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PRODUCT GUIDE

ENGINEERING STEELS

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Steel & Tube is pleased to provide this Engineering Steels Product Guide to assist you in the design and specification process for these products.

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Engineering Steel enquiries

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ENGINEERING STEELS

Steel & Tube holds a range of engineering steels in multiple branches throughout New Zealand, with the main hubs in Auckland and Christchurch.

Common ranges (bright and black round bars) are available nationwide, while specialty products - such as induction hardened hard chrome bar - are generally held in one of our main centres. We can update stock to best suit local needs so please contact one of our product specialists to discuss your requirements.

Steel & Tube also offers an indent service to complement our local stock.

CUTTING SERVICES

Steel & Tube offers a cutting service on a range of engineering steels, with the main cutting centres located in Auckland and Christchurch.

Smaller bars can be cut for transport on abrasive saws held in most branches – whilst larger pieces or billet jobs can be cut on automated bandsaws from some locations (the largest being 580mm diameter in Auckland)

The cutting tolerance is generally given as -0/+3mm.

For more detailed information and pricing, please contact one of our specialists.

BRIGHT FREE MACHINING STEEL AISI 1215

AISI 1215 low carbon free cutting steel, bright drawn or smooth turned with a high and consistent level of machinability but limited strength and ductility.

COLOUR CODE PINK

TYPICAL CHEMICAL ANALYSIS

C	Si	Mn	P	S
0.07%	0.01%	1.00%	0.050%	0.30%

TYPICAL APPLICATIONS
Heavily machined parts and components subject to low stresses.

Will ***Carburise*** or ***Carbonitride*** – typical surface hardness up to ***HRC 60***.
Not suitable for nitriding, flame or induction hardening or through hardening.

PLATING
Will electroplate but not recommended for hot dip galvanising.

TYPICAL MECHANICAL PROPERTIES
for guidance only

FINISH	Re (MPa)	Rm (MPa)	A %	HB
Bright Drawn	290 – 550	400 – 650	7 min	115 – 200
Smooth Turned	230 – 310	370 – 500	17 min	100 – 150

WELDABILITY
Moderate due to high sulphur content.

WELDING
Electrodes suitable for re-sulphurised steel are recommended, a pre-heat or post-heat is not generally required however; pre-heating larger sections can be beneficial as can a post-weld stress relieve.

CARBURISE	AT 900°C – 920°C	**CORE REFINE OPTIONAL**	AT 880°C – 900°C
CASE HARDEN	AT 760°C – 790°C	**TEMPER**	AT 120°C – 230°C

› Welding and Carburising details for guidance only

BRIGHT FREE MACHINING STEEL AISI 1215 - STOCK RANGE

ROUND DRAWN	ROUND TURNED	HEX DRAWN	SQUARE DRAWN
3/16"	2-3/4"	7/16"	5/16"
1/4"	3"	1/2"	3/8"
5/16"	3-1/4"	9/16"	1/2
3/8"	3-1/2"	5/8"	5/8"
7/16"	4"	3/4"	3/4"
1/2"	4-1/2"	7/8"	7/8"
9/16"	5"	15/16"	1"
5/8"	6"	1"	1-1/4"
11/16"	70mm	1-1/8"	1-1/2"
3/4"	75mm	1-1/4"	1-3/4"
7/8"	80mm	1-3/8"	2"
1"	85mm	1-1/2"	2-1/2"
1-1/8"	90mm	1-5/8"	3"
1-1/4"	100mm	1-3/4"	3-1/2"
1-3/8"		1.67"	4"
1-1/2"		2"	5"
1-5/8"		2-1/4"	6"
1-3/4"		2-1/2"	
1-7/8"		2-3/4"	
2"		2.76"	
2-1/8"		3"	
2-1/4"		3-1/2"	
2-1/2"		27mm	
6mm		30mm	
8mm		60mm	
10mm		70mm	
15mm			
20mm			
25mm			
30mm			
35mm			
36mm			
40mm			
45mm			
50mm			
60mm			
65mm			

BRIGHT COMMERCIAL QUALITY MILD STEEL AISI 1018

AISI 1018 low carbon commercial quality mild steel, bright drawn or smooth turned with a good balance of strength, ductility and toughness plus excellent weldability, very good formability and machinability.

COLOUR CODE RED

TYPICAL CHEMICAL ANALYSIS

C	Si	Mn	P	S
0.17%	0.27%	0.80%	0.050% max	0.050% max

TYPICAL APPLICATIONS:
Axles, bolts, connecting rods, motor shafts, hydraulic shafts, pins, pump shafts, camshafts, light duty gears, spindles and ratchets etc.

Will ***Carburise*** or ***Carbonitride*** – typical surface hardness up to ***HRC 60***.
Not suitable for nitriding, flame or induction hardening or through hardening.

PLATING:
Will electroplate but not recommended for hot dip galvanising unless silicon content is below 0.05%.

TYPICAL MECHANICAL PROPERTIES

FINISH	Re (MPa)	Rm (MPa)	A %	HB
Bright Drawn	340 – 600	430 – 750	12 min	120 – 220
Smooth Turned	230 – 330	410 – 560	22 min	120 – 170

WELDING
low carbon electrodes recommended. Pre-heat or post-heat not usually required however; pre-heating larger sections can be beneficial as can a post-weld stress relieve.

CARBURISE AT 880°C – 920°C

CASE HARDEN AT 780°C – 820°C

CORE REFINE OPTIONAL AT 870°C – 900°C

TEMPER AT 150°C – 200°C

› Welding and Carburising details for guidance only

BRIGHT COMMERCIAL QUALITY MILD STEEL AISI 1018 - STOCK RANGE

STOCK SIZES BRIGHT ROUND	STOCK SIZES BRIGHT ROUND	STOCK SIZES BRIGHT FLAT
1/4"	6mm	1" x 5/16"
5/16"	8mm	3" x 2"
3/8"	10mm	50 x 10mm
7/16"	12mm	50 x 12mm
1/2"	16mm	72 x 25mm
9/16"	20mm	80 x 40mm
5/8"	30mm	
3/4"	35mm	
7/8"	40mm	
1"	45mm	
1-1/8"	50mm	
1-1/4"	60mm	
1-3/8"	65mm	
1-1/2"	70mm	
1-3/4"	75mm	
1-7/8"	80mm	
2"	90mm	
2-1/4"	100mm	
2-1/2"		
2-3/4"		
3"		
3-1/4"		
3-1/2"		
4"		
4-1/2"		
5"		
6"		

MEDIUM TENSILE STEEL AISI 1045

AISI 1045 medium tensile steel, hot rolled or forged and bright drawn or smooth turned with a good combination of strength, toughness and wear resistance.

