



Handled by, phone
Feng Chao,
Tel: +86 10 6526 3318
Fax: + 86 10 6522 1975
E-mail
fengchao@cmisi.cn

ISO/TC156 BUSINESS PLAN

Date	Reference
2015-01-12	ISO/TC 156
Version	201501

CMISI(China Metallurgical Information and Standardization Institute)

Address: P.O.Box 1823,74 Dengshikou St. Beijing 100730

STRATEGIC BUSINESS PLAN OF ISO/TC 156

"CORROSION OF METALS AND ALLOYS"

1 INTRODUCTION

ISO/TC 156 is responsible for standardization in the field of corrosion of metals and alloys including corrosion test methods and corrosion prevention methods. It also deals with the coordination of these activities within ISO.

Corrosion is a process which exerts its influence in many applications , and its consequences affect every individual. It is driven by thermodynamic considerations which dictate that metallic materials will tend to return to their most stable state, often as oxides or other combined forms, particularly under aggressive environmental conditions which accelerate the process. Corrosion can manifest itself in many forms, both general and localized (including cracking under conditions of tensile or cyclic stressing). Particularly rapid attack can occur in the presence of reactive gases, high temperatures, and in combination with abrasion and wear.

It is inevitable that corrosion can incur huge financial costs, not only due to the need to replace manufactured components and plant, which become degraded by the process, but also due to the consequences of corrosion for health and safety, the environment, and the quality of life of individuals. Corrosion can be a major cause of pollution where it results in the leakage of hazardous materials from pipes or vessels. It can also result in the sudden catastrophic failure of critical components, particularly where corrosion-assisted cracking takes place, with an associated threat of injury and loss of life.

The successful management of corrosion depends on access to reliable information on performance of structural materials under conditions that are relevant to the intended application of metals and alloys. This is essential for the safe design and operation of plant and as an aid to materials selection, the establishment of appropriate operating parameters, protection measures and inspection procedures. This is where the standards produced by ISO/TC 156 find their application. To date, 70 standards have been published by the Committee, most of which define test methods, both generic and specific to particular applications or circumstances. There is also an expanding work programme, which currently includes 29 items.

The mission of ISO/TC 156 is to curb corrosion-related threats to both health and safety and the environment (e.g. through the avoidance of emissions due to leaks), to support technical innovation (e.g. with regard to functional materials), and to facilitate international trade by providing industry with the means to avoid unnecessary financial losses due to corrosion. It is estimated that a significant proportion (approximately 10 %) of the costs of corrosion can be avoided by the more effective implementation of current knowledge. Corrosion standards are one of the most effective ways of implementing expertise, and through its work, ISO/TC 156 expects to contribute savings in excess of US\$ 10 billion per year to the international economy.

1.1 ISO technical committees and business planning.

The extension of formal business planning to ISO Technical Committees (ISO / TCs) is an important measure which forms part of a major review of business. The aim is to align the ISO work programme with expressed business environment needs and trends and to allow ISO/TCs to prioritize among different projects, to identify the benefits

expected from the availability of International Standards, and to ensure adequate resources for projects throughout their development. Your role in the implementation of the Business Planning concept will contribute significantly to the overall effectiveness of international standardization.

We express our sincere appreciation and thanks for your time in reviewing this Business Plan.

1.2 International standardization and the role of ISO.

The foremost aim of international standardization is to facilitate the exchange of goods and services through the elimination of technical barriers to trade.

Three bodies are responsible for the planning, development and adoption of International Standards: ISO (International Organization for Standardization) is responsible for all sectors excluding Electrotechnical, which is the responsibility of IEC (International Electrotechnical Committee), and most of the Telecommunications Technologies, which are largely the responsibility of ITU (International Telecommunication Union).

ISO is a legal association, the members of which are the National Standards Bodies (NSBs) of 161¹ countries (organizations representing social and economic interests at the international level), supported by a Central Secretariat based in Geneva, Switzerland.

The principal deliverable of ISO is the International Standard.

An International Standard embodies the essential principles of global openness and transparency, consensus and technical coherence. These are safeguarded through its development in an ISO Technical Committee (ISO/TC), representative of all interested parties, supported by a public comment phase (the ISO Technical Enquiry). ISO and its Technical Committees are also able to offer the ISO Technical Specification (ISO/TS), the ISO Public Available Specification (ISO/PAS) and the ISO Technical Report (ISO/TR) as solutions to market needs. These ISO products represent lower levels of consensus and have therefore not the same status as an International Standard.

ISO offers also the Industry Technical Agreement (ITA) as a deliverable which aims to bridge the gap between the activities of consortia and the formal process of standardization represented by ISO and its national members. An important distinction is that the ITA is developed by ISO workshops and fora, comprising only participants with direct interest, and so it is not accorded the status of an International Standard.

2 BUSINESS ENVIRONMENT OF THE ISO/TC 156

Corrosion of metals and alloys is the physicochemical interaction between a metal and its environment which results in changes in the properties of the metal, and which may lead to significant impairment of the function of the metal, the environment, or the technical system, of which these form part. This interaction is often of an electrochemical nature and may manifest itself in many ways. For example the corrosion may be general, resulting in a uniform loss of component thickness, with the risk of leakage or bursting. Alternatively, it may be more localized, resulting in pitting or intergranular attack that may eventually penetrate the wall, leading to leakage. In the presence of sufficiently high tensile or cyclic stresses, cracks may form, sometimes at corrosion pits, due to stress corrosion or corrosion fatigue, posing a threat of sudden catastrophic failure should the critical length be attained.

Corrosion is an all-pervasive phenomenon and failures due to corrosion impact on health and safety, the environment, and the economy in every nation. Corrosion affects every sector of industry as well as the infrastructure and the general population as a whole. We are all in daily contact with products and materials that are subject to corrosion effects. When failures occur they can be catastrophic, resulting in injury and loss of life, contamination of the environment by the release of chemicals and other toxic substances, and economic penalties resulting from damage to plant and loss of production.

The avoidance and control of corrosion are, therefore, of the utmost importance.

