

BALUCHISTAN ENERGY COMPANY LIMITED

DEVELOPMENT OF LPG TESTING LABORATORY AT TAFTAN

SPECIFICATION FOR ERECTION & INSTALLATION OF SKID MOUNTED/FIELD ERECTED EQUIPMENT



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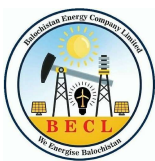
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SPECIFICATION FOR ERECTION & INSTALLATION OF SKID MOUNTED EQUIPMENT

1.0 SCOPE

The specification covers the minimum care and procedures to install the mechanical equipment belonging to LPG Testing Laboratory at Taftan.

2.0 REFERENCE CODES AND STANDARDS

The reference codes and standards to be referred within mechanical equipment installation are:

- Local laws or decrees on safety during working.
- OSHA (Occupational Safety and Health Administration) to back up the previous ones, for special duties.
- Manufacturer's instructions.
- Enclosed specifications.

3.0 GENERAL

As a general rule, all mechanical equipment's shall be installed strictly following the manufacturer's instructions. Said instructions are a part of Technical Documentation to be supplied to Client.

4.0 STATIC EQUIPMENT ERECTION

4.1 This section refers to all static equipment's e.g. vessels, columns, re-boilers, flare stacks, tubular heat exchangers, oil water separator packages, skid mounted equipment's, filters, etc., to be erected/installed by the Contractor.

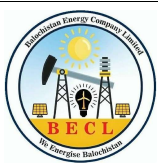
The erection work should conform in each specific case to the following codes, standards and relevant Specifications:

- ASME Section VIII Div. I.
- Instructions and drawings issued by Manufacturer.



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- Layout of each equipment and orientation for correct positioning, shown in the piping drawings.
- 4.2 Handling of each equipment or part should be performed such as to eliminate over-stressing.
 - 4.3 Use of slings, where indicated in the equipment drawings shall be used.
 - 4.4 Wherever the equipment is provided with lifting lugs they shall be used as the only main points for lifting.
 - 4.5 The nozzles and/or the man ways may be used as lifting points only if specifically indicated so.
 - 4.6 All stiffeners, protection covers, temporary supports and all other facilities provided by the equipment manufacturer should be left in their places until erection time.
 - 4.7 Before placing the equipment on foundations, the top of concrete should be chipped by hammering to remove the surface layer, which has low strength and to ensure a suitable bond between the foundation concrete and grouting.
 - 4.8 The equipment should be laid on blocks of steel wedges and/or shims to ensure a grouting space as specified in the drawing, if not, then 25 to 35mm, to be maintained.
 - 4.9 Minimum two blocks of wedges and/or packages of shims should be considered for each foundation bolt (one on each side of each bolt).
 - 4.10 The sliding supports of the horizontal equipment should rest on intermediate bedplates of steel and the necessary blocks of wedges and/or shims should be installed under such bedplates only.
 - 4.11 The two nuts of each foundation bolt shall be tightened to each other above the base plates of the sliding supports such as to ensure free spaces of 1.5 to 3mm.
 - 4.12 No welding shall be permitted on the equipment supplied as completely shop assembled. Site welding of certain external attachments may be considered when specifically ordered only.



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- 4.13 All welding procedure test and welder's qualification should be done as per ASME Section IX & other Specification prepared by Client.
- 4.14 Preheat and post weld heat treatments (stress relieving) when required, should be done using electric induction equipment provided with temperature recorders.
- 4.15 Nozzle of the equipment should be checked for tension/stresses. All the piping attached with the equipment should be free of tension/stresses.
- 4.16 The telltale hole is to be used to pneumatically test attachment welds on reinforcing pads. The telltale hole shall be plugged after hydrotest with non-hardening sealant or grease.
- 4.17 The final tightening of all the studs should be done uniformly and in the proper diametric sequence to impose equal pressure on the gasket and to avoid distortion or over-stressing of equipment.
- 4.18 Colloidal molybdenum disulfide or other approved lubricants shall be applied to all studs before the joints are assembled.
- 4.19 All equipment components shall be sorted separately as per Supplier's instructions and stored on wooden sleepers above the ground.
- 4.20 Access and service platforms which affect the erection of equipment and sub-assemblies should be erected after box-up of equipment.
- 4.21 Field hydrostatic pressure testing of all equipment's shall be conducted in accordance with the equipment manufacturer's instructions.
- 4.22 Test records shall be maintained for all tests conducted. Format for test record shall be provided by the Contractor for Client's approval, which would include the following:
 - a) Date of test
 - b) Equipment number
 - c) Test medium
 - d) Inspector's name and signature



