UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NOAA Marine and Aviation Operations
NOAA Ship FAIRWEATHER S-220
1010 Stedman Street
Ketchikan, AK 99901

May 21, 2014

MEMORANDUM FOR: Commander Benjamin K. Evans, NOAA
Chief, Pacific Hydrographic Branch

FROM: Commander David J. Zezula, NOAA
Commanding Officer, NOAA Ship *Fairweather*

David Zezula
2014.05.26 16:27:48 -08'00'

TITLE: 2013 Data Acquisition and Processing Report Approval
(OPR-L318-FA-13)

As Chief of Party, I acknowledge that all of the information contained in this report is complete and accurate to the best of my knowledge.

This report is respectfully submitted to N/CS34, Pacific Hydrographic Branch.

In addition, the following individuals were responsible for oversight and compilation of this report:

Tami M. Beduhn
Chief Survey Technician

Ryan Wartick
2014.05.26
16:17:28 -08'00'

Lieutenant Ryan A. Wartick, NOAA
Field Operations Officer

Attachment

APPENDICES

A. INTRODUCTION

This Data Acquisition and Processing Report outlines the acquisition and processing procedures used for the Hydrographic survey of Central Puget Sound (OPR-N395-FA-13) by NOAA Ship *Fairweather*.

Survey specific details will be listed in Descriptive Reports as needed. Unless otherwise noted, the acquisition and processing procedures used and deliverables produced are in accordance with the NOAA *Hydrographic Survey Specifications and Deliverables Manual (HSSD) April 2013*, the *Field Procedures Manual (FPM), April 2013*, and all active Hydrographic Surveys Technical Directives (HTD).

Any additions and changes to the following will be included with the individual Descriptive Reports or by submission of an addendum.

B. EQUIPMENT

Detailed descriptions of the equipment and systems, including hardware and software, used for bathymetric data acquisition and processing are listed below.

1.0 Hardware

1.1 Hardware Systems Inventory

Detailed hardware information, including models and serial numbers, is included in Appendix I of this report. All launch hardware was installed during April 2013. Manufacturer's product specifications are maintained with reference documentation on board *Fairweather*.

1.2 Echo Sounding Equipment

1.2.1 Reson 7111 Multibeam Echosounder (MBES)

Fairweather is equipped with a Reson 7111 MBES. The system was upgraded from a Reson 8111 in October 2009, which involved replacing the dry end transceiver and processor units but leaving the wet end hull-mounted projector and receiver intact. The Reson 7111 is a 100 kHz multibeam system with swath coverage of 150°. The swath is made up of 301 discrete equidistant beams with an along-track and across-track beamwidth of 0.5°. It has a specified depth range of 3 to 1200 meters, though the typical operational depth range of the Reson 7111 on *Fairweather* is 20 to 300 meters. No calibration information was provided by the manufacturer for the system. However, since there are a limited number of systems in the world used for hydrography, we have worked with RESON and INFREMER regarding improvement with the sonar bottom detection algorithms. Engineering quality receiver and transceiver boards were replaced in 2012 with new production level boards.

The Reson 7111 is hull-mounted within a reinforced projection that extends 27 inches below the keel. It is located 39.5" starboard of the centerline at approximately frame 29 (see Figure 1 & Figure 2).

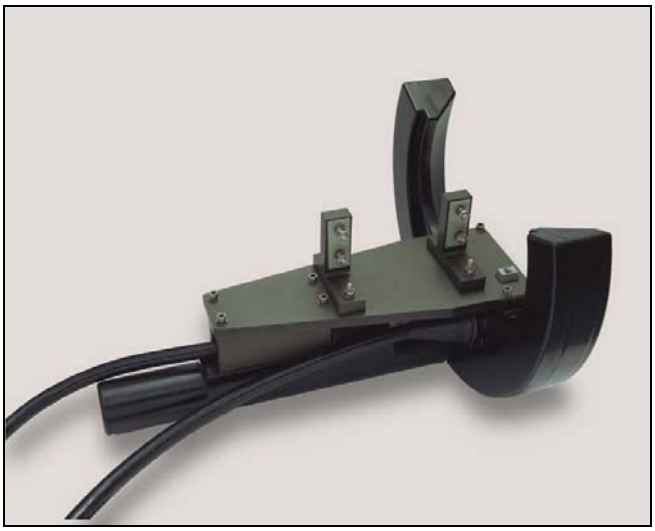

Figure 1: RESON SeaBat 7111 MBES

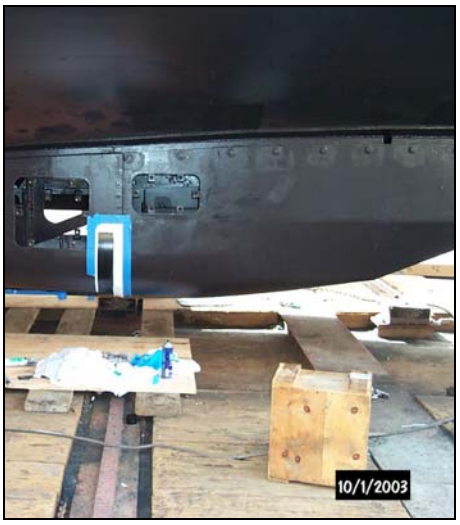

Figure 2: 7111 Installed on *Fairweather*

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Unusually high uncertainty values are often experienced in the outer 6 degrees of Reson 7111 data on either side of the swath. To avoid exceeding IHO Order 1 specifications for depths shoaler than 100 meters, these outer beams were rejected in post processing for surveys with data collected in this depth range. Multibeam line spacing is tightened in these areas during acquisition to prevent the creation of holidays in the data.
Use of the RESON 7111 was limited to mid-season due to a failure of the systems receiver assembly. No data was collected following this failure and the system is currently scheduled to be replaced.

1.2.2 Reson 7125 SV Multibeam Echosounder (MBES)

Survey launches 2805, 2806, 2807, and 2808 are each equipped with a dual frequency Reson 7125 SV MBES. The Reson 7125 SV has both a low frequency (200kHz) and high frequency (400kHz) transmit array with a swath coverage of 128°. The swath is made up of 256 discrete beams for 200 kHz and both 256 or 512 discrete beams for 400 kHz. The typical operational depth ranges for the Reson 7125 SV operating at 200kHz is 3 to 400 meters and 3 to 100 meters operating with the 400kHz system. Each system is hull mounted along the centerline and includes a single topside unit (see Figure 3 & Figure 4. No calibration information was provided by the manufacturer for the systems; however, the unit installed on 2805 was tank calibrated for backscatter at the University of New Hampshire (UNH) during the winter of 2011. Preliminary calibration reports are forthcoming. Research is ongoing for 7125 SV backscatter calibration.

Figure 3: Reson 7125 SV topside processor

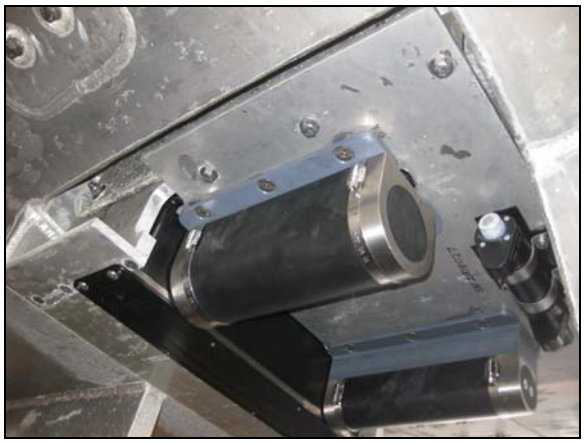


Figure 4: Reson 7125 SV transducer arrays

1.2.3 Reson 8125 Multibeam Echosounder (MBES)

Fairweather is equipped with a Reson SeaBat 8125 MBES with snippet option. The Reson 8125 is a 455 kHz multibeam system with swath coverage of 120°. The swath is made up of 240 discrete beams with an along-track beamwidth of 1° and an across-track beam spacing of 0.5°. It has a maximum range scale of 120 meters for surveying depths less than 60 meters with a complete swath. The typical operational depth range of the Reson 8125 is 3 to 50 meters. No calibration information was provided by the manufacturer for the system.

The system can be attached to any of the launches using a bolt-on variable angle adjustable sled mount which can be on either side of the keel and approximately centered fore and aft (see Figure 5). The configuration can be mounted from 0 – 33 degrees off center. The tilt mount system is utilized to assist with ensonifying vertical surfaces or inshore features for safer near-shore MBES collection.

Figure 5 : Reson 8125 Tilted Head Mounted on Launch 2808

This sonar was installed for a brief period of time during LA / Long Beach surveys H12617 and H12618. During that time, suitable patch values were unable to be determined after several attempted patch tests. The values from the previous installation of the same mount provided the best quality data and were deemed sufficient by Fairweather personnel for the limited 8125 data submitted with survey H12618. Reson 8125 MBES data for H12617 was not deemed useful as it only contributed with the ensonification of kelp on the breakwaters and the seafloor under piers within the harbor. The RAW data was submitted for archival to NGDC, however, the processed depths were not retained.

1.3 Positioning, Heading, and Attitude Equipment

1.3.1 Applanix Positioning and Orientation System for Marine Vehicles (POS MV)

Fairweather and her launches are each equipped with a POS MV 320 V4, configured with TrueHeave™. The POS MV calculates position, heading, attitude, and vertical displacement (heave) of a vessel. It consists of a rack mounted POS Computer System (PCS), a strap down IMU-200 Inertial Measurement Unit (IMU), and two GNSS antennas corresponding to GNSS receivers in the PCS. Launches 2805, 2806, 2807, and 2808 are equipped with Zephyr II GNSS antennas with BD960 (Launch 2805) and BD950 (Launch 2808) PCS receiver cards. Both launch PCS units for 2805, 2806, 2807, and 2808 have internal logging capabilities to eliminate packet drops across the acquisition network. The port side antenna is designated as the primary receiver, and the starboard side antenna is the secondary receiver for all vessels (see Figure 6). The POS MV firmware versions and the controller software versions that are currently installed are listed in the Hardware Inventory in Appendix I.

For all multibeam systems aboard *Fairweather's* launches, timing between the sonar swath, position, heading and attitude information was synchronized by utilizing the proprietary UTC string from POS MV. A timing string is sent from the POS MV to the Reson topside unit via serial connection and to the Hypack acquisition computer via Ethernet.

For the launch PCS units with internal logging capabilities, data is logged as small 12 MB files which can be concatenated into a single .000 file. When files are concatenated, it occurs through the NOAA in-house tool "POSConcatenator" created by Grant Froelich of the Pacific Hydrographic Branch.

POS MV controller software was used to monitor position accuracy and quality during data acquisition. This ensured that positioning accuracy requirements are met, as outlined in section 3 of the *HSSD*. The POS MV controller software provides clear visual indications whenever accuracy thresholds are exceeded.

1.3.2 POS MV GAMS Calibration

In the spring of 2013, GNSS Azimuth Measurement System (GAMS) calibrations were performed on each of *Fairweather's* POS MV units mounted to launches 2805. The GAMS calibration procedure was conducted in accordance with instructions in chapter 4 of the *POS MV V4 User Guide*, 2009. Results and calibration reports are maintained with reference documentation aboard *Fairweather*. Actual calibration dates are listed in the Hardware Inventory included in Appendix I.

Figure 6: POS GNSS Antennas

1.3.3 DGPS Receivers

Launches 2805, 2806, 2807, and 2808 are equipped with Hemisphere GPS MBX-4 DGPS receivers to correct the POS MV GPS positions used during real-time MBES and SSS data acquisition. The DGPS receivers are configured in manual mode to allow reception of only one U.S. Coast Guard (USCG) differential GPS beacon station at a time.

Differential GPS (DGPS) is the primary method of real-time positioning. The individual descriptive reports for each survey list the U.S. Coast Guard beacon sites and frequencies used for differential corrections utilized during hydrographic surveying.

All individual vessel POSMV files from all platforms are post processed unless otherwise noted in respective survey Descriptive Reports and project Horizontal and Vertical Control Reports.

1.4 Sound Speed Equipment

1.4.1 Sound Speed Profiles

1.4.1.1 SBE 19plus SEACAT Profiler

Fairweather is equipped with two SBE 19*plus* and two SBE 19*plusV2* SEACAT sound speed profilers used to acquire conductivity, temperature, and depth (CTD) data in the water column to determine the speed of sound through water. One of the SBE 19*plus* profilers has pressure

sensors rated to 1000 meters. The second SBE 19*plus* profiler has a pressure sensor rated to 3,500 meters. The two SBE 19*plusV2* profilers have pressure sensors and units rated to 600 meters.

The SBE 19*plusV2* SEACAT sound speed profilers were calibrated by the manufacturer during the 2012-2013 winter repair period. The current calibration files can be found in Appendix I.

Periodic quality assurance checks include comparison casts between CTD instruments. Data quality assurance (DQA) checks are conducted during each survey leg include comparison casts between two instruments as per section 1.5.2.2.2 of the *FPM* for each survey. Records of the DQA tests performed are kept aboard the ship and are included with the digital Separates II – Sound Speed Data for each survey. To ensure that the CTDs continue to function properly a stringent maintenance schedule is followed using guidelines from the manufacturer's recommendations.

1.4.2 Surface Sound Speed

1.4.2.1 Reson Sound Velocity Probe (SVP 71)

Survey launches 2805, 2806, 2807, and 2808 are each equipped with a Reson SVP 71. The SVP 71 measures the speed of sound near the transducer to provide real time surface sound speed values to the Reson 7125's processing unit. The 7125 SV requires surface sound speed information for beam forming due to the flat faced transducer. The units are hull-mounted adjacent to the Reson 7125's transducers as shown in Figure 7.

All of the sensors were initially calibrated by the manufacturer and current calibration files were supplied with the units upon receipt in 2010. The delivery calibration files can be found in Appendix I. Daily quality assurance checks are completed with the annually calibrated Seabird 19+ CTD's.

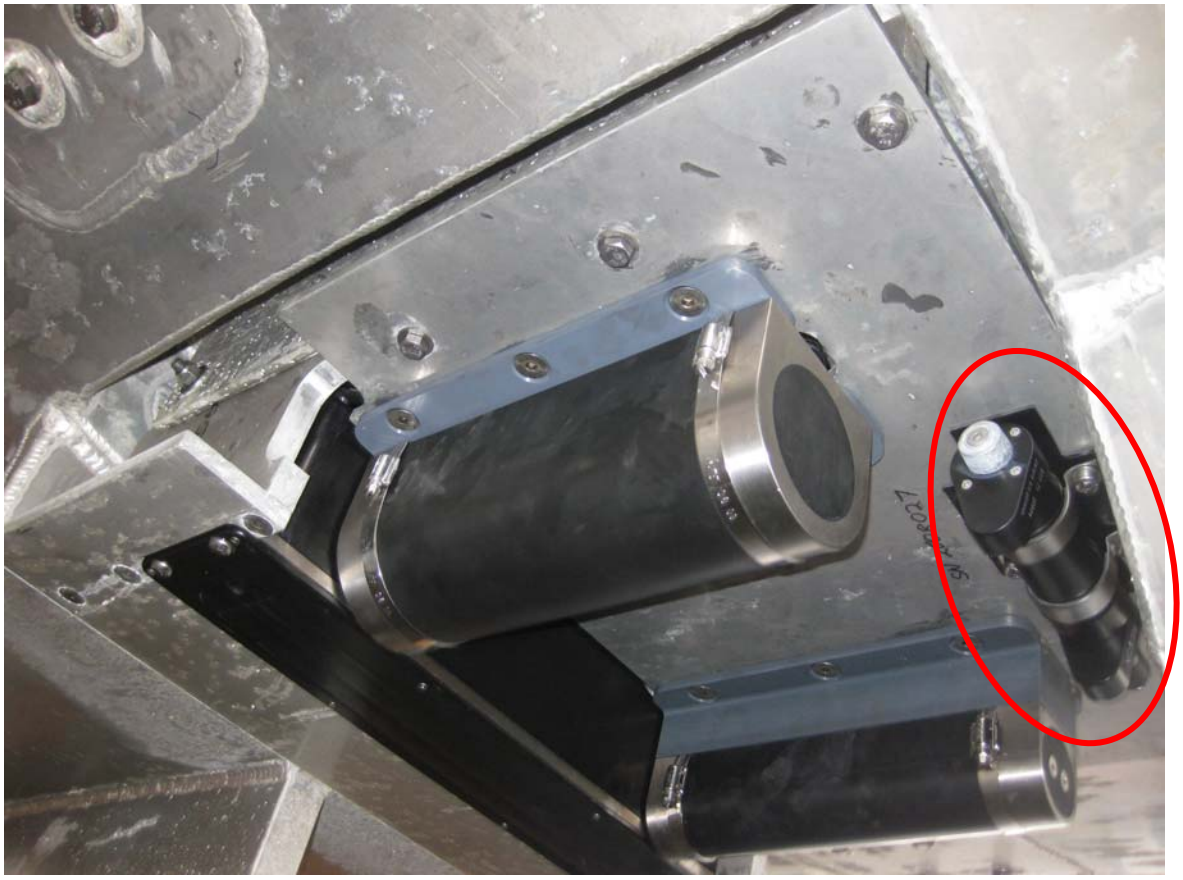


Figure 7: SVP 71 sound speed unit (right) and a Reson 7125

1.4.2.2 Reson Sound Velocity Probe (SVP 70)

1.4.2.3 Odom Digibar Pro

Fairweather is equipped with one Odom Digibar Pro. The Digibar measures the speed of sound near the Reson 8125 and is attached to the same sled mount to provide real-time surface sound speed values. The unit is mounted horizontally to starboard and above to the aft of the Reson 8125 on the sled as shown below.

Figure 8 : Odom Digibar and Reson 8125 Tilted Head on Launch 2808

2.0 Software

2.1 Software Systems Inventory

An extensive software inventory with documentation of the software systems used by *Fairweather* is maintained as a survey *Software Inventory* spreadsheet on board *Fairweather*. This spreadsheet includes specifics such as software applications, versions, and hotfixes that are loaded on specific survey processing computers. Snapshot .pdf files are produced approximately bi-monthly or whenever a major software update occurs. The snapshot inventories are included within Appendix I of the DAPR.

2.2 Data Acquisition Software

2.2.1 Hypack® Hysweep

Fairweather uses the Hypack® Hysweep acquisition software package to log all Reson MBES data. Hysweep displays real-time MBES coverage geo-referenced against supporting background files such as charts and vector shoreline files for launch coxswain to follow to acquire adequate MBES coverage. The Hypack Devices (Hysweep Interface and Applanix POS MV Network) and Hysweep Hardware (Hypack Navigation, Applanix POS MV Network, and Reson) *.ini files are created with the support of HSTP field support liaison and are in accordance with HSTP's configuration management documentation.

Three types of files are recorded per logged line of Reson MBES data: .raw, .hsx, and .7k. The .raw file contains the raw navigation files recorded directly from the POS MV (as device 0) and from Hysweep (as device 1). The .hsx files contain data from Hypack Navigation (as device 0), POS MV (as device 1), and the Reson MBES (as device 2). The .7k file contains all raw data that Hysweep can read from the Reson, including the Reson 7008 snippets message.

The .hsx and .raw files are converted into HDCS data in CARIS HIPS by *Fairweather* personnel. The .7k file is not post-processed by *Fairweather* personnel but is recorded for and submitted with the other raw data for outside backscatter research, processing and product development. All three raw files are submitted directly to NGDC for archival.

2.2.2 Applanix POSView

Applanix POSView is the controller software for the POS MV. POSView is used to configure the serial and network input and output ports on the POS MV PCS. POSView is also used to monitor real-time position, attitude data, and their associated accuracies and to log POSPac .000 files. The POSPac .000 file contains the TrueHeave information that is applied to the MBES HDCS data in CARIS HIPS immediately after conversion. The POSPac .000 file is also post-processed into a PPK SBET file using Applanix's POSPac processing software.

2.3 Data Processing Software

2.3.1 CARIS

CARIS HIPS™ (Hydrographic Information Processing System) is used to process all multibeam data including data conversion, filtering, sound speed corrections, tide correction, merging and cleaning. CARIS HIPS also calculates the Total Propagated Uncertainty (TPU) used to produce Bathymetry Associated with Statistical Error (BASE) surfaces which assist the Hydrographer in data cleaning and analysis, and to produce BASE surfaces.

CARIS SIPS™ (Sonar Information Processing System) is used to process all side scan imagery data including data conversion, altitude adjustment, slant-range correction, and beam pattern correction. CARIS SIPS is also used to inspect the imagery for contacts and to produce side-scan imagery mosaics.

CARIS Notebook™ and CARIS Bathy DataBASE™ BASE Editor (BDB) are used to compile, display, and edit source shoreline, shoreline updates and S-57 features that are collected directly in the field. The .hob files created in Notebook and BDB are exported to S-57 file format as the current shoreline deliverables.

CARIS Bathy DataBASE™ BASE Editor is also used for data quality assurance checks on the BASE surface and for surface differencing.

CARIS Plot Composer is used to create final field plots and special constituent products.

2.3.2 Fledermaus™ and FMGT

Fledermaus ™, an Interactive Visualization Systems 3D™ (IVS 3D) program, is used for data visualizations and creation of data quality control products, public relations material and reference surface comparisons. *Fairweather* personnel process one line of multibeam backscatter per sonar, per day to check Reson Snippet backscatter data in following with the best practices established by NOAA personnel to date. If warranted, specifics of its use or findings for a given survey will be documented in the individual descriptive report.

2.3.3 Applanix POSPac MMS and POSGNSS

Applanix POSPac MMS and POSGNSS are used to post process POS MV data files logged during MBES acquisition. The Single Base PPK processing method is typically used when a single *Fairweather* or third party GPS base station is operating within approximately 20 kilometers of MBES acquisition. The SmartBase™ PPK processing method is used when a stable network of approximately 5-10 available third party GPS base stations such as those in the Continuously Operating Reference Station (CORS) system or Plate Boundary Observatory (PBO) suite of stations exists within approximately 200 kilometers of MBES acquisition. On occasion Precise Point Positioning (PPP) is used when sufficient base stations are not available for Single Base or SmartBase™ PPK. In general, *Fairweather* processing procedures follow the methods outlined in the *POSPac MMS GNSS-Intertial Tools User Guide* for each method. Processing methods specific to each project are documented in the Project Horizontal and Vertical Control Report. Processing methods specific to each survey are documented in the Descriptive Report

2.3.4 Velocipy

Velocipy is a NOAA in-house software supported by the Hydrographic Systems and Technology Program (HSTP) that is used to process raw sound velocity cast files taken with the SEACAT CTDs on the launches and the MVP from the ship. Velocipy creates CARIS format .SVP files that are applied during post processing in HIPS to MBES HDCS data to correct for sound speed. The individual CTD and MVP files are concatenated into a single vessel file by survey. Each vessel file contains the survey registry number and the time and location of each sound speed profile measured.

2.3.5 Pydro

Pydro, another NOAA program produced and maintained by HSTP, is used to produce Final Water Level Requests along with DTON Reports and Survey Feature Reports. The xml Descriptive Report (DR) is produced using the xmlDR component of Pydro, the DR pdf file is then produced via a stylesheet. In addition, Pydro is used for Tidal Constituent and Residual Interpolation *(*TCARI) tide application in conjunction with CARIS HIPS and various other macros.

Pydro is utilized to assist with sidescan and multibeam contact correlation. Information about each contact is easily entered, images can be added and a final feature report can be produced.

3.0 Vessels

3.1 Vessel Inventory

Fairweather's survey launches 2805, 2806, 2807, and 2808 are equipped to acquire multibeam echosounder (MBES) and sound speed profile (.svp) data. See Appendix I for the complete vessel inventory.

4.0 Data Acquisition

4.1 Horizontal Control

A complete description of horizontal control will be included in the project's *Horizontal and Vertical Control Report (HVCR)*, submitted for each project under separate cover when necessary as outlined in section 8.1.5.2 of the *HSSD* and section 5.2.3.2.3 of the *FPM*.

The horizontal datum for all projects is the North American Datum of 1983 (NAD83) unless otherwise noted in the individual descriptive reports.

Multibeam and shoreline data are differentially corrected in real time using correctors provided by Coast Guard beacons. The specific beacons used for a given survey will be included in the Horizontal Control section of the survey's descriptive report. If loss of the differential beacon resulted in any data being recorded with C/A GPS positions it will be noted in the Descriptive Report for the specific survey.

When possible, real time DGPS positioning may later be replaced with a post processed kinematic (PPK) single best estimate of trajectory (SBET). The PPK solution is usually dependent on a local base station supported by the ship and processed in Applanix POSPac MMS software using Single Base mode. However, in areas with an adequate network of Continuously Operating Reference Stations (CORS) or public third-party base stations, Applanix POSPac SmartBase™ mode may be used. With either Single Base or SmartBase processing, the resulting navigation from PPK is an improvement over C/A and DGPS navigation. The details of PPK use and application for a given survey will be included in the Horizontal Control section of the project's *HVCR* or the survey's descriptive report.

4.2 Multibeam Echosounder Acquisition and Monitoring Procedures

Acquisition methods and platforms used are determined based on consideration of sonar system specifications, seafloor topography, water depth, and the capability of the acquisition platforms.

All multibeam data are acquired in Hypack's Hysweep® SURVEY extension (.hsx) format and monitored in real-time using the 2-D and 3-D data display windows and the on-screen displays for the Reson 7125 SV. Adjustable parameters that are used to control the Reson include range scale, power, gain, pulse width, absorption, and spreading. These parameters are adjusted as necessary to acquire the highest quality of bathymetry and backscatter. Vessel speed is predominantly between 6-8 knots for acquisition with launch 7125 SV systems. Speeds are reduced as needed to eliminate noise from the data and to ensure the required along-track coverage for object detection in accordance with the *HSSD*.
Survey personnel follow standard operating procedures documented aboard *Fairweather* while setting and utilizing the Reson systems and Hypack for data acquisition. The sensor offsets and mounting biases are entered into the Hysweep® Hardware Reson device. This information is recorded in the Hypack hsx file header for corrected backscatter mosaics created with Hypack Geocoder. These offsets do not have any effect on CARIS HIPS HDCS sounding corrections.

Navigation and motion data are acquired and monitored in POSView and logged into a POS MV file with a .000 extension. Various position and heading accuracies, as well as satellite constellations, are monitored real-time both in POSView and Hypack Hysweep®.

Main scheme MBES acquisition lines using the Reson 7125 SV are generally run parallel to the contours with appropriate overlap to ensure data density requirements for finalized BASE surface resolutions are met. For discrete item developments, 200 percent coverage is acquired to ensure least-depth determination by multibeam near-nadir beams. Hypack Hysweep® real-time coverage display is used in lieu of pre-planned line files. Hysweep® displays the acquired multibeam swath during acquisition and is monitored to ensure overlap and full bottom coverage. If coverage is not adequate, additional lines are run while still in the area.

For areas where shoreline verification is not conducted before multibeam, extra caution is taken by "half stepping" shoreward when operating near shore. Half stepping is done by driving along the edge of real time coverage to prevent the survey vessel from ever being in un-surveyed waters. Survey launch crews in the field survey to the Navigable Area Limit Line (NALL) line as defined by section 1.1.2 of the *HSSD*.

4.3 Shoreline/Feature Verification

The composite source file (CSF) in S-57/.000 format provided with the Project Instructions is the primary source for shoreline features to be verified. The original project file is imported into CARIS BASE Editor, converted to a .hob file, clipped to the sheet limits for the specific survey, and named H#####_Original_Composite_Source.hob to be included with the deliverables. This file is then copied and named H#####_Feature_File.hob to be utilized during field verification. Additionally, AWOIS items and other features to be investigated are provided to the field in the project reference file (PRF). All hob files are re-exported to S-57/.000 format for data submission.

Fairweather personnel conduct limited shoreline verification and reconnaissance at times near predicted negative tides within the survey limits when possible, as directed by section 3.5.5.3 of the *FPM*. Detached positions (DPs) are acquired and edits to the daily field feature files are recorded in CARIS Notebook and on paper DP forms and boat sheets.

An inshore limit buffer line, offset 0.8 mm from the Mean High Water (MHW) line at the scale of the largest chart in the area, is provided with the Project Instructions. This inshore limit buffer line is used in the shoreline acquisition software and on the boat sheet as a reference, and utilized as described in section 1.1.2 of the *HSSD*. The NALL is determined in the field as the farthest off-shore of one of the following; the MHW inshore limit buffer specified above, the 4-meter depth contour, or the inshore limit of safe navigation as defined by the *HSSD*. All shoreline features from the CSF seaward of the NALL are verified (including an update to depth and/or position as necessary) or disproved during operations. Features off-shore of the NALL and not addressed or features of an ambiguous nature include remarks for further clarification. Specifically assigned features may be investigated that are inshore of the NALL in accordance with the associated instruction for a given project area.

Detached positions (DPs) acquired during shoreline verification indicate new features, revisions to source features, or source features not found in the field. They are recorded in the shoreline acquisition software and on DP forms.

4.4 Bottom Samples

Bottom samples are acquired according to section 7.1 of the *HSSD*, any deviations from this protocol will be outlined in the individual Descriptive Report for the survey. Samples are acquired using CARIS Notebook, Hypack target files (.tgt), or by logging the latitude, longitude, and bottom characteristics manually. All samples are processed similarly to other shoreline features as outlined below in section C - 2.2 of this report. Bottom sample results are included in the Notebook .hob deliverable layer, HXXXXX_Final_Feature_File and are descriptively attributed as New.

4.5 Sound Speed

Sound speed casts are taken at least once every 1–4 hours during multibeam survey operations in accordance with section 3.5.1 of the FPM. *Fairweather's* launches collect sound speed casts approximately every 2 hrs utilizing the SBE 19*plus and 19plus V2* SEACAT sound speed profilers. These casts are then compared once daily to the SVP 71 surface sound speed (SSP) sensors to verify their accuracy in lieu of annual SVP 71 calibration. The results of the daily SSP sensor comparisons are logged in the excel acquisition log to track instrument health. Deviations from this procedure will be outlined in the individual Descriptive Report for the survey.

C. QUALITY CONTROL

Fairweather has numerous standard operating procedures (SOPs) that are followed by personnel throughout the survey to ensure consistent high quality data and products.

1.0 Uncertainty Modeling

Uncertainty values for the multibeam and positioning systems on *Fairweather* and her survey launches were compiled from manufacturer specification sheets for each sensor (Heave, Pitch, Roll, Position, and Heading) and from values set forth in section 4.2.3.8 and Appendix 4 – CARIS HVF Uncertainty Values of the 2013 *FPM*.

The manufacturer specification for POSMV heading accuracy is contingent on a 2 meter baseline between primary and secondary GPS antennas. While the *Fairweather* has a 2 meter baseline her launches have on average a 1.4 meter baseline which has been seen to increase accuracy estimates in the field. Based on observations in the field, the heading error value for all launches has been increased from the manufacturer specification and FPM guidance to 0.04 degrees.

Estimates for the Motion Reference Unit (MRU) alignment errors are taken from the standard deviation of the values determined by multiple personnel processing the patch test data (see section D 4.0). In some instances, outlier patch test values are excluded to allow more reasonable MRU uncertainty values.

The *Fairweather* TPU Values spreadsheet located in Appendix III, lists the final uncertainty values for *Fairweather* and her launches, including the default tides and sound velocity values. Uncertainty values relating to vessels and survey systems are entered into the HIPS Vessel File

(HVF) for each platform. The tidal errors for the gauge and for zoning are determined on a project by project basis. Sound speed uncertainties for a given survey are based upon either the defaults listed in the TPU value spreadsheet or based on utilization of NOAA sound speed uncertainty estimation software. Survey specific uncertainty values for tides and sound speed that are entered during the Compute TPU step in CARIS HIPS and how they were determined will be included in the individual Descriptive Report. After SBET application, TPU values are recalculated using the Error Data option for Uncertainty Source in the CARIS Compute TPU window. This loads more precise residual mean square (RMS) values to selected HDCS lines for position, roll, pitch and gyro.

2.0 Data Processing

2.1 Multibeam Echosounder Data Processing

Bathymetry is processed following section 4.2 of the *FPM* unless otherwise noted.

Raw multibeam data is recorded as .HSX files in Hypack, and then converted to CARIS HIPS HDCS format using established and internally documented settings. After TrueHeave™, sound speed, and water level correctors are applied to all lines, the lines are merged. Once lines are merged, Total Propagated Uncertainty (TPU) is computed.

Bathymetric surfaces are created and analyzed using the resolution, depth range, and CUBE parameters outlined in 5.2.2.2 of the HSSD. If these depth range values for specific resolutions require adjustment for analysis and submission of individual surveys then a waiver from HSD Operations is required and would be requested. A detailed listing of the resolutions and the actual depth ranges used during the processing of each survey, along with the corresponding fieldsheet(s), will be provided in the Descriptive Report of each survey.

BASE surfaces are created using the Density & Locale function of the CUBE algorithm and parameters contained in the NOAA CUBEParams_NOAA.xml. The CUBEParams_NOAA.xml will be included with the HIPS Vessel Files with the individual survey data. The NOAA parameter configurations for resolutions 1-32 meters are used.

Multibeam data are reviewed and edited in HIPS subset mode and in swath editor as necessary. The finalized BASE surfaces and CUBE hypotheses are used for directed data editing at the appropriate depth range in subset editor. The surfaces and subset editor view are also used to demonstrate coverage and to check for errors due to tides, sound speed, attitude and timing.

Vessel heading, attitude, and navigation data are reviewed in HIPS navigation editor and attitude editor if deemed necessary upon review of surfaces. Where necessary, fliers or gaps in heading, attitude, or navigation data are manually rejected or interpolated for small periods of time. Any editing of this nature will be outlined in the Descriptive Report for the particular survey.

The Surface Filtering functionality in HIPS may be used in the processing of survey data to reject errant soundings. If utilized, the individual Descriptive Report shall list the confidence

level settings for standard deviation used and discuss the particular way the surface filter was applied.

In depths less than 20 meters and deeper and in areas of navigational significance where the BASE surface does not depict the desired depth for the given area, a designated sounding is selected. Designated soundings are selected as outlined in section 5.2.1.2 of the *HSSD*.

Layers determining "IHOness" are added to the CUBE surfaces allowing the Hydrographer to see where and if the surfaces meet IHO Order. The process is easily performed in HIPS and allows the Hydrographer to identify areas of high uncertainty with respect to depth. This is a spatial quality control check rather than just a statistical list of nodes and allows for specific areas with problems to be isolated and addressed. The following logic equation is used to create "IHO_1" child layers in the 1 through 8 meter finalized surfaces:

IHO-1: -Uncertainty/((0.5^2 +((Depth*0.013)^2))^0.5),

and an "IHO_2" child layer is created in the 8, 16 meter, and greater finalized surfaces using

IHO-2: -Uncertainty/((1.0^2 +((Depth*0.023)^2))^0.5).

It should be noted that both IHO order 1 (~80 to 100) and order 2 (100 to 176) child layers are created for the 8 meter surface since it overlaps the order 1 and order 2 boundary (order1<100 meters, order 2>100 meters). IHO surfaces are used during processing to indicate potential problem areas requiring attention or documentation. Observed grid node uncertainty values are compared to IHO order 1 and Order 2 uncertainty standards. The percentage of nodes meeting or exceeding these standards is calculated for each HIPS CUBE surface with a NOAA-supported and distributed script, and then reported in the Descriptive Report. For surveyed areas that do not meet IHO standards, images of affected areas may be included.

The individual finalized or combined surface's IHO layers are exported from CARIS as a text file and examined to allow the Hydrographer to see the full data distribution rather than just the minimum and maximum values in the surface. These data distribution are used to assess the quality of the survey, to ensure ninety-five percent of the data meets the appropriate IHO order as specified in section 5.1.3 of the *HSSD*.

Additionally, a combined surface is reviewed in 3-D mode using one of the following programs, CARIS HIPS, CARIS Base Editor, or IVS Fledermaus, to ensure that the data are sufficiently cleaned for submission.

2.2 Shoreline/Feature Data Processing

During shoreline verification, field detached positions (DP) are acquired with CARIS Notebook or Hypack .tgt files. Tide application for features requiring tide correction is applied in CARIS Notebook when using discrete zoning.

New features and any updates to the composite source shoreline, such as ledges or reefs, are acquired or digitized with S-57 attribution and compiled from the field daily files into the H#####_Final_Feature_File.hob. Updates to source shoreline features primarily include a change in depth/height, position, or S-57 classification. If the position of a feature changes, current guidelines are to delete current feature and create a new feature in the new location. Any changes to depth/height or S-57 classification are done so as an update to the S-57 object with the inclusion of NOAA's object attributes.

The SORIND and SORDAT S-57 attribute fields for new features or modified source features are updated to reflect the information for the associated survey number and date (US,US,graph,H#####). All new or modified features are S-57 attributed as applicable and descriptively attributed as New or Update respectively. All unmodified source features retain their original SORIND and SORDAT values. Assigned features that are addressed but not updated are descriptively attributed as Retain and unaddressed assigned features are attributed as Not Addressed.

Short descriptive comments taken from the boat sheets or DP forms along with investigation or survey methods are listed under the Remarks field. For significant features that deserve additional discussion, the Hydrographer may include a recommendation to the cartographer in the Recommendations field, along with the Hydrographer notes and investigation methods provided in the Remarks field.

Features that are disproved or that do not adequately portray the shoreline are descriptively attributed as Delete in the H#####_Final_Feature_File.hob layer. Features with the attribution of Delete retain their original SORIND and SORDAT values and include a recommendation from the Hydrographer along with an informative remark.

AWOIS investigation items are received in the Project Reference File and investigated as necessary. Features correlated to the AWOIS item are included in the H#####_Final_Feature_File.hob layer and labeled with the appropriate AWOIS number and include a remark detailing the search methods and a recommendation from the Hydrographer. Items will be attributed as AWOIS for reporting purposes. Any features that are submitted as dangers to navigation (DTON) will be attributed accordingly for reporting purposes. The status of Primary or Secondary may be attributed to aid in deconflicting multiple positions or instances of the same feature.

Images are labeled and associated with a DP/userid number or other descriptive/unique name. They are included with the survey data and stored in the CARIS/Multimedia folder with the deliverables. References to the images are listed with file extension and comma delimited in the Images attribute for the specific feature.

The CARIS Notebook files along with CARIS HIPS BASE surface(s) are viewed to compare MBES coverage and features simultaneously. The current NOAA object catalog will be used for CARIS Notebook processing and the version of such will be documented in the individual Descriptive Reports, along with any deviations in shoreline processing from those listed above.

Final shoreline deliverables are two S-57 (*.000) files exported from Notebook, the H##### Original Composite Source and the H##### Final Feature File, included with the processed data.

3.0 Data Review

Specific procedures are used on *Fairweather* to ensure quality control of data throughout acquisition, processing, and submission. These procedures are documented and followed by the Hydrographer. A detailed Quality Control check is performed by the survey manager. A detailed review is conducted by qualified survey personnel (FOO, CST, SST, or PS) other than the survey manager as an outside review of the survey data and deliverables. Submission checklists are used to ensure that all data and deliverables are complete and included upon submission. Documentation of these tasks is completed for every survey but only the final processing log, H##### Data Log, is included in the Separates submitted with the individual survey data.

D. Corrections to Echo Soundings

1.0 Vessel HVFs

CARIS HIPS Vessel Files (HVF) are created by *Fairweather* personnel and used to define a vessel's offsets and measurement uncertainty. The HVF is used for converting and processing raw Hypack .hsx and .raw files to CARIS HIPS HDCS format. The HVFs used for a given project are included with the digital data submitted with the survey.

2.0 Vessel Offsets

Sensor offsets are measured with respect to each vessel's reference point. The reference point for *Fairweather* and her survey launches 2805, 2806, 2807, and 2808 is the top, center of the POS MV IMU (Figure 9). The offset values from the reference point to the primary GNSS antenna are entered into Applanix's POSView POS MV monitoring software so that all raw position data are centered at the vessel's reference point. The CARIS HVF contains the offset from the vessel's reference point to the multibeam sonar reference point.

Figure 9: Vessel Reference Point (Top of POS MV IMU) & Primary GNSS Antenna (port side).

Additionally, the Reson 7125 sonar mounting offsets measured from the center of each projector to the center of the transceiver are entered in the Reson 7125 hardware configuration with the 7K Center for both the 400 kHz and 200 kHz projectors. The measured values are used instead of Reson's default values because *Fairweather's* mounts are slightly different than of Reson's standard sonar mount (Figure 10).

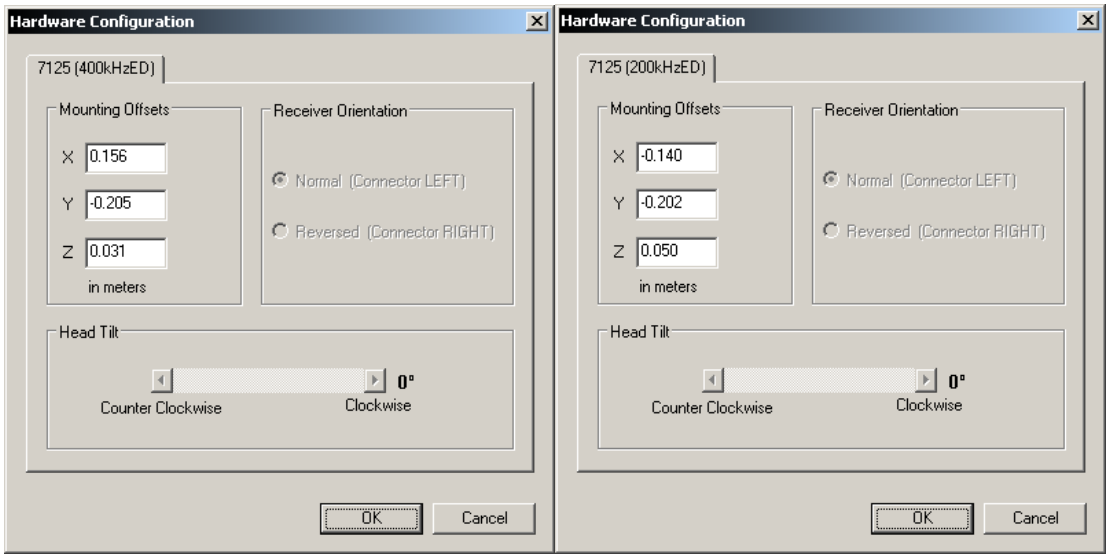


Figure 10: Reson 7125 sonar mounting with 400kHz and 200kHz offsets respectively.

Permanent control points were established on launches 2805, 2806, 2807, and 2808 during construction at All American Marine in 2009. Sensor offsets were measured by NGS in January 2010 using the methods described in the report on each launch located in Appendix II of this report. The resultant offsets, measurements, derivations, descriptions of methodology used, diagrams, and coordinate system references are included in the respective vessel's Offsets & Measurements spreadsheet also included in Appendix II.

Launch 2808 also had the Reson 8125 mounted in a tilted head configuration on September 11, 2013. Offsets for use in the HVF were measured in September 2010 and are documented in Appendix II.

3.0 Static and Dynamic Draft

The static drafts (Waterline Height in the HVF) for launches 2805, 2806, 2807, and 2808 were calculated based on steel tape and plumb bob measurements of the distance from benchmarks on the port and starboard quarter of the vessel to the waterline. The values and calculations for static draft of the various launches are listed in the respective Waterline Measurement spreadsheets included in Appendix II of this report. New values were inconclusive for 2806 and 2807; therefore previous values were retained as no modifications were made to the vessels since the previous measurements.

The dynamic draft data were acquired for launches 2805, 2806, 2807, and 2808 in Seattle, WA in Lake Washington. The measurements were made using the change in ellipsoid height while the vessels were transiting at different speeds in their respective locations. The ellipsoid heights were determined using Post Processed Kinematics (PPK) by recording POSPac data on each vessel and then processing the data with local reference stations in Applanix POSPac MMS software. The resulting Single Best Estimate of Trajectory (SBET) was exported from POSPac and the speed versus ellipsoid height was fit to a third order polynomial curve using a

least squares fit method in a Python Script written by NOAA personnel and implemented within Pydro. The polynomial curve was used to derive the table used in the CARIS HVF, and the standard deviation of the residuals was used to determine the associated uncertainty in the measurement. Written reports for each platform including initial measurement notes, graphs, and finalized values are provided in Appendix II of this report. The polynomial best fit curve of the ellipsoidal height differences from launches 2805, 2806, 2807, and 2808 compare well with each other and previous years. The dynamic draft offset values and standard deviations were then entered into the CARIS HVFs.

4.0 Patch Tests

Patch tests were conducted in accordance with section 5.2.4.1 of the HSSD on launches 2805 and 2808 for the Reson 7125 SV MBES sonar systems during the month of April 2013 using the Shilshole Bay Reference Surface and Patch Test site near Seattle, WA. Launches 2806 and 2807 Reson 7125 SV MBES sonar systems were patch tested September 2013 when the launches were brought back online after being inactive for two years. Launch 2805 was re patch tested in September 2013 and values post dated in HVF for season use. The results of all patch tests to date, along with the acquisition and processing logs, are included in the individual MBES Calibration files in Appendix II.

Also included in Appendix II is the sounding system comparison. This comparison includes surface differencing between launch reference surfaces using CARIS Bathy Database. The result of the comparison shows that the differences between each platform and sonar are within NOAA specification for vertical uncertainty.

5.0 Attitude and Kinematic Data

Vessel attitude is measured by the POS MV and recorded in the Hysweep .hsx file. Roll is corrected in real time for Reson 7125 SV data. Attitude correctors not applied in real time (heave, pitch, roll, and heading) are applied during post processing in CARIS HIPS using the raw POS MV attitude data recorded in the Hysweep .hsx file. Post processed kinematic (PPK) data from the POS MV .000 file are applied to MBES data in CARIS HIPS in the form of SBET files once all data acquisition is complete.

5.1 TrueHeave™

The POS MV TrueHeave™ data is logged within the POS MV .000 files and applied in CARIS HIPS during post processing using the "Apply TrueHeave" function during sound speed correction. TrueHeave™ is a forward-backward filtered heave corrector as opposed to the real time heave corrector, and is fully described in Section 6 of the *POS MV V4 User Guide 2009*. To ensure proper application in CARIS HIPS, POS MV files are logged for at least three to five minutes before and after all MBES files are logged.

In cases where TrueHeave™ cannot be applied, real time heave correctors are used. Real time heave data are recorded and stored in the Hypack Hysweep .hsx file and are applied as the heave corrector for MBES data if TrueHeave™ files are unavailable. Data that do not have TrueHeave™ applied will be listed in the individual Descriptive Report for the survey.

5.2 Post Processed Kinematic Data

Post Processed Kinematic (PPK) data in the form of Single Best Estimate of Trajectory (SBET) files are applied to soundings to increase the accuracy of the kinematic vessel corrections and to allow the ability to reference soundings to the ellipsoid.

Standard daily data processing procedures aboard *Fairweather* include post processing of POS MV kinematic .000 files using Applanix POSPac MMS and POSGNSS software using either Single Base batch processing or SmartBase processing. After processing and quality control analysis of the post-processed SBET files is complete, the SBET and SMRMSG files are applied to the HDCS data in CARIS HIPS using the "Load Attitude/Navigation Data", the "Load error data", and "Compute GPS Tide" processing tools. Ellipsoidal heights are contained within the PPK SBET files. Soundings to which SBETs have been applied can be reduced to the ellipsoid by merging the data in CARIS HIPS with "GPS Tide" applied. Data are frequently referenced to the ellipsoid during data analysis for troubleshooting unexplained vertical offsets, but are reduced back to MLLW for data finalization and submission.

Feature and bottom sample positions are not corrected with post processed GNSS data because at this time as there is not a developed nor streamlined procedure for PPK application to features.

6.0 Sound Speed

Seabird SBE 19*plus* and SBE 19*plusV2* sound speed profilers are used regularly to collect sound speed data for the Reson 7125 SV MBES systems on survey launches 2805, 2806, 2807, and 2808.

Daily sound speed profiles from the SBE 19*plus* and SBE 19*plusV2* profilers are processed with Velocipy and concatenated into single .svp files for each vessel per survey. Individual .svp files and the concatenated vessel files for the survey are submitted with each survey.

The concatenated sound speed files are applied to multibeam data in CARIS HIPS during data processing. CARIS HIPS uses one of four different methods to automatically apply a sound speed profile stored in a concatenated sound speed file. They are: "previous in time," "nearest in time," "nearest in distance" and "nearest in distance within time." The method of applying sound speed for a specific day of data collection is listed in the daily logs included as Separates submitted with the individual survey data.

7.0 Water Level

Unless otherwise noted in the survey Descriptive Report, the vertical datum for all soundings and heights is Mean Lower Low Water (MLLW). Predicted, preliminary, and/or verified water level correctors from the primary tide station(s) listed in the Project Instructions may be downloaded from the CO-OPS website and used for water level corrections during the course

of the project. These tide station files are collated to include the appropriate days of acquisition and then converted to CARIS .tid file format using FetchTides.

Water level data in the .tid files are applied to HDCS data in CARIS HIPS using the zone definition file (.zdf) or a Tidal Constituent and Residual Interpolation (TCARI) model supplied by CO-OPS. Upon receiving final approved water level data, all data are reduced to MLLW using the final approved water levels as noted in the individual survey's Descriptive Report.

If available, a VDATUM model comparison might be requested by Office of Coast Survey, Operations Branch. If accepted, CARIS HIPS data may be reduced to MLLW per supplied separation model instead of through traditional water level application. See the individual survey's Descriptive Report for further information.

A complete description of vertical control utilized for a given project can be found in the project specific *Horizontal and Vertical Control Report (HVCR)*, submitted for each project under separate cover when necessary as outlined in section 5.2.3.2.3 of the *FPM*.

Appendix I

System Tracking

1. **Vessel Inventory**
2. **Hardware Inventory**
3. **Computer Inventory**

Sound Speed Calibration Documentation

1. **SPE 19+**
2. **SPE 19+ V2**
3. **SVP 70**
4. **SVP 71**
5. **ODOM Digibar**

Hydrographic Vessel Inventory

Field Unit: FAIRWEATHER
Effective Date: September 13, 2010
Updated Through: November 11, 2010

SURVEY VESSELS						
Vessel Name	**FAIRWEATHER**	**Launch 2805**	**Launch 2806**	**Launch 2807**	**Launch 2808**	**RA Launch 2801**
Hull Number	S 220	2805	2806	2807	2808	2801
Call Letters	WTEB					
Manufacturer	Aerojet-General Shipyards	All American Marine	All American Marine	All American Marine	All American Marine	All American Marine
Year of Construction	1967	2009	2009	2009	2009	
Type of Construction	Welded steel hull - ice strengthened	Welded Aluminum	Welded Aluminum	Welded Aluminum	Welded Aluminum	Welded Aluminum
Length Overall	70.4 m (231')	8.64 m (28' 6")	8.64 m (28' 6")	8.64 m (28' 6")	8.64 m (28' 6")	8.64 m (28' 6")
Beam	12.8 m (42')	3.48 m (11' 5")	3.48 m (11' 5")	3.48 m (11' 5")	3.48 m (11' 5")	3.48 m (11' 5")
Draft	4.7 m (15' 6")	1.12 m (3' 8")	1.12 m (3' 8")	1.12 m (3' 8")	1.12 m (3' 8")	1.12 m (3' 8")
Cruising Speed	12.5 knots	24 knots	24 knots	24 knots	20 knots	20 knots
Max Survey Speed	8 knots	8 knots	8 knots	8 knots	8 knots	8 knots
Date of Effective Full Vessel Static Offset Survey	Origninal Survey 9/23/2003 POS/MV Offsets Surveyed 2/2007 and 2/15/2009	1/26/2010	1/26/2010	1/27/2010	1/27/2010	3/31/2008
Organization which Conducted the Effective Full Offset Survey	Original Survey - Westlake Consultants POS/MV Spatial Surveys - NGS	NGS/GSD	NGS/GSD	NGS/GSD	NGS/GSD	NGS/GSD
Date of Last Partial Survey or Offset Verification & Methods Used	n/a	n/a	n/a	n/a	n/a	n/a
Date of Last Static Draft Determination & Method Used	6/13/2011 Draft Marks	4/01/2013 Direct Measurement from benchmarks.	3/17/2011 Direct Measurement from benchmarks.	3/9/2011 Direct Measurement from benchmarks.	4/03/2013 Direct Measurement from benchmarks.	3/2/2013 Direct Measurement from Benchmarks.
Date of Last Settlement and Squat/Dynamic Draft Measurements & Method Used	4/19/2012 Post Processed Kinematic (Ellipsoidally referenced)	4/01/2013 Post Processed Kinematic (Ellipsoidally referenced)	9/01/2013 Post Processed Kinematic (Ellipsoidally referenced)	9/3/2013 Post Processed Kinematic (Ellipsoidally referenced)	4/08/2013 Post Processed Kinematic (Ellipsoidally referenced)	3/2/2013

Echo Sounding Equipment

38 records found

Type*	Manufacturer	Owner*	Current Location*	System	Model Number	Component	Serial Number*	CD Number*	Effective Date*
Multibeam Echosounder	Reson	Fairweather	EEB (West)	7111 Wet end	EM 7187 Rx	Transducer 100kHz	5008001	CD0001065312	2013-11-01
Multibeam Echosounder	Reson	Fairweather	FA_2805	7125 SV1		Processor	1812027	CD0001529685	2014-05-09
Multibeam Echosounder	Reson	Fairweather	FA_2805	7125 SV1	EM 7200	Receiver	3008265	CD0001776106	2014-03-01
Multibeam Echosounder	Reson	Fairweather	FA_2805	7125 SV1	TC 2160	Transducer 400kHz	4008071	CD0001776105	2014-03-01
Multibeam Echosounder	Reson	Fairweather	FA_2805	7125 SV1	TC 2163	Transducer 200kHz	4408358	Unknown	2014-03-01
Multibeam Echosounder	Reson	Fairweather	FA_2806	7125 SV1	EM 7200	Receiver	0309012	Unknown	2014-03-01
Multibeam Echosounder	Reson	Fairweather	FA_2806	7125 SV1	TC 2160	Transducer 400kHz	2208007	Unknown	2014-03-01
Multibeam Echosounder	Reson	Fairweather	FA_2806	7125 SV1	TC 2163	Transducer 200kHz	2409098	Unknown	2014-03-01
Multibeam Echosounder	Reson	Fairweather	FA_2807	7125 SV1		Processor	1812023	CD0001529704	2014-03-11
Multibeam Echosounder	Reson	Fairweather	FA_2807	7125 SV1	EM 7200	Receiver	0309019	Unknown	2014-03-01
Multibeam Echosounder	Reson	Fairweather	FA_2807	7125 SV1	TC 2160	Transducer 400kHz	2308110	Unknown	2014-03-01
Multibeam Echosounder	Reson	Fairweather	FA_2807	7125 SV1	TC 2163	Transducer 200kHz	4408351	Unknown	2014-03-01
Multibeam Echosounder	Reson	Fairweather	FA_2808	7125 SV1		Processor	1812028	CD0001529714	2014-03-12
Multibeam Echosounder	Reson	Fairweather	FA_2808	7125 SV1	EM 7200	Receiver	0309014	Unknown	2014-03-01
Multibeam Echosounder	Reson	Fairweather	FA_2808	7125 SV1	TC 2160	Transducer 400kHz	1908209	Unknown	2014-03-01
Multibeam Echosounder	Reson	Fairweather	FA_2808	7125 SV1	TC 2163	Projector 200kHz	85000327	Unknown	2014-03-11
Multibeam Echosounder	Reson	Fairweather	Fairweather	7111		Processor 100kHz	2009003	CD0001065312	2013-06-01
Multibeam Echosounder	Reson	Fairweather	Fairweather	7111	EM 7187	Receiver 100kHz	1409093	Unknown	2013-10-29
Multibeam Echosounder	Reson	Fairweather	Fairweather	7111	TC 2126-3	Transducer 100kHz	4608498	Unknown	2012-11-19
Multibeam Echosounder	Reson	Fairweather	Fairweather	7125 SV1	TC 2163	Transducer 200kHz	1008117	Unknown	2013-08-16
Multibeam Echosounder	Reson	Fairweather	Fairweather	8125		Processor 455kHz	31562	CD0000825308	2014-04-12
Multibeam Echosounder	Reson	Fairweather	Fairweather	8160		Processor 50kHz	5385	CD0001065313	2012-10-03
Multibeam Echosounder	Reson	Fairweather	Fairweather	8160		Transceiver Boards	35028	Unknown	2012-10-03
Multibeam Echosounder	Reson	Fairweather	Fairweather	8160		Transducer 50kHz	FA-8160	Unknown	2012-10-03
Multibeam Echosounder	Reson	Fairweather	RESON	7125 SV1		Processor	1812020	CD0001527818	2014-05-02
Side Scan Sonar	Klein	Fairweather	FA_2805	5000 V1		TPU 455kHz	138	CD0000825294	2013-08-23
Side Scan Sonar	Klein	Fairweather	FA_2807	5000 V1		TPU 455kHz	176	CD0001527021	2013-08-21
Side Scan Sonar	Klein	Fairweather	FA_2808	5000 V1		TPU	166	CD0001722042	2013-08-21
Side Scan Sonar	Klein	Fairweather	Fairweather	5000 Heavy Weight		Towfish 455kHz	293	CD0000825404	2013-09-06
Side Scan Sonar	Klein	Fairweather	Fairweather	5000 Heavy Weight	5410	Towfish 455kHz	260	Unknown	2013-09-06
Side Scan Sonar	Klein	Fairweather	Fairweather	5000 Light Weight		Towfish 455kHz	321	CD0001709343	2013-09-06
Side Scan Sonar	Klein	Fairweather	Fairweather	5000 V1		TPU 455kHz	177	CD0001527022	2013-08-21
Single Beam Echosounder	CEE HydroSystems	Fairweather	Fairweather			Transducer 200kHz	0238-10468-0004	Unknown	2013-03-20
Single Beam Echosounder	Teledyne Odom Hydrographic	Fairweather	Fairweather		SMBB200_4A	Transducer 200kHz	TR5162		2013-03-19
Single Beam Echosounder	Teledyne Odom Hydrographic	Fairweather	Fairweather		SMBB200_4A	Transducer 200kHz	TR5159		2013-03-19
Single Beam Echosounder	Teledyne Odom Hydrographic	Fairweather	Fairweather		SMBB200_9	Transducer 200kHz	TR5138		2013-03-19
Single Beam Echosounder	Teledyne Odom Hydrographic	Fairweather	Fairweather		SMBB200_9	Transducer 200kHz	TR5139		2013-03-19
Single Beam Echosounder	Teledyne Odom Hydrographic	Fairweather	Fairweather	Echotrac CVM-A		System	26034	CD0001703210	2013-03-19

TABLE echo_sounding 690

Edit Transaction | New Transaction

Type*: Multibeam Echosounder
Owner*: Fairweather
Current Location*: FA_2805
Effective Date*: 2014-05-09
Transaction Description: TPU shipped and received by FA, installed on 2805. TPU was untested by RESON following repairs to both the 200kHz and 400kHz receive assemblies. Will perform a patch test ASAP
Manufacturer: Reson
Component: Processor
System: 7125 SV1
Model Number:
Serial Number*: 1812027
Frequency:
Frequency Unit:
CD Number*: CD0001529685
Status: Needs Repair
Part Number:
Last Verified:
Install Date:
Firmware Version:
Firmware Version Install Date:
Software Version:
Software Version Install Date:
Purchase Date: 2009-11-13
Field Calibration Date:
Manufacturer Service Date:
Comments: UNH calibrated sonar 2011.
Reported By: Ryan Wartick
Edited On: 2014-05-10 16:38:01

Transaction History:

16 records found

Owner*	Current Location*	Effective Date*	Transaction Description	Comments	Reported By
Fairweather	FA_2805	2014-05-09	TPU shipped and received by FA, installed on 2805. TPU was untested by RESON following repairs to both the 200kHz and 400kHz receive assemblies. Will perform a patch test ASAP	UNH calibrated sonar 2011.	Ryan Wartick
Fairweather	RESON	2014-03-14	This TPU has been shipped to RESON to for repair. The 200 kHz transmit module does not work and the there is an unknown problem with the 400 kHz side.	UNH calibrated sonar 2011.	Ryan Wartick
Fairweather	FA_2806	2014-03-11	Swapped TPUs between 2806 & 2807 to patch 2807 with fully functional TPU. 400 kHz also potentially providing erroneous results after used on multiple vessels.	UNH calibrated sonar 2011.	CST Fairweather
Fairweather	FA_2807	2014-03-10	Relocated to 2807 until solution can be identified for repair of 200 kHz.	UNH calibrated sonar 2011.	CST Fairweather
Fairweather	FA_2808	2014-03-05	200 kHz non-functional. Transferred to 2808 which does not have a 200 kHz projector until fix can be identified.	UNH calibrated sonar 2011.	CST Fairweather
Fairweather	FA_2807	2013-08-21	Installed on 2807 for 2013 Field Season.	UNH calibrated sonar 2011.	Eric Younkin
Fairweather	FA_2807	2013-08-21	Installed on 2807 for 2013 Field Season.	UNH calibrated sonar 2011.	CST Fairweather
Fairweather	Fairweather	2013-05-31	Sonar repaired and returned from Reson.	UNH calibrated sonar 2011.	CST Fairweather
Fairweather	RESON	2012-12-05	RMA: 507334- Unit sent to Reson for testing and expected repairs. Unit not preforming as it should.	UNH calibrated sonar 2011.	CST Fairweather
Fairweather	Fairweather	2012-10-01	Removed from launch. Awaiting return to Reson for servicing.	UNH calibrated sonar 2011. 400kHz not collecting a full swath.	CST Fairweather
Fairweather	FA_2805	2012-03-21	Calibrated sonar installed on 2805. VFD for HSRR 2012	UNH calibrated sonar 2011.	CST Fairweather
Fairweather	FA_2805	2012-03-21	Calibrated Sonar Installed on 2805.	UNH calibrated sonar 2011.	CST Fairweather
Fairweather	Fairweather	2012-03-20	Returned from UNH	UNH calibrated sonar 2011.	CST Fairweather
Fairweather	UNH	2011-12-13	Backscatter Calibration Testing		CST Fairweather
Fairweather	FA_2807	2011-03-01	VFD for HSRR 2011		CST Fairweather
Fairweather	FA_2807	2010-01-02	New Sonar Install		CST Fairweather

TABLE echo_sounding 694

Edit Transaction | New Transaction

Type*: Multibeam Echosounder
Owner*: Fairweather
Current Location*: RESON
Effective Date*: 2014-05-02
Transaction Description: Shipped back to Reson under RMA: 513063 for 400 kHz repair.
Manufacturer: Reson
Component: Processor
System: 7125 SV1
Model Number:
Serial Number*: 1812020
Frequency:
Frequency Unit:
CD Number*: CD0001527818
Status: Needs Repair
Part Number:
Last Verified:
Install Date:
Firmware Version: Feature Pack 1.3.2
Firmware Version Install Date: 2013-04-02
Software Version:
Software Version Install Date:
Purchase Date: 2009-10-01
Field Calibration Date: 2013-04-23
Manufacturer Service Date:
Comments: UNH calibrated sonar 2012.
Reported By: CST Fairweather
Edited On: 2014-05-17 19:49:39

Transaction History: 17 records found

Owner*	Current Location*	Effective Date*	Transaction Description	Comments	Reported By
Fairweather	RESON	2014-05-02	Shipped back to Reson under RMA: 513063 for 400 kHz repair.	UNH calibrated sonar 2012.	CST Fairweather
Fairweather	FA_2805	2014-04-28	Red lights in the bite screen for the 400kHz projector. The symptoms look identical to the previous failure. Needs to be returned to Reson. **Also the TPU with the bent connector**	UNH calibrated sonar 2012.	CST Fairweather
Fairweather	FA_2805	2014-03-31	Repaired and eventually returned to FA after being incorrectly shipped to San Francisco. Installed on 2805.	UNH calibrated sonar 2012.	CST Fairweather
Fairweather	RESON	2014-03-11	Shipped to Reson for continued repair and evaluation. RMA# 512479.	UNH calibrated sonar 2012.	CST Fairweather
Fairweather	FA_2808	2014-03-10	Still experiencing issues with the recently "repaired" 400 kHz. Still experiencing bite screen failures. Moved to 2808 to patch test new 200 kHz transducer.	UNH calibrated sonar 2012.	CST Fairweather
Fairweather	FA_2807	2014-03-05	Installed on 2807 to troubleshoot TPU 200 kHz issue. Will remain on 2807 for 2014 Field Season.	UNH calibrated sonar 2012.	CST Fairweather
Fairweather	Fairweather	2014-03-04	Returned to FA with 400 kHz repaired.	UNH calibrated sonar 2012.	CST Fairweather
Fairweather	RESON	2013-11-06	Shipped to Reson be Wayne Larson.	UNH calibrated sonar 2012.	CST Fairweather
Fairweather	EEB (West)	2013-10-18	400 kHz board non-functional. Needs return to manufacturer.	UNH calibrated sonar 2012.	CST Fairweather
Fairweather	FA_2808	2013-04-02	Relocated to 2808. VFD for HSRR 2013.	UNH calibrated sonar 2012.	CST Fairweather
Fairweather	PHB	2013-03-14	Calibrated Sonar Returned from UNH. Shipped to Jon Andvick.	UNH calibrated sonar 2012.	CST Fairweather
Fairweather	UNH	2012-09-01	Returned to UNH for additional testing.		CST Fairweather
Fairweather	Thomas Jefferson	2012-08-22	Lent to TJ to send in their unit for repair.		CST Fairweather
Fairweather	UNH	2012-02-21	System on loan to UNH for backscatter calibration testing.		CST Fairweather
Fairweather	Fairweather	2012-02-01	System removed from 2806. Launch not in use for 2012.		CST Fairweather
Fairweather	FA_2806	2011-04-14	VFD for HSRR 2011.		CST Fairweather
Fairweather	FA_2806	2010-01-01	New system install.		CST Fairweather

TABLE echo_sounding 600

Edit Transaction | New Transaction

Type*:	Multibeam Echosounder
Owner*:	Fairweather
Current Location*:	FA_2807
Effective Date*:	2014-03-11
Transaction Description:	Swapped TPUs between 2806 & 2807 to patch 2807 with fully functional TPU.
Manufacturer:	Reson
Component:	Processor
System:	7125 SV1
Model Number:	
Serial Number*:	1812023
Frequency:	
Frequency Unit:	
CD Number*:	CD0001529704
Status:	
Part Number:	
Last Verified:	
Install Date:	
Firmware Version:	Needs update to Feature Pack 1.3.2
Firmware Version Install Date:	
Software Version:	
Software Version Install Date:	
Purchase Date:	2009-11-13
Field Calibration Date:	
Manufacturer Service Date:	
Comments:	
Reported By:	Ryan Wartick
Edited On:	2014-03-12 00:26:24

Transaction History:

11 records found

Owner*	Current Location*	Effective Date*	Transaction Description	Comments	Reported By
Fairweather	FA_2807	2014-03-11	Swapped TPUs between 2806 & 2807 to patch 2807 with fully functional TPU.		Ryan Wartick
Fairweather	FA_2806	2014-03-01	VFD for HSRR 2014.		CST Fairweather
Fairweather	FA_2806	2013-08-21	Installed on 2806 for 2013 Field Season.		Eric Younkin
Fairweather	FA_2806	2013-08-21	Installed on 2806 for 2013 Field Season.		CST Fairweather
Fairweather	Fairweather	2013-04-12	Unit returned to FA		Douglas Bravo
Fairweather	Thomas Jefferson	2013-04-12	Unit returned to FA, but immediately sent back out to TJ.		CST Fairweather
Fairweather	Nancy Foster	2013-01-31	Lent to Foster to Support Mapping Mission		Tami Beduhn
Fairweather	Fairweather	2012-12-03	Removed for installation of new davit hooks.		CST Fairweather
Fairweather	FA_2808	2012-03-21	VFD for HSRR 2012.		CST Fairweather
Fairweather	FA_2808	2011-04-14	VFD for HSRR 2011.		CST Fairweather
Fairweather	Fairweather	2010-01-01	New sonar install.		CST Fairweather

TABLE echo_sounding 601

Edit Transaction | New Transaction

Type*:	Multibeam Echosounder
Owner*:	Fairweather
Current Location*:	FA_2808
Effective Date*:	2014-03-12
Transaction Description:	Swapped to 2808 to complete HSRR Patch testing for 2014.
Manufacturer:	Reson
Component:	Processor
System:	7125 SV1
Model Number:	
Serial Number*:	1812028
Frequency:	
Frequency Unit:	
CD Number*:	CD0001529714
Status:	
Part Number:	
Last Verified:	
Install Date:	
Firmware Version:	Feature Pack 1.3.2
Firmware Version Install Date:	2013-04-03
Software Version:	
Software Version Install Date:	
Purchase Date:	2009-12-18
Field Calibration Date:	2013-04-24
Manufacturer Service Date:	
Comments:	
Reported By:	CST Fairweather
Edited On:	2014-03-12 23:40:47

Transaction History:

10 records found

Owner*	Current Location*	Effective Date*	Transaction Description	Comments	Reported By
Fairweather	FA_2808	2014-03-12	Swapped to 2808 to complete HSRR Patch testing for 2014.		CST Fairweather
Fairweather	FA_2808	2014-03-01	VFD for HSRR 2014.		CST Fairweather
Fairweather	FA_2805	2013-08-20	Re-installed on 2805. Still believe there will be problems.		Eric Younkin
Fairweather	FA_2805	2013-08-20	Re-installed on 2805. Still believe there will be problems.		CST Fairweather
Fairweather	Fairweather	2013-08-16	System returned to FA. Reson claims nothing wrong.		CST Fairweather
Fairweather	RESON	2013-07-26	Shipped to Reson to trouble shoot non-functional 400 kHz system.		CST Fairweather
Fairweather	FA_2805	2013-04-01	Relocated to 2805. VFD for HSRR 2013.		CST Fairweather
Fairweather	Fairweather	2012-03-23	Sonar replaced with calibrated UNH unit. Can be found in C-02 stores.		CST Fairweather
Fairweather	FA_2805	2011-03-01	VFD for HSRR 2011		CST Fairweather
Fairweather	FA_2805	2010-01-01	New Sonar Install		CST Fairweather

TABLE echo_sounding 555

Edit Transaction | New Transaction

Type*:	Multibeam Echosounder
Owner*:	Fairweather
Current Location*:	Fairweather
Effective Date*:	2013-06-01
Transaction Description:	Firmware updated.
Manufacturer:	Reson
Component:	Processor
System:	7111
Model Number:	
Serial Number*:	2009003
Frequency:	100
Frequency Unit:	kHz
CD Number*:	CD0001065312
Status:	
Part Number:	
Last Verified:	
Install Date:	
Firmware Version:	
Firmware Version Install Date:	
Software Version:	
Software Version Install Date:	
Purchase Date:	2009-05-01
Field Calibration Date:	
Manufacturer Service Date:	
Comments:	7k UI: 3.11.2.2 7k Center: 3.4.5.3 7kIO: 3.7.0.14 Updated Summer 2013
Reported By:	CST Fairweather
Edited On:	2014-01-10 20:50:55

Transaction History:

3 records found

Owner*	Current Location*	Effective Date*	Transaction Description	Comments	Reported By
Fairweather	Fairweather	2013-06-01	Firmware updated.	7k UI: 3.11.2.2 7k Center: 3.4.5.3 7kIO: 3.7.0.14 Updated Summer 2013	CST Fairweather
Fairweather	Fairweather	2012-04-14	VFD for HSRR 2012		CST Fairweather
Fairweather	Fairweather	2009-07-01	Upgraded 8111 TPU and replaced with this model, the 7111.		CST Fairweather

Manual Sounding Equipment

8 records found

Type*	Manufacturer	Owner*	Current Location*	System	Model Number	Component	Serial Number*	CD Number	Effective Date*
Lead Line	FA Personnel	Fairweather	Fairweather		Traditional		10_01_05		2013-02-26
Lead Line	FA Personnel	Fairweather	Fairweather		Traditional		10_02_05		2013-02-26
Lead Line	FA Personnel	Fairweather	Fairweather		Traditional		20_01_05		2013-02-26
Lead Line	FA Personnel	Fairweather	Fairweather		Traditional		20_02_05		2013-02-26
Lead Line	FA Personnel	Fairweather	Fairweather		Traditional		20_03_05		2013-02-26
Lead Line	FA Personnel	Fairweather	Fairweather		Traditional		30_01_05		2013-02-26
Lead Line	FA Personnel	Fairweather	Fairweather		V-100/Non-Traditiona		10_05_09		2013-02-26
Lead Line	FA Personnel	Fairweather	Fairweather		V-100/Non-Traditiona		10_06_XX		2013-02-26

Horizontal Vertical Control Equipment

42 records found

Type*	Manufacturer	Owner*	Current Location*	System	Model Number	Component	Serial Number*	CD Number*	Effective Date*
Base Station Equipment	Ashtech	Fairweather	Fairweather		Geodetic 4	GPS Antenna	8365		2013-09-06
Base Station Equipment	Ashtech	Fairweather	Fairweather		Z-Xtreme	GPS Receiver	ZE1200339016	CD0001062363	2013-09-06
Base Station Equipment	GE Energy	Fairweather	Fairweather		GEPV-030-MNA-001	Solar Panel	C30G200506210063		2013-09-06
Base Station Equipment	Morningstar	Fairweather	Fairweather		SS-10-L. 12v	Solar Charger	10331024		2013-03-12
Base Station Equipment	Morningstar	Fairweather	Fairweather		SS-10-L. 12v	Solar Charger	10190179		2013-09-06
Base Station Equipment	Morningstar	Fairweather	Fairweather		SS-10-L. 12v	Solar Charger	10190178		2013-09-06
Base Station Equipment	Morningstar	Fairweather	Fairweather		SS-10-L. 12v	Solar Charger	10190177		2013-09-06
Base Station Equipment	PWM	Fairweather	Fairweather		EPRC5	Solar Charger	0702EPRC5-026		2013-03-06
Base Station Equipment	PWM	Fairweather	Fairweather		EPRC5	Solar Charger	XXX1		2013-03-06
Base Station Equipment	PWM	Fairweather	Fairweather		EPRC5	Solar Charger	XXX2		2013-03-06
Base Station Equipment	Pacific Crest	Fairweather	Fairweather		PDL 4135	UHF Radio	0424 0154	CD0001269910	2013-03-06
Base Station Equipment	Pacific Crest	Fairweather	Fairweather		PDL 4135	UHF Radio	0347 3047	CD0001269896	2013-03-06
Base Station Equipment	Pacific Crest	Fairweather	Fairweather		PDL 4135	UHF Radio	0424 0155	CD0001269912	2013-03-06
Base Station Equipment	Pacific Crest	Fairweather	Fairweather		PDL 4135	UHF Radio	0709 5939	CD0001269911	2013-03-06
Base Station Equipment	Pacific Crest	Fairweather	Fairweather		PDL 4135	UHF Radio	0424 0171	CD0001269910	2013-03-06
Base Station Equipment	Sunlinq	Fairweather	Fairweather		P3-12V-60	Solar Panel	146624		2013-09-06
Base Station Equipment	Sunlinq	Fairweather	Fairweather		P3-12V-60	Solar Panel	146636		2013-09-06
Base Station Equipment	Trimble	Fairweather	Fairweather		NetR5	GPS Receiver	4910K61054	CD0001526973	2013-09-06
Base Station Equipment	Trimble	Fairweather	Fairweather		NetR9	GPS Receiver	5034K69677	CD0001709320	2013-04-01
Base Station Equipment	Trimble	Fairweather	Fairweather		NetR9	GPS Receiver	5034K69698	CD0001709319	2013-09-06
Base Station Equipment	Trimble	Fairweather	Fairweather		DSM 232	GPS Receiver	225111661	CD0001697439	2012-10-03
Base Station Equipment	Trimble	Fairweather	Fairweather		DSM 232RS	GPS Receiver	225111655	CD0001697422	2012-10-03
Base Station Equipment	Trimble	Fairweather	Fairweather		MS 750	GPS Receiver	220339262	CD0001478898	2012-10-03
Base Station Equipment	Trimble	Fairweather	Fairweather		Zephyr Geodetic	GPS Antenna	12297641		2013-03-07
Base Station Equipment	Trimble	Fairweather	Fairweather		Zephyr Geodetic 2	GPS Antenna	30325441		2013-03-07
Base Station Equipment	Trimble	Fairweather	Fairweather		Zephyr Geodetic 2	GPS Antenna	1441027807		2013-03-07
Base Station Equipment	Trimble	Fairweather	Fairweather		Zephyr Geodetic 2	GPS Antenna	1441031361		2013-03-07
Base Station Equipment	Trimble	Fairweather	Fairweather		Zephyr Geodetic 2	GPS Antenna	30767996		2013-03-07
Base Station Equipment	Uni-Solar	Fairweather	Fairweather		FLX 32	Solar Panel	USF-32-14639		2013-09-06
Base Station Equipment	Uni-Solar	Fairweather	Fairweather		FLX 32	Solar Panel	USF-32-14634		2013-09-06
Base Station Equipment	Uni-Solar	Fairweather	Fairweather		FLX 32	Solar Panel	USF-32-14633		2013-09-06
Base Station Equipment	Uni-Solar	Fairweather	Fairweather		FLX 32	Solar Panel	USF-32-14529		2013-09-06
Base Station Equipment	Uni-Solar	Fairweather	Fairweather		FLX 32	Solar Panel	USF-32-14525		2013-09-06
Base Station Equipment	Uni-Solar	Fairweather	Fairweather		FLX 32	Solar Panel	USF-32-14631		2013-09-06
Base Station Equipment	Uni-Solar	Fairweather	Fairweather		MBC 525	Solar Panel	525-011607	CD000684512	2013-09-06
Base Station Equipment	Uni-Solar	Fairweather	Fairweather		MBC 525	Solar Panel	525-011589	CD000684510	2013-09-06
Base Station Equipment	Uni-Solar	Fairweather	Fairweather		MBC 525	Solar Panel	525-011093	CD000684507	2013-09-06
Level	Carl Zeiss	Fairweather	Fairweather		Ni2	Level	103267	Unknown	2014-03-13
Level	Carl Zeiss	Fairweather	Fairweather		Ni2	Level	100056	Unknown	2014-01-27
Level	Leica	Fairweather	Fairweather		NA2 100	Level	5332739	Unknown	2014-01-27
Level	Leica	Fairweather	Fairweather		NA2 100	Level	5332747	Unknown	2014-01-27
Rover Equipment	Trimble	Fairweather	Fairweather		TSCe	Data Logger	37318	CD0001709309	2013-03-20

Positioning Attitude Equipment

57 records found

Type*	Manufacturer	Owner*	Current Location*	System	Model Number	Component	Serial Number*	CD Number*	Effective Date*
Attitude	Applanix	Fairweather	FA_2805		LN 200	IMU	294	CD0001696449	2012-10-22
Attitude	Applanix	Fairweather	FA_2806		LN 200	IMU	991	CD0001722214	2013-07-25
Attitude	Applanix	Fairweather	FA_2808		LN 200	IMU	324	CD0001722041	2013-04-02
Attitude	Applanix	Fairweather	Fairweather		LN 200	IMU	292	CD0001696450	2013-04-14
Attitude Equipment	Applanix	Fairweather	FA_2808	POS MV 320 V4		PCS	2564	CD0001601275	2014-02-20
Attitude Equipment	Applanix	Fairweather	Fairweather		LN 200	IMU	995	CD0001530026	2014-02-20
DGPS	Hemisphere	Fairweather	FA_2805		MBX-4	Receiver	0927-9567-0001	CD0001709331	2013-04-01
DGPS	Hemisphere	Fairweather	FA_2808		MBX-4	Receiver	0923-9416-0007	P004425	2013-04-02
DGPS	CSI Wireless	Fairweather	Fairweather		MBX-3S	Receiver	0324-11969-0002	CD0001065375	2013-03-07
DGPS	CSI Wireless	Fairweather	Fairweather		MBX-3S	Receiver	0328-12362-0001	CD10652291	2013-03-07
DGPS	CSI Wireless	Fairweather	Fairweather		MGL3	Antenna	0328-12352-0002		2013-03-07
DGPS	CSI Wireless	Fairweather	Fairweather		MGL3	Antenna	9824-1779-0002		2013-03-07
DGPS	Hemisphere	Fairweather	Fairweather		MA40	Antenna	0924-9488-0040		2013-03-07
DGPS	Hemisphere	Fairweather	Fairweather		MA40	Antenna	0919-9231-0191		2013-03-07
DGPS	Hemisphere	Fairweather	Fairweather		MA40	Antenna	0919-9231-0193		2013-03-07
DGPS	Hemisphere	Fairweather	Fairweather		MA40	Antenna	0924-9488-0046		2013-03-07
DGPS	Hemisphere	Fairweather	Fairweather		MBX-4	Receiver	0923-9416-0005	CD0001709329	2013-03-07
DGPS	Hemisphere	Fairweather	Fairweather		MBX-4	Receiver	0924-9498-000		2013-03-07
Other	Applanix	Fairweather	Fairweather	POS MV 320 V4		PCS	3627	CD0001527797	2013-11-20
Positioning	Trimble	Fairweather	FA_2805		Zephyr II	Antenna	311717272	Unknown	2013-04-01
Positioning	Trimble	Fairweather	FA_2805	POS MV 320 V4	Zephyr II	Antenna	5000100665	N/A	2013-08-28
Positioning	Trimble	Fairweather	FA_2806	POS MV 320 V4	Zephyr II	Antenna	5000101101	N/A	2013-08-16
Positioning	Trimble	Fairweather	FA_2806	POS MV 320 V4	Zephyr II	Antenna	5000101022	N/A	2013-08-16
Positioning	Trimble	Fairweather	FA_2807		Zephyr II	Antenna	1440925095	N/A	2013-08-16
Positioning	Trimble	Fairweather	FA_2808		Zephyr II	Antenna	1440904832	Unknown	2013-04-02
Positioning	Trimble	Fairweather	FA_2808		Zephyr II	Antenna	31177272	Unknown	2013-04-01
Positioning	NavCom	Fairweather	Fairweather		AN-2004T	Antenna	7020		2013-03-07
Positioning	NavCom	Fairweather	Fairweather		SF-2050G	Receiver	5086	CD0001699203	2013-03-07
Positioning	NavCom	Fairweather	Fairweather		SF-2050R	Receiver	5012	CD0001697402	2013-03-07
Positioning	Trimble	Fairweather	Fairweather			Antenna	0220321059		2013-02-26
Positioning	Trimble	Fairweather	Fairweather		33580-50	Antenna	0220341062		2013-02-26
Positioning	Trimble	Fairweather	Fairweather		33580-00	Antenna	220395038		2013-03-07
Positioning	Trimble	Fairweather	Fairweather		OEM2 3151R	Antenna	60145158		2013-02-26
Positioning	Trimble	Fairweather	Fairweather		OEM2 3151R	Antenna	60268090		2013-02-26
Positioning	Trimble	Fairweather	Fairweather		SPS MSK	Antenna	5876		2013-03-07
Positioning	Trimble	Fairweather	Fairweather		Trimble Micro Centered L1/L2	Antenna	220298707		2013-03-07
Positioning	Trimble	Fairweather	Fairweather		Zephyr I	Antenna	60125191	N/A	2013-08-16
Positioning	Trimble	Fairweather	Fairweather		Zephyr I	Antenna	60130644	N/A	2013-02-26
Positioning	Trimble	Fairweather	Fairweather		Zephyr I	Antenna	60078644	N/A	2013-08-16
Positioning	Trimble	Fairweather	Fairweather		Zephyr II	Antenna	31180200		2013-02-26
Positioning	Trimble	Fairweather	Fairweather		Zephyr II	Antenna	1440912566		2013-02-26

Positioning	Trimble	Fairweather	Fairweather		Zephyr I	Antenna	60078644	N/A	2013-08-16
Positioning	Trimble	Fairweather	Fairweather		Zephyr II	Antenna	31180200		2013-02-26
Positioning	Trimble	Fairweather	Fairweather		Zephyr II	Antenna	1440912566		2013-02-26
Positioning	Trimble	Fairweather	Fairweather		Zephyr II	Antenna	1440941041	N/A	2013-08-16
Positioning	Trimble	Fairweather	Fairweather		Zephyr II	Antenna	1440904133	N/A	2013-08-16
Positioning	Trimble	Fairweather	Fairweather		Zephyr II	Antenna	31185275	Unknown	2013-08-28
Positioning	Trimble	Fairweather	Fairweather	POS MV 320 V4	Zephyr II	Antenna	5000101124	N/A	2013-08-16
Positioning	Trimble	Fairweather	Fairweather	POS MV 320 V4	Zephyr II	Antenna	5000100734	N/A	2013-08-16
Positioning	Trimble	Fairweather	Fairweather	POS MV 320 V4	Zephyr II	Antenna	5000101055	N/A	2013-08-16
Positioning Equipment	Trimble	Fairweather	AHB		Pathfinder Pro XRS		0224078543	CD0001269835	2014-01-29
Positioning Equipment	Trimble	Fairweather	AHB		Pathfinder Pro XRS		0224090101	CD0001269836	2014-01-29
Positioning Equipment	Applanix	Fairweather	FA_2805	POS MV 320 V4		PCS	2411	CD0001697462	2013-08-16
Positioning Equipment	Applanix	Fairweather	FA_2806	POS MV 320 V4		PCS	2560	CD0001601274	2013-08-16
Positioning Equipment	Applanix	Fairweather	FA_2807	POS MV 320 V4		PCS	3628	CD0001527796	2013-09-14
Rangefinder	Laser Tech	Fairweather	Fairweather		Impulse LR		i09290	CD0001269812	2013-10-25
Rangefinder	Laser Tech	Fairweather	Fairweather		TruPulse 200 Laser Rangefinder		000676		2013-03-19
Rangefinder	Laser Tech	Fairweather	Fairweather		TruPulse 200 Laser Rangefinder		041169		2013-03-19
Rangefinder	Laser Tech	Fairweather	Fairweather		TruPulse 200 Laser Rangefinder		041156		2013-03-19
Rangefinder	Laser Tech	Fairweather	Fairweather		TruPulse 200 Laser Rangefinder		001481		2013-03-19

TABLE positioning_attitude 370

Edit Transaction | New Transaction

Type*:	Positioning Equipment
Owner*:	Fairweather
Current Location*:	FA_2805
Effective Date*:	2013-08-16
Transaction Description:	Returned to FA and Relocated to launch 2805. Upgraded to BD960.
Manufacturer:	Applanix
Component:	PCS
System:	POS MV 320 V4
Model Number:	
Serial Number*:	2411
CD Number*:	CD0001697462
Status:	
Part Number:	
Install Date:	
Firmware Version:	
Firmware Version Install Date:	
Software Version:	
Software Version Install Date:	
Purchase Date:	2008-01-01
Field Calibration Date:	
Manufacturer Service Date:	
Verification Date:	
Verification Method:	
PCS GPS Receiver Card:	BD960
IMU Certification:	
IMU Certification Date:	
IMU Tumble Test Date:	
Port Or Starboard:	
Primary Or Secondary:	
Comments:	Has 4GB of Internal Logging.
Reported By:	CST Fairweather
Edited On:	2014-02-20 17:06:47

Transaction History:

7 records found

Owner*	Current Location*	Effective Date*	Transaction Description	Comments	Reported By
Fairweather	FA_2805	2013-08-16	Returned to FA and Relocated to launch 2805. Upgraded to BD960.	Has 4GB of Internal Logging.	CST Fairweather
Fairweather	FA_2805	2013-08-16	Returned to FA and Relocated to launch 2805. Upgraded to BD960.	Has 4GB of Internal Logging.	CST Fairweather
Fairweather	Applanix	2013-07-26	Shipped to Applanix for BD960 and internal logging upgrades.	Needs internal logging upgrade to 4GB.	CST Fairweather
Fairweather	Fairweather	2013-07-05	Unit returned from TJ (Property transferred in Sunflower)	Needs internal logging upgrade to 4GB.	CST Fairweather
Fairweather	Thomas Jefferson	2013-05-15	Unit Loaned to TJ (Property transferred in Sunflower)		OPS Fairweather
Fairweather	Fairweather	2013-04-01	VFD for Wall to wall. Spare.	Needs internal logging upgrade to 4GB.	CST Fairweather
Fairweather	FA_2808	2012-08-05	VFD for HSRR 2012.		CST Fairweather

TABLE positioning_attitude 372

Edit Transaction | New Transaction

Type*: Positioning Equipment
Owner*: Fairweather
Current Location*: FA_2806
Effective Date*: 2013-08-16
Transaction Description: Returned to FA and installed on 2806. Upgraded to BD960.
Manufacturer: Applanix
Component: PCS
System: POS MV 320 V4
Model Number:
Serial Number*: 2560
CD Number*: CD0001601274
Status:
Part Number: PCS-29
Install Date:
Firmware Version: HW2.6-7, SW04.22, POS Cntrlr v. 4.3.4.0
Firmware Version Install Date:
Software Version:
Software Version Install Date:
Purchase Date: 2006-11-07
Field Calibration Date:
Manufacturer Service Date:
Verification Date:
Verification Method:
PCS GPS Receiver Card: BD960
IMU Certification:
IMU Certification Date:
IMU Tumble Test Date:
Port Or Starboard:
Primary Or Secondary:
Comments: Upgraded to Internal logging with 4GB March 2012.
Reported By: CST Fairweather
Edited On: 2014-02-20 17:10:24

Transaction History:

7 records found

Owner*	Current Location*	Effective Date*	Transaction Description	Comments	Reported By
Fairweather	FA_2806	2013-08-16	Returned to FA and installed on 2806. Upgraded to BD960.	Upgraded to Internal logging with 4GB March 2012.	CST Fairweather
Fairweather	Applanix	2013-07-26	Shipped to Applanix for BD960 upgrade.	Upgraded to Internal logging with 4GB March 2012. To be sent back to Applanix for BD960 upgrade.	CST Fairweather
Fairweather	FA_2808	2013-06-26	Currently in use on 2808. Need to verify offsets.	Upgraded to Internal logging with 4GB March 2012. To be sent back to Applanix for BD960 upgrade.	CST Fairweather
Fairweather	FA_2808	2013-04-19	Relocated to 2808 due to receiver card failure.	Upgraded to Internal logging with 4GB March 2012. To be sent back to Applanix for BD960 upgrade.	CST Fairweather
Fairweather	Fairweather	2013-04-02	VFD for HSRR 2013.	Upgraded to Internal logging with 4GB March 2012. To be sent back to Applanix for BD960 upgrade.	CST Fairweather
Fairweather	FA_2808	2012-03-01	VFD for HSRR 2012.	Upgraded to Internal logging with 4GB.	CST Fairweather
Fairweather	FA_2807	2010-01-01	Installed on new launch		CST Fairweather

TABLE positioning_attitude 368

Edit Transaction | New Transaction

Type*: Attitude Equipment
Owner*: Fairweather
Current Location*: FA_2808
Effective Date*: 2014-02-20
Transaction Description: Returned to FA and installed on 2808.
Manufacturer: Applanix
Component: PCS
System: POS MV 320 V4
Model Number:
Serial Number*: 2564
CD Number*: CD0001601275
Status:
Part Number:
Install Date:
Firmware Version: HW2.6-7, SW04.22 , POS Cntrlr v.4.3.4.0
Firmware Version Install Date:
Software Version:
Software Version Install Date:
Purchase Date: 2006-11-07
Field Calibration Date:
Manufacturer Service Date:
Verification Date:
Verification Method:
PCS GPS Receiver Card: BD960
IMU Certification:
IMU Certification Date:
IMU Tumble Test Date:
Port Or Starboard:
Primary Or Secondary:
Comments: Upgraded to 4GB Internal logging.
Reported By: CST Fairweather
Edited On: 2014-02-20 17:03:35

Transaction History:

14 records found

Owner*	Current Location*	Effective Date*	Transaction Description	Comments	Reported By
Fairweather	FA_2808	2014-02-20	Returned to FA and installed on 2808.	Upgraded to 4GB Internal logging.	CST Fairweather
Fairweather	Applanix	2013-09-28	Being shipped out to Applanix for Evaluation and possible repair.	Upgraded to 4GB Internal logging.	CST Fairweather
Fairweather	Fairweather	2013-09-19	Waiting to be sent our for repair.	Upgraded to 4GB Internal logging.	CST Fairweather
Fairweather	Fairweather	2013-09-14	PCS swapped with ship unit to troubleshoot IMU failures.	Upgraded to 4GB Internal logging.	CST Fairweather
Fairweather	FA_2807	2013-09-14	IMU failure warning alarm. Computer restarted. Recorded for tracking purposes.	Upgraded to 4GB Internal logging.	CST Fairweather
Fairweather	FA_2807	2013-09-13	IMU failure warning alarm. Computer restarted. Recorded for tracking purposes.	Upgraded to 4GB Internal logging.	CST Fairweather
Fairweather	FA_2807	2013-09-03	IMU failure warning alarm. Computer restarted and appears fine now. Recorded for tracking purposes.	Upgraded to 4GB Internal logging.	CST Fairweather
Fairweather	FA_2807	2013-08-16	Returned to FA and Installed on 2807. Upgraded to BD960 and internal logging.	Upgraded to 4GB Internal logging.	CST Fairweather
Fairweather	Applanix	2013-07-26	Shipped to Applanix for BD960 and internal logging upgrades.	Needs internal logging upgrade to 4GB and BD960.	CST Fairweather
Fairweather	Fairweather	2013-07-05	Returned from TJ	Needs internal logging upgrade to 4GB and BD960.	CST Fairweather
Fairweather	Thomas Jefferson	2013-05-16	Loaned to TJ.	Needs internal logging upgrade to 4GB.	CST Fairweather
Fairweather	Fairweather	2012-03-01	Moved to C-02-001 as spare for 2012 Field Season. 2806 not in use.	Needs internal logging upgrade to 4GB and BD960.	CST Fairweather
Fairweather	FA_2806	2010-01-01	Installed on New Launch.	Needs internal logging upgrade to 4GB and BD960.	CST Fairweather
Fairweather	Fairweather	2006-11-07	New Applanix POS MV V4 Purchased for FA.		CST Fairweather

TABLE positioning_attitude 369

Edit Transaction | New Transaction

Type*: Other
Owner*: Fairweather
Current Location*: Fairweather
Effective Date*: 2013-11-20
Transaction Description: PCS installed back on Fairweather.
Manufacturer: Applanix
Component: PCS
System: POS MV 320 V4
Model Number:
Serial Number*: 3627
CD Number*: CD0001527797
Status:
Part Number:
Install Date:
Firmware Version: HW4.1-7, SW05.01, POS Cntrlr v.5.1.0.2
Firmware Version Install Date:
Software Version:
Software Version Install Date:
Purchase Date: 2009-08-08
Field Calibration Date:
Manufacturer Service Date:
Verification Date:
Verification Method:
PCS GPS Receiver Card: BD960
IMU Certification:
IMU Certification Date:
IMU Tumble Test Date:
Port Or Starboard:
Primary Or Secondary:
Comments: Upgraded to 4GB Internal Logging.
Reported By: CST Fairweather
Edited On: 2014-02-20 17:05:47

Transaction History:

8 records found

Owner*	Current Location*	Effective Date*	Transaction Description	Comments	Reported By
Fairweather	Fairweather	2013-11-20	PCS installed back on Fairweather.	Upgraded to 4GB Internal Logging.	CST Fairweather
Fairweather	RA-4	2013-10-22	Transfered to 2801 (RA-4) for use on Fairweather's LA/LB leg 3.	Upgraded to 4GB Internal Logging.	CST Fairweather
Fairweather	FA_2808	2013-08-16	Returned to FA and Installed on 2808. Internal logging upgrade complete.	Upgraded to 4GB Internal Logging.	Eric Younkin
Fairweather	FA_2808	2013-08-16	Returned to FA and Installed on 2808. Internal logging upgrade complete.	Upgraded to 4GB Internal Logging.	CST Fairweather
Fairweather	Applanix	2013-07-26	Shipped to Applanix for internal logging upgrade.	Limited Internal Logging. Needs update to 4GB.	CST Fairweather
Fairweather	Fairweather	2013-06-28	In service on FA.	Limited Internal Logging. Needs update to 4GB.	CST Fairweather
Fairweather	FA_2805	2013-04-01	VFD for HSRR 2013.	Upgraded to 4GB Internal Logging.	CST Fairweather
Fairweather	FA_2805	2010-11-01			CST Fairweather

TABLE positioning_attitude 371

Edit Transaction | New Transaction

Type*: Positioning Equipment
Owner*: Fairweather
Current Location*: FA_2807
Effective Date*: 2013-09-14
Transaction Description: Unit swapped with PCS from 2807 to help troubleshoot IMU failures.
Manufacturer: Applanix
Component: PCS
System: POS MV 320 V4
Model Number:
Serial Number*: 3628
CD Number*: CD0001527796
Status:
Part Number: PCS-29
Install Date:
Firmware Version: HW4.1-7, SW05.01, POS Cntrlr v.5.1.0.2
Firmware Version Install Date:
Software Version:
Software Version Install Date:
Purchase Date: 2009-08-08
Field Calibration Date:
Manufacturer Service Date:
Verification Date:
Verification Method:
PCS GPS Receiver Card: BD960
IMU Certification:
IMU Certification Date:
IMU Tumble Test Date:
Port Or Starboard:
Primary Or Secondary:
Comments: Upgraded to Internal logging March 2012. New primary receiver card June 2013.
Reported By: CST Fairweather
Edited On: 2014-02-20 17:07:26

Transaction History:

7 records found

Owner*	Current Location*	Effective Date*	Transaction Description	Comments	Reported By
Fairweather	FA_2807	2013-09-14	Unit swapped with PCS from 2807 to help troubleshoot IMU failures.	Upgraded to Internal logging March 2012. New primary receiver card June 2013.	CST Fairweather
Fairweather	Fairweather	2013-07-25	Unit transferred to FA for use during OA. Installed with offsets but needs GAMS calibration and antenna separation check.	Upgraded to Internal logging March 2012. New primary receiver card June 2013.	CST Fairweather
Fairweather	FA_2805	2013-06-26	Installed on 2805. Need to check offsets and boat books.	Upgraded to Internal logging March 2012. New primary receiver card June 2013.	CST Fairweather
Fairweather	Fairweather	2013-06-04	Repaired unit returned to FA. Problem was bad primary reciver card.	Upgraded to Internal logging March 2012. New primary receiver card June 2013.	CST Fairweather
Fairweather	Applanix	2013-04-23	RMA 13-00160 for return to Applanix.	Upgraded to Internal logging. Moved to launch.	CST Fairweather
Fairweather	Fairweather	2013-04-19	Receiver failure in route to patch test. Removed to send back to Applanix.	Upgraded to Internal logging. Moved to launch.	CST Fairweather
Fairweather	FA_2808	2013-04-02	BD960 unit installed in 2808 for FY 2013.	Upgraded to Internal logging.	CST Fairweather

Sound Speed Equipment

20 records found

Type*	Manufacturer	Owner*	Current Location*	System	Model Number	Component	Serial Number*	CD Number*	Effective Date*
CTD	Sea-Bird Electronics	Fairweather	Sea-Bird Electronics		SBE 19plus		19P36026-4617	CD0001697251	2014-02-08
CTD	Sea-Bird Electronics	Fairweather	Sea-Bird Electronics		SBE 19plus		19P36026-4585	CD0001697254	2014-02-08
CTD	Sea-Bird Electronics	Fairweather	Sea-Bird Electronics		SBE 19plus V2		19P75469-7370	CD0001686726	2014-02-08
CTD	Sea-Bird Electronics	Fairweather	Sea-Bird Electronics		SBE 19plus V2		19P50959-6121	CD0001527777	2014-02-08
CTD	Sea-Bird Electronics	Fairweather	Sea-Bird Electronics		SBE 19plus V2	CTD	19P50959-6122	CD0001527778	2014-02-08
MVP	Rolls-Royce	Fairweather	Fairweather		MVP 200 DU		10328		2012-07-02
MVP	Rolls-Royce	Fairweather	Fairweather		MVP 200 DU		10330	CD0001269854	2012-10-03
MVP	Rolls-Royce	Fairweather	Fairweather		Single Sensor Free Fall Fish		10329		2012-07-02
MVP	Rolls-Royce	Fairweather	Fairweather		Single Sensor Free Fall Fish		10478		2012-07-02
Sound Speed Sensor	AML Oceanographic	Fairweather	EEB (West)	MVP	Smart SV+P	Sound Speed Sensor	4986	N/A	2013-11-25
Sound Speed Sensor	Reson	Fairweather	FA_2805	SVP 71	EM 7213	Surface Sound Speed Sensor	2008038	CD0001776104	2013-04-22
Sound Speed Sensor	Reson	Fairweather	FA_2806	SVP 71	EM 7213	Surface Sound Speed Sensor	2008016	N/A	2013-08-21
Sound Speed Sensor	Reson	Fairweather	FA_2808	SVP 71	EM 7213	Surface Sound Speed Sensor	2008017	Unknown	2013-09-11
Sound Speed Sensor	AML Oceanographic	Fairweather	Fairweather	MVP	Smart SV+P	Sound Speed Sensor	5229		2013-04-05
Sound Speed Sensor	AML Oceanographic	Fairweather	Fairweather	MVP	Smart SV+P	Sound Speed Sensor	5466	N/A	2013-09-27
Sound Speed Sensor	Reson	Fairweather	Fairweather	SVP 70	EM 7211	Surface Sound Speed Sensor	0512018	Unknown	2012-11-20
Sound Speed Sensor	Reson	Fairweather	Fairweather	SVP 70	EM 7211	Surface Sound Speed Sensor	3013020	Unknown	2013-12-17
Sound Speed Sensor	Reson	Fairweather	Fairweather	SVP 71	EM 7213	Surface Sound Speed Sensor	2008024	Unknown	2013-09-09
Sound Speed Sensor	Teledyne Odom Hydrographic	Fairweather	OCS Staff		DB 1200		98207	Unknown	2014-05-10
TSG	Sea-Bird Electronics	Fairweather	Fairweather		SBE 45 TSG		4536628-0117	Unknown	2013-03-20

Bottom Sampling Equipment

4 records found

Type*	Manufacturer	Owner*	Current Location*	Model Number	Component	Serial Number*	CD Number	Effective Date*
Bottom Sampler		Fairweather	Fairweather			BS 1		2013-03-19
Bottom Sampler		Fairweather	Fairweather			BS 2		2013-03-19
Bottom Sampler		Fairweather	Fairweather			BS 3		2013-03-19
Bottom Sampler		Fairweather	Fairweather			BS 4		2013-03-19

Fairweather Software Inventory

Last Updated:
2/4/2013

#/Type of Licenses	CARIS HIPS/SIPS	CARIS Notebook	CARIS Bathy Database	CARIS Plot Composer	Pydro/Velocipy	Mapinfo	Applanix POSPac*	Ashtech Solutions	Fledermaus	SnagIt	Fetchtides	Hypack	Hypack Geocoder	Hysweep Editor (MB Max)	Applanix POSView	Verification Date	MAC Addresses	Additional Comments	Network Comp
FA P1 Process 1	7.1.2.5	3.1.1.1	4.0.0.0	5.1.1.1	12.9 (r3965)		6.1			10.0.0	2.6					5/30/2012	BC-30-5B-E9-FF-0A	New 5/2012	FA-Proc1
FA P1 Process 2	8.0 BETA	3.1.1.1	4.0.0.0	5.1.1.1	12.9 (r3965)	11	5.4 SP2	2.7		10.0.0	2.6					5/30/2012	BC-30-5B-E9-FF-31	New 5/2012	FA-Proc2
FA P1 Process 3	8.0 BETA	3.1.1.1	3.2.2.4	5.1.1.1	12.3 (r3834)		5.4 SP2			10.0.0	2.6					5/30/2012	BC-30-5B-E9-FF-28	New 5/2012	FA-Proc3
FA P1 Process 4	7.1.2.1	3.1.1.1	3.2.2.4	5.1.1.1	12.3 (r3834)		5.4 SP2			10.0.0	2.6					5/30/2012	B8-AC-6F-89-DE-4C	replaced 6/1/11 w/ 64bit machine	FA-Proc4
FA P1 Process 5	7.1.2.1	3.1.1.1	3.2.2.4	5.1.1.1	12.3 (r3834)		5.4 SP2			10.0.0	2.6					5/30/2012	B8-AC-6F-8D-0D-CE	replaced 6/1/11 w/ 64bit machine	FA-Proc5
FA P1 Process 6	7.1.2.1	3.1.1.1	3.2.2.4	5.1.1.1	12.3 (r3834)		5.4 SP2	2.7		10.0.0	2.6					5/30/2012	BC-30-5B-EA-CD-D7	New 5/2012	FA-Proc6
FA P1 Process 7	7.1.2.1	3.1.1.1	3.2.2.4	5.1.1.1	12.3 (r3834)		5.4 SP2		7.3.0 (64bit)	10.0.0	2.6					5/30/2012	B8-AC-6F-89-E0-B4	replaced 6/1/11 w/ 64bit machine	FA-Proc7
FA P1 Process 8	7.1.2.1	3.1.1.1	3.2.2.4	5.1.1.1	12.3 (r3834)		5.4 SP2	2.7		10.0.0	2.6					5/30/2012	BC-30-5B-EA-17-BA	New 5/2012	FA-Proc8
FA P1 Process 9	7.1.2.1	3.1.1.1	3.2.2.4	5.1.1.1	12.3 (r3834)	11	5.4 SP2			10.0.0	2.6					5/30/2012	BC-30-5B-E9-FF-07	New 5/2012	FA-Proc9
FA CST	7.1.2.1	3.1.1.1	3.2.2.4	5.1.1.1	12.3 (r3834)	11	5.4 SP2			10.0.0	2.6					5/30/2012	00-24-E8-3C-49-14	New Machine 3/2010, Formerly Proc_2 5/2012	FA-CST
FA FOO	7.1.1.1	3.1.1.1	3.2.2.4	5.1.1.1	12.3 (r3834)	11	5.4 SP2			10.0.0	2.6					5/30/2012	00-24-E8-3E-BF-FD	New Machine 3/2010, Formerly Proc_3 5/2012	FA-FOO
FA CO		3.1.1.1	3.2.2.4	5.1.1.1	12.3 (r3834)	11											00-23-AE-68-4D-37		
FA P2 Process1	7.1.2.1	3.1.1.1	3.2.2.2	5.1.1.1	12.2 (r3724)		5.4 SP2			10.0.0	2.6					5/30/2012	00-1D-09-30-OB-38	Formerly FOO 5/2012	Fa-P2-P1
FA P3 Process1	7.1.2.1	3.1.1.1	3.2.2.4	5.1.1.1	12.2 (r3724)	10.5	5.4 SP2			10.0.0	2.6					5/30/2012	00-24-E8-3C-49-08	New Machine 3/2010	Fa-P3-P1
FA P3 Process2										10.0.0	2.6					5/30/2012	00-24-E8-3E-BF-12	New Machine 3/2010, Formerly Proc_6 5/2012	Fa-P3-P2
FA P3 Process3										10.0.0	2.6					5/30/2012	00-24-E8-3C-7D-DA	New Machine 3/2010, Formerly Pro_8 5/2012	Fa-P3-P3
FA P3 Process4	7.1.2.1	3.1.1.1	3.2.2.4	5.1.1.1	12.2 (r3724)	10.5	5.4 SP2			10.0.0	2.6					5/30/2012	00-24-E8-3C-8A-30	New Machine 3/2010	Fa-P3-P4
FA O-LAB	7.1.2.1	3.1.1.1	3.2.2.4	5.1.1.1	12.2 (r3724)		5.4 SP2	2.7		10.0.0	2.6					5/30/2012	00-1D-09-30-E1-63	Formerly CST 5/2012	FA-OLAB
S220 Acq					12.1 (r3715)					10.0.0		12.0.0.1		11.0.6.0	5.1.0.1	8/8/2011	00-1D-09-31-BA-34		
S220 Acq 2					12.2 (r3724)					10.0.0		12.0.0.1		11.0.6.0	5.1.0.1	8/8/2011	00-24-E8-3E-BF-24	New Machine 3/2010, Formerly Proc_1 5/2012	
2805 Acq		3.1.1.0			11.11 (r3670)					10.0.0		12.0.0.1		11.0.6.0	5.1.0.1	5/10/2011	00-30-48-CD-32-EF		
2806 Acq		3.1 HF3			10.9 (r3020)					10.0.0		11.0.1.49		11.0.6.0	4.3.4.0	7/2/2011	00-30-48-CA-38-BB		
2807 Acq		3.1 HF2			12.2 (r3724)					10.0.0		11.0.1.49	11.0.6.0	11.0.6.0	4.3.4.0	8/8/2011	00-30-48-CA-38-BD	To *HI* on 7/1/11	
2808 Acq		3.1.1.0			12.2 (r3724)		5.4 SP2			10.0.0		12.0.0.1	11.0.6.0	11.0.6.0	4.3.4.0	2/25/2011	00-30-48-CD-33-E8		
Mobile Station	7.1.0.2	3.1.1.0	3.2 HF2	5.1.1.1	12.2 (r3724)	11		2.7		10.0.0	2.6	2010				12/13/2010	00-24-E8-B5-85-1D		
Toughbook 2		3.1.1.0														11/17/2010	00-0B-97-27-72-92	Tides, Old	
Toughbook 3		3.1.1.0			12.2 (r3724)			2.7				2009				2/25/2011	00-0B-97-33-1C-CD	Some GPS Utilities, Old	
Toughbook 4		3.1.1.0						2.7				2009				2/25/2011	00-21-5C-6C-2B-A3	Bluetooth	
Toughbook 5		3.1.1.0			12.2 (r3724)											11/17/2010	00-1B-D3-38-1B-02	Tides	
Toughbook 6		3.1.1.0						2.7		10.0.0							00-1B-D3-19-EA-4B	Bluetooth	

Fairweather Software Inventory

Last Updated:
5/1/2013

#/Type of Licenses	CARIS HIPS/SIPS	CARIS Notebook	CARIS Bathy Database	CARIS Plot Composer	Pydro/Velocipy	Mapinfo	Applanix POSPac*	Ashtech Solutions	Fledermaus	SnagIt	Fetchtides	Hypack	Hypack Geocoder	Hysweep Editor (MB Max)	Applanix POSView	Verification Date	MAC Addresses	Additional Comments	Network Comp
FA P1 Process 1	8.0.2	3.1.1.1	3.2.2.4	5.2	13.8 (r4311)		6.2			10.0.0	2.6					5/30/2012	BC-30-5B-E9-FF-0A	New 5/2012	FA-Proc1
FA P1 Process 2	8.0.2	3.1.1.1	3.2.2.4	5.2	13.8 (r4311)	11	6.2	2.7		10.0.0	2.6					5/30/2012	BC-30-5B-E9-FF-31	New 5/2012	FA-Proc2
FA P1 Process 3	8.0.2	3.1.1.1	3.2.2.4	5.2	13.8 (r4311)		6.2			10.0.0	2.6					5/30/2012	BC-30-5B-E9-FF-28	New 5/2012	FA-Proc3
FA P1 Process 4	8.0.2	3.1.1.1	3.2.2.4	5.2	13.8 (r4311)		6.2			10.0.0	2.6					5/30/2012	B8-AC-6F-89-DE-4C	replaced 6/1/11 w/ 64bit machine	FA-Proc4
FA P1 Process 5	8.0.2	3.1.1.1	3.2.2.4	5.2	13.8 (r4311)		6.2			10.0.0	2.6					5/30/2012	B8-AC-6F-8D-0D-CE	replaced 6/1/11 w/ 64bit machine	FA-Proc5
FA P1 Process 6	8.0.2	3.1.1.1	3.2.2.4	5.2	13.8 (r4311)		6.2	2.7		10.0.0	2.6					5/30/2012	BC-30-5B-EA-CD-D7	New 5/2012	FA-Proc6
FA P1 Process 7	8.0.2	3.1.1.1	3.2.2.4	5.2	13.8 (r4311)		6.2		7.3.0 (64bit)	10.0.0	2.6					5/30/2012	B8-AC-6F-89-E0-B4	replaced 6/1/11 w/ 64bit machine	FA-Proc7
FA P1 Process 8	8.0.2	3.1.1.1	3.2.2.4	5.2	13.8 (r4311)		6.2	2.7		10.0.0	2.6					5/30/2012	BC-30-5B-EA-17-BA	New 5/2012	FA-Proc8
FA P1 Process 9	8.0.2	3.1.1.1	3.2.2.4	5.2	13.8 (r4311)	11	6.2			10.0.0	2.6					5/30/2012	BC-30-5B-E9-FF-07	New 5/2012	FA-Proc9
FA CST	7.1.2.1	3.1.1.1	3.2.2.4	5.1.1.1	12.9 (r4195)	11	5.4 SP2			10.0.0	2.6					5/30/2012	00-24-E8-3C-49-14	New Machine 3/2010, Formerly Proc_2 5/2012	FA-CST
FA FOO	7.1.1.1	3.1.1.1	3.2.2.4	5.1.1.1	12.9 (r4195)	11	5.4 SP2			10.0.0	2.6					5/30/2012	00-24-E8-3E-BF-FD	New Machine 3/2010, Formerly Proc_3 5/2012	FA-FOO
FA CO		3.1.1.1	3.2.2.4	5.1.1.1	12.3 (r3834)	11											00-23-AE-68-4D-37		
FA P2 Process1	7.1.2.1	3.1.1.1	3.2.2.2	5.1.1.1	12.2 (r3724)		5.4 SP2			10.0.0	2.6					5/30/2012	00-1D-09-30-OB-38	Formerly FOO 5/2012	Fa-P2-P1
FA P3 Process1	7.1.2.1	3.1.1.1	3.2.2.4	5.1.1.1	13.8 (r4311)	10.5	5.4 SP2			10.0.0	2.6					5/30/2012	00-24-E8-3C-49-08	New Machine 3/2010	Fa-P3-P1
FA P3 Process2										10.0.0	2.6					5/30/2012	00-24-E8-3E-BF-12	New Machine 3/2010, Formerly Proc_6 5/2012	Fa-P3-P2
FA P3 Process3	8.0.4	3.1.1.1	3.2.2.2	5.1.1.1	13.8 (r4311)		6.2			10.0.0	2.6					5/30/2012	00-24-E8-3C-7D-DA	New Machine 3/2010, Formerly Pro_8 5/2012	Fa-P3-P3
FA P3 Process4	8.0.4	3.1.1.1	3.2.2.4	5.2	13.8 (r4311)		6.2			10.0.0	2.6					5/30/2012	00-24-E8-3C-8A-30	New Machine 3/2010	Fa-P3-P4
FA O-LAB	8.0.4		4.0.0.5	5.2	13.8 (r4311)		6.2			10.0.0	2.6					5/30/2012	00-1D-09-30-E1-63	Formerly CST 5/2012	FA-OLAB
S220 Acq					12.1 (r3715)					10.0.0		12.0.0.1		11.0.6.0	5.1.0.1	8/8/2011	00-1D-09-31-BA-34		
S220 Acq 2					12.2 (r3724)					10.0.0		12.0.0.1		11.0.6.0	5.1.0.1	8/8/2011	00-24-E8-3E-BF-24	New Machine 3/2010, Formerly Proc_1 5/2012	
2805 Acq		3.1.1.0			11.11 (r3670)					10.0.0		12.0.0.1		11.0.6.0	5.1.0.1	5/10/2011	00-30-48-CD-32-EF		
2806 Acq		3.1 HF3			10.9 (r3020)					10.0.0		11.0.1.49		11.0.6.0	4.3.4.0	7/2/2011	00-30-48-CA-38-BB		
2807 Acq		3.1 HF2			12.2 (r3724)					10.0.0		11.0.1.49	11.0.6.0	11.0.6.0	4.3.4.0	8/8/2011	00-30-48-CA-38-BD	To *HI* on 7/1/11	
2808 Acq		3.1.1.0			12.2 (r3724)		5.4 SP2			10.0.0		12.0.0.1	11.0.6.0	11.0.6.0	4.3.4.0	2/25/2011	00-30-48-CD-33-E8		
Mobile Station	7.1.0.2	3.1.1.0	3.2 HF2	5.1.1.1	12.2 (r3724)	11		2.7		10.0.0	2.6	2010				12/13/2010	00-24-E8-B5-85-1D		
Toughbook 2		3.1.1.0														11/17/2010	00-0B-97-27-72-92	Tides, Old	
Toughbook 3		3.1.1.1			12.2 (r3724)			2.7				2009				2/25/2011	00-0B-97-33-1C-CD	Some GPS Utilities, Old	
Toughbook 4		3.1.1.1						2.7				2009				2/25/2011	00-21-5C-6C-2B-A3	Bluetooth	
Toughbook 5		3.1.1.1			12.2 (r3724)											11/17/2010	00-1B-D3-38-1B-02	Tides	
Toughbook 6		3.1.1.1						2.7		10.0.0							00-1B-D3-19-EA-4B	Bluetooth	

Fairweather Software Inventory

Last Updated:
9/1/2013

#/Type of Licenses	CARIS HIPS/SIPS	CARIS Notebook	CARIS Bathy Database	CARIS Plot Composer	PydroVelocipy	Mapinfo	Applanix POSPac*	Ashtech Solutions	Fledermaus	SnagIt	Hypack	Hypack Geocoder	Hysweep Editor (MB Max)	Applanix POSView	Verification Date	MAC Addresses	Additional Comments	Network Comp
	10-Ntk,1-USB	2-USB	4-Ntk.1-USB	Unlimited	Unlimited	6 St Alone	2 USB Key	?	2-USB	25	5-Keys							
FA P1 Process 1	8.0.4	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)		6.2			10.0.0					5/30/2012	BC-30-5B-E9-FF-0A	New 5/2012	FA-Proc1
FA P1 Process 2	8.0.4	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)	11	6.2	2.7		10.0.0					5/30/2012	BC-30-5B-E9-FF-31	New 5/2012	FA-Proc2
FA P1 Process 3	8.0.4	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)		6.2			10.0.0					5/30/2012	BC-30-5B-E9-FF-28	New 5/2012	FA-Proc3
FA P1 Process 4	8.0.4	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)		6.2			10.0.0					5/30/2012	B8-AC-6F-89-DE-4C	replaced 6/1/11 w/ 64bit machine	FA-Proc4
FA P1 Process 5	8.0.4	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)		6.2			10.0.0					5/30/2012	B8-AC-6F-8D-0D-CE	replaced 6/1/11 w/ 64bit machine	FA-Proc5
FA P1 Process 6	8.0.4	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)		6.2	2.7		10.0.0					5/30/2012	BC-30-5B-EA-CD-D7	New 5/2012	FA-Proc6
FA P1 Process 7	8.0.4	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)		6.2		7.3.0 (64bit)	10.0.0					5/30/2012	B8-AC-6F-89-E0-B4	replaced 6/1/11 w/ 64bit machine	FA-Proc7
FA P1 Process 8	8.0.2	3.1.1.1	4.0.0.3	5.2	13.8 (r4311)		6.2	2.7		10.0.0					5/30/2012	BC-30-5B-EA-17-BA	New 5/2012	FA-Proc8
FA P1 Process 9	8.0.4	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)	11	6.2			10.0.0					5/30/2012	BC-30-5B-E9-FF-07	New 5/2012	FA-Proc9
FA CST	7.1.2.1	3.1.1.1	3.2.2.4	5.1.1.1	12.9 (r4195)	11	5.4 SP2			10.0.0	13.0.0.6				5/30/2012	00-24-E8-3C-49-14	New Machine 3/2010, Formerly Proc_2 5/2012	FA-CST
FA FOO	7.1.1.1	3.1.1.1	3.2.2.4	5.1.1.1	12.9 (r4195)	11	5.4 SP2			10.0.0					5/30/2012	00-24-E8-3E-BF-FD	New Machine 3/2010, Formerly Proc_3 5/2012	FA-FOO
FA CO		3.1.1.1	3.2.2.4	5.1.1.1	12.3 (r3834)	11										00-23-AE-68-4D-37		
FA P2 Process1	7.1.2.1	3.1.1.1	3.2.2.2	5.1.1.1	12.2 (r3724)		5.4 SP2			10.0.0					5/30/2012	00-1D-09-30-OB-38	Formerly FOO 5/2012	Fa-P2-P1
FA P3 Process1	7.1.2.1	3.1.1.1	3.2.2.4	5.1.1.1	13.8 (r4311)	10.5	5.4 SP2			10.0.0					5/30/2012	00-24-E8-3C-49-08	New Machine 3/2010	Fa-P3-P1
FA P3 Process2										10.0.0					5/30/2012	00-24-E8-3E-BF-12	New Machine 3/2010, Formerly Proc_6 5/2012	Fa-P3-P2
FA P3 Process3	8.0.4	3.1.1.1	3.2.2.2	5.1.1.1	13.8 (r4311)		6.2			10.0.0					5/30/2012	00-24-E8-3C-7D-DA	New Machine 3/2010, Formerly Pro_8 5/2012	Fa-P3-P3
FA P3 Process4	8.0.4	3.1.1.1	3.2.2.4	5.2	13.8 (r4311)		6.2			10.0.0					5/30/2012	00-24-E8-3C-8A-30	New Machine 3/2010	Fa-P3-P4
FA O-LAB	8.0.4		4.0.0.5	5.2	13.8 (r4311)		6.2			10.0.0					5/30/2012	00-1D-09-30-E1-63	Formerly CST 5/2012	FA-OLAB
S220 Acq					12.1 (r3715)					10.0.0	13.0.0.6		11.0.6.0	5.1.0.1	8/8/2011	00-1D-09-31-BA-34		
S220 Acq 2					12.2 (r3724)					10.0.0	13.0.0.6		11.0.6.0	5.1.0.1	8/8/2011	00-24-E8-3E-BF-24	New Machine 3/2010, Formerly Proc_1 5/2012	
2805 Acq		3.1.1.0			11.11 (r3670)					10.0.0	13.0.0.6		11.0.6.0	5.1.0.1	5/10/2011	00-30-48-CD-32-EF		
2806 Acq		3.1 HF3			10.9 (r3020)					10.0.0	13.0.0.6		11.0.6.0	4.3.4.0	7/2/2011	00-30-48-CA-38-BB		
2807 Acq		3.1 HF2			12.2 (r3724)					10.0.0	13.0.0.6	11.0.6.0	11.0.6.0	4.3.4.0	8/8/2011	00-30-48-CA-38-BD	To *HI* on 7/1/11	
2808 Acq		3.1.1.0			12.2 (r3724)		5.4 SP2			10.0.0	13.0.0.6	11.0.6.0	11.0.6.0	4.3.4.0	2/25/2011	00-30-48-CD-33-E8		
Mobile Station	7.1.0.2	3.1.1.0	3.2 HF2	5.1.1.1	12.2 (r3724)	11		2.7		10.0.0	2010				12/13/2010	00-24-E8-B5-85-1D		
Toughbook 2		3.1.1.0													11/17/2010	00-0B-97-27-72-92	Tides, Old	
Toughbook 3		3.1.1.1			12.2 (r3724)			2.7			2009				2/25/2011	00-0B-97-33-1C-CD	Some GPS Utilities, Old	
Toughbook 4		3.1.1.1						2.7			2009				2/25/2011	00-21-5C-6C-2B-A3	Bluetooth	
Toughbook 5		3.1.1.1			12.2 (r3724)										11/17/2010	00-1B-D3-38-1B-02	Tides	
Toughbook 6		3.1.1.1						2.7		10.0.0						00-1B-D3-19-EA-4B	Bluetooth	

