TECHNICAL SPECIFICATION

ISO/TS 12928

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Lubricants, industrial oils and related products (class L) — Family R (Products for temporary protection against corrosion) — Guidelines for establishing specifications

Lubrifiants, huiles industrielles et produits connexes (classe L) — Famille R (Produits de protection temporaire contre la corrosion) — Lignes directrices pour l'établissement de spécifications

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

— an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;

— an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

An ISO/PAS or ISO/TS is reviewed every three years with a view to deciding whether it can be transformed into an International Standard.

Attention is drawn to the possibility that some of the elements of this ISO/TS 12928 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TS 12928 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Subcommittee SC 4, *Classifications and specifications*.

Annexes A, B, C, D and E of this Technical Specification are for information only.

Introduction

Considering the difficulties of establishing an international specification for products for temporary corrosion protection, it has been decided to publish guidelines for establishing specifications under the form of an ISO Technical Specification.

This document contains, in annexes A to E, suggested test methods to evaluate some properties.

Lubricants, industrial oils and related products (class L) — Family R (Products for temporary protection against corrosion) — Guidelines for establishing specifications

1 Scope

This Technical Specification has been prepared with the following purposes:

— to facilitate the application of ISO 6743-8 and to specify the characteristics to be taken into account when establishing specifications for a given application;

— to enable these characteristics to serve as a basis for discussion between the end user and the supplier.

This Technical Specification does not cover specific requirements which should be examined separately with a view to a common agreement between the end user and the product supplier.

This Technical Specification does not cover the health, safety, disposal and environment areas which should be delft with separately, according to the regulations or laws in force in each country.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this Technical Specification. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this Technical Specification are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2137:1985, *Petroleum products — Lubricating grease and petrolatum — Determination of cone penetration.*

ISO 3448:1992, *Industrial liquid lubricants — ISO viscosity classification.*

ISO 3696:1987, *Water for analytical laboratory use — Specification and test methods.*

ISO 6743-0:1981, *Lubricants, industrial oils and related products (class L) — Classification — Part 0: General.*

ISO 6743-8:1987, *Lubricants, industrial oils and related products (class L) — Classification — Part 8: Family R (Temporary protection against corrosion).*

EN 10130:1991, *Cold rolled low carbon steel flat products for cold forming — Technical delivery conditions.*

NF T 60-166:1994, *Temporary protection against corrosion — Method of preparing metallic probes for the evaluation of the properties of preservative products.*

NF T 60-170:1994, *Temporary anticorrosion products — Assessment of the covering capacity by dipping.*

NF X 41-002:1975, *Protection against physical, chemical and biological agents — Salt spray test.*

3 Explanations of symbols used

3.1 General

In the column headed "ISO-L" in Tables 1 to 5, the various categories are designated in abbreviated form.

Whereas the complete designation should be ISO-L-RA, ISO-L-RB, etc., it is generally admitted to designate products in the abbreviated form L-RA, L-RB, etc., or even RA, RB, etc.

In the complete designation, the prefix letter "L" designates the class "Lubricants, industrial oils and related products". The letter "R" indicates the family "Products for temporary protection against corrosion" in accordance with ISO 6743-8.

3.2 Plain (neat) products

In the ISO 6743-8 classification, the neat products are designated by the groups of letters RA, RC, RD and RL. For the products RC and RD, the doubling of the second letter indicates that the product exhibits water displacing properties.

The numerical group following the group of letters corresponds to the average kinematic viscosity of the oils, expressed according to ISO 3448.

3.3 Solvent based products

In the ISO 6743-8 classification, the solvent based products are designated by the groups of letters RE, RF, RG, RP, RM. For the products RE and RF, the doubling of the second letter indicates that the product exhibits water displacing properties.

The mention of a numerical group following the group of letters designating the class of viscosity according to ISO 3448 is not mandatory.

3.4 Water miscible products

In the ISO 6743-8 classification, the concentrates intended to be mixed with water by the end user to form aqueous products are designated by RB, RH, RP and RM. For the RB and RH products, the doubling of the second letter indicates that the product exhibits waters displacing properties.

Addition of viscosity class, ISO 3448, is not seen as necessary.

3.5 Plastic compounds and paste products

In the ISO 6743-8 classification, plastic compounds applied as a hot melt are designated by RT, the paste products, which may be applied either hot or cold, are designated by RK.

The mention of a numerical group designating viscosity class ISO 3448 is not necessary. For the grease products it is possible to give the NLGI class, defined by ISO 6743-0, determined by measurement of consistency in accordance with ISO 2137.

4 Specification guide

4.1 General

Generally, specifications are made of sets of characteristics, differing according to the nature of the products.

These characteristics relate to:

— the physico-chemical properties of the product (as delivered);

— the properties after water dilution (for those products used diluted using water);

— the corrosion protection performance;

— the properties of protective film.

For each category of product (neat, solvent based, water miscible, plastic, pasty) Tables 1 to 5 give characteristics which will define the product for the intended application.

The lists of characteristics is not exhaustive.

4.2 Neat products

4.2.1 Physico-chemical characteristics

See Table 1.

These concern the characteristics currently used to characterize the petroleum products by physical characteristics (e.g.: density, flash-point, pour-point) and chemical characteristics (e.g.: ash content, metal content, water content, neutralization/saponification numbers).

4.2.2 Performance characteristics

See Table 1.

These are the characteristics the most difficult to determine, because they shall be representative of the properties required in numerous, various and specific industrial applications.

There are very few standardized methods; some non-standard tests exist but they are very particular or taken from parts of standards relating to products or general documents.

For the products, the performance characteristics have been divided into two sets:

a) protection characteristics, e.g.: protection duration in a humidity cabinet, cyclic humidity cabinet, water displacing properties, fingerprint neutralization;

b) characteristics of the film, e.g.: coverage, removability, compatibility with electrophoretic coatings, compatibility with welding without prior degreasing.

4.3 Solvent based products

4.3.1 Physico-chemical characteristics

See Table 2.

These are divided into two sets: those relating to the product as it is (as delivered) and those relating to the dry extract (residue remaining after solvent evaporation). These characteristics are those currently used to characterize the petroleum products in the physical areas (e.g.: density, kinematic viscosity, flash-point, pour-point, softening point, penetrability, dropping point) and chemical areas (e.g.: ash content, metals content, neutralization/saponification numbers, chlorine and sulphur contents).

4.3.2 Performance characteristics

See Table 2.

Table 1 — Guideline for establishing specifications of neat products for temporary protection against corrosion

No.	Physico-chemical characteristics [a]	Units	ISO-L [b]				ISO Standard	Other standards or methods
			RA (light film)	RC (oily film)	RD [c] (oily film)	RL [d] (oily film)		
1.1	Odour	Rating	X	X	X	X		Olfactory
1.2	Appearance	Rating	X	X	X	X		Visual
1.3	Colour	Rating	X	X	X	X	ISO 2049	
1.4	Viscosity	mm^2/s	X at 20 °C	X at 40 °C	X at 40 °C	X at 40 °C	ISO 3104	
1.5	Density at 15 °C	kg/m^3	X	X	X	X	ISO 3675 or ISO 12185	
1.6	Storage stability	Rating	X	X	X	X		NF T 60-167 [e]
1.7	Flash point	°C	X	X	X	X	ISO 2719/ ISO 2592	
1.8	Fire point	°C	-	X	X	X	ISO 2592	
1.9	Pour point	°C	X	X	X	X	ISO 3015	
1.10	Water content	% (*m/m*)	X	X	X	X	ISO 3733	
1.11	Sulfated ash content	% (*m/m*)	X	X	X	X	ISO 3987	
1.12	Elemental content [f]	% (*m/m*)	X	X	X	X		To be indicated
1.13	Neutralization number	mgKOH/g	X	X	X	X	ISO 6618	
1.14	Saponification number [g]	mgKOH/g	X	X	X	X	ISO 6293	
1.15	Aromatic carbon content [h]	%	X	X	X	X		Brandes
	Protection							
	Protection duration [i]:							
1.16	- humidity cabinet	h	X	X	-	-		j
1.17	- cyclic humidity cabinet	Cycles	X	X	X	-		k
1.18	- salt spray [l]	h	-	-	X	X	ISO 3768	NF X 41-002
	Staining tendency:							
1.19	- long duration	Rating	-	-	X	X		See annex B
1.20	- short duration	Rating	X	X	X	-		NF T 60-176 [e]
1.21	Behaviour to UV/daylight exposure [m]	Rating	-	-	X	X		
1.22	Exposure outer shelter	Rating	-	-	X	X		See annex C
1.23	Fingerprint neutralization	Rating	-	X	-	-		n
1.24	Water displacement	Rating	-	X (to RCC)	X (to RDD)	-		o
1.25	Wet skin pass products compatibility	Rating	-	-	X	-		See annex A