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- e) Duration of test
- f) Pressure records
- g) Ambient Temperature

4.23 The following inspection should be made in the presence of representative of Client and a certificate must be signed for each inspection:

- a) Correct leveling and orientation of equipment
- b) Hydrostatic testing
- c) Stress relieving and hardness testing
- d) Refractory drying if required/applicable
- e) Mechanical completion
- f) Box-up
- g) Equipment Acceptance Certificate

5.0 ROTARY EQUIPMENT ERECTION

5.1 This section refers to all compressors (centrifugal and reciprocating), centrifugal blow-ers, pumps (centrifugal pumps), screw pump, gear pumps, proportioning (metering) pumps, reciprocating pumps with or without gear-box driven by electric motors, gas turbines, steam turbines, or diesel engines single stage or multistage, air coolers, etc. Steel structure attached with air cooler is also part of equipment. It also includes assembly and installation of packaged skid mounted rotary equipment like chemical injection packages, air generation unit and packaged reciprocating compressor.

5.2 Handling of each unit should be performed by placing the slings such as to eliminate over-stressing.

The eye bolts on the top of the drivers or driven casings (if such eye bolts are provided by manufacturers) shall be used when lifting those parts separately and not when lifting the complete unit.

5.3 Storage conditions before erection on foundations and preservations after erection on foundations should conform in all respects to the instructions issued by manufacturers. Suction and discharge flange covers as well as all the protection plugs provided by manufacturers to the other openings must be left in their places until the piping is connected with them. If no covers or protection plugs have been provided by



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manufacturers or if such covers or plugs are not suitable for protection after removing the units from their boxes, they should be replaced by sub-contractor with the suitable ones.

Each equipment should be inspected periodically and additional steps should be considered when necessary (periodic cleaning, filling with oil, etc.).

- 5.4 Before placing the units on foundations, the top of concrete should be chipped by hammering to remove the surface layer, which has low strength and to ensure a suitable bond between the foundation concrete and grout.
- 5.5 The equipment should be laid on blocks of wedges and/or shims to ensure a grouting space as specified in the drawing between the concrete top and base plate bottom. The blocks of wedges and/or shims should be placed near each foundation bolt and adjusted as necessary to ensure a correct level (horizontality) in all directions. After leveling, the nuts of the foundation bolts should be lightly tightened. Grouting should be performed as per Section 6.0 of this specification.
- 5.6 Alignment of the unit (a) driver and speed reducer unit, (b) speed reducer unit and driven (if any) should be performed to conform strictly to the accuracy indicated by the manufacturers using dial “Laser alignment tool”.

Use of dial indicator straight edges and sensor gauges cannot be considered unless approved by Client.

Each alignment should include accurate checking of radial and axial deviations fastening the dial indicator bracket, sequentially to each half of the coupling.

Alignment should be checked:

- Before grouting
- After grouting and
- After connection of piping to the equipment

- 5.7 Lubrication, installation of auxiliary piping and accessories installation of packing or mechanical seals (if the mechanical seals have not been installed by the Manufacturer)



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as well as all operations on the equipment itself like dismantling and reassembling (if required) must conform strictly to the instructions given by the Manufacturer for each equipment.

- 5.8 The piping attached to the compressor should be cleaned chemically before commissioning.
- 5.9 Flanged connections to pumps, compressors, turbines and all other machines shall be left un-tightened and protected by suitable covers until the machines are made available for final connections.
- 5.10 The suction and discharge nozzle flange faces and piping flange faces shall match within the tolerances stated herein and following the Manufacturer's requirement.
- 5.11 No additional stresses shall appear when flange bolts are tightened.
- 5.12 After piping is connected onto pumps and before starting-up of said machinery, a final check of coupling(s) lining-up will be performed, using a dial type indicator. This check shall show the same values, which have been read before piping was connected. This will allow checking that no additional stresses have been induced by piping connection. After agreed-upon operation time, a final check of the shaft lining-up shall take place.
- 5.13 The erection of auxiliary equipment like coolers, pulsation bottles, dampeners, separators, etc. should also include inspection and pressure tests.

