



SPECIFICATIONS FOR PHOTOSYNTHETICALLY ACTIVE RADIATION (PAR) INSTRUMENTS ON MOBILE ASSETS AND PROFILERS

Version 2-01
Document Control Number 1331-00005
2011-10-03

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Specifications for Photosynthetically Active Radiation (PAR) Instruments on Mobile Assets and Profilers

Document Control Sheet

Version	Date	Description	Originator
0-01	5/18/2010	Derived Profiler specs from general PAR spec.	Rob DelCoco
0-02	5/19/2010	Changed title to include all mobile assets and profilers	Rob DelCoco
0-03	5/21/2010	Removed sampling spec as per SWG meeting of 5/19; accepted changes and prepared for SE	Lorraine Brasseur
1-00	5/25/2010	Addressed SE comment regarding sampling rate – resolution – SE agrees that not necessary in this spec.	Lorraine Brasseur
1-01	6/1/2010	Approved by SE, removed watermark, adjusted formatting	Lorraine Brasseur
1-02	6/2/2010	Removed PERF-004 – not an instrument spec (platform requirement)	Lorraine Brasseur
1-03	01/24/2011	Updated spec sheet template to new version	Jennifer Dorton
1-04	2/16/2011	Updated req numbers – removed RSN reqs since UW will issue a PAR RFP for RSN	Jennifer Dorton
1-05	2/17/2011	Added requirement based on RSN PAR requirements	Jennifer Dorton
1-06	2/18/2011	Minor corrections and clean up.	Ed Chapman
1-07	2/22/2011	Minor corrections and clean up.	Ed Chapman
2-00	2/25/2011	ECR #1300-00125.	Ed Chapman
2-01	10/03/2011	Administrative corrections	Ed Chapman

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Signature Page

This document has been reviewed and approved for release to Configuration Management.

OOI Senior Systems Engineer:



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1 General

1.1 Ocean Observatories Initiative (OOI) Overview

Although the ocean is central to the habitability of our planet, it is largely unexplored. Biological, chemical, physical, and geological processes interact in complex ways in the ocean, at the seafloor, and at the air-sea interface. Our ability to learn more about these processes is severely limited by technical infrastructure, and developing a more fundamental scientific understanding of these relationships requires new and transformational approaches to ocean observation and experimentation.

The Ocean Observatories Initiative (OOI) will lay the foundation for future ocean science observations. OOI will enable powerful new scientific approaches by transforming the community's focus from expedition-based data gathering to persistent, controllable observations from a suite of interconnected sensors. The OOI's networked sensor grid will collect ocean and seafloor data at high sampling rates over years to decades. Researchers will make simultaneous, interdisciplinary measurements to investigate a spectrum of phenomena including episodic, short-lived events (tectonic, volcanic, oceanographic, biological, and meteorological), and more subtle, longer-term changes and emergent phenomena in ocean systems (circulation patterns, climate change, ocean acidity, and ecosystem trends).

The OOI will enable multiple scales of marine observations that are integrated into one observing system via common design elements and an overarching, interactive cyberinfrastructure. Coastal-scale assets of the OOI will expand existing observations off both U.S. coasts, creating focused, configurable observing regions. Regional cabled observing platforms will 'wire' a single region in the Northeast Pacific Ocean with a high speed optical and high power grid. Global components address planetary-scale changes via moored open-ocean buoys linked to shore via satellite. Through a unifying cyberinfrastructure, researchers will control sampling strategies of experiments deployed on one part of the system in response to remote detection of events by other parts of the system.

A more detailed discussion of the Oceans Observatories Initiative can be found in the OOI Final Network Design.

1.2 Document Scope and Purpose

This document provides specifications for instruments on profilers that measure Photosynthetically Active Radiation (PAR) in seawater.

Moored wire-following profilers contain a suite of sensors that are raised and lowered through the water column on a regular basis. These are generally used for deep measurements and profiles that can extend to more than 1000 meters in depth. It is expected that these profilers will move vertically at speeds up to about 0.25 m/s.

Moored shallow/surface piercing profilers are expected to be used in the first 200 meters of the water column on OOI arrays. These profilers will carry a somewhat larger payload than wire-following profilers and can move vertically at speeds up to 0.5 m/s

1.3 Documents

1.3.1 Informational

The documents listed in this section are for informational purposes only and may not have been referenced in this specification.

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- Consortium for Ocean Leadership, Inc. 2010, "Final Network Design", Washington, D.C. [Online] Available: <http://www.oceanleadership.org/programs-and-partnerships/ocean-observing/ooi/network-design/>

1.3.2 Applicable

These documents contain requirements and specifications applicable to the instrument specified. The referenced section, requirement, or specification shall be met by the instrument specified herein.

