NEW DEVELOPMENT IN TECHNICAL STANDARDS FOR CORROSION AND CORROSION PROTECTION

Katerina KREISLOVA, Pavel DUSEK

SVUOM Ltd., Prague, Czech Republic, EU, kreislova@svuom.cz, dusek@svuom.cz

Abstract

Technical standards are developed by a panel of experts, within a technical committee in frame of various standardisation organisations. The most important are ISO and ESS - the European standardization system (ESS) comprises the three recognised European Standards Organisations (ESOs) - CEN, CENELEC and ETSI. There are many technical committees or subcommittees for evaluation and testing of corrosion and corrosion protection, for each type of corrosion protection (paint systems, metallic coatings, cathodic protection, vitreous coatings, conversion coatings, …), e.g. ISO/TC 156, ISO/TC 107, ISO/TC 35, CEN/TC 139, CEN/TC 219, CEN/TC 240 and CEN/TC 262. In Czech Republic the activity of all these TC are covered by TNK 32.

The paper presents the most important news in this technical standards´ development during last 2 years. From their large number the most important standards (newly developed or significantly changed) are mentioned in details.

Keywords: Technical standards, protection systems, coatings, evaluation, testing

1. INTRODUCTION

Technical standards are developed by a panel of experts, within a technical committee in frame of various standardisation organisations - the most important are ISO and ESS - the European standardization system (ESS) comprises the three recognised European Standards Organisations (ESOs) - CEN, CENELEC and ETSI.. ISO's aim is to develop standards that are relevant globally which means that they need to be consistent with (or at least not contradictory to) national and regional legislation around the world. Both standardization organisations works together to promote the international harmonisation of standards in the framework of technical cooperation agreements. The 'Vienna Agreement' is the Agreement on technical cooperation between ISO and CEN and the results is that the standards elaborated in each organisation should be accepted by the second ones.

Once the need for a standard has been established, these experts meet to discuss and negotiate a draft standard [1]. As soon as a draft has been developed it is shared with TC's members who are asked to comment and vote on it. If a consensus is reached the draft becomes a standard, if not it goes back to the technical committee for further edits.

The most of technical standards for evaluation and testing of corrosion and corrosion protection by each type of corrosion protection (paint systems, metallic coatings, cathodic protection, vitreous coatings, conversion coatings, ….) are elaborated in many various technical committees or subcommittees, e.g. ISO/TC 156, ISO/TC 107, ISO/TC 35, CEN/TC 139, CEN/TC 219, CEN/TC 240 and CEN/TC 262. The survey of technical standards published in 2012 and 2013 are given in **Table 1** together with standards in various stage of actual development in frame of these committees. In Czech Republic the activity of all these TC are covered by TNK 32 which published 35 standards in 2012 (all CEN standards including EN ISO standards and 3 CEN Technical Specifications) and 34 standards in 2013 (all CEN standards and 3 "pure" ISO standards).

In other chapters the selected standards are mentioned in details.

Table 1 Survey of technical standards

Technical committee	ISO/TC			CEN/TC			
	156	107	35	139	219	240	262
in 2012 and 2013 published standards	18	3	33	39	6	0	8
standards under preparation	25	23	56	65	3	12	17

2. STANDARDS IN SCOPE OF ISO/TC 156

The most of technical standards for evaluation and testing of corrosion and corrosion protection including standard for terminology are elaborated in ISO/TC 156.

2.1 Atmospheric corrosivity classification

Metals, alloys and metallic coatings may suffer atmospheric corrosion when their surfaces are wetted. There are some technical standards define the type of environment in respect to corrosion stress [2].

One of the widely spread and used technical standards elaborated in this TC is ISO 9223 *Corrosion of metals and alloys - Corrosivity of atmospheres - Classification, determination and estimation* and following standards 9224 - 9226. All these standards had been revised in 2012 and approved by CEN as EN ISO standards. The most significant changes had been done for ISO 9223 and ISO 9224. The main accepted changes of the corrosivity classification system are summarized below:

ISO 9223

- corrosivity category CX for corrosion effects higher than those within C5 but still within the scope of the standard,
- derivation of corrosivity categories based on one year exposure of standard specimens defined as ‘determination’ while derivation based on environmental data defined as ‘estimation’,
- dose-response functions for the normative estimation of the corrosivity category based on calculated one year corrosion loss of standard specimens,
- verbal description of environmental conditions for informative estimation of the corrosivity category.

