

Electrical steel strip

Technical Terms of Delivery

Contents

<u>Introduction</u>	<u>4</u>
<u>Product range</u>	<u>5</u>
Electrical steel strip strip by voestalpine	5
<u>Special isovac® grades</u>	<u>6</u>
Low-alloyed electrical steel strip by voestalpine	6
High-permeable electrical steel strip by voestalpine	6
Blued electrical steel strip by voestalpine	7
<u>Final-annealed electrical steel strip</u>	<u>8</u>
<u>Non-final-annealed electrical steel strip</u>	<u>10</u>
<u>Environmentally compatible insulation systems</u>	<u>11</u>
<u>Surface</u>	<u>12</u>
Surface type	12
Surface quality	12
Preservation	12
<u>Weld seams</u>	<u>13</u>
<u>Available dimensions</u>	<u>14</u>

Inspection and Testing	16
Magnetic properties	16
Test certificate	16
Processing information	17
Special processing instructions for non-final-annealed electrical steel strip	17

Introduction

voestalpine Stahl GmbH has become a European center of competence in the field of electrical steel strip. The company consults and supplies a number of renowned customers at home and abroad in ways truly unique to the company: competently as a reliable partner and with true dedication to service.

voestalpine Stahl GmbH in Linz, Austria, operates one of Europe's most modern metallurgical facilities. Each of the plants required for the production of high-quality steel strip is located next to related facilities and is highly integrated into the works.

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

Special emphasis is placed on the further development of electrical steel strip – particularly that of the innovative special isovac® grades.

Electrical steel strip by voestalpine can be supplied directly ex works as slit strip or cut shapes from our Steel Service Centers in Austria, Italy, Germany and Poland.

Product range

Electrical steel strip by voestalpine

voestalpine is among the leading quality producers of non-grain-oriented electrical steel strip and is the market leader in semi-finished grades in Europe.

The innovative isovac® product family developed by voestalpine Stahl GmbH provides optimized benefits in the field of electrical steel strip to our customers with respect to higher energy efficiency and process optimization.

Product range

- Standard electrical steel strip grades
- Special isovac® grades
 - isovac® – low-alloyed electrical steel strip
 - isovac® high-perm – high-permeable electrical steel strip
 - isovac® blue – blued electrical steel strip

Special isovac® grades

isovac® – low-alloyed electrical steel strip by voestalpine

isovac® is an innovative material design for highest energy efficiency in full-finished and semi-finished grades. It features the following beneficial properties:

- Minimum silicon content
- Best electro-magnetic properties
- Excellent workability
- Reduced final-annealing time in semi-finished steel grades

Typical isovac® applications

- Large-scale generators for energy production
- Automotive applications for comfort, safety components and drive systems
- Industrial and railway engines
- Electronic ballasts and transformers

isovac® high-perm – high-permeable electrical steel strip by voestalpine

isovac® high-perm is an electrical steel strip that maintains component size with the highest degree of permeability for additional performance.

- isovac® material design
- Excellent permeability
- Potentially smaller component sizes
- Longer tool service life

Typical isovac® high-perm applications

- Motors in household appliances and compressors
- Wind energy generators
- Electronic ballasts
- Portable generators

isovac® blue – blued electrical steel strip by voestalpine

isovac® blue is an innovative electrical steel strip with an insulating surface.

- isovac® material design
- Insulation effect without paint coating
- Minimization of eddy-current losses
- Cost optimization potential

Typical isovac® blue applications

- Motors for dishwashers, washing machines and dryers
- Automobile starter generators
- Industrial motors up to 75 kW

Final-annealed electrical steel strip

Final-annealed electrical steel strip from voestalpine is final-annealed in continuous furnaces after cold-rolling.

After blanking, final-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 decarburization in the steelmaking plant and the lowest nitrogen content.

The products are also characterized by their excellent punchability. In addition to the standard grades, the product range of final-annealed electrical steel strips also includes special isovac® grades with improved property spectrums. With regard to geometric properties, tolerances and surface types, all final-annealed products by voestalpine are subject to the stipulations set forth in EN 10106.

Upon request, final-annealed electrical steel strip is available in insulated condition.

