

A close-up photograph of several large, dark, weathered structural bolts and nuts on a rusted metal plate. The bolts are arranged in a grid pattern, and the lighting creates strong shadows, highlighting the texture of the metal and the industrial nature of the components.

STRUCTURAL BOLTING GUIDE



MIDLAND FASTENERS LTD.

The background of the image shows three industrial bolts or nuts arranged on a metal surface. The central bolt is in sharp focus, while the two flanking bolts are blurred. The lighting is bright, highlighting the metallic texture and the hexagonal shape of the bolts.

MIDLAND FATENERS **LIMITED.**

Founded in 1997, and has vast experience in supply and manufacture of quality Structural fasteners products.

INTRODUCTION

Our Mission

Our mission is to become a premier provider of high quality fastener products in all sector. We promise on-time delivery and competitive pricing. Midland is committed to fulfilling all customer requirements as promised and to developing and maintaining long term business relationships through treating its customers with honesty, integrity and respect.

Our History

Founded in 1997, Midland has grown and earned the respect of its customers, suppliers and competitors. The company's growth has resulted customers purchase and build-out of a new state-of-the-art warehouse facility to better stock and serve. This expanding customer base the staff at Midland holds over 12 years of combined fastener industry experience.

Our Business

Midland serves manufacturers in most industries including, but not limited to, construction, automotive, aerospace, defense. We work with small to medium size companies and take orders of any size. Midland prides itself in serving these markets with a focus on satisfying individual customer needs and requirements.

Our Values

While we believe our motto "Customer Focus & Quality Commitment" describes the focus of our business, our commitment to honesty, integrity and respect sets us apart from many other companies. When you do business with Midland, you are assured that what we promise is what we deliver.

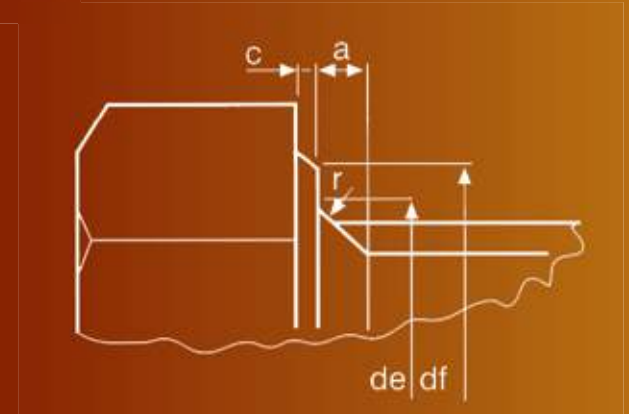
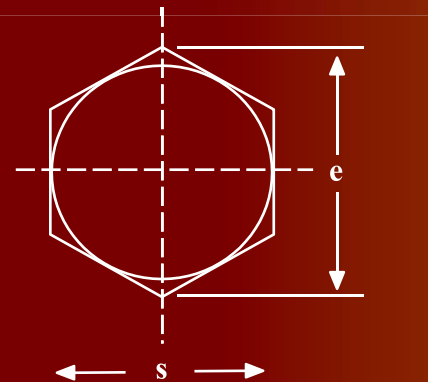
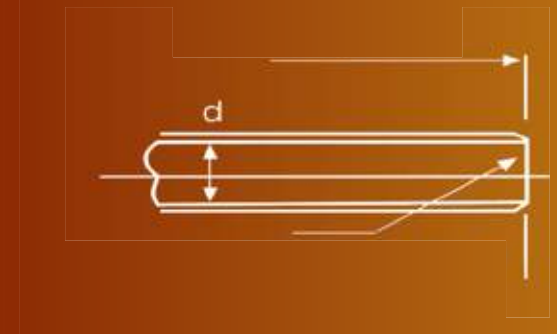
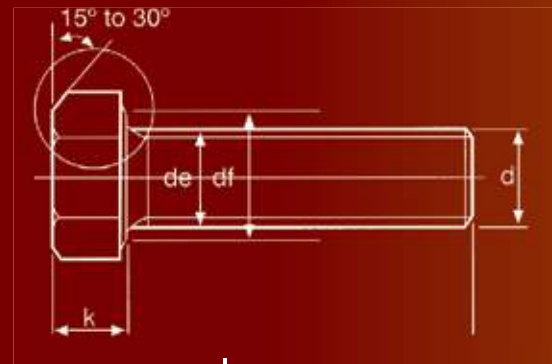
Non Pre-Load Bolt Assemblies BS EN 15048-1&2

BS EN 15048 Fully threaded setscrew dimensions. Classes 8.8 & 10.9												
Nominal size and Thread dia. d	Pitch of thread p	Plain portion a	Width across flats s		Width across corners e	Diameter of washer face d_f	Depth of washer face c		Radius under head r	Transition diameter d_e	Thickness of head k	
			max	min			max	min			max	Min
	Coarse pitch series)	max	max	min	min	min	max	min	min	max	max	Min
M12	1.75	5.25	18.00	17.57	19.85	16.47	0.60	0.15	0.60	13.70	7.68	7.32
M16	2.00	6.00	24.00	23.16	26.16	22.00	0.80	0.20	0.60	17.70	10.29	9.71
M20	2.50	7.50	30.00	29.16	32.95	27.70	0.80	0.20	0.80	22.40	12.85	12.15
M24	3.00	9.00	36.00	35.00	39.55	33.25	0.80	0.20	0.80	26.40	15.35	14.65
M30	3.50	10.50	46.00	45.00	50.85	42.75	0.80	0.20	1.00	33.40	19.12	18.28
M36	4.00	12.00	55.00	53.00	60.78	51.11	0.80	0.20	1.00	39.40	22.92	22.08

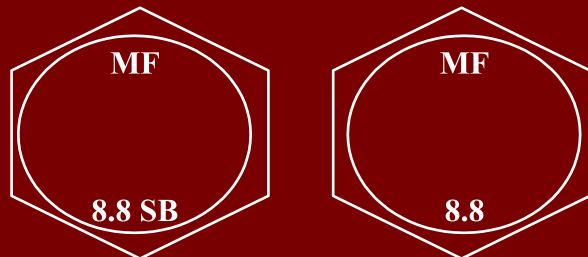
BS EN 15048 Mechanical properties. Grade 8.8 setscrews					
Bolt thread dia	Tensile strength	Proof load	Elongation	Hardness Rockwell HRC	
	N/mm ² min	N/mm ² min	% min	min	Max
M12	800.00	660.00	12.00	23.00	34.00
M16	830.00	660.00	12.00	23.00	34.00
M20	830.00	660.00	12.00	23.00	34.00
M22	830.00	660.00	12.00	23.00	34.00
M24	830.00	660.00	12.00	23.00	34.00
M27	830.00	660.00	12.00	23.00	34.00
M30	830.00	660.00	12.00	23.00	34.00
M36	830.00	660.00	12.00	23.00	34.00

BS EN 15048 Assemblies also require a charpy impact test to en 10045-1

Product Characteristics		Standard
Fully threaded setscrews		
General requirements		ISO 4017
Material & manufacture		ISO 898-1 CLASSES 8.8 & 10.9
Finish /coatings	Zinc electroplated	BS 7371-3 or BS EN ISO 4042
	Hot dip galvanized	BS 7371-6 or BS EN ISO 10684
Mechanical Properties		ISO 898-1 Classes 8.8 & 10.9
Dimensions & tolerances		ISO 4017
Threads		ISO 965-2 class 6G



BS EN 15048 Head Marking



IMPORTANT NOTE it is a requirement of BS EN 15048 that the bolt nut and washer assembly is supplied by one manufacturer who is responsible for the function of the assembly. All the components are identified with the manufacturer's mark. The coating of the assembly is under the control of the manufacturer.

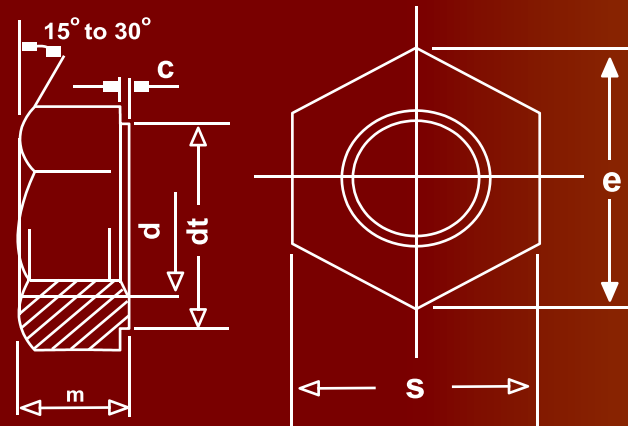
BS EN 15048 Nut ISO 4032/4034, Classes 8 & 10						
Normal Size and Thread Diameter <i>d</i>	Pitch of Thread <i>P</i>	Width Across Flats <i>S</i>		Width Across Corner <i>s</i>	Thickness of Nut <i>m</i>	
		max	min	min	max	min
M12	1.75	18.00	17.57	21.10	12.20	10.40
M16	2.00	24.00	23.16	26.75	15.90	14.10
M20	2.50	30.00	29.16	32.95	19.00	16.90
M24	3.00	36.00	35.00	39.55	22.30	20.20
M30	3.50	46.00	45.00	50.85	26.40	24.50
M36	4.00	55.00	53.80	60.79	31.90	29.40

BS EN 15048 Nut ISO 4032/4034, Proof Loads, Classes 8 & 10			
Nut Thread Diad	Stress Area Test Mandrel	Property Class	
		8	10
		Tolerance Class 6H (1)	Tolerance Class 6AZ(2)
		Proof Load kN	Proof Load kN
M12	84.30	67.0	78.10
M16	157.0	125.0	150.0
M20	245.0	196.0	236.0
M24	353.0	282.0	342.0
M30	561.0	448.0	551.0
M36	817.0	653.0	808.0

6H (1) is the tolerance class for self color & zinc plated nuts.
6AZ(2) is the tolerance class for hot dip galvanized nuts

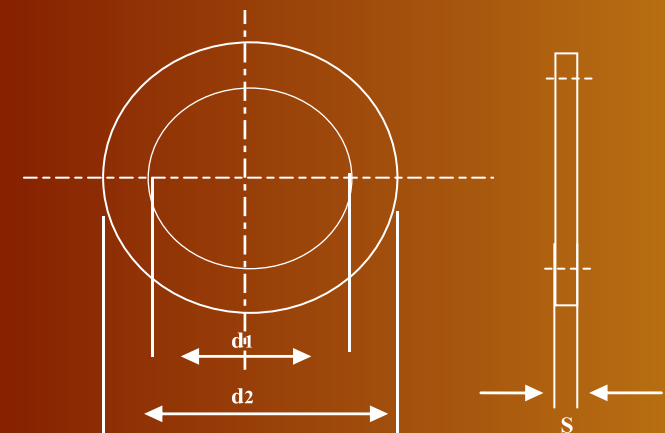
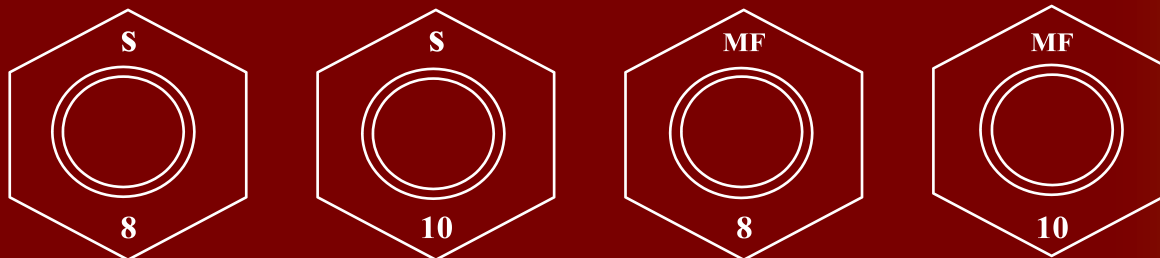
BS EN 15048 Washer ISO 7091 (100 HV Min)						
Normal Size and Thread Diameter <i>d</i>	ISO 7091- 2000					
	Inside Diameter <i>d₁</i>		Outside Diameter <i>d₂</i>		Thickness <i>s</i>	
	max	min	max	min	max	min
M12	13.93	13.50	24.00	22.70	2.80	2.20
M16	17.93	17.50	30.00	28.70	3.60	2.40
M20	22.52	22.00	37.00	35.40	3.60	2.40
M24	26.52	26.00	44.00	42.40	4.60	3.40
M30	33.62	33.00	56.00	54.10	4.60	3.40
M36	40.00	39.00	66.00	64.10	6.00	4.00

