SYNERGY
ENGINEERING SOLUTION

Producing
Fasteners
that are Industry
acknowledged

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Index

Synergy Engineering Solution

Synergy Engineering Solution was established in the year 2015. We at Synergy Engineering Solution are one of the prominent manufacturers, suppliers, and exporters of Stainless Steel, Carbon Steel, Alloy Steel, Nickel Alloys, Fastners.

We manufacture all these products in various Stainless Steel, Monel, Inconel, Hastelloy, Titanium, Duplex Steel, Alloy Steel, and Alloy 20, etc. We have the most advanced technologies and qualified and efficient personnel for inspection. We are also associated with Government Approved laboratories to ensure that the materials supplied by us are as per required specifications. With multiple quality checks placed at every step of the manufacturing process, we ensure that only high-quality products of international standards reach our dedicated packaging unit.

Our basic objective is to cater to the various needs of our clients and provide them with high-quality products for their project needs. We take pride in satisfactorily meeting the need of a wide array of industries ranging from civil engineering to infrastructure development and automotive industries, oil and gas industry, power generation, petrochemicals, pulp and paper industry, etc.

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Bolt / Screw

Bolts belongs to the family of fastener which has three parts- head, chamfer, and a shaft. Materials and objects are positioned using a variety of bolts. A nut is used along with a bolt to secure the objects at a position. Sometimes bolts are called screws as both of them share similar characteristics and differentiating them is complex. In simple terms, a material is fixed together by passing a bolt through it whereas screws fit directly.

Types of Bolt / Screw : Hex Head, Square Head, Socket Head Cap Screw, T Bolt, Flange Bolt, J Bolt, L Bolt, Carriage Bolt, Eye Bolt, Custom Made Bolt, Pan Head Screw, Self Tapping Screw, Round Head Screw, CSK Screws, Grub Screw, Threaded Rod, Studs, Coach Screw, Plow Bolt, Step Bolt, Elevator Bolt, Anchor Bolts, Button Head.

Specification of Bolt/Screw:

Dimension	:	ASTM,DIN, BS,GB, IS and all International Standards
Length	:	10mm upto 500mm & 3/8" upto 20"
Bolts Size	:	M6 upto M72 OR 1/4" upto 3" /Custom Size
Screw Size	:	M02 upto M24/ Custom Size
Heat Treatment	:	Annealing, Stress Relieving, Case Hardening, Quenching and Tempering.

Grades

Stainless Steel	Inconel	Titanium	Alloy Steel
304 / 304L / B8, 310, 316 316L, B8M, 316Ti, 317L, 321/B8T, 347/B8C, 904L, 410, B6	600, 601, 625, 800, 825	Grade 2, Grade 5	HT 8.8, HT 10.9, HT 12.9, ASTM A194 B7, ASTM A194 B16
	Hastelloy	**Duplex Steel**	
	C276, C22	S31803, S32205, S32750, S32760	
	Monel	**Other**	
	400, K500	Alloy 20, SS 17-4PH/ 15-5PH	

Nut

A nut is a type of fastener with a threaded hole. Nuts are almost always used in conjunction with a mating bolt to fasten multiple parts together. The two partners are kept together by a combination of their threads' friction (with slight elastic deformation), a slight stretching of the bolt, and compression of the parts to be held together.

Types of Nut: Hex Nut, Heavy Hex Nut, Lock Nut, Nylock Nut, Weld Nut, Dome Nut, Flange Nut, Square Nut, Eye Nut, T-Nut, Break Away Nut, Shear Nut, Hex Machine Nuts Small Pattern, Keps-K Lock Nut, Knurled Thumb Nut, Nylon Hex Jam Nut, Nylon Insert Lock Nut, Cap Nut, Castle Nut, Hex Finish Nut, Hex Jam Nut, Hex Machine Nut, Structural Heavy Hex Nut, Coupling Nut, Flange Serrated Nut, Prevailing Torque Lock (Stover) Nut, Slotted Hex Nut, Tri-Groove Nut, Wing Nut.

Specification of Nut:

Dimension	:	ASTM, DIN, BS, GB, IS and all International Standards
Size	:	M3 to M75 OR 1/8" to 3"
Heat Treatment	:	Annealing, Stress Relieving, Case Hardening, Quenching and Tempering.

Grades

Stainless Steel	Inconel	Titanium	Alloy Steel
304 / 304L / B8, 310, 316 316L, B8M, 316Ti, 317L, 321/B8T, 347/B8C, 904L, 410/B6	600, 601, 625, 800, 825	Grade 2, Grade 5	HT 8.8, HT 10.9, HT 12.9, ASTM 193 2H/2HM, ASTM A194 (Gr.4, Gr.6, Gr.7/7M)

Hastelloy	Duplex Steel
C276, C22	S31803, S32205, S32750, S32760

Monel	Other
400, K500	Alloy 20, SS 17-4PH/ 15-5PH

Washer

A washer is a thin plate (typically disk-shaped, but sometimes square) with a hole (typically in the middle) that is normally used to distribute the load of a threaded fastener, such as a bolt or nut. Other uses are as a spacer, spring (Belleville washer, wave washer), wear pad, preload indicating device, locking device, and to reduce vibration (rubber washer). Washers often have an outer diameter (OD) about twice their inner diameter (ID), but this can vary quite widely.

Types of Washer: Plain Washer, Spring Washer, Tooth Washer, Tapper Washer, Tab Washer, Star Washer, Bonded sealing washers, Lock washers external tooth, Lock washers internal tooth, Structural washers F436, Fender washer, Lock washers, spring lock washer, Square dock washer, spherical washer, USS flat washers, SAE flat washers, High collar lock washer, Finishing washers, Dock washers, Belleville washers, Wave washers.

Specification of Washer:

Dimension	:	ASTM, DIN, BS, GB, IS and all International Standards
Size	:	M3 to M75 OR 1/8" to 3"
Heat Treatment	:	Annealing, Stress Relieving, Case Hardening, Quenching and Tempering.