COLOUR CODE YELLOW

TYPICAL CHEMICAL ANALYSIS

C	Si	Mn	P	S
0.45%	0.25%	0.75%	0.050% max	0.050% max

TYPICAL APPLICATIONS
Axles, bolts, connecting rods, hydraulic rams, pins, spindles, shafts, studs, rolls etc.

Will ***Flame*** or ***Induction Harden*** with typical surface hardness up to ***HRC 58***, and ***Through Harden*** in sections up to 63mm – with tensile strengths of ***620 – 850MPa***.

PLATING:
Will electroplate but not recommended for hot dip galvanising.

TYPICAL MECHANICAL PROPERTIES

FINISH	Re (MPa)	Rm (MPa)	A %	HB
Bright Drawn	500 – 650	640 – 850	8 min	190 – 270
Turned/Hot Rolled/Forged	300 – 450	570 – 700	14 – 30	170 – 210

WELDING:
low hydrogen electrodes recommended. Pre-heat at 200 – 300°C and maintain during welding. Cool slowly in sand etc, followed when possible with a stress relieve.

HARDEN	AT 820°C – 860°C	**TEMPER**	AT 400°C – 680°C
FLAME OR INDUCTION HARDEN	AT 830°C – 860°C	**TEMPER**	AT 150°C – 200°C

- Welding and Carburising details for guidance only
- All de-carburized material must first be removed

MEDIUM TENSILE STEEL AISI 1045 - STOCK RANGE

STOCK SIZES BRIGHT ROUND IMPERIAL SIZES	STOCK SIZES BRIGHT ROUND METRIC SIZES	BLACK ROUND	STOCK SIZES BLACK ROUND
5/16"	10mm	60mm	250 mm
3/8"	12mm	65mm	260mm
7/16"	16mm	70mm	270mm
1/2"	20mm	75mm	280mm
9/16"	24mm	80mm	290mm
5/8"	25mm	90mm	300mm
3/4"	30mm	95mm	310mm
7/8"	35mm	100mm	320mm
1"	40mm	105mm	330mm
1-1/8"	45mm	110mm	340mm
1-1/4"	50mm	115mm	350mm
1-3/8"	60mm	120mm	360mm
1-1/2"	65mm	130mm	370mm
1-3/4"	70mm	140mm	380mm
1-7/8"	75mm	150mm	400mm
2"	80mm	160mm	410mm
2-1/8"	90mm	170mm	420mm
2-1/4"	100mm	180mm	440mm
2-1/2"	120mm	190mm	450mm
2-3/4"		200mm	470mm
3"		210mm	480mm
3-1/4"		220mm	500mm
3-1/2"		230mm	510mm
4"		240mm	525mm
			540mm
			550mm

HIGH TENSILE STEEL AISI 4140

4140 high tensile steel supplied hardened & tempered with tensile strengths of 850 – 1000 MPa in sections up to 100mm, and aiming for this strength in larger sections. It offers a good combination of strength, toughness and wear-resistance.

COLOUR CODE GREEN

TYPICAL CHEMICAL ANALYSIS:

C	Si	Mn	Cr	Mo
0.40%	0.25%	0.85%	1.00%	0.25%

TYPICAL APPLICATIONS

Axles, conveyor parts, crow bars, gears, logging parts, spindles, shafts, sprockets, studs, pinions, pump shafts, rams, ring gears etc.

Will ***Nitride*** with a typical surface hardness up to ***HRC 60***.

Will ***Flame*** or ***Induction Harden*** with a typical surface hardness up to ***HRC 54***.

MECHANICAL PROPERTY REQUIREMENTS IN CONDITION "T" – TO AS 1444-1996

SECTION mm	Rp 0.2% (MPa)	Rm (MPa)	A %	Izod J	Charpy J	HB
*up to 63	680 min	850 – 1000	9 min	-	-	248 – 302
up to 100	665 min	850 – 1000	13 min	54 min	50 min	248 – 302

* Applies only to bars bright drawn after hardening and tempering.
For sizes over 100mm refer test certificate and allow for lower core strength.

WELDING

Low hydrogen electrodes recommended. Pre-heat at 200 – 300°C and maintain during welding. Cool slowly, followed with a stress relieve.

HARDEN AT 830°C – 880°C **TEMPER** AT 450°C – 700°C

NB: Tempering at 200°C – 420°C results in temper brittleness and should be avoided.

NITRIDE: AT 500°C – 530°C

FLAME OR INDUCTION HARDEN AT 860°C – 890°C **TEMPER** AT 150°C – 200°C

NB: All de-carburised surface material must first be removed.

› Welding and Carburising details for guidance only

HIGH TENSILE STEEL AISI 4140 - STOCK RANGE

STOCK SIZES BRIGHT	STOCK SIZES BRIGHT	STOCK SIZES CG
1/2"	65 mm	1/2"
9/16"	66mm	5/8"
5/8"	70mm	3/4"
11/16"	75mm	7/8"
3/4"	80mm	1"
7/8"	90mm	1-1/8"
1"	100mm	1-1/4"
1-1/8"	105mm	1-3/8"
1-1/4"	110mm	1-1/2"
1-3/8"	115mm	1-3/4"
1-1/2"	120mm	2"
1-5/8"	130mm	2-1/4"
1-3/4"	140mm	2-1/2"
1-7/8"	150mm	2-3/4"
2"	155mm	3"
2-1/8"	160mm	16mm
2"-1/4"	170mm	20mm
2-1/2"	180mm	25mm
10mm	190mm	30mm
12mm	200mm	35mm
16mm	210mm	40mm
20mm	220mm	45mm
24mm	230mm	50mm
25mm	240mm	60mm
30mm	260mm	65mm
35mm	270mm	70mm
36mm	280mm	75mm
40mm	290mm	80mm
45mm	300mm	90mm
50mm	310mm	
60mm	320mm	
	330mm	
	300mm	
	340mm	
	350mm	
	360mm	
	380mm	
	400mm	
	420mm	
	450mm	

HIGH TENSILE STEEL AISI 4340

AISI 4340 high tensile steel supplied hardened & tempered with tensile strengths of 930 – 1080 MPa in sections up to 100mm, and aiming for this strength in larger sections. It offers a good combination of strength, toughness and wear-resistance.

COLOUR CODE BLUE

TYPICAL CHEMICAL ANALYSIS:

C	Si	Mn	Ni	Cr	Mo
0.40%	0.25%	0.70%	1.85%	0.80%	0.25%

TYPICAL APPLICATIONS

Heavy-duty axles and shafts, heavy-duty gears, spindles, couplings,pins, studs etc.

