

General information

Designation

AISI 1040	
Condition	Annealed
UNS number	G10400
US name	ASTM G10420, ASTM 1042, ASTM 1040, ASME G10400, ASME G10390, ASME 1039
EN name	~HS40
ISO name	~CE40E4
JIS (Japanese) name	~STKM16C, ~STKM16A

Typical uses

Heavy duty shafts, axles, crankshafts, couplings, gears (if given a hardening treatment)

Composition overview

Compositional summary

Fe99 / Mn0.6-0.9 / C0.37-0.44 (impurities: S<0.05, P<0.04)
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Material family	Metal (ferrous)
Base material	Fe (Iron)

Composition detail (metals, ceramics and glasses)

C (carbon)	0,37	-	0,44	%
Fe (iron)	* 98,6	-	99	%
Mn (manganese)	0,6	-	0,9	%
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		
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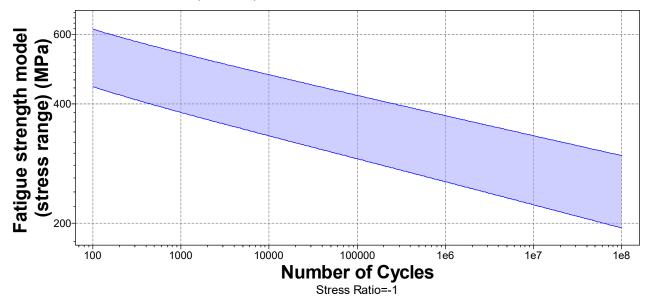
Mechanical properties

Mechanical properties				
Young's modulus	208	-	216	GPa
Specific stiffness	26,5	-	27,5	MN.m/kg
Yield strength (elastic limit)	315	-	390	MPa
Tensile strength	475	-	575	MPa
Specific strength	40,1	-	49,7	kN.m/kg
Elongation	24	-	36	% strain
Compressive strength	* 315	-	390	MPa
Flexural modulus	* 208	-	216	GPa
Flexural strength (modulus of rupture)	315	-	390	MPa
Shear modulus	80	-	85	GPa
Bulk modulus	161	-	176	GPa
Poisson's ratio	0,285	-	0,295	
Shape factor	58			
Hardness - Vickers	143	-	173	HV

Carbon steel, AISI 1040, annealed

Elastic stored energy (springs)	236	-	355	kJ/m^3
Fatigue strength at 10^7 cycles	* 254	-	291	MPa
Fatigue strength model (stress range)	* 222	-	332	MPa

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



Impact & fracture properties

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Fracture toughness	* 46	-	72	MPa.m^0.5
Toughness (G)	10,4	-	23,5	kJ/m^2

Thermal properties

Melting point	1,43e3	-	1,51e3	°C
Maximum service temperature	* 323	-	350	°C
Minimum service temperature	* -63	-	-38	°C
Thermal conductivity	50	-	54	W/m.°C
Specific heat capacity	465	-	505	J/kg.°C
Thermal expansion coefficient	10,5	-	12	μstrain/°C
Thermal shock resistance	130	-	167	°C
Thermal distortion resistance	* 4,29	-	5	MW/m
Latent heat of fusion	* 270	-	275	kJ/kg

Electrical properties

Electrical resistivity	16	-	19	µohm.cm
Electrical conductivity	9,07	-	10,8	%IACS
Galvanic potential	* -0,52	-	-0,44	V

Magnetic properties

Optical, aesthetic and acoustic properties

Transparency	Opaque		
Acoustic velocity	5,14e3 -	5,25e3	m/s
Mechanical loss coefficient (tan delta)	* 8,8e-4 -	0,00109	