N/A

1.4 Definitions

1.4.1 Glossary and Acronyms

- **Accuracy** – Closeness of the agreement between the result of a measurement and the value of the measurand (or true value of the measurement). (Taylor and Kuyatt, 1994).
- **AUV** – Autonomous Underwater Vehicle
- **Coastal** – For OOI, a coastal or coastal ocean site is located on the continental shelf or upper slope at a depth of 1000 m or less.
- **Instrument** – A device that contains one or more sensors and a method for converting the information from the sensor into a transmittable and storable form.
- **Objective Value** – The desired value of a technical parameter. This value, if provided, may be more challenging to achieve than the Threshold value. It is a goal, not a requirement, for the instrument.
- **OOI** – Ocean Observatories Initiative
- **Open Ocean** – Open ocean site is any site located at an ocean depth greater than 1000 meters or more than 500 km from shore.
- **Operate** – Correctly performing designed functionality.
- **PAR** – Photosynthetically Active Radiation
- **Precision** – The closeness of agreement between independent measurements obtained under stipulated conditions of repeatability, generally expressed as a standard deviation (or standard uncertainty) of measurement results. Used as a measure of stability of an instrument/sensor and its capability of producing the same measurement over and over again for the same input signal (Taylor and Kuyatt, 1994).
- **Resolution** – The smallest amount of input signal change that the instrument/sensor can detect reliably.
- **Sensor** – A device that will convert a physical phenomenon into an electrical signal that can in turn be digitized through the use of an analog to digital converter. A sensor is normally housed in an instrument. Data coming from sensors is normally raw and needs to be calibrated.
- **Survive** – Experience an event without major loss of hardware. System might experience loss of functionality requiring repair to return to normal mode functionality. An example of this is loss of a mobile asset resulting in the asset and its on-board instrument suite descending to the bottom. Any internal memory in the instrument would remain accessible, but the sensors might need to be replaced to return to normal functionality.

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- **Sustain** – Experience an event (environmental extreme or condition) without permanent loss of normal mode functionality. System may experience reduction of functionality during event.
- **Threshold Value** – The limiting acceptable value of a technical parameter. If this item does not meet the performance as specified by the threshold value, it may not be sufficient for inclusion in the OOI system.

1.4.2 Conventions

All values contained in this document are Threshold Values unless specifically stated otherwise.

The bidder shall ignore the references in angle brackets < > at the end of each specification. They are for internal OOI use only.

2 Specifications

2.1 Measurement

- a) Measurement with unit(s)
 - $\mu\text{mol photons m}^{-2} \text{s}^{-1}$
- b) Minimum Value
 - PAR-001 The instrument shall measure PAR over a range with a minimum value of $0.1 \mu\text{mol photons m}^{-2} \text{s}^{-1}$. <L2-SR-RQ-3674, L4-CG-IP-RQ-390>
- c) Maximum Value
 - PAR-002 The instrument shall measure PAR over a range of with a maximum value of $2000 \mu\text{mol photons m}^{-2} \text{s}^{-1}$. <L2-SR-RQ-3674, L4-CG-IP-RQ-390>
- d) Accuracy
 - PAR-003 PAR shall be measured with an accuracy of $\pm 5\%$ for the full range of the instrument. <L2-SR-RQ-3673, L4-CG-IP-RQ-388>
- e) Precision
 - Not specified.
- f) Resolution
 - PAR-004 PAR instruments shall have a resolution of $0.01 \mu\text{mol photons m}^{-2} \text{s}^{-1}$. <L2-SR-RQ-3671, L4-CG-IP-RQ-389>
- g) Drift
 - Not specified
- h) Response Times
 - Not specified
- i) Sampling Frequency
 - PAR-005 The PAR instrument shall be capable of sampling at a frequency of 1 Hz. <L2-SR-RQ-3676, L4-CG-IP-RQ-391>.
- j) Dependencies

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Not specified

k) Wavelength range

PAR-006 PAR shall be measured within a wavelength range from 400 nm to 700 nm. <L2-SR-RQ-3672, L4-CG-IP-RQ-387>

l) Integration Angle

PAR-007 The PAR instrument shall integrate irradiance over 2π steradians. <L4-RSN-IP-RQ-620>

2.2 Operational

See platform specifications.

2.3 Mechanical/Physical

See platform specifications.

2.4 Electrical

See platform specifications.

2.5 Data Storage and Processing

See platform specifications.

2.6 Software/Firmware

See platform specifications.

2.7 Platform Interfaces

See platform specifications.

2.8 Compliance

See platform specifications.

2.9 Safety

See platform specifications.

2.10 Shipping and Storage

See platform specifications.

2.11 Identification

See platform specifications.

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2.12 Quality

See platform specifications.

3 Appendices