



SLOVENSKI STANDARD
SIST EN 12540:2000

01-december-2000

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Corrosion protection of metals - Electrodeposited coatings of nickel, nickel plus chromium, copper plus nickel and copper plus nickel plus chromium

Korrosionsschutz von Metallen - Galvanische Nickel-Überzüge und Nickel-Chrom-Überzüge, Kupfer-Nickel-Überzüge und Kupfer-Nickel-Chrom-Überzüge

Protection contre la corrosion des métaux - Revêtements électrolytiques de nickel, nickel plus chrome, cuivre plus nickel et cuivre plus nickel plus chrome

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Ta slovenski standard je istoveten z: EN 12540:2000

ICS:

25.220.40 Kovinske prevleke Metallic coatings

SIST EN 12540:2000 en

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 12540

April 2000

ICS 25.220.40

English version

Corrosion protection of metals - Electrodeposited coatings of
nickel, nickel plus chromium, copper plus nickel and copper plus
nickel plus chromium

Protection contre la corrosion des métaux - Revêtements
électrolytiques de nickel, nickel plus chrome, cuivre plus
nickel et cuivre plus nickel plus chrome

Korrosionsschutz von Metallen - Galvanische Nickel-
Überzüge und Nickel-Chrom-Überzüge, Kupfer-Nickel-
Überzüge und Kupfer-Nickel-Chrom-Überzüge

This European Standard was approved by CEN on 1 March 2000.

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, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Contents

	Page
Foreword.....	3
1 Scope.....	4
2 Normative references.....	4
3 Terms and definitions.....	5
4 Information to be supplied by the purchaser.....	5
5 Designation.....	5
5.1 General.....	5
5.2 Coating type.....	5
6 Heat treatment.....	7
7 Inspection.....	7
7.1 Coating requirements.....	7
7.2 Test methods.....	7
Annex A (normative) Correlation between service condition number and individual item block for standardized coating systems.....	9
Annex B (informative) Service condition number.....	17
Annex C (informative) Examples of designations.....	18
Annex D (normative) Double- and triple-layer nickel coatings.....	19
Annex E (normative) Determination of the number of discontinuities in chromium coatings.....	20
Annex F (informative) Thickness test methods for coatings.....	21
Annex G (informative) Corrosion resistance of nickel coatings.....	22
Bibliography.....	23

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 262 "Metallic and other inorganic coatings", the secretariat of which is held by BSI.

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 October 2000, and conflicting national standards shall be withdrawn at the latest by October 2000.

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

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1 Scope

This European Standard specifies requirements for nickel, nickel plus chromium, copper plus nickel and copper plus nickel plus chromium electrodeposited coatings applied to iron and steel, to zinc alloys and to copper and copper alloys to provide an attractive appearance and corrosion resistance.

The nickel and copper plus nickel coatings without chromium topcoats that are specified in this European Standard are suitable for applications in which tarnishing is prevented by rubbing or handling in service, or by the use of topcoats other than chromium. They are also suitable for those applications where tarnishing is of no importance.

NOTE This European Standard is not intended to be used alone, but is the complement of EN 1403. The purchaser has to specify the electrodeposited coating in accordance with the designation as specified in EN 1403.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 1403:1998, *Corrosion protection of metals - Electrodeposited coatings - Method of specifying general requirements.*

EN ISO 1462, *Metallic coatings - Coatings other than those anodic to the basis metal - Accelerated corrosion tests - Method for the evaluation of results (ISO 1462 :1973).*

EN ISO 1463, *Metallic and oxide coatings - Measurement of coating thickness - Microscopical method (ISO 1463 :1982).*

EN ISO 2177, *Metallic coatings - Measurement of coating thickness - Coulometric method by anodic dissolution (ISO 2177 :1985).*

EN ISO 2361, *Electrodeposited nickel coatings on magnetic and non-magnetic substrates - Measurement of coating thickness - Magnetic method (ISO 2361 :1982).*

EN ISO 2819, *Metallic coatings on metallic substrates - Electrodeposited and chemically deposited coatings - Review of methods available for testing adhesion (ISO 2819 :1980).*

prEN ISO 3497:1999, *Metallic coatings - Measurement of coating thickness - X-ray spectrometric methods (ISO/DIS 3497 :1998).*

EN ISO 4541, *Metallic and other non-organic coatings - Corrodkote corrosion test (CORR test) (ISO 4541 :1978).*

EN ISO 8401:1994, *Metallic coatings - Review of methods of measurement of ductility (ISO 8401 :1986).*

ISO 9227, *Corrosion tests in artificial atmospheres - Salt spray tests.*

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in EN 1403 apply.