2.1 Description of the Business Environment

The following political, economic, technical, regulatory, legal, societal and/or international dynamics describe the

¹ As 2013-12-31, there are 161 national standards bodies, which includes of 117 member bodies, 40 correspondent members and 4 subscriber members.

business environment of the industry sector, products, materials, disciplines or practices related to the scope of this ISO/TC, and they may significantly influence how the relevant standards development processes are conducted and the content of the resulting standards.

The market in this field includes all companies and individuals involved in the prevention of corrosion, including, for example:

- those conducting research to provide improved understanding of corrosion processes;
- those producing test equipment to assess susceptibility to corrosion;
- those engaged in the development, evaluation and manufacture of corrosion-resistant materials;
- those involved in the manufacture of products of all types for service in corrosive environments, including those responsible for design, materials selection and fabrication aspects;
- the manufacturers, users and inspectors of protective measures, such as paint and metallic coatings, other surface modifications, inhibitors, cathodic protection, etc.;
- the suppliers and users of equipment for monitoring corrosion;
- those responsible for the operation, maintenance and repair of plant subject to corrosion;
- those involved in corrosion management, life prediction and life extension of plant;
- those responsible for decommissioning plant, especially where the long term storage of hazardous materials and environmental pollution are issues.

2.2 Quantitative Indicators of the Business Environment.

The following list of quantitative indicators describes the business environment in order to provide adequate information to support actions of the ISO/TC:

The value of the total market relating to corrosion prevention is linked to the worldwide cost of corrosion. Historical surveys, conducted 1970s and 80s, estimated that the impact of corrosion on the economies of various industrialized countries amounted to between about 2 % and 4 % of the Gross Domestic Product, GDP², with an average of 3,5 %. More recent surveys conducted during the past decade in the UK, the USA and Japan have shown that the greater knowledge and better materials now available have led to a reduction of corrosion costs over the past thirty years. The most extensive survey, in the USA, suggests that the cost of corrosion to the national economy fell from 4,2 % of GDP in 1975 to 3,1 % of GDP in 1998, while at the other extreme, in Japan the figure is estimated to have fallen from 1,8 % of GDP in 1977 to 1 % in 2001. These improvements may be attributed largely to progress in research and development, including the application of standards.

Assuming, conservatively, that the estimate of 3,1 % GDP may be extrapolated more widely, an approximation of international expenditure related to corrosion can be based on the 34 countries of the Organization for Economic Co-operation and Development, OECD. Twenty-three of these belong to TC 156, 16 as P members and 7 as O members. These countries represent more than 50% of the TC 156 member countries, of which there are currently 45 (21 P members and 24 O members) and are responsible for the vast majority of world trade. If one takes the most recent estimate of 3,1 % of GDP and applies it to the total GDP of the OECD countries, which was US\$ 29,3 trillion in 2003, the estimated cost of corrosion would amount to US\$ 908 billion. Even this huge sum underestimates the worldwide cost because it omits, for example, any contribution from Brazil, China, Russian Federation and South Africa, each of which is a P-member of TC 156. The World Corrosion Organisation has reported³ that on the basis of recent studies conducted in China, Venezuela and elsewhere, showing similar to even more costly results the estimated worldwide direct cost now exceeds US\$ 1,8 trillion.

Total sales over the last three years

The estimated US\$ 1,8 trillion cost represents the total cost of corrosion, including expenditure on corrosion prevention on the one hand and on remedial work and lost production on the other. Ideally, there should be a balance between these two classes of expenditure. For a 50/50 split between the two, the overall cost of corrosion prevention measures would amount to US \$ 900 billion worldwide in 2009. This will approximate to the average annual sales in the corrosion prevention sector over the last three years (2007 - 2009). On this basis, total sales relating to corrosion preventive measures over the last three years would amount to approximately US\$ 2 700 billion.

² The total market value of all final goods and services produced within a country in one year.

³ Global Needs for Knowledge Dissemination, Research, and Development in Materials Deterioration and Corrosion Control by G. Schmitt et al., World Corrosion Organisation, New York, May 2009.

Total employment over the last three years

An estimate of the overall number of people employed in this field within the OECD countries can be obtained by first dividing the estimated cost of corrosion prevention measures by the average per capita purchasing power parity (PPP). For the OECD countries this gives a figure of 17,3 million people who depend on those employed in the anti-corrosion field. Assuming an average family size of 4, the number of people employed at all levels and on all aspects of corrosion prevention activities in the OECD countries is estimated to be in the order of 4,3 million.

The proportion of these people making direct use of corrosion standards is expected to be relatively small. In the USA, for example, the membership of NACE International, the major association of corrosion engineers, is in the order of 13 000 whereas the estimated total employed in the corrosion prevention field is 1,2 million. This suggests that the number of professional corrosion engineers (i.e those most likely to use corrosion standards) is only 1,1 % of the total employed in corrosion prevention activities. By extrapolation to the OECD countries as a whole, the total number of corrosion specialists is predicted to be approximately 48 000.

Total international trade over the last three years

The main suppliers in the corrosion prevention field are the most wealthy and most highly industrialised members of OECD. These are dominated by the USA, followed by Japan, Germany, France, UK, and Italy.

Description of the market structure and the major market players

Structure of the market: Suppliers/Manufacturers (*descriptive and quantitative*)

A breakdown of total expenditure on corrosion prevention measures is shown in Figure 1.

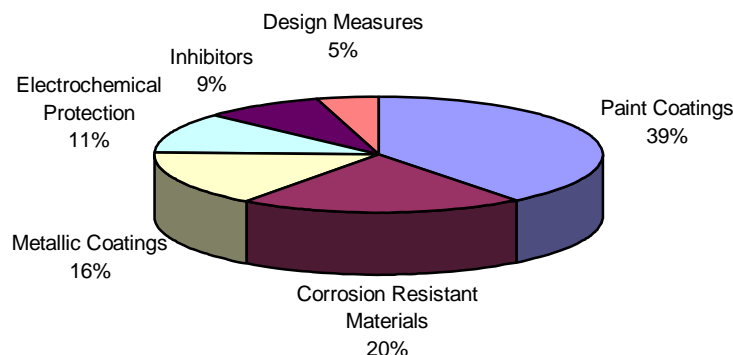


Figure 1. Breakdown of expenditure on corrosion prevention measures

Structure of the market: Customers

An illustrative breakdown of the market for corrosion prevention measures between different sectors of the economy is shown in Figure 2.

