General information

Designation

AISI 1020

Condition	Annealed
UNS number	G10200
US name	ASTM MT1020, ASTM M1020, ASTM 1020, ASME G10200, ASME G10170, ASME 1017, ~SAE 040 X, Y, Z, ~SAE 035S, ~SAE 035C, ~SAE 035B, ~SAE 035A, ~SAE 035 X, Y, Z, ~ASTM A836, ~ASTM 1018 Class A, ~ASME G10210, ~ASME G10180, ~ASME 1021
EN name	S240GP, ~P355NB, ~P310NB, ~HS15
EN number	~1.0021
ISO name	~E235 Quality A, ~CE20E4, ~CC21A
GB (Chinese) name	~ML20Al, ~ML18Mn
JIS (Japanese) name	SWRM 20, SWRCH20A, SG 255, ~SWRCH18A, ~STKM12C, ~STKM12B, ~STKM12A, ~SPHT 2

Typical uses

Forgings, machined parts, shafts, car wheel hubs, general haulage gear

Composition overview

Compositional summary

Fe99.1-99.5 / Mn0.3-0.6 / C0.17-0.23 (impurities: S<0.05, P<0.04)

Material family	Metal (ferrous)
Base material	Fe (Iron)

Composition detail (metals, ceramics and glasses)

C (carbon)		0,17	-	0,23	%
Fe (iron)	*	99,1	-	99,5	%
Mn (manganese)		0,3	-	0,6	%
P (phosphorus)		0	-	0,04	%
S (sulfur)		0	-	0,05	%

Price

Price	*	2,89	-	3,01	BRL/kg
Price per unit volume	*	2,26e4	-	2,38e4	BRL/m^3

Physical properties

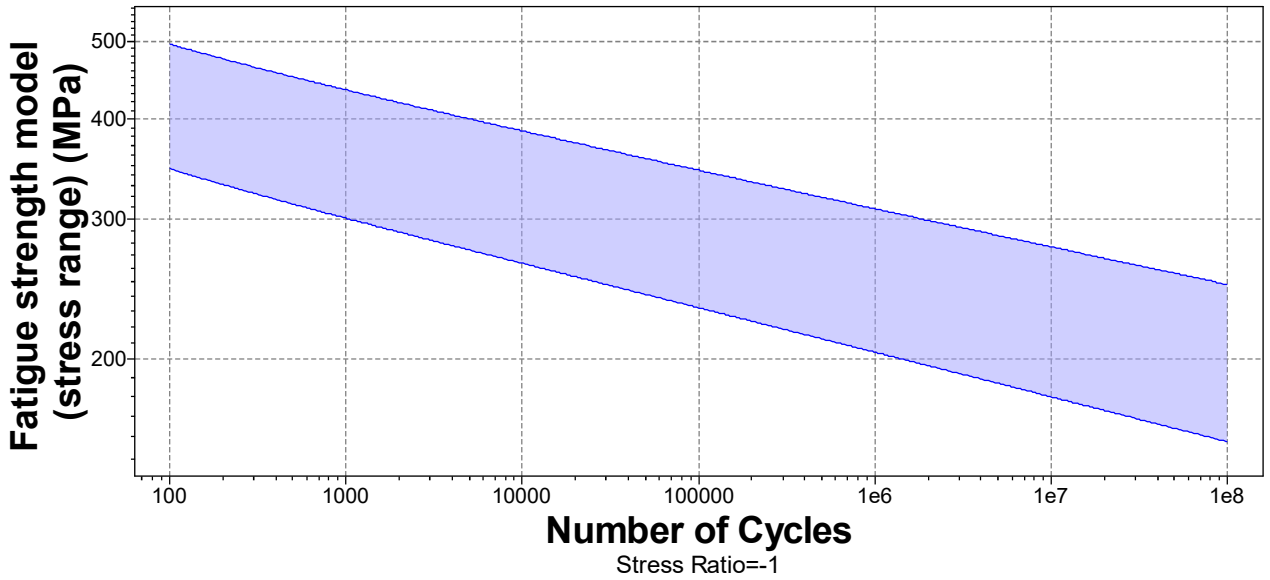
Density	7,8e3	-	7,9e3	kg/m^3

Mechanical properties

Young's modulus	205	-	215	GPa
Specific stiffness	26,1	-	27,4	MN.m/kg
Yield strength (elastic limit)	265	-	325	MPa
Tensile strength	355	-	435	MPa
Specific strength	33,8	-	41,4	kN.m/kg
Elongation	28	-	43	% strain
Compressive strength	* 265	-	325	MPa