Final-annealed electrical steel strip by voestalpine

Steel grade	Nominal thickness [mm]	Density [kg/dm³]	Maximum core loss P max.		Magnetic polarization J min.		
			P1.0 T [W/kg]	P1.5 T [W/kg]	J25 [T]	J50 [T]	J100 [T]
M 250-35 A	0.35	7.60	1.0	2.5	1.49	1.60	1.70
isovac 250-35 A	0.35	7.65	1.0	2.5	1.53	1.64	1.74
M 270-35 A	0.35	7.65	1.1	2.7	1.49	1.60	1.70
isovac 270-35 A	0.35	7.70	1.1	2.7	1.51	1.62	1.72
isovac 270-35 A high-perm	0.35	7.70	1.1	2.7	1.53	1.64	1.74
M 300-35 A	0.35	7.65	1.2	3.0	1.49	1.60	1.70
isovac 300-35 A	0.35	7.70	1.2	3.0	1.53	1.64	1.74
M 330-35 A	0.35	7.65	1.3	3.3	1.49	1.60	1.70
isovac 330-35 A	0.35	7.70	1.3	3.3	1.53	1.64	1.74
isovac 400-35 A	0.35	7.75	1.7	4.0	1.55	1.66	1.76
M 270-50 A	0.5	7.60	1.1	2.7	1.49	1.60	1.70
isovac 270-50 A	0.5	7.65	1.1	2.7	1.51	1.62	1.72
M 290-50 A	0.5	7.60	1.15	2.9	1.49	1.60	1.70
isovac 290-50 A	0.5	7.65	1.15	2.9	1.51	1.62	1.72
M 310-50 A	0.5	7.65	1.25	3.1	1.50	1.60	1.70
isovac 310-50 A	0.5	7.70	1.25	3.1	1.53	1.64	1.74
M 330-50 A	0.5	7.65	1.35	3.30	1.50	1.60	1.70
isovac 330-50 A	0.5	7.70	1.35	3.30	1.53	1.64	1.74
M 350-50 A	0.5	7.65	1.50	3.50	1.50	1.60	1.70
M 400-50 A	0.5	7.70	1.7	4.0	1.53	1.63	1.73
isovac 400-50 A	0.5	7.75	1.7	4.0	1.57	1.67	1.77
isovac 400-50 A high-perm	0.5	7.75	1.7	4.0	1.61	1.71	1.81
M 470-50 A	0.5	7.70	2.0	4.7	1.54	1.64	1.74

Final-annealed electrical steel strip by voestalpine (cont.)

Steel grade	Nominal thickness [mm]	Density [kg/dm ³]	Maximum core loss P max.		Magnetic polarization J min.		
			P1.0 T [W/kg]	P1.5 T [W/kg]	J25 [T]	J50 [T]	J100 [T]
isovac 470-50 A	0.5	7.75	2.0	4.7	1.58	1.68	1.78
M 530-50 A	0.5	7.70	2.3	5.3	1.56	1.65	1.75
isovac 530-50 A	0.5	7.80	2.3	5.3	1.62	1.72	1.80
M 600-50 A	0.5	7.75	2.6	6.0	1.57	1.66	1.76
isovac 600-50 A	0.5	7.80	2.6	6.0	1.62	1.72	1.80
isovac 600-50 A blue	0.5	7.80	2.6	6.0	1.62	1.72	1.80
M 700-50 A	0.5	7.80	3.0	7.0	1.60	1.69	1.77
isovac 700-50 A	0.5	7.80	3.0	7.0	1.62	1.72	1.80
M 800-50 A	0.5	7.80	3.6	8.0	1.60	1.70	1.78
isovac 800-50 A	0.5	7.80	3.6	8.0	1.62	1.72	1.80
isovac 800-50 A blue	0.5	7.80	3.6	8.0	1.62	1.72	1.80
M 940-50 A	0.5	7.85	4.2	9.4	1.62	1.72	1.81
M 350-65 A	0.65	7.60	1.5	3.5	1.53	1.63	1.73
isovac 350-65 A	0.65	7.65	1.5	3.5	1.55	1.65	1.75
M 400-65 A	0.65	7.65	1.7	4.0	1.53	1.63	1.73
isovac 400-65 A	0.65	7.70	1.7	4.0	1.55	1.65	1.75
M470-65 A	0.65	7.65	2.0	4.7	1.53	1.63	1.73
isovac 470-65 A	0.65	7.70	2.0	4.7	1.57	1.67	1.77
isovac 470-65 A high-perm	0.65	7.70	2.0	4.7	1.61	1.71	1.81
M 530-65 A	0.65	7.70	2.3	5.3	1.54	1.64	1.74
isovac 530-65 A	0.65	7.75	2.3	5.3	1.57	1.67	1.77
M 600-65 A	0.65	7.75	2.6	6.0	1.56	1.66	1.76
isovac 600-65 A	0.65	7.80	2.6	6.0	1.60	1.70	1.78
M 700-65 A	0.65	7.75	3.0	7.0	1.57	1.67	1.76
isovac 700-65 A blue	0.65	7.80	3.0	7.0	1.60	1.70	1.78
M 800-65 A	0.65	7.80	3.6	8.0	1.60	1.70	1.78
isovac 800-65 A blue	0.65	7.80	3.6	8.0	1.62	1.72	1.80
isovac 850-65 A	0.65	7.85	3.8	8.5	1.63	1.73	1.82
M 1000-65 A	0.65	7.80	4.4	10.0	1.61	1.71	1.80
isovac 1000-65 A	0.65	7.85	4.4	10.0	1.63	1.73	1.82
isovac 600-80 A	0.8	7.75	2.6	6.0	1.57	1.67	1.77
M 700-100 A	1.0	7.65	3.0	7.0	1.54	1.64	1.73
M 800-100 A	1.0	7.70	3.6	8.0	1.56	1.66	1.75
isovac 940-100 A	1.0	7.80	4.0	9.4	1.60	1.70	1.80
M 1300-100 A	1.0	7.80	5.8	13.0	1.60	1.70	1.78
isovac 1400-100 A high-perm	1.0	7.85	6.2	14.0	1.68	1.76	1.84

