



NASHPA Gas Processing and LPG Recovery Plant

PROC-FC-CB/NASHPA/PROJ-1247 /2015

PROJECT NO.: NASHPA 1247



DOCUMENT NO.:
NGP-000-SCW-15.03-0002-00

SPECIFICATION

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Specification for Grouting

REVISION DETAILS

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00	24/06/2016	Approved for Design	Chen Changqing	Wen Anshun	Li Zhiguang	Zhang Wenhong
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1.0 GENERAL

1.1 Introduction

OIL & GAS Development Company Ltd. (OGDCL) is operating NASHPA Oil & Gas fields in Khyber Pakhtunkhwa of Islamic Republic of Pakistan. OGDCL intends to install LPG Recovery Plant, Compressors & Allied Facilities at this field.

1.2 Scope

This specification defines the materials and workmanship related to grouting for the following applications:

- Bonding of new concrete to existing concrete.
- Grouting of base plates and equipment bases.

Materials include regular cement grout, non-shrink cement-based grout, epoxy grout and bonding mixtures

1.3 Definitions

Within this document the following definitions apply:

Project	NASHPA Gas Processing and LPG Recovery Plant PROC-FC-CB/NASHPA/PROJ-1247 /2015
Company/Owner	Oil & Gas Development Company Ltd.(OGDCL)
Consultant	Zishan Engineers (Pvt.) Ltd.
Contractor	Hong Kong Huihua Global Technology Limited Wholly owned Subsidiary of China OIL HBP Science and Technology Corporation Ltd
Manufacturer/Supplier/Vendor	Party(ies), which manufactures and/or supplies material, equipment and service to perform the duties as specified by CONTRACTOR in the scope of supply
Shall	Indicates a mandatory requirement
Should	Indicates a strong recommendation to comply with the requirement of this document

2.0 REFERENCES AND ABBREVIATIONS

2.1 Codes and Standards

Doc. No.	Description
ASTM-C33 /C33M	Standard Specification for Concrete Aggregates.
ACI 318-08	Building Code Requirements for Structural Concrete
ACI 351.1R	Report on Grouting between Foundations and Bases for Support of Equipment and Machinery



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Doc. No.	Description
ASTM C-1107	Specification for Packaged Dry, Hydraulic- Cement Grout
ASTM C1017/C1017M	Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM-C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2" or 50 mm Cube Specimens)
ASTM-C125	Standard Definition of Terms Relating to Concrete and Concrete Aggregates
ASTM-C150	Standard Specification for Portland Cement
ASTM-C191	Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.
ASTM-C531	Standard Test Method for Shrinkage and Coefficient of Thermal Extension of Chemical-Resistant Mortars Grouts and Monolithic Surfacing.
ASTM-C579	Standard Test Method for Compressive Strength Surfacing.
ASTM-C827	Standard Test Method for Early Volume Change of Cementitious Mixtures
ASTM-C588	Specification for Non-shrink Grout (Corps of Engineers)
AASHTO-T26	Quality of Water to be Used in Concrete
ANSI A10.9	Safety Requirements for Concrete Construction and Masonry Work.

2.2 Project Specifications, Procedures and drawings

Particular reference is made to the following project specifications:

[1]	Design Basis for civil and Structure works
[2]	General Notes for Structural Steel Works

2.3 Abbreviations

The following abbreviations are used in this document:

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
API	American Petroleum Institute
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BS	British Standards
EN	European Standard
ISO	International Organization for Standardization

3.0 DESIGN



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3.1 Delivery, Storage and Handling

Non-shrink Cement-Based Grout and Epoxy Grout aggregate shall be delivered to the site in sound dry bags and Epoxy Grout liquid components in sealed hardener and resin containers. The Contractor shall be responsible for storing the grout in a dry, weatherproof area. All materials and tools shall be stored in a clean and organized manner.

3.2 Materials

3.2.1 General

Sand-cement grouts shall be proportioned at the site. All non-shrink grouts shall consist of pre-measured, pre-packaged materials, supplied by the Manufacturer, except water. All grouts shall be non-corrosive, non-staining and resistant to effects of moisture.

3.2.2 Sand and Cement

Water shall conform to AASHTO T26. When conforming water is not available, mortar test cubes shall be made with non-conforming water in accordance with the requirements of ASTM C109. Tested cubes shall have a minimum of 90% of the 28 day specified strength.

Sand shall be as defined by ASTM C125 and shall conform to ASTM C33, grading for fine aggregates (No. 4 to 100). Sand for bonding mixture shall all pass a No. 16 sieve. Cement shall be Portland Cement Type 1 or Type II, ASTM C150 or other equivalent.

3.2.3 Cement Grouts

Plain Cement Grout shall be two parts sand for every part cement, by weight; with a minimum 28 day compressive stress of 20 MPa in accordance with ASTM C109.

3.2.4 Non-shrink Cement-Based Grout

Non-shrink cement-based grout shall meet the following requirements:

Plastic Volume Change:	No shrinkage (0.0%) and a maximum of 40% Extension at any time before initial set when tested according to ASTM C827.
Hardened Volume Change:	No shrinkage (0.0%) and a maximum of 0.1% Extension in the hardened state when tested according to CRD C588.
Compressive Strength:	Minimum allowable compressive strength at 28 days to be 40 MPa as measured by ASTM C109.
Initial Set Time:	Not less than 60minutes when tested according to ASTM C191.

