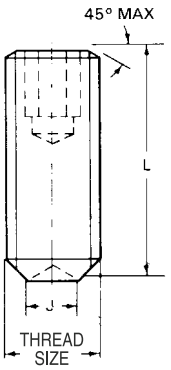
Applicable or Similar Specifications:	
	BS 4168
Flat Point	DIN 913 ISO 4026
Cone Point	DIN 914 ISO 4027
Dog Point	DIN 915 ISO 4028
Plain Cup	DIN 916 ISO 4029

SOCKET SET SCREWS
- UNC, UNF, BA, BSW and BSF Threads

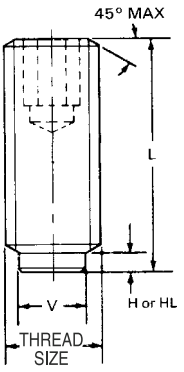




Knurled Cup Point



Plain Cup Point



Half and Full Dog Point

DIMENSIONS AND TIGHTENING TORQUES - UNC, UNF, BA, BSW and BSF Threads

Unified Threads			BA Threads		British Threads				
Thread Size	Threads Per Inch UNC	Threads Per Inch UNF	Thread Size	Threads Per Inch	Thread Size	Threads Per Inch BSW	Threads Per Inch BSF	W Nom.	J Max.
N°0		80						.028	.033*
N°1		72						.035	.040*
N°2	56	64	8BA	59.1				.035	.047*
N°3	48	56	7BA	52.9				.050	.54*
N°4	40	48	6BA	47.9				.050	.061
N°5	40	44	5BA	43.1	1/8	40		1/16	.067
N°6	32	40	4BA	38.5				1/16	.074
N°8	32	36	3BA	34.8	5/32	32		5/64	.087
N°10	24	32	2BA	31.4	3/16	24	32	3/32	.098
N°12	24	28	1BA	28.2				3/32	.113
1/4	20	28	0BA	25.4	1/4	20	26	1/8	.130
5/16	18	24			5/16	18	22	5/32	.169
3/8	16	24			3/8	16	20	3/16	.206
7/16	14	20			7/16	14	18	7/32	.242
1/2	13	20			1/2	12	16	1/4	.281
9/16	12	18			9/16	12	16	1/4	.319
5/8	11	18			5/8	11	14	5/16	.362
3/4	10	16			3/4	10	12	3/8	.440
7/8	9	14			7/8	9	11	1/2	.518
1	8	12			1	8	10	9/16	.594
1 1/8	7	12			1 1/8	7	9	9/16	.675
1 1/4	7	12			1 1/4	7	9	5/8	.758
1 3/8	6	12			1 3/8	6	8	5/8	.833
1 1/2	6	12			1 1/2	6	8	3/4	.911

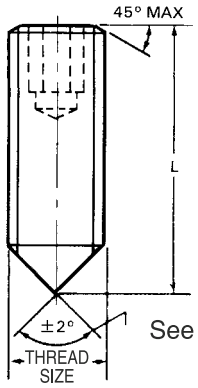
ALL DIMENSIONS IN INCHES

MECHANICAL PROPERTIES

Material Unbrako High Grade Alloy Steel
Hardness Rc 45 Minimum

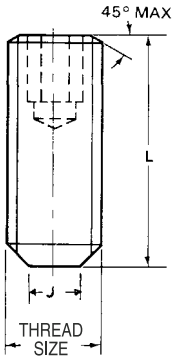
NOTES:

1. Corner of recess must have fillets to minimise stress concentrations.
2. **Thread Class:** BA - Close; BSW and BSF - Medium; UNC and UNF - 3A
3. **Working Temperature:** -50°C +300°C
4. *denotes Plain Cup only.
5. For torque and axial holding power see pages 38 and 39.
6. Inclined angle is 90°, except when length equals diameter or less when inclined angle is 118°.

