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INTRODUCTION

voestalpine is among the leading producers of non-grain-oriented electrical steel strip in Europe. The designation electrical strip is a general term for all strips and sheets made of steel that are applied as punched parts of different shapes and sizes as components in magnetic cores in electrical machinery. These magnetic cores are created by joining individual punched parts to form core packets. Examples of this are rotary and stator packets in electrical engines or core packets in transformers. These magnetic cores made of ferro-magnetic electrical steel strip allow technical and economic applications of basic electromagnetic laws. Electrical steel strip with its electromagnetic properties has a decisive influence on the degree of effectiveness of electrical machinery. A

comprehensive product range of finally annealed and non-finally-annealed electrical steel strips that comply with the valid standards and the innovative ISOVAC® special grades make it possible for **voestalpine** to meet the most varied and specific customer requirements.

The most modern manufacturing technologies, continuous quality control systems and intensive research and development guarantee optimum product quality.

These terms of delivery are based on the currently valid standards for electrical steel strip that are applicable in the European Union (see comparison of standards).

PRODUCT RANGE

voestalpine delivers cold-rolled, non-grain oriented electrical steel strip as wide strip. Our Steel Service Centre delivers electrical steel longitudinally split in rolls or cross-cut in sheets.

Finally annealed electrical steel strip

is cold-rolled, non-grain oriented in finally annealed condition. voestalpine offers the following products:

- Standard grades in accordance with EN 10106
- Finally annealed Special ISOVAC® Grades

Finally annealed electrical steel strip

is cold-rolled, non-grain oriented in finally annealed condition. voestalpine offers the following products:

- Standard grades in accordance with EN 10126 (unalloyed)
- Standard grades in accordance with EN 10165 (alloyed)
- Non-finally-annealed ISOVAC® special grades
- Cold-rolled strip without guarantee
Magnetic properties in accordance with EN 10131

ISOVAC® SPECIAL GRADES

ISOVAC® grades by **voestalpine** are innovative electrical strip grades with an improved spectrum of properties. They are offered as either finally annealed or non-finally-annealed electrical steel strip grades.

The basis for all ISOVAC® grades are special alloying modes with reduced silicon content (main alloying element in electrical steels) when compared with standard grades.

In connection with specially optimised rolling and annealing technologies, certain advantages are achieved with respect to electrical properties as well as with regard to the workability of the material:

- Low core losses, higher magnetic polarization and permeability for high efficiency
- Higher thermal conductivity
- Best punchability through optimised mechanical properties
- Low wear of blanking tools through low silicon content
- Lowest carbon and nitrogen content guarantee magnetic freedom from ageing

FINALLY ANNEALED ELECTRICAL STEEL STRIP

Finally annealed electrical steel strip by **voestalpine** is finally annealed in continuous furnaces after cold-rolling. After blanking, finally annealed electrical steel strip is generally used for building core packets without being previously subjected to further heat treatment. The adjustment of the electromagnetic properties is carried out primarily by carefully adapting the alloying elements and the annealing parameters. Ageing is excluded through deep decarburisation in the steelmaking plant and the lowest nitrogen content. The products are also characterised by their excellent punchability. In addition to the standard grades,

the product range of finally annealed electrical steel strips also includes special ISOVAC® grades with improved property spectrums. With regard to geometric properties, tolerances and surface types, all finally annealed products from **voestalpine** (with the exception of ISOVAC1200-50A, ISOVAC1200-65A) are subject to the stipulations of EN 10106. The stipulations of EN 10126 apply to ISOVAC1200-50A, ISOVAC1200-65A.

Upon request, finally annealed electrical steel strip can also be supplied in insulated condition.

PRODUCT RANGE OF FINALLY ANNEALED ELECTRIC STRIP (EN 10106)

Guaranteed values (measurement made in accordance with IEC 60404-2, f = 50 Hz)

