

GROUTING SERVICES



SCOPE OF SERVICES

Trident Group of Companies offers integrated services on grouting of piles and structural elements of offshore fields infrastructure. These services are provided during installation of jackets and other elements of offshore field's infrastructure, as well as for strengthening of aging facilities.



SCOPE OF SERVICES

- ▶ Structural grouting (cementing of jacket's piles, gravitational foundations and suction piles)
- ▶ Offshore platforms' jackets strengthening and repair
- ▶ Conductor strengthening
- ▶ Pipelines' freespans correction and crossings.



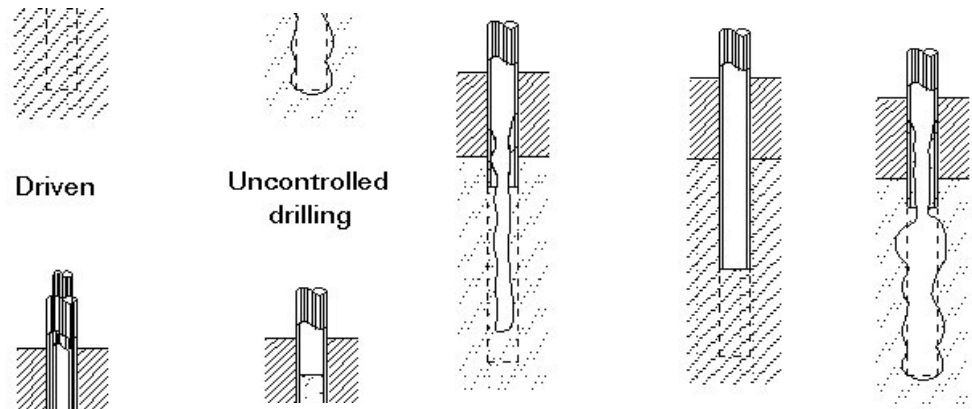
STRUCTURAL GROUTING

▪ Pile grouting

Most of the modern offshore platforms are designed to ensure the jacket and the piles working as one piece jointly resisting horizontal loads and bearing vertical load from the top side. To achieve that, rigid connection between the jacket's legs and the piles driven to the seabed must be ensured. Welding or grouting is commonly used in order to establish such structural connection. However, only filling of the annuli (between the leg and the pile) with a grout can guarantee uniform distribution of the loads throughout a platform's life cycle.

Trident performs grouting of any type of piles including its inner space and annuli:

- Driven piles (inside legs or skirt piles)
- Driven and drilled piles
- Pre-drilled piles
- Insert piles
- Belled piles.



STRUCTURAL GROUTING

▪ Gravity structures underbase grouting

In order to efficiently distribute weight of gravity structures to the seabed, underbase of the structure is filled with grout after it has been set to the sea bottom. Usually, underbase is divided in chambers that are filled with grout individually in order to establish even contact profile with the soil. The grout parameters selected for such applications shall be as close to the soil characteristics as possible.

▪ Suction piles grouting

In some cases subsea templates or even jackets are secured on the seabed with suction piles (spud cans) that are lowered to the soil to the predetermined depth followed by pumping out of water and forcing the pile to penetrate deeper. The planned or unplanned voids inside the spud cans are then filled with grout in order to distribute the weight of the structure to the seabed.



JACKET STRENGTHENING

Nowadays over 70% of world's hydrocarbons are produced from mature fields with ageing facilities. Over 40% of the world's offshore platforms are beyond their original service life. Life of many platforms can be extended through modernizations, upgrades and repairs.

Decrease of structural strength of the offshore platforms is inevitable. Over the years of operation deterioration or complete destruction of the loadbearing elements of the platform affected by corrosion, mechanical damages or fatigue takes place.

Trident provides the following services aimed to increase structural integrity of the offshore platforms:

- Subsea surveys
- Structural analysis
- Infill grouting
- Strengthening by means of grouted clamps or elements replacing.