Critical materials risk

Contains >5wt% critical elements?	No
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Metal cold forming Acceptable Metal press forming Acceptable Metal deep drawing Limited use Machining speed 33,5 m/min Weldability Good Proheating and post weld heat heat heatherists are required Carbon equivalency 0,47 - 0,59 Durability Water (fresh) Water (fresh) Water (salt) Limited use Strong acids United use Strong acids United use Strong acids United use Strong acids United use Organic solvents Excellent Oxidation (sunlight) Excellent Oxidation (sunlight) Excellent Oxidation (sunlight) Excellent Oxidation (sunlight) Excellent		
Metal cold forming Acceptable Metal hot forming Acceptable Metal hot forming Acceptable Metal press forming Acceptable Metal deep drawing Machining speed 33,5 m/min Machining speed 43,5 m/min Machining speed 44,5 m/min Machining speed 44	Processing properties	
Metal hot forming	Metal casting	Unsuitable
Metal press forming	Metal cold forming	Acceptable
Meachining speed 33.5 ms/min Market	Metal hot forming	Acceptable
Meldability Good Frenheating and post weld heat treatments are required	Metal press forming	Acceptable
Maria	Metal deep drawing	Limited use
Maria	Machining speed	33,5 m/min
Durability Water (fresh) Acceptable Water (fresh) Limited use Weak acids Limited use Strong acids Unacceptable Weak akids Limited use Strong acids Unacceptable Weak akids Limited use Strong acids Unacceptable Weak akidalis Acceptable Weak akidalis Limited use Organic solvents Excellent Oxidation at 500C Acceptable Weak akidalis Acceptable Weak akidalis Limited use Organic solvents Excellent Oxidation (sunlight) Excellent Galling resistance (adhesive wear) Limited use Oxidation (sunlight) Excellent Calling resistance (adhesive wear) Limited use Oxidation (sunlight) Excellent Oxidation (sunlight) Repair Oxidation (sunlight) Excellent Oxidation (sunlight) Oxi	Weldability	Good
Water (fresh) Acceptable	Notes	Preheating and post weld heat treatments are required
Water (fresh)	Carbon equivalency	0,47 - 0,59
	Durability	
Weak acids Strong acids What alkalis Acceptable Weak alkalis Acceptable Strong alkalis Crganic solvents Crganic solvents Excellent Oxidation at 500C Acceptable UV radiation (sunlight) Excellent Calling resistance (adhesive wear) Notes Can be used for gears only if hardened. Aluminum bronze is the most suitable mating material to minimize gailing. Flammability Corrosion resistance of metals Stress corrosion cracking Notes Not susceptible Rated in chlorids: Other susceptible environments: Nitrate, hydroxide, carbonate, ammonia Primary production energy, CO2 and water Embodied energy, primary production Sources 19.4 MJ/kg (Phingra, Overly, Davis, 1999); 23 MJ/kg (Norgate, Jahanshahi, Rankin, 2007); 27.9 MJ/kg (Eccinvent v2.2); 29.2 MJ/kg (Hammond and Jones, 2008); 35.4 MJ/kg (Hammond and Jones, 2008); 37.2 MJ/kg (Hammond and Jones, 2008); 38.4 MJ/kg (Hammond and Jones, 2008); 37.2 MJ/kg (Hammond and Jones, 2	Water (fresh)	Acceptable
Strong acids Weak alkalis Acceptable Strong alkalis Cimited use Oxidation at 500C Acceptable UV radiation (sunlight) Salling resistance (adhesive wear) Notes Can be used for gears only if hardened. Aluminum bronze is the most suitable mating material to minimize gailing. Flammability Non-flammable Corrosion resistance of metals Stress corrosion cracking Notes Stress corrosion cracking Notes Primary production energy, CO2 and water Embodied energy, primary production Sources 194 Mulkig (Dhingra, Overly, Davis, 1999); 23 Mulkig (Norgate, Jahanshahi, Rankin, 2007); 27.9 Mulkig (Eccinvent V.2.); 29.2 Mulkig (Hammond and Jones, 2008); 37.2 Mulkig (Hammond