Product Characteristics		Standard
Hexagon Full Nuts		
General Requirement		ISO 4032 & 4034
Material & Manufacturer		ISO 4032 & 4034 Classes 8 & 10
Finish Coating	Zinc Electroplated	BS 7371-3 OR BS EN ISO 4032
	Hot Dip Galvanized	BS 7371-6 OR BS EN ISO 10684
Mechanical Properties	Self Colour / Zinc Electroplated	ISO 4032 & 4034 Class 8
	Hot Dip Galvanized	ISO 4032 & 4034 Class 10
Dimensions & Tolerances		ISO 4032 & 4034
Threads	Self Colour / Zinc Electroplated	ISO 965-2 Class 6H
	Hot Dip Galvanized	ISO 965-2 Class 6AZ



Product Characteristics		Standard
Washer		
General Requirement		ISO 7089/7091-2000
Material & Manufacturer		ISO 7089/7091-2000
Finish /Coating	Zinc Electroplated	BS 7371/3 or BS EN 442
	Hot Dip Galvanized	BS 7371-6 or BS EN ISO 10684
Dimensions & Tolerance		ISO 7091-2000

BS EN 15048 Nut Marking



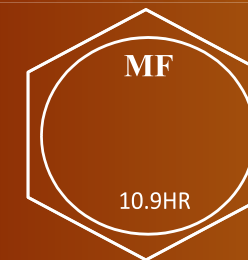
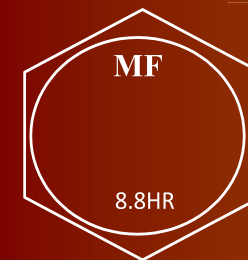
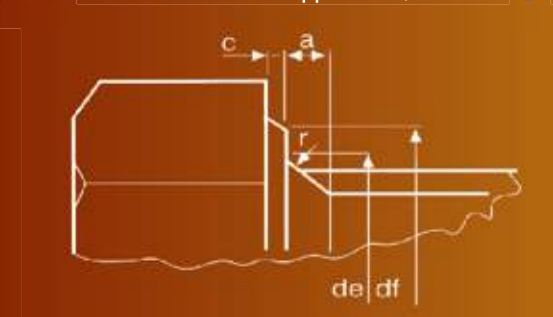
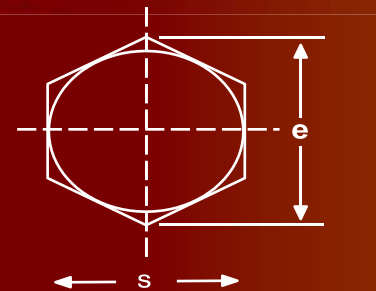
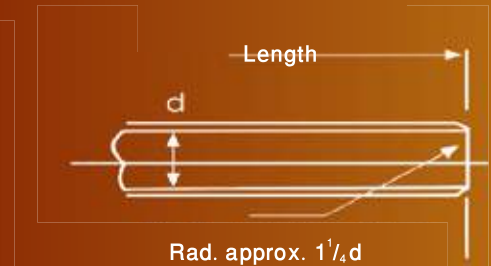
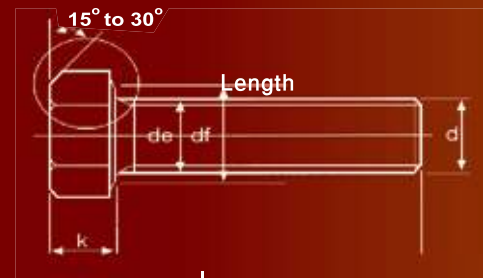
Pre-Load Bolt Assemblies HR BS EN 14399-3

BS EN 14399-3		HR Bolt Dimension Classes 8.8 & 10.9											
Nominal Size and Thread Diameter $r d$	Pitch of Thread p (coarse pitch series)	Diameter of Unthreaded Shank d_a		Width Across Flats s		Width Across Corners e	Diameter Of Washer Face d_f	Depth of Washer Face c		Radius Under Head r	Transition Diameter d_e	Thickness of Head k	
		max	min	max	min	min	min	max	min	min	max	max	min
M12	1.75	12.70	11.30	22.00	21.16	23.91	20.10	0.8	0.4	1.2	15.20	7.95	7.05
M16	2.00	16.70	15.30	27.0	26.16	29.56	24.90	0.8	0.4	1.2	19.20	10.75	9.25
M20	2.50	20.84	19.16	32.00	31.00	35.03	29.50	0.8	0.4	1.5	24.40	13.40	11.60
M22	2.50	22.84	21.16	36.00	35.00	39.55	33.50	0.8	0.4	1.5	26.40	14.90	13.10
M24	3.00	24.84	23.16	41.00	40.00	45.20	38.00	0.8	0.4	1.5	28.40	15.90	14.10
M27	3.00	27.84	26.16	46.00	45.00	50.85	42.80	0.8	0.4	2.0	32.40	17.90	16.10
M30	3.50	30.84	29.16	50.00	49.00	55.37	46.60	0.8	0.4	2.0	35.40	19.75	17.65
M36	4.00	37.00	35.0	60.00	58.80	66.40	55.90	0.8	0.4	2.0	42.40	23.55	21.45

Bolt / Nut / Washer Assembly Systems HR	
General Requirement	BS EN 14399-1
Materials & Manufacture	BS EN 14399-3
Marking	HR
Property Classes	8.8/8 10.9/10
Washer (s)	EN 14399-5 Or EN 14399-6
Marking	H
Suitable Test for Preloading	EN 14399-2

Product Characteristic	Standard	
Material	Steel	
General Requirements	EN 14399-1	
Thread	Tolerance	6g ^a
	International Standard	ISO 261, ISO 965-2
Mechanical Properties	Property Class	8.8 or 10.9
	European Standard	EN ISO 898-1
Impact strength	Value	K V _{min} = 27 J at - 20 ° C
	Test Piece ^b	ISO 148
	Test	EN 10045-1
Tolerances	Product Grade	C except: dimensions c and r . Tolerance for lengths ≥ 160 mm ± 4.0 mm
	International Standard	EN ISO 4759-1
Surface Finish	Normal	As processed ^c
	Hot Dip Galvanized	EN ISO 10684 ^d
	Others	To be agreed ^e
Surface Discontinuities	Limits for surface discontinuities as specified in EN 26157-1	
Acceptability	For acceptance procedure, see EN ISO 3269	

^{a.} The tolerance class specified supplies before hot dip galvanizing bolts are intended for assembly with oversize tapped nuts.
^{b.} The location of the Charpy V-notch test pieces in the bolt shall be as specified in EN ISO 898-1
^{c.} As processed^e means the normal finish resulting from manufacture with a light coating of oil.
^{d.} Attention is drawn to the need to consider the risk of hydrogen embrittlement in the case of bolts of property class 10.9, when selection an appropriate surface treatment process (eg. Cleaning and coating.)
^{e.} Other coating may be negotiated between the purchaser and the manufacturer provided they do not impair the mechanical properties or the functional characteristics. Coating of cadmium or cadmium alloys are not permitted.



BS EN 14399-3 HR
Head Marking

IMPORTANT NOTE: It is a requirement of BS EN 15048 that the bolt, nut and washer assembly is supplied by one manufacturer who is responsible for the function of the assembly. All the components are identified with the manufacturer's mark, the coating of the assembly is under the control of the manufacturer.

Pre-Load Bolt Assemblies HR BS EN 14399-3

399-3 Nut Dimensions. Classes 8 & 10

Nominal Size & Thread Diameter <i>d</i>	Pitch of thread <i>p</i>		Width Across Flats <i>s</i>		Width Across Corner <i>e</i>		Diameter of washer face <i>df</i>		Depth of washer face <i>c</i>		Thickness of nut <i>m</i>		Tolerance on squareness
	(coarse pitch series)	max	min	min	min	max.	min	max.	min.	max.	min.	max.	max.
M12	1.75	22.00	21.16	23.91	20.10	0.8	0.4	10.80	10.37	0.38			
M16	2.00	27.00	26.16	29.56	24.90	0.8	0.4	14.80	14.10	0.47			
M20	2.50	32.00	31.00	35.03	29.50	0.8	0.4	18.00	16.90	0.58			
M22	2.50	36.00	35.00	39.55	33.30	0.8	0.4	19.40	18.10	0.63			
M24	3.00	41.00	40.00	45.20	38.00	0.8	0.4	21.50	20.20	0.72			
M27	3.00	46.00	45.00	50.85	42.80	0.8	0.4	23.80	22.50	0.80			
M30	3.50	50.00	49.00	55.37	46.60	0.8	0.4	25.60	24.30	0.87			
M36	4.00	60.00	58.80	66.44	55.90	0.8	0.4	31.00	29.40	1.05			

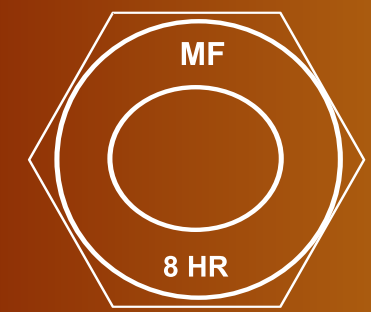
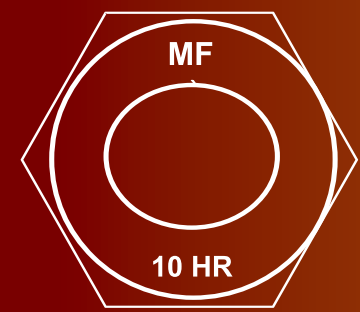
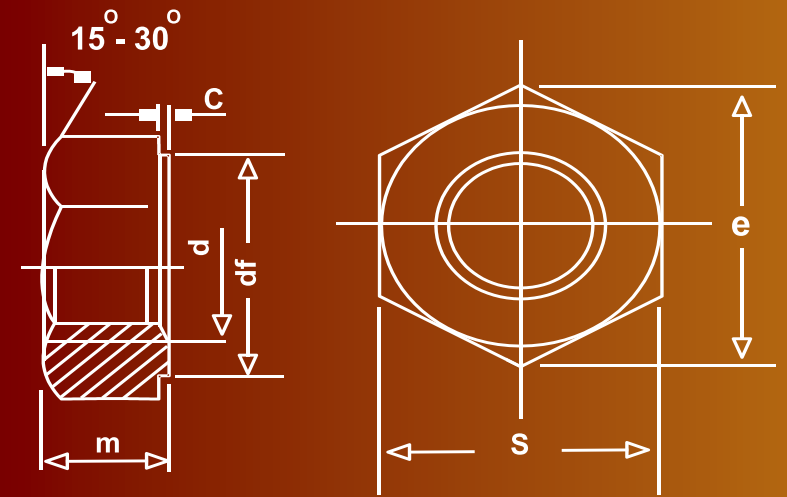
BS EN 14399-3 Nut Proof Loads. Classes 8 & 10

Nut Thread Dia	Stress Area Test Mandrel mm ²	Property class	
		8	10
		Tolerance Class 6H or 2) 6AZ	Tolerance Class 6H or 2) 6AZ
		Proof load kN	Proof load kN
M12	84.30	84.30	97.80
M16	157.70	157.0	182.1
M20	245.0	245.0	284.2
M22	303.0	303.0	351.2
M24	353.0	353.0	409.5
M27	459.0	459.0	532.4
M30	561.0	561.0	650.8
M36	817.0	817.0	947.7

6H is the tolerance class for self colour & zinc plated nuts .
6AZ is the tolerance class for hot dip galvanized nuts.

