

2027 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.

MATE ROV Competition: 25 Years of Engineering for the Win From the Deep Sea to Outer Space

CONTEXT & NEED

What’s on deck for the 2027 MATE ROV Competition season? Besides celebrating our 25th MATE World Championship, we are shooting for the stars while still diving deep into mission scenarios that, using a sports-based metaphor, pair veteran tasks with new rookie challenges not seen before. So, let’s step up to the plate and swing for the fences, aka the 2027 MATE ROV Competition!

Again this year, the MATE ROV Competition highlight reel captures the priorities of the [Decade of Ocean Science for Sustainable Development \(2021-2030\)](#). Two-thirds of the way through the decade is an opportune time to take stock of what has been accomplished *and* what remains to be done. Significant milestones have been met, with over 500 research projects initiated globally. These projects include the [Ocean Biodiversity Information System](#), which has recorded over 180,000 new marine species, as well as projects like the [Seabed 2030 Project](#), which maps the ocean floor in high resolution, and the [Great Barrier Reef Foundation](#), which works to restore the Great Barrier Reef. And although goals have been scored and projects have crossed the finish line, the health and vitality of our oceans is more of a marathon than a sprint. Endurance and commitment are needed to remain in the game and on track for the long haul – for the remainder of the decade and beyond.

For example, in many parts of the world, including the Pacific Northwest (PNW), the home field of the 25th MATE World Championship, seagrass beds remain under threat. These vital habitats support fisheries, protect coastlines, store carbon, filter pollutants, and keep our oceans protected and healthy. Fortunately, there is an all-star line-up of research institutions, non-profits, commercial companies, and community organizations developing and implementing game plans to survey and reestablish lost seagrass beds. ROVs are playing a role, evaluating and providing imagery of seagrass beds, including the overall size of the bed, density and patchiness, sediment conditions, and more. Once bare areas are identified, ROVs are being used to transplant hybrid seagrass seedlings, which have been bred to better survive the current conditions.

And to restore habitat, you must first understand the playing conditions. Data on temperature, salinity, pH, oxygen, light, suspended particles, and nitrate inform scouting reports on habitats from coastal seagrass beds to communities on the seafloor. The PNW's roster of research institutions, non-profits, and commercial companies include those that develop, build, and deploy sensors and other ocean observing assets that collect this data. From vertical profiling floats to biogeochemical sensors and cabled arrays that include primary nodes, moorings, and vehicle docking stations, the University of Washington, with its [School of Oceanography](#) and [Argo Float Lab](#), is one of the organizations leading the pack to better understand, manage, and sustain healthy ocean ecosystems.

The PNW can claim home field advantage beyond ocean science and technology. The region includes dozens of prominent players and heavy hitters in the aerospace industry that combine decades of aviation expertise with cutting-edge satellite, launch, and space systems innovation. Whether the mission task is drilling into the lunar landscape to move materials for landing pad construction or creating continuous mobility for spacecraft using solar thermal propulsion, both rookie start-up companies and established veteran organizations are tackling problems that appear on the horizon.

Not only are these creative companies building systems to advance the exploration of outer space but they are also building systems that advance our understanding of inner space. More than half of all satellites currently in orbit were built in Washington state, earning it the nickname of "satellite state." These satellites enable global communication as well as capture data, providing rapid, on-demand information and near real-time viewing of weather and ocean phenomena. This data informs predictions of the paths of hurricanes and harmful algal blooms, contributing to the understanding of our oceans and further tying together inner and outer space.

Innovation, creativity, and outside of the box thinking are what companies rely on, from a robotic arm that can catch an object in zero-g, to one that can pick up a sample 6,000 meters below the surface of the ocean. Whether it's a gas sensor or spectrometer used high above the atmosphere or a probe measuring the temperature and composition of a black smoker off the Pacific Northwest coast, the engineering challenges are similar: design the equipment you need for the environment you will operate in to collect the data you desire.

With a nod to the location of our 25th World Championship, the MATE ROV Competition is challenging its global community of learners to design and build a remotely operated vehicle, vertical profiling float, and the necessary sensors, tooling, and complementary technologies to tackle mission tasks that level the playing field for seagrass beds, send invasive species to the penalty box, highlight midwater organisms in replay, re-establish sideline (onshore) communications with the huddle (subsea assets), and use technology to visualize the playing field of hurricane alley.

And tying together the region's excellence in ocean and space tech by embracing oceans as analogs for space, the 2027 competition season also calls on its community to replace a damaged solar panel instead of a corroded pipe, recover a lost tool instead of a midwater jellyfish, and assist with cargo docking instead of placing a sensor in a designated location.

