
NON-GRAIN ORIENTED
ELECTRICAL
STEEL
MARCEGAGLIA
CARBON STEEL

MARCEGAGLIA IS THE LEADING ITALIAN INDUSTRIAL GROUP IN THE NATIONAL AND INTERNATIONAL STEEL SCENARIO, ACTIVE FOR OVER SIXTY YEARS IN STEEL PROCESSING.

6.5
MILLION TONNES OF FINISHED PRODUCT

7.5
BILLION EUROS IN TURNOVER

7,800
EMPLOYEES

36
PLANTS ACROSS 4 CONTINENTS

15,000
CUSTOMERS

WINNING DNA

WITH A UNIQUE COMBINATION OF OPERATIONAL FLEXIBILITY, STRATEGIC MARKET PRESENCE, AND COMMITMENT TO SUSTAINABILITY, MARCEGAGLIA IS CONFIRMED AS A REFERENCE POINT IN THE STEEL SECTOR.

1st PLAYER IN STEEL PROCESSING SECTOR IN THE WORLD

PRODUCER OF STAINLESS STEEL WELDED TUBES IN THE WORLD

PRODUCER OF CARBON STEEL WELDED TUBES IN EUROPE

SERVICE CENTER IN ITALY

WINNING DNA

THE COMPANY BOASTS A UNIQUE PRODUCTION AND BUSINESS MODEL, TYPICAL OF ITALIAN FAMILY ENTREPRENEURSHIP, CAPABLE OF COMBINING ITS OPERATIONAL FLEXIBILITY WITH A STRONG MARKET PRESENCE, CHARACTERISTIC OF MULTINATIONAL COMPANIES.

MARCEGAGLIA IS DISTINGUISHED BY CONSTANT GROWTH, HIGH-QUALITY PRODUCTS AND PROCESSES, SIGNIFICANT VALUE-ADDED CONTRIBUTION TO THE MARKET, AND A STRONG FOCUS ON SUSTAINABILITY: CHARACTERISTICS THAT MAKE IT A MAJOR PLAYER IN THE STEEL INDUSTRY.

THE WIDEST RANGE IN THE WORLD, FOR A PRODUCT OF EXCELLENCE

LEVERAGING UNIQUE KNOW-HOW
IN THE FIELD OF CARBON STEELS,
MARCEGAGLIA HAS CREATED THE ADVANCED STEEL
FOR SUCCESSFUL ELECTRICAL PERFORMANCE.

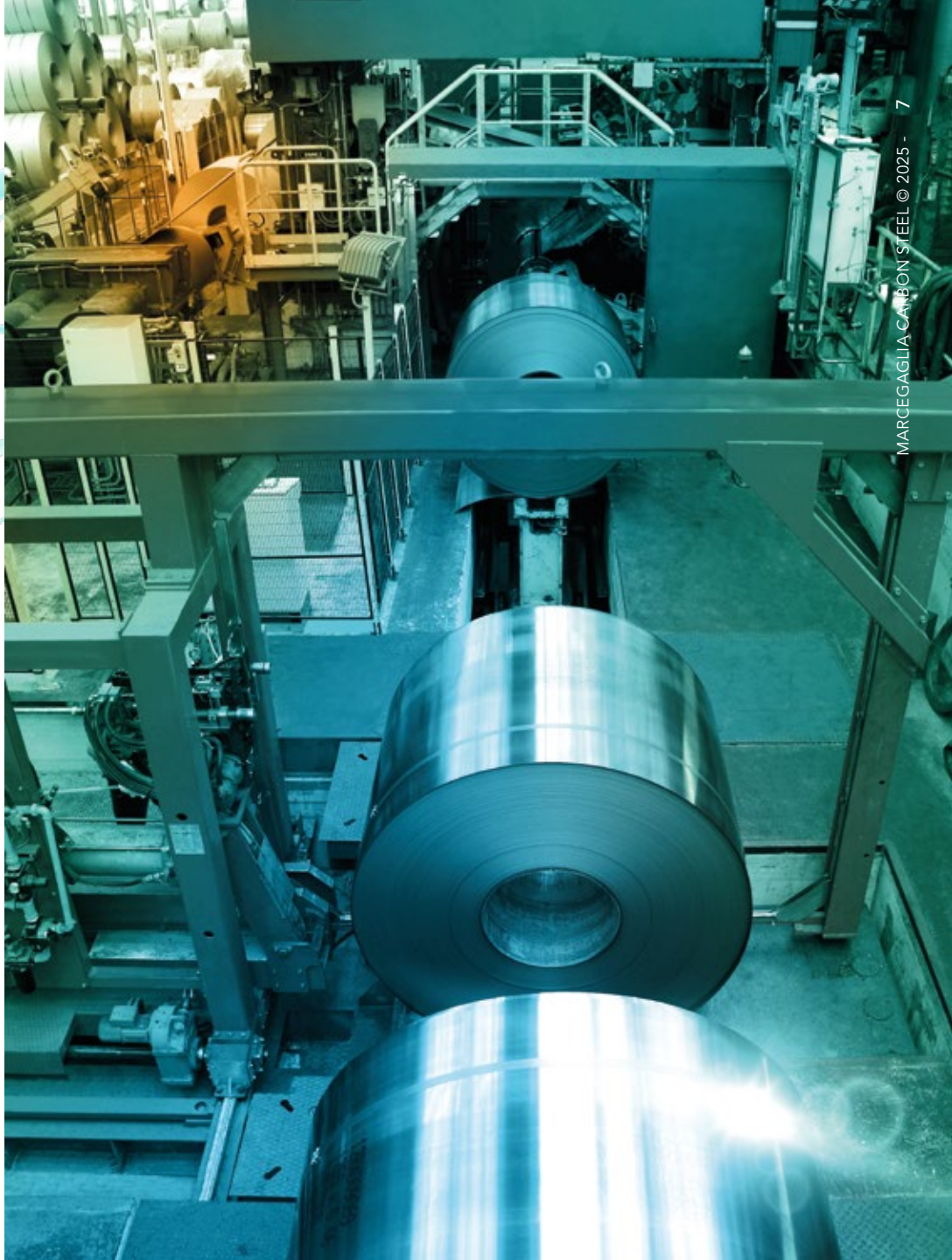
READY TO SEIZE EVERY OPPORTUNITY FOR INVESTMENT AND GROWTH, WITH A CONSTANT FOCUS ON THE NEEDS OF ITS CUSTOMERS, THE MARCEGAGLIA GROUP HAS CREATED A NETWORK OF 36 PLANTS CAPABLE OF ENSURING A HIGH LEVEL OF EXPERTISE, QUALITY, SERVICE AND KNOW-HOW, ALONGSIDE AN EFFICIENT LOGISTICS AND DISTRIBUTION NETWORK.