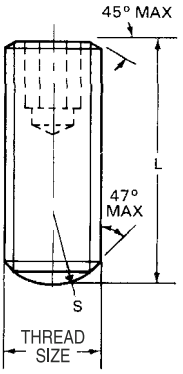


See Note 6

Cone Point



Flat Point



Oval Point

Plain & KCP	Dog Point					Cone Point	Flat Point	Oval Point	
L Minimum Preferred	H Half Dog Max.	L Min. Pref. Half Dog	HL Full Dog Max.	L Min. Pref. Full Dog	V Max.	L Minimum Preferred	L Minimum Preferred	L Minimum Preferred	S Max.
.062*	.017	.094	.033	.094	.040	.062	.062	.062	.057
.062*	.021	.094	.039	.094	.049	.062	.062	.062	.065
.062*	.024	.094	.048	.125	.057	.125	.094	.094	.072
.094*	.027	.125	.054	.125	.066	.125	.094	.094	.088
.094	.030	.125	.066	.188	.075	.125	.094	.094	.093
.094	.033	.125	.070	.188	.083	.125	.094	.094	.104
.094	.038	.125	.080	.188	.092	.125	.094	.094	.119
.094	.043	.125	.090	.250	.109	.125	.094	.125	.135
.094	.049	.125	.100	.250	.127	.125	.125	.125	.151
.188	.059	.188	.120	.250	.144	.188	.188	.188	.166
.188	.067	.188	.135	.312	.156	.188	.188	.188	.197
.250	.082	.250	.166	.375	.203	.188	.188	.188	.244
.250	.099	.375	.198	.437	.250	.250	.250	.250	.291
.250	.114	.375	.229	.500	.296	.312	.250	.250	.338
.312	.130	.375	.260	.500	.343	.375	.312	.312	.385
.375	.148	.437	.291	.625	.390	.437	.375	.375	.432
.437	.164	.437	.323	.750	.468	.500	.437	.437	.479
.500	.196	.500	.385	.875	.562	.562	.500	.500	.573
.562	.227	.625	.448	1.000	.656	.625	.562	.625	.666
.625	.260	.750	.510	1.000	.750	.750	.625	.750	.760
.750	.291	.873	.573	1.500	.843	.875	.750	.750	.853
.875	.323	1.000	.635	1.500	.937	1.000	.875	.875	.948
1.000	.353	1.125	.697	1.750	1.031	1.000	1.000	1.000	1.062
1.000	.385	1.250	.760	1.750	1.125	1.000	1.250	1.250	1.156

Length 'L' Tolerance		
Screws Over	Up to and including	Tolerance
-	5/8"	±0.010"
5/8"	2"	±0.020"
2"	6"	±0.031"
6"	-	±0.062"

Applicable or Similar Specifications:	
UNC/UNF	BS 2470
	ANSI B 18.3
BA/BSW/BSF	BS 2470

SOCKET SET SCREWS
- Torsional and axial holding power - seated against steel shaft. Based on recommended seating torques.
ISO Metric Threads

Thread Size	Seating Torque Nm	Axial Holding Power (kN)	Shaft diameter (shaft hardness Rc 15 to Rc 35) Torsional holding power Nm									
			1.4	1.6	1.8	2.0	3.0	4.0	5.0	6.0	8.0	10
M1.4	.10	.19	.13	.15	.17	.19	.29	.38	.48			
M1.6	.10	.22	.15	.18	.20	.22	.33	.44	.55	.66		
M1.8	.10	.25	.18	.20	.23	.25	.38	.50	.63	.75	1.0	
M2.0	.21	.29	.20	.23	.26	.29	.44	.58	.73	.87	1.2	1.5
M2.5	.60	.53		.42	.48	.53	.80	1.10	1.30	1.60	2.1	2.7
M2.6	.60	.56			.50	.56	.84	1.10	1.40	1.70	2.2	2.8
M3	.87	.71				.71	1.07	1.40	1.80	2.10	2.8	3.6
M4	2.20	1.70				1.70	2.60	3.40	4.30	5.10	6.8	8.5
M5	4.60	2.50					3.80	5.00	6.30	7.50	10.0	13.0
M6	7.80	4.20							11.00	13.00	17.0	21.0
M8	18.00	6.70								20.00	27.0	34.0
M10	36.00	9.30									37.0	47.0
M12	62.00	12.00										60.0
M14	62.00	15.00										
M16	150.00	18.00										
M18	290.00	21.00										
M20	290.00	23.00										
M22	475.00	26.00										
M24	475.00	29.00										

ALL DIMENSIONS IN MILLIMETRES

UNC, UNF, BA, BSW and BSF Threads

Thread Size	Seating Torque lbf. in.	Axial Holding Power (lbf.)	Shaft diameter (shaft hardness Rc 15 to Rc 35) Torsional Holding Power lbf.in.									
			1/16	3/32	1/8	5/32	3/16	7/32	1/4	5/16	3/8	7/16
N°0	1.0	50	1.5	2.3	3.1	3.9	4.7	5.4	6.2			
N°1	1.8	65	2.0	3.0	4.0	5.0	6.1	7.1	8.1	10.0		
N°2/8BA	1.8	85	2.6	4.0	5.3	6.6	8.0	9.3	10.6	13.2	16.0	
N°3/7BA	5.0	120	3.2	5.6	7.5	9.3	11.3	13.0	15.0	18.7	22.5	26.3
N°4/6BA	5.0	160		7.5	10.0	12.5	15.0	17.5	20.0	25.0	30.0	35.0
N°5/5BA	10.0	200			12.5	15.6	18.7	21.8	25.0	31.2	37.5	43.7
N°6/4BA	10.0	250				19.0	23.0	27.0	31.0	39.0	47.0	55.0
N°8/3BA	20.0	385				30.0	36.0	42.0	48.0	60.0	72.0	84.0
N°10/2BA	36.0	540					51.0	59.0	68.0	84.0	101.0	118.0
1/4/0BA	87.0	1,000							125.0	156.0	187.0	218.0
5/16	165.0	1,500								234.0	280.0	327.0
3/8	290.0	2,000									375.0	437.0
7/16	430.0	2,500										545.0
1/2	620.0	3,000										
9/16	620.0	3,500										
5/8	1,325.0	4,000										
3/4	2,400.0	5,000										
7/8	5,200.0	6,000										
1	7,200.0	7,000										

