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**Metallic and other inorganic coatings —
Evaluation of properties of dark-stain
phenomenon of chromated coiled or
sheet products**

*Revêtements métalliques et autres revêtements inorganiques —
Évaluation des propriétés du phénomène de tache foncée des produits
chromés enroulés ou en tôle d'acier*

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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 2.

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 exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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

ISO/TR 15922 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, Subcommittee SC 8, *Chemical conversion coatings*.

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Introduction

The existence of the dark- or black- stain phenomenon related to chromated hot-dip metallic zinc and electroplated-zinc steel products has been known, but the cause for the occurrence of this phenomenon so far does not appear to have been rationalized. One possible reason for this incidence is due to the packed or stacked storage conditions of coils and sheets in high temperature, pressure and high relative humidity (RH) conditions.

The test method specified in this Technical Report employs exposure of unstacked specimens to accelerated environmental storage conditions. Specimens made from unstacked product representing the unstressed condition typify the outer surface of the coil-packed product whilst similar specimens, when subjected to applied stress, temperature and humidity, represent the inner-surface layers of the packed coil and stacked sheet products and signify the stressed condition of those layers.

The properties are determined qualitatively by test methods to confirm the presence of chromated layers and quantitatively by a colorimetric method. The colorimetric method measures the radiance of the surface and analyses the difference in luminosity or intensity before and after the tests are performed.

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Metallic and other inorganic coatings — Evaluation of properties of dark-stain phenomenon of chromated coiled or sheet products

WARNING — This Technical Report may not be compliant with some countries' health, safety and environmental legislations and calls for the use of substances and/or procedures that may be injurious to health if adequate safety measures are not taken. This Technical Report does not address any health hazards, safety or environmental matters and legislations associated with its use. It is the responsibility of the producers, purchasers and/or user of this Technical Report to establish appropriate health, safety and environmentally acceptable practices and take appropriate actions to comply with any national, regional and/or International rules and regulations. Compliance with this Technical Report does not, in itself, confer immunity from legal obligations.

1 Scope

This Technical Report describes the methods to evaluate the properties of dark-stain phenomenon observed in chromate conversion-coated coiled and sheet products.

Chromate conversion coatings, with trivalent or hexavalent chromium ions, are applied to hot-dip metallic zinc and electroplated-zinc steel products to enhance corrosion resistance of the components.

When zinc-coated packed coiled and sheet products with conversion coatings are unpacked after long-term storage at elevated temperature and high relative humidity (RH), the surface of the sheet products appears tarnished. This discolouration appears as dark or black stain and influences the appearance and corrosion resistance, when parts are produced using these affected sheets.

2 Normative references

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

ISO 3613, *Metallic and other inorganic coatings — Chromate conversion coatings on zinc, cadmium, aluminium-zinc alloys and zinc-aluminium alloys — Test methods*

ISO 3892, *Conversion coatings on metallic materials — Determination of coating mass per unit area — Gravimetric methods*

ISO 4520, *Chromate conversion coatings on electroplated zinc and cadmium coatings*

ISO 6789, *Assembly tools for screws and nuts — Hand torque tools — Requirements and test methods for design conformance testing, quality conformance testing and recalibration procedure*

IEC 60068-2-30, *Environmental testing — Part 2-30: Tests — Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-3-5, *Environmental testing — Part 3-5: Supporting documentation and guidance — Confirmation of the performance of temperature chambers*

IEC 60068-3-6, *Environmental testing — Part 3-6: Supporting documentation and guidance — Confirmation of the performance of temperature/humidity chambers*

ASTM E1347, *Standard Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry*

ASTM D2244, *Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3613, ISO 3892, ISO 4520, ISO 6789, appropriate parts of ISO 60068 and the following apply.

