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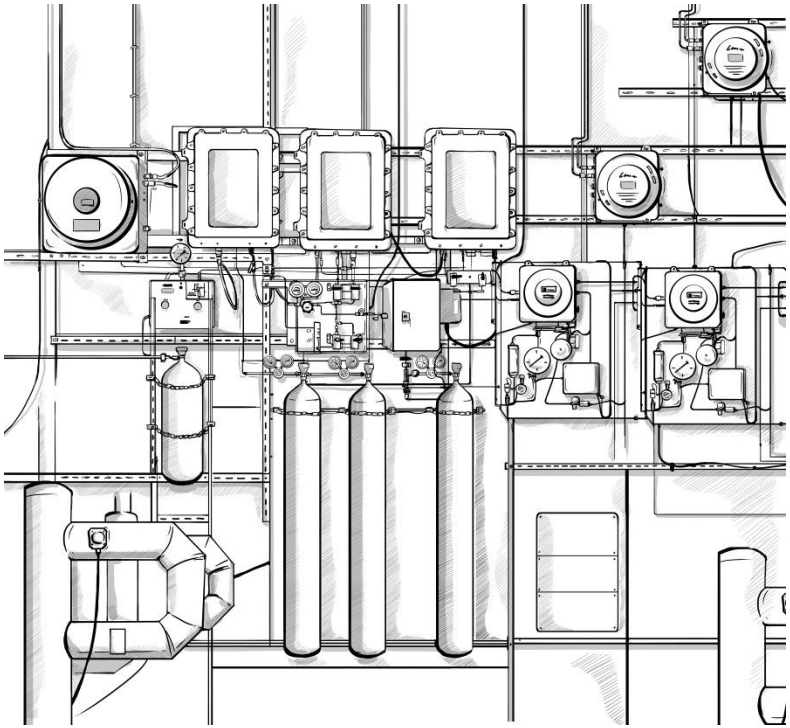
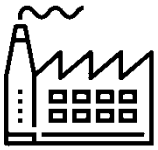
BACS

COMPLEX SOLUTIONS AND ANALYTICAL INSTRUMENTS FOR OIL AND GAS INDUSTRY



1992	3	200+	1300+
year of foundation	number of production and assembly sites	number of employees	analytical instruments produced

Products and Services:



Integrated solutions for the oil and gas, energy industries, including the system for measuring the quantity and quality of gas and liquid hydrocarbons;

Process **gas chromatographs**, analytical complex, **gas analyzers**

Coriolis mass **flow meters**

Design and implementation of **automated control systems**

Service facilities.

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BACS LLC manufactured and supplied more than 1000 analytical instruments

GAZPROM ROSNEFT NOVATEK SIBUR Maire Tecnimont HEDVIGA GROUP

Non-exhaustive Reference of foreign contracts:
Analytical Equipment

Czech Republic

«HEDVIGA GROUP» - **2 complexes for pyrolysis products** analyses based on the MAG Chromatograph

England

«HEDVIGA GROUP» - **complex for pyrolysis products** analyses based on the MAG Chromatograph

Italy

«2i Rete Gas» - process **analytical system for biomethane analysis** based on the MAG Chromatograph

USA

«Ohio Lumex» - process **analytical system for biomethane analysis** based on the MAG Chromatograph

Kazakhstan

«BatysMunayGas Zhabtyktary» LLP – **2 process gas chromatographs** MAG, oxygen analyzer AnOx, moisture analyzer HygroScan.

Belarus

«Gazprom Transgaz Belarus» PJSC - **Portable Oxygen Analyzers**

Gas flow metering unit with Gas Quality Control Unit

Serbia

Infrastructure Development and Construction doo Beograd-Zemun - «**Transmission gas pipeline (interconnector)** border of Bulgaria – border of Hungary»

Gas Quality Control Unit

Kyrgyzstan

«Gazprom Kyrgyzstan» LLC - «**Transmission gas pipeline (interconnector)** border of Kyrgyzstan – border of Kazakhstan»

Gas flow metering unit

Belarus

«Gazprom Transgaz Belarus» PJSC – «**Transmission gas pipeline (interconnector)** border of Belarus– border of Latvia»

Kazakhstan

«Asian Gas pipeline» LLP – «**Transmission gas pipeline (interconnector)** border of Kazakhstan– border of China»

ANALYTICAL INSTRUMENTS FOR GAS INDUSTRY

B
A
C
S

MAG PROCESS GAS CHROMATOGRAPH MARKET POSITION

Price

Performance

- ✓ TCD only;
- ✓ Gas samples only;
- ✓ Isothermal oven
- ✓ Low variety of configurations

- ✓ Different detector types;
- ✓ Gas and liquid samples;
- ✓ Isothermal oven
- ✓ Middle variety of configurations

- ✓ Different detector types;
- ✓ Gas and liquid samples;
- ✓ Isothermal or temperature programming oven
- ✓ High variety of configurations

MAG is the series of newest modern process GC developed by BACS LLC which provide excellent performance thanks to years of experience in chromatography and usage of the advanced technologies

Key benefits

Superior Performance

- ✓ Types of detectors: TCD, CCD, ECD (for sulfur), FID, CRRD.
- ✓ Analyzed media: gas, liquefied gas or liquid
- ✓ High measurement accuracy and fast analysis
- ✓ Built-in sample stream selector for up to 6 analyzed lines
- ✓ Compliance with international standards

Improved Usability

- ✓ 12” LCD touch screen with user-friendly interface
- ✓ Automatic operation due to built-in PC with nonvolatile memory
- ✓ Flexible PC software for remote access, settings and data acquisition
- ✓ Wide variety of the data transmitting opportunities
- ✓ External pressure sensors for carrier and test gas cylinders

Key benefits (continuation)

Flexile Design

- ✓ Compact design with Ex d explosion-proof enclosure
- ✓ Flexible modular configuration with up to 4 independent analytical channels fits various of applications
- ✓ Optional injector-vaporizer for liquid samples
- ✓ Optional heated gas inlets for lossless heavy samples injection
- ✓ Integrated power supply unit 220V

Analytical GC channel

Cost-efficiency

- ✓ Low power and gas consumption
- ✓ No instrument air or other auxiliary gases required
- ✓ Easy maintenance: each part of the GC can be relapsed separately even in field
- ✓ Low service cost

Injector-vaporizer

SPECIFICATION OF MAG GC

Technical characteristics		
Number of analytical channels		Up to 4 (1 channel consists of 1 detector, 1 sampling valve and column system)
Oven type and temperature		Airless, isothermal, from 60 to 150°C
Chromatographic columns		Capillary, micropacked, packed
Number of analyzed streams		up to 6 analyzed streams (including calibration mixture)
Analyzed media		Gas, liquified gas or liquid
Carrier gas		He, Ar, N_2, H_2 (for TCD) or air (for ECD and CCD)
Carrier gas consumption		5 - 30 cm^3/min (depending on application)
Operation mode		Automatic, controlled by internal PC with integrated software
Display and data input		12” LCD with touch screen (option)
Communication interfaces	Standard	RS 232/485 (ModbusRTU) – 2 pcs., Ethernet (ModbusTCP) – 1 pc., Discrete inputs (NAMUR) – 4 pcs. (optionally extendable)
	Optional	RS 232/485 – extra 1 pc., 4-20 mA – up to16 pcs., Discrete outputs, optical Ethernet, GSM/GPRS
Power supply		110-220 V, (50±1) Hz
Power consumption		up to 180 W (warm-up); up to 80 W (steady mode)
Explosion protection, IP rating		1Ex d IIB T4Gb or 1Ex d IIB+H2 T4 Gb, IP65
Ambient temperature range		From -10 to +50°C
Weight, kg		No more than 40 or 58 (depending on version)
Dimensions (L×W×H), mm		400×300×481 or 436×318×607 (depending on version)

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Components that can be analyzed with the MAG GC:

- **Permanent gases**: He, H_2, N_2, O_2, CO, CO_2;
- **Inorganic compounds**: H_2O, H_2S, COS, SO_2, NH_3, N_2O, NOx, etc.;
- **Saturated hydrocarbons:** methane, ethane, propane, butanes, etc. up to n-decane;
- **Unsaturated hydrocarbons:** ethylene, acetylene, propylene, propadiene, methylacetylene, butylenes, butadiene, etc.;
- **Aromatic hydrocarbons:** benzene, toluene, ethylbenzene, xylenes, etc.;
- **Oxygenated organic compounds**: alcohols (methanol, ethanol, TMC (trimethyl carbinol), etc.), glycols, ethers and esters (dimethyl ether, MTBE, TAME, etc.), aldehydes (acetic aldehyde, acrolein, etc.), ketones, fatty acids;
- **Halogen-containing compounds**, **nitrogen-containing compounds** and other polar volatile organic compounds;
- **Sulfur-containing organic compounds**: mercaptans, sulfides, disulfides.

Transportation of natural gas

Analysis of

the **composition of natural gas** and associated gas according to ISO 10723 and ISO 6974 with the calculation of its physicochemical parameters according to ISO 6976;

liquefied natural gas (LNG) and **boil-off gas** (BOG) composition;

the mass concentration of **sulfur-containing compounds** according to ISO 19739 (GOST R 53367-2009).

Natural and associated gas processing

Analysis of **natural gas liquids** (NGL) and **liquefied petroleum gases** (LPG), the quality control of liquid and gaseous commercial products on gas fractionation and acid gas removal plants;

Analysis of natural gasoline, **gas condensate** and dry stripped gas composition.

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Petrochemical production

Analysis of various products of organic synthesis processes:

- ✓ Production of lower olefins and dienes (pyrolysis of oil fractions);
- ✓ Production of propylene (propane dehydrogenation);
- ✓ Production of isobutylene (dehydrogenation of isobutane);
- ✓ Production of methyl tert-butyl ether (MTBE) (synthesis from methanol and isobutylene, comprising fraction);
- ✓ Production of acrylic acid (two-stage oxidation of propylene).

Alternative energy

Analysis of biogas, biomethane;

Control of **waste-to-energy** (landfill gas, synthesis gas, products of pyrolysis);

Control of **power-to-gas** processes (H_2 and H_2+ NG mixtures).

