

CP Marine Robotics Specialist

Version 1.0 - Certification Exam: CP-MRS-100

Exam Objectives

The CP Marine Robotics Specialist Exam is written to the following Exam Objectives:

Domain 1: Marine Robotics Fundamentals

ROV/USV systems, components, propulsion, navigation, communications, electrical systems, payloads, and safety

- 1.1 Explain the purpose, common applications, and operating environments of Remotely Operated Vehicles (ROVs) and Uncrewed Surface Vehicles (USVs).
- 1.2 Identify major ROV/USV components and subsystems, including frames/hulls, propulsion system, controllers, sensors, payloads, and communication systems.
- 1.3 Explain how propulsion systems, and steering systems control marine robotic vehicle movement.
- 1.4 Compare tethered, wireless, remotely operated, and autonomous marine robotic systems.
- 1.5 Explain how GNSS/GPS, compasses, inertial sensors, cameras, telemetry, communication systems, and other technologies support vehicle positioning, monitoring, and control.
- 1.6 Explain basic DC electrical systems, power sources, batteries, charging, power management, umbilicals, and tethers used in marine robotic systems.
- 1.7 Perform basic pre-mission system inspections and identify common operational hazards associated with marine robotic systems.

Domain 2: Marine Robotics Programming & Control

Programming logic, vehicle commands, sensors, inputs/outputs, and robotic behavior

- 2.1 Explain how software and programming are used to control ROV and USV systems.
- 2.2 Identify and apply basic programming concepts, including variables, constants, operators, and data types.
- 2.3 Explain and apply conditional statements and loops to control marine robotic behavior.
- 2.4 Explain how functions and reusable procedures organize marine robotics programs.
- 2.5 Identify system inputs and outputs and explain how sensor input can influence vehicle behavior.
- 2.6 Create or modify basic programs and programmed sequences that control vehicle movement or mission behavior.
- 2.7 Test marine robotics programs and identify and correct basic programming errors.

Domain 3: ROV Operations, Autonomous Navigation & Mission Programming

Manual piloting, waypoints, coordinates, autonomous routes, navigation parameters, and mission execution

- 3.1 Explain manual, remotely operated, and autonomous navigation methods used in marine robotic systems.
- 3.2 Operate or simulate an ROV using basic piloting, maneuvering, positioning, and navigation techniques.
- 3.3 Explain how GNSS/GPS coordinates, waypoints, and waypoint sequences are used to define autonomous USV mission routes.
- 3.4 Configure or program waypoints, vehicle speed, and other navigation parameters for an autonomous marine robotics mission.
- 3.5 Develop systematic autonomous survey routes using transects, parallel survey lines, appropriate line spacing, and coverage requirements.
- 3.6 Verify programmed mission routes, navigation settings, and vehicle behavior before deployment.

3.7 Modify manual or autonomous mission operations in response to obstacles, environmental conditions, equipment limitations, or changing mission requirements.

Domain 4: Sonar & Marine Sensor Systems

Sonar principles, transducers, sensor configuration, environmental effects, interpretation, and data quality

4.1 Explain sonar principles, including sound propagation and how acoustic signals are used to determine depth and detect underwater objects and surfaces.

4.2 Explain how environmental factors, including temperature, salinity, depth, bubbles, vegetation, and suspended material, affect sonar performance.

4.3 Explain the relationship between sonar frequency, range, resolution, and penetration.

4.4 Explain the function of sonar transducers and how placement, orientation, and mounting affect sonar measurements.

4.5 Compare single-beam and multibeam sonar systems and their marine robotics and survey applications.

4.6 Configure sonar and marine sensor settings based on water depth, mission requirements, and environmental conditions.

4.7 Interpret basic sonar data and imagery, recognize common causes of inaccurate or poor-quality data, and determine appropriate corrective actions.

Domain 5: Autonomous Survey Planning & Data Collection

Survey boundaries, routes, coverage, data synchronization, inspection, and autonomous operation

5.1 Explain the purpose, requirements, and desired outcomes of bathymetric, underwater inspection, and marine survey missions.

5.2 Establish survey boundaries and develop systematic transects or survey lines for a marine robotics mission.

5.3 Determine appropriate survey-line spacing, coverage, and overlap based on sonar capabilities, water depth, and desired resolution.

5.4 Plan cross-lines or verification passes to evaluate survey-data consistency and coverage.

5.5 Program or configure an ROV/USV for a planned survey or inspection route and conduct appropriate pre-mission system checks.

