
**Metallic coatings for electromagnetic
interference shielding — Designation
and characterization method**

*Revêtements métalliques pour le blindage contre les interférences
électromagnétiques — Désignation et méthode de caractérisation*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 7582:2023

<https://standards.iteh.ai/catalog/standards/sist/1f963afd-646c-4fb0-9f03-743c87049df6/iso-7582-2023>



iTeh STANDARD PREVIEW (standards.iteh.ai)

ISO 7582:2023

<https://standards.iteh.ai/catalog/standards/sist/1f963afd-646c-4fb0-9f03-743c87049df6/iso-7582-2023>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2023

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

	Page
Foreword.....	iv
Introduction.....	v
1 Scope.....	1
2 Normative references.....	1
3 Terms and definitions.....	1
4 Designation.....	2
4.1 General.....	2
4.2 Shielding effectiveness of electromagnetic waves.....	3
4.2.1 Frequency classification.....	3
4.2.2 Electromagnetic interference shielding effectiveness.....	3
4.3 Adhesion of metallic coatings.....	4
4.3.1 General.....	4
4.3.2 Peel strength.....	4
4.3.3 Thermal cycle.....	4
4.4 Substrate materials.....	4
4.5 Metallic coatings.....	5
4.6 Examples of designation.....	5
5 Characterization methods.....	6
5.1 Electromagnetic interference shielding effectiveness.....	6
5.2 Adhesion of metallic coatings.....	6
5.3 Sampling.....	7
Annex A (informative) Examples of shielding effectiveness measurement of metallic coatings.....	8
Annex B (informative) Examples of adhesion measurement of metallic coatings — Peel strength and substrate surface roughness.....	14
Bibliography.....	19

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document was developed to provide the designation of characteristics and the characterization methods of metallic coatings for electromagnetic interference (EMI) shielding, in response to worldwide demand for the standardization of such products.

ISO 17334 specifies the requirements for autocatalytic copper coatings plus nickel-phosphorous alloy coatings on platable plastics or metallic materials, to provide EMI and electrostatic discharge (ESD) shielding mainly for the housing of computers, telecommunication and other devices. However, varieties of metallic coatings, which are not specified in ISO 17334, are used to provide higher EMI/ESD shielding effectiveness in a wider frequency range. In particular, metallic coatings with a larger thickness or with a higher permeability are used to provide higher EMI/ESD shielding effectiveness in automobile parts and mobile communication devices.

A number of electronic controlling units (ECUs), motors and connectors are used in a car. Their housings and covers are made from engineering plastics for mass reduction and varieties of metallic coatings are applied to these parts to provide a high EMI/ESD shielding effectiveness.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 7582:2023](https://standards.iteh.ai/catalog/standards/sist/1f963afd-646c-4fb0-9f03-743c87049df6/iso-7582-2023)

<https://standards.iteh.ai/catalog/standards/sist/1f963afd-646c-4fb0-9f03-743c87049df6/iso-7582-2023>

Metallic coatings for electromagnetic interference shielding — Designation and characterization method

1 Scope

This document specifies the designation and the characterization methods metallic coatings that provide electromagnetic interference (EMI) shielding for parts fabricated from plastics, ceramics, glasses and other materials.

The designation consists of the EMI shielding effectiveness in a specific frequency range and the adhesion of metallic coatings to the substrate, as well as the substrate material and the principal component, manufacturing process and thickness of the metallic coatings.

The characterization methods consist of the methods to determine the EMI shielding effectiveness of metallic coatings and those to evaluate the adhesion of metallic coatings to the substrate.

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.

ISO 472, *Plastics — Vocabulary*

ISO 2080, *Metallic and other inorganic coatings — Surface treatment, metallic and other inorganic coatings — Vocabulary*

ISO 4525, *Metallic coatings — Electroplated coatings of nickel plus chromium on plastics materials*

ISO 16348, *Metallic and other inorganic coatings — Definitions and conventions concerning appearance*

IEC 60050, *International electrotechnical vocabulary*

ASTM B533, *Standard test method for peel strength of metal electroplated plastics*

JIS H 8630, *Electroplated coatings on plastics materials for decorative purposes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472, ISO 2080, ISO 16348 and IEC 60050 and the following apply.