ALL DIMENSIONS IN INCHES.

NOTES:

Tabulated axial and torsional holding powers are typical strengths and should be used accordingly, with specific safety factors appropriate to the given application and load conditions.

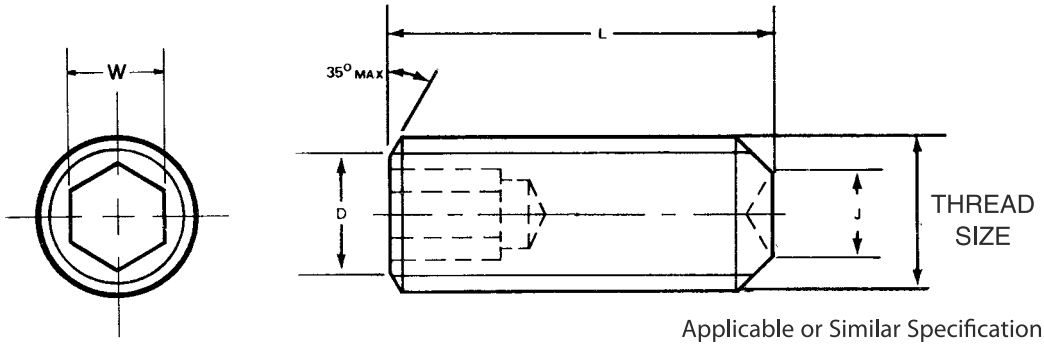
Unbrako®

12	14	16	18	20	25	30	40	50	60	70	80	90	100
3.2													
3.4	3.9	4.5											
4.3	5.0	5.7	6.4	7.1									
10.0	12.0	14.0	15.0	17.0	21								
15.0	18.0	20.0	23.0	25.0	31	38							
25.0	29.0	34.0	38.0	42.0	53	63	84						
40.0	47.0	54.0	60.0	67.0	84	101	134	168	201				
56.0	65.0	74.0	84.0	93.0	116	140	186	233	279				
72.0	84.0	96.0	108.0	120	150	180	240	300	360	420			
90.0	105.0	120.0	135.0	150.0	188	225	300	375	450	525	600		
	126.0	144.0	162.0	180.0	225	270	360	450	540	630	720	810	
		168.0	189.0	210.0	263	315	420	525	630	735	840	945	1050
			207.0	230.0	288	345	460	575	690	805	920	1040	1150
				260.0	325	390	520	650	780	910	1040	1170	1300
					363	435	580	725	870	1020	1160	1310	1450

1/2	9/16	5/8	3/4	7/8	1	1 1/4	1 1/2	1	2	2 1/2	3	3 1/2	4
40.0													
50.0	56.2	62											
62.0	70.0	78	94	109									
96.0	108.0	120	144	168	192								
135.0	152.0	169	202	236	270	338							
250.0	281.0	312	375	437	500	625	750						
375.0	421.0	468	562	656	750	937	1125	1310	1500				
500.0	562.0	625	750	875	1000	1250	1500	1750	2000				
625.0	702.0	780	937	2095	1250	1560	1875	2210	2500	3125			
750.0	843.0	937	1125	1310	1500	1875	2250	2620	3000	3750	4500		
	985.0	1090	1310	1530	1750	2190	2620	3030	3500	4370	5250	6120	
		1250	1500	1750	2000	2500	3000	3500	4000	5000	6000	7000	8000
			1875	2190	2500	3125	3750	4375	5000	6250	7500	8750	10000
				2620	3000	3750	4500	5250	6000	7500	9000	10500	12000
					3500	4375	5250	6120	7000	8750	10500	12250	14000

Good results have been obtained with a factor of 1.5-2.0 under static load conditions (i.e. where a collar is supporting a vertical load on a post) and of 4.0-8.0 for various dynamic conditions. Values in bold type in the chart indicate recommended set screw sizes on the basis that screw diameter should be roughly one-half shaft diameter.