Non-final-annealed electrical steel strip

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

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

The material is annealed in special annealing furnaces where it is decarburized 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 final-annealed electrical steel strips includes special isovac® grades with an improved property spectrum. This is in accordance with EN standard 10341.

With regard to geometric properties, tolerances and surface types, all final-annealed products by voestalpine are subject to the stipulations set forth in EN 10341.

Non-final-annealed electrical steel strip by voestalpine

Steel grade	Nominal thickness [mm]	Density [kg/dm³]	Maximum core loss P max.		Magnetic polarization J min.		
			P1.0 T [W/kg]	P1.5 T [W/kg]	J25 [T]	J50 [T]	J100 [T]
isovac 310-50 K high-perm	0.5	7.70	1.38	3.1	1.55	1.63	1.73
M 340-50 K	0.5	7.65	1.42	3.4	1.54	1.62	1.72
isovac 340-50 K high-perm	0.5	7.70	1.42	3.4	1.56	1.64	1.74
M 390-50 K	0.5	7.70	1.62	3.9	1.56	1.64	1.74
isovac 420-50 K high-perm	0.5	7.80	1.72	4.2	1.58	1.66	1.76
M 450-50 K	0.5	7.75	1.92	4.5	1.57	1.65	1.75
isovac 450-50 K high-perm	0.5	7.85	1.92	4.5	1.59	1.67	1.77
M 660-50 K	0.5	7.85	2.8	6.6	1.62	1.70	1.79
M 890-50 K	0.5	7.85	3.7	8.9	1.60	1.68	1.78
M 390-65 K	0.65	7.65	1.62	3.9	1.54	1.62	1.72
isovac 390-65 K high-perm	0.65	7.70	1.62	3.9	1.56	1.64	1.74
M 450-65 K	0.65	7.70	1.92	4.5	1.56	1.64	1.74
isovac 470-65 K high-perm	0.65	7.75	2.0	4.7	1.58	1.66	1.76
M 520-65 K	0.65	7.75	2.22	5.2	1.57	1.65	1.75
isovac 520-65 K high-perm	0.65	7.80	2.22	5.2	1.59	1.67	1.77
isovac 570-65 K high-perm	0.65	7.85	2.43	5.7	1.60	1.68	1.78
M 800-65 K	0.65	7.85	3.3	8	1.62	1.70	1.79
M 1000-65 K	0.65	7.85	4.2	10	1.60	1.68	1.78

Environmentally compatible insulation systems

Depending on customer requirements, voestalpine offers various carefully selected insulation systems. The utilized systems contain no toxic, carcinogenic or mutagenic substances, are free of chromium and formaldehyde compounds and meet all applicable EC directives (RoHS Directive 2002/95/EC).

