DATA PRODUCT SPECIFICATION FOR L1 BULK METEOROLOGICAL DATA PRODUCTS

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Document Control Sheet

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1-01	2013-08-02	Correction to data product levels in Section 4.2 Inputs and Section 4.4 Outputs; correction to source of magnetic variation estimate in Section 4.2 Inputs and Appendix A-2; correction to test data set in Section 4.6	M. Gibney E. Chapman S. Pearce

Signature Page

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

OOI Senior Systems Engineer: ______________________________

Date: 2013-03-04

This document has been reviewed and meets the needs of the OOI Cyberinfrastructure for the purpose of coding and implementation.

OOI CI Signing Authority: ______________________________

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Table of Contents

1 Abstract

This document describes the processing needed to generate the OOI Level 1 Bulk Meteorological data products: RELHUMI, TEMPAIR, BARPRES, WINDAVG, PRECIPM, SHRTIRR, LONGIRR, CONDSRF, TEMPSRF.

2 Introduction

2.1 Author Contact Information

Please contact Robert Weller (rweller@whoi.edu), Janet Fredericks (jfredericks@whoi.edu) or the Data Product Specification lead (DPS@lists.oceanobservatories.org) for more information concerning the computation and other items in this document.

2.2 Metadata Information

2.2.1 Data Product Name

The OOI L1 Core Data Product Names and Descriptive Names for the products are:

Name	**Descriptive Name**
RELHUMI	Relative Humidity
TEMPAIR	Air Temperature
BARPRES	Barometric Pressure
WINDAVG	Mean Wind Velocity
PRECIPM	Precipitation
SHRTIRR	Downwelling Shortwave Irradiance
LONGIRR	Downwelling Longwave Irradiance
CONDSRF	Sea Surface Conductivity
TEMPSRF	Sea Surface Temperature

2.2.2 Data Product Abstract (for Metadata)

The METBK is an instrument package including the sensors listed in Section 2.3, below. This document describes how to read the real-time stream and unpack the raw data from the instrument upon recovery to create the OOI Level 0 and Level 1 products.

RELHUMI: **Relative humidity** is defined as the percentage of the actual partial pressure of the water vapor and the saturation pressure of water at the temperature of the ambient air. [The Original Rotronic Humidity Manual, 2005]

TEMPAIR: **Air temperature** is the bulk temperature of the ambient air.

BARPRES: **Barometric pressure** is the measure of the weight of the atmosphere, or atmospheric pressure.

WINDAVG: The **Mean Wind Velocity representing wind toward (not wind from) and includes the Northward and Eastward vector components of the average wind speed relative to North True.**

PRECIPM: **Precipitation** represents a relative amount of rain that has fallen over the observation period.

SHRTIRR: **Downwelling Shortwave irradiance** is a measure of radiant energy emitted by the sun in the visible and near-ultraviolet wavelengths.

LONGIRR: **Downwelling Longwave irradiance** is a measure of infrared energy radiating downward from the sky to the ocean surface.

CONDSRF: **Sea Surface Conductivity** is a measure of conductivity that relates to the salinity and temperature of a particular volume.

TEMPSRF: **Sea Surface Temperature** is the temperature of the seawater near the surface.

2.2.3 Computation Name

N/A

2.2.4 Computation Abstract (for Metadata)

The instrument raw data contains an ASCII stream or binary file of meteorological and surface water data. That stream is unpacked/deinterleaved to create the OOI Level 0 METBK products - WINDAVG, and BARPRES and the Level1 METBK products - RELHUMI, TEMPAIR, PRECIPM, SHRTIRR, LONGIRR, CONDSRF, and TEMPSRF.

No computations are done for the Level 1 products: RELHUMI, TEMPAIR, PRECIPM, SHRTIRR, LONGIRR, CONDSRF and TEMPSRF. The Level 0 WINDAVG northward and eastward components are in the reference frame of the compass; the local magnetic variation is applied to rotate these to reference true north and east for the WINDAVG L1 product. BARPRES L1 product is derived by converting the BARPRES L0 from mbars to Pascals.

