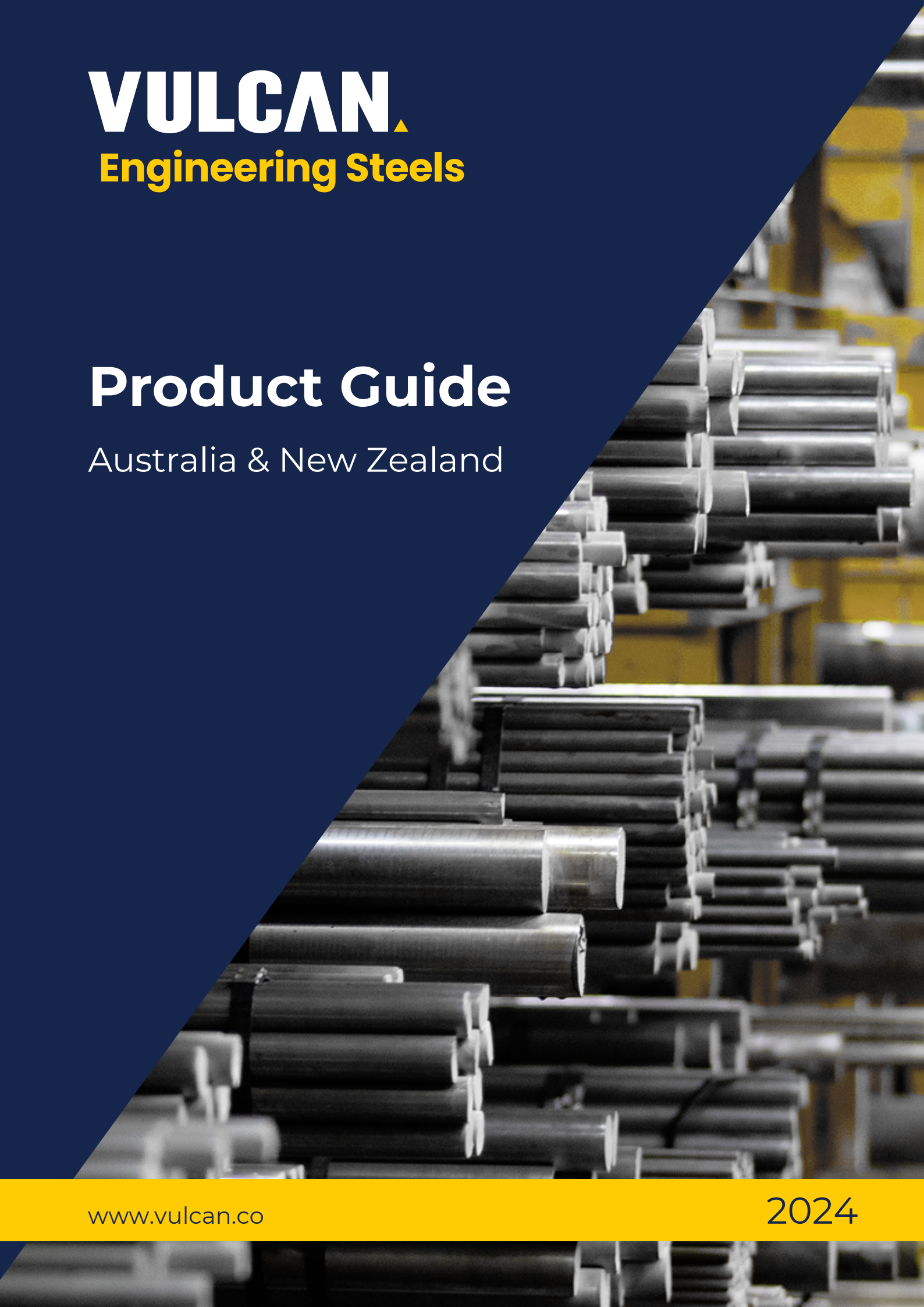
VULCAN.

Engineering Steels

Product Guide

Australia & New Zealand



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2024

Contents

VULCAN. Hollow Bar Specifications

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Produced to "Euro Norm" EN10294-1 Specifications (Except where items shaded grey)

Sizes			Weight	Clean Turned Sizes Centring on OD	
OD	ID	WT	Approx.	OD	ID
mm	mm	mm	kg/m	mm	mm
30	15	7.5	5.5	30	15
	20	5.0	4.4	30	20
35	20	7.5	6.5	35	20
	25	5.0	5.1	35	25
40	20	10.0	8.8	40	20
	25	7.5	7.5	40	25
	30	5.0	5.9	40	30
45	30	7.5	8.9	45	30
50	25	12.5	13.2	50	25
	30	10.0	11.9	50	30
	35	7.5	10.5	50	35
55	30	12.5	16.4	55	30
	35	10.0	14.1	55	35
	40	7.5	12.0	55	40
60	35	12.5	17.3	60	35
	40	10.0	15.0	60	40
	45	7.5	12.5	60	45
65	35	15.0	21.4	65	35
	40	12.5	19.2	65	40
	45	10.0	16.5	65	45
	50	7.5	13.7	65	50
70	35	17.5	26.0	70	35
	40	15.0	23.6	70	40
	45	12.5	21.0	70	45
	50	10.0	19.8	70	50
	55	7.5	14.9	70	55
75	40	17.5	28.4	75	40
	45	15.0	25.8	75	45
	50	12.5	22.9	75	50
	55	10.0	19.6	75	55
	60	7.5	16.2	75	60
80	40	20.0	33.6	80	40
	45	17.5	31.0	80	45
	50	15.0	28.1	80	50
	55	12.5	24.9	80	55
	60	10.0	21.2	80	60
85	45	20.0	36.5	85	45
	50	17.5	33.5	85	50
	55	15.0	30.3	85	55
	60	12.5	26.7	85	60
	65	10.0	22.7	85	65
	70	7.5	18.7	85	70
90	40	25.0	43.4	90	40
	45	22.5	40.9	90	45
	50	20.0	39.3	90	50
	55	17.5	36.1	90	55
	60	15.0	32.5	90	60
	65	12.5	28.6	90	65
	70	10.0	24.4	90	70
95	45	25.0	50.5	95	45
	50	22.5	45.5	95	50
	55	20.0	42.3	95	55
	60	17.5	38.8	95	60
	65	15.0	34.8	95	65
	70	12.5	30.7	95	70
	75	10.0	26.0	95	75
100	45	27.5	53.2	100	45
	50	25.0	51.9	100	50
	55	22.5	48.9	100	55
	60	20.0	45.2	100	60
	65	17.5	41.3	100	65
	70	15.0	37.1	100	70
	75	12.5	32.5	100	75
	80	10.0	27.6	100	80
105	50	27.5	57.0	105	50
	55	25.0	54.5	105	55
	60	22.5	50.2	105	60
	65	20.0	48.2	105	65
	70	17.5	44.0	105	70
	75	15.0	38.0	105	75
	80	12.5	34.5	105	80
	85	10.0	30.3	105	85
110	60	25.0	59.2	110	60
	70	20.0	51.1	110	70
	75	17.5	46.6	110	75
	80	15.0	41.7	110	80
	85	12.5	36.4	110	85
	90	10.0	30.9	110	90
115	65	25.0	62.7	115	65
	70	22.5	58.5	115	70
	75	20.0	53.0	115	75
	80	17.5	49.2	115	80
	85	15.0	43.0	115	85
	90	12.5	38.4	115	90
120	65	27.5	70.6	120	65
	70	25.0	66.4	120	70
	80	20.0	57.1	120	80
	90	15.0	46.4	120	90
	95	12.5	40.4	120	95
125	70	27.5	73.0	125	70
	75	25.0	70.0	125	75
	80	22.5	65.2	125	80
	90	17.5	54.5	125	90
	95	15.0	48.6	125	95
	100	12.5	42.3	125	100
130	55	37.5	93.8	130	55
	65	32.5	88.0	130	65
	70	30.0	83.0	130	70
	75	27.5	78.5	130	75
	80	25.0	73.8	130	80
	85	22.5	68.6	130	85
	90	20.0	64.3	130	90
	95	17.5	57.2	130	95
	100	15.0	51.0	130	100
	105	12.5	44.5	130	105
	110	10.0	37.0	130	110
140	75	32.5	96.3	140	75
	80	30.0	91.6	140	80
	85	27.5	86.4	140	85
	90	25.0	80.9	140	90
	100	20.0	68.9	140	100
	105	17.5	62.4	140	105
	110	15.0	55.6	140	110
	115	12.5	48.3	140	115
150	75	37.5	113.5	150	75
	80	35.0	110.7	150	80
	85	32.5	105.7	150	85
	95	27.5	94.5	150	95
	100	25.0	88.3	150	100
	105	22.5	81.8	150	105
	110	20.0	75.1	150	110
	115	17.5	67.8	150	115
	120	15.0	61.7	150	120
	125	12.5	52.5	150	125
	130	10.0	44.6	150	130
160	85	37.5	122.1	160	85
	90	35.0	118.4	160	90
	95	32.5	110.9	160	95
	105	27.5	102.5	160	105
	115	22.5	88.6	160	115
	125	17.5	73.3	160	125
	135	12.5	56.5	160	135
170	80	45.0	148.2	170	80
	95	37.5	136.9	170	95
	105	32.5	124.5	170	105
	110	30.0	117.7	170	110
	120	25.0	103.2	170	120
	125	22.5	95.3	170	125
	130	20.0	85.5	170	130
	135	17.5	78.7	170	135
	140	15.0	70.0	170	140
	145	12.5	60.8	170	145
180	70	55.0	175.0	180	70
	85	47.5	165.4	180	85
	90	45.0	160.2	180	90
	100	40.0	150.9	180	100
	105	37.5	147.7	180	105
	115	32.5	134.0	180	115
	120	30.0	126.6	180	120
	125	27.5	116.0	180	125
	130	25.0	110.8	180	130
	140	20.0	93.4	180	140
	145	17.5	84.3	180	145
	150	15.0	74.8	180	150
190	100	45.0	173.5	190	100
	105	42.5	167.1	190	105
	110	40.0	160.6	190	110
	115	37.5	153.6	190	115
	120	35.0	146.3	190	120
	135	27.5	122.1	190	135
	140	25.0	118.0	190	140
	150	20.0	99.4	190	150
	160	15.0	79.5	190	160
	165	12.5	68.8	190	165
200	100	50.0	202.6	200	100
	110	45.0	189.0	200	110
	115	42.5	178.9	200	115
	120	40.0	174.9	200	120
	125	37.5	172.4	200	125
	140	30.0	147.3	200	140
	140	30.0	129.6	*	*
	145	27.5	134.9	200	145
	150	25.0	120.9	200	150
	160	20.0	105.2	200	160
	165	17.5	95.2	200	165
	175	12.5	80.4	200	175
210	130	40.0	197.2	210	130
	150	30.0	161.6	210	150
	155	27.5	143.3	210	155
	160	25.0	141.9	210	160
	170	20.0	120.2	210	170
220	125	47.5	229.7	220	125
	135	42.5	213.6	220	135
	140	40.0	186.5	220	140
	150	35.0	177.1	220	150
	160	30.0	166.4	220	160
	180	20.0	122.8	220	180
230	140	45.0	241.5	230	140
	145	42.5	224.1	230	145
	160	35.0	196.2	230	160
	170	30.0	182.5	230	170
	170	30.0	152.4	*	*
	180	25.0	160.0	230	180
	190	20.0	128.6	230	190
237	135	51.0	238.6	*	*
250	140	55.0	299.1	250	140
	150	50.0	281.5	250	150
	150	50.0	254.0	*	*
	160	45.0	262.0	250	160
	170	40.0	241.0	250	170
	180	35.0	191.2	*	*
	190	30.0	194.9	250	190
	200	25.0	169.7	250	200
254	180	37.0	204.0	*	*
273	173	50.0	283.2	*	*
	183	45.0	260.6	*	*
	193	40.0	236.8	*	*
	203	35.0	211.6	*	*
	213	30.0	185.2	*	*
	223	25.0	157.5	*	*
292	165	63.5	368.6	*	*
298	198	50.0	315.0	*	*
	208	45.0	289.2	*	*
	218	40.0	262.2	*	*
	226	36.0	239.6	*	*
	238	30.0	204.2	*	*
	248	25.0	173.4	*	*
	258	20.0	141.2	*	*
324	224	50.0	348.0	*	*
	244	40.0	288.6	*	*
	264	30.0	224.0	*	*
	274	25.0	189.7	*	*
340	215	62.5	440.6	*	*
356	236	60.0	451.1	*	*
	256	50.0	388.6	*	*
	276	40.0	321.1	*	*
	286	35.0	285.4	*	*
	296	30.0	248.4	*	*
	306	25.0	210.2	*	*
368	258	55.0	437.3	*	*
	268	50.0	403.9	*	*
	288	40.0	333.3	*	*
380	280	50.0	415.0	*	*
406	286	60.0	527.3	*	*
	306	50.0	452.2	*	*
	326	40.0	371.9	*	*
	346	30.0	286.5	*	*
	356	25.0	242.0	*	*
419	299	60.0	547.2	*	*
	309	55.0	508.5	*	*
457	317	70.0	688.1	*	*
	327	65.0	647.2	*	*
	337	60.0	605.1	*	*
	347	55.0	561.6	*	*
	357	50.0	516.9	*	*
	377	40.0	423.7	*	*
508	368	70.0	778.8	*	*
	388	60.0	682.8	*	*
	408	50.0	581.7	*	*
540	406	67.0	797.2	*	*
559	399	80.0	973.3	*	*
610	470	70.0	950.8	*	*
	490	60.0	838.2	*	*

