

HI-LITE

HIGH PERFORMANCE - ULTRA LIGHT



Electrical steel for next generation designs.

Prioritize, optimize, minimize.
Maximum magnetic permeability – minimum power loss.

Hi-Lite – a whole new world of possibilities.

Hi-Five for Hi-Lite

Hi-Lite is the ultimate non-oriented ultra-thin-gauge electrical steel. Its unsurpassed material properties enable the development of high-frequency applications with exceptional performance. Fast-forward to the “best of the best” in materials science, design support, tooling and stamping.

Hi-Lite – a whole new world of possibilities.

Your challenges. Less challenging.

Founded on a proud tradition in specialist steels, backed by the extensive R&D resources of its global parent, Tata Steel, the Hi-Lite team is dedicated to the advance of electric motor and generator technology. Hi-Lite goes beyond the supply of ultra-thin electrical steels – it represents a new form of collaboration on developing pioneer applications for high-speed/low-loss laminated silicon-steel components.

Designers of advanced electric motors and generators face multiple challenges.

To achieve an optimal fusion between performance, economy and durability,

you must constantly balance apparently incompatible demands: high strength, low weight, a compact format, advanced performance, cost, minimal energy loss and, in certain cases, extreme durability. Hi-Lite electrical steels are your fast-track to new-found harmony. Avoid the constraints of heavier-gauge electrical steels. Balancing high speed, low weight and minimal energy loss is now less of a challenge. Choose Hi-Lite and gain immediate access to the “best of the best” in materials science, design, tooling and stamping.

The blistering pace of technological innovation requires not only constant improvement in the generating and power, torque and mechanical performance of electric motors – for certain applications, they must be more compact too. Demanding the same power from smaller machines means higher rotor speeds. Weight must be reduced, energy efficiency increased and service-life extended.

From automotive applications to dental drills, the trend is clear: lighter, smaller, smarter.

Hi-Lite points the way to the next generation of electric motors and generators.

The same principles apply to non-rotating devices. The increased switching frequencies of converters mean reduced size and weight. Specifying Hi-Lite for related harmonic filters will cope with the increased frequencies, while making them smaller and lighter.

Working with thin materials can be challenging. Achieving industrial volumes in a given time span is never certain. Make life easy for yourself. Less stress, more cost efficient. Contact Hi-Lite's team of dedicated experts.

Backed by the multiple skills of our international network, we'll help transform your innovative visions into commercial reality. We can even help set up pilot units prior to establishing your own production facilities. From single elements to the design, manufacture and supply of complete components, the choice is yours.

The whole process is available - You pick and choose.

FROM ORDER...

DESIGN SUPPORT

We assist with electrical and mechanical design and supply-chain optimization.

COLD ROLLING

We produce all standard NO steel grades, as well as specially developed Hi-Lite grades in thicknesses of 0.1 to 0.3mm.

SLITTING & CUTTING

Full-width or customized strip. We can also supply sheets cut to length, from 1150 x 3000 mm down to 12x12mm.

TOOLING

Our partners are experts in the design and production of tooling for the processing of thin steels.

STACKING

We can supply finished stacks of laminations or help you find the right supplier, whether you require interlocked, welded or bonded stacks.

PACK, LABEL & SHIP

We package and label orders as per your instructions – and handle all shipping requirements.

ANNEALING & PICKLING

The hot rolled coils are annealed before pickling to ensure optimal magnetic properties.

FINAL ANNEALING & COATING

Hi-Lite's unique properties are developed during the final annealing process. The strip is then coated to ensure minimum eddy current losses.

LASER CUTTING, ETCHING OR WIRE CUTTING

We help you find the right laminations supplier for prototypes and smaller pilot series.

STAMPING

Stamping thin metal has long posed a challenge. Our partners are specialized in this field.

QUALITY CONTROL

Quality at every stage of production and supply.

... TO INSTALLATION

Go ahead. Tell me it can't be done.