WITH THE BROADEST RANGE IN THE WORLD
OF CARBON STEEL PRODUCTS,
MARCEGAGLIA IS NOW ENTERING THE MARKET
OF **'FULLY FINISHED' NON-GRAIN ORIENTED**
(NGO) ELECTRICAL STEELS,
OFFERINGITS CUSTOMERS EXCELLENCE
IN QUALITY AND PERFORMANCE.

TENSIL-PRO®
INNOVATION SYSTEM

MARCEGAGLIA'S DEVELOPMENT OF NGO PRODUCTS
IS BASED ON CAREFUL **CONTROL OF STEEL**
MANUFACTURING AND TRANSFORMATION PROCESSES.

THIS FORMED THE BASIS FOR THE DEVELOPMENT
OF THE **TENSIL-PRO®** SYSTEM, THE EXCLUSIVE MARCEGAGLIA
MATHEMATICAL MODEL THAT USES A SYSTEM
OF PHYSICAL EQUATIONS TO EVALUATE THE MECHANICAL
AND MICROSTRUCTURAL CHARACTERISTICS
OF MATERIALS BASED ON DATA RELEASED
DURING SKIN PASSING AND HOT AND COLD ROLLING.

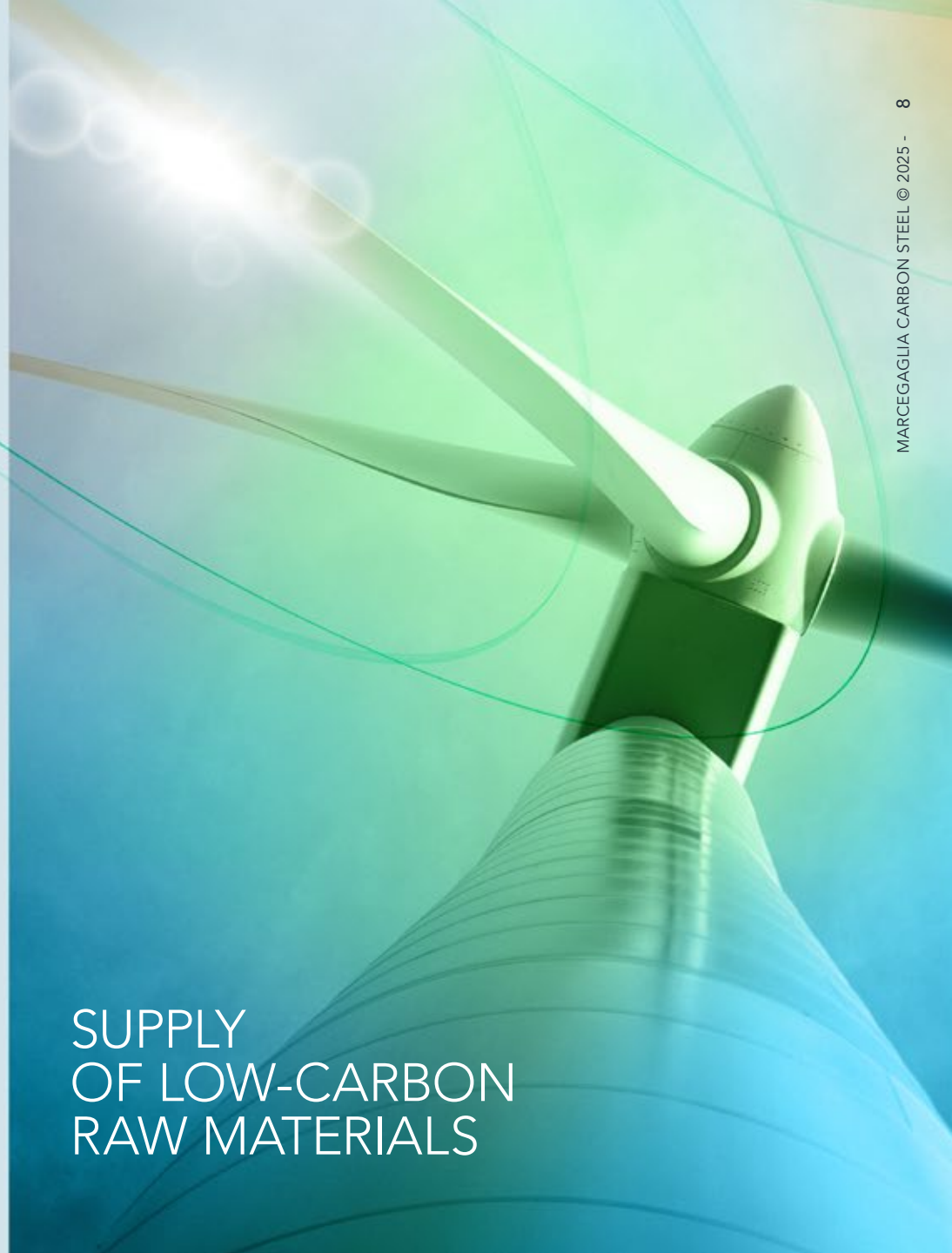


SUSTAINABLE CHOICES FOR A RESPONSIBLE FUTURE

A CONTROLLED SUPPLY CHAIN ENSURES MARCEGAGLIA
AN ENVIRONMENTALLY CONSCIOUS PRODUCTION
AND DISTRIBUTION CHAIN.

MARCEGAGLIA HAS ALWAYS CARED GREATLY
FOR THE ENVIRONMENT AND ITS SOCIAL IMPACT,
AS **KEY FACTORS IN THE GROUP'S CORPORATE CULTURE**.

THANKS TO A SOLID NETWORK OF INTERNATIONAL RELATIONS,
INCLUDING IMPORTANT AND LONG-LASTING OFF-TAKE AGREEMENTS
ALREADY ESTABLISHED THROUGHOUT THE SUPPLY CHAIN,
THE COMPANY CAN GUARANTEE