Fairweather Software Inventory

Last Updated:
5/23/2014

#/Type of Licenses	CARIS HIPS/SIPS	CARIS Notebook	CARIS Bathy Database	CARIS Plot Composer	PydroVelocipy	Mapinfo	Applanix POSPac*	Ashtech Solutions	Fledermaus	SnagIt	Hypack	Hypack Geocoder	Hysweep Editor (MB Max)	Applanix POSView	Verification Date	MAC Addresses	Additional Comments	Network Conf
FA P1 Process 1	7.1.2.6	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)		6.2		7.3.5a	10.0.0					5/30/2012	BC-30-5B-E9-FF-0A	New 5/2012	FA-Proc1
FA P1 Process 2	7.1.2.6	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)	11	6.2	2.7	7.3.5a	10.0.0					5/30/2012	BC-30-5B-E9-FF-31	New 5/2012	FA-Proc2
FA P1 Process 3	7.1.2.6	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)		6.2		7.3.5a	10.0.0					5/30/2012	BC-30-5B-E9-FF-28	New 5/2012	FA-Proc3
FA P1 Process 4	7.1.2.6	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)		6.2		7.3.5a	10.0.0					5/30/2012	B8-AC-6F-89-DE-4C	replaced 6/1/11 w/ 64bit machine	FA-Proc4
FA P1 Process 5	7.1.2.6	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)		6.2		7.3.5a	10.0.0					5/30/2012	B8-AC-6F-8D-0D-CE	replaced 6/1/11 w/ 64bit machine	FA-Proc5
FA P1 Process 6	7.1.2.6	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)		6.2	2.7	7.3.5a	10.0.0					5/30/2012	BC-30-5B-EA-CD-D7	New 5/2012	FA-Proc6
FA P1 Process 7	7.1.2.6	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)		6.2		7.3.5a	10.0.0					5/30/2012	B8-AC-6F-89-E0-B4	replaced 6/1/11 w/ 64bit machine	FA-Proc7
FA P1 Process 8	7.1.2.6	3.1.1.1	4.0.0.3	5.2	13.8 (r4311)		6.2	2.7	7.3.5a	10.0.0					5/30/2012	BC-30-5B-EA-17-BA	New 5/2012	FA-Proc8
FA P1 Process 9	7.1.2.6	3.1.1.1	4.0.0.5	5.2	13.8 (r4311)	11	6.2		7.3.5a	10.0.0					5/30/2012	BC-30-5B-E9-FF-07	New 5/2012	FA-Proc9
FA CST	7.1.2.6	3.1.1.1	3.2.2.4	5.1.1.1	13.8 (r4311)	11	6.2		7.3.5a	10.0.0	13.0.0.6				5/30/2012	00-24-E8-3C-49-14	New Machine 3/2010, Formerly Proc_2 5/2012	FA-CST
FA FOO	7.1.2.6	3.1.1.1	3.2.2.4	5.1.1.1	13.8 (r4311)	11	6.2			10.0.0					5/30/2012	00-24-E8-3E-BF-FD	New Machine 3/2010, Formerly Proc_3 5/2012	FA-FOO
FA CO		3.1.1.1	3.2.2.4	5.1.1.1	12.3 (r3834)	11										00-23-AE-68-4D-37		
FA P2 Process1	7.1.2.6	3.1.1.1	3.2.2.2	5.1.1.1	12.2 (r3724)		6.2			10.0.0					5/30/2012	00-1D-09-30-OB-38	Formerly FOO 5/2012	Fa-P2-P1
FA P3 Process1	7.1.2.6	3.1.1.1	3.2.2.4	5.1.1.1	13.8 (r4311)	10.5	6.2		7.3.5a	10.0.0					5/30/2012	00-24-E8-3C-49-08	New Machine 3/2010	Fa-P3-P1
FA P3 Process2										10.0.0					5/30/2012	00-24-E8-3E-BF-12	New Machine 3/2010, Formerly Proc_6 5/2012	Fa-P3-P2
FA P3 Process3	7.1.2.6	3.1.1.1	3.2.2.2	5.1.1.1	13.8 (r4311)		6.2		7.3.5a	10.0.0					5/30/2012	00-24-E8-3C-7D-DA	New Machine 3/2010, Formerly Pro_8 5/2012	Fa-P3-P3
FA P3 Process4	7.1.2.6	3.1.1.1	3.2.2.4	5.2	13.8 (r4311)		6.2		7.3.5a	10.0.0					5/30/2012	00-24-E8-3C-8A-30	New Machine 3/2010	Fa-P3-P4
FA O-LAB	7.1.2.6		4.0.0.5	5.2	13.8 (r4311)		6.2			10.0.0					5/30/2012	00-1D-09-30-E1-63	Formerly CST 5/2012	FA-OLAB
S220 Acq					12.1 (r3715)					10.0.0	13.0.0.6		11.0.6.0	5.1.0.1	8/8/2011	00-1D-09-31-BA-34		
S220 Acq 2					12.2 (r3724)					10.0.0	13.0.0.6		11.0.6.0	5.1.0.1	8/8/2011	00-24-E8-3E-BF-24	New Machine 3/2010, Formerly Proc_1 5/2012	
2805 Acq		3.1.1.0			13.8 (r4311)					10.0.0	13.0.0.6		11.0.6.0	5.1.0.1	5/10/2011	00-30-48-CD-32-EF		
2806 Acq		3.1 HF3			13.8 (r4311)					10.0.0	13.0.0.6		11.0.6.0	4.3.4.0	7/2/2011	00-30-48-CA-38-BB		
2807 Acq		3.1 HF2			13.8 (r4311)					10.0.0	13.0.0.6	11.0.6.0	11.0.6.0	4.3.4.0	8/8/2011	00-30-48-CA-38-BD	To *HI* on 7/1/11	
2808 Acq		3.1.1.0			13.8 (r4311)					10.0.0	13.0.0.6	11.0.6.0	11.0.6.0	4.3.4.0	2/25/2011	00-30-48-CD-33-E8		
Mobile Station	7.1.0.2	3.1.1.0	3.2 HF2	5.1.1.1	12.2 (r3724)	11		2.7		10.0.0	2010				12/13/2010	00-24-E8-B5-85-1D		
Toughbook 2		3.1.1.0													11/17/2010	00-0B-97-27-72-92	Tides, Old	
Toughbook 3		3.1.1.1			12.2 (r3724)			2.7			2009				2/25/2011	00-0B-97-33-1C-CD	Some GPS Utilities, Old	
Toughbook 4		3.1.1.1						2.7			2009				2/25/2011	00-21-5C-6C-2B-A3	Bluetooth	
Toughbook 5		3.1.1.1			12.2 (r3724)										11/17/2010	00-1B-D3-38-1B-02	Tides	
Toughbook 6		3.1.1.1						2.7		10.0.0						00-1B-D3-19-EA-4B	Bluetooth	

SEA-BIRD ELECTRONICS, INC.
13431 NE 20th St. Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Temperature Calibration Report

Customer:	Pacific Marine Center / NOAA		
Job Number:	71841	**Date of Report:**	1/21/2013
Model Number	SBE 19Plus	**Serial Number:**	19P31464-4343

Temperature sensors are normally calibrated 'as received', without adjustments, allowing a determination sensor drift. If the calibration identifies a problem, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing coefficients to convert sensor frequency to temperature. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients. The coefficient 'offset' allows a small correction for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair apply only to subsequent data.

'AS RECEIVED CALIBRATION' ☑ Performed ☐ Not Performed

Date: 1/19/2013 Drift since last cal: +0.00053 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: Degrees Celsius/year

Comments:

Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA

Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4343
CALIBRATION DATE: 19-Jan-13

SBE19plus TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

a0 = 1.201200e-003
a1 = 2.637740e-004
a2 = -4.502162e-008
a3 = 1.503142e-007

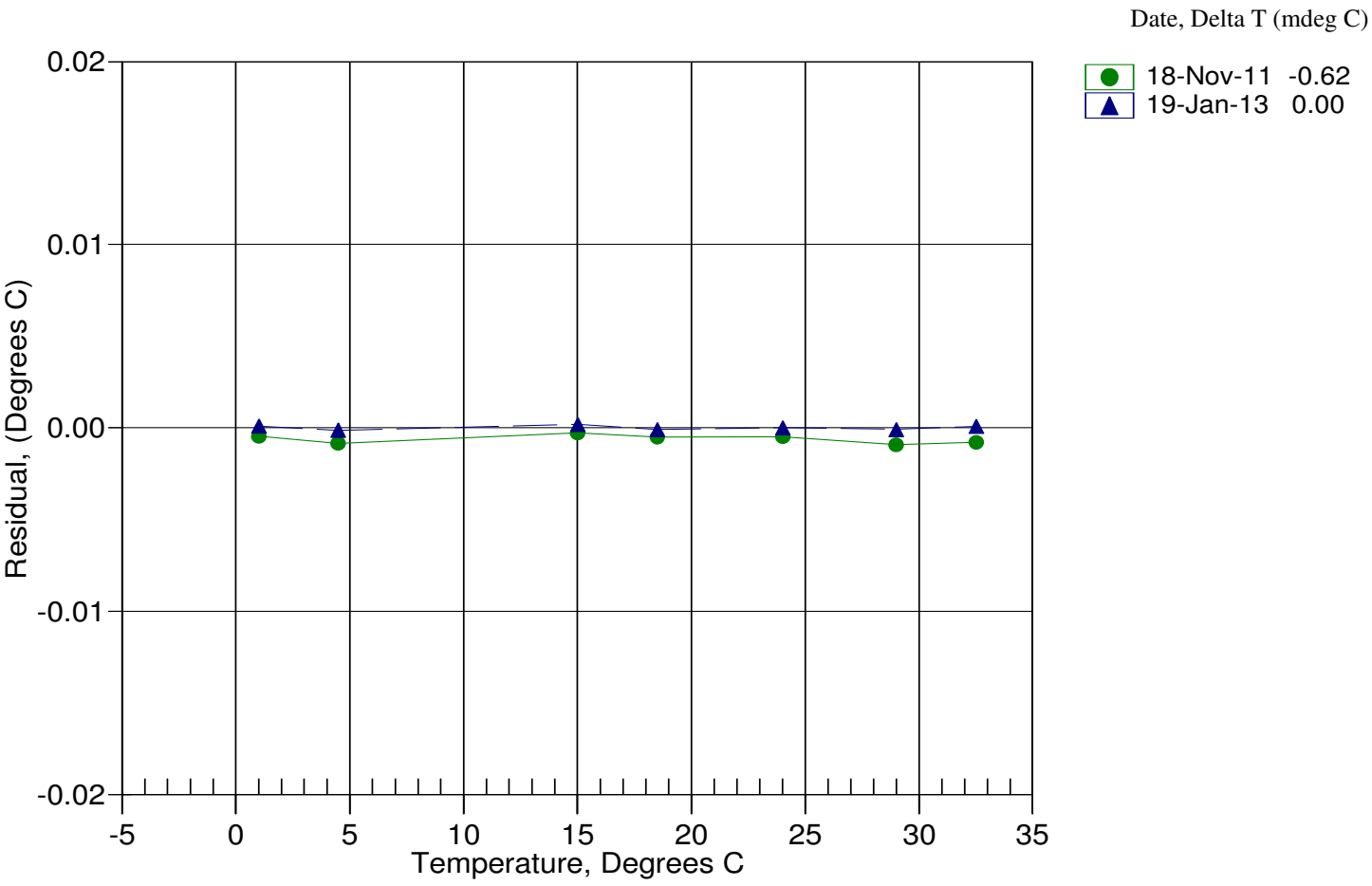
BATH TEMP (ITS-90)	INSTRUMENT OUTPUT(n)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
0.9999	693461.410	1.0000	0.0001
4.4999	619965.967	4.4998	-0.0001
15.0000	434193.607	15.0002	0.0002
18.5000	383468.783	18.4999	-0.0001
23.9999	313992.967	23.9999	0.0000
29.0000	260624.433	28.9999	-0.0001
32.5000	228178.250	32.5001	0.0001

MV = (n - 524288) / 1.6e+007

R = (MV * 2.900e+009 + 1.024e+008) / (2.048e+004 - MV * 2.0e+005)

Temperature ITS-90 = $1/\{a0 + a1[ln(R)] + a2[ln^2(R)] + a3[ln^3(R)]\} - 273.15$ (°C)

Residual = instrument temperature - bath temperature



SEA-BIRD ELECTRONICS, INC.
13431 NE 20th Street Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Conductivity Calibration Report

Customer:	Pacific Marine Center / NOAA		
Job Number:	71841	**Date of Report:**	1/21/2013
Model Number	SBE 19Plus	**Serial Number:**	19P31464-4343

Conductivity sensors are normally calibrated 'as received', without cleaning or adjustments, allowing a determination of sensor drift. If the calibration identifies a problem or indicates cell cleaning is necessary, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing the coefficients used to convert sensor frequency to conductivity. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients. The coefficient 'slope' allows small corrections for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair or cleaning apply only to subsequent data.

'AS RECEIVED CALIBRATION' ☑ Performed ☐ Not Performed

Date: 1/19/2013 **Drift since last cal:** +0.00010 **PSU/month***

Comments:

'CALIBRATION AFTER CLEANING & REPLATINIZING' ☐ Performed ☑ Not Performed

Date: **Drift since Last cal:** **PSU/month***

Comments:

**Measured at 3.0 S/m*

Cell cleaning and electrode replatinizing tend to 'reset' the conductivity sensor to its original condition. Lack of drift in post-cleaning-calibration indicates geometric stability of the cell and electrical stability of the sensor circuit.

Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA

Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4343
CALIBRATION DATE: 19-Jan-13

SBE19plus CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

```
g = -1.035501e+000
h =  1.425434e-001
i = -2.565273e-004
j =  3.764616e-005

CPcor = -9.5700e-008
CTcor =  3.2500e-006
```

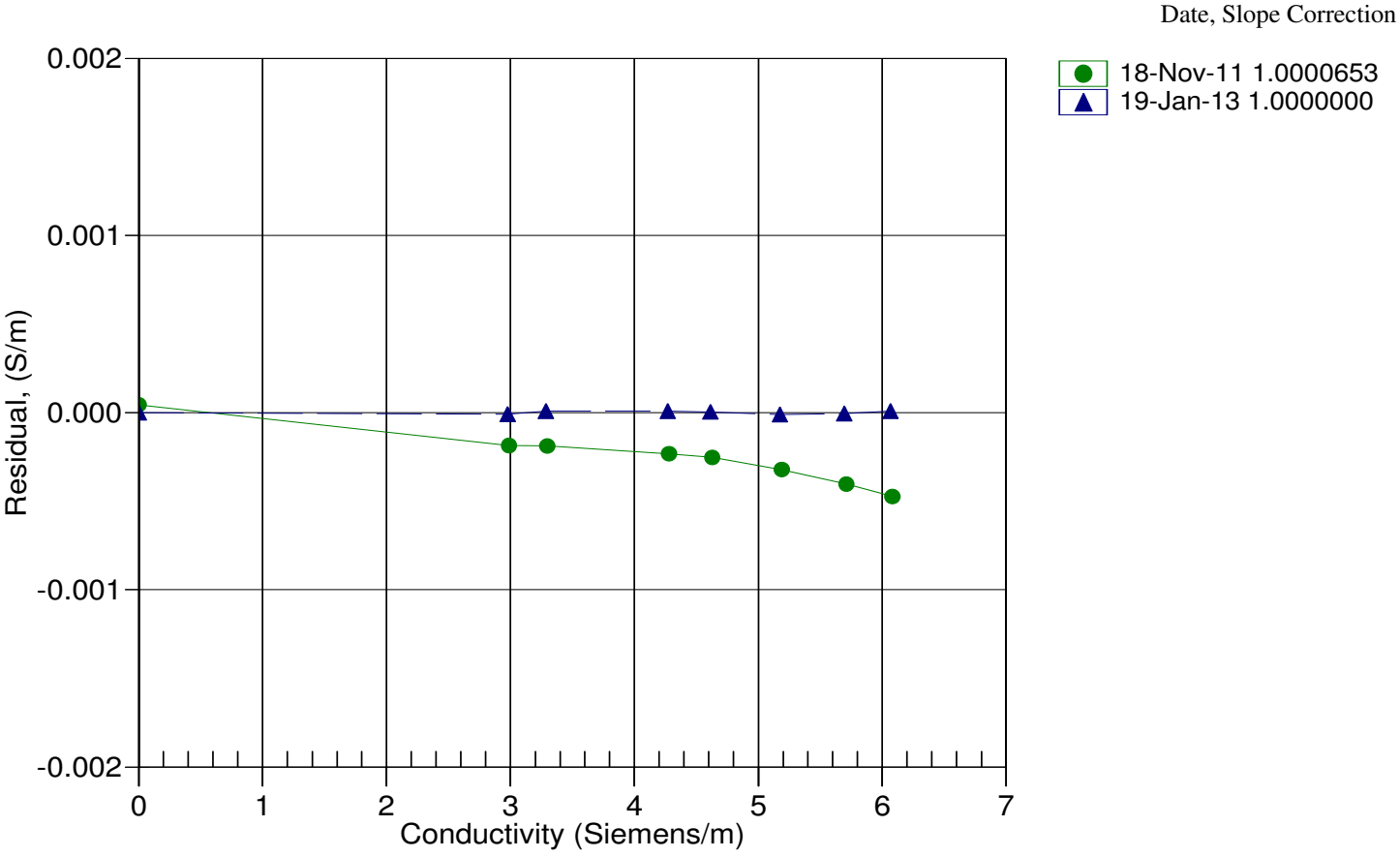
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2699.23	0.0000	0.00000
0.9999	34.8497	2.97854	5312.21	2.9785	-0.00001
4.4999	34.8293	3.28582	5511.25	3.2858	0.00001
15.0000	34.7856	4.26825	6103.45	4.2683	0.00001
18.5000	34.7746	4.61343	6298.06	4.6134	0.00000
23.9999	34.7615	5.17136	6600.20	5.1714	-0.00001
29.0000	34.7512	5.69285	6870.31	5.6928	-0.00001
32.5000	34.7416	6.06444	7056.28	6.0644	0.00001

f = INST FREQ / 1000.0

Conductivity = $(g + hf^2 + if^3 + jf^4) / (1 + \delta t + \varepsilon p)$ Siemens/meter

t = temperature[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = instrument conductivity - bath conductivity



Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA

Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4343
CALIBRATION DATE: 17-Jan-13

SBE19plus PRESSURE CALIBRATION DATA
1450 psia S/N 2101

COEFFICIENTS:

PA0 =	6.662245e-001	PTCA0 =	5.211780e+005
PA1 =	4.437491e-003	PTCA1 =	8.212492e+000
PA2 =	-2.626252e-011	PTCA2 =	-6.270641e-002
PTEMPA0 =	-8.012708e+001	PTCB0 =	2.480825e+001
PTEMPA1 =	4.648875e+001	PTCB1 =	-3.500000e-004
PTEMPA2 =	-1.914972e-001	PTCB2 =	0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE PSIA	INST OUTPUT	THERMISTOR OUTPUT	COMPUTED PRESSURE	ERROR %FSR
14.79	524514.0	2.2	14.81	0.00
301.75	589165.4	2.2	301.67	-0.01
588.85	653903.0	2.2	588.69	-0.01
875.69	718691.2	2.2	875.71	0.00
1162.53	783439.3	2.2	1162.34	-0.01
1449.63	848380.3	2.2	1449.60	-0.00
1162.54	783530.8	2.2	1162.74	0.01
875.62	718688.1	2.2	875.70	0.01
588.62	653913.7	2.2	588.73	0.01
301.62	589155.5	2.2	301.62	-0.00
14.78	524513.8	2.2	14.80	0.00

THERMAL CORRECTION

TEMP ITS90	THERMISTOR OUTPUT	INST OUTPUT
32.50	2.45	524615.63
29.00	2.37	524606.26
24.00	2.26	524585.64
18.50	2.14	524549.45
15.00	2.06	524523.54
4.50	1.83	524451.31
1.00	1.76	524430.35

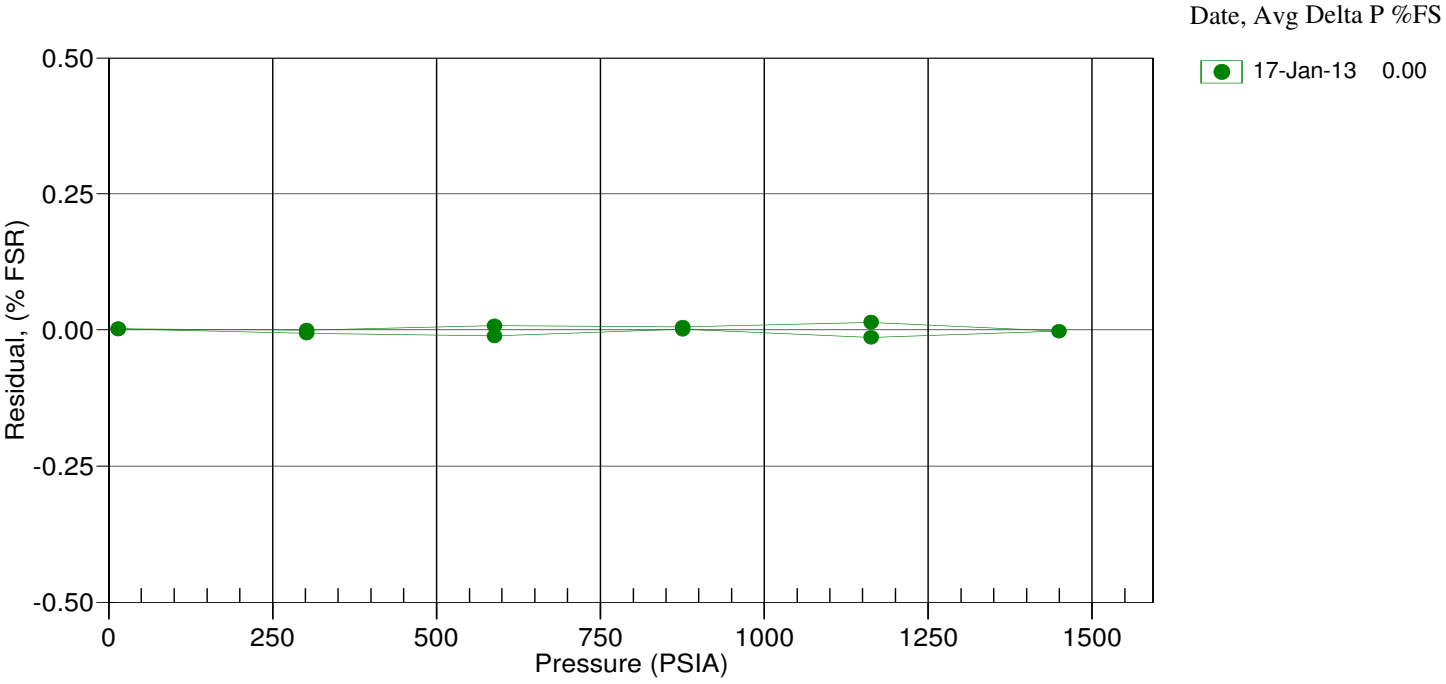
TEMP(ITS90)	SPAN(mV)
-5.00	24.81
35.00	24.80

y = thermistor output; $t = PTEMPA0 + PTEMPA1 * y + PTEMPA2 * y^2$

x = pressure output - $PTCA0 - PTCA1 * t - PTCA2 * t^2$

$n = x * PTCB0 / (PTCB0 + PTCB1 * t + PTCB2 * t^2)$

pressure (psia) = $PA0 + PA1 * n + PA2 * n^2$



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13431 NE 20th Street Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Conductivity Calibration Report

Customer:	Pacific Marine Center / NOAA		
Job Number:	72195	**Date of Report:**	1/16/2013
Model Number	SBE 19Plus	**Serial Number:**	19P36026-4617

Conductivity sensors are normally calibrated 'as received', without cleaning or adjustments, allowing a determination of sensor drift. If the calibration identifies a problem or indicates cell cleaning is necessary, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing the coefficients used to convert sensor frequency to conductivity. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients. The coefficient 'slope' allows small corrections for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair or cleaning apply only to subsequent data.

'AS RECEIVED CALIBRATION' ☑ Performed ☐ Not Performed

Date: 1/15/2013 **Drift since last cal:** -0.00020 **PSU/month***

Comments:

'CALIBRATION AFTER CLEANING & REPLATINIZING' ☐ Performed ☑ Not Performed

Date: **Drift since Last cal:** **PSU/month***

Comments:

****Measured at 3.0 S/m***

Cell cleaning and electrode replatinizing tend to 'reset' the conductivity sensor to its original condition. Lack of drift in post-cleaning-calibration indicates geometric stability of the cell and electrical stability of the sensor circuit.

Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA

Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4617
CALIBRATION DATE: 15-Jan-13

SBE19plus CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

```
g = -9.988382e-001
h =  1.277109e-001
i = -2.422985e-004
j =  3.298924e-005

CPcor = -9.5700e-008
CTcor =  3.2500e-006
```

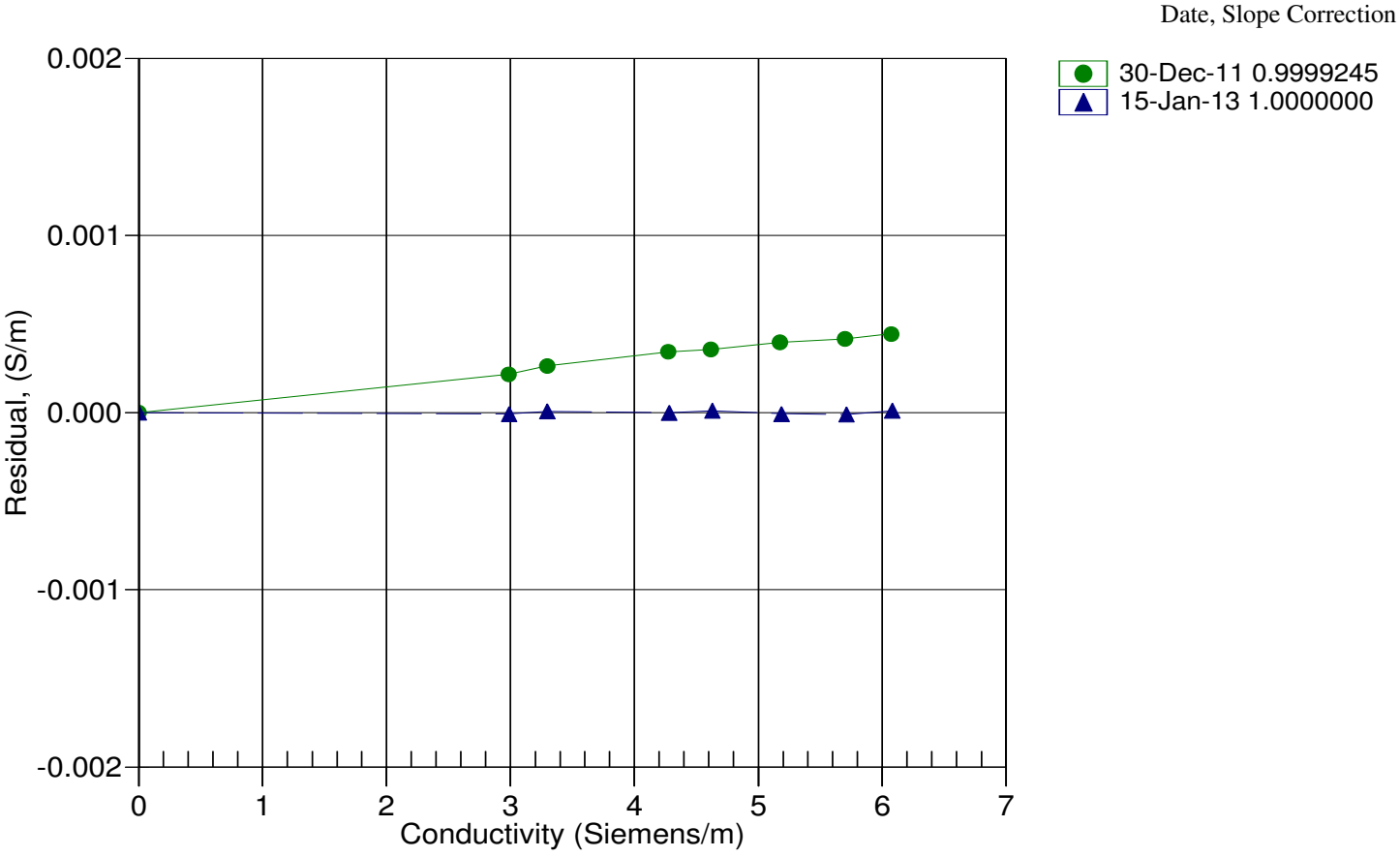
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2801.23	0.0000	0.00000
1.0000	34.9579	2.98691	5593.60	2.9869	-0.00001
4.4999	34.9380	3.29506	5805.19	3.2951	0.00001
14.9999	34.8945	4.28018	6434.28	4.2802	-0.00000
18.4999	34.8842	4.62639	6640.94	4.6264	0.00001
23.9999	34.8718	5.18596	6961.65	5.1860	-0.00001
29.0000	34.8625	5.70903	7248.27	5.7090	-0.00001
32.5000	34.8528	6.08163	7445.52	6.0816	0.00001

f = INST FREQ / 1000.0

Conductivity = $(g + hf^2 + if^3 + jf^4) / (1 + \delta t + \varepsilon p)$ Siemens/meter

t = temperature[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = instrument conductivity - bath conductivity



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13431 NE 20th St. Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Temperature Calibration Report

Customer:	Pacific Marine Center / NOAA		
Job Number:	72195	**Date of Report:**	1/16/2013
Model Number	SBE 19Plus	**Serial Number:**	19P36026-4617

Temperature sensors are normally calibrated 'as received', without adjustments, allowing a determination sensor drift. If the calibration identifies a problem, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing coefficients to convert sensor frequency to temperature. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients. The coefficient 'offset' allows a small correction for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair apply only to subsequent data.

'AS RECEIVED CALIBRATION' ☑ Performed ☐ Not Performed

Date: 1/15/2013 Drift since last cal: +0.00039 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: Degrees Celsius/year

Comments:

Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA

Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4617
CALIBRATION DATE: 15-Jan-13

SBE19plus TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

a0 = 1.267255e-003
a1 = 2.620479e-004
a2 = 2.503373e-007
a3 = 1.427996e-007

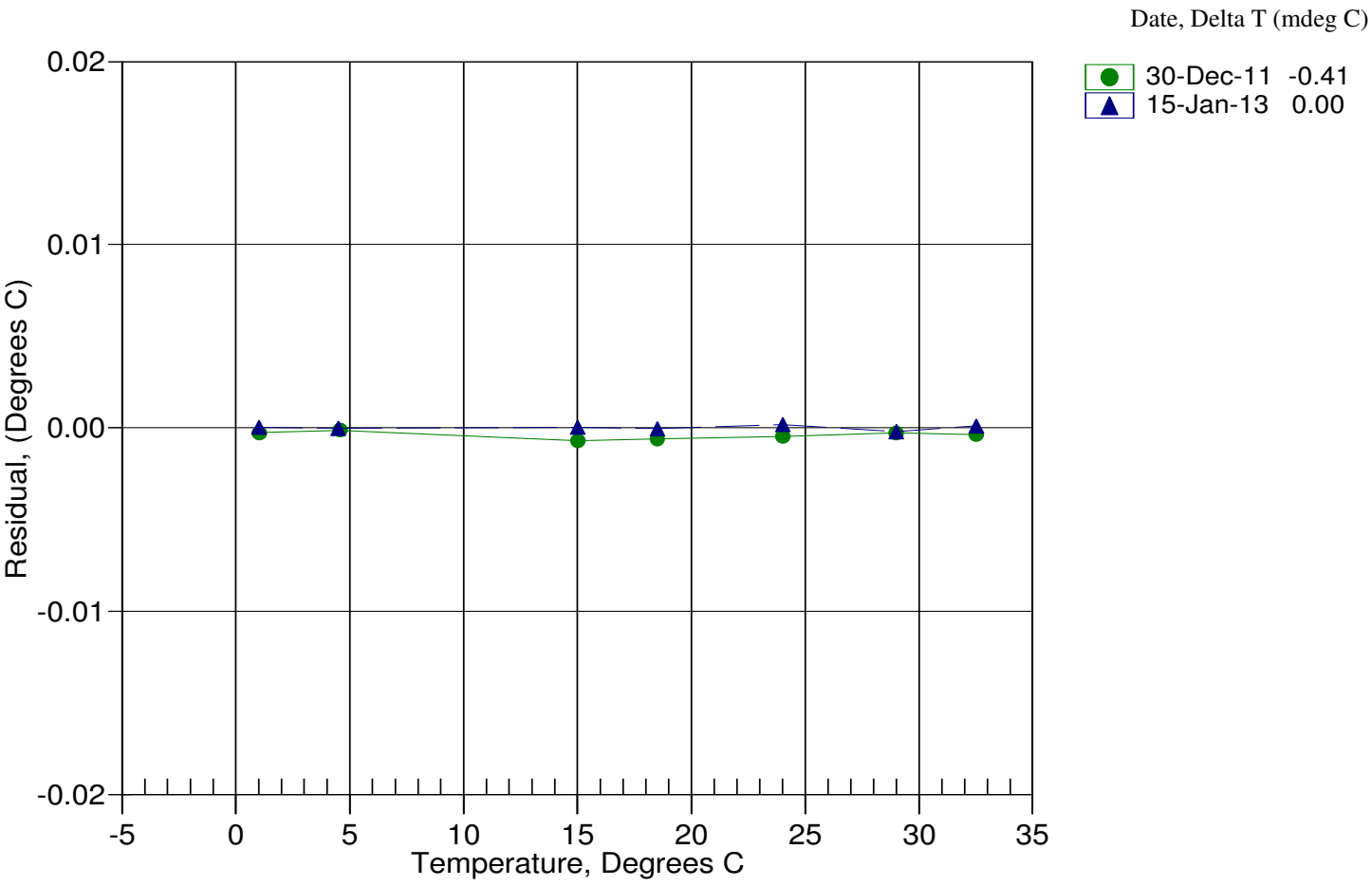
BATH TEMP (ITS-90)	INSTRUMENT OUTPUT(n)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	585630.288	1.0000	0.0000
4.4999	518796.780	4.4999	-0.0000
14.9999	354147.797	14.9999	0.0000
18.4999	310219.797	18.4999	-0.0000
23.9999	250754.017	24.0001	0.0002
29.0000	205618.712	28.9998	-0.0002
32.5000	178401.119	32.5001	0.0001

MV = (n - 524288) / 1.6e+007

R = (MV * 2.900e+009 + 1.024e+008) / (2.048e+004 - MV * 2.0e+005)

Temperature ITS-90 = $1/\{a0 + a1[ln(R)] + a2[ln^2(R)] + a3[ln^3(R)]\} - 273.15$ (°C)

Residual = instrument temperature - bath temperature



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13431 NE 20th Street, Bellevue, WA 98005-2010 USA

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SENSOR SERIAL NUMBER: 4617
CALIBRATION DATE: 11-Jan-13

SBE19plus PRESSURE CALIBRATION DATA
1450 psia S/N 5513

COEFFICIENTS:

PA0 =	-4.701047e-001	PTCA0 =	5.192728e+005
PA1 =	4.447332e-003	PTCA1 =	-1.041390e+001
PA2 =	-1.304121e-011	PTCA2 =	2.558563e-001
PTEMPA0 =	-7.822603e+001	PTCB0 =	2.460838e+001
PTEMPA1 =	4.830428e+001	PTCB1 =	6.750000e-004
PTEMPA2 =	-1.958091e-001	PTCB2 =	0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE PSIA	INST OUTPUT	THERMISTOR OUTPUT	COMPUTED PRESSURE	ERROR %FSR
14.76	522594.8	2.1	14.76	0.00
301.47	587124.9	2.1	301.52	0.00
588.36	651711.6	2.1	588.42	0.00
875.32	716329.0	2.1	875.34	0.00
1162.35	780976.5	2.1	1162.29	-0.00
1449.33	845661.7	2.1	1449.30	-0.00
1162.30	781002.2	2.1	1162.41	0.01
875.32	716327.8	2.1	875.34	0.00
588.05	651593.1	2.1	587.89	-0.01
301.46	587111.5	2.1	301.46	0.00
14.76	522593.5	2.1	14.76	-0.00

THERMAL CORRECTION

TEMP ITS90	THERMISTOR OUTPUT	INST OUTPUT
32.50	2.31	522702.93
29.00	2.24	522693.29
24.00	2.13	522685.00
18.50	2.02	522674.61
15.00	1.95	522671.91
4.50	1.73	522725.79
1.00	1.65	522776.42

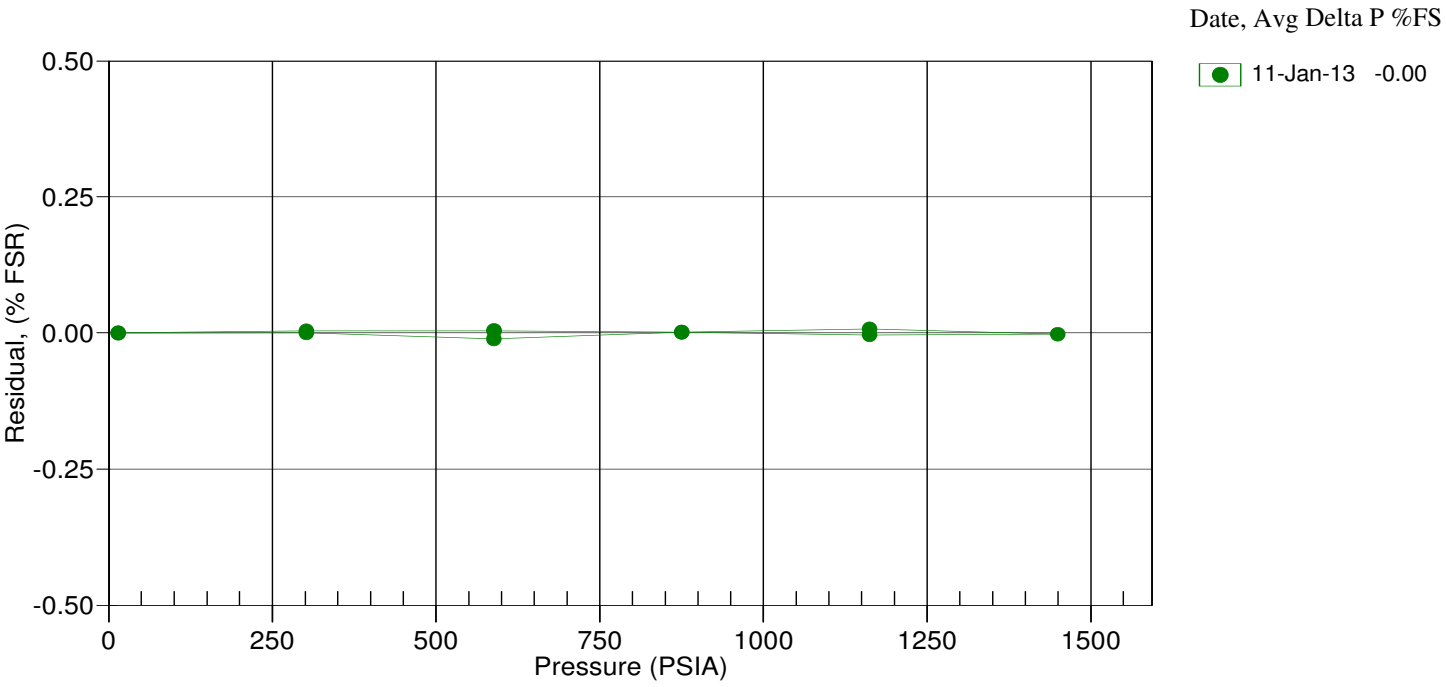
TEMP(ITS90)	SPAN(mV)
-5.00	24.61
35.00	24.63

y = thermistor output; $t = PTEMPA0 + PTEMPA1 * y + PTEMPA2 * y^2$

x = pressure output - $PTCA0 - PTCA1 * t - PTCA2 * t^2$

$n = x * PTCB0 / (PTCB0 + PTCB1 * t + PTCB2 * t^2)$

pressure (psia) = $PA0 + PA1 * n + PA2 * n^2$



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13431 NE 20th Street Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Conductivity Calibration Report

Customer:	Pacific Marine Center / NOAA		
Job Number:	72195	**Date of Report:**	1/14/2013
Model Number	SBE 19Plus	**Serial Number:**	19P50959-6122

Conductivity sensors are normally calibrated 'as received', without cleaning or adjustments, allowing a determination of sensor drift. If the calibration identifies a problem or indicates cell cleaning is necessary, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing the coefficients used to convert sensor frequency to conductivity. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients. The coefficient 'slope' allows small corrections for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair or cleaning apply only to subsequent data.

'AS RECEIVED CALIBRATION' ☑ Performed ☐ Not Performed

Date: 1/12/2013 **Drift since last cal:** -0.00020 **PSU/month***

Comments:

'CALIBRATION AFTER CLEANING & REPLATINIZING' ☐ Performed ☑ Not Performed

Date: **Drift since Last cal:** **PSU/month***

Comments:

****Measured at 3.0 S/m***

Cell cleaning and electrode replatinizing tend to 'reset' the conductivity sensor to its original condition. Lack of drift in post-cleaning-calibration indicates geometric stability of the cell and electrical stability of the sensor circuit.

Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA

Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 6122
CALIBRATION DATE: 12-Jan-13

SBE19plusV2 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

```
g = -9.952241e-001
h =  1.571720e-001
i = -5.010477e-004
j =  6.360475e-005

CPcor = -9.5700e-008
CTcor =  3.2500e-006
```

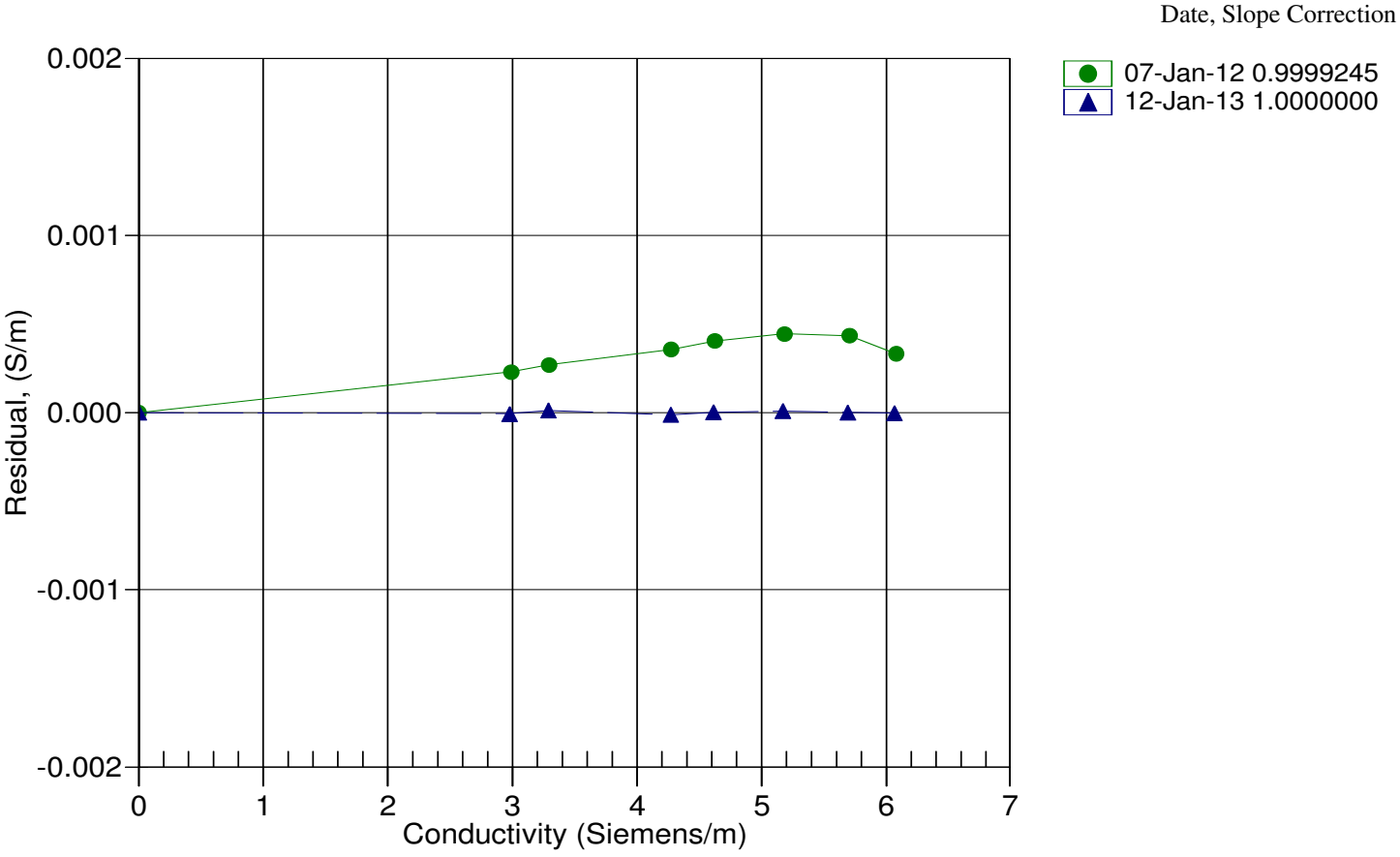
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2523.27	0.0000	0.00000
1.0000	34.8497	2.97855	5042.82	2.9785	-0.00001
4.4999	34.8298	3.28586	5233.74	3.2859	0.00001
14.9999	34.7859	4.26827	5801.21	4.2683	-0.00001
18.5000	34.7749	4.61347	5987.57	4.6135	0.00000
24.0000	34.7616	5.17139	6276.75	5.1714	0.00001
29.0000	34.7500	5.69268	6535.02	5.6927	0.00000
32.5000	34.7379	6.06386	6712.66	6.0639	-0.00000

f = INST FREQ / 1000.0

Conductivity = $(g + hf^2 + if^3 + jf^4) / (1 + \delta t + \varepsilon p)$ Siemens/meter

t = temperature[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = instrument conductivity - bath conductivity



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13431 NE 20th St. Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Temperature Calibration Report

Customer:	Pacific Marine Center / NOAA		
Job Number:	72195	**Date of Report:**	1/14/2013
Model Number	SBE 19Plus	**Serial Number:**	19P50959-6122

Temperature sensors are normally calibrated 'as received', without adjustments, allowing a determination sensor drift. If the calibration identifies a problem, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing coefficients to convert sensor frequency to temperature. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients. The coefficient 'offset' allows a small correction for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair apply only to subsequent data.

'AS RECEIVED CALIBRATION' ☑ Performed ☐ Not Performed

Date: 1/12/2013 Drift since last cal: -0.00110 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: Degrees Celsius/year

Comments:

Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA

Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 6122
CALIBRATION DATE: 12-Jan-13

SBE19plusV2 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

a0 = 1.311436e-003
a1 = 2.512171e-004
a2 = 7.670896e-007
a3 = 1.064799e-007

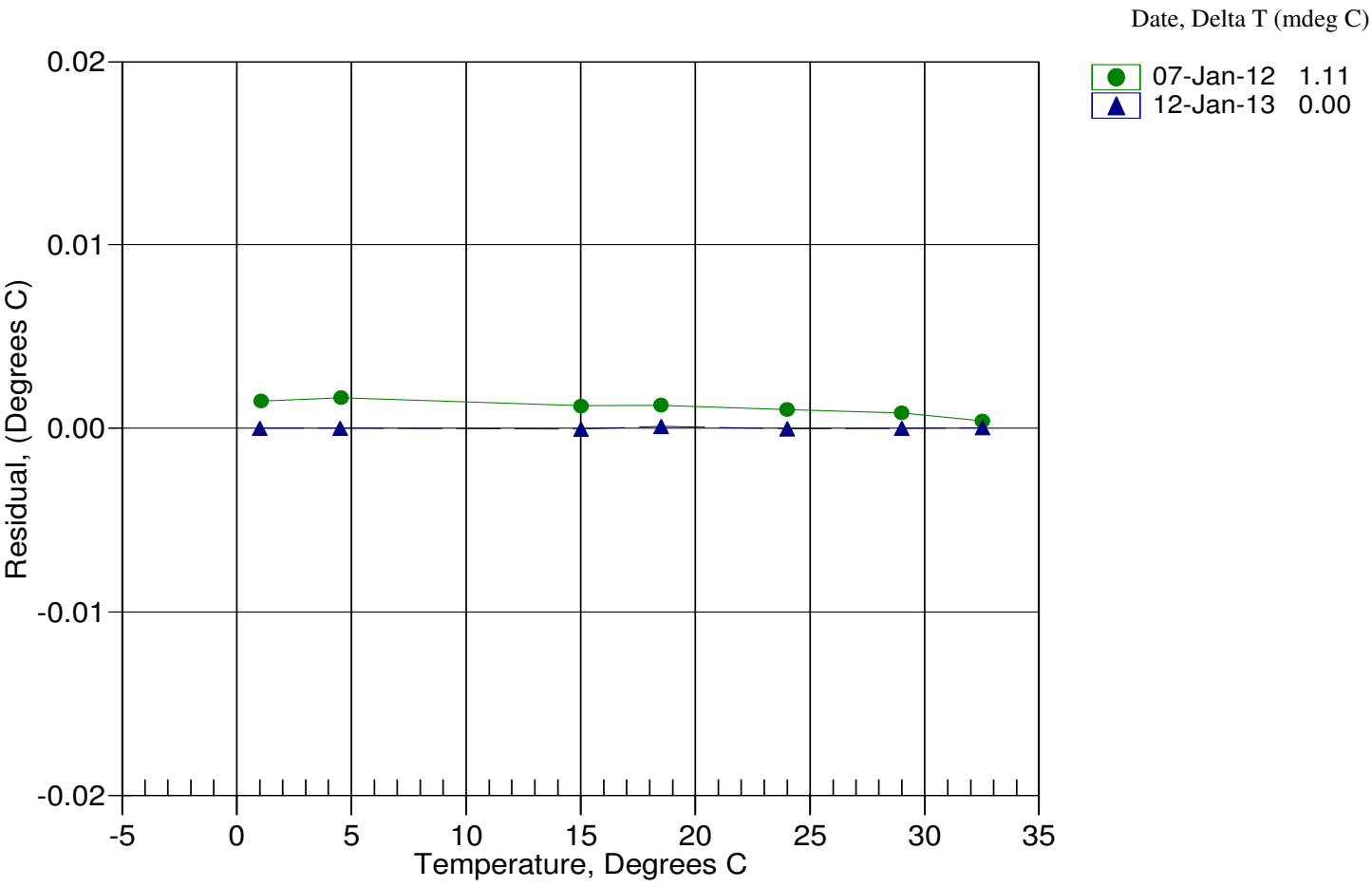
BATH TEMP (ITS-90)	INSTRUMENT OUTPUT(n)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	640406.164	1.0000	0.0000
4.4999	567830.450	4.4999	-0.0000
14.9999	387717.410	14.9998	-0.0001
18.5000	339443.533	18.5001	0.0001
24.0000	274050.383	24.0000	-0.0000
29.0000	224422.115	29.0000	-0.0000
32.5000	194529.770	32.5000	0.0000

MV = (n - 524288) / 1.6e+007

R = (MV * 2.900e+009 + 1.024e+008) / (2.048e+004 - MV * 2.0e+005)

Temperature ITS-90 = $1/\{a0 + a1[ln(R)] + a2[ln^2(R)] + a3[ln^3(R)]\} - 273.15$ (°C)

Residual = instrument temperature - bath temperature



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SENSOR SERIAL NUMBER: 6122
CALIBRATION DATE: 11-Jan-13

SBE19plusV2 PRESSURE CALIBRATION DATA
870 psia S/N 2752080

COEFFICIENTS:

PA0 =	-1.625248e-001	PTCA0 =	5.244217e+005
PA1 =	2.635779e-003	PTCA1 =	-1.948462e+000
PA2 =	2.061527e-011	PTCA2 =	-5.889249e-002
PTEMPA0 =	-6.146598e+001	PTCB0 =	2.507825e+001
PTEMPA1 =	5.373745e+001	PTCB1 =	-5.500000e-004
PTEMPA2 =	-2.607578e-001	PTCB2 =	0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE PSIA	INST OUTPUT	THERMISTOR OUTPUT	COMPUTED PRESSURE	ERROR %FSR
14.71	530001.0	1.5	14.72	0.00
179.99	592641.0	1.5	179.99	0.00
360.00	660791.0	1.5	359.99	-0.00
540.02	728880.0	1.5	540.02	-0.00
720.05	796899.0	1.5	720.05	0.00
875.06	855399.0	1.5	875.05	-0.00
720.08	796915.0	1.5	720.10	0.00
540.09	728910.0	1.5	540.10	0.00
360.06	660813.0	1.5	360.05	-0.00
180.04	592653.0	1.5	180.03	-0.00
14.72	529999.0	1.5	14.72	-0.00

THERMAL CORRECTION

TEMP ITS90	THERMISTOR OUTPUT	INST OUTPUT
32.50	1.76	530074.05
29.00	1.70	530095.03
24.00	1.60	530119.00
18.50	1.50	530143.08
15.00	1.43	530159.73
4.50	1.24	530187.25
1.00	1.17	530200.03

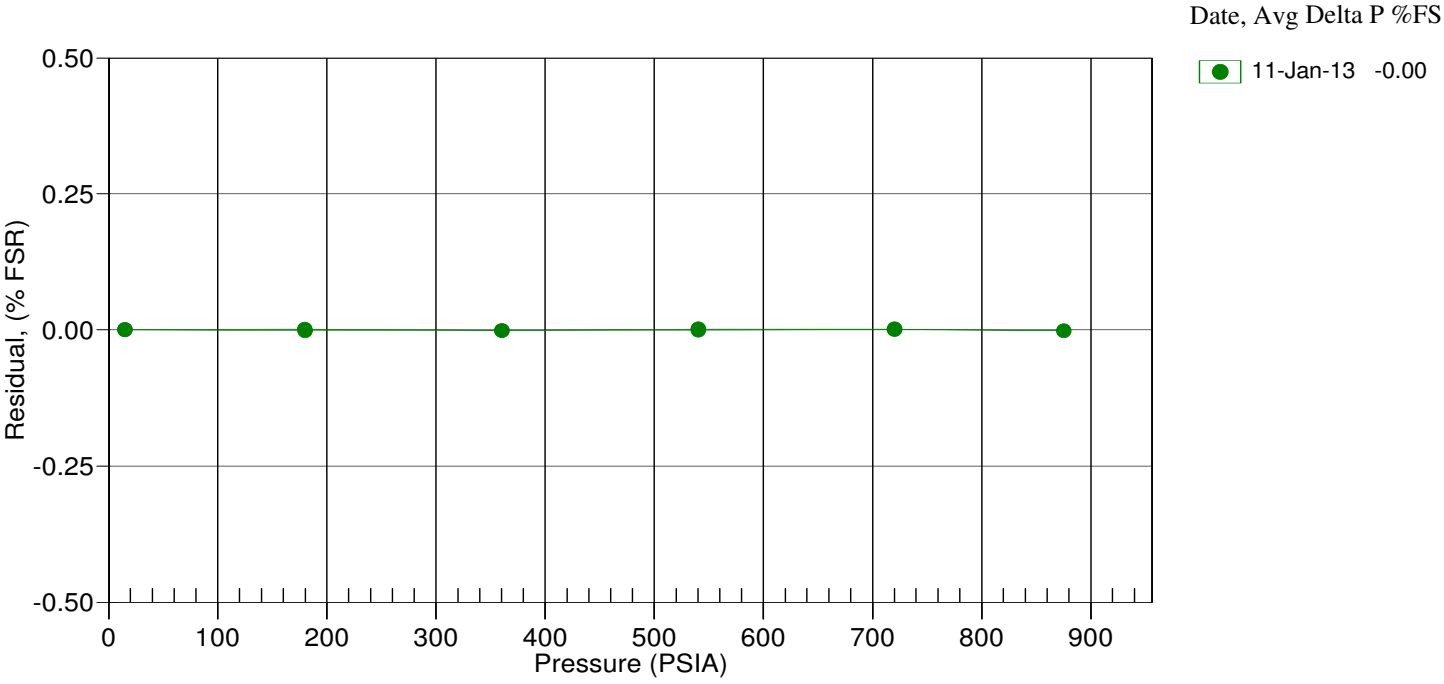
TEMP(ITS90)	SPAN(mV)
-5.00	25.08
35.00	25.06

y = thermistor output; $t = PTEMPA0 + PTEMPA1 * y + PTEMPA2 * y^2$

x = pressure output - $PTCA0 - PTCA1 * t - PTCA2 * t^2$

$n = x * PTCB0 / (PTCB0 + PTCB1 * t + PTCB2 * t^2)$

pressure (psia) = $PA0 + PA1 * n + PA2 * n^2$



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Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Conductivity Calibration Report

Customer:	Pacific Marine Center / NOAA		
Job Number:	72195	**Date of Report:**	1/16/2013
Model Number	SBE 19Plus	**Serial Number:**	19P50959-6121

Conductivity sensors are normally calibrated 'as received', without cleaning or adjustments, allowing a determination of sensor drift. If the calibration identifies a problem or indicates cell cleaning is necessary, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing the coefficients used to convert sensor frequency to conductivity. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients. The coefficient 'slope' allows small corrections for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair or cleaning apply only to subsequent data.

'AS RECEIVED CALIBRATION' ☑ Performed ☐ Not Performed

Date: 1/15/2013 **Drift since last cal:** -0.00010 **PSU/month***

Comments:

'CALIBRATION AFTER CLEANING & REPLATINIZING' ☐ Performed ☑ Not Performed

Date: **Drift since Last cal:** **PSU/month***

Comments:

****Measured at 3.0 S/m***

Cell cleaning and electrode replatinizing tend to 'reset' the conductivity sensor to its original condition. Lack of drift in post-cleaning-calibration indicates geometric stability of the cell and electrical stability of the sensor circuit.

Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA

Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 6121
CALIBRATION DATE: 15-Jan-13

SBE19plusV2 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

```
g = -1.001225e+000
h =  1.548297e-001
i = -3.722102e-004
j =  5.023761e-005

CPcor = -9.5700e-008
CTcor =  3.2500e-006
```

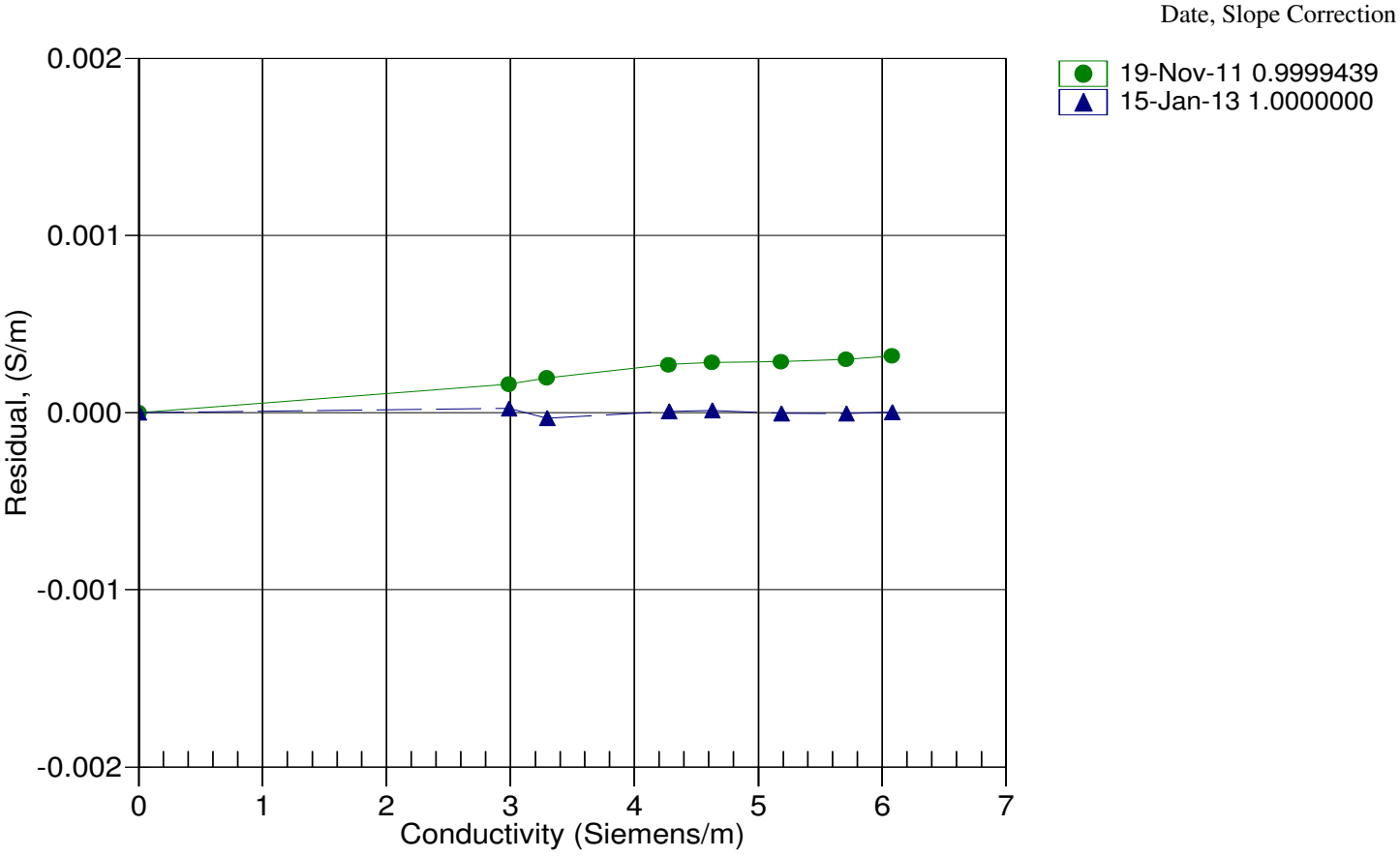
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2548.08	0.0000	0.00000
1.0000	34.9579	2.98691	5085.03	2.9869	0.00002
4.4999	34.9380	3.29506	5277.33	3.2950	-0.00003
14.9999	34.8945	4.28018	5849.25	4.2802	0.00001
18.4999	34.8842	4.62639	6037.13	4.6264	0.00001
23.9999	34.8718	5.18596	6328.72	5.1860	-0.00000
29.0000	34.8625	5.70903	6589.32	5.7090	-0.00001
32.5000	34.8528	6.08163	6768.66	6.0816	0.00000

f = INST FREQ / 1000.0

Conductivity = $(g + hf^2 + if^3 + jf^4) / (1 + \delta t + \varepsilon p)$ Siemens/meter

t = temperature[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = instrument conductivity - bath conductivity



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Temperature Calibration Report

Customer:	Pacific Marine Center / NOAA		
Job Number:	72195	**Date of Report:**	1/16/2013
Model Number	SBE 19Plus	**Serial Number:**	19P50959-6121

Temperature sensors are normally calibrated 'as received', without adjustments, allowing a determination sensor drift. If the calibration identifies a problem, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing coefficients to convert sensor frequency to temperature. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients. The coefficient 'offset' allows a small correction for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair apply only to subsequent data.

'AS RECEIVED CALIBRATION' ☑ Performed ☐ Not Performed

Date: 1/15/2013 Drift since last cal: -0.00058 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: Degrees Celsius/year

Comments:

Sea-Bird Electronics, Inc.

13431 NE 20th Street, Bellevue, WA 98005-2010 USA

Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 6121
CALIBRATION DATE: 15-Jan-13

SBE19plusV2 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

a0 = 1.295516e-003
a1 = 2.542861e-004
a2 = 4.335425e-007
a3 = 1.208696e-007

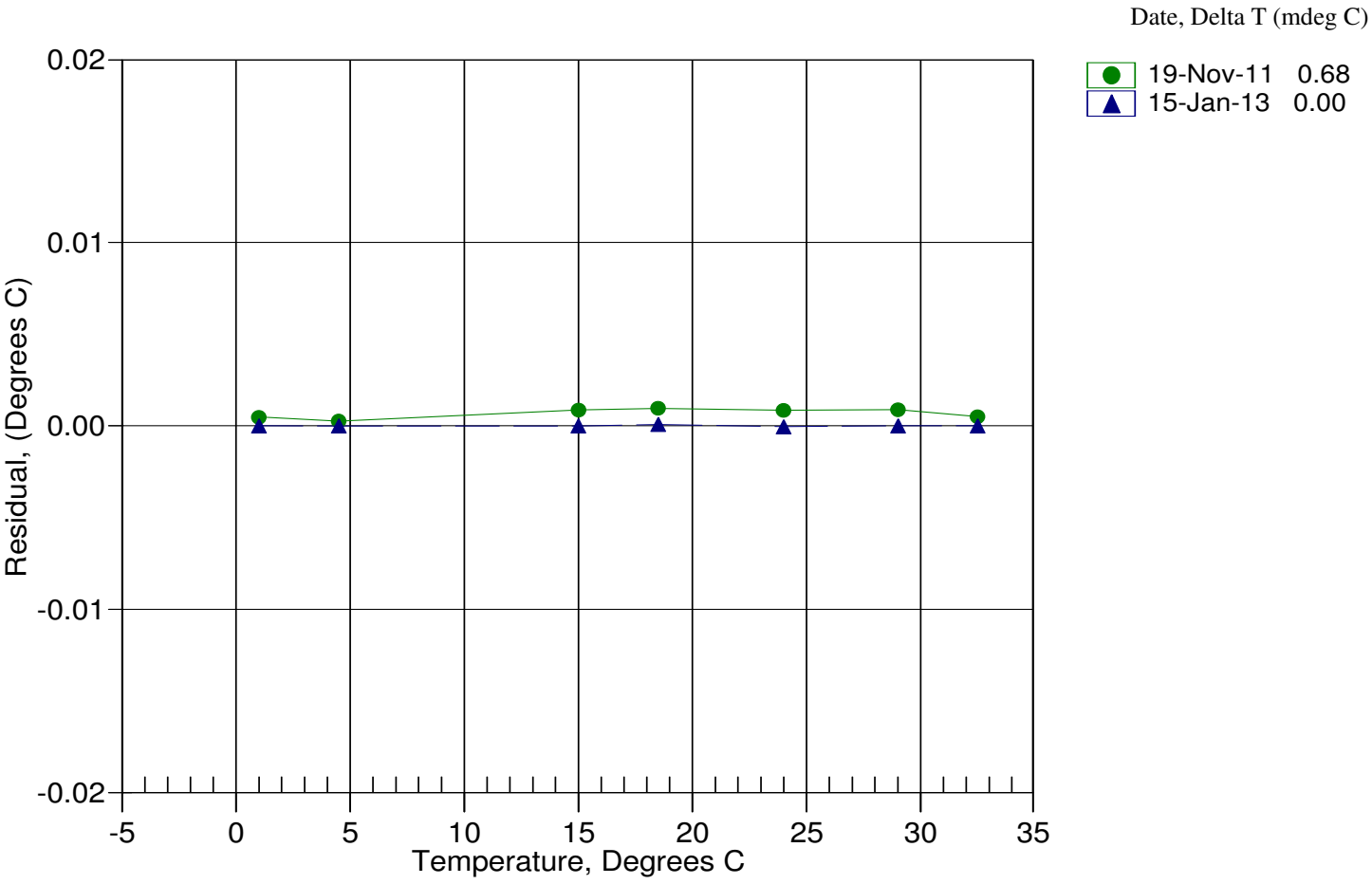
BATH TEMP (ITS-90)	INSTRUMENT OUTPUT(n)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	648465.131	1.0000	0.0000
4.4999	575538.623	4.4999	-0.0000
14.9999	394119.067	14.9999	-0.0000
18.4999	345384.617	18.5000	0.0001
23.9999	279281.852	23.9999	-0.0000
29.0000	229047.393	29.0000	0.0000
32.5000	198761.600	32.5000	0.0000

MV = (n - 524288) / 1.6e+007

R = (MV * 2.900e+009 + 1.024e+008) / (2.048e+004 - MV * 2.0e+005)

Temperature ITS-90 = $1/\{a0 + a1[ln(R)] + a2[ln^2(R)] + a3[ln^3(R)]\} - 273.15$ (°C)

Residual = instrument temperature - bath temperature



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SENSOR SERIAL NUMBER: 6121
CALIBRATION DATE: 11-Jan-13

SBE19plusV2 PRESSURE CALIBRATION DATA
870 psia S/N 2752079

COEFFICIENTS:

PA0 =	-2.168329e-001	PTCA0 =	5.247699e+005
PA1 =	2.639989e-003	PTCA1 =	-5.009466e+000
PA2 =	1.757815e-011	PTCA2 =	4.527557e-002
PTEMPA0 =	-5.976510e+001	PTCB0 =	2.511463e+001
PTEMPA1 =	5.349302e+001	PTCB1 =	-1.075000e-003
PTEMPA2 =	-4.374279e-001	PTCB2 =	0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE PSIA	INST OUTPUT	THERMISTOR OUTPUT	COMPUTED PRESSURE	ERROR %FSR
14.76	530357.0	1.5	14.77	0.00
180.02	592862.0	1.5	180.01	-0.00
360.04	660899.0	1.5	360.04	0.00
540.06	728872.0	1.5	540.06	0.00
720.08	796790.0	1.5	720.10	0.00
875.07	855198.0	1.5	875.05	-0.00
720.09	796792.0	1.5	720.10	0.00
540.10	728886.0	1.5	540.10	-0.00
360.08	660913.0	1.5	360.08	-0.00
180.07	592875.0	1.5	180.05	-0.00
14.76	530351.0	1.5	14.76	-0.00

THERMAL CORRECTION

TEMP ITS90	THERMISTOR OUTPUT	INST OUTPUT
32.50	1.75	530473.02
29.00	1.68	530482.08
24.00	1.59	530496.28
18.50	1.48	530512.41
15.00	1.41	530522.78
4.50	1.21	530565.61
1.00	1.15	530585.51

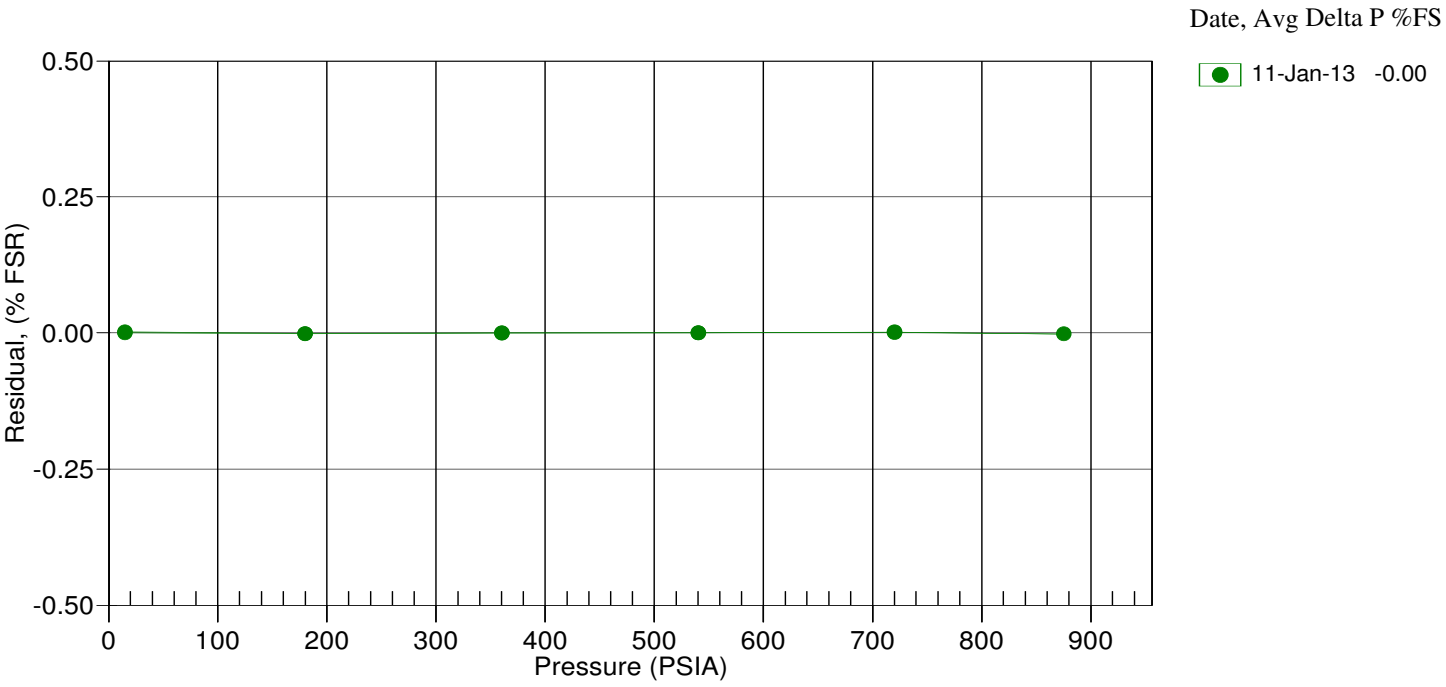
TEMP(ITS90)	SPAN(mV)
-5.00	25.12
35.00	25.08

y = thermistor output; $t = PTEMPA0 + PTEMPA1 * y + PTEMPA2 * y^2$

x = pressure output - $PTCA0 - PTCA1 * t - PTCA2 * t^2$

$n = x * PTCB0 / (PTCB0 + PTCB1 * t + PTCB2 * t^2)$

pressure (psia) = $PA0 + PA1 * n + PA2 * n^2$



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13431 NE 20th Street, Bellevue, WA 98005-2010 USA

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SENSOR SERIAL NUMBER: 7370
CALIBRATION DATE: 22-Aug-13

SBE19plusV2 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

```
g = -9.858560e-001
h =  1.406405e-001
i = -2.133730e-004
j =  3.563735e-005

CPcor = -9.5700e-008
CTcor =  3.2500e-006
```

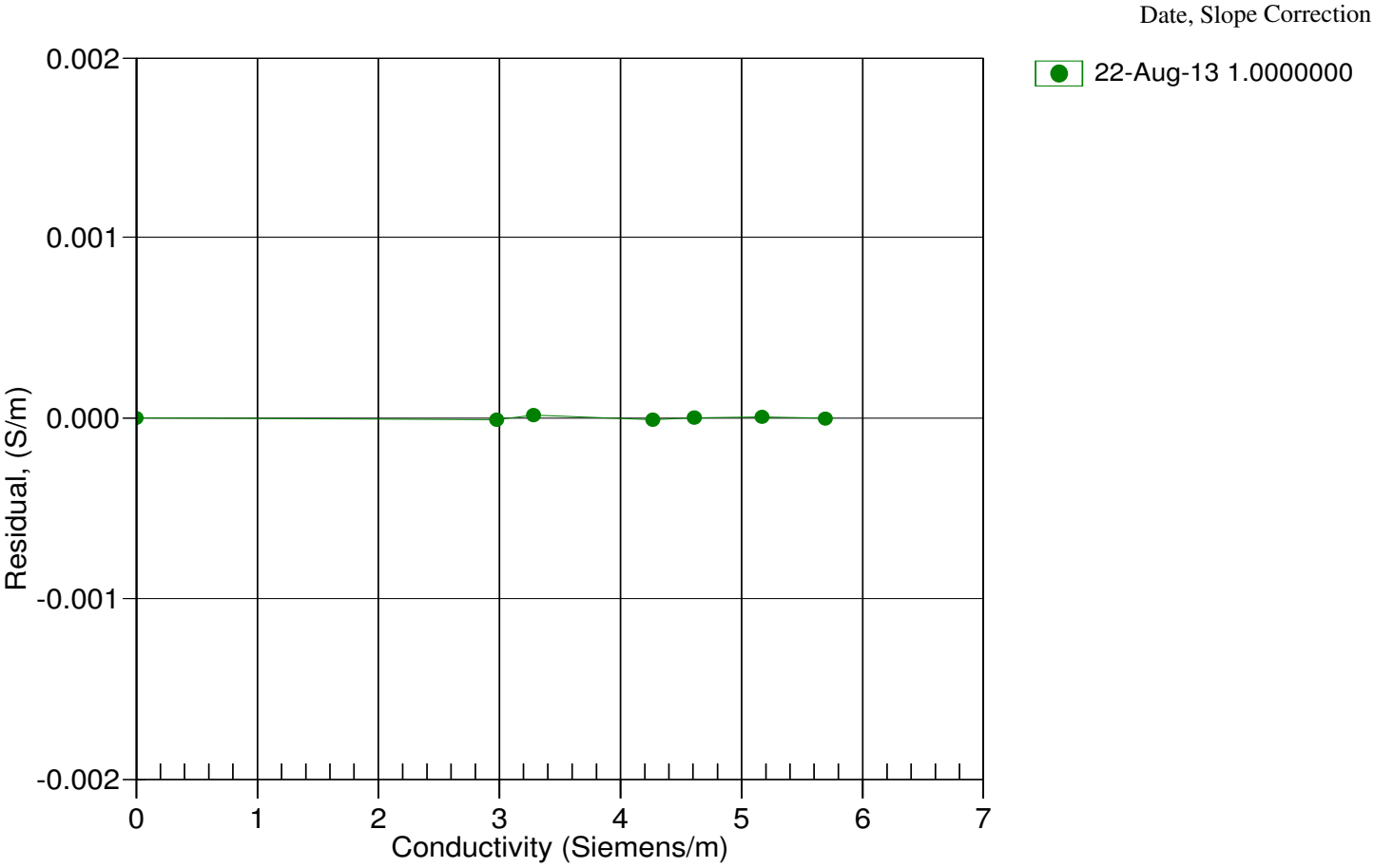
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2650.57	0.0000	0.00000
1.0052	34.8099	2.97592	5309.92	2.9759	-0.00001
4.5000	34.7893	3.28243	5510.86	3.2824	0.00002
15.0000	34.7475	4.26407	6109.26	4.2641	-0.00001
18.5000	34.7385	4.60916	6305.88	4.6092	0.00000
24.0000	34.7287	5.16703	6611.07	5.1670	0.00000
29.0000	34.7224	5.68867	6883.88	5.6887	-0.00000

f = INST FREQ / 1000.0

Conductivity = $(g + hf^2 + if^3 + jf^4) / (1 + \delta t + \varepsilon p)$ Siemens/meter

t = temperature[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = instrument conductivity - bath conductivity



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SENSOR SERIAL NUMBER: 7370
CALIBRATION DATE: 22-Aug-13

SBE19plusV2 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

a0 = 1.267939e-003
a1 = 2.728750e-004
a2 = -1.197541e-006
a3 = 1.872534e-007

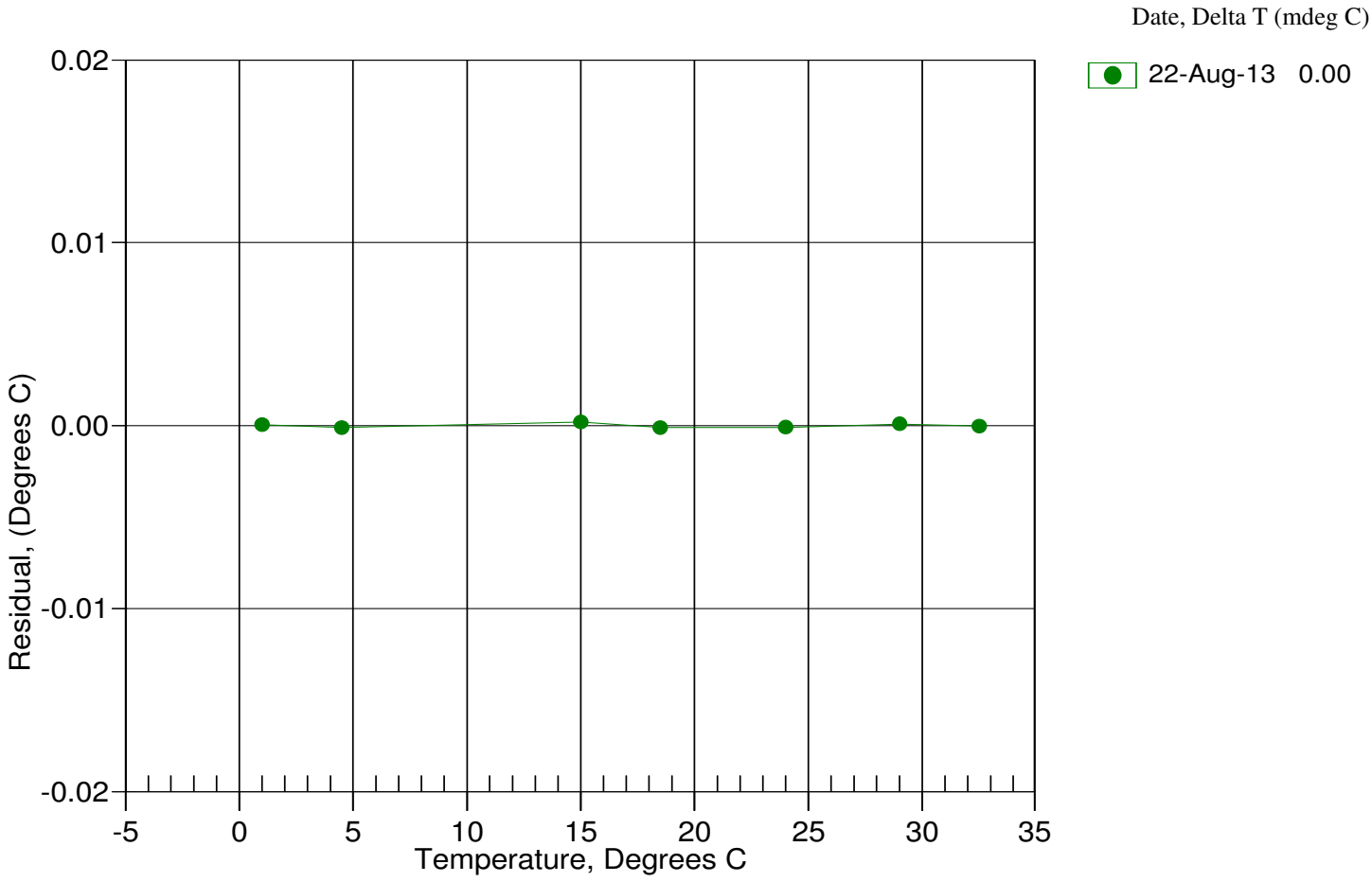
BATH TEMP (ITS-90)	INSTRUMENT OUTPUT(n)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0052	563301.525	1.0053	0.0001
4.5000	497154.136	4.4999	-0.0001
15.0000	335314.542	15.0002	0.0002
18.5000	292515.729	18.4999	-0.0001
24.0000	234866.966	23.9999	-0.0001
29.0000	191350.051	29.0001	0.0001
32.5000	165226.051	32.5000	-0.0000

MV = (n - 524288) / 1.6e+007

R = (MV * 2.900e+009 + 1.024e+008) / (2.048e+004 - MV * 2.0e+005)

Temperature ITS-90 = $1/\{a0 + a1[ln(R)] + a2[ln^2(R)] + a3[ln^3(R)]\} - 273.15$ (°C)

Residual = instrument temperature - bath temperature



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Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 7370
CALIBRATION DATE: 16-Aug-13

SBE19plusV2 PRESSURE CALIBRATION DATA
870 psia S/N 3874647

COEFFICIENTS:

PA0 =	1.958656e+000	PTCA0 =	5.243849e+005
PA1 =	2.645782e-003	PTCA1 =	4.683156e+001
PA2 =	2.212452e-011	PTCA2 =	-5.575220e-001
PTEMPA0 =	-6.436287e+001	PTCB0 =	2.507550e+001
PTEMPA1 =	5.272571e+001	PTCB1 =	-3.000000e-004
PTEMPA2 =	-3.391841e-001	PTCB2 =	0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE PSIA	INST OUTPUT	THERMISTOR OUTPUT	COMPUTED PRESSURE	ERROR %FSR
14.60	529892.0	1.6	14.58	-0.00
179.89	592287.0	1.6	179.80	-0.01
359.90	660195.0	1.6	359.81	-0.01
539.92	728037.0	1.6	539.86	-0.01
719.93	795795.0	1.6	719.89	-0.01
874.92	854081.0	1.6	874.91	-0.00
719.95	795842.0	1.6	720.01	0.01
539.95	728102.0	1.6	540.03	0.01
359.94	660274.0	1.6	360.01	0.01
179.92	592368.0	1.6	180.00	0.01
14.61	529928.0	1.6	14.65	0.00

THERMAL CORRECTION

TEMP ITS90	THERMISTOR OUTPUT	INST OUTPUT
32.50	1.86	530289.59
29.00	1.79	530249.11
24.00	1.69	530163.80
18.50	1.59	530036.31
15.00	1.52	529934.00
4.50	1.32	529551.97
1.01	1.25	529410.13

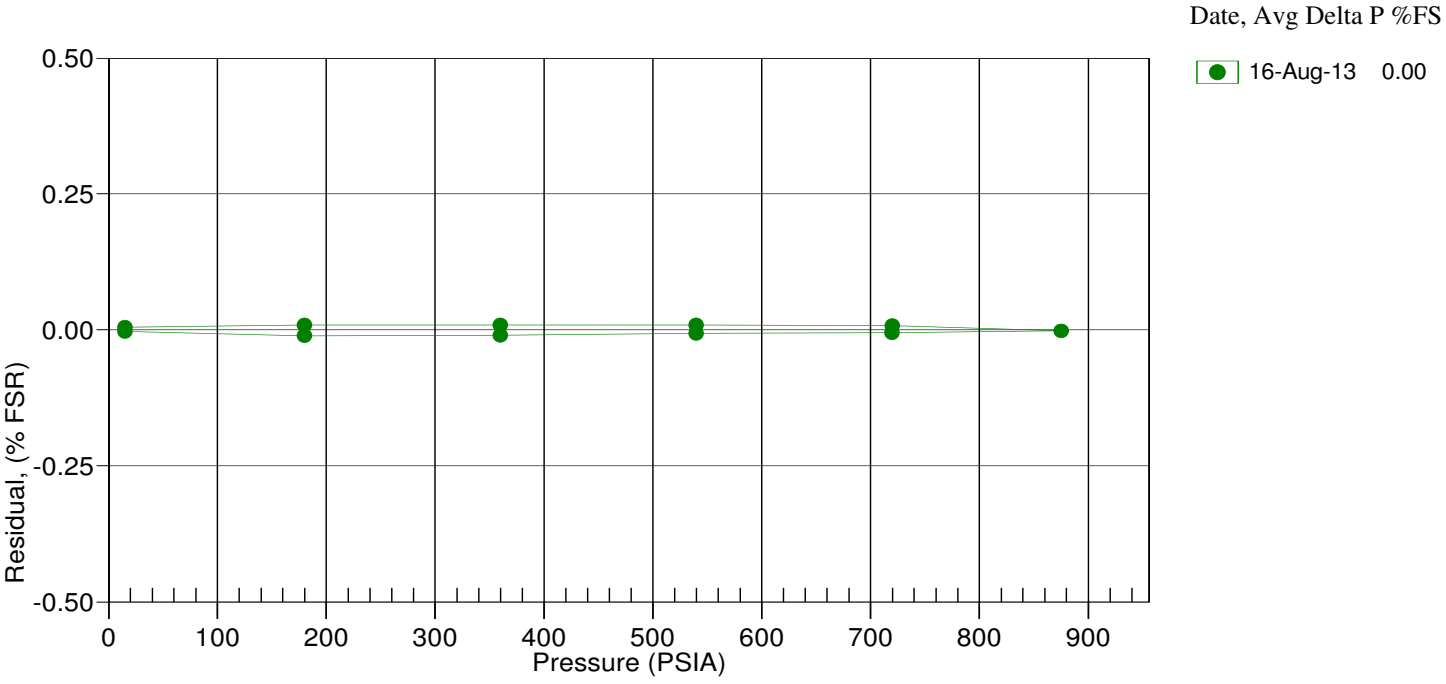
TEMP(ITS90)	SPAN(mV)
-5.00	25.08
35.00	25.07

y = thermistor output; $t = PTEMPA0 + PTEMPA1 * y + PTEMPA2 * y^2$

x = pressure output - $PTCA0 - PTCA1 * t - PTCA2 * t^2$

$n = x * PTCB0 / (PTCB0 + PTCB1 * t + PTCB2 * t^2)$

pressure (psia) = $PA0 + PA1 * n + PA2 * n^2$



SVP Test and Calibration certificate

SVP Type :	SVP70
SVP Serial No.	4111053

Date of issue : 06-03-2012

Temperature Calibration :	Hart 1504 s/n A6B554 & Thermistor s/n 3014
Point 1:	4.6 ℃
Point 2:	16.5 ℃
Point 3:	25.5 ℃
Pressure Calibration :	Custom Built Tank (TestUnit ASF150 Ser# 41-10-0007-R03)
Point 1:	0 Bar
Point 2:	300.5 Bar
Point 3:	600.7 Bar

	RMS Speed of Sound Errors
Temperature Validation :	0.0299 m/s
Pressure Validation :	0.1419 m/s

Calibration & Final Function Test : Sign : Finn Petersen

QA Signature : Inits : OSkr

2012.03.09

RESON A/S, Fabriksvangen 13, DK-3550 Slangerup
Fax: +45 4738 0066, Phone: +45 4738 0022

SVP Test and Calibration certificate

SVP Type :	SVP71
SVP Serial No.	2008016

Date of issue :	08-10-2009

Functionality Test : Sign : Michael Hansen

Temperature Calibration :	Hart 1504 s/n A6B554 & Thermistor s/n 3014
Point 1:	4.6 °C
Point 2:	16.6 °C
Point 3:	25.5 °C
Pressure Calibration :	Custom Built Tank (TestUnit ASF150 Ser# 41-10-0007-R03)
Point 1:	0 Bar
Point 2:	100.3 Bar
Point 3:	206.2 Bar

	RMS Speed of Sound Errors
Temperature Validation :	0.0080 m/s
Pressure Validation :	0.1071 m/s

Calibration Completed : Sign : Michael Hansen

Final Function Test : Sign : Michael Hansen

QA Signature : Inits : JCHR

RESON A/S
Jegstrupvej 54
8361 Hasselager
Tel: +45 86 28 82 44

SVP Test and Calibration certificate

SVP Type :	SVP71
SVP Serial No.	2008017

Date of issue :	11-06-2009

Functionality Test : Sign : Jhim H Nielsen

Temperature Calibration :	Hart 1504 s/n A6B554 & Thermistor s/n 3014
Point 1:	4.6 °C
Point 2:	16.5 °C
Point 3:	25.5 °C
Pressure Calibration :	Custom Built Tank (TestUnit ASF150 Ser# 41-10-0007-R03)
Point 1:	0 Bar
Point 2:	100 Bar
Point 3:	204.6 Bar

	RMS Speed of Sound Errors
Temperature Validation :	0.0126 m/s
Pressure Validation :	0.0669 m/s

Calibration Completed : Sign : Jhim H Nielsen

Final Function Test : Sign : Jhim H Nielsen

QA Signature : Inits : Michael H.

RESON A/S
Jegstrupvej 54
8361 Hasselager
Tel: +45 86 28 82 44

SVP Test and Calibration certificate

SVP Type :	SVP71
SVP Serial No.	2008027

Date of issue :	04-11-2009

Functionality Test : Sign : Jhim H Nielsen

Temperature Calibration :	Hart 1504 s/n A6B554 & Thermistor s/n 3014
Point 1:	4.6 °C
Point 2:	16.5 °C
Point 3:	25.5 °C
Pressure Calibration :	Custom Built Tank (TestUnit ASF150 Ser# 41-10-0007-R03)
Point 1:	0 Bar
Point 2:	102 Bar
Point 3:	206.2 Bar

	RMS Speed of Sound Errors
Temperature Validation :	0.0122 m/s
Pressure Validation :	0.0250 m/s

Calibration Completed : Sign : Jhim H Nielsen

Final Function Test : Sign : Jhim H Nielsen

QA Signature : Inits : Michael Bo-Hansen

RESON A/S
Jegstrupvej 54
8361 Hasselager
Tel: +45 86 28 82 44

SVP Test and Calibration certificate

SVP Type :	SVP71
SVP Serial No.	2008038

Date of issue :	14-07-2009

Functionality Test : Sign : Michael Hansen

Temperature Calibration :	Hart 1504 s/n A6B554 & Thermistor s/n 3014
Point 1:	4.6 °C
Point 2:	16.6 °C
Point 3:	25.5 °C
Pressure Calibration :	Custom Built Tank (TestUnit ASF150 Ser# 41-10-0007-R03)
Point 1:	0 Bar
Point 2:	100.1 Bar
Point 3:	206.4 Bar

	RMS Speed of Sound Errors
Temperature Validation :	0.0034 m/s
Pressure Validation :	0.1263 m/s

Calibration Completed : Sign : Michael Hansen

Final Function Test : Sign : Michael Hansen

QA Signature : Inits : JHN

RESON A/S
Jegstrupvej 54
8361 Hasselager
Tel: +45 86 28 82 44

Date:
Apr 16, 2009

Serial #:
98013-041609

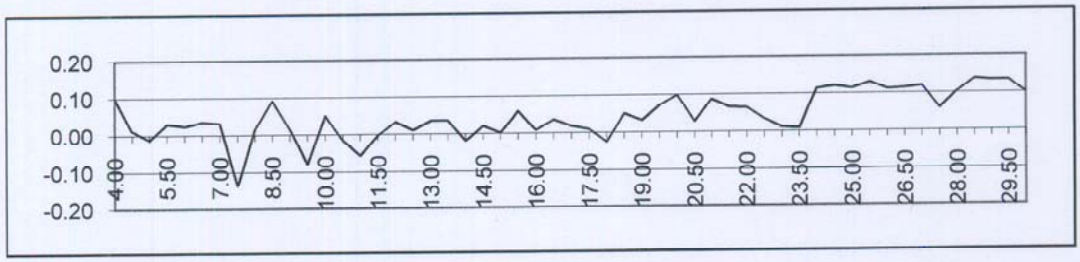
DIGIBAR CALIBRATION REPORT

version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.

STANDARD DEL GROSSO H^2O

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
4.00	1421.62	5555.38	1421.72	0.10
4.50	1423.90	5563.65	1423.91	0.01
5.00	1426.15	5572.06	1426.14	-0.01
5.50	1428.38	5580.63	1428.41	0.03
6.00	1430.58	5588.91	1430.60	0.02
6.50	1432.75	5597.16	1432.79	0.04
7.00	1434.90	5605.25	1434.93	0.03
7.50	1437.02	5612.62	1436.88	-0.14
8.00	1439.12	5621.12	1439.13	0.02
8.50	1441.19	5629.22	1441.28	0.09
9.00	1443.23	5636.66	1443.25	0.02
9.50	1445.25	5643.93	1445.18	-0.08
10.00	1447.25	5651.96	1447.30	0.05
10.50	1449.22	5659.15	1449.21	-0.02
11.00	1451.17	5666.35	1451.11	-0.06
11.50	1453.09	5673.82	1453.09	0.00
12.00	1454.99	5681.13	1455.03	0.03
12.50	1456.87	5688.13	1456.88	0.01
13.00	1458.72	5695.22	1458.76	0.04
13.50	1460.55	5702.13	1460.59	0.04
14.00	1462.36	5708.74	1462.34	-0.02
14.50	1464.14	5715.63	1464.17	0.02
15.00	1465.91	5722.21	1465.91	0.00
15.50	1467.65	5728.99	1467.70	0.06
16.00	1469.36	5735.28	1469.37	0.01
16.50	1471.06	5741.78	1471.09	0.04
17.00	1472.73	5748.03	1472.75	0.02
17.50	1474.38	5754.23	1474.39	0.01
18.00	1476.01	5760.25	1475.98	-0.03
18.50	1477.62	5766.61	1477.67	0.05
19.00	1479.21	5772.53	1479.24	0.03
19.50	1480.77	5778.59	1480.84	0.07
20.00	1482.32	5784.53	1482.42	0.10
20.50	1483.84	5790.02	1483.87	0.03
21.00	1485.35	5795.92	1485.43	0.09
21.50	1486.83	5801.44	1486.89	0.07
22.00	1488.29	5806.96	1488.36	0.06
22.50	1489.74	5812.30	1489.77	0.03
23.00	1491.16	5817.59	1491.17	0.01
23.50	1492.56	5822.88	1492.57	0.01
24.00	1493.95	5828.51	1494.06	0.11
24.50	1495.32	5833.69	1495.44	0.12
25.00	1496.66	5838.75	1496.78	0.11
25.50	1497.99	5843.82	1498.12	0.13
26.00	1499.30	5848.69	1499.41	0.11
26.50	1500.59	5853.57	1500.70	0.11
27.00	1501.86	5858.39	1501.98	0.12
27.50	1503.11	5862.89	1503.17	0.06
28.00	1504.35	5867.72	1504.45	0.10
28.50	1505.56	5872.44	1505.70	0.14
29.00	1506.76	5876.95	1506.89	0.13
29.50	1507.94	5881.41	1508.08	0.13
30.00	1509.10	5885.67	1509.20	0.10



Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue, Baton Rouge, Louisiana 70810-6261, USA
Telephone: (225)-769-3051, Facsimile: (225)-766-5122
E-mail: email@odomhydrographic.com, HTTP: www.odomhydrographic.com

Date:
Apr 16, 2009

Serial #:
98013-041609

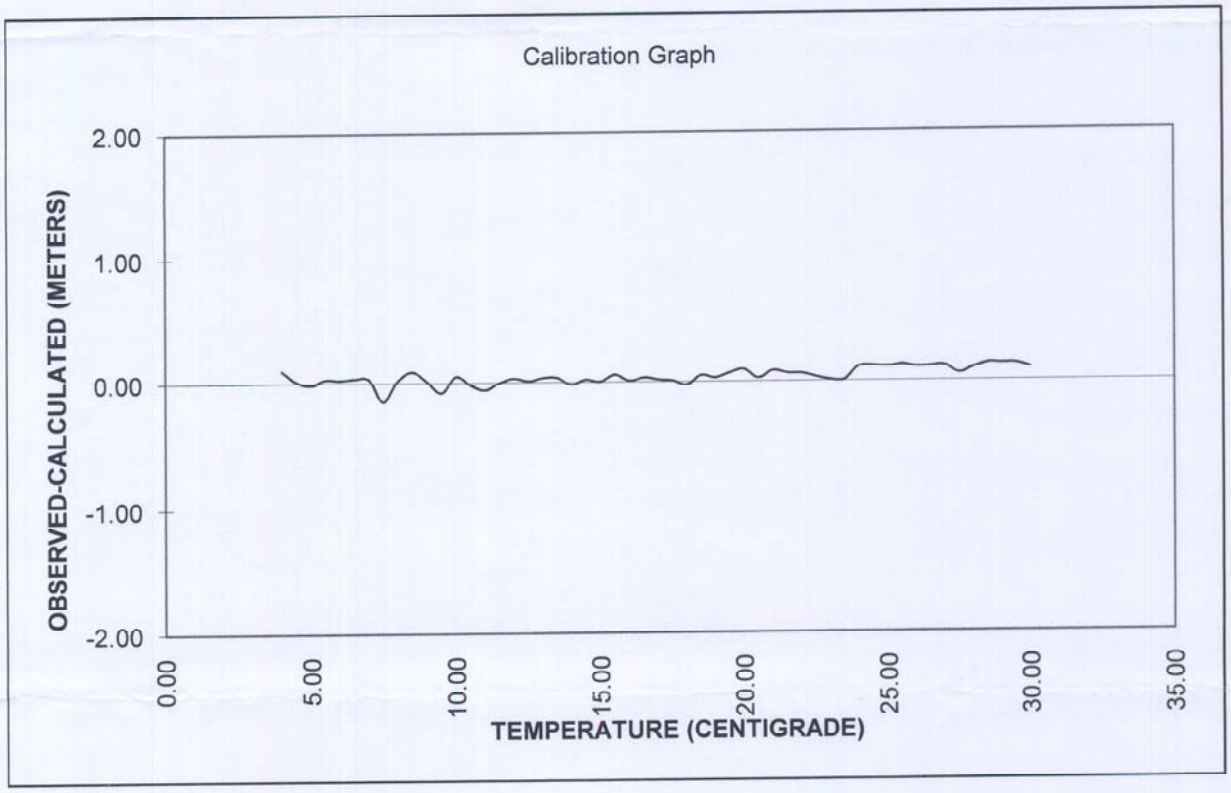
DIGIBAR CALIBRATION REPORT

version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.

Burn these numbers to EPROM:

Gradient	**3391**
Intercept	**497**



The instruments used in this calibration have been calibrated to the published manufacturer specifications using standards traceable to NIST, to consensus standards, to ratio methods, or to acceptable values of natural physical constants that meets the requirements of ANSI/NCSL Z540-1, ISO 9001, ISO 10012 and ISO 17025. Certificate/traceability numbers: 0002-2655.00-23491-001, 0002-2655.00-23491-002. ID#'s:294,295,762,172,56

Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue, Baton Rouge, Louisiana 70810-6261, USA
Telephone: (225)-769-3051, Facsimile: (225)-766-5122
E-mail: email@odomhydrographic.com, HTTP: www.odomhydrographic.com

TELEDYNE
ODOM HYDROGRAPHIC
A Teledyne Technologies Company

Digibar

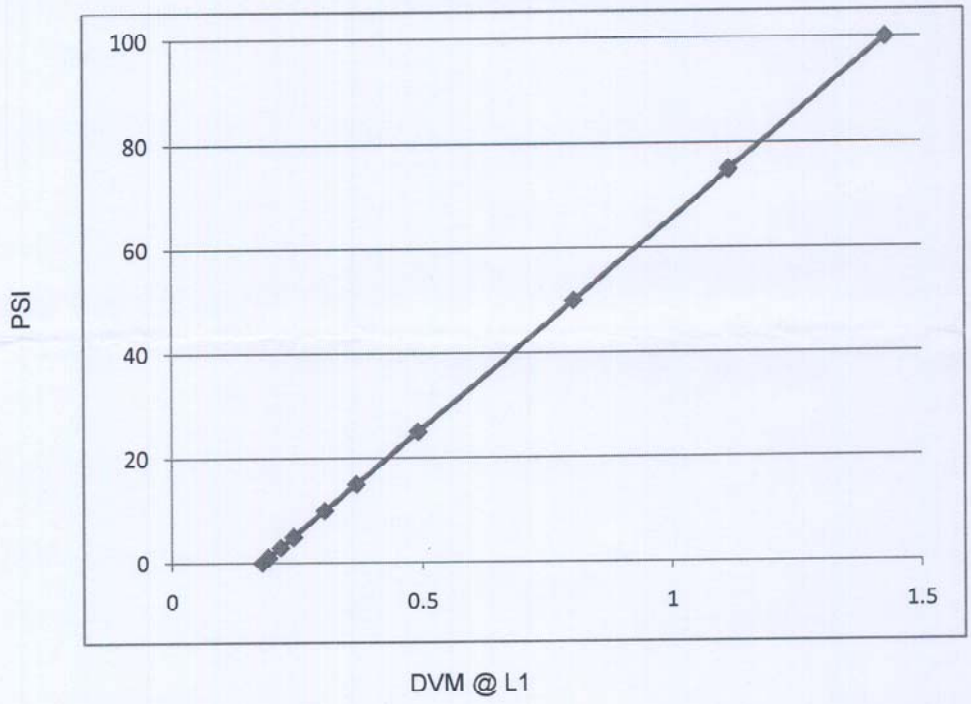
Date	4/17/2009
Serial #	98013
SW Version	1.11
Cable Length	20 meters

Press Transducer	79842
Zero Voltage	.18
Span Volage	2.68
Mid-Scale Voltage	1.43
R5	3.9K
R9	10K
Gradient	3391
Intercept	497

Max psi:	200 psi
Velocity Check:	√
Depth Check:	√
Communications:	√
External Power:	NA

Board Identification	Serial #
Power Supply	
Control PCB	
LCD	
Probe Sensor	
Probe Controller	
Airmar Transducer	853906

Pressure Transducer Linearity



Transducer Linearity	
PSI	DVM@L1
0	0.18
1	0.192
3	0.217
5	0.242
10	0.304
15	0.367
25	0.491
50	0.804
75	1.116
100	1.43

Appendix II

Vessel Reports, Offsets, and Diagrams

Launch 2801

1. Offsets
2. Patch Test
3. POS MV GAMS Calibration
4. Dynamic Draft

Launch 2805

5. Offsets
6. Patch Test
7. POS MV GAMS Calibration
8. Dynamic Draft

Launch 2806

1. Offsets
2. Patch Test
3. POS MV GAMS Calibration
4. Dynamic Draft

Launch 2807

1. Offsets
2. Patch Test
3. POS MV GAMS Calibration
4. Dynamic Draft

Launch 2808

1. Offsets
2. Patch Test
3. POS MV GAMS Calibration
4. Dynamic Draft

S-220

1. Offsets
2. Patch Test
3. POS MV GAMS Calibration

Coordinate Systems Utilized in Vessel Offsets

Sonar Offsets

RA-4 (2801) FWD Keel BM to Sonar

Crew: McGovern, Jackson, Geiger, Phillips

6 March 2013 (DN065)

	HF	LF
x (+fwd)	-0.4811	-0.4830
y (+stbd)	0.0010	0.0010
z (+down)	-0.1620	-0.1850

Vessel Orientation during measurement

Pitch	-0.03
Roll	-0.05

Offset vector corrected for pitch

x (+fwd)	-0.4811	-0.4831
y (+stbd)	0.0010	0.0010
z (+down)	-0.1617	-0.1847

Counter Pitch Matrix

1.0000	0.0000	0.0006
0.0000	1.0000	0.0000
-0.0006	0.0000	1.0000

Offset vector corrected for roll

x (+fwd)	-0.4811	-0.4831
y (+stbd)	0.0011	0.0011
z (+down)	-0.1617	-0.1847

Counter Roll Matrix

1.0000	0.0000	0.0000
0.0000	1.0000	-0.0008
0.0000	0.0008	1.0000

Remember to reverse the X and Y coordinates when shifting from POS coordinate system to CARIS coordinate system!!!

Sonar coordinates corrected for NGS BM

	HF	LF
x (+fwd)	**0.0539**	**0.0519**
y (+stbd)	**0.0051**	**0.0051**
z (+down)	**0.4443**	**0.4213**

NGS 2801 BM Coordintes	
x (+fwd)	0.535
y (+stbd)	0.004
z (+down)	0.606

2012 for Reference

HF	LF	Differences	
0.055	0.053	-0.001	-0.001
0.003	0.003	0.002	0.002
0.444	0.426	0.000	-0.005

GPS Offsets

RA-4 (2801)

Crew: McGovern, Jackson, Geiger, Phillips

(HORIZONTAL - Enter horizontal distance between points)

6 March 2013 (DN065)

a (port-to-stbd)	1.434
b (BM-to-port)	0.988
c (BM-to-stbd)	0.983

Measured offset vector (Cabin BM to Antenna)

	Port GPS	Stbd GPS
x (+fwd)	-0.676	-0.676
y (+stbd)	-0.720	0.714
z (+down)	-0.485	-0.490

Vessel Orientation during measurement

Pitch	-0.07
Roll	0.00

Offset vector corrected for pitch

x (+fwd)	-0.6769	-0.6769
y (+stbd)	-0.7202	0.7138
z (+down)	-0.4837	-0.4892

Counter Pitch Matrix

1.0000	0.0000	0.0012
0.0000	1.0000	0.0000
-0.0012	0.0000	1.0000

POSPAC 2012		Diff
x (+fwd)	**-0.7681**	-0.003
y (+stbd)	**-0.7219**	0.003
z (+down)	**-3.1699**	0.028

Offset vector corrected for roll

x (+fwd)	-0.6769	-0.6769
y (+stbd)	-0.7202	0.7138
z (+down)	-0.4837	-0.4892

Counter Roll Matrix

1.0000	0.0000	0.0000
0.0000	1.0000	0.0000
0.0000	0.0000	1.0000

POSPac GAMS	(Differences)	
x (+fwd)	-0.026	0.026
y (+stbd)	1.436	-0.002
z (+down)	0.005	-0.010
Separation	1.437	-0.003

Antenna coordinates corrected for Cabin BM

	Port GPS	Stbd GPS
x (+fwd)	**-0.7709**	-0.7709
y (+stbd)	**-0.7192**	0.7148
z (+down)	**-3.1417**	-3.1472

Cabin BM Coordinates

x (+fwd)	-0.094	
y (+stbd)	0.001	(NGS)
z (+down)	-2.658	(NGS)

Remeasure

Baseline vector

		Real-time GAMS	(Differences)
x (+fwd)	0.000	-0.03	0.030
y (+stbd)	1.434	1.445	-0.011
z (+down)	-0.005	0.012	-0.017
Ant. Separation	1.434	1.446	-0.012

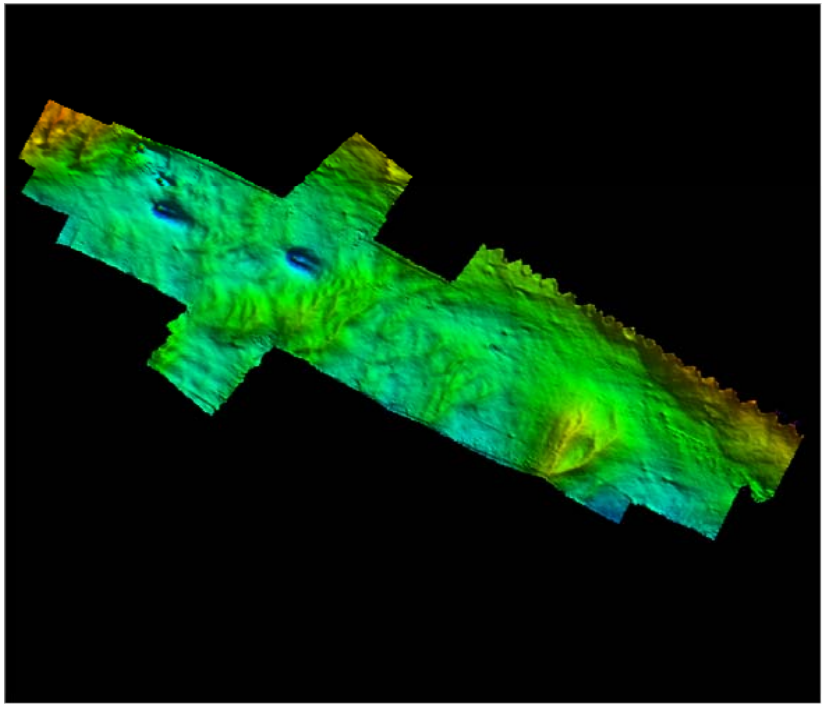
Vessel - 2801_Reson7125_LF_256
Date Acquired -

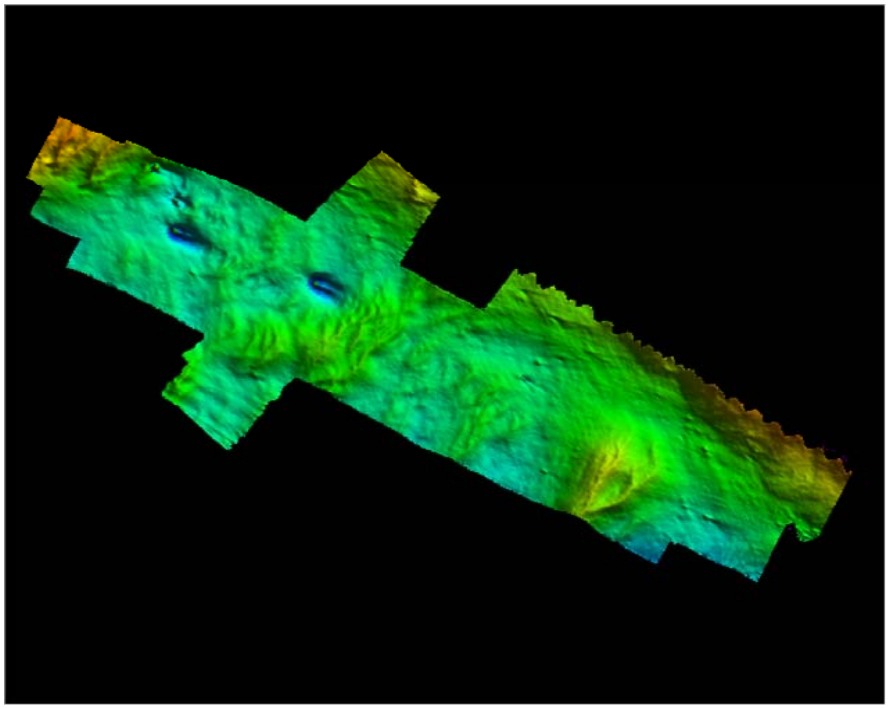
	User Initials	TIMING (s) Value	TIMING (s) Line(s) Used	PITCH (°) Value	PITCH (°) Lines Used	ROLL (°) Value	ROLL (°) Lines Used	YAW (°) Value	YAW (°) Lines Used	YAW (°) 2 Value	YAW (°) 2 Lines Used	initials
Trial 1	BJ			~~-0.226~~	~~1706,1708~~	-0.25	1726,1727	0.428	1716,1723	0.388	1716,1721	JD
Trial 2	WC					-0.24	1726,1727					
Trial 3	RB			-0.41	1706,1708	-0.24	1726,1727	0.328	1716,1723			
Trial 4	BB					-0.232	1726,1727					
Trial 5	JC/RA			-0.56	1706,1708	-0.256	1726,1727	0.494	1716,1723	~~0.1~~	~~1718,1723~~	JK
Trial 6	MEM			-0.49	1706,1708			0.382	1716,1723	~~0.272~~	~~1716,1721.~~	MEM
Trial 7	JBJ			-0.53	1706,1708			0.486	1716,1723	0.4575	1716/1721 & 1718/1723	mog
average		0.000		-0.498		-0.244		0.424		0.304		
std. dev.		0.000		0.066		0.010		0.070		0.156		

Values entered in HVF...	
Timing (s)	0.000
Roll (°)	-0.244
Pitch (°)	-0.498
Yaw (°)	0.423

Uncertainties entered in HVF...	
Timing (s)	
MRU Roll/Pitch	0.067
MRU Gyro	0.061

All YAW	
AVG	**0.423357143**
Std Dev	**0.060766434**





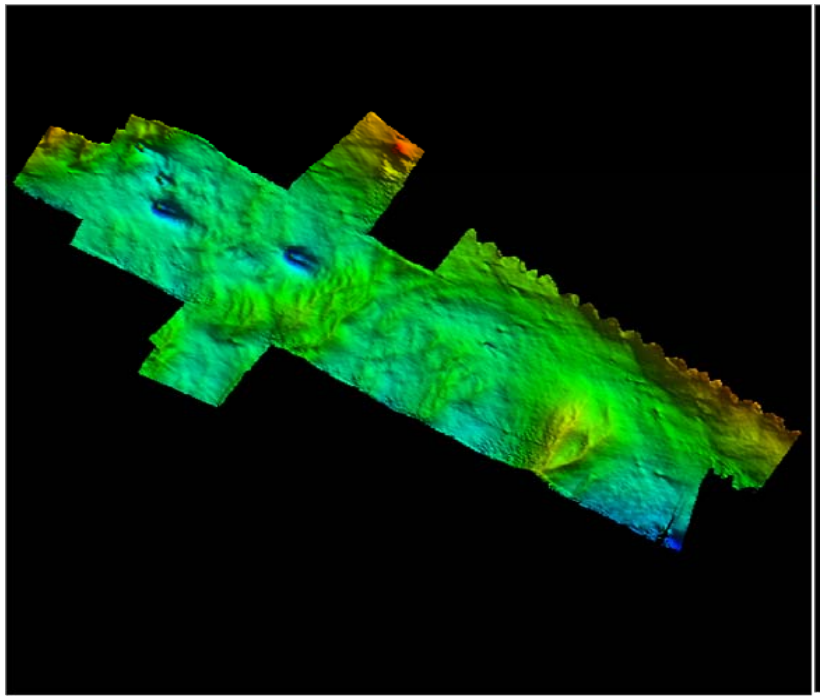
Vessel - 2801_Reson7125_HF_512
Date Acquired -

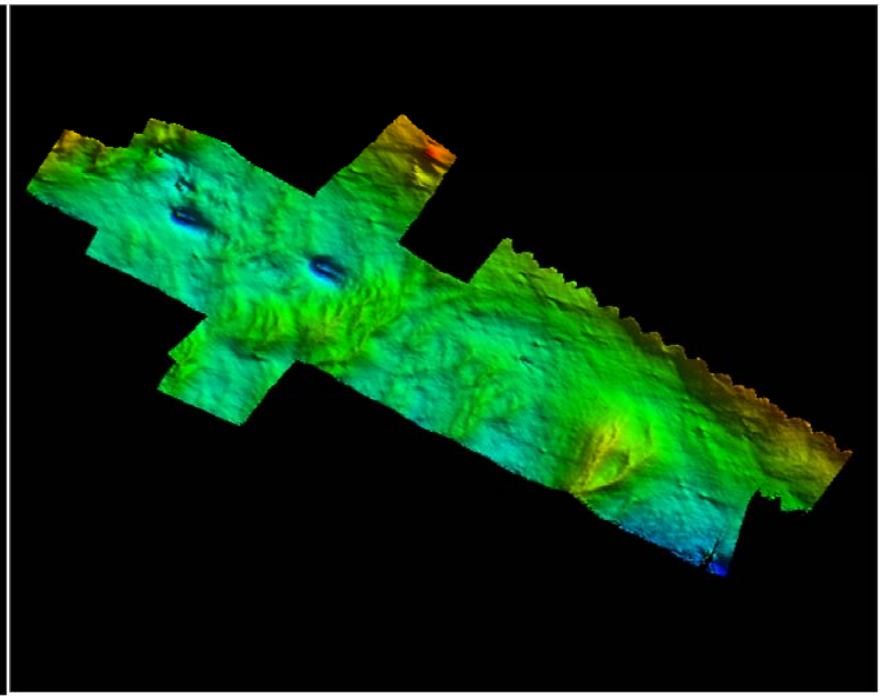
	User Initials	TIMING (s) Value	TIMING (s) Line(s) Used	PITCH (°) Value	PITCH (°) Lines Used	ROLL (°) Value	ROLL (°) Lines Used	YAW (°) Value	YAW (°) Lines Used	YAW (°) 2 Value	YAW (°) 2 Lines Used	Initials
Trial 1	BJ			-0.528	1740,1742	-0.22	1758, 1759	~~0.724~~	~~1751,1756~~			
Trial 2	RB			-0.64	1740,1742	-0.224	1758,1759	~~0.638~~	~~1751,1756~~			
Trial 3	RA			-0.47	1740,1742	-0.198	1758,1759					
Trial 4	BB					-0.198	1758,1759			~~0.068~~	~~1753,1756A~~	JK
Trial 5	WC/JBJ					-0.214	1758,1759	~~0.656~~	~~1751,1756~~	0.39	1753,1756A	JC
Trial 6	MEM			-0.435	1740,1742			~~0.73~~	~~1751,1756~~	0.468	1751,1755	MEM
Trial 7	CM/AS			~~-0.24~~	~~1740,1742~~			~~0.684~~	~~1751,1756~~	0.442	1751,1755	JD
Trial 8	mog			-0.59	all					0.482	1751/1755 & 1753/1756A	mog
average		0.000		-0.533		-0.212		~~0.686~~		**0.446**		
std. dev.		0.000		0.083		0.013		~~0.041~~		**0.041**		