We love to challenge convention, pioneer new perspectives – and redefine the possible. Once our dedicated Hi-Lite team accepts the assignment, you are on course for success.

Our ultra-thin-gauge electrical steel laminations already handle the highest rotational speeds recorded. Specified for the greenest hybrid vehicles, the most advanced vacuum cleaners and the fastest cars in the F1 circus, Hi-Lite puts a new spin on innovation. So: tell me it can't be done – and let me prove you wrong.



*Magnus Lindemo, Development Manager.
One of the brains behind Hi-Lite.*

Magnus Lindenmo, head of the electrical steels development team at Surahammar, describes the challenges of manufacturing electrical steel, its many benefits and the evolution of Surahammars Bruk's Hi-Lite high-speed/low-loss laminated silicon-steel components.

"Today's high-tech electrical steels are essential in the manufacture of the cost-effective stators and rotors needed for a huge range of electric motor applications, as well as in generators and transformers. They ensure high magnetic permeability and low power losses, to secure peak performance. Power losses in electrical steels derive from several factors. Eddy currents, induced by the alternating magnetic field, play a critical role. Rolling steel to a thinner gauge confines these eddy currents to a smaller volume, reducing 'classical' eddy current losses. Losses can of course also be limited by increasing the silicon or aluminium content, for improved resistivity."

"Some ten years ago we were among the first in the world to produce thin gauge electrical steels at a 4-high wide-strip mill, making these grades more generally available to the market. Now that some producers cater to this need, we have taken the next step in further facilitating the design, manufacture and use of thin gauge electrical steels – by introducing Hi-Lite."

HIGH FREQUENCIES – BUT LOW LOSSES

"For application frequencies beyond the standard 50 or 60 Hz, thinner steel may be needed to maintain low losses. The Hi-Lite range, available with a Suralac®7000 insulating coating, and now also with the Suralac®9000 bonding coating, has been optimized for medium to high fundamental frequencies (200 -2500 Hz) and harmonics up to about 25 kHz. For the most extreme applications, we have developed Hi-Lite NO 10, the thinnest wide strip electrical steel on the market."

"The special qualities of the Hi-Lite range are particularly relevant to today's automotive industry. Global interest in

electric vehicles (EVs) and hybrid electric vehicles (HEVs) is growing dramatically: the key technological enablers for these applications are electric machines (motors), along with their drive systems. Design optimization of electric motors for automotive applications has become an urgent priority."

THE PROBLEM OF STRESS

"The electrical steel in an IPM (Internal Permanent Magnet) electric motor is not only important for minimising losses in the stator. It also plays an important structural role in the rotor. At high rotational speeds of several thousands of rotations per minute (rpm), electrical steel in the rotor can experience high levels of stress. High stresses are particularly prevalent in regions around the magnet slots, where narrow 'bridges' keep the magnets in place."

EXTENDING ROTOR LIFE

Since 2007, Surahammars Bruk and Tata Steel Product Engineering group have jointly explored ways of optimizing the durability and efficiency of EV/HEV motors. Particular attention has been paid to understanding the influence of magnet pole arrangements, magnet slot geometry and 'bridge' dimensions on rotor fatigue lives and air-gap flux densities. This joint research clearly demonstrates that it is now possible to design durable IPM motor rotors with a service life beyond that of the host EV/HEV vehicle. The design knowledge and unique data on the fatigue properties of electrical steels is now a part of the Hi-Lite concept.

FILTER APPLICATIONS

"A growing area of interest is filters related to variable speed drives. The principles are the same as for smaller motors for HEV/EV vehicles: higher frequency means higher power density. But this also results in higher frequency harmonics from the converter. The use of Hi-Lite thin electrical steel grades enables the design of energy efficient harmonic filters for these applications."

Speeding up eco-technology.

In Italy, Magneti Marelli, a key designer and supplier of components to the world's automakers, has selected Hi-Lite as a critical element in its new high-performance electric motor for supercars.