THE **SUPPLY OF LOW-CARBON RAW MATERIALS**.
THESE STRATEGIC PARTNERSHIPS ENABLE SUSTAINABLE PRACTICES
AT ALL LEVELS, THUS PROMOTING A RESPONSIBLE
AND CONSCIOUS APPROACH TO THE SUPPLY CHAIN.



SUPPLY
OF LOW-CARBON
RAW MATERIALS

SUSTAINABLE CHOICES FOR A RESPONSIBLE FUTURE

THE COMPANY ALSO INVESTS CONTINUOUSLY
IN NUMEROUS HIGHLY SUSTAINABLE PRODUCTION PROCESSES,
INCLUDING THE RECENT ACQUISITION
OF THE **ELECTRIC FURNACE STEELWORKS**
IN FOS-SUR-MER (FRANCE) AND PARTICIPATION
IN THE PROJECT TO CREATE **STEGRA** (BODEN, SWEDEN),
THE WORLD'S FIRST CARBON-FREE STEELWORKS,
POWERED ENTIRELY BY GREEN HYDROGEN.

MARCEGAGLIA IS COMMITTED TO ENSURING
THAT THE ENTIRE CHAIN, FROM PRODUCTION TO DISTRIBUTION,
IS MANAGED IN A COMPLETELY RESPONSIBLE MANNER,
AS A DRIVER OF POSITIVE CHANGE WITHIN THE INDUSTRY.

THE NEW FRONTIER
OF GREEN STEEL

CUTTING-EDGE RESEARCH AND DEVELOPMENT NETWORK

THANKS TO NUMEROUS PARTNERSHIPS
WITH UNIVERSITIES AND RESEARCH BODIES,
MARCEGAGLIA CAN OFFER A PRODUCT
ORIENTED TOWARDS THE FUTURE OF THE INDUSTRY.

MARCEGAGLIA'S STRATEGY IN DEVELOPING 'FULLY FINISHED'
NON-GRAIN ORIENTED ELECTRICAL STEELS
HAS INVOLVED **ACTIVE PARTICIPATION IN RESEARCH PROJECTS**
AIMED AT INCREASING METALLURGICAL KNOWLEDGE
AND SKILLS IN THIS FIELD.