This breakdown is based on the division of corrosion costs between different industrial and other sectors. However, in addition to the above, it must be stressed that all consumers of metallic goods, such as central heating systems and cars, are end users and bear the cost of corrosion once guarantee periods have expired.

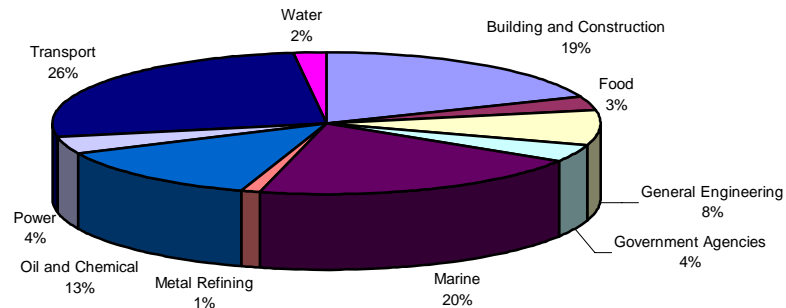


Figure 2. Breakdown of market for corrosion prevention measures between different sectors

Major factors, which may have an impact on the development of the markets

Suppliers

Stainless steel technology has been revolutionised by argon-oxygen decarburisation (AOD) and alloying with nitrogen, niobium and titanium, producing a wide range of alloys with improved resistance to localized corrosion (including stress corrosion cracking) and, in specific cases, resistance to oxidising or reducing conditions. Alloys for service in hot corrosive conditions have been improved by aluminium and rare earth additions and better processing. Also, much progress has been made in recent years over the development of new alloys with improved resistance to corrosion, including for example the super duplex stainless steels, nickel-based alloys and titanium alloys. These advances are helping to contain corrosion costs.

The growing availability of clad, overlaid and co-extruded products which allow the structural strength of reasonably inexpensive steels to be combined with the corrosion resistance of more costly corrosion resistant alloys will help to cut the cost of corrosion.

Experience is growing of ways to join different alloys without a serious threat of bimetallic corrosion by depositing progressively overmatching overlays in the transition region. This will also help to combat corrosion.

Customers

In the pursuit of greater efficiency in sectors such as the chemical and power industries, demand is growing for materials which are suitable for service at still higher temperatures and pressures than hitherto (i.e. supercritical conditions).

Service environments are becoming more severe because of the depletion of natural resources and, for

example, the need to exploit less readily accessible and more highly contaminated reserves in the offshore oil and gas sectors.

Commercial pressures are limiting capital expenditure on new plant so that more reliance must be put on ageing plant, also tending to increase corrosion costs. Similar pressures, also mean that increased output must be achieved from a reduced number of plants. This requires the achievement of very high plant availability figures (often as high as 96% - 98 %) and increases the need to avoid corrosion failures.

Technological changes

Small changes in process conditions sometimes have unexpected and disastrous consequences. One example relates to breakaway corrosion due to a sudden increase in the rate of oxidation once a critical temperature is exceeded, e.g. in the application of ferritic-martensitic (9 Cr) steels at about 650 °C. Another relates to the metal dusting phenomenon. This is a form of high temperature attack involving decarburization that can manifest itself where relatively small changes in process parameters occur in process streams containing CO/CO₂/H₂/H₂O gas mixtures at temperatures in the range 350°C - 800 °C. A small change of temperature or level of sulphur impurities in the gas stream can reduce the protectiveness of the surface film, resulting in severe loss of metal as carbides into the gas stream. Such attack has been reported increasingly in recent years and has resulted in a number of serious fires in petrochemical process plant and refineries. A better understanding of the metal dusting phenomenon is needed so that appropriate prevention measures can be implemented otherwise losses will continue to rise.

As the boundaries in process design terms are pushed out into areas where there are little or no materials performance data or there are problems predicting precise process conditions, the need for rapid yet reliable test methods to assess the corrosion performance of materials under circumstances which bracket the service conditions will be of paramount importance. This is particularly true in the case of high temperature corrosion processes and this is the area where ISO/TC 156/WG13 on High temperature corrosion is making good progress. In this area, the impact of service transients (temperature, chemistry, stress, etc.,) on corrosion performance can be severe.

In addition, new mechanisms of corrosion failure continue to emerge at more modest temperatures, especially where cyclic loading is encountered, pointing to the need for better test data. The problems are even more marked where corrosion is accompanied by wear processes such as fretting fatigue, erosion, and sliding wear.

More powerful generic models of corrosion processes are needed together with dependable quantitative data to provide a predictive ability for materials performance in complex environments, particularly with regard to the kinetics of various corrosion processes and their controlling parameters. This is particularly the case in connection with the advent of risk-based management, which promises to provide large savings in inspection costs without increased risk of failures. Reliable corrosion data are also needed for use in the application of life-cycle costing methodologies which can also facilitate valuable financial savings during the lifetime of plant.

Innovative corrosion monitoring techniques are required to enable remote monitoring to be undertaken reliably. There is also a need for improved coatings capable of offering a thirty-year design life under atmospheric corrosion conditions. In this regard, new sensor developments for coatings offer great promise.

Other examples of technological change that may be expected to influence the need for new corrosion testing standards in future relate to:

- the increasing use of lightweight materials in automotive applications
- the application of nano-technologies in manufacturing industry
- the need to make greater use of alternative energy technologies, such as wind- and wave-power which involve the exposure of cyclically stressed components to aggressive atmospheres;
- the extension to more severe operating conditions of plant used in the chemical and offshore oil industries

- problems associated with the ageing of process plant, aircraft structures, etc.
- loss of technical expertise due to downsizing in key industries, which emphasises the importance of standards from the standpoint of education and technology transfer.

Social changes

The number of experienced corrosion engineers employed by both suppliers and customers is tending to fall because of social and commercial pressures, which are leading people to retire at an earlier age. In the short term, the loss of expertise can be made up by using these people as consultants. However, adequate provision must be made to educate successors to these corrosion specialists or there will be an adverse effect on corrosion costs.

In some countries, the number of university courses on metallurgy and the corrosion of metals and alloys has decreased significantly in recent decades and is continuing to fall. This is a serious matter because it threatens the ability of companies to replenish their expertise. Also, it is estimated that the current cost of corrosion to national economies could be reduced by at least 10 % (ca. US\$100 billion per annum) simply by the better application of existing knowledge. An adequate provision of education, training and certification courses must be available if the potential savings are to be achieved.

