



MIR Submersibles

Owned and Operated by the PP Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow
Commercial Management by Deep Ocean Expeditions



DEEP OCEAN EXPEDITIONS

"To the depths of the ocean, the world's last great frontier."





The MIR Submersibles

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The MIR submersibles can dive to a maximum depth of 6000 metres (19,680 feet), giving them access to up to 98% of the world's oceans. The MIR submersibles are two of only five manned submersibles in the world that can dive beyond 3,000m (9,840 feet).

The MIR submersibles are very safe and relatively spacious; they are equipped with view ports, exterior lights and an impressive array of instruments.

They are inspected and certified on an annual basis and undergo a major overhaul every five years with the most recent just completed in September 2004. The MIR submersibles are classified by German Lloyd, a leading ship and submersible classification bureau.

The pressure sphere is constructed of thick nickel steel. It is designed to withstand the enormous pressures found at ocean depths. The MIR submersibles have an overall length of 7.8 metres (25 feet) and their cabin is 2.1 metres (7 feet) in diameter, accommodating one pilot and two passengers. Air pressure inside the cabin remains at a constant one atmosphere; the air is recycled in a manner similar to that used on board spacecraft, with lithium hydroxide scrubbers removing accumulated carbon dioxide.

“As I peered down I realised I was looking toward a world of life almost as unknown as that of Mars.” William Beebe 1930

More than fifty worldwide expeditions have been conducted with the MIR submersibles and their dedicated mothership RV Akademik Mstislav Keldysh.

The discovery of hydrothermal vent life on the ocean floor was one of the greatest discoveries of the 20th century. The MIR submersibles have visited 12 of these hydrothermal vent sites, both in the Pacific Ocean and Atlantic Ocean. The MIRs were the first submersibles ever to visit three of these sites.

Other voyages completed include extensive oceanographic research and sampling expeditions and filming on the legendary RMS Titanic including such productions as *IMAX Titanica*, James Cameron's Hollywood blockbuster *Titanic* and *Ghosts of the Abyss*.

A number of expeditions have also been mounted to the site of the German battleship Bismarck as well as other interesting deep ocean sites.

Expeditions are made possible with the experience and expertise of the Chief of the Expedition and Chief Pilot Dr Anatoly Sagalevitch and his MIR submersible team. Assisting him is Captain Yuriy Gorbach and his Keldysh crew. The RV Keldysh and MIR teams are highly skilled professionals and together they run one of the safest underwater operations in the world.

MIR Submersible Features

Visibility / Viewing ports

The pressure hull consists of two joined nickel-steel hemispheres. Fitted into the sphere are three viewing ports, 200mm in diameter (7 inches) and two 120mm in diameter (4 inches). The large central port provides the pilot with extensive vision forward, while the two observers each have their own side-forward facing ports.

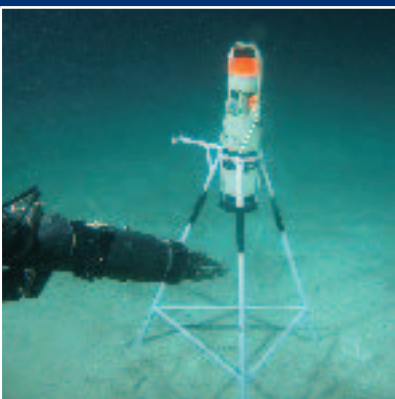
Comfort

The submersible is entered through a top-opening hatch. The pilot and two observers sit or lie comfortably on padded seating whilst contained at one atmosphere within the 2.1-metre (7.0 feet) diameter sphere.

Safety

The submersibles were designed, built and tested in accordance with the very precise rules of the Germanischer Lloyd marine surveying company and are surveyed on an ongoing basis for compliance.

The MIR pressure spheres are pressure tested to 1.25 their maximum working depth of 6,000 meters (19,680 feet) allowing a generous safety reserve.



Reliability

The two MIR submersibles have logged over 720 successful dives between them since their launch in 1987.

