



SPECIFICATIONS FOR NITRATE INSTRUMENTS ON PROFILERS

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Specifications for Nitrate Instruments on Coastal Global Profilers

Document Control Sheet

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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 to measure dissolved nitrate (NO_3^-) in seawater. These instruments will be used on profilers in the OOI.

Moored profilers contain a suite of sensors that are raised and lowered through the water column on a regular basis. The profiler body may travel through the water column by using a wire-following mechanism for deep measurements or by a winched technique for surface piercing measurements.

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.

- 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/>

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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.

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).
- **Cabled** – Any OOI platform that is connected to a communications/power cable connected to shore. The platforms on the backbone cable in the Northeast Pacific are examples.
- **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.
- **EIA** – Electronics Industries Association
- **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.
- **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.
- **PSS** – Practical Salinity Scale, the UNESCO Practical Salinity Scale of 1978 (PSS78). PSS defines salinity as a dimensionless conductivity ratio.
- **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 knockdown of a global mooring or loss of some part of the mooring resulting in the instrument 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

Values provided are threshold unless otherwise stated.

2.1.1 Nitrate in seawater (NO_3^-)

a) Measurement with unit(s)

Dissolved Nitrate (micromolar; μM)

b) Minimum Value

NITR-001 The instrument shall measure dissolved nitrate (NO_3^-) in seawater over a range with a minimum value of 0.5 μM <L4-CG-IP-RQ-234, L2-SR-RQ-3130>

NITR-002 The instrument should measure dissolved nitrate (NO_3^-) in seawater over a range with a minimum value of 0.03 μM . This is an objective. <L4-CG-IP-RQ-556, L4-RSN-IP-RQ-614, L2-SR-RQ-3795>

c) Maximum Value

NITR-003 The instrument shall measure dissolved nitrate (NO_3^-) in seawater over a range with a maximum value of 50 μM <L4-CG-IP-RQ-234, L2-SR-RQ-3130>

d) Accuracy

NITR-004 The instrument shall measure dissolved nitrate (NO_3^-) in seawater with an accuracy of $\pm 2 \mu\text{M}$ for nitrate concentrations below 20 μM <L4-CG-IP-RQ-233, L2-SR-RQ-3508>

NITR-005 The instrument should measure dissolved nitrate (NO_3^-) in seawater with an accuracy of $\pm 0.05 \mu\text{M}$ for nitrate concentrations below 20 μM . This is an objective. <L4-CG-IP-RQ-557, L4-RSN-IP-RQ-615, L2-SR-RQ-3796>

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NITR-006 The instrument shall measure dissolved nitrate (NO_3^-) in seawater with an accuracy of $\pm 10\%$ for nitrate concentrations at or above $20 \mu\text{M}$ <L4-CG-IP-RQ-403, L2-SR-RQ-3509>

e) Precision

NITR-007 The instrument shall measure dissolved nitrate (NO_3^-) in seawater with a precision of $\pm 2\%$ of the measured value. <L4-RSN-IP-RQ-330, L2-SR-RQ-3510, L4-CG-IP-RQ-558>

f) Resolution

Not specified

g) Drift

NITR-008 The instrument shall measure dissolved nitrate (NO_3^-) in seawater with a drift of no greater than $4 \mu\text{M}$ over a deployment of seven months <L4-CG-IP-RQ-404, L2-SR-RQ-3514>

h) Response Times

Not specified

i) Sampling Frequency

NITR -009 The instrument shall be capable of measuring dissolved nitrate at a sampling frequency of 1Hz <L4-CG-IP-RQ-239, L2-SR-RQ-3511>

j) Dependencies

Not specified.

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.

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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.

2.12 Quality

See platform specifications.

3 Documentation

See the RFP for documentation that the vendor shall be required to supply.

4 Appendices

None