Product Characteristic	Standard	
Material	Steel	
General requirements	EN 14399-1	
Thread	Tolerance	6H or 6AZ
	International standard	ISO 261, ISO 965-2, ISO 965-5
Mechanical Properties	Property Class	8 ^a or 10 ^a
	European Class	EN 20898-2
Tolerances	Product Grade	B expect dimensions m and c
	International standard	EN ISO 4759-1 ^b
Surface Finish	Normal	As processed ^c
	Hot Dip Galvanized	EN ISO 10684
	Others	To be agreed ^d
Surface discontinuities	Limits of surface discontinuities as specified in EN 493	
Acceptability	For acceptance procedure see EN ISO 3269	

For proof load values, see 4.3 all other mechanical properties as specified in EN 20898 -2
Except tolerance on perpendicularity of bearing face. See tolerance / in table 4.
"As processed" means the normal finish resulting from manufacture with a light coating of oil
Other coating may be negotiated between the purchaser and the manufacturer they do not impair the mechanical properties of the functional characteristics. Coating of cadmium alloys are not permitted .

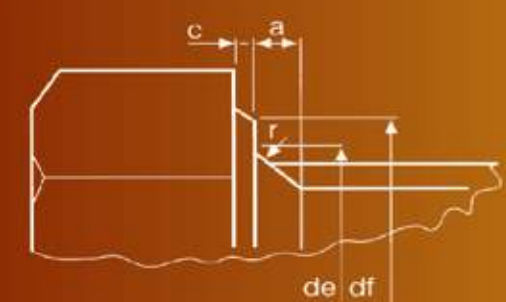
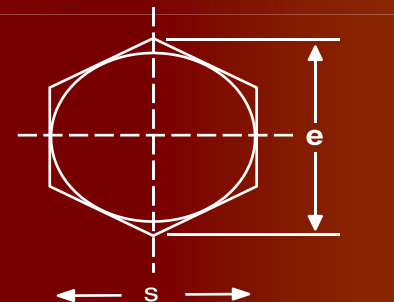
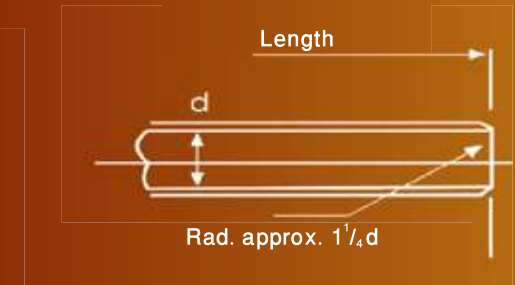
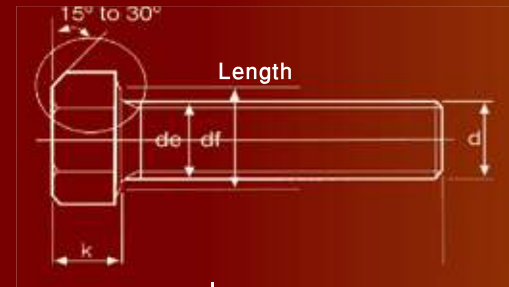


Pre-Load Bolt Assemblies HV BS EN 14399-4

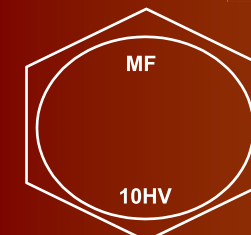
BS EN 14399-4		HR Bolt Dimension Classes 10.9											
Nominal Size and Thread Diameter <i>d</i>	Pitch of Thread <i>p</i>	Diameter of Unthreaded Shank <i>d_a</i>		Width Across Flats <i>s</i>		Width Across Corners <i>e</i>	Diameter Of Washer Face <i>df</i>	Depth of Washer Face <i>c</i>		Radius Under Head <i>r</i>	Transition Diameter <i>d_e</i>	Thickness of Head <i>k</i>	
	(coarse pitch series)	max	min	max	min	min	min	max	min	min	max	max	min
M12	1.75	12.70	11.30	22.00	21.16	23.91	20.10	0.6	0.4	1.2	15.20	8.45	7.55
M16	2.00	16.70	15.30	27.0	26.16	29.56	24.90	0.6	0.4	1.2	19.20	10.75	9.25
M20	2.50	20.84	19.16	32.00	31.00	35.03	29.50	0.8	0.4	1.5	24.00	13.90	12.10
M22	2.50	22.84	21.16	36.00	35.00	39.55	33.50	0.8	0.4	1.5	26.00	14.90	13.10
M24	3.00	24.84	23.16	41.00	40.00	45.20	38.00	0.8	0.4	1.5	28.00	15.90	14.10
M27	3.00	27.84	26.16	46.00	45.00	50.85	42.80	0.8	0.4	2.0	32.00	17.90	16.10
M30	3.50	30.84	29.16	50.00	49.00	55.37	46.60	0.8	0.4	2.0	35.00	20.05	17.95
M36	4.00	37.00	35.00	60.00	58.80	66.44	55.90	0.8	0.4	2.0	41.00	24.05	21.95

Bolt / Nut / Washer Assembly Systems HV	
General Requirement	BS EN 14399-1
Materials & Manufacture	BS EN 14399-4
Marking	HV
Property Classes	10.9/10
Washer (s)	EN 14399-5 Or EN 14399-6
Marking	H
Suitable Test for Preloading	EN 14399-2

Product Characteristic		Standard
Material		Steel
General Requirements		EN 14399-1
Thread	Tolerance	6g ^a
	International Standard	ISO 261, ISO 965-2
Mechanical Properties	Property Class	10.9
	European Standard	EN ISO 898-1
Impact strength	Value	K V _{min} = 27 J at - °C
	Test Piece ^b	ISO 148
	Test	EN 10045-1
Tolerances	Product Grade	C except: dimensions C and r. +IT 17 Tolerance for lengths ≥ 155 mm 1/2 IT 17
	International Standard	EN ISO 4759-1
Surface Finish	No	As pcessed ^c
	Hot Dip Galvanized	EN ISO 10684 ^d
	Others	To be agreed ^c
Surface Discontinuities		Limits for surface discontinuities as specified in EN 26157-1
Acceptability		For acceptance procedure, see EN ISO 3269
<p>a. The tolerance class specified supplies before hot dip galvanizing bolts are intended for assembly with oversize tapped nuts.</p> <p>b. The location of the charpy V-notch test pieces in the bolt shall be as specified in EN ISO 898-1</p> <p>c. Attention is drawn to the need to consider the risk of hydrogen embrittlement in the case of bolts of property class 10.9, when selection an appropriate surface treatment process (eg. Cleaning and coating.)</p> <p>d. ^aAs processed^d means the normal finish resulting from manufacture with a light coating of oil.</p> <p>e. Other coating may be negotiated between the purchaser and the manufacturer provided they do not impair the mechanical properties or the functional characteristics. Coating of cadmium or cadmium alloys are not permitted.</p>		



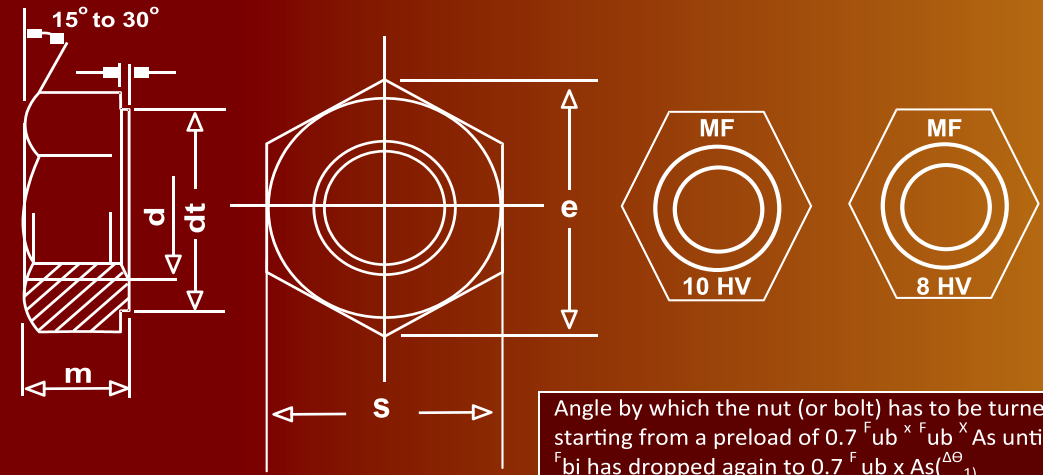
BS EN 14399-4 HV
Head Marking



IMPORTANT NOTE: It is a requirement of BS EN 15048 that the bolt, nut and washer assembly is supplied by one manufacturer who is responsible for the function of the assembly . All the components are identified with the manufacturer's mark, the coating of the assembly is under the control of the manufacturer.

BS EN 14399-4 HV dimension. Classes 10

Nominal Size & Thread Diameter d	Pitch of thread p (coarse pitch series)	Width Across Flat s		Width Across Corner e	Diameter of Washer Face df	Thickness of Nut m	
		max	min	min	min	max	min
M12	1.75	22.00	21.16	23.91	20.10	10.80	10.37
M16	2.00	27.00	26.16	29.56	24.90	14.80	14.10
M20	2.50	32.00	31.00	35.03	29.50	18.00	16.90
M22	2.50	36.00	35.00	39.55	33.30	19.40	18.10
M24	3.00	41.00	40.00	45.20	38.00	21.50	20.20
M27	3.00	46.00	45.00	50.85	42.80	23.80	22.50
M30	3.50	50.00	49.00	55.37	46.60	26.60	24.30
M36	4.00	60.00	58.80	66.44	55.90	31.00	29.40



Product Characteristic		Standard
Material		Steel
General requirements		EN 14399-1
Thread	Tolerance	6H or 6AZ
	International standard	ISO 261, ISO 965-2, ISO 965-5
Mechanical Properties	Property Class	10
	European Class	EN 20898-2
Tolerances	Product Grade	B
	International standard	EN ISO 4759-1
Surface Finish	Normal	as processed ^f
	Hot Dip Galvanized	EN ISO 10684
	Others	To be agreed ^d
Surface discontinuities		Limits of surface discontinuities as specified in EN 493
Acceptability		For acceptance procedure see EN ISO 3269

^fAs processed" means the normal finish resulting from manufacture with a light coating of oil. Other coating may be negotiated between the purchaser and the manufacturer they do not impair the mechanical properties of the functional characteristics. Coating of cadmium alloys are not permitted.

Value for $\Delta\theta!$	
Clamp length Σt^a	$\Delta\theta_t$ min
$\Sigma t < 2d$	90° 120°
$2d \leq \Sigma t < 6d$	150°
$6d \leq \Sigma t \leq 10d$	

a Σ is the total thickness of the clamped parts including washer(s).

Functional Characteristics of the Bolt/Nut/Washer(s) Assembly

The functional characteristics of bolt /nut/washer(s) assembly according to 7.2 to 7.5 shall be achieved when tested in accordance with EN 14399-2.

NOTE: For further background information as to these functional characteristics see EN 14399-2.

Minimum clamp lengths as specified in Annex A.

There shall be sufficient suitable lubricant on the nuts or on the bolts and washers in the as delivered condition, to ensure that seizure will not take place on tightening the assembly and that the required preload is obtained. Maximum individual value of the bolt force during tightening test ($F_{bi} \max$)

The following applies: $F_{bi} \max \geq 0.9 F_{ub} \times A_s$
 Where F_{ub} is the nominal tensile strength (A_m)
 A_s is the nominal stress area of the bolt.
 Angle by which the nut (or bolt) has to be turned starting from a preload of $0.7 F_{ub} \times A_s$ until F_{bi} max is reached ($\Delta\theta_1$)

Angle by which the nut (or bolt) has to be turned starting from a preload of $0.7 F_{ub} \times A_s$ until F_{bi} has dropped again to $0.7 F_{ub} \times A_s$ ($\Delta\theta_2$)

Value for $\Delta\theta_2$	
Clamp length Σt^a	$\Delta\theta_2$ min
$\Sigma t < 2d$	180°
$2d \leq \Sigma t < 6d$	210°
$6d \leq \Sigma t \leq 10d$	240°

a Σ is the total thickness of the clamped parts including washer(s).