and Jones, 2008); 38.4 Mulkig (Hammond and Jones, 2008); 37.2 Mulkig (Weat, van der and Geines, 2010); 38 Mulkig (Hammond and Jones, 2008); 47.4 Mulkig (Hammond and Jones, 2008); 27.7 kg/kig (Hammond and Jones, 2008); 28.8 Mulkig (Hammond and Jones, 2008); 47.4 kg/kig (Hammond and Jones, 2008); 27.7 kg/kig (Hammond and Jones, 2008); 28.9 kg/kig (Nogate, Jahanshahi, Rankin, 2007); 27.4 kg/kig (Hammond and Jones, 2008); 37.2 Mulkig (Sullivan and Gaines, 2010); 38 Mulkig (Hammond and Jones, 2008); 47.4 Mulkig (Hammond and Jones, 2008); 37.2 Mulkig (Hammond and Jones, 2008); 37.2 Mulkig (Hammond and Jones, 2008); 37.2 kg/kig (Hammond and Jones, 2008); 37.2 kg/kig (Hammond and Jones, 2008); 37.2 kg/kig (Hammond and Jones, 2008); 27.7 kg/kig (Hammond and Jones, 2008); 37.2 kg/kig (Hammond and Jones, 2008); 28.8 kg/kig (Nogate, van der and Oers, van, 2003); 28.8 kg/kig (Nogate, van der and Oers, van, 2003); 28.8 kg/kig (Nogate, van der and Oers, van, 2003); 28.8 kg/kig (Nogate, Jahanshahi) Rankin, 2007); 27.4 kg/kig (Hammond and Jones, 2008); 27.7 kg/kig (Hammond and Jones, 2008); 27.7 kg/kig (Hammond and Jones, 2008); 28.4 kg/kig (Mammond and Jones, 2008); 28.4	Water (salt)	Limited use
Strong alkalis Acceptable	Weak acids	Limited use
Strong alkalis Organic solvents Excellent Oxidation (sunlight) Galling resistance (adhesive wear) Notes Can be used for gears only if hardened. Aluminum bronze is the most suitable mating material to minimize galling. Flammability Non-flammable Corrosion resistance of metals Stress corrosion cracking Notes Rated in chloride. Other susceptible environments: Nitrate, hydroxide, carbonate, ammonia Primary production energy, CO2 and water Embodied energy, primary production Sources 194 MJ/kg (Dhingra, Overly, Davis, 1999); 23 MJ/kg (Norgate, Jahanshahi, Rankin, 2007); 27 MJ/kg (Ecoinvent V.2); 29.2 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); 37.2 MJ/kg (Sources and Oers, van, 2003); 23 kg/kg (Voet, van der and Oers, van, 2003); 23 kg/kg (Voet, van der and Oers, van, 2003); 23 kg/kg (Voet, van der and Oers, van, 2003); 23 kg/kg (Voet, van der and Jones, 2008); 37 kg/kg (Hammond a	Strong acids	Unacceptable
Organic solvents Excellent Oxidation at 500C Acceptable UV radiation (sunlight) Excellent Galling resistance (adhesive wear) Limited use Notes Can be used for gears only if hardened. Aluminum bronze is the most suitable mating material to minimize gailing. Flammability Non-flammable Corrosion resistance of metals Stress corrosion cracking Not susceptible Notes Primary production energy, CO2 and water Embodied energy, primary production 30,8 - 33,9 MJ/kg Sources 19.4 MJ/kg (Diniga, Overly, Davis, 1999); 23 MJ/kg (Norgate, Jahanshahi, Rankin, 2007); 27,9 MJ/kg (Ecoinvent v.2.2); 29.2 kJM/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); 37.4 MJ/kg (Hammond and Jones, 2008); 37.2 MJ/kg (Sullivan and Gaines, 2010); 38 MJ/kg (Hammond and Jones, 2008); 37.2	Weak alkalis	Acceptable
Oxidation at 500C Acceptable UV radiation (sunlight) Excellent Galling resistance (adhesive wear) Limited use Notes Can be used for gears only if hardened. Aluminum bronze is the most suitable mating material to minimize galling. Flammability Corrosion resistance of metals Stress corrosion cracking Notes Not susceptible 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 194 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); 35,4 MJ/kg (Hammond and Jones, 2008); 35,4 MJ/kg (Hammond and Jones, 2008); 37,2 MJ/kg (MJ/kg (MJ/kg) 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 (Eccinvent v2.2); 1.81 kg/kg (Voet, van der and Oers, van, 2003); 2.3 kg/kg (Noet, van der and Oers, van, 2003); 2.3 kg/kg	Strong alkalis	Limited use