Technical barriers to trade

Some national standards have been developed with locally produced metals and alloys in mind. These can mitigate against the products of other countries so international standards are essential to eliminate technical barriers to trade.

Regulatory and legal measures

Recent developments in health and safety regulations have encouraged increased attention to be given to high-risk activities where corrosion poses a threat to safety. When catastrophic failures occur due to corrosion the consequences can be very serious. One absorber tower failure at a chemical plant in the USA killed 17 people and caused damage worth over \$100 million. More recently, the explosion of a corroded natural gas pipeline in New Mexico resulted in 12 fatalities.

Environmental legislation is also causing increased attention to be devoted to the avoidance of emissions of hydrocarbons and other toxic species into the environment. Historically, over 50 % of such releases in the oil industry have been attributed to corrosion. Many companies now have zero emissions as their target and this increased the need for effective corrosion prevention measures to be implemented.

These developments are major drivers for corrosion studies. In the wealthiest countries there is considerable government support for corrosion research. For example, annual expenditure by the various US Government agencies, including NSF, DOE-BES, DOE-Fossil, DOD, NASA, etc., on corrosion research amounts to over \$100 million. In Japan, there have been several major projects, including work on the development of marine corrosion resistant steel, heat resistant ferritic stainless steel and hydrogen cracking which have received support in excess of \$60, million from the government agency for science and technology (SAT) under the "Ultra Steel" national project which was valued at about \$1 billion in total for the period 1996-2001.

3 BENEFITS EXPECTED FROM THE WORK OF THE ISO/TC 156.

The standards produced by TC 156 provide an important basis for the avoidance and control of corrosion. 71 standards have been published since the committee was formed in 1974. Many of these provide generic information on how to test metals and alloys under environmental conditions of relevance to service in order to quantify the risk of failure due to various corrosion and corrosion-related processes. The results of these tests allows corrosion engineers to make reliable judgements about the fitness for purpose of particular metals and alloys, including in some cases metals to which protective coatings have been applied.

Major aspects of corrosion addressed in the standards include:

- bimetallic corrosion

- atmospheric corrosion
- sea water corrosion
- pitting corrosion
- stress corrosion cracking
- corrosion fatigue

Standards which relate to accelerated corrosion tests are of great value in comparing the corrosion resistance of different alloys for quality control purposes.

Other standards are concerned with categorization of the corrosivity of atmospheric environments in terms of their time of wetness and levels of contamination by chloride and sulphur dioxide, and the measurement of pollution. Information is also provided on the corrosion rates of steel, copper, aluminium and zinc based on the corrosivity category of the environment.

Some published standards are applicable to particular alloys and corrosion processes. These include:

- stress corrosion cracking of aluminium alloys
- aqueous corrosion of zirconium alloys for nuclear reactors
- intergranular corrosion of solution heat-treatable aluminium alloys
- intergranular corrosion of nickel-based alloys

One standard provides information on over 150 basic corrosion terms, with definitions, while two others provide general guidance, one on corrosion testing and the other on stress corrosion testing.

Examples of standards under development t will provide methods for the assessment of:

- corrosion in indoor environments
- critical pitting temperatures
- dezincification of copper alloys with zinc
- stress corrosion testing of magnesium alloys
- electrochemical parameters from polarisation tests
- oxidation rates during isothermal exposure at high temperatures

The worldwide application of these standards will promote international trade by removing barriers associated with incompatibility of materials, equipment, procedures and specifications between different countries. They provide a framework for the safe, environment sensitive and economic utilization of materials. They also represent a tremendous information resource that will assist in the transfer of technology from developed to developing countries, contributing to the quality of specification and operation of industrial plant and advancing the field of knowledge in corrosion technology. It has been estimated that corrosion costs could be reduced by 10 % by better implementation of existing corrosion knowledge. If the availability of both the published TC 156 standards, and those currently under preparation contributes only one-tenth of this saving, the benefit in financial terms would be approximately US\$ 10 billion per year. As an example of the potential savings that are available through the use of corrosion testing standards, in one oil field the adoption of a cheaper corrosion resistant alloy, based on laboratory testing, saved about US\$ 30 million.

4 REPRESENTATION AND PARTICIPATION IN THE ISO/TC 156.

TC 156 currently has 56 nominated experts from its P-member, 32 nominated experts from its O-member and 31 experts from its liaisons. WGs of TC 156 also have more than 260 nominated experts from its members. It is an active TC and its Plenary and Working Group meetings in Berlin (June 2013), were attended by more than experts from 11 member countries (Belgium, China, Czech Republic, France, Germany, Japan, Korea, Sweden, UK and USA). Representatives of the TC 156 Secretariat from China also attended.

The experts belonging to TC 156 represent wide range of industrial sectors, including :

- Power
- Oil and gas
- Chemical
- Transport
- Metal production
- Water supplier

Members originate from industry, academia, research institute, government organization etc. Most areas of expertise needed to address the future work programme of TC 156 are currently available. However, in one or two areas it would be helpful to strengthen the expertise. For example, more people with expertise in the fields of tribo-corrosion, marine corrosion and electronics would be helpful.

5 OBJECTIVES OF THE ISO/TC AND STRATEGIES FOR THEIR ACHIEVEMENT.

5.1 Defined objectives of the ISO/TC 156

Based on the considerations above, the TC 156 proposes the following objectives and strategic directions for its future work.

1. To develop standard corrosion test methods
2. To develop standard corrosion prevention methods (excluding the development of inhibitors and coatings)
3. To coordinate the development of corrosion standards within ISO

Emphasis will be given to the development of standards that will provide a framework for the safe and economic utilization of metals and alloys and which promote international trade by removing barriers associated with the incompatibility of equipment, assessment procedures and specifications between different countries.

5.2 Identified strategies to achieve the ISO/TC's defined objectives.

A sub-structure has been established within TC 156 of 12 active working groups and an advisory group, each reporting directly to the parent committee to ensure a short line of communication.

Twelve of the working groups deal with different corrosion topics for standardisation and the AG is concerned with the coordination of all activity on corrosion standards within ISO.