Grades

Stainless Steel	Inconel	Titanium
304 / 304L, 310, 316 316L, 316Ti, 317L, 321, 347, 904L, 410	600, 601, 625, 800, 825	Grade 2, Grade 5
	Hastelloy	**Duplex Steel**
	C276, C22	S31803, S32205, S32750, S32760
	Monel	**Other**
	400, K500	Alloy 20, SS 17-4PH/ 15-5PH

Socket Screw

A socket cap screw, also known as a socket head capscrew, socket screw, or Allen bolt, is a type of cap screw with a cylindrical head and hexagonal drive hole. The term socket head capscrew typically refers to a type of threaded fastener whose head diameter is nominally 1.5 times that of the screw shank (major) diameter, with a head height equal to the shank diameter.

Types of Socket Screw: Allen Bolt/Socket Head Cap Screw, Allen CSK Bolt, Grub Screw/Socket Head Set Screw, Button Head Screw, Socket Low Head Cap Screw, Socket Head Shoulder Screw, Flange Button Head Socket Screw, Flat Head Cap Screw, Metric Socket Head Cap Screw, Fully Threaded Socket Head Cap Screw, Partial Threaded Socket Head Cap Screw, Socket Head Cap Screw, Countersunk Socket Head Screw, Button Head Socket Screw, Imperial Socket Head Cap Screw.

Specification of Socket Screw:

Dimension	:	ASTM, DIN, BS, GB, IS and all International Standards
Length	:	3mm to 200mm
Socket Screw Size	:	M1.6 to M64 | Custom Sizes
Heat Treatment	:	Annealing, Stress Relieving, Case Hardening, Quenching and Tempering.

Grades

Stainless Steel	Inconel	Titanium	Alloy Steel
304 /304L / B8, 310, 316 / 316L / B8M, 316Ti, 317L, 321 / B8T, 347 / B8C, 904L, 410 / B6	600, 601, 625, 800, 825	Grade 2, Grade 5	HT 8.8, HT 10.9, HT 12.9
	Hastelloy	**Duplex Steel**	
	C276, C22	S31803, S32205, S32750, S32760	
	Monel	**Other**	
	400, K500	Alloy 20, SS 17-4PH / 15-5PH	

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Machine Screw

A machine screw is generally a smaller fastener (less than 1/4 inch (6.35 mm) in diameter) threaded the entire length of its shank that usually has a recessed drive type. Machine screws are also made with socket heads, in which case they may be referred to as socket head machine screws.

Types of Machine Screw: Pan, CSK, Cheese Head/Round Head Slotted Screw, CSK Philips, Slotted round head, Combo round head, One way round head, Star pin-in button head, Star drive pan head, Spanner pan head, Phillips flat head, Slotted flat head, Star drive flat head type F (trailer screws), Star drive flat head, Spanner flat head, Phillips oval head, Slotted oval head, Spanner oval head, Phillips truss head, Slotted truss head, Combo truss head, Star drive truss head, Star pin-in flat head, Star drive pan head type F (trailer screws), Slotted hex washer head type F Screws.

Specification of Machine Screw:

Dimension	:	ASTM, DIN, BS, GB, IS and all International Standards
Length	:	3mm to 100mm
Machine Screw Size	:	M1.6 to M64 | Custom Sizes
Test pressure	:	2.4 to 3 Mpa
Heat Treatment	:	Annealing, Stress Relieving, Case Hardening, Quenching and Tempering.

Grades

Stainless Steel	Inconel	Titanium	Alloy Steel
304 /304L, 316 / 316L, 321	600, 601, 625, 800, 825	Grade 2, Grade 5	HT 4.6
	Hastelloy	**Duplex Steel**	
	C276, C22	S31803, S32205, S32750, S32760	
	Monel	**Other**	
	400, K500	Alloy 20, SS 17-4PH / 15-5PH	

Self Tapping Screw

A self-tapping screw is a screw that can tap its own hole as it is driven into the material. More narrowly, self-tapping is used only to describe a specific type of thread-cutting screw intended to produce a thread in relatively soft material or sheet materials, excluding wood screws. Other specific types of self-tapping screw include self-drilling screws and thread rolling screws.

Types of Self Tapping Screw: Pan Slotted, CSK Slotted, Pan Philips, CSK Philips, Wood Screw, Hex Head Self-Tapping Screw, Socket Self-Tapping Screw, Wafer Head Self-Tapping Screw, Countersunk Self-Drilling Screw, Flat Head Self-Drilling Screw, Allen Head Self-Tapping Screw, Dome Head Self-Tapping Screw, Pan Head Self-Tapping Screw, Flange Head Self-Tapping Screw, Socket Head Self-Tapping Screw, Bugle Head Self-Tapping Screw, Button Head Self-Tapping Screw, Pancake Head Self-Tapping Screw, Square Head Self-Tapping Screw, Truss Head Self-Tapping Screw.

Specification of Self Tapping Screw:

Dimension	:	ASTM, DIN, BS, GB, IS and all International Standards
Length	:	3mm to 200mm
Socket Screw Size	:	M1.6 to M64 | Custom Sizes
Heat Treatment	:	Annealing, Stress Relieving, Case Hardening, Quenching and Tempering.

Grades

Stainless Steel	Inconel	Titanium	Alloy Steel
304 /304L, 316 / 316L, 321	600, 601, 625, 800, 825	Grade 2, Grade 5	HT 4.6
	Hastelloy	**Duplex Steel**	
	C276, C22	S31803, S32205, S32750, S32760	
	Monel	**Other**	
	400, K500	Alloy 20, SS 17-4PH / 15-5PH	

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Threaded Rods

A threaded rod, also known as a stud, is a relatively long rod that is threaded on both ends; the thread may extend along the complete length of the rod. They are designed to be used in tension. Threaded rod in bar stock form is often called all-thread.

Types of Threaded Rods: Zinc Plated, Plain, Hot Dip Galv. & Yellow Zinc, Double End Threaded Rods, Fine Pitch Threaded Rods, Metric Threaded Rods, All thread Rods, Heavy Threaded Rods, Acme Threaded Rods, Fully Threaded Rods, Partially Threaded Rods, Tap End Threaded Rods, Trapezoidal Threaded Rods, Coil Rod, Threaded Bars.

