



Exploration & Production

GENERAL SPECIFICATION

CORROSION

GS COR 101

**Design of internal cathodic protection of equipment
and storage tanks**

02	09/03	Change of Group name and logo
01	10/02	General revision - Requirement of Certification of specialised personnel
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Rev.	Date	Notes



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1. Scope

This document defines the minimum requirements for engineering, installation and commissioning of the internal cathodic protection of equipment such as vessels, separators, desalters, filters, etc. and the sacrificial anodes for it.

This document concerns also tanks containing crude oils with an electrolyte and tanks containing sea water or industrial water. External areas possibly exposed to corrosion risks are not covered by this document.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
prEN 12499	Internal cathodic protection of metallic structures - General principles
ISO 8044	Corrosion of metals Other associated Total General Specification and alloys - Technical terms and definitions
IEC 79	Electrical apparatus for potentially explosive atmospheres
IEC 529	Degrees of protection of electrical material enclosures (IP Code)
IEC 227	PVC isolated conductors and cables for rated voltage of 450 - 750 V

Professional Documents

Reference	Title
NACE RP-0595	Design, Installation, Operation and Maintenance of Internal Cathodic Protection Systems in Oil Treating Vessels
NACE RP-0196	Galvanic anode cathodic protection of internal submerged surfaces of steel water storage tanks
NACE RP 0388	Impressed current cathodic protection of internal submerged surfaces of steel water storage tanks
DNV RP-B401	Cathodic protection design

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS COR 201	Supply of sacrificial anodes
GS COR 352	Internal protection of equipment by painting
GS ELE 079	Electric apparatus for explosive gas atmosphere

3. Qualification and Certification of Cathodic Protection specialists responsible for the design

Design of cathodic protection systems to be installed for the internal cathodic protection of equipment shall be carried out exclusively by competent specialised personnel. The qualification of each of the specialists working for such a design shall be demonstrated to the OWNER before commencement of the job. Therefore the verification of the formal Certification of the individuals shall be carried out as follows:

- Conventional design work to be carried out by level 2 certified personnel
- Complex design work or verification to be carried out by level 3 certified personnel

Accepted Certification schemes are AFNOR Compétence (Internal Protection Application Sector), APCE (Internal Protection Application Sector), Institute of Corrosion, NACE International. Any other Certification scheme should be approved by the OWNER.

Any use of non certified personnel for cathodic protection design shall be subject to the approval of the OWNER on a case by case basis (demonstration of competence through detailed curriculum vitae and description of experience).

4. Study conditions

4.1 General

Unless otherwise stated, all the requirements of the prEN 12499 Standard are applicable. In particular, in the case where several materials are to be cathodically protected, the less noble material shall reach its potential level protection.

In addition and unless otherwise stated, all the requirements of the NACE recommendations RP-0595 and RP-0196 are applicable.

Except for particular cases duly justified, the internal surfaces of equipment and tanks in contact with an electrolyte are cathodically protected by sacrificial anodes.

4.2 Protection criteria

In order to limit the protection system by sacrificial anodes, it shall be completed by an efficient coating on metallic (non or low alloyed steel) surfaces.

4.2.1 Potential level for protection

For mild steels, the superior level for protection is in accordance with the following values:

- More negative than -0.8 V/Ag-AgCl-seawater for seawater
- More negative than -0.9 V/Ag-AgCl-seawater for water at high temperature, for acid water (pH < 6), or water containing bacteria or H₂S.

4.2.2 Coating breakdown factor

Coating with thickness > 300 microns in agreement with **GS COR 352** shall be applied in order to increase the durability of anodes or even to allow the feasibility of the protection, and the coating breakdown factors taken into account are those of III or IV category of the **DNV RP-B401** recommendation.

4.2.3 Sacrificial alloy selection

If the electrolyte is an effluent containing H₂S, zinc alloys are proscribed.

If the electrolyte temperature is above 25°C, the practical consumption of the alloy shall take into account the service temperature of the equipment. With electrolyte temperature over 50°C, zinc alloys are proscribed.

