# IEC TS 63573

Edition 1.0 2026-04

# TECHNICAL SPECIFICATION

**Technical requirements for electrical sheet metal and strip metal used in rotating electrical machines**

ICS 29.160.10

ISBN 978-2-8327-1130-9

IEC TS 63573:2026-04(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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# Technical requirements for electrical sheet metal and strip metal used in rotating electrical machines

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IEC TS 63573 has been prepared by IEC technical committee 2: Rotating machinery. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

| Draft | Report on voting |
|---|---|
| 2/2287/DTS | 2/2302/RVDTS |

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,
– withdrawn, or
– revised.

## 1 Scope

This Technical Specification defines specific requirements for materials to be used for the stator and/or rotor core of rotating electrical machines according to the IEC 60034 series. This document applies in addition to IEC 60404- series and is addressed to the suppliers of the raw material (electrical sheet), to producers of magnetic cores (including a possible annealing treatment), to electric motor manufacturers as well as to users of electrical steel. This document does not apply to motor customers.

The objective of this document is to address the immediate needs of motor manufacturers striving to achieve high IEC efficiency classes.

IEC TS 63573 is an independent product-specific specification focusing on rotating electrical machines in accordance with the IEC 60034 series and can be applied as a supplement to IEC 60404-8-4.

At the time of publication of this document it is anticipated that collaboration with IEC Technical Committee 68 (Magnetic alloys and steels) will lead to the development of Amendment 2 to IEC 60404-8-4:2022. This amendment is expected to clarify the relevant issues and provide a comprehensive solution.

This Technical Specification will be withdrawn once Amendment 2 to IEC 60404-8-4:2022 is published and takes effect, provided it addresses the identified need.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

IEC 60404-1-1:2004, *Magnetic materials - Part 1-1: Classification - Surface insulations of electrical steel sheet, strip and laminations*

IEC 60404-8-4:2022, *Magnetic materials - Part 8-4: Specifications for individual materials - Cold-rolled non-oriented electrical steel strip and sheet delivered in the fully-processed state*

IEC 60404-9:2018, *Magnetic materials - Part 9: Methods of determination of the geometrical characteristics of electrical steel strip and sheet*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60404-8-4:2022 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

– IEC Electropedia: available at https://www.electropedia.org/
– ISO Online browsing platform: available at https://www.iso.org/obp

**3.1**
**stator core**
**magnetic stator core**
static part of an electric machine, which is composed of high-permeability material and intended to conduct magnetic flux

Note 1 to entry: The magnetic core is surrounded by the stator winding.

**3.2**
**rotor core**
**magnetic rotor core**
rotating part of an electric machine, which is composed of high permeability material and intended to conduct magnetic flux

**3.3**
**core stacking method**
method used to join individual electric sheets to form a complete magnetic core, which can be done among other technologies by stacking, welding, riveting, interlocking or glueing

Note 1 to entry: See also Figure B.7.

**3.4**
**punching**
**shear cutting**
cutting process for shaping electrical steel sheets

**3.5**
**lasering**
cutting process for shaping electrical sheets

**3.6**
**specific total losses processing factor $P_{SPF}$ (%)**
factor used to represent the specific total losses deviation determined at the electrical steel (e.g., Epstein test acc. to IEC 60404-2) in relation to the specific total losses at the magnetic core

$$P_{SPF} = \frac{P_{S2}}{P_{S1}} \times 100$$

where

$P_{S2}$ is specific total losses at the magnetic core

$P_{S1}$ is specific total losses at the electric steel (For example as a result from the Epstein test method)

**3.7**
**magnetic field strength processing factor $\hat{H}_{PF}$ (%)**
factor used to represent the magnetic field strength dissipation determined at the electric sheet in relation to the magnetic field strength determined at the magnetic core

$$\hat{H}_{PF} = \frac{\hat{H}_2}{\hat{H}_1} \times 100$$

where

$\hat{H}_2$ is magnetic field strength at the magnetic core

$\hat{H}_1$ is magnetic field strength at the electric steel (e.g.as a result from the Epstein test method)

**3.8**
**specific total losses $P_S$ (W/kg)**
mass-related power loss which occurs in the electric sheet or in the magnetic core due to the re-magnetization process in the electromagnetic alternating field

Note 1 to entry: The mass-related power loss $P_S$ is composed of the mass-related hysteresis losses $P_h$ (W/kg) and the mass-related eddy current losses $P_e$ (W/kg).