Table 1 — *(continued)*

No.	Physico-chemical characteristics [a]	Units	ISO-L [b] RA (light film)	RC (oily film)	RD [c] (oily film)	RL [d] (oily film)	ISO Standard	Other standards or methods
	Film characteristics							
1.26	Coverage	g/m²	X	X	X	X		NF T 60-170 [e]
1.27	Wetting/film homogeneity	Rating	X	X	X	-		See Annex D
1.28	Removability	Rating	X	X	X	X		NF T 60-159 [e]
1.29	Compatibility with electrophoretic coatings	Rating	-	-	X	-		See annex E
1.30	Compatibility with welding without grease removal [p]	Rating	-	-	X	-		

a In the above list of characteristics, one shall choose those that are useful to define product performance for the foreseen application. This list is not exhaustive.

b In the columns below, "X" means that the characteristic applies to the type of product.

c RD Products: other properties such as ability to facilitate deep drawing, exposure outside shelter in specific environments, could be requested. Methods and limits shall be negociated between the end user and the supplier.

d RL Product: other properties could be requested. Methods and limits shall be negociated between the end user and the supplier. Wettability and film homogeneity; outdoor exposure (ISO 2810 - NF T30-056); compatibility with coating (for example: Tarnish); removability; film resistance to erosion and outdoor exposure; resistance to humid and corrosive atmosphere (e.g. sulfur dioxide ISO 3231, ISO 6988, NF T30-055).

e English translation available from AFNOR or BS 1133 section 6.1, appendix A.

f For special applications, the absence of elements such as, heavy metals, sulfur, chlorine, phosphorus, boron can be requested. The concentration limits of these elements shall be negotiated between the end user and the supplier.

g The presence of some chemicals in the formulation may interfere with the determination of this characteristic. This characteristic may be useful for products requiring deep drawing properties.

h For RA products, if they contain a solvent, nature and type shall be specified. For all product types, the aromatic content may be determined on the base stock by infrared spectrometry (Brandes method). PCA content by IP 346/NF T60-605 on the base stock may be requested.

i The protection performance of the products can be established either on the delivered product, or on the aged product. The ageing conditions shall be negociated between the end user and the supplier. Most generally ageing is performed on the metal panels on which a film of the product has been applied.

j NF T 60-173, ASTM D 1748/IP 366 or BS 1133:1991 section 6.1, appendix K.

k NF T 60-174 or DIN 50017/DIN 51386-1.

l For RD products only if they exhibit a protection duration of more than 24 h.

m Method to be agreed between the end user and the supplier.

n NF T 60-165 or MIL C 15074 D.

o NF T 60-168, IP 178 or BS 1133:1991 section 6.1, appendix B.

p This characteristic can only be evaluated in actual use.

Table 2 — Guideline for establishing specifications of solvent based products for temporary protection against corrosion

No.	Physico-chemical characteristics [a]	Units	ISO-L [b]					ISO Standard	Other standards or methods
			RE (oily film)	RF (waxy to dry film)	RG (bituminous film)	RM [c] (pealable film)	RP (waxy to dry film)		
2.1	Appearance	Rating	X	X	X	X	X		Visual
2.2	Odour	Rating	X	X	X	X	X		Olfactory
2.3	Colour	Rating	X	X	X	X	X	ISO 2049	
2.4	Density at 15 °C	kg/m^3	X	X	X	X	X	[d]	
2.5	Viscosity	-	X	X	X	-	X	[e]	
2.6	Flash point	°C	X	X	X	X	X	ISO 2719	
2.7	Dry extract	% (*m/m*)	X	X	X	X	X	ISO 3251	NF T 30-084
2.8	Storage stability	Rating	X	X	X	X	X		NF T 60-167 [f]
	On the dry extract								
2.9	Dropping point	°C	-	X	-	X	-	ISO 2176	
2.10	Sulphated ash content	% (*m/m*)	X	X	X	X	X	ISO 3987	
2.11	Elements content [g]	% (*m/m*)	X	X	X	X	X		To be indicated
2.12	Softening point	°C	-	X	-	X	-		NF T 60-147
		°C	-	-	X	-	-		EN 1427
2.13	Penetration	10^{-4}m	-	X	-	X	-	ISO 2137	[h]
		10^{-4}m	-	-	X	-	-		EN 1426
	Performance characteristics								
	Protection duration:								
2.14	- humidity cabinet	h	X	X	X	X	-		[i]
2.15	- cyclic humidity cabinet	cycles	X	X	-	X	X		[j]
2.16	-salt spray	h	X	X	X	X	X	ISO 3768	NF X 41-002
2.17	Exposure outer shelter [k]	h	X	X	X	X	-		See annex C
2.18	Outdoor exposure [k]	Rating	-	X	X	X	-		NF T 30-056
2.19	Water displacement	Rating	X (to REE)	X (to RFF)	-	-	-		[l]
2.20	Finger print neutralisation	Rating	X	X	-	-	-		[m]
2.21	Behaviour UV/daylight exposure [k]	Rating	X	X	-	X	X		[n]
	Film characteristics								
2.22	Appearance	Rating	X	X	X	X	X		Visual
2.23	Hardness [o]	Rating	-	X	X	X	X	ISO 1522	NF T 30-016
2.24	Thickness	min	X	X	X	X	-	ISO 2808	[p]
2.25	Film selfhealing properties		X	X	X	X	-		[q]
2.26	Film adhesivity/pealability [r]	Rating	-	-	-	X	X (dry)		

Table 2 — *(continued)*

No.	Physico-chemical characteristics [a]	Units	ISO-L [b] RE (oily film)	RF (waxy to dry film)	RG (bituminous film)	RM [c] (pealable film)	RP (waxy to dry film)	ISO Standard	Other standards or methods
2.27	Drying time [s]	h	-	X	X	X	X	ISO 1517/ ISO 3678	
2.28	Coverage	g/m^2	X	X	X	X	X		NF T 60-170 [f]
2.29	Flexibility	Rating	-	-	X	-	X	ISO 1519/ ISO 6860	BS 1133, section 6, appendix E
2.30	Removability	Rating	X	X	X	-	-		NF T 60-159 [f]
2.31	Film homogeneity/wetting	Rating	X	X	X	X	X		See annex D

a In the above list of characteristics, one shall choose those that are useful to define product performance for the foreseen application. This list is not exhaustive. For all products, the nature and characteristics of the solvents shall be specified. The solvents used shall comply with the local regulations concerning health, safety and environmental protection.

b In the columns, below "X" means that the characteristic applies to the type of product

c RM products: other properties could be requested such as behaviour to outdoor exposure; compatibility with paints, lacquer, coatings; resistance to humid and corrosive atmospheres (e.g. sulfur dioxide: ISO 3231, ISO 6988, NF T 30-055). Methods and limits shall to be negociated between the end user and the supplier.

d The method for evaluation of density must be chosen depending on the nature of the product using: ISO 2811, ISO 3675 or ISO 12185.

e The method for evaluation of viscosity must be chosen depending on the rheological properties of the product. Among possible methods: ISO 9262 (Brookfield method), ISO 2431 (flow cup method).

f English translation available from AFNOR or BS 1133:1991, section 6.1, appendix A.

g For special applications the absence of elements such as heavy metals, sulfur, chlorine, phosphorus, boron can be requested. The concentration limits of these elements shall be negotiated between the end user and the supplier.

h NF T 60-123, DIN 51579 or ASTM D 1321.

i NF T 60-173, ASTM 1748/IP 366 or BS 1133:1991, section 6.1, appendix K.

j NF T 60-174 or DIN 50017/DIN 51386-1.

k Film thickness must be specified.

l NF T 60-168, IP 178 or BS 1133:1991, section 6.1, appendix B.

m NF T 60-165 or MIL C 15074 D.

n Method to be agreed between the end user and the supplier.

o When applicable (sufficient film thickness).

p May be calculated from the coverage of the product, determined by NF T 60-170 or measured by NF T 30-120, according to product nature.

q Method to be agreed between the end user and the supplier. Salt spray testing of the panel covered with a film of the test product, with an indented cross may be used.

r Applicable to RP pealable by of RM waxy dry products.

s Complete apparent time for the waxy dry films - May be also evaluated by BS 1133:1991, section 6.1, appendix E.