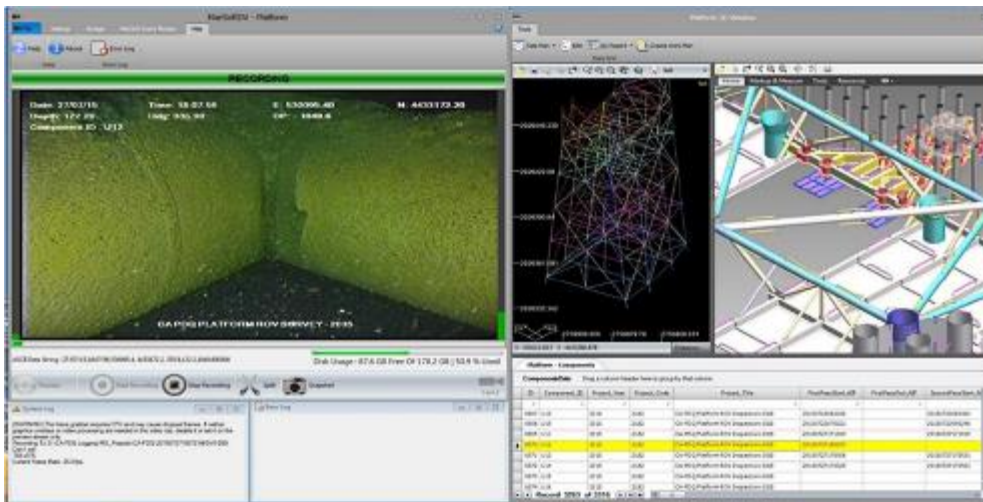


JACKET STRENGTHENING

- Subsea Surveys

Trident operates inspection class ROVs, ultrasonic thickness gauges and advanced software, which ensure accurate and comprehensive surveys for proper engineering and further operations planning.

Survey of jacket's underwater structures can be also conducted by the in-house team of divers.



Underwater Systems

PTZ Video Cameras

Inspecam® PT

Pan-Tilt - Zoom Camera



FEATURES

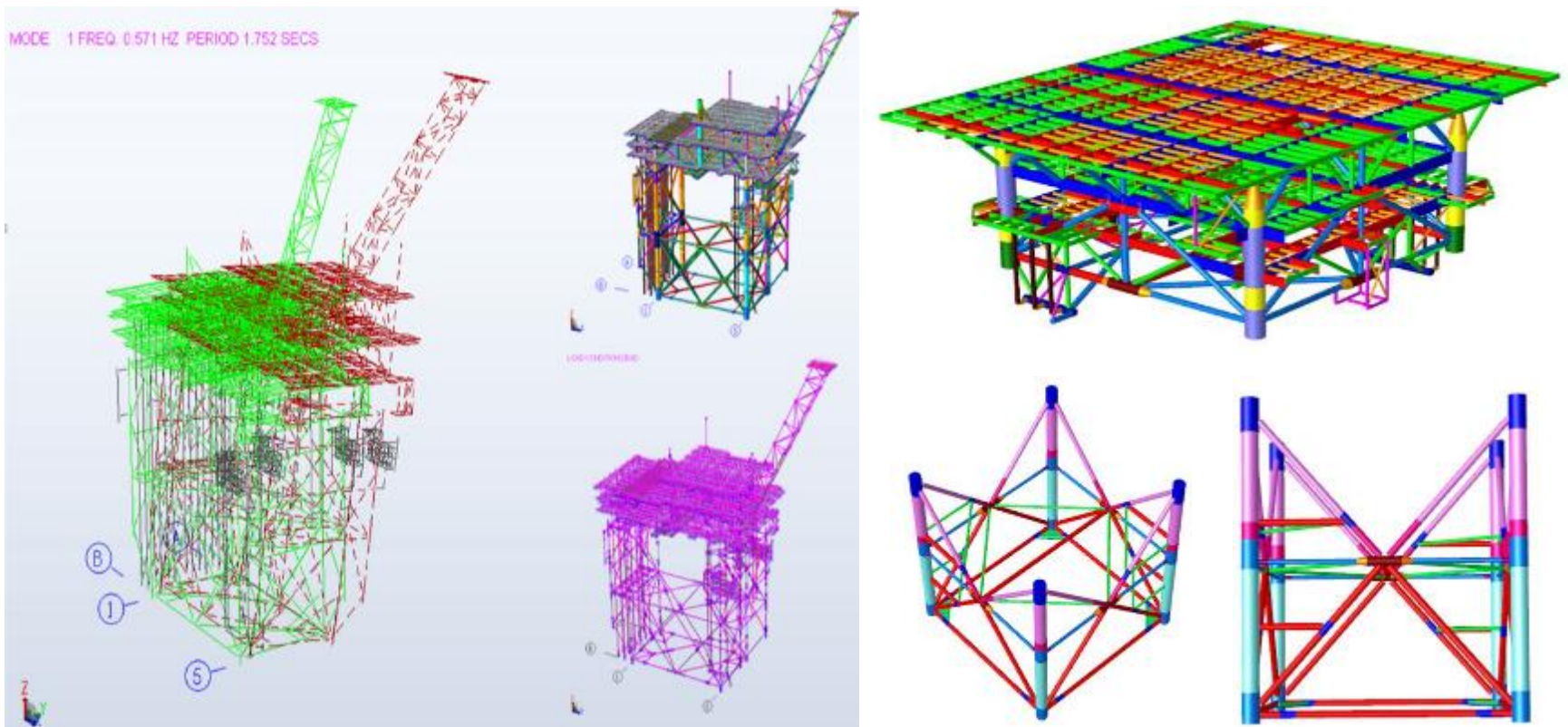
- Rugged and affordable.
- Pan 360° free rotation / Tilt 90°
- 10x optical zoom (10x digital)
- Programmable functions: Focus, iris, day/night, white balance, etc.