	Nominal thickness ¹⁾ [mm]	Density ²⁾ [kg/dm ³]	Maximum Core Loss		Minimum Magnetic Polarisation		
			P1,0 T [W/kg] ³⁾	P1,5 T [W/kg]	J25 [T]	J50 [T]	J100 [T]
M 330-35 A	0.35	7.65	1.3	3.3	1.49	1.60	1.70
M 350-50 A	0.5	7.65	1.5	3.5	1.50	1.60	1.70
M 400-50 A	0.5	7.70	1.7	4.0	1.53	1.63	1.73
M 470-50 A	0.5	7.70	2.0	4.7	1.54	1.64	1.74
M 530-50 A	0.5	7.70	2.3	5.3	1.56	1.65	1.75
M 600-50 A	0.5	7.75	2.6	6.0	1.57	1.66	1.76
M 700-50 A	0.5	7.80	3.0	7.0	1.60	1.69	1.77
M 800-50 A	0.5	7.80	3.6	8.0	1.60	1.70	1.78
M 940-50 A	0.5	7.85	4.2	9.4	1.62	1.72	1.81
M 470-65 A	0.65	7.65	2.0	4.7	1.53	1.63	1.73
M 530-65 A	0.65	7.70	2.3	5.3	1.54	1.64	1.74
M 600-65 A	0.65	7.75	2.6	6.0	1.56	1.66	1.76
M 700-65 A	0.65	7.75	3.0	7.0	1.57	1.67	1.76
M 800-65 A	0.65	7.80	3.6	8.0	1.60	1.70	1.78
M 940-65 A	0.65	7.80	4.4	9.4	1.61	1.71	1.80
M 1300-100 A	1.0	7.80	5.8	13.0	1.60	1.70	1.78

¹⁾ Other sheet thicknesses only by special agreement.

²⁾ Density values in accordance with EN 10106. Separately agreed typical density values may deviate.

³⁾ P10, Values only for information.

PRODUCT RANGE OF FINALLY-ANNEALED ISOVAC® GRADES

Guaranteed values (measurement made in accordance with IEC 60404-2, f = 50 Hz)

	Nominal thickness ¹⁾ [mm]	Density ²⁾ [kg/dm ³]	Maximum Core Loss		Minimum Magnetic Polarisation		
			P1,0 T [W/kg] ³⁾	P1,5 T [W/kg]	J25 [T]	J50 [T]	J100 [T]
ISOVAC 400-50 A High Perm	0.5	7.80	1.7	4.0	1.60	1.70	1.80
ISOVAC 400-50 A	0.5	7.80	1.7	4.0	1.57	1.67	1.77
ISOVAC 600-50 A	0.5	7.80	2.6	6.0	1.60	1.70	1.80
ISOVAC 800-50 A	0.5	7.80	3.6	8.0	1.62	1.70	1.80
ISOVAC 1200-50 A	0.5	7.85	6.0	12.0	1.60	1.70	1.80
ISOVAC 530-65 A	0.65	7.80	2.3	5.3	1.57	1.67	1.77
ISOVAC 600-65 A	0.65	7.80	2.6	6.0	1.60	1.70	1.80
ISOVAC 940-65 A	0.65	7.80	4.4	9.4	1.62	1.70	1.80
ISOVAC 1200-65 A	0.65	7.85	6.0	12.0	1.60	1.70	1.80

¹⁾ Other sheet thicknesses only by special agreement.

²⁾ Typical values of density.

³⁾ P10, Values only for information.

NON-FINALLY-ANNEALED ELECTRICAL STEEL STRIP

Non-finally-annealed electrical steel strip is delivered in cold-rolled (skin-passed) condition. Skin-pass rolling achieves optimum processing properties and an optimised microstructure during recrystallising annealing.

After the non-finally-annealed electrical steel strip is punched, either the individual components or the finished core packets are subjected to recrystallising annealing.

The material is annealed in special annealing furnaces where it is decarburised in order to attain specific electromagnetic properties that prevent it from ageing and to apply a thin oxide layer that acts as an insulating surface between the punching

parts. In addition to the standard grades, the product range of finally annealed electrical steel strips includes special ISOVAC® grades with an improved property spectrum. This is in accordance with EN standards (EN 10126, EN 10165).

voestalpine also offers cold-rolled strip without guaranteed magnetic properties for application in extremely small engines (tolerances in accordance with EN 10131).

With regard to geometric properties, tolerances and surface types, all finally annealed products from **voestalpine** are subject to the stipulations of EN 10126 as well as EN 10165.

PRODUCT RANGE OF NON-FINALLY-ANNEALED ELECTRIC STRIP (EN 10165)

Guaranteed values (measurement made in accordance with IEC 60404-2, f = 50 Hz)

	Nominal ¹⁾ thickness [mm]	Density ²⁾ [kg/dm ³]	Maximum Core Loss		Minimum Magnetic Polarisation		
			P1,0 T [W/kg] ³⁾	P1,5 T [W/kg]	J25 [T]	J50 [T]	J100 [T]
M 340-50 E	0.5	7.65	1.42	3.4	1.54	1.62	1.72
M 390-50 E	0.5	7.70	1.62	3.9	1.56	1.64	1.74
M 450-50 E	0.5	7.75	1.92	4.5	1.57	1.65	1.75
M 450-65 E	0.65	7.70	1.92	4.5	1.56	1.64	1.74
M 520-65 E	0.65	7.75	2.22	5.2	1.57	1.65	1.75

¹⁾ Other sheet thicknesses only by special agreement.

