



Steel Casting for Structural Purpose

Nominal Analysis

SMM Symbol	C	Mn	Cr	Ni	Mo	Others
A1	0.18 - 0.24	0.60 - 0.90				
A2	0.25 - 0.35	0.60 - 0.90				
A3	0.35 - 0.45	0.60 - 0.90				
A4	0.18 - 0.25	1.20 - 1.60				
A5	0.25 - 0.33	1.20 - 1.60				

Mechanical Properties

SMM Symbol	Yield (N/mm ²)	Tensile (N/mm ²)	Elongation (%)	Reduction Area (%)	Hardness (HB)
A1	230	430	22		135
A2	260	490	18		145
A3	295	540	14		158
A4	320	540	16		158
A5	370	620	13		170

Other Properties

SMM Symbol	Typical Heat Treatment	Criteria & Application	Weldability	Equivalent Standard
A1	N	General engineering parts requiring good weldability and mechinability.	*	BS 3100 A1
A2	N	Good tensil strength, suitable for bearing housings, valve bodies and structural parts.	0	BS 3100 A2
A3	N	Can case-hardened by flame or induction hardening- suitable for gears, sheaves, chain-links, etc.	^	BS 3100 A3
A4	N, NT, NQT	Higher Tensile strength than normal carbon steels, very suitable for gears and pinins, bogie wheels, moulds ends of concrete pipes, roller shells, mantle locking nut, head nut, pipe elbow and others.	0	BS 3100 A4 AS 2074 - L1A
A5	N, NT, NQT			BS 3100 A5 AS 2074 L1B



Steel Casting for Pressure Containig for High Temperature Service

Nominal Analysis

SMM Symbol	C	Mn	Cr	Ni	Mo	Others
CSP1	0.12 - 0.20	0.50 - 0.80	1.00 - 1.50		0.45 - 0.65	
CSP2	0.10 - 0.18	0.40 - 0.70	0.50 - 0.90	0.60 - 1.00	0.90 - 1.20	
CSP3	0.10 - 0.18	0.40 - 0.70	2.00 - 2.75		0.90 - 1.20	
CSP4	0.10 - 0.20	0.35 - 0.65	8.00 - 10.00		0.90 - 1.20	

Mechanical Properties

SMM Symbol	Yield (N/mm ²)	Tensile (N/mm ²)	Elongation (%)	Reduction Area (%)	Hardness (HB)
CSP1	275	485	20	35	145 - 148
CSP2	275	485	20	35	145 - 148
CSP3	275	485	20	35	145 - 148
CSP4	415	620	18	35	185 - 235

Other Properties

SMM Symbol	Typical Heat Treatment	Criteria & Application	Weldability	Equivalent Standard
CSP1	NT	Casting service temperatures : 425 - 525 °C	^	ASTM A217 GR WC6
CSP2	NT	Casting service temperatures : 525 - 585 °C	^	ASTM A217 GR WC5
CSP3	NT	Casting service temperatures : 585 - 625 °C	^	ASTM A217 GR WC9
CSP4	NT	Casting service temperatures : 625 - 725 °C	^	ASTM A217 GR C12



Chrome - Molybdenum

Nominal Analysis

SMM Symbol	C	Mn	Cr	Ni	Mo	Others
E1	0.28 - 0.33	0.70 - 0.90	0.90 - 1.10		0.15 - 0.25	
E2	0.38 - 0.43	0.70 - 0.90	0.90 - 1.10		0.15 - 0.25	
E3	0.45 - 0.55	0.70 - 0.90	0.90 - 1.10		0.15 - 0.25	
E4	0.55 - 0.65	0.70 - 0.90	0.90 - 1.10		0.15 - 0.25	

Mechanical Properties

SMM Symbol	Yield (N/mm ²)	Tensile (N/mm ²)	Elongation (%)	Reduction Area (%)	Hardness (HB)
E1					200 - 240
					220 - 320
E2					200 - 240
E3					270 - 300
E4					300 - 350