Running test of each item should be performed after all necessary facilities are available to check for proper operation. Temporary provisions may be considered if safe enough only.

- 5.14 All fabrication and erection of steel structure shall comply with American Institute of Steel Construction (AISC).
- 5.15 All welding procedure tests and welders qualification should be done as per ASME Section IX.
- 5.16 The following inspection should be made by representative of Client and a certificate must be signed for each inspection:
 - a) Correct leveling and orientation of equipment.



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b) Alignment:

- Before grouting
- After grouting
- After connecting the pipe to the equipment

c) Mechanical completion certificate.

d) Test run certificate/acceptance certificate.

5.17 No spare parts should be used for replacing the defective ones during erection work, unless specifically agreed upon.

6.0 GROUTING

6.1 Scope

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

28) Bonding of new concrete to existing concrete

ii) Grouting of base plates and equipment bases

Materials include – regular cement grout, no shrink cement-based grout, epoxy grout and bonding mixtures.

6.2 Reference Codes and Standards

The standards to be taken into consideration in addition to the terms of the present specification are:

ASTM-C33-79 Standard Specification for Concrete Aggregates

ASTM-C109-77 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2” or 50mm Cube Specimens)

ASTM-C125-79 Standard Definition of Terms Relating to Concrete and Concrete Aggregates



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ASTM-C150-78	Standard Specification for Portland Cement.
ASTM-C191-79	Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
ASTM-C531-74	Standard Test Method for Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic Surfacing
ASTM-C579-75	Standard Test Methods for Compressive Strength Surfacing.
ASTM-C827-78	Standard Test Method for Early Volume Change of Cementitious Mixtures
CRD-C588-79 (Corps of Engineers)	Specification for Nonshrink Grout
AASHTO-T26-78	Quality of Water to be used in Concrete
ANSI A10.9-70	Safety Requirements for Concrete Construction & Masonry Work

6.3 Delivery, Storage & Handling

- a) Nonshrink 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 and within the temperature range of 4°C to 32°C.
- b) The total job storage time for non-shrink grout shall be limited to ten months.

6.4 Materials

a) General

Sand-cement grouts shall be proportioned at the site. All non-shrink grouts shall consist of pre-measured, prepackaged materials, supplied by the Manufacturer, except water.

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



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b) Water, 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 used as defined by ASTM C125 and shall conform to ASTM C33, grading for fine aggregates (No. 4 to 100). Sand for bonding mixture shall pass a No. 16 sieve.

Cement shall be Portland Cement Type I or Type II, ASTM C150.

c) Cement Grouts

Plain Cement Grout shall be two parts sand for every part cement, by weight; with a minimum 28 days compressive stress of 20 Mpa (3000 psi) in accordance with ASTM C109.

d) Non-shrink Cement-Based Grout shall meet the following requirements:

Plastic Volume Change: No shrinkage (0.0%) and a maximum of 4.0% expansion 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% expansion in the hardened state when tested according to CRD C588.

Compressive Strength: Minimum allowable compressive strength at 28 days to be 40 Mpa (6000 psi) as measured by ASTM C109.

Initial Set Time: Not less than 60 minutes when tested according to ASTM C191.

Soundness: No grout shall contain metallic substances (catalyzed or non-catalyzed), aluminum powder, water reducing agents, fluidifiers, accelerators, super plasticizers, or other materials known to increase drying shrinkage and/or compromise long-term durability.

e) Non-shrink Epoxy Grout shall meet the following requirements:



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Volume Change: No shrinkage and a maximum of 4.0% expansion when tested according to ASTM C827 (modified).

Compressive Strength: Minimum allowable compressive strength at 7 days to be 40 Mpa (6000 psi) as measured by ASTM C579.

Heat Development: The peak exothermal temp of a 50 mm (2") diameter by 100 mm (4") high cylinder of grout not to exceed 35°C (95°F) when tested at 24°C (75°F) material and laboratory temperatures.

