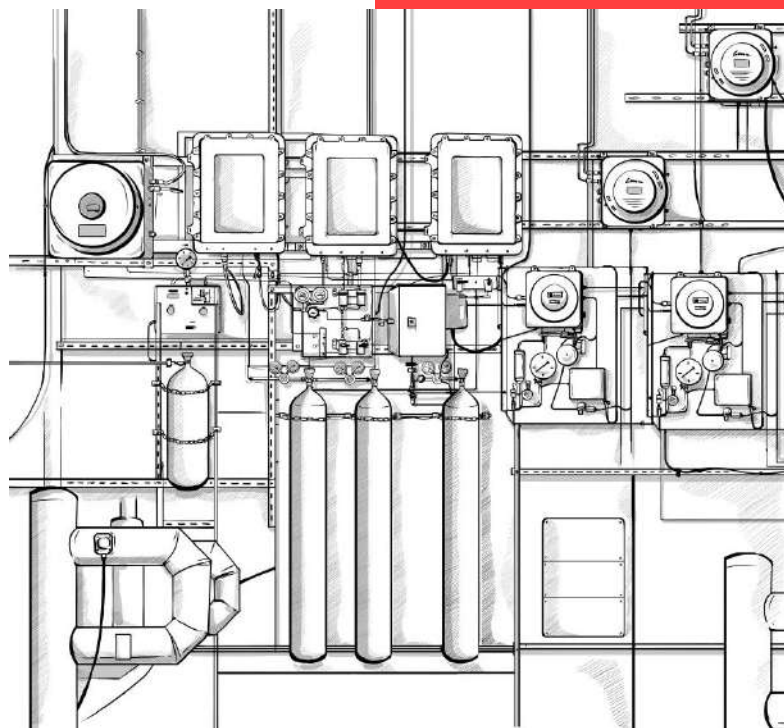


[www.bacs.ru](http://www.bacs.ru)

# COMPLEX SOLUTIONS AND ANALYTICAL INSTRUMENTS FOR OIL AND GAS INDUSTRY

**B  
A  
C  
S**



**1992**

year of foundation

**200+**

number of employees

**1000+**

analytical instruments produced

**500+**

Projects of large complex solutions realized

**1000+**

projects of medium and small metering systems realized

## Products and Services:



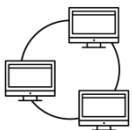
**Integrated solutions** for the oil and gas, energy industries, including the system for measuring the quantity and quality of gas and liquid hydrocarbons;



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



Coriolis mass **flow meters**



Design and implementation of **automated control systems**



Service facilities.

BACS LLC has been developing of solutions more than 28 years for the analysis of various gases, including natural and associated petroleum gas



**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  
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S**



# MAG PROCESS GAS CHROMATOGRAPH MARKET POSITION

**P  
r  
i  
c  
e**

- ✓ 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

**Performance**

**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

- ✓ Three types of detectors: **TCD**, **CCD** and **ECD** (for sulfur)
- ✓ 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

### 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



**Analytical GC channel**



**Injector-vaporizer**

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 <sub>2</sub> , H <sub>2</sub> (for TCD) or air (for ECD and CCD)	
Carrier gas consumption	5 - 30 cm <sup>3</sup> /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 to 16 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)	

## Components that can be analyzed with the MAG GC:



**Permanent gases:** He, H<sub>2</sub>, N<sub>2</sub>, O<sub>2</sub>, CO, CO<sub>2</sub>;



**Inorganic compounds:** H<sub>2</sub>O, H<sub>2</sub>S, COS, SO<sub>2</sub>, NH<sub>3</sub>, N<sub>2</sub>O, NO<sub>x</sub>, 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.

## Examples of chromatograph application



Analysis of the blend **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;



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



Analysis of the mass concentration of **sulfur-containing compounds** in natural gas according to ISO 19739 (GOST R 53367-2009), associated gas and other substances;



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



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



Analysis of synthesis gas, coal-derived gas, **pyrolysis products**;

## Examples of chromatograph application



Determination of **methanol** and other oxygenates in different hydrocarbon substances;



Analysis of biogas, biomethane;



**Quality control** of **supply streams** and **commercial products** on MTBE and TAME plants;



Control of the operation of manufacturing plants and analysis of commercial products in the **production of olefins** (ethylene, propylene, butylene fractions);