Flexural modulus	* 205	-	215	GPa
Flexural strength (modulus of rupture)	265	-	325	MPa
Shear modulus	79	-	84	GPa
Bulk modulus	158	-	175	GPa
Poisson's ratio	0,285	-	0,295	
Shape factor	61			
Hardness - Vickers	110	-	130	HV
Elastic stored energy (springs)	169	-	249	kJ/m^3
Fatigue strength at 10^7 cycles	* 207	-	240	MPa
Fatigue strength model (stress range)	* 180	-	277	MPa

Parameters: Stress Ratio = -1, Number of Cycles = 1e7cycles



Impact & fracture properties

Fracture toughness	* 42	-	67	MPa.m^0.5
Toughness (G)	8,78	-	20,5	kJ/m^2

Thermal properties

Melting point	1,48e3	-	1,52e3	°C
Maximum service temperature	* 340	-	356	°C
Minimum service temperature	* -68	-	-43	°C
Thermal conductivity	50	-	54	W/m.°C
Specific heat capacity	465	-	505	J/kg.°C
Thermal expansion coefficient	11,5	-	12,5	µstrain/°C
Thermal shock resistance	104	-	130	°C
Thermal distortion resistance	* 4,1	-	4,58	MW/m
Latent heat of fusion	* 270	-	275	kJ/kg

Electrical properties

Electrical resistivity	16	-	18	µohm.cm
Electrical conductivity	9,58	-	10,8	%IACS
Galvanic potential	* -0,51	-	-0,43	V

Magnetic properties

Magnetic type	Magnetic

Optical, aesthetic and acoustic properties

Transparency	Opaque			
Acoustic velocity	5,11e3	-	5,24e3	m/s
Mechanical loss coefficient (tan delta)	* 0,00111	-	0,00137	

Critical materials risk

Contains >5wt% critical elements?	No

Processing properties

Metal casting	Unsuitable			
Metal cold forming	Acceptable			
Metal hot forming	Excellent			
Metal press forming	Excellent			
Metal deep drawing	Acceptable			
Machining speed	45,7			m/min
Weldability	Good			
Notes	Preheating and post weld heat treatments are required			
Carbon equivalency	0,22	-	0,33	

Durability

Water (fresh)	Acceptable
Water (salt)	Limited use
Weak acids	Limited use
Strong acids	Unacceptable
Weak alkalis	Acceptable
Strong alkalis	Limited use
Organic solvents	Excellent
Oxidation at 500C	Acceptable
UV radiation (sunlight)	Excellent
Galling resistance (adhesive wear)	Acceptable
Notes	Aluminum bronze is the most suitable mating material to minimize galling.
Flammability	Non-flammable

Corrosion resistance of metals

Stress corrosion cracking	Not susceptible
Notes	Rated in chloride; Other susceptible environments: Nitrate, hydroxide, carbonate, ammonia

Primary production energy, CO2 and water

Embodied energy, primary production	30,8	-	33,9	MJ/kg

Sources

19.4 MJ/kg (Dhingra, Overly, Davis, 1999); 23 MJ/kg (Norgate, Jahanshahi, Rankin, 2007); 27.9 MJ/kg (Ecoinvent v2.2); 29.2 MJ/kg (Hammond and Jones, 2008); 32.8 MJ/kg (Hammond and Jones, 2008); 34.7 MJ/kg (Hammond and Jones, 2008); 35.4 MJ/kg (Hammond and Jones, 2008); 37.2 MJ/kg (Sullivan and Gaines, 2010); 38 MJ/kg (Hammond and Jones, 2008); 45.4 MJ/kg (Hammond and Jones, 2008)

CO2 footprint, primary production	2,26	-	2,49	kg/kg

Sources

0.396 kg/kg (Voet, van der and Oers, van, 2003); 1.75 kg/kg (Ecoinvent v2.2); 1.81 kg/kg (Voet, van der and Oers, van, 2003); 2.23 kg/kg (Voet, van der and Oers, van, 2003); 2.3 kg/kg (Norgate, Jahanshahi, Rankin, 2007); 2.74 kg/kg (Hammond and Jones, 2008); 2.77 kg/kg (Hammond and Jones, 2008); 2.87 kg/kg (Hammond and Jones, 2008); 2.89 kg/kg (Hammond and Jones, 2008); 3.03 kg/kg (Hammond and Jones, 2008); 3.27 kg/kg (Hammond and Jones, 2008)