2.2.5 Instrument-Specific Metadata

The height (in meters) of each sensor above the nominal sea surface must be recorded and kept as part of the metadata for the WINDAVG, BARPRES, RELHUMI, TEMPAIR, PRECIPM, SHRTIRR, and LONGIRR. The depth (in meters) below the nominal sea surface for the CONDSRF and TEMPSRF must be recorded and kept as part of the metadata.

The recording period (length of time over which an observation is taken) is needed as part of the metadata.

When available, the compass reading used to convert from instrument frame to earth coordinates should also be available as associated metadata. The degrees used in the correction for magnetic variance should also be saved as metadata and associated with the WINDAVG data stream.

The logger hardware and software versions should be associated with the observations, for example: MET Datalogger - Firmware LOGR53 v4.11cf

The following auxiliary data should be associated with the data upon recovery and as a part of the binary unpacking process:

- vdavg, compass (vane degrees and the last compass reading used to convert from instrument frame to earth coordinates should also be available as associated metadata)
- Wsavg (wind speed average), wmax (maximum wind speed), wmin (minimum wind speed)
- Dome, body (long wave dome and body thermistors, deg K, used to compute air temp)*
- Tpile (thermopile output of the LONGIRR, microvolts)*
- Bat1, bat2, bat3, bat4 (battery voltages, VDC)

* The body and dome temperatures as well as thermopile voltage output of the LONGIRR should be saved. The calculation in incoming longwave from these is nonlinear, and saving these allows later corrections as well as additional quality control.

2.2.6 Data Product Synonyms

Downwelling irradiance is also known as incoming irradiance.
Barometric pressure is also known as atmospheric pressure.
Sea surface temperature is also known as seawater temperature, water temperature, in situ water temperature and ITS-90 water temperature.

2.2.7 Similar Data Products

CONDSRF is similar to CONDWAT (1341-00010) and TEMPSRF is similar to TEMPWAT (1341-00020). All products are output from CTDs. CONDSRF and TEMPSRF are merged with other instruments (listed in 2.2.1) and become part of the METBK instrument class data stream. The output from the METBK is expected as either ASCII or binary. They do not require a HEX2DEC conversion, as does the CONDWAT and TEMPWAT products.

Prior to 1990, when the ITS-90 standard was adopted (Sea-Bird App Note 42, 2010), a different calibration, the IPTS-68 standard, was in use. The relationship between T_90 and T_68 is a simple, linear one (T_68 = 1.00024 * T_90).

2.3 Instruments

The table in section below includes the list of sensors that are installed in the METBK package.

Data Product Name	Descriptive Name	Sensor	Units
RELHUMI	Relative Humidity	Rotronic MP-101A	%
TEMPAIR	Air Temperature	Rotronic MP-101A	°C
BARPRES	Barometric Pressure	Heise DXD	mbars
WINDAVG	Mean Wind Velocity	Gill Windobserver II	m/s
PRECIPM	Precipitation	RM Young 50202	mm
SHRTIRR	Downwelling Shortwave Irradiance	KippZonen CMP 21	W/m^2
LONGIRR	Downwelling Longwave Irradiance	Eppley PIR	W/m^2
CONDSRF	Sea Surface Conductivity	SBE-37	S/m
TEMPSRF	Sea Surface Temperature	SBE-37	°C

The Gill Windobserver II ultrasonic anemometers measure the horizontal velocity components in the reference frame of the buoy from differences in the time of flight of acoustic pulses emitted from 3-pairs of opposing transducers.

Precipitation is measured using a RM Young 50202 self-siphoning rain gauge and recorded as mm. The gauge fills and the sensor returns the level in the gauge; when it is full a siphon path is completed and its drains to allow it to fill again. The difference in the level, when increasing, represents the amount of precipitation between successive samples. Decreasing levels, with the decrease due to evaporation, are ignored. The siphoning events create rapid (typically within a 1 min sample) downward spikes in precipitation level. These may confound things like the "spike test", which should have default parameters set broadly enough as to allow the events to pass through.

