

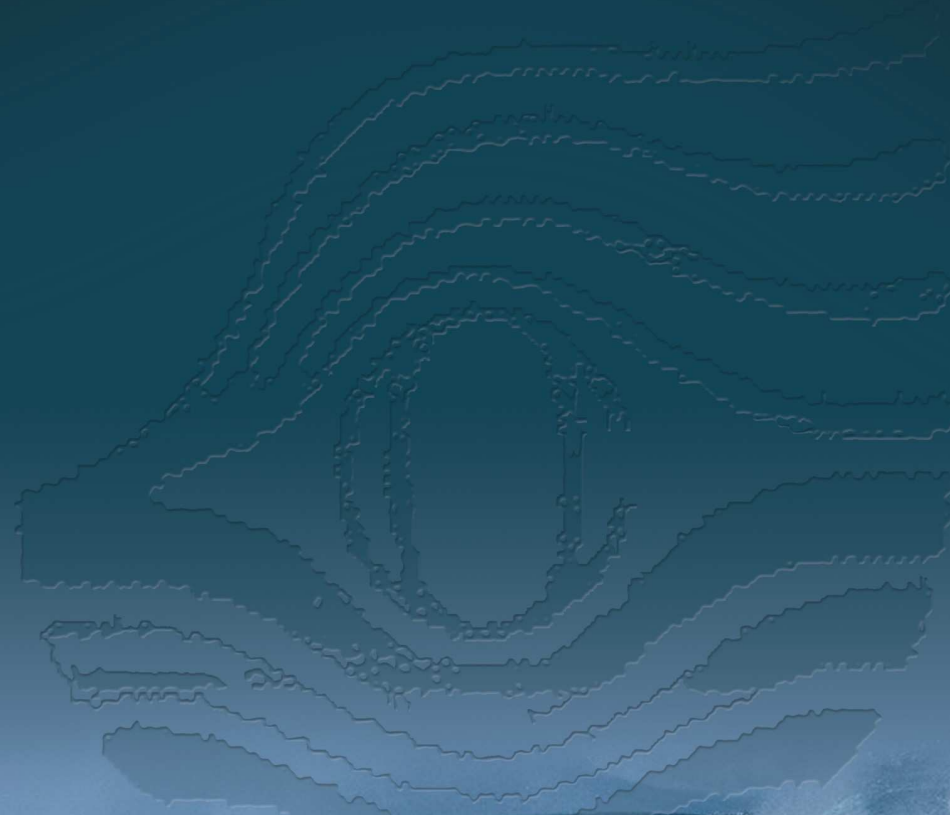


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**[www.edboe.ru](http://www.edboe.ru)**



EDBOE RAS was established in 1970 by the Decree № 33-306 of the Presidium of Academy of Science according to the Regulation of State Committee on Science & Technology of the USSR.

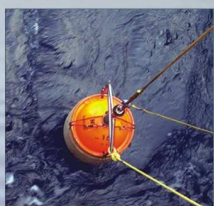
## Main directions of activity:

- Providing research and experimental design of scientific instrumentation for fundamental research in physics, chemistry, biology, geology, geomorphology, ecology and acoustics of World Ocean
- Development, design and manufacture of special instruments and scientific equipment for onshore and ocean research, environmental monitoring, investigation and exploration of natural resources.
- Development, design and manufacture different types of geophysical, hydro chemical, hydrological, hydroacoustic and other scientific measurement devices, sensors, ocean bottom stations and observatories, multi-purpose manned and unmanned research submersibles and others.
- Supply facilities and maintenance of equipment for measurement, processing, analysis and interpretation of geophysical and oceanographic data
- Scientific research and engineering survey

**The main office of EDBOE RAS is in Moscow, the Southern branch is in Gelendzhik, Black Sea.**

## Structure of EDBOE RAS:

- Electronic R&D department
- Mechanical R&D department
- Submersibles R&D department
- Geophysical systems R&D department
- Department of designing and production of printed circuit boards
- Processing department
- Metrological department
- Experimental manufacturing department
- Marketing department
- Administrative and financial group
- Maintenance group



