Yuzhpolymetal-Holding Group

Modus LLC

KERBER

Ion Mobility Spectrometers

Handheld Trace Detectors for Explosives, Narcotics and Toxic Chemicals

Fully certified by Russian Federal Security Service

IMS Kerber is designed to detect trace quantities of low-volatile organic substances, among them are explosives, drugs and toxic (**Kerber-T** model only) substances in the air around controlled objects, on the surface of different objects, on fingers and clothes.

The scope of application for the detector:

- vehicle, cargo and people inspection at customs control;
- territories and objects inspection by environmental control services;
- suspects inspection by law-enforcement officials etc.

The detector can be used when inspecting territories, premises, mobile objects and cargo during customs and border control, in forensic laboratories of different departments, analytical laboratories of industrial enterprises and research organizations.

Main advantages

- ✓ Rapid simultaneous detection of positive and negative ions
- ✓ Non-radioactive ionization source
- ✓ Doesn't require high-priced expandable materials
- ✓ Wide range of detected chemical agents including home-made peroxide explosives
- ✓ Open database of substances with possibility of alter extension

Modus LLC. (Yuzhpolymetal-Holding Group)
✉56, Varshavskoye street, Moscow 117638 Russia
☎ +7 499 723-11-28, +7 499 723-11-49
e-mail: sales@modus-ltd.ru
www.modus-ltd.ru

Substances detected by IMS Kerber

№	Full name	Marker	Chemical formula
List of explosives detected by the device			
1	Ammonium nitrate	NIT	NH_4NO_3
2	Dinitrotoluene	DNT	$C_6H_3CH_3(NO_2)_2$
3	Trinitrotoluene	TNT	$C_6H_2CH_3(NO_2)_3$
4	Trinitroresorcinol (styphnic acid)	TNR	$C_6H(NO_2)_3(OH)_2$
5	Trinitrophenol (picric acid)	TNPH	$C_6H_2(NO_2)_3OH$
6	Dinitronaphthalene	DNN	$C_{10}H_6(NO_2)_2$
7	Dimethyldinitrobutane	DMNB	$CH_3(NO_2CCH_3)_2CH_3$
8	Ethyleneglycoldinitrate	EGDN	$C_2H_4(ONO_2)_2$
9	Nitroglycerine	NG	$CHONO_2(CH_2ONO_2)_2$
10	Pentaerythritol tetranitrate (penthrite)	PETN	$(CH_2ONO_2)_4C$
11	Hexogen (RDX)	RDX	$(CH_2)_3N_3(NO_2)_3$
12	Octogen (HMX)	HMX	$(CH_2)_4N_4(NO_2)_4$
13	Tetryl	TETR	$(NO_2)_3C_6H_2N(NO_2)CH_3$
14	Tetrazole	TZ	CH_2N_4
15	Benzofuroxan	BF	$C_6H_4O_2N_2$
16	Triacetone triperoxide	TATP	$(C_3H_6O_2)_3$
17	Hexamethylene triperoxide diamine	HMTD	$N(CH_2OOCH_2)_3N$
18	Plastic explosives based on hexogen (hexogen+plasticiser)	RDX	Prev. $(CH_2)_3N_3(NO_2)_3$
19	Plastic explosives based on octogene (octogene+plasticiser)	HMX	Prev. $(CH_2)_4N_4(NO_2)_4$
20	«Octol» (HMX+TNT)	HMX, TNT	Mixture
21	«Semtex» (RDX+PETN+ plasticiser)	RDX, PETN	Mixture
22	Ammonite, amatol	TNT, NIT, (RDX)	Mixture
List of drugs detected by the device			
1	Amphetamine	AMP	$C_9H_{13}N$
2	Methamphetamine	MET	$C_{10}H_{15}N$
3	Cocaine	COCS	$C_{17}H_{21}NO_4$
4	Heroin (diacetylmorphine)	HER	$C_{21}H_{23}NO_5$
5	THC (psychoactive constituent of the cannabis plant)	THC	$C_{21}H_{30}O_2$
6	Methylenedioxyamphetamine (“Sassafras”)	MDA	$C_{10}H_{13}NO_2$
7	Methylenedioxymethamphetamine (“Ecstasy”)	MDMA	$C_{11}H_{15}NO_2$
8	Phenobarbital	PHNB	$C_{12}H_{12}N_2O_3$
9	Morphine	MORP	$C_{17}H_{19}NO_3$
10	Codeine	CODN	$C_{18}H_{21}NO_3$
List of toxic chemicals detected by the device (Kerber-T model)			
1	Hydrogen sulfide	H2S	H_2S
2	Hydrogen chloride	HCL	HCl
3	Hydrogen fluoride	HF	HF
4	Sulfur dioxide	SO2	SO_2
5	Chlorine	CL2	Cl_2
6	Ammonia	NH3	NH_3
7	Nitrogen oxide	NO	NO
8	Nitrogen dioxide	NO2	NO_2
List of chemical warfare agents detected by the device (Kerber-T model)			
1	Sarin	GB	$C_4H_{10}FO_2P$
2	Soman	GD	$C_7H_{16}FO_2P$
3	Mustard gas	MG	$C_4H_8Cl_2S$
4	Vx	VX	$C_{11}H_{26}NO_2PS$
5	Phosgene	CG	CCl_2O
6	Hydrocyanic acid	HCN	HCN