Will ***Nitride*** with a typical surface hardness up to ***HRC 60***.

Will ***Flame*** or ***Induction Harden*** with a typical surface hardness up to ***HRC 58***.

MECHANICAL PROPERTY REQUIREMENTS IN CONDITION "U" – TO AS 1444-1996

SECTION mm	Rp 0.2% (MPa)	Rm (MPa)	A %	Izod J	Charpy J	HB
*up to 63	755 min	930 – 1080	9 min	-	-	269 – 331
up to 100	740 min	930 – 1080	12 min	47 min	42 min	269 – 331

* Applies only to bars bright drawn after hardening and tempering.
For sizes over 100mm refer test certificate and allow for lower core strength.

WELDING

Low hydrogen electrodes recommended. Pre-heat at 200 – 300°C and maintain during welding. Cool slowly, followed with a stress relieve.

HARDEN AT 830°C – 880°C **TEMPER** AT 450°C – 660°C

NB: Tempering at 250°C – 450°C results in temper brittleness and should be avoided.

NITRIDE: AT 500°C – 530°C

FLAME OR INDUCTION HARDEN AT 850°C – 870°C **TEMPER** AT 150°C – 200°C

NB: All de-carburised surface material must first be removed.

› Welding and Carburising details for guidance only

HIGH TENSILE STEEL AISI 4340 - STOCK RANGE

STOCK SIZES BRIGHT	STOCK SIZES BRIGHT	STOCK SIZES CG
1-1/4"	70 mm	1/2"
1-3/8"	75mm	9/16"
1-1/2"	80mm	5/8"
1-5/8"	90mm	11/16"
1-3/4"	100mm	3/4"
2"	110mm	7/8"
2"-1/4"	115mm	1"
2-1/2"	120mm	1-1/8"
3"	130mm	1-1/4"
35mm	140mm	1-3/8"
40mm	150mm	1-1/2"
45mm	155mm	2"
50mm	160mm	2-1/4"
60mm	165mm	2-1/2"
65mm	170mm	16mm
	180mm	20mm
	190mm	25mm
	200mm	30mm
	210mm	35mm
	220mm	40mm
	230mm	45mm
	240mm	50mm
	250mm	55mm
	270mm	60mm
	280mm	65mm
	290mm	70mm
	300mm	80mm
	310mm	90mm
	320mm	100mm
	330mm	110mm
	340mm	115mm
	350mm	120mm
	360mm	
	380mm	
	400mm	
	420mm	
	450mm	
	460mm	
	480mm	
	500 mm	

CASE HARDENING STEEL TO BS 970-1955 EN 36A

EN 36A carburising steel, generally supplied annealed to HB 229max. Carburised and heat treated it develops a wear resistant case to HRC 60-63 and a tough strong core with tensile strengths of 850 - 1200 MPa in small to fairly large sections.

COLOUR CODE WHITE

TYPICAL CHEMICAL ANALYSIS

C	Si	Mn	Ni	Cr
0.13%	0.25%	0.50%	3.25%	0.85%

TYPICAL APPLICATIONS

Heavy-duty gears, bushes, ring gears, shafts, collets, king pins, sprockets etc; or through hardened (uncarburised) for high tensile applications, offering good strength with excellent toughness.

Will ***Nitride*** with a typical surface hardness up to ***HRC 60***.

Flame or induction hardening not recommended.

TYPICAL CORE PROPERTIES
QUENCHED AT 850°C AND TEMPERED AT 200°C

SECTION SIZE	UP TO 16mm	OVER 16 – 40mm	OVER 40 – 100mm
U. T. S.	1000 MPa min	870 MPa min	790 MPa min

WELDING

Low hydrogen electrodes recommended. Pre-heat at 250 – 350°C and maintain during welding. Cool slowly, followed with a stress relieve.

CARBURISE	AT 900°C – 950°C	**CORE REFINE**	AT 840°C – 880°C
CASE HARDEN	AT 780°C – 820°C	**TEMPER**	AT 150°C – 200°C
HARDEN	AT 830°C – 860°C	**TEMPER**	AT 150°C – 200°C
NITRIDE	AT 500°C – 530°C		

› Welding and heat treatment details for guidance only

STOCK RANGE EN 36A

STOCK SIZES ROUND
28 mm
30mm
36mm
40mm
45mm
50mm
55mm
60mm
65mm
70mm
75mm
80mm
85mm
90mm
95mm
100mm
120mm
140mm
150mm
170mm
180mm
200mm
230mm
240mm
280mm
310mm
350mm
360mm
410mm

CASE HARDENING STEEL TO BS 970-1955 EN 39B

EN 39B carburising steel, generally supplied annealed to HB 277max. Carburised and heat treated it develops a wear resistant case to HRC 60-63 and a tough strong core with tensile strengths of 1000 - 1400 MPa in small to very large sections.

COLOUR CODE ORANGE

TYPICAL CHEMICAL ANALYSIS

C	Si	Mn	Ni	Cr	Mo
0.15%	0.25%	0.40%	4.20%	1.20%	0.20%

TYPICAL APPLICATIONS

Highly stressed or large gears, camshafts, bearings and heavy-duty worms etc; or through hardened (uncarburised) for high tensile applications, offering good strength with excellent toughness.

Will ***Nitride*** with a typical surface hardness up to ***HRC 60***.

Flame or induction hardening not recommended.

TYPICAL CORE PROPERTIES
QUENCHED AT 850°C AND TEMPERED AT 200°C

SECTION SIZE	25mm	50mm	100mm	200mm
U. T. S.	1350 MPa	1300 MPa	1180 MPa	1130 MPa

WELDING

Low hydrogen electrodes recommended. Pre-heat at 250 – 350°C and maintain during welding. Cool slowly, followed with a stress relieve.

CARBURISE	AT 900°C – 950°C	**CORE REFINE**	AT 850°C – 880°C
CASE HARDEN	AT 760°C – 800°C	**TEMPER**	AT 150°C – 200°C
HARDEN	AT 830°C – 860°C	**TEMPER**	AT 150°C – 200°C
NITRIDE	AT 500°C – 530°C		

› Welding and heat treatment details for guidance only

STOCK SIZES EN 39 B

STOCK SIZES ROUND
2"
38mm
40mm
70mm
75mm
85mm
95mm
100mm
120mm
130mm
160mm
180mm
190mm
210mm
230mm
260mm
280mm
310mm
320mm

HOLLOW BAR HB20MNV6 AR

HB 20MnV6 AR hollow bar, supplied as rolled with tensile strengths of 600 – 750 MPa, offering good strength and toughness with excellent machinability and weldability.