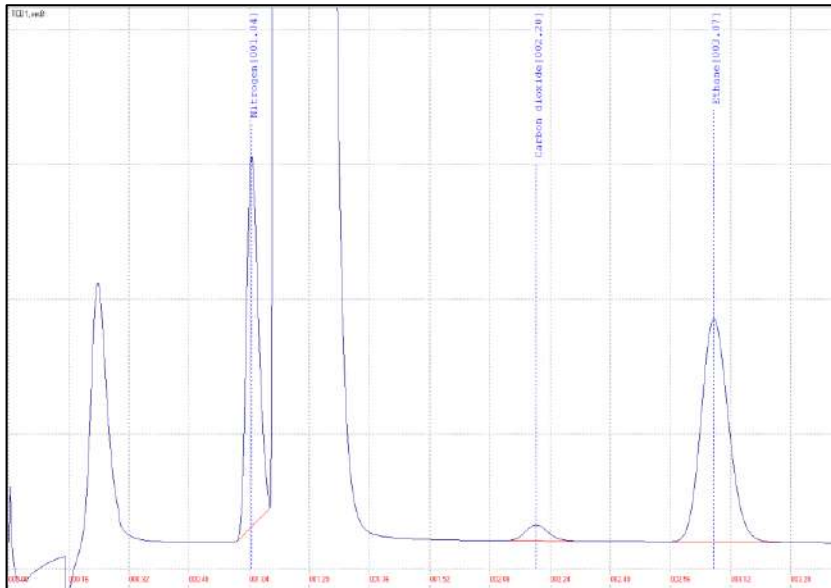
Analysis of process streams and commercial products in the production of **rubbers** including control of operation of **isoprene production** units;



Analysis of various products of **organic synthesis processes**.

## Scope of application

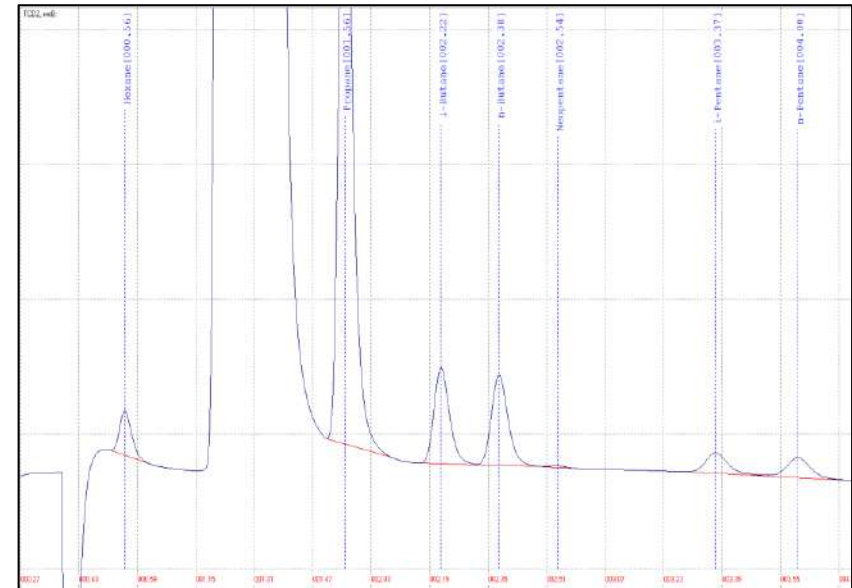
Analysis of natural gas composition according to **ISO 6974** with calculation of calorific values, relative and absolute density, compressibility factor and Wobbe index in accordance with **ISO 6976**.



Chromatogram of 1-st analytical channel:  
Air, CH<sub>4</sub>, CO<sub>2</sub>, C<sub>2</sub>H<sub>6</sub> separation

## Configuration and parameters

- ✓ Two analytical channels with  $\mu$ -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).