The TC 156 working groups and their future plans, are as follows:

- WG1 - Terminology: the work is focus on the definition of additional commonly-used corrosion terms to complement those already contained in ISO 8044.
- WG2 - Environmentally assisted cracking: Corrosion of metals and alloys -- Determination of dezincification resistance of brass (ISO/CD 6509); Stress corrosion testing - Part 1. Guide to testing procedures (ISO/DIS 7539-1) ;Stress corrosion testing - Part 11 guidelines for testing the resistance of metals and alloys to hydrogen embrittlement and hydrogen assisted cracking (ISO/CD 7539-11) ; Methodology for determining the resistance of metals to stress corrosion cracking using the four-point bend method (ISO/WD 16540) ; Guidelines for assessing the significance of stress corrosion cracks detected in service (ISO/DIS 21601) . Possibly, the development of new standards to do with determination of crack growth rates both for long cracks and for short cracks.
- WG4 - Atmospheric corrosion testing and classification of corrosivity of atmosphere: attention is being directed to the determination of run-off rates from metals exposed to atmospheric corrosion(ISO/FDIS 17752) and to the development of determination of bimetallic corrosion in outdoor exposure corrosion tests (ISO/CD 7441). Future work will include the development of Quartz crystal micro-balance methodology.
- WG5 - Intergranular corrosion: China will proposed a new work items in due course.
- WG6 - General principles for testing and data interpretation: “new guidelines are being prepared on the use of statistical techniques in the analysis of corrosion data” (ISO/FDIS 14802).
- WG7 - Accelerated corrosion tests: “Corrosion tests in artificial atmospheres – Salt spray tests” (ISO/FDIS 9227), “guidelines will be prepared concerning the selection of accelerated corrosion tests for product qualification” (ISO/WD TR 16335) . A new standard of accelerated cyclic corrosion tests with exposure to the synthetic ocean water salt deposition process, "dry" and "wet" conditions at a constant absolute humidity” (ISO/CD 16539) and accelerated corrosion test involving exposure under controlled conditions of humidity cycling and intermittent spraying of a salt solution(ISO/DIS 16701) are under development.
- WG9 - Corrosion testing of materials for power generation: a test method is being developed for reverse U-bend stress corrosion testing(ISO/DIS 7539-10). Future plans include the preparation of a standard concerning the evaluation of selective corrosion of alloys by visual inspection and hardness measurement

and another on methods for measuring stress corrosion crack growth rates in high temperature and high pressure environments.

- WG10 - Cathodic protection of buried and immersed metallic structures: activity in CEN TC 219 on cathodic protection will be shadowed with a view to adopting its new cathodic protection standards as international standards, where appropriate. In addition the new work item “Cathodic Protection - Engineering Symbols” (ISO/WD 13388) is under development, future work will include the development the new work item “Cathodic Protection - Design of Galvanic Cathodic Protection”.
- WG11 - Electrochemical test methods: new standards are under development concerned with pitting potential measurements for stainless steels(ISO/DIS15158), Guidelines for corrosion test by electrochemical noise measurements (ISO/CD 17093)and electrochemical impedance measurements (ISO/DTR 16208). Future work will include standards critical crevice temperature measurements and on both scanning reference electrode and scanning vibrating electrode techniques.
- WG12 - Corrosion, scale and fouling inhibition: a new standard concerns the development of a test method for evaluation of corrosion inhibitors for use in closed heating and cooling systems(ISO/ WD 16319). An outline of new proposal “Remote monitoring of closed heating and cooling systems” will be proposed in due course.
- WG13 - High temperature corrosion: The initial work programme addressed several topics of high temperature corrosion testing on which standards had been eagerly awaited by industry. Standards for these topics were established by WG13 and published in 2012: isothermal and thermal cycling oxidation testing of metallic samples in gaseous atmospheres (ISO 21608 and ISO 13573) and metallographic examination after high temperature exposure (ISO 26146). Further projects now focus on different methods of hot corrosion testing of metallic samples, such as embedding in salt, ashes, or other solids (ISO/DIS 17248); immersing in molten salt or other liquids (ISO/DIS 17245); applying a deposit of salt, ashes, or other solids (ISO/DIS 17224).
- WG14 - Tribo-corrosion: this working group is developing an international standard on the industrially important process of erosion-corrosion in flowing liquids(ISO/DTR 16203). Further standards on on “Jet in slit” testing will be developed as soon as an adequate technological basis is available.

The coordination of corrosion standardisation activity within ISO is dealt with by Advisory Group. Also, working in conjunction with the TC 156 Secretariat, it updates the ISO/TC 156 Business Plan. The objective is to utilize resources as effectively as possible by avoiding any unnecessary duplication of activity. With this in mind, liaison is being maintained with the following ISO Technical Committees:

- TC8/SC8: Ship design
- TC 17: Steel
- TC 17/SC 7: Steel - Methods of testing (other than mechanical tests and chemical analyses)
- TC18: Zinc and Zinc alloys
- TC 26: Copper and copper alloys
- TC 28: Petroleum products and lubricants
- TC 35/SC 9: Paints and varnishes - General test methods for paints and varnishes
- TC 35/SC12: Paints and varnishes - Preparation of steel substrates before application of paints
- TC58: Gas cylinders
- TC 59/SC 14: Building construction - Design life
- TC 67: Materials, equipment and offshore structures for petroleum and natural gas industries
- TC79: Light metals and their alloys
- TC 79/SC 2: Light metals and their alloys - Anodized aluminium
- TC 107: Metallic and other inorganic coatings
- TC107/SC 4: Metallic and other inorganic coatings- Hot dip coatings (galvanized, etc.)
- TC 107/SC 7: Metallic and other inorganic coatings - Corrosion tests
- TC 119: Powder metallurgy
- TC119/SC2: Sampling and testing methods for powders (including powders for hardmetals)
- TC119/SC5: Specifications for powder metallurgical materials (excluding hardmetals)
- TC 146/SC3: Air quality
- TC 155: Nickel and nickel alloys
- TC164: Mechanical testing of metals
- TC 164/SC 5: Fatigue testing
- TC 167: Steel and aluminium structures

6 FACTORS AFFECTING COMPLETION AND IMPLEMENTATION OF THE ISO/TC 156 WORK PROGRAMME

The main threat to the TC 156 strategy concerns the difficulty sometimes encountered in securing support from the national standards bodies (NSBs) and others for the activities of the working group convenors and members. This problem seems to be particularly acute in the corrosion field because of the generic nature of the corrosion process. Because its effects are felt throughout industry, nobody feels bound to claim ownership of the problem. It is feared that the gradual erosion of support could threaten the future of this important committee, despite the important role of its standards in the avoidance of corrosion-related failures and the reduction of costs in industry. In some working groups, the activity of the convenors appears to be resource-limited in that they are unable to participate in every meeting, and in others the attendance of meetings, particularly by younger workers, is restricted because of the associated costs.

