

Laboratory for Testing Full Scale Oil Country Tubular Goods Subjected to Complex Loading

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Abstract

The paper presents the construction and the operating mode of equipment that has been designed and manufactured for the laboratory testing of petroleum tubulars (make-up/break-out stand of threaded connection, tension/compression stand with internal pressure). The equipment offers the possibility to test the full scale OCTG subjected to complex loading.

Key words: *OCTG (oil country tubular goods), complex loading, make-up, tension, internal pressure.*

Introduction

The exploitation of petroleum and gas resources and their transport to the beneficiaries requires a wide range of OCTG for each specific operation (drilling, extraction and transport). Taking into account that oil products belong to the category of polluting substances, their development and transport need to be carried out under conditions of maximum industrial security so that the environment would be protected at all times.

The industrial security and the protection of the surrounding environment depend on the characteristics of OCTG. In the same time the accidental failure of OCTG is cost intensive, sometimes conducting to well abandon. For this reason, the international standardisation bodies have forced the manufacturing companies of petroleum tubulars to certify the quality of their products for different field conditions on loading (such as tensile strength, internal pressure strength, strength to external pressure etc.) by carrying out complex tests on strength and tightness. The determination of these characteristics requires the use of special testing equipment, which may subject the petroleum tubulars to the combined action of field loads (tension/compression, internal pressure, external pressure, torsion, bending etc.).

Testing Equipment and Methods

In the case of OCTG, the main loads occur on make-up (torsion), tension, internal pressure and external pressure. To determine the strength and tightness of OCTG on the simple or combined action of these loads, the Petroleum – Gas University of Ploiesti developed a series of stands and facilities, and among them those that allow the testing of OCTG on make-up, tension/compression and internal pressure.

Make-up and Break-out Stand

In order to determine the make-up/break-out strength, inside the laboratory it was developed a stand that allows the controlled make-up of threaded connections of petroleum tubular with torque ranging between 100 Nm and 6000 Nm (figure 1); the maximum diameter of a connection is 9 inch (228,6 mm).

The operation of the make-up stand, shown in figure 1, is as follows: the tested specimen, rigidly fixed by a box, is made-up under control by two reducer gears driven by a DC motor, allowing the variation of speed on a large scale and the fast exchange of the direction of revolution (required for unscrewing). The clamping of the box was done by four slips placed at a 90° angle from each other, driven by two hydraulic cylinders.

The unscrewing of threaded connections can be carried on and on until reaching the value of the desired torque, or in equal steps of the spinning angle (in case of the determination of the state of tension by electro resistive tensometry during make-up).

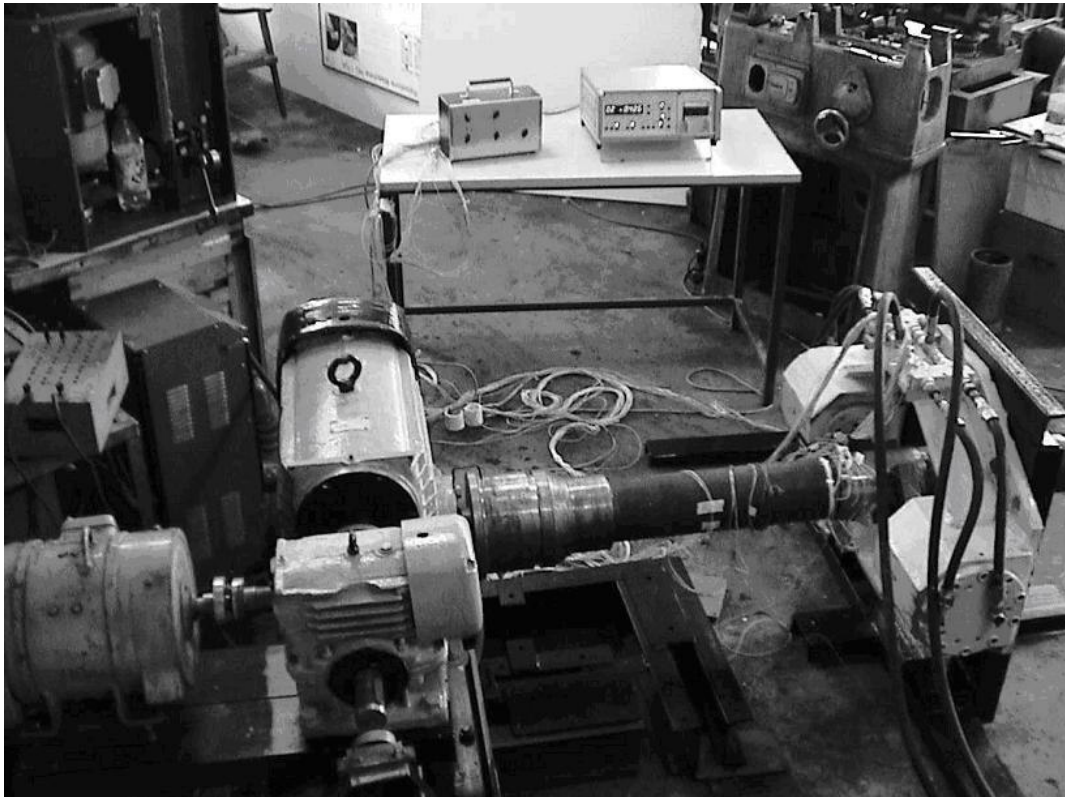


Fig.1. Make-up stand of threaded connection

The following stages are required for the make-up test:

- o cleaning, washing drying and degreasing of box and pin threads;
- o application of a uniform layer of grease on the two threads;
- o fixing the pin in the stand;
- o box make-up by hand;
- o fixing the box in the clamping unit;
- o gradual tightening (make-up) of the connection, and recording of the make-up torque values on each according to the angle of spinning.