Customers and partners of EDBOE RAS in Russia are: Shirshov Institute of Oceanology RAS, Institute of Physics of the Earth RAS, Oil and Gas Research Institute RAS, Institute of Water Problems, Institute of Water & Ecological Problems RAS, Institute of Nuclear Research RAS, Institute of Radio-Electronics RAS, Acoustic Institute, Oceanography & Navigation Department, State Research Institute of Hydrography & Navigation of Ministry of Defense, Research Institute "Electropribor", Scientific & Industrial Enterprise "Sevmorgeologiya", State Scientific Center "Yuzhmorgeologiya", Scientific & Industrial Enterprise "Volna", Ltd "Navdyne", Ltd "Gradient", OOO "Tatneft", EMERCOM, Moscow Institute of Physics & Technology, Ltd "Seatechrim", Bauman Moscow State Technology University, OAO "Gazprom" and other institutes and companies.



EDBOE RAS collaborates with foreign research and design institutes and companies from the USA, India, Japan, Greece, Germany, France, England, Spain, Taiwan, Norway, Poland, Denmark and others.

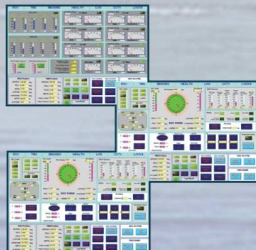
Main directions of EDBOE RAS activities during last years are geophysical onshore and offshore investigation and exploration using in-house designed state-of-the-art scientific instruments like ocean bottom stations, autonomous recorders of seismic signals, underwater observatories.





## Multipurpose Mobile Complex of the Deep Water Remotely Operated Vehicle

ROSUB-6000 is intended for the various scientific and engineering survey, search-and-rescue applications etc. in the World Ocean at the depth up to 6000 m.



### Structure:

Remotely Operated Vehicle (ROV),  
Tether Management System (TMS),  
Launch & Recovery System,  
Storage Winch, Control Van,  
Power System, Storage-Service Lab

### ROV specification:

Operating depth 6000 m  
Dimensions L2,53m x H1,8m x W1,7m  
Weight 3080 kg in air (- 20 kg in water)  
Payload 150 kg  
Propulsion system 7 electrical thrusters  
(2 cruising, 2 lateral, 3 vertical)  
Power supply 6,6 kV (three-phase), 460 Hz  
Manipulators 2 pcs:  
- 7 Function manipulator with payload max 150 kg  
- 5 Function manipulator with payload max 450 kg  
TV Cameras 5 pcs: 2 color, 1 B&W,  
2 mini-cams integrated with manipulators  
Lights 6 lamps (LED and halogen)  
Speed, up to cruising - 2,5 knots, lateral - 2,0 knots,  
vertical - 1,5 knots

### TMS:

Operating depth 6000 m  
Dimensions d 2,5 m x H 3 m  
Weight 3000 kg in air ( 2200 kg in water)  
Tether 400 m  
Pan&Tilt Camera & HID Lamp

**Precision navigation system:** Inertial navigation subsystem,  
Hydroacoustic navigation subsystem, Doppler velocity log,  
Depth sensor, Sound velocity probe, Multibeam  
echosounder with forward-looking and bottom-looking  
sonar operating modes.