CUSTOMIZED ELECTRICAL STEEL

An international Group committed to the design and production of hi-tech systems and components for the automotive sector, Magneti Marelli supplies most key car manufacturers in Europe, North and South America and Asia. In 2010, the Group received a very special commission – to develop and manufacture the power electronics and electric motor for a highly exclusive hybrid supercar.

Vincenzo Giorgianni, who heads Electromagnetic Design at Magneti Marelli's Hybrid & Electric Systems Division, explains the requirement and challenges.

"This electric motor must deliver considerable torque at very low speeds, requiring a high magnetic flux between rotor and stator. But it must deliver high power at high speeds too, to provide powerful acceleration at speeds over 200 km/h with no loss of efficiency. This means magnetic losses must be kept low, even at very high rotation speeds. A motor able to perform at high rotation speeds can generate the specified power output in a more compact design than one performing at lower rotation speeds, offering a clear space gain.

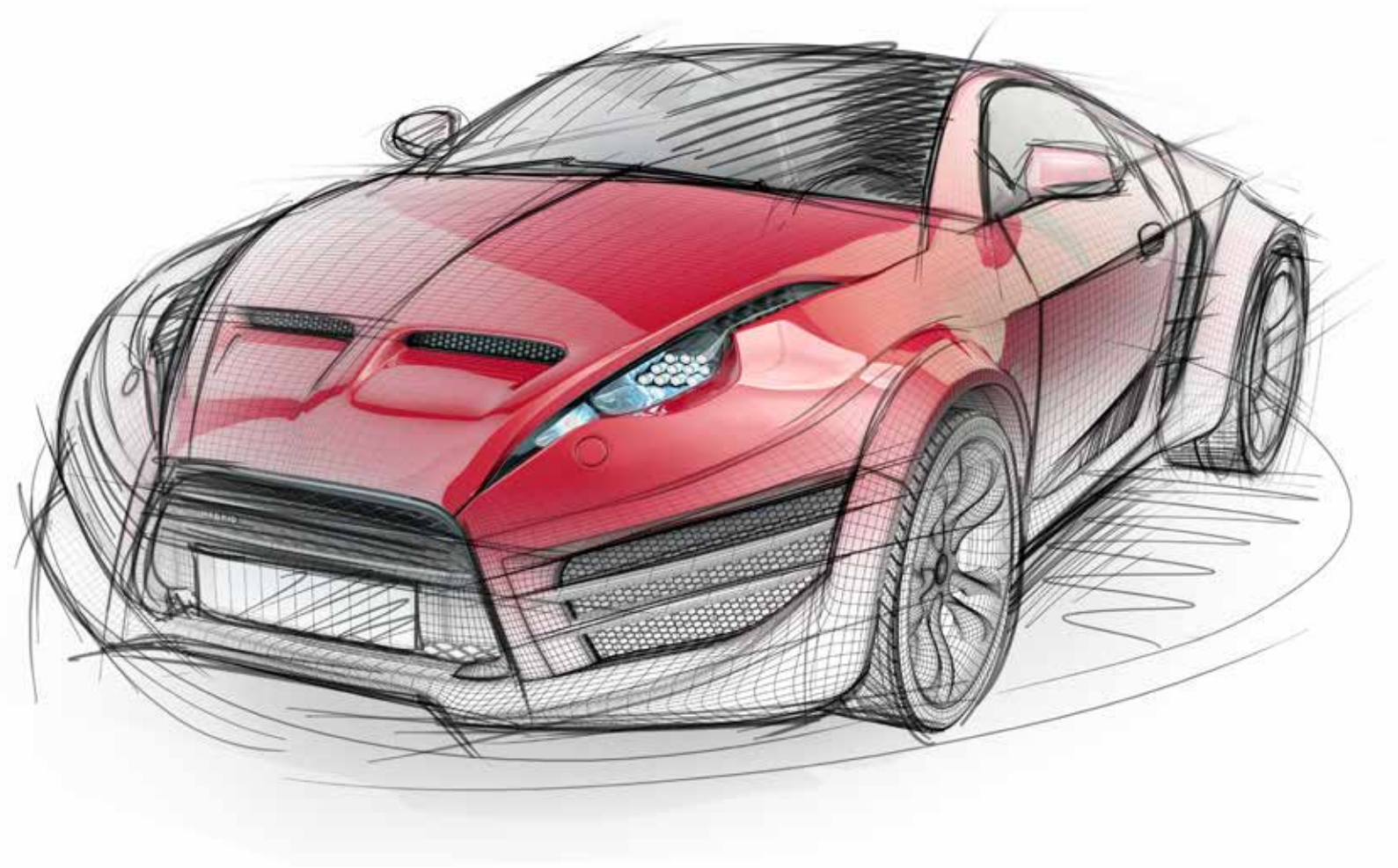
THIN BUT STRONG

"We went for an internal permanent magnet motor. In such a motor, to achieve the high torque/magnetic flux required, the 'bridges' of material surrounding the pockets containing the rotor's permanent magnets must be as thin as possible. This places severe demands on the strength of the electrical steel used. The fundamental magnetizing frequency for the electric motor running at high speed was 1000 Hz. Using electrical steel grades with a standard thickness of 0.35 mm, magnetic losses would have been too high," explains Mr Giorgianni.

"We searched for an electrical steel grade that met our requirements and found a thin-gauge Hi-Lite grade from

Cogent Surahammar, which looked promising. Following discussions and tests, the plant was able to provide the special guarantees we sought. We chose a customized 0.27 mm Hi-Lite grade that offers 30% lower losses at high rotation speeds when compared to the best available 0.35 mm grades. Furthermore, it provides higher mechanical strength, ensuring a 6% improvement in torque compared to standard grades."