The Eppley PIR also returns the temperatures of the sensor body and of the sensor dome, as well as the voltage output of the thermopile, which can be used as diagnostics of sensor performance.

The METBK Processing Flow document (DCN 1342-00360) describes the flow of data from the METBK through all of the relevant QC, calibration, and data product computations and procedures.

Please see the Instrument Application in the SAF for specifics of instrument locations and platforms.

2.4 Literature and Reference Documents

Colbo, Keir and Weller, Robert A. (2009). "Accuracy of the IMET Sensor Package in the Subtropics." American Meteorological Society **DOI: 10.1175/2009JTECHO667.1**
(see DPS Artifacts >> METBK >> colbo_weller_jaot-3.pdf)

Rotronics, Inc, "The Original Rotronic Humidity Manual", 09/01/2005 (*See DPS Artifacts >> METBK >> Rotronic Humidity Handbook.pdf*)

2.5 Terminology

2.5.1 Definitions

None

2.5.2 Acronyms, Abbreviations and Notations

General OOI acronyms, abbreviations and notations are contained in the Level 2 Reference Module in the OOI requirements database (DOORS).

2.5.3 Variables and Symbols

ITS-90 International Temperature Scale of 1990

3 Theory

3.1 Description

There is no theory because there is no processing other than conversion of units or reference frame.

3.2 Mathematical Theory

N/A

3.3 Known Theoretical Limitations

None.

3.4 Revision History

No revisions to date.

4 Implementation

4.1 Overview

Data are input as ASCII or downloaded from the logger as binary and unpacked and associated with the appropriate property stream with metadata.

Note that which temperature standard to use (IPTS-68 or ITS-90) is an option on the Sea-Bird CTDs, and all OOI CTDs are set to use the ITS-90 standard (Sea-Bird 2010, App Note 42).

4.2 Inputs

Inputs

- Raw Instrument Data (which includes L1 Relative Humidity [%], L1 Air Temperature [°C],L0 Barometric Pressure [mbars], L0 Mean Wind Velocity Eastward and Northward components relative to Magnetic North [m/s], L1 Precipitation [mm], L1 Downwelling Shortwave Irradiance [W/m^2], L1 Downwelling Longwave Irradiance [W/m^2], L1 Sea Surface Conductivity [S/m], L1 Sea Surface Temperature [°C])

The magnetic variation estimate for each deployment is calculated from the World Magnetic Model (WMM) implemented in ION. See Appendix A-2 for more details.

4.2.1 Real-time Telemetered Data

The ASCII stream appears as follows:

```
2011/09/24 00:00:58.953 1017.50 95.409 23.727 438.5 18.92 23.752
     5.1385 1.9 2.47 6.52 5.1385 12.50
```

Each record is separated by a CR/LF. The data are parsed as follows: year/mo/da followed by the time HR:MN:dec_seconds.
Then from the same line parse the following properties in the order listed:
BARPRESm RELHUMI TEMPAIR LONGIRR PRECIPM TEMPSRF CONDSRF SHRTIRR WINDAVG (Eastward component) WINDAVG (Northward component) mux bat

If data from a given instrument are missing, they will have a NaN in the corresponding field.

4.2.2 Binary Downloaded Data

The packed binary file contains a series of 1-minute records with time, eastward wind, northward wind, wind speed average, maximum wind speed, minimum wind speed, last observed wind vane, last observed compass, barometric pressure, relative humidity, air temperature, shortwave radiation, longwave radiation components (dome and body temperatures, thermopile voltage), longwave radiation, precipitation level, sea temperature and conductivity. See Appendix A-1 for the data structure and unpacking algorithms.

