طرح نگهداشت و افزایش تولید 27 مخزن

SPECIFICATION FOR GROUTING

نگهداشت و افزایش تولید میدان نفتی بینک

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1.0 INTRODUCTION

Binak oilfield in Bushehr province is a part of the southern oilfields of Iran, is located 20 km northwest of Genaveh city.

With the aim of increasing production of oil from Binak oilfield, an EPC/EPD Project has been defined by NIOC/NISOC and awarded to Petro Iran Development Company (PEDCO). Also PEDCO (as General Contractor) has assigned the EPC-packages of the Project to "Hirgan Energy - Design and Inspection" JV.

GENERAL DEFINITION

The following terms shall be used in this document.

CLIENT:	National Iranian South Oilfields Company (NISOC)
PROJECT:	Binak Oilfield Development – General Facilities
EPD/EPC CONTRACTOR (GC):	Petro Iran Development Company (PEDCO)
EPC CONTRACTOR:	Joint Venture of : Hirgan Energy – Design & Inspection(D&I) Companies
VENDOR:	The firm or person who will fabricate the equipment or material.
EXECUTOR:	Executor is the party which carries out all or part of construction and/or commissioning for the project.
THIRD PARTY INSPECTOR (TPI):	The firm appointed by EPD/EPC CONTRACTOR (GC) and approved by CLIENT (in writing) for the inspection of goods.
SHALL:	Is used where a provision is mandatory.
SHOULD:	Is used where a provision is advisory only.
WILL:	Is normally used in connection with the action by CLIENT rather than by an EPC/EPD CONTRACTOR, supplier or VENDOR.
MAY:	Is used where a provision is completely discretionary.

2.0 SCOPE

This specification covers the minimum requirements for materials and type of Grout, testing and methods for the grouting, which shall be considered in the Project.

3.0 NORMATIVE REFERENCES

3.1 LOCAL CODES AND STANDARDS

- IPS-C-PM-216(2) Construction Standard for Process Machineries Assembling and Installation
- IPS-E-CE-120 Engineering Standard for Foundations
- INBC Part 5 Iranian National Building Code, Part 5
- PUB.No.55 Planning and Budget Organization

3.2 INTERNATIONAL CODES AND STANDARDS

- ASTM C33 Standard Specification for Concrete Aggregates
- ASTM C109 Standard Test for Compressive Strength of Hydraulic Cement Mortars
- ASTM C150 Standard Specification for Portland cement
- ASTM C190 Test for Tensile Strength of Hydraulic Cement Mortars
- ASTM C191 Test of Time of Setting of Hydraulic Cement by Vica Needle
- ASTM C230 Standard Specification for Flow Table for Use in Tests of Hydraulic Cement
- ASTM C305 Mechanical mixing of pastes and mortars for the testing of hydraulic cements
- ASTM C307 Test Method for Tensile Strength of Chemical Resistant Resin mortars, Grout, and Monolithic Surfacing
- ASTM C531 Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts and Monolithic Surfacing and Polymer Concrete
- ASTMC579 Standard test method for compressive strength of chemical Resistant mortars, grouts and monolithic surfaces
- ASTMC827 Standard test method for change in height at early age's cylindrical specimens for cementations mixtures
- ASTM C940 Expansion and bleeding characteristics of freshly mixed fluid hydraulic cement grout
- ASTM C1181 Compressive Creep of Chemical-Resistant Polymer Machinery Grouts

- BS EN 1008 — Mixing Water for Concrete
- BS 3148 — Methods of Test for Water for Making Concrete
- BS 812 — Testing Aggregates Method for Determination of Particle Size
- ACI 351.R — Grouting between Foundations & Bases for Support of Equipment and Machinery
- API RP 686 — Recommended Practices for Machinery Installation and Installation Design

3.3 THE PROJECT DOCUMENTS

- BK-GNRAL-PEDCO-000-ST-DC-0001 — Design Criteria for Structural Works
- BK-GNRAL-PEDCO-000-ST-SP-0001 — Specification for Concrete Work

3.4 ENVIRONMENTAL DATA

Refer to "Process Basis of Design; Doc. No. BK-GNRAL-PEDCO-000-PR-DB-0001 ".

