

**METROLOGICAL SUPPLY OF MEASUREMENTS OF
GEOMETRIC PARAMETERS OF THREADS OF OIL AND
GAS SORTAMENT ON 6-AXIAL COORDINATE-MEASURING
MACHINE WITH PARALLEL KINEMATICS**

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Abstract: The paper presents the results of research on the possibility of using a 6-axis coordinate measuring machine with parallel kinematics ("Hexapod" type) for precise measurements of the geometric parameters of calibers for tapered threads of the oil assortment within their nomenclature and in accordance with international standards (ISO, API) and national standards [1, 2, 3,4].

Keywords: coordinate measuring machines, parallel kinematics, geometric parameters of threads

Introduction: Safety of threaded joints of oil and gas pipelines is ensured by regular monitoring of production and operation of geometric parameters of oil and gas threads, according to the standards of the American Institute of Standards (international accreditation of measuring and calibration laboratories are owned by the National Metrology Institutes of Great Britain (NPL), USA (NIST), China, Brazil and In Russia, which holds the first place in the world along the length of oil and gas pipelines, such accreditation There are no laboratories available).

Domestic and foreign statistics of accidents in various industries due to variations in the parameters of threaded connections in their production and operation of the established norms indicates the importance of creating and maintaining the world level of the requirements of the reference base of the country in the field of measuring the geometric parameters of the thread oil and gas nomenclature. A large fleet and a wide range of used in the oil and gas industry, threaded pipes, together with downhole equipment and tools with threaded connections, which together form the corresponding column of pipes, determine the relevance of the solution to the problem of ensuring the unity of measurements and full interchangeability of threaded connections manufactured (or repaired) by different manufacturers.

1. Quality control system of tapered threads in accordance with API standards

On the example of control of gauges for the lock thread Z-122 (NC46) it is shown that the use of these coordinate-measuring machines with

interference sensors provides precise measurements of the geometric parameters of conical thread gauges in a single installation with a single metrological base. The complex of measuring instruments (SI) used in the present practice in the form of length gauges, microscopes, contour charts and other types allows to measure separately only separate geometrical parameters on each SI. From this point of view, the traditional method underestimates the accuracy of measurements due to the need to bring the measurement results of individual parameters to a single metrological base and limits the range of measured parameters. The use of interference sensors based on the Michelson interferometer in 6-axis coordinate measuring machines with parallel kinematics provides the ability to bind the measurement results directly to the primary standard of length through the wavelength of the stabilized he-Ne laser built into the interference sensors.

A large range of gauges and a wide range of taper threaded connections used in the oil and gas industry, determine the relevance of the problem of ensuring the unity of measurements and their full interchangeability in conditions of construction (or repair) by different manufacturers.

The solution of this problem is based on the hierarchical (centralized) quality control system of conical threaded connections widely used in foreign practice (under the auspices of the American petroleum Institute - API). The system provides for the sequential transmission of the main (integrating) indicator-tension in the connection from the main reference caliber through the lower-level calibres (regional and control) to the working calibres, which

in turn transmit the value of the specified controlled parameter directly to the product. This scheme involves periodic certification of control gauges on the appropriate caliber of a higher status and virtually eliminates all issues related to the interchangeability of tapered threaded connections made by different manufacturers, including the international level.

Currently, Russian consumers are unable to calibrate their control SI in API according to the above procedure. Therefore, the problem of creating a modern scheme of control and certification of gauges in our country (by analogy with the current international system of API), capable of further adapting to the conventional procedure of calibration of SI conical threaded connections, becomes urgent. In the future, the developed Centralized system of metrological support involves the use of the entire range of conical threaded gauges of different levels (reference, regional, control and working), different sizes and the introduction of periodic certification of subordinate SI.

It should be noted that high-tech coordinate measuring machines with laser interference measuring systems are used as precision SI geometric parameters of conical threads in accordance with API standards in NIST (USA), PTB (Germany), NPL (UK). Within the framework of the organization EUROMED there is an international project on the creation of a system of metrological support for the measurement of geometric parameters of oil and gas thread range on the basis of coordinate measuring machines.