Typical Chemical Composition

Steel Grade	C %	Si %	Mn %	P %	S %	Cr %	Ni %	V %
Ovako 280T	0.17-0.20	0.30-0.45	1.45-1.60	0.025 Max	0.020-0.035	0.20-0.30	0.20 Max	0.08-0.12
20MnV6 (E470)	0.16-0.22	0.10-0.50	1.30-1.70	0.03 Max	0.015-0.050	-	-	0.08-0.15
E355J2 (Normalised)	0.22 Max	0.55 Max	1.60 Max	0.03 Max	0.015-0.050	0.30 Max	0.30 Max	0.10 Max

Typical Mechanical Properties

	Tensile Strength (MPa Min)			Yield Strength (MPa Min)				
Steel Grade	Up to 16mm Wall	16mm to 25mm wall	Over 25mm to 50mm wall	Up to 16mm Wall	16mm to 25mm wall	Over 25mm to 50mm wall	Elongation	Impact
Ovako 280T	670	670	640	500	500	470	20%	27J Min
20MnV6 (E470)	650	620	550	470	460	430	17%	-
E355J2 (Normalised)	490	490	470	355	345	335	20%	27J Min

*Please ask for a Test Certificate for sizes with Wall Thickness Greater than 50mm

Items produced to the Euro Norm Standard EN10294-1 are guaranteed dimensions after machining with external chucking over a maximum clean-up length of 200mm or 3 times the OD, whichever is shorter.

Items shaded in grey are nominal sizes, ordered to DIN, ISO or ASTM standards and offer no guarantee of clean up. Sizes shown are indicative only.

The sizes shown on this chart are typical of the stock carried at Vulcan Engineering Steels nationally. If you require a size other than that shown here, please contact our sales team for assistance. These and other sizes are also available ex mill production. The weight values indicated are approximate only.


20MnV6 Euronorm EN10294-1


DIN or ISO standard


S355J2 Euronorm EN10294-1


Ovako 280T Euronorm EN10294-1


Some sizes are available in 316L, 2205 stainless and 4140 hardened and tempered grades

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VULCAN. Metal Products Colour Codes

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Bright + Carbon Steels

1020	AISI C1020 DIN 1.0402 1.1152	Low strength and high ductility. Typical UTS 410-790 MPa. Excellent weldability. Good machinability. Can be carburised. End use: Lightly stressed parts.
1030	AISI C1030 1.0528 1.1178	Low/medium strength and good ductility. Typical UTS 500-850 MPa Good machinability. Good weldability. Low hardenability. Used: Light/medium stressed parts.
1045	AISI C1045 DIN 1.0503 1.1191	Medium strength and good ductility. Typical UTS 600-950 MPa Good machinability. Care needed welding. Can be flame/ind. hardened. Used: Medium stressed parts.
S1214	AISI 1213/1215 DIN 1.0715	Low strength and moderate ductility. Typical UTS 370-760 MPa Excellent machinability. Care needed welding. Can be carburised. Used: Very lightly stressed parts.
S12L14	AISI 12L14 DIN 1.0718	Premium grade of free cutting steel. Typical UTS 370-760 MPa Suitable for case hardening used for automotive components.

Hollow Bar

ISO 20MnV6	DIN 1.5217	A low carbon-manganese-vanadium steel with typical UTS 500-750 MPa Excellent machinability and weldability. Can be carburised or nitrided. Used: Medium stressed parts. Supplied in ISO/ASTM sizing.
EN 20Mv6	DIN 1.5217	A low carbon-manganese-vanadium steel produced to the Euro Norm size range of EN 10294-1:2005
4140	AISI 4140 DIN 1.7225	A chrome moly steel with typical UTS 850-1100 MPa Can be flame/ind. hardened or nitrided. Good machinability. Used: Medium/highly stressed parts.

Case Hardening Steels

8620	AISI 8620 DIN 1.6523	General purpose grade with good machinability/weldability. Carb. & H.T.: Case hardness typical RC 62. Core: Good strength and toughness. End use: Lightly stressed parts.
DIN 1.6587	AS 1444 X4317 17CrNiMo6/18CrNiMo7-6	High strength grade with good machinability/weldability. Carb. & H.T.: Case hardness typical RC 62. Core: High strength and good toughness. End use: Moderate/highly stressed parts.
EN36A	AISI E3310 9310 DIN 1.5752	High nickel grade with good machinability/weldability. Carb. & H.T.: Case hardness typical RC 62. Core: High strength and excellent toughness. End use: Highly stressed parts.
EN39B	AS 1444 X9315 DIN 1.6723 SAE 9315	High nickel grade with exceptionally high hardenability, good machinability. Case hardened typical RC 62.Core: Very high core strength and toughness.

High Tensile Steels

4140	AISI 4140 DIN 1.7225	High strength and good toughness with typical UTS 850-1000 MPa Can be flame/ind. hardened or nitrided. Good machinability. End use: Medium to highly stressed parts.
4340	AISI 4340 DIN 1.6563	High strength and good toughness with typical UTS 930-1080 MPa Can be flame/ind. hardened or nitrided. Good machinability. End use: Highly stressed parts.
EN26	AS X9940 DIN 1.6745	High strength plus good toughness and fatigue resistance with typical UTS 1000-1150 MPa Can be flame/ind. hardened or nitrided. Good machinability. Used: Severely stressed parts.
4145H Mod	SAE J1268 ASTM A304 DIN 1.7225	1% Chrome Molybdenum high tensile steel to API7 specification for oilfield applications.

Chrome Bar

K1045	AISI C1045 DIN 1.0503 1.1191	A medium carbon steel hard chrome plated to a thickness of 0.025/0.050mm and surface hardness of HV1000-1150. Good machinability. Care needed welding. Used: Hydraulic cylinders, etc.
K1045 IH	AISI C1045 DIN 1.6503 1.1191	A medium carbon steel induction hardened to a case depth of 3.2mm and hardness of RC 55-65 beforechrome plating (as above). Used: Parts resistant to surface impact.
4140	AISI 4140 DIN 1.7225	A chrome moly steel with typical UTS 850-1000 MPa Chrome plated (as above). Good machinability. End use: Highly stressed hydraulic parts, etc.
4140 IH	DIN 1.7225	High Tensile Chrome Plated bar with the addition of Induction Hardening to further improve surface hardness.

Tool Steels

D2	AISI D2 DIN 1.2379	12% Chrome steel, high resistance against abrasive wear, dimensionally stable, for cold punches, dies, shear blades, deep drawing, thread rolling dies, fine cutting tools.
D3	AISI D3 DIN 1.2080	12% Chrome steel, high wear resistance, highly stress cutting and punching tools for thin sheet, profile rolls, paper knives, drawing and deep drawing dies.
H13	AISI H13 DIN 1.2344	High strength hot work steel such as extrusion and forging dies, pressure casting tools, hot shear knives, tools for the plastic industry, also available in EFS and ESR.
P20	AISI P20 DIN 1.2311 1.2738	Plastic mould steel, supplied in the HT condition, for plastic moulds, frames for pressure dies, hydro forming tools, can be nitrided.

Feedline Tube

*NC	ST37.4	ASTM A179/A450 DIN 1.0255	Ideally suited for hydraulic/pneumatic applications where both bending and flaring is normally required.

Brass

385	DIN 1.7672 ASTM B455	Specifically developed for the mass production of brass components in high speed lathes. Used: Nuts, bolts, screw threads.

Wear Plate

C4800	Creusabro 4800	Superior wear plate material for general impact abrasion service. 430HB hardness, providing 30-50% service improvement over standard Q&T 400-450HB plate. Used: Truck trays and bucket liners, general industrial applications.
C8000	Creusabro 8000	Superior wear plate material for high impact abrasion service. 530HB hardness, providing 50-100% service improvement over standard Q&T 400-550HB plate. Used: Bucket liners and trays, load chutes, feeders and wear bars.
DUAL	Creusabro DUAL	Superior wear plate material for high slide and impact abrasion service. 530HB hardness, providing 100-200% service improvement over standard Q&T 500-600HB plate. Used: Skip and feeder liners, roller screen flowers, grizzly and scalping screen decks.