3.5 ORDER OF PRECEDENCE

In case of any conflict between the contents of this document or any discrepancy between this document and other project documents or reference standards, this issue must be reported to the CLIENT. The final decision in this situation will be made by CLIENT.

4.0 GENERAL

The grout thickness shall be the minimum necessary to provide adequate levelling. The minimum grout thickness shall be 25 mm and maximum thickness of grout under the highest point of machinery base should be 50 mm unless otherwise specified by Vendor.
Grout should be finished at a slope of 1:1 from bottom corners of base plates to the finished concrete level.

5.0 MATERIALS

5.1 GENERAL

All grout material's shall not contain metallic substances, aluminium powder, measurable amounts of water soluble chlorides, or other substances that may be potentially harmful to concrete or steel reinforcement.

All grout shall be non-corrosive, non-staining and resistant to the effects of moisture.

6.0 TYPE OF GROUT

Grout for filling under base plates of steel structures, equipment shall be one of the following types:

6.1 SAND - CEMENT GROUT

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This type of grout shall be a mixture of one part of Portland cement and three parts of clean fine sand. The grout shall have a minimum crushing strength of 20 N/mm^2 after 28 days and not less than 13 N/mm^2 at 7 days. The use shall be limited to grouting of minor steel structures (e.g. instrument stands) only.

Portland cement shall be carefully chosen for a normal setting time. The chlorine content of chlorides must be less or equal to 0.02% of cement weight; the sulphur content of sulphides must be less or equal to 0.10% of cement weight. The cement must be fresh, dry and free of slag or agglomerates.

Cement shall be of same type as used for the corresponding concrete class in accordance with DOC. BK-GNRAL-PEDCO-000-ST-SP-0001'' Specification for Concrete Work'' unless otherwise specified.

The sand aggregate shall comply with the relevant sections of BS 812 or equivalent code with respect to mechanical, physical and chemical properties, and be capable of freely passing a filter mesh of 1.5 mm.

Water shall be fresh, with a chlorine content less than 250 mg/l. It shall not contain substances that might cause steel corrosion and shall be free of detergents. Mixing water for cementitious grout shall be at a temperature not greater than 24°C.

Mix proportion (cement, sand, water) shall be determined by trial mixes or Vendor's instructions (for prepared grouts), to the entire satisfaction of the CLIENT. Preparation of grout shall be in paddle type mortar mixer (not a concrete mixer) or by other suitable mechanical means. Grout shall not be mixed by hand.

Dry materials shall be mixed first in the designed proportion then with water as quickly as possible, consistent with fluidity and placed as soon as possible.

This type of grout usually have follow characteristic:

- High Ultimate Strength
- Suitable Flow ability
- Resistant Against Vibration and Impact
- Non Corrosion
- Easily Consumption and admixture

Cement grout aggregate shall be delivered to the site in complete and dry bags. The contractor shall be responsible for storing materials for making grout in a dry, weatherproof area on pallets and within the temperature ranges specified by their manufacturers.

6.2 NON-SHRINK GROUT

A grout is regarded as non-shrink if its volume is not less than the initial volume, after hardening for 28 days. During this period the test specimens shall have been completely protected against drying, evaporating, carbonation and exposure to temperatures outside the range 23 °C ± 3 °C.

The type and brand of non-shrink grout shall, after approval, be indicated on the drawings and/or specification for concrete work Contractor shall supply the Vendor's data sheets and certificates. The grout shall be free of chlorides and shall have a pouring consistency.

The mixing and handling of grout shall be carried out strictly in accordance with the Vendor's instructions. Sand or admixtures shall not be added unless specified by the Vendor.

In general one of the following types of non-shrink grout shall be used.

- Cement-based non-shrink grout, with a minimum compressive strength of 75 N/mm^2
- Epoxy-based non-shrink grout, with a minimum compressive strength of 95 N/mm^2
- Non-shrink grouts usually have follow characteristic:
- High Strength
- High Workability and Flow ability
- High Durability and Impermeable
- High Strength against Vibration and Impact
- Protection of Bars Against Corrosion

All No shrink grout constituents except water shall consist pre-measured, prepackaged materials supplied by the manufacturer.

