



Exploration & Production

## GENERAL SPECIFICATION

### CORROSION

#### GS COR 401

|                                                      |
|------------------------------------------------------|
| <b>Installation of anodes on submerged pipelines</b> |
|------------------------------------------------------|

|      |       |                                               |
|------|-------|-----------------------------------------------|
|      |       |                                               |
| 02   | 09/03 | Change of Group name and logo                 |
| 01   | 10/02 | Possibility of connection of anodes by cables |
| 00   | 02/01 | First issue                                   |
| Rev. | Date  | Notes                                         |



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## 1. Scope

The Standard Specification sets out the technical requirements governing the installation of sacrificial anode bracelets designed to provide submerged pipelines with cathodic protection, with or without concrete weight coating.

The anode bracelets are installed from a laying barge or at an on-shore site.

## 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                                                                   |
|------------|-------------------------------------------------------------------------|
| EN 12474   | Cathodic protection of sea lines                                        |
| ISO 13623  | Petroleum and natural gas industries – Pipeline transportation system   |
| BS 4515    | Welding of steel pipelines on land and offshore                         |
| EN 287-1   | Approval testing of welders. Fusion welding, Part 1: Steels             |
| EN 288     | Specification and approval of welding procedures for metallic materials |
| ISO 10474  | Steels and steel products - Inspection documents                        |
| ISO 8501-1 |                                                                         |

### Professional Documents

| Reference          | Title                                                                                                |
|--------------------|------------------------------------------------------------------------------------------------------|
| DNV RP B 401       | Cathodic Protection Design                                                                           |
| API 5 L            | Specification for pipeline                                                                           |
| ASME B 31-4        | Liquid transportation systems for hydrocarbons, liquid petroleum gas, anhydrous ammonia and alcohols |
| ASME B 31-8        | Gas transmission and distribution piping systems                                                     |
| ASTM A 283 grade C | Standard specification for low and intermediate tensile strength carbon steel plates                 |
| ASTM E 165         | Standard Test Method for liquid penetrant examination                                                |
| NACE RP 0675       | Control of External corrosion on offshore steel pipelines                                            |
| API 1104           | Welding of pipelines and related facilities                                                          |

## Regulations

| Reference      | Title |
|----------------|-------|
| Not applicable |       |

## Codes

| Reference      | Title |
|----------------|-------|
| Not applicable |       |

## Other documents

| Reference      | Title |
|----------------|-------|
| Not applicable |       |

## Total General Specifications

| Reference  | Title                                                                                     |
|------------|-------------------------------------------------------------------------------------------|
| GS COR 102 | Design of cathodic protection of sealines by sacrificial anodes                           |
| GS COR 201 | Supply of sacrificial anodes                                                              |
| GS PLR 420 | Site welding of carbon steel pipelines to API 1104 (sweet and mild sour service)          |
| GS PLR 421 | Site welding of carbon steel pipelines to API 1104 (intermediate and severe sour service) |

## 3. Shape, dimensions and number of sacrificial anode bracelets

The quality, inspection and warranty requirements governing the supply of sacrificial anode bracelets are defined in **GS COR 201**.

The Job Specification drawn up for each pipeline shall define the dimensions, weight, design and number of bracelets to be installed in compliance with **GS COR 102**.

The two documents mentioned above, and this document shall be an integral part of any call for tenders for the supply and installation of sacrificial anode bracelets.

## 4. Installation of the bracelets

### 4.1 Technique

On all line pipes on which sacrificial anodes are to be installed, the bracelets shall be positioned:

- At one end (line pipes without concrete coating), or
- In the middle of the line pipe if concreted.

In the second case, the CONTRACTOR may also provide a position that is unconcreted and without reinforcing rods at one end of the line pipe on which the bracelets are to be installed.

When the bracelets are installed at the ends, they shall be located outside of the butt jointing zone, in other words, at least 0.25 m from the end of the line pipe.

## 4.2 Electrical connection systems

The lugs serving for electrical contact are positioned and shaped to achieve good contact with the pipe from which the coating has been stripped locally.

### 4.2.1 Welding of anode pads

Welding of anode pads is the preferred method for establishing electrical contact between the sacrificial anode and the sea line.

### 4.2.2 Electrical connection through cables

In some cases defined here after, electrical connection between anode pads and pipe through cables can be accepted by the OWNER provided that the following requirements are fulfilled:

- 2 cables are used per anode
- Cables are protected from mechanical damage by adequate location and/or mastic infill in case of concrete weight coated pipelines
- Connection of cables to steel pipe is carried out either through a doubler plate or directly by approved methods based on aluminothermy or Pin brazing by electrical discharge.

