2024 MATE ROV COMPETITION: PRODUCT DEMONSTRATION AND SPECS BRIEFING

MATE Competition Philosophy

The MATE ROV competition is about **student learning**.

It is designed to be an event that challenges **students** to apply the physics, math, electronics, and engineering skills they are learning in the classroom to solving problems from the workplace.

Mentors (teachers, parents, working professionals) are expected to limit their input to educational and inspirational roles and encouraged to focus on the benefits of the **learning process** and not simply on "winning" the competition.

Observing Our Oceans: Understanding Our World and Creating Our Future

CONTEXT & NEED

It's official – and we are still celebrating!

On July 1, 2023, MATE Inspiration for Innovation, along with the MATE ROV Competition, the SeaMATE Store, MATE professional development workshops, and instructional resources that support student learning, became part of the Marine Technology Society (MTS).

For MATE, it is a "homecoming;" while the MATE ROV Competition has evolved and expanded over the years, with its "alumni" embarking on careers in the ocean enterprise and other sectors, the mission to inspire and develop the next generation of ocean professionals remains at its core.

For MTS, it extends its reach to a much younger audience, one that is primed to connect with this international community of ocean scientists, engineers, practitioners, policy-makers, and educators – first as students then as early career ocean professionals then as society leaders.

We are also still celebrating the United Nations Decade of Ocean Science for Sustainable Development. Via the MATE ROV Competition mission scenarios and tasks, we continue to highlight the Decade, embrace and inspire ESG, and challenge our global community of learners to come together to inspire, innovate, and create solutions to the problems that impact us all.

By now you know that the United Nations (UN) proclaimed a Decade of Ocean Science for Sustainable Development (2021-2030) to support efforts to reverse the cycle of decline in ocean health and to gather the global community behind a common goal: creating improved conditions for sustainable use and development of our world ocean. More recently, the UN Decade of Ocean Science for Sustainable Development laid out "10 Challenges for Collective Impact." The four mission tasks of the 2024 MATE ROV Competition align with those challenges and, like the U.N., ask us to consider "how do we move from the ocean we have to the ocean we want?"

From expanding the Global Ocean Observing System to protecting and restoring ecosystems and biodiversity and unlocking ocean-based solutions to climate change, the 2024 competition mission tasks focus on SOLUTIONS that include ocean observing assets for data collection, reimagining the utility of

telecommunications cables, administering probiotics for diseased coral, identifying healthy habitats for lake sturgeon, and deploying GO-BGC floats to monitor ocean health. Again this year we embark on the 2024 season with optimism that together we can inspire, innovate, and create technology solutions to mitigate the impacts of climate change and pave the way to a sustainable future. And with ocean technologies and scientific data to support us, we are also optimistic that we can influence mindsets and guide communities to embrace and adapt practices for the good of us all.

If you have competed in the MATE ROV Competition over the last 3 years, it will come as no surprise that once again this MATE ROV Competition season the "client" is us – our global community of learners, inspired by the ocean, innovating and collaborating to address societal challenges. We acknowledge and embrace the UN's "10 Challenges - 10 Years - One Ocean" and task our MATE competition community to design and build a remotely operated vehicle and the necessary sensors, tooling, and complementary technologies to monitor the health of the aquatic habitats of our Blue Planet, so that we can proactively and confidently answer the question "how do we move from the ocean we have to the ocean we want?"

And this is where your mission begins.

Task #1: OOI: Coast Pioneer Array – Relocating ocean observing assets to "answer pressing science questions and gather data"
Ocean Decade Challenges for collective impact:

#7: Expand the Global Ocean Observing System

Task #2: SMART Cables for Ocean Observing: "Undersea cables connect the planet – what if they could help save it?"
Ocean Decade Challenges for collective impact:

#7: Expand the Global Ocean Observing System

Task #3: From the Red Sea to Tennessee: Understanding ecosystems and saving species
Ocean Decade Challenges for collective impact:

#2: Protect and restore ecosystems and biodiversity

Task #4: MATE Floats!
Ocean Decade Challenges for collective impact:

- **#5: Unlock ocean-based solutions to climate change**

REFERENCES

United Nations Decade of Ocean Science for Sustainable Development
17 UN Sustainable Development Goals
10 Challenges - Ocean Decade
A Hotter Future Is Certain, Climate Panel Warns. But How Hot Is Up to Us.
ESG (environmental, social and governance)
What is blue carbon? - Great Barrier Reef Foundation

OOI: Coast Pioneer Array – Relocating ocean observing assets to "answer pressing science questions and gather data"

Ocean Observatories Initiative – A new era of oceanography
Coastal Pioneer New England Shelf Array – Ocean Observatories Initiative
CP04OSPM – Ocean Observatories Initiative
OOI Coastal & Global Scale Nodes
The Ocean Observatories Initiative
Scientific rationale and conceptual design of a process-oriented shelfbreak observatory: the OOI Pioneer Array
Coastal Surface Mooring Developments for the Ocean Observatories
OOI Data Explorer

SMART Cables for Ocean Observing: "Undersea cables connect the planet – what if they could help save it?"