6.3 EPOXY GROUT

Epoxies typically have over three times the compressive strength of cementitious grouts and tend have a longer service life.

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Minimum compressive strength shall be 95 N/mm^2 at 7 days as determined by test in accordance with ASTM C579.

Epoxy grouts usually have follow characteristic:

- High Ultimate Strength
- Suitable Workability and Flow ability
- Adequate Strength against Vibration and Impact
- Protection of Bars against Corrosion
- Consumption Easily
- Resistant to Chemical Attack

Epoxy product shall be submitted for prior approval of the CLIENT and applied in closely accordance with Vendor's instructions.

Epoxy grout shall be applied for grouting compressors or heavy equipment's subject to vibration and elsewhere specified on the drawings. Epoxy grouts are available that are resistant to chemical attack. Epoxy grout shall never be poured on "green" or uncured concrete. Ready mix grout as per vendor specification shall be used .

7.0 USE OF GROUTS

7.1 SAND - CEMENT GROUT

The usage shall be limited for grouting minor steel structures not assuming structural function or self-supporting structures subject to the approval of the CLIENT.

This type of grout also is used to ensure adequate transfer of force to pre-cast concrete elements.

Cementitious grouts are suitable as filler materials in less demanding applications where vibration, dynamic loading, and temperature extremes are not a concern. This type of grout is typically used as filler inside structural steel baseplates to increase damping and reduce vibration transmission or for use on static equipment where vibration is not a concern. Cementitious grouts are also typically not resistant to acid and chemical attack.

7.2 NON-SHRINK GROUT

Non-shrink grout shall be applied under all major steel structures and stationary, rotating and reciprocating equipment unless Epoxy grout is specified on drawing.

This type of grout shall be also used to fill box after installation of post embedded anchor bolts. A metal-oxidizing or gypsum-forming non-shrink grout shall not be used.

Anchor bolts shall be positioned within the reinforcing bar cage. As general rule, anchor bolts shall be installed before concrete casting. If necessary, adequate pockets shall be provided in the foundation when anchor bolts are installed later. Pockets shall be filled using non-shrinking grout.

Ready mix grout as per vendor specification shall be used.

7.3 EPOXY GROUT

Epoxy grout shall be applied for grouting compressors or heavy equipment's subject to vibration and elsewhere specified on the drawings.

Epoxy grouts are available that are resistant to chemical attack. Epoxy grout shall never be poured on "green" or uncured concrete. Ready mix grout as per vendor specification shall be used.

8.0 TRIAL MIX PROPERTIES FOR GROUT

Trial mixing shall be performed by the Construction Contractor prior to casting according to a schedule submitted to and approved by the CLIENT.

The Construction Contractor shall study a mix in order to comply with the specified requirements, prepared with the same materials as those to be used on the work site.

The Construction Contractor shall make systematic tests to determine the optimum water cement ratio (W/C) and the final trial mix. These tests shall include:

- The measurement of flow ability and bleeding compared to water-cement ratio (W/C):
- Determination of a range of water-cement ratios (W/C) consistent with high flow ability and low bleeding
- Measurement of shrinkage for the proposed mix, with three different values of water Content (variation of ± 1 to 2 liters of water for 100 kg of optimum water content)
- Grout strength (compression and tensile strength by flexure method).

Mixing time shall be specified taking into account the equipment on work site.

The CLIENT may request additional trial test such as: setting time, capillary absorption, resistance to frost, etc.

The mix design study and all tests shall be at the Construction Contractor expenses.