Stainless Steels

Austenitic Grades

303	AISI 303 UNS S30300	Free machining grade with excellent machinability. Corrosion resistance lowest of all Austenitic grades. Welding not recommended. Used: Where extensive machining is involved.
304	AISI 304 UNS S30400	General purpose grade with improved machinability. Corrosion resistance higher than 303, lower than 316. Readily welded. Used: Domestic, dairy appliances.
304L	AISI 304L UNS S30303	General purpose grade with improved machinability. Corrosion resistance higher than 303, lower than 316. 304L (low carbon) has excellent weldability. Used: Domestic, dairy appliances.
316	AISI 316 UNS S31600	General purpose grade with improved machinability. Corrosion resistance higher than 321 or 304. Readily welded. Used: Domestic, dairy appliances.
316L	AISI 316L UNS S31603	Marine grade with improved machinability. Corrosion resistance higher than 321 or 304. 316L (low carbon) has excellent weldability. Used: Marine and Chemical industries.
321	AISI 321 UNS S32100	Titanium stabilised grade with reasonable machinability. Corrosion resistance similar 304, lower than 316. Excellent weldability, resists scaling up to 800°C plus. Used when welding or high temperature involved.
253MA	AISI 253MA UNS S30815	High temperature alloy possessing high strength and resistance to sigma phase formation. Resistant to temperatures up to 1150°C. Used: furnace parts, radiant shields, fluidised beds.
2RK65	AISI 904L UNS N08904	High resistance to general corrosion in: sulphuric and acetic acids, crevice corrosion, stress corrosion cracking, pitting in chloride bearing solutions etc. Good weldability.

Ferritic Grades

430	AISI 430 UNS S43000	Moderate to good corrosion resistance, magnetic and non-hardenable. Low weldability. Used: Interior architectural components, stove and automotive trim, dishwashers and whitegoods.
5CR12	AISI 5CR12 UNS S41003	Moderate to good corrosion resistance, magnetic and non-hardenable. Fair to good weldability. Used: Mildly corrosive environments where better life cycle cost over carbon or galvanised steel is desired.

Martensitic Grades

416	AISI 416 UNS S41600	Free machining grade with typical UTS 550-700 MPa Corrosion resistance the lowest of the Martensitic grades. Excellent machinability. Welding not recommended. Used where extensive machining involved.
420	AISI 420 UNS S42000	Medium carbon grade with typical UTS 700-930 MPa Corrosion resistance similar to 410. Good machinability. Welding not recommended. Used in pump and valve parts, etc.
431	AISI 431 UNS S43100	Low nickel grade with typical UTS 850-1000 MPa Corrosion resistance approaching 302. Good machinability. Welding not recommended. Used in high tensile parts.
440C	AISI 440C UNS S44004	High carbon grade supplied fully annealed. Low machinability. Do not weld. Can be H & T to RC 55-60 with excellent wear resistance. Corrosion resistance best H & T. Used in surgical knives, etc.

Precipitation Hardened

630	AISI 630 UNS S17400	Martensitic age hardening grade. Typical UTS 930-1100 MPa Corrosion resistance similar to 304. Reasonable machinability. Good weldability. Used where strength and corrosion resistance required.

Duplex

LDX2101	AISI LDX2101 UNS S32101	Lean duplex Ferritic/Austenitic grade with corrosion resistance approaching 316, with higher strength and stress corrosion cracking resistance. Good weldability. Used: Storage tanks and structural applications.
2205	AISI 2205 UNS S31803	Ferritic/Austenitic grade with high Y.S. Typical 570 MPa. Corrosion resistance higher than 316L/316. Reasonable machinability. Good weldability. Used where high strength/corrosion resistance required.
2507	AISI 2507 UNS S32750	Super duplex Ferritic/Austenitic grade with extremely high resistance to corrosion in severe marine, chloride and acid environments. Good weldability. Used: Heat exchangers, reactors, pipework.

Cast Iron

GJS450/ 500	EN-GJS450 ASTM A536 65-45-12	A spheroidal graphite cast iron with typical UTS 415 MPa Excellent machinability, shock and fatigue resistance. Used: Gears, moulds, etc.
GJL300	EN-GJL300 BS 1452 300	High strength grade with good machinability/weldability. Carb. & H.T.: Case hardness typical RC 62. Core: High strength and good toughness. Used: Moderate/highly stressed parts.

Bronze

LG2	AS C83600	A leaded gunmetal bronze with typical UTS 270 MPa Excellent machinability. Good corrosion resistance. Used: Bushings, bearings, valve/pump bodies.
954	AS C95400	An aluminium bronze with typical UTS 500 MPa Very good corrosion resistance. Good machinability. Used: Marine, oil and chemical industries.
PB1	AS C90710	A phosphor bronze with typical UTS 360 MPa Very good corrosion resistance. Good toughness. Used: Gears, bearings and bushes.

Cylinder Tube

	UNHONED	Supplied with undersized I.D. suitable for honing to finished diameter. Used: Agricultural & Industrial cylinders.
*NC	SSID	Economical alternative to a honed finish, specially drawn tubes drawn for use in less critical applications, i.e. agricultural cylinders.
	HONED	I.D. prehoned to size. Precision finish suitable for agricultural & Industrial hydraulic applications.
	SKIVED & ROLLER BURNISHED	Thin layers of material removed from I.D. by knives "skiving" Followed by rollers "burnishing" ensuring a smooth finish.

Aluminium

2011T6	DIN 3.1655	General purpose free machining grade. Not suitable for anodising.
6061T6	DIN 3.3211	High strength and good toughness with typical UTS 930-1080 MPa Can be flame/ind. hardened or nitrided. Good machinability. End use: Highly stressed parts.
6026T6		Good corrosion resistance. Automotive components. Can be anodised.
7075 T6/T73	DIN 3.4365	High strength plus good toughness and fatigue resistance with typical UTS 1000-1150 MPa Can be flame/ind. hardened or nitrided. Good machinability. End use: Severely stressed parts.

* NC Signifies no colour code. Colour coding should only ever be used as a secondary source of identification.

October 2021

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VULCAN
Engineering Steels

4140 HIGH TENSILE STEEL

4140 is a 1% Chrome Moly general purpose high tensile steel and is the most commonly used of the high tensile steels.
4140 is generally supplied hardened and tempered (to condition T or U).
Pre hardened and tempered 4140 can be further surface hardened by flame or induction hardening as well as nitriding.
4140 is used in almost all industry sectors where high tensile parts/components are required.

Stocked Sizes	-	Rounds	8 mm – 710 mm Ø
		Hexagons	19 mm – 65 mm A/F
Bar Finishes	-	Hot Rolled, Peeled, Turned & Polished, Cold Drawn & Centreless Ground	

Related Specifications	
Australia	AS 1444 – 1996 4140
Japan	JIS G4105 SCM440
USA	AISI 4140 ASTM A29/A29M – 91 4140 SAE 4140

Chemical Composition		
	Min. %	**Max %**
Carbon	0.36	0.44
Silicon	0.10	0.40
Manganese	0.65	1.10
Chromium	0.75	1.20
Molybdenum	0.15	0.35
Phosphorous	0	0.04
Sulphur	0	0.04

Mechanical Properties – Hardened & Tempered 4140 to AS1444 (all finishes except cold drawn)*

Mechanical Property Designation		**R**	**S**	**S**	**T**	**U**	**V**	**W**
Limited Ruling Section mm*		250	250	150	100	63	30	20
Tensile Strength Mpa	Min	700	770	770	850	930	1000	1080
	Max	850	930	930	1000	1080	1150	1230
0.20% Proof Stress (Yield) Mpa	Min	480	540	570	665	740	835	925
Elongation on %	Min	15	13	15	13	12	12	12
Izod Impact J	Min	34	27	54	54	47	47	40
Charpy Impact J	Min	28	22	50	50	42	42	35
Hardness Brinell HB	Min	201	223	223	248	269	293	311
	Max	255	277	277	302	331	352	375

*For Cold Drawn information contact our office or refer to AS1444-1996

Annealing

Heat to 800-850 Deg C. Hold until temperature is uniform throughout the section and allow to cool in furnace.

Normalising

For As Rolled, Heat to 870- 900 Deg C. Hold until temperature is uniform through the section, soak for 10-15 minutes per 25mm of cross section, and allow to cool in still air. For Q&T 4140 normalising temperature is restricted by the tempering temperature of the material otherwise the mechanical properties will be affected. It is highly recommended that normalizing of Q&T steel be undertaken by a recognized heat treatment company.

VULCAN
Engineering Steels

4145H MODIFIED HIGH TENSILE STEEL

4145H Modified is a Chromium – Molybdenum high tensile steel produced specifically for the Oil and Gas Industry and combines ductility, shock resistance and wear resistance.
Produced to conform to the API Spec 7, 4145H is used to produce Drill Collars, Kelly Bars, Connecting Rods, shafts and gears etc.

Stocked Sizes	-	Rounds	116 mm – 285 mm Ø
Finishes	-	Hot Rolled, Peeled	

Related Specifications		
Australia		
International	API Spec 7	
Chemical Composition		
	Min. %	**Max %**
Carbon	0.42	0.49
Silicon	0.15	0.35
Manganese	0.90	1.25
Nickel	0	0.25
Chromium	0.90	1.35
Molybdenum	0.20	0.35
Phosphorous	0	0.035
Sulphur	0	0.04
Copper	0	0.35

Mechanical Properties – Hardened & Tempered		
Mechanical Property Designation		**API -7**
Limited Ruling Section mm*		N/A
Tensile Strength Mpa	Min	970 (140,000 PSI)
	Max	
0.20% Proof Stress (Yield) Mpa	Min	755 (110,000 PSI)
Elongation on %	Min	13
Izod Impact J	Min	
Charpy Impact J	Min	54
Hardness Brinell HB	Min	
	Max	352
Annealing		
Heat to 815-850 Deg C. Hold until temperature is uniform throughout the section and allow to cool in furnace.		

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4340 HIGH TENSILE STEEL

4340 is a 1.8% Nickel-Chrome-Moly high hardenability, high tensile steel. 4340 is generally supplied hardened and tempered (to condition U).
Pre hardened and tempered 4340 can be further surface hardened by flame or induction hardening as well as nitriding. 4340 is used for Heavy duty shafts, Gears spindles, Couplings, Pins. With the addition of Nickel over 4140, 4340 has a better depth of mechanical properties allowing for a larger Limited Ruling Section and resulting in higher core strength at larger diameters.