THE RESEARCH HAS FOCUSED ON:

MATERIAL CHARACTERIZATION

Study of the magnetic, mechanical, and microstructural properties of NGO products in order to identify the metallurgical parameters that determine their optimal performance for each electric motor application.

OPTIMIZATION OF CHEMICAL COMPOSITION

Modifying the chemical composition of electrical steels to improve performance in terms of magnetic losses and permeability, optimizing mechanical strength.

ADVANCED PRODUCTION PROCESSES

Developing innovative manufacturing processes to produce electrical steels with controlled microstructures and optimized magnetic properties.

EVALUATION OF MOTOR PERFORMANCES

Testing electrical steels in electric motor prototypes to assess performance in real conditions of use, including energy efficiency and thermal stability.

SCALABILITY AND SUSTAINABILITY

Considering the aspect of large-scale production of electrical steels and the environmental sustainability of manufacturing processes.

All this has been made possible thanks to a consortium of laboratories and companies representative of the entire supply chain related to the production of electric motors, with **complementary expertise** ranging from the production and characterization of magnetic materials to their final use in the automotive sector.

MAGNETIC VERSATILITY IN INDUSTRIAL APPLICATIONS

MARCEGAGLIA'S ELECTRICAL STEEL
IS THE IDEAL SOLUTION
FOR ADVANCED ELECTRICAL PERFORMANCE

HOME APPLIANCES
INDUSTRIAL WASHING MACHINES
INDUSTRIAL REFRIGERATORS
MEDICAL DEVICES
AUTOMATED VENDING SYSTEMS
VIDEO SURVEILLANCE SYSTEMS
AUTOMATIC MACHINES
ROBOTICS
PACKAGING AND WRAPPING MACHINES
TELESCOPES
SERVOMECHANISMS
NUMERICAL CONTROL MACHINES
ADJUSTMENT AUTOMATISMS
PRINTERS
CIRCUIT BREAKERS
SUN TRACKING SOLAR PANELS
WIND TURBINES
DIY TOOLS

MAGNETIC VERSATILITY IN INDUSTRIAL APPLICATIONS

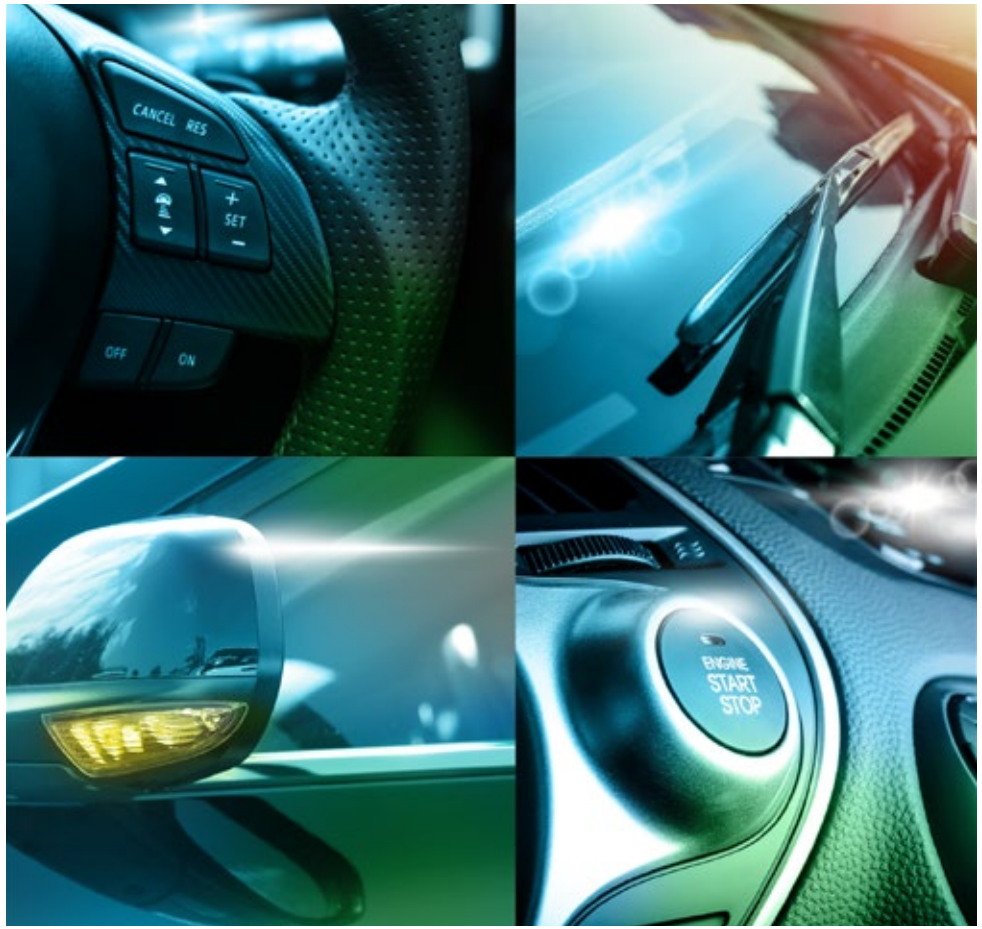
MARCEGAGLIA'S ELECTRICAL STEEL IS A FUNDAMENTAL MATERIAL FOR NUMEROUS APPLICATIONS REQUIRING **HIGH MAGNETIC PERFORMANCE AND EFFICIENCY**.