²⁾ Density values in accordance with EN 10165. Separately agreed typical density values may deviate.

³⁾ P10, Values only for information.

PRODUCT RANGE OF NON-FINALLY-ANNEALED ELECTRIC STRIP (EN 10126)

Guaranteed values (measurement made in accordance with EN 60404-2, f = 50 Hz)

	Nominal thickness ¹⁾ [mm]	Density ²⁾ [kg/dm ³]	Maximum Core Loss		Minimum Magnetic Polarisation		
			P1,0 T [W/kg] ³⁾	P1,5 T [W/kg]	J25 [T]	J50 [T]	J100 [T]
M 660-50 D	0.5	7.85	2.8	6.6	1.62	1.70	1.79
M 890-50 D	0.5	7.85	3.7	8.9	1.60	1.68	1.78
M 800-65 D	0.65	7.85	3.3	8.0	1.62	1.70	1.79
M 1000-65 D	0.65	7.85	4.2	10.0	1.60	1.68	1.78

¹⁾ Other sheet thicknesses only by special agreement.

²⁾ Density values in accordance with EN 10126. Separately agreed typical density values may deviate.

³⁾ P10, Values only for information.

PRODUCT RANGE OF NON-FINALLY-ANNEALED ISOVAC® GRADES

Guaranteed values (measurement made in accordance with IEC 60404-2, f = 50 Hz, Wärmebehandlung lt. EN 10126)

	Nominal thickness ¹⁾ [mm]	Density ²⁾ [kg/dm ³]	Maximum Core Loss		Minimum Magnetic Polarisation		
			P1,0 T [W/kg] ³⁾	P1,5 T [W/kg]	J25 [T]	J50 [T]	J100 [T]
ISOVAC High Perm 420-50 D	0.5	7.80	1.8	4.2	1.59	1.67	1.77
ISOVAC High Perm 450-50 D	0.5	7.85	1.9	4.5	1.59	1.67	1.77
ISOVAC High Perm 570-65 D	0.65	7.85	2.5	5.7	1.59	1.67	1.77

¹⁾ Other sheet thicknesses only by special agreement.

²⁾ Typical values of density.

³⁾ P10, Values only for information.

PRODUCT RANGE NON-FINALLY-ANNEALED GRADES

WITHOUT GUARANTEED MAGNETIC PROPERTIES

(Toleranzen gemäß EN 10131)

	Nominal thickness ¹⁾ [mm]	Density ²⁾ [kg/dm ³]	Maximum Core Loss		Minimum Magnetic Polarisation		
			P1,0 T [W/kg]	P1,5 T [W/kg]	J25 [T]	J50 [T]	J100 [T]
M -50 D	0.5	7.85					
M -65 D	0.65	7.85					
M -70 D	0.7	7.85					
M -80 D	0.80	7.85					
M -100 D	1.00	7.85					

**MAGNETIC PROPERTIES
NOT GUARANTEED.**

¹⁾ Other sheet thicknesses only by special agreement.

²⁾ Typical values of density.

INSULATION

All electrical grades from **voestalpine** can be requested in insulated condition.

In order to comply with the growing ecological requirements, our insulation systems do not contain any toxic, carcinogenic or mutagenic components. Furthermore, our insulation is free of chrome compounds and substances that release formaldehyde and comply with all pertinent EC guidelines (such as EC 58 dated 27 July 2001, as well as EC 59 dated 6 August 2001).

The following insulation systems are offered:

The C-3 System is an organic, unfilled insulation system that leads to significant improvements in punchability. The insulation is resistant toward insulating oils, punching and cooling agents as well as organic solvents. In thick layers, the paint provides excellent insulation resistance. The insulation is not resistant to annealing and is only weldable in very thin layer thicknesses.

Available layer thickness ranges roughly 0.5–4.0 μm .

C-3 Baked Paint System Baked paint systems are only available upon request.

The C-5 System is a mixture of organic and anorganic polymer products that are partially augmented with anorganic fillers. This insulation system is weldable and suitable for pressure die casting. It leads to an improvement in punchability and can be finally annealed in contrast to C-3 insulations.