Stocked Sizes - Rounds 25 mm – 610 mm Ø

Finishes - Hot Rolled, Peeled, Turned & Polished, Centreless Ground

Related Specifications	
Australia	AS 1444 – 1996 4340
Japan	JIS G4103 SNCM439
USA	AISI 4340 ASTM A29/A29M – 91 4340 SAE 4340 ASTM A322 43430 UNS G43400

Chemical Composition		
	Min. %	**Max %**
Carbon	0.37	0.44
Silicon	0.10	0.35
Manganese	0.55	0.90
Nickel	1.55	2.00
Chromium	0.65	0.95
Molybdenum	0.20	0.35
Phosphorous	0	0.04
Sulphur	0	0.04

Mechanical Properties – Hardened & Tempered 4340 to AS1444 (all finishes except cold drawn)*

Mechanical Property Designation		**R**	**S**	**S**	**T**	**U**	**V**	**W**
Limited Ruling Section mm*		250	250	150	100	63	30	20
Tensile Strength Mpa	Min	700	770	770	850	930	1000	1080
	Max	850	930	930	1000	1080	1150	1230
0.20% Proof Stress (Yield) Mpa	Min	480	540	570	665	740	835	925
Elongation on %	Min	15	13	15	13	12	12	12
Izod Impact J	Min	34	27	54	54	47	47	40
Charpy Impact J	Min	28	22	50	50	42	42	35
Hardness Brinell HB	Min	201	223	223	248	269	293	311
	Max	255	277	277	302	331	352	375

*For Cold Drawn information contact our office or refer to AS1444-1996

Annealing

Heat to 800-850 Deg C. Hold until temperature is uniform throughout the section and allow to cool in furnace.

VULCAN
Engineering Steels

EN26 (X9940) HIGH TENSILE STEEL

EN26 is a 2.5% Nickel-Chrome-Moly high hardenability, high tensile steel & is generally supplied hardened and tempered (to condition V).
Pre hardened and tempered EN26 can be further surface hardened by flame or induction hardening as well as nitriding.
EN26 is used for Heavy duty shafts, Axles, Connecting Rods, Spindles, Motor Shafts, Tool and Die holders etc.

Stocked Sizes - Rounds 24 mm – 300 mm Ø

Finishes - Hot Rolled, Peeled, (Turned and Polished/Centreless Ground available against request)

Related Specifications								
Australia	AS 1444 – 1996 X9940							
Great Britain	BS970 Part 3 1991 – 826M40 BS970 1955 – EN26							
Chemical Composition								
	Min. %				**Max %**			
Carbon	0.36				0.44			
Silicon	0.10				0.35			
Manganese	0.45				0.70			
Nickel	2.30				2.80			
Chromium	0.50				0.80			
Molybdenum	0.45				0.65			
Phosphorous	0				0.04			
Sulphur	0				0.04			
Mechanical Properties – Hardened & Tempered EN26 (X9940) to AS1444								
Mechanical Property Designation		**U**	**U**	**V**	**V**	**W**	**W**	**X**
Limited Ruling Section mm*		250	150	250	150	250	150	150
Tensile Strength Mpa	Min	930	930	1000	1000	1080	1080	1150
	Max	1080	1080	1150	1150	1230	1230	1300
0.20% Proof Stress (Yield) Mpa	Min	725	740	820	835	910	925	1005
Elongation on %	Min	12	12	12	12	11	11	10
Izod Impact J	Min	34	47	34	47	27	40	34
Charpy Impact J	Min	28	42	28	42	22	35	28
Hardness Brinell HB	Min	269	269	293	293	311	311	340
	Max	331	331	352	352	375	375	401
Annealing								
Heat to 790-840 Deg C. Hold until temperature is uniform throughout the section and allow to cool in furnace.								

VULCAN
Engineering Steels

M1020 BRIGHT CARBON STEEL BAR

M1020 is a low carbon mild steel. This bar is supplied in cold drawn or Turned and Polished condition. This bar has excellent weldability, good machinability, reasonable strength and good ductility.
M1020 is used extensively across all industrial sectors and is also suitable for carburizing (case hardening). Due to it's low carbon content M1020 is not suitable for Flame or Induction hardening. In a bright finish it is ideally suited for CNC machining, and machining components where much of the length does not require machining.

Stocked Sizes	-	Round Metric	-	6 mm – 200 mm Ø
		Round Imperial	-	3/16'' – 8'' Ø
		Square Metric	-	20mm – 75 Sq
		Square Imperial	-	3/8'' – 5'' Sq

Closest Related Specifications	
Australia	AS 1443 – 2004 M1020
Japan	JIS G4051 S20C
USA	AISI C1020 ASTM A29 – 91 1020 SAE 1020 UNS G10200

Chemical Composition		
	Min. %	**Max %**
Carbon	0.15	0.25
Silicon		0.35
Manganese	0.30	0.90
Phosphorous		0.05
Sulphur		0.05

Typical Mechanical Properties – Cold Drawn & Turned and Polished (For Guidance Only)				
	Up to 16mm	17-38mm	39-63mm	Turned & Polished (All Sizes)
Tensile Strength (Mpa)	480-790	460-710	430-660	410-560
Yield Strength (Mpa)	380-610	370-570	340-480	230-330
Elongation in 50mm (%)	10	12	13	22
Hardness (Brinell BHN)	142-235	135-210	120-195	115-170

Standard Bright Tolerance (h11) in mm								
3-6mm	+6-10mm	+10-18mm	+18-30mm	+30-50mm	+50-80mm	+80-120mm	+120-180mm	+180-250mm
+0/-0.075	+0/-0.09	+0/-0.11	+0/-0.13	+0/-0.16	+0/-0.19	+0/-0.22	+0/-0.25	+0/-0.29mm

Annealing

Heat to 870-910 Deg C. Hold until temperature is uniform throughout the section and allow to cool in furnace.

Normalizing

Heat to 890- 940 Deg C. Hold until temperature is uniform through the section, soak for 10-15 minutes and allow to cool in still air.

Stress Relieving

Heat to 650-700 Deg C. Hold until temperature is uniform throughout the section, soak for 1 hour per 25mm of section, and cool in still air

VULCAN
Engineering Steels

M1030 BRIGHT CARBON STEEL BAR

M1030 is a low carbon mild steel. This bar is supplied in cold drawn or Turned and Polished condition, and has reasonable weldability, good machinability, medium strength and good ductility.
M1030 is used across all industrial sectors where higher strength than M1020 is required. In a bright finish it is ideally suited for CNC machining, and machining components where much of the length does not require machining.

Stocked Sizes - Round Metric - 10 mm – 100 mm Ø
Round Imperial - 5/16'' – 4'' Ø
(Larger & smaller sizes available on request)

Closest Related Specifications	
Australia	AS 1443 – 2004 M1030
Japan	JIS G4051 S30C
USA	AISI C1030 ASTM A29 – 91 1030 SAE 1030 UNS G10300

Chemical Composition		
	Min. %	**Max %**
Carbon	0.25	0.35
Silicon		0.35
Manganese	0.30	0.90
Phosphorous		0.05
Sulphur		0.05

Typical Mechanical Properties – Cold Drawn & Turned and Polished (For Guidance Only)				
	Up to 16mm	17-38mm	39-63mm	Turned & Polished (All Sizes)
Tensile Strength (Mpa)	560-850	540-740	520-710	500-630
Yield Strength (Mpa)	440-670	430-600	410-570	250-350
Elongation in 50mm (%)	10	11	12	20
Hardness (Brinell BHN)	170-245	160-215	155-210	150-190

Standard Bright Tolerance (h11) in mm								
3-6mm	+6-10mm	+10-18mm	+18-30mm	+30-50mm	+50-80mm	+80-120mm	+120-180mm	+180-250mm
+0/-0.075	+0/-0.09	+0/-0.11	+0/-0.13	+0/-0.16	+0/-0.19	+0/-0.22	+0/-0.25	+0/-0.29mm

Annealing
Heat to 850-900 Deg C. Hold until temperature is uniform throughout the section and allow to cool in furnace.
Normalizing
Heat to 870- 920 Deg C. Hold until temperature is uniform through the section, soak for 10-15 minutes per 25mm of cross section, and allow to cool in still air.
Stress Relieving
Heat to 600-700 Deg C. Hold until temperature is uniform throughout the section, soak for 1 hour per 25mm of section, and cool in still air

VULCAN
Engineering Steels

1045 BRIGHT CARBON STEEL BAR

1045 is a medium carbon steel with medium tensile strength. This bar is supplied in As Rolled bright condition (can be cold drawn or turned and polished). 1045 combines reasonable weldability, with good machinability, and can be flame or induction hardened.
Typical Applications are: Various axles, bolts, connecting rods, Hydraulic Clamps and Rams, pins, studs, spindles, rolls and other general engineering applications. Also used for Sprockets, and lower strength gears.

Stocked Sizes	-	Round Metric	10 mm – 150 mm Ø	Square Metric	20 mm – 40 mm Sq
		Round Imperial	3/8'' – 6'' Ø	Square Imperial	3/4'' – 1. 1/2'' Sq
		Hexagon	19 mm – 50.8 mm		

Related Specifications	
Australia	AS 1443 – 1994 1045
Japan	JIS G4051 S45C
USA	AISI C1045 ASTM A29 – 91 1045 SAE 1045 UNS G10450

Chemical Composition		
	Min. %	**Max %**
Carbon	0.43	0.50
Silicon	0.10	0.35
Manganese	0.60	0.90
Phosphorous		0.04
Sulphur		0.04

Typical Mechanical Properties – Cold Drawn & Turned and Polished (For Guidance Only - indicative)				
	Up to 16mm CD	17-38mm CD	39-63mm CD	Turned & Polished (All Sizes)
Tensile Strength (Mpa)	690-950	650-830	640-800	600-730
Yield Strength (Mpa)	540-760	510-650	500-630	300-450
Elongation in 50mm (%)	8	8	9	14
Hardness (Brinell BHN)	205-280	195-245	190-235	179-215

Standard Bright Tolerance (h11) in mm								
3-6mm	+6-10mm	+10-18mm	+18-30mm	+30-50mm	+50-80mm	+80-120mm	+120-180mm	+180-250mm
+0/-0.075	+0/-0.09	+0/-0.11	+0/-0.13	+0/-0.16	+0/-0.19	+0/-0.22	+0/-0.25	+0/-0.29mm

Annealing

Heat to 800-850 Deg C. Hold until temperature is uniform throughout the section and allow to cool in furnace.

Normalizing

Heat to 870- 920 Deg C. Hold until temperature is uniform through the section, soak for 10-15 minutes per 25mm of cross section, and allow to cool in still air.

