FERRIUM® C64

Applicable specifications: AMS 6509

Associated specifications: U.S. Patent 8,801,872 B2, UNS K92731

Type analysis

Single figures are nominal except where noted.

Iron	Balance	**Cobalt**	16.30 %	**Nickel**	7.50 %
Chromium	3.50 %	**Molybdenum**	1.75 %	**Tungsten**	0.20 %
Carbon	0.11 %	**Vanadium**	0.02 %		

Forms manufactured

Bar-Flats	**Bar-Rectangles**	**Bar-Rounds**	**Billet**

Description

Ferrium C64 is a premium quality carburizing steel that offers high core strength, high fatigue strength, high temperature resistance, and high hardenability versus AISI 9310, X53 (AMS 6308), EN36, and other standard carburizable alloys. The benefits of using Ferrium C64 include light weighting of components and increasing power density.

The ability of Ferrium C64 to achieve 62–64 HRC while also providing excellent core strength benefits highly loaded components requiring wear and fatigue resistance. Ferrium C64 is being qualified by leading helicopter OEMs to replace X53 for next-generation transmission gears.

Ferrium C64 is manufactured and sold under license from QuesTek Innovations LLC.

Key Properties:

- High core strength
- High surface fatigue resistance
- High hardenability
- High temperature resistance

Markets:

- Aerospace
- Automotive
- Energy

Applications:

- Gears
- Power transmission shafts

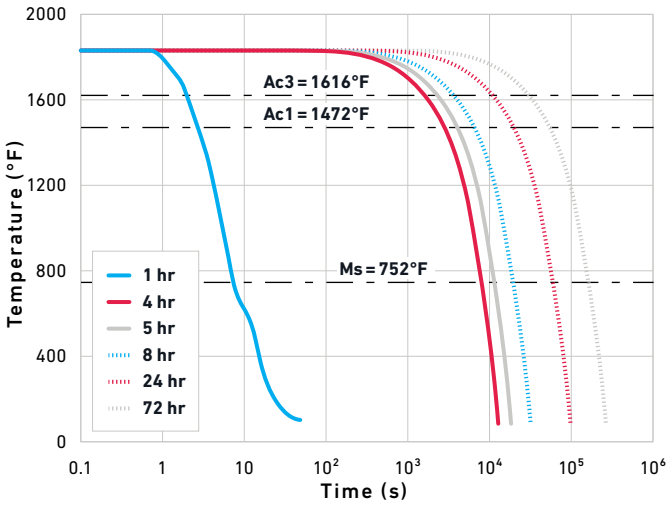
info@cartech.com | 610 208 2000

> FERRIUM C64

Physical properties

PROPERTY	At or From	English Units
DENSITY	—	0.2880 lb/in^3
MEAN CTE	75 to 200°F	5.29 x 10^{-6} in/in/°F
	75 to 400°F	5.18 x 10^{-6} in/in/°F
	75 to 600°F	5.32 x 10^{-6} in/in/°F
	75 to 800°F	5.53 x 10^{-6} in/in/°F
	75 to 1000°F	5.69 x 10^{-6} in/in/°F
CRITICAL TEMPERATURE (AC1)	1472°F	—
CRITICAL TEMPERATURE (AC3)	1616°F	—
MARTENSITE START	752°F	—

CONTINUOUS COOLING TRANSFORMATION (CCT) CURVES



Data provided by Questek Innovations LLC.