COLOUR CODE YELLOW

CHEMICAL COMPOSITION (WT %)

C	Si	Mn	V	P	S	AL	Nb	Ti
0.16/0.22	0.10/0.50	1.30/1.70	0.08/0.15	≤ 0.030	≤ 0.035	≤ 0.010	≤ 0.010	≤ 0.020

TYPICAL APPLICATIONS
bushes, cylinders, hollow shafts, rings, conveyor rolls, nuts etc.

Will ***Through Harden, Nitride, Carburise*** or ***Carbonitride***.

TYPICAL CORE PROPERTIES – MINIMUM AT ROOM TEMPERATURE – AS ROLLED

WALL THICKNESS	Rp 0.2% (MPa)	Rm (MPa)	P
≤ 16mm	470	650	17
>16mm ≤ 40mm	430	600	17

TYPICAL CORE PROPERTIES – MINIMUM AT ROOM TEMPERATURE – AS ROLLED

SECTION SIZE	Rp 0.2% (MPa)	Rm (MPa)	A %	Charpy J	HB
≤ 16mm	590	700	16	40	205
≤ 25mm	540	570	16	40	160
≤ 50mm	480	570	16	-	160

WELDING
W/T up to 16mm - Pre-heat at 100 - 120°C
W/T over 16mm - Pre-heat at 200 - 250°C - post-weld stress relieve.

HARDEN	AT 870°C – 890°C	**TEMPER**	AT 500°C - 600°C
NITRIDE	AT 490°C – 530°C	TYPICAL CASE ***HRC 55***	
CARBURISE	AT 880°C – 920°C	**CORE REFINE OPTIONAL**	AT 870°C – 890°C
CASE HARDEN	AT 760°C – 800°C	TYPICAL CASE ***HRC 60***	
CARBONITRIDE	AT 870°C – 880°C	TYPICAL CASE ***HRC 60***	

› Welding and heat treatment details for guidance only

HOLLOW BAR HB20MNV6 AR - STOCK RANGE

GUARANTEED DIMENSIONS AFTER MACHINING O/D CHUCKING		TYPICAL MANUFACTURING DIMENSIONS			GUARANTEED DIMENSIONS AFTER MACHINING I/D CHUCKING		GUARANTEED DIMENSIONS AFTER MACHINING O/D CHUCKING		TYPICAL MANUFACTURING DIMENSIONS			GUARANTEED DIMENSIONS AFTER MACHINING I/D CHUCKING	
O/D max mm	I/D min mm	O/D mm	W/T mm	Weight kg/m	O/D max mm	I/D min mm	O/D max mm	I/D min mm	O/D mm	W/T mm	Weight kg/m	O/D max mm	I/D min mm
30	15	30.75	8.90	**4.8**	28.9	13.8	110	75	111.60	20.00	**45.2**	108.2	72.9
30	20	30.75	6.20	**3.8**	29.3	19.2	110	90	111.60	12.10	**29.7**	109.0	88.6
35	25	36.50	6.90	**5.0**	34.1	24.0	115	75	116.60	22.65	**52.5**	112.9	72.6
40	25	45.75	8.90	**7.0**	38.6	23.8	125	75	126.80	28.10	**68.4**	122.3	72.2
45	30	45.75	8.90	**8.1**	43.9	28.8	125	80	126.80	25.50	**63.7**	122.5	77.4
50	30	51.30	12.20	**11.8**	48.7	28.2	125	90	126.80	20.15	**53.0**	123.1	88.0
50	35	51.30	9.50	**9.8**	49.1	33.5	125	95	126.80	17.55	**47.3**	123.4	93.2
55	30	56.80	15.10	**15.5**	53.4	27.8	125	100	126.80	14.90	**41.1**	123.6	98.4
55	40	56.80	9.70	**11.3**	54.0	38.5	130	75	132.00	30.90	**77.0**	127.0	71.8
60	35	61.20	14.80	**16.9**	58.3	32.8	130	90	132.00	22.95	**61.7**	127.9	87.6
60	40	61.20	12.10	**14.7**	58.7	38.2	130	95	132.00	20.35	**56.0**	128.2	92.8
60	45	61.20	9.40	**12.0**	59.0	43.5	140	80	142.00	33.50	**89.6**	136.7	76.7
65	40	66.80	15.15	**19.3**	63.4	37.8	140	100	142.00	23.00	**67.5**	137.9	97.5
65	45	66.80	12.45	**16.7**	63.7	43.2	140	105	142.00	20.40	**61.2**	138.1	102.7
70	40	71.40	17.20	**23.0**	68.3	38.2	140	115	142.00	15.10	**47.3**	138.7	113.3
70	45	71.40	14.56	**20.4**	68.6	43.4	150	80	152.20	39.00	**108.9**	146.2	76.1
70	50	71.40	12.20	**17.8**	68.7	48.2	150	85	152.20	36.35	**103.8**	146.5	81.3
75	40	76.20	19.70	**27.4**	73.0	38.0	150	105	152.20	25.80	**80.4**	147.6	102.3
75	45	76.20	17.10	**24.9**	73.3	43.2	150	125	152.20	15.30	**51.7**	148.7	123.2
75	55	76.20	12.10	**19.1**	73.7	53.2	150	130	152.20	12.65	**43.5**	149.0	128.4
75	60	76.20	9.40	**15.5**	74.1	58.5	160	90	162.10	39.00	**118.4**	156.2	86.1
80	45	81.40	19.80	**30.1**	78.1	43.0	160	95	162.10	36.35	**112.7**	156.5	91.3
80	50	81.40	17.20	**27.2**	78.4	48.2	160	100	162.10	33.70	**106.7**	156.7	96.6
80	55	81.40	14.55	**24.0**	78.6	53.4	160	115	162.10	25.80	**89.3**	157.6	112.3
85	55	91.20	17.20	**29.4**	83.4	53.2	160	120	162.10	23.15	**79.3**	157.9	117.6
85	60	91.20	14.55	**25.8**	83.6	58.4	160	130	162.10	17.90	**63.7**	158.4	128.0
90	50	91.20	22.90	**38.6**	87.6	46.8	170	95	172.30	41.80	**134.5**	166.0	90.7
90	65	91.20	14.40	**27.3**	88.6	63.5	170	140	172.30	18.00	**68.5**	168.4	138.0
90	70	91.20	12.10	**23.6**	88.8	68.2	180	100	182.20	44.40	**150.9**	175.6	95.5
95	50	96.20	25.00	**43.9**	92.5	47.5	180	125	182.20	31.15	**116.0**	177.1	121.8
95	75	96.20	12.20	**25.3**	93.8	73.0	180	140	182.20	23.25	**91.1**	177.9	137.5
100	55	101.60	25.20	**47.5**	97.6	52.5	180	150	182.20	18.00	**72.9**	178.4	148.0
100	70	101.60	17.30	**36.0**	98.5	68.2	180	155	182.20	15.70	**64.5**	178.5	152.6
100	75	101.60	14.70	**31.5**	98.8	73.4	190	125	192.30	36.50	**140.2**	186.6	121.3
105	60	106.60	25.25	**50.7**	102.6	57.4	190	160	192.30	18.10	**77.8**	188.4	157.9
105	65	106.60	22.60	**46.8**	102.9	62.7	200	130	203.00	39.60	**159.6**	196.2	125.9
105	70	106.60	20.00	**42.7**	103.2	67.8	200	150	203.00	29.10	**124.8**	197.3	146.7
105	75	106.60	17.35	**38.2**	103.5	73.1	210	150	214.10	36.30	**159.2**	206.3	144.4
105	80	106.60	14.70	**33.3**	103.7	78.4	250	190	254.00	37.40	**199.8**	244.0	182.7
110	70	111.60	22.60	**49.6**	107.9	67.7	250	200	254.00	31.80	**174.2**	244.8	193.7

