

	ERECTION OF GLASS REINFORCED PLASTIC PIPING JOB SPECIFICATION	 NIOC <i>Pars Oil & Gas Company</i>
Contract No.: POGC 653-89-35	Doc. No.: RP-14 -999 -1300- 032-I	Rev.:D0 Class:1

FOR CONSTRUCTION

NATIONAL IRANIAN OIL COMPANY

SOUTH PARS GAS FIELD DEVELOPMENT

PHASE 14

TOMBAK-ONSHORE FACILITIES

DETAIL DESIGN

DOCUMENT TYPE : Project Specification

DOCUMENT TITLE : ERECTION OF GLASS REINFORCED PLASTIC PIPING JOB SPECIFICATION

DOCUMENT NUMBER : RP-14-999-1300-032-I

SITE : TOMBAK/ SOUTH PARS GAS FIELD DEVELOPMENT, PERSIAN GULF, IRAN

D3							
D2							
D1				S.M	A.D	M.F.	
D0	26.Jan. 2011	Approve for construction	IPMI	S.M.	A.D.	M. F.	P.T.B.
REV	DATE	DESCRIPTION	ORIG.	PRPD	CHKD	APPD	CONTRACTOR APPD



	ERECTION OF GLASS REINFORCED PLASTIC PIPING JOB SPECIFICATION		 NIOC <i>Pars Oil & Gas Company</i>	
Contract No.: POGC 653-89-35	Doc. No.: RP-14 -999 -1300- 032-I		Rev.:D0	Class:1

CONTENTS

- PROJECT DESCRIPTION
- GENERAL STATEMENT
- ADDENDUM
- TEP GENERAL SPECIFICATION No. SP-TCS-178 Rev. 0

	ERECTION OF GLASS REINFORCED PLASTIC PIPING JOB SPECIFICATION		 NIOC <i>Pars Oil & Gas Company</i>	
Contract No.: POGC 653-89-35	Doc. No.: RP-14 -999 -1300- 032-I		Rev.:D0	Class:1

PROJECT DESCRIPTION

The South Pars gas field located 130 Km offshore shall be developed to produce 2 bscfd reservoir fluids and to transport the fluids to the mainland (TOMBAK) at a distance of 130 Km. approximately for further treatment.

This development phase referred to as PHASE 14 will be integrated into the overall development plan of South Pars Gas Field.

GENERAL STATEMENT

The attached TOTAL EXPLORATION PRODUCTION (TEP) General Specification No. : SP-TCS-178 Rev.0 is confirmed as the Project Specification, except as amended herein and renumbered/reissued as Specification No. : RP-14-999-1300-032 for SOUTH PARS GAS FIELD DEVELOPMENT, Phase 14 Project.

	ERECTION OF GLASS REINFORCED PLASTIC PIPING JOB SPECIFICATION		 NIOC <i>Pars Oil & Gas Company</i>	
Contract No.: POGC 653-89-35	Doc. No.: RP-14 -999 -1300- 032-I		Rev.:D0	Class:1

ADDENDUM

The following items refer to the attached TEP General Specification No. : SP-TCS-178 REV. 0.

The clauses set out below modify or replace the existing clauses in the original specification as noted.

GENERAL COMMENTS

- The following terms which are used in this general Job Specification are deleted and replaced by:

Engineering company by contractor: shall mean the party which has entered under a Contract Agreement with CONTRACTOR for the design, engineering, procurement and construction of the Onshore Facilities regarding the South Pars Gas Field Development, Phase 14 Project.

TOTAL TEP: shall be read as COMPANY or his nominated representative.

Manufacturer: shall mean any person, firm or company which manufacture or supply equipment or services for the performance of any item of the work.

Work: shall mean works and/or services entrusted by CONTRACTOR under the contract with COMPANY.