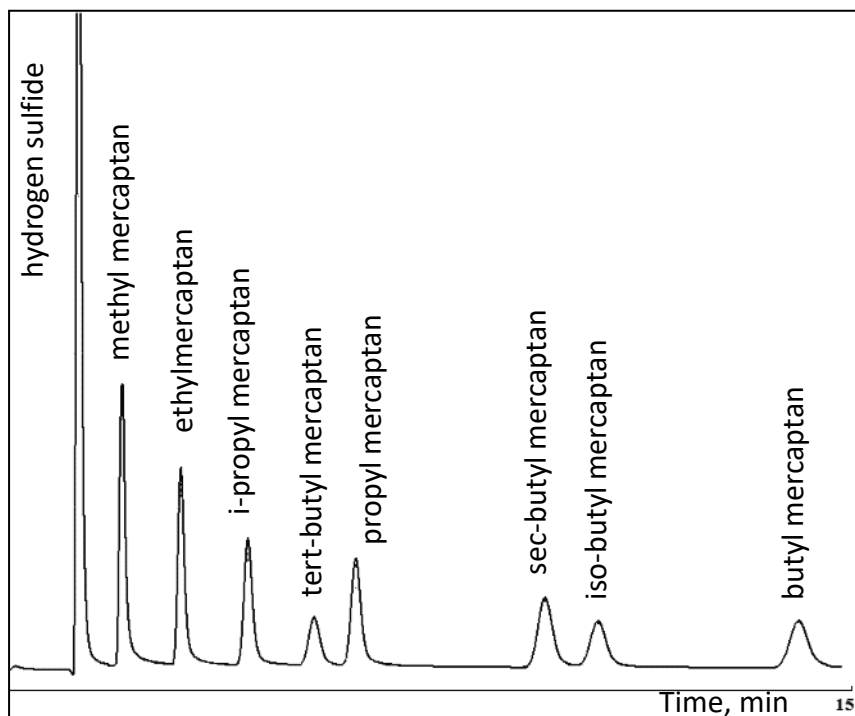


Chromatogram of 2-nd analytical channel:  
C<sub>6+</sub>, C<sub>3</sub>H<sub>8</sub>, i-C<sub>4</sub>H<sub>10</sub>, C<sub>4</sub>H<sub>10</sub>, neo-C<sub>5</sub>H<sub>12</sub>, i-C<sub>5</sub>H<sub>12</sub>, C<sub>5</sub>H<sub>12</sub> separation



## Scope of application

Determination of sulfur-containing substances in natural gas including H<sub>2</sub>S 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.



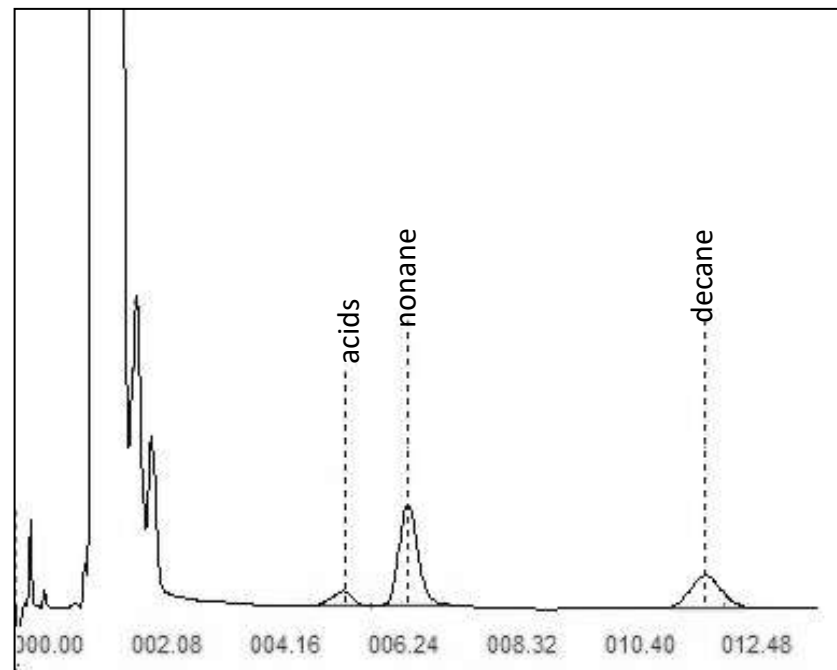


## Scope of application

Quality control of C<sub>6</sub>-C<sub>10</sub> 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  $\mu$ -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.



## MAG laboratory chromatograph

An economical, flexible and efficient instrument for solving 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;



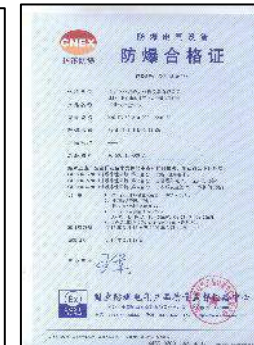
Easy maintenance with low service cost;



Wireless connection to PC via WI-FI.

