



## RESEARCH TEST BENCH

for mass flow rate of gas liquid mixtures

The common project of HMS Neftemash JSC and HMS Group R&D Directorate in cooperation with Federal State Autonomous Educational Institution of Higher Education, Tyumen State University, sponsored by the Ministry of Education and Science of the Russian Federation.





### APPLICATION

The research test bench is intended for:

- verification of separation and separation-free (multiphase flow meters) units for oil and gas flowrate measurement;
- verification of liquid flow meters, both coriolis and positive displacement types;
- testing samples of sampling devices;
- testing and certification of measurement procedures;
- testing aimed at approval of type of measurement instruments;
- research practice, testing advanced design solutions for flowrate, water cut and density measurement instruments and measurement systems;
- research practice with regard to engineering fluid and gas separation units.

Moreover, the test bench can be applied for solving the following issues:

#### **Metrological tasks:**

- developing procedures for calculation of method and instrument errors;
- engineering flow measurement instruments;
- testing, verification and calibration of measurement instruments.

#### **Scientific research tasks:**

- studying dynamics of multiphase flows and flow modes;
  - designing numerically simulated models for multiphase flow description;
  - studying various effects and their distinguishing characteristics at oil and gas transfer (paraffins, hydrates, asphaltenes, corrosion, erosion, etc.).
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## ADVANTAGES

1

The test bench is equipped with an exclusive mixing assembly for getting one-hundred-percent homogeneous mixture for further analysis.

2

The mixture is being prepared on regular basis and is not restricted by a certain operational volume

3

The test bench is ensured with a master system both for gas liquid flow and for the gas liquid flow blend composition along with the fluid density and water cut measurement system and sampling system.



## SPECIFICATION

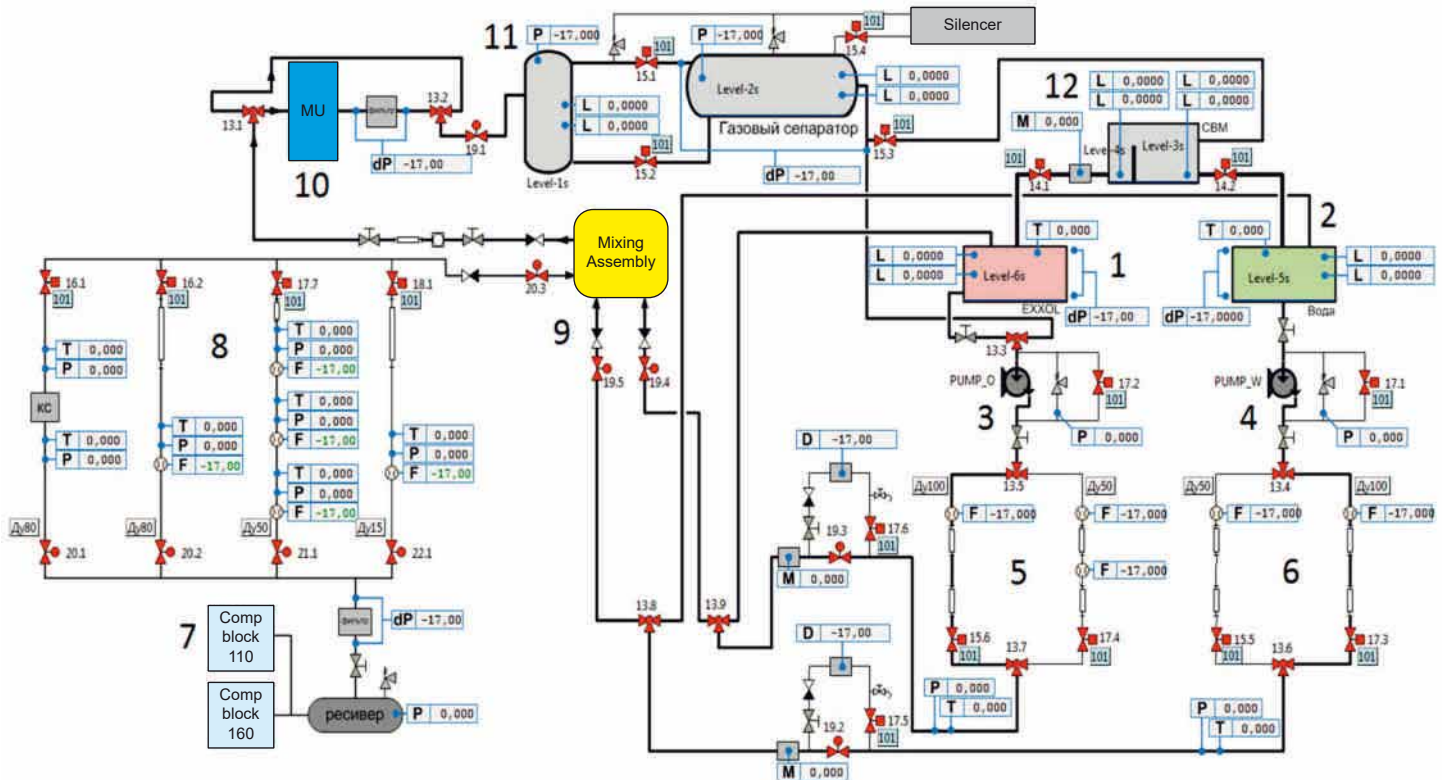
Наименование параметра	Значение
Service fluids	Exxol D100 oil simulator and water
Service gas	air
Mass fluid flow rate, t/h	from 0.1 up to 100
Gas volume flow rate, converted to standard conditions, m3/h	from 1,0 up to 2500
Service pressure range, MPa	from 0.2 up to 1.0
Mixture service temperature range, °C	from 15 up to 40
Limits of unit allowable relative tolerance when measuring mass flow rate of liquid components, % maximum	± 0.1
Limits of unit allowable relative tolerance when measuring air volume flow rate under the operating conditions, % maximum	± 0.5
Limits of unit conventional error at pressure measurement, % maximum	± 0.3
Limits of unit conventional error at temperature measurement, °C maximum	± 0.3
Limits of unit absolute tolerance at differential pressure measurement, % maximum	± 0.3