Another threat is the paucity of legislation requiring companies to make use corrosion standards, e.g. for health and safety reasons or when bringing new products into the market. Such legislation would help to make companies realize that standards are of vital importance for their business.

Finally, as the average age of committee members goes up, the need for the NSBs to become involved in succession management grows. The NSBs must be reminded of the need to nominate delegates to the ISO/TC 156 Working Groups, and to bear in mind the need to include some younger members within their delegations.

7 STRUCTURE, SCOPE AND WORK PROGRAMME OF THE ISO/TC 156.

This section gives an overview of ISO/TC's structure, scopes of the ISO/TCs and any existing subcommittees and information on existing and planned standardization projects, including resources needed for their completion. The aim of this section is to demonstrate the adequacy of the proposed programme of work in relation to the business environment and/or stakeholders' needs. Only structures directly responsible for standardization projects are listed. Therefore, no co-ordination or advisory groups are included.

SCOPE AND ORGANISATION

ISO/TC 156 Corrosion of metals and alloys

Responsible ISO Member: Standardization Administration of China (SAC)

Chairperson: Mr. Göran Engström (Sweden)

Vice Chairperson: Mrs. Yuchun Zhang (CMISI)

Secretary: Mr. Chao Feng (China Metallurgical Information and Standardization Institute) (CMISI)

Secretary Assistant: Ms. Jie Hou (China Metallurgical Information and Standardization Institute) (CMISI)

Chairperson & Secretary Time Allocation Per Year = 100 % FTE

Scope: standardization in the field of corrosion of metals and alloys, including corrosion prevention methods, and general coordination of activities in these fields within ISO

STRUCTURE

AG	Advisory Group	SAC
WG 1	Terminology	SIS
WG 2	Environmentally assisted cracking	BSI
WG 4	Atmospheric corrosion testing and Classification of corrosivity of atmosphere	UNMZ
WG 5	Intergranular corrosion	SAC
WG 6	General principles for testing and data interpretation	SIS
WG 7	Accelerated corrosion tests	SIS
WG 9	Corrosion testing of materials for power generation	AFNOR
WG 10	Cathodic protection of buried and immersed metallic structures	SNV
WG 11	Electrochemical test methods	JISC
WG 12	Corrosion, scale and fouling inhibition:	BSI
WG 13	High temperature corrosion	DIN
WG 14	Tribo-corrosion	KATS

WORK PROGRAMME

Projects directly under this technical committee: 68 publications

No	Standardt number	Standardt title
1.	ISO 6509:1981	Corrosion of metals and alloys - Determination of dezincification resistance of brass
2.	ISO 7384:1986	Corrosion tests in artificial atmosphere - General requirements
3.	ISO 7441:1984	Corrosion of metals and alloys - Determination of bimetallic corrosion in outdoor exposure corrosion tests
4.	ISO 7539-1:2012	Corrosion of metals and alloys - Stress corrosion testing, Part 1 : General guidance on testing procedures
5.	ISO 7539-2:1989	Corrosion of metals and alloys - Stress corrosion testing, Part 2 : Preparation and use of bent-beam specimens
6.	ISO 7539-3:1989	Corrosion of metals and alloys - Stress corrosion testing, Part 3 : Preparation and use of U-bend specimens
7.	ISO 7539-4:1989	Corrosion of metals and alloys - Stress corrosion testing, Part 4: Preparation and use of uniaxially loaded tension specimens
8.	ISO 7539-5:1989	Corrosion of metals and alloys - Stress corrosion testing, Part 5: Preparation and use of C-ring specimens
9.	ISO 7539-6:2011	Corrosion of metals and alloys - Stress corrosion testing, Part 6: Preparation and use of pre-cracked specimens for tests under constant load or constant displacement
10.	ISO 7539-7:2005	Corrosion of metals and alloys - Stress corrosion testing, Part 7: Slow strain rate testing
11.	ISO 7539-8:2000	Corrosion of metals and alloys - Stress corrosion testing, Part 8: Preparation and use of specimens to evaluate weldments
12.	ISO 7539-9:2003	Corrosion of metals and alloys - Stress corrosion testing, Part 9: Preparation and use of pre-cracked specimens for tests under rising load or rising displacement
13.	ISO 7539-10:2013	Corrosion of metals and alloys -- Stress corrosion testing -- Part 10: Reverse U-bend method
14.	ISO 7539-11:2013	Corrosion of metals and alloys -- Stress corrosion cracking -- Part 11: Guidelines for testing the resistance of metals and alloys to hydrogen embrittlement and hydrogen-assisted cracking
15.	ISO 8044:1999	Corrosion of metals and alloys - Basic terms and definitions
16.	ISO 8407:2009	Corrosion of metals and alloys - Removal of corrosion products from corrosion test specimens
17.	ISO 8565:2011	Metals and alloys - Atmospheric corrosion testing - General requirements for field tests
18.	ISO 9223:2012	Corrosion of metals and alloys - Classification of corrosivity of atmospheres
19.	ISO 9224:2012	Corrosion of metals and alloys - Guiding values for the corrosivity categories of atmospheres
20.	ISO 9225:2012	Corrosion of metals and alloys - Corrosivity of atmospheres - Methods of measurement of pollution
21.	ISO 9226:2012	Corrosion of metals and alloys - Corrosivity of atmospheres - Methods of determination of corrosion rate of standard specimens for the evaluation of corrosivity
22.	ISO 9227:2012	Corrosion tests in artificial atmospheres - Salt spray tests
23.	ISO 9400:1990	Corrosion of metals and alloys - Nickel-based alloys - Determination of resistance to intergranular corrosion
24.	ISO 9591:2004	Corrosion of aluminium alloys -- Determination of resistance to stress corrosion cracking