C-3 organic insulation system

- High level of insulation resistance
- Highly improved punchability

C-3 self-bonding insulation system

- High degree of adhesiveness
- Good punchability

C-5 inorganic/organic insulation system

- Best weldability
- Improved punchability
- Resistant to annealing under protective gas up to 850°C
- Suitable for pressure die casting

C-6 organic/inorganic insulation system

- Pressure-resistant
- Highly improved punchability
- Thermal rating up to 420 °C (suitable for burn-off repair)

Property spectrum of insulation systems

Legend: ++ excellent suitability + good suitability

Requirements	C-3		C-5		C-6
	0.5 – 1.5 µm	– 4 µm	0.5 – 1.0 µm	– 3 µm	4 – 10 µm
Layer thickness	thin	thick	thin	thick	
Insulation resistance	+	++	+	++	++
Corrosion resistance	+	++	+	++	++
Punchability	++	++	++	+	+
Suitability for Al die casting	++	+	++	+	+
Weldability			++	+	
Final annealing resistance			++	++	
Pressure stability			++	++	++
Abrasion	++	++	++	+	++
Suitability for burn-off repair			++	++	++
AISI classification	C3	C3	C3/C5	C5	C6

Surface

Surface type

Electrical steel strips are generally delivered as Surface Type A. This surface type allows isolated occurrences of drag lines, bubbles, light scratches, discoloration, etc., as long as these do not significantly interfere with the intended application.

Guidelines apply in accordance with EN 10106 and EN 10341.

Surface quality

Final-annealed electrical steel strip is delivered with a smooth surface (Ra of 1.0 μm max.).

As a standard, non-final-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 recrystallization annealing. Other surface types are subject to special agreement at the time the material is ordered. Determination of the mean Ra roughness value is subject to a wavelength limit of 2.5 mm in accordance with EN 10049 (standard length of 12.5 mm).

Preservation

Electrical steel strips are generally delivered in unoiled condition. Edge-oiled or oiled condition is subject to special agreement 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 dimensions

The following limiting dimensions apply to orders for mother coils. Deliveries of split rolls or transverse-cut sheets are possible and are subject to prior approval by our Steel Service Center.

Final-annealed electrical steel strip by voestalpine

Grade	Nominal thickness [mm]	Maximum order width [mm]	Maximum inner diameter [mm]	Order volume [kg/mmBB]
M 250-35 A	0.35	1265	600	17
isovac 250-35 A	0.35	1265	600	17
M 270-35 A	0.35	1265	600	17
isovac 270-35 A	0.35	1265	600	17
isovac 270-35 A high-perm	0.35	1265	600	17
M 300-35 A	0.35	1265	600	17
isovac 300-35 A	0.35	1265	600	17
M 330-35 A	0.35	1265	600	17
isovac 330-35 A	0.35	1265	600	17
isovac 400-35 A	0.35	1265	600	17
M 270-50 A	0.5	1265	600	17
isovac 270-50 A	0.5	1265	600	17
M 290-50 A	0.5	1265	600	17
isovac 290-50 A	0.5	1265	600	17
M 310-50 A	0.5	1265	600	17
isovac 310-50 A	0.5	1265	600	17
M 330-50 A	0.5	1265	600	17
isovac 330-50 A	0.5	1265	600	17
M 350-50A	0.5	1265	600	17
M 400-50 A	0.5	1265	600	17
isovac 400-50 A	0.5	1265	600	17
isovac 400-50 A high-perm	0.5	1265	600	17
M 470-50 A	0.5	1265	600	17
isovac 470-50 A	0.5	1265	600	17
M 530-50 A	0.5	1265	600	17
isovac 530-50 A	0.5	1425	600	25
M 600-50 A	0.5	1425	600	25
isovac 600-50 A	0.5	1425	600	25
isovac 600-50 A blue	0.5	1425	600	25
M 700-50 A	0.5	1425	600	25
isovac 700-50 A	0.5	1425	600	25
M 800-50 A	0.5	1500	600	25
isovac 800-50 A	0.5	1500	600	25
isovac 800-50 A blue	0.5	1500	600	25
M 940-50 A	0.5	1500	600	25

Final-annealed electrical steel strip by voestalpine (cont.)