Other Properties

SMM Symbol	Typical Heat Treatment	Criteria & Application	Weldability	Equivalent Standard
E1	N	Higher tensile and yield strength than normal carbon steel.	^	AISI 4130
E2	N, NT	High yield strength and combination of hardness and toughness in wear resistant application-powered wheels, gears, rollers, machine parts & others.	^	AISI 4140
E3	N, NT	Abrasion resistant high tensile strength where impact is not a service condition.	^	
E4	N, NT	Abrasion resistant high tensile strength where impact is not a service condition and where austenetic manganese will not work harden.	^	AS 2074 - L2B



Nickel - Chrome - Molybdenum Steel

Nominal Analysis

SMM Symbol	C	Mn	Cr	Ni	Mo	Others
E7	0.28 - 0.33	0.70 - 0.90	0.40 - 0.65	0.40 - 0.80	0.15 - 0.25	
E7A	0.26 - 0.30	0.75 - 0.95	0.45 - 0.65	0.30 - 0.50	0.15 - 0.30	
E7B	0.27 - 0.32	0.70 - 0.90	0.75 - 1.00	0.40 - 0.70	0.35 - 0.55	
E8L	0.26 - 0.30	0.60 - 0.90	0.70 - 0.90	1.60 - 2.00	0.20 - 0.30	
WS3	0.24 - 0.30	0.60 - 0.90	1.60 - 2.00	0.35 - 0.55	0.30 - 0.50	

Mechanical Properties

SMM Symbol	Yield (N/mm ²)	Tensile (N/mm ²)	Elongation (%)	Reduction Area (%)	Hardness (HB)
E7					220 - 350
E7A	585	725	17	35	260 - 350
E7B	795	905	11	25	265 - 350
E8L	695	1000	6		300 - 350
WS3					350 - 400

Other Properties

SMM Symbol	Typical Heat Treatment	Criteria & Application	Weldability	Equivalent Standard
E7	NQT	General engineering application that require high tensile and good impact strength-powered wheels, gears, rollers and others.	^	AISI 8630
E7A	NQT			ASTM A148 GR 105/85
E7B	NQT			ASTM A148 GR 130/115
E8L	NQT	General engineering application of high tensile strength and good impact-resistance with through hardness for wear-resistance application. under NQT condition. Good choice for impact hammers, drop balls and others.		
WS3	NQT	Best combination of hardness and toughness for wear-resistant application.	^	



Austenitic Manganese Steel

Nominal Analysis

SMM Symbol	C	Mn	Cr	Ni	Mo	Others
SK1	1.00 - 1.30	11.50 - 14.00	0.70 max		0.9 - 1.3	
SK4	1.00 - 1.28	11.00 - 14.00	0.70 max			
SWM 6 & 7	1.15 - 1.30	11.00 -14.00	1.00 - 1.30		0.5 max	
SWM 3 & 3H	1.15 - 1.30	11.00 -14.00	1.50 - 2.20			
SWM 8	1.25 - 1.35	16.00 - 18.00	1.70 - 2.20			

Mechanical Properties

SMM Symbol	Yield (N/mm ²)	Tensile (N/mm ²)	Elongation (%)	Reduction Area (%)	Hardness (HB)
SK1	420	850	40		200 (550WH)
SK4	380	800	45		200 (550WH)
SWM 6 & 7					
SWM 3 & 3H	400	800	35		200 (550WH)
SWM 8					