2. Harmonization of the international and domestic regulatory framework in the field of measuring the geometric parameters of oil and gas thread range

Prior to the introduction of market relations in our country, the head structure in the metrological insulation of the unity of measurements of the geometric parameters of threads of the oil grade was the laboratory of threaded connections of JSC NPO "Drilling equipment"-VNIIBT, carrying out control and certification of threaded gauges of different levels.

Currently, FGUP VNIIMS, together with JSC "NPO Burovaya Tekhnika", RSU named after I. M. Gubkin, LAPIK LLC and Azerbaijan technical University are conducting research on a complex of precision laser heterodyne reference systems consisting of 6-axis coordinate-measuring machines

and measures in the field of measuring the geometric parameters of oil and gas range threads in order to improve the system of metrological support for the production and operation of critical threaded connections of high-tech industries and critical submicron level technologies that meet new international requirements and standards. Specialists of LLC Lapik develop the software (SOFTWARE) of measurement of threaded calibers-plugs and calibers-rings of the oil grade of the following types:- Buttress according to API 5B [5],- Buttress according to GOST 51906-2015 [6],- OTM and OTG according to GOST 25575-2014 [7] which is supposed to be certified in FSUE "VNIIMS" in system of voluntary certification of the software of measuring instruments according to GOST R 8.654 – 2015, GOST R 8.883. 2015 and GOST R 8.839 – 2013.

3. Implementation of the procedure for measuring the parameters of the threaded gauge

Below is the implementation of the procedure for measuring the threaded caliber Buttress API 5B including, preparation of the caliber (Fig. 1), measurement of its parameters on the 6-axis coordinate measuring machine produced by LAPIK LLC»

KIM-1400 with interference sensors (Fig. 2) and a screenshot of the Protocol of the program of measurements of geometrical parameters of the threaded caliber-buttress plugs according to API 5B (Fig. Three)

Conclusion: as a result of research it is established that the accuracy and range of measured parameters used coordinate measuring machines fully ensure the implementation of all metrological requirements of these standards.



Figure 1 - Gauge-cork Buttress by API 5B

Section II: SENSORS, TRANSDUCERS AND DEVICES FOR MEASUREMENT OF PHYSICAL QUANTITIES



Figure 2 - measurement of geometric parameters of the Butress gauge-tube according to API 5B on the coordinate measuring machine KIM 1400 with interference sensors of LAPIK LLC»

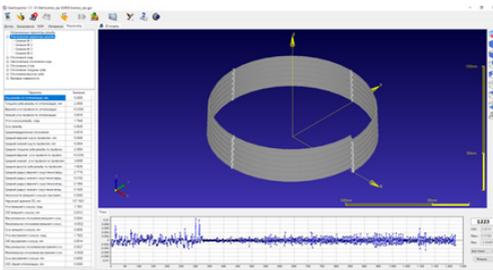


Figure 3 - Screenshot of the program for processing the results of measurements of geometric parameters of caliber-tube Butress by API 5B

Literature.

[1] 56349-2015 GOST R (ISO 10424-2: 2007) drill Pipes and other elements of drill strings in the oil and gas industry. Part 2. Basic parameters and control of threaded thrust connections. General technical requirements.

[2] ISO 10424-2: 2007 Oil and gas industry - rotary drilling equipment - Part 2 of the thread and the calibration of rotary threaded joints are shouldered.

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[3] ANSI / API specification 7-2 (previously in Specification 7).

Specification for threading and Gauging of rotary Shouldered thread connections.

(Specification for threading and calibration of rotary threaded connections with thrust shoulder).

[4] GOST 8867-89 Gauges for tool joint thread. Views. Basic dimensions and tolerances.

[5] API Spec 5B threading, Grooving, and inspection of casing, tubing, and pipe line threads, sixteenth edition. The standard of the American petroleum Institute, 12/01/2017

[6] GOST R 51906-2015 Connections of threaded casing tubing, pipes for pipelines and threaded gauges for them. General technical requirements.

[7] GOST 25575-2014 Gauges for connection with trapezoidal thread of sedimentary pipes and couplings to them. Types and basic sizes.

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