APPLICATIONS OF MAG GC: NATURAL GAS ANALYSIS

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Off-shore gas production

Gas flow metering unit

Filter for drying and gas purification

Gas flow metering unit

Gas-compressor station (GCS)

Natural gas extraction

Gas flow metering unit

Biomethane production

Gas flow metering unit

Gas flow metering unit

Gas flow metering station with gas quality control unit

Natural and Associated Gas Processing

Gas flow metering unit

Gas distribution station

Gas flow metering unit

Gas flow metering unit

Gas flow metering unit

LNG plant

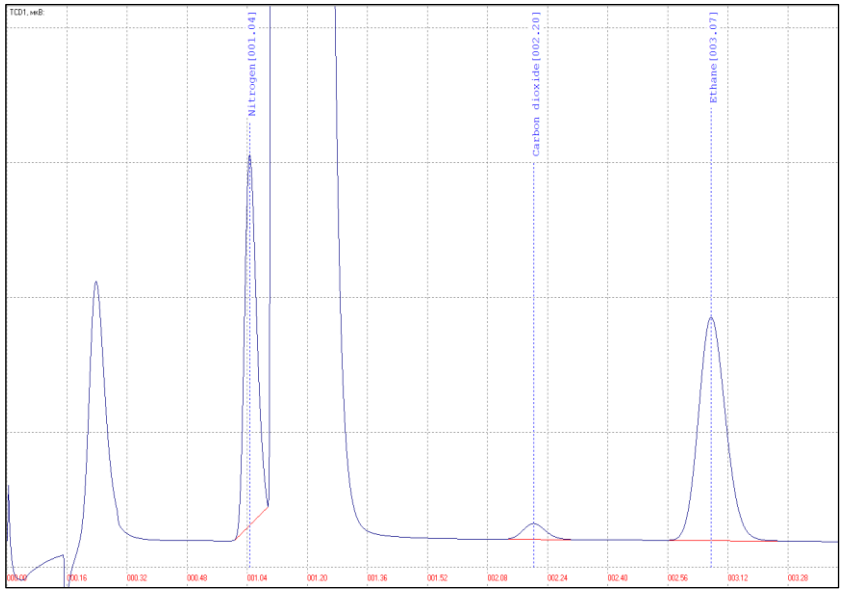
APPLICATIONS OF MAG GC: NATURAL GAS ANALYSIS

Scope of application

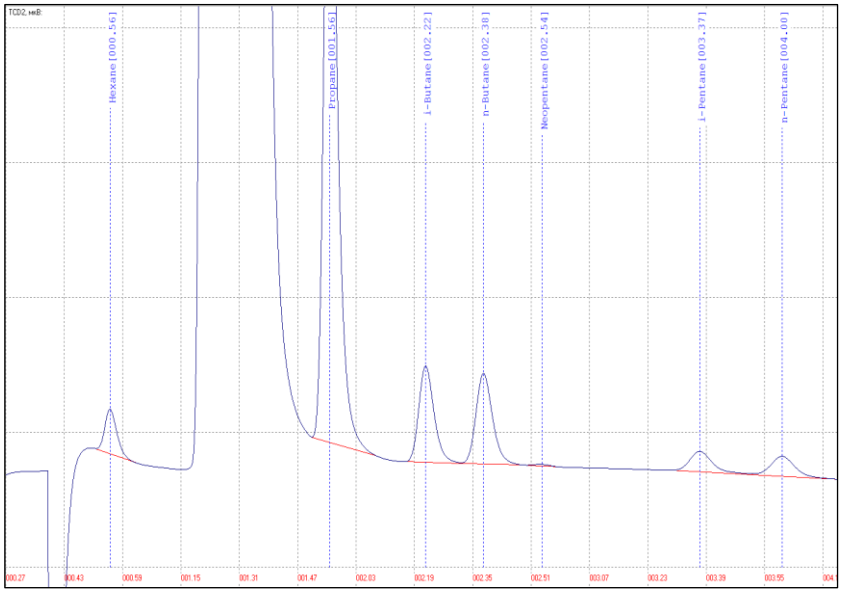
Analysis of natural gas composition according to ISO 6974 with calculation of calorific values, relative and absolute density, compressibility factor and Wobbe index in accordance with ISO 6976.

Configuration and parameters

- ✓ Two analytical channels with µ-TCD;
- ✓ C6+ backflush precolumn;
- ✓ Total analysis time – up to 5 min;
- ✓ Carrier gas (He) consumption – up to 12 ml/min (one 40 L cylinder per year).



Chromatogram of 1-st analytical channel: Air, CH4, CO2, C2H6 separation

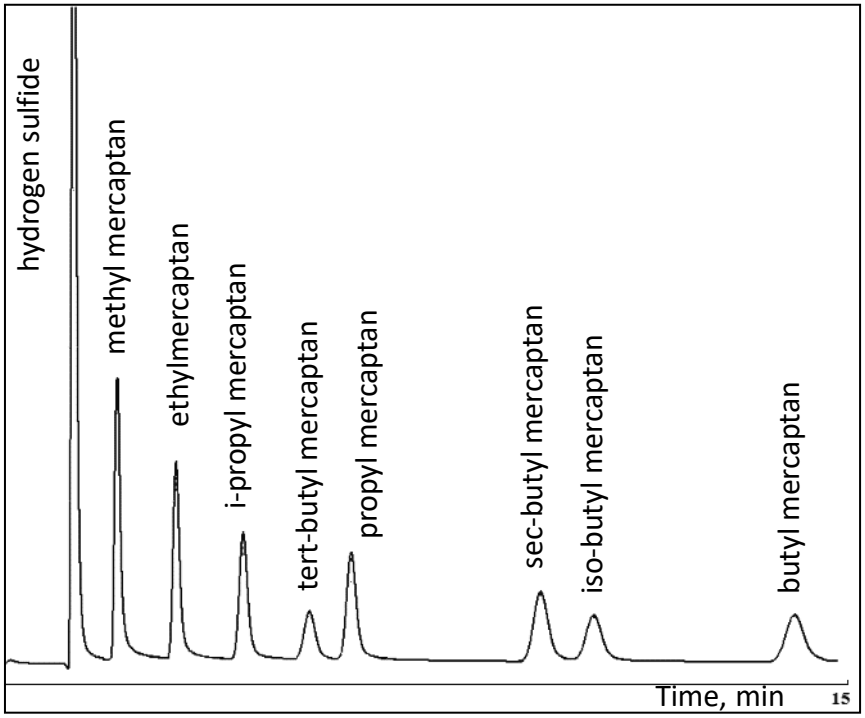


Chromatogram of 2-nd analytical channel: C6+, C3H8, i-C4H10, C4H10, neo-C5H12, i-C5H12, C5H12 separation

APPLICATIONS OF MAG GC: ANALYSIS OF SULFUR COMPOUNDS

Scope of application

Determination of sulfur-containing substances in natural gas including H_2S and mercaptans and following calculation of total and sour sulfur according to ASTM D 7493, ISO 19739.



Configuration and parameters

- ✓ Analytical module with capillary column and high-sensitive electrochemical detector;
- ✓ No interference with hydrocarbons;
- ✓ Compressed air as a carrier gas;
- ✓ No auxiliary gases required;
- ✓ Detection level – from 0,01 ppm;
- ✓ Analysis time – up to 15 min.

Extended natural gas composition analysis

- ✓ Additional analytical channel for determining the content of **hydrogen** and **helium** with a carrier gas argon;
- ✓ Additional analytical channel for determining the molar fraction of **oxygen**;
- ✓ Extended analysis of the hydrocarbon composition of natural gas to **C_8 (C_{9+})**
- ✓ Additional analytical channel for **methanol** analysis;
- ✓ Combined analysis of the **component composition** of natural gas in accordance with ISO 6974 and **sulfur-containing compounds** in NG in complying with ASTM D 7493, ISO 19739.

Chromatogram of 1-st analytical channel:

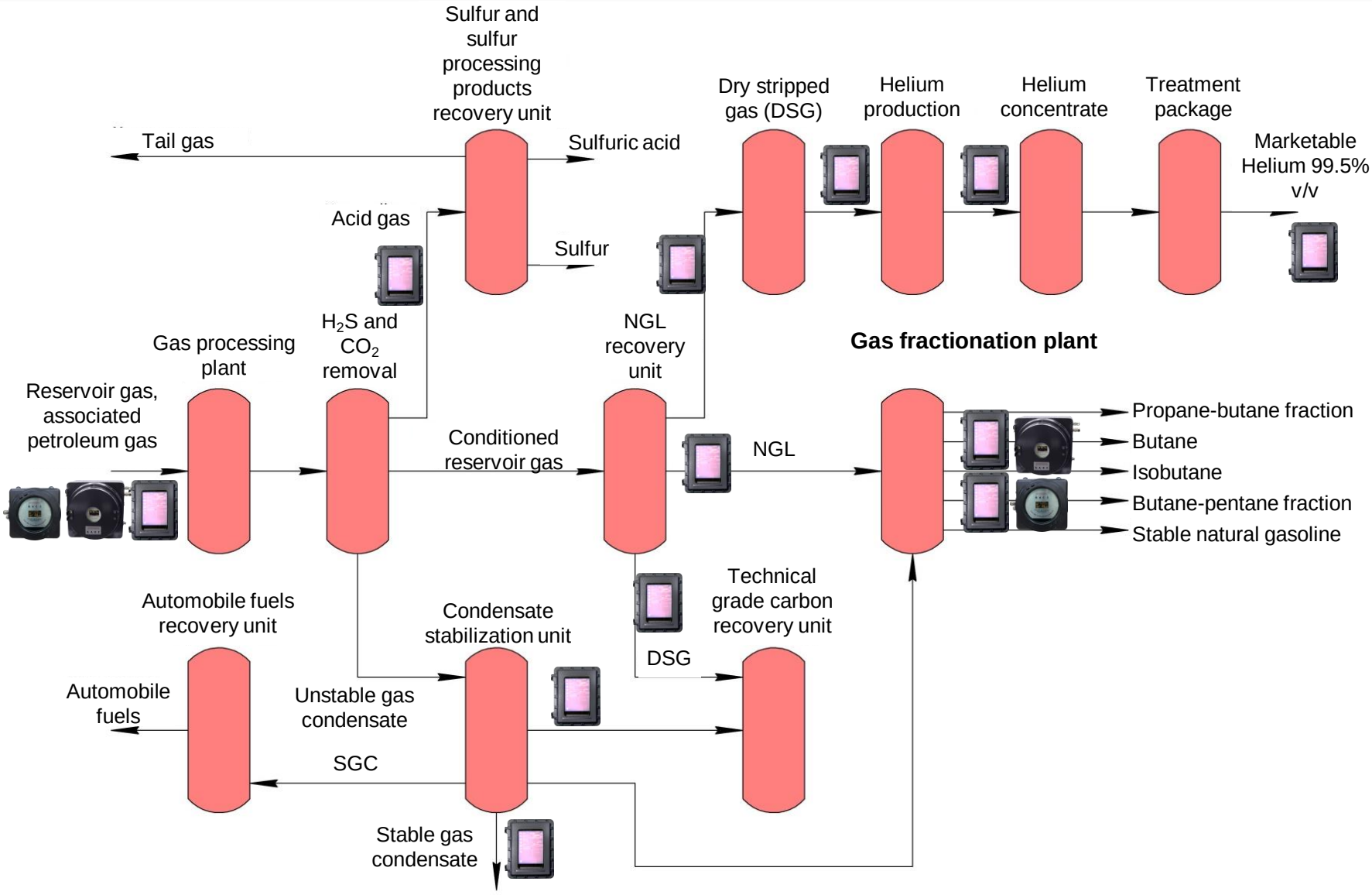
Detector: TCD

Analyzed components: He, H_2, N_2 + O_2

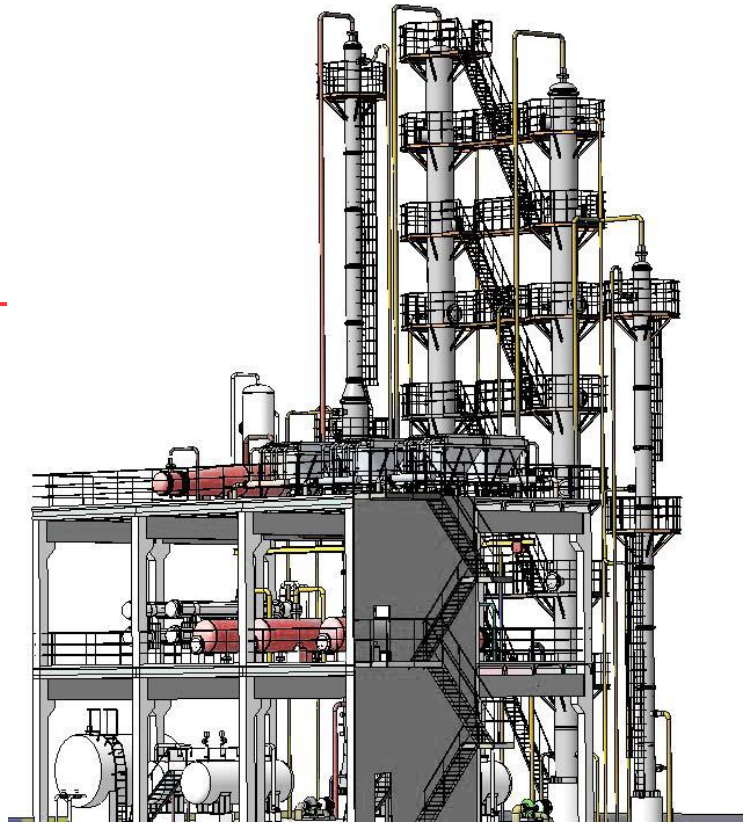
Analysis time: 10 min.

Carrier gas: argon

APPLICATIONS OF MAG GC: NATURAL AND ASSOCIATED GAS PROCESSING



APPLICATIONS OF MAG GC: GAS FRACTIONATION PLANT



Butane fraction

Pentane-hexane fraction

Propane fraction

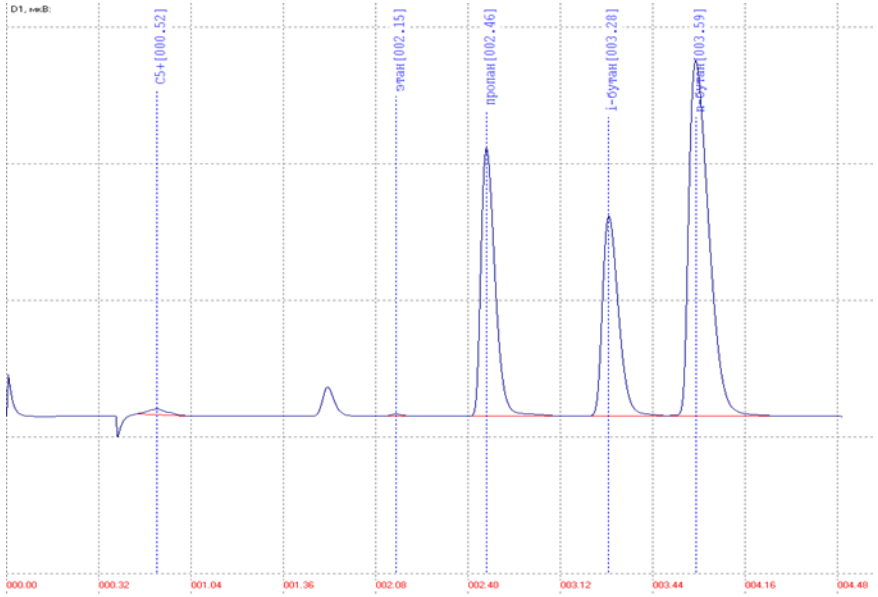
Stable natural gasoline

Chromatograph MAG
Compositional analysis

Chromatograph MAG-S
Measurement of mass concentration of **H_2S** and **mercaptans**

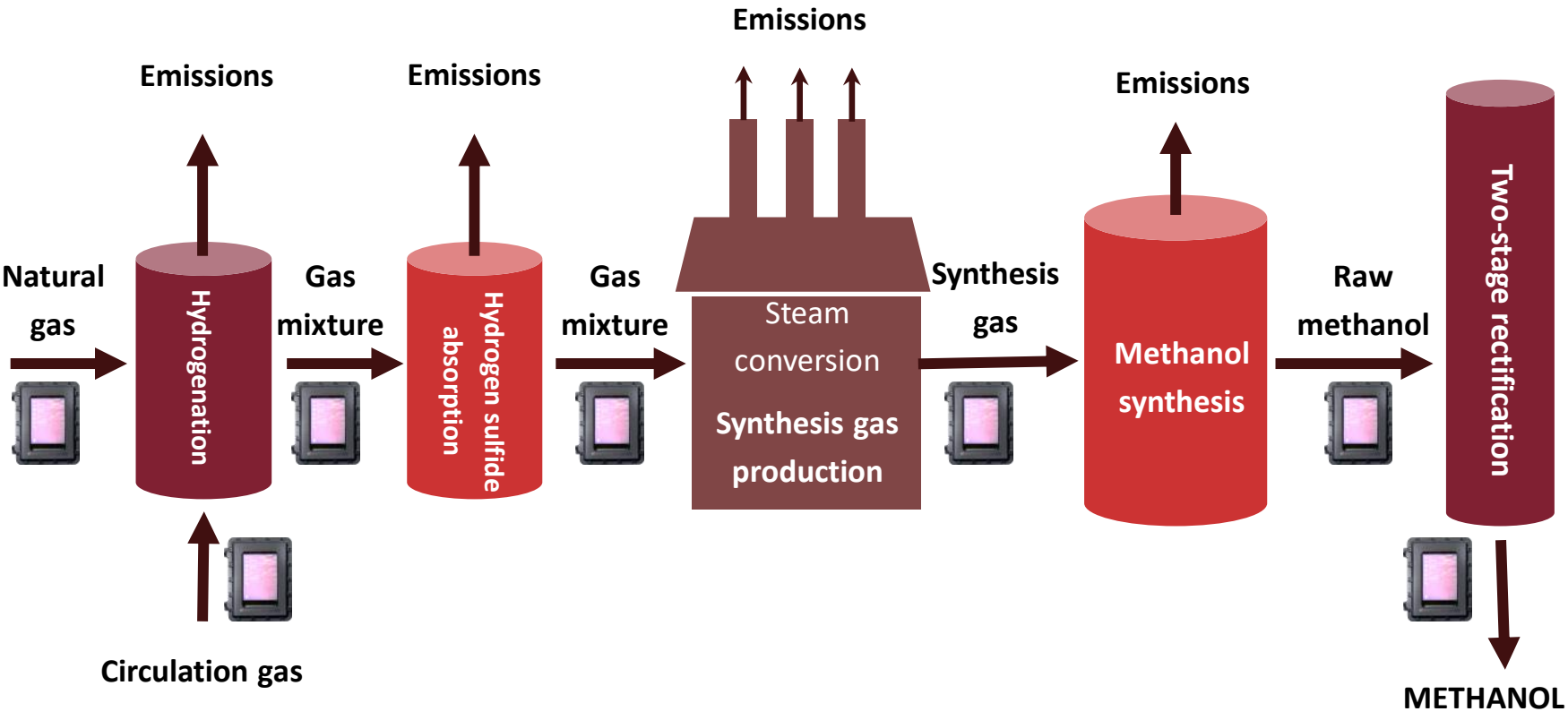
Composition monitoring for GFP produced propane and butane fractions

Features	
Analyzed medium	Liquefied gas
Analyzed components	Ethane, propane, isbutane, n-butane (in propane fraction)
Detector type	TCD
Number of analytical channels	1
Column type	Micropacked
Carrier gas	Helium
Duration of analysis	5:50 AM [min:s]



Channel 1 chromatogram

Methanol production



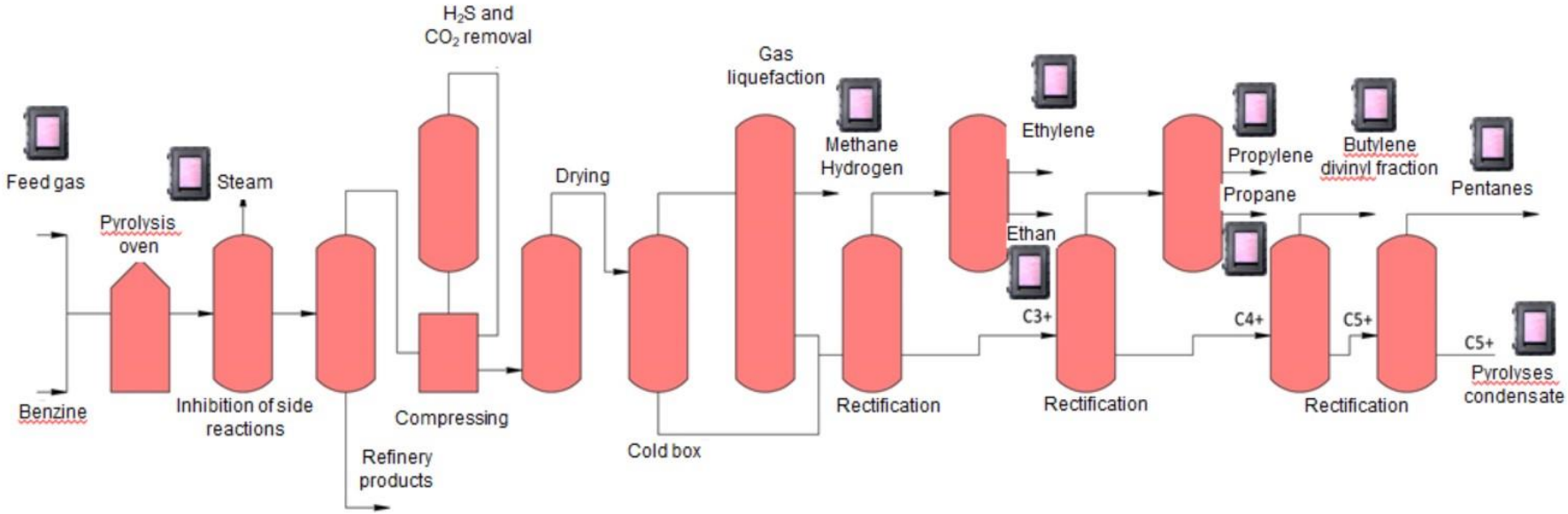
Process flow diagram of the methanol production from natural gas