Basic features

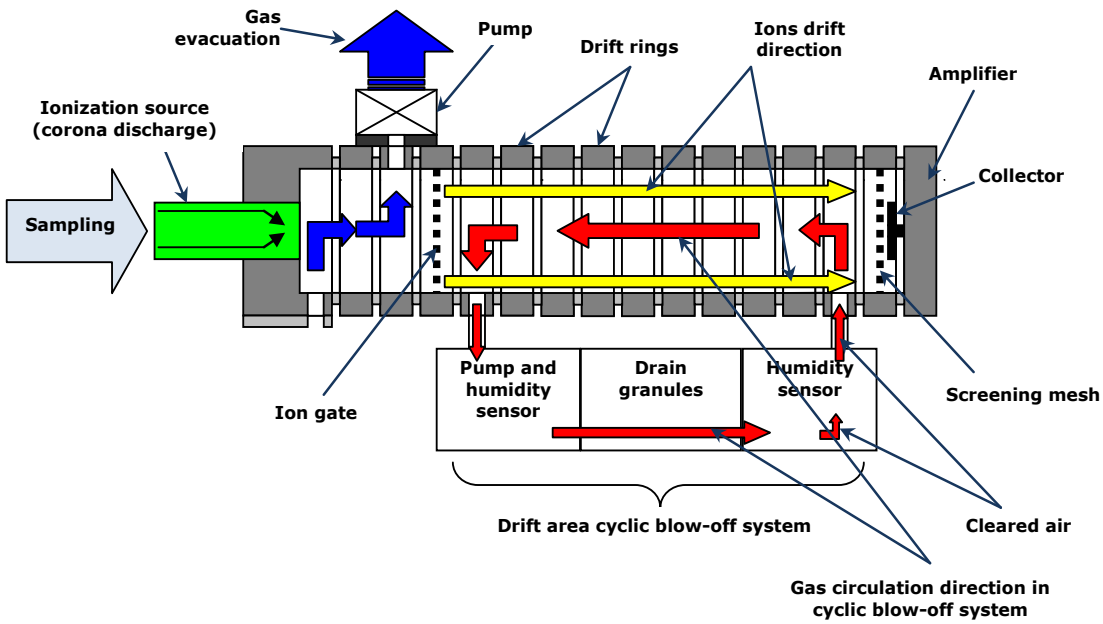
Feature	Value
Overall dimensions of the detector (L×W×H), mm, not more	410×110×170
Weight, kg, not more	3.7
Measurement range of normalised (reduced) mobility of analyzed ions, $cm^2V^{-1}s^{-1}$	0.5 – 3.0
Detection range of low-volatile organic substances based on 2,4,6-trinitrotoluene (TNT), g,	$1.0\cdot10^{-11} – 2.0\cdot10^{-7}$
Threshold for detecting low-volatile organic substances based on 2,4,6-trinitrotoluene (TNT),	
- particulate matter, g, not more	$1.0\cdot10^{-11}$
- vapours, g/cm^3, not more	$1.0\cdot10^{-14}$
Time for operating mode start-up, min, not more	15
Measurement time, s, not more	5
Time of changing the type of analyzed ions (negative or positive),	
- in unipolar mode (manual switching), sec	10
- in bipolar mode (automatic cyclic polarity change), sec	0.2
Possibility of false response, %, not more	1
Time of continuous autonomy work with regular block of accumulation batteries, hours, not less	4
Time of detector cleaning under regular operating conditions, min, not more	3

Principles of operation

IMS Kerber works according to method of ion mobility spectrometry. This method is based upon division of ions in substances according to their mobility during movement in the drift tube in the constant electric field.

The detector working in the search mode for target substances continually takes in air surrounding an inspected object with the speed **5-10 cm^3/s**. Taken air containing molecules of target substances gets into ionization source based on an impulse corona discharge where molecules partially ionize.