UV radiation (sunlight)	Organic solvents	Excellent
Galling resistance (adhesive wear) Notes Can be used for gears only if hardened. Aluminum bronze is the most suitable matting material to minimize galling. Flammability Non-flammable Corrosion resistance of metals Stress corrosion cracking Notes Rated in chloride; Other susceptible environments: Nitrate, hydroxide, carbonate, ammonia Primary production energy, CO2 and water Embodied energy, primary production 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); 34.7 MJ/kg (Hammond and Jones, 2008); 35.4 MJ/kg (Hammond and Jones, 2008); 37.2 MJ/kg (Sullivars and Gaines, 2010); 38 MJ/kg (Hammond and Jones, 2008); 34.7 MJ/kg (Hammond and Jones, 2008); 37.2 MJ/kg (Hammon	Oxidation at 500C	Acceptable
Notes Can be used for gears only if hardened. Aluminum bronze is the most suitable mating material to minimize galling. Non-flammable Corrosion resistance of metals Stress corrosion cracking Notes Not susceptible Rated in chloride: Other susceptible environments: Nitrate, hydroxide, carbonate, ammonia Primary production energy, CO2 and water Embodied energy, primary production Sources 194 MJ/kg (Dhingra, Overly, Davis, 1999); 23 MJ/kg (Norgate, Jahanshahi, Rankin, 2007); 27.9 MJ/kg (Eccinvent V2.2); 29.2 MJ/kg (Hammond and Jones, 2008); 33.4 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); 37.2 MJ/kg (Sullivan and Gaines, 2010); 38 MJ/kg (Hammond and Jones, 2008); 45.4 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); 37.2 MJ/kg (Sullivan and Gaines, 2010); 38 MJ/kg (Hammond and Jones, 2008); 45.4 MJ/kg (Hammond and Jones, 2008); 37.2 MJ/kg (Noet, van der and Oers, van, 2003); 2.2 kg/kg (Noet, van der and Oers, van, 2003); 2.3 kg/kg (Noet, van der and Oers, van, 2003); 2.3 kg/kg (Noet, van der and Oers, van, 2003); 2.3 kg/kg (Noet, van der and Oers, van, 2003); 2.3 kg/kg (Hammond and Jones, 2008); 2.7 kg/kg (Hammond and Jones, 2008); 3.2 kg/kg (Noet, van der and Oers, van, 2003); 2.3 kg/kg (Noet, van der and Oers, van, 2003); 2.3 kg/kg (Noet, van der and Oers, van, 2003); 2.3 kg/kg (Noet, van der and Oers, van, 2003); 2.3 kg/kg (Noet, van der and Oers, van, 2003); 2.3 kg/kg (Noet, van der and Oers, van, 2003); 2.3 kg/kg (Noet, van der and Oers, van, 2003); 2.3 kg/kg (Noet, van der and Oers, van, 2003); 2.3 kg/kg (Noet, van der and Oers, van, 2003); 2.3 kg/kg (Noet, van der and Oers, van, 2003); 2.3 kg/kg (Noet, van der and Oers, v	UV radiation (sunlight)	Excellent
Non-flammability	Galling resistance (adhesive wear) Notes	Limited use
Corrosion resistance of metals Stress corrosion cracking Notes Rated in chloride; Other susceptible environments: Nitrate, hydroxide, carbonate, ammonia Primary production energy, CO2 and water Embodied energy, primary production 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); 34.5 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); 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); 2.23 kg/kg (Voet, van der and Oers, van, 2003); 2.23 kg/kg (Norgate, Jahanshahi, Rankin, 2007); 2.74 kg/kg (Hammond and Jones, 2008); 2.77 kg/kg (Hammond and Jones, 2008); 2.77 kg/kg (Hammond and Jones, 2008); 2.89 kg/kg (Hammond and Jones, 2008); 3.72 kg/kg (Hammond and Jones, 2008); 3.72 kg/kg (Hammond and Jones, 2008); 3.74 kg/kg (Hammond and Jones, 2008); 3.75 kg/kg (Hammond and		