5.6 Conduct or simulate a marine survey or underwater inspection mission while collecting synchronized sonar, geographic-position, imagery, and sensor data.

5.7 Monitor mission progress and modify survey or inspection operations when obstacles, environmental conditions, equipment problems, or poor-quality data require changes.

Domain 6: Marine Robotics Data Processing

Data organization, cleaning, validation, sensor integration, quality control, and export

6.1 Import, organize, and identify common data fields in marine robotic survey datasets, including coordinates, depth, timestamps, imagery, and sensor values.

6.2 Review raw survey and inspection data and identify erroneous, duplicate, missing, or unrealistic measurements.

6.3 Distinguish legitimate underwater features from sonar errors or artifacts and remove or flag invalid measurements.

6.4 Apply appropriate corrections and verify that depth, sonar, imagery, and sensor measurements are correctly associated with geographic positions.

6.5 Compare overlapping survey lines and verification passes to evaluate data consistency, quality, and coverage.

6.6 Organize and export validated survey and inspection data in appropriate formats for mapping, analysis, and reporting.

Domain 7: Bathymetric Mapping & Data Visualization**Depth maps, contours, 2D/3D surfaces, underwater features, interpretation, and communication**

- 7.1 Explain bathymetry and the purpose and applications of bathymetric maps.
- 7.2 Plot geographic-position and depth measurements and explain how interpolation is used to estimate underwater surfaces.
- 7.3 Generate 2D depth maps and depth contour lines from processed survey data.
- 7.4 Create 3D representations of underwater surfaces and apply appropriate map elements, including labels, legends, scales, coordinates, and depth units.
- 7.5 Interpret depth, slope, bottom topography, and underwater features, including channels, depressions, drop-offs, ridges, submerged structures, and anomalies.
- 7.6 Evaluate map and survey accuracy and communicate findings using maps, sonar imagery, data visualizations, technical observations, and reports.

Domain 8: Safety, Troubleshooting & Applied Marine Robotics**Safety, fault finding, system troubleshooting, mission execution, documentation, and reporting**

- 8.1 Conduct pre-mission safety and risk assessments and identify hazards associated with water, weather, vessels, electrical systems, batteries, propellers, and launch/recovery operations.
- 8.2 Apply safe procedures for electrical equipment, battery handling, equipment preparation, vehicle launch, operation, and recovery.
- 8.3 Apply basic fault-finding and troubleshooting techniques to ROV/USV electrical, hardware, software, programming, communication, navigation, propulsion, sonar, positioning, and power systems.
- 8.4 Determine when environmental, equipment, safety, or programming conditions require a mission to be modified, postponed, or terminated.
- 8.5 Plan, configure, execute, and document a complete marine robotics survey or inspection mission, including equipment, programming/configuration, environmental conditions, problems, corrective actions, and mission changes.
- 8.6 Process and validate mission data and produce a final technical report documenting methodology, inspection or survey findings, maps or imagery, data quality, results, limitations, and conclusions.

Domain 9: Offshore & Subsea ROV Operations**Offshore industry, subsea systems, inspection, intervention, vessels, renewable energy, emerging technology, and professional practices**

- 9.1 Explain the structure of the offshore industry and how ROVs, AUVs, and other marine robotic systems support oil and gas, offshore wind, renewable energy, surveying, inspection, and subsea operations.
- 9.2 Identify career pathways associated with ROV operations, AUV systems, subsea engineering, hydrographic surveying, inspection, and offshore technology.
- 9.3 Explain buoyancy, stability, ballast, hydraulic systems, and other fundamental principles affecting underwater robotic vehicle and subsea equipment operation.
- 9.4 Read and interpret basic ROV technical drawings, electrical diagrams, system schematics, and equipment documentation.
- 9.5 Explain the purpose and basic operation of dynamic positioning systems, offshore support vessels, and Launch and Recovery Systems (LARS) used during ROV and subsea operations.
- 9.6 Explain how ROVs and other marine robotic systems support offshore wind, pipeline, cable, structure, and subsea infrastructure inspection and common intervention activities, including observation, manipulation, installation, maintenance, and recovery.

9.7 Explain how AI-assisted inspection, automated defect detection, digital twins, IMCA guidance, human factors, communication, teamwork, situational awareness, and operator competence support safe and effective offshore ROV operations.