Sonar

Each MIR is fitted with a 250 metre (820 feet) acoustic imaging sonar allowing it not only to detect the bottom as it approaches but also to locate objects both man-made and geological on the ocean bottom.

Life Support

The life support system installed in the submersible allows for 246 man-hours of life support. This equates to 3.5 days of life support per person.

Simultaneous Two Sub Operation

The dual submersible MIR operation is like no other 6,000 metre (19,680 feet) operation of its kind. The MIRs can operate simultaneously or independently while still retaining the ability to operate autonomously when required. They are able to mutually assist and guide one another yet they do not rely on one another. This two-sub operation is a feature that strongly appeals to filmmakers.

Ease of Handling / Thrusters

A main stern thruster and two side thrusters provide excellent manoeuvrability on the ocean floor. The MIRs are capable of a top speed of 5 knots – almost twice the top speed of other deep diving submersibles.

Navigation

Prior to diving, a series of navigation transponders are deployed. The positions of these transponders are then integrated into a grid pattern relative to latitude and longitude using information from the mother vessels GPS satellite positioning system. The MIR submersibles then navigate within this grid pattern.

The MIRs are also equipped with a depth sounder; long distance sonar and compass.

Manipulators

Each MIR is equipped with two manipulators. Each manipulator has seven functions plus a rotating jaw.

Launch and Retrievals

The MIRs are launched from a 27-tonne crane mounted on the starboard side of the RV Keldysh. Each MIR has a hangar within which it is stowed in whilst on board the vessel. A smaller tow vessel is used to position the MIRs for launch and retrieval.

Lighting

Any combination of lighting packages can be installed on the MIRs. Lights available include 400 and 1200 Watt HMI lights.

Filmmaking

A package of cameras and lighting equipment can be fitted to the MIRs to enable filmmaking. An optional pan-and-tilt mechanism, high definition video systems and specialised deep-water housings are available at an extra negotiated cost. Internal monitors can be installed inside the pressure sphere along with interior cameras. An important feature of the double submersible dive system is the ability to use one submersible for lighting and the second submersible for filming.

Pilots and Sub Crew

Many of the Russian team of 25 submersible pilots and engineers have been working with the MIRs since their launch, and prior to that on other submersibles operated by the P.P. Shirshov Institute. This is reflected in the efficient way the team functions. All MIR submersible operations are conducted in a highly professional and safe manner.

RV Akademik Keldysh

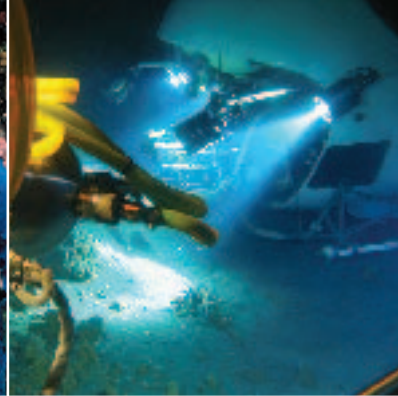
The Akademik Keldysh is one of the largest oceanographic research and deep-diving support vessels in the world.

Keldysh is also owned and operated by the Moscow-based P.P. Shirshov Institute of Oceanology. She was built in Finland in 1980 and is a fully equipped oceanographic vessel capable of lengthy worldwide scientific expeditions.

Keldysh is equipped with a range of laboratories and is the only vessel in the world capable of supporting the operation of two deep-diving submersibles simultaneously. Keldysh can accommodate 130 personnel in total and up to 35 of these berths are allocated to visiting scientists, filmmakers or other charter groups.