SMART Cables for Ocean Observing
Science Monitoring and Reliable Telecommunications (SMART)
SMART Cables for Observing the Global Ocean: Science and Implementation
SMART Subsea Cables for Observing the Ocean and Earth

From the Red Sea to Tennessee: Understanding ecosystems and saving species

allencoralatlas
KAUST Reefscape restoration initiative at Shushah
Robotic Customized Medicine for Corals
Exploration Tools: Photogrammetry
Lake Sturgeon · Tennessee Aquarium
Ecoacoustic Monitoring of Lake Sturgeon
Sound Production of Spawning Lake Sturgeon
Sturgeon Bend

MATE Floats!

GO-BGC | Global Ocean Biogeochemistry Array
Expanding Fleet of Autonomous Floating Robots Targets Deeper Understanding of Global Ocean Dynamics
2021 MATE Floats! | MATE ROV Competition Website
Adopt-a-Float Newsletters | GO-BGC

DESIGN BRIEF

Below is a summary of the product demonstrations organized by competition class – EXPLORER, PIONEER, RANGER, NAVIGATOR, and SCOUT. All product demonstration tasks will be attempted in one product demonstration run.

Task #1: OOI: Coast Pioneer Array – Relocating ocean observing assets to "answer pressing science questions and gather data"

Removing assets from the New England Continental Shelf-Slope

EXPLORER, PIONEER, RANGER, and NAVIGATOR class tasks:

- "Trigger" the release of the multi-function node's recovery float
- Visually determine failed deployment of recovery float
- Pull pin to release recovery float to the surface
- Return the recovery float to the surface, side of the pool
- Connect a recovery line to the bale on the multi-function node for ship recovery
- Manually return the multi-function node to the surface, side of the pool

SCOUT tasks:

- "Trigger" the release of the multi-function node's recovery float
- Pull pin to release recovery float to the surface
- Return the recovery float to the surface, side of the pool
- Connect a recovery line to the multi-function node for ship recovery
- Manually return the multi-function node to the surface, side of the pool

Task #2: SMART Cables for Ocean Observing: "Undersea cables connect the planet – what if they could help save it?"

EXPLORER, PIONEER, and RANGER class tasks:

- Deploy SMART cable through waypoints
- Place SMART repeater in the designated area
- Return SMART cable end to surface, side of the pool
- Measure temperature to verify SMART cable sensor readings
- Connect AUV docking station power to SMART cable
    - Retrieve the power connector
    - Install the power connector

NAVIGATOR and SCOUT tasks:

- Deploy SMART cable through waypoints
- Place SMART repeater in the designated area
- Return SMART cable end to surface, side of the pool
- Connect AUV docking station power to SMART cable
    - Retrieve the power connector
    - Install the power connector

Task #3: From the Red Sea to Tennessee: Understanding ecosystems and saving species

EXPLORER, PIONEER, and RANGER class tasks:

Smart Reefs

- Probiotics 2
    - Place probiotic irrigation system in designated location
    - Deploy probiotic sprinkler on coral head
    - Activate the irrigation system
- Coral Restoration
    - Transplant branching coral

    - Transplant brain coral
        - Autonomously
        - Manually
- 3D Coral Modeling
    - Create a scaled 3D image of the coral restoration area
        - Autonomously
        - Manually (CAD)
        - Manually (paper) - RANGER/PIONEER only

Tennessee Lakes and Rivers

- Determine location of sturgeon spawning grounds
    - Recover an acoustic receiver to retrieve its data
    - Determine the location of a potential spawning site
        - Create a graph of sturgeon locations from acoustic receiver data
        - Determine the potential spawning site
    - Determine habitat at potential spawning site
        - Place ADCP
        - Recover sediment sample

NAVIGATOR tasks:

Smart Reefs

- Probiotics II
    - Place probiotic irrigation system in designated location
    - Deploy probiotic sprinkler on coral head
    - Activate the irrigation system
- Coral Restoration
    - Transplant corals into reef structure
- 3D Coral Modeling
    - Manually create a scaled 3D model of the coral restoration area using CAD
        - Create a 3D image of the coral restoration area using CAD
        - Measure the length of the coral restoration area
        - Scale the 3D image using the measured length
    - Manually create a technical drawing of the coral restoration area using paper
        - Create a technical drawing of the coral restoration area using paper
        - Label technical drawing with proper length of coral restoration area

Tennessee Lakes and Rivers

- Determine location of sturgeon spawning grounds
    - Recover an acoustic receiver to retrieve its data
    - Determine the location of a potential spawning site
        - Create a graph of sturgeon locations from acoustic receiver data
        - Determine the potential spawning site
    - Determine habitat at potential spawning site
        - Place ADCP
        - Recover sediment sample

SCOUT tasks:

Smart Reefs

- Probiotics II
    - Place probiotic irrigation system in designated location
    - Deploy probiotic sprinkler on coral head
    - Activate the irrigation system
- Coral Restoration
    - Transplant corals into reef structure

Tennessee Lakes and Rivers

- Determine location of sturgeon spawning grounds
    - Recover an acoustic receiver to retrieve its data
    - Determine the location of a potential spawning site
        - Create a graph of sturgeon locations from acoustic receiver data
        - Determine the potential spawning site
    - Determine habitat at potential spawning site
        - Place ADCP
        - Recover sediment sample

Task #4: MATE Floats!

The goal of the National Science Foundation (NSF)-funded GO-BGC Project is to build a global network of chemical and biological sensors that will monitor ocean health. Scientists, engineers, and technicians from multiple organizations are using NSF grant funds to build and deploy 500 robotic ocean-monitoring floats around the globe. The temperature, depth, and bio-geochemical information that these floats collect will add significantly to the repository of data needed to better understand ocean processes and predict the consequences of climate change.

(For details, see the **Preview Mission** for your respective competition class.)

EXPLORER, PIONEER, and RANGER class tasks:

Design and construct an operational profiling float

- Prior to the competition, design and construct an operational vertical profiling float
- Deploy the float into a designated area
- Float communicates with the mission station prior to descending
- Float completes two vertical profiles -
    - Vertical profile 1
        - Float completes first vertical profile
        - Float communicates data to mission station
        - Data is graphed as depth over time
    - Vertical profile 2
        - Float completes second vertical profile
        - Float communicates data to mission station
        - Data is graphed as depth over time

NAVIGATOR and SCOUT tasks:

- Design and construct an operational profiling float
- Deploy the float into a designated area
- Float completes a vertical profile

    - Float collects temperature data at four depths
- Graph temperature versus depth

SPECS

What follows is a summary of the electrical and fluid power requirements for each competition class. The complete design and building specifications will be included within the competition manual.

NOTE: Watch for new safety requirements and additional, detailed electrical specifications within the competition manuals.

EXPLORER

- 48 volts, 30 amps DC. Conversion to lower voltages must be done on the ROV, not topside.
- SBS50 Anderson Powerpoles, Littelfuse (30-amp or less) and Littlefuse fuse holders required on all vehicles. These specific components are REQUIRED.
- Pneumatics and hydraulics are permitted provided that the company follows the specifications included within the competition manual.
- Lasers are permitted provided that the team follows the specifications included within the competition manual.
- Camera is required.
- Depth requirement at the world championship: 4 meters.
- Maximum size: None. However, tasks will require companies to launch through a 1-meter x 1-meter square hole on the surface.
- Maximum weight: 35 kg. Vehicles above 35 kg will not be allowed to compete in the product demonstration. See below for additional details on weight requirements.

PIONEER

- 48 volts, 30 amps DC or 12 volts, 25 amps DC. If 48 volts is used, conversion to lower voltages must be done on the ROV, not topside.
- 48 volt systems must use SBS50 Anderson Powerpoles and Littelfuse (30-amp or less) and Littlefuse fuse holders on all vehicles. 12 volt systems must use ATO type blade fuses or MINI blade fuses for any fusing. These specific components are REQUIRED for vehicles using 48 volts or 12 volts.
- Pneumatics and hydraulics are permitted provided that the company follows the specifications included within the competition manual.
- Lasers are permitted provided that the team follows the specifications included within the competition manual.
- Camera is required.
- Depth requirement at the world championship: 4 meters.
- Maximum size: None. However, tasks will require companies to launch through a 1-

meter x 1-meter square hole on the surface.

- Maximum weight: 35 kg. Vehicles above 35 kg will not be allowed to compete in the product demonstration. See below for additional details on weight requirements.