Ionization process passes through several stages. When the device works there appear positive and negative ions of ambient air (reactant ions) in the discharge chamber (**ionization source**) and their concentration substantially exceed concentration of detected substances.



When target substances get into the device reactant ions transfer a charge to their molecules based on mechanism of chemical ionization under atmospheric pressure.

Non-ionized molecules of target substances and air are removed from the system and the ions received are held in the ionization chamber with the help of **ion gate**. After certain periods of time the ion gate opens and ions portion gets into the drift tube with electric field gradient **E** (V/cm).

Ionized molecules of different substances have various drift velocity v_d in the drift tube depending on their charge, mass and size. Ions with small mass come earlier whereas ions with large mass move more slowly and arrive to the collector later. Molecular ions of various compounds differ in arrival time to the collector which allows defining their nature.

This time is proportional to drift tube length L (cm) and inversely proportional to electric field gradient E:

$$\tau_d = \frac{1}{K} \cdot \frac{L}{E}$$

where K is mobility coefficient in units of $cm^2V^{-1}s^{-1}$.

This relation is of a static character, i.e. it is true only for ions swarm and not for individual ions.

Ions mobility depends on temperature and pressure. In order to compare values of ions mobility received under different conditions K values are compared as being under normal conditions:

$$K_0 = K \frac{P}{760} \cdot \frac{273}{T}$$

where T – temperature (K) and P – pressure (mmHg) of gas atmosphere where ions move. K_o is called reduced mobility (or normalized mobility coefficient).

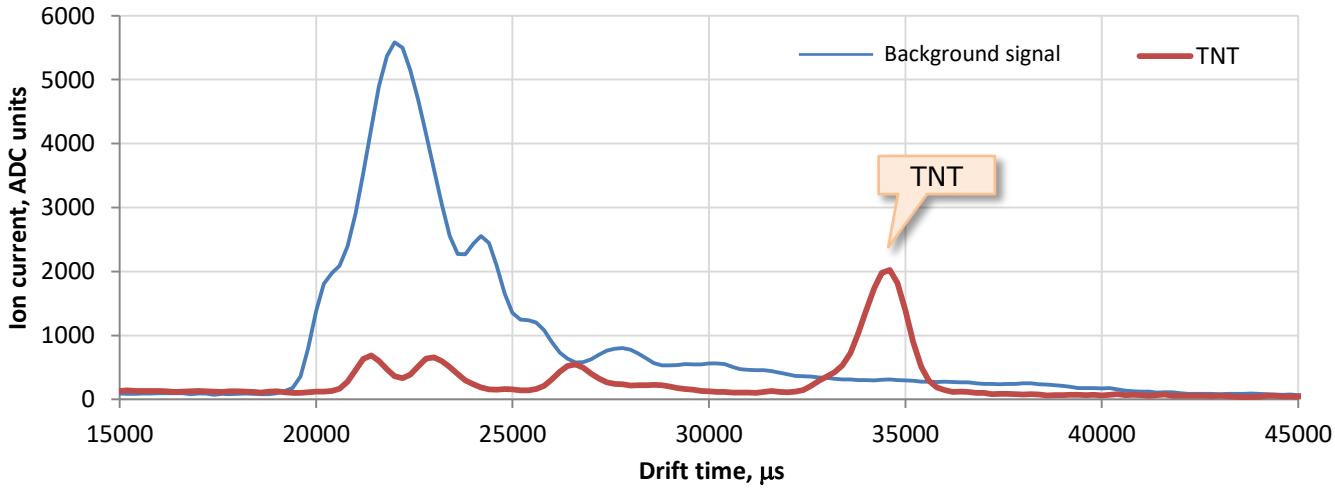
Separated ions get onto the ions current collector signals from which they come into special amplifying and processing system.

Operation frequency of ions source is 10 Hz, i.e. every second the system generates 10 ranges. The results are constantly averaged out. Outliers caused by random fluctuations of gas current composition and electric disturbances are being eliminated whereby. The results averaged out are additionally smoothed and might be presented in the form of a ions mobility "spectrum". There are peaks on the curve of dependence of ions current upon drift time which correspond to ions of various mobility.

Detector software allows analyzing the received range as far as peaks are concerned which correspond to target substances taken into database according to mathematical expectation (assembly average) and time dispersion.

If a target organic compound is found and its peak prevails set response threshold the detector gives a signal of alarm and the marker (code) of the detected substance.

IMS Kerber has a combined sampling apparatus allowing both sampling of air containing vapours and suspended particulate matter and sampling of particles collected on a special sampling wipe.