Looking back on our 25-year history, these space mission tasks are similar to those that we staged in the 6.2-million-gallon pool at the NASA Johnson Space Center's [Neutral Buoyancy Laboratory](#), where water was also used as a test bed for technology bound for outer space. The pressure change may be opposite, but water serves to offset the Earth's gravitational pull, simulating the weightlessness of space. In either case, any technology must be able to function in the extreme environments and harsh conditions found in inner and outer space.

The thrill of victory depends on an educated and skilled workforce, one that has trained in the off-season, staying aware of and informed about the opponents we face and is prepared to apply knowledge, skills, grit, and determination to tackling them.

And this is where you come in – and where your mission begins.

Overarching:

Ocean Decade Challenges for collective impact:

[#9: Skills, knowledge, and technology for all](#)

[#10: Skills, knowledge, technology and participation for all](#)

Task #1: Zone Defense: Protecting the Pacific

Ocean Decade Challenges for collective impact:

[#2: Protect and restore ecosystems and biodiversity](#)

[#7: Expand the Global Ocean Observing System](#)

[#8: Create a digital representation of the ocean](#)

Task #2: Zero-G Training Camp: From Sea to Space

Ocean Decade Challenges for collective impact:

[#4: Develop a sustainable and equitable ocean economy](#)

[#5: Unlock ocean-based solutions to climate change](#)

[#6: Increase community resilience to ocean and coastal risks](#)

Task #3: The Vertical Game: MATE Floats!

Ocean Decade Challenges for collective impact:

[#5: Unlock ocean-based solutions to climate change](#)

[#7: Expand the Global Ocean Observing System](#)

[#8: Create a digital representation of the ocean](#)

REFERENCES

- [United Nations Decade of Ocean Science for Sustainable Development](#)
- [17 UN Sustainable Development Goals](#)
- [10 Challenges - Ocean Decade](#)
- [The Challenges of ROV Operations at Sea - Deep Ocean Education Project](#)
- [A Hotter Future Is Certain, Climate Panel Warns. But How Hot Is Up to Us](#)
- [ESG \(environmental, social and governance\)](#)

Task #1: Zone Defense: Protecting the Pacific

- [Little Robot, Big Impact: How ROVs Can Help Us Protect and Restore Kelp and Eelgrass](#)
- [Managing biotic interactions during early seagrass life stages to improve seed-based restoration](#)
- [Bagging & Planting seagrass restoration](#)
- [Seagrass Study Points to Promising Pathway for Ocean Restoration](#)
- [Mapping seagrass with the BlueBoat, Omniscan SideScan, and the Washington DNR](#)
- [Seagrass Mapping](#)
- [WDFW EGC Hub](#)
- [European green crab management: field updates and partner highlights from 2025](#)
- [Washington State's Fight Against the Invasive European Green Crab Continues with More Than 400,000 Trapped and Removed](#)
- [Midwater Journey](#)
- [Who Is NOAA Ocean Exploration?](#)
- [The 2026 Regional Cabled Array Expedition is Underway](#)
- [Bottom Pressure and Tilt Meter](#)
- [America is building seabed batteries that charge drone submarines](#)

Task #2: Zero-G Training Camp: From Sea to Space

- [Vection underwater illustrates the limitations of neutral buoyancy as a microgravity analog](#)
- [The ISS Engineering Feat: Solar Array Repair](#)
- [Astronauts "MacGyver" Ripped Solar Array Repair](#)
- [Astronauts Lost a Tool Bag During a Spacewalk—and You Can See It Floating From Earth](#)
- [Astrobee](#)
- [Welcome to The Satellite State. - Washington State - Where the Next Big Thing begins](#)
- [New and improved satellites will help track storms this hurricane season](#)
- [Live Hurricane Tracker](#)
- [Zoom Earth Weather Map & Hurricane Tracker](#)
- [SpaceX Dragon Docks to Station Filled with New Science Experiments](#)
- [SpaceX Dragon Approaching Station Packed with Science and Supplies](#)
- [ESA - Second spacewalk completed for Sophie Adenot](#)
- [We Have Lost Telemetry! | LinkedIn](#)

Task 3: The Vertical Game: MATE Floats!

- [GO-BGC | Global Ocean Biogeochemistry Array](#)
- [Expanding Fleet of Autonomous Floating Robots Targets Deeper Understanding of Global Ocean Dynamics](#)
- [Profiling Floats in SOCCOM: Technical Capabilities for Studying the Southern Ocean](#)
- [NASA - PACE Equation](#)

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 within one product demonstration run.