Specification of Threaded Rods:

Dimension	:	ASTM, DIN, BS, GB, IS and all International Standards
Size	:	M6 to M52 & 1/4" to 2"
Length	:	1000mm to 3000mm & 1feet to 12feet
Standard	:	DIN 975, DIN 976, DIN 938, DIN 939, DIN 940, DIN 835 etc.
Finish	:	Zinc Plated, Plain, Hot Dip Galv. & Yellow Zinc

Grades

Stainless Steel	Inconel	Titanium	Alloy Steel
304 /304L / B8, 310, 316 / 316L, 316Ti, 317L, 321 / B8T, 347 / B8C, 904L, 410 / B6	600, 601, 625, 800, 825	Grade 2, Grade 5	HT 8.8, HT 10.9, HT 12.9, ASTM 194 B7/ ASTM A193 2H, ASTM A194 B16/ ASTM A194 Gr. 4
	Hastelloy	Duplex Steel	
	C276, C22	S31803, S32205, S32750, S32760	
	Monel	Other	
	400, K500	Alloy 20, SS 17-4PH / 15-5PH	

Anchor Fasteners

Anchor bolts are used to connect structural and non-structural elements to concrete. The connection can be made by a variety of different components: anchor bolts (also named fasteners), steel plates, or stiffeners. Anchor bolts transfer different types of load: tension forces and shear forces.

Types of Anchor Fasteners: Hammer Drive, Lag Screw Shields, Toggle Wings, Plastic, Wedge, Flat Head Sleeve, Acorn Nut Sleeve, Hex Nut Sleeve, Drop-In, Hollow Wall, Hollow Wall Drive, Hammer Drive Mushroom Head, Hammer Drive Flat Head, Concrete Screws, Toggle Wing Bolts

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Specification of Anchor Fasteners:

Dimension	:	ASTM, DIN, BS, GB, IS and all International Standards
Size	:	M6 to M60
Diameters	:	1/4" – 1-1/4"
Thread Types	:	METRIC, BSW, BSF, UNC, UNF or as required
Tolerance	:	+/-0.01mm to +/-0.05mm

Grades

Stainless Steel	Inconel	Titanium	Alloy Steel
304 /304L, 316 / 316L, 321	600, 601, 625, 800, 825	Grade 2, Grade 5	HT 8.8, HT 10.9, HT 12.9,

Hastelloy	Duplex Steel
C276, C22	S31803, S32205, S32750, S32760

Monel	Other
400, K500	Alloy 20, SS 17-4PH / 15-5PH

Forgings

Forging is a manufacturing process involving the shaping of metal using localized compressive forces. When it comes to forging, there are four main ways to forge a part. Those four are impression die forging, cold forging, open die forging and seamless rolled ring forging.

Types of Forgings: Chain Link, D Shackle, Bow Shackle, Single Jack Chain, Lifting Chain, Double Loop Chain, Special Bow Shackle w/ No-Snag Pin, Open Die Forging, Closed Die Forging, Seamless Rolled Ring, Crane Hooks, Step Shafts, Forged Hollow Bars, Anchor Shackle, Safety Chain Shackle, Bolt Chain Shackle, Forged Flat Bars, Forged Circles, Forged Circular Plates, Joining Shackle, Forged Discs, Mandrel Rings, Shafting & Bars, Long Link Chain.

Specification of Forgings:

Dimension	:	ASTM, DIN, BS, GB, IS and all International Standards
Forged Between	:	2300/1700°F (1260/930°C) and air cooled
Severe Reductions	:	Ingot breakdown, Roll forging, Drawing, Blocking and Backward extrusion - 2300°F (1260°C).
Moderate Reductions	:	Finish forging and upsetting- 2200°F (1200°C).
Slight Reductions	:	Coining, restriking and end upsetting- 2050°F (1120°).

Grades

Stainless Steel	Inconel	Titanium	SAE 8620
304 /304L, 310, 316 / 316L, 316Ti, 317L, 321, 347, 904L, 410	600, 601, 625, 800, 825	Grade 2, Grade 5	SAE 8620
	Hastelloy	**Duplex Steel**	
	C276, C22	S31803, S32205, S32750, S32760	
	Monel	**Other**	
	400, K500	Alloy 20, SS 17-4PH / 15-5PH	

Anchors

Anchors get their name because they serve a similar function to a boat's anchor, which embeds itself in the seabed to keep a ship from moving. Generally, people use these fasteners to connect something to a material like drywall or concrete. They embed themselves in the material and hold the object you're affixing in place.

Types of Anchors: Y Anchor, U Anchor, V Anchor, Crook Anchor, Sleeve Anchor, Wedge Anchor, U Hooks, Resin Anchor Bolt, Drop-In Anchors, Hollow Wall Anchors, Hollow Wall Drive Anchors, Hammer Drive Mushroom Head Anchors, Hammer Drive Anchors, Lag Screw Shields, Toggle Wings, Plastic Anchors, Flat Head Sleeve Anchors, Acorn Nut Sleeve Anchors, Hex Nut Sleeve Anchors, Hammer Drive Flat Head Anchors, Concrete Screws, Toggle Wing Bolts.

Specification of Anchors:

Dimension	:	ASTM, DIN, BS, GB, IS and all International Standards
Thickness	:	2mm to 12mm
Heat Treatment	:	Annealing, Stress Relieving, Case Hardening, Quenching and Tempering.

Grades

Stainless Steel	Inconel	Titanium
304 /304L, 310, 316 / 316L, 316Ti, 317L, 321, 347, 904L, 410	600, 601, 625, 800, 825	Grade 2, Grade 5
	Hastelloy	**Duplex Steel**
	C276, C22	S31803, S32205, S32750, S32760
	Monel	**Other**
	400, K500	Alloy 20, SS 17-4PH / 15-5PH

ASTM A193 SPECIFICATION

ASTM A193 Specification for high tensile alloy and stainless steel bolts including most popular grade B5, B6, B7, B7M, B8, B8M, B8T, B16, etc.