GENERALLY:

All Referenced documents to ANSI should be changed to ASME, as it is described below:

Replace ANSI B16.5 shall be replaced by:

ASME B 16.5: Pipe Flanges and Flanged Fittings

Replace ANSI B31.3 shall be replaced by:

ASME B 31.3: Process Piping

The following sentence shall be added:

Effective date of all Standards shall be considered: latest revision

	ERECTION OF GLASS REINFORCED PLASTIC PIPING JOB SPECIFICATION		 NIOC <i>Pars Oil & Gas Company</i>	
Contract No.: POGC 653-89-35	Doc. No.: RP-14 -999 -1300- 032-I		Rev.:D0	Class:1

2. REFERENCE DOCUMENTS

2.1. CODE AND STANDARDS

The following Standard shall be added in this part:

ASME B 16.47: Large Diameter Steel Flanges-NPS 26" through NPS 60"

2.2. TOTAL CFP SPECIFICATIONS:

SP-TCS-118 shall be replaced by: RP-14-999-1300-020 Design of Glass Reinforced Plastic Piping

SP-TCS-148 shall be replaced by: RP-14-999-6500-027

Glass Reinforced Plastic Piping Material

4. ASSEMBLY

4.2. FLANGED JOINTS

4.2.2. Loose Flanges

Replace "ANSI B 16.5" by: "ASME B 16.5 or ASME B 16.47"

4.2.3. Fixed Flanges

Replace "ANSI B 16.5" by: "ASME B 16.5 or ASME B 16.47"

7. INSPECTION AND TESTS

7.2. VISUAL INSPECTION

SP-TCS-148 shall be replaced by: RP-14-999-6500-027

Glass Reinforced Plastic Piping Material

TOTAL

COMPAGNIE FRANCAISE DES PETROLES
TOTAL EXPLORATION PRODUCTION

GENERAL SPECIFICATION

PIPING - VESSELS - WELDING

SP-TCS-178

ERECTION OF GLASS-REINFORCED PLASTIC PIPING

0	03/87	First issue
REV.N°	DATE	SUBJECT OF THE REVISION

This document is the property of C.F.P. , it must not be reproduced or transmitted to others without written authorisation from the company

TABLE OF CONTENT

	Date rev.	Page
1 - SCOPE		3
2 - REFERENCE DOCUMENTS		3
2.1 - Codes and Standards		3
2.2 - TOTAL CFP Specifications		3
3 - STORAGE AND HANDLING		3
3.1 - General		3
3.2 - Storage		3
3.3 - Handling		4
4 - ASSEMBLY		4
4.1 - Cemented joints		4
4.2 - Flanged joints		7
5 - REPAIRS		9
6 - BURYING OF UNDERGROUND PIPING		10
7 - INSPECTION AND TESTING		10
7.1 - General		10
7.2 - Visual Inspection		11
7.3 - Hydrostatic testing		11

1 - SCOPE

The aim of this specification is to define the requirements for the erection of glass-reinforced plastic piping (G.R.P.), for both above ground piping and underground piping. This document also presents the various assembly techniques which are acceptable and gives the list of inspection and tests which are to be carried out before start-up.

2 - REFERENCE DOCUMENTS

The latest revisions of the following documents shall apply to the erection of Glass Reinforced Plastic Piping within the scope of the present specification :

2.1 - Codes and Standards

ANSI B 16-5 : "Steel Pipe Flanges and Flanged Fittings"

ANSI B 31-3 : "Petroleum Refinery Piping"

2.2 - TOTAL CFP Specifications

SP-TCS-118 : Design of Glass-Reinforced Plastic Piping

SP-TCS-148 : Glass-Reinforced Piping Materials (Tubes and Accessories)

If there is a disagreement between this specification and any of these documents, the VENDOR must so inform TOTAL CFP who will decide ; it is understood that in this case, the more stringent requirement shall be assumed to apply in the absence of formal approval by TOTAL CFP.