These are the most difficult to determine, because they shall be representative of the properties required in numerous, various and specific industrial applications.

There are very few standardized methods and where they do exist, they do not relate to petroleum products but rather to products of enamel and paint types. In other respects, some interesting methods are not standardized or are not parts of standards relating to products.

For the solvent based products, the performance characteristics have been divided into two sets:

a) the protection characteristics, e.g.: protection duration in a humidity cabinet, cyclic humidity cabinet or salt spray, water displacing properties, fingerprint neutralization, ageing and weathering resistance;

b) the characteristics of the film, e.g.: homogeneity, wettability, removability, coverage, mechanical, ageing and weathering resistance.

4.4 Water miscible products

This type of product may be delivered to the end user either:

— as a concentrate to be diluted using water;

— as an aqueous emulsion/solution.

Depending on the state of delivery, the applicable characteristics to check physico-chemical properties are different.

4.4.1 Physico-chemical characteristics of the product delivered as a concentrate

These characteristics are those currently used to characterize petroleum products (e.g. viscosity, density, ash content). In addition the emulsifiability of the product and the stability of the so obtained emulsion are listed.

4.4.2 Physico-chemical characteristics of the product delivered in the diluted condition

Some physico chemical characteristics are determined on the dry extract.

4.4.3 Physico-chemical characteristics of the aqueous product

This can be either the emulsion prepared from the concentrate or the product delivered in the diluted condition; pH value, foaming properties, protection against bacteria are important.

Depending on stability, water miscible products shall be kept agitated during their use or be non agitated.

4.4.4 Performance characteristics

See Table 3.

These are the most difficult to determine, because they shall be representative of the properties required in many industrial applications.

There are very few standardized methods and where they do exist, they do not relate to petroleum products but rather to paint types. In other respects, some interesting methods are not standardized or are not parts of standards relating to products.

For the aqueous products, the performance characteristics have been divided into two sets:

a) the protection characteristics, e.g.: protection duration in a humidity cabinet, cyclic humidity cabinet or salt spray, water displacing properties, fingerprint neutralization, outdoor exposure with and without shelter;

b) the characteristics of the film, e.g.: homogeneity, wettability, removability, coverage, mechanical properties, drying time.

4.5 Plastic products, applied melted

4.5.1 Physico-chemical characteristics

See Table 4.

These are the characteristics currently used to characterize the petroleum products, waxy or bituminous.

4.5.2 Performance characteristics

See Table 4.

They have been divided into two sets, that relating to film properties (mainly the mechanical properties) and that relating to corrosion protection.

4.6 Paste products, applied hot or cold

4.6.1 Physico-chemical characteristics

See Table 5.

These are the characteristics currently used to characterize the petroleum products by means of physical tests (e.g.: density, flash point, softening/melting/dropping points, penetration) and chemical tests (e.g.: ash content, metal content, neutralization and saponification numbers).

4.6.2 Performance characteristics

See Table 5.

They have been divided into two sets, that relating to properties of the film and that relating to corrosion protection.

Table 3 — Guideline for establishing specifications of water miscible products for temporary protection against corrosion

N°	Physico-chemical characteristics [a]	Units	ISO-L [b]				ISO Standards	Other standards or methods
			RB (light oily film)	RH (waxy to fatty film)	RM (waxy to dry film	RP (pealable film)		
	Products delivered as concentrates							
	On the concentrate:							
3.1	Appearance	Rating	X	X	X	X		Visual
3.2	Odour	Rating	X	X	X	X		Olfactory
3.3	Colour	Rating	X	X	X	X	ISO 2049	
3.4	Density at 15 °C	kg/m^3	X	X	X	X	ISO 3675/ ISO 12185	
3.5	Viscosity at 20 °C	mm^2/s	X	X	X	X	ISO 3104	
	Storage stability:							
3.6	- cyclic conditions	Rating	X	X	X	X		NF T 60-167 [c]
3.7	- short/long duration	Rating	X	X	X	X		NF T 60-197 [c]
3.8	Sulphated ash content	% (*m/m*)	X	X	X	X	ISO 3987	
3.9	Water content	% (*m/m*)	X [d]	X [d]	X [d]	X [d]	ISO 3733	
3.10	Elements content	% (*m/m*)	X [e]	X [e]	X [e]	X [e]		
3.11	Emulsifying ability/stability	Rating	X	X	X	X		f
	On the diluted product [g]:							
3.12	pH	pH units	X	X	X	X		NF T 60-193 [h]
3.13	Foaming	Rating	X [i]	X [i]	X [i]	X [i]		
3.14	Protection against bacteria	Rating	X [j]	X [j]	X [j]	X [j]		
	Products delivered as emulsions [g]							
	On the dry extract [g]:							
3.15	Dropping point	°C	-	X	X	-	ISO 2176	
3.16	Penetration	10^{-4}m	-	X	X	-	ISO 2137	k
3.17	Softening point	°C	-	X	X	-		NF T 60-147
3.18	Viscosity	mm^2/s	X	-	-	-	ISO 3104	
	Performance characteristics [g]							
	Protection duration:							
3.19	- humidity cabinet	h	X	-	X	-		l
3.20	- cyclic humidity cabinet	h	-	X	X	X		m
3.21	- salt spray	h	-	X	X	X		NF X 41-002
3.22	Outer shelter exposure	Rating	-	X	X	-		See annex C
3.23	Outdoor exposure	Rating	-	X	X	-	ISO 2810	NF T 30-056
3.24	Finger print neutralisation	Rating	X	X	-	-		n
3.25	Behaviour UV/daylight exposure	Rating	-	X	X	X		o

Table 3 — *(continued)*

N°	Physico-chemical characteristics [a]	Units	ISO-L [b] RB (light oily film)	RH (waxy to fatty film)	RM (waxy to dry film	RP (pealable film)	ISO Standards	Other standards or methods
	Film characteristics [g]							
3.26	Appearance	Rating	X	X	X	X		Visual
3.27	Hardness		-	-	X	X	ISO 1522	NF T 30-016
3.28	Thickness	mm	X [p]	X [p]	X [p]	X [p]	ISO 2808	
3.29	Self healing properties	Rating	-	X	X	-		q
3.30	Flexibility	Rating	-	-	-	X		r
3.31	Film adhesivity/pealability	Rating	-	-	X	X		AIR 80624-4
3.32	Drying time [s]	h	-	X	X	X	ISO 1517/ ISO 3678	
3.33	Coverage	g/m^2	X	X	X	X		NF T 60-170 [c]
3.34	Removability	Rating	X	X	-	-		NF T 60-159 [c]
3.35	Film homogeneity/wetting	Rating	X	X	X	X		See annex D

a In the above list of characteristics, one shall choose those that are useful to define product performance for the foreseen application. This list is not exhaustive.

b In the columns below "X" means that the characteristic applies to the type of product.

c English translation available from AFNOR or BS 1133:1991, section 6.1, appendix A.

d The water content can be specified by the supplier, if necessary.

e For special applications, the absence of elements such as for example: heavy metals, sulfur, chlorine, phosphorus, boron can be requested. The concentration limits of these elements shall be negociated between the end user and the supplier.

f The method NF T 60-187 calls for a synthetic water defined in NF T 60-188 (40 French degrees of hardness). Any other water agreed between the end user and the supplier may be used. Other methods are possible: DIN 51367, IP 263, BS 1133:1991, section 6.1, appendix C. English translation of NF T 60-187 is available from AFNOR.

g Characteristic 3.12 to 3.14 and 3.19 to 3.35 can be determined either on the product as delivered (ready to use) or on the product (concentrate) at the recommended dilution rate in water.

h NF T 60-193 or DIN 51369.

i This property can only be evaluated in actual use.

j The supplier shall indicate if the concentrate contains or not a biocidal and/or fungicidal system. The protection level shall be negotiated between the end user and the supplier.

k Other methods may be used : NF T 60-123, DIN 51579 or ASTM D 1321.

l NF T 60-173, ASTM D 1748/IP 366 or BS 1133:1991, section 6.1, appendix K.

m NF T 60-174 or DIN 50017/DIN 51386-1.

n NF T 60-165 or MIL C 1507 4 D.

o Method to be agreed between the end user and the supplier.

p May be calculated from the coverage of the product, determined by NF T 60-170 or measured by NF T 30-120, according to the nature of the product.

q Method to be agreed between the end user and the supplier. Salt spray testing of a panel covered with a film of the test product, with an idented cross, may be used.

r Method to be agreed between the end user and the supplier.

s Complete apparent time for the waxy to dry films.