Grade	Nominal thickness [mm]	Maximum order width [mm]	Maximum inner diameter [mm]	Order volume [kg/mmBB]
M 350-65 A	0.65	1265	600	17
isovac 350-65 A	0.65	1265	600	17
M 400-65 A	0.65	1265	600	17
isovac 400-65 A	0.65	1265	600	17
M 470-65 A	0.65	1265	600	17
isovac 470-65 A	0.65	1265	600	17
isovac 470-65 A high-perm	0.65	1265	600	17
M 530-65 A	0.65	1265	600	17
isovac 530-65 A	0.65	1265	600	17
M 600-65 A	0.65	1265	600	17
isovac 600-65 A	0.65	1265	600	17
M 700-65 A	0.65	1550	600	25
isovac 700-65 A blue	0.65	1550	600	25
M 800-65 A	0.65	1550	600	25
isovac 800-65 A blue	0.65	1550	600	25
isovac 850-65 A	0.65	1550	600	25
M 1000-65 A	0.65	1550	600	25
isovac 1000-65 A	0.65	1550	600	25
isovac 600-80 A	0.8	1265	600	17
M 700-100 A	1	1265	600	17
M 800-100 A	1	1265	600	17
isovac 940-100 A	1	1600	600	25
M 1300-100 A	1	1600	600	25
isovac 1400-100 A high-perm	1	1600	600	25

Non-final-annealed electrical steel strip by voestalpine

Grade	Nominal thickness [mm]	Maximum order width [mm]	Maximum inner diameter [mm]	Order volume [kg/mmBB]
isovac 310-50 K high-perm	0.5	1500	600	25
M 340-50 K	0.5	1500	600	25
isovac 340-50 K high-perm	0.5	1500	600	25
M 390-50 K	0.5	1500	600	25
isovac 420-50 K high-perm	0.5	1500	600	25
M 450-50 K	0.5	1500	600	25
isovac 450-50 K high-perm	0.5	1500	600	25
M 660-50 K	0.5	1500	600	25
M 890-50 K	0.5	1500	600	25
M 390-65 K	0.65	1600	600	25
isovac 390-65 K high-perm	0.65	1600	600	25
M 450-65 K	0.65	1600	600	25
isovac 470-65 K high-perm	0.65	1600	600	25
M 520-65 K	0.65	1600	600	25
isovac 520-65 K high-perm	0.65	1600	600	25
isovac 570-65 K high-perm	0.65	1600	600	25
M 800-65 K	0.65	1600	600	25
M 1000-65 K	0.65	1600	600	25

Inspection and Testing

Specific tests are restricted to a test unit of 20 tons or a portion of 20 tons of the same type and nominal thickness. Each roll that weighs more than 20 tons is automatically considered to be one testing unit.

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

- Magnetic properties
- Mechanical properties

Magnetic properties

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

The magnetic properties of non-final-annealed electrical steel strip are the result of a test conducted subsequent to heat treatment in accordance with EN 10341.

Measurement is pursuant to IEC 60404-2.

Test certificate

Test certificates requested by the customer are issued in accordance with EN 10204.

The minimum value for core loss is indicated as 1.5 days. Other properties are subject to agreement.

Processing information

Special processing instructions for non-final-annealed electrical steel strip

Because of the method of manufacturing and delivery in rolls, non-final-annealed electrical steel strip (in accordance with EN 10341 and non-final-annealed isovac® grades) in delivered condition may display residual curvature in the direction of rolling as well as inner tension. Preventive measures should be taken by the consumer to minimize or eliminate the effects of these properties during processing or application of the product.

Technically more advanced. Successful together.

voestalpine Steel Division – the partner you can trust.

High-quality materials are the basis for our products. We strive to be the best partner for our customers and want to provide them with the best-possible solution. We focus our expertise on two aspects:

The personal aspect, with dedicated and highly competent employees

The technical aspect, with high-quality methods, products and services.

The companies in the voestalpine Steel Division and their employees understand partnership to be the following:

- Understanding for their customers' business
- Expertise and reliability
- Responsibility for satisfactory project completion
- Partnerships based on trust

Many years of successful partnerships with our customers prove our point.

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