COMMON SPECIFICATIONS FOR INSTRUMENTS ON FIXED PLATFORMS

Version 1-14
Document Control Number 1336-00000
2011-10-07

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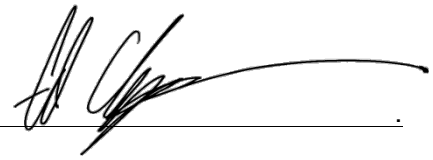
Document Control Sheet

Version	Date	Description	Originator
0-01	5/12/2010	Initial Draft	Rob DelCoco
0-02	5/13/2010	Minor updates	Rob DelCoco
0-03	5/19/2010	Includes suggestions from Sheri and questions.	Rob DelCoco
0-04	5/19/2010	Updates from 5/19 SWG included.	Rob DelCoco
0-05	6/1/2010	Updates from suggestions by Sheri at CG. Removed field replaceability and sampling specs.	Rob DelCoco
1-00	6/3/2010	Spec Approved; rev version and formatting	Lorraine Brasseur
1-01	8/10/2010	Control number for this document changed from 1330-00000 to 1336-00000.	Rob DelCoco
1-02	2010/09/22	Ported to the revised template; Included revisions from SWG review on 09/01/2010 and 09/08/2010	Noblis
1-03	2010/09/30	Updates as a result of the open 5-day Program Revision and Approval Process	Noblis
1-04	2010/10/05	Updates as a result of the CCB liens	Ed Chapman
1-05	2011/02/17	Updates to material coatings (MECH-006), added OPER-008 re: attachment with other instruments, added INTF-016 re: bulkhead connector, added appendix 4.1 re: preferred connector types	OL/Noblis
1-06	2011/02/25	Updates as a result of the CCB liens. ECR 1300-00123	Ed Chapman
1-07	2011/03/10	Removed watermark	Ed Chapman
1-08	2011/04/07	Added “This is an objective” to ELEC-001.	Rob DelCoco
1-09	2011/06/01	Multiple changes based on lessons learned from procurements (OPER-006, MECH-001 through 008, ELEC-001, and SHIP-002)	Ed Chapman
1-10	2011/06/03	Minor edits	Arthur Salwin (Noblis)
1-11	2011/06/08	Minor edits	Ed Chapman
1-12	2011/06/28	Changes per CCB on ECR 1300-00178	Arthur Salwin (Noblis)
1-13	2011/08/01	Minor administrative updates – incorrect references	Rob DelCoco
1-14	2011/10/07	Change to shipping standard in accordance with ECR 1303-00413	Ed Chapman

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 Ocean Observatories Initiative can be found in the OOI Final Network Design.

1.2 Document Scope and Purpose

This document contains the common specifications applicable to instruments integrated with fixed platforms. Fixed platforms for the OOI include buoys, cabled and uncabled moorings, and seafloor packages. The unique specifications for each particular instrument are contained in separate instrument specifications documents. In case of conflicting specifications between documents, the unique instrument specifications shall have precedence. Contractual terms and other non-technical information are not part of this document.

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, DC. [Online] Available: http://www.oceanleadership.org/programs-and-partnerships/ocean-observing/ooi/network-design/

1.3.2 Applicable

These documents contain additional requirements and specifications applicable to the instrument being specified for procurement.

None

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.

- **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

The unique specifications for each particular instrument are contained in separate instrument specifications documents. For any subsection of this document that does not contain text, refer to the individual instrument specification document and any relevant platform specification documents.

2.1 Measurement

See individual instrument specification

2.2 Operational

2.2.1 Operational Depth Range

2.2.2 Environmental

a) Salinity

OPER-001 The Instruments shall be capable of operating in water salinities from 0 to 40 on the PSS. <L2-SR-RQ-3497, L4-CG-IP-RQ-443>

b) Temperature

OPER-002 The Instruments shall be capable of operating in water temperatures from -2 to 35 °C. <L2-SR-RQ-3494, L4-RSN-IP-RQ-530, L4-CG-IP-RQ-442>

c) Biofouling

OPER-003 The Instruments shall be provided with biofouling mitigation measures. < L2-SR-RQ-3610, L4-CG-IP-RQ-446>

OPER-004 The biofouling mitigation should provide for operation within the specified accuracy for the defined deployment intervals. This is an objective. <L2-SR-RQ-3608, 3609> See section 2.2.6 for the defined deployment intervals.

d) Corrosion

e) Maximum Wave Height

f) Maximum Wind Speed

2.2.3 Service Requirements

2.2.4 Calibration Requirements

OPER-005 Instruments should maintain calibration within the specified accuracy for the defined deployment intervals. This is an objective. <L4-CG-IP-RQ-286, L4-RSN-IP-RQ-680> See section 2.2.6 for the defined deployment intervals.

2.2.5 Maintenance

OPER-006 Instruments should meet all performance requirements for the defined deployment intervals without the need for physical maintenance. This is an objective. See section 2.2.6 for the defined deployment intervals.

2.2.6 Deployment

The deployment interval for uncabled, open ocean platforms will be 13 months.