CHROME PLATED BAR AISI 1045

AISI 1045 medium carbon steel with a U. T. S. of 600 – 800 Mpa, and a hard chrome plated surface of over HV 900. The surface finish is extremely smooth with excellent wear resistance and good corrosion resistance.

COLOUR CODE YELLOW

TYPICAL CHEMICAL ANALYSIS – BASE METAL

C	Si	Mn	P	S
0.45%	0.25%	0.75%	0.040% max	0.04% max

TYPICAL APPLICATIONS

Hydraulic and pneumatic cylinders for mining, earth moving, waste disposal, transport, agricultural plus various other processing equipment etc.

TYPICAL HARD CHROME PLATING

- **Hardness:** HV 900-1100 (HRC 65-69)
- **Roughness:** 0.10-0.30 Ra microns
- **Thickness:** 15-30 microns
- **NB:** 100-150mm unplated at bar ends

SIZE TOLERANCE – TO ISO f8 OR AS BELOW

STRAIGHTNESS – 0.2 mm / m

DIAMETER	30 – 50mm	50 – 80mm	80mm – 120mm
TOLERANCE	-0.025 / -0.064mm	-0;030 / -0.079mm	-0.036 / -0.090mm

WELDING

Similar to 1045 unplated bar. Remove cardboard tube from the heat affected zone as it can emit fumes which may corrode the chrome plating.

- For other tolerances on different size ranges, please consult our specialists

TYPICAL MECHANICAL ANALYSIS – BASE METAL

FINISH	Rp 0.2% (MPa)	Rm (MPa)	A %	HB
DRAWN	600	800	9	230
Turned	400	670	20	200

TYPICAL BAR LENGTHS

- **Up to 18mm Ø** 2000 - 3600mm
- **Over 18mm Ø** 4000 - 7500mm

PACKAGING & PROTECTION

Each bar supplied in a cardboard tube.

STOCK RANGE CHROME PLATED AISI 1045

STOCK SIZES STANDARD	STOCK SIZES STANDARD
1”	25mm
1/2”	30mm
3/4”	35mm
1-1/4"	40mm
1-3/8"	50mm
1-1/2"	60mm
1-3/4”	65mm
2”	70mm
2”-1/4”	75mm
2-1/2”	80mm
3”	90mm
3-1/2”	100mm
4”	
5”	

CHROME PLATED BAR AISI 1045 INDUCTION HARDENED

AISI 1045 medium carbon steel with a U. T. S. of 600 – 800 Mpa and an induction hardened case of HRC 55-60, plus a hard chrome plated surface of over HV 900, giving excellent wear plus good corrosion resistance.

COLOUR CODE YELLOW / BLACK STRIPE

TYPICAL CHEMICAL ANALYSIS – BASE METAL

C	Si	Mn	P	S
0.45%	0.25%	0.75%	0.040% max	0.040% max

TYPICAL APPLICATIONS
Hydraulic & pneumatic cylinders with high resistance to surface impact for mining, earth moving, waste disposal, transport, agricultural equipment etc.

INDUCTION HARDENED CASE

HARDNESS – HRC 55 – 60

BAR DIAMETER	18 – 40mm	40 – 80mm	80 – 125mm
CASE THICKNESS	1.00 – 2.00mm	1.25 – 2.50mm	2.00 – 3.00mm

TYPICAL HARD CHROME PLATING

- **Hardness:** HV 900-1100 (HRC 65-69)
- **Roughness:** 0.10-0.30 Ra microns
- **Thickness:** 15-30 microns
- **NB:** 100 - 150mm unplated at bar ends

SIZE TOLERANCE – TO ISO f8 OR AS BELOW

STRAIGHTNESS – 0.2 mm / m

DIAMETER	30 – 50mm	50 – 80mm	80mm – 120mm
TOLERANCE	-0.025 / -0.064mm	-0.030 / -0.079mm	-0.036 / -0.090mm

WELDING
not recommended due to induction hardened case.

- For other tolerances on different size ranges, please consult our specialists

TYPICAL MECHANICAL ANALYSIS – BASE METAL

FINISH	Rp 0.2% (MPa)	Rm (MPa)	A %	HB
DRAWN	600	800	9	230
TURNED	400	670	20	200

MACHINABILITY
Ceramic tipped tools required for machining and special cutting blades for sawing due to induction hardened case.

PACKAGING & PROTECTION
Each bar supplied in a cardboard tube.

STOCK RANGE AISI 1045 INDUCTION HARDENED

STOCK SIZES INDUCTION HARDENED
1"
1-1/2"
1-3/4"
2"
2-1/4"
2-1/2"
3"
3-1/2"
4"
5-1/2"
6"
40mm
50mm
60mm
80mm
100mm

CHROME PLATED BAR AISI 4140

AISI 4140 high tensile steel hardened & tempered with a U. T. S. of 800 – 1200 Mpa, and a hard chrome plated surface of over HV 900. The surface finish is extremely smooth with excellent wear resistance and good corrosion resistance.

COLOUR CODE GREEN

TYPICAL ANALYSIS – BASE METAL

C	Si	Mn	Cr	Mo
0.40%	0.25%	0.85%	1.00%	0.25%

TYPICAL APPLICATIONS

Highly stressed hydraulic and pneumatic cylinders for mining, earth moving, waste disposal, transport, agricultural and food processing equipment etc.