ASTM A193 specification covers high tensile alloy and stainless steel fasteners for pressure vessels,valves, flanges, and fittings for high temperature or high pressure service, or other special purposebolting applications. Several grades are covered, including ferritic steels and austenitic stainlesssteels designated B5, B6, B7, B8, B8M, etc.Selection will depend upon design, service conditions,mechanical properties, and high temperature characteristics. This specification is expressed in bothinch-pound unitsand in SI units; however, unless the purchase order or contract specifies theapplicable A193M specification designation (SI units), the inch-pound units shall apply. (For Metric Units, please visit *ASTM A193M Specification*)

Bolt Grades

BOLT GRADE	RAW MATERIAL
B5	5% Chromium Ferritic Steel
B6	13% Chromium Ferritic Steel
B7	Chromium Molybdenum Alloy Steel, Quenched & Tempered
B7M	Chromium Molybdenum Alloy Steel, Quenched & Tempered
B16	Chromium-molybdenum-vanadium Alloy Steel, Quenched & Tempered
B8	AISI 304 Stainless Steel, Carbide Solution Treated
BB Class 2	AISI 304 Stainless Steel, Carbide Solution Treated and Strain Hardened
B8M	AISI 316 Stainless Steel, Carbide Solution Treated
B8M Class 2	AISI 316 Stainless Steel, Carbide Solution Treated and Strain Hardened
B8T	AISI 321 Stainless Steel, Carbide Solution Treated
B8T Class 2	AISI 321 Stainless Steel, Carbide Solution Treated and Strain Hardened

Recommended Nuts & Washers

Bolt Specification	Nut Specification	Washer Specification
ASTM A193 Grade B5	ASTM A194 Grade 3	ASTM A36 Mild Steel
ASTM A193 Grade B6	ASTM A194 Grade 6	ASTM A240 Grade 410
ASTM A193 Grade B7	ASTM A194 Grade 2H	ASTM F436 Type 1
ASTM A193 Grade B7M	ASTM A194 Grade 2HM	ASTM F436 Type 1
ASTM A193 Grade B16	ASTM A194 Grade 16	ASTM F436 Type 1
ASTM A193 Grade B8	ASTM A194 Grade 8	ASTM A240 Grade 304
ASTM A193 Grade B8M	ASTM A194 Grade 8M	ASTM A240 Grade 316
ASTM A193 Grade B8T	ASTM A194 Grade 8T	ASTM A240 Grade 321

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CHEMICAL PROPERTIES OF BOLTS/SCREWS/STUDS TO ASTM A193 - A193 M-95

Grade/Den SYMBOL/ MARKING	CHEMICAL PROPERTIES (COMPOSITION, PERCENT)												
	C	MN	P	S	SI	CR	NI	MO	V	CO+TI	N	CU	EQUIVALENT GRADE
A. FERRITIC STEELS													
B5 B5	0.10 MIN.	1.00 MAX.	0.040 MAX.	0.030 MAX.	1.00 MAX.	4.00- 6.00	—	0.40- 0.65	—	—	—	—	AISI 501
B6 B6	0.15 MIN.	1.00 MAX.	0.040 MAX.	0.030 MAX.	1.00 MAX.	11.50- 13.50	—	—	—	—	—	—	AISI 410 12Cr13
B6X B6X	0.15 MIN.	1.00 MAX.	0.040 MAX.	0.030 MAX.	1.00 MAX.	11.50- 13.50	—	—	—	—	—	—	AISI 410 12Cr13
B7 B7	0.37- 0.49	0.65- 1.00	0.35- MAX	0.40- MAX	0.15- 0.35	0.75- 1.20	—	0.15- 0.25	—	—	—	—	AISI 4140/ En-19
B7 M B7 M	0.37- 0.49	0.65- 1.00	0.35- MAX	0.40- MAX	0.15- 0.35	0.75- 1.20	—	0.15- 0.25	—	—	—	—	AISI 4140/ En-19, 19A
B16 B16	0.36- 0.47	0.45- 0.70	0.35- MAX	0.40- MAX	0.15- 0.35	0.80- 1.15	—	0.50- 0.65	0.25- 0.35	—	—	—	45CrMoV67 TO DIN SP.
B. AUSTENITIC STEELS													
B8/CLASS 1 B8	0.08 MAX.	2.00 MAX.	0.050 MAX.	0.030 MAX.	1.00 MAX.	18.00- 20.00	8.00- 10.50	—	—	—	—	—	AISI 304/ O4Cr18Ni10
B8A/CLASS 1A B8A	0.08 MAX.	2.00 MAX.	0.050 MAX.	0.030 MAX.	1.00 MAX.	18.00- 20.00	8.00- 10.50	—	—	—	—	—	AISI 304/ O4Cr18Ni10
B8C/CLASS 1 B8C	0.08 MAX.	2.00 MAX.	0.045 MAX.	0.030 MAX.	1.00 MAX.	17.00- 19.00	9.00- 13.00	—	—	10XC MIN.	—	—	AISI 347
B8CA/CLASS 1A B8C	0.08 MAX.	2.00 MAX.	0.045 MAX.	0.030 MAX.	1.00 MAX.	17.00- 19.00	9.00- 13.00	—	—	10XC MIN.	—	—	AISI 347
B8M/CLASS 1 B8M	0.08 MAX.	2.00 MAX.	0.045 MAX.	0.030 MAX.	1.00 MAX.	16.00- 18.00	10.00- 14.00	2.00- 3.00	—	—	—	—	AISI 316/ 04Cr17Ni12Mo2
B8MA/CLASS 1A B8D	0.08 MAX.	2.00 MAX.	0.045 MAX.	0.030 MAX.	1.00 MAX.	16.00- 18.00	10.00- 14.00	2.00- 3.00	—	—	—	—	AISI 347 04Cr17Ni12Mo2
B8M2/CLASS 2B B9G	0.08 MAX.	2.00 MAX.	0.045 MAX.	0.030 MAX.	1.00 MAX.	16.00- 18.00	10.00- 14.00	2.00- 3.00	—	—	—	—	AISI 347 04Cr17Ni12Mo2
B8M3/CLASS 2C B9H	0.08 MAX.	2.00 MAX.	0.045 MAX.	0.030 MAX.	1.00 MAX.	16.00- 18.00	10.00- 14.00	2.00- 3.00	—	—	—	—	AISI 347 04Cr17Ni12Mo2
B8N/CLASS 1B B8N	0.08 MAX.	2.00 MAX.	0.045 MAX.	0.030 MAX.	1.00 MAX.	18.00- 20.00	8.00- 10.50	—	—	—	0.10- 0.16	—	AISI 304N 04Cr17Ni12Mo2
B8NA/CLASS 1A B8V	0.08 MAX.	2.00 MAX.	0.045 MAX.	0.030 MAX.	1.00 MAX.	18.00- 20.00	8.00- 10.00	—	—	—	0.10- 0.16	—	AISI 347 04Cr17Ni12Mo2
B8MNA/CLASS 1B B8Y	0.08 MAX.	2.00 MAX.	0.045 MAX.	0.030 MAX.	1.00 MAX.	16.00- 18.00	10.00- 14.00	2.00- 3.00	—	—	0.10- 0.16	—	AISI 347 04Cr17Ni12Mo2
B8MNA/CLASS 1 B8Y	0.08 MAX.	2.00 MAX.	0.045 MAX.	0.030 MAX.	1.00 MAX.	16.00- 18.00	10.00- 14.00	—	—	—	0.10- 0.16	—	AISI 316
B8T/CLASS 2 B8T	0.08 MAX.	2.00 MAX.	0.045 MAX.	0.030 MAX.	1.00 MAX.	17.00- 19.00	9.00- 12.00	—	—	5XC MIN.	—	—	AISI 321 04Cr17Ni12Mo20
B8TA/CLASS 1A B8J	0.08 MAX.	2.00 MAX.	0.045 MAX.	0.030 MAX.	1.00 MAX.	17.00- 19.00	9.00- 12.00	—	—	5XC MIN.	—	—	AISI 321 04Cr17Ni12Mo20