RV Akademik Mstislav Keldysh Technical Specifications

Displacement	6,259 tonnes
Length – overall	122.2 metres / 401 feet
Length – waterline	108.2 metres / 355 feet
Height	10.4 metres / 32.8 feet
Draft	5.9 metres / 19.4 feet
Beam	17.8 metres / 58.4 feet
Laboratories	17 wet / dry laboratories
Engine power	4,280 kw
Max speed	12.5 knots
Cruising speed	10.5 knots
Winches	15
Hydraulic cranes	4
A – frame	1
Ship crew	53
Sub crew / technicians	25
Scientists / guests	52
Date of delivery	1981
Conversion	To support MIR submersibles 1987
Builder	Holming Oy (Finland)



MIR Submersible Technical Specifications

Built	December 1987.
Builder	Rauma-Repolä, Finland. Designed by Rauma Repolä Oy Finland and the PP Shirshov Institute of Oceanology, Moscow, Russia. Surveyed by Germanischer Lloyd Maritime Service, Germany.
Overhaul	2004.
Size	Length – 7.8 m / 25.6 ft. Width – 3.6 m / 11.8 ft. Height – 3.0 m / 9.8 ft. Weight – 18,600 kg.
Service Depth	Maximum 6,000 m / 19,680 ft. Maximum Ocean trial depth MIR I – 6170 m / 20,238 ft. Maximum Ocean trial depth MIR II – 6120 m / 20,074 ft.
Crew	1 pilot, 2 observers/passengers.
Pressure Hull	Material – nickel steel. Inside diameter – 2.1 m / 6.9 ft.
Viewing Ports	Central 200 mm / 7 1/2 in diameter. Side 2 x 120 mm / 4 1/2 in diameter. Thickness 180 mm / 7 in.
Manoeuvring	Stern thruster – main hydraulic 9 kW. Side thruster – hydraulic 2 x 2.5 kW.
Maximum Speed	5 Knots.
Power Source	Nickel cadmium batteries oil filled – 100 kWh. DC / AC inverter N1 oil filled – 12 kWh. DC / AC inverter N2 – 05 kWh.
Ballast	Soft ballast water tanks/air blow – 1500 kgf. Variable (water) – 999 kgf. High pressure pump 1 – 10 l/min at 6,000m. High pressure pump 2 – 03 l / min at 6,000m.

Trim	Water (fwd / aft spheres) +/- 25 degrees.
Payload	290 kg / 640 lbs.
Life Support	246 man hours.
Emergency Systems	Nickel drop shots – 350 kg / 775 lb. Emergency life support system. Jettisonable: manipulators, thrusters, lower battery box, and rescue buoy.
Hydraulic Systems	Number one 12 kW. Number two 5 kW. Number three 0.5 kW (emergency).
Navigation Systems	LBL acoustic positioning. Gyro compass. Long distance sonar echo sounder – 1000 m / 3280 ft. Speed log.
Observation/ Documentation	Acoustic imaging sonar 250 m / 820 ft. TV cameras – PAL, NTSC. Still cameras – 35 mm to 75 mm. HMI lights – 2 x 1200 Watt (each submersible). Halogen running lights. Ability to add lighting and camera packages (including high definition TV systems).
Research	Data acquisition system – 12 external sensors. Two identical hydraulic manipulators with 7 degrees of movement and ability to integrate additional scientific equipment. Slurp gun, geological tubes, biological nets, water bottles.
Communication	UQC telephone. VHF radio.

About Deep Ocean Expeditions

Deep Ocean Expeditions adheres to three simple founding principles:

- To offer unique experiences for the adventurer
- To educate people about the world's deep oceans
- To help support scientific research.

Deep Ocean Expeditions is interested in educating by adventure. Only a small percentage of the world's oceans has been explored. Deep Ocean Expeditions works with partners and colleagues, including the PP Shirshov Institute, to expand opportunities for deep ocean research and documentation as a way of increasing the knowledge and understanding of our

Photos: Deep Ocean Expeditions, WHOI, Peter Batson/www.exploretheabyss.com, Doug Seifert

planets' major geographical feature. All submersible dives are conducted with negligible or no impact on our oceans. All sites, whether they be manmade or natural are treated with the greatest of respect.

Deep Ocean Expeditions is always planning an array of exciting expeditions through all levels of the water column, on features both man-made and natural. In addition to planned expedition itineraries the submersibles from the Deep Ocean Expeditions fleet are available for private charter to interested parties. Underlying this expansion of itineraries is a solid commitment to our founding principles: adventure, education and science. This is Deep Ocean Expedition's commitment to its participants.

DEEP OCEAN EXPEDITIONS

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