4 Information to be supplied by the purchaser

Information shall be supplied by the purchaser in accordance with EN 1403.

Additional information shall be supplied by the purchaser to identify special types of nickel and/or chromium coatings in accordance with table 1.

5 Designation

5.1 General

In addition to the requirements specified in EN 1403 the purchaser shall select the appropriate designation according to the severity that the coating has to withstand (see annex A).

NOTE 1 Service condition numbers are associated with typical service conditions in table B.1.

NOTE 2 Examples of designations are given in annex C.

5.2 Coating type

5.2.1 Types of nickel and chromium coating

The type of nickel and chromium coating shall be designated by the appropriate symbol in accordance with table 1.

NOTE 1 Black chromium thicknesses are in the range 0,5 μm to 2 μm .

NOTE 2 Micro-cracked chromium thicknesses may vary over the range 0,3 μm to 0,8 μm depending on the process used to achieve the micro-cracked effect. With some processes approximately 0,8 μm will be required to achieve a satisfactory crack pattern, and sometimes even more. It may be produced either as a single or a double layer coating using special chromium plating solutions or by depositing regular chromium over a 1 μm to 3 μm layer of micro-cracked nickel, this being applied on top of b, s, p or d-nickel.

NOTE 3 Micro-porous chromium is often achieved by depositing chromium over a special thin nickel layer which contains inert, non-conducting particles, the special nickel layer being applied on top of b, s, p or d-nickel.

NOTE 4 There may be some loss of lustre after a period of service in the case of mp or mc chromium deposits which may be unacceptable in some applications. This tendency can be reduced by increasing the minimum chromium coating thickness to 0,5 μm in every case where micro-porous or micro-cracked chromium is specified in tables A.1 to A.3.

Table 1 — Nickel and chromium coating types

Chemical symbol	Symbol	Properties of the coating	Possible alternatives to be decided by the purchaser with the ordering information
Ni	b	A coating in the full-bright condition	-
	p	A dull or semi-bright coating that has been mechanically polished	The type of nickel coating that has to be polished shall be specified
	s	A dull, satin or semi-bright coating that has not been polished mechanically	The type of nickel coating that shall be deposited, i.e. dull, semi-bright or "proprietary satin" ^a
	d	A double or triple layer coating (see table D.1)	It shall be specified whether the coating shall be double or triple layered
Cr	r	A regular chromium coating (0,3 µm minimum local thickness)	-
	b	A black chromium coating (see NOTE 1 to 5.2.1)	-
	mc	A micro-cracked chromium coating that, when tested by the method described in annex E, shall have more than 250 cracks per centimetre in any direction and form a closed network over the whole surface (see NOTE 2 to 5.2.1)	The method used to achieve micro-cracking has to be specified
	mp	A micro-porous chromium coating that, when tested by the method described in annex E, shall contain at least 10 000 pores per square centimetre (see NOTE 3 to 5.2.1)	

^a Some proprietary satin nickel coatings may not meet corrosion test requirements (see table A.1).

5.2.2 Types and thickness of copper coating

All copper coatings directly applied on iron or steel shall be plated from a cyanide solution to a thickness of 3 µm to 8 µm.

All nickel coatings on zinc alloys shall be applied over an undercoat of copper plated from a cyanide solution to a thickness of at least 8 µm.

NOTE Where coatings of copper thicker than 10 µm are specified, the additional thicknesses are normally achieved using high levelling acid copper electroplating solutions.

6 Heat treatment

The heat treatment shall be designated in accordance with EN 1403.

