



Type Approval Certificate

No. 0111-CS-A011-20

Czech Metrology in accordance with the Law of metrology No. 505/1990 Coll. as amended

approved

**process gas chromatograph
for determination of calorific value of natural gas
type MAG KC 50.310-000**

under observation of technical data referred to in Annex of this Certificate.

Type approval mark:

TCM 144/20 - 5724

Applicant: **BRK Technologies s.r.o.**
Českobratrská 2864/3
130 00 Praha
Czech Republic
ID: 28375807

Manufacturer: **OOO NTF BACS, Russian Federation**
BRK Technologies s.r.o., Czech Republic

Valid until: **29 April 2030**

Information on judicial remedies:

The judicial remedies against this decision are available to the applicant through Czech Metrology Institute to Czech Office for Standardization, Metrology and Testing within 15 days since the receipt of this Certificate.

Description:

Essential characteristic, approved conditions special conditions, examination results including technical drawings and schemas are set out in the technical test report appertaining to this certificate. The certificate comprises the front page and the technical test report. Certificate has 7 pages.

Brno, 30 April 2020



RNDr. Pavel Klenovský
Director General

Technical test report

1 Device description

1.1 Characteristic of device

The process gas chromatograph (PGC) is the device, which is able to sampling and analyse a natural gas. From the obtained chemical composition, the device can calculate calorific value and relative density of natural gas according to ČSN EN ISO 6976:2017.

Calorific values (CV) are expressed in units: MJ/m³ or kWh/m³ at given conditions (temperature, pressure). The PGC evaluate these compounds: nitrogen, carbon dioxide, methane, ethane, propane, 2-methylpropane, butane, 2,2-dimethylpropane, 2-methylbutane, n-pentane, hexane (hydrocarbons above hexane are evaluate as a sum and express as a value of hexane).

Process Gas chromatograph MAG is compatible with gas-volume conversion device (GVCD), type Summit 8800, manufacture Krohne Oil & Gas (or analogue), via RS232, RS485 or Ethernet interface.

1.2 Principle of analysis

The measuring principle is based on the separation analytical method, which is able to separate compound of natural gas on chromatograph column (in accordance with ISO 6974).

The thermal conductivity detector is used for detection. The results are evaluated according to the current calibration table which is part of the analytical software.

After the determination of the chemical composition of nature gas the calorific value and the relative density according to ČSN EN ISO 6976:2017 is calculated.

1.3 Parts of the device

The PGC is composed of parts, which all together create the device called MAG KC 50.310-000.

- analytical unit
- internal calibration gas

1.3.1 Analytical unit

Analytical unit MAG KC 50.310-000 consists of (see figure. 1):

- Analytical part
- Electronic control unit (incl. software)
- Front communication panel
- Gas streams and sampling part



Figure 1: Analytical unit MAG KC 50.310-000

Analytical part:

- contains the chromatographic system, which analyses the samples of natural gas
- helium is the carrier gas
- 2xTCD

Electronical control unit:

The electronical control unit (ECU) consists of the power source and hardware for control and evaluation measured data. ECU provides communication with analytical part, gas connection and communication ports for external devices: 10/100 Mbps Ethernet, RS-232, RS-485. Outputs are configurable by Modbus protocol.

The controlling software is also the part of the ECU. PGC contains firmware, which is responsible for the control user part, the sampling part and the evaluation measured data.

Approved firmware in Czech Republic with checksums (legally relevant software):

| | |
|--------------------------------|------------|
| Main SW core: (CRC-32): | 0x6528D89A |
| Main SW gui: (CRC-32): | 0xB51F590A |
| AnalizCalc.dll: (CRC-32): | 0x1BFEB1EF |
| RegressCacl.dll: (CRC-32): | 0xF2532F35 |
| DewPoint.dll: (CRC-32): | 0x7F06F760 |
| AddFunct.dll: (CRC-32): | 0x18B1811B |
| Integral settings (CRC-32): | 0xEB2841D9 |
| Component parameters (CRC-32): | 0x954ADCD6 |
| Embedded formulas (CRC-32): | 0xF5D47CE2 |
| Additional formulas (CRC-32): | 0x6CBA8755 |
| Functions (CRC-32): | 0x12A7AF65 |

The "Verifier" is used to check checksum for PGC without Local operation interface (see figure 3):

Legally relevant software: v1.0.0, CRC-32: 0x865CE475

PGC is possible controlled by software ANALYZ. This software allows to user set up the communication channel, the calibration table and the run analysis.