This kind of connection may be accepted in the following cases:

- **S-laying pipelines method**

For S-layed pipeline method, when concrete weight coating is applied and when yield strength of the steel grade is less than 420 MPa (X60), pin brazing by electrical discharge method can be used.

When the yield strength is 420 MPa and higher, a special metallurgical evaluation is required in order to approve the pin brazing, or the cable is to be pin brazed on to a double plate welded on the pipeline.

- **J-laying pipelines**

For J-laying pipelines when yield strength of the steel grade is less than 420 MPa and when there is installed mechanical protection to the anode, the pin brazing by electrical discharge method can be used. If concrete coating is applied, no special mechanical protection of the anode is required.

When the yield strength steel grade is 420 MPa and higher a special metallurgical evaluation is required in order to approve the pin brazing, or the cable is to be pin brazed on to a doubler plate welded on the pipeline.

### 4.2.3 Other connection or laying method

For any other connection or laying method (like reel barge method), SUPPLIER shall provide any necessary information in the same way as defined above through a specific procedure for COMPANY approval.

### 4.3 Connection qualification requirements

In all cases where welding of anode pads or welding of doubler plates is applied, a fully qualified procedure is required in accordance with the requirement defined for the main pipe welding ([GS PLR 420](#) or [GS PLR 421](#)).

In all cases where any pin brazing method or alumino-thermy method is applied, a fully qualified procedure shall be required in accordance with [BS 4515](#) and [GS PLR 420](#) or [GS PLR 421](#).

#### 4.3.1 Electrical connections on the line pipe by welding of anode pads

Details of the connections are defined in the sections below. However, before executing the welds, the coating must be entirely removed at the point where the fixing lugs or flaps (shaped for welding) are to be fitted, according to the type of bracelet to be installed.

To minimize damage to the coating, the reconstructed bracelet shall be offered up to the line pipe, in the welding position, to define the exact position of the fixing lugs or flaps.

The stripped areas shall extend no more than 10 to 15 mm beyond the metallic elements to be welded.

#### 4.3.2 Assembly of half-shell anode bracelets

The half-bracelets are assembled in pairs, by arc welding the two steel plates (30 x 6 mm flats) to the uncovered parts of the cores, in the transverse openings provided (in accordance with type 1 in the drawing in Appendix 1) or by arc welding the transverse cores making the half-shells stand out (in accordance with type 2 in the drawing in Appendix 1).

The lengthwise cores (2 or 4 depending on SUPPLIER) making the half-shells stand out shall be welded along two generatrices of the line pipe.

These parts of the cores shall ensure electrical continuity between anodes and line pipes and the mechanical strength of the anodes on the line pipes.

#### 4.3.3 Assembly of segmented anode bracelets

The half-bracelets are assembled by bolting, in pairs, in accordance with the drawing in Appendix 2. This method of fixing provides mechanical strength.

Electrical continuity with the line pipe is provided by at least eight spot welds (for each reconstructed anode bracelet) each 10 mm long, or by shaped flats welded to collars and then to the line pipe.

### 4.4 Assembly on concreted sea line

The assembly of half-shell or segmented anodes on a concreted sea line will entail particular specifications.

Where anodes are located in mid line pipe, the concrete CONTRACTOR shall execute a groove in the concrete such that **the meshed reinforcing steel rods cannot under any circumstances come into contact with the core of the anodes.**

This groove shall be as long as the overall length of the bracelet, plus two times 5 cm as a minimum.



## 5. Welding

All welding operations must be carried out by qualified welders according to a previously qualified procedure, submitted to the OWNER for approval.

The procedure shall specify:

- Preparation of the joints
- Execution of the joints
- Quality of welds/inspections.

Interconnecting plates shall be welded by continuous fillet welds around the entire periphery of each plate.