Table 4 — Guideline for establishing specifications of plastic products (applied melted) for temporary protection against corrosion

No.	Characteristics [a]	Units	ISO-L-RT [b]	ISO Standards	Other standards or methods
	Physico-chemical characteristics				
4.1	Appearance	Rating	X		Visual
4.2	Odour [c]	Rating	X		Olfactory
4.3	Colour	Rating	X		Visual
4.4	Penetration	10^{-4}m	X		ASTM D 1321 [d]
4.5	Melting point	°C	X	ISO 6244	e
4.6	Softening point	°C	X		NF T 66-008
4.7	Density	kg/m^3	X		NF T 66-014
4.8	Flash point	°C	X	ISO 2592	
	Film characteristics				
4.9	Thickness [f]	mm	X	ISO 2808	
	Mechanical resistance:				NF T 46-002
4.10	- tensile strength		X		
4.11	- % elongation at breaking		X		
4.12	Hardness		X	ISO 1522	NF T 30-016
4.13	Adhesivity	Rating	X		g
4.14	Shock resistance	Rating	X		g
4.15	Transparency	Rating	X		g
4.16	Exudation	% (*m*/*m*)	X		h
4.17	Fragility	Rating	X		i
	Protection performance [j]				
4.18	Humidity cabinet	h	X		NF T 60-173
4.19	Salt spray	h	X		NF X 41-002

a In the above list of characteristics, one shall choose those that are useful to define product performance for the foreseen application. This list is not exhaustive.

b In this column "X" means that the characteristic applies to the type of product.

c At the recommended application temperature.

d Or any other method agreed between the end user and the supplier.

e NF T 60-123, DIN 51579. The knowledge of this characteristic is important for the determination of the application temperature.

f To be determined at the recommended application temperature.

g Method to be agreed between the end user and the supplier. MIL P 149 B could serve as a reference.

h See g). For example, loss of volatile or liquid components at 71 °C over 24 h.

i See g). For example, occurrence of cracks and spalls after 24 h at 71 °C and 24 h at 40 °C.

j Generally, the protection properties of this type of products are good, provided the film is sufficiently adhesive and continuous.

NOTE This type of product is very similar to type TP7 described in BS 1133:1991, section 6.1, paragraph 51.

Table 5 — Guideline for establishing specifications of paste products (applied hot or cold) for temporary protection against corrosion

No.	Characteristics [a]	Units	ISO-L-RT [b]	ISO Standards	Other standards or methods
	Physico-chemical characteristics				
5.1	Appearance	Rating	X		Visual
5.2	Odour [c]	Rating	X		Olfactory
5.3	Colour	Rating	X		Visual
5.5	Penetration	10^{-4}m	X	ISO 2137	d
5.5	Melting point	°C	X	ISO 6244	
5.6	Density	kg/m^3	X		NF T 66-014
5.7	Flash point	°C	X	ISO 2592	
	Thermal stability:				
5.8	- oxidation stability	Rating	X		e
5.9	- evaporation losses	% (m/m)	X		e
5.10	Oil content	% (m/m)	X	ISO 2908	
5.11	Elements content [f]	% (m/m)	X		
	Film characteristics				
5.12	Coverage	g/m^2	X		g
5.13	Thickness	mm	X		
5.14	Self heating properties	Rating	X		h
	Protection performance [i]				
5.15	Salt spray	h	X		NF X 41-002
5.16	Humidity cabinet	h	X		NF T 60-174
5.17	Finger print neutralization	Rating	X		NF T 60-165

a In the above list of characteristics, one shall choose those that are useful to define product performance for the foreseen application. This list is not exhaustive.

b The characteristic applies to the type of product.

c At the recommended application temperature.

d NF T 60-123 ; DIN 51579 or ASTM D 1321.

e Method to be agreed between the end user and the supplier.

f For special applications the absence of elements such as for example: heavy metals, sulfur, chlorine, phosphorus, can be requested. The concentration limits shall be negotiated between the end user and the supplier.

g Method to be agreed between the end user and the supplier. Characteristic to be determined at the recommended application temperature.

h Method to be agreed between the end user and the supplier. Salt spray testing of a panel covered with a layer of the product, with an indented cross, may be used.

i These characteristics can be determined on the product as delivered or on the product thermally aged. The ageing conditions shall be negotiated between the end user and the supplier.

Annex A
(informative)

Compatibility with wet skin pass products

WARNING — The use of this method may involve hazardous materials, operations and equipment. This method does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this method to establish appropriate safety and health practice and determine the applicability of regulatory limitations prior to use.

A.1 Scope

This method is intended for the evaluation of the compatibility between the products used during wet skin pass operations and the temporary protection products applied to the metal plates after skin pass.

It applies to the categories RB and RC of temporary protection products defined in ISO 6743-8.

A.2 Principle

This method contains two procedures.

A.2.1 Method A

A drop of an emulsion composed of the skin pass solution and the protection product to be studied is placed on a panel positioned horizontally. This panel is then covered with another panel. The assembly is then placed in an oven for a specified time. The aspect of the panels is then examined.

A.2.2 Method B

Two strips of the skin pass solution are deposited on a panel. This is covered with another panel coated by immersion in the test product. The assembly is maintained at room temperature for six days. The aspect of the test panels is examined.

A.3 Apparatus

A.3.1 Test panel, made of cold rolled low carbon steel in accordance with EN 10130 with dimensions of 150 mm × 100 mm × (0,7 to 1,1) mm.

NOTE Any other substrate may be used in accordance with the users' specifications.

A.3.2 Dipping tank

A.3.3 Balance, accurate to the nearest 1 g.

A.3.4 Lint-free paper

A.3.5 Syringe

A.3.6 Oven

A.3.7 Mass, of 2 kg, with a surface area identical to that of the test panels.

A.4 Reagents and materials

A.4.1 Petroleum ether, technical grade

A.4.2 Aqueous solution, of skin pass product

A.5 Procedure

A.5.1 General

Clean the test panel (A.3.1) according to NF T 60-166.

NOTE Specific conditions may be negotiated between the supplier and the user.

A.5.2 Method A

A.5.2.1 Prepare a mixture of 19 g of the protection product to be tested and 1 g of the aqueous solution of the skin pass product (A.4.2). Shake vigorously to ensure homogeneous dispersion.

A.5.2.2 Deposit a 1 ml drop of the mixture in the middle of one of the test panels (A.3.1) positioned horizontally. Cover this with another test panel (A.3.1) and place the mass (A.3.7) on it.

A.5.2.3 Place the assembly thus formed in the oven (A.3.6) at 60 °C ± 1 °C for six days.

A.5.2.4 At the end of six days, rinse the test panels with petroleum ether (A.4.1). Then examine the aspect of the surfaces in contact.

A.5.3 Method B

A.5.3.1 Coat a test panel (A.3.1) by immersion in the protection product to be tested and leave to drain for 72 h at room temperature.

A.5.3.2 Use the syringe (A.3.5) to deposit two small parallel strips of the aqueous solution of the skin pass product (A.4.2) on another uncoated test panel (A.3.1).

A.5.3.3 Stack these two test panels in such a way that the skin pass product does not come into contact with the coated test panel.

A.5.3.4 Place the mass (A.3.7) upon it.

A.5.3.5 Maintain this stacked assembly at room temperature for six days.

A.5.3.6 At the end of six days, rinse the test panels with petroleum ether (A.4.1). Then examine the aspect of the surfaces in contact.

A.6 Expression of results

The results shall be expressed in terms of

— corrosion,

— pitting,

— staining,

— discoloration/coloration and

— odour

of the surfaces of the test panels at the end of the testing.

A.7 Test report

The test report shall contain at least the following information:

a) the type and complete identification of the product under test;

b) reference to this method, i.e. annex A of ISO/TS 12928:1999;

c) the name of the manufacturer;

d) the nature of the test panel;

e) the results of the test according to A.6;

f) any observation concerning the wettability of the test panel;

g) any deviation, by agreement or otherwise, from the specified procedure.

Annex B
(informative)

Long duration cyclic staining test on stacked plates

WARNING — The use of this method may involve hazardous materials, operations and equipment. This method does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this method to establish appropriate safety and health practice and determine the applicability of regulatory limitations prior to use.

B.1 Scope

The purpose of this method is to evaluate the ability of temporary protection products to avoid the staining and corrosion of test panels made of cold-rolled soft steel or any other substrate desired by the user, stored in packs of plates and in coils.