Stress corrosion cracking Notes 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); 37.2 MJ/kg (Sullivan and Gaines, 2010); 38 MJ/kg (Hammond and Jones, 2008); 45.4 MJ/kg (Hammond and Jones, 2008); 37.2 kg/kg CO2 footprint, primary production 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 (Voet, van der and Oers, van, 2003); 2.3 kg/kg (Voet, van der and Oers, van, 2003); 2.23 kg/kg (Voet, van der and Oers, van, 2003); 2.77 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 * 43,6 - 48,2 l/kg Processing energy, CO2 footprint & water Casting energy * 10,9 - 12,1 MJ/kg Augustation of the more of the production of	Flammability	Non-flammable
Stress corrosion cracking Notes 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); 37.2 MJ/kg (Sullivan and Gaines, 2010); 38 MJ/kg (Hammond and Jones, 2008); 45.4 MJ/kg (Hammond and Jones, 2008); 37.2 kg/kg CO2 footprint, primary production 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 (Voet, van der and Oers, van, 2003); 2.3 kg/kg (Voet, van der and Oers, van, 2003); 2.23 kg/kg (Voet, van der and Oers, van, 2003); 2.77 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 * 43,6 - 48,2 l/kg Processing energy, CO2 footprint & water Casting energy * 10,9 - 12,1 MJ/kg Augustation of the more of the production of	Corresion resistance of metals	
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); 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); 37.2 MJ/kg (Sullivan and Gaines, 2010); 38 MJ/kg (Hammond and Jones, 2008); 45.4 MJ/kg (Hammond and Jones, 2008); 37.2 Mg/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); 2.3 kg/kg (Voet, van der and Oers, van, 2003); 2.3 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); 2.89 kg/kg (Hammond and Jones, 2008); 2.7 kg/kg (Hammond and Jones, 2008); 2.7 kg/kg Processing energy, CO2 footprint & water Casting energy * 10,9 - 12,1 MJ/kg Processing energy * 10,9 - 12,1 MJ/kg Casting water * 20,7 - 31 I/kg Roll forming, forging energy * 3,11 - 3,44 MJ/kg Roll forming, forging energy * 2,88 - 4,32 I/kg		Not suscentible
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 √2.2); 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 √2.2); 1.81 kg/kg (Voet, van der and Oers, van, 2003); 2.23 kg/kg (Voet, van der and Oers, van, 2003); 2.28 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); 2.89 kg/kg (Hammond and Jones, 2008); 3.03 kg/kg (Hammond and Jones, 2008); 3.27 kg/kg (Hammond and Jones, 2008); 3.28 kg/kg (Ham	-	·
Embodied energy, primary production 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); 32.8 MJ/kg (Hammond and Jones, 2008); 34.4 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 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); 2.89 kg/kg (Hammond and Jones, 2008); 2.77 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 Processing energy, CO2 footprint & water Casting energy * 10.9 - 12.1 MJ/kg Casting CO2 * 0,819 - 0,906 kg/kg Casting water * 20,7 - 31 l/kg Roll forming, forging energy * 3,11 - 3,44 MJ/kg Roll forming, forging cO2 * 0,233 - 0,258 kg/kg Roll forming, forging water * 2,88 - 4,32 l/kg Extrusion, foil rolling energy * 5,94 - 6,57 MJ/kg		hydroxide, carbonate, ammonia
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); 2.23 kg/kg (Voet, van der and Oers, van, 2003); 2.27 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 * 43,6 - 48,2 l/kg Processing energy, CO2 footprint & water Casting energy * 10,9 - 12,1 MJ/kg Casting CO2 * 0,819 - 0,906 kg/kg Casting water * 20,7 - 31 l/kg Roll forming, forging energy * 3,11 - 3,44 MJ/kg Roll forming, forging CO2 * 0,233 - 0,258 kg/kg Roll forming, forging water * 2,88 - 4,32 l/kg Extrusion, foil rolling energy * 5,94 - 6,57 MJ/kg	Primary production energy, CO2 and water	