Individual values of the k-factor (k_i), mean value of the k-factor (k_m) and coefficient of variation of the k-factor (k_v)

Individual values of the k-factor (k_i) for class K1

When k_i - values are required, they shall be in the range of $0.10 \leq k_i \leq 0.16$.

Means value of the k-factor (k_m) and coefficient of variation of the k-factor (k_v) for k-factor K2. Mean value of the k-factor is given by:

$$\sum k_i$$

$$K_m = \frac{1}{n} \sum k_i \quad \text{with} \quad k_i = \frac{M_i}{F_p \times d}$$

Where M_i is the individual value of the applied torque F_p is the specified preload. d is the nominal bolt diameter for the co-efficient of variation of the k-factor (k_v) the following applies:

$$S_k = \frac{1}{n} \sqrt{\sum (k_i - K_m)^2}$$

Where S_k is the standard deviation

When k_m and V_k are required, the following values apply.
 $0.10 \leq k_m \leq 0.23$
 $V_k \leq 0.10$

Pre-Load Bolt Assemblies HRC BS EN 14399-10

BS EN 14399-10 HRC Bolt Dimension

Thread <i>d</i>	<i>pb</i>	<i>b(ref.)</i>			<i>c</i>		<i>da</i>			<i>ds</i>		<i>dw</i>		<i>e</i>	<i>k</i>			<i>kw</i>	<i>r</i>	<i>s</i>	
		<i>c</i>	<i>d</i>	<i>e</i>	<i>max</i>	<i>min</i>	<i>max</i>	<i>max</i>	<i>min</i>	<i>max</i>	<i>min</i>	<i>min</i>	<i>nom</i>		<i>max</i>	<i>min</i>	<i>min</i>			<i>max</i>	<i>Min</i>
M12	1.75	30			0.8	0.4	15.2	12.70	11.30	<i>f</i>	20.1	23.91	7.50	7.95	7.05	4.9	1.2	22	21.16		
M16	2.00	38	44		0.8	0.4	19.2	16.70	15.30		24.9	29.56	10.0	10.75	9.25	6.50	1.2	27	26.16		
M20	2.50	46	52	65	0.8	0.4	24.4	20.84	19.16		29.5	35.03	12.5	13.40	11.60	8.1	1.5	32	31.00		
M22	2.50	50	56	69	0.8	0.4	26.4	22.84	21.16		33.3	39.55	14.0	14.90	13.10	9.2	1.5	36	35.00		
M24	3.00	54	60	73	0.8	0.4	28.4	24.84	23.16		38.0	45.20	15.0	15.90	14.10	9.9	1.5	41	40.00		
M27	3.00	60	66	79	0.8	0.4	32.4	27.84	26.16		42.8	50.85	17.0	17.90	16.10	11.3	2.0	46	45.00		
M30	3.50	66	72	85	0.8	0.4	35.4	30.84	29.16		46.6	55.37	18.75	19.75	17.65	12.4	2.0	50	49.00		

BS EN 14399-10 HRC Spline End Dimensions

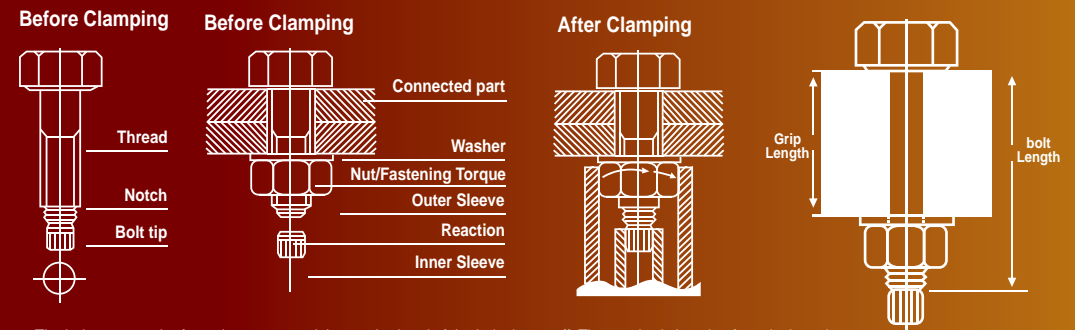
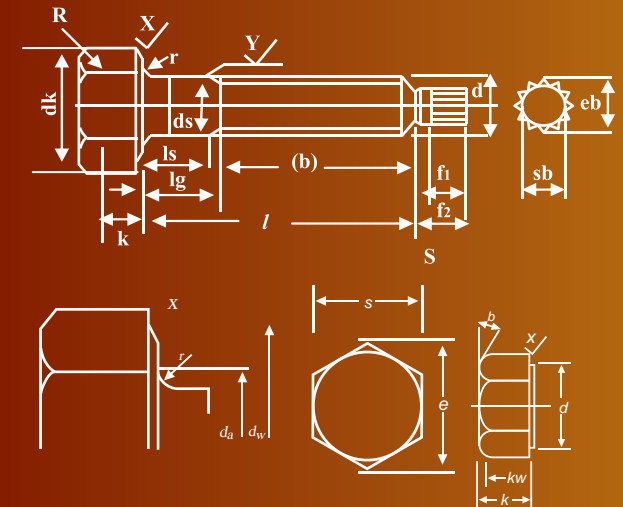
Thread <i>d</i>	Width Across Flats of Spline-end <i>rb b</i>			Width Across Corners of Spline-end <i>eb b</i>	Length Of Spline-End <i>F1</i>	Break off Length <i>F2</i>
	<i>nom</i>	<i>max</i>	<i>min</i>	<i>min</i>	<i>min</i>	<i>max</i>
M12	7.7	8.0	7.4	8.36	11.0	16.0
M16	11.3	11.6	11.0	12.43	13.0	18.0
M20	14.1	14.4	13.8	15.60	15.0	20.0
M22	15.4	15.7	15.1	17.06	15.5	21.0
M24	16.8	17.1	16.5	18.65	16.0	21.5
M27	19.0	19.3	18.7	21.13	19.0	24.0
M30	21.1	21.4	20.8	23.50	21.0	26.0

Product Characteristic	Standard	
Material	Steel	
General Requirements	EN 14399-1	
Thread	Tolerance	6ga
	International Standard	ISO 261, ISO 965-2
Mechanical Properties	Property Class	10.9
Impact strength	European Standard	EN ISO 898-1
	Value	$K VL_{min} = 27 J \text{ at } -20 \text{ }^\circ C$
	Test Piece	ISO 148-1
Tolerances	Test	EN 10045-1
	Product Grade	C except: dimensions C and r. Tolerance for lengths $150 \text{ mm} \pm 4.0 \text{ mm}$
	International Standard	EN ISO 4759-1
Surface Finish	Normal	As processed
	Hot Dip Galvanized	EN ISO 10684d
	Others	After tightening, the non-coated area appearing at the end of the bolt resulting from the fracture of the spline-end may be protected against corrosion by applying an efficient protective treatment (e.g by a complementary zinc-rich paint.)
	Additional Protection against Corrosion	
Surface Discontinuities	Limits for surface discontinuities as specified in EN 26157-1	
Acceptability	For acceptance procedure, see EN ISO 3269	
a.	The tolerance class specified supplies before hot dip galvanizing bolts are intended for assembly with oversize tapped nuts.	
b.	The location of the Charpy V-notch test pieces in the bolt shall be as specified in EN ISO 898-1	
c.	μ As processed means the normal finish resulting from manufacture with a light coating of oil.	
d.	Attention is drawn to the need to consider the risk of hydrogen embrittlement in the case of bolts of property class 10.9, when selection an appropriate surface treatment process (eg. Cleaning and coating.)	
e.	Other coating may be negotiated between the purchaser and the manufacturer provided they do not impair the mechanical properties or the functional characteristics. Coating of cadmium or cadmium alloys are not permitted.	

Features of High Strength HRC (Tension Control) Bolt

Developed for more simplified bolt fastening and more accurate performance. HRC (Tension Control) Bolts offer excellent characteristics as shown below

1. Controlled clamping force can be ensured.
2. Completion of bolt fastening can be confirmed by the shear-off of the notched end of the bolt.
3. Removes the possibility of operator error.
4. Fastening can easily be done by electric wrench.
5. Noiseless installation and no need of wrench adjustment.
6. The bolt does not rotate when fastening.



The bolt reacts to the fastening torque and the notched end of the bolt shears off. The required clamping force is thus given.

BS EN 14399-3 HR Nut Dimensions

Thread <i>d</i>	<i>Pd</i>	<i>d_a</i>		<i>d_w</i>		<i>c</i>		<i>m</i>		<i>M_w</i>		<i>c</i>		<i>s</i>		<i>r</i>
		<i>max</i>	<i>min</i>	<i>min</i>	<i>min</i>	<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Min</i>	<i>min.</i>	<i>Max</i>	<i>min</i>	<i>Max</i>	<i>min</i>		
M12	1.75	13.0	12	e	20.1	23.91	10.8	10.37	8.3	0.8	0.4	22	21.16	0.38		
M16	2.00	17.3	16		24.9	29.56	14.8	14.10	11.3	0.8	0.4	27	26.16	0.47		
M20	2.50	21.6	20		29.5	35.03	18.0	16.90	13.5	0.8	0.4	32	31.00	0.58		
M22	2.50	23.7	22		33.3	39.55	19.4	18.10	14.5	0.8	0.4	36	35.00	0.63		
M24	3.00	25.9	24		38.0	45.20	21.5	20.20	16.2	0.8	0.4	41	40.00	0.72		
M27	3.00	29.1	27		42.8	50.85	23.8	22.50	18.1	0.8	0.4	46	45.00	0.80		
M30	3.50	32.4	30		46.6	55.37	25.6	24.00	19.5	0.8	0.4	50	49.00	0.87		

Product Characteristic

Standard

Material	Steel	
General requirements	EN 14399-1	
Thread	Tolerance	6H or 6AZ
	International standard	ISO 261, ISO 965-2, ISO 965-5
Mechanical Properties	Property Class	10 ^a
	European Class	EN 20898-2
Tolerances	Product Grade	B expect dimensions m and c
	International standard	EN ISO 4759-1 ^b
Surface Finish	Normal	As processed ^c
	Hot Dip Galvanized	EN ISO 10684
	Others	To be agreed ^d
Surface discontinuities	Limits of surface discontinuities as specified in EN ISO 6157-2	
Acceptability	For acceptance procedure see EN ISO 3269	

For proof load values, see 4.3 all other mechanical properties as specified in EN 20898 -2

Except tolerance on perpendicularity of bearing face. See tolerance / in table 4.

"As processed" means the normal finish resulting from manufacture with a light coating of oil
Other coating may be negotiated between the purchaser and the manufacturer they do not impair the mechanical properties of the functional characteristics. Coating of cadmium alloys are not permitted.

Galvanized HRC Assemblies.(bolt, nuts, washer) are supplied in a fully assembled condition ready for use. No treatments such as T-Washing or Etching can be applied before installation as this will change the tightening characteristics and prevent the correct preload being achieved.

The components of the assembly, as supplied, have been tested as a batch and must not be mixed with components from any other batch of HRC assemblies.

Care must always be taken to avoid any contamination of the assemblies with anything that may change the lubrication of the nut, bolt thread or washer.

SUCH CONTAMINATION WILL EFFECT THE ASSEMBLY PRELOAD THAT IS ACHIEVED DURING TIGHTENING.