## International certificates and testing of **MAG GC's**:

- ✓ **IECEX** CCVE explosion-proof certificate;
- ✓ **ATEX** explosion-proof certificate;
- ✓ Explosion-proof certificate of China;
- ✓ Pattern approval 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;
- ✓ **OIML R 140:2007** metrology certificate, accuracy class **A**.



Elements of construction of the GC are protected by **patents**.

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



## Applications

### Analysis of H<sub>2</sub>S and mercaptans in



Natural gas (NG)



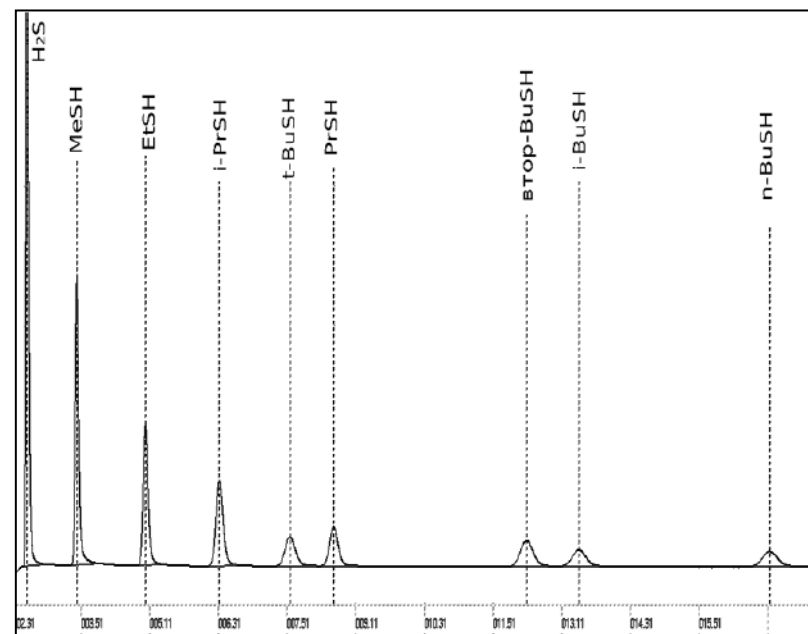
Associated petroleum gas



Liquefied gases (LPG)



Oil and oil products



Chromatogram of sulfur compounds in natural gas

### 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<sub>2</sub>S** 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	<b>Electrochemical</b>
Carrier gas	<b>Air</b>
Carrier gas consumption	No more than 40 cm <sup>3</sup> /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 <sub>2</sub> S, mercaptans
Repeatability (RSD), %	No more than 3
Detection limit, ppm	No more than 0,02 (for H <sub>2</sub> S), No more than 0,03 (for C <sub>2</sub> H <sub>5</sub> SH)
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

Transmitters



HygroScan-T  
Light

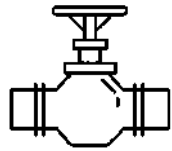


HygroScan-T  
Micro



HygroScan-P

Portable analyzer



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



Automatic **pressure** and **temperature** compensation for the most accurate measurement



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 wide 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)          | ✓ No gas pressure sensor                           |
| ✓ Continuous or periodic operation mode            | ✓ Automated continuous operation mode              |
| ✓ LCD and control button                           | ✓ Control from external devices                    |
| ✓ Operation temperature range: from -40°C to +50°C | ✓ 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

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 <sub>2</sub> O 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<sub>2</sub>**, **N<sub>2</sub>** and **Ar** or **O<sub>2</sub>** 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.





Industrial stationary analyzer

## Applications

- ✓ Natural gas analysis
- ✓ Refinery gas analysis
- ✓ Petrochemical processes
- ✓ O<sub>2</sub> 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** 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  $-40^{\circ}\text{C}$ );
- ✓ 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**.