Tension/Compression with Internal Pressure Stand

In order to determine the tensile strength with or without internal pressure, the laboratory of the Petroleum – Gas University of Ploiesti developed a stand that can test the full scale OGTC on tension or compression and, by connecting to a high pressure pump, to the combined action of tension/compression and internal pressure loading, with the possibility of controlling (maintaining) the action force (figure 2). The testing facility is based on a loading frame designed by the Institute of Petroleum Engineering of Technical University of Claustrhal.

The specimen subjected to the test (4) is rigidly fixed to one end by the adapter (1) to the body of the stand (3), and to the other end by a connecting part (6), to the piston of the hydraulic cylinder provided with two active pressurisation chambers (7). Because the fixation of the testing material in the connecting parts (1) and (6) is carried out by a conical thread, the plugs (2) and (5) for stiffness and tightness were introduced inside the testing material by the threaded section, in order to avoid the tearing of the sample from these connecting parts during loading on tension and tightening the sample in case it is subjected also to internal pressure. The hydraulic cylinder is connected by admission and discharge hoses (8) and (9) to a hydraulic group (10) which can provide a maximum pressure of 300 bar. The maximum tension that can be achieved is of 1200 kN. If the specimen is subjected to tension it is also subjected to internal pressure; after mounting on the stand, it is filled completely with water or oil and, to achieve the internal pressure, it is connected to a high pressure piston pump (11) using pipe (12).

Figure 3 shows a photo of the tension and compression stand used for the tension test of the two tests.

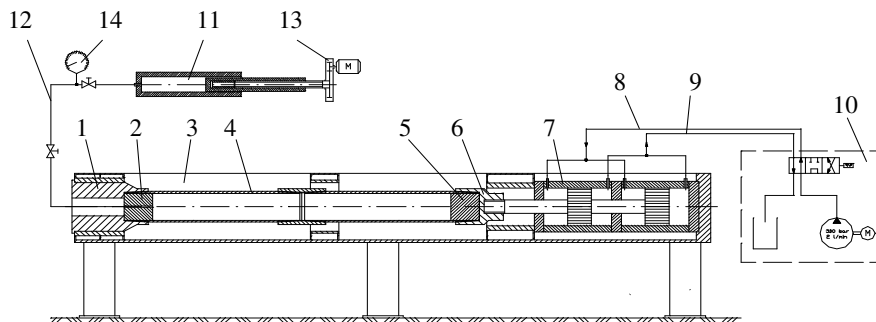
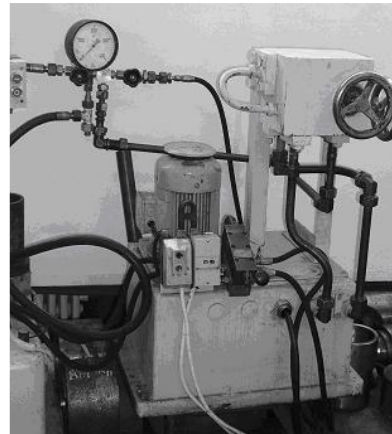


Fig.2. Test stand for petroleum tubular on combined loads of tension and internal pressure



a.



b.

Fig.3. Tension/compression stand used for the tension test with/without internal pressure
a – tension machine; b – hydraulic group

Conclusions

1. The security of the industry and of the surrounding environment depends on the quality of OCTG. This requires quality certification of petroleum tubulars.
2. To certify the quality of petroleum tubulars, the international standards require the guarantee of OCTG properties (such as tensile strength, internal pressure strength, strength to external pressure etc.), during the action of the well specific loads. The determination of these characteristics requires the use of special testing equipment, which may subject the OCTG specimens to the combined action of well acting loads (tension/compression, internal pressure, external pressure, torsion, bending etc.).
3. The equipment carried out inside the testing laboratory for OCTG at the Petroleum – Gas University of Ploiesti can simulate the complex well loads.

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Laborator pentru încercarea materialului tubular petrolier supus solicitărilor complexe

Rezumat

În lucrare se prezintă construcția și modul de funcționare a două echipamente proiectate și realizate în cadrul laboratorului pentru încercarea materialului tubular petrolier (standul de înșurubare / deșurubare al îmbinărilor filetate și standul de tracțiune / compresiune cu presiune interioară). Echipamentele oferă posibilitatea testării la scară reală a materialului tubular supus acțiunii solicitărilor complexe din exploatare.