



Exploration & Production

GENERAL SPECIFICATION

PIPELINES - RISERS

GS EP PLR 410

Concrete coating for submarine pipelines

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1. Scope

This specification defines general requirements for the concrete weight coating for submarine pipelines (in sea, river and estuary conditions). This specification will apply also for concrete weight coatings of temporary or permanently submerged pipelines such as partially flooded areas or swamps.

Pipes are assumed to have already been anti corrosion coated either in the same plant or alternatively arriving coated from another location or plant.

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
ASTM A 82	Standard Specification for steel wire, plain, for concrete reinforcement
ASTM C 31	Std Method of making and curing concrete tests specimens
ASTM C 33	Concrete Aggregates
ASTM C 39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 150	Standard Specification for Portland Cement
ASTM C 171	Standard specification for sheet materials for curing concrete
ASTM C 227	Standard method for potential Alkali reactivity of cement aggregate
ASTM C 309	Liquid membrane. Forming compounds for curing concrete
BS 1881	Methods of testing concrete
BS 4027	Specification for sulphate resisting Portland cement
BS 4482	Specification for cold reduced wire for the reinforcement of concrete
BS 4483	Steel fabrication for the reinforcement of concrete
BS EN 196	Methods of testing cement - Part 1: Determination of strength
BS EN 197	Cement. Composition, specifications and conformity criteria for low heat common cements
EN 1008	Mixing water for concrete-specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete
EN 12504-1	Testing concrete in structures - Part 1: Cored specimens - taking, examining and testing in compression

Reference	Title
EN 12620	Aggregates for concrete
ISO 1920	Testing of concrete

Professional Documents

Reference	Title
API 5L	Specification for high-test line pipe
DNV-RP-F111	Interference between trawl gear and pipelines

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
GS EP COR 220	Three layer polyethylene external coating for pipelines
GS EP COR 221	Three layer polypropylene external coating for pipelines
GS EP COR 223	Bituminous hot applied external pipeline coatings
GS EP COR 401	Installation of anodes on submerged pipelines
GS EP PLR 406	Storage and transportation of line pipes
GS EP PLR 420	Site welding of carbon steel pipelines to API 1104 (sweet service)
GS EP PLR 421	Site welding of carbon steel pipelines to API 1104 (mild, intermediate and severe sour service)

3. Definitions and abbreviations

3.1 Definitions

The Inspector The COMPANY's representative or a member from an inspection agency duly appointed in writing by the COMPANY to act as his representative for the purpose of the contract shall be referred to herein as the "Inspector".

3.2 Abbreviations

PPS	Project Particular Specification
PQT	Procedure Qualification Trial
PU	Polyurethane

4. Concrete weight coating design

4.1 General

Such concrete coating is intended to:

- Achieve the required pipeline negative buoyancy
- Provide the required additional mechanical protection to the pipeline (if any)
- Provide thermal insulation (if any)

The particular project specification (PPS) - see also Appendix 1 - will provide the following information for each category of pipe:

- Concrete density
- Concrete thickness
- Value of negative buoyancy required (with tolerances)
- Shear strength

Note 1: In close liaison with Engineering, to get best economical compromise, CONTRACTOR may proposed to COMPANY approval an alternative concrete coating thickness by balancing concrete thickness and concrete composition to achieve the required submerged weight necessary for the stability of the pipeline.

Note 2: This specification is covering continuous cylindrical concrete coating. In some circumstances, stability of the submerged pipelines may be achieved by other means or tools (concrete blocks, concrete poured in situ into mini cofferdams, etc.).

The concrete coating thickness shall not be less than 40 mm.

4.2 Service conditions

The coating materials shall be designed to meet the following general service conditions, of underwater pipeline i.e. unless other wise specified in the particular specification:

- Installation shall be by the lay barge method
- Temperatures during storage may vary from -15°C to 50°C
- Air temperature during installation may vary from 5°C to 40°C

- Pipeline may be laid in a trench or on the seabed
- Pipeline may be thermally insulated.

The PPS (see Appendix 1) will give other needed information as for instance pipeline operating temperature range.

4.3 Concrete coating materials

4.3.1 Cement

All cement used for the preparation of the concrete shall conform to [ASTM C 150](#) Type II.

Type I is acceptable in fresh water only.

The tricalcium aluminate content (C3 A) of the cement shall be within the range of 3 to 10% for cement Type II (% cement weight).

Alkalies content (Na₂O) shall be maximum 0.6% (% cement weight).

The cement shall resist to the effects of sulphates.

The minimum required cement dosing shall be 400 kg/m³ of concrete mix.