THANKS TO THEIR MAGNETIC PROPERTIES, LOW LOSSES, AND HIGH PERMEABILITY, NGO STEELS ARE MAINLY USED IN ELECTRIC MOTORS IN NUMEROUS SECTORS, FROM INDUSTRY TO MECHANICAL ENGINEERING, ENSURING PERFORMANCE STABILITY OVER TIME AND HIGH ENERGY EFFICIENCY.

CONTINUOUS INNOVATION FOR ELECTRIC MOTORS

MARCEGAGLIA'S ELECTRICAL STEEL ALSO FINDS APPLICATION IN THE PRODUCTION OF ROTORS AND STATORS OF ELECTRIC MOTORS IN THE **AUTOMOTIVE** SECTOR, ESPECIALLY STARTER MOTORS, TO OPERATE WINDSHIELD WIPERS, PUMP WINDSHIELD WASHER FLUID, TURN ON AIR CIRCULATION FANS, ADJUST SEATS AND REARVIEW MIRRORS, OPERATE POWER WINDOWS, OPEN AND CLOSE DOOR LOCKS, AND MUCH MORE.

THE CONTINUOUS INNOVATION OF NGO PRODUCTS ENABLES THE CREATION OF NEW STEEL GRADES THROUGH THE OPTIMIZATION OF CHEMICAL COMPOSITIONS AND MANUFACTURING PROCESSES.
CONTROL OF THE MICROSTRUCTURE CAN GUARANTEE LOW MAGNETIC LOSSES AND EXCELLENT PERMEABILITY, **IMPROVING MOTOR EFFICIENCY**, **REDUCING CONSUMPTION**, AND **CONTRIBUTING TO ENVIRONMENTAL SUSTAINABILITY**.



A UNIQUE PRODUCT FOR COUNTLESS APPLICATIONS IN THE AUTOMOTIVE SECTOR

THE PRODUCT RANGE

ELECTRICAL STEEL (NO) – STANDARD GRADES **FULLY FINISHED**

STANDARD DESIGNATION	THICKNESS (mm)	DENSITY (kg/dm³)	MIN CORE LOSS (W/kg) at 50Hz		TENSILE PROPERTIES		MIN POLARISATION (A/m)		
			1,5 T	1,0 T	Re (Mpa)	Rm (Mpa)	2,500	5,000	10,000
M1000-65A	0,65	7,80	10,00	4,40	310-360	410-460	1,61	1,71	1,80
M800-65A	0,65	7,80	8,00	3,60	310-360	410-460	1,60	1,70	1,78
M700-65A	0,65	7,75	7,00	3,00	310-360	410-460	1,57	1,67	1,76
M600-65A	0,65	7,75	6,00	2,60	330-380	450-500	1,56	1,66	1,76
M530-65A	0,65	7,70	5,30	2,30	330-380	450-500	1,54	1,64	1,74
M470-65A	0,65	7,65	4,70	2,00	340-390	470-520	1,53	1,63	1,73
M400-65A	0,65	7,65	4,00	1,70	340-390	470-520	1,52	1,62	1,72
M350-65A	0,65	7,60	3,50	1,50	350-400	490-540	1,49	1,60	1,70
M330-65A	0,65	7,60	3,30	1,30	350-400	490-540	1,49	1,60	1,70
M310-65A	0,65	7,60	3,10	1,25	360-420	490-540	1,49	1,60	1,70
M940-50A	0,5	7,85	9,40	4,20	310-360	410-460	1,62	1,72	1,81
M800-50A	0,5	7,80	8,00	3,60	310-360	410-460	1,60	1,70	1,78
M700-50A	0,5	7,80	7,00	3,00	310-360	410-460	1,60	1,69	1,77
M600-50A	0,5	7,75	6,00	2,60	330-380	450-500	1,57	1,66	1,76
M530-50A	0,5	7,70	5,30	2,30	330-380	450-500	1,56	1,65	1,75
M470-50A	0,5	7,70	4,70	2,00	330-380	450-500	1,54	1,64	1,74
M400-50A	0,5	7,70	4,00	1,70	340-390	470-520	1,53	1,63	1,73
M350-50A	0,5	7,65	3,50	1,50	340-390	470-520	1,50	1,60	1,70
M330-50A	0,5	7,65	3,30	1,35	340-390	470-520	1,49	1,60	1,70
M310-50A	0,5	7,65	3,10	1,25	350-400	490-540	1,49	1,60	1,70
M290-50A	0,5	7,60	2,90	1,15	350-400	490-540	1,49	1,60	1,70
M270-50A	0,5	7,60	2,70	1,10	360-420	490-540	1,49	1,60	1,70
M250-50A	0,5	7,60	2,50	1,05	360-420	490-540	1,49	1,60	1,70
M330-35A	0,35	7,65	3,30	1,30	340-390	470-520	1,49	1,60	1,70
M300-35A	0,35	7,65	3,00	1,20	340-390	470-520	1,49	1,60	1,70
M270-35A	0,35	7,65	2,70	1,10	350-400	490-540	1,49	1,60	1,70
M250-35A	0,35	7,60	2,50	1,00	360-420	490-540	1,49	1,60	1,70
M235-35A	0,35	7,60	2,35	0,95	360-420	490-540	1,49	1,60	1,70