**Containerized Deck Equipment:** Launch&Recovery  
System, Storage Winch, Control Van, Power System,  
Storage-Service Lab

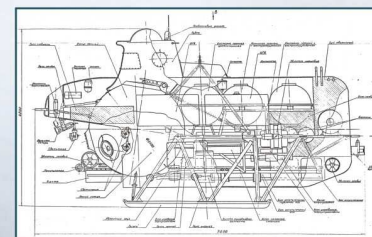
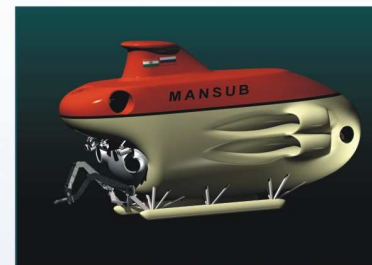
### Software:

- System consists of 3 industrial computers, PXI controller, TMS controller and ROV controller. They are networked through TCP/IP.
- Entire test results – data, events and errors that will give a detailed description of the current status in the user interface screens and as log files.
- These files are stored at real-time controllers if link is failed, hence there is no data loss.
- Redundant RS-485 serial link establishment if failure in ROV or TMS.
- Selectable video channels from ROV and TMS to view in three plasma screens.
- Redundant control of ROV by Pilot/Co-pilot.
- Interlocks and alarm sound for critical operation.

Research Manned Submersible are 15-ton, three-man vehicles capable to operate at depth up to 4 km Submersibles are intended primarily to carry out scientific research, works with research drilling ship, underwater inspection, search and recovery etc.

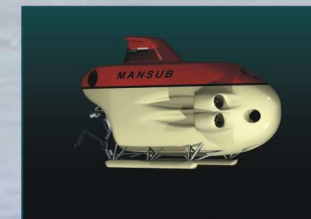
All structures of were produced from Ti alloys.

Two submersibles are being built simultaneously.



### Main Technical Data

Operational depth, m	4000
Weight in air, ton	18
Length, m	7.5
Width, m	3.5
Height, m	4.2
Cruising speed, knots, approx.	3
Life support endurance, man-house	246
Battery capacity (4000m), kq	150





# Underwater Geophysical Observatory



Underwater geophysical complex



Multi-component bottom seismometer



Horizontal Seismic sensor SM-5VH



3D Flux-gate magnetometer LEMI

Jointly with  
Schmidt Institute of  
Physics of the Earth RAS

## Intended for fundamental and applied research at the bottom area of World Ocean:

- real-time geo-ecological monitoring
- revealing of seismic and hydrophysical precursors of catastrophic earthquakes and tsunami
- monitoring of changes in stress-deformation state of the Earth's crust in shelf areas near oil & gas production zones
- geophysical monitoring of complex waterside constructions, underwater oil wells, oil platforms and underwater pipelines

## Composition:

- multi-component bottom seismometer;
- hydrophysical unit (current velocity meter & CTD);
- 3D flux-gate magnetometer LEMI;
- hydro-acoustic telemetry subsystem;
- data acquisition & control system and incline alarm unit;
- reserve power supply, sealed cable connector;
- noise protection cover.

## Multi-component modular designed bottom seismometer:

- spatial orientation sensor;
- horizontal velocity meter SM-5VH (N-S);
- horizontal velocity meter SM-5VH (E-W);
- vertical velocity meter SM-5V(Z) and vertical accelerometer SM-5A(Z);
- 3D seismic acoustic sensor (type A1632, frequency range - 0,2 - 400 Hz);
- bottom seismometer platform;
- frequency rang:  
SM-5V - 0,03-40 Hz, SM-5A - 0,006-20 Hz
- dynamic range:  
SM-5V- 120 dB, SM-5A- 120 dB
- max amplitude of registered signal  
SM-5V- 0,025 m/s

## 3D Flux-gate magnetometer LEMI

- range  $\pm 60\,000$  nT
- frequency range 0 - 0,3 Hz
- sensitivity 0,01 nT

# Underwater Geophysical Complex

Underwater Geophysical Observatory is new generation of multicomponent integrated deepwater system with on-line data communication, intended for continuous geo-ecological monitoring in the World Ocean, increasing accuracy of forecast of earthquake and tsunami, analysis and early warning of them, forecast of evaluation of the Earth's crust structure deformation and induced seismicity, investigations in areas of marine hydrocarbon fields.