Available layer thickness ranges roughly 0.5–3.0 μm .

C-6 System is a mixture of organic film forming agents and anorganic fillers. Electrical strip coated with the C-6 insulation system shows good punchability and resistance to insulating oils and organic solvents. The insulation is thermally resistance up to roughly 420 °C and thus suitable for repairs after the burn-off method has been applied.

Available layer thicknesses range between 4.0 and 1.0 μm .

PROPERTY SPECTRUM IN INSULATION SYSTEMS

Requirements	C-3		C-6	C-5	
	0.5–1.5 μm	-4 μm		0.5–1.0 μm	-3 μm
Layer Thickness	thin	thick		thin	thick
Insulation resistance	+	++	++	+	++
Corrosion resistance	+	++	++	+	++
Punchability	++	++	+	++	+
Suitability for Al die casting	++	+	+	++	+
Weldability				++	+
Final annealing resistance				++	++
Pressure stability			++	++	++
Drive resistance	++	++	++	++	+
Suitability for burn-off repair			++	++	++
AISt classification	C3	C3	C6	C3/C5	C5

Legend:

++ Excellent suitability

+ Good suitability

SURFACE

TYPE OF SURFACE

Electrical strips are generally delivered in Surface Type A. This surface type allows isolated occurrences of drag lines, bubbles, light scratches, discolouration, etc., as long as these do not significantly interfere with the intended application. Guidelines apply in accordance with EN 10106, EN 10126 and EN 10165.

SURFACE QUALITY

Finally annealed electrical steel strip is delivered with a smooth surface (Ra of 1.0 µm max.). An exception to this is ISOVAC 1200-50A, ISOVAC 1200-65A, for which a higher degree of roughness can be designated.

As a standard, non-finally-annealed electrical steel strip is delivered with a rough surface (Ra 1.5–3.0 µm) in order to avoid sticking of the punched parts during recrystallising annealing. Other surface types can be specially negotiated at the time the material is ordered.

Determination of the median roughness value Ra is subject to a wavelength limit of 2.5 mm in accordance with prEN 10049, 2003 edition (standard measuring length of 12.5 mm).

PRESERVATION

Electrical strips are generally delivered in unoiled condition. Edge-oiled or oiled condition can be specially negotiated at the time the material is ordered.

WELD SEAMS

The rolls may show weld seams or interruptions if this is agreed upon at the time the material is ordered.

AVAILABLE SHAPES AND DIMENSIONS

The following limiting dimensions apply to orders for mother coils. Deliveries of longitudinally split rolls or cross-cut as sheets are possible, but are subject to prior approval by our Steel Service Centre.

FINALLY ANNEALED ELECTRIC STRIP (EN 10106)

Grade	Nominal Thickness [mm]	Maximum Order Width [mm]	Inner diameter ¹⁾ [mm]	Ordered Quantity [kg/mmBB]
M 330-35 A	0.35	1265	ca. 600	ca. 17
M 350-50 A	0.50	1265	ca. 600	ca. 17
M 400-50 A	0.50	1265	ca. 600	ca. 17
M 470-50 A	0.50	1265	ca. 600	ca. 17
M 530-50 A	0.50	1265	ca. 600	ca. 17
M 600-50 A	0.50	1265	ca. 600	ca. 17
M 700-50 A	0.50	1265	ca. 600	ca. 17
M 800-50 A	0.50	1265	ca. 600	ca. 17
M 940-50 A	0.50	1265	ca. 600	ca. 17
M 470-65 A	0.65	1265	ca. 600	ca. 17
M 530-65 A	0.65	1265	ca. 600	ca. 17
M 600-65 A	0.65	1265	ca. 600	ca. 17
M 700-65 A	0.65	1265	ca. 600	ca. 17
M 800-65 A	0.65	1265	ca. 600	ca. 17
M 940-65 A	0.65	1265	ca. 600	ca. 17
M 1300-100 A	1.00	1265	ca. 600	ca. 17

¹⁾ Inner diameter of roughly 500 mm only upon request.

