Ferrium® C61™

Product Data Sheet

Offering a superior alternative

Ferrium 61® is a case-hardened Gear Steel with ultra-high strength core

Advances in racing engine designs and increased engine power have caused an increase in the failure of dog rings, gears, camshafts, input shafts, racks and pinions.

The design objective for Ferrium® C61 was to develop a high performance secondary-hardening gear and bearing steel with similar surface properties to conventional gear steels such as AISI 9310 and EN36C, but with the added benefits of an ultra high-strength core and excellent fracture toughness.

Ferrium C61 is a member of a new class of martensitic secondary-hardening gear and bearing steels that utilize an efficient M2C precipitate strengthening dispersion. Because of the efficiency of this strengthening dispersion, a superior combination of properties can be attained for a given application. Ferrium C61 was designed to provide carburized surface properties (60-62 HRC) similar to conventional gear steels such as AISI 9310 and EN36C with the added benefit of an ultra high-strength core along with excellent fracture toughness.

Ferrium® C61™ Chemical Composition (nominal wt. %)						
Fe	**C**	**Co**	**Cr**	**Ni**	**Mo**	**V**
Bal	0.15	18	3.5	9.5	1.1	0.08

Overview of Ferrium® C61 Properties (typical)					
YS (ksi)	**UTS** (ksi)	**El** (%)	**Core Hardness** (HRC)	**CVN** (ft-lb)	**K_{IC}** (ksi $\sqrt{in}$)
225	240	15	48-50	50	130

Advantages

Ferrium C61 is targeted as a superior alternative to conventional gear materials such as AISI 9310 and EN36C for new smaller, lighter, high-temperature resistant component designs, or to upgrade the material in an existing component where a re-design is not feasible.

Ferrium C61 has surface-wear properties similar to those found in current commercial alloys, but provides an ultra high-strength, high-toughness, high-temperature-resistant core. Superior axial and STBF fatigue resistance data has also been demonstrated. Ferrium C61 can be particularly advantageous to reduce the size and weight of integrally geared driveshafts.

About Smiths High Performance

Smiths High Performance is a leading stockholder and supplier of high performance engineering materials to the global motorsport sector. We are supply partners in a range of specialist motorsport markets including **Formula 1, Formula E, NASCAR, MOTO GP, WEC & WRC.**

Further technical data available on the reverse of this Datasheet

Ferrium® C61™

Processing

Ferrium C61 was designed for high-temperature carburizing. This allows solution heat treatment to be combined with the carburizing treatment and is therefore quenched directly from the carburizing temperature. After quenching to room temperature Ferrium C61 is subjected to liquid nitrogen immersion to assure a complete martensitic transformation. It is typically tempered at 900°F (482°C) and has excellent thermal resistance approaching this temperature. If desired, nitriding can be used in lieu of carburizing in order to achieve higher surface hardness. Using both nitriding and case carburizing may result in a brittle surface, resulting in sub-surface spalling initiation and significantly lower fatigue life; users should complete internal trials before considering this combination.

Case carburizing produces a gradient in the volume fraction of the M2C carbides and results in an increase in hardness and surface residual compressive stress. The efficiency of the M2C strengthening response allows this class of steels to achieve very high surface hardness with very low carbon content. Thus, this class of steels has the ability to achieve very high surface hardness without the formation of detrimental primary carbides. Final shot peening is recommended for superior fatigue performance.

Fatigue

Ferrium C61 alloy has the longest fatigue life of several materials evaluated and shows 15% enhancement over EN36C in a notch bending fatigue test. The sample is a Ford Research Lab design, incorporating 4-point loading and an approximately 0.050 inch notch root radius. All samples were finish ground and shot peened after heat treatment.

Mean Coefficient of Thermal Expansion

Temperature Range		Heat Treated Condition	
°C	°F	10^{-8}/°C	10^{-8}/°F
20-100	68-212	9.54	5.30
20-200	68-392	9.59	5.33
20-300	68-572	10.76	5.98
20-400	68-752	11.09	6.16
20-500	68-932	11.28	6.27

Alloy	Cycles to Failure
Ferrium	4.61×10^4
EN36C	4.00×10^4

Product Forms

Manufactured in typical ingot, bar and billet forms.

Patent

US Patent Number 6,176,946 B1.

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When you purchase high performance materials from **Smiths High Performance**, you will be joining some of the biggest and best global engineering companies. We are a Tier 1 supply chain partner to the world's leading motorsport companies. Our unique business structure and ethos allows us to offer services which are otherwise unavailable in this market sector.

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Stratton Business Park, London Road,
Biggleswade, Bedfordshire, United Kingdom SG18 8QB

t +44 (0)1767 604708
f +44 (0)1767 312885
t info@smithshp.com
f www.smithshp.com

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