The deployment interval for uncabled, coastal platforms will be 7 months.

The deployment interval for cabled, open ocean and coastal platforms will be 13 months.

OPER-007 Instruments shall be capable of being deployed, recovered, and redeployed without impairment of the performance of any of their components.
<L4-RSN-IP-RQ-78>

2.2.7 Attachment with other Instruments

OPER-008 Where practicable instruments should connect to, interface with, and/or be controlled by other instruments to share resources and reduce hardware. Shared resources may include pumps, inductive modems, A/D's, data storage memory/buffers, instrument agent components, and battery power. This is an objective.

2.3 Mechanical/Physical

This section of the document provides specifications for the mechanical properties of instruments. See section 2.7.1 for specifications for the mechanical interface between instruments and platforms.

2.3.1 Materials

MECH-001 The instrument housing shall be designed to be corrosion resistant.<L4-CG-IP-RQ-288>

MECH-002 The instrument connector shall be designed to be corrosion resistant.

MECH-007 Instruments fixed on cabled Open Ocean platforms should have housings constructed using titanium alloy or non-metallic materials. This is an objective.

MECH-008 Instruments fixed on cabled Open Ocean platforms should have instrument connectors constructed using titanium alloy or non-metallic materials. This is an objective.

MECH-003 Instruments fixed on uncabled Open Ocean platforms should have electronics housings capable of sustaining immersion in seawater to 6000 m. This is an objective. <L4-CG-IP-RQ-448> Performance specifications for specific instruments have priority in case of conflict.

MECH-005 Instruments fixed on cabled and uncabled Coastal platforms should have electronics housings capable of sustaining immersion in seawater to 600 m. This is an objective. <L4-CG-IP-RQ-435> Performance specifications for specific instruments have priority in case of conflict.

MECH-006 Titanium material having threaded connections or sliding fittings should have a form of galling protection at contact surfaces, such as anodizing per AMS 2488 type 2 or galling lubricants. When contact surfaces for electrical current are involved, the change in resistivity should be evaluated to determine if a surface should be protected. This is an objective.

2.3.2 Size

2.3.3 Weight

2.4 Electrical

This section of the document provides specifications for the internal electrical properties of instruments. See section 2.7.2 for specifications for the electrical interface between instruments and platforms.

2.4.1 Interference Requirements

2.4.2 Voltage

2.4.3 Current

2.4.4 Power

2.4.5 Grounding

ELEC-002 Instruments should ground all circuitry internally with no connection to the seawater. This requirement means that there should be no low resistance connection between either side of the power supply, or any communications line, and the ground (or seawater) at or within the instrument. This is an objective.

2.4.6 Battery Life

ELEC-003 Instruments required to be powered by internal batteries shall have battery capacity to operate the sensors at the typical sampling frequency for the defined deployment interval. <L4-CG-IP-RQ-298> See section 2.2.6 for the defined deployment interval.

Typical sampling frequencies are found in the individual instrument specification documents.

2.4.7 Modes/State of Operation

ELEC-004 Instruments shall return to a defined operational state upon being depowered and repowered. <L4-RSN-IP-RQ-80, L4-CG-IP-RQ-447>

2.4.8 Isolation

ELEC-001 The Instrument should provide galvanic isolation between power/data pins and the pressure case of up to +/- 50VDC. This is an objective.

ELEC-005 All instrument electronics and electrical connections shall be isolated from seawater by greater than 10 MΩ.

ELEC-006 All instrument electronics and electrical connections should be isolated from seawater by greater than 100 MΩ. This is an objective.

2.5 Data Storage and Processing

2.5.1 Storage Capacity

DATA-001 Instruments shall provide internal data storage on uncabled moorings.

Specific data storage capacities will be identified in the individual instrument specifications

2.6 Software/Firmware

2.7 Platform Interfaces

2.7.1 Mechanical

2.7.2 Electrical

a) Voltage

INTF-001 Instruments shall be powered by two-wire (+VDC, -VDC) voltages floating free of the housing. <L4-RSN-IP-RQ-85>

INTF-002 Instruments shall operate from a supply voltage of either 12 VDC +/- 5% or 24 VDC+/- 5% unless otherwise specified in the instrument specification.
<L4-CG-IP-RQ-287>

b) Current

c) Power

d) Connector

INTF-016 The instrument should include a standard type of OOI bulkhead connector on the instrument housing (see Appendix 3.1). This is an objective.

2.7.3 Data and Communication

a) Timing

INTF-003 Instruments shall provide time-stamping capabilities or fully characterize the latency between data sampling and appearance of the data at the output connector. Preferences for instrument time stamping capabilities are as follows (best first):

1. Time stamp embedded in every data record to the design accuracy of the instrument's clock, using ISO 8601 compliant timestamp
2. Time stamp embedded in every data record to the design accuracy of the instrument's clock, using another described, parse-able timestamp format
3. Time stamp every data sequence, with fixed time between every data record
4. Fully characterize the latency between data sampling and appearance of the data at the output connector
5. Time stamp embedded in every data record, with precision that is less than the accuracy of the instrument's clock, using ISO 8601 compliant timestamp
6. Time stamp embedded in every data record, with precision that is less than the accuracy of the instrument's clock, using another described, parseable timestamp format. <L4-CG-IP-RQ-450>

b) Clock Synchronization

INTF-004 Instruments should have an internal clock capability. This is an objective.