NOTE 1 Heat treatment procedures and classes are specified in ISO 9587 for stress relieving before processing and in ISO 9588 for embrittlement relief after processing, but other conditions may be specified by the purchaser provided that they can be shown to be effective.

NOTE 2 Heat treatment in accordance with the recommended conditions can never guarantee complete freedom from hydrogen embrittlement and tests should be specified whenever possible. Freedom from failure of test samples will enable a degree of confidence in the procedure to be demonstrated depending on the size of the sample tested.

7 Inspection

7.1 Coating requirements

7.1.1 Appearance

Over the significant surface, the electroplated articles shall be free from clearly visible plating defects such as blisters, pits, roughness, cracks, unplated areas, stains or discolorations.

7.1.2 Thickness

See EN 1403.

The coating thickness shall be determined in accordance with 7.2.1.

In the case of double- or triple-layer nickel coatings, the total minimum local thickness of nickel shall be that specified in the designation.

7.1.3 Adhesion

The coating shall continue to adhere to the basis metal, and the coating layers shall continue to adhere to each other when submitted to the test method specified in 7.2.2.

7.1.4 Corrosion resistance

Coated articles shall be sufficiently corrosion-resistant and pore-free to pass the appropriate test specified in 7.2.3 for the particular service condition number. The performance rating shall be determined in accordance with EN ISO 1462. The minimum acceptance rating, after testing in accordance with 7.2.3, shall be a rating of 9.

7.2 Test methods

7.2.1 Measurement of minimum local thickness

The minimum local thickness shall be determined in accordance with one of the following methods: EN ISO 1463, EN ISO 2177, EN ISO 2361 and prEN ISO 3497:1999. (See annex F.)

In case of dispute, EN ISO 2177 (coulometric method) shall be used to determine the thickness of the chromium coating and of nickel coatings less than 10 μm thick. EN ISO 1463 (microscopical method) shall be used to determine the thickness of nickel coatings and undercoats of thickness 10 μm and above.

7.2.2 Burnishing test for adhesion

The requirements specified in EN ISO 2819 shall apply for this test.

7.2.3 Corrosion resistance

Corrosion resistance shall be determined in accordance with table 2.

The requirements specified in table 2 shall not apply to the edges of test specimens, which do not belong to the significant surface of the part (see EN 1403).

NOTE For nickel coating without chromium topcoat, see annex G.

Table 2 — Corrosion testing of nickel plus chromium coatings

Basis metal	Service condition	Duration of corrosion test		
		(h)		
		CASS test (ISO 9227)	Corrodkote test (EN ISO 4541)	Acetic acid salt spray test (ISO 9227)
Steel	4	24	2 x 16	144
	3	16	16	96
	2	8	8	48
	1	-	-	8
Zinc alloy	4	24	2 x 16	144
	3	16	16	96
	2	8	8	48
	1	-	-	8
Copper or copper alloy	4	16	-	96
	3	-	-	24
	2	-	-	8
	1	-	-	-

NOTE Dashes indicate that there is no test requirement.

Annex A (normative)

Correlation between service condition number and individual item block for standardized coating systems

Table A.1 — Coatings on steel or iron

Service condition number	(Partial) designation			
	Nickel coatings	Copper plus nickel coatings	Nickel + chromium coatings	Copper + nickel + chromium coatings
4			Fe//Ni40d/Crr Fe//Ni30d/Crnc Fe//Ni30d/Crmp Fe//Ni30d/Crb Fe//Ni30p/Crnc Fe//Ni30p/Crmp Fe//Ni30p/Crb	Fe//Cu20/Ni30d/Crr Fe//Cu20/Ni25d/Crnc Fe//Cu20/Ni25d/Crmp Fe//Cu20/Ni25d/Crb Fe//Cu20/Ni25p/Crnc Fe//Cu20/Ni25p/Crmp Fe//Cu20/Ni25p/Crb Fe//Cu20/Ni25b/Crnc Fe//Cu20/Ni25b/Crmp Fe//Cu20/Ni25b/Crb

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