

# PORTABLE HIGH-SPEED AUTOMATIC GAS CHROMATOGRAPH

## GC-FN



### BRIEF TECHNICAL DESCRIPTION

## **GENERAL INFORMATION**

Portable high-speed automatic Gas Chromatograph GC-FN is an individually graduated measuring tool (Certificate of approval of the measuring tool type RU.C.31.001.A № 26303).

GC-FN is designed for application in both laboratory conditions and within mobile autonomous complexes (for example, criminalistic ones) with a purpose of qualitative and quantitative analysis of organic substances, in particular, for detection and identification of narcotic substances in extracts.

## **FIELDS OF APPLICATION**

Criminalistics – express-analysis and identification of narcotic substances, most frequently met in the illicit turnover.

Public security - identification of persons, contacted with narcotic substances.

Mobility and quick-action of the chromatograph allow to accomplish tasks of inspection of various objects:

- at the personal inspection/examination of individuals (suspects/patients),
- at the inspection of different types of premises, luggage, cars and other vehicles;
- at the check-points of the various events with a mass gathering of people, for example, at customs, at public and sport events, airports, etc.;
- at the security screening of cargo transport (road, railway, water and air);
- of the items of mail.

## **SPECIFIC FEATURES AND ADVANTAGES**

Short analysis time (tens of seconds) for complex organic compounds

High sensitivity and selectivity

Analysis of samples in both liquid and gas phases. For this purpose the chromatograph is equipped with the exchangeable assemblages for samples input – syringe and concentrating injectors, as well as with the device for gaseous sampling that ensures enrichment of gas samples on the concentrator (adsorption pre-concentration).

Remote sampling

Clean ambient air is used as a gas-carrier

Low power consumption

Efficient and easy operation

Specialized Chrom software for control of the chromatograph's operation, data acquisition and processing as well as for forming the chromatograms archive and for updating of the detectable substances databases

Customization for the needs of the end user

## OPERATION PRINCIPLE

Principle of the GC-FN operation is based on the chromatographic separation of the sample (mixture of substances) in a multicapillary column followed by ionization and registration of the individual substances by the photo-ionization detector (PID).

Upon processing of the analysis results a signal of the PID is displayed by the control and visualization unit in a form of chromatogram and results of its calculation.

Straight multicapillary columns of different types with stationary liquid phases (SE-30, SE-54) can be installed into the chromatograph.

Sample analysis is possible after the chromatograph's warming-up in accordance with the given Application and its calibration with the test-substances.

Analysis of the sample in a liquid phase includes the following stages:

1. Sample preparation – dissolving of the analyzed substance in an appropriate solvent (ethanol, acetonitrile or methanol).
2. Injection of the obtained solution into evaporator chamber by the chromatographic syringe (or concentrator).
3. Automatic input of the sample from the evaporator chamber into multicapillary column.
4. Separation of the sample to individual components in a column.
5. Ionization and detection of the sample's components by the photo-ionization detector (PID).
6. Amplification of the PID signal in the electro-magnetic amplifier.
7. Transmission of the amplified signal to the control unit for preliminary processing.
8. Transmission of the preliminary processed signal to a PC for the final processing of the analysis results by the Chrom software.
9. Identification of the target components according to times of their retention in a column by comparison with the calibrating chromatograms of the test-substances.

For analysis of the sample in a gaseous phase the sampling and sample enrichment is performed with a help of the sampling device by pumping the analyzed air through the concentrator, adsorbing the vapors of substances, or by dropping the analyzed solution on the concentrator surface.

In this case a sample analysis starts automatically at the sample introduction into evaporator chamber.

## SOFTWARE

Software of the chromatograph is divided to firmware and software.