INTF-005 Instruments with internal clocks shall have the ability to time synchronize the clock and/or set the clock over the interface. <L4-CG-IP-RQ-449>

c) Data Rate

INTF-006 Instruments communicating via serial interfaces shall communicate at a minimum data rate of 9600 bits/sec.

INTF-007 Instruments should have a user-settable data rate, up to 115,200 bits/sec for serial interfaces. This is an objective.

d) Data Format

e) Protocols

INTF-008 Instruments with an Ethernet interface should provide an auto-discovery mechanism, (e.g., PUCK, Universal Plug'n'Play', ZeroConf/Bonjour, etc.) This is an objective.

INTF-009 Instruments shall acknowledge command execution, including an indication as to whether a command has succeeded or failed <L4-RSN-IP-RQ-92>

f) Physical Interface

g) Electrical Interface

INTF-010 Instruments shall communicate (Data and Commands) while deployed with the OOI infrastructure (e.g., CI device driver or platform interface) via at least one of the following interfaces: Ethernet (10/100 Mb), or serial EIA standards: RS-422, RS-485, or RS-232. < L4-CG-IP-RQ-291, L4-CG-IP-RQ-297, L4-RSN-IP-RQ-88>

h) Remote Access

INTF-011 Instruments shall be capable of being remotely accessed and controlled via the communication interface. <L4-CG-IP-RQ-294, L4-RSN-IP-RQ-91>

INTF-012 Instruments should support remote firmware installation. This is an objective.

INTF-013 All data stored on the instrument shall be accessible remotely over the communication interface

i) Modes

INTF-014 Instruments should allow polled and asynchronous mode operation. This is an objective.

j) Modem

INTF-015 Instruments on uncabled, open ocean moorings shall be able to communicate via inductive modem. <L4-CG-IP-RQ-463>

2.8 Compliance

COMP-001 To the greatest extent practical, all OOI infrastructure should be compatible with applicable national and international standards, including those of the IEEE, ANSI, and IEC. This is an objective.

2.8.1 Environmental

2.8.2 FCC

2.8.3 OSHA

2.9 Safety

2.10 Shipping and Storage

2.10.1 Shipping

SHIP-001 Instruments shall be provided with reusable transportation cases that meet or exceed ASTM-D3951 "Standard Practice for Commercial Packaging." <L3-CG-RQ-432>

2.10.2 Storage

SHIP-002 Instruments should be capable of being stored without damage or degradation between -20 and 50°C for periods of up to twelve (12) months. This is an Objective.

2.10.3 Safe Handling

SHIP-003 Instrument transportation cases shall have external labels specifying safe handling precautions.

2.11 Identification

2.11.1 Physical Markings

IDEN-001 Instruments shall be marked indelibly on an exterior surface. Marking shall include manufacturer's part number, unit serial number, and OOI provided identification numbers.

IDEN-002 Instruments shall be capable of being marked indelibly by OOI without damage to the instrument or housing.

2.12 Quality

2.12.1 Product Quality

QUAL-001 The materials used in construction of the instrument body, sensors, and sensor mounts shall be chosen and treated in such a way as to reduce the levels of wear, corrosion and deterioration to allow multiple deployments of each unit.

3 Appendices

3.1 Preferred Standard OOI Connector Types

Instruments should use an MCBH connector installed on the housing. The number of pins, and pinout assignments, should be appropriate to the communication protocol of the instrument, and as shown in the table below. This is an objective.

If the instrument is deployed below the surface, the underwater connector should be water blocked so that there is a back-up o-ring seal in the event that the elastomeric sealing surface delaminates from the metal shell. This is an objective. (An example of a 6 pin water blocked connector is the MCBH(WB)-6-FS-Ti, manufactured by Teledyne Impulse.)

Protocol	RS-232	RS-232	RS-485 (half duplex)	RS-485 (full duplex)	10/100 BaseT	10/100 BaseT
Pin #	4 Pin	6 Pin	6 Pin	8 Pin	8 Pin	10 Pin
1	Gnd	Pwr Gnd	Pwr Gnd	Data Gnd	Data Gnd	Data Gnd
2	RXD	RXD	Data B+	RD B+	Rx+	Rx+
3	TXD	TXD	Data A-	RD A-	Rx-	Rx-
4	12Vdc	12Vdc*	12Vdc*	PPS	PPS	PPS+
5		24Vdc*	24Vdc*	TD A-	Tx+	PPS-
6		Data Gnd	Data Gnd	TD B+	Tx-	Tx+
7				Pwr Gnd	Pwr Gnd	Tx-
8				+Vdc	+Vdc	Pwr Gnd
9						12Vdc*
10						24Vdc*

* Only one voltage will be populated, depending on instrument input power needs.