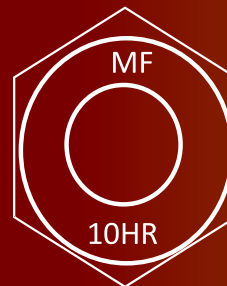
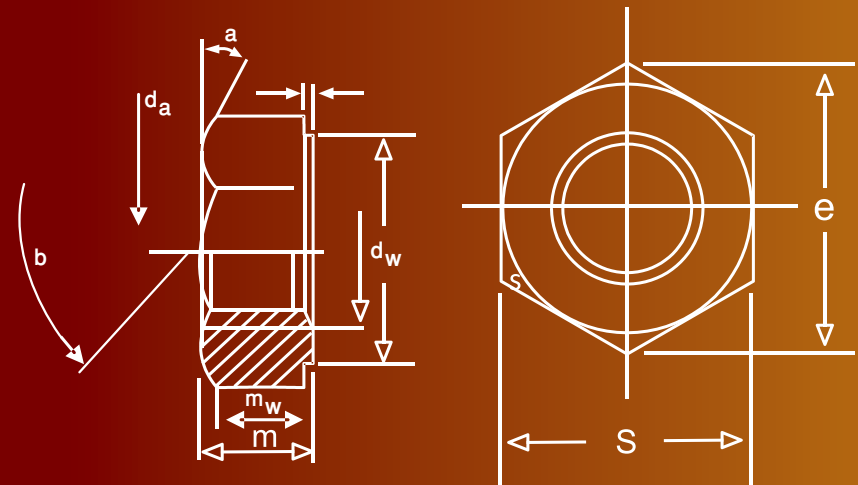
Although HRC assemblies are designed to withstand the maximum preloads that can occur when contaminated with water, we would advise that tightening of HRC assemblies is avoided in the rain.

BS EN 14399-3 Nut Proof Loads. Classes 8 & 10

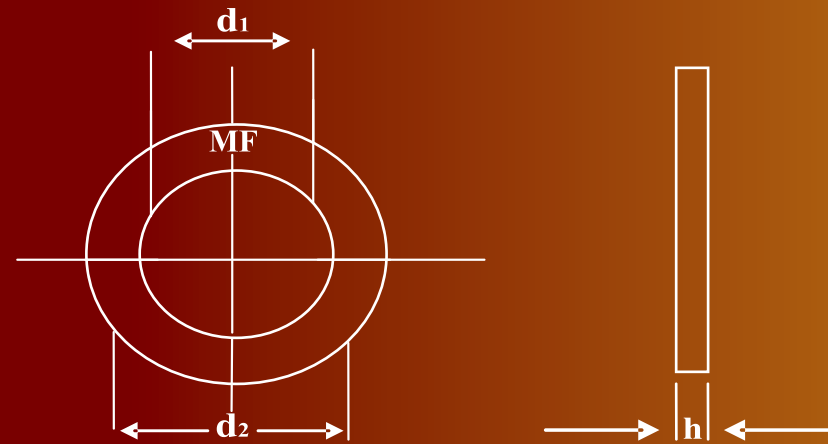
Nut Thread <i>d</i>	Nominal Stress Area of Standard Test Mandrel <i>A_s</i> mm ²	Property Class 10 Tolerance Class 6H or 6HZ	
		Proof Load (<i>A_s</i> × <i>S_p</i>) N	
		Nuts According to EN 14399-3 HR ^a	Nuts with Height <i>m</i> = <i>d</i> HRD ^D
	mm ²	Proof load kN	Proof load kN
M12	84.3	97 800	104 900
M16	157.0	182 100	195 500
M20	245.0	284 200	305 000
M22	303.0	351 200	377 200
M24	353.0	409 500	439 500
M27	459.0	532 400	571 500
M30	561.0	650 800	698 400

a. The proof load values are based on the stress under proof load of 1 160 MPa

b. The proof load values are based on the stress under proof load of 1 245 MPa



Pre-Load Bolt Washers BS EN 14399-5 & 6

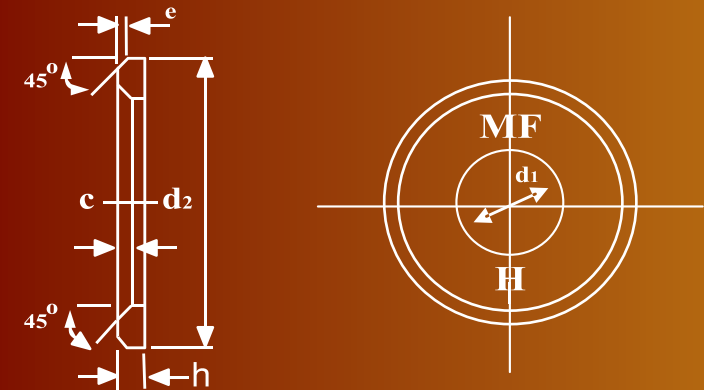


BS EN 14399-5 Washer Dimensions (Hardened)						
Nominal Size of bolt or screw	BS EN 14399 Part 5					
	Inside diameter d_1		Outside diameter d_2		Thickness h	
	max	min	max	min	max	min
M12	13.27	13.00	24.00	23.48	3.3	2.7
M14	15.27	15.00	28.00	27.48	3.3	2.7
M16	17.27	17.00	30.00	29.48	4.3	3.7
M18	19.33	19.00	34.00	33.38	4.3	3.7
M20	21.33	21.00	37.00	36.38	4.3	3.7
M22	23.33	23.00	39.00	38.38	4.3	3.7
M24	25.00	25.00	44.00	43.38	4.3	4.4
M27	28.52	28.00	5.00	49.00	5.6	4.4
M30	31.62	31.00	56.00	54.80	5.6	4.4
M36	37.62	37.00	66.00	64.80	6.6	5.4

Product Characteristic		Standard
General requirements		BS EN 14399-1
Finish/ coating	Self colour /black	BS EN 14399-5 & 6
	Zinc electroplated	BS 7371-3 OR BS EN ISO 4042
	Hot dip galvanized	BS 7371-6 OR BS EN ISO 10684
Mechanical Properties		BS EN 14399-5 & 6
Dimension & tolerances		BS EN 14399-5 & 6
Product marking		BS EN 14399-5 & 6

BS EN 14399-6 Chamfered Washer Dimensions (Hardened)										
Nominal Size of bolt or screw	BS EN 14399 Part 5									
	Inside diameter d_1		Outside diameter d_2		Thickness h		External chamfer e		Internal chamfer c	
	max	min	max	min	max	min	max	min	max	min
M12	13.27	13.00	24.00	23.48	3.3	2.7	1.00	0.50	1.9	1.6
M14	15.27	15.00	28.00	27.48	3.3	2.7	1.00	0.50	1.9	1.6
M16	17.27	17.00	30.00	29.48	4.3	3.7	1.50	0.75	1.9	1.6
M18	19.33	19.00	34.00	33.38	4.3	3.7	1.50	0.75	2.5	2.0
M20	21.33	21.00	37.00	36.38	4.3	3.7	1.50	0.75	2.5	2.0
M22	23.33	23.00	39.00	38.38	4.3	3.7	1.50	0.75	2.5	2.0
M24	25.00	25.00	44.00	43.38	4.3	4.4	1.50	0.75	2.5	2.0
M27	28.52	28.00	5.00	49.00	5.6	4.4	2.00	1.00	3.0	2.5
M30	31.62	31.00	56.00	54.80	5.6	4.4	2.00	1.00	3.0	2.5
M36	37.62	37.00	66.00	64.80	6.6	5.4	2.50	1.25	3.0	2.5

BS EN 14399 -5 & 6 Washer mechanical properties		
Nominal size	Vickers hardness (HV)	
	min	max
M16 TO M36 inclusive	300	370



Direct Tension Indicator Washers BS EN 14399-9

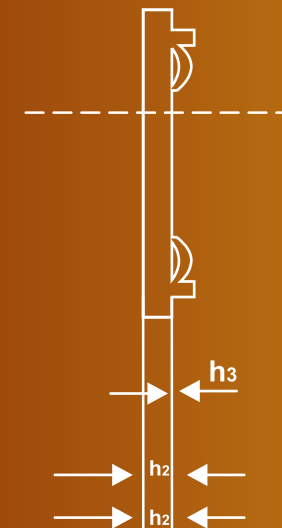
BS EN 14399-9 Direct Tension Indicator Washer Dimensions									
For Use with Bolts of designation	Internal diameter d1		External diameter d2	Material thickness h1	Height over protrusions h2	Height of protrusions h3	Protrusion tangential diameter d3		Protrusion internal diameter d4
	min.	max.	min	min	max	min	max	min	
	M12	12.75	12.85	26.0	32.5	2.50	5.50	0.80	20
M16	16.75	16.85	35.0	36.8	3.00	6.00	0.80	25	17.85
M20	20.95	21.05	41.0	46.0	3.50	6.50	0.80	29	22.05
M22	23.05	23.15	46.5	50.6	4.00	7.00	0.80	33	24.15
M24	25.15	25.25	50.0	55.2	4.00	7.00	0.80	38	26.25
M27	28.30	28.40	54.0	62.1	4.00	7.00	0.80	43	29.40
M30	31.45	31.55	59.0	69.0	4.00	7.00	0.80	46.5	32.55
M36	37.75	37.85	78.0	83.0	4.00	7.50	0.80	56	38.85

Product Characteristic		Standard
Material		Steel
General requirements		EN 14399-1
Heat treatment		Hardened and tempered or controlled rolled and tempered
Maximum Hardness		380 HV
Surface Finish	Normal	As processed ^c
	Sherardized ^b	EN 13811
	Others	To be agreed ^d
Associated bolts and nuts		EN 14399-3, EN 14399-4, EN 14399-7 or EN 14399-8
Associated washers		EN 14399-5 or EN 14399-6
Acceptability		For acceptance procedure see EN ISO 3269 ^e
<p>The direct indicators shall not be electroplated or subjected to any process that could result in hydrogen embrittlement.</p> <p>Sherardizing is considered to provide corrosion protection equivalent to hot dip galvanizing.</p> <p>"As Processed" means the normal finish resulting from manufacture with oil coating.</p> <p>Other coating may be negotiated between the purchaser and the manufacturer providing they do not impair the mechanical properties of functional characteristics. coating of cadmium or cadmium alloys are not permitted.</p> <p>For acceptance criteria use 0,65 AQL, Ac No 0; see EN ISO 3269:2000, Tables 5 and 6</p>		

BS EN 14399-9 DTI Compression Loads at Specified Gap				
For use with bolts of designation	Compression load			
	Designated H8		Designated H10	
	Min.	Max.	Min.	Max.
M12	47	56	59	71
M16	88	106	110	132
M20	137	164	172	206
M22	170	204	212	254
M24	198	238	247	296
M27	257	308	321	385
M30	314	377	393	472
M36	458	550	572	688

These minimum values are equal to 0.7 fub. As in accordance with EN 1993-1-1

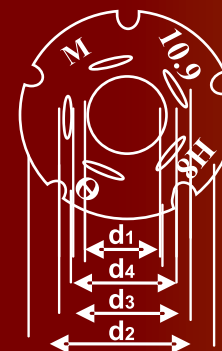
BS EN 14399-9 DTI Washer feeler gauge requirements	
Direct tension indicator positions	Designation H8 and H10 Thickness of feeler gauge
Under bolt head, when nut is rotated	0.40
Under nut, when bolt is rotated	
Under nut, when nut is rotated	0.25
Under bolt head, when bolt is rotated	



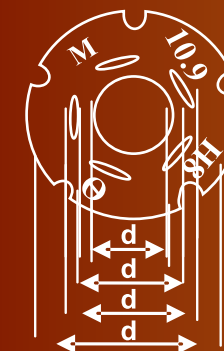
The DTI is a specially Hardened washer used totally independently of the bolts torque resistance.

DTI are one of four methods allowed to ensure that structural bolting is correctly installed.

