DATA PRODUCT SPECIFICATION FOR VENT FLUID TEMPERATURE FROM RASFL

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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: ______________________________

Date: 2014-05-09

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

OOI CI Signing Authority: ______________________________

Date: ______________________________

Table of Contents

1 Abstract

This document describes the computation used to calculate the OOI Level 1 Vent Fluid Temperature data product from the D1000 instrument (a RTD temperature transmitter within the housing for the RASFL instrument). The D1000 instrument collects and preserves fluid samples at specified intervals, on demand, or adaptively as a response to event detection. Associated with the D1000/RASFL instrument is the particulate sampler (PPSDN). The control electronics for these two instruments are integrated into a single pressure housing, and share the same sample inlet. The particulate sampler filters a volume of water and preserves the particulate matter for genetic analysis upon recovery. Although fluids are sampled once every ~10 days and particulates once every ~20 days, temperature is measured continuously at the sample inlet using a platinum resistance temperature detector (RTD). The D1000 instrument measures temperature at three locations, with three separate RTDs. The planned locations of the three RTDs are: two RTDs incorporated into the inlet funnel covering a low-temperature hydrothermal vent, and one RTD in higher temperature flow of a proximal vent. The locations of the RTDs will be made available in metadata after deployment. The data product is a simple parsing of calibrated temperature values measured at the inlet RTD. The instrument temperature output is a “real-time” value that is reported only when queried. The reported value has internally been converted from raw voltage to scientific units using the onboard calibration coefficients of the instrument.

2 Introduction

2.1 Author Contact Information

Please contact Giora Proskurowski (giora@uw.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 Core Data Product Name for this product is
- TEMPVNT

The OOI Core Data Product Descriptive Name for this product is
- Vent Fluid Temperature from RASFL

2.2.2 Data Product Abstract (for Metadata)

The OOI Level 1 Vent Fluid Temperature core data product is the measured temperature at the sample inlet of the RASFL/PPSDN/D1000 instrument.

2.2.3 Computation Name

Not required for data products.

2.2.4 Computation Abstract (for Metadata)

This algorithm parses the OOI Level 1 Vent Fluid Temperature core data product, from the instrument data string.

2.2.5 Instrument-Specific Metadata

See Section 4.4 for instrument-specific metadata fields that must be part of the output data.

2.2.6 Data Product Synonyms

Synonyms for this data product are

- Fluid temperature

2.2.7 Similar Data Products

Similar data products that may be confused with this data product include: “Seafloor Temperature” and/or “Vent Fluid Temperature from TRHPH”. While all of these products measure temperature at seafloor hydrothermal vents, they use different methodologies.

2.3 Instruments

For information on the instruments from which the L1 Vent Fluid Temperature core data product inputs are obtained, see the TEMPVNT Data Processing Flow document (DCN 1342-00140). This document contains information on instrument classes and make/models; it also describes the flow of data from the instrument 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

Not applicable.

2.5 Terminology

2.5.1 Definitions

Not Applicable.

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

The following variables and symbols are defined here for use throughout this document.

t_vent = Temperature, °C, at the sample inlet

3 Theory

3.1 Description

Temperature is measured at the sample inlet using a platinum RTD. When queried, the raw measurement is converted to °C using the calibration coefficients associated with the RTD.

3.2 Mathematical Theory

Not Applicable.

3.3 Known Theoretical Limitations

Not Applicable.

3.4 Revision History

No revisions to date.

4 Implementation

4.1 Overview

Instrument output in °C is parsed from the full response string.

4.2 Inputs

- Raw Vent Temperature ASCII string

Input Data Formats:
When queried, the instrument provides an echo of the query and a response as ASCII text strings:

```
yyyymmddThhmmss.sssZ $command      % this is an echo of the query
yyyymmddThhmmss.sssZ *Sxxxxx.xx    % this is the instrument response
```

The input to be parsed is the numerical value following the instrument time stamp and the "*", formatted as 2 decimal place floating point value, width of 8 including decimal, signed, padded with zeros (%+07.1f).

