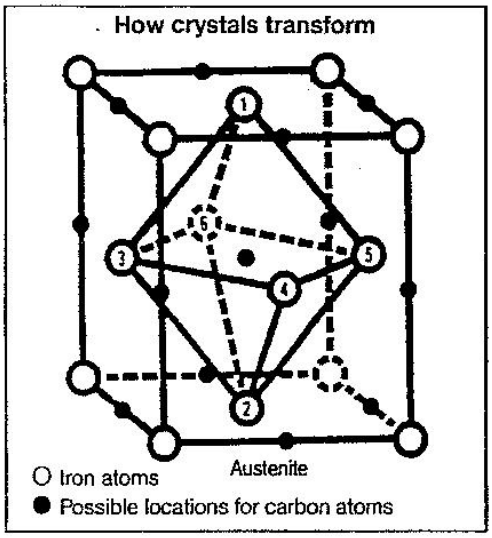
COLDfire™ Thermal Technologies

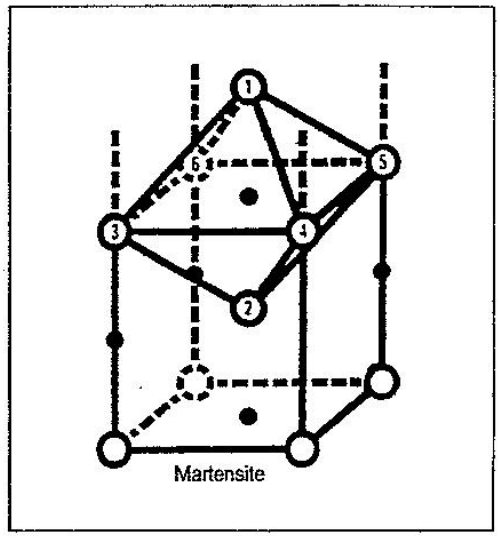
TECHNOLOGY FOCUS

Austenite to Martensite

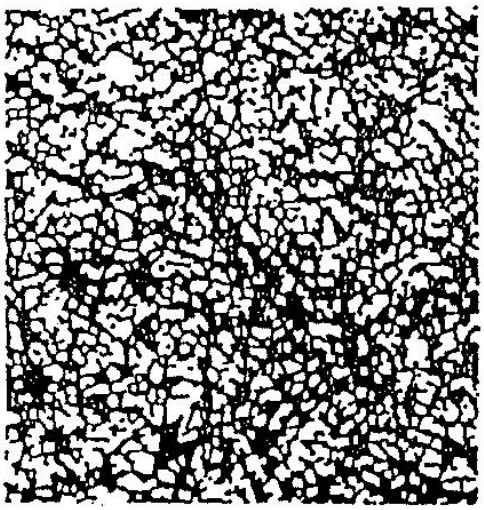
Conversion Process Technical Data

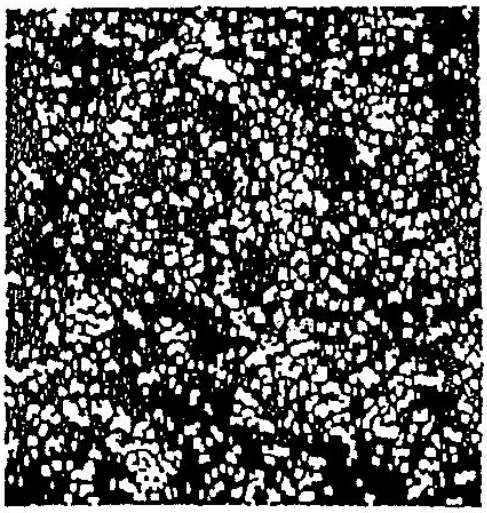


In austenite, a crystalline form of steel, each unit cell is a cubic structure with iron atoms at the corners and center of each face of the cube. These face-centered atoms, labeled 1-6, form an octahedron. Carbon atoms can occupy any of the sites indicated between iron atoms. Upon quenching from high temperature, austenite becomes martensite, a different, crystalline form of steel. Cryogenic treatment can cause any austenite retained after heat treatment to transform to martensite.



A unit cell of the martensite crystal is not cubic but is slightly elongated. Iron atoms still occupy the corners, but those that were face-centered in the austenite cell (1-6) move as shown, leaving the No. 2 atom in the center of the cell rather than on one of the faces. The No. 1 iron atom occupies the center of the adjacent cell (indicated by dotted lines). Austenite crystals are ductile but soft; martensite crystals are hard but must be tempered to combat brittleness.





Black "needles" in the photomicrographs of tool steel (above) are martensite crystals; white background is retained austenite. After cryogenic treatment and tempering (right), retained austenite is transformed to a finer martensite matrix. Samples were magnified 400 times under a microscope and photograhed by metallurgical consultant Paul Nowich.

Gilmore, V.E., "Frozen Tools," Popular Science, June 1987, pg. 64