B.2 Principle

Steel test panels of known roughness, coated with the temporary protection product, are stacked and pressed between two "covering" plates. The whole pack then undergoes temperature and humidity cycles.

B.3 Apparatus

B.3.1 **Test panel**, made of ZES type cold low carbon soft steel whose roughness is in accordance with EN 10130 and whose dimensions are 150 mm × 100 mm × (0,7 to 1,1) mm.

NOTE Any other type of steel according to the users' specifications may be used.

B.3.2 **Immersion tank**

B.3.3 **Stainless steel hook,** for suspension

B.3.4 **Stainless steel "covering" plate**

B.3.5 **Lint-free absorbent paper**

B.3.6 **Climatic cabinet**

B.3.7 **Mass**, of 2 kg to ensure uniform pressure on the test panel

B.4 Reagents and materials

B.4.1 **Petroleum ether**, technical grade

B.5 Procedure

B.5.1 Prepare the test panels (B.3.1) as described in NF T 60-166.

NOTE Specific conditions may be negotiated between the supplier and the user.

B.5.2 Coat by immersion in the tank (3.2) and drain for 72 h at room temperature in dust-free conditions.

B.5.3 Stack the plates and clamp between two "covering" plates, with positioning of the mass (B.3.7).

B.5.4 Place the pack in the climatic cabinet (B.3.6) in which it undergoes a series of cycles. Each 7-day cycle consists of:

— five days of alternation involving 8 h at 99 % RH/40 °C, and 16 h at 75 % RH/20 °C;

— two days at 65 % RH/20 °C.

B.5.5 At the end of each cycle, open the pack to check the aspect of the surfaces in contact.

The rating given shall reflect the observations made on each of the four interfaces:

a) no visible deterioration;

b) appearance of some marks or stains which are easily removable;

c) appearance of marks or stains, some of which are not removable;

d) appearance of very intense marking and staining which is not removable.

B.6 Expression of results

The results shall be expressed as the number of weeks (or cycles) without any visible degradation.

The evolution of eventual visible degradation shall be noted and the test stopped when rating is greater than 2.

Odour of the product shall be noted.

B.7 Test report

The test report shall contain at least the following information:

a) the type and complete identification of the product under test;

b) reference to this method, i.e. annex B of ISO/TS 12928:1999;

c) the name of the manufacturer;

d) the nature of the test panel;

e) the results of the test according to B.6;

f) any observation concerning the wetting of the test panel;

g) any deviation, by agreement or otherwise, from the specified procedure.

Annex C
(informative)

Test of exposure under outside shelter

WARNING — The use of this method may involve hazardous materials, operations and equipment. This method does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this method to establish appropriate safety and health practice and determine the applicability of regulatory limitations prior to use.

C.1 Scope

The purpose of this method is to define an outside shelter and the parameters to be taken into account for the evaluation of the protection properties of products for temporary protection against corrosion.

C.2 Principle

Steel plates coated with the product to be tested are placed vertically in movable racks which are then put in the shelter. The plates are inspected daily and the time elapsed before the appearance of corrosion in the significant zone is noted.

The shelter is equipped with apparatus enabling continuous recording of the temperature and humidity.

C.3 Apparatus

C.3.1 Outside shelter, see figure C.1

C.3.2 Panel holder, see figure C.2

C.3.3 Test panel, made of cold rolled ZES type low carbon steel with known roughness in accordance with EN 10130 with the following dimensions: 150 mm × 100 mm × (0,7 to 1,1) mm (see figure C.3)

NOTE Any other type may be used, depending on the user's specifications,

C.3.4 Temperature recorder

C.3.5 Humidity recorder

C.3.6 Balance, accurate to within 1 mg

C.3.7 Tank, for soaking the plates

C.3.8 Hook, stainless steel

C.4 Procedure

C.4.1 Preparation of the test panels

Prepare three test panels (C.3.3) in accordance with NF T 60-166.

NOTE Specific conditions may be defined by negotiation between the suppliers and users.

Weigh test panels using the balance (C.3.6) ; record the mass as m_1.

C.4.2 Coating of the test panels

Introduce the test panels (C.3.3) into the tank (C.3.7) containing the product to be tested using the hook (C.3.8). Leave to drain for 72 h at room temperature in dust-free conditions. After 72 h, weigh the test piece with the balance (C.4.6) to give mass m_2.

The mass of oil remaining on the plate is therefore $m_2 - m_1$. Note this mass.

C.4.3 Execution of the test

Place the test panels prepared as described in C.4.1 and coated as described in C.4.2, in the test panel holder (C.3.2). Place the test panel holder thus loaded in the shelter (C.3.1). Inspect the plates daily. When the inspection is carried out, note also the temperature and humidity using the temperature and humidity recorders, respectively (C.3.4) and (C.3.5).

Care shall be taken to ensure that the test panel holders are constantly filled (using stainless steel plates for example), in order to maintain a constant air circulation speed.

C.5 Expression of results

Express the result as the number of hours until the appearance of corrosion on the test panels, in the significant zone (see Figure C.3). If the difference between the corrosion protection durations is not too great the result is the mean for the three plates. If there is considerable deviation, the minimum and maximum durations shall be indicated.

C.6 Test report

The test report shall contain at least the following information:

a) the type and complete identification of the product under test;

b) reference to this method, i.e. annex C of ISO/TS 12928:1999;

c) the nature and roughness of the test panels;

d) the coverage (calculated in accordance with NF T 60-170);

e) the date of the beginning of the test;

f) the date of the end of the test (appearance of corrosion in the significant zone);

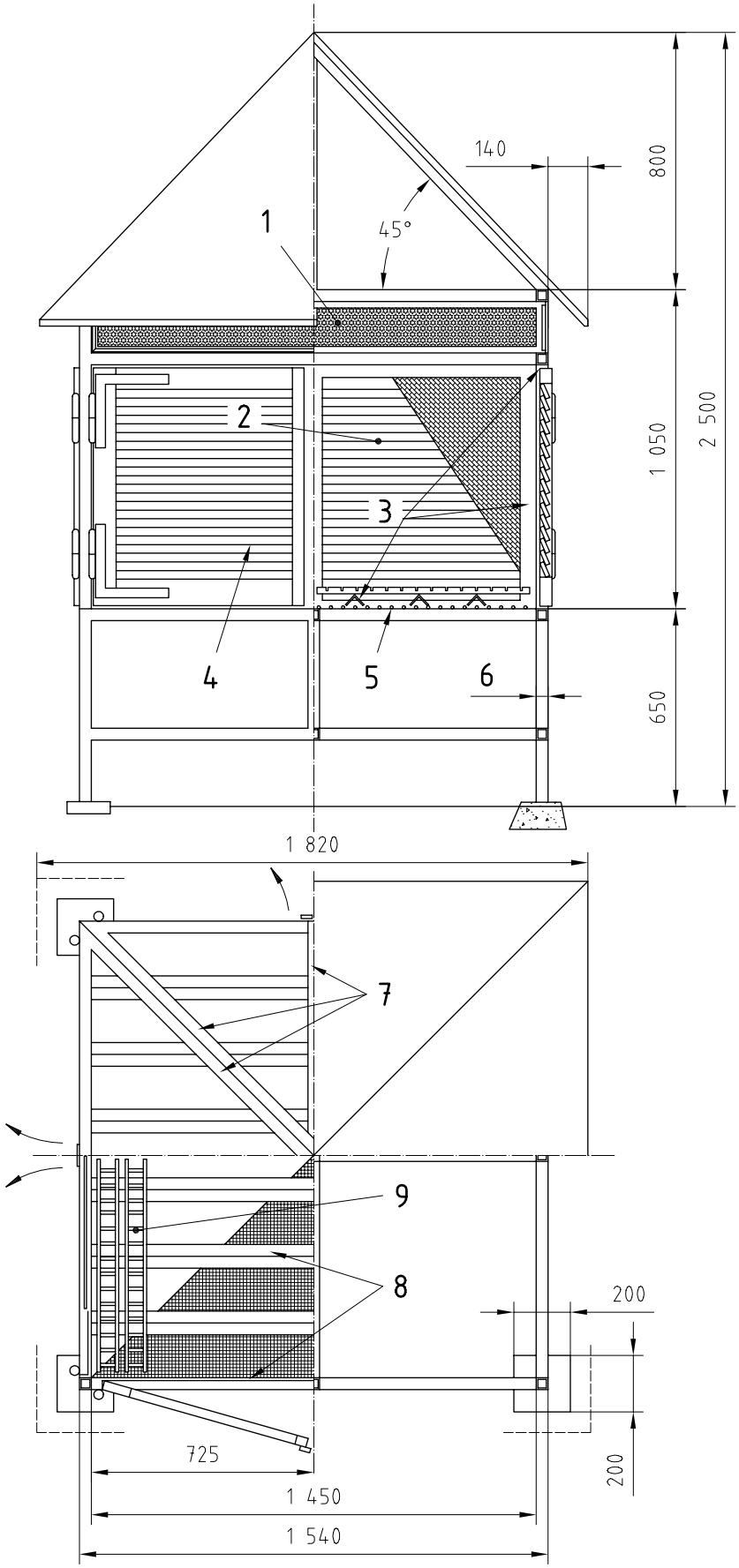
g) the temperature and humidity data recorded;

h) an overall assessment through the variability of the atmospheric conditions between the start and the end of the test;

i) the results of the test according to C.5;

j) any deviation, by agreement or otherwise, from the procedure specified

Dimensions in millimetres



Key

1 Ground glass
2 Filter cloth
3 Angle iron 40 × 40
4 Dutch wood shutter
L = 1450 × 780 × *h*
5 Grating filter cloth
6 Squared iron 40 × 40
7 Flat iron width 40
8 Angle iron 40 × 40
9 Panel holder = 370 × 770 × 20