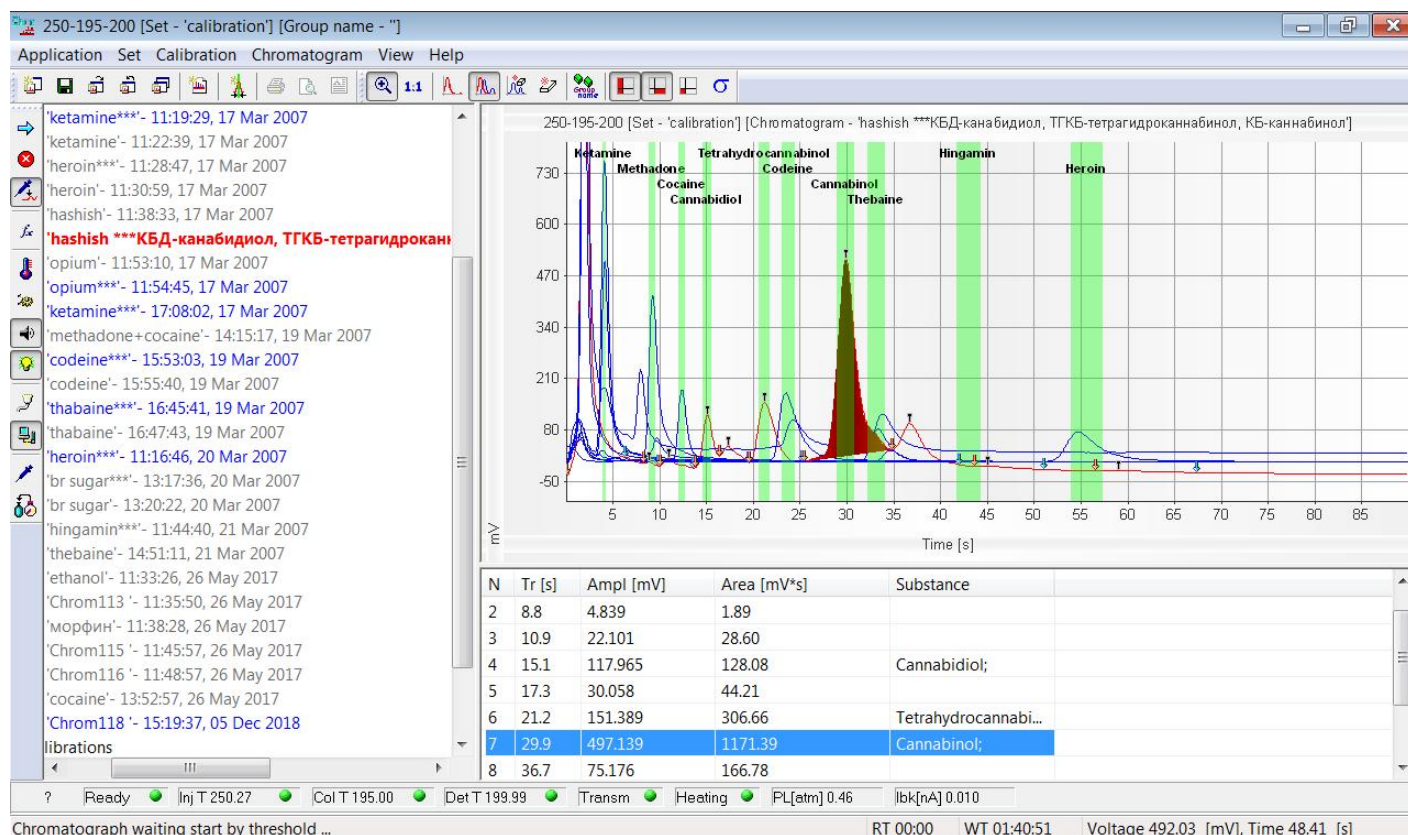
Firmware manages operation of all chromatograph's blocks under the control of the software.

As the software, especially designed program **Chrom**, is used. It performs the following functions:

- connection between the chromatograph and a PC through a serial data transmission channel (transmitting and receiving of commands and data)
- creating and storage of the chromatograph's parameters and analysis modes parameters, of chromatographic data (so-called Application, created by operator for any kind of chromatographic analysis)
- chromatograms processing
- visualization, storage and reading of chromatograms
- visualization of chromatograms processing results
- printing of chromatograms and its processing results
- data transferring to another Windows programs
- notification of the operator about chromatograph's malfunctions
- providing the operator with the information about control and visualization

means

- user's training for operation with Chrom and with the chromatograph (software support Help).