Stress Relieving

Heat to 550-660 Deg C. Hold until temperature is uniform throughout the section, soak for 1 hour per 25mm of section, and cool in still air

VULCAN
Engineering Steels

S12L14 BRIGHT CARBON STEEL BAR

S12L14 is a premium free machining low tensile, low hardenability carbon steel, with free machining characteristics due to the addition of both Lead and Sulphur. As this material contains Lead, it is not recommended for welding, as it is both problematic and a possible health hazard.
S12L14 is generally only used in the as rolled condition, and then either cold drawn or turned to allow feeding through NC machines. S12L14 can be carburised and electroplated. Core strength will, however, remain low. S12L14 is not recommended for flame, induction or nitride hardening.
Typical applications included lightly stressed components, and machinery parts. Ideally suited for high volume lightly stressed components.

Stocked Sizes - Generally stocked for customer specific requirements. Contact your local branch for further information.

Related Specifications	
Australia	AS 1443 – 1994 12L14
Japan	JIS G 4804 SUM22L
USA	AISI/SAE 12L14 UNS G12144

Chemical Composition		
	Min. %	**Max %**
Carbon	0	0.15
Silicon	0	0.10
Manganese	0.80	1.20
Phosphorous	0.04	0.09
Sulphur	0.25	0.35
Lead	0.15	0.35

Typical Mechanical Properties – Cold Drawn & Turned and Polished (For Guidance Only - indicative)				
	Up to 16mm CD	17-38mm CD	39-63mm CD	Turned & Polished (All Sizes)
Tensile Strength (Mpa)	480-760	430-690	400-630	370-520
Yield Strength (Mpa)	350-590	330-550	290-500	230-310
Elongation in 50mm (%)	7	8	9	17
Hardness (Brinell BHN)	142-225	120-205	115-185	105-155

Standard Bright Tolerance (h11) in mm								
3-6mm	+6-10mm	+10-18mm	+18-30mm	+30-50mm	+50-80mm	+80-120mm	+120-180mm	+180-250mm
+0/-0.075	+0/-0.09	+0/-0.11	+0/-0.13	+0/-0.16	+0/-0.19	+0/-0.22	+0/-0.25	+0/-0.29mm

Annealing
Heat to 890-920 Deg C. Hold until temperature is uniform throughout the section and allow to cool in furnace.
Normalizing
Heat to 900-940 Deg C. Hold until temperature is uniform through the section, soak for 10-15 minutes per 25mm of cross section, and allow to cool in still air.
Stress Relieving
Heat to 500-700 Deg C. Hold until temperature is uniform throughout the section, soak for 1 hour per 25mm of section, and cool in still air

VULCAN
Engineering Steels

1214 BRIGHT CARBON STEEL BAR

1214 is a free machining low tensile, low hardenability carbon steel, with free machining characteristics due to the addition of Sulphur. The addition of Sulphur makes welding of this material difficult.
1214 is generally only used in the as rolled condition, and then either cold drawn or turned to allow feeding through NC machines. 1214 can be carburised achieving surface hardness of around 60HRC in smaller sections, however this will reduce as section size increases. Core strength will, however, remain low. 1214 is not recommended for flame, induction or nitride hardening.
Typical applications included lightly stressed components, and machinery parts.

Stocked Sizes	-	Round Metric	5 mm – 110 mm Ø
		Round Imperial	1/4'' – 5'' Ø
		Hexagon	7/16'' – 75 mm A/F
		Square	1/4'' – 4'' A/F

Related Specifications	
Australia	AS 1443 – 1994 1214
Japan	JIS G 4804 SUM22
USA	AISI 1213 and 1215 ASTM A29/A29M – 91 1213 and 1215 SAE 1213 and 1215 UNS G12130

Chemical Composition		
	Min. %	**Max %**
Carbon	0	0.15
Silicon	0	0.10
Manganese	0.80	1.20
Phosphorous	0.04	0.09
Sulphur	0.25	0.35

Typical Mechanical Properties – Cold Drawn & Turned and Polished (For Guidance Only - indicative)				
	Up to 16mm CD	17-38mm CD	39-63mm CD	Turned & Polished (All Sizes)
Tensile Strength (Mpa)	480-760	430-690	400-630	370-520
Yield Strength (Mpa)	350-590	330-550	290-500	230-310
Elongation in 50mm (%)	7	8	9	17
Hardness (Brinell BHN)	142-225	120-205	115-185	105-155

Standard Bright Tolerance (h11) in mm								
3-6mm	+6-10mm	+10-18mm	+18-30mm	+30-50mm	+50-80mm	+80-120mm	+120-180mm	+180-250mm
+0/-0.075	+0/-0.09	+0/-0.11	+0/-0.13	+0/-0.16	+0/-0.19	+0/-0.22	+0/-0.25	+0/-0.29mm

Annealing
Heat to 890-920 Deg C. Hold until temperature is uniform throughout the section and allow to cool in furnace.
Normalizing
Heat to 900-940 Deg C. Hold until temperature is uniform through the section, soak for 10-15 minutes per 25mm of cross section, and allow to cool in still air.
Stress Relieving
Heat to 500-700 Deg C. Hold until temperature is uniform throughout the section, soak for 1 hour per 25mm of section, and cool in still air

VULCAN
Engineering Steels

954 ALUMINIUM BRONZE

954 Bronze is a high strength aluminium bronze, with high hardness and abrasion resistance. 954 combines excellent strength and wear resistance with reasonable machining properties and good general corrosion resistance.
954 Bronze is suitable for high strength bearings with good impact resistance, but requires reliable full film lubrication due to poor anti seizing properties.

Sizes Available	-	Solid	3/4'' – 8'' Ø
		Hollow	1'' – 8'' O/D

Related Specifications		
United Kingdom	BS1400 AB-1	
UNS	C95400	
German	CuAl11Fe4	
Japan	CAC702C	
USA	ASTM B271/B505 SAE 9C	
Chemical Composition*		
	Min. %	**Max %**
Aluminium	10.0	11.5
Iron	3.0	5.0
Nickel	0	1.5
Manganese	0	0.5
Copper	Balance	

Typical Mechanical Properties – (For Guidance Only)	
Tensile Strength (Mpa)	510-590 MPa
Yield Strength (Mpa)	200-230 MPa
Elongation (%)	12% Min
Hardness (Brinell BHN)	170-180 BHN
Other Information	
Specific Gravity	7.45
Maximum Recommended Operating Temperature	260 Deg C
Stress Relieving Temperature	316 Deg C
Time at Temperature	1 hour per 25mm of section thickness

VULCAN
Engineering Steels

LG-2 BRONZE

LG-2 Bronze is a general purpose leaded gunmetal conforming to BS1400 – 1985. Lg-2 has excellent machining properties, medium strength, and is not subject to dezincification (Category I alloy). It has reasonable resistance to saltwater and brine making it suitable for pump and valve components.
LG-2 is also suitable for bearing and gearing applications that are light duty and negligible loading.

Stocked Sizes	-	Solid	½'' – 8'' Ø
		Hollow	1'' – 10'' O/D

Related Specifications		
UNS	C83600	
German	CuSn5ZnPb	
Japan	JIS CAC402C (BC6)	
USA	ASTM B271/B505 SAE 40/J462	
Chemical Composition*		
	Min. %	**Max %**
Tin	4.0	6.0
Lead	4.0	6.0
Zinc	4.0	6.0
Nickel	0	1.0
Copper	Balance	

Typical Mechanical Properties – (For Guidance Only)	
Tensile Strength (Mpa)	270-300 MPa
Yield Strength (Mpa)	120 MPa
Elongation (%)	20
Hardness (Brinell BHN)	75 BHN
Other Information	
Specific Gravity	8.8
Maximum Recommended Operating Temperature	230 Deg C
Stress Relieving Temperature	260 Deg C
Time at Temperature	1 hour per 25mm of section thickness

VULCAN
Engineering Steels

PB-1 PHOSPHOR BRONZE

PB-1 is a phosphor bronze in accordance with BS1400 (1985). It has good machining properties and combines high strength with good corrosion resistance to saltwater and brine. This makes it ideally suitable for pump and valve components. PB-1 is also suitable for bearings with medium to high loads but must have adequate lubrication and good alignment. It is also ideally suited for heavy duty gears and wormwheels with high working loads and speeds providing adequate lubrication and alignment is considered.

Sizes Available	-	Solid	3/4'' – 8'' Ø
		Hollow	1'' – 8'' O/D

Related Specifications		
United Kingdom	BS1400 PB-1	
UNS	C90700/C90710	
German	CuSn10	
Japan	CAC502C (PBC2C)	
USA	ASTM B505 SAE 65	
Chemical Composition*		
	Min. %	**Max %**
Tin	10.0	11.0
Phosphorous	0.50	1.0
Lead		0.25
Copper	Balance	

Typical Mechanical Properties – (For Guidance Only)	
Tensile Strength (Mpa)	340-360 MPa
Yield Strength (Mpa)	170 MPa
Elongation (%)	10%
Hardness (Brinell BHN)	100-150 BHN
Other Information	
Specific Gravity	8.8
Maximum Recommended Operating Temperature	250 Deg C
Stress Relieving Temperature	260 Deg C
Time at Temperature	1 hour per 25mm of section thickness

VULCAN
Engineering Steels

1020 CARBON STEEL BAR

1020 is a low carbon mild steel. This bar is supplied in As Rolled black condition, with sizes over 250mm also supplied in forged and Rough Machined condition. 1020 combines excellent weldability, with good machinability and very good ductility.
Typical Applications are: General Engineering Parts and Components, Welded Structures etc. In carburised condition: Camshafts, Light Duty Gears, Gudgeon Pins, Ratchets, Spindles, Worm Gears etc.

Stocked Sizes	-	As Rolled Round	36 mm – 300 mm Ø
		Forged Rough Machined	250 mm – 530 mm Ø

Related Specifications		
Australia	AS 1442/1443 – 1992 1020	
Japan	JIS G4051 S20C	
USA	AISI 1020 ASTM A29 – 91 1020 SAE 1020 UNS G10200	
Chemical Composition*		
	Min. %	**Max %**
Carbon	0.18	0.23
Silicon	0.10	0.35
Manganese	0.30	0.60
Phosphorous		0.04
Sulphur		0.04

*Vulcan allow for a maximum Chromium content of 0.5%

Typical Mechanical Properties – As Rolled (For Guidance Only)	
Tensile Strength (Mpa)	360-560
Yield Strength (Mpa)	280-350
Elongation in 50mm (%)	36
Hardness (Brinell BHN)	110-170
Annealing	
Heat to 870-910 Deg C. Hold until temperature is uniform throughout the section and allow to cool in furnace.	
Normalizing	
Heat to 890- 940 Deg C. Hold until temperature is uniform through the section, soak for 10-15 minutes and allow to cool in still air.	
Stress Relieving	
Heat to 650-700 Deg C. Hold until temperature is uniform throughout the section, soak for 1 hour per 25mm of section, and cool in still air	

VULCAN
Engineering Steels

1045 MEDIUM TENSILE CARBON STEEL BAR

1045 is a medium tensile carbon mild steel. This bar is supplied in As Rolled black condition, with sizes over 250mm also supplied in forged and Rough Machined condition. 1045 combines good strength and impact properties with good machinability with reasonable weldability.
1045 is used extensively across all industry sectors due to it's versatility and flame/induction hardening capabilities.
Typical applications include Axles, Bolts, Sprockets/Gears, Connecting Rods, Hydraulic Clamps, Rams, Pins, Rolls, Studs, Shafts Spindles etc.