9.0 SURFACE PREPARATION

The following surface preparation shall apply for all grouts:

1) Concrete foundation shall be at least 7 days old before surface preparation.
2) All laitance shall be removed down to sound concrete.
3) Surfaces to receive grout shall be rough at reasonably level.
4) Surfaces shall have been wet-cured or if not, curing compounds shall be removed by roughening the surface.
5) The surfaces of concrete , underside of base plate , bolt holes and bolts shall be clean and free from oil, grease, chemicals, dirt and other harmful matter and thoroughly blown clean of dust and small particles by compressed , oil-free air prior to grouting .
6) Where cement based grout is used the concrete surface including bolt holes shall be saturated with clean water for 24 hours prior to grouting.
7) All excess water shall be removed from the concrete and bolt holes before grouting leaving only a damp film.

After cleaning the foundation surface is to be tightly covered to keep it dust and oil free. Bolt holes and bolts shall be clean and free of all foreign matter. Protective sheeting (such as sheets of clean polyethylene) shall be used to cover the prepared surfaces when work is not in progress.

Adequate wedges or shims shall be used for levelling structures or stationary equipment, prior to grouting.

A weather-protective cover may be necessary during inclement weather conditions. Wind, sun, rain, and ambient temperatures have a definite effect on the quality of a grouting installation. During hot weather, the foundation and equipment should be covered with a shelter to keep the uncured grout from being exposed to direct sunlight as well as dew, mist, or rain.

Where practical, epoxy grout vertical thickness at the edge of the foundation should be equal to or greater than the distance from the foundation edge to the baseplate periphery. For machinery foundations where the grout extends to the edge of the concrete, the corners of the concrete shall be chipped to form a 50-millimeter (2-inch) minimum 45 degree chamfer. Grout forms shall be placed so as to allow proper filling of the chamfer area. The purpose of the concrete foundation chamfer is to provide a shear plane at the grout-to-concrete interface to prevent delamination.

10.0 FORMWORK

Formwork shall be provided for grout and shall be compatible with the Method of placing grout specified herein and according to Vendor recommendations.

Forms shall be designed for rapid, continuous and complete filling of space to be grouted. Forms shall be of adequate strength to withstand the horizontal forces of the fluid grout, and shall be caulked or sealed with tape to provide a watertight seal. The forms shall be coated with form oil or heavy wax to prevent grout adherence and absorption.

For equipment requiring part of the base to remain ungrouped, such parts shall be blocked off with rope, oakum, inflated hose or other suitable method. Unless otherwise shown on the drawings, the entire top surface of the foundation shall be grouted.

The forms shall extend a minimum of 25 mm above underside of the base plate being grouted and a minimum of 13 mm in plan shall be left between the form and the edge of the base plate.

On the pouring side, the forms shall be located a minimum of 50 mm away from the edge of the base plate. The top of the forms on the pouring side shall be sufficiently high but no less than 150 mm. [Owner Requirement]

11.0 PLACING, FINISHING AND CURING

Grouting shall only commence once the base is leveled.

Placing of grout, base plate and grout material for foundations shall be at an ambient temperature between 10-24ºC. This temperature shall be maintained within this range for 48 hours following installation and thereafter above 40ºC until strength exceeds 28 N/mm². Cold water shall be used to extend working time in hot weather.

Care shall be taken to ensure that the pocket or base area is completely filled with grout which must be thoroughly compacted, free from air pockets and in full contact with the concrete surfaces.

All trapped pockets shall be vented to allow full penetration of the grouting material. Where vent holes have been provided in base plates these shall be used, during the pouring of grout and then the holes must be filled with grout material to the top level of the base plate or hole surround.

Place grout rapidly and continuously to avoid cold joints under the base plate. Grout from one side to the other in one direction. Tamp or rod grout to eliminate voids. Be careful not to over tamp or rod such that air is taken into the grout.

Grout placed by gravity flow shall be applied continuously under a head of not less than 30 mm and worked until the space is completely filled.

The grout shall not be overworked. Sufficient quantities shall be mixed to ensure complete use within 1 hour. All bolt holes and sleeves shall be adequately filled and pressure grouting used where necessary. Vibration shall not be used to ensure filling.

Shade the foundation from direct sunlight for at least 24 hours before and 48 hours after grouting.

Where a field service is offered by the manufacturer's it shall be utilized. The manufacturer's guarantees may be dependent on such involvement.