Note 2 to entry: See also Figure B.6.

Note 3 to entry: For calculation of $P_S$, see IEC 60404-2, IEC 60404-3, IEC 60404-6.

**3.9**
**specific hysteresis power loss $P_h$ (W/kg)**
power loss resulting from the frequency-dependent re-magnetization of the Weiss domains in the electrical sheet and depends on the structure of the electrical sheet

Note 1 to entry: $P_h = \frac{P_S}{P_e}$; $P_h$ can be calculated or determined indirectly by measurement.

**3.10**
**specific eddy current loss $P_e$ (W/kg)**
losses caused by closed current paths in the laminated core which depend on the thickness of the laminations and the material electrical resistivity

Note 1 to entry: $P_e = \frac{P_S}{P_h}$; $P_e$ can be calculated or determined indirectly by measurement.

**3.11**
**electric sheet**
single, thin (e.g., 0,5 mm) sheet, made from very low carbon alloys, cold rolled, with soft magnetic behavior and reduced magnetic conductivity (compared to pure iron) which is joined together with other electrical sheets by a suitable stacking process to form a magnetic core

**3.12**
**density $\rho$ (kg/dm$^3$)**
at a given point within a three-dimensional domain of quasi-infinitesimal volume d$V$, scalar quantity equal to the mass d$m$ within the domain divided by the volume d$V$, thus $\rho$ = d$m$/d$V$

Note 1 to entry: Mass density is an intensive quantity describing a local property of a substance.

Note 2 to entry: The concept of mass density may also be applied to the mass m in a domain D with volume V, leading to the average density $\rho_{av} = \frac{m}{V} = \frac{1}{V}\int_{\rho} \rho \mathrm{d}V$.

Note 3 to entry: The coherent SI unit of mass density is kilogram per cubic meter, kg/m$^3$. Other units are tons per cubic meter, t/m$^3$ (1 t/m$^3$ = 1 000 kg/m$^3$ = 1 g/cm$^3$), and kilogram per liter, kg/l (1 kg/l = 1 000 kg/m$^3$).

[SOURCE: IEC 60050-113:2011, 113-03-07]

**3.13**
**thermal conductivity $\lambda$ (W/(m*K))**
at a point fixed in a medium with a temperature field, scalar quantity λ characterizing the ability of the medium to transmit heat through a surface element containing that point: φ = −λ grad T, where φ is the density of heat flow rate and T is thermodynamic temperature

Note 1 to entry: In an anisotropic medium, thermal conductivity is a tensor quantity.

Note 2 to entry: The coherent SI unit of thermal conductivity is watt per meter kelvin, W/(m·K).

[SOURCE: IEC 60050-113:2011, 113-04-38]

**3.14**
**fully-finished**
**fully-processed**
<electrical steel> already finally annealed and insulated

**3.15**
**semi-finished**
**semi-processed**
<electrical steel> without being finally annealed and non-insulated

## 4 Guidance on the application of the specification

This specification contains information regarding the requirements for non-grain-oriented electrical sheets for electric machines.

Interesting technical background information related to the electric steels can be found in the informative Annex B.

The specifications concern, among other details, requirements for the electrical sheets regarding the specific total losses as well as the magnetic field strengths at defined magnetic polarisation values.

These defaults are delimited by defined tolerance bands. The practically existing differences in properties are considered by 3 gradations (Range A, Range B, Range C) of the standardised tolerances. In addition, steel names, standardised thicknesses, specific total losses and magnetic field strengths may be agreed individually. These must be defined between the supplier and the customer.