Other Properties

SMM Symbol	Typical Heat Treatment	Criteria & Application	Weldability	Equivalent Standard
SK1	WQ	Castings which require higher resistance to deformation than normal austenitic manganese steel such as track pads of excavators, etc.	^	ASTM A128 GR E1
SK4	WQ	Suitable for scratching wear application in less abrasive condition with high impact produces work hardening of castings, resulting in resistance to wear. Best choice for apron pan & side plate.	^	ASTM A128 GR B3 AS 2074 - H1A
SWM 6 & 7	WQ	Suitable for gouging wear application in condition where impact are not severe and casting must resist spreading. e.g. bowls & mantles.	^	
SWM 3 & 3H	WQ	Suitable for gouging and grinding wear application in normal condition where impacts are not severe and wear is more due to abrasion than high gouging loads. e.g. jaw liners, mantles & bowls.	^	ASTM A128 GR C AS 2074 - H1B
SWM 8	WQ	Conditions where high impact produces work hardening of the castings, resulting in resistance to wear. e.g. bowls & mantles.	^	GX 120MN CR 17 2



Stainless Steel

Nominal Analysis

SMM Symbol	C	Mn	Cr	Ni	Mo	Others
C8	0.80 max	1.50 max	18.00 - 21.00	8.00 - 11.00		
C8M	0.80 max	1.50 max	18.00 - 21.00	9.00 - 12.00	2.00 - 3.00	

Mechanical Properties

SMM Symbol	Yield (N/mm ²)	Tensile (N/mm ²)	Elongation (%)	Reduction Area (%)	Hardness (HB)
C8	255	530	55		140
C8M	310	605	50		160

Other Properties

SMM Symbol	Typical Heat Treatment	Criteria & Application	Weldability	Equivalent Standard
C8	WQ	Corrosion-resistant applications suitable for low corrosion environment.	0	ASTM A743 GR CF-8
C8M	WQ	All corrosion-resistant applications particularly against acid attack and widely used in chemical plant pump parts, valves, impeller and castings used in sea-water marine services.	0	ASTM A743 GR CF-8M



Pearlitic Chrome - Molybdenum Steel

Nominal Analysis

SMM Symbol	C	Mn	Cr	Ni	Mo	Others
PSC6	0.60 - 0.66	0.50 - 0.90	2.10 - 2.40		0.30 - 0.50	
PSC8	0.80 - 0.86	0.50 - 0.90	2.10 - 2.40		0.30 - 0.50	

Mechanical Properties

SMM Symbol	Yield (N/mm ²)	Tensile (N/mm ²)	Elongation (%)	Reduction Area (%)	Hardness (HB)
PSC6					300 - 400
PSC8					300 - 400

Other Properties

SMM Symbol	Typical Heat Treatment	Criteria & Application	Weldability	Equivalent Standard
PSC6	N, NT	Combination of hardness and toughness provide high abrasion-resistance in application. Suitable choice for breaker bars used in cement mills, ball mill liners etc.	^	
PSC8	N, NT			



Heat Resistant Steel

Nominal Analysis

SMM Symbol	C	Mn	Cr	Ni	Mo	Others
HC	0.5 max	1.00 max	26.00 - 30.00	4.00 max		
HD	0.5 max	1.50 max	26.00 - 30.00	4.00 - 7.00		
HF	0.20 - 0.40	2.00 max	18.00 - 23.00	8.00 - 12.00		
HH	0.20 - 0.50	2.00 max	24.00 - 28.00	11.00 - 14.00		
HI	0.20 - 0.50	2.00 max	26.00 - 30.00	14.00 - 18.00		
HK	0.20 - 0.60	2.00 max	24.00 - 28.00	18.00 - 22.00		
HT	0.35 - 0.75	2.00 max	15.00 - 19.00	33.00 - 37.00		

Mechanical Properties

SMM Symbol	Yield (N/mm ²)	Tensile (N/mm ²)	Elongation (%)	Reduction Area (%)	Hardness (HB)
HC		380			
HD	240	515	8		
HF	240	485	25		
HH	240	515	10		
HI	240	485	10		
HK	240	450	10		
HT		450	4		