TYPICAL HARD CHROME PLATING

- **Hardness:** HV 900-1100 (HRC 65-69)
- **Roughness:** 0.10-0.30 Ra microns
- **Thickness:** 15-30 microns
- **NB:** 100 - 150mm unplated at bar ends

SIZE TOLERANCE – TO ISO f8 OR AS BELOW

STRAIGHTNESS – 0.2 mm / m

DIAMETER	30 – 50mm	50 – 80mm	80mm – 120mm
TOLERANCE	-0.025 / -0.064mm	-0.030 / -0.079mm	-0.036 / -0.090mm

WELDING

Remove cardboard tube from the heat affected zone. Low hydrogen electrodes recommended. Pre-heat at 200-300°C and maintain during welding, cool very slowly.

- For other tolerances on different size ranges, please consult our specialists

TYPICAL PROPERTIES – BASE METAL

DIAMETER	Rp 0.2 (MPa)	Rm (MPa)	A %	HB
18 - 40mm	750 min	1000 - 1200	11 min	295 - 360
40 - 100mm	650 min	900 - 1100	12 min	265 - 330
100 - 125mm	550 min	800 - 950	13 min	240 - 280

PACKAGING & PROTECTION

Each bar supplied in a cardboard tube.

STOCK RANGE AISI 4140 CHROME PLATED

STOCK SIZES CHROME PLATED
60mm

CHROME PLATED BAR AISI 4140 INDUCTION HARDENED

AISI 4140 high tensile steel hardened & tempered with a U. T. S. of 800 – 1200 Mpa and an induction hardened case of HRC 55 +/- 2, plus a hard chrome plated surface of over HV 900, giving excellent wear plus good corrosion resistance.

COLOUR CODE GREEN / WHITE STRIPE

TYPICAL ANALYSIS – BASE METAL

C	Si	Mn	Cr	Mo
0.40%	0.25%	0.85%	1.00%	0.25%

TYPICAL APPLICATIONS
Highly stressed hydraulic & pneumatic cylinders with high resistance to surface impact for mining, earth moving, transport lifting equipment etc.

TYPICAL HARD CHROME PLATING

- **Hardness:** HRC 55 +/- 2

TYPICAL HARD CHROME PLATING

- **Hardness:** HV 900-1100 (HRC 65-69)
- **Roughness:** 0.10-0.30 Ra microns
- **Thickness:** 15-30 microns
- **NB:** 100 - 150mm unplated at bar ends

SIZE TOLERANCE – TO ISO f8

STRAIGHTNESS – 0.3 mm / m

WELDING
Not recommended due to induction hardened case and effect on mechanical properties however, if unavoidable the procedure given is a guide only.

WELDING
Remove cardboard tube from H.A.Z. Low hydrogen electrodes recommended. Pre-heat at 200-300°C and cool very slowly.

TYPICAL PROPERTIES – BASE METAL

DIAMETER	Rp 0.2 (MPa)	Rm (MPa)	A %	HB
18 - 40mm	750 min	1000 - 1200	11 min	295 - 360
40 - 100mm	650 min	900 - 1100	12 min	265 - 330
100 - 125mm	550 min	800 - 950	13 min	240 - 280

MACHINABILITY
Ceramic tipped tools required for machining and special cutting blades for sawing due to induction hardened case.

PACKAGING & PROTECTION
Each bar supplied in a cardboard tube.

STOCK RANGE AISI 4140 INDUCTION HARDENED

STOCK SIZES INDUCTION HARDENED
35mm
40mm
45mm
50mm
55mm
60mm
65mm
70mm
75mm
80mm
85mm
90mm
95mm
100mm

HYDRAULIC CYLINDER TUBE JIS G3445 STKM13C

JIS G3445 STKM13C Hydraulic Cylinder Tubes seamless or welded, cold drawn & stress relieved (BK+S) with typical yield strengths over 380 MPa. The inside diameter is honed and oiled with the tube ends capped for protection.

COLOUR CODE RED

TYPICAL CHEMICAL ANALYSIS

C	Si	Mn	P	S
0.25%	0.35%	0.30 - 0.90	0.040% max	0.040% max

TYPICAL APPLICATIONS
Hydraulic and pneumatic cylinders for mining, earth moving, waste disposal, transport, agricultural, processing equipment, hoists, compressors etc

STRAIGHTNESS
1 / 1000mm

TOLERANCE I/D HONED : ISO H8

TYPICAL ROUGHNESS
0.20/0.04 Ra Micron

TYPICAL MECHANICAL PROPERTIES COLD DRAWN AND STRESS RELIEVED

Yield Strength	Tensile Strength	Elongation
382 MPA MIN	510 MPA MIN	10% MIN

WELDING
Low carbon electrodes recommended. Pre-heat or post-heat not required.

MACHINABILITY
Excellent in the cold drawn and stress relieved condition.

HYDRAULIC CYLINDER TUBE JIS G3445 STKM13C - STOCK RANGE

STOCK SIZES HONED	STOCK SIZES HONED
1" id x 1/4" wt	45mm id x 5mm wt
1-1/2" id x 1/4" wt	60mm id x 5mm wt
1-3/4" id x 1/4" wt	70mm id x 5mm wt
2" id x 1/4" wt	80mm id x 5mm wt
2-1/2" id x 1/4" wt	90mm id x 7.5mm wt
2-3/4" id x 1/4" wt	90mm id x 10mm wt
3" id x 1/4" wt	100mm id x 10mm wt
3" id x 5/16" wt	
3" id x 1/2" wt	
3-1/4" id x 1/4" wt	
3-1/2" id x 1/4" wt	
3-1/2" id x 5/16" wt	
4" id x 1/4" wt	
4" id x 5/16" wt	
4" id x 3/8" wt	
4" id x 1/2" wt	
4-1/2" id x 1/4" wt	
4-1/2" id x 1/2" wt	
5" id x 3/8" wt	
6" id x 3/8" wt	
6" id x 1/2" wt	
6-1/2" id x 1/2" wt	
7" id x 1/2" wt	
7-1/2" id x 1/2" wt	
8" id x 1/2" wt	
9" id x 1/2" wt	
9-1/2" id x 1/2" wt	
10" id x 1" wt	

COLD WORK TOOL STEEL AISI D2

AISI D2 Cold Work Tool Steel air or oil hardening with maximum dimensional stability during heat treatment, offering very high hardness and abrasion resistance. Generally supplied annealed to HB 250 max.