Production of Lower Olefins and Dienes

Process: pyrolysis of oil fractions or hydrocarbon gases (steam cracking)

Synthesis:

- ethylene
- propylene
- i-butylene
- isoprene
- 1,3-butadiene



Process flow diagram of pyrolysis unit

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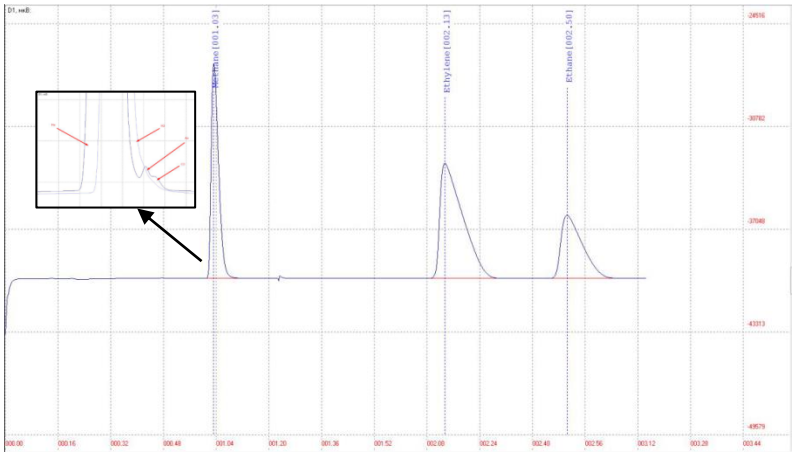
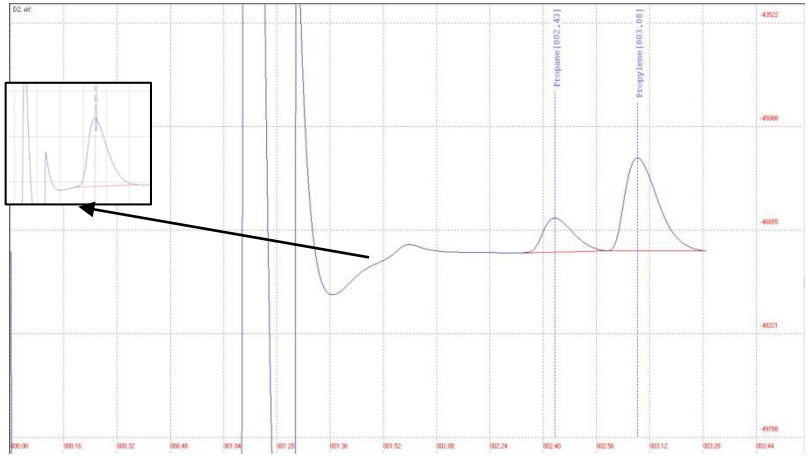
Oil Fraction and Hydrocarbon Gases Pyrolyses

Features of Chromatograph	
Analyzed medium	Gas
Analyzed components	H_2, CO, CH_4, ethylene, ethane, propylene, propane, $C4_+$
Detector type	TCD
Number of analytical channels	2
Column type	Micro-packed
Carrier gas	Argon, Helium
Duration of analysis	4:30 [min:sec]



Analytical channel №1 chromatogram (H_2, CO, CH_4, ethylene, ethane)



Analytical channel №2 chromatogram (propylene, propane, $C4_{+)}$

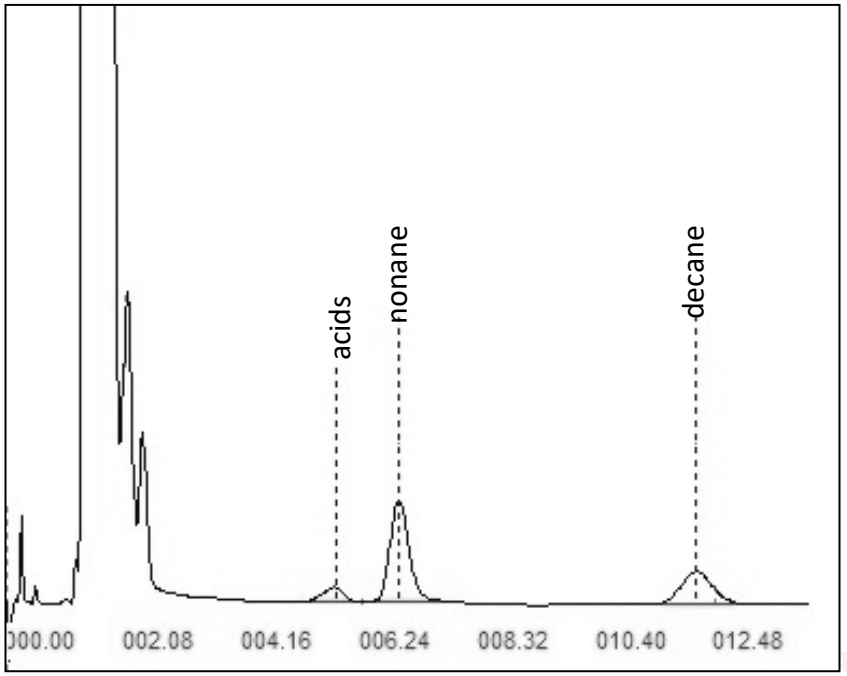
APPLICATIONS OF MAG GC: ANALYSIS OF LIQUEFIED HYDROCARBONS

Scope of application

Quality control of C_6-C_{10} hydrocarbons according to ASTM D 2597 at complex gas treatment facilities and gas processing plant, and also in commercial liquid hydrocarbons measurement units.

Configuration and parameters

- ✓ One or two analytical channels with μ-TCD depending on component list;
- ✓ Liquid sample injection system with an external heated pneumatic-actuated sampling valve;
- ✓ Vaporization and injection without losses of analyzed sample;
- ✓ Max. sample pressure: 70 bar;
- ✓ Max. valve temperature: 220°C.



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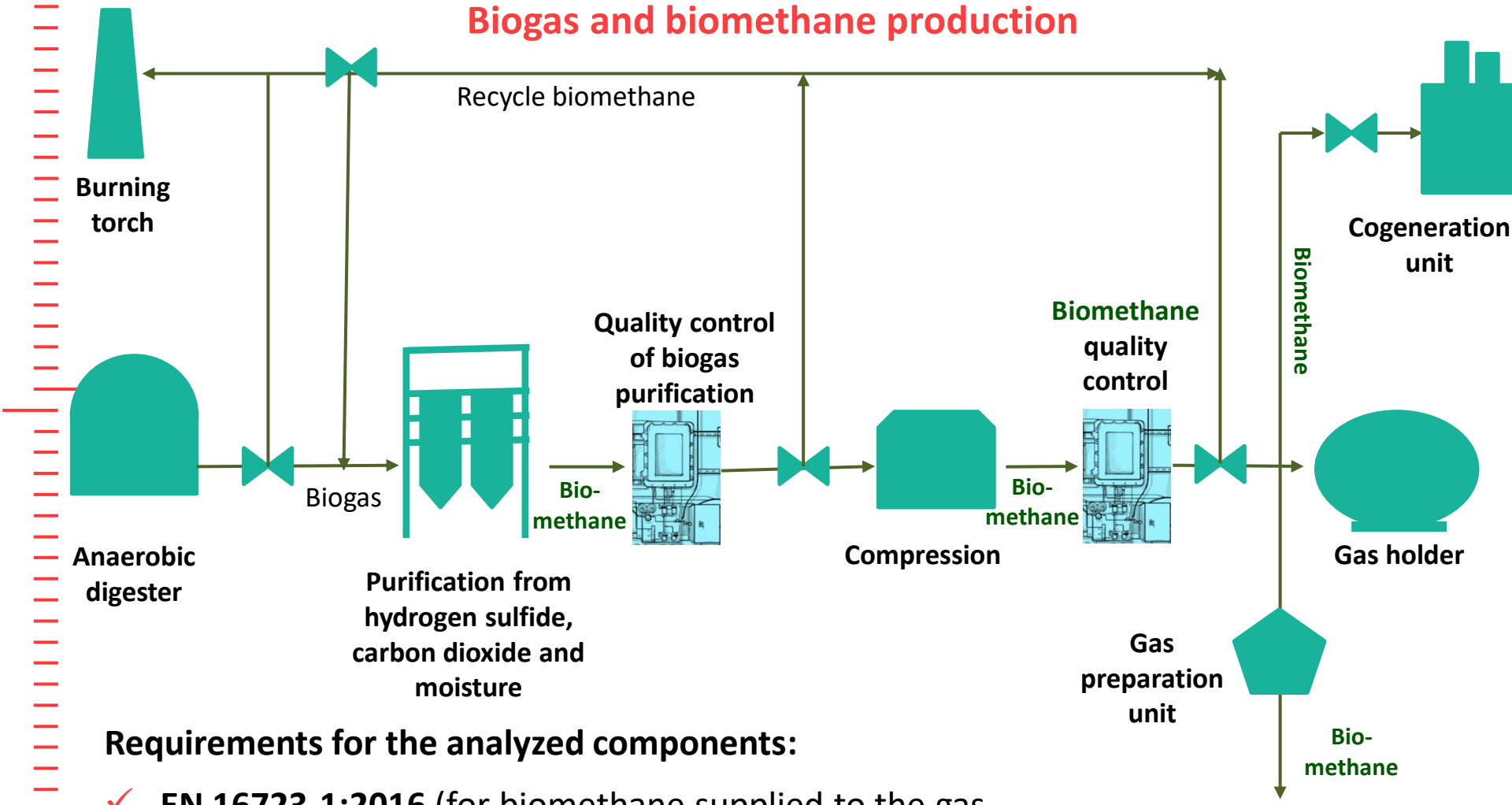
Biogas and biomethane production



Requirements for the analyzed components:

- ✓ **EN 16723-1:2016** (for biomethane supplied to the gas transmission network);
- ✓ **EN 16723-2:2017** (for biomethane used as automobile fuel).