SOCKET SET SCREWS
- ISO Metric Microsize Plain Cup Point



Applicable or Similar Specifications:

BS 4168

DIN 916

ISO 4029

DIMENSIONS AND TIGHTENING TORQUES - ISO Metric Threads

Thread Size	Pitch	D Max.	J Max.	Range of Length 'L'		W Nom.	Maximum Tightening Torques	
				Min.	Max.		Nm	lbf. in.
M1.4	0.30	0.90	0.70	2.5	5.0	0.71	0.10	0.9
M1.6	0.35	1.00	0.80	2.5	5.0	0.71	0.10	0.9
M1.8	0.35	1.20	0.90	2.5	5.0	0.71	0.10	0.9
M2.0	0.40	1.32	1.00	2.5	10.0	0.89	0.21	1.8
M2.5	0.45	1.75	1.20	3.0	10.0	1.27	0.60	5.3

ALL DIMENSIONS IN MILLIMETRES.

MECHANICAL PROPERTIES

Material Unbrako High Grade Alloy Steel

Hardness Rc 45 Minimum

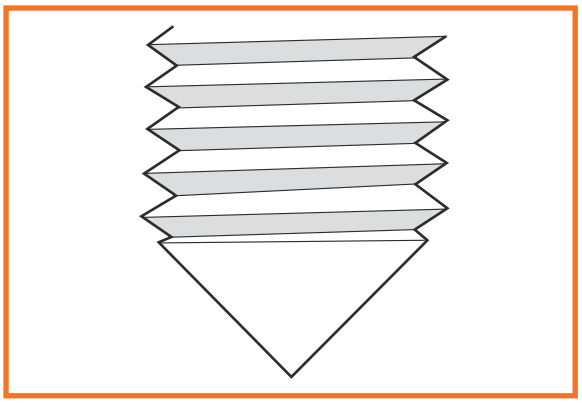
NOTES:

1. Thread Class: 4g 6g

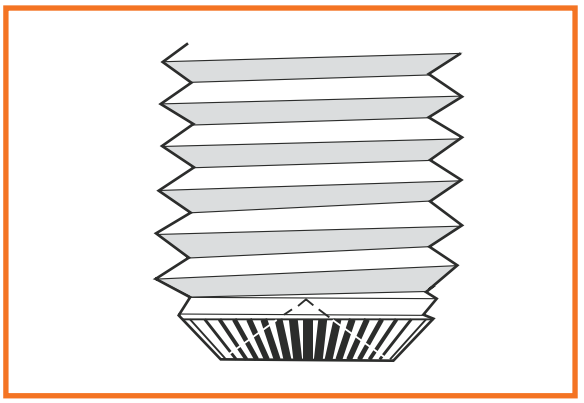
2. Working Temperature: -50°C +300°C

3. For torque and axial holding power see pages 38 & 39.

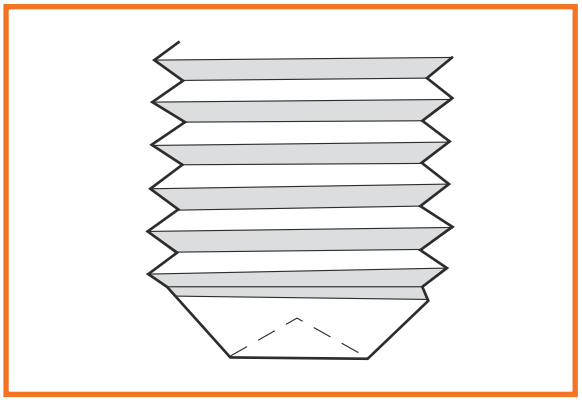
SOCKET SET SCREWS



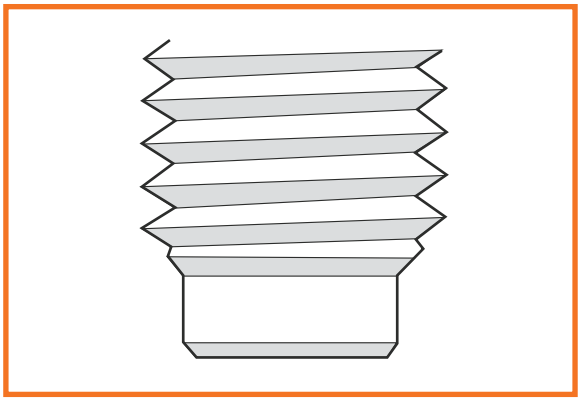
Cone Point - Use for permanent location of parts. Deep penetration gives highest axial and torsional holding power. Unbrako cone point set screws are ideally suited for use as pivots and for applications where fine adjustments are necessary.