## Modifications of odorant Analyzers

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



Industrial stationary analyzer



Transmitter

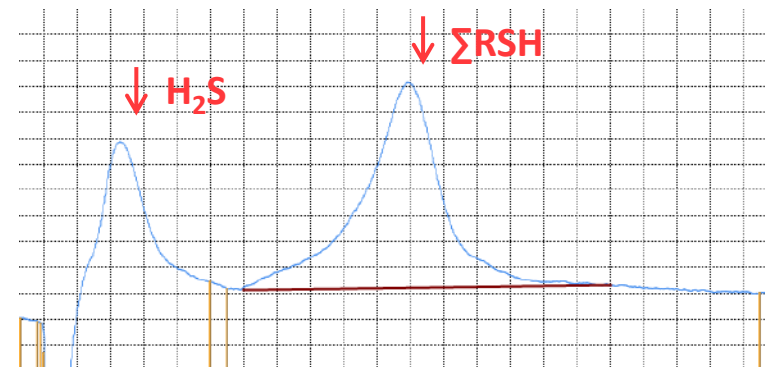




## MAIN FEATURES OF ANOD

**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



**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 ( LxWxH)	450x238x485		350x196x284
Metrological characteristics		Maximum relative uncertainty, %	
Principle of operation	Electrochemical	For range 0-10 mg/m <sup>3</sup>	± 20 of full scale
Detection range, mg/m <sup>3</sup>	0-100 for mercaptans	For range 10-100 mg/m <sup>3</sup>	± 20 relative
Display range, mg/m <sup>3</sup>	0-50 for mercaptan sulfur	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 <sup>3</sup>	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 <sub>2</sub> T6 Gb; IP 66
Interfaces	4 - 20 mA, 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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**B  
A  
C  
S**

## 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)



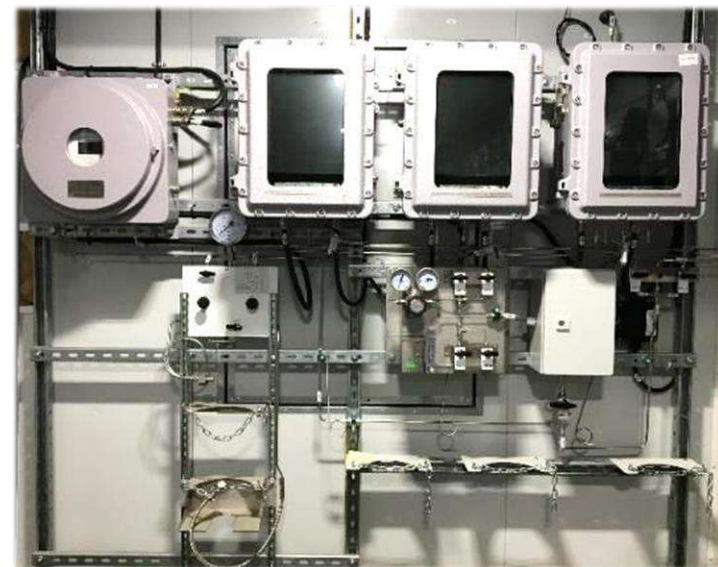
Volume fraction of **oxygen** (ASTM D 7607-11)



**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

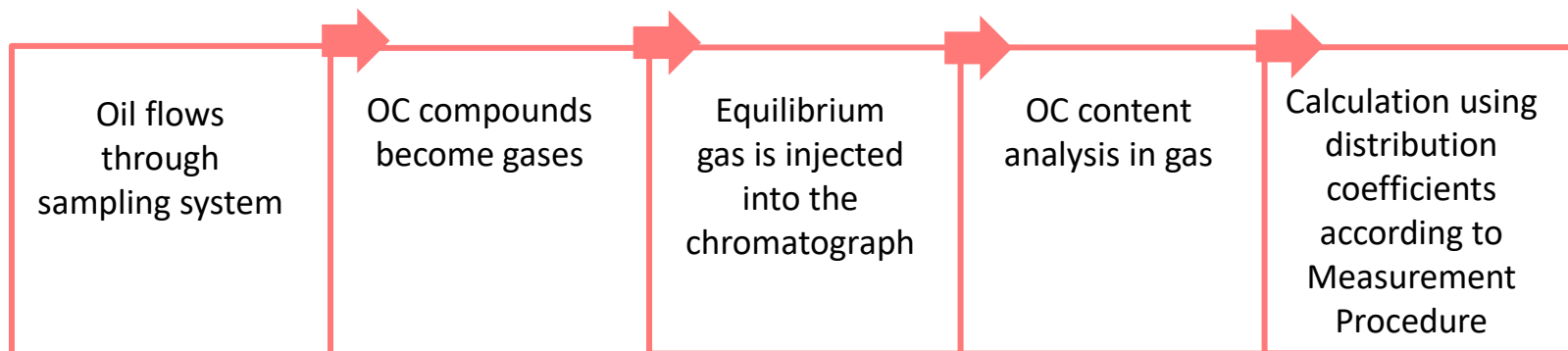


Vapor-phase sampler

## Unique patented online vapor-phase sampler

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



## 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.

## Parts of the complex:

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

## Analyzed components:

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



Ex d explosion protection



Laboratory design with direct injection of oil intake to the injector.