## Structure:

### \* Submersible geophysical system:

- Seismological geophysical module - 3D electrochemical seismometer (velocity meter), frequency range 0,1-40 Hz; sensitivity on frequency  $1\text{Hz}-10^{-8}$  m/s;
- Seismoacoustic module - 3D electromagnetic seismometer (magneto elastic sensor), frequency range 0,1-5000 Hz; displacement measurement sensitivity  $10^{-15}$  m on frequency  $\geq 1000$  Hz,  $10^{-3}$  m on frequency  $\leq 1,0$  Hz;
- Spatial orientation sensor, azimuth measurement accuracy -  $\pm 0,8^\circ$ , range  $\pm 50^\circ$ ;
- Hydrophysical module - CTD: electrical conductivity 0,1-7,0 ms/cm, accuracy  $\pm 0,002$  ms/cm; temperature -2 - +32°C, accuracy  $\pm 0,002^\circ\text{C}$ ; pressure 0-60 MPa; accuracy  $\pm 0,02\%$  full scale;
- 3-axis magnetometer, measuring range  $\pm 65000$  nT, sensitivity 0,01 nT;
- Acoustic Doppler current profiler velocity range  $\pm 5$  m/s, accuracy 0,3% of the water velocity relative to ADCP,  $\pm 0,3$  cm/s;
- Sensors of hydro chemical parameters -  $\text{O}_2$ , pH, methane (others available);
- Bottom pressure sensor for surface level measurements, 0-60MPa, accuracy  $\pm 0,01\%$  FS;
- Data acquisition system - two control and data recording units, six 24-bit ADCs, 40 Gb flash memory (another available), 10 channel analog and digital interface (another available);
- Cable and hydroacoustic link modems, slant hydroacoustic range - 8000 m;
- Carrying platform and pressure cases;
- Power supply unit, 2 rechargeable batteries, 12 v, 130 A\*hour;
- Self-contained hydroacoustic release;
- Light and radio retrieval beacons;

**Working depth - up to 6000 meters.**



\* Ship system, consisted from launch - recovery subsystem, the set of hydro acoustic equipment for release control, hydroacoustic telemetry subsystem, electronic unit for the test, GPS-synchronization, control of Submersible geophysical system before and during deployment and after recovery to the ship board, data reading, processing and visualization subsystem.

\* Data-buoy equipped with proper sensors like heave sensor, GPS, hydroacoustic telemetry module, special satellite navigating measuring module (for the record of sea level changes), satellite telemetry module, transmitters and power sources;

\* Onshore data processing and collecting center, equipped by satellite communication subsystem with data-buoy;



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# Autonomous bottom seismic stations

Autonomous bottom seismic station (ABSS) is intended for registration local and distant earthquakes for seismicity study, seismic prospecting by the method of recording and analysis of reflected and refracted waves study of Earth's crust and mantle structure, research lithosphere and hydrosphere interaction.

## Onboard equipment

- GPS unit for ABSS initialization and synchronization
- Data transmission unit (from ABSS to onboard PC)
- Shipboard unit & hydroacoustic antenna with cable for the hydroacoustic release control

## Carrier:

Aluminium sphere	450 mm
Max operation depth	6000 m
Weight in air	
without anchor	40 kg
Anchor weight	40 kg
Buoyancy	> 7 kg
Height	700 mm
Diameter	560 mm
Immersion velocity	1,7 m/s
Emersion velocity	1,0 m/s

## 3D seismometer in special cardan joint:

Geophone:	
sensitivity	2000 V/m/s
Seismic	
frequency range	1 – 125 Hz
	(0,5 - 40 Hz optional)

Hydrophone:	
Sensitivity	25 mkV/Pa
Seismo-acoustic	
frequency range	1,0 - 1000 Hz



## Hydroacoustic release:

Slant distance	8000 m
Distance	
measurement accuracy	15 m
Autonomous power supply	12 V
Emergency triggering by	
autonomous timer	