Task #1: Zone Defense: Protecting the Pacific

EXPLORER, PIONEER, RANGER, NAVIGATOR and SCOUT class tasks:

Seagrass Field Championship: Survey the field, strengthen the lineup, and help seagrass make a comeback (ALL CLASSES)

- Draft the All-Stars: Collect seagrass from a healthy seagrass bed (ALL CLASSES)
- Run the Sideline: Survey seagrass by following a transect line through the seagrass bed (EX PN RN NV)
- Plant the Starting Lineup: Deploy seagrass seedlings in designated locations (ALL CLASSES)
- Instant Replay Review: Compare images to determine the recovery of seagrass over time (EX PN RN NV)
- Check the Playing Conditions: Determine the turbidity of the seagrass bed (EX PN RN)
- Into the Net: European Green crab mitigation efforts in the Pacific Northwest (ALL CLASSES)
 - Deploy a new crab trap in the designated location
 - Return the old crab trap to the surface, side of the pool

Mid-water play by play (EX PN RN)

- Mid-water Play by Play: Develop a program to autonomously identify species in a midwater transect (EX PN RN)
- You Make the Call: Successfully identify species in the midwater transect (EX PN RN)
 - Autonomously
 - Manually

Deep Sea Relay: Carry critical observing technology across the finish line to reconnect the offshore network (ALL CLASSES)

- Anchor the Starting Block: Install the primary node in the designated location (ALL CLASSES)
- Power Play: Connect the primary node to the generator (EX PN RN NV)
 - Remove the cover from the generator port
 - Install the power connector into the generator port
- Sensor, Set, Match: Install a pressure and tilt sensor on the bottom (ALL CLASSES)
 - Install pressure and tilt sensor in designated location
 - Connect pressure and tilt sensor to the primary node
 - Level the pressure and tilt sensor (EX PN RN only)

Task #2: Zero-G Training Camp: From Sea to Space

EXPLORER, PIONEER, RANGER, NAVIGATOR and SCOUT class tasks:

Solar Panel Pit Stop: Inspect, Repair, and Return the Spacecraft's Power System to the Race (ALL CLASSES)

- Debris on the Track: Inspect the solar panel array and identify the damaged area (EX PN RN NV)
- Raise the Red Flag: Disconnect the solar panel array (EX PN RN)
 - Disengage the breaker on the power line
 - Unplug main power from the solar panel array
- Enter the Pits: Replace the damaged solar panel array (ALL CLASSES)
 - Remove the damaged solar panel
 - Install a new solar panel

- Wave the Green Flag: Reconnect the solar panel array (EX PN RN)
- Plug in main power from the solar panel array
- Engage the breaker on the power line

Orbital Fumble Recovery: Locate and recover a dropped item before it is lost from play (EX PN RN NV)

- Locate: Move ROV to designated location (EX PN RN NV)
- Secure: Recover the tool (EX PN RN NV)
 - Prior to tool hitting the bottom
 - After the tool hits the bottom
- Protect and Advance: Return the tool to the surface, side of the pool (EX PN RN NV)

Video Review: AI Predictions From Satellite Imagery (ALL CLASSES)

- Video Assistant Referee: Use an image of a hurricane on a map to determine the longitude and latitude of the eye of the hurricane (ALL CLASSES)
- Use the Telestrator: Input data into mapping software to create a detailed track of the hurricane (EX PN RN)
- Expert Analysis: Use the data of the hurricane positions in the track to generate a prompt for AI to create a graphic of the hurricane's movement and predicted path (EX PN RN)

Catch the Pass: Cargo Payload Docking (ALL CLASSES)

- 1st Down Completion: Maneuver cargo payload into the docking bay (ALL CLASSES)
 - Autonomously (EX PN RN only)
 - Manually (ALL CLASSES)

Call in the Play: Install a New Space to Ground ANTenna (SGANT) (ALL CLASSES)

- Install the new SGANT (ALL CLASSES)
- Connect the power and communications link (EX PN RN NV)

Technical Difficulties: Loss of Communications Recovery Testing (EX PN RN)

- The Crew is Working: Prior to the competition, describe the loss of communication protocol (EX PN RN)
- Trying Our Best to Restore Systems: Surface after communications are disengaged (EX PN RN)
 - Fully autonomous
 - Initiate program
 - Buoyancy
- Back on the Air: Signal to the mission station (EX PN RN)

Task 3: The Vertical Game: MATE Floats!

EXPLORER, PIONEER and RANGER class tasks:

The Vertical Game – MATE Floats!: Design and construct a vertical profiling float (EX PN RN)

- Game Plan: Prior to the competition, design and construct a vertical profiling float (EX PN RN)
- Mic'd Up: Float communicates with the station prior to descending (EX PN RN)
- Execute: Float completes up to two vertical profiles (EX PN RN)
 - Float completes a vertical profile
 - Float communicates data to the mission station
 - Data verifies float maintained depth of 2.0 meters for 30 seconds
 - Data shows temperature and light measurements within expected range every 0.5 meters on ascent
- Review the Play: Graph the data from the float (EX PN RN)

- Graph temperature versus depth
- Graph light versus depth

NAVIGATOR and SCOUT class tasks:

The Vertical Game – *MATE Floats!*: Design and construct a vertical profiling float (NV SC)

- Game Plan: Prior to the competition, design and construct a vertical profiling float (NV SC)
- Execute: Float completes up to two vertical profiles (NV SC)
 - As an independent float (NV only)
 - As an autonomous float (NV SC)
 - As a manual float (NV SC)
- Check the Playing Conditions: Float collects temperature data (NV SC)
- Review the Play: Data is graphed as temperature versus depth (NV SC)

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 (look for the *New in 2027!!!* label).