Metric Series
General Grade Part 1

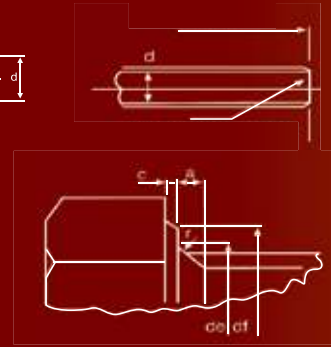
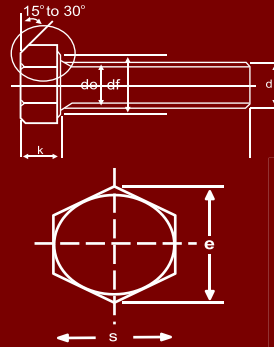


BS 4395 Higher
Grade Part 2



Pre-Load Bolt Assemblies ASTM

A325M Bolt	
Standard Specification	A325M B18.2.3.7M
Material	Medium Carbon Steel
Strength	8.8
Screw Thread	ASME B1.13. 6G
Surface Finish	Plain as Processed Hot Dip Galvanized



A490M Bolt	
Standard Specification	A490M B18.2.3.7M
Material	Alloy Steel
Strength	10.9
Screw Thread	ASME B1.13. 6G
Surface Finish	Plain as Processed

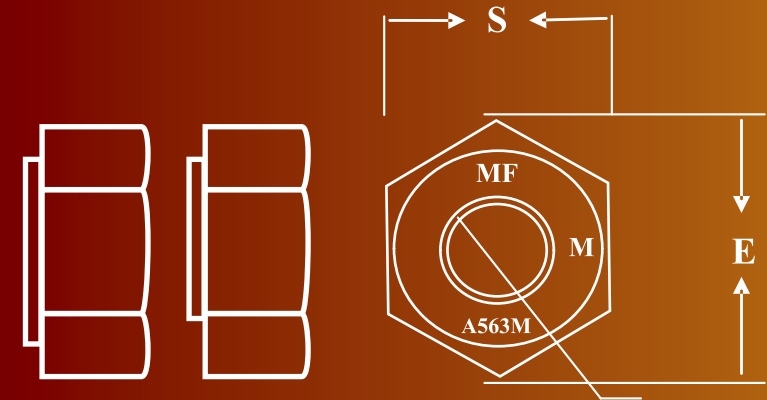
ANSI B18.2.3.7M		Heavy hex structural bolt dimensions							
Nominal Size and Thread Pitch	S		E		K		B(Ref)		
	Width across flats		Width across corners		Head height		Thread length		
	Max.	Min.	Max.	Min.	Max.	Min.	Bolt Length ≤ 100	Bolt Length > 100	
M16x2	27.00	26.16	31.18	29.56	10.75	9.25	31	38	
M20x2.5	34.00	33.00	39.26	37.29	13.40	11.60	36	43	
M22x2.5	36.00	35.00	41.57	39.55	14.90	13.10	38	45	
M24x3	41.00	40.00	47.34	45.20	15.90	14.10	41	48	
M27x3	46.00	45.00	53.12	50.85	17.90	16.10	44	51	
M30x3.5	50.00	49.00	57.74	55.37	19.75	17.65	49	56	
M36x4	60.00	58.80	69.28	66.44	23.55	21.45	56	63	

A325M Bolt Characteristics								
Nominal Bolt Dia & Thread Pitch	Strees Area ₁ mm ²	Proof Load, kN		Tensile Strength min, kN	Hardness			
		Length Measureme nt Method,	Yeild Strength Method,		Rockwell		Vickers	
					min	max	min	max
M16x2	157	94.2	104	130	C23	C34	255	336
M20x2.5	245	147	162	203				
M22x2.5	303	182	200	251				
M24x3	353	212	233	293				
M27x3	459	275	303	381				
M30x3.5	561	337	370	466				
M36x4	817	490	539	678				

A490M Bolt Characteristics										
Nominal Bolt Dia & Thread Pitch	Strees Area ₁ mm ²	Proof Load, kN		Tensile Strength min, kN	Product Hardness				Surface Hardness	
		Length Measure ment Method	Yeild Strength Method		HRC Rockwell C		HV (Vickers)		HR 30N (Rockwell 30N)	
					min	max	min	max	Max	
M16x2	157	130	148	163	188	33	39	327	336	59
M20x2.5	245	203	230	255	294					
M22x2.5	303	251	285	315	364					
M24x3	353	293	332	367	424					
M27x3	459	381	431	477	551					
M30x3.5	561	466	527	583	673					
M36x4	817	678	768	880	980					

ANSI B18.2.4.6M A563M Heavy Hex Nut Dimensions						
Nominal nut diameter and thread pitch	S		E		M	
	Width across flats		Width across corners		Thickness	
	max.	min.	max.	min.	max.	min.
M16x2	27.00	26.16	31.18	29.56	17.1	16.4
M20x2.5	34.00	33.00	39.26	37.29	20.7	19.4
M22x2.5	36.00	35.00	41.57	39.55	23.6	22.3
M24x3	41.00	40.00	47.34	45.20	24.2	22.9
M27x3	46.00	45.00	53.12	50.85	27.6	26.3
M30x3.5	50.00	49.00	57.74	55.37	30.7	29.1
M36x4	60.00	58.80	69.28	66.44	36.6	35.0

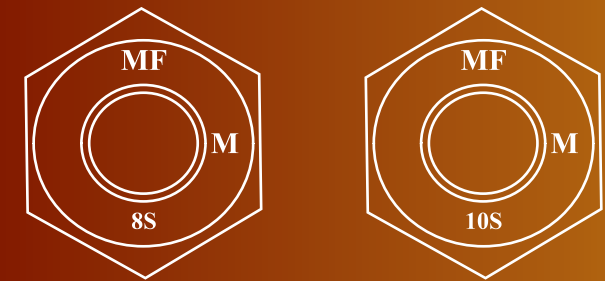
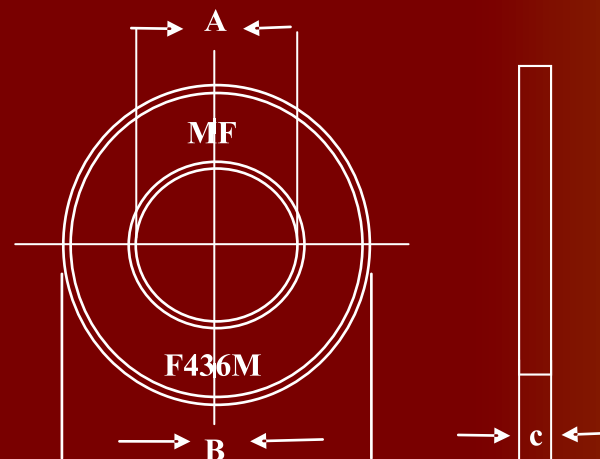
Standard specification	A563 ANSI B18.2.4.6M
Material	Carbon & Alloy Steel
Strength grade	8S , 10S
Screw thread	ANSI B18.2.4.1M
Surface finish	Plain as processed
	Hot dipped galvanized ASTM A153C



ASTM Nut Marking

ASTM F436M Circular Washer Dimensions						
Flat Circular Washers						
Nominal nut diameter and thread pitch	A		B		C	
	Inside		Outside		Thickness	
	Max.	Min.	Max.	Min.	Max.	Min.
16	18.4	18.0	34.0	32.4	4.6	3.1
20	22.5	22.0	42.0	40.4	4.6	3.1
22	24.5	24.0	44.0	42.4	4.6	3.4
24	26.5	26.0	50.0	48.4	4.6	3.4
27	30.5	30.0	56.0	54.1	4.6	3.4
30	33.6	33.0	60.0	58.1	4.6	3.4
36	39.6	39.0	72.0	70.1	4.6	3.4

Standard specification	ASTM F436M
Material	Hardened steel
Material properties	38 to 45 HRC
Surface finish	Plain as processed
	Hot dipped galvanized ASTM A153C



Sq. Sq. Holding Down Bolts BS 7419

BS 7419 Grades 4.6 & 8.8 Dimensions																
Thread Size <i>d</i>	Pitch of Thread <i>p</i>	Thread Length <i>t</i>				Diameter of Unthreaded Shank <i>ds</i>		Thickness of Head <i>h</i>		Radius under Head <i>r</i>	Width Across Flats <i>af</i>		Depth of Washer Face <i>s</i>		Width Across Square <i>sq</i>	
		<i>a</i>		<i>b</i>		max.	min.	max.	min.	min.	max.	min.	max.	min.	max.	min.
		max.	min.	max.	min.											
M16	2.0	122.0	116	225	200	16.70	15.30	10.75	9.250	0.6	24.00	23.16	8.75	7.25	16.70	15.30
M20	2.5	127.5	120	225	200	20.84	19.16	13.40	11.60	0.8	30.00	29.16	10.75	9.25	20.84	19.16
M24	3.0	133.0	124	225	200	24.84	23.16	15.90	14.10	0.8	36.00	35.00	12.90	11.10	24.84	23.16
M30	3.5	140.5	130	225	200	30.84	29.16	19.75	17.65	1.0	46.00	45.00	15.90	14.10	30.84	29.16
M36	4.0	148.0	136	225	200	37.00	35.00	23.55	21.45	1.0	55.00	53.80	18.90	17.10	37.00	35.00
M42	4.5	155.5	142	225	200	43.00	41.00	27.05	24.95	1.2	65.00	63.10	22.05	19.95	43.00	41.00
M48	5.0	163.0	148	225	200	49.00	47.00	31.05	28.95	1.6	75.00	73.10	25.05	22.95	49.00	47.00
M56	5.5	172.0	156	225	200	57.20	54.80	36.25	33.75	2.0	85.00	82.80	29.05	26.95	57.20	54.80
M64	6.0	182.0	164	225	200	65.20	62.80	41.25	38.75	2.0	95.00	92.80	33.25	30.75	65.20	62.80

a For nominal lengths L < 600. *b* For nominal lengths L > 600.

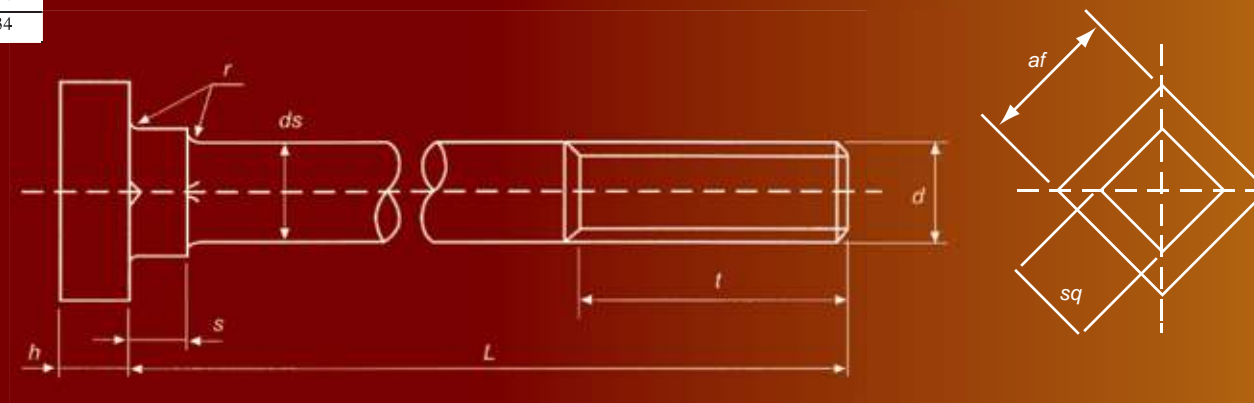
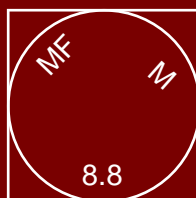
Product Characteristic	Standard	
General Requirements	BS 7419	
Threads	BS 3643 Parts 1 & 2 tolerance class 8g	
Materials & Manufacture	ISO 896-1 Property Classes 4.6 & 8.8	
Mechanical Properties	ISO 898-1 Property Classes 4.6 & 8.8	
Dimensions & Tolerances	BS 7419	
Finish / Coatings	Self Colour / Black	BS 7419
	Hot Dip Galvanized	BS 729 & BS 7371 Part 6

BS 7419 Ultimate Tensile Load & Hardness							
Nominal Dia	Stress Area	Property Class 4.6			Property Class 8.8		
		Tensile Load min		Hardness Rockwell HRB	Tensile Load min		Hardness Rockwell HRC
		mm ²	kN	min	max	kN	min
M16	157	62.80	67	95	130	23	34
M20	245	98.00	67	95	203	23	34
M24	353	141.0	67	95	293	23	34
M30	561	224.0	67	95	486	23	34
M36	817	327.0	67	95	678	23	34