ELECTRICAL STEEL (NO) – STANDARD GRADES **SEMI-FINISHED**

STANDARD DESIGNATION	THICKNESS (mm)	DENSITY (kg/dm³)	MIN CORE LOSS (W/kg) at 50Hz		MIN POLARISATION (A/m)		
			1,5 T	1,0 T	2,500	5,000	10,000
M390-65K	0,65	7,65	3,90	1,62	1,54	1,62	1,72
M450-65K	0,65	7,70	4,50	1,92	1,56	1,64	1,74
M520-65K	0,65	7,75	5,20	2,22	1,57	1,65	1,75
M630-65K	0,65	7,80	6,30	2,72	1,58	1,66	1,76
M800-65K	0,65	7,85	8,00	3,30	1,62	1,70	1,79
M1000-65K	0,65	7,85	10,00	4,20	1,60	1,68	1,78
M1200-65K	0,65	7,85	12,00	5,00	1,57	1,65	1,77
M340-50K	0,5	7,65	3,40	1,42	1,54	1,62	1,72
M390-50K	0,5	7,70	3,90	1,62	1,56	1,64	1,74
M450-50K	0,5	7,75	4,50	1,92	1,57	1,65	1,75
M560-50K	0,5	7,80	5,60	2,42	1,58	1,66	1,76
M660-50K	0,5	7,85	6,60	2,80	1,62	1,70	1,79
M890-50K	0,5	7,85	8,90	3,70	1,60	1,68	1,78
M1050-50K	0,5	7,85	10,50	4,30	1,57	1,65	1,77

INSULATION COATING

MARCEGAGLIA'S INORGANIC C5 COATINGS
ARE CHARACTERIZED BY HIGH SURFACE INSULATION RESISTANCE
AND EXCELLENT WELDABILITY.
THEY ARE SUITABLE FOR COMMON JOINING TECHNIQUES
USED IN ELECTRICAL STEEL LAMINATION STACKS,
SUCH AS INTERLOCKING, WELDING, AND CLAMPING.

A NEW GENERATION OF JOINING TECHNIQUES,
INCLUDING SELF-BONDING TECHNOLOGY,
IS CURRENTLY UNDER DEVELOPMENT AND TESTING.
THESE ADVANCEMENTS AIM TO ACHIEVE
THE NARROWEST TOLERANCES AND EXCELLENT SHAPE STABILITY
FOR ELECTRIC MOTORS IN THE MOST DEMANDING APPLICATIONS.

WIDTH / THICKNESS VARIATIONS AND GEOMETRIC PROPERTIES

WIDTH VARIATIONS

STRIP WIDTHS	NARROW STRIP	WIDE STRIP	
	30 * to 500	EDGE TRIMMED	MILL EDGE
		500 to 1,250	700 to 1,250
≤ 300	0 / + 0.2	-	-
> 300 – 500	0 / + 0.3	-	-
> 500 – 600	-	0 / + 0.5	-
> 600 – 1,000	-	0 / + 1.0	0 / + 10.0
> 1,000 – 1,250	-	0 / + 1.5	0 / + 10.0

* Narrower on request

THICKNESS VARIATIONS

STRIP WIDTHS	NOMINAL THICKNESS (mm)			
	0.35	0.50	0.65	1.00
Max. variation from thickness	± 8%	± 6%	± 5%	± 5%
Max. thickness variation parallel to rolling direction over a gauge length of 1 m	6%	4%	4%	4%
Max. thickness variation perpendicular to rolling direction, measured at least 30 mm from edge	0.02 mm	0.02 mm	0.03 mm	0.03 mm

Electrical steel for e-mobility and high frequencies according to DIN EN 10303

WIDTH / THICKNESS VARIATIONS AND GEOMETRIC PROPERTIES

GEOMETRIC PROPERTIES

	GUARANTEED VALUE	
	FULLY FINISHED	SEMI-FINISHED
Max. burr height	0.03 mm	0.03 mm
Max. waviness for product width > 100 mm with trimmed edges mill edges	 1.5% 2.0%	 1.5% 2.0%
Max. camber for products > 100 mm and nominal thickness ≤ 0.65 mm to DIN EN 10251	 35 mm	
Max. edge camber to DIN EN 10251 over 1 m gauge length for strip widths > 30 – 150 mm > 150 mm	 1.0 mm 0.5 mm	
On 1 m gauge length for products with trimmed edges mill edges	 - -	 4.0 mm 6.0 mm
Max. deviation from shearing line per 1 m gauge length for products > 150 mm	 2.0 mm	