JACKET STRENGTHENING

- Structural analysis

Prior to commencement of any repair or strengthening operations detailed structural analysis must be made. Using subsea survey data engineers assess the effect of damaged jacket members, wall thickness loss, as well as new loads expected from planned platform modernization.



JACKET STRENGTHENING

- Infill grouting

Infill grouting is a process of filling jacket elements with grout in order to improve its strength and stiffness. Infill grouting is performed for the aging assets in order to extend their design life or in case planned modernization calls for structure strengthening. Depending on the jacket design and the water depth grouting can be performed either by pressure balance or by displacement techniques.

Strengthening of existing offshore jackets may be performed by following scenarios:

- filling of jacket members with grout
- filling of annuli between piles and legs
- filling of jacket legs inner space with grout (for new insert and anchored piles).



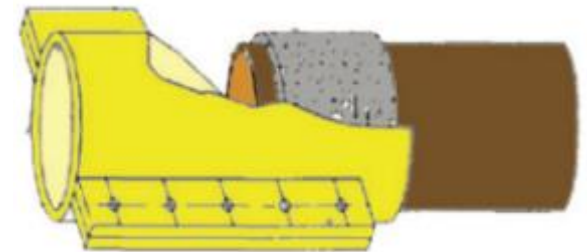
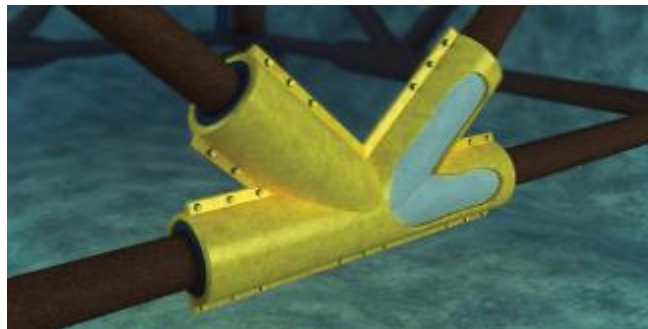
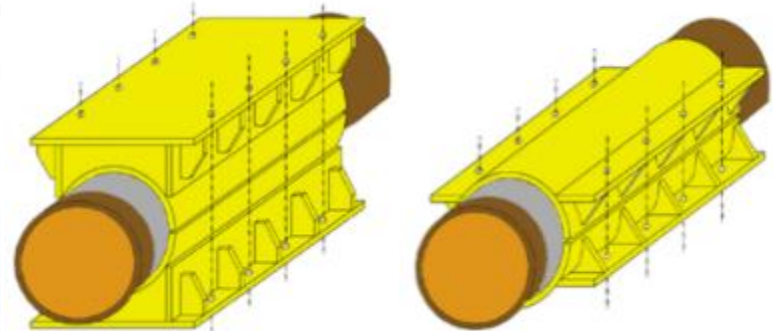
JACKET STRENGTHENING

- Grouted Clamps

Grouted clamp is a pipe sleeve made of two segments installed around existing pipe joint of a smaller diameter. Two segments are bolted and tightened together and inner space between the clamp and existing pipe is filled with grout. Grouted clamps are mostly used to repair damaged members of the jackets for them to regain original (designed) structural strength where replacement of such member is not possible, nor economically feasible.