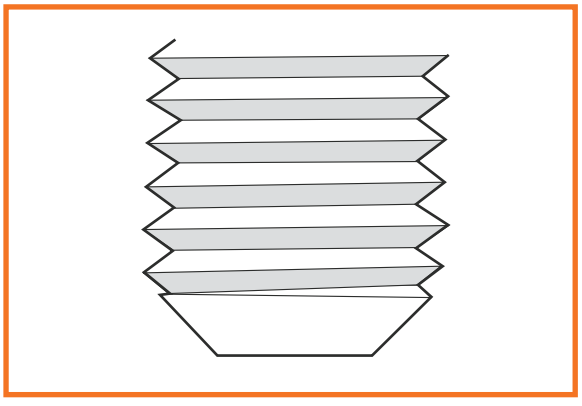
Knurled Cup Point - Use for quick, permanent location of gears, collars, and pulleys on shafts. Exclusive counter-clockwise knurl prevents Unbrako screws from loosening even in poorly tapped holes. Resists severe vibration. On all set screws over 1/4" the cup is counterbored to provide maximum holding power.



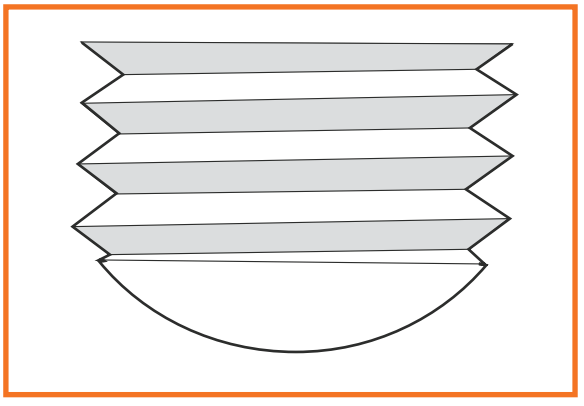
Plain Cup - Use against hardened shafts, in zinc, die castings and other soft materials where high tightening torques are impractical.



Half and Full Dog Point - Use for permanent location of one part to another. The point is usually spotted in a hole drilled in a shaft or on a flat surface milled on the shaft.



Flat Point - Use where parts must be frequently re-set, as it causes little or no damage to the part it bears against. Can be used against hardened shafts (usually with ground flat for better contact) and as adjusting screw. Preferred for thin wall thickness and on soft plugs.



Oval Point - Use for frequent adjustment without deformation of the part it bears against, also for seating against an angular surface. Circular U-grooves or axial V-grooves sometimes put in shaft to permit rotational or longitudinal adjustment.

SOCKET HEAD SHOULDER SCREWS

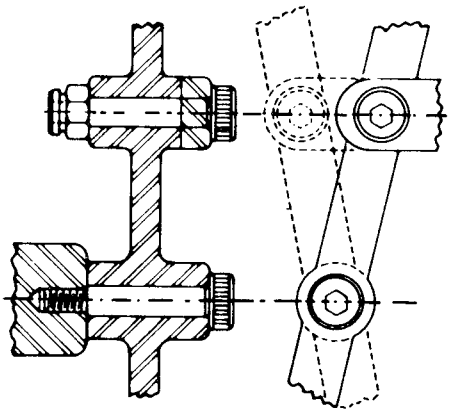
Unbrako shoulder screws are actually hardened shafts with a knurled head and threaded portion. The shoulder formed where the threads meet the larger diameter body acts as a stop when the screw is threaded into a tapped hole, permitting the screw to be used as a pivot, shaft, or stationary guide.

Unbrako shoulder screws are used to operate stripper plates and in pressure pads a wide variety of tool and die work. They are also used as shafts or pivots, holding pulleys, gears, cams and cam followers, ratchets and circular form tools. Stationary guide applications including locating pins in fixtures, latch stops, alignment of stationary members, linkage blocks, and stock guides in dies. Unbrako shoulder screws are especially advantageous in applications where the fastened part must be removed frequently. For instance, when the shoulder screw is used as a shaft for circular form tools, the screw can be removed to permit sharpening of the tool in a matter of seconds. Assembly is equally as fast.

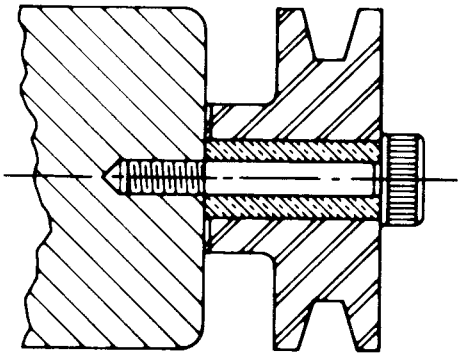
Unbrako shoulder screws are made of high grade alloy steel and have knurled heads for sure gripping and quick assembly. The precision hexagon socket gives maximum wrench engagement to allow tightening to the full strength of the screw. Concentricity between body and threads is closely controlled, permitting easy, accurate assembly. Fully formed radius root threads ensure maximum tensile strength and resist stripping.