4.3 Processing Flow

The specific steps necessary to create all calibrated and quality controlled data products for each OOI core instrument are described in the instrument-specific Processing Flow documents (DCN 1342-00360). These processing flow documents contain flow diagrams detailing all of the specific procedures (data product and QC) necessary to compute all levels of data products from the instrument and the order in which these procedures.

Minimum processing is necessary because the ASCII stream provides the data product in decimal and with the correct OOI-specified units.

Step 1: Parse or unpack data the raw stream or file and check for valid records and dates.

Each record should be checked for completeness. Incomplete records should be discarded. There should be a valid date along with the required 12 additional properties. Appendix B has the accuracy and valid range for each property.

Step 2: Convert the L0 BARPRES air pressure from millibars to L1 BARPRES in pascals by multiplying by 100 (1 mbar = 100 Pa).

Step 3: Rotate wind vector to correct for magnetic variance. See Appendix A-2 for example code to rotate the wind vector.

Step 4: Trigger automated data QC algorithms on the generated data products. (See DCN 1342-00360 Data Processing Flow.)

Step 5: Trigger computation of seawater salinity and density from CONDSRF and TEMPSRF (See DCN 1341-00040 Data Product Specification for PRACSAL and 1341-00050 Data Product Specification for Density.) The L1 Pressure [dbar] used for the computation of salinity and density is the associated deployment metadata: Conductivity/Temperature depth.

4.4 Outputs

For each valid record, all time-stamped output properties and corresponding units are listed in the OUTPUT section of 2.2.1.

Outputs are

- L1 Relative Humidity [%]
- L1 Air Temperature [°C]
- L1 Barometric Pressure [Pa]
- L1 Mean Wind Velocity Northward relative to North True [m/s]
- L1 Mean Wind Velocity Eastward relative to North True [m/s]
- L1 Precipitation [mm]
- L1 Downwelling Shortwave Irradiance [W/m^2]
- L1 Downwelling Longwave Irradiance [W/m^2]
- L1 Sea Surface Conductivity [S/m]
- L1 Sea Surface Temperature [°C]

The metadata that must be included with the output include the Magnetic Variance used in the correction to Mean Wind Velocity Northward and Eastward; components of this are latitude, longitude, and height or depth (in meters) relative to sea level.

See Appendix B for a discussion of the accuracy of the output.

4.5 Computational and Numerical Considerations

4.5.1 Numerical Programming Considerations

There are no numerical programming considerations for this computation. No special numerical methods are used.

4.6 Computational Requirements

N/A

4.7 Code Verification and Test Data Set

From the example data in section 4.2.1, the only values that are changed are the barometric pressure and the wind vectors:

L0 BARPRES = 1017.50 mbars

L1 BARPRES = 101750 Pascals

And below is a table showing test data for correcting for magnetic variance:

			L0 Input		L1 Output	
Date	Lat	Lon	East Velocity	North Velocity	East Velocity	North Velocity
2013-05-30	43.340	-66.000	2.47	6.52	0.46	6.96
2013-05-30	43.340	-66.000	-2.47	6.52	-4.27	5.51
2013-05-30	43.340	-66.000	-2.47	-6.52	-0.46	-6.96
2013-05-30	43.340	-66.000	2.47	-6.52	4.27	-5.51
2013-05-30	47.767	-126.000	2.47	6.52	4.27	5.51
2013-05-30	47.767	-126.000	-2.47	6.52	-0.46	6.96
2013-05-30	47.767	-126.000	-2.47	-6.52	-4.27	-5.51
2013-05-30	47.767	-126.000	2.47	-6.52	0.46	-6.96

Example raw data from a recovered logger, Matlab code that unpacks the raw data, and the corresponding ASCII version of the raw data are included in the DPS artifacts. The files are located by following the following path: https://alfresco.oceanobservatories.org/ and navigate to REFERENCES->OOI >> REFERENCE >> Data Product Specification Artifacts >> 1341-00360_BULKMET.