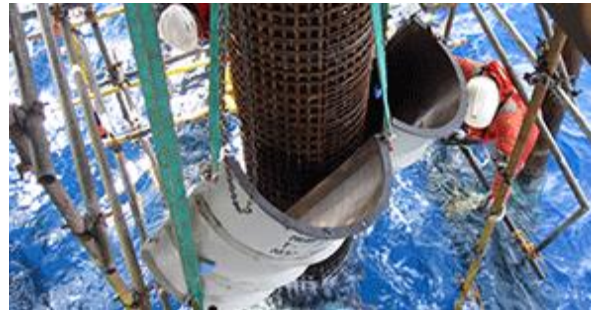
Following applications of the grouted clamps are common:

- Installing a designed clamp onto the jacket bracing and grouting of the annulus
- Installing a designed clamp onto the jacket leg section and grouting of the annulus.



CONDUCTOR STRENGTHENING

Corroded well conductors can lead to the well collapse under the weight of surface wellhead and x-mas tree. In order to strengthen conductor and keep production online high strength grout is pumped into the annulus between conductor and surface casing that facilitates load transfer between two and prevents its further corrosion. In case of highly corroded or damaged conductors grout clamps can be used.

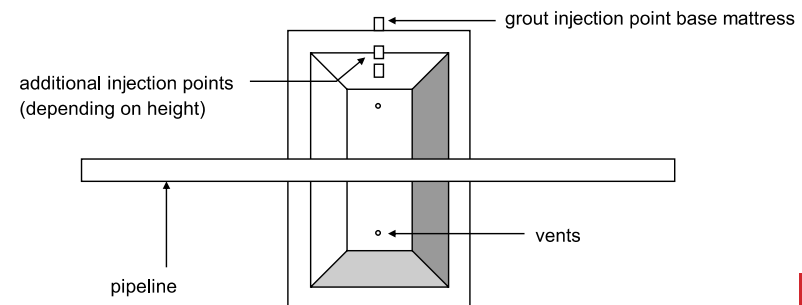
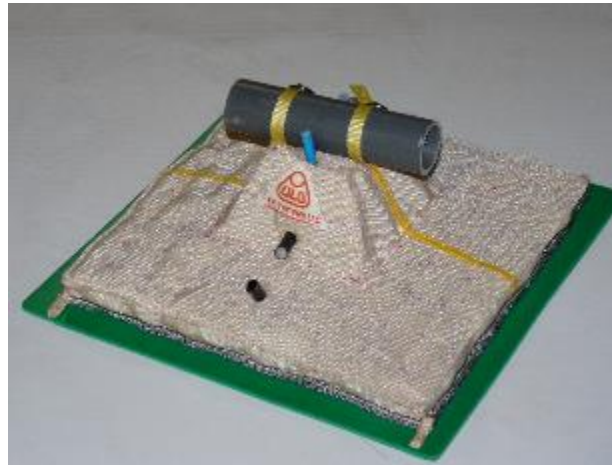


FREESPANS CORRECTION

Freespans of the subsea pipeline appear almost in every project where there is high dependency on the seabed topography, installation method, pipeline route etc. Some of the freespans might not meet safety regulations and require support to prevent overstressing of the pipe. To achieve that, various types of the grout bags produced by leading manufacturers are used.

Grout bags can be used for:

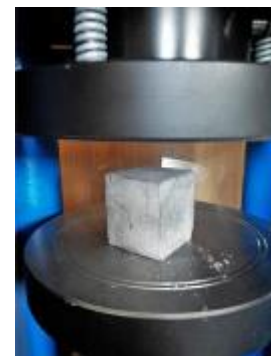
- Pipeline freespan corrections
- Pipeline crossing
- Support of the added weight of repaired sections pipelines (by installing clamps for instance)
- Support of the J-tubes and risers
- Elevation of the pipelines and structures.