Finally, the precision tolerance on the shoulder provides close and accurate mating with the fastened components. Unbrako manufacture to a tolerance position closer than required by international standards.

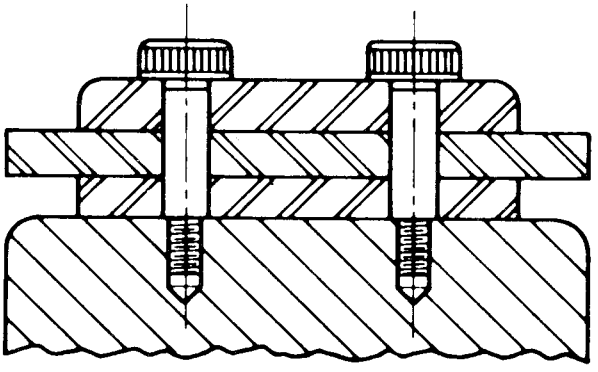
APPLICATIONS



Moving Shaft or Pivot



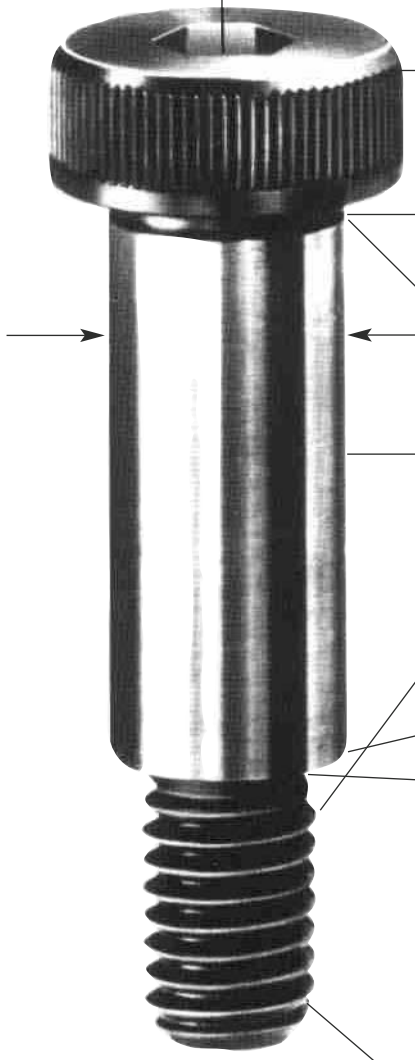
Pulley Shaft Uses



Stationary Guide

SOCKET HEAD SHOULDER SCREWS

Precise control of socket depth gives more wrench engagement than with other screws, permits full tightening without cracking or reaming socket, yet provides ample metal in the crucial fillet area for maximum strength.



Knurled head allows sure finger grip, fast assembly.

Neck allows assembly with no chamfering or other hole preparation.

Shoulder diameter held to close tolerance.

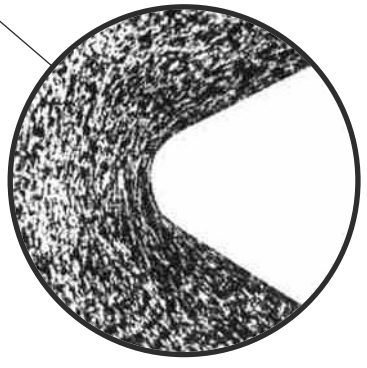
Controlled concentricity between head, body, and threads for easier, more accurate assembly.

Heat treated alloy steel for maximum strength without brittleness or decarburisation.

Squareness of shoulder is held to close tolerances to provided more accurate seating.

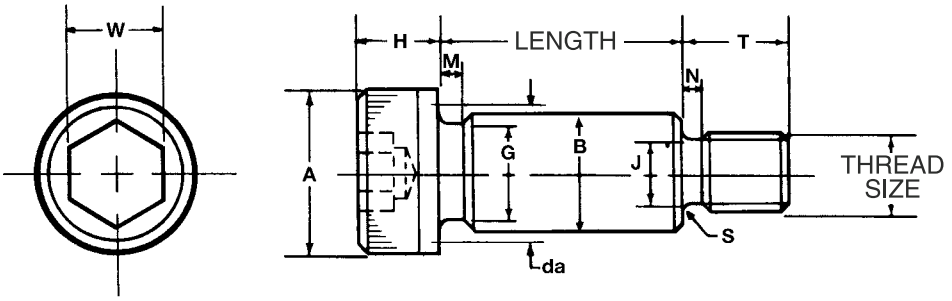
Fully formed threads are finished close to shoulder.

Threads for closest fit possible without selective assembly, give maximum cross-section for strength, make parts fit better to utilise full strength of screw.