Appendix A Example Code

Appendix A-1. Binary data structure and unpacking algorithms.
Example Matlab code that unpacks the raw data are included in the DPS artifacts. The files are located by following the following path: https://alfresco.oceanobservatories.org/ and navigate to REFERENCES->OOI >> REFERENCE >> Data Product Specification Artifacts >> 1341-00360_BULKMET.

LOGR53 Record Format - Firmware Version 2.50 or later - 06 Apr 2006

The current record format provides for storage of data at each 1 minute sample interval. 64 bytes binary are currently stored per record in fixed format. (Note that this will likely change in the future). Storage is based upon a 'C' language structure shown here:

```
/* LOGR 64 byte packed data record structure for storage in FLASH */
struct LOGR_record
   {
   unsigned char hour;   /* time is not packed for ease of verifying */
   unsigned char min;
   unsigned char day;
   unsigned char mon;
   unsigned char year;
          /* year is offset from 2000 (no good after year 2255 :-) */
   unsigned short record;   /* sequential record number from startup */
   unsigned char mux_parm;  /* which option parameter in this record */
   short we,wn;    /* wind speed m/sec */
                  /* (short)(we * 100) ==> +/- 327.67 m/s */
                  /* (short)(wn * 100) ==> +/- 327.67 m/s */
   unsigned short wsavg,wmax,wmin;
                  /* (ushort)(wsavg * 100) ==> 0 - 655.35 m/s */
                  /* (ushort)(wmax * 100) ==> 0 - 655.35 m/s */
                  /* (ushort)(wmin * 100) ==> 0 - 655.35 m/s */

   short vdavg,compass;  /* last vane degrees, last compass degrees */
                     /* (short)(vdavg * 10) ==> +/- 3276.7 degrees */
                     /* (short)(compass * 10) ==> +/- 3276.7 degrees */

   unsigned short bp;   /* barometer millibars */
          /* (ushort)((bp - 900.0) * 100) ==> 900.00 - 1555.35 mbar */

   short rh;  /* humidity %, deg C */
              /* (short)(rh * 100) ==> +/- 327.67 %RH */
   unsigned short th;
        /* (ushort)((th + 20.0) * 1000) ==> -20.000 to +45.535 degC */

   short sr;  /* short wave w/m^2 */
              /* (ushort)(sr * 10) ==> +/- 3276.7 w/m^2 */

   unsigned short dome,body;  /* long wave dome and body thermistors
                                 deg Kelvin, thermopile microvolts */
                        /* (ushort)(dome * 100) ==> 0 - 655.35 degK */
                        /* (ushort)(body * 100) ==> 0 - 655.35 degK */
   short tpile;     /* (short)(tpile * 10) ==> +/- 3276.7 microvolts */

   short lwflux;  /* lwr flux */
                  /* (short)(lwflux * 10) ==> +/-3276.7 w/m^2 */

   short prlev;  /* precipitation values */
                /* (short)(prlev * 100) ==> +/-327.67 mm */

   unsigned short sct; /* SeaCat sea temp deg C */
```

```
        /* (ushort)((sct + 5.0) * 1000) ==> -5.000 to +60.535 degC */
unsigned short scc; /* SeaCat conductivity Siemens */
       /* (ushort)(scc * 10000) ==> 0.000 to +6.5535 Siemens/meter */

short bat1,bat2,bat3,bat4;  /* misc. battery */
                        /* (short)(bat1 * 1000) ==> +/- 32.767 VDC */

unsigned long opt_parm;   /* optional value indicated in mux_parm */
unsigned short spare1,spare2,spare3;      /* optional spare value */
unsigned short used;         /* set to 0xA5A5 upon record write */
```

Records may be dumped via XMODE command (very slow!) or by directly reading the removable FLASH storage card in a Linux-based PC.
A typical 64 byte binary record looks something like this (in HEX-ASCII):
0A222D150707CE01........841A0604FE0C3E247F4500F07F45A5A5
First, note the following: All integers are 2 bytes, stored MS byte first.
From the structures above, note that time is stored first, so:

TIME:
Bytes 0 - 4
0A22150700 is time as follows:
Byte 0 - hour = 0Ah ==> 10
Byte 1 - minute = 22h ==> 34
Byte 2 - day = 15h ==> 21
Byte 3 - month = 07h ==> 7
Byte 4 - year = 00h ==> 2000 (add to base year 2000)

SEQUENTIAL RECORD NUMBER:
Bytes 5,6
A sequential record number is kept from power up - possibly useful for untangling problem data records with bad time (may be eliminated in future software versions)

MUX'ED PARAMETER NUMBER (NOT USED - more detail later...):
Byte 7

DATA VALUES (details above):
Bytes 8 - 61
Refer to the 'C' structure above for position and packing of each 2-byte integer data value (remember, MS byte first)

USED TAG
Bytes 62 – 63 These bytes are used to indicate that a record in FLASH storage has been written by the LOGR53. It is used internally by the instrument firmware to, for example, determine the next available record location upon power-up. These bytes should always be A5A5h in a used record, and FFFFh in an unused portion of the FLASH card.

Appendix A-2. Correct for magnetic variance:
The magnetic poles are not located at the true poles. The magnetic North Pole, for example, is located roughly in Hudson's Bay. Thus, vector wind collected using a magnetic compass needs to be rotated into true north and east components by an angle known as the magnetic variation (also called magnetic declination) that quantifies the difference in heading between magnetic and true north. The Department of Defense’s World Magnetic Model (WMM) has been implemented in the OOI Network, which is used to calculate the magnetic variation (see http://ngdc.noaa.gov/geomag/WMM/DoDWMM.shtml). The location of the sensor (latitude, longitude) and the time of the data collection are used together as inputs to the calculation of

magnetic variation to determine the amount the wind vector has to be rotated to yield true north and true east. Below is Matlab sample code.

```
% test fix_magvar

Ewnds = [ 2.47 -2.47 -2.47  2.47 ] ;
Nwnds = [ 6.52  6.52 -6.52 -6.52 ];
magvar_deg = -17;

for jj=1:2
  [Ewnd_true, Nwnd_true]=fix_magvar(Ewnds,Nwnds,magvar_deg);
    for n=1:length(Ewnds)
        fprintf('%5.2f\t%5.2f\t%.0f\t%5.2f\t%5.2f\n',...
        Ewnds(n),Nwnds(n),magvar_deg,Ewnd_true(n),Nwnd_true(n));
    end
    magvar_deg = -1*magvar_deg;
end

function [Ewnd_true,Nwnd_true] = fix_magvar(Ewnds,Nwnds,magvar_deg)
% function [Ewnd_true,Nwnd_true] = fix_magvar(Ewnds,Nwnds,magvar_deg)
%  eastward winds, northward winds
%   magvar_deg is the degrees from North True of the magnetic north
%       It is the value reported in the NOAA calculation above.
%
% convert to radians
magvar = magvar_deg * ((2*pi)/360);
    Ewnd_true = (Ewnds * cos(magvar)) + (Nwnds * sin(magvar));
    Nwnd_true = (-1 * Ewnds * sin(magvar)) + (Nwnds * cos(magvar));
end
```

Appendix B Output Accuracy

Source (unless otherwise specified):
http://frodo.whoi.edu/asimet/asimet_module_specs.html#bpr_mod

ASIMET Barometric Pressure Module (BPR)

- Sensor: Heise DXD (Dresser Instruments)
- Range: 850 to 1050 mb, Resolution: 0.01 mb
- Accuracy: UOP lab calibration, 0.2 mb; Manufacturer, 0.02% F.S.
- Drift (post vs. pre cal after 1 yr): 1.5 mb (Colbo&Weller, 2009)

ASIMET Relative Humidity & Air Temperature Module (HRH)