Stocked Sizes	-	**Round** -	As Rolled Round	20 mm – 250 mm Ø
			Forged Rough Machined	250 mm – 750 mm Ø
		Square -	As Rolled Square	40 mm – 100 mm Sq

Related Specifications	
Australia	AS 1442/1443 – 1992 1045
Germany	C45 (W.Nr 1.0503) CK45 (W. Nr 1.1191)
Japan	JIS G4051 S45C
USA	AISI C1045 ASTM A29 – 91 1045 SAE 1045 UNS G10450

Chemical Composition*		
	Min. %	**Max %**
Carbon	0.43	0.50
Silicon	0.10	0.35
Manganese	0.60	0.90
Phosphorous		0.04
Sulphur		0.04

*Vulcan allow for a maximum Chromium content of 0.5%

Typical Mechanical Properties – As Rolled (For Guidance Only)	
Tensile Strength (Mpa)	570-700
Yield Strength (Mpa)	300-450
Elongation in 50mm (%)	14-30
Hardness (Brinell BHN)	170-210
Annealing	
Heat to 800-850 Deg C. Hold until temperature is uniform throughout the section and allow to cool in furnace.	
Normalizing	
Heat to 870- 920 Deg C. Hold until temperature is uniform through the section, soak for 10-15 minutes and allow to cool in still air.	
Stress Relieving	
Heat to 550-660 Deg C. Hold until temperature is uniform throughout the section, soak for 1 hour per 25mm of section, and cool in still air	

VULCAN
Engineering Steels

1.6587 CASE HARDENING STEEL

1.6587 is a 1.8% Chromium – Nickel – Molybdenum high hardenability, case hardening steel, generally supplied in the annealed condition with hardness around 225 Bhn. As with EN36A, 1.6587 has high core strength and toughness with case hardening capability up to 62 HRC.
Typical uses include: Large gears, heavy duty bushing, bearings, cam followers, extractors, shafts, wear pins, pump shafts, sprockets etc.

Stocked Sizes	-	Rounds	33 mm – 610 mm Ø
Finishes	-	Peeled/Rough Machined	

Related Specifications		
Australia	AS1444-1996-X4317	
Germany	W. Nr 1.6587 DIN 17CrNiMo6/18CrNiMo7-6	
United Kingdom	BS970 Part 3 1991 – 820M17/822M17 BS 970 1955 – EN354/EN355	
USA	SAE 4317	
Chemical Composition		
	Min. %	**Max %**
Carbon	0.15	0.21
Silicon		0.40
Manganese	0.50	0.90
Nickel	1.40	1.70
Chromium	1.50	1.80
Molybdenum	0.25	0.35
Phosphorous		0.035
Sulphur		0.035

Typical Mechanical Properties in the Annealed Condition		
Mechanical Property Designation		
Tensile Strength Mpa	Approx.	700
0.20% Proof Stress (Yield) Mpa	Approx.	520
Elongation on %	Approx.	23
Hardness Brinell HB	Approx.	200 (Max. 230 BHN)
Annealing		
Heat to 830-850 Deg C. Hold until temperature is uniform throughout the section and allow to cool in furnace.		

VULCAN
Engineering Steels

8620 CASE HARDENING STEEL

8620 is a low nickel – chromium – molybdenum case hardening steel. 8620 is generally supplied in the as rolled condition and is primarily carburised with surface hardness up to 62 HRC.
Used for light to medium stressed components where surface hardness and wear resistance is required, uses include: Arbors, bearings, bushings, cam shafts, pinions, gears, guide pins, splined shafts, ratchets sleeves etc.

Stocked Sizes	-	Rounds	14 mm – 230 mm Ø
Finishes	-	Hot Rolled, Peeled	

Related Specifications		
Australia	AS1444-1996-8620/8620H	
Germany	W. Nr 1.6523 – DIN 21NiCrMo2	
United Kingdom	BS970 Part 3 1991 - 805M20 BS 970 1955 – EN362	
Japan	JIS G4052 SNCM 220H	
USA	SAE/AISI 8620 ASTM A29/A29M 1991 8620 UNS G86200	
Chemical Composition		
	Min. %	**Max %**
Carbon	0.17	0.23
Silicon	0.10	0.35
Manganese	0.60	0.95
Nickel	0.35	0.75
Chromium	0.35	0.65
Molybdenum	0.15	0.25
Phosphorous		0.04
Sulphur		0.04

Typical Mechanical Properties in the As Rolled Condition		
Mechanical Property Designation		
Tensile Strength Mpa	Approx.	820
0.20% Proof Stress (Yield) Mpa	Approx.	590
Elongation on %	Approx.	22
Hardness Brinell HB	Approx.	240
Annealing		
Heat to 820-850 Deg C. Hold until temperature is uniform throughout the section and allow to cool in furnace.		

VULCAN
Engineering Steels

EN36A CASE HARDENING STEEL

EN36A is a 3.2% Nickel – chromium high hardenability case hardening steel, generally supplied in the annealed condition. Exhibiting high core strength and toughness whilst having the ability to be case hardened up to 62 HRC, typical uses include: Gears, heavy duty bushing, collets, conveyor pins, sprockets, shafts etc.

Stocked Sizes	-	Rounds	14 mm – 260 mm Ø
Finishes	-	Peeled	

Related Specifications		
Australia	AS1444-1996-X3312/X3312H	
Germany	W. Nr 1.5752 – DIN 14NiCr14	
United Kingdom	BS970 Part 3 1991 – 655M13 BS 970 1955 – EN36A	
USA	SAE 3310 9310 UNS G33106/G93106	
Chemical Composition		
	Min. %	**Max %**
Carbon	0.10	0.16
Silicon	0.10	0.40
Manganese	0.35	0.60
Nickel	3.00	3.75
Chromium	0.70	1.00
Molybdenum		0.20
Phosphorous		0.04 (Ultraclean – Max. 0.01)
Sulphur		0.04 (Ultraclean – Max. 0.01)

Typical Mechanical Properties in the Annealed Condition		
Mechanical Property Designation		
Tensile Strength Mpa	Approx.	700/770
0.20% Proof Stress (Yield) Mpa	Approx.	540
Elongation on %	Approx.	25
Hardness Brinell HB	Approx.	220 (Max. 255 BHN)
Annealing		
Heat to 830-850 Deg C. Hold until temperature is uniform throughout the section and allow to cool in furnace.		

VULCAN
Engineering Steels

1045 HARD CHROME PLATED BAR

1045 Chrome Plated Bar is supplied Cold Drawn or Turned, ground, chrome plated and polished condition. Chrome plating hardness has a surface hardness of HV 1000-1150.
1045 Chrome bar is the most commonly used of the Chrome Bar options as it combines good strength and impact properties and a cost effective solution.
Typical Applications include: Agricultural equipment, compressors, jacks, transport lifting equipment, hoists and mining/earthmoving equipment.

Available Sizes - Metric - 6 mm – 200 mm Ø
Imperial - ½'' – 8'' Ø

Related Specifications – Base Material	
Australia	AS 1442/1443 – 1992 1045
Germany	C45 (W.Nr 1.0503) CK45 (W. Nr 1.1191)
Japan	JIS G4051 S45C
USA	AISI C1045 ASTM A29 – 91 1045 SAE 1045 UNS G10450

Chemical Composition*		
	Min. %	**Max %**
Carbon	0.43	0.50
Silicon	0.10	0.35
Manganese	0.60	0.90
Phosphorous		0.04
Sulphur		0.04

Typical Mechanical Properties Based on Turned Bar – (For Guidance Only)	
Tensile Strength (Mpa)	570-700
Yield Strength (Mpa)	300-500
Elongation in 50mm (%)	14-30
Hardness (Brinell BHN)	170-210
Hard Chrome Plating	
Typical Surface Hardness (Chrome Plated)	HV 1000-1150
Typical Surface Smoothness	0.10 – 0.30 um Ra (Microns)
Typical Surface Deposit	0.025-0.050mm (0.001''-0.002'')

Diameter & Straightness Tolerance

Size mm	Up to 51mm dia		Over 51mm to 102mm Dia		Over 102 mm dia	
Dia Tol (mm)	+0	-0.025	+0	-0.05	+0	-0.075
Straightness	0.25mm/1000mm		0.30mm/1000mm			

VULCAN
Engineering Steels

1045 INDUCTION HARDENED CHROME PLATED BAR

1045 Chrome Plated Bar is supplied Cold Drawn or Turned, Induction Hardened, ground, chrome plated and polished condition. Chrome plating hardness has a surface hardness of HV 1000-1150, and is Induction Hardened to a depth of approximately 3mm and a hardness of 55-65 HRC.
1045 Chrome bar is the most commonly used of the Chrome Bar options as it combines good strength and impact properties and a cost effective solution.
Typical Applications include: Mining and Earthmoving Equipment as well as heavy duty industrial equipment.