MAG LABORATORY GAS CHROMATOGRAPH

MAG laboratory chromatograph

An economical, flexible and efficient instrument for routine analyses in laboratories for quality control of gas and low-boiling liquids based on analytical modules of the MAG industrial gas chromatograph.

Benefits

- The ability to carry out a series of measurements and calibration in automatic mode;
- High measurement accuracy and fast analysis;
- Low power and gas consumption;
- Easy maintenance with low service cost;
- Wireless connection to PC via WI-FI.

TESTING AND CERTIFICATION OF MAG GC

MAG series GC's have all necessary certificates for Russian and CIS market, including:

- ✓ Explosion-proof certificate;
- ✓ Software certification;
- ✓ Pattern approval certificate.

International certificates and testing of MAG GC's:

- ✓ **IECEx** CCVE explosion-proof certificate;
- ✓ **ATEX** explosion-proof certificate;
- ✓ **OIML R 140**:2007 metrology certificate, accuracy class **A**;
- ✓ Pattern approval and Explosion-proof certificate of China;
- ✓ **MAG GC** has passed validation tests in accordance with requirements of **ISO 10723**, **ISO 6974** standards in **VSL** Dutch Metrology Institute, Netherlands in 2012


eurofins Expert Services

EESF 19 ATEX 020
Page 1 of 3

EU-TYPE EXAMINATION CERTIFICATE

Equipment or Protective System intended for use in Potentially explosive atmospheres Directive 2014/34/EU

3. EU-Type Examination Certificate Number: **EESF 19 ATEX 020**
4. Product: **Process Gas Chromatograph MAG**
   Certified types: **KC 50.310-000, KC 50.310-000-01, KC 50.360-000, KC 50.360-000-01**
5. Manufacturer: **OOO NTF BACS**
6. Address: **Prospekt Kirova 10, 443022 Samara, Russian Federation**
   Manufacturing locations:
   Prospekt Kirova 22, 443022 Samara, Russian Federation
7. This product and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.
8. Eurofins Expert Services Oy, Notified Body number 0537, in accordance with Article 17 of Directive 2014/34/EU of the European Parliament and of the Council, dated 26 February 2014, certifies that this product has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of products intended for use in potentially explosive atmospheres given in Annex II to the Directive.
   The examination and test results are recorded in confidential report No. RU/CCVE/ExTR18.0001/00.
9. Compliance with the Essential Health and Safety Requirements has been assured by compliance with:
   EN 60079-0:2012/A11:2013 **EN 60079-1:2014**
10. If the sign "X" is placed after the certificate number, it indicates that the product is subject to the Specific Conditions of Use specified in the schedule to this certificate.
11. This EU-Type Examination Certificate relates only to the design and construction of the specified product. Further requirements of the Directive apply to the manufacturing process and supply of this product. These are not covered by this certificate.
12. The marking of the product shall include the following:
    II 2G Ex db IIB+H_2 T4 Gb

Espoo, 22.03.2019
Eurofins Expert Services Oy

Kari Koskela
Expert

Jenni Hirvelä
Expert

This document is digitally signed.

FINAS

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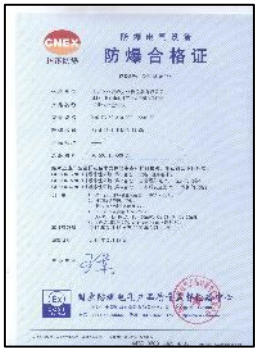
IECEx Certificate of Conformity


IECEx Certificate of Conformity


防爆合格证

Elements of construction of the GC are protected by patents.

PORTABLE GC FOR H_2S AND MERCAPTANS ANALYSIS S-CHROME

Portable GC **S-Chrome** – compact instrument for sulfur-containing compounds analysis in various media for stationary and mobile laboratories

Applications

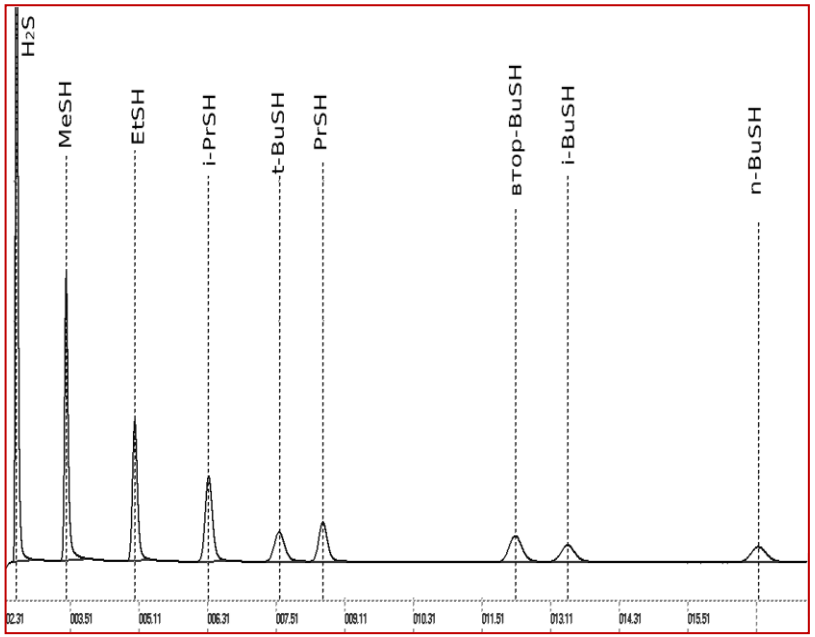
Analysis of H_2S and mercaptans in

Natural gas (NG)

Associated petroleum gas

Liquefied gases (LPG)

Oil and oil products



Chromatogram of sulfur compounds in natural gas

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Features and benefits

- ✓ High-sensitive **electrochemical detector** (ECD) and capillary columns;
- ✓ **Air** as a carrier gas; compressor could be used for mobility;
- ✓ High measurement accuracy and fast analysis;
- ✓ A specialized injection unit with the same dividing rate for gas and liquid samples;
- ✓ The possibility of analysis high concentrations of **H_2S** due to the attenuation of the detector signal by a factor of 10 at selected sections of chromatograms;
- ✓ Wide detection range and good linearity;
- ✓ Built-in gas flow meter at output of the detector and column (autonomous setting of gas flow without additional devices);
- ✓ Easy to handle and service;
- ✓ Compact size and low power consumption;
- ✓ Easy maintenance with low service cost.

SPECIFICATION OF S-CHROME

Technical characteristics	
Analyzed media	Gas, liquefied gas or liquid
Type of detector	**Electrochemical**
Carrier gas	**Air**
Carrier gas consumption	No more than 40 cm^3/min
Temperature of columns,°C	From +40 to +160
Temperature of vaporizer,°C	From +40 to +160
Temperature of detector,°C	From +40 to +50
Communication interfaces	RS-485
Power consumption	up to 120 W (warm-up); up to 15 W (steady mode)
Ambient temperature range,°C	From +10 to +40
Weight, kg	No more than 10
Dimensions (L×W×H), mm	360×160×285

Metrological characteristics	
Detector	Electrochemical (ECD)
Analyzed components	H_2S, mercaptans
Repeatability (RSD), %	No more than 3
Detection limit, ppm	No more than 0,02 (for H_2S), No more than 0,03 (for C_2H_5SH)
Analysis time, min	No more than 6 (up to EtSH), No more than 20 (up to BuSH)

HygroScan: Moisture Analyzers with explosion protection

HygroScan is a series of **analyzers** designed for fast, reliable and accurate measurement of the water vapor content and water dew point in gases.

Modifications of HygroScan Analyzers

HygroScan-S

Stationary process analyzer

HygroScan-T PRO

HygroScan-T Light

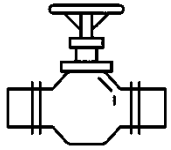
HygroScan-T Micro

Transmitters

HygroScan-P

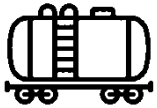
Portable analyzer

APPLICATIONS OF MOISTURE ANALYZERS



Water dew point analysis in **natural gas**

Analysis of water content in **refinery** and **petrochemical** gases



Control of **drying process** during LNG production

Determination of moisture concentration in **compressed natural gas** (CNG) for vehicles

MAIN FEATURES OF MOISTURE ANALYZERS

Sorption-capacitive sensor with high sensitivity (measuring range from **-70°C DP** or 2 ppm)

Measurement at the process pressure up to **250 bar**

Integrated pressure sensor for moisture content calculation

Continuous measurement with **fast response**

Reliable construction with no maintenance required

No calibration is required during operation of the analyzer

Cost efficient solution

HygroScan-S – reliable and precise stationary process moisture analyzer with vide variety of additional options and opportunities

Benefits

- ✓ Continuous or intermittent analysis mode thanks to optional internal high-pressure solenoid valve
- ✓ Up to 2 sample streams can be analyzed by turns
- ✓ Wide operation temperature range (from -40°C to +50°C)
- ✓ Automated operation
- ✓ Internal data storage and variety of output interfaces
- ✓ Integrated software and power supply unit
- ✓ Wide operation ambient temperature range
- ✓ Easy maintenance with low service cost

HygroScan-T «PRO»

HygroScan-T «Light»

HygroScan-T «Micro»

Key benefits

- ✓ 1 sample streams can be analyzed
- ✓ Explosion protection
- ✓ Automated continuous operation
- ✓ Possibility to connect several transmitters to one controller
- ✓ Possibility to use together with a process GC
- ✓ Low life cost. The unit doesn't require regular technical maintenance

- ✓ Internal gas pressure sensor (optional)
- ✓ Continuous or periodic operation mode
- ✓ LCD and control button
- ✓ Operation temperature range: from -40°C to +50°C

- ✓ No gas pressure sensor
- ✓ Automated continuous operation mode
- ✓ Control from external devices
- ✓ Operation temperature range: from -10°C to +50°C

Portable analyzer provides efficiency and reliability of stationary HygroScan-S in compact casing.

The analyzer is designed to measure water vapor content and water dew point in the field conditions in gases including natural gas.

Benefits

- ✓ Mobile moisture analysis in gas
- ✓ Superior accuracy and fast response
- ✓ Internal gas pressure sensor
- ✓ Long time of autonomous work on built-in battery even in cold conditions
- ✓ Explosion and IP protection
- ✓ Easy to handle and service;
- ✓ Neither auxiliary gases nor external sample; preparation required;
- ✓ Compact size and light weight.