FINALLY ANNEALED ISOVAC® GRADES

Grade	Nominal Thickness [mm]	Maximum Order Width [mm]	Inner diameter ¹⁾ [mm]	Ordered Quantity [kg/mmBB]
ISOVAC 400-50 A HP	0,50	1265	ca. 600	ca. 17
ISOVAC 400-50 A	0,50	1265	ca. 600	ca. 17
ISOVAC 600-50 A	0,50	1265	ca. 600	ca. 17
ISOVAC 800-50 A	0,50	1400	ca. 600	ca. 19
ISOVAC 1200-50 A	0,50	1400	ca. 600	ca. 19
ISOVAC 530-65 A	0,65	1265	ca. 600	ca. 17
ISOVAC 600-65 A	0,65	1265	ca. 600	ca. 17
ISOVAC 940-65 A	0,65	1500	ca. 600	ca. 19
ISOVAC 1200-65 A	0,65	1500	ca. 600	ca. 19

¹⁾ Inner diameter of roughly 500 mm only upon request.

NON-FINALLY-ANNEALED ELECTRIC STRIP (EN 10165)

Grade	Nominal Thickness [mm]	Maximum Order Width [mm]	Inner diameter ¹⁾ [mm]	Ordered Quantity [kg/mmBB]
M 340-50 E	0.50	1400	ca. 600	ca. 17
M 390-50 E	0.50	1400	ca. 600	ca. 17
M 450-50 E	0.50	1475	ca. 600	ca. 17
M 450-65 E	0.65	1475	ca. 600	ca. 17
M 520-65 E	0.65	1475	ca. 600	ca. 17

¹⁾ Inner diameter of roughly 500 mm only upon request.

NON-FINALLY-ANNEALED ELECTRIC STRIP (EN 10126)

Grade	Nominal Thickness [mm]	Maximum Order Width [mm]	Inner diameter ¹⁾ [mm]	Ordered Quantity [kg/mmBB]
M 660-50 D	0.50	1425	ca. 600	ca. 19
M 890-50 D	0.50	1425	ca. 600	ca. 19
M 800-65 D	0.65	1500	ca. 600	ca. 19
M 1000-65 D	0.65	1500	ca. 600	ca. 19

¹⁾ Inner diameter of roughly 500 mm only upon request.

NON-FINALLY-ANNEALED ISOVAC® GRADES

Grade	Nominal Thickness [mm]	Maximum Order Width [mm]	Inner diameter ¹⁾ [mm]	Ordered Quantity [kg/mmBB]
ISOVAC High Perm 420-50 D	0.50	1400	ca. 600	ca. 19
ISOVAC High Perm 450-50 D	0.50	1400	ca. 600	ca. 19
ISOVAC High Perm 570-65 D	0.65	1500	ca. 600	ca. 19

¹⁾ Inner diameter of roughly 500 mm only upon request.

COLD-ROLLED STRIP WITHOUT GUARANTEED MAGNETIC PROPERTIES

Grade	Nominal Thickness [mm]	Maximum Order Width [mm]	Inner diameter ¹⁾ [mm]	Ordered Quantity [kg/mmBB]
M 50 D	0.50	1575	ca. 600	ca. 19
M 65 D	0.65	1575	ca. 600	ca. 19
M 70 D	0.70	1575	ca. 600	ca. 19
M 80 D	0.80	1575	ca. 600	ca. 19
M 100 D	1.00	1575	ca. 600	ca. 19

¹⁾ Inner diameter of roughly 500 mm only upon request.

TEST CERTIFICATES

Specific tests shall be restricted to a test unit of 20 tons or a portion of 20 tons of the same type and nominal thickness. Roll weights of more than 20 tons shall be deemed as a testing unit.

In the event not otherwise agreed, the following properties are tested for each unit:

- Magnetic properties
- Mechanical properties

MAGNETIC PROPERTIES

The magnetic properties of finally annealed electrical steel strip are determined in delivered condition.

The magnetic properties of non-finally-annealed electrical steel strip are the result of a test conducted subsequent to heat treatment in accordance with EN 10126 or EN 10165.

The measurement is made in accordance with IEC 60404-2.

TEST CERTIFICATE

In the event the customer desires a test certificate, it will be issued in accordance with EN 10204. The minimum value for core loss will be indicated as 1.5 days. Other properties can be negotiated.

PROCESSING INSTRUCTIONS

SPECIAL PROCESSING INSTRUCTIONS FOR NON-FINALLY-ANNEALED ELECTRICAL STEEL STRIP

Because of the method of manufacturing and delivery in rolls, non-finally-annealed electrical steel strip (in accordance with EN 10126, EN 10165 as well as non-finally-

annealed ISOVAC® grades) in delivered condition may have a residual curvature in the direction of rolling as well as inner tensions. Preventive measures should be taken by the consumer to minimise or eliminate the effects of these properties during processing or application of the product.