Available Sizes - Metric - 25 mm – 110 mm Ø
Imperial - 1'' – 6'' Ø

Related Specifications – Base Material		
Australia	AS 1442/1443 – 1992 1045	
Germany	C45 (W.Nr 1.0503) CK45 (W. Nr 1.1191)	
Japan	JIS G4051 S45C	
USA	AISI C1045 ASTM A29 – 91 1045 SAE 1045 UNS G10450	
Chemical Composition*		
	Min. %	**Max %**
Carbon	0.43	0.50
Silicon	0.10	0.35
Manganese	0.60	0.90
Phosphorous		0.04
Sulphur		0.04

Typical Mechanical Properties Based on Turned Bar – (For Guidance Only)						
Tensile Strength (Mpa)	570-700					
Yield Strength (Mpa)	300-500					
Elongation in 50mm (%)	14-30					
Hardness (Brinell BHN)	170-210					
Typical Induction Hardened Case Properties						
Depth of hardness	Approx. 3mm					
Hardness	55-65 HRC					
Hard Chrome Plating						
Typical Surface Hardness (Chrome Plated)	HV 1000-1150					
Typical Surface Smoothness	0.10 – 0.30 um Ra (Microns)					
Typical Surface Deposit	0.025-0.050mm (0.001''-0.002'')					
Diameter & Straightness Tolerance						
Size mm	Up to 51mm dia		Over 51mm to 102mm Dia		Over 102 mm dia	
Dia Tol (mm)	+0	-0.025	+0	-0.05	+0	-0.075
Straightness	0.25mm/1000mm		0.30mm/1000mm			

VULCAN
Engineering Steels

4140 HARD CHROME PLATED BAR

4140 High Tensile Chrome Plated Bar is supplied in the hardened and tempered condition, Cold Drawn or Turned, ground, chrome plated and polished. Chrome plating hardness has a surface hardness of HV 1000-1150.
4140 Chrome bar is used in applications demanding higher yield and tensile strength compared to 1045 Chrome Bar, and is also available in the Induction Hardened condition in some sizes. Induction Hardened 4140 generally has a hardened depth of approximately 3mm and hardness of 55-65 HRC.
Typical Applications include: Agricultural equipment, compressors, jacks, transport lifting equipment, hoists and mining/earthmoving equipment.

Available Sizes - Metric - 20 mm – 120 mm Ø
Imperial - 3/4'' – 6'' Ø

Related Specifications – Base Material	
Australia	AS 1444 – 1996 4140
Germany	W. Nr 1.7225 42CrMo4
Japan	JIS G4105 SCM440
USA	AISI/SAE 4140 ASTM A29/A29M – 91 4140 UNS G41400

Chemical Composition*		
	Min. %	**Max %**
Carbon	0.36	0.44
Silicon	0.10	0.40
Manganese	0.65	1.10
Chromium	0.75	1.20
Molybdenum	0.15	0.35
Phosphorous		0.04
Sulphur		0.04

Typical Mechanical Properties Based on Turned Bar – (For Guidance Only)						
Tensile Strength (Mpa)	850-1000					
Yield Strength (Mpa)	650-850					
Elongation in 50mm (%)	14-30					
Hardness (Brinell BHN)	248-302					
Hard Chrome Plating						
Typical Surface Hardness (Chrome Plated)	HV 1000-1150					
Typical Surface Smoothness	0.10 – 0.30 um Ra (Microns)					
Typical Surface Deposit	0.025-0.050mm (0.001''-0.002'')					
Diameter & Straightness Tolerance						
Size mm	Up to 51mm dia		Over 51mm to 102mm Dia		Over 102 mm dia	
Dia Tol (mm)	+0	-0.025	+0	-0.05	+0	-0.075
Straightness	0.25mm/1000mm		0.30mm/1000mm			

VULCAN
Engineering Steels

20MnV6 HOLLOW BAR

20MnV6 Hollow Bar is a Vanadium micro alloyed carbon-manganese steel. Supplied in the as rolled or cold drawn condition (size dependent), it has a typical ultimate tensile range of 550-790 Mpa and high typical yield strength of 430-570 Mpa. 20mnV6 is a readily weldable, high yield/tensile strength micro alloy steel, and is extensively used in almost all industry sectors for a wide range of applications.

Stocked Sizes	-	Rounds	EN Sizes - 30 mm O/D – 250 mm O/D ISO Sizes – 250 mm O/D to 610 mm O/D
Finishes	-	Hot Rolled and Cold Rolled	

Related Specifications		
Europe	EN 10294-1 2005 – E470	
Germany	W. Nr. 1.5217 20MnV6	
USA	UNS K01907	
Chemical Composition		
	Min. %	**Max %**
Carbon	0.16	0.22
Silicon	0.10	0.50
Manganese	1.30	1.70
Vanadium	0.08	0.15
Phosphorous	0	0.03
Sulphur	0.015	0.05

Mechanical Properties as Rolled		
Tensile Strength Mpa (Min)	<16mm Wall	650
	16mm<25mm Wall	620
	>25mm Wall	550
0.20% Proof Stress (Yield) Mpa	<16mm Wall	470
	16mm<25mm Wall	460
	25mm<70mm Wall	430
	<70mm Wall	Ask For Test Cert
Elongation % Min		17%
Hardness Brinell HB Min		170 BHN
Annealing		
Heat to 815-850 Deg C. Hold until temperature is uniform throughout the section and allow to cool in furnace.		

VULCAN
Engineering Steels

316/L STAINLESS STEEL HOLLOW BAR

316/L is a low carbon austenitic marine grade stainless steel. It is characterized as a good strength stainless steel with excellent corrosion resistance in the annealed condition. Optimum corrosion resistance is achieved in annealed condition.
316/L Stainless Steel is not suitable for hardening by thermal treatment, but can be increased by cold working. Note that this has a corresponding reduction in ductility.
Typical uses include: Textile Equipment, Marine Equipment and fittings, Pulp and Paper processing equipment, medical equipment etc.

Stocked Sizes - 32 mm – 400 mm O/D

Related Specifications		
Germany	W Nr 1.4404 X2CrNiMo17 13 2 W Nr 1.4435 X2CrNiMo18 14 3	
USA	ASTM A511-96 316L SAE 30316L AISI 316L UNS S31603	
Chemical Composition		
	Min. %	**Max %**
Carbon	0	0.08 (316L – 0.03)
Silicon	0	1.00
Manganese	0	2.00
Nickel	10.00	15.00
Chromium	16.00	18.00
Molybdenum	2.00	3.00
Phosphorous		0.045
Sulphur		0.030

Typical Mechanical Properties – At Room Temperature in rolled annealed condition (For Guidance Only)	
Tensile Strength (Mpa)	580
Yield Strength (Mpa)	290
Elongation in 50mm (%)	50
Hardness (Brinell BHN)	175
Annealing	
Heat to 1020-1100 Deg C. Hold until temperature is uniform throughout the section. Soak as required (Min 30 minutes per 25mm of section). Quench in water to optimize corrosion resistance.	

VULCAN
Engineering Steels

303 STAINLESS STEEL

303 is a free machining austenitic stainless steel with good strength and corrosion resistance. 303 is characterized by excellent machinability and non-galling properties. The Sulphur addition does slightly lower it's corrosion resistance when compared to 304 S/S, and has low resistance to acids.
303 cannot be hardened by thermal treatment, but strength and hardness can be improved by cold drawing with subsequent reduction in ductility.

Stocked Sizes	-	Rounds	6 mm – 150 mm Ø
Bar Finishes	-	Peeled, Turned & Polished, Cold Drawn & Centreless Ground	

Related Specifications		
Germany	W Nr 1.4305 X10CrNiS 18 9	
Japan	JIS G4303 SUS 303	
United Kingdom	BS970 Part 3 1991 303S31 BS970 1955 EN58M	
USA	ASTM A582/582M-95b 303 SAE 30303 AISI 303 UNS S30300	
Chemical Composition*		
	Min. %	**Max %**
Carbon	0	0.15
Silicon	0	1.00
Manganese	0	2.00
Nickel	8.00	10.00
Chromium	17.00	19.00
Phosphorous	0	0.06
Sulphur	0.15	0.35
***Molybdenum content up to 1.00% is optional**		
Mechanical Property Requirements to ASTM A582/582M-95b 303 is annealed to Max 262 Bhn		
Typical Mechanical Properties (For Ref Only)	**Cold Drawn**	**Other**
Tensile Strength Mpa	690	550
0.20% Proof Stress (Yield) Mpa	415	240
Elongation on %	36	55
Charpy Impact J		120
Hardness Brinell HB	220	165
Annealing		
Heat uniformly to 1150-1200 Deg C. Hold until temperature is uniform throughout section. Soak as required (as a guide 30 minutes per 25mm of section) Quench in water to optimize corrosion resistance.		

VULCAN
Engineering Steels

304 STAINLESS STEEL

304 is a chromium-nickel austenitic stainless steel with good strength and very good corrosion resistance. 304 has very good corrosion resistance to most oxidizing agents. 304 cannot be hardened by thermal treatment, but strength and hardness can be improved by cold drawing with subsequent reduction in ductility. This is a non-magnetic grade, however it can become mildly magnetic following cold working. Annealing is required to rectify if necessary.

Stocked Sizes	-	Rounds	4.76 mm – 203.2 mm Ø
Bar Finishes	-	Peeled, Turned & Polished, Cold Drawn & Centreless Ground	

Related Specifications		
Germany	W. Nr 1.4301 X5CrNi 18 10	
Japan	JIS G4303 SUS 304	
United Kingdom	BS 970 Pt 3 1991 304S15/304S31	
USA	ASTM A276-98b 304 SAE 30304 AISI 304 UNS30400	
Chemical Composition*		
	Min. %	**Max %**
Carbon	0	0.08
Silicon	0	1.00
Manganese	0	2.00
Nickel	8.00	10.50
Chromium	18.00	20.00
Phosphorous	0	0.045
Sulphur	0	0.03
***Molybdenum content up to 1.00% is optional**		

Typical Mechanical Properties (For Ref Only)	**Cold Drawn**	**Other**
Tensile Strength Mpa	680	590
0.20% Proof Stress (Yield) Mpa	500	240
Elongation on %	42	55
Hardness Brinell HB	195	155

Annealing

Heat uniformly to 1020-1100 Deg C. Hold until temperature is uniform throughout section. Soak as required (as a guide 30 minutes per 25mm of section) Quench in water to optimize corrosion resistance.

VULCAN
Engineering Steels

316/316L STAINLESS STEEL

316 is a chromium-nickel-molybdenum austenitic stainless steel with good strength and excellent corrosion resistance. Supplied in the annealed condition and with the addition of molybdenum, 316 stainless steel is ideally suited for marine applications, as well as showing excellent resistance to a variety of chemicals. 316L has a reduced carbon content which increases weldability and reduces the need for post weld annealing. Both 316 and 316L cannot be hardened further by thermal heat treatment, but strength and hardness can be significantly improved by cold working, with subsequent reduction in ductility. 316/316L is non magnetic, but can become mildly magnetic after heavy cold working. Annealing is required to rectify this problem, as well as optimizing corrosion resistance.

