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**Magnetni materiali – Razvrstitev površinskih izolacij elektropločevine, trakov in laminatov**

Magnetic materials - Classification of surface insulations of electrical steel sheet, strip and laminations

Magnetische Werkstoffe - Einteilung der Isolationen auf Elektroblech und -band und daraus gefertigten Stanzteilen

Matériaux magnétiques - Classification des isolations de surface des tôles, bandes et lamelles magnétiques en acier

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**Ta slovenski standard je istoveten z: EN 10342:2005**

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**ICS:**

29.030	Magnetni materiali	Magnetic materials
77.140.50	Ploščati jekleni izdelki in polizdelki	Flat steel products and semi-products

**SIST EN 10342:2005**

**en**

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EUROPEAN STANDARD

EN 10342

NORME EUROPÉENNE

EUROPÄISCHE NORM

June 2005

ICS 29.030; 77.140.50

English version

## Magnetic materials - Classification of surface insulations of electrical steel sheet, strip and laminations

Matériaux magnétiques - Classification des isolations de surface des tôles, bandes et lamelles magnétiques en acier

Magnetische Werkstoffe - Einteilung der Isolationen auf Elektroblech und -band und daraus gefertigten Stanzteilen

This European Standard was approved by CEN on 12 May 2005.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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## Foreword

This document (EN 10342:2005) has been prepared by Technical Committee ECISS/TC 24 “Electrical steel sheet and strip qualities - Qualities, dimensions, tolerances and specific tests”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2005, and conflicting national standards shall be withdrawn at the latest by December 2005.

This document is technically equivalent to IEC 60404-1-1.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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**EN 10342:2005 (E)****1 Scope**

This document establishes a classification of surface insulations for electrical steel sheet, strip and laminations according to their general composition, relative insulating ability and function.

These surface insulations are either oxide layers or applied coatings.

The purpose of this classification is to create a nomenclature for the various types of surface insulations and to assist users of surface insulations by providing general information about the chemical nature and use of the surface insulations.

It is not the intent of this classification to specify insulation requirements in terms of specific values of surface insulation resistance. Such requirements are to be agreed between the purchaser and the steel producer, where applicable.

The classification is to be used in conjunction with the various specifications for cold rolled electrical steels (see the European Standards listed in Clause 2).

**2 Normative references**

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 10106, *Cold rolled non-oriented electrical steel sheet and strip delivered in the fully processed state*

EN 10107, *Grain-oriented electrical steel sheet and strip delivered in the fully processed state*

EN 10126, *Cold rolled electrical non-alloyed steel sheet and strip delivered in the semi-processed state*

EN 10165, *Cold rolled electrical alloyed steel sheet and strip delivered in the semi-processed state*

EN 10265, *Magnetic materials – Specification for steel sheet and strip with specified mechanical properties and magnetic permeability*

EN 10282:2001, *Magnetic materials – Method of test for the determination of surface insulation resistance of electrical sheet and strip*

EN 10303, *Thin magnetic steel sheet and strip for use at medium frequencies*

IEC 60050-221:1990, *International Electrotechnical Vocabulary — Chapter 221: Magnetic materials and components*

**3 Terms and definitions**

For the purposes of this document, the terms and definitions given in IEC 60050-221:1990 and in EN 10106, EN 10107, EN 10126, EN 10165, EN 10265, EN 10282:2001 and EN 10303 apply.

#### 4 Classification of surface insulations of electrical steel, strip and laminations

Table 1 specifies the classification of surface insulations of electrical steel sheet, strip and laminations.

**Table 1 — Classification of surface insulation of electrical steel, strip and laminations**

Insulation designation	Insulation description – Characteristics – Typical application, limits of use
EC-0	<p>An oxide layer that is formed naturally on the steel surface during electrical steel manufacture. This oxide layer is thin, tightly adherent and provides sufficient surface insulation resistance for many types of small cores.</p> <p>This oxide layer will withstand normal stress relief annealing temperatures.</p> <p>If subjected to a user's anneal after stamping, the surface insulation resistance of this oxide layer may be affected by the oxidizing potential of the anneal.</p> <p>It is not appropriate to specify the surface insulation resistance <sup>a</sup> for this type of insulation.</p>
EC-1	<p>An oxide layer that is created on the surface of the steel laminations by contact with an oxidizing furnace atmosphere at the end of the heat treatment cycle following the stamping of the laminations.</p> <p>This oxide layer is usually bluish to grey in colour.</p> <p>This oxide layer is primarily relevant to steel sheet, strip and laminations in the semi-processed state.</p> <p>It is not appropriate to specify the surface insulation resistance <sup>a</sup> for this type of insulation.</p>
EC-2	<p>An inorganic insulation coating predominantly comprised of magnesium silicate.</p> <p>This coating is formed on the surface of grain oriented electrical steel by the reaction of the annealing separator with the steel surface during high temperature annealing.</p> <p>This coating is often referred to as "mill glass" or "glass", even though the coating is not technically a glass.</p> <p>This coating is very abrasive. Steels coated with this type of coating only are not typically used for stamped laminations.</p> <p>The primary application of this coating is for materials used in wound core transformers.</p> <p>This coating will withstand normal stress relief annealing temperatures.</p> <p>It is not appropriate to specify the surface insulation resistance <sup>a</sup> for this type of coating.</p>
EC-3	<p>An organic varnish/enamel coating that is applied to the steel surface.</p> <p>This coating is preferably used for fully processed non-oriented electrical steels.</p> <p>This coating generally improves the punchability <sup>b</sup> of the steel and, hence, is suitable for the production of stamped laminations.</p> <p>This coating may adversely affect weldability <sup>b</sup> and will not withstand normal stress relief annealing temperatures. The coating is normally suitable for operating temperatures up to about 180 °C. The user should take into account any problems due to coating off-gassing during welding or exposure of the steel coated with this type of coating to elevated temperatures.</p> <p>It may be appropriate to specify the surface insulation resistance <sup>a</sup> of this type of coating.</p>
EC-4	<p>A coating formed by phosphating or some other chemical treatment of the steel surface followed by a curing treatment at elevated temperature.</p> <p>This type of coating is used in applications requiring moderate levels of surface insulation resistance.</p> <p>This type of coating will withstand normal stress relief annealing temperatures but some reduction of the surface insulation resistance may result.</p> <p>It may be appropriate to specify the surface insulation resistance <sup>a</sup> of this type of coating before stress relief annealing.</p>
EC-4-AS	<p>A thinner EC-4 coating primarily used for preventing sticking during heat treatment of electrical steel laminations.</p> <p>This coating is often referred to as "anti-stick".</p> <p>It is not appropriate to specify the surface insulation resistance <sup>a</sup> or the thickness <sup>b</sup> of this type of coating.</p>