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

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

3.1

ABS

acrylonitrile-butadiene-styrene

plastic, based on terpolymers and/or blends of polymers and copolymers, made with acrylonitrile, butadiene and styrene

[SOURCE: ISO 472:2013, 2.5]

3.2

EMI shielding effectiveness

electromagnetic interference effectiveness

ratio of voltage signals transmitted by the samples with and without metallic coatings for the same incident power of electromagnetic waves

3.3

LCP

liquid crystal plastic

plastic material with the property of liquid crystal

3.4

PBT

polybutylene terephthalate

polymer made by the polycondensation of butylene glycol and terephthalic acid or dimethyl terephthalate

[SOURCE: ISO 472:2013, 2.729]

3.5

PTFE

polytetrafluoroethylene

polymer of tetrafluoroethylene

[SOURCE: ISO 472:2013, 2.796]

3.6

TRL calibration method

through-reflect-line calibration method

calibration method to fix the systematic errors with the network analyser measurements using a zero-length “through”, a longer “through” (called “line”) and high-reflect standards

3.7

VNA

vector network analyser

instrument to measure the transfer and/or impedance characteristics, that is, both magnitude and phase changes, of a linear network, device, or material through stimulus response testing over a given frequency range

4 Designation

4.1 General

A designation shall consist of the following:

- a) the letters “SdM” as the elementary symbol indicating that the metallic coating has the ability for EMI shielding effectiveness (see 4.2);
- b) a letter designating the frequency band classification (see 4.3.1);
- c) the letter “S” and a number designating the EMI shielding effectiveness (see 4.3.2) followed by a solidus (/);
- d) the letter “A” with lowercase letters designating the adhesion test method and a number designating the adhesion of the metallic coatings (see 4.4) followed by a solidus (/);
- e) letters designating the substrate materials (see 4.5) followed by a solidus (/);
- f) an elemental symbol of the principal component element of the coatings with lowercase letters designating the coating process (see 4.6);

- g) a number indicating the minimum local thickness in micrometres, followed by a space when the subsequent metallic coating is applied.

For multi-layered metallic coatings, designations f) and g) shall be repeated from the bottom to the top.

See 4.6 for examples of designations.

4.2 Shielding effectiveness of electromagnetic waves

4.2.1 Frequency classification

The letters shown in Table 1 shall designate the frequency bands of the electromagnetic waves under consideration.

Table 1 — Designation of frequency bands under consideration

Designation	Frequency band of the electromagnetic waves under consideration ^a Hz	General identification
A	50 to 60	Ultra-low frequency wave ^b
B	$(3,0 \times 10^3)$ to $(3,0 \times 10^4)$	Very low frequency wave
C	$(3,0 \times 10^4)$ to $(3,0 \times 10^5)$	Low frequency wave
D	$(3,0 \times 10^5)$ to $(3,0 \times 10^6)$	Medium wave
E	$(3,0 \times 10^6)$ to $(3,0 \times 10^7)$	Short wave
F	$(3,0 \times 10^7)$ to $(3,0 \times 10^8)$	Very high frequency wave
G	$(3,0 \times 10^8)$ to $(3,0 \times 10^9)$	Ultra-high frequency wave
H	$(3,0 \times 10^9)$ to $(3,0 \times 10^{10})$	Centimetre wave
I	$(3,0 \times 10^{10})$ to $(3,0 \times 10^{11})$	Millimetre wave
J	$(3,0 \times 10^{11})$ to $(3,0 \times 10^{12})$	Sub-millimetre wave
^a Lower limit exclusive, upper limit inclusive.		
^b Frequency of commercial power source.		

4.2.2 Electromagnetic interference shielding effectiveness

The letter “S” and a number shall designate the EMI shielding effectiveness as shown in Table 2.

Table 2 — Designation of EMI shielding effectiveness

Designation	Shielding effectiveness ^a dB
S-	31 or below
S35	31 to 35
S40	36 to 40
S50	41 to 50
S60	51 to 60
S70	61 to 70
S80	71 to 80
S90	above 80
^a Lower limit exclusive, upper limit inclusive.	

4.3 Adhesion of metallic coatings

4.3.1 General

The letters shown in [Table 3](#) and [Table 4](#) shall designate the adhesion of metallic coatings.