Values entered in HVF...	
Timing (s)	0.000
Roll (°)	-0.212
Pitch (°)	-0.533
Yaw (°)	0.446

Uncertainties entered in HVF...	
Timing (s)	
MRU Roll/Pitch	0.084
MRU Gyro	0.041

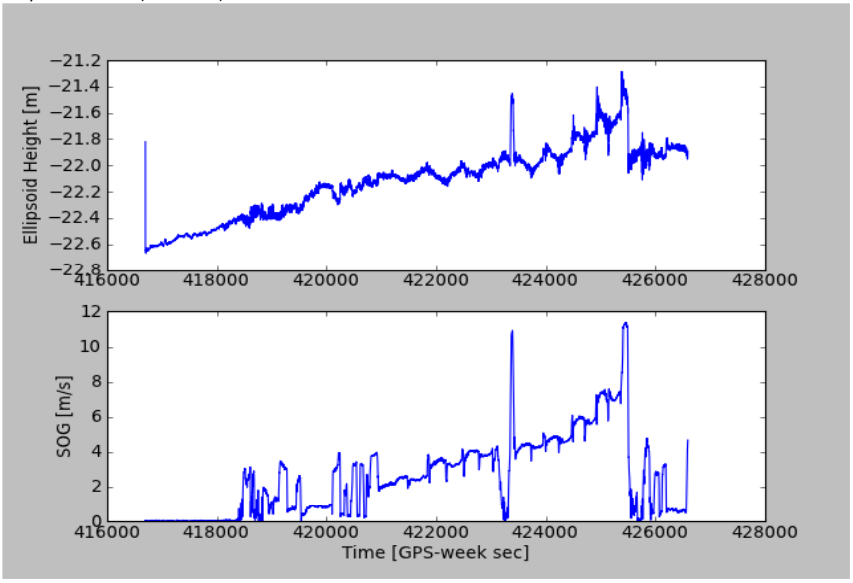
~~All YAW~~	
~~AVG~~	~~0.5282~~
~~Std Dev~~	~~0.204340565~~

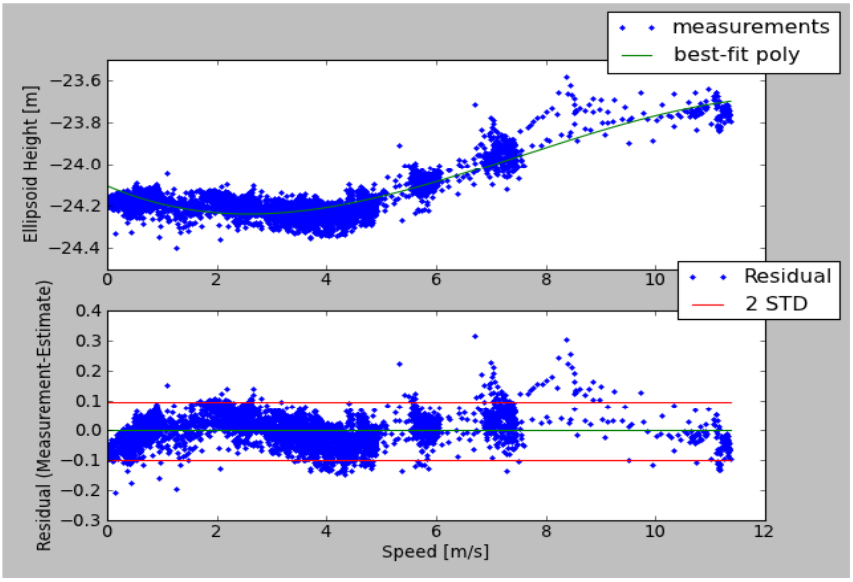




```
--------------------------------------------------------------------------------
IINPP Forward-Backward Navigator [Jan 26 2012]
Copyright (c) 2008-2012 Applanix Corporation.  All rights reserved.
Date : 03/14/13    Time : 09:52:30
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Extracted data path   : I:\GNSS_Data\GNSS_Templates\Unnamed\Mission 1\Extract
Extracted data kernel : Mission 1
Processed data path   : I:\GNSS_Data\GNSS_Templates\Unnamed\Mission 1\Proc
Processed data kernel : Mission 1
Processing start time : 249215.000
Processing end time   : 251032.000
--------------------------------------------------------------------------------
--------------------------------------------------------------------------------
Selected GNSS mode                    :  IN-Fusion SmartBase
Selected subsystems                   :  IMU
                                      :  Primary GNSS
                                      :  Secondary GNSS
                                      :  Base GNSS
Vehicle to reference alignment angles :  0.000  0.000  0.000
Multipath setting                     :  LOW
Reference to IMU lever arm            : -0.008 -0.031  0.130
Reference to IMU alignment angles     :  0.000  0.000  0.000
Reference to primary GNSS lever arm    : -0.768 -0.722 -3.170
GAMS antenna separation               :  0.000
GAMS baseline vector                  :  0.000  0.000  0.000
GAMS heading calibration threshold    :  0.100
GAMS heading correction               :  0.000
Base GNSS coordinates                 :  44.625664260 -124.042353512 -19.811
--------------------------------------------------------------------------------
249215.005 : New or modified IIN install data
   Reference-IMU lever arm:             -0.01  -0.03  0.13
   Reference-primary GNSS lever arm:    -0.77  -0.72  -3.17
   Multipath environment:                LOW
249215.005 : Forward-time processing started
249215.100 : IIN coarse leveling started.
249215.100 : IIN secondary GPS in use.
249225.100 : IIN coarse leveling ended.
249225.100 : IIN navigator initialized.
249225.100 : IIN degraded navigation solution.
249225.100 : IIN initial position valid.
249226.000 : GAMS status changed to 4 (Degraded Float solution)
249226.005 : SmartBase observables in use
249226.005 : IIN primary GPS observables in use.
249226.005 : IIN in code DGPS aided mode.
249226.105 : IIN navigator alignment active.
249226.000 : Reference to Primary GPS lever arm calibration started.
249309.104 : IIN quadrant resolved.
249309.104 : IIN user velocity performance.
249351.000 : GAMS status changed to 7 (No solution)
249351.000 : GAMS cycle slip in channel  1 - Slip size = -2
249351.000 : GAMS cycle slip in channel  2 - Slip size = -2
249351.000 : GAMS cycle slip in channel  3 - Slip size = 4
249351.000 : GAMS cycle slip in channel  4 - Slip size = 4
249351.000 : GAMS cycle slip in channel  6 - Slip size = 3
249351.000 : GAMS cycle slip in channel  7 - Slip size = 4
249352.000 : GAMS status changed to 4 (Degraded Float solution)
249414.104 : IIN fine align active.
249414.104 : IIN degraded navigation solution CLEARED.
249415.004 : IIN in Float RTK mode.
249415.104 : IIN user position performance.
249417.104 : IIN user attitude performance.
249676.000 : GAMS ambiguities resolved
249677.000 : GAMS status changed to 0 (Fixed solution)
249840.000 : GAMS cycle slip in channel 10 - Slip size = 3
249880.000 : GAMS status changed to 7 (No solution)
249880.000 : GAMS fixed ambiguities abandoned.  NSV = 9  PDOP = 1.59
249880.000 : GAMS cycle slip in channel  1 - Slip size = -2
249880.000 : GAMS cycle slip in channel  3 - Slip size = 4
249880.000 : GAMS cycle slip in channel  4 - Slip size = 5
249880.000 : GAMS cycle slip in channel  6 - Slip size = 3
249880.000 : GAMS cycle slip in channel  7 - Slip size = 4
249880.000 : GAMS cycle slip in channel 10 - Slip size = 3
249881.000 : GAMS status changed to 4 (Degraded Float solution)
250008.000 : GAMS ambiguities resolved
250009.000 : GAMS status changed to 0 (Fixed solution)
250098.002 : IIN in Fixed WL RTK mode.
250370.000 : GAMS cycle slip in channel  3 - Slip size = 4
250370.000 : GAMS cycle slip in channel  4 - Slip size = 5
250370.000 : GAMS cycle slip in channel  6 - Slip size = 3
250370.000 : GAMS cycle slip in channel  7 - Slip size = 4
250370.000 : GAMS cycle slip in channel 10 - Slip size = 3
250425.001 : GAMS calibration requested.
250441.000 : GAMS status changed to 2 (Degraded Fixed solution)
250442.000 : GAMS status changed to 0 (Fixed solution)
250517.001 : GAMS calibration in progress.
250572.000 : GAMS status changed to 2 (Degraded Fixed solution)
250573.000 : GAMS status changed to 0 (Fixed solution)
250587.001 : New or modified GAMS install data
   A-B length          =   1.437
   A-B baseline vector = (  -0.026,   1.436,   0.005 )
```

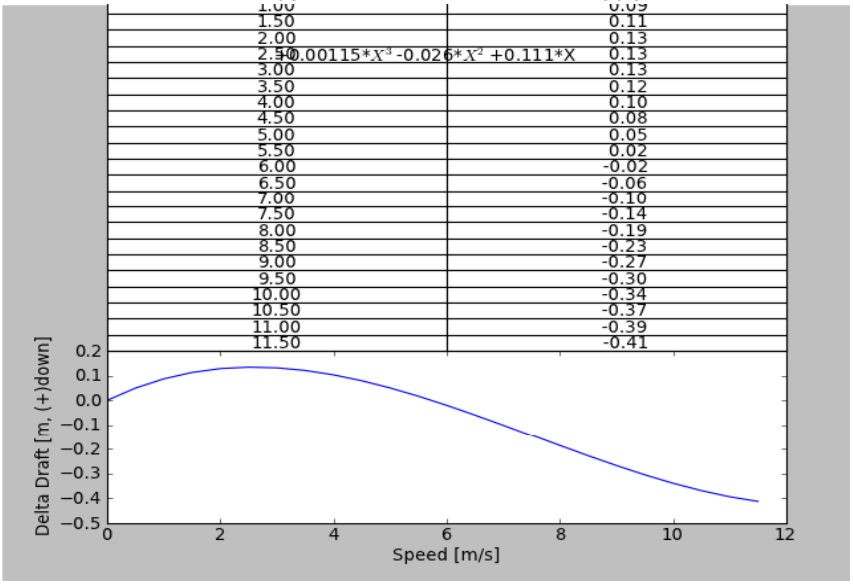
Vessel	2801 RA4		
Date	March 14,2013		
DN	73		
			0.5
Ellipsoidally Referenced			
Processing Interval?	20:32:40	22:29:00	$+0.00115*X^3 -0.026*X^2 +0.111*X$
	419560	426540	
Polynomial Order (3rd or 4th)?		3rd	



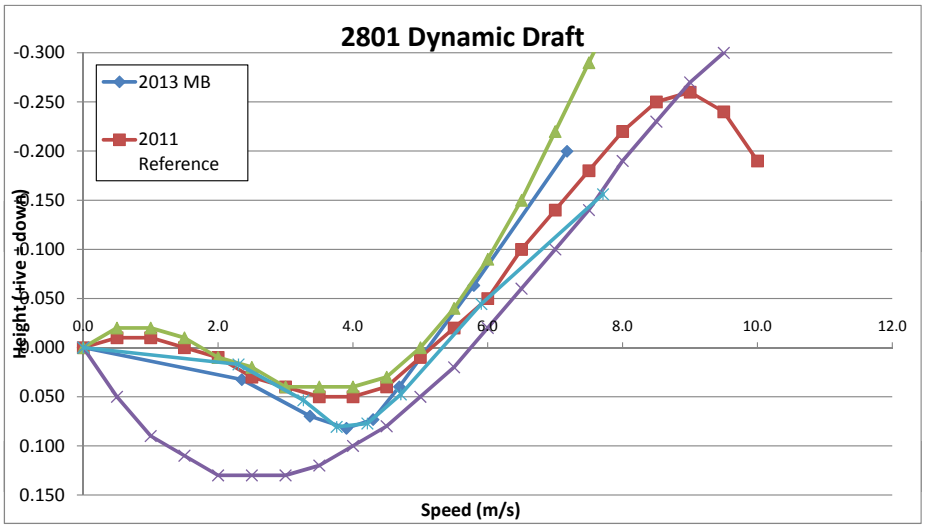


0.5	0.0491
1.00	0.09
1.50	0.11
2.00	0.13
2.50	0.13
3.00	0.13
3.50	0.12
4.00	0.10
4.50	0.08
5.00	0.05
5.50	0.02
6.00	-0.02
6.50	-0.06
7.00	-0.10
7.50	-0.14
8.00	-0.19
8.50	-0.23
9.00	-0.27
9.50	-0.30
10.00	-0.34
10.50	-0.37
11.00	-0.39
11.50	-0.41

$= 0.00115*X^3 - 0.026*X^2 + 0.111*X$

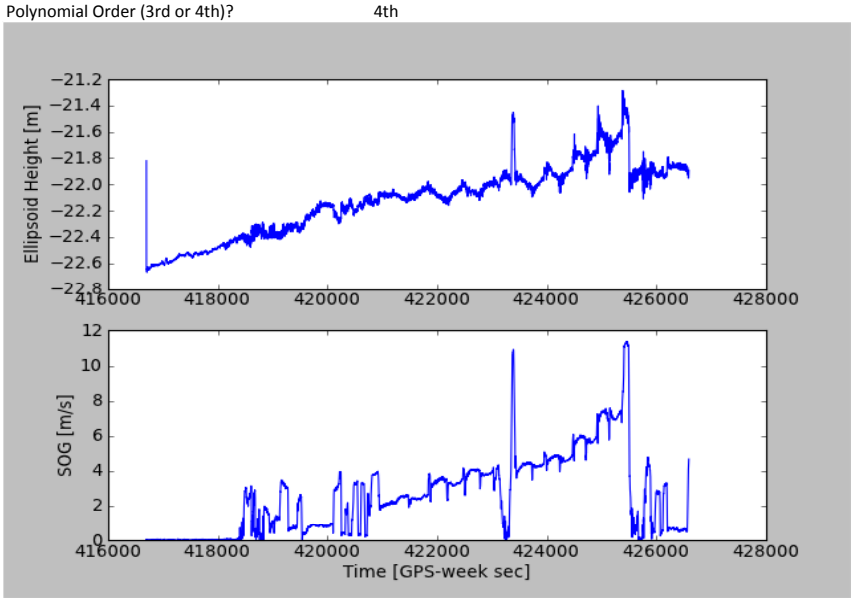


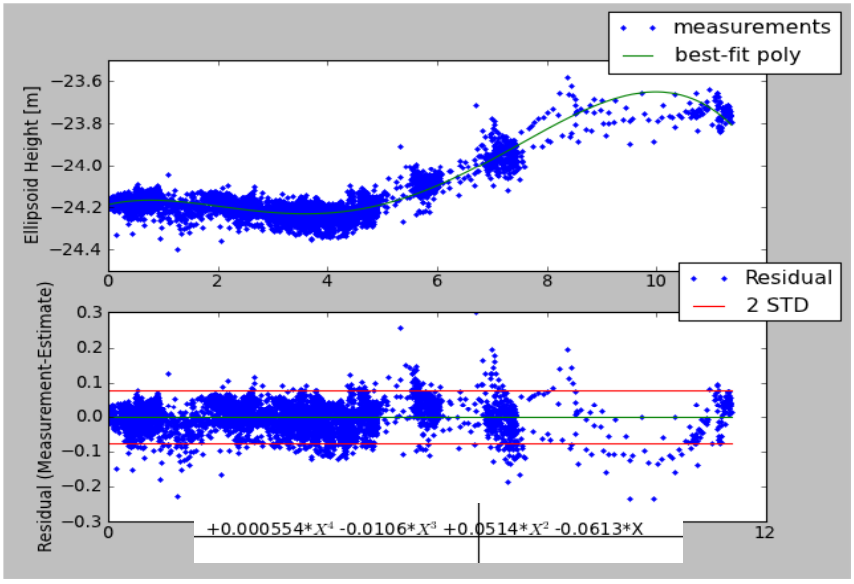
2012 ER (3rd O.)		3rd/4th O. Diff	2012 ER (4th O.)	
Draft (m)	Speed (m/s)	(~2kt vs. slack)	Draft (m)	Speed (m/s
0.00	0.0	0.00	0.00	0.0
0.05	0.5	0.07	-0.02	0.5
0.09	1.0	0.11	-0.02	1.0
0.11	1.5	0.12	-0.01	1.5
0.13	2.0	0.12	0.01	2.0
0.13	2.5	0.11	0.02	2.5
0.13	3.0	0.09	0.04	3.0
0.12	3.5	0.08	0.04	3.5
0.10	4.0	0.06	0.04	4.0
0.08	4.5	0.05	0.03	4.5
0.05	5.0	0.05	0.00	5.0
0.02	5.5	0.06	-0.04	5.5
-0.02	6.0	0.07	-0.09	6.0
-0.06	6.5	0.09	-0.15	6.5
-0.10	7.0	0.12	-0.22	7.0
-0.14	7.5	0.15	-0.29	7.5
-0.19	8.0	0.17	-0.36	8.0
-0.23	8.5	0.20	-0.43	8.5
-0.27	9.0	0.21	-0.48	9.0
-0.30	9.5	0.22	-0.52	9.5
-0.34	10.0	0.20	-0.54	10.0
.σ - Uncert.		0.053	0.050	



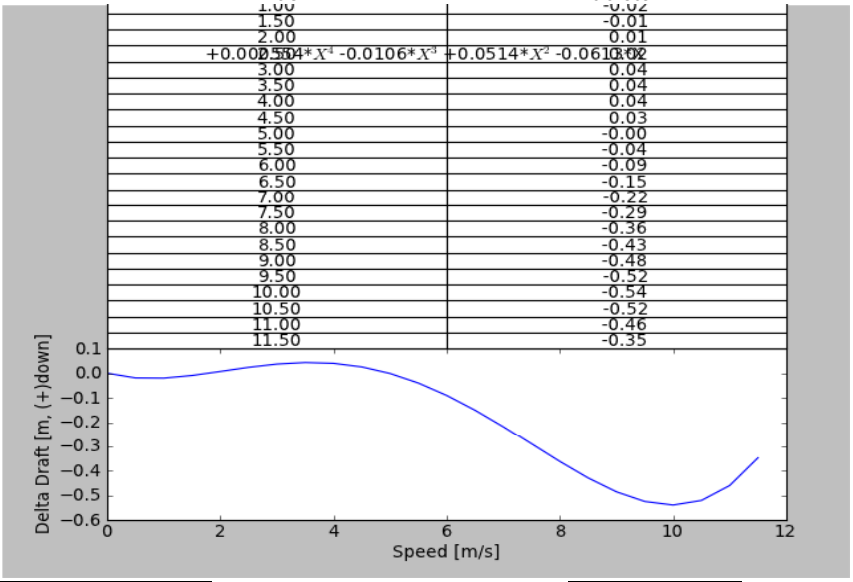
Ellipsoidally Referenced

Processing Interval?	20:32:40	22:29:00
	419560	426540
Polynomial Order (3rd or 4th)?		4th





0.5	-0.01909
1.00	-0.02
1.50	-0.01
2.00	0.01
+0.0025*X^4 -0.0106*X^3 +0.0514*X^2 -0.0610*X	0.02
3.00	0.04
3.50	0.04
4.00	0.04
4.50	0.03
5.00	-0.00
5.50	-0.04
6.00	-0.09
6.50	-0.15
7.00	-0.22
7.50	-0.29
8.00	-0.36
8.50	-0.43
9.00	-0.48
9.50	-0.52
10.00	-0.54
10.50	-0.52
11.00	-0.46
11.50	-0.35



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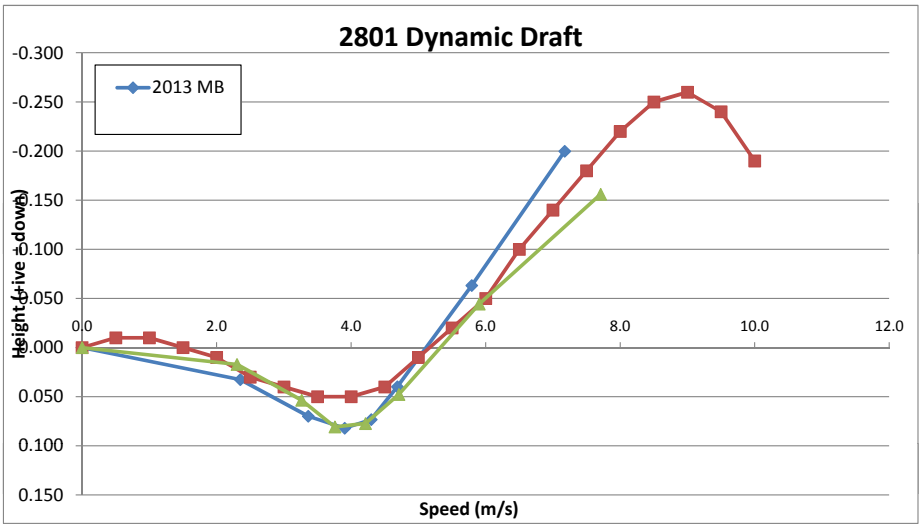
2013 MB			2011 Reference		2012 MB	
Draft (m)	Speed (m/s)	kts	Draft (m)	Speed (m/s)	Draft (m)	Speed (m/s)
0.000	0.0	0	0.00	0.0	0.000	0.0
0.033	2.35	4.5719617	-0.01	0.5	0.017	2.30
0.070	3.36	6.5352616	-0.01	1.0	0.054	3.26
0.082	3.90	7.5888345	0.00	1.5	0.081	3.76
0.073	4.30	8.3556877	0.01	2.0	0.077	4.21
0.040	4.69	9.1128217	0.03	2.5	0.048	4.71
-0.063	5.79	11.259816	0.04	3.0	-0.044	5.90
-0.200	7.18	13.947205	0.05	3.5	-0.156	7.71
			0.05	4.0		
2013 HVF ENTRY			0.04	4.5		
Caris bug needs knots			0.01	5.0		
			-0.02	5.5		
			-0.05	6.0		
			-0.10	6.5		
			-0.14	7.0		
			-0.18	7.5		
			-0.22	8.0		
			-0.25	8.5		
			-0.26	9.0		
			-0.24	9.5		
			-0.19	10.0		

0.025



	BM to Water line	HEIGHT NGS	Difference	Ave.	Std. Dev.	2012 Waterline	2011 Waterline
2801	RA-4				Fuel:	103/120	
PORT	0.987	1.078	-0.091				
	0.991	1.078	-0.087				
	0.984	1.078	-0.094				
		PORT Ave & Stdev		**-0.091**	**0.004**		
STBD	0.997	1.078	-0.081				
	1.003	1.078	-0.075				
	0.994	1.078	-0.084				
		STBD Ave & Stdev		**-0.080**	**0.005**		

2013 HVF Entries	Average of Six Observations	**-0.085**
2013 Draft Uncertainty	Max. of Two Stdev	**0.005**

2012 Reference	2011 Reference
-0.099	-0.099

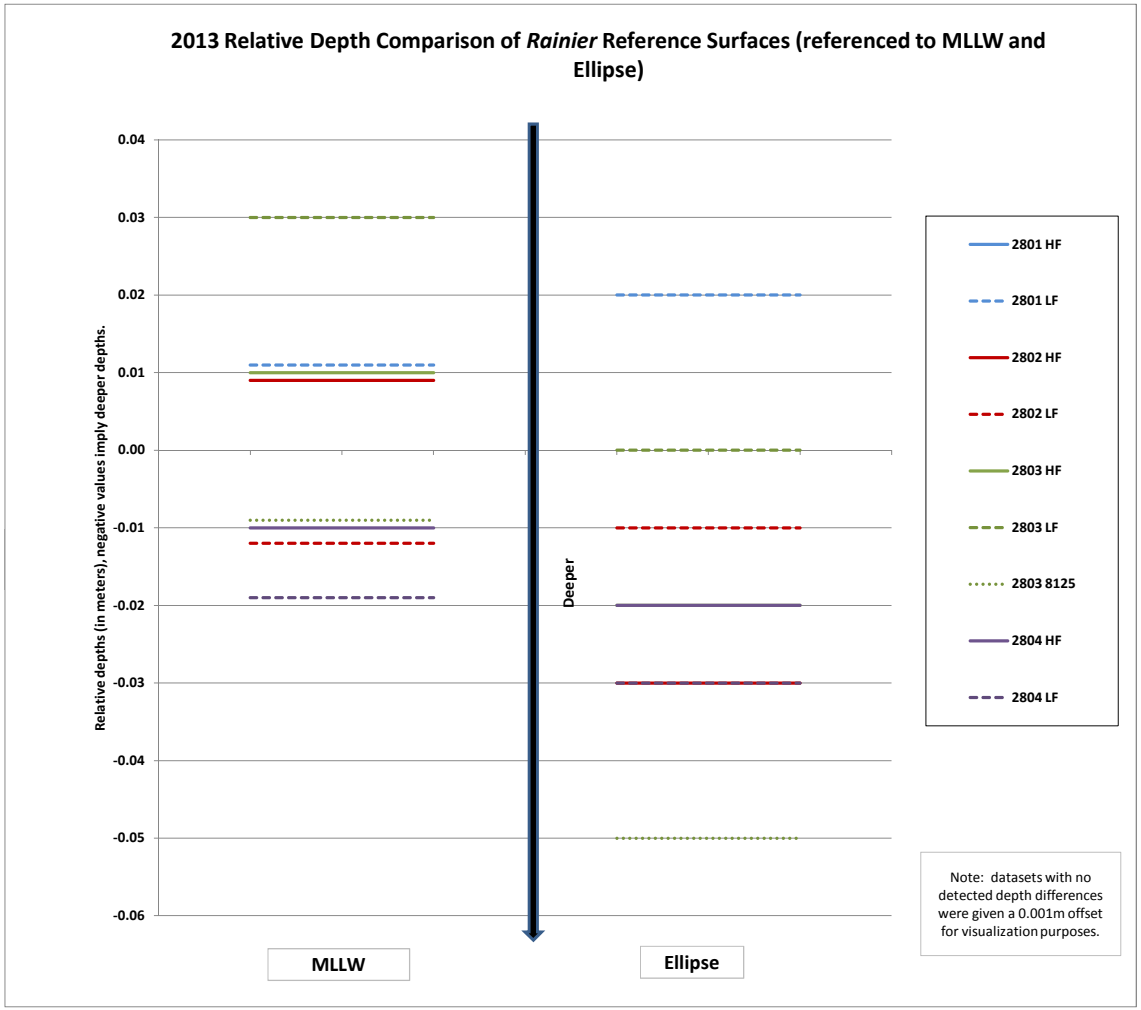
ALL Differences Relative to 2801 HF

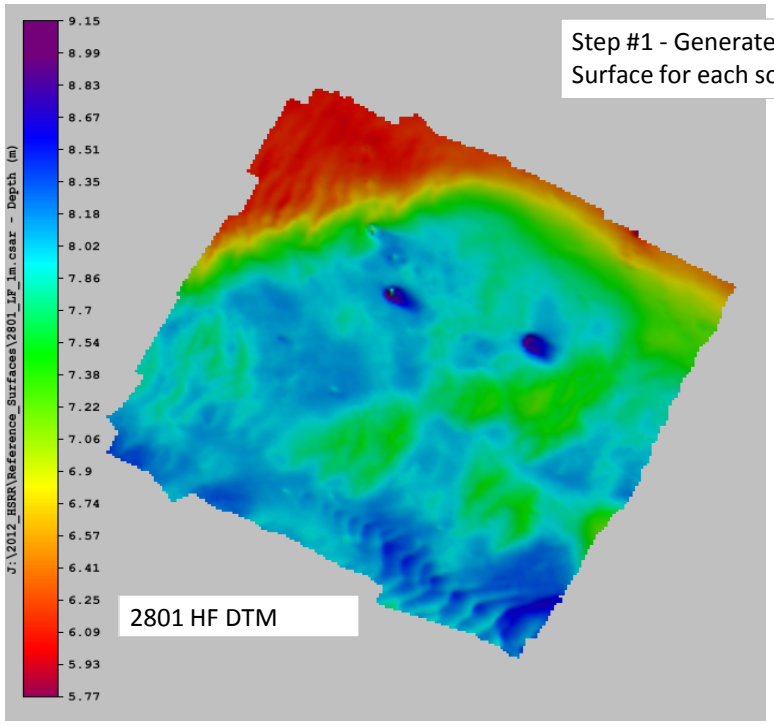
MLLW Difference Relative to 2801 HF

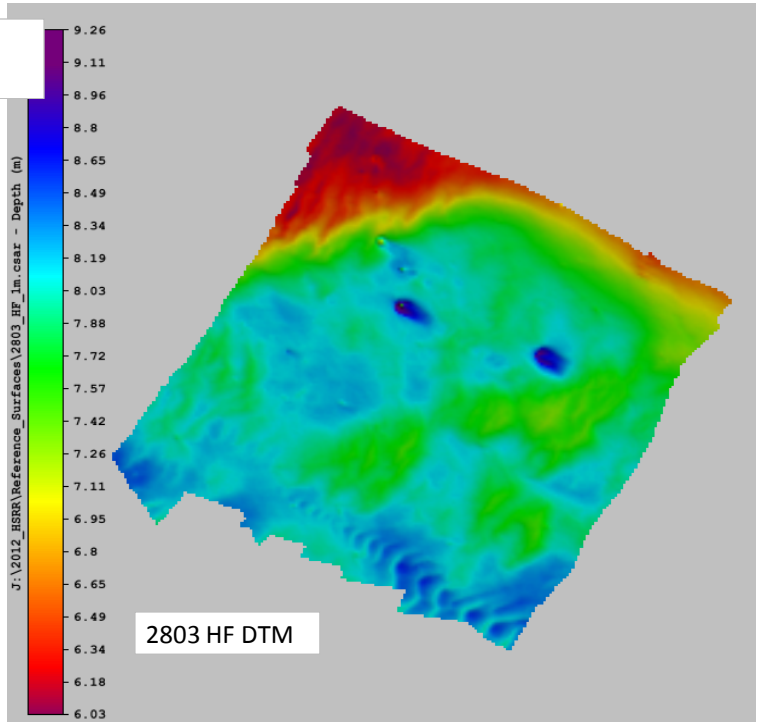
Sensor 1	Multibeam
2801 HF	0.00
2801 LF	0.01
2802 HF	0.01
2802 LF	-0.01
2803 HF	0.01
2803 LF	0.03
2803 8125	-0.01
2804 HF	-0.01
2804 LF	-0.02

Ellipse Difference Relative to 2801 HF

Sensor 1	Multibeam
2801 HF	0.00
2801 LF	0.02
2802 HF	-0.03
2802 LF	-0.01
2803 HF	-0.02
2803 LF	0.00
2803 8125	-0.05
2804 HF	-0.02
2804 LF	-0.03



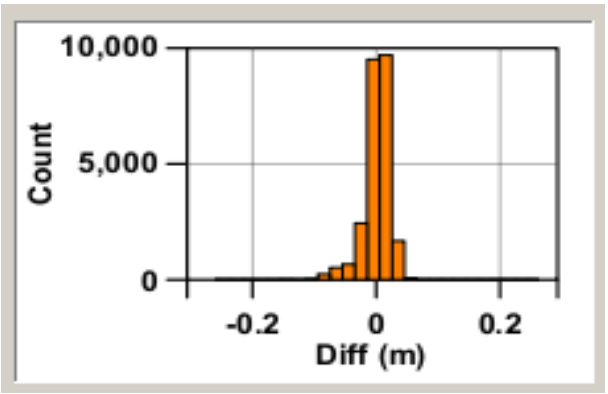




Step #3 - Compute Difference Surface Statistics.

Statistics

Mininum: -0.83 m	Maximum: 0.4 m
Mean: 0 m	Area: N/A
Std_dev: 0.02 m	Total count: 24,854



2805 Offsets and Measurements - Summary

Measurement aka Coord. Sys.	IMU to RP* Caris	IMU to 7125 *SWATH1 x,y,z & MRU to Trans* Caris	Port Ant to 7125 *Nav to Trans x,y,z* Caris	RP* to Waterline Caris	Port Ant to Stbd Ant	IMU to Port Ant Caris	IMU to Port Ant Pos/Mv	IMU to Heave Caris	IMU to Heave Pos/Mv
x	0.000	0.004	0.686	n/a	Scaler Distance 1.447	-0.682	-0.806	0.000	0.000
y	0.000	0.245	1.051	n/a		-0.806	-0.682	0.000	0.000
z	0.000	0.482	3.656	-0.097		-3.174	-3.174	0.000	0.000

*IMU is Reference Point

-0.111 (2010 used for K5K)

Vessel Offsets for 2805 7125 are derived from the NGS Survey, January 2010, Trimble Equipment Specs, and 2011 and 2010 Measured Values.

Calculations

Coord. Sys./ Source	IMU to 7125			Port Ant to 7125			RP to Waterline			Port Ant to Stbd Ant			IMU to Port Ant			IMU to Heave		
NGS	IMU (m)	x	0.00000	IMU to Port Ant (m) (calculated)	x	-0.68217	RP to Waterline (m) (waterline worksheet)	z	0.097	IMU to Port Ant (m) (calculated)	x	-0.68217	IMU (m)	x	0.00000	IMU (m)	x	0.00000
		y	0.00000		y	-0.80598					y	-0.80598		y	0.00000		y	0.00000
		z	0.00000		z	3.17407					z	3.17407		z	0.00000		z	0.00000
	MBES RP Rcvr - Phase Center (m)	x	0.00401	IMU to 7125 Phase Ctr (calculated)	x	0.00401	2010 RP to Waterline (m) (waterline worksheet)	z	0.111	IMU (m)	x, y, z	0.00000	Top of Port Ant (m)	x	-0.68217	Heave Pt (by design) (m)	x	0.00000
		y	0.24503		y	0.24503								y	-0.80598		y	0.00000
		z	-0.48191		z	-0.48191				Top of Stbd Ant (m)	x	0.76454		z	3.16277		z	0.00000
											y	-0.80778	Base to top of Port Ant (measured) (m)	z	0.073			
											z	3.14528						
										Base to top of Stbd Ant (measured) (m)	z	0.073	Bottom of Port Ant (calculated) (m)	z	3.08977			
										Bottom of Stbd Ant (calculated) (m)	z	3.07228	Base to Phase Cntr of Port Ant (eqp spc) (m)	z	0.0843			
										Base to Phase Cntr of Stbd Ant (eqp spc) (m)	z	0.0843						

Coord. Sys.	IMU to 7125			Port Ant to 7125			RP to Waterline			Port Ant to Stbd Ant			IMU to Port Ant			IMU to Heave		
NGS	IMU to 7125 Phase Ctr	x	0.00401		x	0.68618		x	n/a					x	-0.68217		x	0.00000
		y	0.24503		y	1.05101		y	n/a	Scalar Distance		1.4468		y	-0.80598		y	0.00000
		z	-0.48191		z	-3.65598		z	0.097					z	3.17407		z	0.00000
	Coord. Sys. CARIS	x	0.00401	Coord. Sys. CARIS	x	0.68618	Coord. Sys. CARIS	x	n/a				Coord. Sys. Pos/Mv	x	-0.80598	Coord. Sys. Pos/Mv	x	0.00000
		y	0.24503		y	1.05101		y	n/a					y	-0.68217		y	0.00000
		z	0.48191		z	3.65598		z	-0.097					z	-3.17407		z	0.00000

2012 2011 Measured Values

Measurement aka Coord. Sys.	IMU to RP* Caris	IMU to K5K Caris	IMU to Tow PT K5K Caris
x	0.000	0.534	0.609
y	0.000	0.845	-5.525
z	0.000	0.772	-2.186

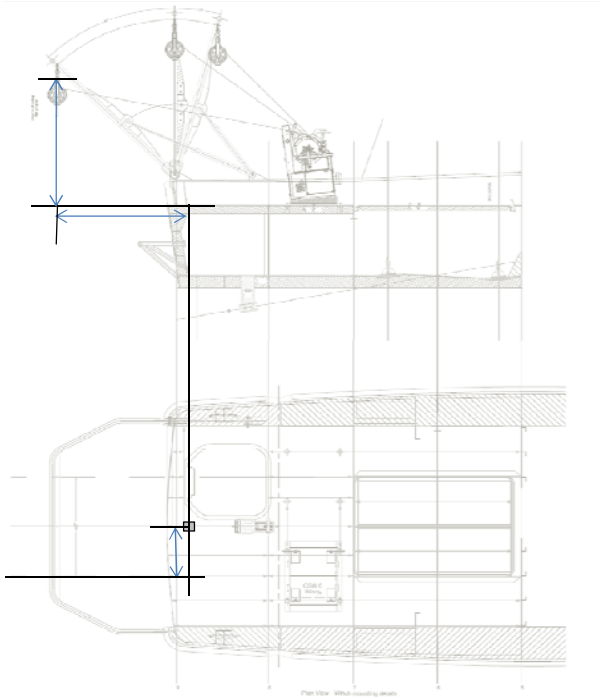
*IMU is Reference Point

Vessel Offsets for 2805 K5K are derived from the NGS Survey, January 2010, Trimble Equipment Specs, and

Calculations

Coord. Sys./ Source		IMU to K5K			IMU to Tow PT K5K		
NGS	IMU (m)		x	0.00000	IMU (m)	x	0.00000
			y	0.00000		y	0.00000
			z	0.00000		z	0.00000
	KEEL FORE BM		x	-0.00202	Centerline Stern BM	x	-0.01735
			y	0.44007		y	-4.04803
			z	-0.6141		z	0.67574
	KEEL FORE BM to K5K				CSBM to Tow PT		
	Rcvr - Phase		x	0.536		x	0.626
	Center		y	0.405		y	-1.477
	(measured)		z	-0.158	(measured)	z	1.510

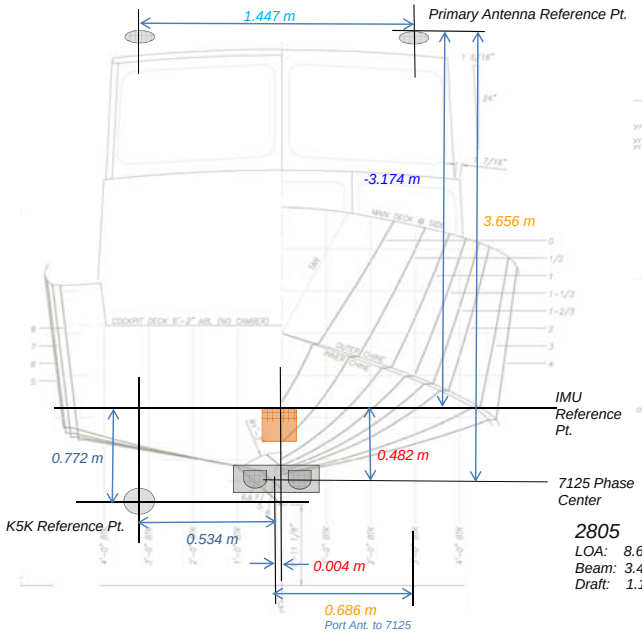
Coord. Sys.		IMU to K5K			IMU to Tow PT K5K		
NGS	IMU to K5K		x	0.53398	IMU to Tow PT K5K	x	0.60865
	Phase Ctr		y	0.84507		y	-5.52503
			z	-0.77210		z	2.18574
	Coord. Sys.		x	0.53398	Coord. Sys.	x	0.60865
	CARIS		y	0.84507	CARIS	y	-5.52503
			z	0.77210		z	-2.18574

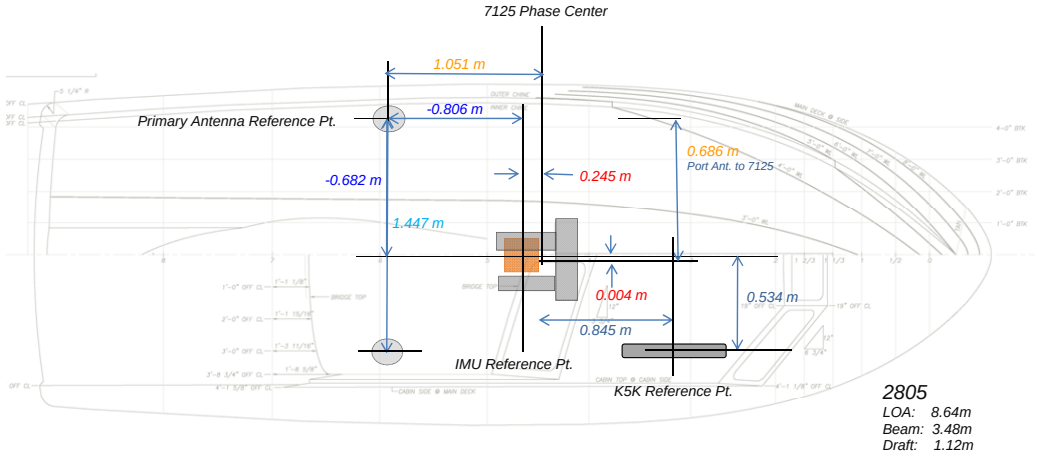


Description of Offsets for Launch 2805

All Values Shown are in CARIS Coordinates

The Ship Reference Frame (SRF) for Launch 2805 was based from the IMU reference point as the 0,0,0 point. Physical locations were measured with x,y,z offsets from this point. These locations were used to calculate offsets of items with respect to each other, as described for each offset.





IMU to 7125		
x	y	z
0.004	0.245	0.482

The physical positions of the IMU and the receiver phase center of the 7125 were measured during the NGS survey. These physical measurements were taken while the launch was secured on the pier and thought to be as level as possible. The measured values for the IMU and MB were taken directly for the report. The difference is the offset from the IMU to the phase center of the 7125 which was then transposed from the NGS to the CARIS coordinate system.

Port Ant to 7125		
x	y	z
0.686	1.051	3.656

The values were calculated by subtracting the physical height of the Port Antenna to the IMU x, y, z values from the respective values of the IMU to the 7125. The calculated values were then transposed from the NGS to the CARIS coordinate system.

RP to Waterline		
x	y	z
N/A	N/A	-0.097

The average vertical distance from Port Benchmark to waterline and the Starboard Benchmark to the waterline were measured by FAIRWEATHER personnel using a steel tape and bubble level. These values were combined with the Z value of the Benchmarks to the RP/IMU to get an average for the waterline to RP. The Waterline Measurement value is in NGS coordinates initially and is converted to CARIS coordinates.

Port Ant to Stbd Ant
Scalar Distance
1.447

The location of the phase center of the port and starboard POS/MV antennas were surveyed by NGS. The z-values were adjusted to the phase center. Then the scalar distance between the phase centers was calculated.

IMU to Port Antenna		
x	y	z
-0.682	-0.806	-3.174

The location of the IMU and the location of the top of port antenna were surveyed by NGS. The z-value of the antenna was calculated by subtracting the height of the antenna and then adding the value from the base of the antenna to the phase center of the antenna. The calculation results were then transposed from the NGS to the CARIS coordinate system.

IMU to Heave		
x	y	z
0.000	0.000	0.000

The Heave Point is assumed to coincide with the IMU location.

IMU to K5K		
x	y	z
0.534	0.845	0.772

The location of the IMU and the location of the forward keel benchmark were surveyed by NGS. BM to K5K were measured by FAIRWEATHER personnel using a steel tape and bubble level.

US DEPARTMENT OF COMMERCE
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
NATIONAL GEODETIC SURVEY
GEODETIC SERVICES DIVISION
INSTRUMENTATION & METHODOLOGIES BRANCH

NOAA SURVEY VESSEL 2805
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY
FIELD REPORT

Kendall L. Fancher
January, 2010

NOAA SURVEY VESSEL 2805
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

PURPOSE

The primary purpose of the survey was to precisely determine the spatial relationship between various hydrographic surveying sensors, launch bench marks and the components of a POS MV navigation system aboard the NOAA survey vessel 2805.

PROJECT DETAILS

This survey was conducted in Seattle, WA at the NOAA Western Center on the 26th of January, 2010. The weather was sunny early then cloudy with temperatures in the 40s to 50s. For this survey, the vessel was on blocks, supported by boat jacks. The vessel was reported to have been leveled relative to the IMU.

INSTRUMENTATION

A Leica TDA5005 precision total station was used to make all measurements.
Technical Data:

Standard Deviation	
Horizontal angle	0.5 seconds
Vertical angle	0.5 seconds
Distance measurement	1mm + 1ppm

Leica precision prisms were used as sighting targets. Prisms were configured to have a zero mm offset.

PERSONNEL

Kendall Fancher — NOAA/NOS/NGS/GSD/I&M BRANCH
(540) 373-1243
kendall.fancher@noaa.gov

Dennis Lokken — NOAA/NOS/NGS/GSD/I&M BRANCH
(540) 373-1243
dennis.lokken@noaa.gov

NOAA SURVEY VESSEL 2805
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

DEFINITION OF THE REFERENCE FRAME

For this survey, data was collected in a 3-D right handed Cartesian coordinate system. The origin of this coordinate system is defined as the center of the IMU target. The Y (Northing) axis is parallel to the centerline of the launch and is positive towards the bow of the launch. The X (Easting) axis is perpendicular to the Y axis and is positive towards the starboard side of the launch. The Z (Elevation) axis is perpendicular to the XY plane and is positive towards the top of the launch. The coordinates of the points established this survey are reported in this coordinate system and are provided in Appendix A.

SURVEY METHODOLOGY

Four temporary control points, (1, 2, 3, and 4), were established around the vessel such that every point to be positioned on the launch could be observed from at least two separate locations.

Coordinates of 100.000N, 100.000E, and 100.000U were assumed for temporary control point 1. A distance and height difference were measured between control points 1 and 2. Temporary control point 2 was assumed to have an Easting of 100.000. The measured distance between these two points was used to determine the Northing for temporary control point 2. The height difference between the two points was used to determine the Up component for control point 2.

Control point 1 was occupied and control point 2 was observed to initialize the instrument. After initialization, control point 4 and all visible points to be observed on the launch were observed in both direct and reverse. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 2.

Control point 2 was occupied and control point 1 was observed to initialize the instrument. After initialization, control point 3 and all visible points to be observed on the launch were observed in both direct and reverse. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 1.

Control point 3 was occupied and control point 2 was observed to initialize the instrument. After initialization, control point 4 and all visible points to be observed on the launch were observed in both direct and reverse. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 2.

NOAA SURVEY VESSEL 2805
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

Control point 4 was occupied and control point 3 was observed to initialize the instrument. After initialization, all visible points to be observed on the launch were observed in both direct and reverse. Control point 1 was also observed in order to evaluate the accuracy of the traverse. Inverse computations between the original and observed control point yielded a horizontal accuracy, or traverse closure of of 0.000m and a vertical accuracy of 0.000m. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 2.

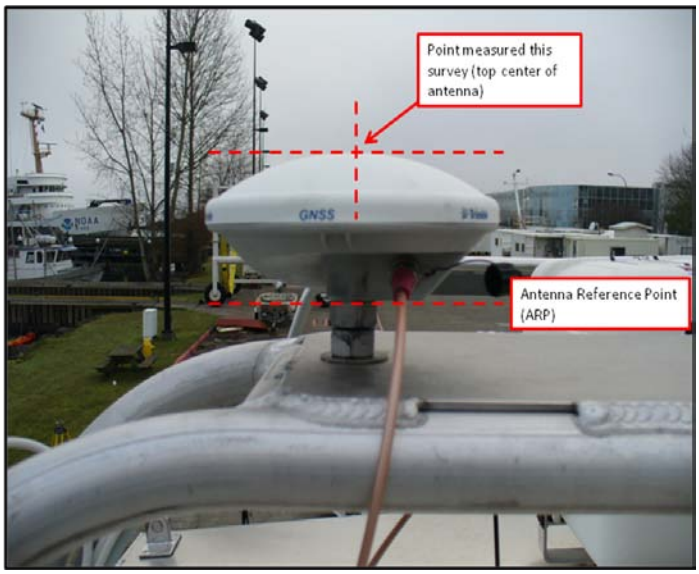
Inverses were computed between the two positions determined for all points surveyed to evaluate their accuracy relative to the temporary control network. Inverse reports are included in appendix B.

The reference frame was rotated using CENTERLINE STERN BM (CLS) as the point of rotation. A zero degree azimuth was used during the rotation from CLS to CENTERLINE BOW BM (BMB). The reference frame was then translated to relocate the origin of the reference frame to the IMU.

DISCUSSION

The positions given for the POS GPS antennas (Zephyr Model II p/n 57970-00) are to the top center of the antenna. To correct the Z value provided in this report for each antenna to the electronic phase center, I recommend the following steps be taken;

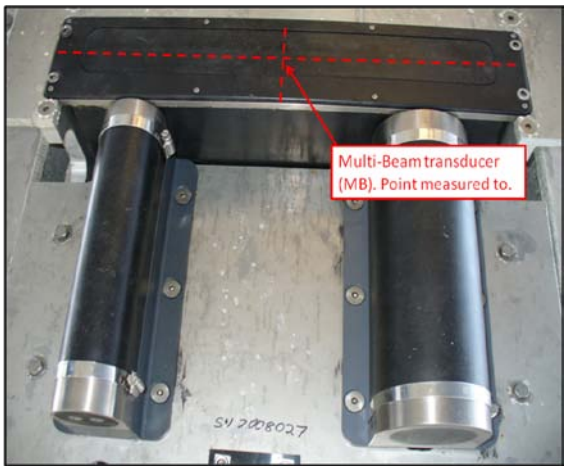
1) Determine the physical height of the GPS antenna. This information is probably located on the antenna or with equipment documentation.
2) Investigate to find the electronic phase center offset of the antenna. This information is probably located on the antenna or with equipment documentation. This value may also be available at the NGS website for antenna modeling.
3) Subtract the total height of the antenna from the Z value for each antenna. This will give you a Z value for the antenna ARP (antenna reference point)
4) Then add to this value the electronic phase center offset value appropriate for the antenna model.



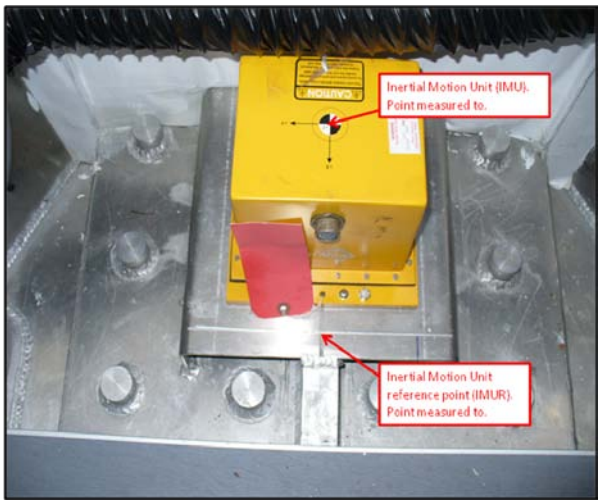
NOAA SURVEY VESSEL 2805
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

Two reference points (MBF and MBA) were positioned in order to facilitate future measurements to the Multi-Beam sensor by launch personnel. These reference points are punch marks set along the center of the keel, at the locations described in the image at right.

A point on the Multi-Beam transducer (MB) was measured directly this survey. The measured point was at the center of the bottom of the transducer. No mark was left to indicate the measured point.



The point positioned for the Inertial Motion Unit (IMU) this survey was the center of the target affixed to the top of the unit. Additionally, a reference mark (IMUR) was established on the plate the IMU is attached to at a point where two scribed lines intersect, forward of the IMU.



NOAA SURVEY VESSEL 2805
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

STATION LISTING

BMB- CENTERLINE BOW BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the deck, along the centerline and near the bow of the launch.

CLS- CENTERLINE STERN BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the deck, along the centerline and near the stern of the launch.

BMC- CENTERLINE CAB BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the top of the cab, along the centerline of the launch.

BMP- PORT SIDE BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the top of the deck, near the middle of and along the port side of the launch.

BMS- STARBOARD SIDE BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the top of the deck, near the middle of and along the starboard side of the launch.

MBF- KEEL BM
A punch mark set along the bottom center of the keel, fore of the multi-beam transducer, 0.030 m from a point where the keel makes a 90 degree angle upwards.

MBA- KEEL BM
A punch mark set along the bottom center of the keel, aft of the multi-beam transducer, 0.030 m from a point where the keel makes a 90 degree angle upwards.

IMU- IMU TARGET
Center of a target affixed to the top of the IMU housing.

IMUR- IMU REFERENCE BM
The intersection of two scribed lines atop a metal support plate for the IMU and forward of the IMU.

GPSP- PORT SIDE GPS ANTENNA REFERENCE POINT
The top center of the port side GPS antenna for the POS system.

GPSS- STARBOARD GPS ANTENNA REFERENCE POINT
The top center of the starboard side GPS antenna for the POS system.

MB- MULTI-BEAM REFERENCE POINT
The physical bottom center of the Multi-Beam transducer.

Appendix A

Coordinate Report Launch 2805

Pt Name	*North(Y)*	*East(X)*	*Elev.(Z)*	*ID*
IMU Target	0.00000	0.00000	0.00000	IMU
IMU Reference BM	0.13270	-0.00348	-0.16937	IMUR
Centerline Stern BM	-4.04803	0.01735	0.67574	CLS
Centerline Bow BM	3.46914	0.01735	1.39751	BMB
Portside GPS Ant. Ref. Point	-0.80598	-0.68217	3.16277	GPSP
Starboard GPS Ant. Ref. Point	-0.80778	0.76454	3.14528	GPSS
Multi-Beam Ref.Point	0.24503	0.00401	-0.48191	MB
Keel BM	0.44007	-0.00202	-0.61410	MBF
Keel BM	-0.22895	-0.00227	-0.53363	MBA
Port Side BM	0.10603	-1.42637	1.07535	BMP
Starboard Side BM	0.10926	1.45859	1.04250	BMS
Centerline Cab BM	-0.19024	0.03192	2.65903	BMC

Units = meters

Appendix B

Point to Point Inverse Launch 2805

Pt. 1	*Pt. 2*	*Dist.*	*Northing*	*Easting*	*Elevation*	*ID*
18	31	0.004	-0.003	0.003	-0.00141	BMC
9	29	0.001	0.001	- 0.001	0.00051	BMP
39	49	0.003	-0.003	0.001	-0.00063	BMS
8	48	0.001	-0.001	-0.001	0.00016	CLS
10	30	0.002	-0.001	0.002	0.00033	GPSP
11	41	0.000	0.000	0.000	0.00034	GPSS
16	53	0.001	0.000	0.001	0.00024	IMU
17	54	0.002	0.000	0.002	0.00029	IMUR
4	46	0.006	0.005	0.002	-0.00018	MB
5	47	0.001	0.000	0.001	0.00016	MBA
3	45	0.002	0.001	0.001	-0.00017	MBF

Units = meters

FAIRWEATHER

Multibeam Echosounder Calibration

Launch 2805 200kHz
Vessel

8/28/2013	140	Newport, OR (Yaquina River)
Date	Dn	Local Area

Welton, Wartick, Chensue, Nalley
Calibrating Hydrographer(s)

Reson 7125	2805	?
MBES System	MBES System Location	Date of most recent EED/Factory Check

Sonar Serial Number	Processing Unit Serial Number
Sonar Mounting Configuration	Date of current offset measurement/verification
Description of Positioning System	Date of most recent positioning system calibration

Acquisition Log

	240	Yaquina River	Calm
Date	Dn	Local Area	Wx

Bottom Type	Approximate Water Depth

Ferguson, Welton, Wartick, Chensue, Nalley
Personnel on board

Comments

TrueHeave filename

Use 2807					
SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
		44d37'28.2855"N	124d02'03.8379"W		
SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

NAV TIME LATENCY view parallel to track, one line with induced roll (outerbeam) or same lines bounded slope (nadir) [same direction, different speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	002_2204	110	5.0	
	002_2221	110	8.0	
	002_2222	290	8.0	
	002_2225	290	5.0	

PITCH view parallel to track, same line (at nadir) [opposite direction, same speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	002_2204	110	5.0	
	002_2207	290	5.0	May not have enough time before and after
	002_2221	110	8.0	
	002_2222	290	8.0	
	002_2225	290	5.0	

HEADING/YAW view parallel to track, offset lines (outerbeams) [opposite direction, same speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	001_2228	110	7.0	
	001_2230	290	7.0	
	003_2231	110	7.0	
	003_2233	290	7.0	

ROLL view across track, same line [opposite direction, same speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	005_2152	301	7.0	
	005_2155	121	7.0	
	005_2158	301	6.7	
	005_2201	121	6.7	

Processing Log

Date	Dn	Personnel
8/30/2013	242	Beduhn

☑ **Data converted --> HDCS_Data in CARIS**

☑ **TrueHeave applied** Not applied to 002_2209

☑ **SVP applied** NIDWT 2hrs- Not applied to 002_2209

☑ **Tide applied** 9435380.tid (Prelim)

Zone file N/A

Lines merged ☑

Data cleaned to remove gross fliers ☑

Compute correctors in this order

1. Precise Timing **2. Pitch bias** **3. Heading bias** **4. Roll bias**

Do not enter/apply correctors until all evaluations are complete and analyzed.

PATCH TEST RESULTS/CORRECTORS

Evaluators	Latency (sec)		Pitch (deg)		Roll (deg)		Yaw (deg)
Welton		2222&2225		2221&2222			
Beduhn	0.00	2204&2221	-1.54	2221&2222	-0.12	2152&2155	0.33
Wartick	0.00	2204&2221	-1.50	2204&2225	-0.13	2152&2155	0.35
Faulkes	0.00	2204&2221	-1.47	2221&2222	-0.11	2152&2201	0.30
Averages	0.00		-1.50		-0.12		0.33
Standard Deviation	0.00		0.04		0.01		0.03
FINAL VALUES							

Final Values based on

Resulting HVF File Name

MRU Align StdDev gyro 0.03 Value from standard deviation of Heading offset values

MRU Align StdDev Roll/Pitch 0.02 Value from averaged standard deviations of pitch and roll offset values

NARRATIVE

☑ **HVF Hydrographic Vessel File created or updated with current offsets** Updated to beginning of season

Name: **Date:**

FAIRWEATHER

Multibeam Echosounder Calibration

Launch 2805 400kHz
Vessel

8/28/2013	140	Newport, OR (Yaquina River)
Date	Dn	Local Area

Welton, Wartick, Chensue, Nalley
Calibrating Hydrographer(s)

Reson 7125	2805	?
MBES System	MBES System Location	Date of most recent EED/Factory Check
Sonar Serial Number		Processing Unit Serial Number
Sonar Mounting Configuration		Date of current offset measurement/verification
Description of Positioning System		Date of most recent positioning system calibration

Acquisition Log

	240	Yaquina River	Calm
Date	Dn	Local Area	Wx
Bottom Type			Approximate Water Depth

Ferguson, Welton, Wartick, Chensue, Nalley
Personnel on board

Comments

TrueHeave filename

Use 2807					
SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
		44d37'28.2855"N	124d02'03.8379"W		
SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

NAV TIME LATENCY view parallel to track, one line with induced roll (outerbeam) or same lines bounded slope (nadir) [same direction, different speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	002_2104	290	4.0	
	002_2108	290	4.0	
	002_2113	290	8.0	
	002_2115	109	8.0	

PITCH view parallel to track, same line (at nadir) [opposite direction, same speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	002_2108	290	4.0	
	002_2111	109	4.0	
	002_2113	290	8.0	
	002_2115	109	8.0	

HEADING/YAW view parallel to track, offset lines (outerbeams) [opposite direction, same speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	001_2117	290	7.3	
	003_2120	109	7.1	short fat finger line after this one
	003A2122	290	6.7	
	001_2124	109	6.9	

ROLL view across track, same line [opposite direction, same speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
2	005_2137	301	7.0	
2	005_2139	122	7.0	
2	005_2141	301	6.9	
2	005_2143	122	7.0	

Processing Log

8/30/2013	242	Beduhn
Date	Dn	Personnel

☑ **Data converted --> HDCS_Data in CARIS**

☑ **TrueHeave applied** all files

☑ **SVP applied** NIDWT 2hrs

☑ **Tide applied** 9435380.tid (Prelim)

Zone file N/A

Lines merged ☑

Data cleaned to remove gross fliers ☑

Compute correctors in this order

1. Precise Timing **2. Pitch bias** **3. Heading bias** **4. Roll bias**

Do not enter/apply correctors until all evaluations are complete and analyzed.