Ideally, all three RTD sensors will be queried within a second, and thus have a Digiport time stamp that is the same (resolved to 1 second). However, at the time of this DPS creation the ability for ION to query and digest data from the three RTD sensors is untested, although the response time for the "RD" command is 10mS. The default sampling period will initially be 15 s.

Example RASFL data output:

```
$1RD        % this is a local echo of the query to #1
*+00021.7   % this is the instrument response
$2RD        % this is a local echo of the query to #1
*+00032.2   % this is the instrument response
$3RD        % this is a local echo of the query to #1
*+00185.6   % this is the instrument response
```

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 document (DCN 1342-00140). This processing flow document contains 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.

The processing flow for the temperature computation is as follows:

Step 1:
Parse t_vent_1 from instrument ASCII string from query to RTD1 ($1RD). Time stamp for all three sensors from Digiport response on this query.

Step 2:
Parse t_vent_2 from instrument ASCII string from query to RTD2 ($2RD).

Step 3:

Parse t_vent_3 from instrument ASCII string from query to RTD3 ($3RD).

4.4 Outputs

The outputs of the parsing are

- T1: RTD1 Temperature, ℃, %.1f. (Digi timestamp—this will be used for timestamping the array for T1-T2-T3)
- T2: RTD2 Temperature, ℃, %.1f. (Digi timestamp)
- T3: RTD2 Temperature, ℃, %.1f. (Digi timestamp)

The metadata that must be included with the output are

- A flag indicating the sampling status of the RASFL and PPSDN instruments. See DPS for PHSSAMP - 16s rRNA sequence of filtered physical sample (DCN 1341-00641) and DNASAMP – Physical Fluid Sample (DNC 1341-00630).
- Description of position of sensors T1, T2 and T3

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

Time stamp should be the time from the Digiport, rather than from the data string, or ION. As all three temperature sensors can be queried within one second, it would be preferable to combine the three outputs into a single array with a single timestamp (of the last query, eg [Timestamp T1 T2 T3]).

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.

4.5.2 Computational Requirements

Not Applicable.

4.6 Code Verification and Test Data Set

The code will be verified using the test data set provided, which contains inputs and their associated correct outputs. CI will verify that the code is correct by checking that the output, generated using the test data inputs, is identical to the test data output.

The test data set below provides a few data points.

Input:

```
$1RD #this, as with all the commands below, is a local echo
*+00031.4
$2RD
*+00032.2
$3RD
*+00185.6
$1RD
*+00032.6
$2RD
*+00033.3
$3RD
*+00184.6
$1RD
```

```
*+00030.9
$2RD
*+00033.0
$3RD
*+00185.1
$1RD
*+00031.2
$2RD
*+00032.9
$3RD
*+00185.3
```

Output:

(Digi timestamp = DTS, of the 1st query)

As the RTDs can be queried within one second the output should be:
[DTS T1 T2 T3]
[DTS 31.4 32.2 185.6]
[DTS 32.6 33.3 184.6]
[DTS 30.9 33.0 185.1]
[DTS 31.2 32.9 185.3]

L1 product includes the 3 Seafloor Temperature products (T1, T2, T3) merged with the time stamp information corresponding to the query for T1. The 3 temperature values can be stored in an array, but should have the full functionality during plotting and downloads of 3 parameters.

In addition, the output should have metadata fields containing a flag indicating the status of sampling activities by the RASFL or PPSDN instruments, and a short description of the position of the sensors T1, T2 and T3.

Appendix A Example Code

Not applicable.

Appendix B Output Accuracy

The accuracy of the L1 product is identical to the instrument accuracy.

The OOI-RSN requirements for the accuracy and precision of the Seafloor Temperature measurement, as represented in DOORS are:

> Temperature shall be measured with an accuracy of ±0.5℃. <L4-RSN-IP-RQ-666>
>
> Temperature shall be measured with a precision of ±0.5℃. <L4-RSN-IP-RQ-667>

Factory reported resolution and accuracy are 0.1℃ and 0.3℃, respectively, for the 4-wire RTD design.

Appendix C Sensor Calibration Effects

The three temperature sensors are calibrated in ice water and boiling water and compared to a laboratory Hg thermometer. Data were collected over the network. The standard deviation of all probes was less than 0.1℃ at zero and 100, and the accuracy was within 0.5℃.