Figure C.1 — Outside shelter

Dimensions in millimetres

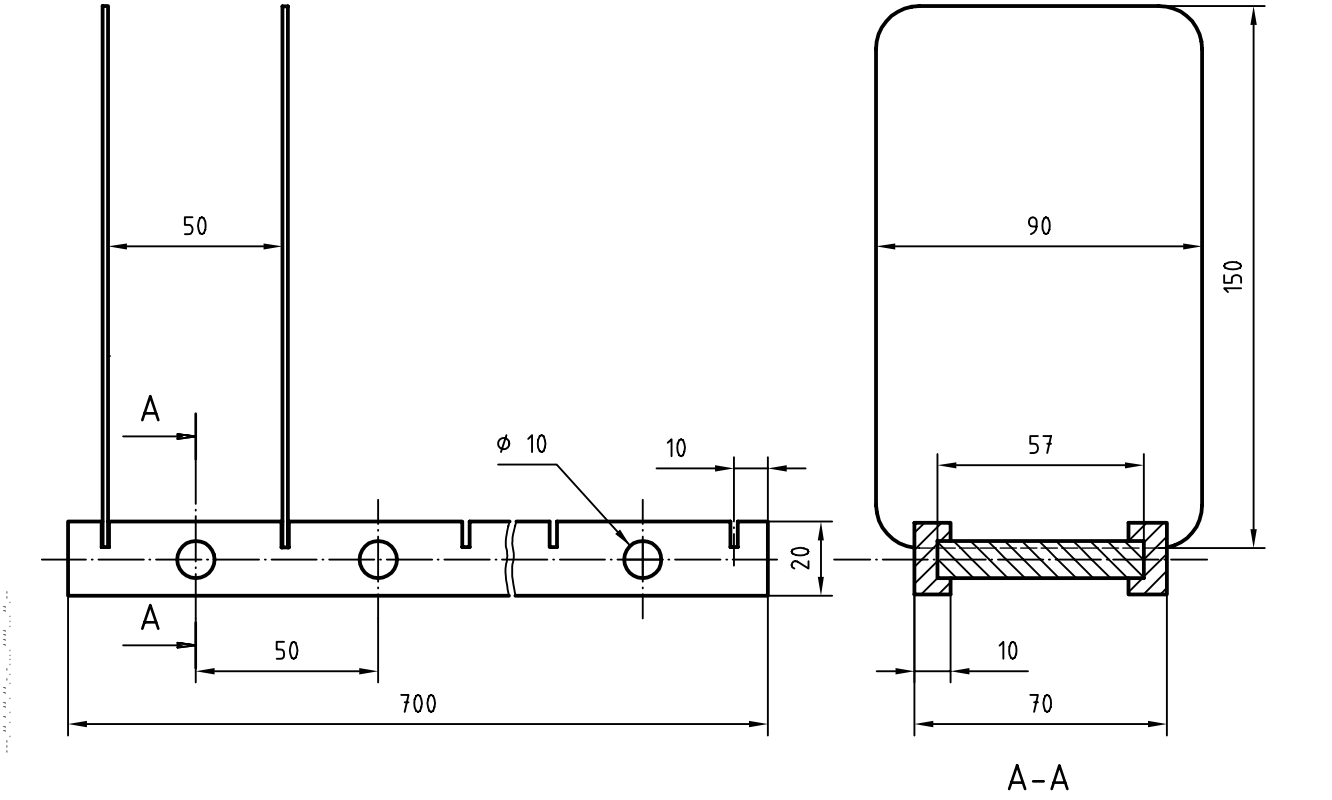
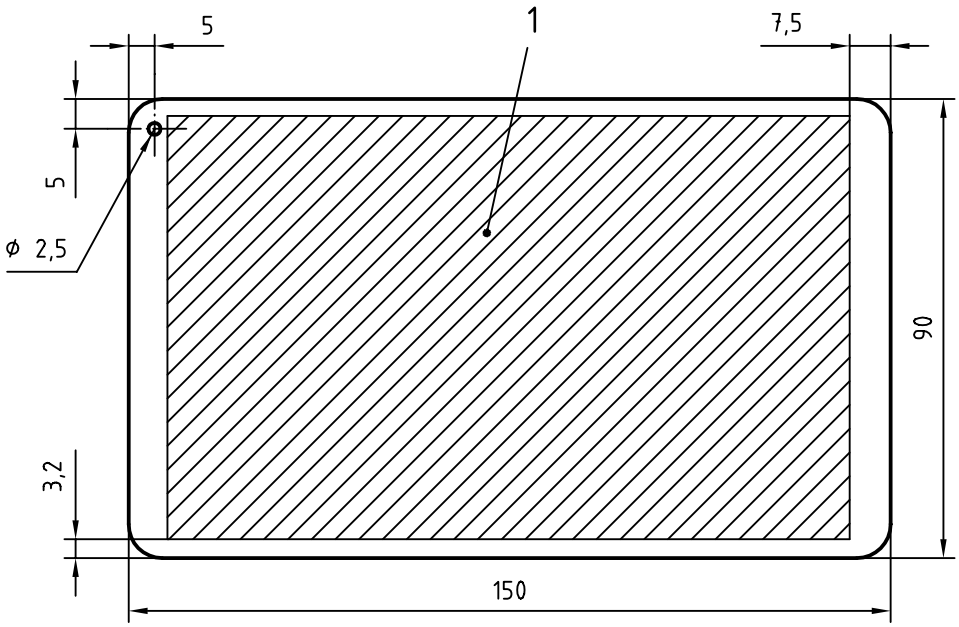


Figure C.2 — Panel holder



Key

1 Significant zone

Figure C.3 — Panel and significant zone

Annex D
(informative)

Evaluation of film homogeneity/wetting

WARNING — The use of this method may involve hazardous materials, operations and equipment. This method does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this method to establish appropriate safety and health practice and determine the applicability of regulatory limitations prior to use.

D.1 Scope

The purpose of this method is the evaluation of the wetting tendency, or ability to spread over a given surface, of products for temporary protection against corrosion.

D.2 Definitions

For the purposes of this method, the following definitions apply:

D.2.1
wetting tendency
tendency of a liquid to spread over a surface

NOTE Reduction in the angle between the liquid and the surface leads to an increase in the wetting. A zero angle between them corresponds to full spreading.

D.2.2
wettability
wetting ability

D.2.3
wetting power
degree of wettability

D.2.4
moistening
in the specific case of a surface agent in solution, action corresponding to the implementation of the wetting tendency and wettability properties

D.3 Principle

A calibrated volume of the product to be tested, in the form of a drop, is deposited at the centre of a carefully degreased glass plate.

The evaluation of the spreading diameter of the drop over the first two hours and at then end of 24 h is recorded. After 24 h, the distribution of the film of product on the glass plate and the film's homogeneity are examined.

NOTE Instead of a glass plate, it is possible to use metallic plates, either as-rolled or skin-passed, or prepared according to NF T 60-166, or totally degreased, in accordance with the user's specifications.