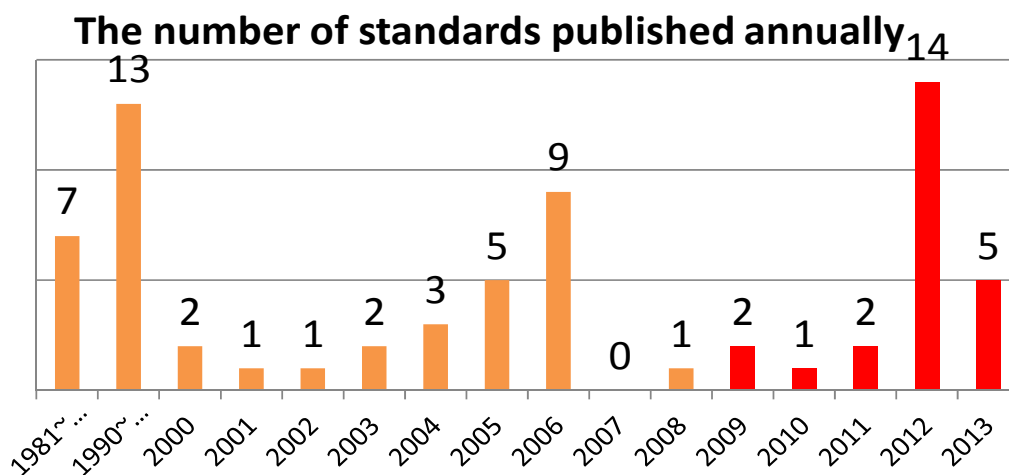
25.	ISO 10062:2006	Corrosion tests in artificial atmosphere at very low concentrations of polluting gas(es)
26.	ISO 10270:1995	Corrosion of metals and alloys - Aqueous corrosion testing of zirconium alloys for use in nuclear power reactors
27.	ISO 10270:1995	Corrigendum 1:1997
28.	ISO 11130:2010	Corrosion of metals and alloys -- Alternate immersion test in salt solution
29.	ISO 11303:2002	Corrosion of metals and alloys -- Guidelines for selection of protection methods against atmospheric corrosion
30.	ISO 11306:1998	Corrosion of metals and alloys - Guidelines for exposing and evaluating metals and alloys in surface sea water
31.	ISO 11463:1995	Corrosion of metals and alloys - Evaluation of pitting corrosion
32.	ISO 11474:1998	Corrosion of metals and alloys - Determination of corrosion resistance through accelerated outdoor atmosphere testing
33.	ISO 11782-1:1998	Corrosion of metals and alloys - Corrosion fatigue tests, Part 1: Cycles to failure testing
34.	ISO 11782-2:1998	Corrosion of metals and alloys - Corrosion fatigue tests, Part 2: Crack propagation testing
35.	ISO 11844-1:2006	Corrosion of Metals and Alloys – Classification of low corrosivity of indoor atmospheres – Part 1: Determination and estimation of indoor corrosivity
36.	ISO 11844-2:2005	Corrosion of Metals and Alloys – Classification of low corrosivity of indoor atmospheres – Part 2: Determination of corrosion attack in indoor atmospheres
37.	ISO 11844-3:2006	Corrosion of Metals and Alloys – Classification of low corrosivity of indoor atmospheres – Part 3 – Measurement of environmental parameters affecting indoor corrosivity
38.	ISO 11845:1995	Corrosion of metals and alloys - General principles for corrosion testing
39.	ISO 11846:1995	Corrosion of metals and alloys - Determination of resistance to intergranular corrosion of solution heat treatable aluminum alloys
40.	ISO 11881:1999	Corrosion of metals and alloys - Determination of resistance to exfoliation corrosion of high strength aluminum alloys
41.	ISO 11881:1999	Corrigendum 1:1999
42.	ISO 12473:2006	General principles of cathodic protection in sea water
43.	ISO 12696:2012	Cathodic protection of steel in concrete
44.	ISO 12732:2006	Corrosion of metals and alloys – Electrochemical potentiokinetic reactivation measurement using the double loop method (based on Cihal's method)
45.	ISO 13174:2012	Cathodic protection of harbour installations
46.	ISO 13573:2012	Corrosion of metals and alloys -- Test method for thermal-cycling exposure testing under high-temperature corrosion conditions for metallic materials
47.	ISO 14802:2012	Corrosion of metals and alloys -- Guidelines for applying statistics to analysis of corrosion data
48.	ISO 14993:2001	Corrosion of metals and alloys -- Accelerated testing involving cyclic exposure to salt mist, "dry" and "wet" conditions
49.	ISO 15324:2000	Corrosion of metals and alloys -- Evaluation of stress corrosion cracking by the drop evaporation test
50.	ISO 15329:2006	Corrosion of metals and alloys – Anodic test for evaluation of intergranular corrosion susceptibility of heat-treatable aluminium alloys
51.	ISO 16151:2005	Corrosion of Metals and Alloys -- Accelerated cyclic tests with exposure to acidified salt spray, "dry" and "wet" conditions
52.	ISO/TR 16335:2013	Corrosion of metals and alloys -- Corrosion tests in artificial atmospheres -- Guidelines for selection of accelerated corrosion test for product qualification
53.	ISO 16539:2013	Corrosion of metals and alloys -- Accelerated cyclic corrosion tests with exposure to synthetic ocean water salt-deposition process -- "Dry" and "wet"