3.1 dark stain

phenomenon of discolouration of the surfaces of steel packed coil or stacked sheet products during storage at elevated temperature and high relative humidity

3.2 unstacked plate specimen

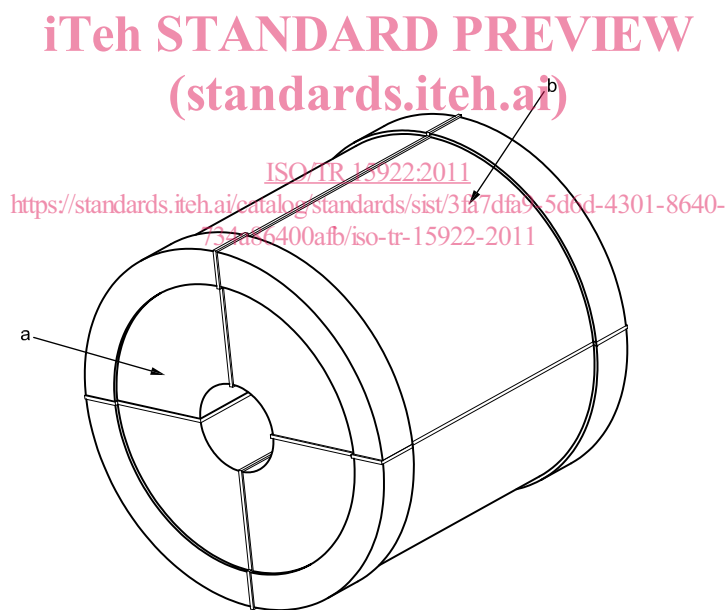
specimen to represent the outer-surface layer of coiled or sheet product that is not stacked

3.3 stacked plate specimen

specimen to represent the inner-surface layer of coiled or packed sheet product that is stacked

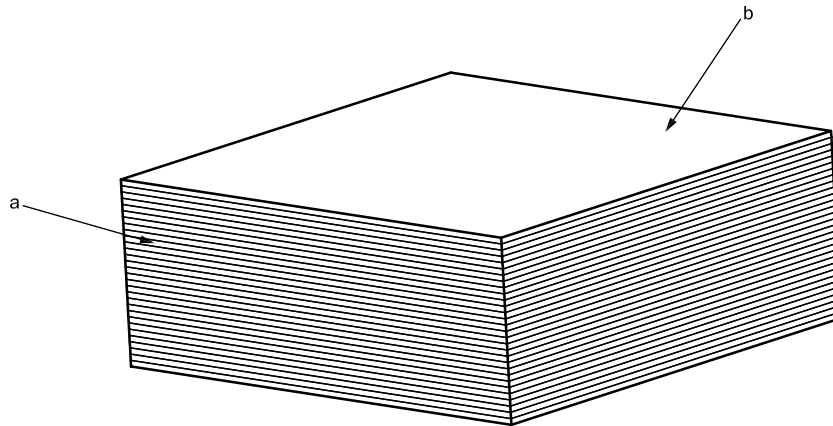
NOTE The inner surface is under stress due to stacking.

Figures 1 and 2 exhibit inner and outer layers of packed coil and sheet products in stacked and unstacked conditions.



- a Represents inner-surface layer of stacked coil.
- b Represents outer-surface layer of stacked coil.

Figure 1 — Illustration of packed coil product



- a Represents inner-surface layer of packed sheet product.
- b Represents outer-surface layer of packed sheet product.

Figure 2 — Illustration of packed sheet product

4 Information to be supplied by the producer to the user or purchaser

4.1 Essential information

When ordering the product in accordance with this Technical Report, the purchaser or user should be provided by the producer with the following information in writing, in, for example, the contract or purchase order, or on engineering drawings:

- a) number and distribution of defects, and time elapsing before the appearance of the first sign of defect;
- b) temperature, relative humidity, applied pressure in N/m^2 and test duration;
- c) the AQL level and sampling plan used;

NOTE Widely used sampling plans are provided in Technical Reports (see Bibliography).

4.2 Additional information

The following additional information should also be provided by the purchaser, when appropriate:

- a) any deviation from the agreed test procedures;
- b) whether test samples are packed with vinyl before placing them to apparatus used for stacking pressures.

5 Apparatus

Normal laboratory apparatus and the following:

5.1 Environmental test cabinet, capable of environmental testing in accordance with IEC 60068-2-30, Test Db: Damp heat, cyclic (12 h + 12 h cycles).

Ensure that the conditions inside the working area of the test chamber are identical at all points, within the specified tolerances, including the immediate vicinity of measurement sensing devices. The chamber should conform to the requirements of IEC 60068-3-6.

Ensure that no condensed water is allowed to drop on the specimens.