D.4 Apparatus

D.4.1 Glass plate, flat and homogeneous, with dimensions of 200 mm × 200 mm and a thickness of 2 mm to 4 mm

D.4.2 Adjustable supports, to keep the plate horizontal

D.4.3 Spirit level, for checking that the plate is horizontal

D.4.4 Syringe, capable of measuring 0,1 ml and 0,5 ml with an accuracy of ± 0,01 ml

D.4.5 Drying oven, capable of heating to 110 °C

D.4.6 Desiccator, with a drying agent

D.4.7 Ruler, calibrated in millimeters

D.5 Reagents and materials

D.5.1 Sulfo-chromic mixture, obtained by dissolving 50 g of technical grade potassium dichromate with 1 l of concentrated sulphuric acid 96 % mass, density 1,84 g/ml

D.5.2 Ethyl alcohol, technical grade

D.5.3 Water, conforming to grade 2 of ISO 3696

D.6 Procedure

D.6.1 Cleaning of the glass plate

Clean three glass plates (D.4.1) by immersion for six hours in the sulfo-chromic mixture (D.5.1). Remove and rinse the plates in tap water until the rinse water is neutral. Then rinse the plates in water (D.5.3) followed by rinsing in ethyl alcohol (D.5.2). Place the rinsed plate in the drying oven (D.4.5) at 110 °C for 3 h. At the end of this time, remove the plate place from the oven and place it in the desiccator (D.4.6).

D.6.2 Execution of the test

Place the three glass plates (D.4.1), prepared according to D.6.1, on three supports (D.4.2). Adjust the supports so that the glass plate is rigorously horizontal (check with the spirit level) (D.4.3).

Use the syringe (D.4.4) to place a 0,5 ml ± 0,1 ml drop of the product to be tested at the centre of the plate.

If the product is too viscous or consistent, a 0,1 ml ± 0,02 ml drop shall be used.

Using the calibrated ruler (D.4.7), monitor the evolution of the drop's diameter and note its diameter after 30 min, 1 h, 2 h and 24 h.

D.7 Expression of results

The results are:

a) the arithmetical mean of the drops' diameters from three tests after 24 h, in millimeters rounded to the nearest 0,1 ml;

b) the film's appearance (homogeneity, presence of bubbles, etc.).

D.8 Test report

The test report shall contain at least the following information:

a) the type and complete identification of the product under test;

b) reference to this method, i.e.; annex D of ISO/TS 12928:1999;

c) the room temperature at the moment of the test;

d) the temperature of the fluid at the moment of application;

e) the quantity of fluid placed on the plate;

f) the results of the test according to D.7;

g) any deviation, by agreement or otherwise, from the specified procedure.

Annex E
(informative)

Compatibility of the products with the primary crosslinkable paints applied by electro-deposition

WARNING — The use of this method may involve hazardous materials, operations and equipment. This method does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this method to establish appropriate safety and health practice and determine the applicability of regulatory limitations prior to use.

E.1 Scope

The purpose of this method is to verify the compatibility of the products for temporary protection against corrosion which are likely to accidentally remain on the cold rolled sheets with the primary crosslinkable coatings applied by dipping.

E.2 Principle

The test consists of the deposition of a primary crosslinkable coating on a metallic specimen covered

— either by products applied in the steel strip-rolling factories and present on the strips when delivered or

— by products applied in the car body factories during the manufacturing operations.

Before the deposition of the primary coating, the metallic specimen may be submitted to a heat treatment. After deposition, a visual rating of the primary coating is performed, as well as after 250 h exposure to a salt spray.

Two electro-deposition systems may be used :

a) anodic: i.e. the coatings depose on the metal connected to the anode;

b) cathodic: i.e. the coatings depose on the metal connected to the cathode.

Cathodic electro-deposition (cataphoresis) is the most currently used in the automotive industry and is taken as a reference for the following operating procedure.

E.3 Apparatus

E.3.1 Laboratory cathodic electrode position assembly, (see figure E.1) consisting of:

E.3.1.1 Continuous current generator, fitted with a voltmeter, capable of delivering a maximum intensity of 15 A and a voltage variable in the range 50 V to 500 V

E.3.1.2 Electrolysis cell, insulated, solvent resistant

E.3.1.3 Stirring device, (e.g.: a spiral) electrically insulated

E.3.1.4 Coulometer, to obtain deposits of constant thickness only taking into account the quantity of current, without control of the factors influencing the deposit

E.3.1.5 **Anode of stainless steel**, (ratio of the electrodes areas anode:cathode 1:4)

E.3.1.6 **Water bath**, with temperature regulation system

NOTE It is recommended to follow the security rules for the protection of the operators against the electrical hazards.

E.3.2 **Ventilated oven,** with a maximum working temperature of 200 °C, temperature regulated at ± 5 °C

E.3.3 **Absorbent paper**, (or non fluffy rag)

E.3.4 **Balance**, accurate to 0,001 g.

E.3.5 **Stopwatch**

E.3.6 **Metallic specimen**, dimensions 100 mm × 150 mm with a thickness of 0,7 mm to 1,0 mm, made of cold rolled low carbon steel, degreased in accordance with NF T 60-166 (see figure E.2)

NOTE It is possible to use specimens of other sizes and metallurgical composition.

E.3.7 **Adhesive tape**, transparent or opaque, adhesivity in the range 600 g/cm to 750 g/cm.

E.3.8 **Temperature probe**, to determine the surface temperature of the metallic specimen (E.3.6).

E.3.9 **Device**, to measure the thickness of the deposited film, after crosslinking.

E.4 Reagents

E.4.1 **Bath** of primary crosslinkable paint, either supplied by the paint manufacturers or taken out from an industrial installation.

NOTE 1 For the preparation of the bath it is advisable to follow the recommendations of the manufacturer.

Table E.1 — Typical characteristics of primary crosslinkable product baths

Characteristics	Unit	Anodic	Cathodic
dry extract	% *(m/m)*	10 – 20	15 – 20
pH value	pH unit	7 – 8,5	5 – 6,5
conductivity	µS/cm	1 000 – 3 000	1 000 – 2 500

NOTE 2 The bath of primary crosslinkable paint should be permanently maintained under agitation, even when testing is not being performed.

E.4.2 **Water**, complying with grade 2 of ISO 3696.

E.5 Procedure

E.5.1 Determination of the ideal conditions for deposit

The deposit to be obtained shall have a thickness of 15 µm to 17 µm, i.e. a mass deposited of 20 g/m^2 to 25 g/m^2.

E.5.1.1 Prepare the specimen (E.3.6) in accordance with the clause on degreasing in NF T 60-166.

E.5.1.2 Draw a line parallel to the shortest edge corresponding to a surface of 120 cm² on the lower part of the specimen.

E.5.1.3 Weigh the specimen to the nearest milligramme.

E.5.1.4 Bring the bath to the desired temperature (the optimum temperature for deposition depends on the age of the bath and is given by the supplier).

E.5.1.5 Put in place the specimen (cathode) and connect it to the plug of the generator (E.3.1.1).

E.5.1.6 Connect the anode (E.3.1.5) to the exit plug of the coulometer (E.3.1.4).

E.5.1.7 Progressively apply the working voltage, over a period of 30 s, until it reaches its optimum value (180 V for a fresh bath, 250 V to 320 V for an aged bath).

E.5.1.8 Increase the voltage over a predetermined period lying between 120 s and 180 s so as to obtain a dry film with a thickness in the range 15 µm to 17 µm.

E.5.1.9 At the end of this period, record on the coulometer (E.3.1.4) the quantity of current C, the voltage and the time.

E.5.1.10 Remove the specimen from the bath and rinse under a flow of tap water, then with water (E.4.2).

E.5.1.11 Crosslink the deposited film by cooking in the oven (E.3.2) set at 180 °C for 20 min, determined from the moment at which a specimen (E.3.6) placed in the oven has reached the temperature of 180 °C measured by means of the temperature probe (E.3.8).

E.5.1.12 After cooling at room temperature, weigh the specimen to the nearest milligramme and determine the weight of the deposited film. By means of the device (E.3.9), determine the thickness of the dry film.

E.5.2 Compatibility with fresh product for temporary protection against corrosion

E.5.2.1 Operate as from E.5.1.1 to E.5.1.3.

E.5.2.2 Deposit the temporary protection product to be tested on one side of the specimen (E.3.6) prepared as in E.5.2.1 and spread it all over the surface as regularly as possible, by means of the absorbent paper E.(3.3), so as to obtain a mass deposited of 60 mg ± 2 mg on the 120 cm² (i.e. 5 g/m²).

E.5.2.3 Operate as in E.5.1.4 to E.5.1.12 under the conditions of deposition determined in E.5.1 so as to obtain the deposition of a film of the desired thickness (after cooking).