3 - STORAGE AND HANDLING

3.1 - General

It is important that the external surface of piping and piping extremities be protected against contact or shocks with hard or sharp-angled objects. The protective materials should generally be softer than G.R.P. Wood and polyethylene foam may be used. Should a shock arise, it is detectable by a white mark at the contact point. If this local damage only affects the outer skin, it is of no consequence to the integrity of the pipe. However, it shall be repaired, so as to maintain a protection against outside elements.

3.2 - Storage

During the transportation of finished products to the storage area, all necessary precautions shall be taken so as to avoid any deterioration.

The storage shall be made on a flat surface from which all roughness has been removed.

Storage on several levels is permitted. In this case, wide planks, approximately 2,00 m apart and vertically lined-up, shall be placed between layers. The thickness of planks shall be such that the bell ends of the tubes do not touch.

3.3 - Handling

The handling of pipes without extremity protection is strictly prohibited.

The only acceptable handling methods are :

- by hand, the pipes are thus handled individually,
- by crane, using large slings made of textile straps held spread by a bar.

4 - ASSEMBLY

4.1 - Cemented joints

4.1.1 - General

This is made by an overlapping glued seal, with a certain contact surface (socket assembly).

Butt-assembly is not authorized.

A cement joint relies on several factors :

- surface preparation
- type of glue
- shape and thickness of joint

4.1.2 - Surface preparation

a) General principles

The junction is made between the external surface of a pipe and the internal surface of a bell or a sleeve.

The joint shall be made between two surfaces where the glass fibre has been uncovered and where there is no trace of grease, humidity or dust.

Unless exceptional protective methods are used, no gluing shall be undertaken during sand-storm or rainfall periods.

b) External surface of pipe

The external surface of the pipe shall be ground. The external layer of resin shall be taken off and the first glass fibres uncovered. It is recommended that a machine which fixes to the pipe, and enables this descaling to be carried out in a perfectly circular geometric manner with exact dimensions, be adopted. Sizing shall be made by a machine similar to a lathe.

This operation may be carried out on the assembly area or in advance, in the shop. In the latter case, the freshly cut surface shall be recovered with a light coat of varnish so as to protect it from dampness. This coat shall disappear during the next operation.

The surface is finally rubbed with emery cloth and cleaned with a volatile solvent so as to remove all traces of grease, dust and humidity.

As a volatile solvent, acetone may be used. This substance is mixable in water in all proportions and removes surface humidity as it evaporates. However, this property does not enable work to be performed under rainfalls.

c) Internal surface of the bell or sleeve

The internal surface of the bell or sleeve shall not have a gel coat at the gluing area. Defrosting by grindstone or emery cloth is adequate enough for the uncovering of the first glass fibres of reinforcement.

As for the pipe, a cleaning with a volatile solvent shall remove all traces of grease, dust and humidity.

4.1.3 - Glue

The type of glue to be used shall depend upon the resin used for the piping materials. The glues shall be compatible with the resin. They shall be of the same type. The glues shall always be of the two components, cold polymerization type.

The two components are kept separately at a certain temperature which shall not be exceeded. They shall be mixed before use. It is quite difficult to obtain a homogeneous mixture. However, this homogeneity is indispensable for a good joint, as the chemical reaction of the resin with the hardener takes place when accurate proportions are respected.

The quantity to be mixed shall correspond to the work to be carried out, as the excess product shall be thrown away and cannot be reused. After mixing, the glue shall form a rather viscous paste. It shall pour out in a trickle when drawn. The female part of the assembly shall receive a light coat of glue over its surface, including the tube stopper ; the male part shall receive a thick coat over its surface and a light coat over its edge.

So that the glue may be used rationally, and assuming a perfect mixture of the two components, the two following values shall be known :

- gelation time, as a function of temperature,
- hardening evolution through time after gelation, for varying temperatures.

By the selection of hardener and accelerators, the curing time may be modified to a great extent. It is often technically preferable to obtain a rather slow hardening. This is possible if the two parts to be glued remain perfectly still.