## Digital recorder:

4-th channel ADC	24 bit
Sampling rate	2,4,8,16 ms
FLASH memory	2 Gb
	(optionally 4 - 20 Gb)
3D compass, accuracy	$\pm 2^\circ$
Temperature sensor,	
accuracy	$\pm 0,1^\circ\text{C}$
Internal timer error	$10^{-9}$ sec



## Switch on/of by time

Power consumption	3,2 W
Max record time:	
2 ms sampling rate	110 hours
16 ms sampling rate	744 hours
Power supply -	
rechargeable battery	6 V

## Application experience:

- Geophysical investigations in Pacific Ocean, 2006-2008, 40 ABSS
- Marine operations in Indian Ocean 2003 – 2004, seismic investigations of crust structure, more than 100 deployments
- Marine operations in Mediterranean Sea 2003, investigations of sediments and basement, 21 ABSS



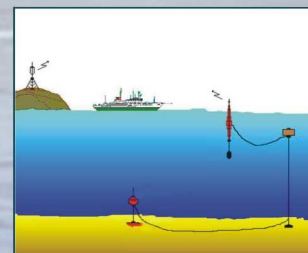
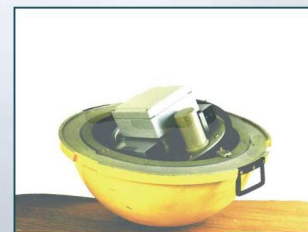
# Ocean Bottom Broad-Band Seismograph

## Function:

Measurement and record of signals from local and distant earthquakes on deep sea floor in wide frequency range and on-line data transfer to coastal data collecting center.

## Practical application:

The study of the seismicity of regions and applied problems solving for anti-seismic construction. Logging of remote earthquake for investigation the deep structure of the Earth's crust and mantle.



## Structure and operating parameters:

Autonomous Ocean Bottom station:

- Three component electrochemical seismological sensor (velocity meter):  
Frequency range – 0,003 - 20Hz;  
Sensitivity (on 1 Hz) –  $10^{-8}$  m/s;  
Dynamic range – 120 dB;
- Three component piezoelectric sensor (strong motion meter):  
Sensitivity (on 1 Hz) -  $10^{-5}$  m/s;  
Dynamic range – 2g;
- Two hydroacoustic channels,  
Frequency range 1,0-1000 Hz;
- 8-chennals Data Logger:  
8 channels of 24 bit ADC, sampling rate – up to 4000 SPS, dynamic range 136dB (sampling rate 200 SPS),  
FLASH memory - up to 64 Gb,  
Interface – RS-232, Ethernet.  
Continuous record time – 120 days;  
Precise time generator, accuracy -  $10^{-9}$  sec;
- Hydracoustic release, operated by the internal timer and/or by the commands via hydroacoustic communication link.  
Slant range – up to 8000 m;
- Hydroacoustic and satellite communication modems;  
Total Power consumption – 1W;  
Max depth – 6000m;  
All-up weight (with 70 kg anchor) – 150 kg;

- Ship board equipment for test, control and synchronization of OBS-BB, including release control.

- Subsurface and surface buoys for data transfer from OBS-BB to the onshore data collecting center and equipped by special hydroacoustic and satellite modems, operated in alarm and data telemetry modes, power supply modules, light and radio beacons.

- Equipment of onshore Data Collecting & Processing Center.

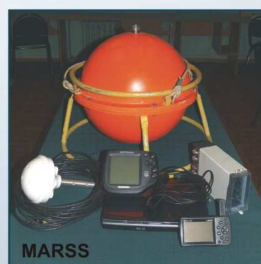




Autonomous recorders of seismic signals are self-contained cost-effective geophysical instruments for seismic investigation and geophysical prospecting on land and shallow water areas (ARSS- autonomous recorder of seismic signals) and offshore zones (MARSS - marine autonomous recorder of seismic signals). Used for microseismic background study of various land, coastal and offshore areas, as well as for the registration and online analysis of seismic signals of different sources.