### Application

A 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**.

### Composition of the complex

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

- ✓ Thermal conductivity detector (TCD);
- ✓ Electrochemical detector (ECD) for H<sub>2</sub>S;
- ✓ O<sub>2</sub>-sensor;
- ✓ Sorption-capacitive sensor for H<sub>2</sub>O.

















Components	Measurement ranges
<b>Fiscal metering</b>	
Methane	40 - 100%
Ethane	0,001 - 15%
C3-C5	from 0,001 up to 6%
C6+	0,001 - 1,5%
CO <sub>2</sub>	0,005 - 10%
N <sub>2</sub>	0,001-3%
<b>Quality control</b>	
CO	0,02 - 1%
H <sub>2</sub> S	0 - 100 mg/m <sup>3</sup>
H <sub>2</sub> O (dew point)	-70°C ... +20°C
O <sub>2</sub>	0 - 10%
H <sub>2</sub>	0,01 - 3%

**Analysis time: up to 5 minutes**

## 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<sub>2</sub>O and H<sub>2</sub>S 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:

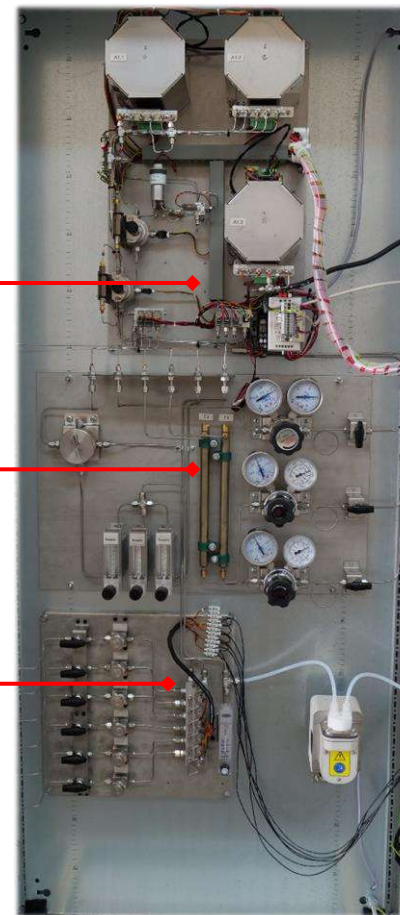
- ✓ Process Gas Chromatograph MAG
- ✓ Sample Conditioning System
- ✓ Stream Switching System



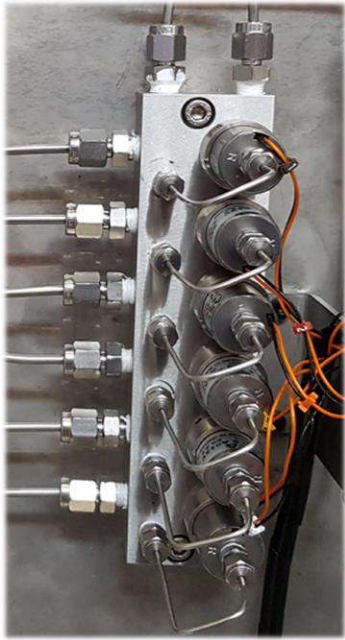
Analytical  
GC channel

### 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.







Sample switching valves

## Sample conditioning system

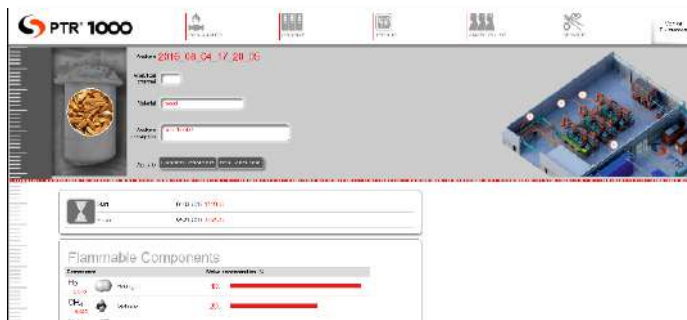
Used for the sample intake by pump, separation of the water from the gaseous sample, filtration, bypass purging, delivering the sample into the Gas Chromatograph and forwarding the sample to the waste.