SYNERGY
ENGINEERING SOLUTION

MECHANICAL PROPERTIES OF BOLTS/SCREWS/STUDS TO ASTM A193 - A193 M-95

Grade/Den SYMBOL/ MARKING	MECHANICAL PROPERTIES (FOR DIAMETER 65MM AND UNDER						
	UTS, MIN. ksi (MPa)	Y.S. MIN. 0.2% OFFSET ksi (MPa)	ELONG. % MIN.	RED. OF AREA %, MIN.	HARDNESS MAX.	MIN. TEMPER TEMP°C	HEAT TREATMENT DETAILS
A. FERRITIC STEELS							
B5 B5	100 (690)	80 (550)	16	50	14.20 HRC	593	H & T
B6 B6	110 (760)	85 (585)	15	50	18-25 HRC	593	H & T
B6X B6X	90 (620)	70 (485)	16	50	26 HRC	593	H & T
B7 B7	125 (860)	105 (720)	16	50	23-22 HRC	593	H & T
B7 M B7 M	125 (860)	105 (720)	16	50	14-21 HRC 100% TEST	62C	H & T
B16 B16	125 (860)	105 (725)	16	50	23-32 HRC	650	H & T
B. AUSTENITIC STEELS							
B8/CLASS 1 B8	75 (515)	30 (205)	30	50	16 HRC MAX.	CARBIDE SOLUTION TREATED	
B8A/CLASS 1A B8A	75 (515)	30 (205)	30	50	192 BHN MAX.	CARBIDE SOLUTION TREATED IN FINISHED CONDITION	
B8C/CLASS 1 B8C	75 (515)	30 (205)	30	50	18 HRC	CARBIDE SOLUTION MAX TREATED	
B8CA/CLASS 1A B8C	75 (515)	30 (205)	30	50	192 BHN MAX.	CARBIDE SOLUTION TREATED IN FINISHED CONDITION	
B8M/CLASS 1 B8M	75 (515)	30 (205)	30	50	18 HRC MAX.	CARBIDE SOLUTION TREATED	
B8MA/CLASS 1A B8D	75 (515)	30 (205)	30	50	192 BHN MAX.	CARBIDE SOLUTION TREATED IN FINISHED CONDITION	
B8M2/CLASS 2B B9G	75 (515)	30 (205)	30	40	35 HRC MAX.	CARBIDE SOLUTION TREATED IN FINISHED CONDITION	
B8M3/CLASS 2C B9H	75 (515)	30 (205)	30	60	35 HRC MAX.	CARBIDE SOLUTION TREATED & STRAIN HARDENED	
B8N/CLASS 1B B8N	80 (550)	35 (240)	30	40	18 HRC MAX.	CARBIDE SOLUTION TREATED	
B8NA/CLASS 1A B8V	75 (515)	30 (205)	30	50	192 BHN MAX.	CARBIDE SOLUTION TREATED IN FINISHED CONDITION	
B8MNA/CLASS 1B B8Y	75 (515)	30 (240)	30	40	18 HRC MAX.	CARBIDE SOLUTION TREATED	
B8MNA/CLASS 1 B8Y	75 (515)	30 (205)	30	50	192 BHN MAX.	CARBIDE SOLUTION TREATED IN FINISHED CONDITION	
B8T/CLASS 2 B8T	125 (860)	100 (690)	12	35	35 BHN MAX.	CARBIDE SOLUTION TREATED & STRAIN HARDENED	
B8TA/CLASS 1A B8J	75 (515)	30 (205)	30	50	192 BHN MAX.	CARBIDE SOLUTION TREATED IN FINISHED CONDITION	