Now completed, the new high-performance electric motor can operate at a maximum of 16 000 rpm, delivering 165 bhp. Combined with its big V12 combustion engine, this generates an impressive maximum of almost 1000 bhp.



30%

LOWER LOSSES AT HIGH ROTATION SPEEDS

6%

IMPROVEMENT IN TORQUE

Accelerating motor demands.

Germany's ATE (AntriebsTechnik und Entwicklungs) GmbH, which designs and produces high-speed electric motors for automotive, aerospace and medical applications, relies on Hi-Lite for its low energy loss at high frequencies, its high saturation and its cost efficiency.

"We are seeing growing market demand for higher-speed motors," explains Herbert Sutter, CEO of German manufacturer ATE Antriebstechnik und Entwicklungs GmbH, who is directly responsible for Sales & Projects at the company. "Higher speed means higher efficiency. Our main product line is high-speed motors for a broad range of applications. There is no exact definition for a high-speed motor, but we consider any that operate at a frequency of several hundred Hz or higher to be high-speed. Our largest market is the machine tool industry (high-speed spindles)."

AUTOMOTIVE APPLICATIONS FUEL GROWTH

Herbert Sutter comments on the automotive industry's particularly sharp growth in interest for high-speed machines. "We manufacture a range of products for the automotive sector and participate in several development projects. Our electric drives for turbo chargers are just one

good example, where rotational speeds of up to 200 krpm are attracting keen interest. Other key application areas for high-speed motors are found in the aircraft industry and medical technology. Energy is another segment in which we are active, where we are engaged in developing a micro turbine generator for inclusion in a combined heat-and-power unit for family homes."

IDEAL COMBINATION OF STEEL QUALITIES

"Although a small specialist manufacturer, we produce tens of thousands of units, as well as many prototypes," continues Mr Sutter. "We produce induction motors, permanent magnet motors and torque motors. Our highest-speed motor can achieve one million rpm. For handling frequencies well into the kHz range while meeting requirements for high torque, Hi-Lite grades offer a good combination of low loss at high frequency, high saturation and cost effectiveness."