- Sensor: Rotronic MP-101A
- Range: 0 to 100 %RH, - 40 to +60 ^{o}C
- Resolution: 0.01%RH, 0.02 C
- Accuracy: UOP lab calibration, 1 %RH, 0.05 ^{o}C
- Drift (post vs. pre cal after 1 yr): 1 %RH, 0.05 ^{o}C (Colbo&Weller, 2009)

ASIMET Precipitation Module (PRC)

- Sensor: RM Young 50202 Self-siphoning rain gauge
- Range: 0 to 50 mm, Resolution: 0.1 mm
- Accuracy, Level: Manufacturer spec, 1 mm
- Accuracy, Rate: Lab calibration, 1 mm/hr (Serra et al., 2001)

Source:
http://www.kippzonen.com/?download/72112/CMP+6,+CMP+11,+CMP+21,+CMP+22+Pyranometers+-+Manual.aspx
ASIMET Shortwave Radiation Module (SWR)

- Sensor: Kippzonen CMP 21 10K
- Range: 0 to 4000 W/m^2, Resolution: 0.1 W/m^2
- Accuracy:
- Drift: < 0.5/year

ASIMET Longwave Radiation Module (LWR)

- Sensor: Eppley Precision Infrared Radiometer (PIR)
- Range: 0 to 700 W/m^2, Resolution: 0.1 W/m^2
- Accuracy: Comparison to standard, 2 W/m^2 (Colbo & Weller, 2009)
- Drift (post vs. pre calibration after 1 yr): 2 W/m^2 (Colbo & Weller, 2009)

Source: http://www.gill.co.uk/data/manuals/WindObserver-II-Pipe-Mount-Manual.pdf
ASIMET Horizontal Wind Speed (WND)

- Sensor: Gill Windobserver II
- Range: 0 to 65 m/s*, 0 to 359 deg
- Resolution: 0.01 m/s, 1°
- Accuracy: 2%, 2°
- Drift

Source: **http://www.seabird.com/products/spec_sheets/37smdata.htm**
ASIMET Surface Conductivity/Temperature Module (CT)

- Sensor: Seabird Electronics SBE-37
- Range: 0 to 7 S/m, -5 to 35 °C
- Resolution: 0.00001 S/m, 0.0001 °C
- Initial Accuracy: 0.0003 S/m, 0.002 °C

Stability: 0.0003S/m per month, 0.0002 per month

The DOORS requirements for accuracy and resolution of the Level 1 Bulk Meteorological data products calculated as described herein are:

Relative humidity shall be measured with an accuracy of 2%. [L2-SR-RQ-3235]
Relative humidity shall be measured with a resolution of 0.1%. [L2-SR-RQ-3236]

Barometric pressure measurements shall have a resolution of 0.1 millibars. [L2-SR-RQ-3209]
Barometric pressure measurements shall have an accuracy of 0.2 millibars. [L2-SR-RQ-3207]

Mean wind speed shall be measured with an accuracy of 2% of the measured value. [L2-SR-RQ-3243]
Mean wind speed shall be measured with a resolution of 0.1 ms-1. [L2-SR-RQ-3244]
Mean wind direction shall be measured with an accuracy of 2°. [L2-SR-RQ-3246]
Mean wind direction measurements shall have a resolution of 0.2 degrees. [L2-SR-RQ-3710]

Precipitation shall be measured with an accuracy of 1 mm hr-1. [L2-SR-RQ-3230]
Precipitation shall be measured with a resolution of 0.1 mm hr-1. [L2-SR-RQ-3231]

Downwelling shortwave radiation shall be measured with a resolution of 0.1 W/m^2. [L2-SR-RQ-3218]
Downwelling shortwave radiation shall be measured with an accuracy of +/- 4 W/m^2. [L2-SR-RQ-3219]

Downwelling longwave radiation shall be measured with a resolution of 0.1 W/m^2. [L2-SR-RQ-3660]
Downwelling longwave radiation shall be measured with an accuracy of 2 W/m^2. [L2-SR-RQ-3661]

Appendix C Sensor Calibration Effects

<None>