3.2.5 Non-shrink Epoxy Grout



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Non-shrink epoxy grout shall meet the following requirements:

Volume Change:	No shrinkage and a maximum of 4.0% Extension when tested according to ASTM C827.
Compressive Strength:	Minimum allowable compressive strength at 7 days to be 40 MPa as measured by ASTM C579.
Heat Development:	The peak exotherm of a 50 mm diameter by 100 mm high cylinder of grout not to exceed 35°C when tested at 24°C material and laboratory temperatures.
Thermal Extension:	Not exceed a coefficient of thermal Extension of 54 x 10-6 mm/mm/°C when tested according to ASTM C531.

3.2.5 Bonding Mixtures and Adhesives

The following bonding mixture or adhesive can be used to create cohesion or water tightness between new concrete and existing concrete:

- Cement Bonding Mixture – Neat cement and water mixed to the consistency of creamy paint.
- Epoxy Adhesive – Mixture consists of a proprietary epoxy adhesive, mixed and applied in accordance with Manufacturer's instructions. Epoxy adhesive to be approved by Buyer use epoxy adhesive only, where it is specified in the drawings.

3.3 Applications

3.3.1 Grout to be provided between the top of foundation concrete and the bottom of bearing plates. Thickness of grout shall be as specified in drawing, if not, than to be a nominal thickness of 25 mm with a minimum thickness of 12 mm in order to avoid feather edging.

3.3.2 Non-shrink grout or epoxy grout shall be used for the following applications. Non-shrink grout shall be used unless epoxy grout is specified by equipment Vendor or Contractor.

- All compressors
- Reciprocating pumps greater than 75 kW and centrifugal pumps greater than 375 kW.
- Structures with a height to width ratio over 2, or with large vibrating equipment, if one column load is over 500 kN.
- Normal structures if one column load is in excess of 1000 kN

3.3.3 For grouts that will experience maximum temperatures above those listed below, high temperature grouts to be used.

- Cement based grout: 200°C



- Epoxy grout: 135°C

3.3.4 High temperature cement-based grout is faster setting than normal temperature grout.

3.3.5 Because of the difference in thermal coefficient of Extension between epoxy grout and concrete, stresses are formed at grout edges. Grout details to allow for Extension joints, grout cut back, corner reinforcing or added epoxy depth at corners.

3.4 Execution

3.4.1 Surface Preparation

- Surface of the existing concrete shall be cleaned of oil, paint and other coatings. The surface shall be roughened to expose the aggregate and thoroughly flushed with clean water.
- Before grouting, equipment bases and base plates shall be leveled and aligned in accordance with recommendations of equipment Supplier and drawings.
- Whenever any cement-based grout or bonding mixture is used, the concrete surface shall be thoroughly soaked until absorption stops. Excess water shall be removed just before grouting of bonding.
- When epoxy grouts or adhesives are used all surfaces shall be kept dry before application.

3.4.2 Form Work

- Forms or back braces used shall be securely anchored to withstand the forces of the placement of grout.
- For non-shrink cement based grout cement Mortar tight forms shall be provided with sealed joints. Form oil to be applied for easy form release.
- For non-shrink epoxy grout, watertight forms shall be provided with chamfer strips in place where chamfer edge is required. Forms to be lined with polyethylene or heavy wax for easy form release.

3.4.3 Placement

Grout placement shall be done in a manner that will assure the filling of all surfaces and the intimate contact of grouting materials with surfaces grouted. Grout shall be placed rapidly and continuously to avoid cold joints under the baseplate. Grouting shall be done from one side to the other in one direction with tamping or rodding to eliminate voids.

3.4.4 Finishing

- Cement-based grout shall be trimmed back to the level indicated on the drawings after the grout has reached an initial set. Surfaces to be sloped away from base plant and protruding edges cut back.
- Epoxy grout cannot be trimmed after set. Top surfaces shall be finished to proper slope prior to initial set.
- Finish coating shall be applied over grout holes and vent holes after grout has set.

3.4.5 Curing



- a) Immediately after placement, cement-based grout shall be protected from premature drying, excessively hot or cold temperatures and mechanical injury. Grout to be maintained with minimal moisture loss at relatively constant temperature for the period necessary for hydration of cement and hardening of concrete.
- b) Epoxy grout shall be cured in accordance with Manufacturer's instructions.

3.4.6 Shims and Wedges

Removal of shims and wedges is not required unless specified by equipment Supplier. All shims or wedges left in place shall be completely encased in grout

3.4.7 Anchor Bolts and Pipe Sleeves

- a) For anchor bolts and pipe sleeves requiring grout, all surfaces shall be cleaned of oil, grease and other foreign substances.
- b) Where anchor bolts or pipe sleeves are to remain isolated, sleeves shall be filled with a pliable material such as Silicone Rubber molding compound or other material shown on the drawings.

3.4.8 Bonding New Concrete to Existing Concrete

- a) The bonding mixture shall be applied by working it into the surface with a stiff brush. New concrete to be placed before bonding mixture dries out.
- b) Epoxy adhesive shall be applied in accordance with Manufacturer's instructions.

3.4.9 Testing

Cement-based grout shall be tested under ASTM C109 and epoxy grout under ASTM C579. Cubes shall be prepared for each type of grout and tested for required compressive strength according to the following schedule.

Grout Type	24 Hrs.	2 Days	7 Days	28 Days	Compressive Strength at 28 C
Plain Cement Grout	-	2	2	2	21 N/mm ² min
Non-shrink Cement Grout Master flow 928 or equivalent	3	-	3	3	As per Manufacturers Specification