COLOUR CODE RED / BLACK

TYPICAL CHEMICAL ANALYSIS

C	Si	Mn	Cr	Mo	V
1.55%	0.30%	0.35%	12.00%	0.75%	0.90%

TYPICAL APPLICATIONS

Deep drawing and forming dies, cold drawing punches, hobbing and lamination dies, stamping dies, blanking dies, shear blades, burnishing rolls, cold extrusion dies, slitting cutters, thread rolling and wire dies, master tools and gauges etc.

HEAT TREATMENT

FORGE	at 900°C min – 1100°C max.	Cool slowly and anneal when hand-warm.
ANNEAL	at 830°C – 860°C	Cool in furnace at 20°C per hour max.
STRESS RELIEVE	at 650°C – 700°C	Cool in furnace or still air Stress relieve prior to hardening.
HARDEN	Preheat at 650°C – 850°C Raise quickly to 1000°C – 1050°C.	Cool in air or quench in oil or hot bath held at 500°C – 550°C and then air cool. Temper when hand-warm.
TEMPER	at 150°C – 400°C	Cool in still air. Triple temper recommended.

TYPICAL HARDNESS / APPLICATIONS
AIR COOLED AT 1000°C-1050°C AND TEMPERED

TEMPER	HRC	TYPICAL APPLICATIONS
150°C	63 – 64	Wire drawing, lamination and cold extrusion dies
	62 – 64	Deep drawing dies, moulding dies for abrasives, gauges
200°C	62 – 63	Knurling tools, thread rolling dies
	61 – 64	Blanking dies and punches, forming dies, burnishing rolls
220°C	57 – 62	Cold drawing punches, hobbing dies
300°C	58 – 59	Stamping dies, shear blades, plastic moulds and inserts
400°C	57 – 58	Cold forging dies and forming rolls

› Heat treatment details and typical hardness figures for guidance only

STOCK RANGE AISI D2

STOCK SIZES
60mm
80mm
90mm
100mm
120mm
140mm
150mm
160mm
170mm
180mm
190mm
200mm
220mm
240mm
260mm
280mm
300mm
320mm
330mm
333mm
353mm
360mm
363mm

CONTINUOUS CAST DUCTILE IRON 3D

Flocast 3D ductile cast iron has spherical particles of graphite in an essentially ferritic structure, having high elasticity and impact resistance. With higher strength generally than grey cast iron it is ductile rather than brittle and is tough and readily machined making it suitable for applications involving thermal and mechanical shock. Can be welded but not readily flame or induction hardened.

COLOUR CODE GREEN

TYPICAL CHEMICAL ANALYSIS

C	Si	Mn	Mg	Ni
3.30 – 3.80%	2.30 – 2.70%	0.20 – 0.40%	0.03 – 0.05%	0.02 – 0.04%

TYPICAL APPLICATIONS

Pump bodies, glands, glass moulds, spur gears, worm gears, sprockets, heavy duty gears, impellors and rotors etc.

MANUFACTURED SIZE RANGE

ROUNDS	40mm to 610mm	**Bar length:** 3 metres (10 feet) standard

TYPICAL MECHANICAL PROPERTIES

TENSILE STRENGTH	0.2% PROOF STRESS	HARDNESS BRINELL
415 MPa	250 MPa	187 Max

REPAIR WELDING

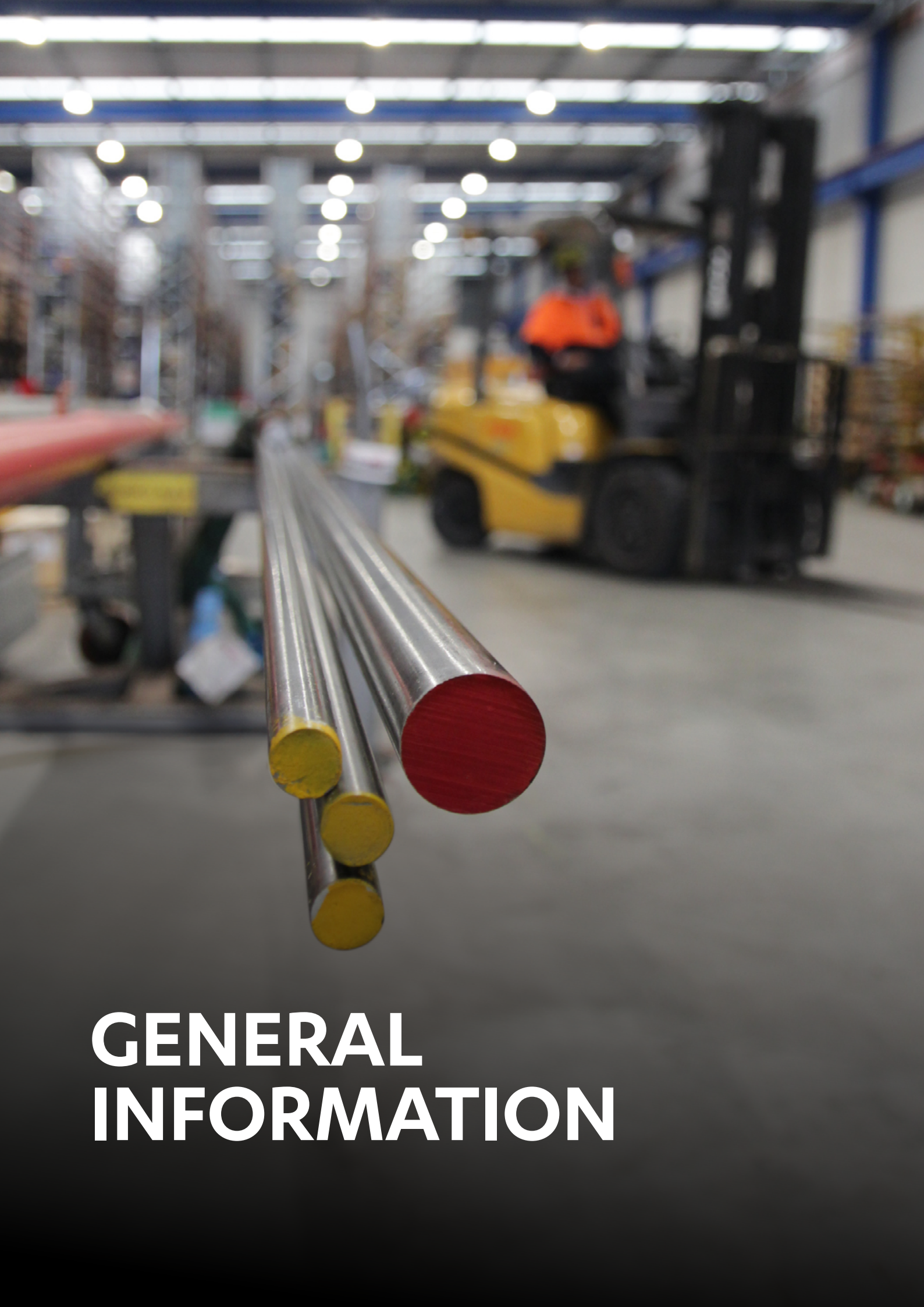
for guide only Pre-heat at 300°C and cool slowly. Post-weld stress relieve at 650°C