Front communication panel:

The instrument allows the installation two type of front panel:

Variant A: Local operation interface (LOI), see figure. 2.

Variant B: Without LOI, see figure. 3.



Figure 2:
LOI on MAG (variant A)

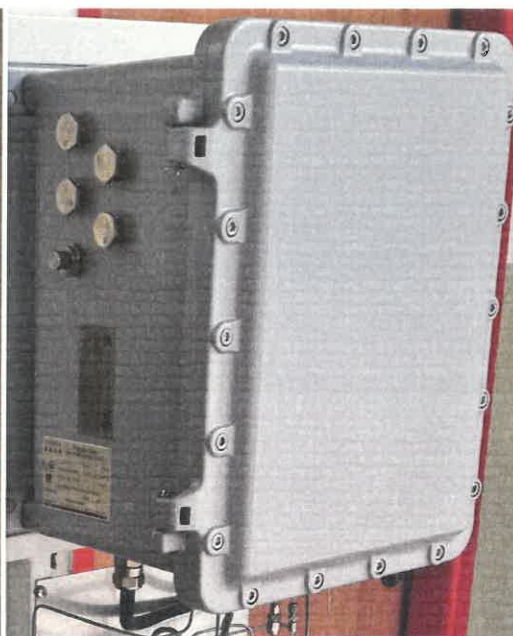


Figure 3:
Without LOI (variant B)

Gas streams and sampling part

PGC can be equipped with the different numbers of input gas streams for external samples, but one of this gas streams shall be placed with internal calibration gas. ECU is able to be switching between streams.

1.3.2 Internal calibration gas

The internal calibration gas is the integral part of PGC and must content all compounds in table 2.

The calibration frequency is stated in general measure (in OOP).

The certificate of internal calibration gas shall be issue in compliance with ČSN EN ISO 17025 or ČSN EN ISO 17034.

The pressured cylinders with internal calibration gas must be equipped with heating system, which provides homogeneous internal calibration gas. The Sampling system and the internal calibration gas must be situated in controlled environment to avoid condensation of gas compounds on cylinder's and pipe's wall. The temperature of environment must remain stable (etc. $20 \pm 5^\circ\text{C}$).

The internal calibration gas must not be detached from PGC and must be metrological secure.

2 Basic metrological characteristic

Table 1: Specification of instrument:

| | |
|---|---|
| Range of calorific value (15/15 °C, 101,325 kPa): | 4,1 – 15,5 kWh/m ³ |
| Temperature of environment for analytical part of MAG KC 50.310-000: | -25 °C / +60 °C |
| Temperature of environment for internal calibration gas and sampling system of MAG KC 50.310-000: | must be situated in controlled environment to avoid condensation of gas compounds on cylinder's and pipe's wall |
| Carrier gas: | helium |
| Time of analysis: | approx. 300 s |
| Number of compounds: | 11 |
| Accuracy class (OIML R140): | A (mpes $\pm 0,5\%$) |

Table 2: Range of measured compounds:

| | compound: | range (10 ⁻² mol/mol) |
|----|-----------------------------------|----------------------------------|
| 1 | methane | 50 – 100 |
| 2 | ethane | 0,05 – 15 |
| 3 | propane | 0,05 – 10 |
| 4 | 2-methylpropane (i-butane) | 0,01 – 4 |
| 5 | butane (n-butane) | 0,01 – 4 |
| 6 | 2,2-dimethylpropane (neo-pentane) | 0,001 – 0,1 |
| 7 | 2-methylbutane (i-pentane) | 0,005 – 2 |
| 8 | pentane (n-pentane) | 0,005 – 2 |
| 9 | hexane (C ₆₊) | 0,005 – 1 |
| 10 | nitrogen (+ oxygen) | 0,05 – 15 |
| 11 | carbon dioxide | 0,01 - 10 |

3 Type label placed on instrument

Table 3: Instrument specifications, for natural gas (11 compounds)

| | |
|--|-------------------------------|
| Type approval: | TCM 144/20 - 5724 |
| Type/model: | MAG KC 50.310-000 |
| Serial number: | |
| Date of production: | |
| Measuring range of calorific value (15/15 °C, 101,325 kPa): | 4,1 – 15,5 kWh/m ³ |

4 Test

Technical test was made according to:

OOP (0111-OOP-C018-10)

OIML R140:2007

Welmec 7.2.2018

All results from the technical test done by CMI are saved at executor of these tests. The results are mentioned in table 4.