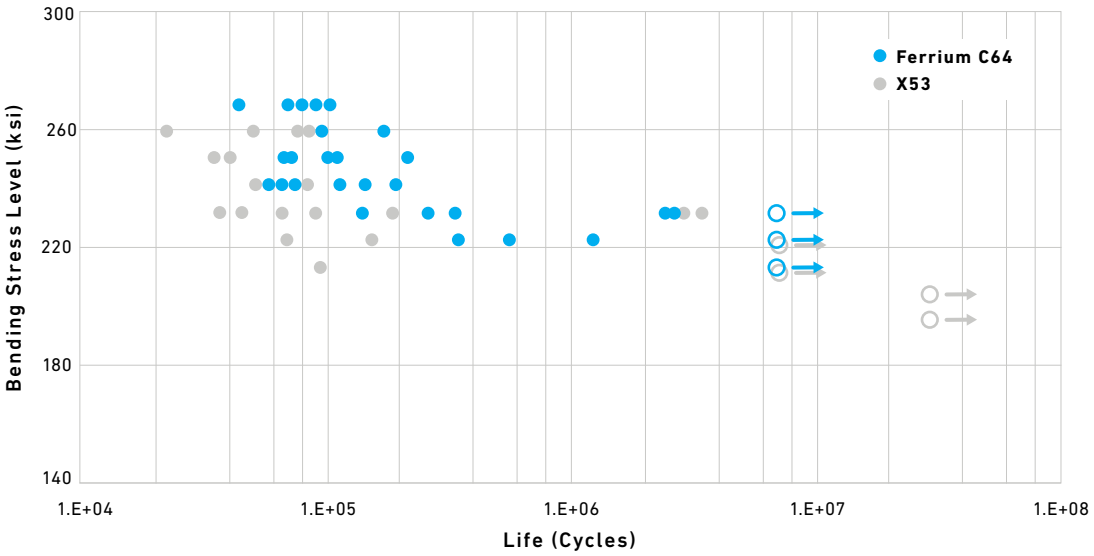
> FERRIUM C64

Typical mechanical properties

Ferrium C64 is a secondary hardening steel that will increase hardness after tempering.
The typical hardness after tempering is 47–50 HRC.

AVERAGE JOMINY END QUENCH HARDENABILITY								
DISTANCE FROM QUENCHED END (1/4 INCH)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Rockwell C	43.0	43.0	43.0	43.0	43.0	43.0	42.5	42.5

SINGLE TOOTH BENDING FATIGUE VS X53



> FERRIUM C64

CORE TENSILE PROPERTIES OF FERRIUM C64

TEST TEMPERATURE		TENSILE STRENGTH		YIELD STRENGTH		ELONGATION	REDUCTION OF AREA	FRACTURE TOUGHNESS	
°F	°C	ksi	MPa	ksi	MPa	% IN 1 INCH	%	ksi√in	MPa√m
Room temperature		229	1579	199	1372	18	65	85	94

Heat treatment

Normalizing	Heat uniformly to 1800°F (982°C) and air cool.
Annealing	Heat uniformly to 1250°F (677°C), hold for 2 to 8 hours, and air cool.
Carburizing	Vacuum carburize at 1830°F (1000°C), followed by quenching in gas (1.5 bar nitrogen or higher) or oil medium.
Solution treatment	If it is desired to achieve the core properties of Ferrium C64 without carburizing, this can be done by performing an austenitizing step at 1830 +/- 25°F (999 +/- 14°C) for 1 hour followed by quenching in gas (1.5 bar nitrogen or higher) or oil medium.
Quenching	Gas, oil, or equivalent.
Cold treatment	A refrigeration treatment at -100°F (-73°C) or lower for 1 hour is recommended. This should be performed with minimal delay after completion of the quench, and is mandatory within 8 hours of quench.

> FERRIUM C64

Straightening	Operations such as shaft straightening (if required) should preferably be done after the sub-zero treatment but prior to the temper. Ferrium C64 achieves full mechanical strength after tempering, and thus trying to straighten parts after tempering will be more difficult. If excessive distortion exists after the solution treatment, quench, and sub-zero treatment, then it is recommended to heat the part to 392°F (200°C) in air for 1 hour, hot-straighten the part (temperature determined by amount of force required to straighten part; temperature should be maintained below 700°F (371°C) to avoid any tempering or decarburization; a small oxide layer may form at this temperature), and allow the component to air cool. The full temper cycle must then be applied.
Tempering	Temper at 925°F (496°C) for 6 to 10 hours and air cool. It is preferred that tempering be performed in vacuum but can also be performed in air.

Workability

Hot working	1800–2100°F (982–1149°C) Recommended reduction ratio of 4:1.
Forging	Standard forging of billet and bar stock should be conducted at 1800–2050°F (982–1121°C). If higher forging temperatures are preferred, hot fire temperatures of 2300–2350°F (1260–1288°C) may be used, provided a minimum of 4:1 forging reduction ratio is achieved. Following forging, the parts should be air cooled to room temperature, followed by normalization, cold treatment, and annealing to improve machinability.
Machinability	Bars and forgings for machining shall not exceed 352 HRB, or equivalent, as descaled.

> FERRIUM C64

Preheating of dies	None.
Plating	Like other carburizing-grade steels, Ferrium C64 can be copper-plated prior to carburization (in accordance with ASTM 2418 or other standards), in order to protect or shield the surfaces that are not to be carburized. Suitable stop-off paints may also be used. It is highly recommended that areas adjacent to carburized surfaces (e.g., the tips and side faces of gear teeth, splines, etc.) be masked with copper plating, stop-off paint, or other suitable means in order to prevent excess carburization at the edges/corners of carburized surfaces.

Other Information

Descaling (cleaning)	Bar peeling.

For additional information, please contact your nearest sales office:
info@cartech.com | 610 208 2000