RANGER

- 12 volts, 25 amps DC. Conversion to lower voltages is permitted topside and on the ROV.
- 12 volt systems must use ATO type blade fuses or MINI blade fuses for any fusing. These fuses are REQUIRED for all vehicles.
- Pneumatics and hydraulics are permitted provided that the company follows the specifications included within the competition manual.
- Lasers are permitted provided that the team follows the specifications included within the competition manual.
- Camera is required.
- Depth requirement at the international competition: less than 2 meters. Depth requirement may vary at regional competitions. Contact your regional coordinator or check your regional competition information document.
- Maximum size: None. However, tasks will require companies to launch through a 1-meter x 1-meter square hole on the surface.
- Maximum weight: 25 kg. Vehicles above 25 kg will not be allowed to compete in the product demonstration. See below for additional details on weight requirements.

NAVIGATOR

- 12 volts, 15 amps DC. Conversion to lower voltages is permitted topside and on the ROV. Any onboard electrical power source is not permitted.
- Pneumatics and hydraulics are permitted provided that the company follows the specifications included within the competition manual.
- Lasers are permitted provided that the team follows the specifications included within the competition manual.
- Camera is required.
- Depth requirement: Varies depending on the regional event. Contact your regional coordinator or check your regional competition information document.
- Anderson Powerpole connectors are required on all vehicles. ATO type blade fuses or MINI blade fuses are required.
- Maximum size: None. However, tasks will require companies to launch through a 1-meter x 1-meter square hole on the surface.

SCOUT

- 12 volts, 15 amps DC. Conversion to lower voltages is permitted topside and on the ROV. Any onboard electrical power source is not permitted.

- Manually powered hydraulics and pneumatics are permitted. Pneumatic systems cannot exceed ambient pool pressure and must follow the fluid power specifications included within the competition manual.
- Lasers are NOT permitted.
- Depth requirement: Varies depending on the regional event. Contact your regional coordinator or check your regional competition information document.
- Anderson Powerpole connectors are required on all vehicles. ATO type blade fuses or MINI blade fuses are required.
- Maximum size limit: None.

WEIGHT POINT VALUES

Considering some of the environments in which the ROVs will be operating, an ROV weight requirement has been included in the request for proposals (RFP). Lighter vehicles will be given special consideration and vehicles above a certain weight will not be considered. Certain product demonstration tasks will also limit the overall size of the vehicle.

All weight measurements will include the vehicle and all tools and components but will not include the tether. The following will NOT be included in the weight measurement:

- The topside control system and the tether
- EXPLORER, PIONEER, and RANGER vertical profiling floats

EXPLORER & PIONEER

Weight (in air)	
< 18 kg	+10 points
18.01 kg to 25 kg	+5 points
25.01 kg to 35 kg	+0 points

Vehicles that cannot fit through the hole on the surface, or vehicles greater than 35 kg in weight will not be allowed to compete in the product demonstration.

RANGER

Weight (in air)	
< 15 kg	+10 points
15.01 kg to 20 kg	+5 points
20.01 kg to 25 kg	+0 points

Vehicles that cannot fit through the hole on the surface, or vehicles greater than 25 kg in weight will not be allowed to compete in the product demonstration.

NAVIGATOR and SCOUT

NAVIGATOR and SCOUT class companies do not have a weight limit. NAVIGATOR and SCOUT companies will not receive additional points for lighter weight vehicles.

NOTE for all classes: In addition to the weight limitations described above, companies must be

able to transport the vehicle and associated equipment to the product demonstration station and to the engineering presentation room. The ROV systems must be capable of being safely hand launched.

RESOURCES

Companies are permitted to use the materials of their choice provided that they are safe, will not damage or otherwise mar the competition environment, and are within the defined design and building specifications.

Companies are encouraged to focus on engineering a vehicle to complete the product demonstration tasks, when considering design choices, teams should ask themselves which one most efficiently and effectively allows them to solve the problem. Re-using components built by previous team members is permitted provided that the current team members evaluate, understand, and can explain their engineering and operational principles. Using or re-using commercial components is also permitted, provided that team members evaluate, understand, and can explain their engineering and operational principles. Teams will be questioned extensively on their overall design and component selections during their engineering presentations.

TIME

The complete competition manual will be released in December 2023; teams have from that date until the regional events in the spring of 2024 to construct their vehicles and prepare the engineering and communication components (technical documentation, engineering presentations, and marketing displays). Visit www.materovcompetition.org for more information or join the MATE competition listserv to ensure a timely delivery of important information.