## 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.

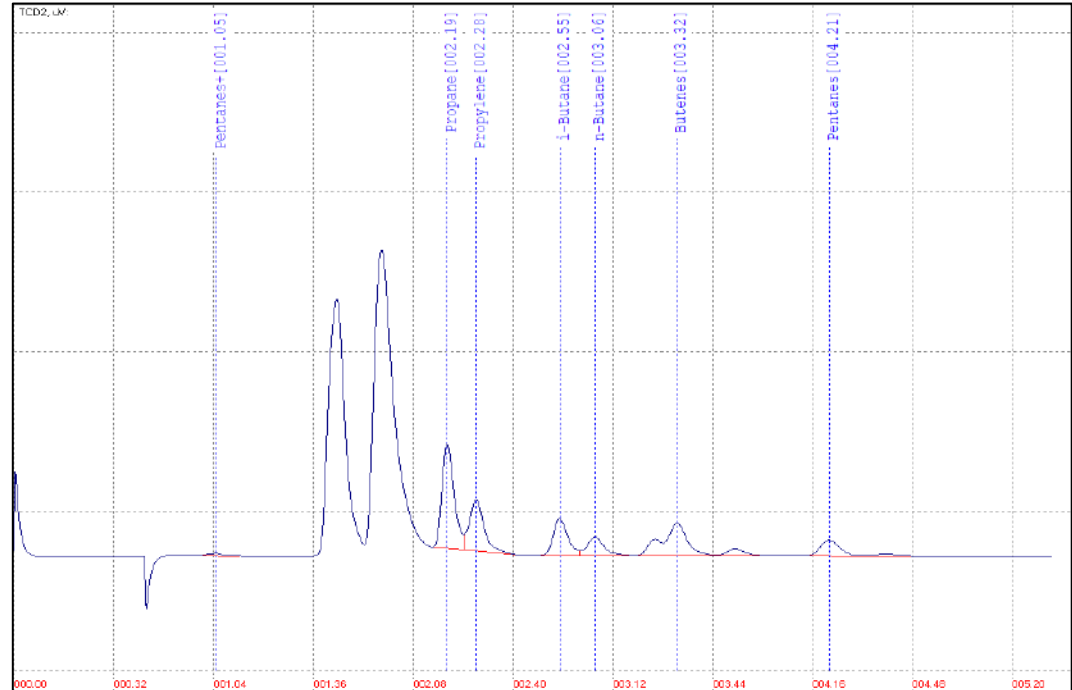
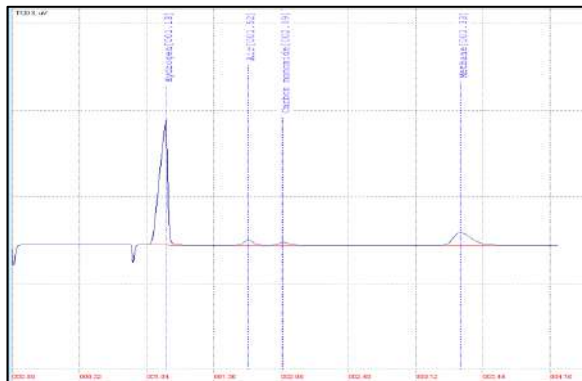
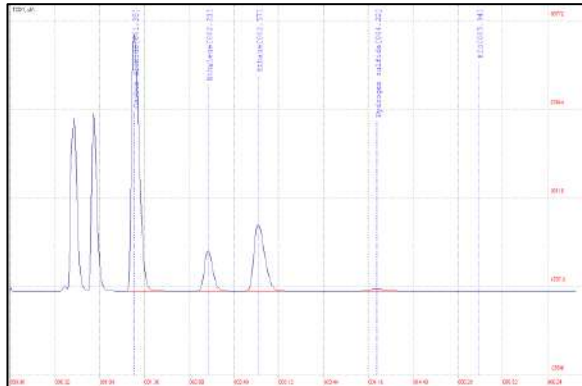
## Web interface