AIRCRAFT INDUSTRY



MEDICAL EQUIPMENT



AUTOMOTIVE INDUSTRY



MACHINE TOOL EQUIPMENT



Cutting costs with higher prices.

AQ Trafo, a major Global manufacturer of inductive components, has chosen Hi-Lite for its high-performance products.

Designed in Sweden and manufactured at its plants in Bulgaria, China and India, AQ Trafo produces inductive components for some of the most demanding applications – high-speed trains, relay protection systems, military equipment, aircraft and process-automation equipment. Increasingly, the company is turning to Hi-Lite grades for its high-performance components. Christer Eriksson, Senior Engineer, explains why.

"The main reason is advances in solid-state power electronics. There has been a significant increase in the switching frequencies of converters (used to control the speed of electric motors), allowing components to be made smaller and lighter. Higher switching frequencies generate high-frequency harmonics, negatively affecting both the electric motor and other devices connected to the grid. One such effect is increased energy loss."

SIZE AND WEIGHT MATTER

"An inductor is often fitted to filter unwanted harmonics before they affect the motor or spread on the grid – but the harmonics causes losses in the core of the inductor/

filter. We now use Hi-Lite grades to reduce such losses to acceptable levels. Losses in the core can make it too hot and a bigger core would be impractical for the traction applications that are our main focus. A bigger and heavier filter would cancel out the benefits of a smaller and lighter converter. Employing Hi-Lite instead of more conventional electrical steel grades for high-frequency applications (typically 2-20 kHz) allows us to design more compact cores with low losses."

The higher price of Hi-Lite is normally no problem. Less material is needed for the core, reducing the quantity and cost of other materials in the inductor (e.g. copper wire). Sometimes, using Hi-Lite actually cuts total inductor costs, compared to a more conventional grade.

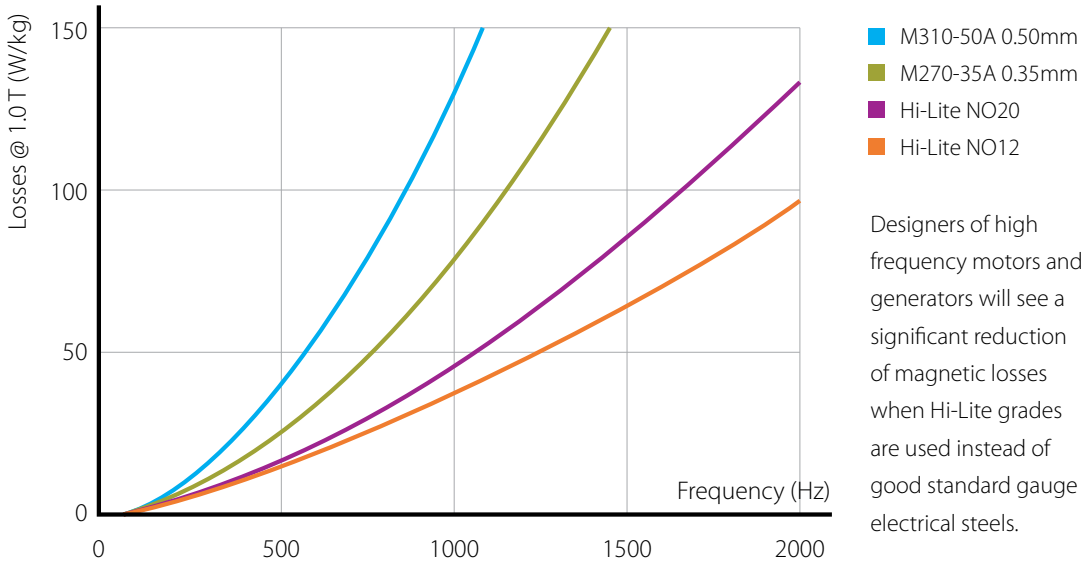
"When it comes to fulfilling the technical requirements in terms of function, space and weight, Hi-Lite offers the most economical solution. As long as our production tooling is adapted for these thinner grades, Hi-Lite presents no manufacturing problems."