PATCH TEST RESULTS/CORRECTORS

Evaluators	**Latency (sec)**	Lines Used	**Pitch (deg)**	Lines Used	**Roll (deg)**	Lines Used	**Yaw (deg)**
Beduhn	0.00	2108 &2113	-1.20	2113&2115	-0.16	2137&2139	0.17
Wartick	0.00	2108 &2113	-1.20	2113&2115	-0.18	2137&2139	0.13
Welton	0.00	2108&2113	-1.20		-0.15		0.15
Faulkes	0.00	2108&2113	-1.03	2108&2104	-0.12	2141&2143	
Averages	0.00		-1.16		-0.15		0.15
Standard Deviation	0.00		0.09		0.02		0.02
FINAL VALUES							

Final Values based on

Resulting HVF File Name

MRU Align StdDev gyro 0.02 Value from standard deviation of Heading offset values

MRU Align StdDev Roll/Pitch 0.06 Value from averaged standard deviations of pitch and roll offset values

NARRATIVE

☑ **HVF Hydrographic Vessel File created or updated with current offsets** Values used through whole season

Name: **Date:**

NOAA POS/MV Calibration Report

Fill out all fields! See previous years as an example.

Yellow areas require screen grabs!

Ship: FAIRWEATHER **Vessel:** 2805

Date: 4/16/2013 **Dn:** 106

Personnel: SS Brooks, ENS Broo, ENS Chensue, ENS Marwine

PCS Serial # 3627 **IMU Serial #** 294

IP Address: 129.100.1.231

POS controller Version (Use Menu Help > About) 5.1.0.2

POS Version (Use Menu View > Statistics) MV-320, VER4 (BD960)

GPS Receivers

Primary Receiver Serial #: 4851K33806

Secondary Receiver Serial #: 4851K33772

2013_106_2805.040

POSMV filename(s)

Calibration area

Location: Lake Washington

Approximate Position:

Lat	47	41	24
Lon	122	15	36

DGPS Beacon Station: Point Robinson **DGPS Receiver Serial#:** 0927-9567-0001

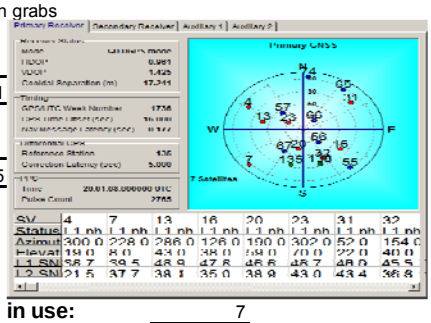
Frequency(kHz): 323

Satellite Constellation

(Use View> GPS Data)

Primary GPS

Insert screen grabs



HDOP 0.961

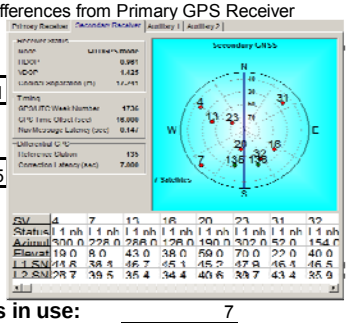
VDOP 1.425

Sattelites in use: 7

L1 SNR > 30 35 40

Secondary GPS

Note any differences from Primary GPS Receiver



HDOP 0.961

VDOP 1.425

Sattelites in use: 7

L1 SNR > 30 35 40

PDOP (Use View> GAMS Solution)

POS/MV Configuration
Settings

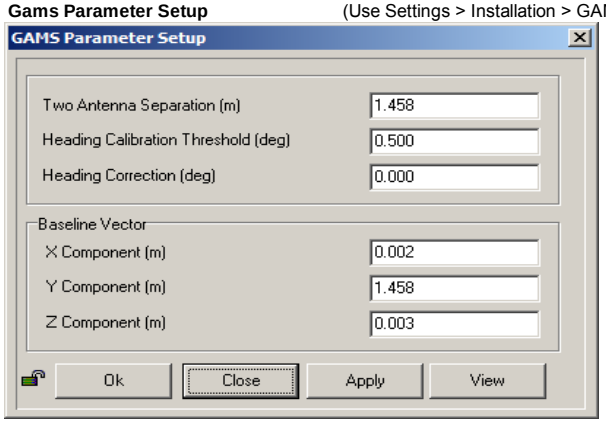
POS/MV Calibration

Calibration Procedure: (Refer to POS MV V4 Installation and Operation Guide, 4-25)

Start time: 19:40:00
End time: 20:09:05
Heading accuracy achieved for calibration: 0.469

Calibration Results:

Gams Parameter Setup (Use Settings > Installation > GAMS Intallation)



Save POS Settings on PC (Use File > Store POS Settings on PC)

File Name: 2013_04_16_POSCONFIG_GAMS.nvm
D:\HYPACK 2012\Projects\HSRR2012\Raw\Positioning

General Notes:

The POS/MV uses a Right-Hand Orthogonal Reference System

The right-hand orthogonal system defines the following:

- The x-axis is in the fore-aft direction in the appropriate reference frame.
- The y-axis is perpendicular to the x-axis and points towards the right (starboard) side in the appropriate reference frame.
- The z-axis points downwards in the appropriate reference frame.

The POS/MV uses a Tate-Bryant Rotation Sequence

Apply the rotation in the following order to bring the two frames of reference into complete alignment:

a) Heading rotation - apply a right-hand screw rotation θz about the z-axis to align one frame with the other.

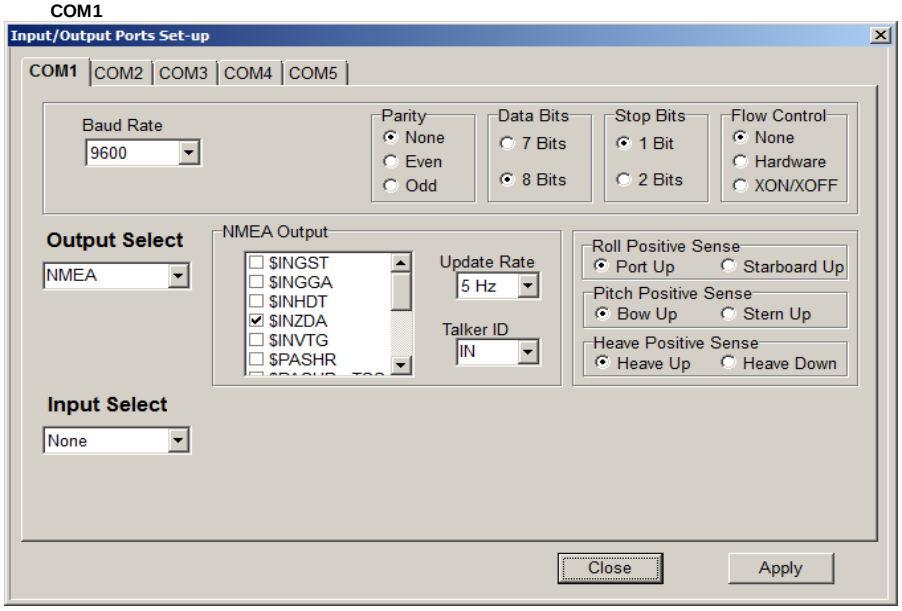
b) Pitch rotation - apply a right-hand screw rotation θy about the once-rotated y-axis to align one frame with the other.

c) Roll rotation - apply a right-hand screw rotation θx about the twice-rotated x-axis to align one frame with the other.

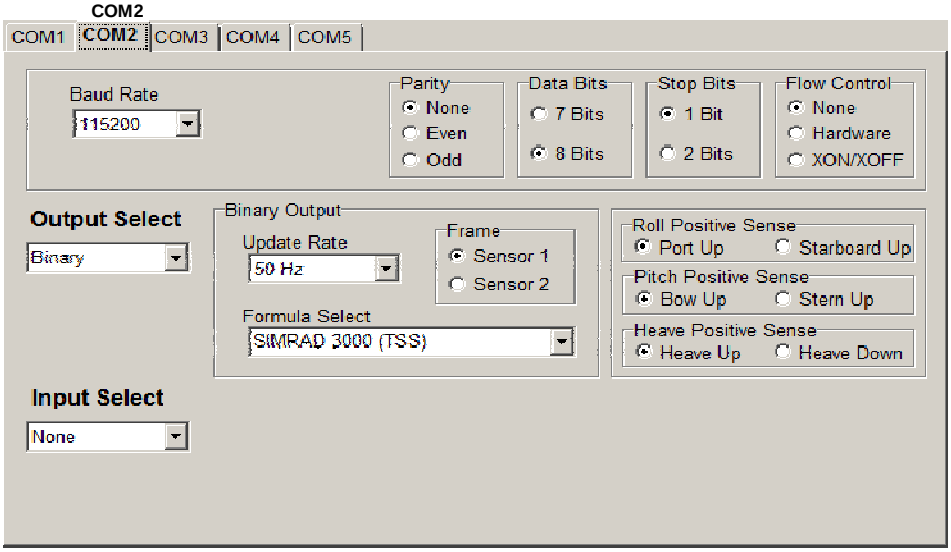
SETTINGS

Input/Output Ports (Use Settings > Input/Output Ports)

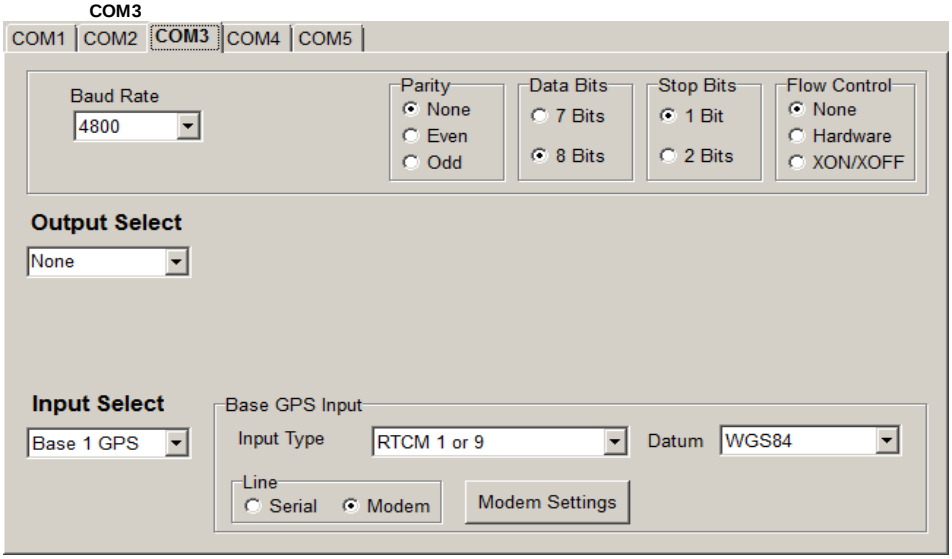
COM1



COM2

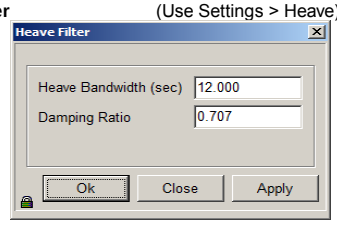


COM3

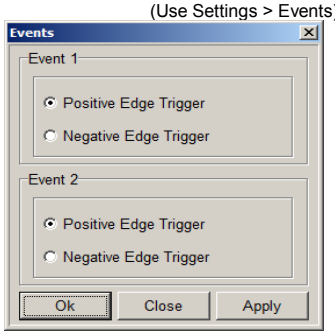


SETTINGS Continued

Heave Filter (Use Settings > Heave)

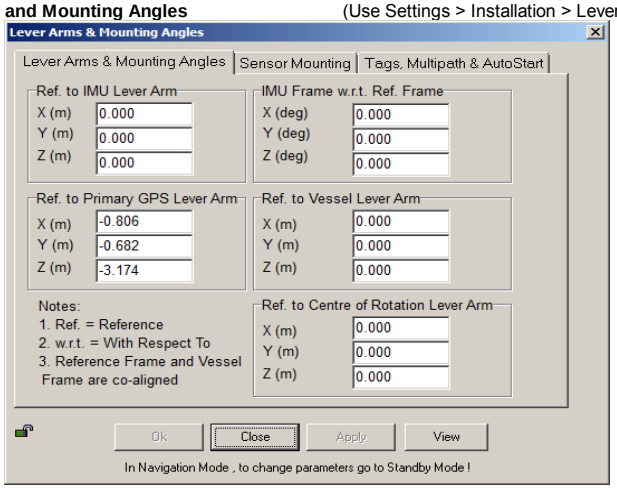


Events (Use Settings > Events)

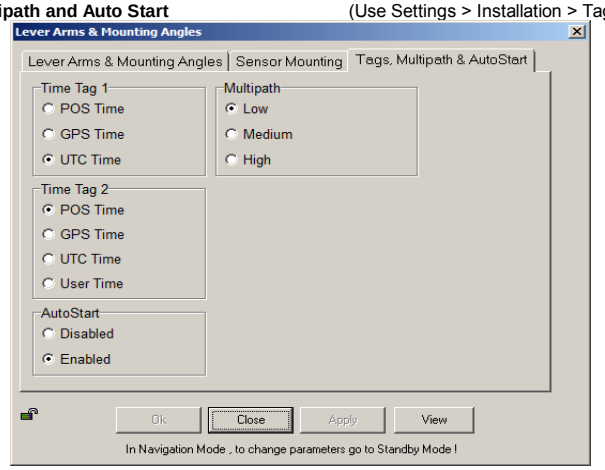


INSTALLATION (Use Settings > Installation)

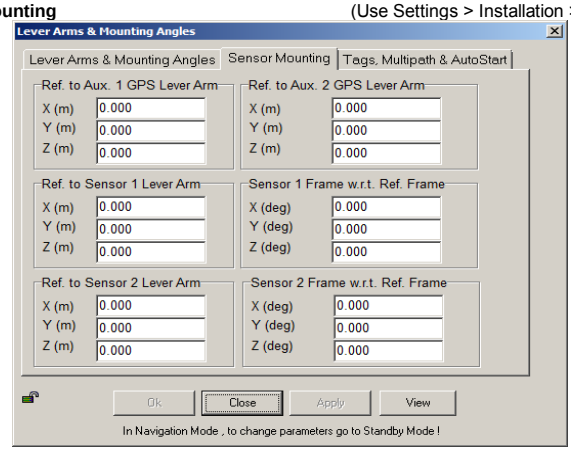
Lever Arms and Mounting Angles (Use Settings > Installation > Lever Arms and Offsets)



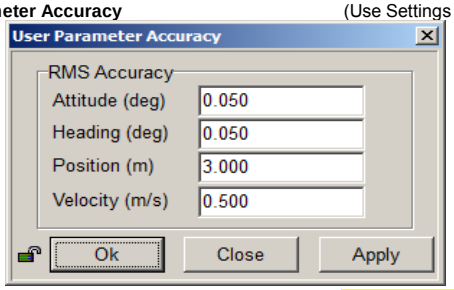
Tags, Multipath and Auto Start (Use Settings > Installation > Tags, Multipath and Auto Start)



Sensor Mounting (Use Settings > Installation > Sensor Mounting)



User Parameter Accuracy (Use Settings > Installation > User Accuracy)



Frame Control (Use Tools > Config) Diagnostics

☐ User Frame ☐ IMU Frame

Primary GPS Measurement

Auxiliary GPS Measurement

☐ **Use GAMS enabled**

ERDDM Acquisition Log

Launch 2805 200kHz
Vessel

4/16/2013	106	Lake Washington	Partly Cloudy, Calm
Date	Dn	Local Area	Wx

SS Brooks, ENS Broo, ENS Chensue, ENS Marwine
Personnel

Comments

N/A	Please select DGPS Beacon
Tidal Cycle Notes	USCG DGPS Beacon Used

2013_106_2805.056 - .076
POSMV filename(s)

POS File	Azmuth	Vessel Speed	RPM	Start and End Time
2013_106_2805.056 – 059	350	04	600	20:18:30 – 20:23:40
2013_106_2805.061 – 063	350	06	840	20:29:32 – 20:34:32
2013_106_2805.063 – 066	350	08	1310	20:38:30 – 20:43:30
2013_106_2805.066 – 069	170	010	1770	20:47:25 – 20:52:25
2013_106_2805.070 - 073	350	012	1900	20:56:45 – 21:01:45
2013_106_2805.073 – 076	170	014	2050	21:06:10 – 21:11:10

Processing Log

4/17/2013	107	Bravo and Witmer
Date	Dn	Personnel

☑ **POS Files Processed in POS Pac**

Smartbase
Smartbase or Singlebase? Station used.

☑ **SBET Processed in Pydro Using the ERDDM Tool**

☑ **Graph and Table Values compared with previous year**

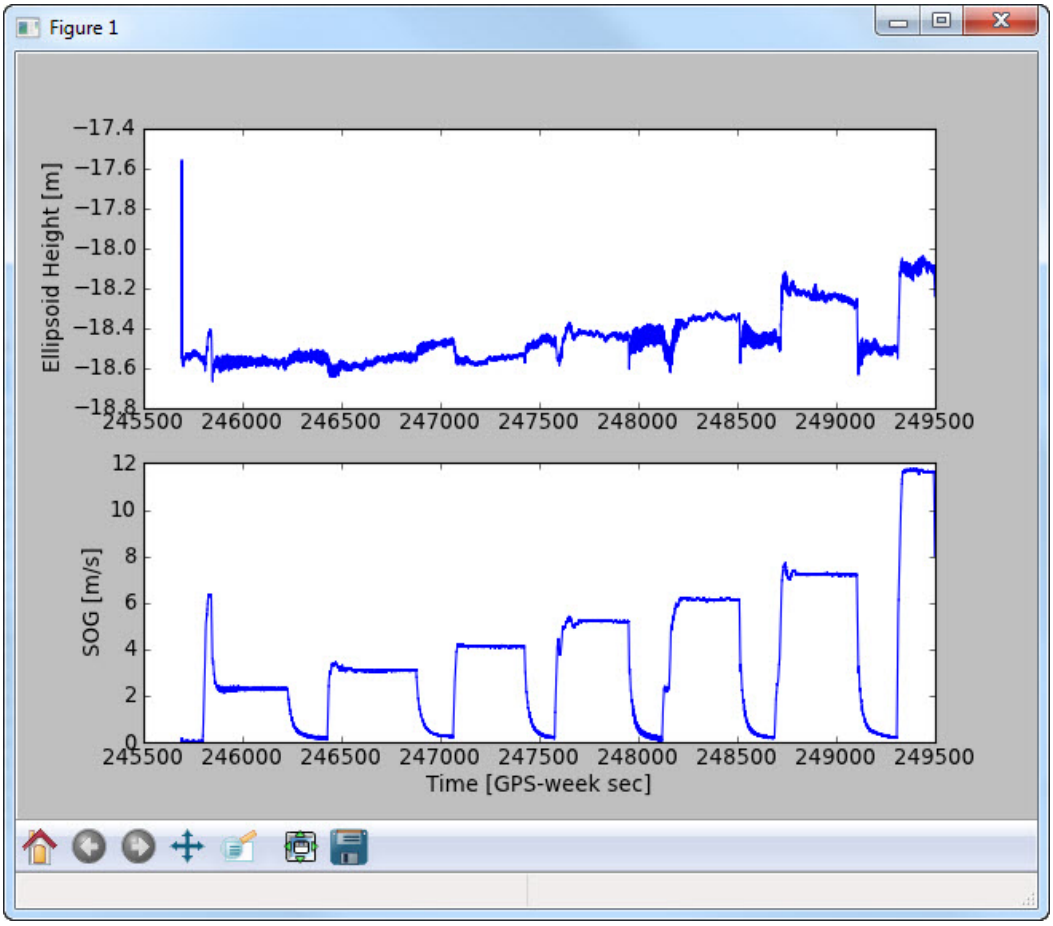
☑ **Documentaion Complete in DAPR Appendix**

☑ **See OPS/CST for updating HVF with new values**

FA – 2805

2013- DN106

4th Order Ellipsoidally Referenced ERDDM



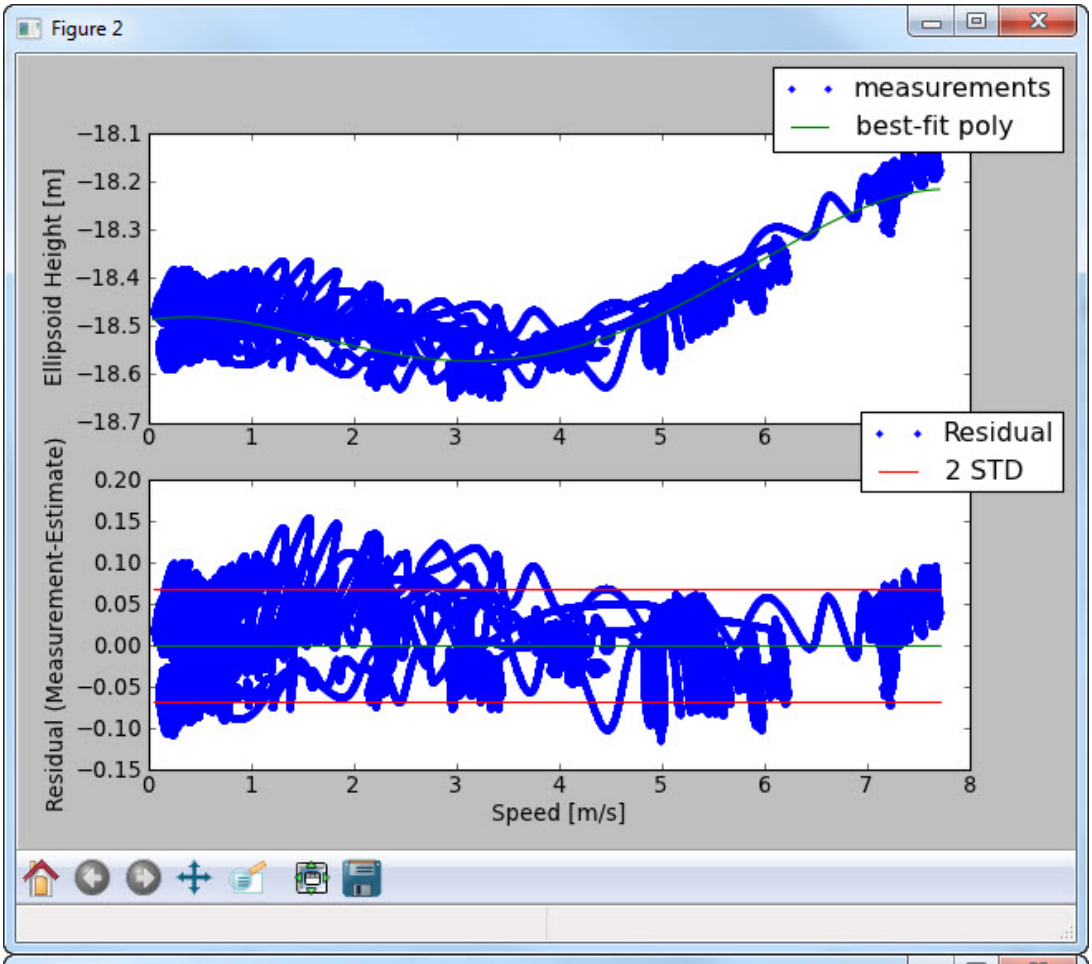


Figure 2
measurements
best-fit poly
Ellipsoid Height [m]
−18.1
−18.2
−18.3
−18.4
−18.5
−18.6
−18.7
0
1
2
3
4
5
6
Residual
2 STD
Residual (Measurement-Estimate)
0.20
0.15
0.10
0.05
0.00
−0.05
−0.10
−0.15
0
1
2
3
4
5
6
7
8
Speed [m/s]

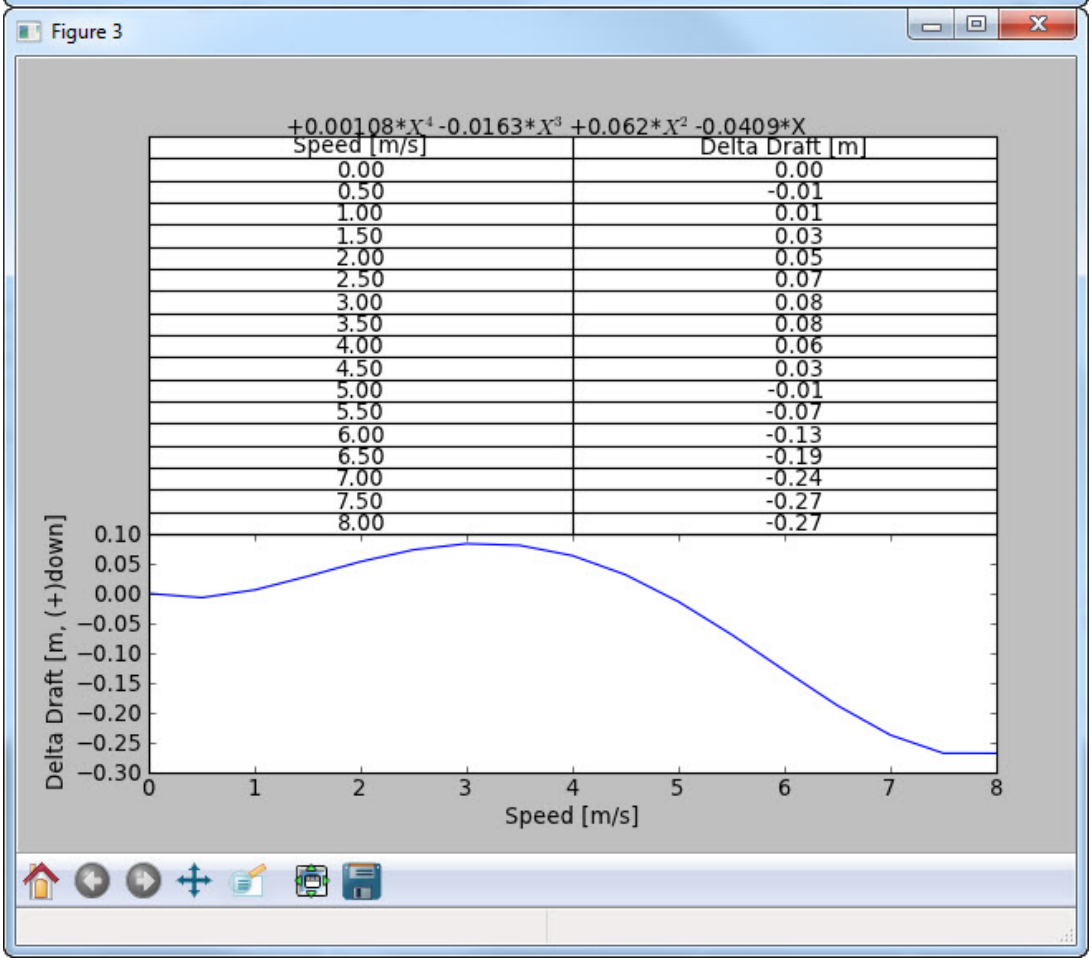


Figure 3
+0.00108*X⁴ -0.0163*X³ +0.062*X² -0.0409*X
Speed [m/s]
Delta Draft [m]
0.00
0.00
0.50
-0.01
1.00
0.01
1.50
0.03
2.00
0.05
2.50
0.07
3.00
0.08
3.50
0.08
4.00
0.06
4.50
0.03
5.00
-0.01
5.50
-0.07
6.00
-0.13
6.50
-0.19
7.00
-0.24
7.50
-0.27
8.00
-0.27
Delta Draft [m, (+)down]
0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20
−0.25
−0.30
0
1
2
3
4
5
6
7
8
Speed [m/s]

Waterline Measurements

Fill in Yellow squares only!

Measuring Party: Beduhn, Golmon, Gluntz

2805

Waterline measurements should be negative and cm!

	2805	
	Port Benchmark to Waterline	Stbd Benchmark to Waterline
Measure 1	-97.800	-95.200
Measure 2	-95.900	-95.100
Measure 3	-97.600	-96.000
Avg (cm)	-97.10	-95.43
Avg (m)	-0.9710	-0.9543
Stdev	0.01044	0.00493
BM Z-value (m)*	1.07535	1.04250
BM to WL (m)	0.104	0.088
Individual measurement	0.09735	0.09050
	0.11635	0.09150
StDev for TPU xls (of 6 #'s)	0.011	0.09935	0.08250

Date: 4/3/2013
Fuel Level: 32.3
Draft Tube:

Port-to-Stbd Z-difference

Theoretical	Actual	Error
0.0329	0.0167	-0.0162

RP to WL Average (m)
0.096

Measuring Party: Beduhn, Golmon, Gluntz

Waterline measurements should be negative and cm!

	2805	
	Port Benchmark to Waterline	Stbd Benchmark to Waterline
Measure 1	-92.200	-91.400
Measure 2	-91.900	-91.100
Measure 3	-93.000	-90.600
Avg (cm)	-92.37	-91.03
Avg (m)	-0.9237	-0.9103
Stdev	0.00569	0.00404
BM Z-value (m)	1.07535	1.04250
BM to WL (m)	0.151683333	0.132
Individual measurement	0.15335	0.12850
	0.15635	0.13150
StDev for TPU xls (of 6 #'s)	0.012	0.14535	0.13650

Date: 4/3/2013
Fuel Level: 101
Draft Tube:

Port-to-Stbd Z-difference

Theoretical	Actual	Error
0.0329	0.0133	-0.0195

RP to WL Average (m)
0.142
(Add this value to VSSL_Offsets & Measurements_20XX.xls)

utilized in Offsets and Measurements and TPU spreadsheet

2806 Offsets and Measurements - Summary

Measurement aka Coord. Sys.	IMU to RP* Caris	IMU to 7125 (Receiver) *SWATH1 x,y,z & MRU to Trans* Caris	Port Ant to 7125 *Nav to Trans x,y,z* Caris	RP* to Waterline Caris	Port Ant to Stbd Ant	IMU to Port Ant Caris	IMU to Port Ant Pos/Mv	IMU to Heave Caris	IMU to Heave Pos/Mv
x	0.000	-0.013	0.624	n/a	Scaler Distance 1.448	-0.637	-0.832	0.000	0.000
y	0.000	0.254	1.087	n/a		-0.832	-0.637	0.000	0.000
z	0.000	0.481	3.602	-0.086		-3.121	-3.121	0.000	0.000

*IMU is Reference Point

Vessel Offsets for 2808 7125 are derived from the NGS Survey, January 2010, Trimble Equipment Specs, and 2011 and 2010 Measured Values. 2013

Calculations

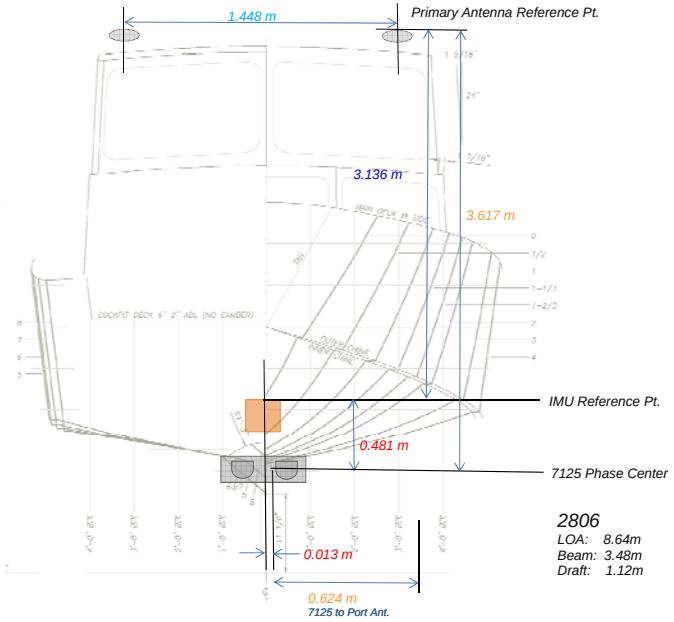
Coord. Sys./ Source	IMU to 7125			Port Ant to 7125			RP to Waterline			Port Ant to Stbd Ant			IMU to Port Ant			IMU to Heave		
NGS	IMU (m)	x	0.00000	IMU to Port Ant (m) (calculated)	x	-0.63695	RP to Waterline (m) (waterline worksheet)	z	0.086	IMU to Port Ant (m) (calculated)	x	-0.63695	IMU (m)	x	0.00000	IMU (m)	x	0.00000
		y	0.00000		y	-0.83249					y	-0.83249		y	0.00000		y	0.00000
		z	0.00000		z	3.12121					z	3.12121		z	0.00000		z	0.00000
	MBES RP Rcvr - Phase Center (m)	x	-0.01284	IMU to Phase Ctr (calculated)	x	-0.01284				IMU (m)	x, y, z	0.00000	Top of Port Ant (m)	x	-0.63695	Heave Pt (by design) m)	x	0.00000
		y	0.25447		y	0.25447								y	-0.83249		y	0.00000
		z	-0.48083		z	-0.48083				Top of Stbd Ant (m)	x	0.81062		z	3.14938		z	0.00000
											y	-0.82526						
											z	3.10821	Base to top of Port Ant (measured) (m)	z	0.074			
										Base to top of Stbd Ant (measured) (m)	z	0.059	Bottom of Port Ant (calculated) (m)	z	3.07521			
										Bottom of Stbd Ant (calculated) (m)	z	3.04921	Base to Phase Cntr of Port Ant (eqp spc) (m)	z	0.046			
										Base to Phase Cntr of Stbd Ant (eqp spc) (m)	z	0.046						

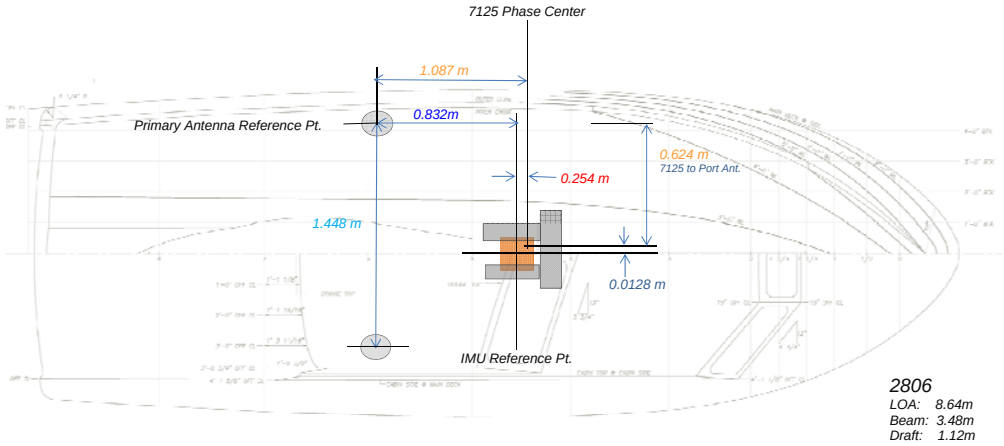
Coord. Sys.	IMU to 7125			Port Ant to 7125			RP to Waterline			Port Ant to Stbd Ant			IMU to Port Ant			IMU to Heave		
NGS	IMU to Phase Ctr	x	-0.01284		x	0.62411		x	n/a					x	-0.63695		x	0.00000
		y	0.25447		y	1.08696		y	n/a	Scalar Distance		1.4478		y	-0.83249		y	0.00000
		z	-0.48083		z	-3.60204		z	0.086					z	3.12121		z	0.00000
	Coord. Sys. CARIS	x	-0.01284	Coord. Sys. CARIS	x	0.62411	Coord. Sys. CARIS	x	n/a				Coord. Sys. Pos/Mv	x	-0.83249	Coord. Sys. Pos/Mv	x	0.00000
		y	0.25447		y	1.08696		y	n/a					y	-0.63695		y	0.00000
		z	0.48083		z	3.60204		z	-0.086					z	-3.12121		z	0.00000

Description of Offsets for Launch 2806

All Values Shown are in CARIS Coordinates

The Ship Reference Frame (SRF) for Launch 2806 was based from the IMU reference point as the 0,0,0 point. Physical locations were measured with x,y,z offsets from this point. These locations were used to calculate offsets of items with respect to each other, as described for each offset.





IMU to 7125		
x	y	z
-0.013	0.254	0.481

The physical positions of the IMU and the receiver phase center of the 7125 were measured during the NGS survey. These physical measurements were taken while the launch was secured on the pier and thought to be as level as possible. The measured values for the IMU and MB were taken directly for the report. The difference is the offset from the IMU to the phase center of the 7125 which was then transposed from the NGS to the CARIS coordinate system.

Port Ant to 7125		
x	y	z
0.624	1.087	3.602

The values were calculated by subtracting the top of the Port Antenna to the IMU x, y, z values then from the respective values of the IMU to the 7125. The calculated values were then transposed from the NGS to the CARIS coordinate system.

RP to Waterline		
x	y	z
n/a	n/a	-0.086

The average vertical distance from Port Benchmark to waterline and the Starboard Benchmark to the waterline were **measured by FAIRWEATHER personnel using a steel tape and** bubble level. These values were combined with the Z value of the Benchmarks to the RP/IMU to get an average for the waterline to RP. The Waterline Measurement value is in NGS coordinates initially and is converted to CARIS coordinates.

Port Ant to Stbd Ant
Scalar Distance
1.448

The location of the phase center of the port and starboard POS/MV antennas were surveyed by NGS. The z-values were adjusted to the phase center. Then the scalar distance between the phase centers was

IMU to Port Antenna		
x	y	z
-0.637	-0.832	-3.121

The location of the IMU and the location of the top of port antenna were surveyed by NGS. The z-value of the antenna was calculated by subtracting the height of the antenna and then adding the value from the base of the antenna to the phase center of the antenna. The calculation results were then transposed from the NGS to the CARIS coordinate system.

IMU to Heave		
x	y	z
0.000	0.000	0.000

The Heave Point is assumed to coincide with the IMU location.

US DEPARTMENT OF COMMERCE
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
NATIONAL GEODETIC SURVEY
GEODETIC SERVICES DIVISION
INSTRUMENTATION & METHODOLOGIES BRANCH

NOAA SURVEY VESSEL 2806
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY
FIELD REPORT

Kendall L. Fancher
January, 2010

NOAA SURVEY VESSEL 2806
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

PURPOSE

The primary purpose of the survey was to precisely determine the spatial relationship between various hydrographic surveying sensors, launch bench marks and the components of a POS MV navigation system aboard the NOAA survey vessel 2806.

PROJECT DETAILS

This survey was conducted in Seattle, WA at the NOAA Western Center on the 26th of January, 2010. The weather was sunny then cloudy with temperatures in the 40s to 50s. For this survey, the vessel was on blocks, supported by boat jacks. The vessel was reported to have been leveled relative to the IMU.

INSTRUMENTATION

A Leica TDA5005 precision total station was used to make all measurements.
Technical Data:

Standard Deviation	
Horizontal angle	0.5 seconds
Vertical angle	0.5 seconds
Distance measurement	1mm + 1ppm

Leica precision prisms were used as sighting targets. Prisms were configured to have a zero mm offset.

PERSONNEL

Kendall Fancher — NOAA/NOS/NGS/GSD/I&M BRANCH
(540) 373-1243
kendall.fancher@noaa.gov

Dennis Lokken — NOAA/NOS/NGS/GSD/I&M BRANCH
(540) 373-1243
dennis.lokken@noaa.gov

NOAA SURVEY VESSEL 2806
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

DEFINITION OF THE REFERENCE FRAME

For this survey, data was collected in a 3-D right handed Cartesian coordinate system. The origin of this coordinate system is defined as the center of the IMU target. The Y (Northing) axis is parallel to the centerline of the launch and is positive towards the bow of the launch. The X (Easting) axis is perpendicular to the Y axis and is positive towards the starboard side of the launch. The Z (Elevation) axis is perpendicular to the XY plane and is positive towards the top of the launch. The coordinates of the points established this survey are reported in this coordinate system and are provided in Appendix A.

SURVEY METHODOLOGY

Four temporary control points, (1, 2, 3, and 4), were established around the vessel such that every point to be positioned on the launch could be observed from at least two separate locations.

Coordinates of 100.000N, 100.000E, and 100.000U were assumed for temporary control point 1. A distance and height difference were measured between control points 1 and 2. Temporary control point 2 was assumed to have an Easting of 100.000. The measured distance between these two points was used to determine the Northing for temporary control point 2. The height difference between the two points was used to determine the Up component for control point 2.

Control point 1 was occupied and control point 2 was observed to initialize the instrument. After initialization, control point 4 and all visible points to be observed on the launch were observed in both direct and reverse. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 2.

Control point 2 was occupied and control point 1 was observed to initialize the instrument. After initialization, control point 3 and all visible points to be observed on the launch were observed in both direct and reverse. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 1.

Control point 3 was occupied and control point 2 was observed to initialize the instrument. After initialization, control point 4 and all visible points to be observed on the launch were observed in both direct and reverse. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 2.

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Control point 4 was occupied and control point 3 was observed to initialize the instrument. After initialization, all visible points to be observed on the launch were observed in both direct and reverse. Control point 1 was also observed in order to evaluate the accuracy of the traverse. Inverse computations between the original and observed control point yielded a horizontal accuracy, or traverse closure of of 0.000m and a vertical accuracy of 0.000m. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 2.

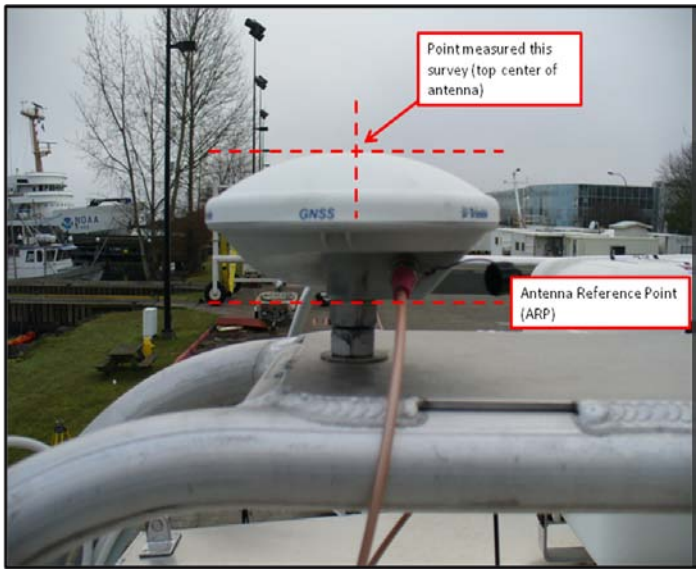
Inverses were computed between the two positions determined for all points surveyed to evaluate their accuracy relative to the temporary control network. Inverse reports are included in appendix B.

The reference frame was rotated using CENTERLINE STERN BM (CLS) as the point of rotation. A zero degree azimuth was used during the rotation from CLS to CENTERLINE BOW BM (BMB). The reference frame was then translated to relocate the origin of the reference frame to the IMU. The resulting coordinates are reported in appendix A.

DISCUSSION

The positions given for the POS GPS antennas (Zephyr p/n 39105-00) are to the top center of the antenna. To correct the Z value provided in this report for each antenna to the electronic phase center, I recommend the following steps be taken;

1) Determine the physical height of the GPS antenna. This information is probably located on the antenna or with equipment documentation.
2) Investigate to find the electronic phase center offset of the antenna. This information is probably located on the antenna or with equipment documentation. This value may also be available at the NGS website for antenna modeling.
3) Subtract the total height of the antenna from the Z value for each antenna. This will give you a Z value for the antenna ARP (antenna reference point)
4) Then add to this value the electronic phase center offset value appropriate for the antenna model.



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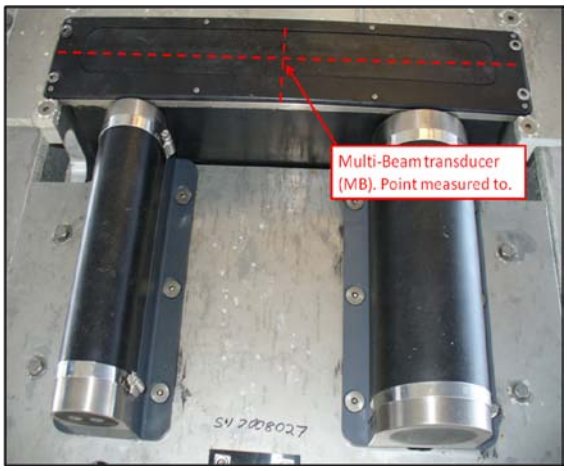
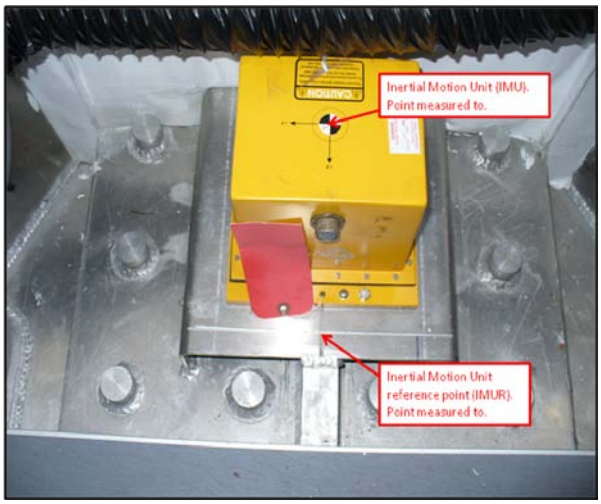
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

Two reference points (MBF and MBA) were positioned in order to facilitate future measurements to the Multi-Beam sensor by launch personnel. These reference points are punch marks set along the center of the keel, at the locations described in the image at right.

A point on the Multi-Beam transducer (MB) was measured directly this survey. The measured point was at the center of the bottom of the transducer. No mark was left to indicate the measured point.



The point positioned for the Inertial Motion Unit (IMU) this survey was the center of the target affixed to the top of the unit. Additionally, a reference mark (IMUR) was established on the plate the IMU is attached to at a point where two scribed lines intersect, forward of the IMU.



NOAA SURVEY VESSEL 2806
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

STATION LISTING

BMB- CENTERLINE BOW BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the deck, along the centerline and near the bow of the launch.

CLS- CENTERLINE STERN BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the deck, along the centerline and near the stern of the launch.

BMC- CENTERLINE CAB BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the top of the cab, along the centerline of the launch.

BMP- PORT SIDE BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the top of the deck, near the middle of and along the port side of the launch.

BMS- STARBOARD SIDE BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the top of the deck, near the middle of and along the starboard side of the launch.

MBF- KEEL BM
A punch mark set along the bottom center of the keel, fore of the multi-beam transducer, 0.030 m from a point where the keel makes a 90 degree angle upwards.

MBA- KEEL BM
A punch mark set along the bottom center of the keel, aft of the multi-beam transducer, 0.030 m from a point where the keel makes a 90 degree angle upwards.

IMU- IMU TARGET
Center of a target affixed to the top of the IMU housing.

IMUR- IMU REFERENCE BM
The intersection of two scribed lines atop a metal support plate for the IMU and forward of the IMU.

GPSP- PORT SIDE GPS ANTENNA REFERENCE POINT
The top center of the port side GPS antenna for the POS system.

GPSS- STARBOARD GPS ANTENNA REFERENCE POINT
The top center of the starboard side GPS antenna for the POS system.

MB- MULTI-BEAM REFERENCE POINT
The physical bottom center of the Multi-Beam transducer.

Appendix A

Coordinate Report Launch 2806

Pt Name	*North(Y)*	*East(X)*	*UP(Z)*	*ID*
IMU Target	0.00000	0.00000	0.00000	IMU
IMU Reference BM	0.13142	-0.01122	-0.16986	IMUR
Centerline Stern BM	-4.08215	0.02583	0.62671	CLS
Centerline Bow BM	3.44035	0.02583	1.42590	BMB
Portside GPS Ant. Ref. Point	-0.83249	-0.63695	3.14938	GPSP
Starboard GPS Ant. Ref. Point	-0.82526	0.81062	3.10821	GPSS
Multi-Beam Ref.Point	0.25447	-0.01284	-0.48083	MB
Keel BM	0.44302	-0.02150	-0.61052	MBF
Keel BM	-0.22767	-0.01641	-0.53926	MBA
Port Side BM	0.08725	-1.41542	1.09615	BMP
Starboard Side BM	0.09859	1.46945	1.01777	BMS
Centerline Cab BM	-0.21255	0.06840	2.64944	BMC

Units = meters

Appendix B

Point to Point Inverse Launch 2806

Pt. 1	*Pt. 2*	*Dist.*	*Northing*	*Easting*	*Elevation*	*ID*
24	42	0.001	0.000	-0.001	0.00012	SBF
6	22	0.000	0.000	0.000	0.00025	SBA
7	23	0.001	0.001	-0.001	0.00048	SB
33	35	0.004	0.003	0.001	0.00015	IMUR
36	32	0.004	-0.002	-0.004	0.00010	IMU
37	25	0.002	0.001	0.001	0.00013	CLS
12	26	0.002	-0.001	-0.002	0.00054	BMS
38	50	0.002	-0.002	0.000	0.00010	BMP
52	20	0.006	0.006	-0.003	0.00045	BMB
51	15	0.002	0.001	0.002	0.00011	BMC
13	27	0.003	0.003	-0.001	0.00080	GPSS
28	14	0.000	0.000	0.000	0.00023	GPSP

Units = meters

FAIRWEATHER

Multibeam Echosounder Calibration

Launch 2806 200kHz
Vessel

9/7/2013	250	Newport Turning Basin
Date	Dn	Local Area

Marcus and Berube
Calibrating Hydrographer(s)

MBES System	MBES System Location	Date of most recent EED/Factory Check

Sonar Serial Number	Processing Unit Serial Number

Sonar Mounting Configuration	Date of current offset measurement/verification

Applanix POS/MV S/N:2560 IMU S/N:991	
Description of Positioning System	Date of most recent positioning system calibration

Acquisition Log

9/7/2013	250		
Date	Dn	Local Area	Wx

Bottom Type	Approximate Water Depth

Marcus and Berube
Personnel on board

Comments

.554
POSMV Filename(s)

	1832	44/37/33	124/02/28	9	
SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
	1909	44/37/32	124/02/25	8.3	
SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
SV Cast #3 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

NAV TIME LATENCY view parallel to track, one line with induced roll (outerbeam) or same lines bounded slope (nadir) [same direction, different speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	002_1838	095	4.1	
2	002_1841	297	4.1	
3	002_1844	103	7.6	
4	002_1846	293	8.2	
5	004_1904	305	6.1	
6				
7				
8				

PITCH view parallel to track, same line (at nadir) [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	002_1838	095	4.1	
2	002_1841	297	4.1	
3	002_1844	103	7.6	
4	002_1846	293	8.2	
5				
6				
7				
8				

HEADING/YAW view parallel to track, offset lines (outerbeams) [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	003_1848	098	6.4	
2	003_1850	297	6.2	
3	001_1852	106	6.1	
4	001_1855	293	6.1	
5				
6				
7				
8				

ROLL view across track, same line [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	004_1858	120	6.1	
2	004_1900	299	5.9	waked by another boat
3	004_1902	118	6.3	
4				
5				
6				
7				
8				

Processing Log

9/7/2013	250	Marcus, Berube
Date	Dn	Personnel

☑ **Data converted --> HDCS_Data in CARIS**

☑ **TrueHeave applied** crm

☑ **SVP applied** 2013_2806_250

☑ **Tide applied** 9435380.tid

Zone file

Lines merged ☑

Data cleaned to remove gross fliers ☑

Compute correctors in this order

1. Precise Timing **2. Pitch bias** **3. Heading bias** **4. Roll bias**

Do not enter/apply correctors until all evaluations are complete and analyzed.

PATCH TEST RESULTS/CORRECTORS

Evaluators	Latency Lines Used	Latency (sec)	Pitch Lines Used	Pitch (deg)	Roll Lines Used	Roll (deg)	Yaw Lines Used	Yaw (deg)
Wartick	1841&1846	0.00	1838&1841	-2.90	1900&1902	0.10	1850&1852	
Froelich	1841&1846	0.00	1838&1841	-2.43	1858&1900	0.11	1850&1852	1.30
Faulkes	1838&1844	0.00	1844&1846	-2.10	1900&1902	0.10	1850&1855	1.53
Beduhn	1841&1846	0.00	1844&1846	-2.40	1900&1902	0.06	1850&1852	1.33

Averages	0.00	-2.46	0.09	1.39
Standard Deviation	0.00	0.33	0.02	0.13
FINAL VALUES	0.00	-2.46	0.09	1.39

Final Values based on

Resulting HVF File Name

MRU Align StdDev gyro 0.13 Value from standard deviation of Heading offset values

MRU Align StdDev Roll/Pitch 0.18 Value from averaged standard deviations of pitch and roll offset values

NARRATIVE

☑ **HVF Hydrographic Vessel File created or updated with current offsets**

Name: Ryan Wartick and ami Beduhn **Date:** 9/9/2013

FAIRWEATHER

Multibeam Echosounder Calibration

Launch 2806 400kHz
Vessel

9/9/2013	252	Newport,Or
Date	Dn	Local Area

Froelich, Hemlricks
Calibrating Hydrographer(s)

400 kHz		
MBES System	MBES System Location	Date of most recent EED/Factory Check

Sonar Serial Number	Processing Unit Serial Number

Sonar Mounting Configuration	Date of current offset measurement/verification

Applanix POS/MV S/N:XXXX IMU S/N:XXX	
Description of Positioning System	Date of most recent positioning system calibration

Acquisition Log

9/9/2013	252	Newport, OR	Calm
Date	Dn	Local Area	Wx

Bottom Type	Approximate Water Depth

Froelich, Helmricks, Brooks
Personnel on board

Comments

2013_252_2806
POSMV Filename(s)

2013_252_18328	18:53	44/37/36.7	124/02/99	9.01	
SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
SV Cast #3 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

NAV TIME LATENCY view parallel to track, one line with induced roll (outerbeam) or same lines bounded slope (nadir) [same direction, different speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	2521922	289	3.9	
2	2521916	289	6.0	
3				
4				
5				
6				
7				
8				

PITCH view parallel to track, same line (at nadir) [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	2521916	289	6.0	good line
2	2521918	109	6.4	
3				
4				
5				
6				
7				
8				

HEADING/YAW view parallel to track, offset lines (outerbeams) [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	2521903	109	6.0	little far out in the outer beams
2	2521905	289	5.7	off track due to traffic
3	2521909	289	6.0	good line
4	2521912	289	5.9	good line
5	2521914	109	5.9	good line
6				
7				
8				

ROLL view across track, same line [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	2521916	289	6.0	good line
2	2521918	109	6.4	
3				
4				
5				
6				
7				
8				

Processing Log

9/8/2013	252	wartick
Date	Dn	Personnel

☑ **Data converted --> HDCS_Data in CARIS**

☑ **TrueHeave applied**

☑ **SVP applied**

☑ **Tide applied** zerotides

Zone file

Lines merged ☑

Data cleaned to remove gross fliers ☑

Compute correctors in this order

1. Precise Timing **2. Pitch bias** **3. Heading bias** **4. Roll bias**

Do not enter/apply correctors until all evaluations are complete and analyzed.

PATCH TEST RESULTS/CORRECTORS

Evaluators	Latency Lines Used	Latency (sec)	Pitch Lines Used	Pitch (deg)	Roll Lines Used	Roll (deg)	Yaw Lines Used	Yaw (deg)
Wartick	1922&1916	0.00	1916&1918	-1.50	1916&1918	-0.16	1912&1914	0.70
Faulkes	1916&1922	0.00	1916&1918	-1.40	1916&1918	-0.14	1909&1912	0.63
Froelich	1916&1922	0.00	1916&1918	-1.20	1916&1918	-0.13	1909&1912	0.70
Beduhn	1916&1922	0.00	1916&1918	-1.57	1916&1918	-0.13	1909&1912	0.65

Averages	0.00	-1.42	-0.14	0.67
Standard Deviation	0.00	0.16	0.01	0.03
FINAL VALUES	0.00	-1.42	-0.14	0.67

Final Values based on

Resulting HVF File Name

MRU Align StdDev gyro 0.03 Value from standard deviation of Heading offset values

MRU Align StdDev Roll/Pitch 0.09 Value from averaged standard deviations of pitch and roll offset values

NARRATIVE

☑ **HVF Hydrographic Vessel File created or updated with current offsets**

Name: Tami Beduhn and Ryan Wartick **Date:** 9/10/2013

NOAA POS/MV Calibration Report

Fill out all fields! See previous years as an example.

Yellow areas require screen grabs!

Ship: Fairweather **Vessel:** 2806

Date: 9/8/2013 **Dn:** 250

Personnel: Welton, Marcus

PCS Serial # 2560 **IMU Serial #**

IP Address: 129.100.1.231

POS controller Version (Use Menu Help > About)

POS Version (Use Menu View > Statistics)

GPS Receivers

Primary Receiver Serial #: 5211K23462

Secondary Receiver Serial #: 5213K23675

POSMV filename(s)

Calibration area

Location:

Approximate Position: **Lat** **Lon**

DGPS Beacon Station: 287 **DGPS Receiver Serial#:**

Frequency: 287

Satellite Constellation

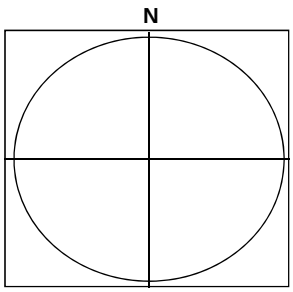
(Use View> GPS Data)

Primary GPS

Insert screen grabs

HDOP 0.706

VDOP 1.031



Sattelites in use: 17

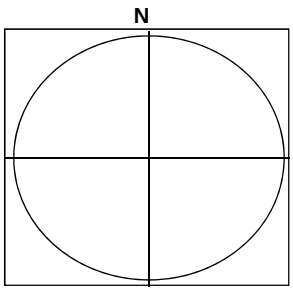
L1 SNR > 30 35 40

Secondary GPS

Note any differences from Primary GPS Receiver

HDOP 0.979

VDOP 1.198



Sattelites in use: 10

L1 SNR > 30 35 40

PDOP 2.228 (Use View> GAMS Solution)

ERDDM Acquisition Log

Launch 2806 400kHz	NO RESON MB LINES COL
Vessel	

9/18/2013	261	LA/LB/San Pedro Bay	PC/ High 78°F
Date	Dn	Local Area	Wx

SS Brooks, LT Wartick, ENS Witmer
Personnel

TRIM TABS ALL THE WAY UP; NO MB LINES COLLECTED
Comments

5.72 ft High @ 0910 (PDT); 0.47 ft Low @ 1511 (PDT)	**Point Loma, CA - 302 kHz (100**
Tidal Cycle Notes	USCG DGPS Beacon Used

2013_261_2806b.791 - .798
POSMV filename(s)

POS File	Azimuth (°T)	Vessel Speed	RPM	Start and End Time (UTC)
2013_261_2806b.791 - .791	N/A	DIW	N/A	1650 - 1656
.791 - .792	250	clutch/ 4 kts	600 in Trawl	1656 - 1700
.792 - .793	250	6 kts	770	1701 - 1705
.793 - .793	250	8 kts	1160	1705 - 1709 (waked @ 1708)
.793 - .794	250	10 kts	1520	1709 - 1713
.794 - .794	N/A	DIW	N/A	1713 - 1719
.794 - .795	070	clutch/ 4 kts	600 in Trawl	1719 - 1723 (waked @ 1723)
.795 - .795	070	6 kts	770	1723 - 1727 (waked @ 1723)
.795 - .796	070	8 kts	1160	1727 - 1731
.796 - .797	070	10 kts	1520	1731 - 1735
.797 - .797	N/A	DIW	N/A	1735 - 1741

Processing Log

10/19/2013	262	Josh Witmer
Date	Dn	Personnel

☑ **POS Files Processed in POS Pac** — Singlebase

Smartbase or Singlebase? Station used.