BS 7419 Machined Test Requirements				
Tensile Strength min	Elongation min	Reduction of Area min	Hardness Rockwell HRC	
N/mm ²	%	%	min	max
830	12	52	23	34

For bolts > M36 testing would generally be on machined test pieces

BS 7419 Head Markings

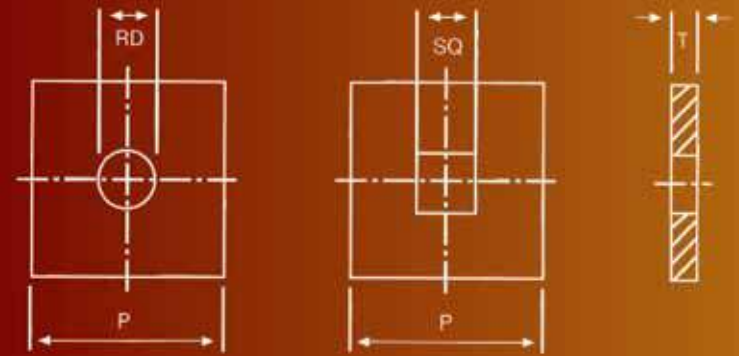
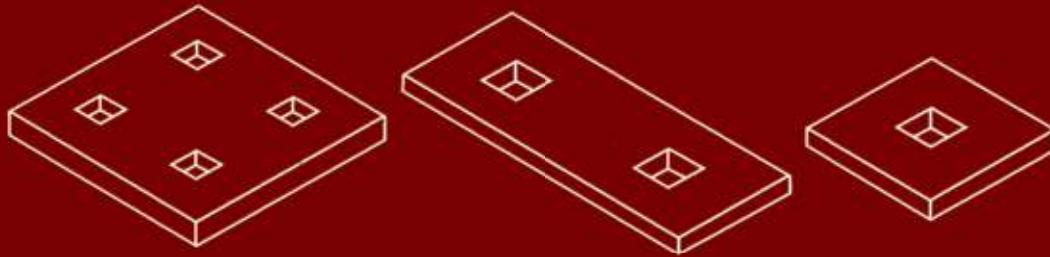


Washer Plates

Washer plates are produced from mild steel plate (S275).

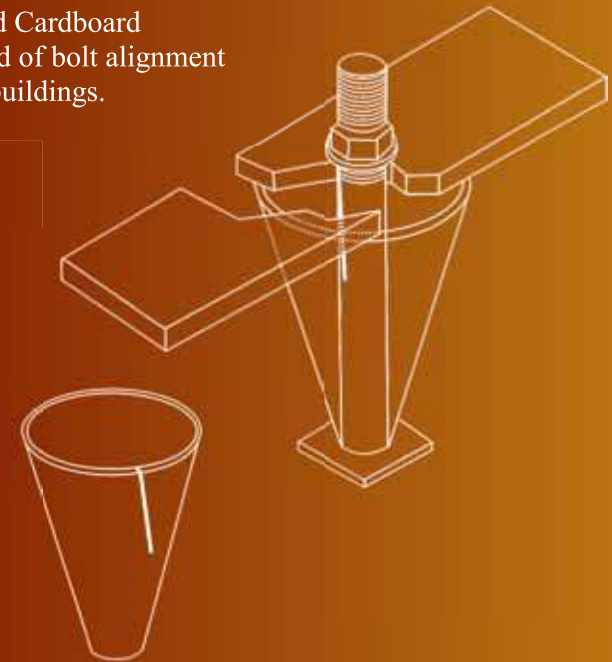
All holes are produced on a diameter + 2mm tolerance on both square and round hole.

As well as single holed plates, we can produce a range of multiple holed plates to customer specification.



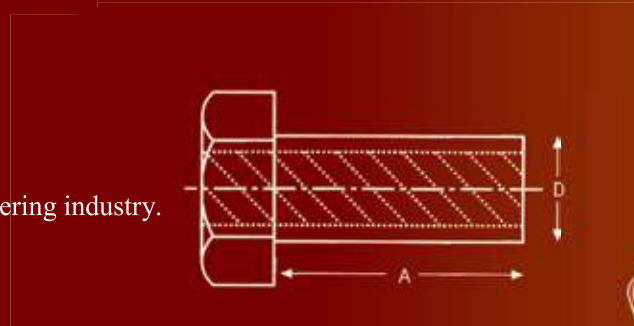
Conical Bolt Boxed

Material: Waxed Cardboard
A simple method of bolt alignment for steel frame buildings.



Bolt Extenders

Midland Fasteners produce bolt extenders specifically for the structural engineering industry. All bolt extenders are produced as Grade 8.8 (40cr mo4) as standard.

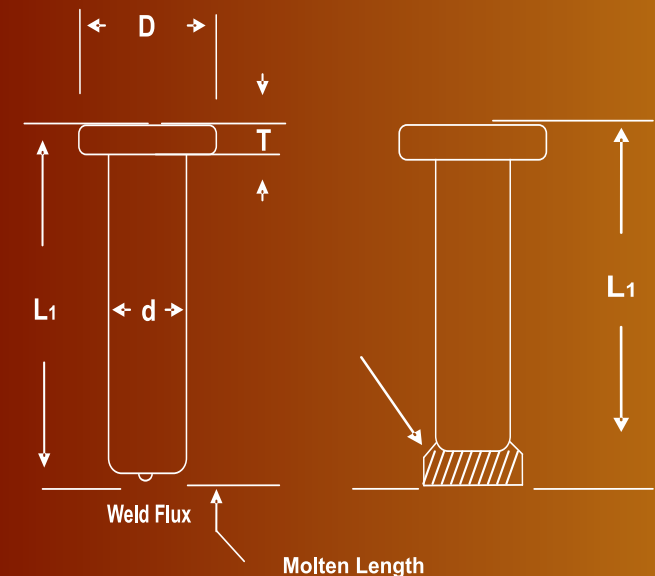


Internally Threaded	D Shank Diameter mm	A Width Across Flats mm	C Width Across Corners mm
M16	24	36	41.6
M20	30	45	53.1
M22	33	50	57.8
M24	36	55	63.5
M27	42	65	69.3
M30	45	70	80.8
M36	52	80	92.4

SHEAR CONNECTORS Dimensions

Stud Diameter	d	13		16		19	
		Max	Min	Max	Min	Max	Min
Stud length (Before)		12.95	12.70	15.95	15.70	19.00	18.62
Stud Length (after)	[L1]	$L1 \pm 1.6$					
	[L]	3~5mm Shorter Than L1					
Head Diameter	[D]	25.4 ± 0.4		31.7 ± 0.4		31.7 ± 0.4	
Head Height	[T]	$8^{+1.0}_0$		$8^{+1.0}_0$		$9.5^{+1.0}_0$	
Ferrule Inner Diameter	[FA]	Vertical	1400	1700	2050	Vertical	2050
		Weld-Thru	-	1700	2050	Weld-Thru	2050
Ferrule Outer Diameter	[FD]	Vertical	2100	3000	3200	Vertical	3200
		Weld-Thru	-	3000	3200	Weld-Thru	3200
Ferrule Height	[FH]	Vertical	1000	1450	1650	Vertical	1650
		Weld-Thru	-	1800	1650	Weld-Thru	1650

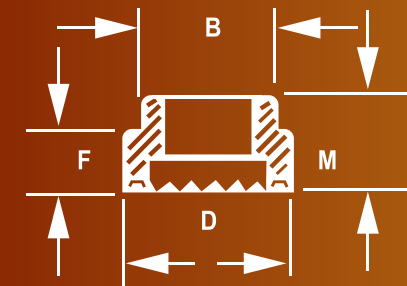
Stud Diameter	d	22		25	
		Max	Min	Max	Min
Stud length (Before)		22.10	21.72	25.40	25.02
Stud Length (after)	[L1]	$L1 \pm 1.6$			
	[L]	3~5mm Shorter Than L1			
Head Diameter	[D]	39.9 ± 0.4		41.3 ± 0.4	
Head Height	[T]	$9.5^{+1.0}_0$		$8^{+1.0}_0$	
Ferrule Inner Diameter	[FA]	Vertical	2350	2650	-
		Weld-Thru	2350	-	-
Ferrule Outer Diameter	[FD]	Vertical	3600	1800	-
		Weld-Thru	4000	-	-
Ferrule Height	[FH]	Vertical	1800	2100	-
		Weld-Thru	2100	-	-



AWS D1.1 Mechanical Property Shear Connectors

Tensile Strength	Yield Strength	Elongation	Reduction Area
Mpa	Mpa	%	%
450	350	15	50

Midland Shear Connector also complies with mechanical requirements as per BS5950, Part3, Section3.1:1990
EN ISO 14555 and DIN EN ISO 13918 are available upon request.



PROPERTIES OF GRADE 10.9 BOLT & NUT (ISO)

			BOLT/STUD/SCREW ISO 898-1 Gr.10.9						NUT ISO 898-2 Gr.1		
BOLT SIZE	PITCH	STRESS AREA MM ²	PROOF STRESS N/MM ²	PROOF LOAD KN	TENSILE STRESS	TORQUE* N-m	HARDNESS HRC	ELONGATION# %	PROOF STRESS N/MM ²	PROOF LOAD KN	HARDNESS HRC
M6	1	20.1	830	16.7	1,040.0	13.4	32-39	9.0	1050	20.9	28.38
M8	1.25	36.6	830	30.4	1,040.0	32.6	32-39	9.0	1060	38.1	28.38
M10	1.50	58.8	830	48.8	1,040.0	65.5	32-39	9.0	1060	61.7	28.38
M12	1.75	84.3	830	70.0	1,040.0	112.7	32-39	9.0	1050	88.5	28.38
M14	2.0	115.0	830	95.5	1,040.0	179.4	32-39	9.0	1050	120.8	28.38
M16	2.0	157.0	830	130.3	1,040.0	279.9	32-39	9.0	1060	166.4	28.38
M18	2.5	192.0	830	159.4	1,040.0	385.1	32-39	9.0	1060	203.5	28.38
M20	2.5	245.0	830	203.4	1,040.0	546.0	32-39	9.0	1060	259.7	28.38
M22	2.5	303.0	830	251.3	1,040.0	742.8	32-39	9.0	1060	321.2	28.38
M24	3.0	353.0	830	293.0	1,040.0	944.0	32-39	9.0	1060	374.2	28.38
M27	3.0	459.0	830	381.0	1,040.0	1318	32-39	9.0	1060	486.5	28.38
M30	3.5	561.0	830	465.6	1,040.0	1875	32-39	9.0	1060	594.7	28.38
M33	3.5	694.0	830	576.0	1,040.0	2552	32-39	9.0	1060	735.6	28.38
M36	4.0	817.0	830	678.1	1,040.0	3277	32-39	9.0	1060	866.0	28.38
M39	4.0	976.0	830	810.1	1,040.0	4241	32-39	9.0	1060	1034.6	28.38
M42	4.5	1120.0	830	929.6	1,040.0	5242	32-39	9.0	1060	1187.2	28.38
M45	4.5	1310.0									
M48	5.0	1470.0									
M52	5.0	1760.0									
M56	5.5	2030.0									
M60	5.5	2360.0									
M64	6.0	2680.0									
M68	6.0	3030.0									
M72	6.0	3460.0									
NOTES:											
Left hand side of '-' is minimum value											
Right hand side of '-' is maximum value											
Eg. 0.5 -0.7 min. is 0.5 and max is 0.7											
Eg. -0.8 max is 0.8 no maximum value											
Eg. 2.0- min is 2.0 no minimum value											
*Torque value based on 75% of proof load and finish as received steel											
	DIMENSIONS		NORMAL HEX					NORMAL HEX			
	MARKINGS		'MF' 'M' '10.9'					'MF' '10'			
	CARBON		0.15-0.35					-0.58			
	MAGANESE		0.7-					V0.30-			
	SULPHUR		-0.035					-0.058			
	SILICON										
	CHROMIUM										
	MOLYDENUM										
	NICKLE										
	VANADIUM										
	BORON		-0.003								
	PHOSPHOROUS		-0.035					-0.046			
	MATERIAL		Carbon with add Eg or Cr Quenched & tempered					Medium carbon or alloy steel			