Otherwise, quick hardening glues or heating is necessary to increase the speed of curing time. For this, hot air can be blown or even small heating covers with electrical resistances may be used. The heating temperature shall be 70°-120°C. The assembly shall never be brought into direct contact with a flame. Despite the heating, the polymerization is always considered as a cold process because the temperature remains moderate.

The heat shall not at all, or almost not, decrease the viscosity of the resin, because it could run. A quick hardening is necessary, for example, especially in climates where daily temperatures are very variable. In this case, thermal expansion could extend or dilate the parts during curing and the joint obtained might be of poor quality.

4.1.4 - Shape and thickness of glued joint

For strength and tightness, a glued joint should be thin. In the case of a thick joint, the glue must not only be made of a resin and a hardener mixed together to form polymers : solid substances must be added, for example, silica powder. These substances act like sand and gravel in concrete. The joints may be cylindro-conical or cone/cone.

a) Cylindro-conical joints

The male part is prepared on the assembly area with a straight pipe, as indicated in 4.1.2.

The conical part is workshop made. Its fabrication is delicate and thus the fittings are most often provided with conical female bells at each end.

The straight pipes may end by bells or have plain ends. The joining of straight pipes is made by sleeves which have conical bells on each end. The conical bell is obtained by filament winding on a mandrel, without discontinuity with the rest of the part.

The conicity shall vary from 1 to 2 %. The conical part shall halt at a stopper on which the male part shall come to rest. The gel-coat of the pipe shall go no further than the stopper, the conical part shall not have a gel-coat. This part shall have only a small coat of resin above the reinforcement fibres. This coat shall be removed before gluing by simply using sand-paper.

For joining of pipes, more glue shall be put on the male part than on the female part. The male part shall be pushed in to a maximum until it touches the stopper.

b) Cone/cone joints

The advantage to these joints is that they require only a light film of glue, in comparison to cylindro-conical assemblies. The machining principle remains identical to that used for cylindro-conical assemblies.

4.1.5 - Flow direction

The direction of flow shall preferably run from the male side of the joint towards the female side.

4.1.6 - Inspections on glued assemblies

a) Cylindro-conical assemblies

In cylindro-conical assemblies, the points to be checked are as follows :

- on the cylindrical male part :
 - . external diameter
 - . length of the machined end
- on the conical female part :
 - . regularity of the external bell
 - . conicity
 - . length of cone up to stopper
 - . internal diameter at bottom of bell

b) Cone/cone assemblies

In cone/cone assemblies, the conicity of both parts shall be checked.

4.2 - Flanged joints

4.2.1 - General

This type of joints allows the fabrication of systems which may be dismantled. It also enables the joining of heterogeneous materials, for instance G.R.P. and steel. For plastic pipes reinforced with glass fibre, either loose flanges or fixed flanges, integrated to the pipe, may be used.

4.2.2 - Loose flanges

Loose flanges are generally made of steel. They shall have bolt holes in compliance with ANSI B 16-5, enabling connections to metallic materials.

The flange shall have no sharp edges at the point where its cylinder bore comes in contact with the collar. The collar shall be made of G.R.P. It is rarely fabricated by hot pressure moulding. It is rather made by filament winding of rovings, or better still, by strip winding. The latter offers a better resistance to stresses according to pipe axis.

The MANUFACTURER shall allow adequate collar length to withstand the operating pressure and, in all cases, to withstand the pressure applied to the joint.

4.2.3 - Fixed flanges

Fixed flanges shall be industrially made for the specific pipes and the specific pressures. They shall be fabricated by hot pressure moulding, or by filament winding. They shall be added and glued to pipes or fittings by cylindro-conical or cone/cone glued joints.

The bolt holes of flanges shall comply with ANSI B 16-5, enabling connections to metallic materials.

4.2.4 - Flange tightening

G.R.P. flanges have a breaking limit close to the elastic limit. The tightening of flanges is thus more delicate than for steel which is a ductile material. It is accordingly essential that great care be taken during tightening. Tightening on faces which are not parallel leads to breaking. Even if the faces are parallel, the limit given by the MANUFACTURER shall not be exceeded for bolt tightening (often 7 kgm). There shall be naturally fitted with washers.