ISO 9224

- calculation model for derivation of long term corrosion rates,
- values of calculated maximum corrosion attack after extended exposure for six standardized corrosivity categories,
- values of presumed average initial and steady state corrosion rates of standard metals for six standardized corrosivity categories,
- calculation procedure for calculation of corrosion attack of steels based on their composition.

ISO 9225

- general methodological information for measurement of temperature and humidity,
- updated methods for measurement of pollution (SO_2 and salinity),
- conversion factors between selected pollution measurement methods.

ISO 9226

- more precise specification of methods for evaluation of one year corrosion losses of standard specimens,
- exclusion of wire helix specimens as standard specimens.

Technical standard which is also connected with exposure of samples in various conditions is revised ISO 8407 *Corrosion of metals and alloys - Removal of corrosion products from corrosion test specimens*. The revision

consists in changes in recommended pickling solutions. This standard was in 2013 approved by CEN as EN ISO standards.

Because of revision of ISO 9223 to ISO 9226, all parts of ISO 11844 *Corrosion of metals and alloys - Classification of low corrosivity of indoor atmospheres* should be revised. The aim of this standard is to characterise indoor atmospheric environments from metal corrosion attack point of view. The proposed changes are:

- better characteristics for temperature-humidity complex,
- including lead as metal specifically sensitive to volatile organic pollution (formic acid, acetic acid, etc.),
- possibility to use a month period of measurement or exposure coupons for indoor environments with stable conditions,
- addition of quartz crystal microbalance (QCM) as monitoring method of indoor corrosivity - in some environments, the quartz crystal resonance technique allows measurement of the gain of the mass of copper and silver specimens directly, and could facilitate the task of classifying these environments in accordance with their corrosivity.

2.2 Accelerated corrosion tests

ISO 9227 *Corrosion tests in artificial atmospheres - Salt spray tests* is an old method of accelerated corrosion test used by both in industries and by test institutes. One of results of revision in 2007 was that this standard was also accepted as European standard EN ISO 9227 and all European national standards had to be cancelled, e.g. well known DIN 50021. During the minor revision of ISO 9227 in 2012 many technical comments were given so the other revision of this standard had been proposed. The revision of ISO 9227 should include the knowledge of DIN 50021 because there is a strong pressure from Germany member to do it. Also the device capability should change and the field of interest shifted from quality control outside the cabinet to inside the cabinet. In the ISO 9227:2007 the empty cabinet is validated and the results in loaded cabinet will be different. After minor revision from 2012 the validation of the corrosivity is of interest for a loaded cabinet with dummy samples.

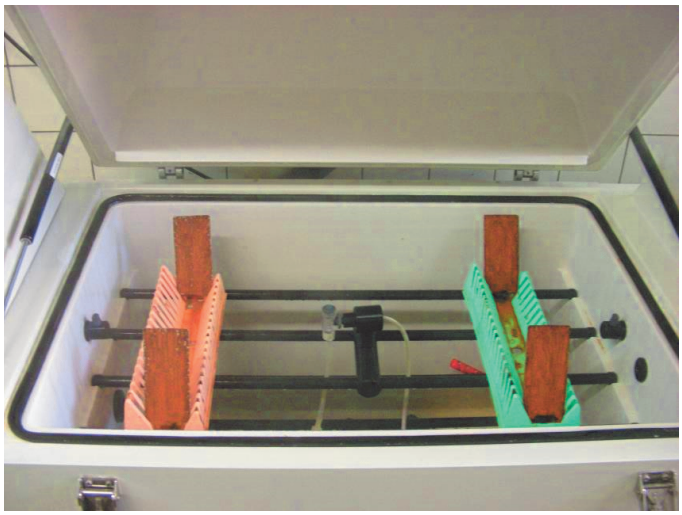

Fig. 1 Samples for control of corrosivity - empty cabinet

Table 2 Categories of accelerated atmospheric corrosion tests

A	Continuous salt spray tests
B	Tests with alternating immersion of test objects in a salt solution followed by drying or intermittent salt spraying and drying
C	Tests with cyclic variation of humidity (dry/wet) and including also steps of salt spraying
D	Tests with continuous exposure to atmospheres with low concentrations of corrosion promoting gases and at moderately high humidity
E	Tests with continuous exposure to atmospheres with higher concentrations of corrosion promoting gases and at higher humidity including also steps of drying and short period of salt spraying
F	High humidity tests

The technical report ISO/TR 16335 Corrosion of metals and alloys - Corrosion tests in artificial atmospheres - Guidelines for selection of accelerated corrosion test for product qualification is applicable for the selection of suitable accelerated atmospheric corrosion tests for qualification of products with metallic materials without or with permanent corrosion protection or temporary corrosion protection. The characteristics of a number of standardised accelerated corrosion tests are also given to serve as guide in preparation of test specifications - **Table 2**. The main purpose of this technical report is to present a framework for comparing the different accelerated corrosion test methods, which presently are available as international standards. The suitability of a test method varies with the requirements set by the intended application of the product.