		conditions at constant absolute humidity
54.	ISO 16701:2003	Corrosion of metals and alloys -- Corrosion in artificial atmosphere -- Accelerated corrosion test involving exposure under controlled conditions of humidity cycling and intermittent spraying of a salt solution
55.	ISO 16784-1:2006	Corrosion of metals and alloys – Corrosion and fouling in industrial cooling water systems – Part 1: Guidelines for conducting pilot-scale evaluation of corrosion and fouling control additives for open recirculating cooling water systems
56.	ISO 16784-2:2006	Corrosion of metals and alloys – Corrosion and fouling in industrial cooling water systems – Part 2: Evaluation of the performance of cooling water treatment programmes using a pilot-scale test rig
57.	ISO 17081:2004	Method of measurement of hydrogen permeation and the determination of hydrogen uptake and transport in metals by electrochemical technique
58.	ISO 17474:2012	Corrosion of metals and alloys -- Conventions applicable to electrochemical measurements in corrosion testing
59.	ISO 17475:2005	Corrosion of metals and alloys – Electrochemical test methods – Guidelines for conducting potentiostatic and potentiodynamic polarization measurements
60.	ISO 17475:2005	Corrigendum 1:2006
61.	ISO 17752:2012	Corrosion of metals and alloys -- Procedures to determine and estimate runoff rates of metals from materials as a result of atmospheric corrosion
62.	ISO 17864:2005	Corrosion of metals and alloys – Determination of the critical pitting temperature under potentiostatic control
63.	ISO 21207:2004	Accelerated corrosion test involving alternative exposure for corrosion promoting gases, neutral salt spray and drying
64.	ISO 21207:2004	Corrigendum 1:2008
65.	ISO 21601:2013	Corrosion of metals and alloys -- Guidelines for assessing the significance of stress corrosion cracks detected in service
66.	ISO 21608:2012	Corrosion of metals and alloys -- Test method for isothermal-exposure oxidation testing under high-temperature corrosion conditions for metallic materials
67.	ISO 21610:2009	Corrosion of metals and alloys - Accelerated corrosion test for intergranular corrosion susceptibility of austenitic stainless steels
68.	ISO 26146:2012	Corrosion of metals and alloys -- Method for metallographic examination of samples after exposure to high-temperature corrosive environments

Work in Progress –29 items

No	WG	Project number	Project title
1.	2	ISO/DIS 6509-1	Corrosion of metals and alloys -- Determination of dezincification resistance of copper alloys with zinc—Part 1:Test method
2.	2	ISO/WD 6509-2	Corrosion of metals and alloys -- Determination of dezincification resistance of copper alloys with zinc-- Part 2: Acceptance criteria
3.	4	ISO/DIS 7441	Corrosion of metals and alloys -- Determination of bimetallic corrosion in outdoor exposure corrosion tests
4.	1	ISO 8044:1999/DAmD 1	Corrosion of metals and alloys -- Basic terms and definitions -- Amendment 1
5.	7	ISO/WD 9227	Corrosion tests in artificial atmospheres -- Salt spray tests
6.	10	ISO/NP 12495	Cathodic protection for fixed steel offshore structures
7.	10	ISO/NP 13173	Cathodic protection for steel offshore floating structures
8.	10	ISO/WD 13388	Corrosion of metals and alloys -- Cathodic protection -- Engineering symbols

<i>No</i>	<i>WG</i>	<i>Project number</i>	<i>Project title</i>
9.	11	ISO 15158	Corrosion of metals and alloys -- Method of measuring the pitting potential for stainless steels by potentiokinetic control in sodium chloride solution
10.	10	ISO/WD 15257	Corrosion of metals and alloys -- Competence levels and certification of cathodic protection personnel
11.	14	ISO/DTR 16203	Corrosion of metals and alloys -- Guidelines for selection of methods for erosion-corrosion testing in flowing liquids
12.	11	ISO/TR 16208	Corrosion of metals and alloys -- Test method for corrosion of materials by electrochemical impedance measurements
13.	12	ISO/WD 16319	Corrosion of metals and alloys -- Test method for inhibitors for use in closed central heating systems
14.	2	ISO/DIS 16540	Corrosion of metals and alloys -- Methodology for determining the resistance of metals to stress corrosion cracking using the four-point bend method
15.	7	ISO/FDIS 16701	Corrosion of metals and alloys -- Corrosion in artificial atmosphere -- Accelerated corrosion test involving exposure under controlled conditions of humidity cycling and intermittent spraying of a salt solution
16.	2	ISO/FDIS 17081	Method of measurement of hydrogen permeation and determination of hydrogen uptake and transport in metals by an electrochemical technique
17.	11	ISO/DIS 17093	Corrosion of Metals and Alloys -- Guidelines for corrosion test by electrochemical noise measurements
18.	13	ISO/DIS 17224	Corrosion of metals and alloys -- Test method for high temperature corrosion testing of metallic materials by application of a deposit of salt, ash, or other substances
19.	13	ISO/DIS 17245	Corrosion of metals and alloys -- Test method for high temperature corrosion testing of metallic materials by immersing in molten salt or other liquids under static conditions
20.	13	ISO/DIS 17248	Corrosion of metals and alloys -- Test method for high temperature corrosion testing of metallic materials by embedding in salt, ash, or other solids
21.	9	ISO/DIS 17918	Corrosion of metals and alloys -- Evaluation of selective corrosion of alloys by visual inspection and hardness measurement
22.	6	ISO/CD 18069	Corrosion of metals and alloys -- Method for determination of the uniform corrosion rate of stainless steels and nickel based alloys
23.	11	ISO/CD 18070	Corrosion of metals and alloys -- Crevice corrosion formers with disk springs for flat specimens or tubes of stainless steels in corrosive solutions
24.	10	ISO/DIS 18086	Corrosion of metals and alloys -- Determination of AC corrosion -- Protection criteria
25.	11	ISO/CD 18089	Corrosion of metals and alloys -- Determination of the critical crevice temperature (ECCT) for stainless steels under potentiostatic control
26.	5	ISO/AWI 18298	Corrosion of metals and alloys -- Corrosion test for intergranular corrosion susceptibility of low -- Cr ultrapure ferritic stainless steels
27.	14	ISO/AWI 18897	Corrosion of metals and alloys -- Standard test method for erosion -- Corrosion of metallic materials by Jetin-slit
28.	10	ISO/AWI 19097	Corrosion of metals and alloys -- Accelerated life test method of mixed metal oxide anodes for cathodic protection
29.	9	ISO/AWI 19280	Measurement of crevice corrosion temperature for cylindrical crevice geometries



The chart shows the number of standards published annually. Along with the continuous development of science and technology from this new century, ISO/TC156 has been coming to its fast development. After SAC took over the work of secretariat, the standards published more and faster because of the efficiency work and the ISO new policy, which made the cycle of standard development reduced. 2012 was a productive year for ISO/TC156, 14 standards published.