The bolts shall be tightened using a torque wrench.

4.2.5 - Gaskets

The tightness of the assembly is always ensured by gaskets. These shall be flat gaskets covering the whole contact surface of the collar or the fixed flange. On the latter case, the gaskets shall be drilled for the tightening bolts to be placed.

In general, the gaskets are softer and thicker than those for steel, for several reasons. The gasket should be softer than the G.R.P. The G.R.P. distorts a lot more than steel and the gasket should be able to distort a lot more than the G.R.P. The G.R.P. does not have the same machining precision as steel ; the gaskets must be thick and flexible to absorb the unevenness. For these reasons, neoprene gaskets of max. A60 shore hardness shall be used. At heavy pressures, the gasket flow poses a problem. For surfaces with relief scores, a synthetic rubber gasket of 3 to 5 mm thickness may be used, depending on the diameter.

4.2.6 - G.R.P. to steel assembly

In this case, steel flanges shall be of the flat face type in compliance with ANSI B 31-3. The joints shall also be of neoprene type max. A60 shore hardness and of 3-5 mm thickness according to diameters.

4.2.7 - Inspections of flanged joints

a) Fixed flanges

The contact face of the flange shall be perfectly perpendicular to the axis of the pipe. This contact face shall be designed to fit a gasket extending to the external diameter of the flange (the gasket should be drilled for the passage of bolts).

b) Loose flanges

The flange collar shall be added and glued to the pipe or the fitting with a glued joint. Its external diameter shall be flush with the flange bolts. The face of the collar in contact with the gasket shall be smooth and perfectly perpendicular to the pipe axis.

5 - REPAIRS

With G.R.P. materials, there is the possibility of making local repairs in case of damage or even in case of perforation of a pipe.

The surface preparation, which plays an extremely important part, shall be carried out immediately before gluing. The damaged surface shall be cleaned. The existing resin layer shall be rubbed with a metallic brush and sand-paper. It shall then be cleaned with methyl-ethyl-ketone. This strong solvent will remove any traces of grease and will attack the existing resin.

This shall enable a better adhesion of the new resin. Once the solvent has evaporated, a coat of new resin shall be applied by brush over the former one, without any trace of humidity. The presence of water would prevent adhesion.

Following this, a coat of glass mat shall be applied. On the contact surface, adhesion is improved by the small glass fibres which pass beyond the former surface. The mat catches these small fibres, evens the surface for the subsequent winding of glass strips, and absorbs well the resin. Sometimes, two coats of mat are required if the surface is very irregular.

Glass tape is then wound over the mat. These tapes shall have finished edges and shall be quite light (300 g/m²). They shall be wound with a 30 % overlap and manually imbibed. On each layer, the air pockets shall be removed. The winding shall be carried out in such a way that the mechanical solidity of the piece shall be restored. For a pipe, crossed spiral winding like primitive filament winding shall be applied. The various layers of tape shall uncross regularly so that the external surface, once the winding has been finished, takes a tapered shape.

All this does not involve making a cylindrical sleeve which would be less strong. This work, which can be carried out in the factory, is often difficult on site because of adverse working conditions, for instance humidity. This repair is a sort of "dressing". The continuity of the pipe glass fibre is not ensured. Strength is only obtained if the defect is largely covered over its whole extent (the winding extending both sides of the defect by 3 to 4 diameters), the thickness of the swelling to the centre being more than the thickness of the pipe (at least 150 %).

Whenever possible, it is preferable to replace the damaged section by a new one. This is easy in the case of flanged assemblies. The operation becomes more delicate in the case of cement joints, as the pipes have to be slid over a bell or a half sleeve length. This depends on expansion systems employed. Without lengthwise displacement possibility, it is possible to cut, to glue flanges on both ends and to make a flanged assembly.