☑ **SBET Processed in Pydro Using the ERDDM Tool**

☑ **Graph and Table Values compared with previous year**

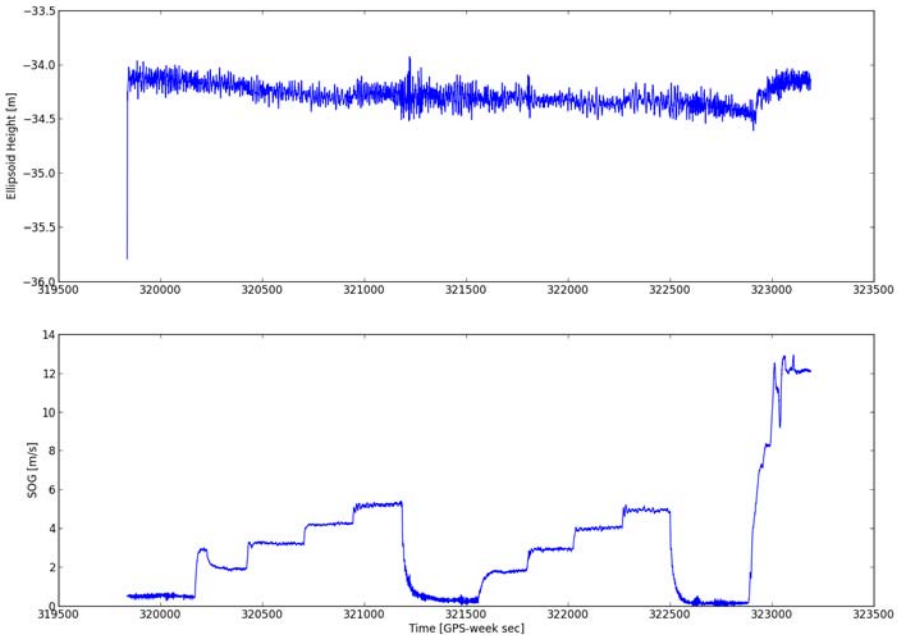
☑ **Documentaion Complete in DAPR Appendix**

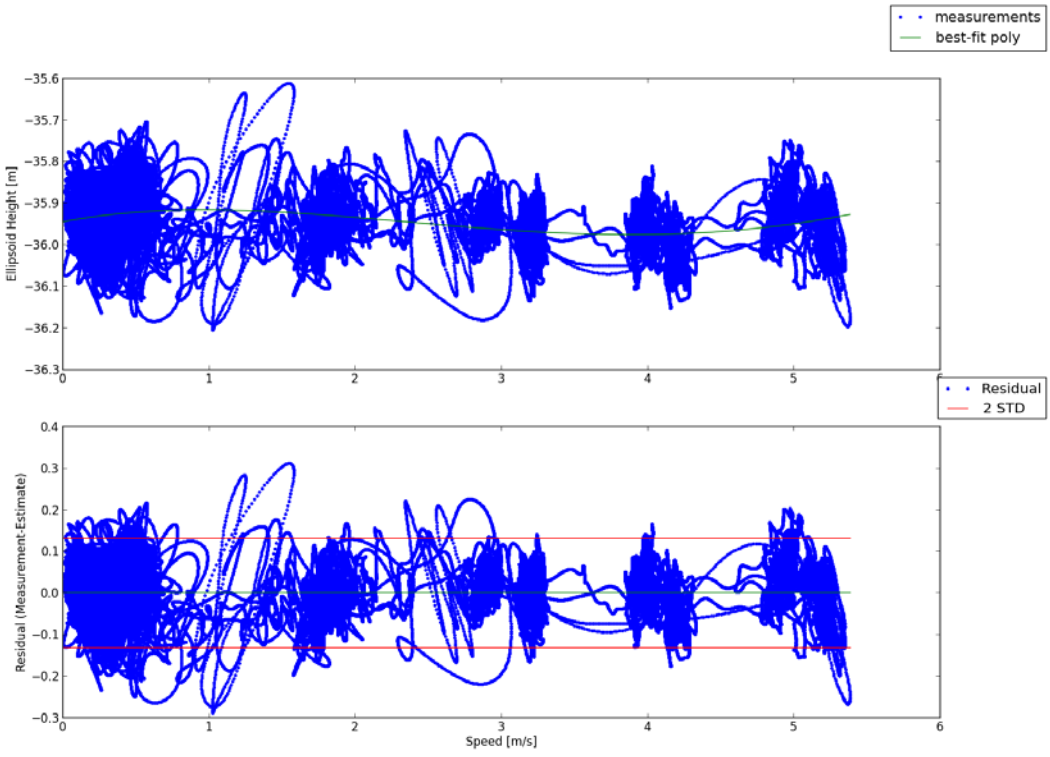
☑ **See OPS/CST for updating HVF with new values**

FA – 2806

2013- DN261

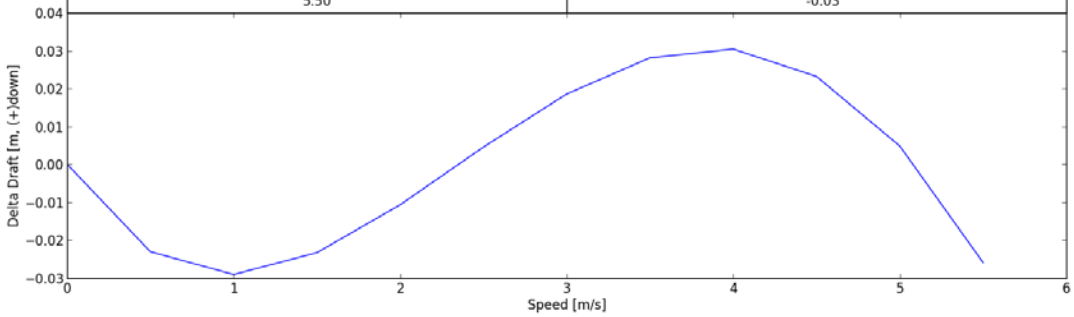
4th Order Ellipsoidally Referenced ERDDM





$+0.000348*X^4 -0.00819*X^3 +0.0459*X^2 -0.0671*X$

Speed [m/s]	Delta Draft [m]
0.00	-0.00
0.50	-0.02
1.00	-0.03
1.50	-0.02
2.00	-0.01
2.50	0.00
3.00	0.02
3.50	0.03
4.00	0.03
4.50	0.02
5.00	0.00
5.50	-0.03



Waterline Measurements

Fill in Yellow squares only!

Measuring Party: ST Francksen, AST Mallory, ENS Smith

2806

Waterline measurements should be negative and cm!

	2806	
	Port Benchmark to Waterline	Stbd Benchmark to Waterline
Measure 1	-97.2	-98.5
Measure 2	-96.2	-98.0
Measure 3	-95.8	-97.1
Avg (cm)	-96.40	-97.87
Avg (m)	-0.9640	-0.9787
Stdev	0.00721	0.00709
BM Z-value (m)*	1.09615	1.01777
BM to WL (m)	0.132	0.039
Individual measurement	0.12415	0.03277
	0.13415	0.03777
StDev for TPU xls (of 6 #'s)	0.051364	0.13815	0.04677

Date: 4/5/2011
Fuel Level: 41.3 gallons
Draft Tube:

Port-to-Stbd Z-difference

Theoretical	Actual	Error
0.0784	-0.0147	-0.0930

RP to WL Average (m)

0.086 NGS Coordinate System (do not enter in CARIS directly)

(Add this value to VSSL_Offsets & Measurements_20XX.xls)

utilized in Offsets and Measurements and TPU spreadsheet

Measuring Party: ENS Pfundt, AST Mallory, ENS Smith

Waterline measurements should be negative and cm!

	2806	
	Port Benchmark to Waterline	Stbd Benchmark to Waterline
Measure 1	-93.1	-98.4
Measure 2	-95.0	-97.6
Measure 3	-93.7	-95.8
Avg (cm)	-93.93	-97.27
Avg (m)	-0.9393	-0.9727
Stdev	0.00971	0.01332
BM Z-value (m)	1.09615	1.01777
BM to WL (m)	0.156816667	0.045
Individual measurement	0.16515	0.03377
	0.14615	0.04177
StDev for TPU xls (of 6 #'s)	0.06207	0.15915	0.05977

Date: 4/26/2011
Fuel Level: 110 gallons
Draft Tube:

Port-to-Stbd Z-difference

Theoretical	Actual	Error
0.0784	-0.0333	-0.1117

RP to WL Average (m)

0.101 NGS Coordinate System (do not enter in CARIS directly)

2807 Offsets and Measurements - Summary

Measurement aka Coord. Sys.	IMU to RP* Caris	IMU to 7125 (Receiver) SWATH1 x,y,z & MRU to Trans Caris	Port Ant to 7125 Nav to Trans x,y,z Caris	RP* to Waterline Caris	Port Ant to Stbd Ant	IMU to Port Ant Caris	IMU to Port Ant Pos/Mv	IMU to Heave Caris	IMU to Heave Pos/Mv
x	0.000	0.019	0.804	n/a	Scaler Distance 1.440	-0.786	-0.812	0.000	0.000
y	0.000	0.244	1.056	n/a		-0.812	-0.786	0.000	0.000
z	0.000	0.481	3.628	-0.090		-3.147	-3.147	0.000	0.000

*IMU is Reference Point

Vessel Offsets for 2808 7125 are derived from the NGS Survey, January 2010, Trimble Equipment Specs, and 2011 and 2010 Measured Values.

Calculations

Coord. Sys./ Source: **NGS**

IMU to 7125			Port Ant to 7125			RP to Waterline		Port Ant to Stbd Ant			IMU to Port Ant			IMU to Heave		
IMU (m)	x	0.00000	IMU to	x	-0.78576	RP to Waterline (m)		IMU to	x	-0.78576	IMU (m)	x	0.00000	IMU (m)	x	0.00000
	y	0.00000	Port Ant (m)	y	-0.81181	(waterline	z 0.090	Port Ant (m)	y	-0.81181		y	0.00000		y	0.00000
	z	0.00000	(calculated)	z	3.14689	worksheet)		(calculated)	z	3.14689		z	0.00000		z	0.00000
MBES RP	x	0.01867	IMU to	x	0.01867			IMU (m)	x, y, z	0.00000	Top of	x	-0.78576	Heave Pt (m)	x	0.00000
Rcvr - Phase (m)	y	0.24441	Phase Ctr	y	0.24441						Port Ant (m)	y	-0.81181	(by design)	y	0.00000
Center	z	-0.48063	(calculated)	z	-0.48063			Top of	x	0.65423		z	3.13559		z	0.00000
								Stbd Ant (m)	y	-0.81691						
									z	3.16283	Base to top of Port Ant					
								Base to top of Stbd Ant			(measured) (m)	z	0.073			
								(measured) (m)	z	0.073	Bottom of Port Ant					
											(calculated) (m)	z	3.06259			
								Bottom of Stbd Ant								
								(calculated) (m)	z	3.08983	Base to Phase Cntr of Port Ant					
											(eqp spc) (m)	z	0.0843			
								Base to Phase Cntr of Stbd Ant								
								(eqp spc) (m)	z	0.0843						

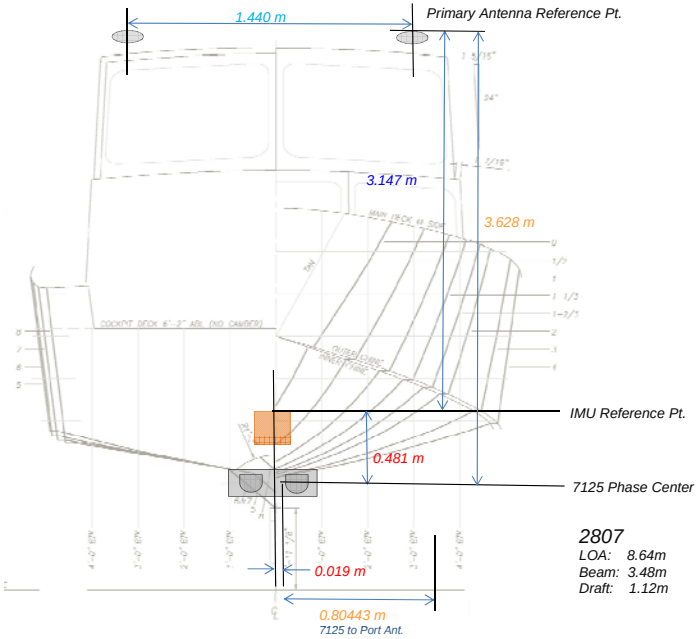
Coord. Sys.: **NGS**

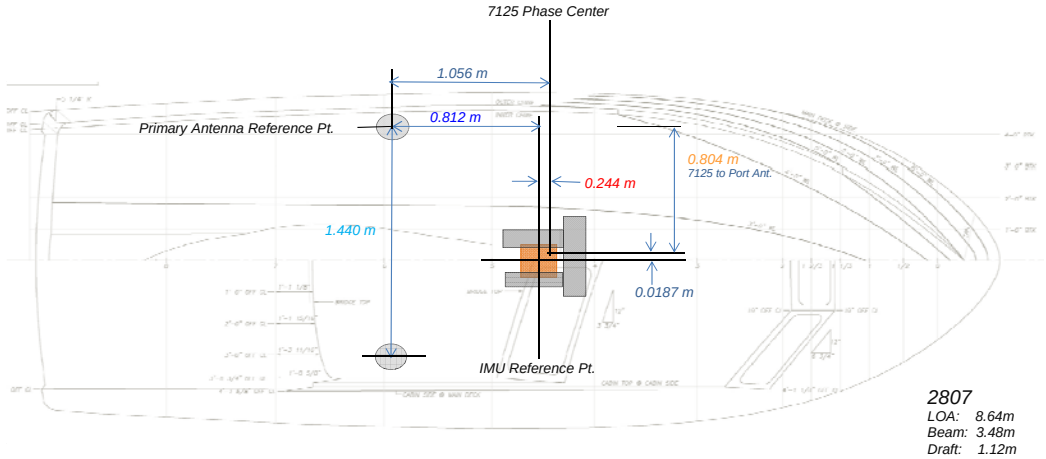
IMU to 7125			Port Ant to 7125			RP to Waterline			Port Ant to Stbd Ant		IMU to Port Ant			IMU to Heave		
IMU to	x	0.01867		x	0.80443		x	n/a				x	-0.78576		x	0.00000
Phase Ctr	y	0.24441		y	1.05622		y	n/a	Scalar Distance	1.4403		y	-0.81181		y	0.00000
	z	-0.48063		z	-3.62752		z	0.090				z	3.14689		z	0.00000
Coord. Sys.	x	0.01867	Coord. Sys.	x	0.80443	Coord. Sys.	x	n/a			Coord. Sys.	x	-0.81181	Coord. Sys.	x	0.00000
CARIS	y	0.24441	**CARIS**	y	1.05622	**CARIS**	y	n/a			**Pos/Mv**	y	-0.78576	**Pos/Mv**	y	0.00000
	z	0.48063		z	3.62752		z	-0.090				z	-3.14689		z	0.00000

Description of Offsets for Launch 2807

All Values Shown are in CARIS Coordinates

The Ship Reference Frame (SRF) for Launch 2807 was based from IMU Reference Point as the 0,0,0 point. Physical locations were measured with x,y,z offsets from this point. These locations were used to calculate offsets of items with respect to each other, as described for each offset.





IMU to 7125		
x	y	z
0.019	0.244	0.481

The physical positions of the IMU and the receiver phase center of the 7125 were measured during the NGS survey. These physical measurements were taken while the launch was secured on the pier and thought to be as level as possible. The measured values for the IMU and MB were taken directly for the report. The difference is the offset from the IMU to the phase center of the 7125 which was then transposed from the NGS to the CARIS coordinate system.

Port Ant to 7125		
x	y	z
0.804	1.056	3.628

The values were calculated by subtracting the physical height of the Port Antenna to the IMU x, y, z values from the respective values of the IMU to the 7125. The calculated values were then transposed from the NGS to the CARIS coordinate system.

RP to Waterline		
x	y	z
N/A	N/A	-0.090

The average vertical distance from Port Benchmark to waterline and the Starboard Benchmark to the waterline were measured by FAIRWEATHER personnel using a steel tape and bubble level. These values were combined with the Z value of the Benchmarks to the RP/IMU to get an average for the waterline to RP. The Waterline Measurement value is in NGS coordinates initially and is converted to CARIS coordinates.

Port Ant to Stbd Ant
Scalar Distance
1.440

The location of the phase center of the port and starboard POS/MV antennas were surveyed by NGS. The z-values were adjusted to the phase center. Then the scalar distance between the phase centers was calculated.

IMU to Port Antenna		
x	y	z
-0.786	-0.812	-3.147

The location of the IMU and the location of the top of port antenna were surveyed by NGS. The z-value of the antenna was calculated by subtracting the height of the antenna and then adding the value from the base of the antenna to the phase center of the antenna. The calculation results were then transposed from the NGS to the CARIS coordinate system.

IMU to Heave		
x	y	z
0.000	0.000	0.000

The Heave Point is assumed to coincide with the IMU location.

US DEPARTMENT OF COMMERCE
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
NATIONAL GEODETIC SURVEY
GEODETIC SERVICES DIVISION
INSTRUMENTATION & METHODOLOGIES BRANCH

NOAA SURVEY VESSEL 2807
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY
FIELD REPORT

Kendall L. Fancher
January, 2010

NOAA SURVEY VESSEL 2807
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

PURPOSE

The primary purpose of the survey was to precisely determine the spatial relationship between various hydrographic surveying sensors, launch bench marks and the components of a POS MV navigation system aboard the NOAA survey vessel 2807.

PROJECT DETAILS

This survey was conducted in Seattle, WA at the NOAA Western Center on the 27th of January, 2010. The weather was foggy early then sunny with temperatures in the 40s to 50s. For this survey, the vessel was on blocks, supported by boat jacks. The vessel was reported to have been leveled relative to the IMU.

INSTRUMENTATION

A Leica TDA5005 precision total station was used to make all measurements.
Technical Data:

Standard Deviation	
Horizontal angle	0.5 seconds
Vertical angle	0.5 seconds
Distance measurement	1mm + 1ppm

Leica precision prisms were used as sighting targets. Prisms were configured to have a zero mm offset.

PERSONNEL

Kendall Fancher — NOAA/NOS/NGS/GSD/I&M BRANCH
(540) 373-1243
kendall.fancher@noaa.gov

Dennis Lokken — NOAA/NOS/NGS/GSD/I&M BRANCH
(540) 373-1243
dennis.lokken@noaa.gov

NOAA SURVEY VESSEL 2807
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

DEFINITION OF THE REFERENCE FRAME

For this survey, data was collected in a 3-D right handed Cartesian coordinate system. The origin of this coordinate system is defined as the center of the IMU target. The Y (Northing) axis is parallel to the centerline of the launch and is positive towards the bow of the launch. The X (Easting) axis is perpendicular to the Y axis and is positive towards the starboard side of the launch. The Z (Elevation) axis is perpendicular to the XY plane and is positive towards the top of the launch. The coordinates of the points established this survey are reported in this coordinate system and are provided in Appendix A.

SURVEY METHODOLOGY

Four temporary control points, (1, 2, 3, and 4), were established around the vessel such that every point to be positioned on the launch could be observed from at least two separate locations.

Coordinates of 100.000N, 100.000E, and 100.000U were assumed for temporary control point 1. A distance and height difference were measured between control points 1 and 2. Temporary control point 2 was assumed to have an Easting of 100.000. The measured distance between these two points was used to determine the Northing for temporary control point 2. The height difference between the two points was used to determine the Up component for control point 2.

Control point 1 was occupied and control point 2 was observed to initialize the instrument. After initialization, control point 4 and all visible points to be observed on the launch were observed in both direct and reverse. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 2.

Control point 2 was occupied and control point 1 was observed to initialize the instrument. After initialization, control point 3 and all visible points to be observed on the launch were observed in both direct and reverse. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 1.

Control point 3 was occupied and control point 2 was observed to initialize the instrument. After initialization, control point 4 and all visible points to be observed on the launch were observed in both direct and reverse. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 2.

NOAA SURVEY VESSEL 2807
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

Control point 4 was occupied and control point 3 was observed to initialize the instrument. After initialization, all visible points to be observed on the launch were observed in both direct and reverse. Control point 1 was also observed in order to evaluate the accuracy of the traverse. Inverse computations between the original and observed control point yielded a horizontal accuracy, or traverse closure of of 0.001 m and a vertical accuracy of 0.000 m. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 2.

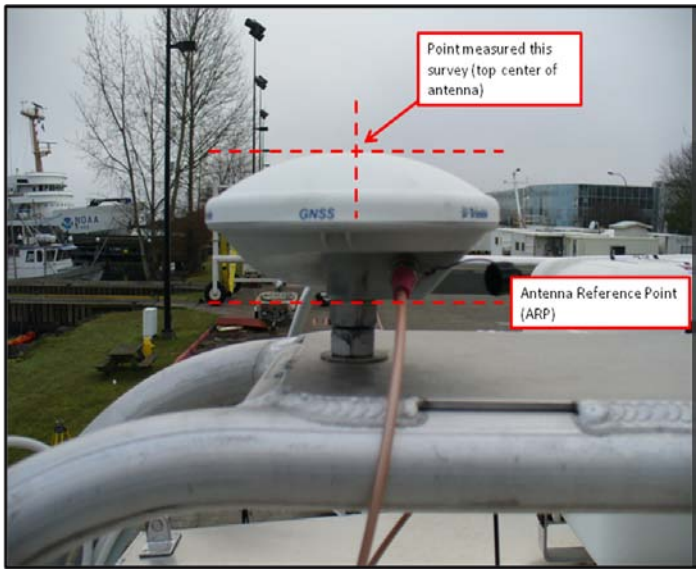
Inverses were computed between the two positions determined for all points surveyed to evaluate their accuracy relative to the temporary control network. Inverse reports are included in appendix B.

The reference frame was rotated using CENTERLINE STERN BM (CLS) as the point of rotation. A zero degree azimuth was used during the rotation from CLS to CENTERLINE BOW BM (BMB). The reference frame was then translated to relocate the origin of the reference frame to the IMU. The resulting coordinates are reported in appendix A.

DISCUSSION

The positions given for the POS GPS antennas (Zephyr Model II p/n 57970-00) are to the top center of the antenna. To correct the Z value provided in this report for each antenna to the electronic phase center, I recommend the following steps be taken;

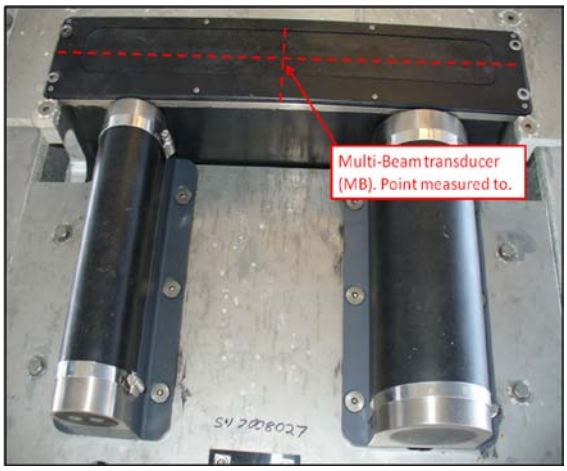
1) Determine the physical height of the GPS antenna. This information is probably located on the antenna or with equipment documentation.
2) Investigate to find the electronic phase center offset of the antenna. This information is probably located on the antenna or with equipment documentation. This value may also be available at the NGS website for antenna modeling.
3) Subtract the total height of the antenna from the Z value for each antenna. This will give you a Z value for the antenna ARP (antenna reference point)
4) Then add to this value the electronic phase center offset value appropriate for the antenna model.



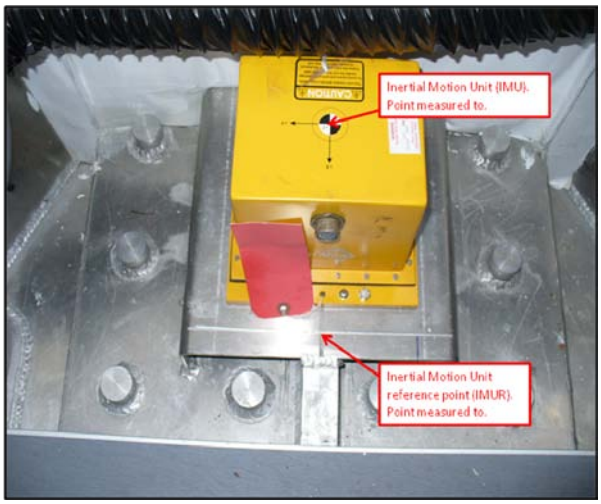
NOAA SURVEY VESSEL 2807
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

Two reference points (MBF and MBA) were positioned in order to facilitate future measurements to the Multi-Beam sensor by launch personnel. These reference points are punch marks set along the center of the keel, at the locations described in the image at right.

A point on the Multi-Beam transducer (MB) was measured directly this survey. The measured point was at the center of the bottom of the transducer. No mark was left to indicate the measured point.



The point positioned for the Inertial Motion Unit (IMU) this survey was the center of the target affixed to the top of the unit. Additionally, a reference mark (IMUR) was established on the plate the IMU is attached to at a point where two scribed lines intersect, forward of the IMU.



NOAA SURVEY VESSEL 2807
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

STATION LISTING

BMB- CENTERLINE BOW BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the deck, along the centerline and near the bow of the launch.

CLS- CENTERLINE STERN BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the deck, along the centerline and near the stern of the launch.

BMC- CENTERLINE CAB BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the top of the cab, along the centerline of the launch.

BMP- PORT SIDE BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the top of the deck, near the middle of and along the port side of the launch.

BMS- STARBOARD SIDE BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the top of the deck, near the middle of and along the starboard side of the launch.

MBF- KEEL BM
A punch mark set along the bottom center of the keel, fore of the multi-beam transducer, 0.030 m from a point where the keel makes a 90 degree angle upwards.

MBA- KEEL BM
A punch mark set along the bottom center of the keel, aft of the multi-beam transducer, 0.030 m from a point where the keel makes a 90 degree angle upwards.

IMU- IMU TARGET
Center of a target affixed to the top of the IMU housing.

IMUR- IMU REFERENCE BM
The intersection of two scribed lines atop a metal support plate for the IMU and forward of the IMU.

GPSP- PORT SIDE GPS ANTENNA REFERENCE POINT
The top center of the port side GPS antenna for the POS system.

GPSS- STARBOARD GPS ANTENNA REFERENCE POINT
The top center of the starboard side GPS antenna for the POS system.

MB- MULTI-BEAM REFERENCE POINT
The physical bottom center of the Multi-Beam transducer.

Appendix A

Coordinate Report Launch 2807

Pt Name	*North(Y)*	*East(X)*	*UP(Z)*	*ID*
IMU Target	0.00000	0.00000	0.00000	IMU
IMU Reference BM	0.13111	0.00714	-0.16724	IMUR
Centerline Stern BM	-4.06155	-0.02156	0.64902	CLS
Centerline Bow BM	3.44775	-0.02156	1.41160	BMB
Portside GPS Ant. Ref. Point	-0.81181	-0.78576	3.13559	GPSP
Starboard GPS Ant. Ref. Point	-0.81691	0.65423	3.16283	GPSS
Multi-Beam Ref.Point	0.24441	0.01867	-0.48063	MB
Keel BM	0.43114	0.01129	-0.61049	MBF
Keel BM	-0.23560	0.00988	-0.53203	MBA
Port Side BM	0.09979	-1.46918	1.03292	BMP
Starboard Side BM	0.08626	1.42671	1.08830	BMS
Centerline Cab BM	-0.21841	-0.05358	2.65245	BMC

Units = meters

Appendix B

Point to Point Inverse Launch 2807

Pt. 1	*Pt. 2*	*Dist.*	*Northing*	*Easting*	*Elevation*	*ID*
18	37	0.002	-0.002	0.000	0.00024	MBF
35	39	0.001	-0.001	-0.001	0.00027	MBA
19	36	0.004	0.001	0.004	0.00043	MB
29	27	0.006	0.001	0.006	0.00023	IMUR
26	30	0.006	0.005	0.004	0.00012	IMU
20	31	0.001	-0.001	-0.001	0.00038	CLS
32	45	0.000	0.000	0.000	0.00005	BMP
21	9	0.000	0.000	0.000	0.00057	BMS
49	16	0.007	0.007	0.000	0.00076	BMB
12	46	0.001	-0.001	0.000	0.00044	BMC
11	47	0.003	-0.002	0.001	0.00094	GPSP
10	48	0.002	-0.002	0.001	0.00068	GPSS

Units = meters

FAIRWEATHER

Multibeam Echosounder Calibration

Launch 2807 200kHz
Vessel

9/17/2013	260	LA
Date	Dn	Local Area

marcus,bradley
Calibrating Hydrographer(s)

7125- 400khz		
MBES System	MBES System Location	Date of most recent EED/Factory Check

	1812027
Sonar Serial Number	Processing Unit Serial Number

Sonar Mounting Configuration	Date of current offset measurement/verification
Applanix POS/MV S/N:3628 IMU S/N:037	
Description of Positioning System	Date of most recent positioning system calibration

Acquisition Log

9/17/2013	260	LA	Calm, minimal wind
Date	Dn	Local Area	Wx

	18m
Bottom Type	Approximate Water Depth

Marcus,Bradley, Glunz
Personnel on board

Comments

2013_260_2807.074-090
POSMV Filename(s)

2013_260_163209		33/43/25.34N	118/12/35.88W		
SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
2013_260_182752		33/43/20.96N	118/12/50.11W		
SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
SV Cast #3 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

NAV TIME LATENCY view parallel to track, one line with induced roll (outerbeam) or same lines bounded slope (nadir) [same direction, different speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	28072013M_2601739	065	4.0	
2	28072013M_2601742	066	4.0	don't use
3	28072013M_2601745	064	4.0	
4	28072013M_2601748	065	8.0	
5	28072013M_2601750	065	8.0	
6				
7				
8				

PITCH view parallel to track, same line (at nadir) [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	28072013M_2601753	246	4.0	
2	28072013M_2601755	065	4.0	
3	28072013M_2601757	250	4.0	best line
4	28072013M_2601759	064	4.0	2nd best line
5				
6				
7				
8				

HEADING/YAW view parallel to track, offset lines (outerbeams) [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	28072013M_2601808	245	5.0	20m
2	28072013M_2601809	060	5.0	20m
3	28072013M_2601811	246	5.0	15m
4	28072013M_2601813	064	5.0	15m
5				
6				
7				
8				

ROLL view across track, same line [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	28072013M_2601815	252	5.0	
2	28072013M_2601818	068	5.0	
3	28072013M_2601820	248	5.0	
4	28072013M_2601822	070	5.0	
5				
6				
7				
8				

Processing Log

9/17/2013	260	Helmricks, Beduhn
Date	Dn	Personnel

☑ **Data converted --> HDCS_Data in CARIS**

☑ **TrueHeave applied**

☑ **SVP applied** Nearest with in Distance with in Time 4 Hrs

☑ **Tide applied** Fill's used from LA Project

Zone file L318FA2013CORP_Rev.zdf

Lines merged ☑

Data cleaned to remove gross fliers ☑

Compute correctors in this order

1. Precise Timing **2. Pitch bias** **3. Heading bias** **4. Roll bias**

Do not enter/apply correctors until all evaluations are complete and analyzed.

PATCH TEST RESULTS/CORRECTORS

Evaluators	Latency Lines Used	Latency (sec)	Pitch Lines Used	Pitch (deg)	Roll Lines Used	Roll (deg)	Yaw Lines Used	Yaw (deg)
Wartick	1745&1748	0.00	1753&1755	-2.70	1815&1818	0.16	1808&1809	0.33
Froelich	1745 & 1748	0.00	1757 & 1759	-2.80	1815 & 1818	0.15	1808 & 1809	0.80
Smith	1745 & 1748	0.00	1757 & 1759	-2.78	1815 & 1818	0.15	1808 & 1809	0.70
Beduhn	1745 & 1748	0.00	1757 & 1759	-2.75	1815 & 1818	0.15	1808 & 1809	0.80

Averages	0.00	-2.76	0.15	0.66
Standard Deviation	0.00	0.04	0.01	0.22
FINAL VALUES	0.00	-2.76	0.15	0.66

Final Values based on

Resulting HVF File Name

MRU Align StdDev gyro 0.22 Value from standard deviation of Heading offset values

MRU Align StdDev Roll/Pitch 0.02 Value from averaged standard deviations of pitch and roll offset values

NARRATIVE

Used Average Values

☑ **HVF Hydrographic Vessel File created or updated with current offsets**

Name: Tami Beduhn **Date:** 9/25/2013

FAIRWEATHER

Multibeam Echosounder Calibration

Launch 2807 400kHz
Vessel

9/17/2013	260	LA
Date	Dn	Local Area

marcus,bradley
Calibrating Hydrographer(s)

7125- 400khz		
MBES System	MBES System Location	Date of most recent EED/Factory Check

	1812027
Sonar Serial Number	Processing Unit Serial Number

Sonar Mounting Configuration	Date of current offset measurement/verification

Applanix POS/MV S/N:3628 IMU S/N:XXX	
Description of Positioning System	Date of most recent positioning system calibration

Acquisition Log

9/17/2013	260	LA	Calm, minimal wind
Date	Dn	Local Area	Wx

	18m
Bottom Type	Approximate Water Depth

Marcus,Bradley, Glunz
Personnel on board

Comments

2013_260_2807.074
POSMV Filename(s)

2013_260_163209		33/43/25.34N	118/12/35.88W		
SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

2013_260_182752		33/43/20.96N	118/12/50.11W		
SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

SV Cast #3 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

NAV TIME LATENCY view parallel to track, one line with induced roll (outerbeam) or same lines bounded slope (nadir) [same direction, different speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1				
2				
3				
4				
5				
6				
7				
8				

PITCH view parallel to track, same line (at nadir) [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (m/s)	Remarks
1	1649	240	4.0	
2	1651	240	2.0	
3	1653	240	4.0	
4	1656	060	2.0	
5	1658	240	2.0	
6	1700	060	2.0	
7	1702	240	2.0	
8	1644	240	2.0	

HEADING/YAW view parallel to track, offset lines (outerbeams) [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	1722	240	2.0	
2	1720	060	2.0	
3				
4				
5				
6				
7				
8				

ROLL view across track, same line [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	1724	065	2.3	
2	1726	246	2.3	
3				
4				
5				
6				
7				
8				

Processing Log

9/17/2013	260	Helmricks, Beduhn
Date	Dn	Personnel

☑ **Data converted --> HDCS_Data in CARIS**

☑ **TrueHeave applied**

☑ **SVP applied** Nearest with in Distance with in Time 4 Hrs

☑ **Tide applied** Fill's used from LA Project

Zone file L318FA2013CORP_Rev.zdf

Lines merged ☑

Data cleaned to remove gross fliers ☑

Compute correctors in this order

1. Precise Timing **2. Pitch bias** **3. Heading bias** **4. Roll bias**

Do not enter/apply correctors until all evaluations are complete and analyzed.

PATCH TEST RESULTS/CORRECTORS

Evaluators	Latency Lines Used	Latency (sec)	Pitch Lines Used	Pitch (deg)	Roll Lines Used	Roll (deg)	Yaw Lines Used	Yaw (deg)
Wartick	1651&1653	0.00	1656&1658	-2.60	1724&1726	0.15	1722&1720	0.35
Froelich	1649 &1651	0.00	1656 &1658	-2.61	1724 & 1726	0.19	1720 & 1722	0.20
Smith	1649 &1651	0.00	1656 &1658	-2.60	1724 & 1726	0.17	1720 & 1722	0.25
Beduhn	1649 &1651	0.00	1656 &1658	-2.50	1724 & 1726	0.15	1720 & 1722	0.23

Averages	0.00	-2.58	0.17	0.26
Standard Deviation	0.00	0.05	0.02	0.07
FINAL VALUES	0.00	-2.58	0.17	0.26

Final Values based on

Resulting HVF File Name

MRU Align StdDev gyro 0.07 Value from standard deviation of Heading offset values

MRU Align StdDev Roll/Pitch 0.04 Value from averaged standard deviations of pitch and roll offset values

NARRATIVE

☑ **HVF Hydrographic Vessel File created or updated with current offsets**

Name: Tami Beduhn **Date:** 9/25/2013

NOAA POS/MV Calibration Report

Fill out all fields! See previous years as an example.

Yellow areas require screen grabs!

Ship: Fairweather **Vessel:** 2807

Date: 9/16/2013 **Dn:** 259

Personnel: Wartick, Madsen, Glunz

PCS Serial # 3628 **IMU Serial #**

IP Address: 129.100.1.231

POS controller Version (Use Menu Help > About) 5.1.0.2

POS Version (Use Menu View > Statistics)

GPS Receivers

Primary Receiver Serial #: 5044K18796

Secondary Receiver Serial #: 4904K34026

POSMV filename(s)

Calibration area

Location: LA

Approximate Position:

Lat	33	43	22.92n
Lon	118	2	40.70w

DGPS Beacon Station: Point Loma **DGPS Receiver Serial#:** CD P004420

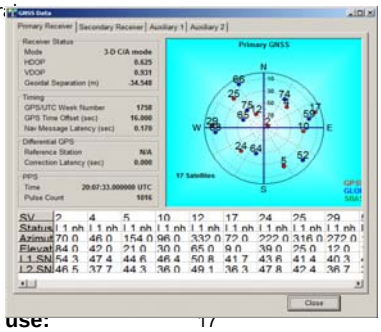
Frequency: 302

Satellite Constellation

(Use View> GPS Data)

Primary GPS

Insert screen gr



HDOP 0.625

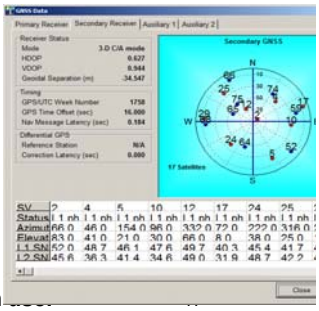
VDOP 0.937

Sattelites in use: 17

L1 SNR > 30 35 40

Secondary GPS

Note any differences from Primary GPS Receiver



HDOP 0.627

VDOP 0.95

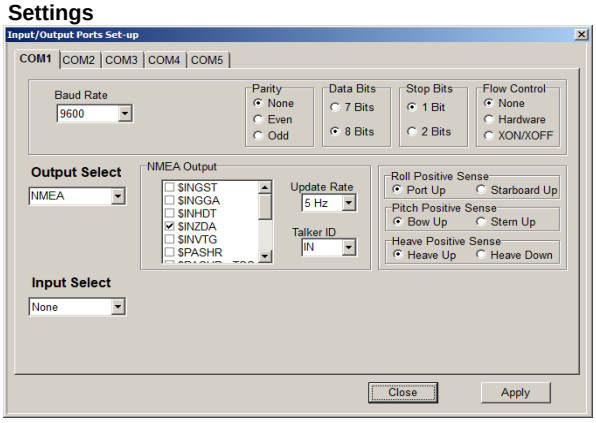
Sattelites in

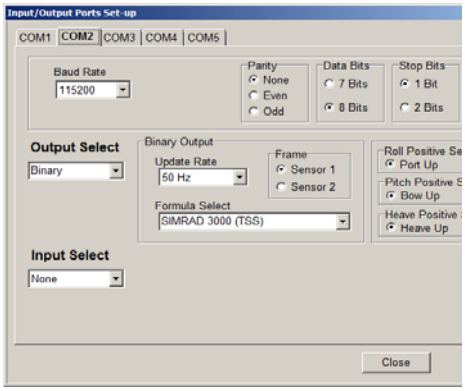
L1 SNR > 30 35 40

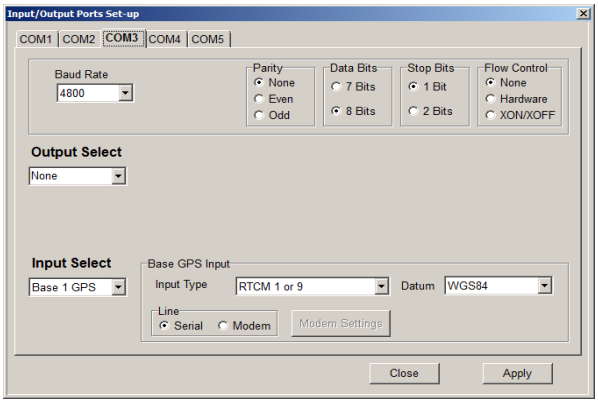
PDOP 1.532 (Use View> GAMS Solution)

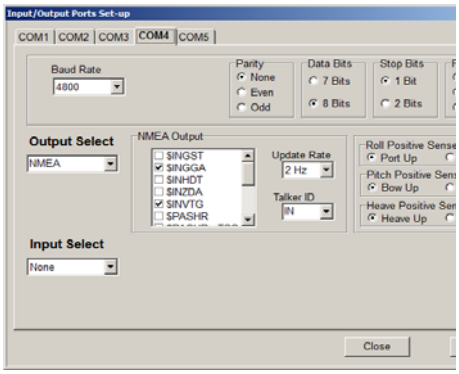
POS/MV Configuration

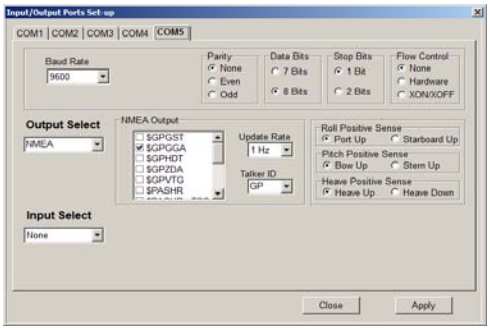
Settings











POS/MV Calibration

Calibration Procedure: (Refer to POS MV V4 Installation and Operation Guide, 4-25)

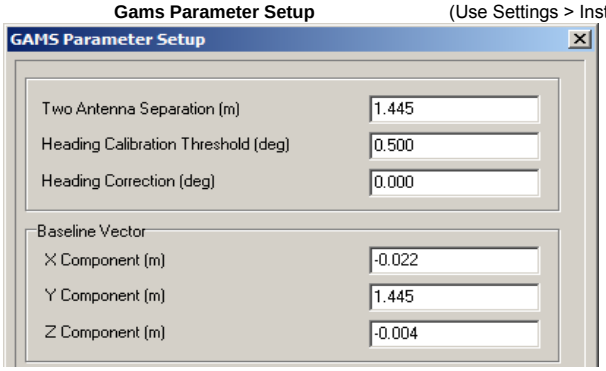
Start time: _____

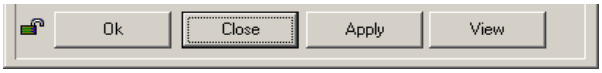
End time: _____

Heading accuracy achieved for calibration: 0.469

Calibration Results:

Gams Parameter Setup (Use Settings > Installation > GAMS Intallation)





Save POS Settings on PC (Use File > Store POS Settings on PC)

File Name:

D:\HYPACK 2012\Projects\HSRR2012\Raw\Positioning

General Notes:

The POS/MV uses a Right-Hand Orthogonal Reference System

The right-hand orthogonal system defines the following:

- The x-axis is in the fore-aft direction in the appropriate reference frame.
- The y-axis is perpendicular to the x-axis and points towards the right (starboard) side in the appropriate reference frame.
- The z-axis points downwards in the appropriate reference frame.

The POS/MV uses a Tate-Bryant Rotation Sequence

Apply the rotation in the following order to bring the two frames of reference into complete alignment:

a) Heading rotation - apply a right-hand screw rotation θz about the z-axis to align one frame with the other.

b) Pitch rotation - apply a right-hand screw rotation θy about the once-rotated y-axis to align one frame with the other.

c) Roll rotation - apply a right-hand screw rotation θx about the twice-rotated x-axis to align one frame with the other.

SETTINGS

Input/Output Ports (Use Settings > Input/Output Ports)

COM1

Baud Rate | Rate | Parity | Data | Stop

Output Select NMEA Output

NMEA

Roll Positive Sense
Pitch Positive Sense
Heave Positive Sense

Update Rate

Input Select Taker ID

None

NMEA Output (selected strings shown here)

$INVTG	$PASHR TB	$INZDA
$INGST	$PASHR TSS	$INGGK
$INGGA	$PRDID TB	$UTC
$INHDT	$PRDID TSS	

COM2

Baud Rate | Rate | Parity | Data | Stop

Output Select Binary Output

Binary

Roll Positive Sense
Pitch Positive Sense
Heave Positive Sense

Update Rate

Formula Select

Input Select

None

COM3

Baud Rate Rate Parity Data Stop

Output Select
None

Input Select Input
? Input Type
Line

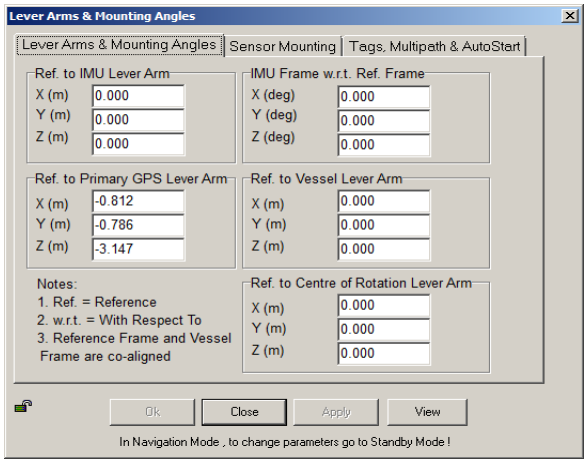
SETTINGS Continued

Heave Filter (Use Settings > Heave)

Events (Use Settings > Events)

INSTALLATION (Use Settings > Installation)

Lever Arms and Mounting Angles (Use Settings > Installation > Lever Arms and Offsets)



Tags, Multipath and Auto Start (Use Settings > Installation > Tags, Multipath and Auto Start)

Sensor Mounting (Use Settings > Installation > Sensor Mounting)

User Parameter Accuracy (Use Settings > Installation > User Accuracy)

Frame Control (Use Tools > Config)

☐	User Frame	Primary GPS Measurement	
☐	IMU Frame	Auxiliary GPS Measurement	

☐ **Use GAMS enabled**

GPS Receiver Configuration (Use Settings> Installation> GPS Receiver Configuration)

Primary GPS Receiver

Secondary GPS Receiver

Baud Rate Parity Data Stop

Auto Configuration
Enabled
Disabled

Post Processing of GAMS Calibration
Processing Log

Date	Dn	Personnel
☐	**POS Pac Processing**	Allow decimeter level freedom when processing
☐		Reprocess using new values, but restrict to 10 cm of freedom
☐		Reprocess using new values, again use 10 cm of freedom
☐		Continue itterating until values no longer change

Final Antena Seperation/ Lever Arms Determined ☐ **See FOO/CST with values**

New Values entered in POS View? ☐

Values

ERDDM Acquisition Log

Launch 2807 400kHz
Vessel

9/3/2013	246	Newport, OR	Sunny, Partly Cloudy
Date	Dn	Local Area	Wx

Furguson, Welton, Berube
Personnel

Comments

Slack	Please select DGPS Beacon
Tidal Cycle Notes	USCG DGPS Beacon Used

2013_246_2807_ERDDM.000
POSMV filename(s)

POS File	Azmuth	Vessel Speed	RPM	Start and End Time
	122	04	600	19:39-1942
	298	05	600	1944-1947
	121	05	800	1948-1951
.	295	06	800	1952-1955
	121	06	1000	1957-2000
	298	07	1000	2001-2004
	115	07	1200	2005-2008
	298	07	1200	2009-2012
	119	08	1400	2012-2015
	300	09	1400	2016-2019
	125	09	1600	2019-2022
	296	010	1600	2023-2026
		0	0	2032-2037, engaged gear due to drift

Processing Log

Date	Dn	Personnel
9/5/2013	248	Witmer

☑ **POS Files Processed in POS Pac** — Singlebase

Smartbase or Singlebase? Station used.

☑ **SBET Processed in Pydro Using the ERDDM Tool**

☑ **Graph and Table Values compared with previous year**

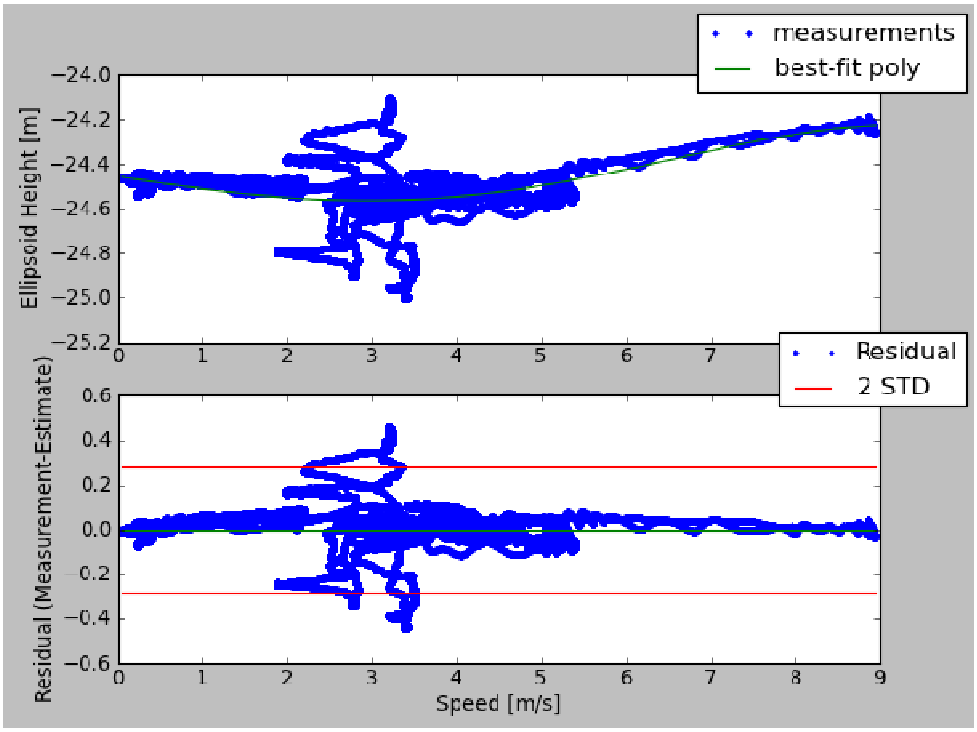
☑ **Documentaion Complete in DAPR Appendix**

☑ **See OPS/CST for updating HVF with new values**

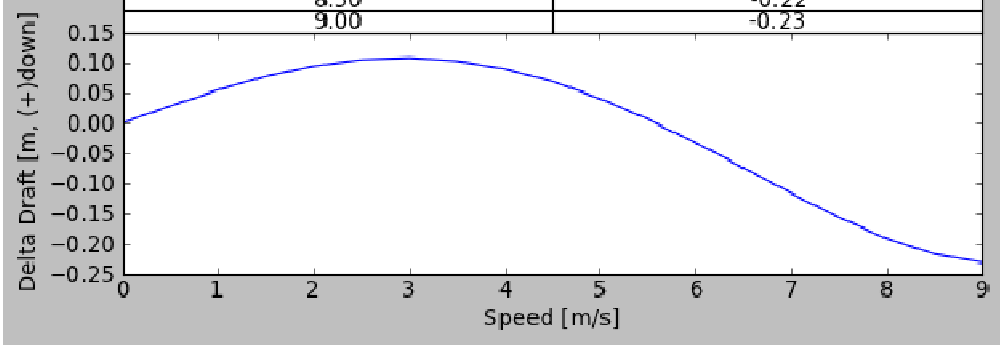
FA – 2807

2013- DN246

4th Order Ellipsoidally Referenced ERDDM



Speed [m/s]	Delta Draft [m]
$+0.00260*x^4 -0.00352*x^3 +0.00147*x^2 +0.05608*x$	
0.50	0.03
1.00	0.05
1.50	0.08
2.00	0.09
2.50	0.10
3.00	0.11
3.50	0.10
4.00	0.09
4.50	0.07
5.00	0.04
5.50	0.01
6.00	-0.03
6.50	-0.07
7.00	-0.12
7.50	-0.16
8.00	-0.19
8.50	-0.22
9.00	-0.23



Waterline Measurements

Fill in Yellow squares only!

Measuring Party:

2807

Waterline measurements should be negative and cm!

	2807	
	Port Benchmark to Waterline	Stbd Benchmark to Waterline
Measure 1	-96.5	-99.7
Measure 2	-98.5	-94.5
Measure 3	-98.4	-94.5
Avg (cm)	-97.80	-96.23
Avg (m)	-0.9780	-0.9623
Stdev	0.01127	0.03002
BM Z-value (m)*	1.03292	1.08830
BM to WL (m)	0.055	0.126

Date: 4/6/2011

Fuel Level: 21 US Gal

Draft Tube:

Port-to-Stbd Z-difference

Theoretical	Actual	Error
-0.0554	0.0157	0.0710

RP to WL Average (m)

0.090 NGS Coordinate System (do not enter into CARIS directly)

(Add this value to VSSL_Offsets & Measurements_20XX.xls)

Individual measurement		0.06792	0.09130
		0.04792	0.14330
StDev for TPU xls (of 6 #'s)	0.043882	0.04892	0.14330

utilized in Offsets and Measurements and TPU spreadsheet

2808 Offsets and Measurements - Summary

Measurement aka Coord. Sys.	IMU to RP* Caris	IMU to 7125 (Receiver) *SWATH1 x,y,z & MRU to Trans* Caris	Port Ant to 7125 *Nav to Trans x,y,z* Caris	RP* to Waterline Caris	Port Ant to Stbd Ant	IMU to Port Ant Caris	IMU to Port Ant Pos/Mv	IMU to Heave Caris	IMU to Heave Pos/Mv
x	0.000	0.004	0.685	n/a	Scaler Distance 1.453	-0.682	-0.837	0.000	0.000
y	0.000	0.250	1.086	n/a		-0.837	-0.682	0.000	0.000
z	0.000	0.477	3.637	-0.093		-3.160	-3.160	0.000	0.000

*IMU is Reference Point

-0.123 (2010 used for K5K)

Vessel Offsets for 2808 7125 are derived from the NGS Survey, January 2010, Trimble Equipment Specs, and 2011 and 2010 Measured Values.

Calculations

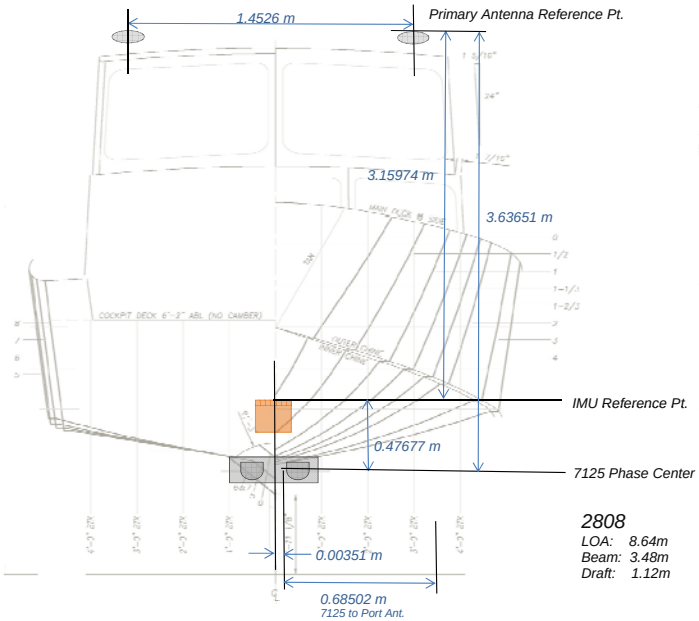
Coord. Sys./ Source	IMU to 7125	Port Ant to 7125	RP to Waterline	Port Ant to Stbd Ant	IMU to Port Ant	IMU to Heave
NGS	IMU (m) x 0.00000 y 0.00000 z 0.00000	IMU to Port Ant (m) (calculated) x -0.68151 y -0.83666 z 3.15974	RP to Waterline (m) (waterline worksheet) z 0.093	IMU to Port Ant (m) (calculated) x -0.68151 y -0.83666 z 3.15974	IMU (m) x 0.00000 y 0.00000 z 0.00000	IMU (m) x 0.00000 y 0.00000 z 0.00000
	MBES RP Rcvr - Phase Center (m) x 0.00351 y 0.24969 z -0.47677	IMU to Phase Ctr (calculated) x 0.00351 y 0.24969 z -0.47677	2010 RP to Waterline (m) (waterline worksheet) z 0.123	IMU (m) x, y, z 0.00000 Top of Stbd Ant (m) x 0.77098 y -0.83402 z 3.13235 Base to top of Stbd Ant (measured) (m) z 0.073 Bottom of Stbd Ant (calculated) (m) z 3.05935 Base to Phase Cntr of Stbd Ant (eqp spc) (m) z 0.0843	Top of Port Ant (m) x -0.68151 y -0.83666 z 3.14844 Base to top of Port Ant (measured) (m) z 0.073 Bottom of Port Ant (calculated) (m) z 3.07544 Base to Phase Cntr of Port Ant (eqp spc) (m) z 0.0843	Heave Pt (by design) m) x 0.00000 y 0.00000 z 0.00000

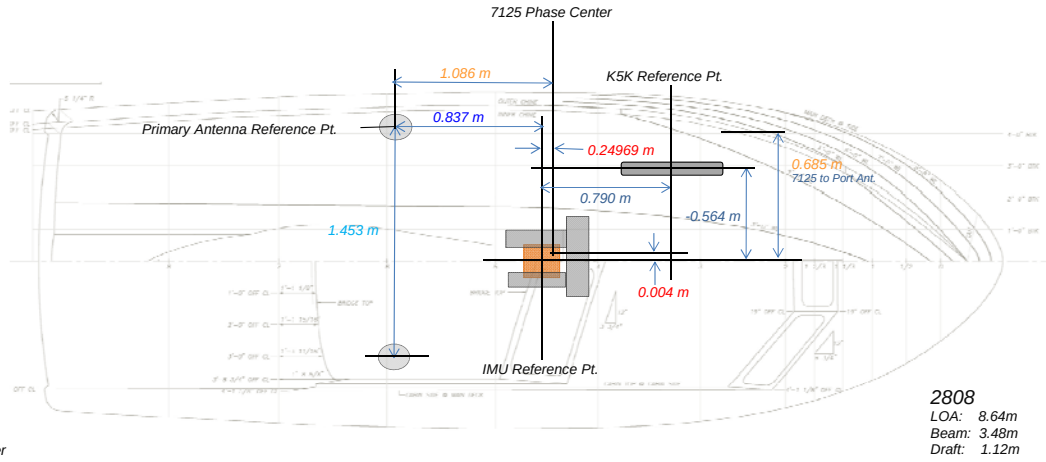
Coord. Sys.	IMU to 7125	Port Ant to 7125	RP to Waterline	Port Ant to Stbd Ant	IMU to Port Ant	IMU to Heave
NGS	IMU to Phase Ctr x 0.00351 y 0.24969 z -0.47677	x 0.68502 y 1.08635 z -3.63651	x n/a y n/a z 0.093	Scalar Distance 1.4526	x -0.68151 y -0.83666 z 3.15974	x 0.00000 y 0.00000 z 0.00000
	Coord. Sys. CARIS x 0.00351 y 0.24969 z 0.47677	Coord. Sys. CARIS x 0.68502 y 1.08635 z 3.63651	Coord. Sys. CARIS x n/a y n/a z -0.093		Coord. Sys. Pos/Mv x -0.83666 y -0.68151 z -3.15974	Coord. Sys. Pos/Mv x 0.00000 y 0.00000 z 0.00000

Description of Offsets for Launch 2808

All Values Shown are in CARIS Coordinates

The Ship Reference Frame (SRF) for Launch 2808 was based from the IMU reference point as the 0,0,0 point. Physical locations were measured with x,y,z offsets from this point. These locations were used to calculate offsets of items with respect to each other, as described for each offset.





IMU to 7125		
x	y	z
0.004	0.250	0.477

The physical positions of the IMU and the receiver phase center of the 7125 were measured during the NGS survey. These physical measurements were taken while the launch was secured on the pier and thought to be as level as possible. The measured values for the IMU and MB were taken directly for the report. The difference is the offset from the IMU to the phase center of the 7125 which was then transposed from the NGS to the CARIS coordinate system.

Port Ant to 7125		
x	y	z
0.685	1.086	3.637

The values were calculated by subtracting the physical height of the of the Port Antenna to the IMU x, y, z values from the respective values of the IMU to the 7125. The calculated values were then transposed from the NGS to the CARIS coordinate system.

RP to Waterline		
x	y	z
n/a	n/a	-0.093

The average vertical distance from Port Benchmark to waterline and the Starboard Benchmark to the waterline were measured by FAIRWEATHER personnel using a steel tape and bubble level. These values were combined with the Z value of the Benchmarks to the RP/IMU to get an average for the waterline to RP. The Waterline Measurement value is in NGS coordinates initially and is converted to CARIS coordinates.

Port Ant to Stbd Ant
Scalar Distance
1.453

The location of the phase center of the port and starboard POS/MV antennas were surveyed by NGS. The z-values were adjusted to the phase center. Then the scalar distance between the phase centers was calculated.