While every care has been taken in preparation of the information, the company accepts no liability for any loss or damage either direct or consequential.
Please refer original standards for detail

SET SCREW COMPARISION

Diameter		M12 DIN 933	M12 BS 3692	M12 BS 4190	M12 BS EN 4017	M16 DIN 933	M16 BS 3692	M16 BS 4190	M16 BS EN 4017	M20 DIN 933	M20 BS 3692	M20 BS 4190	M20 BS EN 4017	M22 DIN 933	M22 BS 3692	M22 BS 4190	M22 BS EN 4017
Thickness (k)	A ¹	7.32- 7.68	7.82- 8.18	7.55- 8.45	7.32- 7.68	9.82- 10.18	9.82- 10.18	9.55- 10.45	9.82- 10.18	12.28- 12.72	12.785	12.10- 13.90	12.285- 12.715	13.78- 14.22	13.785	13.1- 14.9	13.785- 14.215
	B ²	7.21- 7.79		8.45	7.21- 7.79	9.71- 10.29	10.18	10.45	9.71- 10.29	12.15- 12.85	13.215	13.90	12.15- 12.85	13.65- 14.35	14.215	14.9	14.35
Across Flats (s)	Max	19			18.0	24			24.00	30			30.0	32			34.0
	A ¹ Min	18.67	18.67- 19.0	18.48- 19.00	17.73	23.67	23.67- 24.0	23.16- 24.00	23.67	29.67	29.67- 30.0	29.16- 30.0	29.67	31.61	31.61- 32.0	31.0- 32.0	33.38
	B ² Min	18.48			17.57	23.16			23.16	29.16			29.16	31			33.0
Across Corners (e)	A ¹ Min	21.1	21.10- 21.9	20.88- 21.9	20.03	26.75	26.75- 27.7	26.17- 27.7	26.75	33.53	33.53- 34.6	32.95- 34.6	33.53	35.72	35.72- 36.9	35.03- 36.9	37.72
	B ² Min	20.88			19.85	26.17			26.17	32.95			32.95	35.03			37.29
Min Tensile Load Gr. 8.8		67.4 kN ³				125 kN ³				203 kN				252 kN			
Min Tensile Load Gr. 10.9		87.7 kN				163 kN				255 kN				315 kN			
Diameter		M24 DIN 933	M24 BS 3692	M24 BS 4190	M24 BS EN 4017	M27 DIN 933	M27 BS 3692	M27 BS 4190	M27 BS EN 4017	M30 DIN 933	M30 BS 3692	M30 BS 4190	M30 BS EN 4017	M36 DIN 933	M36 BS 3692	M36 BS 4190	M36 BS EN 4017
Thickness (k)	A ¹	14.78- 15.22	14.785- 15.215	14.10- 15.90	14.780- 15.215	-	16.785- 17.215	16.10- 17.90	-	-	18.74- 19.26	17.95- 20.05	-		22.74- 23.26	21.95- 24.05	-
	B ²	14.65- 15.35			14.65- 15.35	16.65- 17.35	17.215	17.90	16.65- 17.35	18.28- 19.12	19.26	20.05	18.28- 19.12	22.08- 22.92	23.26	24.05	22.08- 22.92
Across Flats (s)	Max	36			36.0	41			41	46			46	55			55.0
	A ¹ Min	35.38	35.38- 36.0	35.0- 36.0	35.28	-	40.38- 41.0	40.0- 41.0	-	-	45.38- 46.0	45.0- 46.0	-	-	54.26- 55.0	53.80- 55.0	-
	B ² Min	35			35.00	40			40	45			45	53.8			53.8
Across Corners (e)	A ¹ Min	39.98	39.98- 41.6	39.55- 41.6	39.98	-	45.63- 47.3	45.20- 47.3	-	-	51.28- 53.1	50.85- 53.1	-	-	61.31- 63.5	60.79- 63.5	-
	B ² Min	39.55			39.55	45.2			45.2	50.85			50.85	60.79			60.79
Min Tensile Load Gr. 8.8		293 kN				381 kN				466 kN				678 kN			
Min Tensile Load Gr. 10.9		367 kN				477 kN				583 kN				850 kN			

- 1) LENGTH(MM)A refers to type/product A, which are products with threads upto M24 and nominal lengths up to and including 10 d or 150 mm whichever is shorter.
- 2) B refers to type/product B, which are products with threads over M24 and nominal lengths over 10 d or 150 mm whichever is shorter.
- 3) For structural bolting 70kN (for M 12) and 130 kN (for M16).

While every care has been taken in preparation of the information, the company accepts no liability for any loss or damage either direct or consequential. Please refer original standards for detail

MECHANICAL PROPERTIES OF STEEL BOLTS, SCREWS AND STUDS AS PER ISO STANDARD

DIMENSIONS:

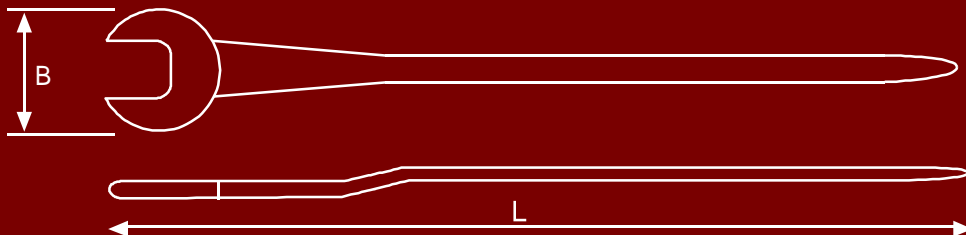
Sub- Clause No.	Mechanical Property		Property Class											
			3.6	4.6	4.8	5.6	5.8	6.8	8.8 ¹⁾ <i>d</i> < 16mm <i>d</i> > 16mm ²⁾		9.8	10.9	12.9	
5.1 and 5.2	Tensile strength, $R_M^{4),5)}$ N/mm ²	nom.	300	400		500		600	800	800	900	1000	1000	
		Min.	330	400	420	500	520	600	800	830	900	1040	1220	
5.3	Vickers hardness, HV, $F \geq 98$ N	Min.	95	120	130	155	160	190	250	255	290	320	385	
		Max.	250						320	335	360	380	435	
5.4	Brinell hardness, HB, $F = 30 D^2$	Min.	90	114	124	147	152	181	238	242	276	304	366	
		Max.	238						304	318	342	361	414	
5.5	Rockwell hardness, HR	Min.	HRB	52	67	71	79	82	89					
			HRC	--	--	--	--	--	--	22	23	28	32	39
		Max.	HRB	99.5										
			HRC	--						32	34	37	39	44
5.6	Surface hardness, HV 0.3	Max.	--						6)					
5.7	Lower yield stress, $ReL^7)$ N/mm ²	nom.	180	240	320	300	400	480	--	--	--	--	--	
		Min.	190	240	340	300	420	480	--	--	--	--	--	
5.8	Proof stress, $Rp0.2$ N/mm ²	nom.	--						640	640	720	900	1080	
		Min.	--						640	660	720	940	1100	
5.9	Stress under proofing load, Sp	Sp/ReL or $Sp/Rp0.2$	0.94	0.94	0.91	0.93	0.90	0.92	0.91	0.91	0.90	0.88	0.88	
		N/mm ²	180	225	310	280	380	440	580	600	650	830	970	
5.10	Elongation after fracture, A	Min.	25	22	14	20	10	8	12	12	10	9	8	
5.11	Strength under wedge loading ⁵⁾	The Values For Full Size Bolts And Screw (not studs) Shall not be smaller than the minimum values for tensile strength shown in 5.2												
5.12	Impact strength, J	Min.	--			25	--		30	30	25	20	15	
5.13	Head soundness	No fracture												
5.14	Maximum height of non-decarburized thread zone, E	mm	--						$\frac{1}{2} H_t$	$\frac{2}{3} H_t$	$\frac{3}{4} H_t$			
	Maximum depth of complete decarburization, G		--						0.015					

- 1) For bolts of property class 8.8 in diameters $d < 16$ mm, there is increased risk of nut shipping in the case of inadvertent over tightening inducing a load in excess of proofing load. Reference to ISO 898-2 is recommended.
- 2) For structural bolting the limits is 12 mm
- 3) Applies only to nominal thread diameters $d < 16$ mm
- 4) Minimum tensile properties apply to products of nominal length $l > 2.5 d$. Minimum hardness applies to products of length $l < 2.5 d$ and other products which cannot be tensile-tested (e.g. due to head configuration).
- 5) For testing of full- size bolts, screw and studs, the load s given in tables 6 to 9 shall be applied.
- 6) Surface hardness shall not be more than 30Vickers points above the measured core hardness on the products when reading of both surface and core are carried out at HV 0.3 For property class 10.9, any increase in hardness at the surface which indicates that the surface hardness exceeds 390 HV is not acceptable.
- 7) In cases where the lower yield stress ReL cannot be determine, it is permissible to measure the proof stress $Rp0.2$
- 8) The surface condition of bolts, screws and nuts should be in accordance with the requirement of the relevant parts of ISO 6157.

While every care has been taken in the preparation of the information in this catalogue, the company accepts no liability of any loss of damage either direct or consequential arising out of use this catalogue. This compilation is for reference only, for detail refers relevant Original Standard Manuals.

Non Pre-load Bolt Assemblies BS EN 15048 Parts 1 & 2

Tightening Method



The advisory service regularly receives requests for a set of torque values in connection with the installation of ordinary bolts. This usually arises because a criterion is required for the project QA procedures in order to ensure that ordinary bolts are 'correctly tightened'.

Section 6.1 in the National Specification for Structural Steelwork for Building Construction 4th edition (NSSS) deals with the installation of ordinary bolted assemblies and clause 6.1.8 states that 'Bolts may be assembled using power tools or shall be fully tightened by hand using appropriate spanners in accordance with BS 2583'. It should be noted that BS 2583 is a spanner standard and does not deal with tightening procedures or torque values.

Traditional British practice has been to hand tighten ordinary bolts using podger spanners. That is, when an average erector fully tightens an ordinary bolt using a podger spanner the bolt is correctly tightened. There is no specified minimum torque values required and this is all that is necessary to ensure that the nut does not come loose in steelwork used in building construction. The commentary on the NSSS 4th edition states 'The intention of 6.1.8. on bolt tightening of ordinary bolts is that the bolts are at least 'spanner tight' whether they be assembled using impact tools or hand spanners to BS 2583'.

The following table appears in the Commentary to the NSSS 4th edition as well as in two of the green book series on Joints in Steel Construction; Simple Connections P 212 and Moment Connections P 207. The torque values given in the table are simply an equivalent to hand tightening using a podger spanner.

Podger Spanner

Bolt Size	B	L	Approximate Torque (Nm)	*Values are indicative of torque achieved when hand tightened using a force of 250N.
M16	60	460	90*	
M20	70	550	110*	
M24	85	640	130*	
M30	100	730	160*	

The SCI recommends that generally, torque on ordinary bolts need not be checked. If torque values are required, then the values shown in the above table may be used. Verification should take place after the installation of all the bolts in a joint at the steel erection stage. It is acceptable to retighten bolts which become loose due to the subsequent tightening of the other bolts in the joint.

However, it is not necessary to retighten or verify the bolts in a joint following the erection of other members, or tightening of the bolts in other joints in the structure. Likewise, it is not required to check the bolts in joints following subsequent erection operations; pouring of concrete or erection of cladding for example. These torque values are irrespective of the bolt grade used and in no way imply that installation by power tools is to be preferred to hand tightening using a podger spanner.

Ordinary bolts particularly those specified to BS 4190, should not be torqued to the values used for preloaded (HSFG) bolts because they have thinner nuts than preloaded bolts. The risk of thread stripping exists if these higher torque values are applied.

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