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 [Littelfuse 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.
- *New in 2027!!!* Lasers are **NOT** permitted in 2027.
- Camera is required.
- Depth requirement at the world championship: up to 6 meters.
- Maximum size: 100 cm.
- Maximum weight: 22 kg.

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 [Littelfuse 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.

- **New in 2027!!!** Lasers are **NOT** permitted in 2027.
- Camera is required.
- Depth requirement at the world championship: up to 6 meters.
- Maximum size: 100 cm.
- Maximum weight: 22 kg.

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.
- **New in 2027!!!** Lasers are **NOT** permitted in 2027.
- Camera is required.
- Depth requirement at the international competition: up to 6 meters. Depth requirement may vary at regional competitions. Contact your [regional coordinator](#) or check your regional competition information document.
- Maximum size: 90 cm.
- Maximum weight: 22 kg.

NAVIGATOR

- 12 volts, 15 amps DC. Conversion to lower voltages is permitted topside and on the ROV. Onboard electrical power source is not permitted for the ROV but is permitted for the float.
- Anderson Powerpole connectors are required on all vehicles. [ATO](#) type blade fuses or [MINI](#) blade fuses are required.
- Pneumatics and hydraulics are permitted provided that the company follows the specifications included within the competition manual.
- **New in 2027!!!** Lasers are **NOT** permitted in 2027.
- Camera is required.
- Depth requirement: Varies depending on the regional event. Contact your [regional coordinator](#) or check your regional competition information document.
- Maximum size & weight limit: None.

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.
- Anderson Powerpole connectors are required on all vehicles. [ATO](#) type blade fuses or [MINI](#)

blade fuses are required.

- 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.
- Maximum size & weight limit: None.

SIZE AND WEIGHT POINTS

Launching payloads into orbit can cost anywhere from \$3,000 to \$7,000 per kilogram; therefore, limiting the size and weight of objects bound for outer space is important. Smaller, lighter vehicles will be given special consideration, and vehicles above a certain size and weight will not be considered.

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

- The topside control system and the tether
- The vertical profiling float
- Any independent sensors if removable from the ROV

Size measurements will be made using the three dimensions of the ROV; length, width and height. The combined values for length, width and height will be added together to calculate the size of the vehicle. Points will be awarded based on that size.

Weight measurements will be conducted using a digital scale.

EXPLORER

Size	
120 cm	+30 points
140 cm	+10 points
160 cm	+5 points
200 cm	0 points

Weight	
8 kg	+30 points
8.01 - 12 kg	+10 points
12.01 - 18 kg	+5 points
18.01 - 22 kg	0 points

Any ROV with one dimension over 1 meter will not be allowed to compete.

Any ROV over 22 kg will not be allowed to compete.

PIONEER

Size	
100 cm	+30 points
130 cm	+10 points
160 cm	+5 points
200 cm	0 points

Weight	
7 kg	+30 points
7.01 - 12 kg	+10 points
12.01 - 18 kg	+5 points
18.01 - 22 kg	0 points

Any ROV with one dimension over 1 meter will not be allowed to compete.
Any ROV over 22 kg will not be allowed to compete.

RANGER

Size	
100 cm	+30 points
130 cm	+10 points
160 cm	+5 points
180 cm	0 points

Weight	
6 kg	+30 points
6.01 - 10 kg	+10 points
10.01 - 15 kg	+5 points
15.01 - 22 kg	0 points

Any ROV with one dimension over 90 cm will not be allowed to compete.
Any ROV over 22 kg will not be allowed to compete.

NAVIGATOR and SCOUT

No size limits. No weight limits.

All ROV systems for all classes must be capable of being safely launched by hand.

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, companies should ask themselves which one most efficiently and effectively allows them to solve the problem. Re-using components built by previous company members is permitted provided that the current company members evaluate, understand, and can explain their engineering and operational principles. Using or re-using commercial components is also permitted, provided that company members evaluate, understand, and can explain their engineering and operational principles. Companies should address these decisions in their technical documentation, and will be questioned extensively on their overall design and component selections during their engineering presentations.

TIME

The complete competition manual will be released in November 2026; teams have from that date until the regional events in the spring of 2027 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 e-mail list to ensure a timely delivery of important information.