There is increasing trend to develop new cyclic tests which results - mainly the type and character of degradation is similar as in various natural conditions only the laboratory test would be accelerated. So these testing methods should be standardised. The various cyclic tests had been standardised in ISO 16701, ISO 10062, ISO 21207, ISO 16151, etc.

3. STANDARDS IN SCOPE OF ISO/TC 107

Two standards prepared in ISO/TC 107 in previous years have been taken over by CEN as EN ISO standards and supersede previous EN standards:

- ISO 9717 *Metallic and other inorganic coatings - Phosphate conversion coating of metals*
- ISO 27830 *Metallic and other inorganic coatings - Guidelines for specifying metallic and inorganic coatings*

Standard EN ISO 9717 supersedes EN 12476. Standard specifies requirements for the processing of ferrous metals, aluminium, zinc, cadmium and their alloys to produce coatings consisting essentially of inorganic phosphates, which are intended to be used in conjunction with supplementary treatments for the protection of the basis metal against corrosion and to provide anti-wear properties to sliding surfaces, adhesion to organic finishes and ease of cold-forming operations. The classification of phosphate coatings for steel parts is based on the coating mass per unit area. Newly the guidance for phosphate conversion coatings to ensure good adhesion of organic coatings, varnishes and related finishes, and to improve corrosion resistance of the basis metal, is given in Annex A. The Annex C describes methods for identifying the type of phosphate conversion coating. The corrosion resistance may be tested by salt spray test according to ISO 9227 and on contrary to EN 12476 the phosphate coating may be also tested without supplementary treatments or organic coatings.

Standard EN ISO 27830 was prepared by ISO/TC 107 and approved by CEN/TC 262 (supersedes EN 1403) - finally was unified the description module for these types of coating in both standardisation systems and this module shall be followed by the number of other standard of the particular coating that is being designated; for example, ISO 1456, ISO 2081, ISO 4527, etc.. In Annex A of this standard the tables with symbols for basic materials, undercoats, top coatings and supplementary treatments are given. In Annex B the examples of new descriptions are given:

- Electrodeposited coating ISO 1456 - **Fe/Cu20a/Ni30b/Cr mc,** i.e. a coating on steel comprising 20 µm (minimum) ductile, levelling copper plus 30 µm (minimum) bright nickel plus 0,3 µm micro-cracked chromium;
- Electrodeposited coating ISO 2081 - **Fe/Zn25/ER (190)8/D/T2**, i.e. an electrodeposited coating of 25 µm zinc (Zn 25) on iron or steel (Fe) which is to be heat treated after electroplating for hydrogen embrittlement relief heat treatment (ISO 9588) for 8 h at 190°C and has been given a supplementary opaque chromate conversion coating, D, followed by a sealing treatment consisting of the application of an organic sealant (T2).

The new proposed project of ISO/TC 107/SC 3 is ISO/NP 19598 - standard for electrodeposited zinc and zinc-alloy (ZnFe and ZnNi) coatings on iron and steel with hexavalent-chromium-free passivation [3 - 6]. This

standard should comply with the requirements of the EU Directive 1907/2006 (REACH) and should be based on DIN 50979.

In last 2 years many new standards for vitreous and porcelain enamels including new terminology were published together in ISO/TC 107 and CEN/TC 262. The ongoing project is the standard for visual representations and descriptions for these coatings as Part 2 to terminology standard. This standard will establish a system for the cataloguing of defects in sheet steel enamelling (**Fig. 2**).