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); 35.4 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); 37.2 MJ/kg (Sullivan and Gaines, 2010); 38 MJ/kg (Hammond and Jones, 2008); 45.4 MJ/kg (Hammond and Jones, 2008); 45.4 MJ/kg (Hammond and Jones, 2008); 2.24 MJ/kg (Mammond and Jones, 2008); 2.25 Mg/kg (Southern 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); 2.89 kg/kg (Hammond and Jones, 2008); 3.03 kg/kg (Hammond and Jones, 2008); 3.27 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); 3.28 kg/kg (Hammond and Jones, 2008); 3.28 kg/kg (Hammond and Jones, 2008); 3.28 kg/kg (Hammond and Jones, 2008); 2.89 kg/kg (Hammond and Jones, 2008); 3.27 kg/kg (Hammond and Jones, 2008); 3.28 kg/kg (Hammond and Jones, 2008); 2.29 kg/kg (Hammond and Jones, 2008); 2.89 kg/kg (Hammond and Jones, 200	Embodied energy, primary production	30,8 - 33,9 MJ/kg
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); 2.23 kg/kg (Voet, van der and Oers, van, 2003); 2.25 kg/kg (Hammond and Jones, 2008); 2.87 kg/kg (Hammond and Jones, 2008); 2.87 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 * 43,6 - 48,2 I/kg Processing energy Casting energy * 10,9 - 12,1 MJ/kg Casting CO2 * 0,819 - 0,906 kg/kg Casting water * 20,7 - 31 I/kg Roll forming, forging energy * 3,11 - 3,44 MJ/kg Roll forming, forging energy * 3,11 - 3,44 MJ/kg Roll forming, forging water * 2,88 - 4,32 I/kg Extrusion, foil rolling energy * 5,94 - 6,57 MJ/kg		popologii Bankin 2007): 27 0 M Ilka (Ecoinyant v2 2): 20 2 M Ilka (Hammond and
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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); 2.23 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); 3.27 kg/kg (Hammond and Jones, 2008); 3.28 kg/kg (Hammond and Jones, 2008); 3.27 kg/kg (Hammond and Jones	CO2 footprint, primary production	2,26 - 2,49 kg/kg
Processing energy, CO2 footprint & water Casting energy * 10,9 - 12,1 MJ/kg Casting CO2 * 0,819 - 0,906 kg/kg Casting water * 20,7 - 31 I/kg Roll forming, forging energy * 3,11 - 3,44 MJ/kg Roll forming, forging CO2 * 0,233 - 0,258 kg/kg Roll forming, forging water * 2,88 - 4,32 I/kg Extrusion, foil rolling energy * 5,94 - 6,57 MJ/kg	0.396 kg/kg (Voet, van der and Oers, van, 2003); 1.75 kg/kg (Ecoir and Oers, van, 2003); 2.3 kg/kg (Norgate, Jahanshahi, Rankin, 20 2008); 2.87 kg/kg (Hammond and Jones, 2008); 2.89 kg/kg (Hammond and Jones)	07); 2.74 kg/kg (Hammond and Jones, 2008); 2.77 kg/kg (Hammond and Jones,
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Casting CO2 * 0,819 - 0,906 kg/kg Casting water * 20,7 - 31 I/kg Roll forming, forging energy * 3,11 - 3,44 MJ/kg Roll forming, forging CO2 * 0,233 - 0,258 kg/kg Roll forming, forging water * 2,88 - 4,32 I/kg Extrusion, foil rolling energy * 5,94 - 6,57 MJ/kg	Processing energy, CO2 footprint & water	
Casting water * 20,7 - 31 I/kg Roll forming, forging energy * 3,11 - 3,44 MJ/kg Roll forming, forging CO2 * 0,233 - 0,258 kg/kg Roll forming, forging water * 2,88 - 4,32 I/kg Extrusion, foil rolling energy * 5,94 - 6,57 MJ/kg	Casting energy	* 10,9 - 12,1 MJ/kg
Roll forming, forging energy * 3,11 - 3,44 MJ/kg Roll forming, forging CO2 * 0,233 - 0,258 kg/kg Roll forming, forging water * 2,88 - 4,32 l/kg Extrusion, foil rolling energy * 5,94 - 6,57 MJ/kg	Casting CO2	* 0,819 - 0,906 kg/kg
Roll forming, forging CO2 * 0,233 - 0,258 kg/kg Roll forming, forging water * 2,88 - 4,32 l/kg Extrusion, foil rolling energy * 5,94 - 6,57 MJ/kg	Casting water	* 20,7 - 31 l/kg
Roll forming, forging water * 2,88 - 4,32 l/kg Extrusion, foil rolling energy * 5,94 - 6,57 MJ/kg	Roll forming, forging energy	* 3,11 - 3,44 MJ/kg
Roll forming, forging water * 2,88 - 4,32 I/kg Extrusion, foil rolling energy * 5,94 - 6,57 MJ/kg	Roll forming, forging CO2	* 0,233 - 0,258 kg/kg
Extrusion, foil rolling energy * 5,94 - 6,57 MJ/kg	Roll forming, forging water	
· · ·		2,00 +,02 l/kg
	Extrusion, toil rolling energy	