Table 1 (continued)

Insulation designation	Insulation description – Characteristics – Typical application, limits of use
EC-5	<p>A class of inorganic or mostly inorganic coatings similar to EC-4 coating to which ceramic fillers and/or film forming inorganic components have been added to increase the quality of the surface insulation of the coating.</p> <p>This class consists of four coatings: EC-5-G, EC-5-N, EC-5-P and EC-5-AS.</p>
EC-5-G	<p>An EC-5 coating specific to grain oriented electrical steel.</p> <p>This coating is generally phosphate or silicate based. This coating is normally applied on top of an EC-2 coating where increased surface insulation resistance is required, e.g. sheared laminations of grain oriented electrical steels for cores of power transformers.</p> <p>The coating will withstand a stress relief annealing treatment at temperatures up to 845 °C.</p> <p>In some cases the EC-5-G coating is applied directly to the surface of grain oriented steel without the EC-2 interface, but then there may be some reduction in the surface insulation resistance.</p> <p>It may be appropriate to specify the surface insulation resistance <sup>a</sup> of this type of coating.</p>
EC-5-N	<p>An EC-5 coating specific to non-oriented electrical steels.</p> <p>The coating will withstand normal stress relief annealing temperatures but some reduction of surface insulation resistance may result.</p> <p>The coating will withstand burn off treatments in the temperature range from 300 °C to 550 °C, used to remove stator winding insulation during rebuilding of stator cores. The user should take into account any problems due to coating decomposition or off-gassing during welding or exposure of steel coated with this type of coating to elevated temperatures.</p> <p>It may be appropriate to specify the surface insulation resistance <sup>a</sup> of this type of coating before stress relief annealing.</p>
EC-5-P	<p>An EC-5 coating to which organic components have been added to enhance punchability <sup>b</sup>. The ceramic fillers in EC-5 coatings may have been reduced or removed.</p> <p>The applications, uses and properties of this type of coating are similar to those of the EC-5-G and EC-5-N coatings. On grain oriented electrical steels, this coating is generally used for punching quality without an EC-2 coating when it may not have such a high surface insulation resistance as an EC-5-G coating can achieve.</p> <p>The user should take into account any problems due to coating decomposition or off-gassing during welding or exposure of the steel coated with this type of coating to elevated temperature.</p> <p>It may be appropriate to specify the surface insulation resistance <sup>a</sup> of this type of coating.</p>
EC-5-AS	<p>A thinner EC-5-N or EC-5-P coating primarily used for preventing sticking during heat treatment of electrical steel laminations.</p> <p>This type of coating is often referred to as "anti-stick".</p> <p>It is not appropriate to specify the surface insulation resistance <sup>a</sup> or the thickness <sup>b</sup> of this type of coating.</p>
EC-6	<p>An organic-based coating to which inorganic fillers have been added to increase the surface insulation resistance of the coating.</p> <p>This coating is typically used for fully processed non-oriented electrical steels, especially for application in large diameter rotating machines such as power station generators.</p> <p>The coating generally improves the punchability <sup>b</sup> of the steel and, hence, is suitable for the production of stamped laminations.</p> <p>The coating will withstand burn off treatments in the temperature range from 300 °C to 550 °C, used to remove stator winding insulation during rebuilding of stator cores but it is not considered to be a coating that will withstand normal stress relief annealing temperatures.</p> <p>The user should take into account any problems due to coating decomposition or off-gassing during welding or exposure of the steel coated with this type of coating to elevated temperatures.</p> <p>It may be appropriate to specify the surface insulation resistance <sup>a</sup> of this type of coating.</p>
<sup>a</sup>	<p>The surface insulation resistance should be determined according to EN 10282. A requirement for the surface insulation resistance may be agreed between the manufacturer and the purchaser.</p>
<sup>b</sup>	<p>Any requirement for this property and the corresponding method of evaluation should be agreed between the manufacturer and the purchaser.</p>