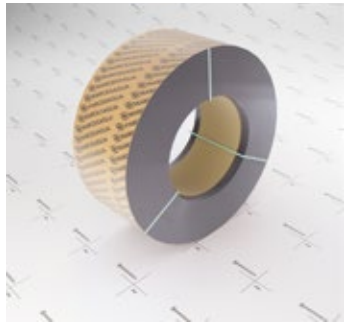
ELECTRICAL STEEL (NO) – DIMENSIONS

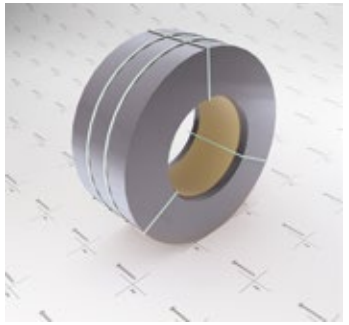
	WIDTH (mm)
Narrow strip	
Inside diameter 508 mm	30 – 500*
Wide strip	
Inside diameter 508 mm and 610 mm	500 – 1,250

* Narrower on request

STRIPS STANDARD PACKAGING

BN1 [1)]

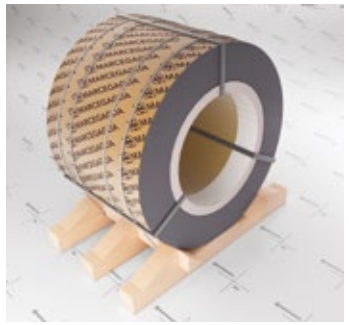


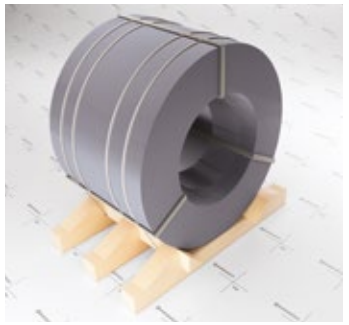


Reconstituted horizontal axis packaging strips for loading onto trucks

max. weight **8,000 kg**

BN2 [1)]





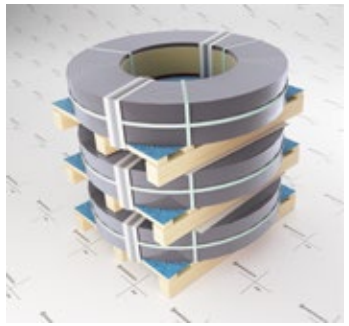
Reconstituted horizontal axis packaging on saddle strips for forklift loading

max. diameter **1,250 mm**

max. weight **5,000 kg**

min. width **400 mm**

BN3 [1)] - BN4*

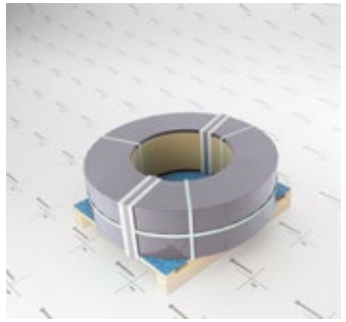


Pallet with minimum height of 80 mm, shape and size of pallet dependent on the external diameter of the strips

max. weight **4,500 kg**

*) without spacers

BN7 [1)]



Packaging consisting of 2 pieces of wood, minimum height 90 mm, strapped to the strips

max. weight **3,000 kg**

BN1M

Packaging with metal box

MARCEGAGLIA STANDARD PALLET

In the event that no packing is specified, standard packing will be used.
Pallet with minimum height of 80 mm, shape and size of pallet according to the external diameter of the strips.
- No separators for strips <100 mm wide: BN 3
- 40 mm separators for strips >100 mm wide: BN 3 - BN 4

Capacity refers to a single pallet. Stacking and securing is the customer's responsibility.
You are reminded that all packaging types are suitable for supporting their own weight and that it is not permitted to stack packages. For packaging requiring spacers not specified in this codification, maximum thickness spacers must be inserted.