Thermal Expansion: Not to exceed a coefficient of thermal expansion of 54×10^{-6} mm/mm/°C (30×10^{-6} in/in/°F) when tested according to ASTM C531.

f) 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 Client\Company.

6.5 Applications

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 (1") with a minimum thickness of 12 mm (½") in order to avoid feather edging.

Non-shrink grout or epoxy grout to be used for the following applications. Nonshrink grout to be used unless epoxy grout is specified by equipment Contractor or Client.

- All compressors



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- Reciprocating pumps greater than 75 kW (100 HP) and centrifugal pumps greater than 375 kW (500 HP).
- Structures with a height to width ratio over 2, or with large vibrating equipment, if one column load is over 500 kN (110 kips).
- Normal structures if one column load is in excess of 1000 kN (220 kips)

Drawings to indicate where non-shrink grout is to be used.

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

		<u>Maximum Temp.</u>
Cement based grout	–	200°C
Epoxy grout	–	135°C

High temperature cement-based grout sets faster than normal temperature grout.

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

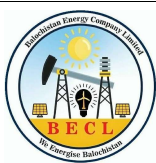
6.6 Execution

a) Surface Preparation

Surface of the existing concrete of grease shall be cleaned from 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 manufacturer and drawings.

When 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.



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When epoxy grouts or adhesives are used, all surfaces shall be kept dry before application.

b) Form work

Forms or back braces used shall be securely anchored to withstand the forces of the placement of grout.

For nonshrink cement based grout tight forms shall be provided with tape sealed joints. Form oil to be applied for easy form release.

For nonshrink 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.

c) 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 to be placed rapidly and continuously to avoid cold joints under the baseplate. Grouting to be done from one side to the other in one direction with tamping or rodding to eliminate voids.

d) 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 plate 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.

e) Curing

Immediately after placement, cement-based grout shall be protected from premature drying, excessively hot or cold temperatures and mechanical injury.



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Grout to be maintained with minimal moisture loss by implying proper methodology at relatively constant temperature for the period necessary for hydration of cement and hardening of concrete.

Epoxy grout shall be cured in accordance with manufacturer's instructions.

f) Shims and Wedges

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

g) Anchor Bolts and Pipe Sleeves

For anchor bolts and pipe sleeves requiring grout, all surfaces shall be cleaned from oil, grease and other foreign substances.

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 in the drawings.

h) Bonding New Concrete to Existing Concrete

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.

Epoxy adhesive shall be applied in accordance with manufacturer's instructions.

i) 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
Plain Cement Grout	—	2	2	2
Nonshrink Cement Grout	3	—	3	3
Epoxy Grout	3	3	3	—



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7.0 PREPARATION OF LUBE OIL PIPING SYSTEMS

7.1 General

Prior to testing of rotating main machinery fitted with lubricating oil piping, the preparation works defined hereunder shall be undertaken.

7.2 Pickling of Oil Piping

After all welding, fabrication and erection of oil piping has been completed, the piping shall be dismantled in suitable sections configuration, so that efficient flow of liquids could be performed through said piping sections.

- **Cleaning**

Before pickling procedure performance, all oil equipment shall be opened inspected, to determine condition of internal parts. When deemed necessary, such material shall be cleaned, using a solvent previously agreed upon by the equipment Manufacturers.

- **Pickling**

After proper and careful preparation every pipe section will be flushed, using hot caustic soda. This will be performed until perfect cleanliness has been reached.

Then the pipe sections shall be flushed with fresh clean water up to elimination of caustic soda.

After performance of this operation flushing with hot muriatic will take place. Pickling shall be repeated until the system is completely clean and to Client's satisfaction.

- **Rinsing**

The piping shall then be rinsed by flushing with fresh clean water, until all traces of acid are removed.

- **Drying**



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The piping shall, after that procedure, be dried by blowing air or gas, until complete removal of all water and humidity.

- **Miscellaneous**

After drying the piping shall receive a coat of clean engine oil to prevent oxidation.

As an alternative, the system may be filled with approved oil, run for 6 hours and kept as it is, up to test operation until the final oil will be filled.

After flushing has been performed, the oil will be drained from the system and the filters' cartridges replaced by new ones.

All new cartridges cost will be borne by the Contractor.