E.5.2.4 Observe the dry film.

E.5.3 Compatibility with a thermally aged product for temporary protection against corrosion

Thermal ageing is intended to simulate stoving after surface treatment and before electro-deposition.

E.5.3.1 Operate as from E.5.1.1 to E.5.1.3.

E.5.3.2 Operate as in E.5.2.2

E.5.3.3 Place the metallic specimen, prepared as in E.5.2.2, horizontally in the oven (E.3.2) adjusted at 135 °C and leave it for 5 min, this period being recorded from the moment at which a bare specimen has reached the temperature of 135 °C measured by means of the temperature probe (E.3.8).

E.5.3.4 Operate as in E.5.1.4 to E.5.1.12 under the conditions determined as in E.5.1 to obtain a dry film of the desired thickness.

E.5.3.5 Observe the dry film.

E.5.4 Corrosion behaviour of the deposited film (salt spray test)

E.5.4.1 Expose the specimen prepared in accordance with E.5.2 and/or E.5.3 under the conditions defined in NF X 41-002 for a period of 250 h, and note the percentage of corrosion.

E.5.4.2 Evaluate the adherence of the paint as follows:

— progressively apply, over the complete length of the specimen, a piece of the adhesive tape, rubbing it gently with a finger so that there is no air entrapped between the tape and the paint;

— rub the tape more strongly exerting uniform pressure over its entire surface;

— tear off the tape using a rapid and continuous motion;

— evaluate the percentage of paint torn off;

E.6 Expression of results

E.6.1 Visual observation after crosslinking

The rating shall be given according to Table E.2.

Table E.2 — Rating of visual observation

Rating	Effect
0	no anomaly
1	stains/diffuse zone
2	orange peel appearance
3	some points of adhesion refusal
4	important adhesion refusal
5	complete adhesion refusal

E.6.2 After salt spray exposure

Give:

— the percentage of corrosion as noted in E.5.4.1;.

— the percentage of torn off paint as evaluated in E.5.4.2.

E.7 Precision

The precision of this method cannot be established.

E.8 Test report

The test report shall contain at least the following information:

a) the type and complete identification of the test product under test;

b) reference to this method, i.e. annex E of ISO/TS 12928:1999;

c) the date of testing ;

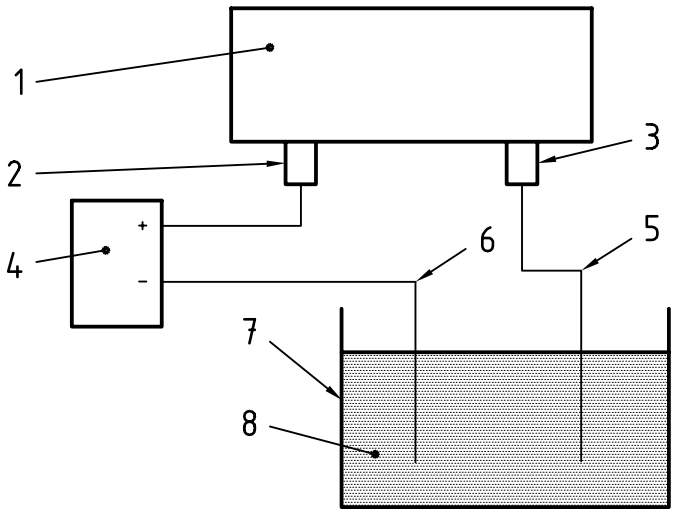
d) the nature of the test specimen ;

e) the application mode ;

f) the results according to E.6;

g) any observation or remark concerning the corrosion ;

h) any deviation, by agreement or otherwise, from the procedure specified.



Key

1 Coulometer (E.3.1.4)
2 In
3 Out
4 Continuous current generator (E.3.1.1)
5 Anode of stainless steel (E.3.1.5)
6 Metallic specimen (E.3.6)
7 Electrolysis cell (E.3.1.2)
8 Bath of crosslinkable paint (E.4.1)

Figure E.1 — Schematic representation of the electro-deposition rig

Dimensions in millimetres

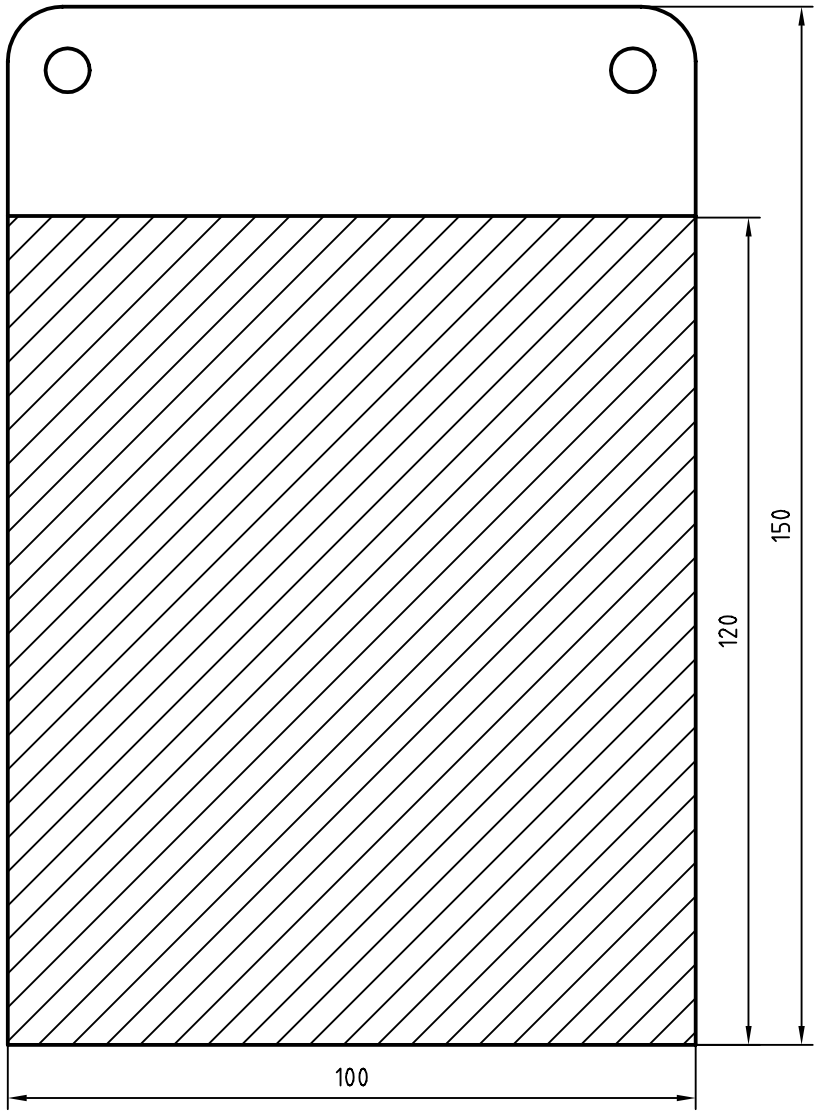


Figure E.2 — Zone of deposit of the primary coating

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[4] ISO 2049:1996, *Petroleum products — Determination of colour (ASTM scale).*

[5] ISO 2176:1995, *Petroleum products — Lubricating grease — Determination of dropping point.*

[6] ISO 2431:1993, *Paints and varnishes — Determination of flow time by use of flow cups.*

[7] ISO 2592:—[1)], *Petroleum products — Determination of flash and fire points — Cleveland open cup method.*

[8] ISO 2719:1988, *Petroleum products and lubricants — Determination of flash point — Pensky-Martens closed cup method.*

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[11] ISO 2811:1974[3)], *Paints and varnishes — Determination of density.*

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[17] ISO 3675:1998, *Crude petroleum and liquid petroleum products — Laboratory determination of density — Hydrometer method.*

[18] ISO 3678:1976, *Paints and varnishes — Print-free test.*

[19] ISO 3733:1999, *Petroleum products and bituminous materials — Determination of water — Distillation method.*

[20] ISO 3768:1976, *Neutral salt spray test (NSS test).*

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1) To be published. (Revision of ISO 2592:1973)

2) To be published. (Revision of ISO 2810:1974)

3) This International Standard has been revised and its subject is now covered by ISO 2811-1:1997, ISO 2811-2:1997, ISO 2811-3:1997 and ISO 2811-4:1997.

[21] ISO 3987:1994, *Petroleum products — Lubricating oils and additives — Determination of sulfated ash.*

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5) See also ISO 3231:1993.

6) See also ISO 3251:1993.

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[67] AIR 80624-4

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