SYNERGY
ENGINEERING SOLUTION

DIN, ISO, BS for Fasteners

DIN STANDARD	BRITISH STANDARD	ISO STANDARD	TYPE OF FASTENER
DIN127	BS4464B	N/A	Rectangular sect. single coil spring washer
DIN439/936	BS3692	ISO4035	Hexagon Lock Nut
DIN6797A	N/A	N/A	Toothed lock washer – external
DIN6797J	N/A	N/A	Toothed lock washer – internal
DIN6923	N/A	ISO4161	Hexagon Flange Nut
DIN7971C	BS4174AB	ISO1481C	Self tapping pan slotted pointed
DIN7971F	BS4174 B	ISO1481F	Self tapping pan slotted blunt
DIN7972C	BS4174AB	ISO1482C	Self tapping csk slotted pointed
DIN7972F	BS4174 B	ISO1482F	Self tapping csk slotted blunt
DIN7980	BS4464A	N/A	Square sect. single coil spring washer
DIN7981CH	N/A	ISO7049CH	Self tapping pan Phillips pointed
DIN7981CZ	BS4174 AB	ISO7049CZ	Self tapping pan recess pointed
DIN7981FH	N/A	ISO7049FH	Self tapping pan phillips blunt
DIN7981FZ	BS4174 B	ISO7049FZ	Self tapping pan recess blunt
DIN7982CH	N/A	ISO7050CH	Self tapping csk Phillips pointed
DIN7982CZ	BS4174 AB	ISO7050CZ	Self tapping csk recess pointed
DIN7982FZ	BS4174 B	ISO7050FZ	Self tapping csk recess blunt
DIN7983C	BS4174AB	ISO1483C	Self tapping raised csk slotted pointed
DIN7983CH	N/A	ISO7051CH	Self tapping raised csk Phillips pointed
DIN7983CZ	BS4174 AB	ISO7051CZ	Self tapping raised csk recess pointed
DIN7985	BS4183	ISO7045	Pan recess machine screw
DIN7991	BS4168	ISO10642	Hex Socket Countersunk
DIN84	BS4183	ISO1207	Cheese Slotted machine screw
DIN84	BS4183	ISO1580	Pan slotted machine screw
DIN912	BS4168	ISO4762	Hex Socket Cap
DIN913	BS EN ISO4026	ISO4026	Hex Socket Setscrew Flat point
DIN914	BS EN ISO4027	ISO4027	Hex Socket Setscrew Cone point
DIN915	BS EN ISO4028	ISO4028	Hex Socket Setscrew Dog point
DIN916	BS EN ISO4029	ISO4029	Hex Socket Setscrew Plain Cup point
DIN928	N/A	N/A	Square Weld Nut
DIN929	N/A	N/A	Hexagon Weld Nut
DIN931	BS3692	ISO4014	Hexagon head bolt - part threaded
DIN933	BS3692	ISO4017	Hexagon head setscrew – fully threaded
DIN934	BS3692	ISO4032	Hexagon Full Nut
DIN963	BS4183	ISO2009	Countersunk slotted machine screw
DIN964	BS4183	ISO2010	Raised Csk Slotted machine screw
DIN965	BS4183	ISO7046	Countersunk recess machine screw
DIN966	BS4183	ISO7047	Raised Csk Recess machine screw
N/A	BS4168	ISO7380	Hex Socket Button
N/A	BS4174 AB	N/A	Self tapping Flange recess pointed
N/A	BS4174 B	N/A	Self tapping Flange recess blunt

SYNERGY
ENGINEERING SOLUTION

IS 1367 (Part 3) : 2002 ISO 898-1: 1999

Is1367 Hight Tensile Details

Property Class	Material and Treatment	hemical composition limits (check analysis) % (mm)					Tempering temparature
		C		P	S	B[a]	°C
		min	max	max	max	max	min
3.6[b]	Carbon Steel	–	0,20	0,05	0,06	0,003	
4.6[b]		–	0,55	0,05	0,06	0,003	
4.8[b]							
5.6		0,13	0,55	0,05	0,06	0,003	
5.8[b]		–	0,55	0,05	0,06		
6.8[b]							
8.8[c]	Carbon steel with additives (e. g. B, Mn or Cr) Quenched and tempered	0,15[d]	0,40	0,035	0,035	0,003	425
	Carbon steel quenched and tempered	0,25	0,55	0,035	0,035		
9.8[c]	Carbon steel with additives (e. g. B, Mn or Cr) Quenched and tempered	0,15[d]	0,35	0,035	0,035	0,003	425
	Carbon steel quenched and tempered	0,25	0,55	0,035	0,035		
10.9[ef]	Carbon steel with additives (e. g. B, Mn or Cr) Quenched and tempered	0,15[d]	0,35	0,035	0,035	0,003	340
10.9[f]	Carbon steel quenched and tempered	0,25	0,55	0,035	0,035	0,003	425
	Carbon steel with additives (e. g. B, Mn or Cr) Quenched and tempered	0,20[d]	0,55	0,035	0,035		
	Alloy steel quenched and tempered g	0,20	0,55	0,035	0,035		
12.9[fhi]	Alloy steel quenched and tempered g	0,28	0,50	0,035	0,035	0,003	380

A) Boron content can reach 0,005% provided that non-effective boron is controlled by addition of titanium and/or Aluminium.
B) Free cutting steel is allowed for these property classes with the following maximum sulfur, phosphorus and lead contents: sulfur 0,34%; phosphorus 0,11%; lead 0,35%.
C) For nominal diameters above 20mm the steels specified for property classe 10.9 may be necessary in order to achieve sufficient hardenability.
D) In case of plain carbon boron steel with a carbon content below 0,25% (ladle analysis), the minimum manganese content shall be 0,6% for property class 8.8 and 0,7% for 9.8, 10.9 and 10.9.
E) Products shall be additionally identified by underlining the symbol of the property class (see clause 9). All properties of 10.9 as specified in table 3 shall be met by 10.9, however, its lower tempering temperature gives it different stress relaxation characteristics at elevated temperatures (see annex A).
F) For the material of these property classes, it is intended that there should be a sufficient hardenability to insure a structure consisting of approximately 90% martensite in the core of the threaded sections for the fasteners in the “as-hardened” condition before tempering.
G) This alloy steel shall contain at least one of the following elements in the minimum quantity given: chromium 0,30%, molybdenum 0,20%, vanadium 0,10%. Where elements are specified in combinations of two, three of four and have alloy contents less than those given above, the limit value to be applied for class determination is 70% of the sum of the individual limit values shown above for the two, three or four elements concerned.
H) A metallographically detectable white phosphorous enriched layer is not permitted for property class 12.9 on surfaces subjected to tensile stress.
I) The chemical composition and tempering temperature are under investigation.