SPECIFICATION OF MOISTURE ANALYZERS

BACS

Technical characteristics					
Parameter	HygroScan-S	HygroScan-T			HygroScan-P
		PRO	Light	Micro	
Operation principle	Sorption-capacitive				
Num. of analyzed streams	Up to 2	1			
Operation mode	Automatic Continuous / Periodic		Automatic Continuous		Manual Periodic
Explosion protection	1 Ex d IIC T6 Gb				1 Ex mb IIC T6 Gb X
Ingress protection	IP66				IP65
Power consumption	65W	20W	10W	5W	20W
Interfaces	RS 232/485, Ethernet, 4-20mA, GSM/GPRS	RS 485, 4-20mA, 4-20mA+HART	RS 485 or 4-20 mA		RS 232
Analyzed sample	Gaseous				
Sample gas pressure	Up to 25 Mpa				
Sample gas flow rate	0,5-5,0 SLM				
Ambient temperature	-40 … +50°C		-10 … +50°C		-40 … +50°C
Dimensions, mm (L×W×H)	380×200×360	180×280×260	180×125×240	85×50×230	300×350×170
Weight, kg	25	3,5	2	0,6	9

Metrological characteristics		
Water dew point measuring range	-70 … +20°C	
Water dew point accuracy	±1°C between -30 and +20°C	±2°C between -70 and -30°C
H_2O concentration measuring range	2 … 20 000 ppm	
Moisture concentration accuracy	±10% full scale from 2 to 20 ppm	±10% relative from 20 to 20000 ppm

Relevance of oxygen analysis

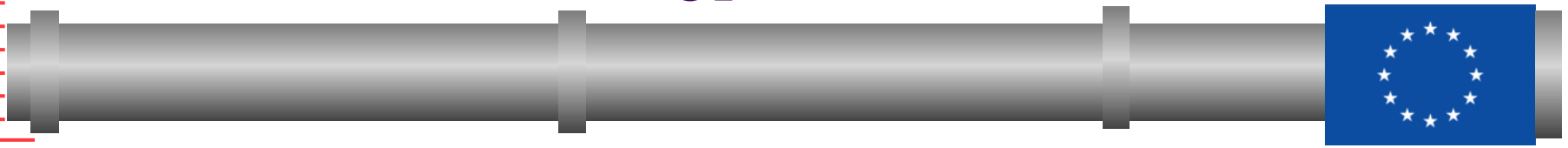
According to new requirements of developing European standard EN 16726:2015 “Gas infrastructure — Quality of gas - Group H” at network entry points and interconnection points the mole fraction of oxygen shall be no more than **0,001 %** (or **10 ppm**), presented as a moving 24 hour average.

Gas chromatography allows to analyze only a mixture of **O_2, N_2** and **Ar** or **O_2** and **Ar** in case of using of MolSieve column.

Detection limit for oxygen in this case is 10 ppm at best.

BACS LLC developed series of analyzers for fast, reliable and accurate measurement of the oxygen concentration in various gases.

O_2



Industrial stationary analyzer

Applications

- ✓ Natural gas analysis
- ✓ Refinery gas analysis
- ✓ Petrochemical processes
- ✓ O_2 measuring in different industrial gases

Transmitter

Key benefits

- ✓ Explosion protection
- ✓ Electrochemical sensor with high sensitivity;
- ✓ Wide detection range (from ppm level to 100%);
- ✓ Complies ASTM D 7607-11. Analysis of Oxygen in Gaseous Fuels;
- ✓ Fast response and superior accuracy;
- ✓ Completely automatic operation;
- ✓ Simple design and easy installation;

- ✓ Automatic calibration;
- ✓ Up to 2 analyzed streams;
- ✓ Integrated software and power supply unit;
- ✓ Integrated power supply unit 220V

- ✓ Manual calibration;
- ✓ 1 analyzed stream;
- ✓ Data could be transmitted;
- ✓ Power supply up to 24V

PORTABLE OXYGEN ANALYZER

Portable oxygen analyzer provides performance and reliability of stationary **AnOx** in compact casing.

Applications

- ✓ Fast field control of oxygen level in natural gas, including monitoring of oxygen level in pipeline during starting-up and after maintenance.
- ✓ Mobile oxygen analysis in gas and oil refinery, petrochemical, chemical, food and other industries.

Benefits

- ✓ Wide operation temperature range (from -40°C);
- ✓ Explosion protection;
- ✓ Long time of autonomous work on built-in battery even in cold conditions
- ✓ Easy to handle and service
- ✓ Neither auxiliary gases nor external sample preparation required
- ✓ Easy maintenance with low service cost;
- ✓ Compact size and light weight

SPECIFICATION OF OXYGEN ANALYZERS

Technical characteristics			
Parameter	**AnOx**	**AnOx-transmitter**	**Portable oxygen analyzer**
Principle of operation	Electrochemical		
Number of analyzed streams	Up to 2	1	
Operation mode	Automatic		Manual
Analysis cycle	Continuous		
Calibration	Automatic	Manual	
Explosion protection	1 Ex d IIC T6 Gb	1 Ex d [ib] mb IIC T6 Gb	1 Ex mb [ib] IIC T6 Gb X
Ingress protection	IP65	IP65	IP66
Power consumption	up to 90 W (start-up) up to 30 W (typical)	up to 10 W	up to 17 W (start-up) up to 7 W (typical)
Communication Interfaces	RS232/RS485, Ethernet, 4-20 mA, GSM / GPRS	RS485, 4-20 mA	RS 232/485
Sample gas pressure, bar	1 ± 0,5	0,5 ± 0,2	up to 240
Sample gas flow rate, SLM	0,2 – 2,0		
Software	Built-in and external	Built-in	Built-in and external
Battery life at -40°C	-		no less than 6 hours
Ambient temperature, °C	from -20 to +50	from 0 to +50	from -40 to +50
Weight, kg, no more than	39	4	8,34
Dimensions, mm (L×W×H)	450x238x485	178x216x272	300×350×170

ODORANT ANALYZERS

AnOd is a series of **odorant analyzers** designed for fast, reliable and accurate measurement of the total concentration of mercaptans separated from hydrogen sulfide in gas phases including **natural gas**.

Industrial stationary analyzer

Modifications of odorant Analyzers

- ✓ **AnOd –** stationary process odorant analyzer
- ✓ **AnOd Transmitter**

Transmitter

Importance of measuring mercaptans in natural gas

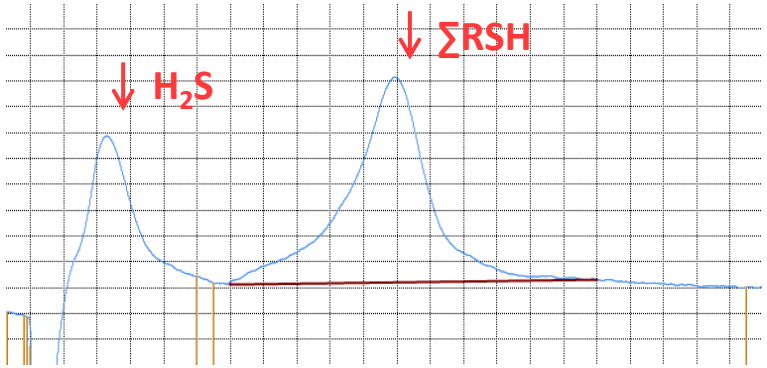
On-line control of odorization process allows to keep required intensity of gas smell and significantly improves safety of natural gas usage.

Also it provides more rational consumption of odorant because it helps to consider the initial concentration of mercaptans before odorization and the losses of odorant during gas transportation through pipelines

MAIN FEATURES OF ANOD

AnOd measures the total concentration of mercaptans in gas separated from hydrogen sulfide.

Another sulfur-containing odorant, such as THT, could also be analyzed.



AnOd - simple and reliable solution for odorant level measuring in gases.

Main Features

- ✓ Wide operation temperature range (from -40°C);
- ✓ Electrochemical sensor with high sensitivity;
- ✓ Fast analysis time
- ✓ No auxiliary gas is needed
- ✓ No interferences with other components of natural gas
- ✓ Superior accuracy
- ✓ Simple design, easy installation and operation
- ✓ Explosion protection for all modifications
- ✓ Automatic calibration

ANOD - ODORANT ANALYZERS

Industrial stationary analyzer

Key benefits

Transmitter

- ✓ Separating hydrogen sulfide by chromatography followed by total mercaptans analysis
- ✓ Automatic calibration with internal permeation tube
- ✓ No sample conditioning system is required
- ✓ Internal data storage and variety of output interfaces
- ✓ Integrated software and power supply unit
- ✓ Wide operation ambient temperature range
- ✓ No heated cabinet required
- ✓ Easy maintenance with low service cost

- ✓ Automated operation
- ✓ No need for PC, all operations are being executed by integrated microcomputer
- ✓ Data could be transmitted
- ✓ Comfort mounting. The unit is compact and light, easily installed in the pipe close to odorization unit.
- ✓ No need for additional heating or block-box.
- ✓ Separating hydrogen sulfide by filter.
- ✓ Low life cost. The unit doesn't require regular technical maintenance, no need for additional gas supply, low power consumption.

SPECIFICATION OF ANOD ANALYZERS

Technical characteristics		
Option	AnOd	AnOd Transmitter
Number of analyzed streams	1	1
Operation mode	Automatic	Automatic
Explosion protection	1 Ex d IIC T6 Gb	
Ingress protection	IP 66	IP65
Power supply	220 V, 50 Hz	24 V
Power consumption	up to 90 W (start-up)/up to 30 W (typical)	up to 15 W
Start-up time, min	up to 60	up to 30
Interfaces	RS232/RS485, Ethernet, 4-20 mA, GSM / GPRS	RS485, 4-20 mA, discrete outputs
Analysis cycle	Periodic, 5 min	
Calibration	Automatic by built-in permeation tube	Automatic by test gas mixture
Sample gas pressure, MPa	0,2-1,2	0,05-0,1
Sample gas flow rate, ml/min	50-200	
Software	Built-in and external	Built-in
Ambient temperature, °C	from +5 (-40*) to +50	from +5 to +50
Weight, no more than, kg	39	8
Dimensions, mm (L×W×H)	450x238x485	350x196x284

Metrological characteristics	
Principle of operation	Electrochemical
Detection range, mg/m^3	0-100 for mercaptans
Display range, mg/m^3	0-50 for mercaptan sulfur

Maximum relative uncertainty, %	
For range 0-10 mg/m^3	± 20 of full scale
For range 10-100 mg/m^3	± 20 relative
Analysis cycle	from 5 min.

* Optional. Heated gas inlet required.

