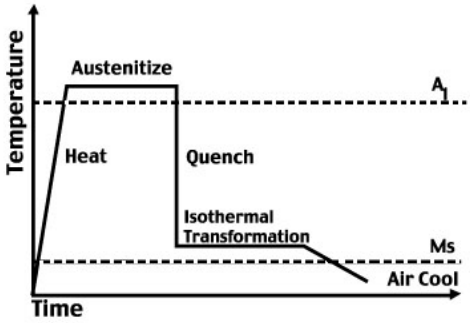
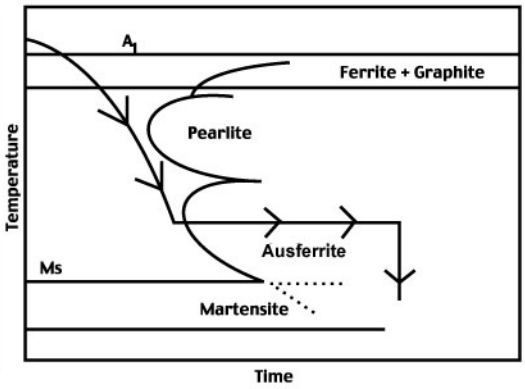
Goldens' Guide to Austempering

Austempering is a form of heat treatment used on ferrous metals, such as iron and steel, to improve the metal's mechanical properties. The metal is heated until it reaches an austenitic* state (carbon dissolved into the iron) and then rapidly cooled, or quenched (avoid the formation of pearlite*), but kept at a temperature high enough to prevent the formation of martensite* for an extended period. Austempered metals have improved strength, toughness, and resistance to distortion and wear. Austempered parts are often used as internal machine parts.



Specific properties are determined by the careful choice of heat treating parameters. Furnaces are used for austenitizing, while molten salt baths are used for quenching, which achieves close dimensional control. Times and temperatures are tightly controlled throughout the entire process to achieve the final mechanical properties.



Initial austenitizing times and temperatures (1550° to 1700° F.) are controlled to ensure formation of fine grain austenite and uniform carbon content in the matrix. The precise temperature is determined by the casting chemistry.

Quench cooling time must be controlled within a few seconds, to avoid formation of pearlite around the carbon nodules, which would reduce mechanical properties. Quench temperatures (450° to 750° F.) must stay above the point of martensite formation (except for ASTM A 897 Grade 6) to achieve the desired mechanical strength.

Austempered Ductile Iron can be used as a substitute for steel castings or fabrications in many applications.

ADI Grade	Tensile Strength (KSI)	Yield Strength (KSI)	Elongation	Typical Brinell Hardness
100-70-11	110	70	11	241-302
130-90-09	130	90	9	269-341
150-110-07	150	110	7	302-375
175-125-04	175	125	4	341-444
200-155-02	200	155	2	388-477
230-185-01	230	185	1	402-512

Austenite: A solution of iron with a small amount of carbon in it, a high temperature ~1800ºF iron phase. Bainite is formed when austenite is cooled rapidly.

Ausferrite: is a phase between pearlite and martensite. Two unique temperature conditions have to exist for the ausferrite microstructure to form. Austenite must be cooled rapidly enough so that pearlite does not form.

Martensite: Martensitic transformation occurs when the austenite is rapidly cooled in a process known as quenching. Martensite is very hard, meaning that it won't dent or scratch easily; this makes it a popular choice for tools, such as hammers and chisels, as well as swords. It is brittle, however, so it will break rather than bend when put under too much pressure.

Pearlite: Pearlite is a common lamellar microstructure occurring in many grades iron and of steels. The layers consist of alternate plates of pure iron and iron carbide. Pearlite is around the middle of the chart in terms of strength when compared to other iron alloys.

Revised 9/3/14