Water usage	* 43,1	-	47,7	l/kg

Processing energy, CO2 footprint & water

Casting energy	* 11	-	12,2	MJ/kg

Casting CO2	* 0,826	-	0,913	kg/kg
Casting water	* 20,9	-	31,3	l/kg
Roll forming, forging energy	* 2,65	-	2,93	MJ/kg
Roll forming, forging CO2	* 0,199	-	0,22	kg/kg
Roll forming, forging water	* 2,69	-	4,03	l/kg
Extrusion, foil rolling energy	* 5,02	-	5,55	MJ/kg
Extrusion, foil rolling CO2	* 0,377	-	0,416	kg/kg
Extrusion, foil rolling water	* 3,7	-	5,55	l/kg
Wire drawing energy	* 18	-	19,9	MJ/kg
Wire drawing CO2	* 1,35	-	1,5	kg/kg
Wire drawing water	* 6,8	-	10,2	l/kg
Metal powder forming energy	* 38,9	-	42,8	MJ/kg
Metal powder forming CO2	* 3,11	-	3,43	kg/kg
Metal powder forming water	* 42,4	-	63,5	l/kg
Vaporization energy	* 1,09e4	-	1,2e4	MJ/kg
Vaporization CO2	* 815	-	901	kg/kg
Vaporization water	* 4,53e3	-	6,8e3	l/kg
Coarse machining energy (per unit wt removed)	* 0,83	-	0,918	MJ/kg
Coarse machining CO2 (per unit wt removed)	* 0,0623	-	0,0688	kg/kg
Fine machining energy (per unit wt removed)	* 4,03	-	4,45	MJ/kg
Fine machining CO2 (per unit wt removed)	* 0,302	-	0,334	kg/kg
Grinding energy (per unit wt removed)	* 7,58	-	8,38	MJ/kg
Grinding CO2 (per unit wt removed)	* 0,568	-	0,628	kg/kg
Non-conventional machining energy (per unit wt removed)	* 109	-	120	MJ/kg
Non-conventional machining CO2 (per unit wt removed)	* 8,15	-	9,01	kg/kg

Recycling and end of life

Recycle	✓			
Embodied energy, recycling	* 8,1	-	8,96	MJ/kg
CO2 footprint, recycling	* 0,636	-	0,703	kg/kg
Recycle fraction in current supply	39,9	-	44	%
Downcycle	✓			
Combust for energy recovery	✗			
Landfill	✓			
Biodegrade	✗			

Notes

Keywords

CS1020, Steelmark-Eagle & Globe (AUSTRALIA); LASALLE 1018, LaSalle Steel Co. (USA);

Standards with similar compositions

• Australia:
S1020 to AS 1442, S1020 to AS 1443, S1020 to AS 1446
• Austria:
C22SP to ONORM M3167
• China:
CRB650 to GB 13788, ML20Al to GB/T 6478, Q235 to GB/T 3524
• Hungary:
B38X to MSZ 500
• India:
17C5 to IS 8053, ERW-3 to IS 3074, Grade 8 to IS 7887, Grade 8 to IS 8952
• International:
CC21A to ISO 4954
• Italy:
C21 to UNI 6922, CB20FF to UNI 7356
• Japan:
SWRCH20A to JIS G3507, SWRM 20 to JIS G3505
• Mexico:
1020 to NMX-B-301, MT1020 to NMX-B-201, MT1020 to NMX-B-203-SCFI
• Pan America:
1020 to COPANT 330, 1020 to COPANT 331, 1020 to COPANT 333
• South Korea:
SWRCH20A to KS D 3592, SWRM 20 to KS D 3554
• Spain:
18KA-DF to UNE 36032, 20KA-DF to UNE 36032, F.7516 to UNE 36032, F.7517 to UNE 36032
• UK:
040A20 to BS 970/1
• USA:
1020, 1020 to ASTM A29/A29M, 1020 to ASTM A512-96, 1020 to ASTM A513, 1020 to ASTM A519, 1020 to ASTM A568/A568M, 1020 to DoD-F-24669/1, 1020 to FED QQ-S-635B, 1020 to FED QQ-S-698, 1020 to FED QQ-W-461H, 1020 to MIL-S-7952A, 1020 to MIL-T-3520, 1020 to SAE J403, 1023, 1023 to ASTM A513, 1023 to ASTM A568/A568M, 1023 to SAE J403, 5032 to AMS 5032E, C2 to MIL-S-16788A, CS1020 to MIL-S-11310E, G10200 to ASTM A510/A510M, G10200 to ASTM A576-90b, G10200 to ASTM A830/A830M, G10200 to MIL-S-46059, Grade A to ASTM A595, Grade B to ASTM A730, M1020, M1020 to ASTM A29/A29M, M1020 to ASTM A575-96, M1020 to SAE J403, MT1020 to ASTM A512-96, MT1020 to ASTM A513, MT1020 to ASTM A519, MT1020 to ASTM A787, UNS G10200, UNS G10200 to UNS, UNS G10230, UNS K01900, UNS K02000, UNS K02004, UNS K11900
• Tradenames:
ASCOMETAL XC18, B-W STANDARDIZED, CS1020, MARREL M5, POMPEY FFC 2, TOLEDO 15, UNION MC QUAID-EHN, V2

Links

ProcessUniverse
Producers
Reference
Shape