EQUIPMENT LIST

Trident operates proprietary spread of equipment including the following:

- Grout mixing unit
- Diesel powered grout pump
- Set of hoses and fittings
- Grout injection devices and clamps
- 20' Offshore field laboratory
- Tanks, bulk cement silos
- 20' Offshore workshop/warehouse
- Auxiliary equipment.



MOBILE LABORATORY

Trident operates mobile field lab for cement slurries and samples testing that has following features:

- State-of-the-art equipment for cement samples compression and bending tests
- Equipment for determining cement slurry parameters
- 20' container based lab (fit both for onshore and offshore facilities use).



MOBILE LABORATORY

Mobile field lab is equipped with C024N Lab Press for Compression Tests to 1300 kN c/w Control Unit "Digitec C108N"

Specifications:

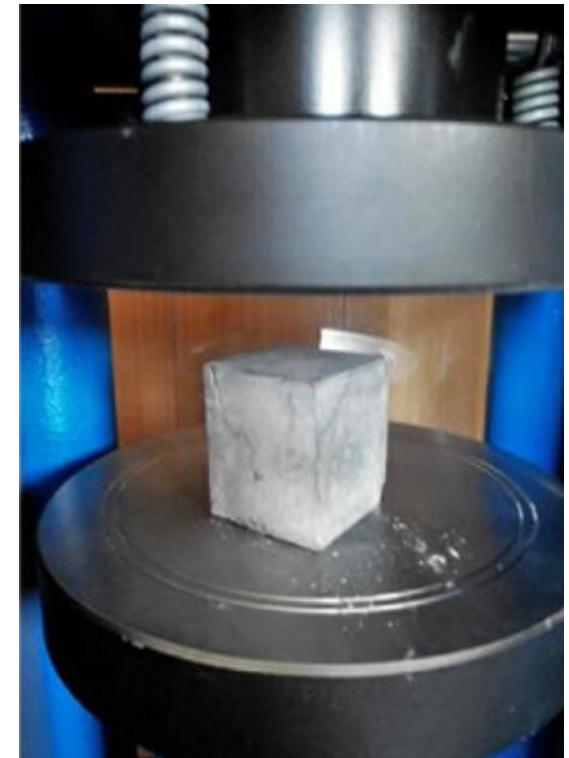
- Load Limit: 1300 kN
- Vertical Air Gap: 336 mm
- Pressure Plates Diameter: \varnothing 216 mm
- Piston Stroke: 55 mm
- Accuracy Class: 1
- Power Supply: 220 V / 750 Wt
- Dimensions: 630x350x1260 mm
- Weight: less 600 kg



MOBILE LABORATORY

Following tests can be performed compliant to UNI EN, ASTM, BS, NF, UNE, DIN Standards:

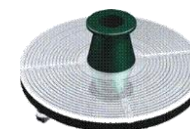
- COMPRESSION of concrete and cement cubes
- BENDING of concrete and cement small bars
- SPLITTING of concrete and cement cubes and cylinders.



MOBILE LABORATORY

Mobile field lab is fitted with equipment for determining of cement slurry parameters such as:

- Funnel for Cement Slurry fluidity test
- Shrinkage measuring device
- Balance scales
- Marsh Funnel Viscometer
- Die Molds for cubic samples 50x50x50
- Die Molds for cubic samples 100x100x100
- Field Lab LGR-3
- Spreadability Cone SC-1
- Scales DL-3000
- Vicat Apparatus
- Specific Gravity Hydrometer ABR-1
- Chemical glassware kit containing measuring cups from 100 to 1000 ml, measuring cylinders from 10 to 500 ml.



TRIDENT EXPERTISE

Project Name	Client	Year
Correction of subsea pipelines unallowable free spans. Subsea pipelines 14" LAM-E - LAM-21, LAM-21 - BLOCK-2 and 10" LAM-F - LAM-22	Dragon Oil	2017
Strengthening of jacket on LAM-10 platform by means of grouting of 66 piles' annuli.	Dragon Oil	2016-2015
Strengthening of jacket on LAM-63 platform by means of grouting of 50 piles' annuli.	Dragon Oil	2015
Strengthening of jacket on LAM-21 platform by means of grouting of 30 piles' annuli.	Dragon Oil	2015