Controlled root radius doubles fatigue life of threads by reducing stress concentrations and avoiding sharp corners where failures may start. Contour following flow lines of rolled threads provide extra strength, prevent stripping.

SOCKET HEAD SHOULDER SCREWS - ISO Metric



ISO Grade 12.9
Body Diameter Tol h8

DIMENSIONS - ISO Metric Threads

Body Size	Thread Size	Pitch	A Max.	B		da Max.	G Max.	H Max.	J Max.	M Max.	N Max.	S Max.	T		W Nom.
				Max.	Min.								Max.	Min.	
6.00	M5	0.8	10.00	6.000	5.982	6.80	5.62	4.50	3.84	1.85	2.00	0.55	9.75	9.25	3.0
8.00	M6	1.0	13.00	8.000	7.978	9.20	7.62	5.50	4.56	1.85	2.50	0.65	11.25	10.75	4.0
10.00	M8	1.25	16.00	10.000	9.978	11.20	9.62	7.00	6.23	1.85	3.00	0.85	13.25	12.75	5.0
12.00	M10	1.50	18.00	12.000	11.973	14.20	11.62	9.00	7.89	1.85	3.50	1.05	16.25	15.75	6.0
16.00	M12	1.75	24.00	16.000	15.973	18.20	15.62	11.00	9.54	1.85	4.00	1.15	18.25	17.75	8.0
18.00	M14	2.00	27.00	18.000	17.973	20.20	17.62	12.00	11.20	2.50	4.50	1.25	20.25	19.75	10.0
20.00	M16	2.00	30.00	20.000	19.967	22.40	19.62	14.00	13.20	2.50	4.50	1.25	22.25	21.75	10.0
22.00	M18	2.50	33.00	22.000	21.967	24.40	21.62	16.00	14.54	2.65	5.60	1.45	25.25	24.75	12.0
24.00	M20	2.50	36.00	24.000	23.967	26.40	23.62	16.00	16.54	2.65	5.60	1.45	27.25	26.75	12.0

ALL DIMENSIONS IN MILLIMETRES.

MECHANICAL PROPERTIES

Material Unbrako High Grade Alloy Steel
Heat Treatment Rc 39-43
Shear Strength 730 N/mm²

NOTES:

1.

Nominal	CONCENTRICITY			SQUARENESS	
	Head to Body	Socket to Body	Body to Thread	Head to Body	Body to Thread
6.0	0.15	0.26	0.10	0.15	0.15
8.0	0.16	0.26	0.10	0.18	0.15
10.0	0.20	0.30	0.10	0.24	0.15
12.0	0.24	0.36	0.10	0.27	0.15
16.0	0.32	0.54	0.10	0.34	0.20
18.0	0.36	0.54	0.10	0.38	0.20
20.0	0.40	0.66	0.10	0.42	0.20
22.0	0.44	0.66	0.10	0.45	0.25
24.0	0.48	0.66	0.10	0.50	0.30

2. Straightness
The maximum deviation of the axis of the shoulder.

B DIA	SHOULDER LENGTH											
	10	20	30	40	50	60	70	80	90	100	110	120
≤ 8	0.07	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.23	0.25	0.27	0.29
> 8	0.075	0.10	0.125	0.15	0.175	0.20	0.225	0.25	0.275	0.30	0.325	0.35

3. Squareness, parallelism, concentricity and bow of body to thread pitch dia shall be within 0.05 TIR per centimetre of shoulder length with a maximum 0.70 when seated against the shoulder in a threaded bushing and checked on the shoulder dia at a distance of 5.0 from the bearing face of the head.

4. Thread Class: 4g 6g

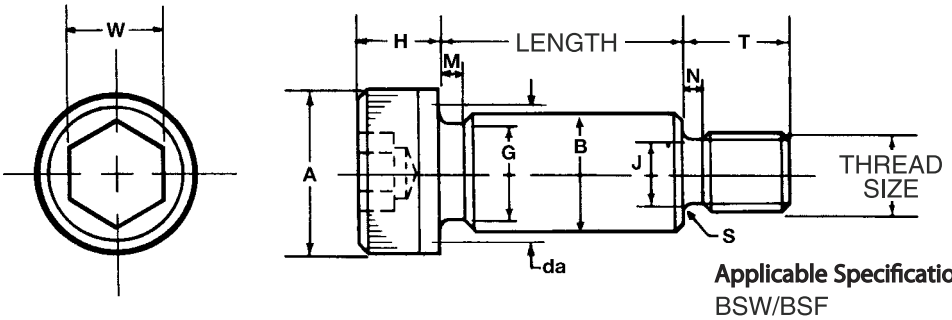
5. da - Transition diameter.