Other Properties

SMM Symbol	Typical Heat Treatment	Criteria & Application	Weldability	Equivalent Standard
HD	C	High temperature corrosion resistance, exhibit better hot strength compared to grade HC and is able to withstand light load at 1050 °C. Typically used for roaster furnace, rabble arms and blades, salt pots and cement kiln ends.	0	ASTM A287 GR HD
HF	C	High temperature corrosion resistance and suitable for use up to 800 °C. Exhibit moderately high hot strength and ductility. Typically used for furnace dampers and annealing furnace parts.	0	ASTM A287 GR HF
HH	C	Exhibit high hot strength and corrosion resistance for elevated temperature service above 870 °C. Able to withstand repeated temperature changes. Useful in parts subject to high constant load condition in the 650 ° to 1000 °C temperature range. Typically used for furnace shafts, beams, rails, rollers and tube spacers.	0	ASTM A287 GR HH
HI	C	Oxidation resistance up to 1180 °C. Typically used for billet skids, conveyor rollers, furnace rails, lead pots, retorts for magnesium production, hearth plates and tube spacers.	0	ASTM A287 GR HI
HK	C	Exhibit high strength and surface stability at temperature above 1040 °C. It can be used in structural applications up to 1150°C where high creep strength is needed, such as gas turbines, furnace parts, brazing fixture, cement kiln nose segments, pier caps, rabble arms and blades.	0	ASTM A297 GR HK
HT	C	High resistance to thermo-shock of heating and cooling. Good oxidation resistance and ability to maintain high strength up to 1040 °C. Typically used for retorts tubes, cyanide, lead and salt pots, hearth plates and quenched trays.	0	ASTM A297 GR HT



Ductile Iron

Nominal Analysis

SMM Symbol	C	Mn	Cr	Ni	Mo	Others
D40	3.50 - 3.85	0.45 - 0.75				Si : 2.1 - 2.8
D45	3.50 - 3.85	0.50 - 0.80				Si : 2.1 - 2.8
D50	3.50 - 3.85	0.60 - 0.90				Si : 2.1 - 2.8
D60	3.50 - 3.85	0.70 - 1.00				Si : 2.1 - 2.8 & Cu : 0.20 - 0.40
D70	3.50 - 3.85	0.70 - 1.00				Si : 2.1 - 2.8 & Cu : 0.40 - 0.60

Mechanical Properties

SMM Symbol	Yield (N/mm ²)	Tensile (N/mm ²)	Elongation (%)	Reduction Area (%)	Hardness (HB)
D40	250	400	12		121 - 197
D45	280	450	10		143 - 217
D50	320	500	7		170 - 241
D60	370	600	3		207 - 285
D70	420	700	2		229 - 321

Other Properties

SMM Symbol	Typical Heat Treatment	Criteria & Application	Weldability	Equivalent Standard
D40	C, T, A	Ferritic Ductile Iron with good damping properties and can withstand shock and fatigue loading. Moderate strength with high ductility, good toughness and excellent machinability.		JIS G5502 CLASS 1 (FCD40) AS1831 Grade 400-12
D45	C, T	Ferritic / Pearlitic Ductile Iron of moderate strength and ductility in which damping property and toughness are of great importance. Popularly used for rollers, sheaves, automotive and machine components.		JIS G5502 CLASS 2 (FCD45)
D50	C, NT, T	Pearlitic Ductile Iron combines high strength, reasonable ductility and toughness to offer good wear-resistance. Popularly used for sheaves, automotive and machine components.		JIS G5502 CLASS 3 (FCD50) AS1831 Grade500-7
D60	C, NT	Bainitic and/or martensitic or pearlitic ductile iron offers high strength and toughness with reasonable ductility. Mainly for rollers, crankshafts, large-size gears and others.		JIS G5502 CLASS 4 (FCD60) AS1831 Grade 600-3
D70	C, N, NT	Martensitic Ductile Iron offers high tensile strength and hardness, but for applications in which ductility and resistance to impact are of less importance.		JIS G5502 CLASS 5 (FCD70) AS1831 Grade 700-2