Table 3 — Designation of peel strength test

Designation	Peel strength ^a kN/m
A _p 1,0	1,0 or above
A _p 0,9	0,9 to 1,0
A _p 0,8	0,8 to 0,9
A _p 0,7	0,7 to 0,8
A _p 0,6	0,6 to 0,7
A _p 0,5	0,5 to 0,6
A _p 0,4	0,4 to 0,5
A _p 0,3	0,3 to 0,4
A _p -	below 0,3

^a Lower limit inclusive, upper limit exclusive.

4.3.2 Peel strength

The letter “A” with a lowercase letter “P” and a number shall designate the adhesion of metallic coatings evaluated by a peel test (see [5.2](#)). The number designates the peel strength as shown in [Table 3](#).

4.3.3 Thermal cycle

The letter “A” with lowercase letters “TC” and a number shall designate the adhesion of metallic coatings assessed by a thermal cycle test as shown in [Table 4](#). The number shall denote the service condition number determining the condition of thermal cycle test as specified in ISO 4525 and shall show the test condition in which the product does not constitute a failure (see [5.2](#)).

Table 4 — Designation of thermal cycle test

Designation	Service condition number ^a	Temperature limits °C	
		High	Low
A _{TC} 5	5	85	-40
A _{TC} 4	4	80	-40
A _{TC} 3	3	80	-30
A _{TC} 2	2	75	-30
A _{TC} 1	1	60	-30

^a Service condition numbers in a thermal cycle test are defined in ISO 4525.

4.4 Substrate materials

The letters shown with lowercase letters as shown in [Table 5](#) shall designate the substrate materials.

Table 5 — Designation of substrate materials

Designation	Substrate material
PL _{XXX} ^a	Plastics
GL ^b	Glasses
CE ^b	Ceramics
OM ^b	Other materials
^a XXX should be replaced by the relevant abbreviated term for the plastics material (see ISO 472 or Clause 3). For other materials, a conventional abbreviated term should be shown accompanied by a note explaining the abbreviated term in a separate line below the designation.	
^b The note explaining the specific material may be given in a separate line below the designation.	

EXAMPLE 1 Polybutylene terephthalate is designated as PL_{PBT}.

EXAMPLE 2 Polyamide resin is designated as PL_{PA} (where “PA” means polyamide resin).

4.5 Metallic coatings

An elemental symbol shall designate the principal element of the metallic coating, i.e. those of metal or alloy coatings, and the subsequent lowercase letters shall designate the coating processes as shown in [Table 6](#). The following number shall indicate the minimum local thickness of the metallic coating in micrometres. The thickness shall be rounded off to one decimal place.

Table 6 — Processes for metallic coatings

Designation	Process
VE	Vacuum evaporation
SP	Sputtering
EL	Electroless plating ^a
EP	Electroplating
OP	Other process
^a Electroless plating includes autocatalytic plating and immersion coating (see ISO 2080).	

4.6 Examples of designation

An autocatalytic copper coating of 1,0 µm thickness plus autocatalytic nickel-8 % phosphorous alloy coating in thickness of 0,25 µm on an ABS substrate, which shows an electromagnetic shielding effectiveness of 80 dB at frequencies from 30 MHz to 3 GHz and a coating adhesion assessed by the thermal cycle test corresponding to service condition 2, shall have the following designation:

SdM F S80/A_{TC}2/PL_{ABS}/ Cu_{EL}1,0 Ni_{EL}0,3

SdM G S80/A_{TC}2/PL_{ABS}/ Cu_{EL}1,0 Ni_{EL}0,3

NOTE These coatings and their performance correspond to autocatalytic coating type 1 Grade 3 in ISO 17334.

A sputter deposited copper coating of 0,6 micrometre thickness plus electroplated copper coating of 3,0 micrometre thickness plus electroplated nickel coating of 20,0 micrometre thickness on a PBT substrate, which shows an electromagnetic shielding effectiveness of 72,7 dB and 101,4 dB at 1 GHz and 100 GHz, respectively, and a peel strength of 0,89 kN/m, shall have the following designation (see [Annexes A](#) and [B](#)):

SdM G S80/A_P0,8/PL_{PBT}/ Cu_{SP}0,6/ Cu_{EP}3,0 Ni_{EP}20,0