## DESIGN AND OPERATION CONCEPT

The test bench operation is designed closed-loop. The air, water and oil simulator are being injected into the mixing assembly under the set flow rate. The fluids are being mixed up making homogeneous three-component gas-liquid flow. The multiphase flow is passing then through the system, which is being tested or verified. The mixture is getting into the gas liquid separator, which separates air from liquid emitting the air into the atmosphere. The degassed emulsion is getting then into the gravity-based dynamic separator, where the two-component fluid is being split into the primary compounds – Exxsol and water, being poured into the relevant storage reservoirs. All test bench operations are completely automatic, which allows remote control of all process parameters (pressure, temperature, flowrate, and moisture content), setting and maintenance of required flow rate value for every component, as well as tracing the process dynamics.

Designing the scientific test bench applying the advanced technologies for engineering smart instrumentation systems based on National Instruments computer-aided technology and LabView graphical programming language allows both for challenging automation tasks at pilot measurement units as well as verification and testing of multiphase flowmeters. Currently there is also an opportunity for studying multiphase flow dynamics and flow modes along with engineering and simulating flows with various effects.

## PROCESS FLOW SHEET



- 1 – oil simulator tank
- 2 – water tank
- 3 – pump transfer stations
- 4 – pump transfer stations
- 5 – oil simulator flowrate measurement line
- 6 – reservoir fluid flowrate measurement line

- 7 – air compressor unit
- 8 – air flowrate measurement line
- 9 – mixing assembly
- 10 – measurement unit (MU)
- 11 – gas liquid separator
- 12 – gravity-based dynamic separator

**HMS Neftemash Joint Stock Company** is one of the leading manufacturers of block-modular oil and gas equipment in Russia and CIS countries. The company was founded in 1965. Since 2005 it has been incorporated by HMS Group JSC machine-building holding.

The company core business domain is fabrication of the equipment for the production processes of oil, petroleum products, gas and gas condensate extraction, transfer and refining:

- Different purpose pump stations (pump transfer station, modular group pumping stations, group pumping stations and other);
- Modular packages for gas (gaseous flows) treatment and transfer;
- Gas separation compressor stations;
- Oil and water treatment equipment;
- Measurement units (separation and separation-free);
- Custody transfer systems for different flows;
- Heat exchange equipment;
- Tanks, vessels and metal frameworks;
- Fire-fighting system equipment;
- Auxiliary buildings and amenities.

HMS Neftemash JSC possess successful experience at realization of projects for the complete supply of process equipment to oil and gas complex facilities.

#### **Advantageous factors:**

- Production facilities of 139.3 thous. m<sup>2</sup>, including machine tool and assembly workshops, bead blasting and painting chambers, testing laboratory, administrative and auxiliary buildings, multi-building warehouse;
- Up-to-date fleet of production equipment, represented by NC-controlled lathes and machining centers by leading German, Italian, Swiss, Turkish, American, Korean and Chinese manufacturers;
- Over 1400 employees, of which 100 are the specialists at designing process and infrastructure facilities for oil and gas recovery industry along with the specialists involved into engineering and introduction of high technologies at oil and gas equipment;
- Integrated Management System certified for its compliance with ISO 9001, ISO 14001, ISO 45001, ISO/IEC 17025 and STO Gazprom 9001 standards;
- Unique multiphase flow scientific research test bench, intended for verification, testing and calibration of different types of flow meters, oil and gas measurement units, as well as for solving wide range of research and metrological tasks.



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The project for engineering the scientific research test bench (hereinafter as the test bench) has been realized by HMS Neftemash specialists in cooperation with HMS Group Directorate and scientists of the Federal State-Funded Educational Institution of Higher Professional Education, Tyumen State University, with funding from the

Ministry of Education and Science of the Russian Federation under the Russian Federation Government Regulation No. 218 dd. 09.04.2010 On measures of state support at extension of cooperation between higher educational institutions and organizations implementing integrated projects for designing high-tech manufacturing. In year 2015, the test bench was certified and approved by the Federal Agency for Technical Regulation and Metrology (Rosstandard) as a first grade operational national reference gauge for measuring gas liquid fluid mass flow rate in compliance with GOST 8.637-2013 verification schedule. This research test bench is the largest in Russia and can transmit the multiphase flowrate unit to both other similar systems and measurement instruments.

The uniqueness of the engineered test bench design is patented by the following documentation:

- Utility Model Patent No. 138529 of 15.11.2013,
- State Registration Certificate of Computer Software No. 2015663259 of 16.09.2015.

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