Description

Image

Caption

Medium carbon steel is the material of cheap tools. Low alloy steels are much superior and only a little more expensive -- quality tools are low alloy. © Granta Design

The material

Medium carbon steel (0.25-0.7% carbon) hardens when quenched - a quality that gives great control over properties. "Hardenability" measures the degree to which it can be hardened in thick sections; plain carbon steels have poor hardenability - additional alloying elements are used to increase it (see Low alloy steels). Medium carbon steels are used on an enormous scale for railroad tracks; there are many other lower-volume applications.

Compositional summary

Fe/0.3 - 0.7%C

General properties

Density		487	-	493	lb/ft^3
Price	*	0.263	-	0.268	USD/lb
Date first used		1610			

Mechanical properties

Young's modulus		29	-	31.3	10^6 psi
Shear modulus		11.2	-	12.3	10^6 psi
Bulk modulus		22.9	-	24.7	10^6 psi
Poisson's ratio		0.285	-	0.295	
Yield strength (elastic limit)		44.2	-	131	ksi
Tensile strength		59.5	-	174	ksi
Compressive strength		44.2	-	255	ksi
Elongation		4	-	39	% strain
Hardness - Vickers		120	-	565	HV
Fatigue strength at 10^7 cycles	*	33.2	-	87	ksi

Fracture toughness	* 10.9	-	83.7	ksi.in^0.5
Mechanical loss coefficient (tan delta)	* 2.2e-4	-	0.00119	

Thermal properties

Melting point	2.52e3	-	2.76e3	°F
Maximum service temperature	* 698	-	788	°F
Minimum service temperature	* -90.7	-	-27.7	°F
Thermal conductor or insulator?	Good conductor			
Thermal conductivity	26	-	31.8	BTU.ft/h.ft^2.F
Specific heat capacity	0.105	-	0.124	BTU/lb.°F
Thermal expansion coefficient	5.56	-	7.78	µstrain/°F

Electrical properties

Electrical conductor or insulator?	Good conductor			
Electrical resistivity	15	-	22	µohm.cm

Optical properties

Transparency	Opaque

Processability

Castability	2	-	3	
Formability	4	-	5	
Machinability	3	-	4	
Weldability	5			
Solder/brazability	5			

Eco properties

Embodied energy, primary production	* 2.72e3	-	3.01e3	kcal/lb
CO2 footprint, primary production	* 1.72	-	1.9	lb/lb
Recycle	✓			

Supporting information

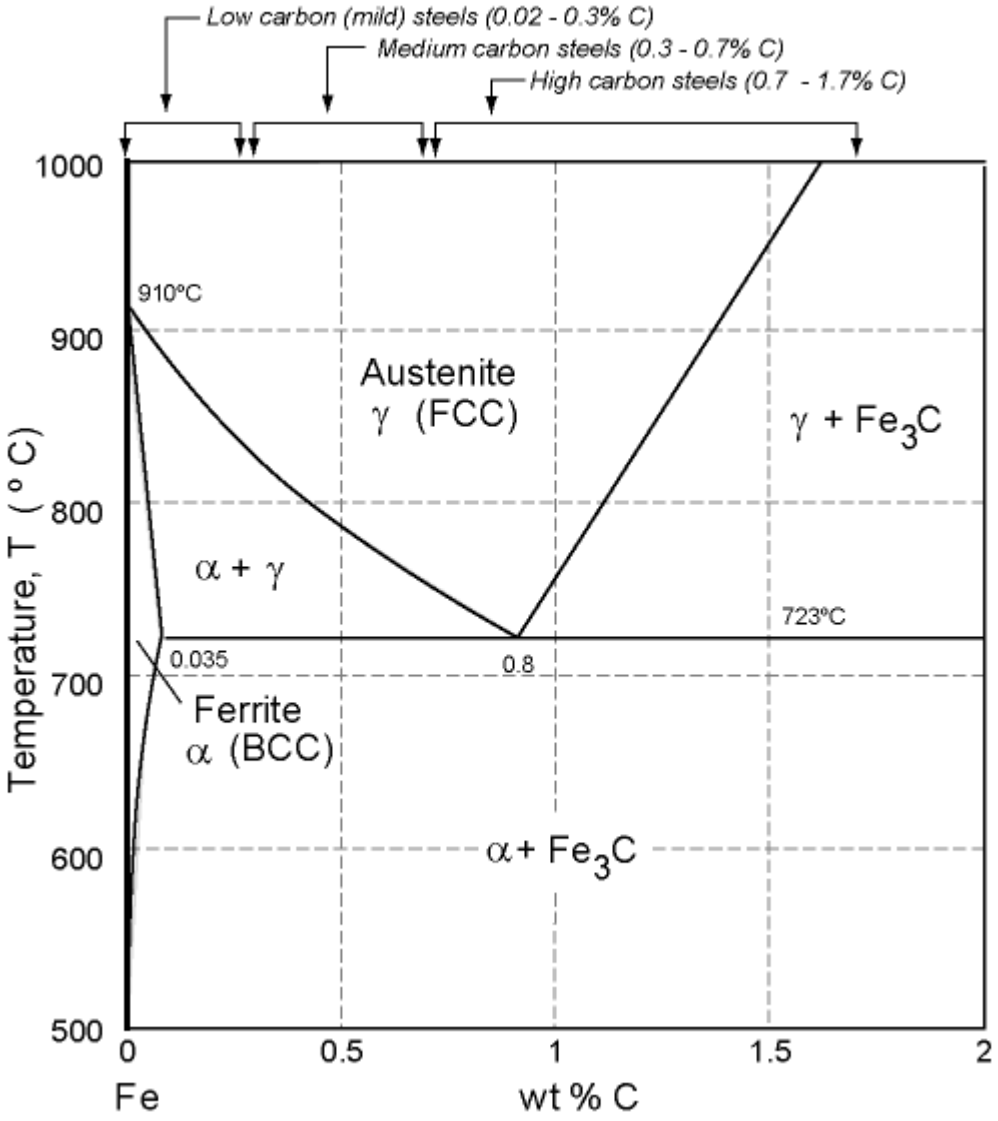
Design guidelines

Hardenability measures the degree to which it can be hardened in thick sections; plain carbon steels have poor hardenability - additional alloying elements are used to increase it (see Low alloy steels).

Technical notes

The two standard classifications for steels, the AISI and the SAE standards, have now been merged. In the SAE-AISI system, each steel has a four-digit code. The first two digits indicate the major alloying elements. The second two give the amount of carbon, in hundredths of a percent. Thus the plain carbon steels have designations starting 10xx, 11xx, 12xx or 14xxx, depending on how much manganese, sulfur and phosphorus they contain. The common low-carbon steels have the designations 1015,1020, 1022, 1117,1118; the common medium carbon steels are 1030,1040, 1050, 1060, 1137, 1141, 1144 and 1340; the common high alloy steels are 1080and 1095. More information on designations and equivalent grades can be found on the Granta Design website at www.grantadesign.com/designations

Phase diagram



Phase diagram description

Medium carbon steels are alloys of iron (Fe) with 0.3 - 0.7% carbon (C), for which this is the phase

Typical uses

General construction; general mechanical engineering; automotive; tools; axles; gears; bearings; cranks; shafts; gears; bells; cams, knives and scissors.

Values marked * are estimates.
No warranty is given for the accuracy of this data

Links

Reference

ProcessUniverse

Producers

Values marked * are estimates.
No warranty is given for the accuracy of this data