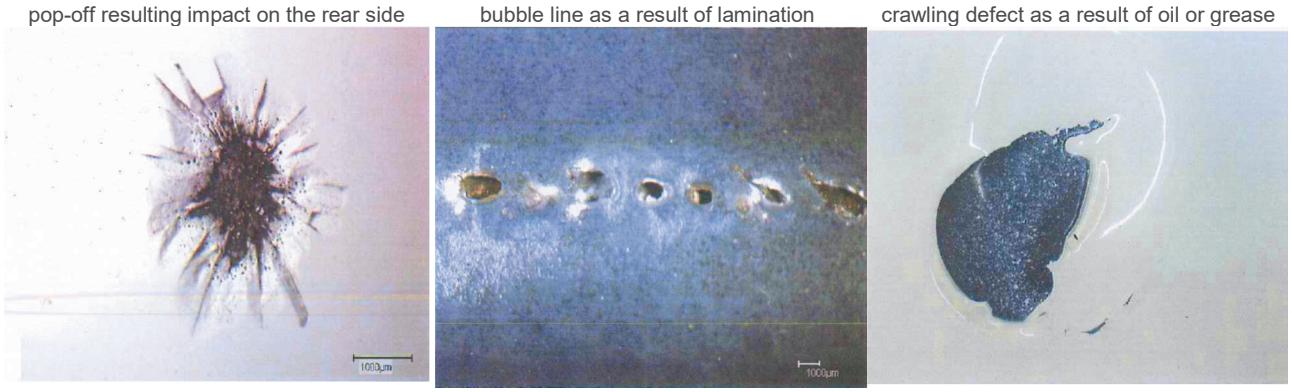

Fig. 2 Example of defects

4. STANDARDS IN SCOPE OF ISO/TC 35

Standards prepared by this TC deal with paints and varnishes - the general test methods for paints and varnishes and their binders; the tests for surface preparation before paint application; etc.

ISO 19840 *Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Measurement of, and acceptance criteria for, the thickness of dry films on rough surfaces* was published in 2012. If a coating is applied to a roughened steel substrate, the measurement of its dry-film thickness is more complicated than for smooth surfaces. Roughened steel substrates include those prepared by abrasive blast-cleaning or abrading. The effect of surface roughness on the measurement result increases with profile depth, but the result will also depend on the design of the measurement probe and the thickness of the coating. Its objective is to achieve uniformity of practice for measuring the dry-film thickness of a coating on a roughened surface. It specifies a procedure for the verification of dry-film thickness against nominal dry-film thickness on rough surfaces, including the adjustment of the instruments used, the definition of inspection areas, sampling plans, measurement methods and acceptance/rejection criteria. Measurements taken on a coating on a roughened steel substrate will be higher than the actual value above the peaks of the profile. The thickness of the dry film above the peaks of the profile is defined as the instrument reading minus an appropriate correction value. If the surface profile is known and conforms to ISO 8503-1, correction values given in **Table 3** shall be used. In Annex D the procedure for determination of specific correction value for given surface is described.

Table 3 Correction values for surface roughness

Surface profile in accordance with ISO 8503-1	Correction value (µm)
Fine	10
Medium	25
Coarse	40

The basic standard of this ISO/TC 35 is set of ISO 12944 *Protective paint systems for steel structures* (8 parts). In 2013 the new WG11 was appointed to prepare revision of these standards. There is still open for experts to this field of corrosion protection.

5. STANDARDS IN SCOPE OF CEN/TC 139

Standards prepared by this TC deal with paints and varnishes applied on hot-dip-galvanised and aluminium substrates and also with coil-coated metals.

In 2013 the revised standard EN 13438 *Paints and varnishes - Powder organic coatings for hot dip galvanised or sherardised steel products for construction purposes* had been produced as a result of the growing demand for products made of powder coated hot dip galvanised or sherardised steel. These products offer a combination of corrosion resistance and decorative appearance. Guidance on the application of the powder coating is given in Annex C. Methods for testing of powder coatings are given in Annex A and Annex D.

CONCLUSION

Technical standards shall always reflect the most recent developments. Technical standards should give state of the specifications for products and/or their surface treatment used as corrosion protection, services and good practice, helping to make industry more efficient and effective so the close cooperation with experts from industry - the final users of technical standards - are necessary. Continuously rising technical requirements for the metallic materials and their surface treatments demand further reaching harmonisation regarding equipment, process, quality insurance and materials. For new and recent developed materials and coatings test work is necessary to establish the validity of test methods before including in the standards.

The need to reduce the potential impacts on the environment of products (materials, coatings) that can occur during all stages of its life is recognized around the world. For this reason the potential environmental impacts of them can be reduced by taking into account environmental issues in all relevant standards. The voluntary power of the industry must be supported by means of mandates in order to achieve a successful continuation of the standardisation work. Additionally, the validation of necessary test methods depends on support in order to undertake co-normative research work.

In the field of corrosion and corrosion protection the development in standards are relative quickly and still open for new project to create standards that are used as the reference for conformity assessment and legitimate access to markets.

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