4.3 Parameters for study of the system

Necessary data for a cathodic protection study by the CONTRACTOR are specified in the Job Specification as:

- The electrolyte characteristics: composition (dissolved gases, H₂S, CO₂), conductivity, pH, temperature, pressure, for the maximum and average operating conditions
- The current density in function to this electrolyte
- The specified life span for the cathodic protection system and the shutdown frequency of the structure for inspection (to allow if necessary the substitution of anodes)
- The monitoring policy for the cathodic protection.

In case of lack of data specified in the Job Specification, the study is established for 10 years life span with an average current density with coating breakdown factor of 10% for the protection of:

- 40 mA/m² of coated surface immersed in a reservoir water (high salinity and corrosivity)
- 20 mA/m² of coated surface immersed in a sea water or an industrial water with similar salinity.

4.4 CONTRACTOR's responsibility

From data given in this document and/or in the Job Specification, the CONTRACTOR shall indicate particularly:

- The construction marked drawings of the structure to be protected, mentioning the metals or alloys nature and mounting details of all internal parts
- The type and characteristics of the coating systems for the surfaces to be protected
- The calculation basis defining the system
- The installation procedures with, eventually, the systems for a replacement during operating conditions.

5. Anodic system

5.1 Current demand for protection

The evaluation of the current demand shall take into account all the metallic surfaces, permanently or sequentially exposed to the electrolyte, bare and coated, by applying them the relevant current density as defined in Section 4 for the specified service life.

5.2 Anodes selection

The anodes selection shall consider:

- The compatibility with the electrolyte (composition, temperature)
- The available space and the current distribution in confined area
- The anodes dimensions (current output, weight) and their installation in order to define an unit weight of anodes.

The unit anode weight is function of the type of the anode and of the utilisation factor. The anodes are flat type on the metallic surface to protect with:

- An average utilisation factor of 0.8
- A trapezoidal or semi-cylindrical section
- An isolating coating on the face of the anode opposite to the surface to be protected.

5.3 Protection monitoring

According to the dimensions of structure to protect, monitoring of the cathodic protection may be required in the Job Specification, with the following equipment:

5.3.1 Permanent reference electrodes

For big equipment or storage tanks, one (or several) reference electrode(s) can be provided to monitor the efficiency of the cathodic protection by measuring directly the structure to electrolyte potential of them at the spot where it (they) is (are) located.

Permanent electrodes position, type and number are defined in the detailed calculations of the protection cathodic system studied by the CONTRACTOR.

5.3.2 Monitored anodes

For big storage tanks, one (or several) anode(s) can be provided to monitor the anode output current. The (these) anode(s) is (are) isolated with isolating joints from the structure and the anode(s) output current (s) is (are) monitored through a resistance.

5.3.3 Cables

Permanent reference electrodes and monitored anodes cables are reset on exterior side by a system passing through the wall of the structure, in order to monitor permanently the protection without penetration in the structure.

6. Quality assurance procedures

6.1 Design

At the beginning of the engineering, a Quality Plan must be drawn up by the CONTRACTOR, detailing all the actions related to the cathodic protection calculation, to the definition of the systems to install, to the provisioning and reception of materials. These shall be described in detailed procedures.

6.2 Qualifications

All the calculations and systems and the used materials shall be approved by the OWNER.

6.3 Materials

In the technical part, characteristics and references of some materials and apparatus used for the cathodic protection system shall be specified as:

- Sacrificial anodes checked in factory by the CONTRACTOR
- Coating
- System for potential replacement of anodes
- Reference electrodes (if necessary)
- Cables and wiring plans (if necessary)
- Insulating joints and shunts (if necessary).

6.4 Technical file

The technical file transmitted by the CONTRACTOR at the end of the works shall include:

- Detailed study of the structure cathodic protection
- Systems concerning the installation
- Detailed drawings of the sacrificial anodes
- Data sheets of anodes with their test certificates.