TECHNOLOGICAL PROPERTIES

MACHINABILITY	Excellent	**WEAR RESISTANCE**	Fair
MICRO FINISH	Excellent	**DAMPING CAPACITY**	Fair
SHOCK RESISTANCE	Excellent	**SURFACE HARDEN**	Can be hard-faced
FATIGUE	Very good	**SURFACE**	Free of sand
RUST & ACID RESISTANCE	Very good	**STRUCTURE**	Oil and pressure-tight
GALVANISING, ENAMELLING	Good		Free of blowholes

STOCK SIZES CONTINUOUS CAST DUCTILE IRON 3D

STOCK SIZES
50mm
55mm
65mm
70mm
80mm
90mm
100mm
105mm
110mm
115mm
120mm
130mm
150mm
155mm
165mm
180mm
210mm



GENERAL INFORMATION

CROSS-SECTIONAL DIMENSION TOLERANCE – IN MILLIMETRES

SIZE		TOLERANCE					
Specified diameter or cross-sectional dimension		h7	h8	h9	h10	h11	k12
	≤3	-0.010	-0.014	-0.025	-0.040	-0.060	+0.100
>3	≤6	-0.012	-0.018	-0.030	-0.048	-0.075	+0.120
>6	≤10	-0.015	-0.022	-0.036	-0.058	-0.090	+0.150
>10	≤18	-0.018	-0.027	-0.043	-0.070	-0.110	+0.180
>18	≤30	-0.021	-0.033	-0.052	-0.084	-0.130	+0.210
>30	≤50	-0.025	-0.039	-0.062	-0.100	-0.160	+0.250
>50	≤80	-0.030	-0.046	-0.074	-0.120	-0.190	+0.300
>80	≤120	-0.035	-0.054	-0.087	-0.140	-0.220	+0.350
>120	≤180	-0.040	-0.063	-0.100	-0.160	-0.250	+0.400
>180	≤250	-0.046	-0.072	-0.115	-0.185	-0.290	+0.460
>250	≤315	-0.052	-0.081	-0.130	-0.210	-0.320	+0.520

› **Note:** h7, h8, h9, h10 and h11 are all to minus tolerance. k12 to plus tolerance.

TO CALCULATE THE WEIGHT PER METER OF STEEL – IN METRIC SIZES

› Round Bar	Diameter in mm²	x	0.00616	=	kgs. per meter
› Hexagon Bar	A.F. in mm²	x	0.00680	=	kgs. per meter
› Octagon Bar	A.F. in mm²	x	0.00650	=	kgs. per meter
› Square Bar	Size in mm²	x	0.00785	=	kgs. per meter
› Flat Bar	Width x thickness in mm	x	0.00785	=	kgs. per meter
› Hollow Bar	(O/D – W/T) x W/T in mm	x	0.02466	=	kgs. per meter

TO CALCULATE THE ROUND BAR SIZE REQUIRED WHEN MACHINING TO A HEXAGON OR A SQUARE – IN METRIC SIZES

› Hexagon	Distance across flats in mm	x	1.1547
› Square	Distance across flats in mm	x	1.4142

HARDNESS AND TENSILE COMPARISON

HARDNESS			TENSILE STRENGTH		
Vickers HV or DPN	Brinell BHN or BH	Rockwell RC	Mpa or N/mm²	kgf/mm²	onf/in²
1150	780	70	2640	270	171
1050	745	68	2517	257	163
960	712	66	2410	246	156
885	682	64	2286	234	148
820	653	62	2193	224	142
765	627	60	2116	216	137
717	601	58	2023	207	131
675	578	57	1946	199	126
633	555	55	1869	191	121
598	534	53	1791	183	116
567	514	52	1730	177	112
540	495	50	1668	170	108
515	477	49	1606	164	104
494	461	47	1544	158	100
472	444	46	1498	153	97
454	429	45	1452	148	94
437	415	44	1405	144	91
420	401	42	1359	139	88
404	388	41	1297	133	84
389	375	40	1266	129	82
375	363	38	1220	125	79
363	352	37	1174	120	76
350	341	36	1143	117	74
339	331	35	1112	114	72
327	321	34	1081	110	70
316	311	33	1050	107	68
305	302	32	1019	104	66
296	293	31	988	101	64
287	285	30	957	98	62
279	277	29	927	95	60
270	269	28	911	93	59
263	262	26	880	90	57
256	255	25	849	87	55
248	248	24	834	85	54
241	241	23	803	82	52

HARDNESS				TENSILE STRENGTH		
Vickers HV or DPN	Brinell BHN or BH	Rockwell RC or RB		Mpa or N/mm²	kgf/mm²	onf/in²
235	235	22	99	788	81	51
229	229	21	98	772	79	50
223	223	20	97	756	77	49
217	217	18	96	726	74	47
212	212	17	96	710	73	46
207	207	16	95	695	71	45
202	202	15	94	680	70	44
197	197	13	93	664	68	43
192	192	12	92	648	66	42
187	187	10	91	633	65	41
183	183	9	90	618	63	40
179	179	8	89	610	62	39.5
174	174	7	88	602	61	39
170	170	6	87	595	61	38.5
166	166	4	86	586	60	38
163	163	3	85	579	59	37.5
159	159	2	84	564	58	36.5
156	156	1	83	556	57	36
153	153	0	82	81	55	35
149	149	-	81	80	54	34
146	146	-	80	79	53	33.5
143	143	-	79	78	52	33
140	140	-	78	77	51	32
137	137	-	77	76	50	31.5
134	134	-	76	74	49	31
131	131	-	74	73	47	30
128	128	-	73	72	47	29.5
126	126	-	72	71	46	29
124	124	-	71	70	45	28.5
121	121	-	70	69	44	28
118	118	-	69	68	43	27
116	116	-	68	67	42	26.5
114	114	-	67	66	41	26
112	112	-	66	65	40	25.5
109	109	-	65	386	39	25

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