[1)] Please see the table for any features such as wood separators, paper, etc.
[2)] To be agreed with the plant's QC

PROTECTIONS	
0	without spacers
4	with 40 mm spacers between strips
5	with 50 mm spacers between strips
8	with 80 mm spacers between strips
10	with 100 mm spacers between strips
A	no protection
B	plastic bag
C	full protection with VCI plastic
G	orbital protection with VCI plastic film
H	paper with VCI
I	maritime shipping packaging
L	paper protective sheet with VCI - no corners

	plastic above and below the material [2)]
	separators wrapped in plastic or paper [2)]

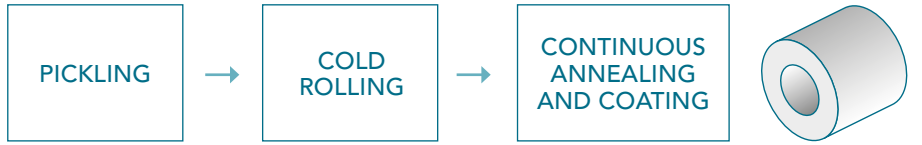
MARCEGAGLIA NGO PRODUCTION CYCLE

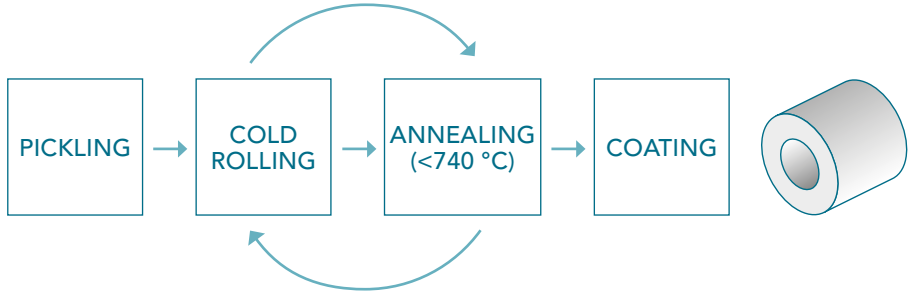
CONVENTIONAL NGO CYCLE

CONTINUOUS ANNEALING AT HIGH TEMPERATURE (950-1100 °C) IN A HNX ATMOSPHERE. CRITICAL MICROSTRUCTURE CONTROL AND PRODUCTION OF THIN THICKNESSES.

MARCEGAGLIA RAVENNA NGO CYCLE

STATIC ANNEALING (T <740 °C) IN BELL FURNACES
TO OBTAIN A MATERIAL WITH HIGH MAGNETIC PROPERTIES
AND LOWER ENVIRONMENTAL IMPACT.
BETTER CONTROL OF MICROSTRUCTURE AND ULTRA-THIN THICKNESS.





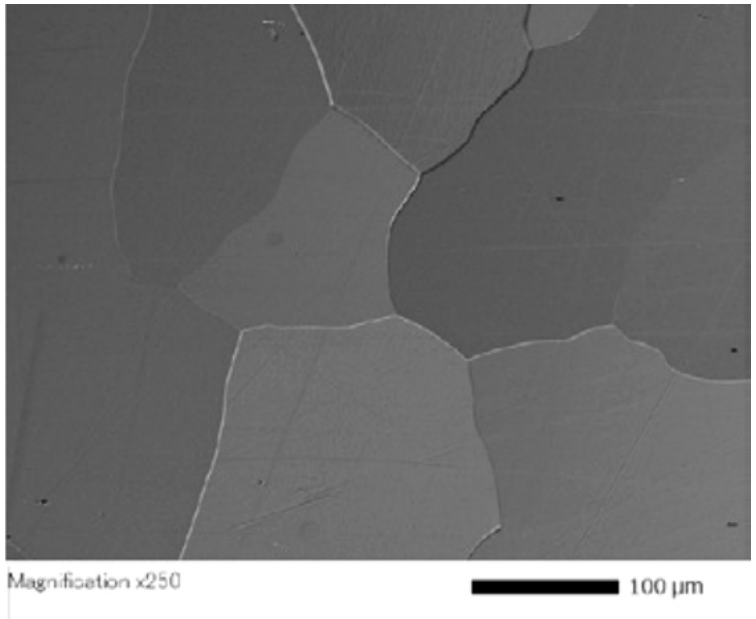
MARCEGAGLIA RAVENNA PLANT

MARCEGAGLIA NGO PRODUCTION CYCLE

ADVANTAGES ACHIEVED IN INDUSTRIAL TRIALS

- BETTER MICROSTRUCTURE CONTROL: GRAIN SIZE AND PRECIPITATION OPTIMIZATION
- BETTER TEXTURE SELECTION (FURTHER IMPROVEMENT ARE UNDER INVESTIGATION)
- LOWER MAGNETIC AGEING WITH RESPECT TO CONVENTIONAL PRODUCTS
- LOWER SPECIFIC EMISSION KG_{CO_2}/T_{STEEL} (-33% OF ANNEALING FURNACE)

NGO Production Cycle	CO_2 specific emission (kg_{CO2}/t_{steel})	CO_2 emission avoided (NG fueled)	CO_2 emission avoided (electric furnace)
Conventional cycle (reference value)	90	-	-
Marcegaglia cycle (typical value)	**56-60**	**-33%**	**-100%**



FUTURE DEVELOPMENT: ELECTRICAL BELL FURNACE TO PRODUCE GREEN NGO STEELS (SCOPE 1 AND 2)


WE ARE IN
JUNE 2025
MARCEGAGLIA
CARBON STEEL
www.marcegaglia.com