MERC Process Mercury Analyzer for gas

Hg is a catalytic poison
Hg can cause damage of equipment due to amalgam formation especially at low temperatures

Application

Process control of mercury concentration in gas:

- ✓ In gas processing industry and petrochemistry;
- ✓ Waste treatment;
- ✓ During LNG production.

Technical characteristics	
Principle of operation	Atomic adsorption
Analyzed component	Elemental Hg
Measurement range, ng/m^3	1,0 – 20 000 OR 10 – 200 000
Repeatability	5%
Sample gas consumption, l/min	4
Explosion protection; IP rating	1 Ex d IIB + H_2 T6 Gb; IP 66
Interfaces	4 - 20 мА, RS 485/232, Ethernet
Power supply	230 V, 50 Hz; 190 W

Features

- ✓ No complex sample preparation required;
- ✓ High sensitivity;
- ✓ Wide measurement range;
- ✓ Completely automatic operation;
- ✓ No auxiliary gas are needed;
- ✓ Fast analysis time;
- ✓ Large LCD for the data display.

COMPLEX SOLUTIONS

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GAS MEASURING STATIONS (GMS)

Technical features

Flow rate of gas, standard conditions	Uncertainty not more than 0,8 %
Surplus pressure	Uncertainty not more than 0,065 %
Dew point (moisture and hydrocarbon)	Uncertainty not more than 0,5 %

GAS QUALITY AND QUANTITY METERING UNIT (GQQ METERING UNIT)

- Modular shelters
- Pipeline diameters up to 1200mm
- According to GOST P 8.733-2011, STO Gazprom 5.37-2011
- Min. pressure 1 bar.
- Velocity of gas from 0,03 m/s до 46 m/s
- All production has certificates
- Uncertainty: from 0,7% (metering units of 1st category); from 2,5…5% (associated natural gas, flare gas)
- The dynamic range of flow measurement 1:120 (metering units of 1st category, DGS, before dellivery to Gazprom main pipe), 1:1500 (flare metering units, associated gas)

Gas quality control unit

Intended for online determination of the following physicochemical parameters of natural gas:

Natural gas composition (**ISO 6974**) followed by calculation of calorific values, relative and absolute density, compressibility factor and Wobbe index (**ISO 6976**)

Mass concentration of hydrogen sulfide, mercaptans and total sulfur (**ISO 19739**)

Volume fraction of oxygen (**ASTM D 7607-11**)

Water dew point (**ISO 18453, ISO 6327:1981**)

Hydrocarbon dew point (**ISO 23874** – GC calculation or **ISO/TR 12148** – direct measurement)

Our solution for natural gas quality control unit

We manufacture the full range of analytical instruments for complete measurement of natural gas properties.

We perform system integration and supply a turnkey solution for quality control of natural gas.

Analytical instruments for natural gas quality control unit

MAG Process gas chromatograph

- ✓ Analysis of natural gas composition followed by calculation of calorific values, relative and absolute density, compressibility factor and Wobbe index
- ✓ Hydrocarbon dew point calculation
- ✓ Mass concentration of hydrogen sulfide, mercaptans and total sulfur analysis *(by separate GC with ECD)*

AnOx Process oxygen analyzer

- ✓ Volume fraction of oxygen measurement by electrochemical sensor

HygroScan Process moisture analyzer

- ✓ Water dew point measurement by sorption-capacitive sensor

Hydrocarbon dew point chilled mirror analyzer is under development for the moment

PROCESS ANALYTICAL SYSTEM FOR BIOMETHANE ANALYSIS

BACS

Application

The complex based on the MAG process gas chromatograph for:

- ✓ monitoring the complete composition of biomethane, including **fiscal metering** in accordance with **OIML R 140:2007** and **technological quality control**.
- ✓ monitoring the operation of **mixing units** of biomethane and natural gas

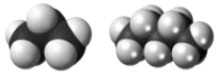
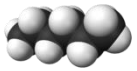
The measuring system consists of up to **5 analytical channels**, including:

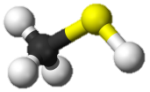
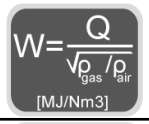
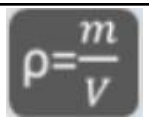
- ✓ Thermal conductivity detector (TCD);
- ✓ Electrochemical detector (ECD) for **H_2S**;
- ✓ **O_2**-sensor;
- ✓ Sorption-capacitive sensor for **H_2O**.

Commercial deliveries are based on the calculation of real calorific value of gas

Analysis time: up to 5 minutes

Analyzed components

	Methane
	saturated hydrocarbons C2-C5
	C6+
	CO_2
	N_2
	CO
	H_2S
	O_2

	H_2
	NH_3 (option)
	RSH (option)
	H_2O (WDP)
	Mass and volume calorific value
	Wobbe index
	Methane number
	Density

Application

The automated process analytical system based on gas chromatography is designed for online measurement and control of pyrolysis process.

The system provides continuous automatic analysis of gaseous products of pyrolysis and calculation of its physical and chemical properties.

H_2	2.016	Hydrogen	C_2H_6	30.068	Ethane
CH_4	16.042	Methane	H_2S	34.076	Hydrogen sulfide
CO	28.01	Carbon monoxide	C_3H_6	42.078	Propylene
C_2H_4	28.052	Ethylene	C_3H_8	44.094	Propane
H_2O	18.016	Water	C_4H_8	56.104	Butenes
N_2	28.02	Nitrogen	C_4H_{10}	58.12	i-Butane
O_2	32	Oxygen	C_4H_{10}	58.12	n-Butane
CO_2	44.01	Carbon dioxide	C_{5+}	>60.05	Pentanes+

Key benefits

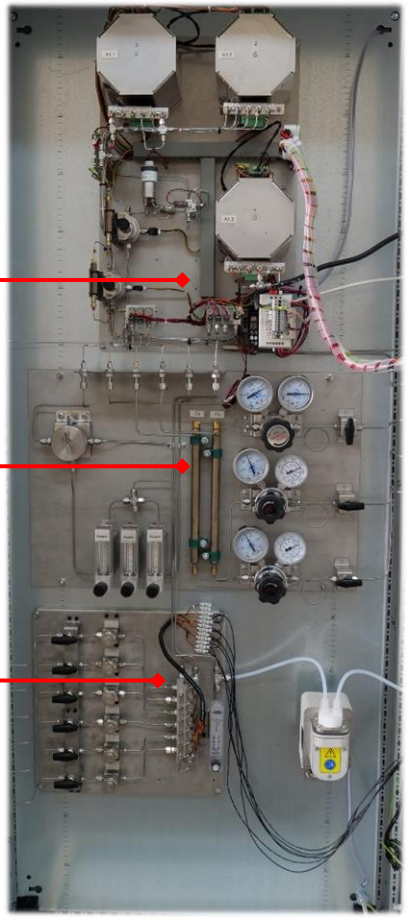
- ✓ Accurate analysis of gaseous pyrolysis products
- ✓ Determination of H_2O and H_2S concentration in gas
- ✓ Advanced Calorific value and Methane number calculation algorithm based on fuel specs of the leading gas engine manufacturers
- ✓ Fast and accurate analysis for online process control, gas mixing and averaging, allowing most efficient fuel consumption in pyrolysis power generation
- ✓ Automatic analysis of up to 6 gaseous streams according to preset sequence
- ✓ Opportunity of manual injection and analysis of samples
- ✓ Variety of the data transmitting interfaces
- ✓ Custom-built WEB-based software for remote access, settings and data acquisition
- ✓ Large LCD touch screen with user-friendly interface for easy control and interaction with the system
- ✓ Advanced sample conditioning system for various pyrolysis products
- ✓ Digital pressure sensors for carrier gas help to replace cylinders on time
- ✓ Low operating and maintenance cost owing to low power and gas consumption

Configuration features

Modular configuration

Pyrolysis Products Analysis System consists of 3 parts:

- ✓ Process Gas Chromatograph MAG
- ✓ Sample Conditioning System
- ✓ Stream Switching System



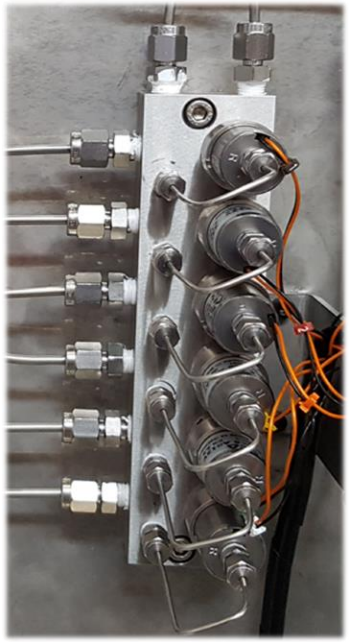
Analytical GC channel

Process Gas Chromatograph

✓ Contains three analytical channels with TCD used for parallel analysis of gaseous sample. Flexible modular configuration of the system allows to equip it with additional modules for extended analysis.

✓ Includes the electrochemical sensor for precise measurement of **oxygen** content of pyrolysis gas.

PROCESS ANALYTICAL SYSTEM FOR PYROLYSIS PRODUCTS ANALYSIS



Sample switching valves

Sample conditioning system

Used for the sample intake by pump, separation of the water from the gaseous sample, filtration, bypass purging, delivering the sample into the Gas Chromatograph and forwarding the sample to the waste.

Stream Switching System

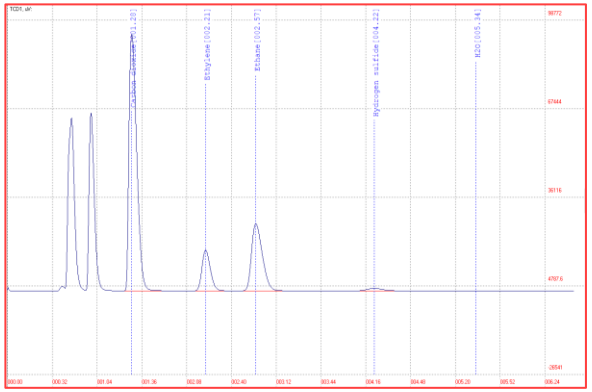
The Stream Switching System is equipped with **6 solenoid valves** for automated switching and selection of analyzed gas stream supplied to the analytical system according to preset sequence.