## Specification:

Frequency range	0,5 - 40 Hz
Sensitivity (1 Hz)	$4 \times 10^{-10}$ m/s
Dynamic range	120 dB
Registration time (for 4-channel)	20 days
ADC period	16, 8, 4, 2 ms
Internal memory	0,5 - 8 Gb
Maximal traceable signal amplitude	$5 \times 10^{-3}$ m/s
Power supply/consumption	12 V / 0,2 W
Internal timer error	$10^{-9}$ sec



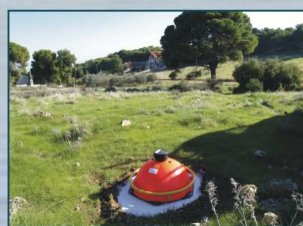
Max operation depth (ARSS)	20 m
Max depth (MARSS, standart hull)	300 m
(MARSS optionally)	6000 m

ARSS is equipped by Z-component seismometer SM-3KV with automatically setting / holding pendulum zero and automatically locking / unlocking.

MARSS is equipped with sensitive seismic sensor SM-3KV mounted in joint cardan in lower part of the station. Such kind of construction lets sensor to keep vertical position up to 25 degree slope of the ocean bottom area.

MARSS have been tested in 2006-2007 on Sea of Azov.

ARSS is successfully applied by for seismic investigation and exploration in Russia (Tatarstan, Western and Eastern Siberia), Spain, Greece, India and others.



## SEISMOMETER SM-3KV

SM-3KV is one-component short-period seismometer, used in seismic observation systems of local and regional zones, for measurement variations and spectral characteristics of microseismic background, detection of earthquakes and explosions, analyzing oscillations of buildings, constructions, machines, etc.



## SPECIFICATION

Operation frequency range (by level 0,7)	0,5 – 40 Hz
Velocity conversion coefficient in relation to “general” at 2 Hz frequency	$4000 \pm 5\%$ Vs/m
Sensitivity limit at 2 Hz frequency	$1,25 \times 10^{-10}$ m/s
Maximal amplitude of velocity converted	$(3-6) \times 10^{-3}$ m/s
Maximal amplitude of output signal	$\pm (6 - 12)$ V
Load resistance, not less than	30 k $\Omega$
Pendulum “zero” adjustment	automatic
Arrest-disarrest	semiautomatic
Power supply voltage	$\pm (9 - 15)$ V
Input power, stationary mode, not more	0,45 W
Input power, arresting and rearresting modes, not more	1,2 W
Overall dimensions	232x173x163 mm
Maximum weight	8,9 kg

## SEISMOMETER SM-5

SM-5 is one-component portable seismometer, used in seismic observation systems in local and regional zones, for measurement strong motion in the Earth's crust and analyzing oscillations of buildings, constructions, machines, etc.

## SPECIFICATION

Operating frequency range	0,035 - 40 Hz
Transformation coefficient	$200 \pm 5\%$ Vs/m
Maximal amplitude of transformed velocity	0,06 m/s
Minimum dynamic range	120 dB
Power supply voltage	+ 15 V
Maximum power consumption	0,21 W
Overall dimensions	88x80x60 mm
Maximum weight	1,2 kg



## SEISMOMETER SM-6

SM-6 is one-component portable seismometer, used in seismic observation systems of close and regional zones, in geophysical field works.



## SPECIFICATION

Operating frequency range	0,8 - 40 Hz
Transformation coefficient	$4000 \pm 10\%$ Vs/m
Maximal amplitude of transformed velocity	0,06 m/s
Dynamic range, not less	120 dB
Power supply	$\pm 15$ V
Maximum power consumption	0,21 W
Overall dimensions	149 x 135 mm
Maximum weight	2,86 kg