Hi-Lite details.

HI-LITE RANGE

Sura Hi-Lite is the widest range of grades in the market. More grades available on demand.

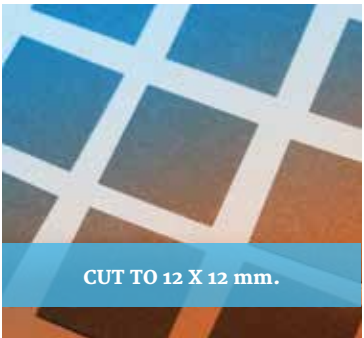
Grade	Gauge (mm)	Max P _{10/400} (W/kg)	Max P _{10/2500} (W/kg)	Typ P _{10/400} (W/kg)	Typ P _{10/2500} (W/kg)	Typ R _{p0.2} (N/mm ²)
N010	0.10	13.0	135	12.1	119	370
N012	0.12	13.5	152	11.8	132	370
N015	0.15	14.0	171	12.1	155	370
N018	0.18	14.3	186	12.2	173	370
N020	0.20	15.0	215	12.3	200	370
NO20-1200	0.20	12.0	195	11.4	180	440
N027	0.27	15.0	300	13.7	255	440
N030	0.30	17.0	355	15.9	306	370



FULL WIDTH COIL, 1150 mm.