- ✓ 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



## Technical characteristics

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





## Complex function

- ✓ Representative LNG sampling in accordance with the requirements of ISO 8943 using a Stream Sampler;
- ✓ Analysis of the component composition of LNG in the stream in accordance with ISO 6974 with the subsequent calculation of physical and chemical parameters of LNG in accordance with ISO 6976;
- ✓ Measurement of the concentration of hydrogen sulfide and mercaptans in LNG in accordance with ISO 19739 in the stream and/or in laboratory;
- ✓ Analysis of the composition of the tank return gas in the flow with the subsequent calculation of physical and chemical parameters in accordance with ISO 6976;
- ✓ Measurement of the oxygen concentration in LNG and in tank return gas according to ASTM D 7493, ISO 19739 continuously in stream and / or with a portable oxygen analyzer in a laboratory or on site in a periodic mode;
- ✓ Measurement of the concentration of elemental Hg.



## 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 Mercury Analyzer «MERC» for measuring concentration of elemental Hg



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





## 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



## AMURSKY GAS PROCESSING PLANT PROJECT

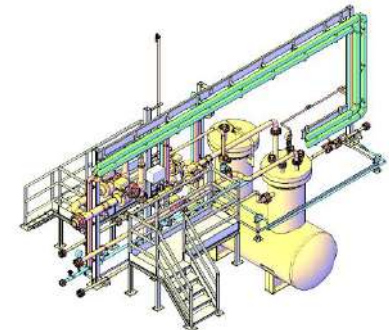
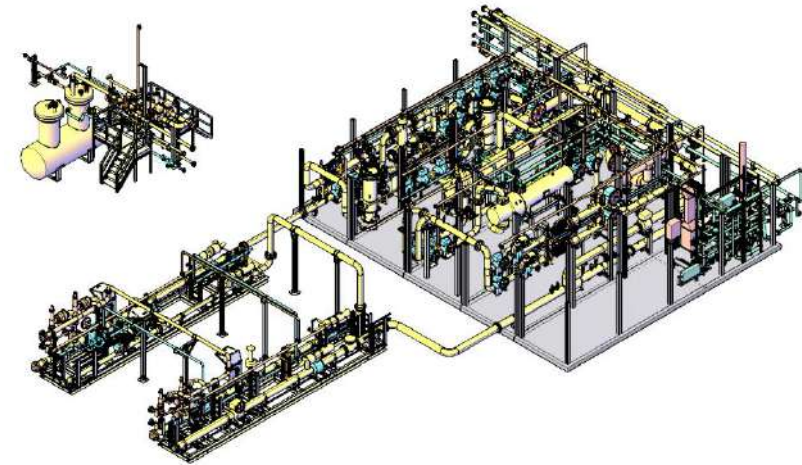
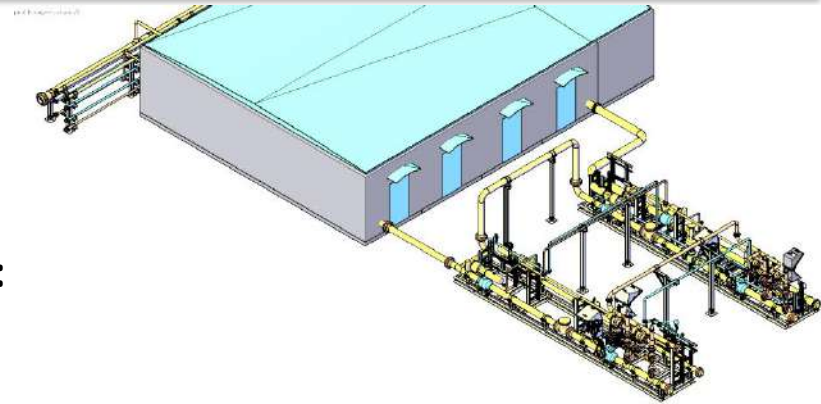
Object: Fuel gas preparation unit (FGPU)

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



## 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<sup>3</sup>/hour

Media: natural gas

Ambient temperature: from -20 to +40 °C





## «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





**Address:** **BACS LLC**, 22 Kirova avenue,  
Samara 443022, Russia  
**Phone/Fax:** +7 (846) 267-38-12 (-13 / -14)  
**E-mail:** kom@bacs.ru  
**Web:** [www.bacs.ru](http://www.bacs.ru)