## TECHNICAL CHARACTERISTICS

**Detectable substances** – wide range of hydrocarbons (including aromatic) and their derivatives, in particular, narcotics

**Detection limit to particular compounds**

- standard (prometrin) - not more than 0.1 nanogram
- cocaine - 0.5 nanogram
- amphetamine - 0.5 nanogram
- THC - 1.5 nanogram
- heroin - 1.5 nanogram

**Column efficiency** – from 1000 to 3000 theoretical plates

**Coefficient of the sample enrichment** on the concentrator – up to 1000

**Analysis cycle duration** – not more than 80 sec.

**Warm-up time** - not more than 30 min at the column temperature of 200 °C

**Time of continuous operation** – not less than 8 hours (from main 110-240 V, 50/60 Hz)

**Operating temperature range of thermostats**

- of the column - from 50 to 200 °C
- of the injector - from 50 to 250 °C
- of the detector - from 50 to 200 °C

**Gas-carrier** – ambient air, cleaned by the built-in compressor and recoverable filter

**Gas-carrier flow rate**

- through the “Gas Discharge” port - 50...80 cm<sup>3</sup>/min
- through the “Drain” port - 4...10 cm<sup>3</sup>/min

**Flow rate maintenance error** - not more than 0.5 cm<sup>3</sup>/min

**Power supply of the chromatograph** - from main 110-240 V, 50/60 Hz

**Power consumption**

- not more than 230 Wt while warming-up
- not more than 110 Wt in operational condition

**Power supply of the sampling device** – from mains (110-240V, 50-60 Hz)

**Time of continuous operation of the sampling device** from the fully charged storage battery - not less than 12 hours

**Weight of the sampling device** – not more than 0.6 kg

Dimensions of the chromatograph - 470 x 250 x 260 mm

**Dimensions of the case** for transportation and storage - 595 x 390 x 380 mm

**Weight of the chromatograph** - 15 kg

**Weight of the complete set** - not more than 20 kg

**Fluctuation noise level** - not more than 0.3 mV

**Retention time drift** for 8 hours of continuous operation doesn't exceed 3%

**Reliability data**

- average error-free running time – not less than 3000 hours
- average life time – not less than 5 years (excluding the column)

**Operating conditions**

- environmental temperature - from +5 to +40 °C
- relative humidity - up to 93% (at +25 °C)
- storage temperature – from +5 to +45 °C (at relative humidity 40-80%)

## COMPLETE SET

1. Gas chromatograph GC-FN..... 1 pc.
2. Exchangeable assemblage for gaseous samples (concentrating)\* ..... 1 pc.
3. Concentrators (4 pcs. in a cassette holder)\* ..... 1 pc.
4. HAMILTON syringe 7001 N 1.0  $\mu$ l ..... 1 pc.
5. Case for transportation and storage ..... 1 pc.
6. Black fabric bag (for accessories) ..... 1 pc.
7. Power cable 220 V..... 1 pc.
8. GC-FN Operating manual ..... 1 pc.
9. Chrom software Operating manual ..... 1 pc.
10. Membrane..... 1 pc.
11. Sealing ring (for lamp) 12,5x17x6,5 mm..... 3 pc.
12. Sealing ring 12x15x1,9 mm ..... 3 pc.
13. Lamp cleaning paste ACM 1/0 HOM (in a syringe, 4 ml) ..... 3 pc.
14. Lamp cleaning cotton napkins..... 3 pc.
15. Concentrators cooling bar\* ..... 1 pc.

*\* supplied by the user's order*



# DESIGN AND OPERATION OF THE CHROMATOGRAPH'S COMPONENTS

## Gas supply unit

Compressor pumps an ambient air through the cleaning filters and forces it into the receiver, supporting the pressure in it within the set range. From the receiver the air passes further through the additional fine cleaning filter further to the analytical unit. Control of gas flows is performed by a gas dispenser, consisting of adjustable choke of gas-carrier flow, pressure sensor, electromagnetic valve, adjustable choke of reverse flow through the injector.

## Syringe input assemblage

Syringe input assemblage is intended for input of the liquid samples with the help of chromatographic syringe. Recommended length of the syringe's needle is 60-65 mm.

Syringe input assemblage consists of the sample input chamber and syringe injector. Syringe injector is installed into the input chamber and is fixed by a nut. On the outer end of the injector's body the nut presses a membrane. The membrane seals the input chamber from the external atmosphere.

To introduce the sample into the chromatograph, the syringe needle is inserted through the nut aperture and membrane into the input chamber and the liquid sample is injected. Evaporation of the sample leads to the short-time increase of pressure (threshold pressure) that automatically actuates operating cycle of the chromatograph. In a definite time interval (start delay time), pneumatic electro-valve gets actuated, a definite gas-carrier flow is transferred through the injector and along with the sample gets into the column.