SYNERGY
ENGINEERING SOLUTION

IS 1367 (Part 3) : 2002 ISO 898-1: 1999
Mechanical and physical properties of bolts, screws and studs

Sub-clause number	Mechanical and physical property		Property Class										
			3.6	4.6	4.8	5.6	5.8	6.8	8.8[a] d ≤ 16[c] mm	8.8[a] d ≥ 16[c] mm	9.8[b]	10.9	12.9
5.1	Nominal tensile strength, $R_{m.\,nom}$	N/mm^2	300	400		500		600	800	800	900	1000	1200
5.2	Minimum tensile strength, $R_{m.\,min}$[de]	N/mm^2	330	400	420	500	520	600	800	830	900	1040	1220
5.3	Vickers hardness, HV F > 98 N	min	95	120	130	155	160	190	250	255	290	320	385
		max	220[f]					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	209[f]					238	304	318	342	361	414
5.5	Rockwell hardness, HR	min HRB	52	67	71	79	82	89	-	-	-	-	-
		max HRC	-	-	-	-	-	-	22	23	28	32	39
		min HRB	95.0[f]					99.5	-	-	-	-	-
		min HRC	-					-	32	34	37	39	44
5.6	Surface hardness, HV 0,3	max	-						g				
5.7	Lower yield stress R_{el}[h], N/mm^2	nom	180	240	320	300	400	480	-	-	-	-	-
		min	190	240	340	300	420	480	-	-	-	-	-
5.8	Stress at 0.2% non-proportional elongation $R_{p0,2}$[i], N/mm2	nom	-					-	640	640	720	900	1080
		min	-					-	640	660	720	940	1100
5.9	Stress at proof load, S_p	S_p/R_{eL} or $S_p/R_{p0,2}$	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	Breaking torque, M_B	Nm min	-						See ISO 898-7				
5.11	Percent elongation after fracture, A	min	25	22	-	20	-	-	12	12	10	9	8
5.12	Reduction area after fracture, Z	% min	-						52		48	48	44
5.13	Strength under wedge loading[e]		The values for full size bolts and screws (no studs) shall not be smaller than the minimum values for tensile strength shown in 5.2										
5.14	Impact strength, KU	J min	-			25	-		30	30	25	20	15
5.15	Head soundness		No fracture										
5.16	Minimum height of non-decarburized thread zone, E		-						$\frac{1}{2}\,H_1$			$\frac{2}{3}\,H_1$	$\frac{3}{4}\,H_1$
	Maximum depth of complete decarburization, G	mm	-						0.015				
5.17	Hardness after retempering		-						Reduction of hardness 20 HV maximum				
5.18	Surface integrity		In accordance with ISO 6157-1 or ISO 6157-3 as appropriate										

A) For bolts of property class 8.8in diameters d < 16mm, there is an increased risk of nut stripping in the case of inadvertent over-tightening inducing a load in excess of prrof load. Reference to ISO 898-2 is recommended.
B) Applies only to nominal thread diameters d < 16mm.
C) For structural bolting the limit is 12mm.
D) Minimum tensile properties apply to products of nominal length / > 2,5 d. Minimum hardness applies to product of length / < 2,5 d and other products which cannot be tensile tested (e.g. due to head configuration).
E) When testing full size bolts, screws and studs, the tensile loads, which are to be applied for the calculation of R_m shall meet the values given in tables 6 and 8.
F) A hardness reading taken at the end of bolts, screws and studs shall be 250 HV, 238 HB or 99,5 HRB maximum.
G) Surface hardness shall not be more than 30 Vickers the measured core hardness on the product 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.
H) In cases where the lower yield stress R_{el} cannot be determined, it is permissible to measure the stress at 0,2% non-proportional elongation $R_{po,2}$. For the property classes 4.8, 5.8 and 6.8 the values for R_{el} are given for calculation purposes only, they are not test values.
I) The yield stress ratio according to the designation of the property class and the minimum stress at 0,2% non-proportional elongation $R_{po,2}$ apply to machined test specimens. These values if received from tests of full size bolts and screws will vary because of processing method and size effects.

SYNERGY
ENGINEERING SOLUTION

Thread Pitch Inches

Coarse Thread Series - UNC			
Nominal Size and Threads	Basic Pitch Dia.	Section at Minor Dia.	Tensile Stress Area
Per In.	In.	Sq in.	Sq in.
3/8 - 16	0.3344	0.0678	0.0775
7/16 - 14	0.3911	0.0933	0.1063
1/2 - 13	0.4500	0.1257	0.1419
9/16 - 12	0.5084	0.162	0.182
5/8 - 11	0.5660	0.202	0.226
3/4 - 10	0.6850	0.302	0.334
7/8 - 9	0.8028	0.419	0.462
1 - 8	0.9188	0.551	0.606
1 1/8 - 7	1.0322	0.693	0.763
1 1/4 - 7	1.1572	0.890	0.969
1 3/8 - 6	1.2667	1.054	1.155
1 1/2 - 6	1.3917	1.294	1.405
–	–	–	–
1 3/4 - 5	1.6201	1.74	1.90
–	–	–	–
2 - 4 1/2	1.8557	2.30	2.50
2 1/4 - 4 1/2	2.1057	3.02	3.25
2 1/2 - 4	2.3376	3.72	4.00
2 3/4 - 4	2.5876	4.62	4.93
3 - 4	2.8376	5.62	5.97
3 1/4 - 4	3.0876	6.72	7.10
3 1/2 - 4	3.3376	7.92	8.33
3 3/4 - 4	3.5876	9.21	9.66
4 - 4	3.8376	10.61	11.08