4.3.2 Sand (Silica type)

Sand used shall be grain rounded and shall be obtained by sieving. Clayey or schistose sands shall not be used. It shall be free of injurious amounts of salt, alkali, deleterious substances or organic impurities.

Suitability of the natural sand for making of concrete shall be determined in accordance with the requirements of [ASTM C 33](#).

Sand size shall not exceed 9.5 mm.

Sand shall be cleaned by washing or de-dusting process in order to meet above mentioned Standards.

Washing will be performed with fresh water. Sand shall be washed so as not to remove the smaller grains as defined (refer to [ASTM C 33](#)).

4.3.3 Coarse aggregate

Selected according to the type of concrete to be produced, coarse aggregate shall be crushed granite or equivalent material.

Coarse aggregate size shall not exceed 9.5 mm.

Coarse aggregates shall not contain any materials which may react with alkalies in the cement.

The cleanliness of the aggregate must be controlled by screening at the crusher and must be clean and free of deleterious material.

Aggregates shall be cleaned by washing or de-dusting process in order to meet above mentioned Standard.

Washing will be performed with fresh water.

4.3.4 Heavy aggregate

The aggregate may be granite or approved equivalent material. Iron ore may be added to achieve the required density and required negative buoyancy.

Heavy aggregate size shall not exceed 9.5 mm.

The heavy aggregate shall be clean and free of clay.

This shall be stored on rolled hard core or other paved area approved by COMPANY.

The cleanliness of the aggregate must be controlled by screening at the crusher and must be clean and free of deleterious material.

Aggregates shall be cleaned by washing or de-dusting process in order to meet above mentioned Standard.

Washing will be performed with fresh water.

4.3.5 Reinforcement

Galvanized steel poultry netting or chicken wire is not allowed for internal reinforcement of concrete coating for pipelines.

Two kinds of reinforcement may be used: welded cage or wire mesh.

4.3.5.1 Welded cage

The reinforcement should be "square grip" conforming to [BS 4483](#). The overlap shall be 100 mm minimum.

Characteristics of the welded cage shall be the following:

	Longitudinal reinforcement	Circumferential reinforcement
Steel bar diameter	3 to 8 mm	5 to 12 mm
Bar spacing	75 to 400 mm	75 to 150 mm
Percentage of coating sectional area	0.1 to 0.2%	0.45 to 1.0%

Detailed positioning of the reinforcement shall be provided.

4.3.5.2 Wire mesh

Wire mesh (spot welded mesh made of galvanized low carbon steel wire) shall be designed, manufactured and tested according to [BS 4482](#) and [BS 4483](#).

Characteristics of the wire mesh shall as follows:

	Longitudinal reinforcement	Circumferential reinforcement
Steel bar diameter	2 to 4 mm	2 to 4 mm
Bar spacing	50 to 300 mm	65 to 100 mm
Percentage of coating sectional area	0.08%	0.4%

The overlap shall be 25 mm minimum.

4.3.5.3 General requirements for reinforcement

Minimum number of reinforcement layers shall be as follows:

Nominal concrete coating thickness	Number of layers
40 mm to 70 mm	1
70 mm to 100 mm	2
100 mm to 150 mm	3

In both cases, the distance between anti corrosion coating and reinforcement shall be 15 mm minimum; the reinforcement shall be covered by 20 mm minimum of concrete.

4.3.6 Mixing water

The mixing water shall comply with [EN 1008](#). The water shall be clean and free from injurious oils, acids, alcohols, salts or organic materials.

Water analysis shall be subject to COMPANY approval.

4.3.7 Fibre reinforcement

To increase the tensile strength of concrete (thickness in the range of 50 to 60 mm), the use of fibre reinforcement may be proposed to COMPANY.

4.4 Properties of the concrete coating

4.4.1 Concrete mix design

Reuses of concrete shall not exceed 10% by weight of the total mix.

Full details shall be provided with respect to:

- The proportions and weights of the respective dry aggregates per cubic meter of concrete
- The cement weight per cubic meter of concrete
- The proportion and volume of water, per cubic meter of concrete
- The results of the preliminary tests for water absorption and resistance
- The density of the proposed mix. This density shall take into account the impact of the weight of reinforcement layers in the final apparent density required.

The component parts of the concrete must be properly mixed in order to provide a continuous, homogenous and consistent mix.

The proposed composition shall meet the minimum mechanical strengths and water absorption specified and shall ensure easy and satisfactory application of the concrete coating.

Proposed composition may be changed during coating operation. Such change needs the written approval of the COMPANY.

Mix design, mixing equipment, components and mix weighing methods shall be clearly documented and subject to COMPANY approval prior to the application. Allowed weighing tolerances specified in 7.3.1.3 shall be taken into account in the mix design.