Steel Casting for Structural Purpose

Nominal Analysis

SMM Symbol	C	Mn	Cr	Ni	Mo	Others
F15	3.10 - 3.50	0.50 - 0.80				Si : 2.20 - 2.70
F20	3.00 - 3.40	0.60 - 0.90				Si : 2.00 - 2.40
F25	2.90 - 3.20	0.70 - 1.00			0.20 - 0.40	Si : 2.00 - 2.40
F30	2.90 - 3.20	0.70 - 1.00			0.30 - 0.60	Si : 1.80 - 2.20
F35	2.90 - 3.20	0.70 - 1.00	0.40 - 0.70	0.30 - 0.60	0.30 - 0.60	Si : 1.80 - 2.20
SC1	3.00 - 3.50	0.50 - 0.90	0.90 - 1.60			Si : 1.50 - 2.60
SC2	3.20 - 3.60	0.50 - 0.90		1.70 - 2.30		Si : 2.10 - 2.60

Mechanical Properties

SMM Symbol	Yield (N/mm ²)	Tensile (N/mm ²)	Elongation (%)	Reduction Area (%)	Hardness (HB)
F15		150			
F20		200			
F25		250			
F30		300			
F35		350			

Other Properties

SMM Symbol	Typical Heat Treatment	Criteria & Application	Weldability	Equivalent Standard
F15	C, SR	This general engineering Grey Cast Iron offers excellent machinability and most suitable for thin sectioned castings.		JIS G5501 GRADE 2 (FC 15)
F20	C, SR	This Grey Cast Iron for general engineering used with excellent machinability. E.g.: small couplings, gear box housing & covers, etc		JIS G5501 GRADE 3 (FC 20)
F25	C, SR			JIS G5501 GRADE 4 (FC25)
F30	C, SR	This Grey Cast Iron offers higher strength with excellent machinability. E.g.: small couplings, gear box housing & covers, etc.		JIS G5501 GRADE 5 (FC 30)
F35	C, SR			JIS G5501 GRADE 6 (FC 35)
SC1	C, SR	Castings can withstand oxidation resistance up to servicing temperature up to 700 °C.		
SC2	C, SR	Castings has good resistance to chemical erosion. Eg. sewage impeller, rotor blades, etc.		



Alloy Cast Iron (Abrasion Resistant)

Nominal Analysis

SMM Symbol	C	Mn	Cr	Ni	Mo	Others
NH1	3.20 - 3.60	0.20 - 0.80	1.50 - 2.50	3.00 - 5.50		
NH2	3.20 - 3.60	0.20 - 0.80	8.00 - 10.00	4.00 - 6.00		
WC1	2.80 - 3.30	0.30 - 0.80	14.50 - 16.50	1.60 - 2.40		
WC2	2.40 - 2.80	0.30 - 0.80	23.00 - 28.00			
WC3	2.40 - 2.80	0.50 - 1.50	14.00 - 16.00	3.00 - 5.50		1.00 - 3.00

Mechanical Properties

SMM Symbol	Yield (N/mm ²)	Tensile (N/mm ²)	Elongation (%)	Reduction Area (%)	Hardness (HB)
NH1					550
NH2					600
WC1					65 HRC
WC2					65 HRC
WC3					60 HRC

Other Properties

SMM Symbol	Typical Heat Treatment	Criteria & Application	Weldability	Equivalent Standard
NH1	C, SR	Resisting low and medium stress abrasion. Can withstand mild impact.	x	BS4844 Pt Types 2B ASTM A532 Class I Type A
NH2	C, SR	Fully martensitic, highly abrasive resistant cast-iron. Higher strength and better impact resistance than NH1.	x	BS4844 Pt Types 2E ASTM A532 Class I Type D
WC1	C, SR	Good toughness with excellent abrasion-resistance and has good corrosion resistance properties.	x	ASTM A532 Class II Type B,C
WC2	N	Good toughness with excellent abrasion-resistance and has good corrosion-resistance properties.	x	ASTM A532 Class III Type A
WC3	N	Good toughness with excellent abrasion-resistance. Can withstand mild impact.	x	ASTM A532 Class II Type B