Fine Thread Series - UNF			
Nominal Size and Threads	Basic Pitch Dia.	Section at Minor Dia.	Tensile Stress Area
Per In.	In.	Sq in.	Sq in.
0.3479	0.3479	0.0809	0.0878
0.4050	0.4050	0.1090	0.1187
0.4675	0.4675	0.1486	0.1599
0.5264	0.5264	0.189	0.203
0.5889	0.5889	0.240	0.256
0.7094	0.7094	0.351	0.373
0.8286	0.8286	0.480	0.509
0.9459	0.9459	0.625	0.663
1.0709	1.0709	0.812	0.856
1.1959	1.1959	1.024	1.073
1.3209	1.3209	1.260	1.315
1.4459	1.4459	1.521	1.581
–	–	–	–
–	–	–	–
–	–	–	–
–	–	–	–
–	–	–	–
–	–	–	–
–	–	–	–
–	–	–	–
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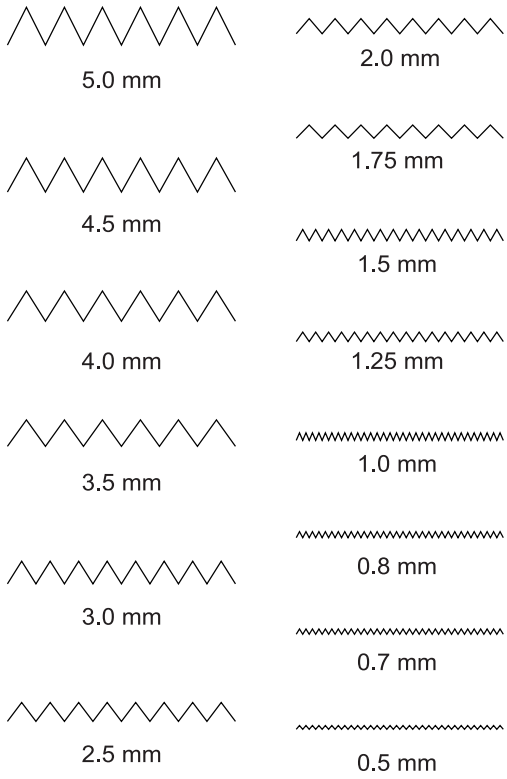
8-Thread Series - 8UN			
Nominal Size and Threads	Basic Pitch Dia.	Section at Minor Dia.	Tensile Stress Area
In.	Per In.	Sq in.	Sq in.
–	–	–	–
–	–	–	–
–	–	–	–
–	–	–	–
–	–	–	–
–	–	–	–
–	–	–	–
1 - 8	0.9188	0.551	0.606
1 1/8 - 8	1.0438	0.728	0.790
1 1/4 - 8	1.1688	0.929	1.000
1 3/8 - 8	1.2938	1.155	1.233
1 1/2 - 8	1.4188	1.405	1.492
1 5/8 - 8	1.5438	1.68	1.78
1 3/4 - 8	1.6688	1.98	2.08
1 7/8 - 8	1.7938	2.30	2.41
2 - 8	1.9188	2.65	2.77
2 1/4 - 8	2.1688	3.42	3.56
2 1/2 - 8	2.4188	4.29	4.44
2 3/4 - 8	2.6688	5.26	5.43
3 - 8	2.9188	6.32	6.51
3 1/4 - 8	3.1688	7.49	7.69
3 1/2 - 8	3.4188	8.75	8.96
3 3/4 - 8	3.6688	10.11	10.34
4 - 8	3.9188	11.57	11.81

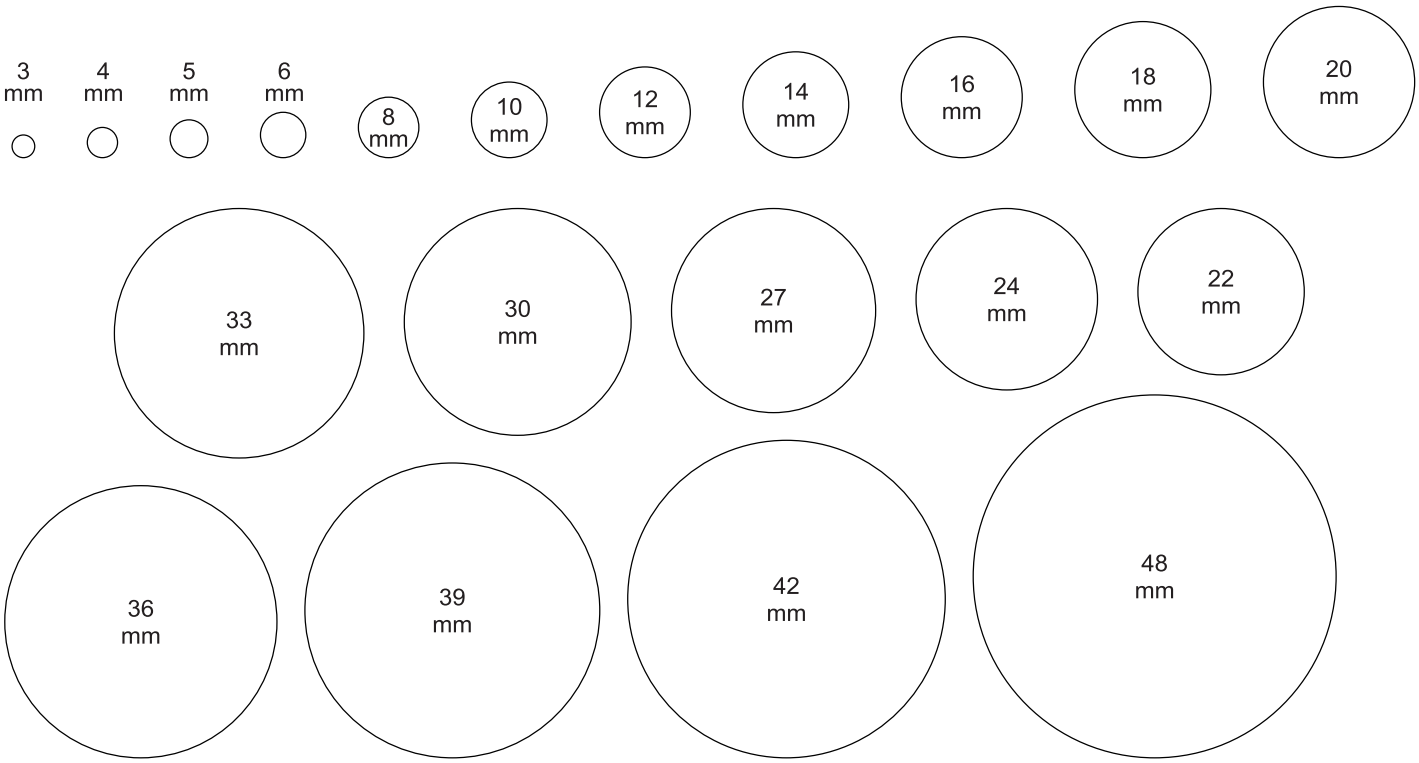
SYNERGY
ENGINEERING SOLUTION

Thread Pitch Chart

Metric Diemeter	Pitch mm	
	Coarse Standard	Fine Standard
3mm	0.50	0.35
4mm	0.70	0.50
5mm	0.80	0.50
6mm	1.00	0.75
8mm	1.25	1.00
10mm	1.50	1.25
12mm	1.75	1.25
14mm	2.00	1.50
16mm	2.00	1.50
18mm	2.50	1.50
20mm	2.50	1.50
22mm	2.50	1.50
24mm	3.00	2.00
27mm	3.00	2.00
30mm	3.50	2.00
33mm	3.50	2.00
36mm	4.00	3.00
39mm	4.00	3.00
42mm	4.50	3.00
48mm	5.00	3.00

Metric Thread Pitches





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