Stocked Sizes	-	Rounds	4.76 mm – 450 mm Ø
	-	Hexagon	7.94mm – 63.5mm A/F
	-	Square	6.35mm – 50mm A/F
Bar Finishes	-	Peeled, Turned & Polished, Cold Drawn & Centreless Ground	

Related Specifications	**316 S/S**	**316L S/S**
Germany	W. Nr 1.4401 X5CrNiMo17 12 2	W. Nr 1.4404 X2CrNiMo17 12 2
Japan	JIS G4303 SUS 316	JIS G4303 SuS 316L
United Kingdom	BS 970 Pt 3 1991 316S31/316S33 BS 970 1955 EN58J	BS 970 Pt 3 1991 316S11/316S13
USA	ASTM A276-98b 316 SAE 30316 AISI 316 UNS31600	ASTM A276-98b 316L SAE 30316L AISI 316L UNS31603
Chemical Composition*		
	316 S/S	**316L S/S**
Carbon	0.07% Max	0.03% Max
Silicon	1.00% Max	1.00% Max
Manganese	2.00% Max	2.00% Max
Nickel	10.00 – 14.00%	10.00 – 14.00%
Chromium	16.00 – 18.00%	16.00 – 18.00%
Molybdenum	2.00 – 3.00%	2.00 – 3.00%
Phosphorous	0.045% Max	0.045% Max
Sulphur	0.030% Max	0.030% Max

Annealed Typical Mechanical Properties (For Ref Only)	**Cold Drawn**	**Other**
Tensile Strength Mpa	680	590
0.20% Proof Stress (Yield) Mpa	500	280
Elongation on %	42	55
Hardness Brinell HB	195	155

Annealing

Heat uniformly to 1020-1100 Deg C. Hold until temperature is uniform throughout section. Soak as required (as a guide 30 minutes per 25mm of section) Quench in water to optimize corrosion resistance. Please consult your heat treater for best results

VULCAN
Engineering Steels

431 MARTENSITIC STAINLESS STEEL

431 is a high chromium- low nickel high hardenability martensitic stainless steel which exhibits high strength and good corrosion resistance. It is generally supplied hardened and tempered to 850-1000 Mpa UTS (Condition T). 431 is capable of being through hardened up to 44 HRC, as well as the ability to be nitride with surface hardness up to 65 HRC. Note that nitriding does reduce the corrosion resistance of this grade and should be considered carefully when choosing this process.
Typical uses include pump shafts, propeller shafts, studs, valve parts, fasteners etc.

Stocked Sizes	-	Rounds	6.35 mm – 230 mm Ø
Bar Finishes	-	Peeled, Turned & Polished, Cold Drawn & Centreless Ground	

Related Specifications		
Germany	W. Nr 1.4057 X20CrNi17 2	
Japan	JIS G4303 SUS 431	
United Kingdom	BS 970 Pt 3 1991 431S29	
USA	ASTM A276-98b 431 SAE 51431 AISI 431 UNS43100	
Chemical Composition		
	Min. %	**Max %**
Carbon	0.12	0.20
Silicon	0	1.00
Manganese	0	1.00
Nickel	1.25	2.50
Chromium	15.00	17.00
Phosphorous	0	0.04
Sulphur	0	0.03

Typical Mechanical Properties	**Annealed**	**Q&T Cond T**
Tensile Strength Mpa		850-1000
0.20% Proof Stress (Yield) Mpa		635 Min
Elongation on %		11
Hardness Brinell HB	277 Max	248-302

Annealing

Full annealing of this grade is not possible, as 431 hardens even during a slow cooling cycle. It is recommended that you consult with a heat treatment company should you wish to anneal this material. Process annealing is performed at 620-660 deg C and then air cooled.

VULCAN
Engineering Steels

HARDNESS CONVERSION CHART

Brinell	Diamond Pyramid Scale HV10 HV30	Rockwell Scale			Approx. Tensile Strength Comparison (Guide Only)			
		"C" Scale	"B" Scale	"A" Scale	Mpa N/mm2	Kg/mm2	Tons Per Sq Inch	1000lb per Sq Inch
116	122		67		401	42	26	58
121	127		70		432	44	28	63
126	132		72.5		448	46	29	65
131	137		75		455	47	29.5	66
137	143		77		463	48	30	67
143	150		80		479	49	31	69
149	156		82		494	51	32	72
156	163		84.2		525	54	34	76
163	171		86		540	55	35	78
170	178		88.5		556	57	36	81
179	188		91		602	62	39	88
187	196		93		632	65	41	92
197	212		96		664	68	43	97
207	218		97		695	71	45	101
212	222		98		710	73	46	103
217	228				741	76	48	107
223	234	20.8		60.7	756	77	49	110
229	241	22		61.6	772	79	50	112
235	247	23		62	787	81	51	114
241	255	24.3		62.6	818	84	53	118
248	261	25.2		34	849	87	55	123
255	269	26.6		63.6	865	89	56	125
262	275	27.5		64	895	91	58	130
269	284	29		64.6	911	93	59	132
277	292	29.8		65.2	942	96	61	136
285	300	30.9		65.7	973	99	63	141
293	308	32		66.2	988	101	64	143
302	318	33		66.8	1019	104	66	147
311	327	34		67.5	1050	107	68	152
321	337	35		68	1096	111	71	159
331	349	36.7		68.8	1127	114	73	163
341	359	37.7		69.2	1158	118	75	168
352	370	38.8		69.8	1189	121	77	172
363	381	39.9		70.3	1235	126	80	179
375	395	41.3		71	1266	129	82	183
388	408	42.4		71.5	1312	134	85	190
401	422	43.7		72.5	1359	139	88	197
415	437	44.8		73	1420	145	92	206
429	452	46		73.5	1467	150	95	212
444	470	47.5		74.2	1513	155	98	219
461	497	49.5		75.5	1559	160	101	226
477	517	50.7		76.3	1621	165	105	235
495	532	51.9		76.9	1668	170	108	241
514	572	54.4		78.2	1729	176	112	250
534	609	56.1		79	1807	184	117	262
555	630	57.1		79.6	1884	192	122	273
578	670	58.9		80.6	1961	200	127	284
601	698	60		81.2	2039	208	132	295
627	710	60.5		81.5				
630	725	61		81.8				
	740	61.7		82.2				
	760	62.5		82.6				
	780	63.3		83				
	800	64		83.4				

VULCAN
Engineering Steels

TOLERANCE TABLES

Most Common Steel Supply Tolerances

ISO h Tolerance (ISO 286-2)

Diameter (mm)	h6	h7	h8	h9	h10	h11	h12
Up to & Incl 3mm	-0.006/+0	-0.010/+0	-0.014/+0	-0.025/+0	-0.040/+0	-0.060/+0	-0.100/+0
3 < 6mm	-0.008/+0	-0.012/+0	-0.018/+0	-0.030/+0	-0.048/+0	-0.075/+0	-0.120/+0
6 < 10mm	-0.009/+0	-0.015/+0	-0.022/+0	-0.036/+0	-0.058/+0	-0.090/+0	-0.150/+0
10 < 18mm	-0.011/+0	-0.018/+0	-0.027/+0	-0.043/+0	-0.070/+0	-0.110/+0	-0.180/+0
18 < 30mm	-0.013/+0	-0.021/+0	-0.033/+0	-0.052/+0	-0.084/+0	-0.130/+0	-0.210/+0
30 < 50mm	-0.016/+0	-0.025/+0	-0.039/+0	-0.062/+0	-0.100/+0	-0.160/+0	-0.250/+0
50 < 80mm	-0.019/+0	-0.030/+0	-0.046/+0	-0.074/+0	-0.120/+0	-0.190/+0	-0.300/+0
80 < 120mm	-0.022/+0	-0.035/+0	-0.054/+0	-0.087/+0	-0.140/+0	-0.220/+0	-0.350/+0
120 < 180mm	-0.025/+0	-0.040/+0	-0.063/+0	-0.100/+0	-0.160/+0	-0.250/+0	-0.400/+0
180 < 250mm	-0.029/+0	-0.046/+0	-0.072/+0	-0.115/+0	-0.185/+0	-0.290/+0	-0.460/+0
250 < 315mm	-0.032/+0	-0.052/+0	-0.081/+0	-0.130/+0	-0.210/+0	-0.320/+0	-0.52/+0

ISO K Tolerance (ISO 286-2)

Diameter (mm)	K6	K7	K8	K9	K10	K11	K12
Up to & Incl 3mm	+0.006/-0	+0.010/-0	+0.014/-0	+0.025/-0	+0.040/-0	+0.060/-0	+0.100/-0
3 < 6mm	+0.009/+0.001	+0.013/+0.001	+0.018/-0	+0.030/-0	+0.048/-0	+0.075/-0	+0.120/-0
6 < 10mm	+0.010/+0.001	+0.016/+0.001	+0.022/-0	+0.036/-0	+0.058/-0	+0.090/-0	+0.150/-0
10 < 18mm	+0.012/+0.001	+0.023/+0.002	+0.027/-0	+0.043/-0	+0.070/-0	+0.110/-0	+0.180/-0
18 < 30mm	+0.015/+0.002	+0.027/+0.002	+0.033/-0	+0.052/-0	+0.084/-0	+0.130/-0	+0.210/-0
30 < 50mm	+0.018/+0.002	+0.032/+0.002	+0.039/-0	+0.062/-0	+0.100/-0	+0.160/-0	+0.250/-0
50 < 80mm	+0.021/+0.002	+0.038/+0.003	+0.046/-0	+0.074/-0	+0.120/-0	+0.190/-0	+0.300/-0
80 < 120mm	+0.025/+0.003	+0.043/+0.003	+0.054/-0	+0.087/-0	+0.140/-0	+0.220/-0	+0.350/-0
120 < 180mm	+0.028/+0.003	+0.050/+0.004	+0.063/-0	+0.100/-0	+0.160/-0	+0.250/-0	+0.400/-0
180 < 250mm	+0.033/+0.004	+0.050/+0.004	+0.072/-0	+0.115/-0	+0.185/-0	+0.290/-0	+0.460/-0
250 < 315mm	+0.036/+0.004	+0.056/+0.004	+0.081/-0	+0.130/-0	+0.210/-0	+0.320/-0	+0.520/-0

Other Tolerances

ISO j Tolerance (ISO 286-2)

Diameter (mm)	j5	j6	j7
Up to & Incl 3mm		+0.004/-0.002	+0.006/-0.004
3 < 6mm	+0.003/-0.002	+0.006/-0.002	+0.008/-0.004
6 < 10mm	+0.004/-0.002	+0.007/-0.002	+0.010/-0.005
10 < 18mm	+0.005/-0.003	+0.008/-0.002	+0.012/-0.006
18 < 30mm	+0.005/-0.004	+0.009/-0.004	+0.013/-0.008
30 < 50mm	+0.006/-0.005	+0.011/-0.005	+0.015/-0.010
50 < 80mm	+0.006/-0.007	+0.012/-0.007	+0.018/-0.012
80 < 120mm	+0.006/-0.009	+0.013/-0.009	+0.020/-0.015
120 < 180mm	+0.007/-0.011	+0.014/-0.011	+0.022/-0.018
180 < 250mm	+0.007/-0.013	+0.016/-0.013	+0.025/-0.021
250 < 315mm	+0.007/-0.016		