BRK s.r.o. provides a testing device MAG KC 50.310-000, s.n. 0679345 and the gas-volume conversion device (GVCD), type Summit 8800, manufacture Krohne Oil & Gas. The Summit 8800 is not subject to approval and has only been used to read data when transmitting data via the communication cable.

Table 4: list of tests

| test number: | The tests done by: | passed: |
|--------------|--|---------|
| 1 | OOP č.: 0111-OOP-C018-10 5.3.1 5.3.2 Zkouška přesnosti a opakovatelnosti | ✓ |
| 2 | OIML R140:2007 10.2.7.4 adjustment interval and drift | ✓ |
| 3 | OIML R140:2007 10.2.7.5 influence of the gas composition | ✓ |
| 4 | OIML R140:2007 10.2.7.6 response time | ✓ |
| 5 | OIML R140:2007 10.2.7.7 influence of gas supply | ✓ |
| 6 | OIML R140 A.4.1 Dry heat | ✓ |
| 7 | OIML R140 A.4.2 Cold | ✓ |
| 8 | OIML R140 A.4.3.a Damp heat steady state | ✓ |
| 9 | OIML R140 A.4.3.b Damp heat cyclic test) | ✓ |
| 10 | OIML R140 A.4.4 Vibration (random) | ✓ |
| 11 | OIML R140 A.4.5 Radiated radio-frequency electromagnetic field | ✓ |
| 12 | OIML R140 A.4.6 Conducted disturbances induced by radio-frequency field | ✓ |
| 13 | OIML R140 A.4.7 Electrostatic discharge: | ✓ |
| 14 | OIML R140 A.4.8 Surges on signal, data and control lines | ✓ |
| 15 | OIML R140 A.4.10 AC mains voltage variation | ✓ |
| 16 | OIML R140 A.4.11 AC mains voltage dips, short interruptions and voltage variations | ✓ |
| 17 | OIML R140 A.4.12 Bursts on AC and DC mains and on signal lines | ✓ |
| 18 | OIML R140 A.4.13 Surges on AC and DC mains power lines | ✓ |
| 19 | 853-MP-C001, WELMEC 7.2, 2018 | ✓ |

The tested subject MAG KC 50.310-000 meets the general measure (0111-OOP-C018-10), OIML R140:2007 and Welmec 7.2.2018 requirements.

5 Verification

The device determines eleven compounds of natural gas, the composition of reference material for verification is stated in table 2. Two reference materials with different value of CV have been used for verification. One of them must not contain a neo-pentane.

The cylinder with internal calibration gas is secured against unauthorized manipulation. This secure can be done by sealing the reduction vent or protection cover of pressurized cylinder (at least upper part of cylinder). The path of calibration gas to PGC shall be secure as well.

The valid calibration protocol of internal calibration gas must be present at cylinder during the period of verification. The calibration protocol shall prove metrological traceability of internal calibration gas and meets ČSN EN ISO 17025 or ČSN EN ISO 17034 requirements. The calibration protocol must issue only the certified (accredited) laboratory or National metrology authority.

During the verification of the firmware version, checksum and CV are checked.

The "Verifier" program, which has been checked metrologically, will be used to check the firmware (checksum). The "check sums" displayed must match the approved version shown in this document (all checksums see in 1.3.1 part "Electronical control unit").

These user accounts shall be locked for CMI purposes:

- Administrator

Only authorized persons from CMI can administrate these accounts.

If the subject of verification meets the general measure technical requirements the verification is finished like this:

- Issued of verification protocol
- Placed official labels (verification marks) on subject (see attachment 1)

6 Time of verification validity

Time of verification validity is specified by the Decree of the Ministry of Industry and Trade.



Annex 1 The marking of measuring instrument with official marks (verification marks)