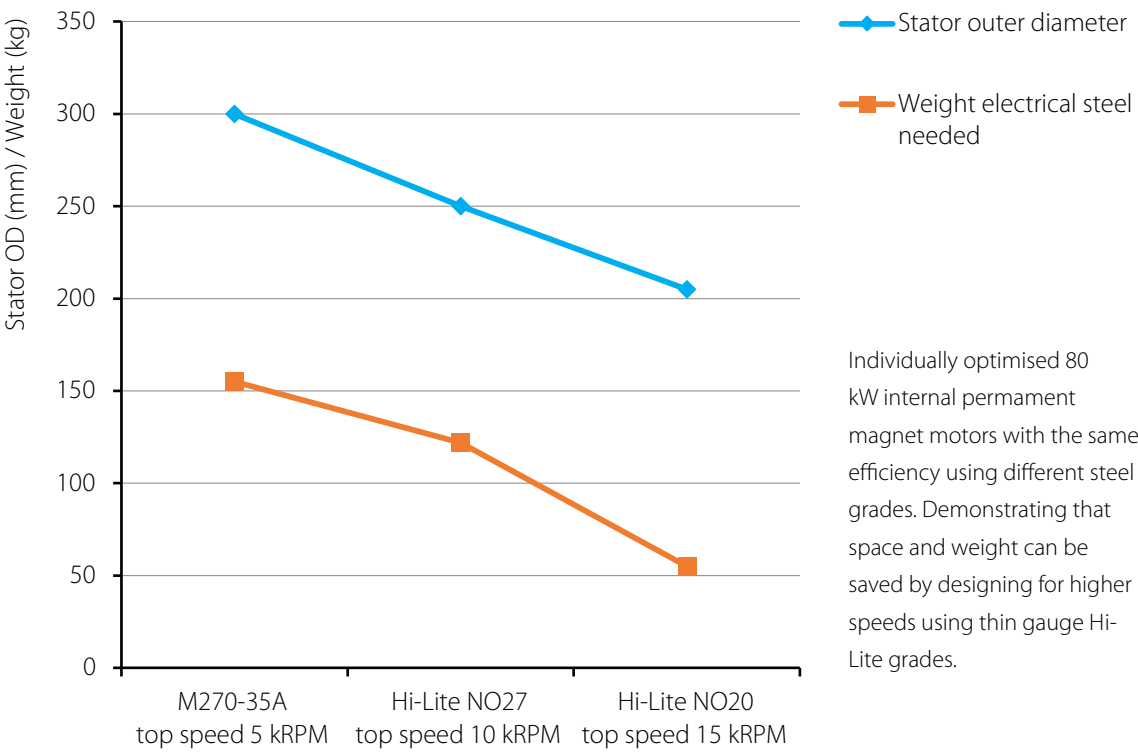
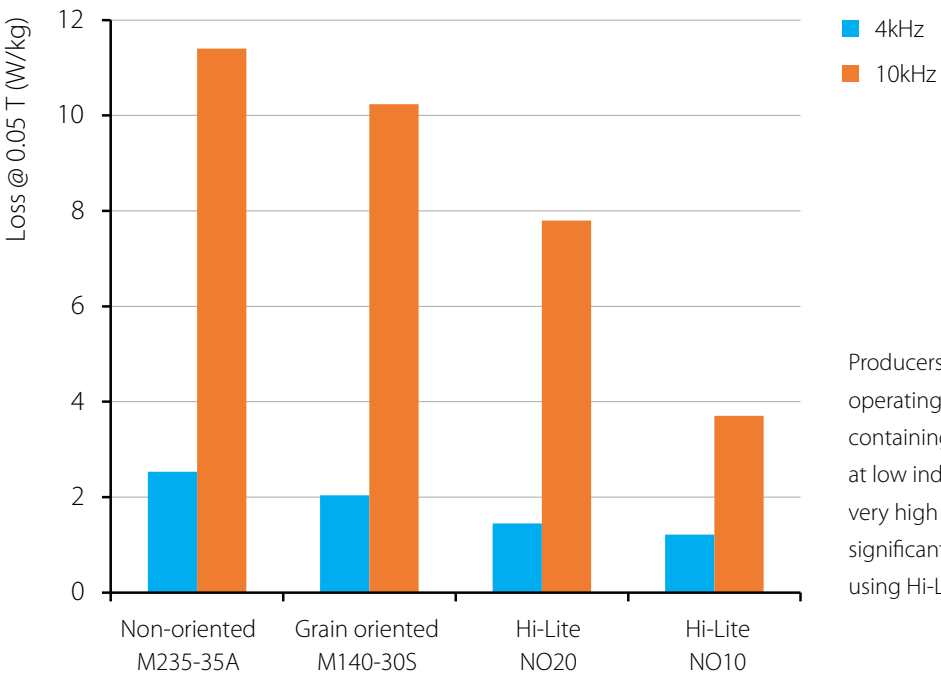
SLITTING FROM 12 mm.



CUT TO 12 X 12 mm.

DELIVERY OPTIONS

How would you prefer to have your Hi-Lite delivered? We can slit it in anything from 12 mm to a full coil of 1150 mm width or cut it into pieces from 3500 x 1150 mm down to 12 x 12 mm.



COATINGS

Hi-Lite grades are normally supplied with a thin Suralac 7000 coating or with a Suralac 9000 bonding coating.

Suralac 7000 is a C-5 type inorganic coating which provides good insulation resistance, very good temperature capability and a high stacking factor.

Suralac 9000 is used to bond laminations, applying temperature and pressure, into a core with good mechanical strength and improved magnetic properties.

Uncoated material or other Suralac coatings are also applicable to Hi-Lite grades depending on customer requirements.



Forging
the future.
In steel.

Surahammars Bruk

From origins that go way back (to year 1622!), when a water wheel-powered forge hammer was first erected on the site, Sweden's Surahammars Bruk has grown into a global leader in the high-tech field of electrical steels.

Tata Steel

Tata Steel is one of the world's top ten steel producers, and our European operations comprise many different and demanding markets worldwide, including aerospace, automotive, construction, energy and power, and packaging.

Find out more on
www.hi-lite.se



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Cogent Power
Together we make the difference