6. Working Temperature: -50°C +300°C

7. Length Tolerance: +0.25mm -0

N.B. Because of their configuration, these screws cannot be tensile tested.

SOCKET HEAD SHOULDER SCREWS
- UNC, UNF, BSW and BSF Threads



Applicable Specifications:

BSW/BSF	BS 2470
UNC/UNF	ANSI B 18.3
	BS 2470

DIMENSIONS - BSW and BSF Threads

Body Size	Thread Size	Threads Per Inch		A Max.	B		da Max.	G Max.	H Max.	J Max.		M Max.	N Max.	S Max.	T		W Nom.
		BSW	BSF		Max.	Min.				BSW	BSF				Max.	Min.	
1/4	3/16	24	32	.375	.2480	.2470	.2760	.235	.188	.129	.138	.093	.083	.023	.375	.355	1/8
5/16	1/4	20	26	.437	.3105	.3095	.3445	.297	.219	.178	.190	.093	.100	.028	.437	.417	5/32
3/8	5/16	18	22	.562	.3730	.3720	.4130	.360	.250	.231	.243	.093	.111	.031	.500	.480	3/16
1/2	3/8	16	20	.750	.4980	.4970	.5500	.485	.313	.285	.299	.093	.125	.035	.625	.595	1/4
5/8	1/2	12	16	.875	.6230	.6220	.6870	.611	.375	.390	.406	.093	.152	.042	.750	.720	5/16
3/4	5/8	11	14	1.000	.7480	.7470	.8260	.736	.500	.497	.518	.093	.182	.051	.875	.845	3/8
7/8	3/4	10	12	1.125	.8730	.8720	.9650	.860	.625	.609	.627	.125	.200	.055	1.000	.970	1/2
1	3/4	10	12	1.312	.9980	.9970	1.0980	.986	.625	.609	.627	.125	.200	.055	1.000	.970	1/2
1 1/4	7/8	9	11	1.750	1.2480	1.2470	1.3680	1.236	.750	.716	.743	.125	.222	.062	1.125	1.095	5/8

ALL DIMENSIONS IN INCHES.

DIMENSIONS - UNC and UNF Threads

Body Size	Thread Size	Threads Per Inch		A Max.	B		da Max.	G Max.	H Max.	J Max.		M Max.	N Max.	S Max.	T		W Max.
		UNC	UNF		Max.	Min.				UNC	UNF				Max.	Min.	
1/4	N°10	24	32	.375	.2480	.2470	.2760	.235	.188	.129	.138	.093	.083	.023	.375	.355	1/8
5/16	1/4	20	28	.437	.3105	.3095	.3445	.297	.219	.178	.190	.093	.100	.028	.437	.417	5/32
3/8	5/16	18	24	.562	.3730	.3720	.4130	.360	.250	.231	.243	.093	.111	.031	.500	.480	3/16
1/2	3/8	16	24	.750	.4980	.4970	.5500	.485	.313	.285	.299	.093	.125	.035	.625	.595	1/4
5/8	1/2	13	20	.875	.6230	.6220	.6870	.611	.375	.390	.406	.093	.152	.042	.750	.720	5/16
3/4	5/8	11	18	1.000	.7480	.7470	.8260	.736	.500	.497	.518	.093	.182	.051	.875	.845	3/8
7/8	3/4	10	16	1.125	.8730	.8720	.9650	.860	.625	.609	.627	.125	.200	.055	1.000	.970	1/2
1	3/4	10	16	1.312	.9980	.9970	1.0980	.986	.625	.609	.627	.125	.200	.055	1.000	.970	1/2
1 1/4	7/8	9	14	1.750	1.2480	1.2470	1.3680	1.236	.750	.716	.743	.125	.222	.062	1.125	1.095	5/8

ALL DIMENSIONS IN INCHES.

MECHANICAL PROPERTIES

Material	Unbrako High Grade Alloy Steel
Heat Treatment	Rc 39-44
Shear Strength	108,000 lbf/in²

N.B. Because of their configuration, these screws cannot be tensile tested.

NOTES:

1. **Length** ±0.005
2. **Concentricity** - Body to head O.D. within 0.002 TIR when checked in a 'V' block. Body to thread P.D. within 0.004 TIR when checked at a distance of 0.188 from the shoulder at the threaded end. Squareness, concentricity, parallelism and bow of body to thread P.D. shall be within 0.005 TIR per inch of body length with a maximum of 0.020 when seated against the shoulder in a threaded bush and checked on the body at a distance of 2M from the underside of the head.
3. **Squareness** - The bearing surface of the head shall be perpendicular to the axis of the body within a maximum deviation of 2°.
4. **Thread Class:** BSW and BSF - Medium
   UNC and UNF - 3A
5. **da** - Transition diameter.
6. **Working Temperature:** -50°C +300°C