6 - BURYING OF UNDERGROUND PIPING

The timing for burying and especially for filling-in shall be chosen so that subsequent thermal effects are kept to a minimum.

The temperature shall be that of average annual temperature. In fact, even at a small depth, the temperature becomes stable and remains approximately equal to the average annual temperature.

In moderate climates, burying shall be carried out a mid-day during the winter. In the summer, it shall be carried out early in the morning while the temperature is cooler.

In desert climates with great daily variations, burying shall be carried out at average annual temperature. Laying at mid-day shall be avoided, as the pipe would remain under stress almost all of the year.

In tropical climates, as daily variations in temperature are only slight, operations may be carried out all through the day. Rainy periods shall be avoided, as the trench would fill with water and the laying of a floating pipe, even if full of water, is difficult. The pipe has to be held to the bottom by piles.

The pipe shall be lowered in the trench by avoiding dangerous curvatures.

The bottom of the trench can not be perfectly straight as it follows the earth's unevenness. One of the purposes of the bed of sand to be provided is to reduce such unevenness.

The following bending radii (in m) are acceptable :

Nominal diameter : 2" 3" 4" 6" 8" 10" 12"

Maximum curvature : 17 25 32 47 60 75 90

Once layed in the bottom of the trench the pipe shall be recovered with a 15 cm thick layer of sand or cleaned loose clay.

This clay shall be carefully rammed on both sides of the pipe and above it. There shall be no empty spaces below the pipe.

The filling-in of the trench may be continued with other clay which has been cleaned of large stones (ϕ 10 cm). Ramming shall be carried out every 25 cm.

7 - INSPECTION AND TESTS

7.1 - General

The assemblies dealt with in this specification are glued assemblies, and fixed or loose flange assemblies. The MANUFACTURER shall guarantee the same operating pressure for assemblies as for the piping.

The CLIENT reserves the right to make a visual inspection on all the pipes and fittings that are received on site, and also to witness hydrostatic tests on the installation.

7.2 - Visual Inspection

The visual inspection of the overall material and particularly of the gel-coat shall reveal no defects than can be considered as unacceptable ; see TOTAL CFP specification no SP-TCS-148. No white marks, indicating delaminations, shall be visible. The thickness of gel-coat having been checked on cut extremities, the external skin should be rich in resin. This resin shall be the same as that of the pipe. The last glass fibres shall be recovered by an approximately 5/10 mm thick coat of resin. The surface aspect shall be glossy and show no difference in colour.

7.3 - Hydrostatic testing

7.3.1 - Testing pressure

The piping shall be tested under water pressure before commissioning. The use of compressed air pressure testing shall be prohibited (the latter accumulates too much energy and apart from this, volume control is impossible).

The testing pressure shall be equal to 1.5 times the design pressure.

7.3.2 - Preparation

During pressure testing, all air shall be removed from the pipe. The water required generally comes from a network where diameter is inferior to that of the piping being tested. This means that the water flow is not sufficient in itself to remove all of the air.

Vents shall be provided at high points to enable the air to escape.

7.3.3 - Procedure

The water is introduced at a low point and the air shall escape at a high point by a partially open valve or a non-tightened flange assembly. After the filling of the line, the valve shall be closed, or the flange blocked. The system shall be brought to test pressure gradually and not all at once.

The piping shall be maintained under pressure during 15 minutes before starting checks. The test pressure shall be maintained during the time which is required for the checking of all joints, and at least for 2 hours.

For a complex installation, the network shall be then maintained at its operating pressure, and no longer at the test pressure, for an observation period of 24 hours.

In this case, the following phenomenon shall be considered : even in absence of residual air, the water pressure in a closed reinforced resin system may change if temperature variations arise. Therefore, at no time in the day shall a limit of 1.5 times design pressure be exceeded.

7.3.4 - Particular case of burried piping

For this type of piping, the hydrostatic test shall be carried out before filling-in.