Cement – based grout is to be trimmed back , after the initial set , to the level shown on the drawings with surfaces sloped away from the base plate neatly pointed and trawled off the left in a workmanlike manner . Chamfers 25 mm wide with the side inclined at 45º must be formed along the whole edge of the base. Exposed edges shall be protected against damage during the curing period.

Where shims are to be removed, or if wedges were used, they shall be removed after 3 days. On removal of the shims or wedges, the resultant spaces shall be filled with similar grout. Foundations bolts should then be adjusted for tightness.

All curing compounds and method for application shall be approved by the Resident Engineer before application may commence. [Owner Requirement]

12.0 TESTING

Field testing of grout shall be as directed by the client representative. The construction contractor shall be responsible for preparing , storing , curing , and transporting test specimens to the laboratory and testing them .

Before injection is being started on the work site, acceptance tests shall demonstrate that the chosen mix for grout complies with the requirements of work site conditions. The Construction Contractor shall make the acceptance tests with the work site equipment and team, using

materials supplied on site and following the procedures provided for here above. It shall be the Construction Contractor responsibility to provide and install in due time all equipment, facilities and personnel on the work site before the first injection operations, in order that acceptance tests can be made and the mix and/or equipment changed, should tests not meet the CLIENT requirements.

Batches for acceptance tests shall be made with quantities of materials corresponding to the normal capacity of the mixing plant. Acceptance tests shall include flow ability (flow rate on the Marsh cone) and bleeding of injection grout, with samples taken at the start and the end of discharging of the feed drum of the mixing plant.

The mixing time determined by trial tests shall be checked with acceptance tests. Flow time shall be equal to that specified in trial test with a tolerance of ±3 sec.; bleeding should not exceed 2%. In the event the trial mix should not give satisfactory test results, new batches should be made in having the water content to vary by ±1 to 2 liters per 100 kg of cement starting from the optimum value. If these batches should not give the anticipated results, the Construction Contractor would propose a new grout mix and/or another type of mixing plant.

The CLIENT can request acceptance tests at any time, even after injection has begun on the work site (for example: to check suitability of a given cement supply).

All acceptance tests shall be at the Construction Contractor expenses.

Test samples for sand-cement grout shall be taken at least once per day or once every 1.0 m^3, whichever is greater. Compressive strength test on cubes shall comply with ASTM C109.

No shrink cement-base grout shall be tested at least once per day in Accordance with ASTM C109.

The following number of cubes for each type of grout shall be prepared and tested after the following periods for required compressive strength according to the following schedule:

Grout Type	24 Hrs	2 Days	7 Days	28 Days
Sand Cement Grout	-	2	2	2
Non shrink Cement & Epoxy Grout	3	-	3	3

If the results of tests indicate that the grout is below the required Specification, the whole of the material shall be removed after the placing of shims, and the base plate regrouted.
[Owner Requirement]

13.0 REMOVAL OF EXCESS MATERIAL

No form or grout should be removed from the formed shoulder until the grout has stiffened sufficiently to ensure that the grout will not sag below plate level when cut back at a slope about 45 degree from the bottom of the plate.

Epoxy grouts are formed to the desired configuration and poured to the desire final elevation. Epoxy grouts are not generally cut back.

14.0 REMOVAL OF GROUTING

Poor quality grout shall be removed. Grout chipping and removal must not be performed with heavy tools, such as jackhammers, as they could damage the structural integrity of the foundation.

Scarifying the surface with a needle gun or bushing tool is unacceptable. A chipping hammer with a chisel bit is a preferred tool for this purpose.

After removal of poor quality grout and cleaning of foundation surface, grouting shall be done again.

15.0 TOLERANCES:

Equipment shall be leveled and positioned to within +3 mm of design center-line locations, unless otherwise recommended by the VENDOR.

Bearing and slide plates shall be set to within 3mm of the reference center-lines and leveled to +3mm measured diagonally across the corners.

Vertical vessels shall be plumb within 1:500, but not to exceed 15mm from vertical.

VENDOR shall meet any required code and specification requirements.