Main customers of IMS Kerber and Kerber-T

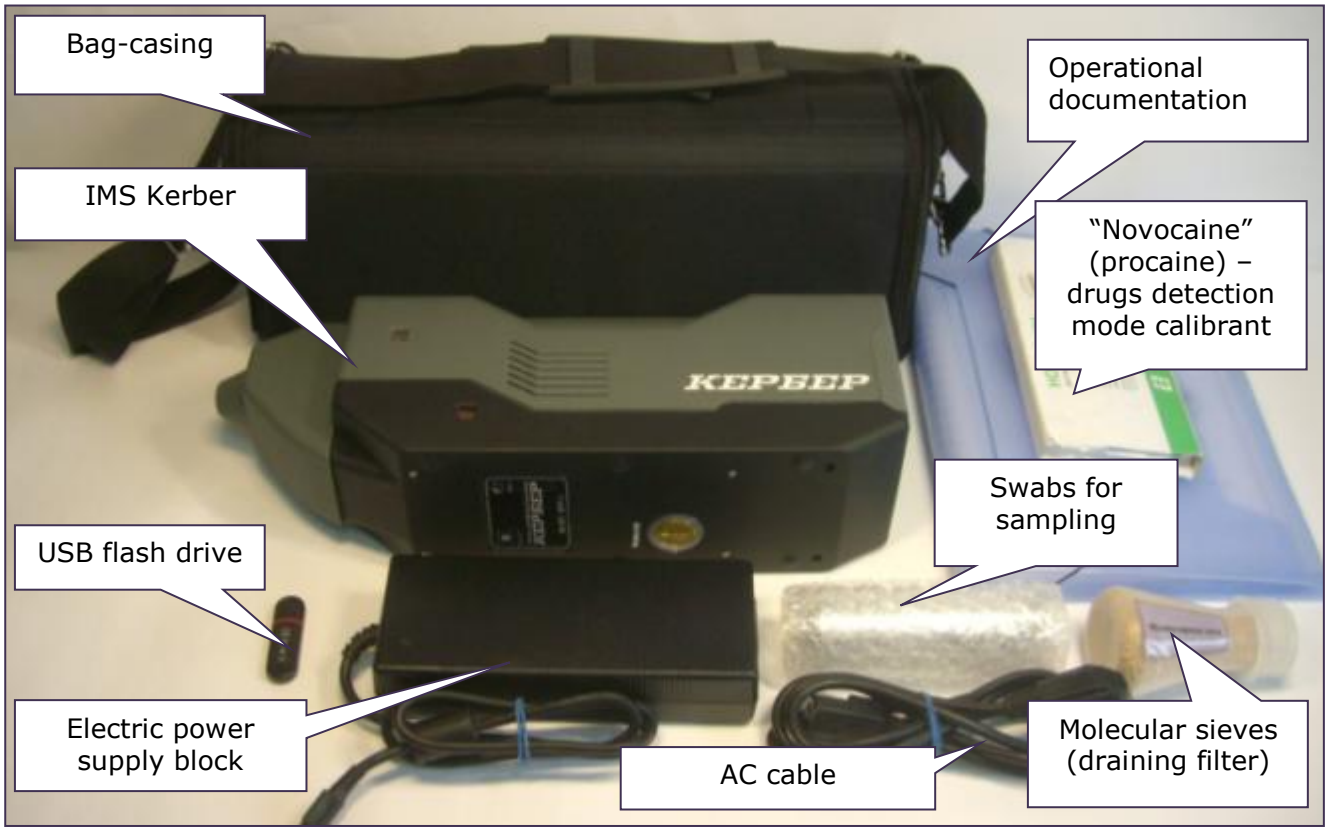
- ✓ **Federal Customs Service of Russia**
- ✓ **Security service of Moscow Metro**
- ✓ **Security service of Sochi-2014 Olympics**
- ✓ **Government corporations "Rosenergoatom" and "RusHydro" security services**
- ✓ **Airports and railway stations**
- ✓ **Forensic laboratories of Russian Federal Security Service and Police**

more than

1000

units have been delivered since 2011

Package of IMS Kerber



The extended package also includes:

Insertion of the sampling wipe

Vapor detection

Taking traces from the hands of the suspect using the sampling wipe

The IMS Kerber has detected traces of heroin

Using of IMS Kerber by customs officers in inspection of unclaimed baggage

Testing of IMS Kerber in Federal Drug Control Service of the Russian Federation (using the unit with the external monitor)

Modus LLC.
56, Varshavskoye str., Moscow 117638, Russian Federation
☎ +7 (499) 723-11-28, 723-11-49
www.modus-ltd.ru ✉ sales@modus-ltd.ru