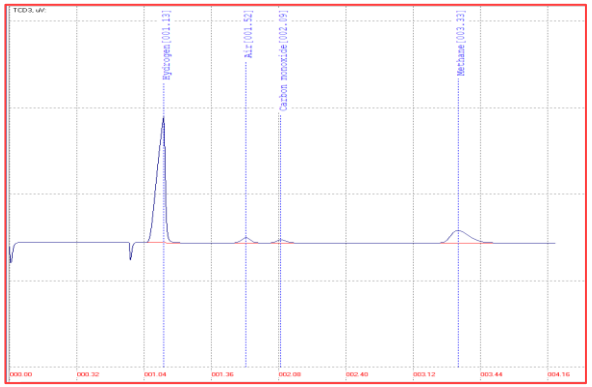
Web interface

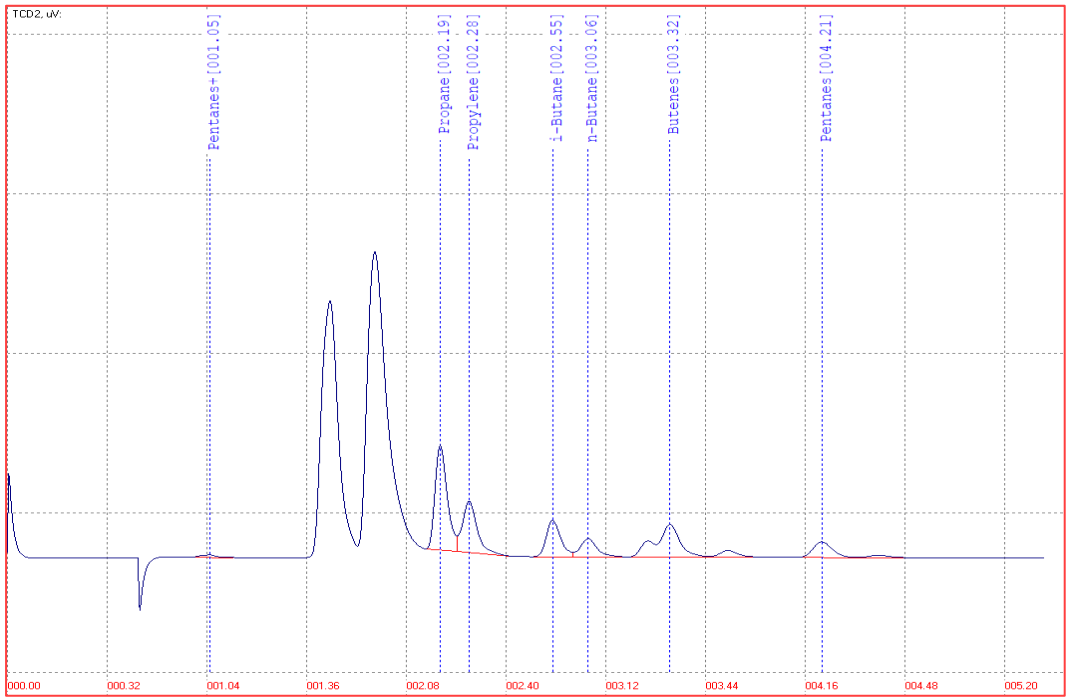
- ✓ Cloud-based storage of analysis reports and trends
- ✓ Secure web-authorization
- ✓ Multiple users, multi-level access
- ✓ XML-based remote data storage
- ✓ Accessible from any mobile device
- ✓ SMART Rules for operation and maintenance

Application details

Online analysis of composition of gaseous products of pyrolysis process followed by calculation of its physicochemical properties including water dew point, calorific values, relative and absolute density, compressibility factor and Wobbe index in accordance with ISO 6976 and methane number using an SAE based Methane Number (MN) calculation (SAE 922359 Eqn. 4) by Cummins Westport.







Chromatograms of pyrolysis gas analysis

PROCESS ANALYTICAL SYSTEM FOR PYROLYSIS PRODUCTS ANALYSIS

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Technical characteristics	
Number of the analytical GC channels	3
Type of detector	Thermal conductivity detector (TCD), Electrochemical oxygen sensor
Carrier gas types	Helium, not worse than 4.5 Grade (99,995%) Argon, not worse than 4.5 Grade (99,995%)
Carrier gas consumption	Helium: 16 sccm (total) Argon: 9,5 sccm
Oven type	Airless, isothermal
Type of chromatograph columns	micropacked
Carrier gas pressure regulator	Mechanical, 2 pcs.
Number of analyzed streams	up to 6
Analysis time	No more than 9:00 min
Chromatograph calibration	Automatic (by test gas mixture)
Data input-output device	12” LCD sensor display
Communication interfaces	RS 485 (ModbusRTU) – 1 pcs., Ethernet (ModbusTCP/) – 1 pc., Discrete inputs (NAMUR) – 4 pcs.
Power voltage	220V and with frequency (50±1) Hz
Power consumption	at the warm-up – not more than 570 W; after the warm-up – not more than 80W.
Ingress Protection Marking	IP65 as per IEC 60529:2013
Ambient conditions	from -10 to +50 °C at atmospheric pressure 84.0-106.7 kPa, at atmosphere relative humidity not more than 95% without humidity condensation
Dimensions (length×width×height)	800×400×1800 mm
Weight	Not more than 100 kg

Application of ASG Complex

Process analysis of the component composition and physical and chemical parameters of commercial LNG and tank return gas, as well as stream monitoring of the composition of technological media in the LNG production process.

PARTS OF THE COMPLEX

- ✓ Stream sampler for taking and evaporation of LNG samples (corresponds to ISO 8943)

- ✓ Process Gas Chromatograph «MAG» for online analysis:
  - ➢ Composition of LNG according to ISO 6974;
  - ➢ Composition of tank return gas;
  - ➢ Concentration of sulfur-containing compounds in LNG according to ISO 19739, or:

- ✓ Laboratorial chromatograph "S-Chrome" for analysis of sulfur-containing compounds in LNG in the laboratory;

- ✓ Process gas analyzer «AnOx» for measuring the volume fraction of oxygen in LNG according to ASTM D 7607 in the process mode, or:
- ✓ Portable gas analyzer for measuring the volume fraction of oxygen in LNG in a laboratory or on site in a periodic mode.

PROCESS ANALYTICAL SYSTEM FOR ORGANIC CHLORIDES

BACS

Application

This process instrument complex is designed for oil sampling and **sample conditioning** to conduct **OC analysis in the oil pumping stream** without stopping the pumping and for in-process monitoring of OC content.

Unique patented online vapor-phase sampler is the main system component.

This device samples equilibrium vapor-phase with increased light OC content in the sample **at constant liquid phase flow** through the sampler, while ensuring stationary gas phase.

Principle of operation

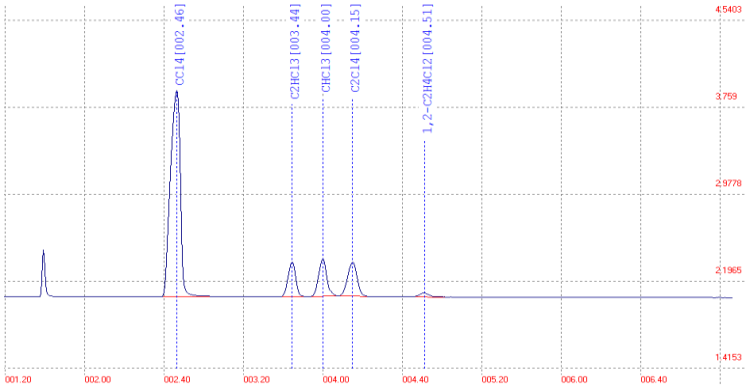
Oil flows through sampling system	OC compounds become gases	Equilibrium gas is injected into the chromatograph	OC content analysis in gas	Calculation using distribution coefficients according to Measurement Procedure

PROCESS ANALYTICAL SYSTEM FOR ORGANIC CHLORIDES

Parts of the complex:

- ✓ **oil conditioning unit** (vapor-phase sampler);
- ✓ **online gas chromatograph** MAG with OC-selective constant recombination rate (CRR) detector

Component	Detection limit for vapor-phase sampling (ppm, by weight)
Tetrachloromethane C Cl_4	0.004
Trichloroethylene C_2H Cl_3	0.1
Chloroform $CHCl_3$	0.03
Tetrachloroethylene C_2 Cl_4	0.1
1,2 -dichloroethane 1,2-$C_2H_4Cl_2$	0.7
Hexachloroethane C_2Cl_6	0.2



Chromatogram for organic chloride content in oil

Ex d explosion protection

ANALYTICAL SYSTEM FOR ORGANIC CHLORIDES

BACS

Laboratory instrument complex for OC analysis

Economical, flexible and efficient instrument for regular analytical tasks, with MAG process gas chromatograph analytical modules **and direct oil intake to injector**.

Benefits:

- ✓ Individual detection of organic chlorides and summarization to **total organic chlorine**;
- ✓ **Wireless connection** to PC with WiFi;
- ✓ No complicated sample preparation, analysis in 10 minutes;
- ✓ Constant recombination rate (CRR) detector is **selective to organic chlorides** and non-sensitive to hydrocarbons;
- ✓ Highly sensitive to organic chlorides: measure individual OCs with **ppm fraction precision;**
- ✓ Compact and lightweight.

OIL QUANTITY MEASUREMENT SYSTEM

Applications

Determination of mass and volume by direct or indirect flow measurements;

Measurement of technological and quality parameters;

Collection, processing, display and recording of measurement results.

Accommodation

- in block-modular buildings
- in shelters
- in the open area

FUEL GAS PREPARATION UNIT

AMURSKY GAS PROCESSING PLANT PROJECT

Object: **Fuel gas preparation unit (FGPU)**

The fuel gas preparation unit design consists of:

- inlet valves assembly;
- FGPU shelter;
- output valve assembly;
- underground condensate drum;

FGPU shelter includes:

- gas cleaning assembly;
- gas heating assembly;
- gas reduction assembly;
- gas metering assembly;
- fan premises with heat carrier supply automatic control unit;
- ACS premises and switchboard

GAS DISTRIBUTING UNIT

STATE DISTRICT POWER STATION

Object: The gas distributing unit (GDU)

GDU is intended for reduction the inlet gas pressure to a target level and keeping it at the outlet constant, regardless of the gas flow.

The gas distributing unit consists of

- hardware units;
- technological units;
- automatic control system;
- operator's automated workplace

Parameters:

Inlet pressure: 12MPa

Output pressure: 1,5MPa

Limits of pressure maintenance accuracy: up to 1%

Flow characteristics: 100..20 000 m^3/hour

Media: natural gas

Ambient temperature: from -20 to +40 ^oC

«ROSPAN INTERNATIONAL», liquid bulk terminal

Object: Automated gas distribution station

Complex automated solution for gas supply of consumers in a given volume with a certain pressure, the necessary degree of purification, odorization and taking into account the amount of gas.

The gas distributing unit consists of

- switching unit;
- technological unit;
- heat carrier preparation unit;
- instrumentation and automation unit;
- odorization unit;
- nitrogen ramp;
- capacitive equipment

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