## 6. Coatings

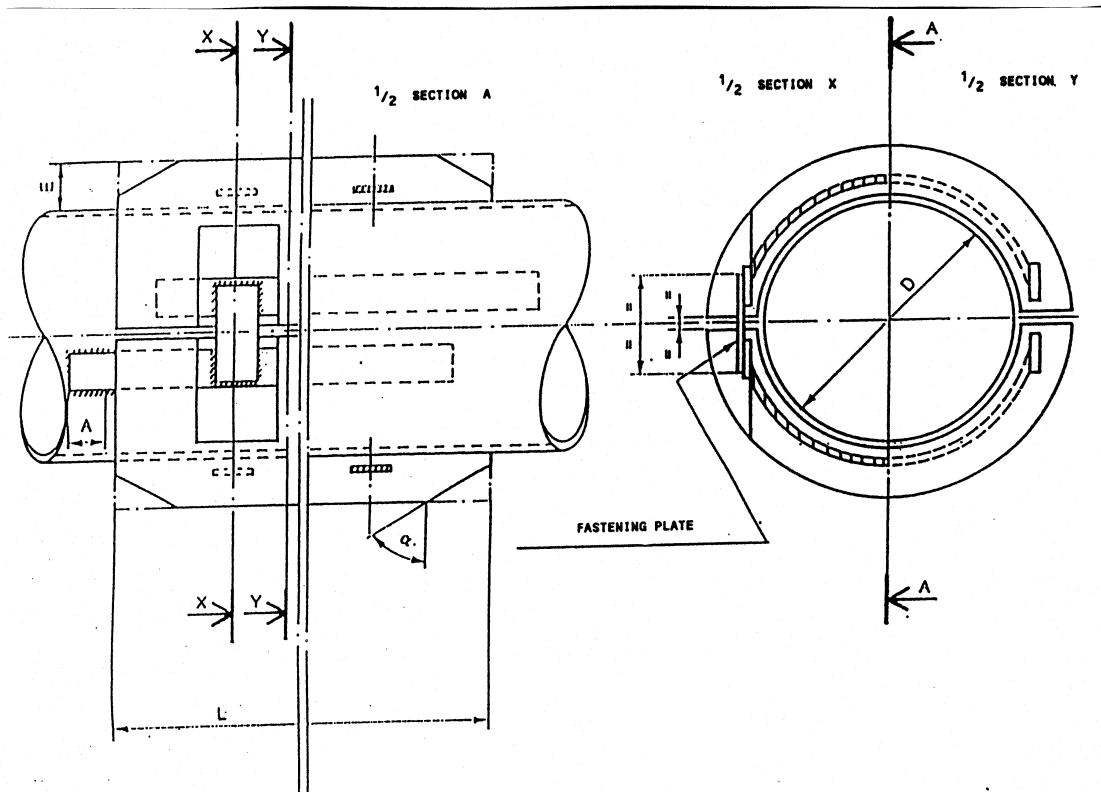
All visible parts of the cores and/or fixing lugs shall, when fitted and welded, be insulated from the environment by a coating. Pitch, an asphalt concrete compound or an elastomer-based mastic may be used.

The surface shall be brushed clean prior to coating to grade of cleanliness ST 2 as specified in [ISO 8501-1](#).

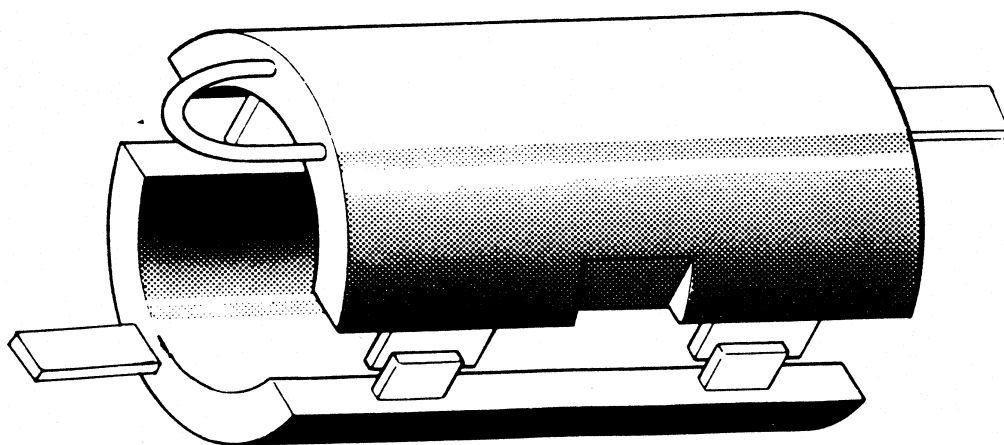
In the case of concreted line pipe, the reinforcing steel rods visible on either side of the groove shall be insulated, preferably using an asphalt concrete compound or one of the products chosen to insulate the cores of the bracelets.

## Appendix 1 Drawings of half-shell anode bracelets

TYPE1



TYPE2



## Appendix 2 Drawing of segmented anode bracelet