Extrusion, foil rolling water	* 4,09	-	6,14	l/kg
Wire drawing energy	* 21,5	-	23,8	MJ/kg
Wire drawing CO2	* 1,61	-	1,78	kg/kg
Wire drawing water	* 8,1	-	12,2	l/kg
Metal powder forming energy	* 38,1	-	42	MJ/kg
Metal powder forming CO2	* 3,05	-	3,36	kg/kg
Metal powder forming water	* 41,5	-	62,2	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)	* 0,899	-	0,994	MJ/kg
Coarse machining CO2 (per unit wt removed)	* 0,0674	-	0,0745	kg/kg
Fine machining energy (per unit wt removed)	* 4,72	-	5,21	MJ/kg
Fine machining CO2 (per unit wt removed)	* 0,354	-	0,391	kg/kg
Grinding energy (per unit wt removed)	* 8,96	-	9,9	MJ/kg
Grinding CO2 (per unit wt removed)	* 0,672	-	0,743	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

Other notes

Responds to heat treatment and can be flame or induction hardened to 500 HV for gears and for good wear resistance.

Keywords

LASALLE 1045, LaSalle Steel Co. (USA); B/43, Steelmark-Eagle & Globe (AUSTRALIA); S/39, Steelmark-Eagle & Globe (AUSTRALIA);

Standards with similar compositions



India:

40C8 to IS 1570/2/1, 45C8 to IS 1570/2/1, C40 to IS 1570/2/1, C45 to IS 1570/2/1, IS 6902 to IS 6902

Mexico:

1038 to NMX-B-301, 1039 to NMX-B-301, 1040 to NMX-B-203-SCFI, 1040 to NMX-B-301, 1042 to NMX-B-301, 1043 to NMX-B-301

· Pan America:

1038 to COPANT 331, 1038 to COPANT 333, 1039 to COPANT 333, 1040 to COPANT 330, 1040 to COPANT 331, 1040 to COPANT 333

• UK:

080M36 to BS 970/1, 080M40 to BS 970/1, 170H41 to BS 970/1

· USA:

1038, 1038 to ASTM A29/A29M, 1038 to ASTM A568/A568M, 1038 to SAE J403, 1039, 1039 to ASTM A29/A29M, 1039 to ASTM A568/A568M, 1039 to SAE J403, 1040, 1040 to ASTM A29/A29M, 1040 to ASTM A513, 1040 to ASTM A519, 1040 to ASTM A568/A568M, 1040 to DoD-F-24669/1, 1040 to FED QQ-S-635B, 1040 to SAE J403, 1042, 1042 to ASTM A29/A29M, 1042 to ASTM A568/A568M, 1042 to SAE J403, 1043, 1043 to ASTM A29/A29M, 1043 to ASTM A568/A568M, 1042 to FED QQ-S-635B, C4 to MIL-S-16788A, CS1040 to MIL-S-11310E, G10380 to ASTM A510/A510M, G10380 to ASTM A576-90b, G10390 to ASTM A510/A510M, G10390 to ASTM A576-90b, G10400 to ASTM A510/A510M, G10420 to ASTM A576-90b, G10430 to ASTM A576-90b, G10430 to ASTM A576-90b, UNS G10380, UNS G10380 to UNS, UNS G10390, UNS G10390 to UNS, UNS G10430, UNS G10420 to UNS, UNS G10430 to UNS

Tradenames:

ALLENOY 1038, ASCOMETAL XC38H1-H2, B/43, BOFORS N91, BOHLER V943, DODGE D-4, DONEGAL D-3, DYNAMIC C-1-4, DYNAMIC C-1-5, FORTUNA W3, GREDE 37, HECLA 37, JESSOP A-5, JESSOP STEEL A-5 (S M-40), KRUPP 1730, RED DIAMOND 9S, S/39, SODING WM, SWB-40M4, TULIPE EXTRA NO. 7, UGINE B 38, V4

Links	
ProcessUniverse	
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