The valve switches off then, the main flow of the gas-carrier enters into the column and delivers the injected sample. The lesser reverse gas flow passes through the injector and clears it from the sample residuals.

The injector design allows to perform necessary periodic washing of its components.



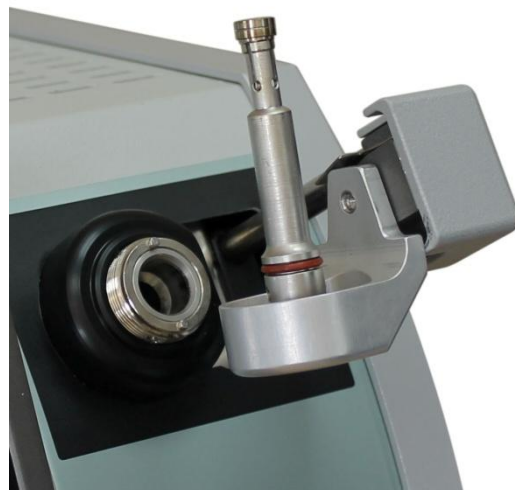


## Concentrating input assemblage

Concentrating input assemblage is intended for input of the gaseous sample into the multicapillary column and consists of the input chamber with the concentrating injector.

Concentrating injector is intended for input of the samples, adsorbed by remote concentrator.

The main part of the injector is a movable tip, where concentrator is hanged on. To input the concentrator, it is put on the tip, taken out from the injector and turned to the vertical position. Then the tip is reversed and inserted into the input chamber that is accompanied by a sound signal.



## Concentrator



Concentrator is used for sampling and input of the sample into chromatograph.

Concentrator is a metal cylinder, containing adsorbent. Concentrators in amount of 4 pieces are stored in a cassette.

## Sampling Device



Sampling Device is intended for sampling of substances by pumping the air from the analyzed surface or volume through a concentrator.

While sampling, the device moves smoothly and slowly, perpendicular to the inspected surface at the distance of 20-30 mm to it. Sampling can take 5-20 seconds depending on the inspected object.

Upon sampling completion, concentrator is taken out from the nozzle of the sampling device and placed into the chromatograph's input chamber or into the cassette for temporary storage before analysis.

### **Chromatographic column unit**

Chromatographic column unit is intended for separation of the analyzed mixture in the gas-carrier flow to individual components. It consists of the thermostat and the column assemblage. The thermostat provides the set temperature of the column.

The column assemblage is placed inside the thermostat in a protective metal housing with the adapters fixed at its ends. Adapters provide a connection of the column assemblage with the input chamber and photo-ionization detector unit.

Multicapillary column is a block of 1200 parallel capillaries, each with inner diameter of 40  $\mu\text{m}$ , baked together. The inner surface of the each glass capillary is covered by thin layer of fixed liquid phase, differently adsorbing the analyzed components depending on their nature.

### **Photo-ionization Detector (PID) unit**

The main element of the PID unit is an ionization chamber with polarizing and measuring electrodes.

Operation of the PID is based on the ultraviolet (UV) ionization of sample components, delivered from the column, and registration of electric current, formed by charged particles between polarizing and measuring electrodes. In the chromatograph the UV lamp with krypton filling and a window of  $\text{MgF}_2$  is used. Radiant energy of the lamp is sufficient for ionizing of majority of narcotics.

UV-lamp is tightly pressed to the ionization chamber with the help of the nut. Its sealing is performed by the ring.

At the PID housing the heater and temperature sensor are placed. The housing of the PID is fastened to the panel of analytical unit. UV-lamp power supply is performed from the PID power supply unit.

## TECHNICAL MAINTENANCE

While exploitation of the chromatograph it is necessary to perform the works to recover some of its technical characteristics, change functional parameters or replace the exhausted elements. These works includes the following:

<b>Procedure</b>	<b>Periodicity</b>
Washing and cleaning of injector	When contaminated
Cleaning of UV-lamp	Before operation
Cleaning of concentrators	After operation
Cleaning of the sampling device	After operation
Intake filters regeneration	Monthly or at presence of water drops in a line between the compressor and receiver
Analytical channel conditioning	After storage for more than 10 days or when contamination occurs
Replacement of the syringe input membrane	At it deterioration
Check of the chromatograph's technical condition	At least monthly
Verification of the device	Once a year

## CONTACTS

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