IMU to Port Antenna		
x	y	z
-0.682	-0.837	-3.160

The location of the IMU and the location of the top of port antenna were surveyed by NGS. The z-value of the antenna was calculated by subtracting the height of the antenna and then adding the value from the base of the antenna to the phase center of the antenna. The calculation results were then transposed from the NGS to the CARIS coordinate system.

IMU to Heave		
x	y	z
0.000	0.000	0.000

The Heave Point is assumed to coincide with the IMU location.

IMU to K5K		
x	y	z
-0.564	0.790	0.777

The location of the IMU and the location of the forward keel benchmark were surveyed by NGS. BM to K5K were measured by FAIRWEATHER personnel using a steel tape and bubble level.

2808 TILTED TRANSDUCER HEAD MULTIBEAM ACQUISITION SYSTEM READINESS REPORT

Vessel: 2808
Sonar: Reson 8125 MBES
Written By: LT Jaskoski
Report Date: 21-SEP-2010

Background:
During the 2010 field season, a RESON 8125 MBES was mounted on a variable angle adjustable sled mount at an angle of 25° to STBD. After the installation *Fairweather* personnel measured the offsets from reference points on the transducer to a reference point on the launch. Additionally, *Fairweather* personnel calculated the offsets from the transducer reference points to the acoustic center of the transducer thereby tying in the acoustic center to the IMU reference frame. The tabulated values below are in the NGS coordinate system (X=+STBD, Y=+Fwd, Z=+up) see figure 1.

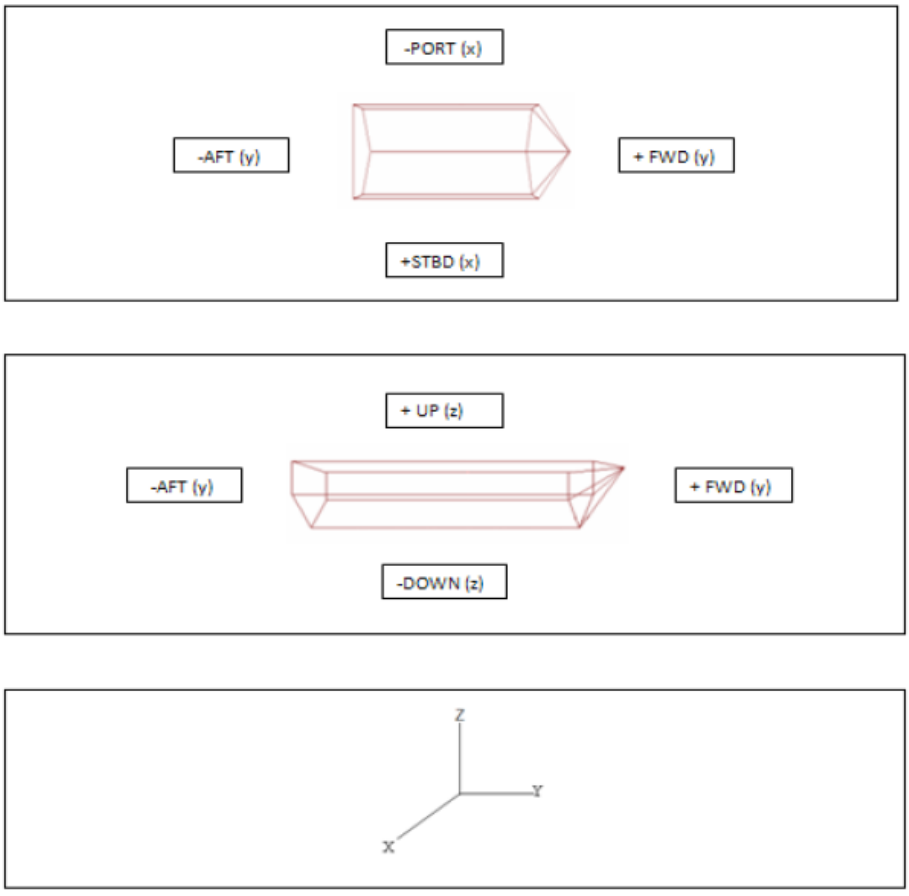


Figure 1. NGS Coordinate system.

Calibration Location, Date, and Personnel:

Personnel: LT Jaskoski
Coxswain: N/A
Location: Kodiak, AK
Date: 20-SEP-2010; DN 263

Procedure for measurement of offsets:
A benchmark located on the keel of the vessel forward of the Reson 7125sv transducer well was surveyed by NGS to be at a position offset from the IMU reference point at the position; x = -0.00126m, y = 0.44021m and z = -0.60545m. From this benchmark measurements were made to two reference points on the Reson 8125 transducer; x and z measurements were taken to a marked reference point at the base of the projector (figure 2), y measurements were taken to the after facing surface of the receiver array housing (figure 2). Offsets to the acoustic center of the Reson 8125 were calculated using system specific values detailed in the Reson 8125 operators manual v4.01 (March, 2004). From the operators manual an offset of 0.121m to the acoustic center was applied to the measured y offset value in the aft direction (-Y) from the after facing surface of the receiver array housing. The acoustic center is also offset orthogonally from the projector by 0.03475m down (-Z) direction when the transducer is in an un-tilted configuration. The x and z components of the acoustic center offset in the 25° tilted configuration were accounted for trigonometrically using the following formulae: x = 0.03475sin25° and z = -0.03475cos25°. This yielded offset of x = 0.01469m and z = -0.03149m (figure 2) from the reference point to the acoustic center. These offsets were then applied to the measured offsets.

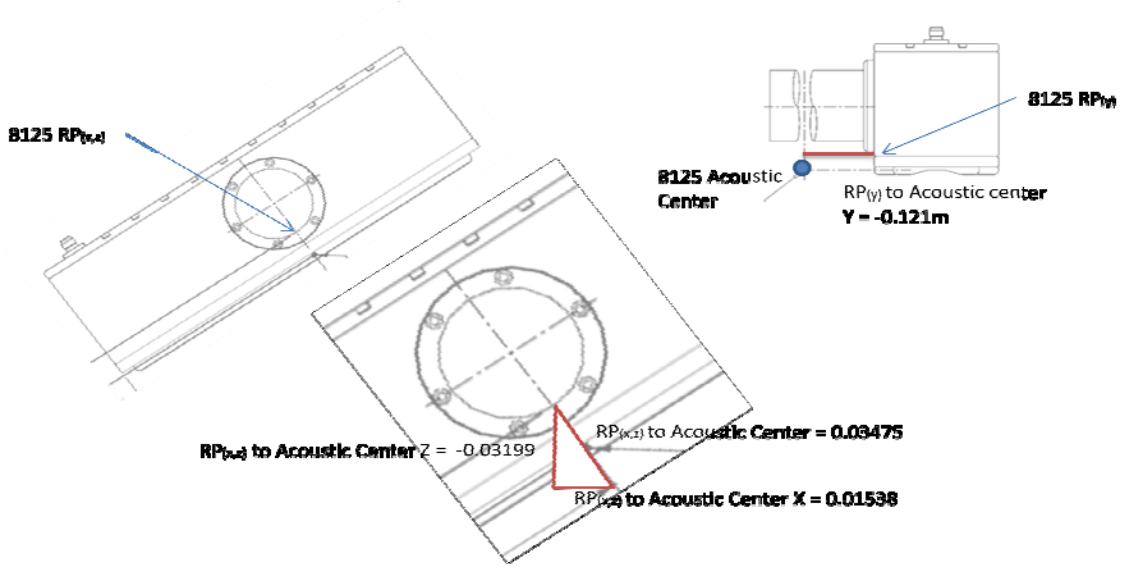


Figure 2: Calculated X, Y, and Z offsets from the Reson 8125 reference point for X and Z (base of projector), and for Y (aft face of receive array housing) to the Reson 8125 acoustic center.

Result:
The surveyed offsets from the IMU reference point to the keel benchmark are:
X = -0.00126m
Y = 0.44021m
Z = -0.60545m

The measured offset from the keel benchmark the Reson 8125 reference points are:
X = 0.639m
Y = 0.212m
Z = -0.076m

The calculated offset from the Reson 8125 reference points to the Reson 8125 acoustic center are:
X = 0.01469m
Y = -0.1210m
Z = -0.03149m

The resultant offsets from the IMU to the Reson 8125 acoustic center are:
X=0.652m
Y=0.531m
Z= -0.713m

Or in the Caris coordinate System:
X= 0.652m
Y= 0.531m
Z= 0.713m

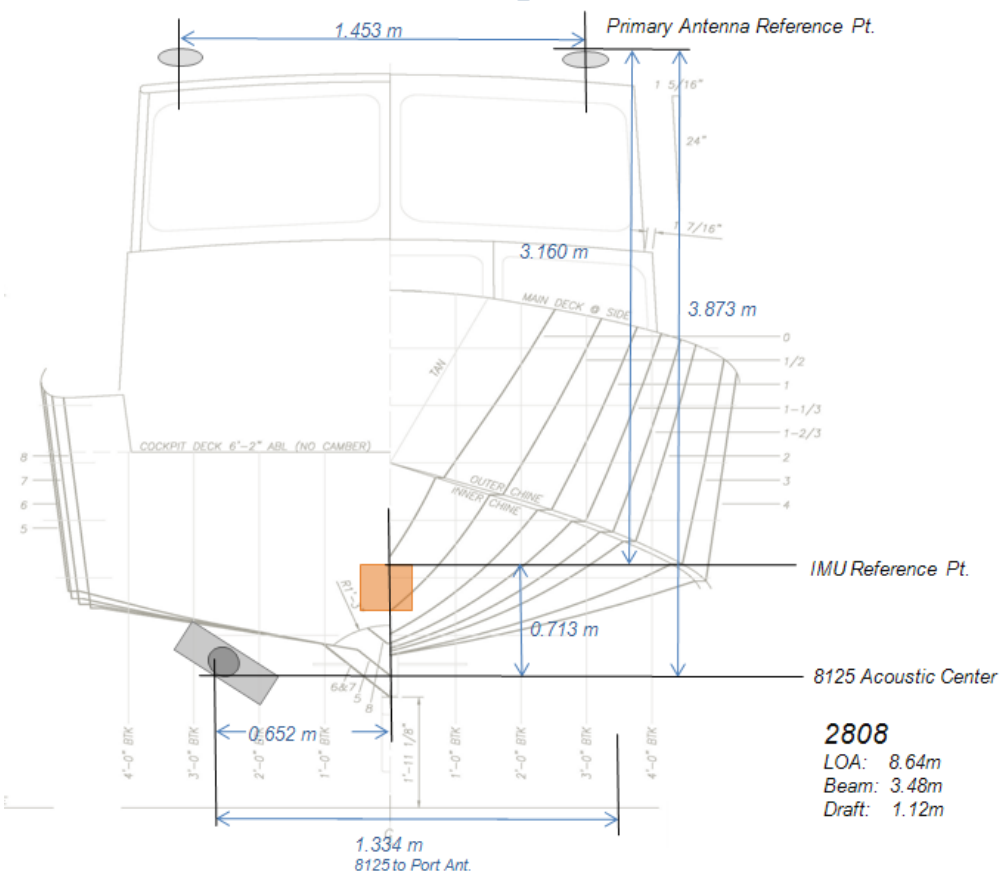


Figure 3: Vessel X and Z offsets from the Reson 8125 acoustic center to IMU reference point and to the Primary Antenna reference point.

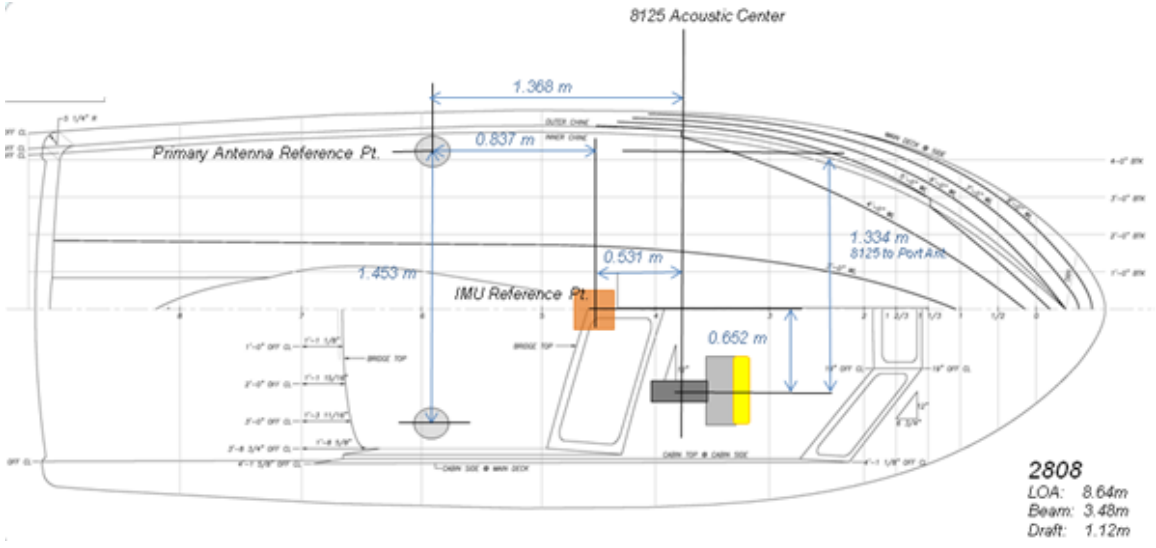
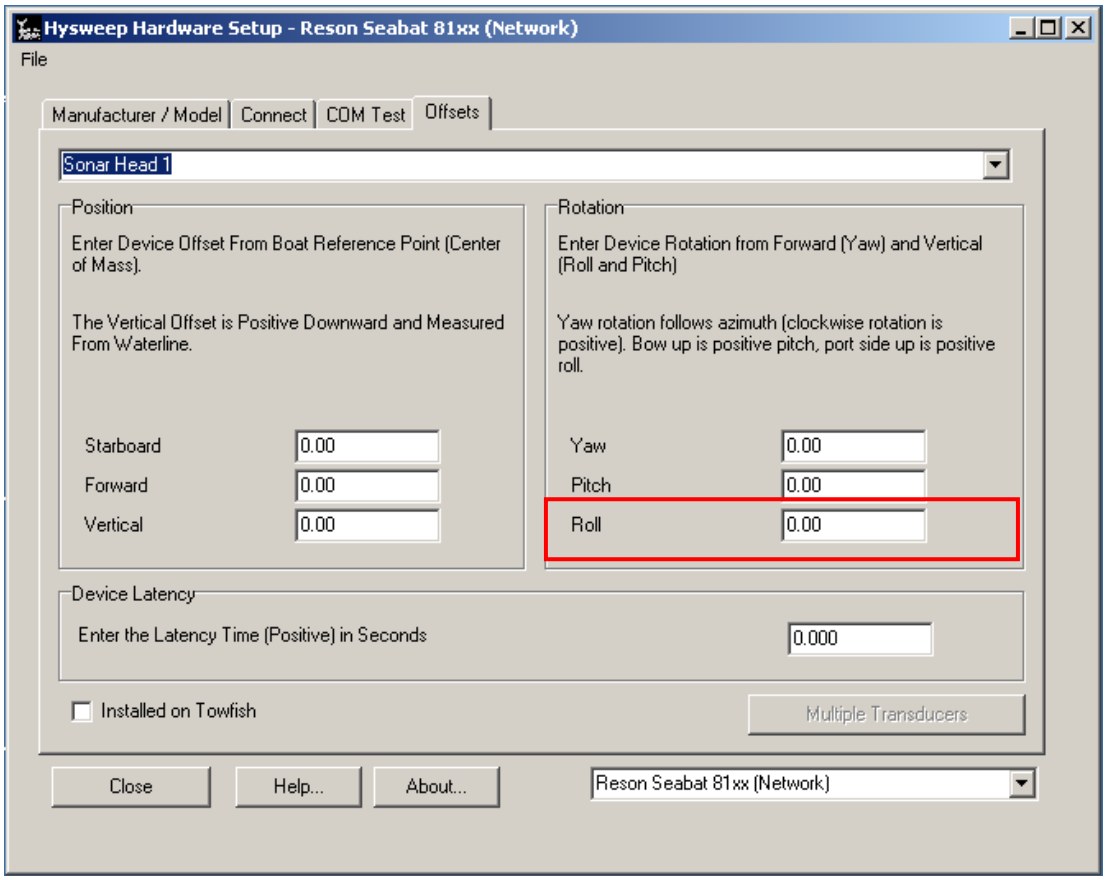


Figure 4: Vessel X and Y offsets from the Reson 8125 acoustic center to IMU reference point and to the Primary antenna reference point.

When changing the sonar head to a tilt or back to normal there are three (3) places the offset is located that needs to be changed.

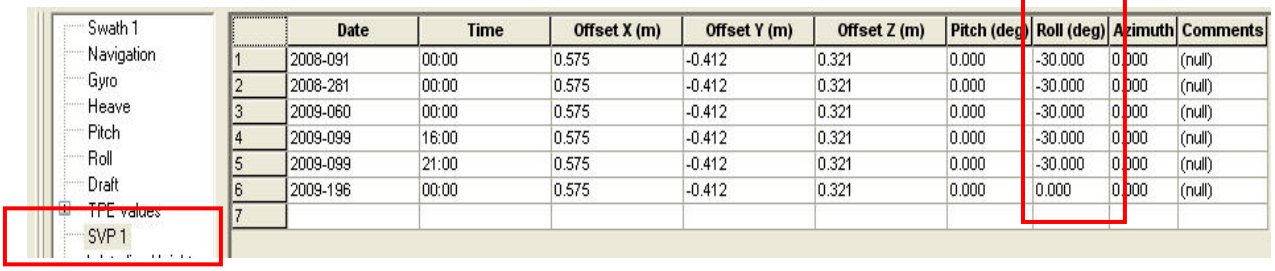
1. Reson Sonar Display – **MENU: Filters head tilt** (- 30˚ / 5˚ / 0˚) *STBD is negative, PORT is positive*

2. Hysweep Hardware – **Reson Seabat 81XX** – Go to the **Offsets Tab**



** Place the sonars tilt in **Roll** (this will ensure a proper matrix is displayed)**

3. Caris HVF – **SVP1** tab
   – **Roll (deg) -** place the sonar tilt here. (reminder: + to Port, – to Stbd)



	Date	Time	Offset X (m)	Offset Y (m)	Offset Z (m)	Pitch (deg)	Roll (deg)	Azimuth	Comments
1	2008-091	00:00	0.575	-0.412	0.321	0.000	-30.000	0.000	(null)
2	2008-281	00:00	0.575	-0.412	0.321	0.000	-30.000	0.000	(null)
3	2009-060	00:00	0.575	-0.412	0.321	0.000	-30.000	0.000	(null)
4	2009-099	16:00	0.575	-0.412	0.321	0.000	-30.000	0.000	(null)
5	2009-099	21:00	0.575	-0.412	0.321	0.000	-30.000	0.000	(null)
6	2009-196	00:00	0.575	-0.412	0.321	0.000	0.000	0.000	(null)
7									

Recommendations

It is the recommendation that the resultant offsets from the IMU to the Reson 8125 acoustic center of: X=0.652m, Y=0.531m, Z= 0.713m be applied to the CARIS vessel configuration file.

The angle of tilt (25° STBD up) should be applied in three separate places:

1) In the Reson sonar display under the filters menu, the "head tilt" should be set to: **-25°**

2) In Hypack Hyseep hardware setup, under the offsets tab for the Reson 8125 the rotational offset "Roll" should be set to: **-25°**

3) In the CARIS *.hvf under the SVP1 tab the "Roll (deg)" should be set to: **-25°**

US DEPARTMENT OF COMMERCE
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
NATIONAL GEODETIC SURVEY
GEODETIC SERVICES DIVISION
INSTRUMENTATION & METHODOLOGIES BRANCH

NOAA SURVEY VESSEL 2808
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY
FIELD REPORT

Kendall L. Fancher
January, 2010

NOAA SURVEY VESSEL 2808
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

PURPOSE

The primary purpose of the survey was to precisely determine the spatial relationship between various hydrographic surveying sensors, launch bench marks and the components of a POS MV navigation system aboard the NOAA survey vessel 2808.

PROJECT DETAILS

This survey was conducted in Seattle, WA at the NOAA Western Center on the 27th of January, 2010. The weather was foggy then sunny with temperatures in the 40s to 50s. For this survey, the vessel was on blocks, supported by boat jacks. The vessel was reported to have been leveled relative to the IMU.

INSTRUMENTATION

A Leica TDA5005 precision total station was used to make all measurements.
Technical Data:

Standard Deviation	
Horizontal angle	0.5 seconds
Vertical angle	0.5 seconds
Distance measurement	1mm + 1ppm

Leica precision prisms were used as sighting targets. Prisms were configured to have a zero mm offset.

PERSONNEL

Kendall Fancher — NOAA/NOS/NGS/GSD/I&M BRANCH
(540) 373-1243
kendall.fancher@noaa.gov

Dennis Lokken — NOAA/NOS/NGS/GSD/I&M BRANCH
(540) 373-1243
dennis.lokken@noaa.gov

NOAA SURVEY VESSEL 2808
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

DEFINITION OF THE REFERENCE FRAME

For this survey, data was collected in a 3-D right handed Cartesian coordinate system. The origin of this coordinate system is defined as the center of the IMU target. The Y (Northing) axis is parallel to the centerline of the launch and is positive towards the bow of the launch. The X (Easting) axis is perpendicular to the Y axis and is positive towards the starboard side of the launch. The Z (Elevation) axis is perpendicular to the XY plane and is positive towards the top of the launch. The coordinates of the points established this survey are reported in this coordinate system and are provided in Appendix A.

SURVEY METHODOLOGY

Four temporary control points, (1, 2, 3, and 4), were established around the vessel such that every point to be positioned on the launch could be observed from at least two separate locations.

Coordinates of 100.000N, 100.000E, and 100.000U were assumed for temporary control point 1. A distance and height difference were measured between control points 1 and 2. Temporary control point 2 was assumed to have an Easting of 100.000. The measured distance between these two points was used to determine the Northing for temporary control point 2. The height difference between the two points was used to determine the Up component for control point 2.

Control point 1 was occupied and control point 2 was observed to initialize the instrument. After initialization, control point 4 and all visible points to be observed on the launch were observed in both direct and reverse. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 2.

Control point 2 was occupied and control point 1 was observed to initialize the instrument. After initialization, control point 3 and all visible points to be observed on the launch were observed in both direct and reverse. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 1.

Control point 3 was occupied and control point 2 was observed to initialize the instrument. After initialization, control point 4 and all visible points to be observed on the launch were observed in both direct and reverse. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 2.

NOAA SURVEY VESSEL 2808
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

Control point 4 was occupied and control point 3 was observed to initialize the instrument. After initialization, all visible points to be observed on the launch were observed in both direct and reverse. Control point 1 was also observed in order to evaluate the accuracy of the traverse. Inverse computations between the original and observed control point yielded a horizontal accuracy, or traverse closure of of 0.001m and a vertical accuracy of 0.000m. The stability of the instrument setup was checked at conclusion of the data set collection by checking back to temporary control point 2.

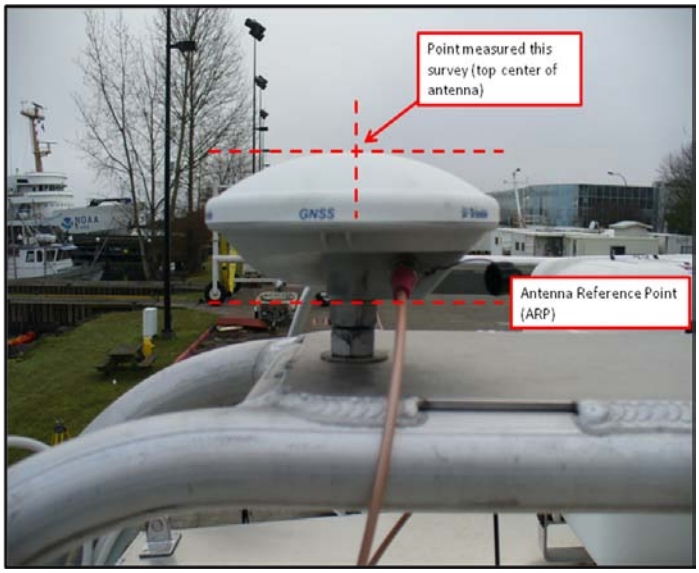
Inverses were computed between the two positions determined for all points surveyed to evaluate their accuracy relative to the temporary control network. Inverse reports are included in appendix B.

The reference frame was rotated using CENTERLINE STERN BM (CLS) as the point of rotation. A zero degree azimuth was used during the rotation from CLS to CENTERLINE BOW BM (BMB). The reference frame was then translated to relocate the origin of the reference frame to the IMU. The resulting coordinates are reported in appendix A.

DISCUSSION

The positions given for the POS GPS antennas (Zephyr Model II p/n 57970-00) are to the top center of the antenna. To correct the Z value provided in this report for each antenna to the electronic phase center, I recommend the following steps be taken;

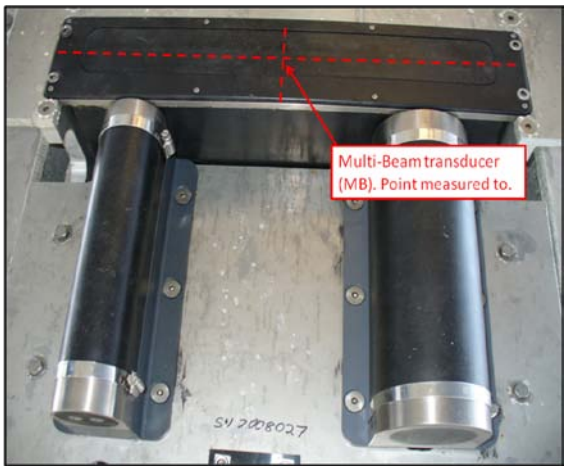
1) Determine the physical height of the GPS antenna. This information is probably located on the antenna or with equipment documentation.
2) Investigate to find the electronic phase center offset of the antenna. This information is probably located on the antenna or with equipment documentation. This value may also be available at the NGS website for antenna modeling.
3) Subtract the total height of the antenna from the Z value for each antenna. This will give you a Z value for the antenna ARP (antenna reference point)
4) Then add to this value the electronic phase center offset value appropriate for the antenna model.



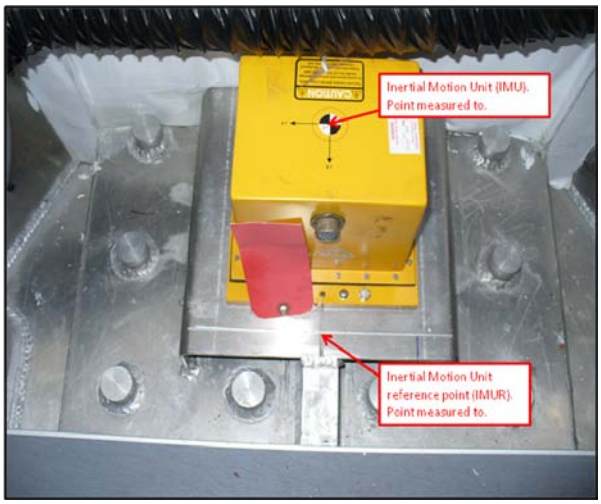
NOAA SURVEY VESSEL 2808
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

Two reference points (MBF and MBA) were positioned in order to facilitate future measurements to the Multi-Beam sensor by launch personnel. These reference points are punch marks set along the center of the keel, at the locations described in the image at right.

A point on the Multi-Beam transducer (MB) was measured directly this survey. The measured point was at the center of the bottom of the transducer. No mark was left to indicate the measured point.



The point positioned for the Inertial Motion Unit (IMU) this survey was the center of the target affixed to the top of the unit. Additionally, a reference mark (IMUR) was established on the plate the IMU is attached to at a point where two scribed lines intersect, forward of the IMU.



NOAA SURVEY VESSEL 2808
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

STATION LISTING

BMB- CENTERLINE BOW BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the deck, along the centerline and near the bow of the launch.

CLS- CENTERLINE STERN BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the deck, along the centerline and near the stern of the launch.

BMP- PORT SIDE BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the top of the deck, near the middle of and along the port side of the launch.

BMS- STARBOARD SIDE BM
The center of a cross mark inscribed into the top of a square metal flange, welded to the top of the deck, near the middle of and along the starboard side of the launch.

MBF- KEEL BM
A punch mark set along the bottom center of the keel, fore of the multi-beam transducer, 0.030 m from a point where the keel makes a 90 degree angle upwards.

MBA- KEEL BM
A punch mark set along the bottom center of the keel, aft of the multi-beam transducer, 0.030 m from a point where the keel makes a 90 degree angle upwards.

IMU- IMU TARGET
Center of a target affixed to the top of the IMU housing.

IMUR- IMU REFERENCE BM
The intersection of two scribed lines atop a metal support plate for the IMU and forward of the IMU.

GPSP- PORT SIDE GPS ANTENNA REFERENCE POINT
The top center of the port side GPS antenna for the POS system.

GPSS- STARBOARD GPS ANTENNA REFERENCE POINT
The top center of the starboard side GPS antenna for the POS system.

MB- MULTI-BEAM REFERENCE POINT
The physical bottom center of the Multi-Beam transducer.

Appendix A

Coordinate Report Launch 2808

Pt Name	*North(Y)*	*East(X)*	*UP(Z)*	*ID*
IMU Target	0.00000	0.00000	0.00000	IMU
IMU Reference BM	0.13282	-0.00186	-0.16518	IMUR
Centerline Stern BM	-4.07730	0.01391	0.61506	CLS
Centerline Bow BM	3.44544	0.01391	1.44047	BMB
Portside GPS Ant. Ref. Point	-0.83666	-0.68151	3.14844	GPSP
Starboard GPS Ant. Ref. Point	-0.83402	0.77098	3.13235	GPSS
Multi-Beam Ref.Point	0.24969	0.00351	-0.47677	MB
Keel BM	0.44021	-0.00126	-0.60545	MBF
Keel BM	-0.22600	0.00192	-0.53583	MBA
Port Side BM	0.08204	-1.42963	1.07600	BMP
Starboard Side BM	0.08324	1.46250	1.04444	BMS

Units = meters

Appendix B

Point to Point Inverse Launch 2808

Pt. 1	*Pt. 2*	*Dist.*	*Northing*	*Easting*	*Elevation*	*ID*
3	40	0.001	-0.001	0.000	0.00026	MBF
5	42	0.003	-0.002	-0.001	0.00013	MBA
4	41	0.002	-0.001	-0.002	0.00062	MB
14	55	0.006	-0.005	0.004	0.00049	IMUR
13	56	0.006	-0.004	0.004	0.00055	IMU
43	6	0.001	0.000	0.001	0.00048	CLS
33	44	0.000	0.000	0.000	0.00006	BMS
8	22	0.001	-0.001	0.000	0.00039	BMP
17	25	0.005	0.000	0.005	0.00011	BMB
24	34	0.001	0.000	0.000	0.00049	GPSS
23	7	0.000	0.000	0.000	0.00022	GPSP

Units = meters

FAIRWEATHER

Multibeam Echosounder Calibration

Launch 2808 200kHz
Vessel

4/24/2013	114	Shilshole
Date	Dn	Local Area

Zacharias, Bradley, Ferguson
Calibrating Hydrographer(s)

Reson 7125		
MBES System	MBES System Location	Date of most recent EED/Factory Check

	182020
Sonar Serial Number	Processing Unit Serial Number

Sonar Mounting Configuration	Date of current offset measurement/verification

Applanix POS/MV S/N:2560	IMU S/N:354	
Description of Positioning System		Date of most recent positioning system calibration

Acquisition Log

4/24/2013	114	Shilshole	calm, sunny
Date	Dn	Local Area	Wx

	80 meters
Bottom Type	Approximate Water Depth

Zacharias, Bradley, Ferguson
Personnel on board

Roll Stabilization on, Used Datagram 2
Comments

2013_114_2808.308-
POSMV Filename(s)

	1630	47/40/37.9791	122/25/14.2623	~34	
SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
SV Cast #3 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

NAV TIME LATENCY view parallel to track, one line with induced roll (outerbeam) or same lines bounded slope (nadir) [same direction, different speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	2808_200_003_1704.RAW	240	7.0	
	2808_200_003_1707.RAW	066	6.0	noisy
	2808_200_003_1710.RAW	238	4.5-5	
	2808_200_003_1713.RAW	058	4.5	

PITCH view parallel to track, same line (at nadir) [opposite direction, same speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	2808_200_10_1649	300	6.5	
	2808_200_10_1650	115	6-6.5	

HEADING/YAW view parallel to track, offset lines (outerbeams) [opposite direction, same speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	2808_200_011_1640	313	6.5/7.5	noisy
	2808_200_001_1641	135	6.5/7.5	noisy
	2808_200_013_1642	313	6.5/7.5	noisy
	2808_200_012_1644	135	6.5/7.5	noisy
	2808_200_002_1645	313	6.5/7.5	noisy
	2808_200_011_1647	135	6.5/7.5	noisy
	2808_200_011_1733	313	5-6	
	2808_200_17_34_23	135	5-6	
	2808_200_013_1736	313	5-6	
	2808_200_001_1737	135	5-6	
	2808_200_002_1739	313	5-6	
	2808_200_001_1740	135	5-6	

ROLL view across track, same line [opposite direction, same speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	2808_200_003_1704.RAW	240	7.0	Roll Stab is on
	2808_200_003_1707.RAW	066	6.0	noisy
	2808_200_003_1710.RAW	238	4.5-5	
	2808_200_003_1713.RAW	058	4.5	

Processing Log

4/26/2013	116	Zacharias
Date	Dn	Personnel

☑ **Data converted --> HDCS_Data in CARIS**

☑ **TrueHeave applied** 2013_114_2808_Concat.000

☑ **SVP applied** 2013_114_2808_concat.svp

☑ **Tide applied** 9447130.tid (got an error that tide data out of range)

Zone file N395FA2010CORP.zdf

Lines merged ☑

Data cleaned to remove gross fliers ☑

Compute correctors in this order

1. Precise Timing **2. Pitch bias** **3. Heading bias** **4. Roll bias**

Do not enter/apply correctors until all evaluations are complete and analyzed.

PATCH TEST RESULTS/CORRECTORS

Evaluators		Latency (sec)		Pitch (deg)		Roll (deg)		Yaw (deg)
Wozumi		0.00		-0.96		0.28		-0.17
Beduhn	1704 & 171	0.00	1640 &1647	-0.99	1710 & 1713	0.33	1740 &1739	-0.20
Zacharias	1701&1710	0.00	1649&1650	-0.73	1710&1713	0.33	1740&1734	-0.20
TMS	3_1701, 3_	0.00	10_1649, 10_	-0.80	3_1710, 3_17	0.33	1_1740, 2_17	-0.18
Averages		0.00		-0.87		0.32		-0.19
Standard Deviation		0.00		0.12		0.02		0.02
FINAL VALUES		0.00		-0.87		0.32		-0.19

Final Values based on

Resulting HVF File Name

MRU Align StdDev gyro 0.02 Value from standard deviation of Heading offset values

MRU Align StdDev Roll/Pitch 0.07 Value from averaged standard deviations of pitch and roll offset values

NARRATIVE

☑ **HVF Hydrographic Vessel File created or updated with current offsets**

Name: Tami Beduhn **Date:** 4/14/2013

FAIRWEATHER

Multibeam Echosounder Calibration

Launch 2808 200kHz
Vessel

9/28/2013	271	LA/LB
Date	Dn	Local Area

marcus,berube
Calibrating Hydrographer(s)

RESON 7125		
MBES System	MBES System Location	Date of most recent EED/Factory Check

Sonar Serial Number	Processing Unit Serial Number

Sonar Mounting Configuration	Date of current offset measurement/verification

Applanix POS/MV S/N:3627 IMU S/N:XXX	
Description of Positioning System	Date of most recent positioning system calibration

Acquisition Log

9/28/2013	271	la/lb	clear, calm
Date	Dn	Local Area	Wx

mud	15m
Bottom Type	Approximate Water Depth

marcus,berube,dodge,ferguson
Personnel on board

Comments

2013_271_2808.241-301 POS files located in H12618 Dn271 folder
POSMV Filename(s)

2013_271_172415.	1724	33/43/19.17N	118/12/47.81W	14.92	
SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
2013_271_182826	1828	33/43/25.61N	118/12/32.05W	14.14	
SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
SV Cast #3 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

NAV TIME LATENCY view parallel to track, one line with induced roll (outerbeam) or same lines bounded slope (nadir) [same direction, different speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	2013M_2711732	067	4.3	
2	2013M_2711736	070	8.1	
3	2013M_2711740	068	4.3	
4	2013M_2711744	069	8.3	
5				
6				
7				
8				

PITCH view parallel to track, same line (at nadir) [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	2013M_2711747	250	4.4	
2	2013M_2711750	063	4.3	
3	2013M_2711753	251	4.1	
4	2013M_2711756	070	4.3	
5				
6				
7				
8				

HEADING/YAW view parallel to track, offset lines (outerbeams) [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	2013M_2711759	245	5.3	20m
2	2013M_2711801	069	5.2	20m
3	2013M_2711804	248	5.1	20m
4	2013M_2711806	068	5.7	20m
5				
6				
7				
8				

ROLL view across track, same line [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	2013M_2711809	244	4.3	
2	2013M_2711814	069	4.5	
3	2013M_2711818	245	4.3	
4	2013M_2711822	063	4.3	
5				
6				
7				
8				

Processing Log

9/29/2013	271	Francksen
Date	Dn	Personnel

☑ **Data converted --> HDCS_Data in CARIS**

☑ **TrueHeave applied**

☑ **SVP applied**

☑ **Tide applied**

Zone file

Lines merged ☐

Data cleaned to remove gross fliers ☐

Compute correctors in this order

1. Precise Timing **2. Pitch bias** **3. Heading bias** **4. Roll bias**

Do not enter/apply correctors until all evaluations are complete and analyzed.

PATCH TEST RESULTS/CORRECTORS

Evaluators	Latency Lines Used	Latency (sec)	Pitch Lines Used	Pitch (deg)	Roll Lines Used	Roll (deg)	Yaw Lines Used	Yaw (deg)
Wartick	1732&1736	0.00	1750&1753	-2.70	1809&1814	0.30	1804&1806	0.35
Beduhn	1732&1736	0.00	1750&1753	-2.85	1809&1814	0.28	1804&1806	0.52
Marcus	1732&1736	0.00	1750&1753	-2.70	1809&1814	0.32	1804&1806	0.32
Francksen	1732&1736	0.00	1747&1750	-2.78	1809&1814	0.31	1804&1806	0.32

Averages	0.00	-2.76	0.30	0.38
Standard Deviation	0.00	0.07	0.02	0.10
FINAL VALUES	0.00	-2.76	0.30	0.38

Final Values based on

Resulting HVF File Name

MRU Align StdDev gyro 0.10 Value from standard deviation of Heading offset values

MRU Align StdDev Roll/Pitch 0.04 Value from averaged standard deviations of pitch and roll offset values

NARRATIVE

☑ **HVF Hydrographic Vessel File created or updated with current offsets**

Name: Tami Beduhn **Date:** 3/3/2014

FAIRWEATHER

Multibeam Echosounder Calibration

Launch 2808 400kHz
Vessel

4/24/2013	114	Shilshole
Date	Dn	Local Area

Zacharias, Bradley, Ferguson
Calibrating Hydrographer(s)

Reson 7125		
MBES System	MBES System Location	Date of most recent EED/Factory Check
Sonar Serial Number		Processing Unit Serial Number
Sonar Mounting Configuration		Date of current offset measurement/verification
Applanix POS/MV S/N:XXX IMU S/N:XXX		
Description of Positioning System		Date of most recent positioning system calibration

Acquisition Log

4/24/2013	114	Shilshole	Sunny, Calm
Date	Dn	Local Area	Wx
Bottom Type			Approximate Water Depth

Zacharias, Bradley, Ferguson
Personnel on board

Roll Stabilization on, Used Datagram 2
Comments

POSMV Filename(s)	

	1900	47/40/29.0347	122/25/25.3342	100m	
SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
SV Cast #3 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

NAV TIME LATENCY view parallel to track, one line with induced roll (outerbeam) or same lines bounded slope (nadir) [same direction, different speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	003_1824_.RAW	240	5.0	
	003_1831.Raw	240	6.5	
	003_1834_.RAW	060	6.0	
	003_1840_.RAW	060	4.0	

PITCH view parallel to track, same line (at nadir) [opposite direction, same speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	010_1810	300	6.5	
	010_1811	110	6.0	

HEADING/YAW view parallel to track, offset lines (outerbeams) [opposite direction, same speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	011_1802	315	6.0	
	001_1803	130	6.0	
	002_1805	315	6.0	
	012_1806	115	6.0	
	013_1807	315	6.5	
	011_1808	130	6.0	

ROLL view across track, same line [opposite direction, same speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	003_1824_.RAW	240	5.0	
	003_1831.Raw	240	6.5	
	003_1834_.RAW	060	6.0	
	003_1840_.RAW	060	4.0	

Processing Log

4/26/2013	116	Zacharias
Date	Dn	Personnel

☑ **Data converted --> HDCS_Data in CARIS**

☑ **TrueHeave applied** 2013_114_2808_Concat.000

☑ **SVP applied** 2013_114_2808_concat.svp

☑ **Tide applied** 9447130.tid (got an error that tide data out of range)

Zone file N395FA2010CORP.zdf

Lines merged ☑

Data cleaned to remove gross fliers ☑

Compute correctors in this order

1. Precise Timing **2. Pitch bias** **3. Heading bias** **4. Roll bias**

Do not enter/apply correctors until all evaluations are complete and analyzed.

PATCH TEST RESULTS/CORRECTORS

Evaluators		Latency (sec)		Pitch (deg)		Roll (deg)		Yaw (deg)
TMS	3_1834, 3_	0.00	10_1810, 10_	-0.73	3_1831, 3_18	0.33	2_1805, 12_1	0.44
Wozumi		-0.01				0.33		
Zacharias	1824&1831	0.00	1810&1811	-0.80	1831&1834	0.30	1803&1807	0.52
Beduhn	1824&1831	0.00	1802&1808	-0.82	1831&1834	0.29	1803 & 1805	0.33
Averages		0.00		-0.78		0.31		0.43
Standard Deviation		0.01		0.05		0.02		0.09
FINAL VALUES		0.00		-0.78		0.31		0.43

Final Values based on

Resulting HVF File Name

MRU Align StdDev gyro 0.09 Value from standard deviation of Heading offset values

MRU Align StdDev Roll/Pitch 0.03 Value from averaged standard deviations of pitch and roll offset values

NARRATIVE

☑ **HVF Hydrographic Vessel File created or updated with current offsets**

Name: Tami Beduhn **Date:** 4/14/2013

FAIRWEATHER

Multibeam Echosounder Calibration

Launch 2808 8125
Vessel

9/23/2010	266	South Chatham Strait
Date	Dn	Local Area

Campbell
Calibrating Hydrographer(s)

Reson 8125	Launch 2808 8125	unknown
MBES System	MBES System Location	Date of most recent EED/Factory Check

4400007	31562
Sonar Serial Number	Processing Unit Serial Number

Tilted Head, hull mount attachment	9/20/10
Sonar Mounting Configuration	Date of current offset measurement/verification

POS/MV 320 v4	3/4/10
Description of Positioning System	Date of most recent positioning system calibration

Acquisition Log

9/23/2010	266	South Chatham Strait	Overcast, breezy, 1-2 ft. chop
Date	Dn	Local Area	Wx

flat and rky	
Bottom Type	Approximate Water Depth

Campbell, Morgan, Brooks
Personnel on board

Comments

2010-266-2805
TrueHeave filename

ship process #1		56/22/40.7N	134/15/39.5W		
SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

NAV TIME LATENCY view parallel to track, one line with induced roll (outerbeam) or same lines bounded slope (nadir) [same direction, different speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks

PITCH view parallel to track, same line (at nadir) [opposite direction, same speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
#1	2661723	257	~4 kts	
1	2661726	085	~4 kts	
1	2661728	257	~4 kts	
1	2661732	085	~4 kts	
1	2661735	190	~4 kts	
1	2661738	348	~4.5 kts	

HEADING/YAW view parallel to track, offset lines (outerbeams) [opposite direction, same speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
#1	2661754	257	4kts	
	2661757	079	5 kts	
	2661759	257	4 kts	
	2661803	079	4.7 kts	
	2661807	180	4.0	
	2661809	353	4.0	
	2661812	180	4.0	
	2661815	353	4.5	

ROLL view across track, same line [opposite direction, same speed]

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
#1	2661818	062	4.0	
	2661821	242	3.9	
	2661912	035	3.0	
	2661915	205	3.8	
	2661918	033	4.5	
	2661921	223	4.0	

Processing Log

9/24/2010	267	Campbell
Date	Dn	Personnel

☑ **Data converted --> HDCS_Data in CARIS**

☑ **TrueHeave applied** bcc

☑ **SVP applied** H12064_2808_Patch, bcc

☑ **Tide applied**

Zone file O322FA2010CORP.zdf

Lines merged ☑

Data cleaned to remove gross fliers ☐

Compute correctors in this order

1. Precise Timing **2. Pitch bias** **3. Heading bias** **4. Roll bias**

Do not enter/apply correctors until all evaluations are complete and analyzed.

PATCH TEST RESULTS/CORRECTORS

Evaluators	Latency (sec)	Pitch (deg)	Roll (deg)	Yaw (deg)
Campbell	0.00	-0.61	0.60	0.65
Welton		-1.41	0.57	0.45
Jaskoski		-0.97	0.53	0.83
Morgan	0.00	-1.00	0.56	0.50
Averages	0.00	-1.00	0.57	0.61
Standard Deviation	0.00	0.33	0.03	0.17
FINAL VALUES	0.00	-1.00	0.57	0.61

Final Values based on Averages

Resulting HVF File Name FA_2808_Rsn8125_TiltedHead_2010.hvf

MRU Align StdDev gyro 0.17 Value from standard deviation of Heading offset values

MRU Align StdDev Roll/Pitch 0.18 Value from averaged standard deviations of pitch and roll offset values

NARRATIVE

☑ **HVF Hydrographic Vessel File created or updated with current offsets**

Name: CST Morgan **Date:** 10/8/10

NOAA POS/MV Calibration Report

Fill out all fields! See previous years as an example.

Yellow areas require screen grabs!

Ship: FAIRWEATHER **Vessel:** 2808

Date: 4/16/2013 **Dn:** 106

Personnel: ENS Marwine ENS Broo ENS Chensue SS Brooks

PCS Serial # 3627 **IMU Serial #** 324

IP Address: 129.100.1.231

POS controller Version (Use Menu Help > About) 5.1.0.2

POS Version (Use Menu View > Statistics) MV-320, Ver4 (BD960)

GPS Receivers

Primary Receiver Serial #:

Secondary Receiver Serial #:

POSMV filename(s)

Calibration area

Location: Lake Washington

Approximate Position:

Lat	47	41	38.4871
Lon	122	15	34.2194

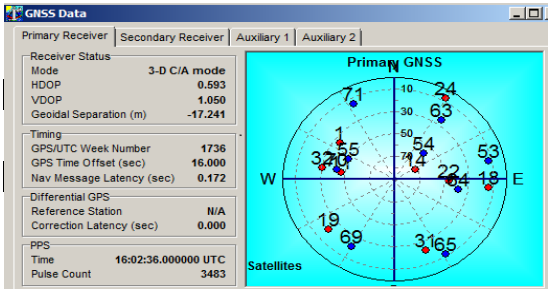
DGPS Beacon Station: Robinson Pt. **DGPS Receiver Serial#:**

Frequency: 323khz

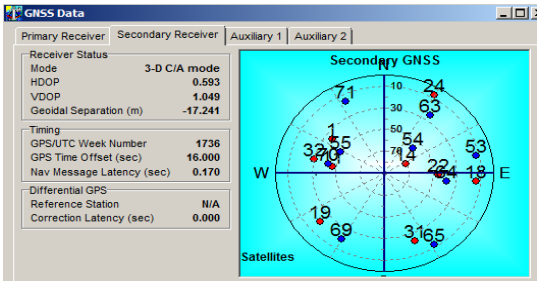
Satellite Constellation

(Use View> GPS Data)

Primary GPS



Secondary GPS



Sattelites in use: 9 **Sattelites in use:** 9

L1 SNR > 30 35 40 **L1 SNR > 30 35 40**

PDOP 2.305 (Use View> GAMS Solution)

POS/MV Configuration
Settings

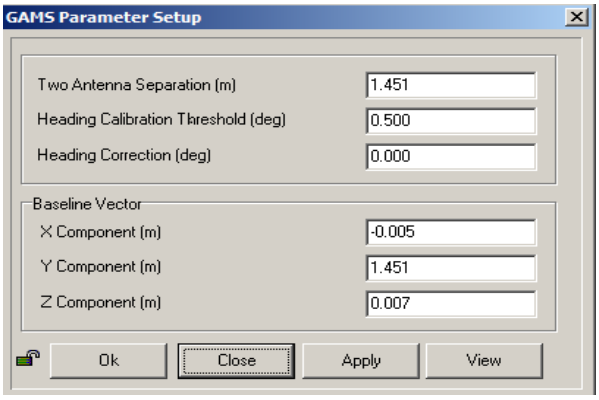
POS/MV Calibration

Calibration Procedure: (Refer to POS MV V4 Installation and Operation Guide, 4-25)

Start time: 15:38:16
End time: 16:41:50
Heading accuracy achieved for calibration: 0.025

Calibration Results:

Gams Parameter Setup (Use Settings > Installation > GAMS Intallation)



Save POS Settings on PC (Use File > Store POS Settings on PC)
File Name:
D:\HYPACK 2012\Projects\HSRR2012\Raw\Positioning

General Notes:

The POS/MV uses a Right-Hand Orthogonal Reference System

The right-hand orthogonal system defines the following:

- The x-axis is in the fore-aft direction in the appropriate reference frame.
- The y-axis is perpendicular to the x-axis and points towards the right (starboard) side in the appropriate reference frame.
- The z-axis points downwards in the appropriate reference frame.

The POS/MV uses a Tate-Bryant Rotation Sequence

Apply the rotation in the following order to bring the two frames of reference into complete alignment:

a) Heading rotation - apply a right-hand screw rotation θz about the z-axis to align one frame with the other.

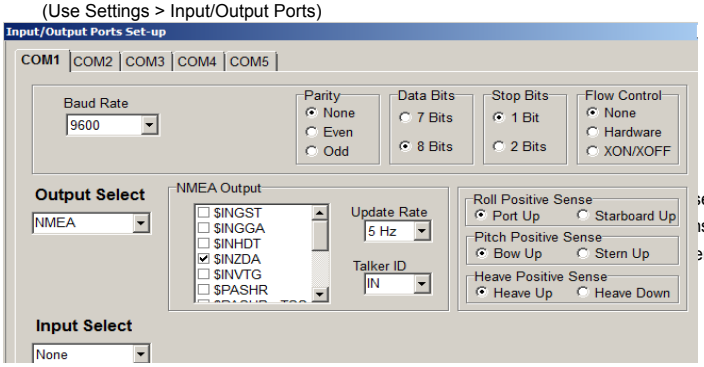
b) Pitch rotation - apply a right-hand screw rotation θy about the once-rotated y-axis to align one frame with the other.

c) Roll rotation - apply a right-hand screw rotation θx about the twice-rotated x-axis to align one frame with the other.

SETTINGS

Input/Output Ports (Use Settings > Input/Output Ports)

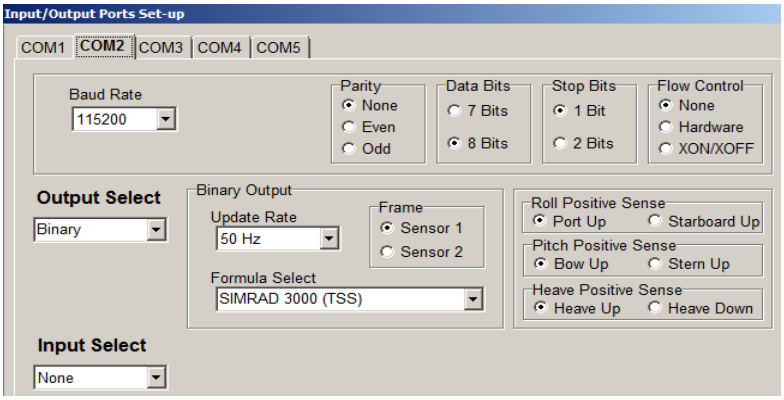
COM1



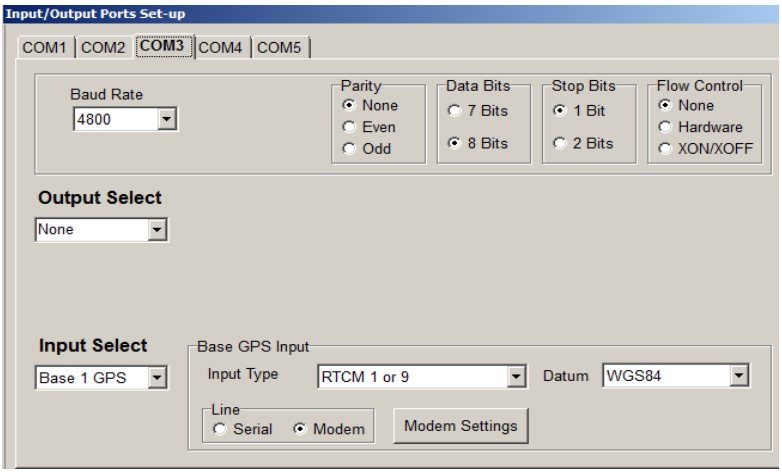
NMEA Output (selected strings shown here)

$INVTG	$PASHR TB	$INZDA
$INGST	$PASHR TSS	$INGGK
$INGGA	$PRDID TB	$UTC
$INHDT	$PRDID TSS	

COM2

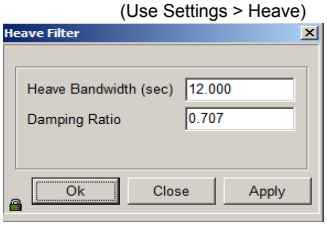


COM3

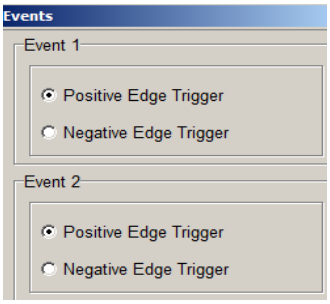


SETTINGS Continued

Heave Filter (Use Settings > Heave)

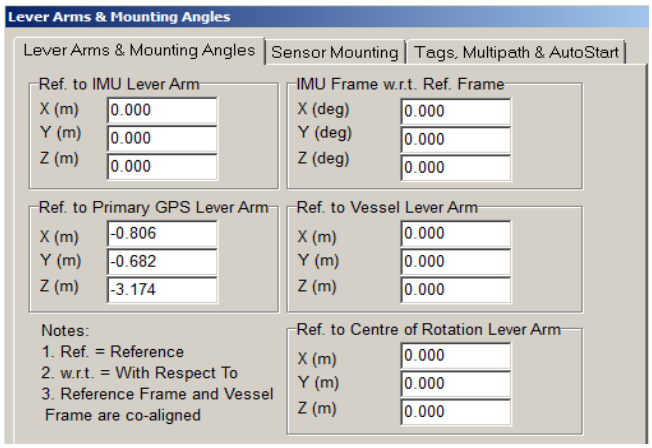


Events (Use Settings > Events)

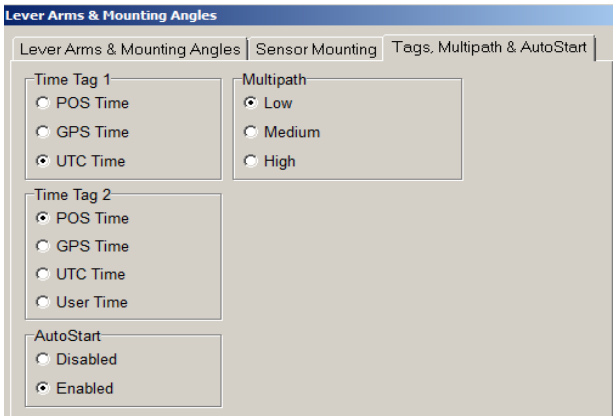


INSTALLATION (Use Settings > Installation)

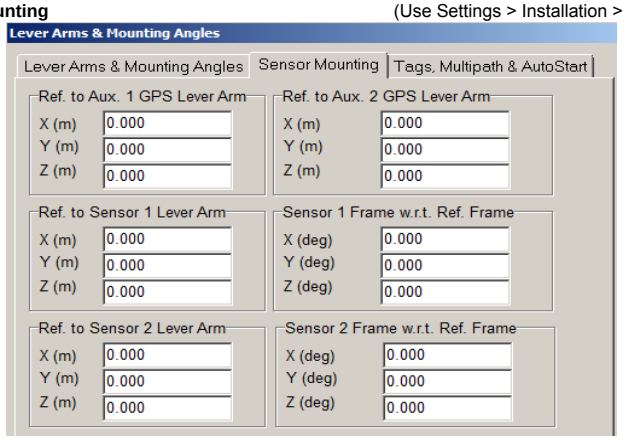
Lever Arms and Mounting Angles (Use Settings > Installation > Lever Arms and Offsets)



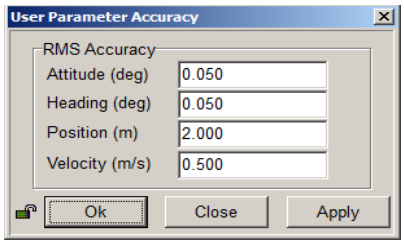
Tags, Multipath and Auto Start (Use Settings > Installation > Tags, Multipath and Auto Start)



Sensor Mounting (Use Settings > Installation > Sensor Mounting)



User Parameter Accuracy (Use Settings > Installation > User Accuracy)



Frame Control (Use Tools > Config)

☐ User Frame
☐ IMU Frame

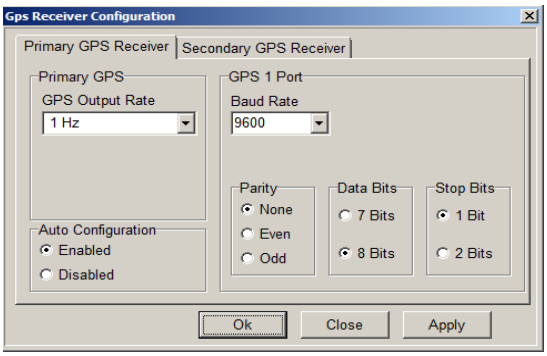
Primary GPS Measurement _____
Auxiliary GPS Measurement _____

☐ **Use GAMS enabled**

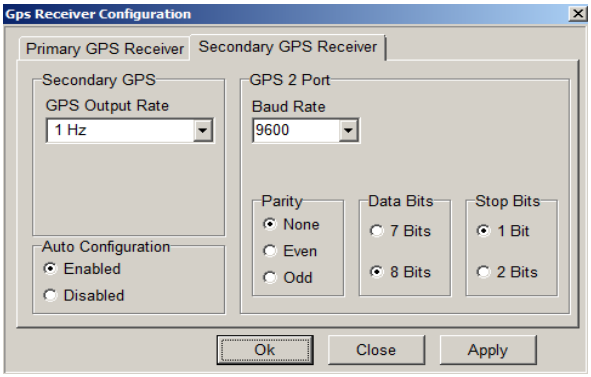
GPS Receiver Configuration

(Use Settings> Installation> GPS Receiver Configuration)

Primary GPS Receiver



Secondary GPS Receiver



ERDDM Acquisition Log

Launch 2808 400kHz
Vessel

4/16/2013	106	Lake Washington	clear, calm
Date	Dn	Local Area	Wx

Brooks, Broo, Chensue, Marwine
Personnel

No multibeam.
Comments

no tides	**Robinson Point, WA - 323 kHz (200 BPS)**
Tidal Cycle Notes	USCG DGPS Beacon Used

2013_106_2808.059 to .xxx
POSMV filename(s)

POS File	Azimuth	Vessel Speed (k	RPM	Start and End Time (UTC)
2013_106_2808.061-062	350	4.1	600	16:47:15 – 16:51:44
2013_106_2808.063-064	350	6.0	890	16:55:42 – 17:00:58
2013_106_2808.065-066	350	8.0	1360	17:06:58 – 17:12:00
2013_106_2808.066-067	170	10.0	1740	17:17:10 – 17:22:20
2013_106_2808.068-069	350	12.0	1890	17:29:20 – 17:33:47
2013_106_2808.070-071	170	14.0	2000	17:39:55 – 17:45:30

Processing Log

4/17/2013	107	Bravo and Witmer
Date	Dn	Personnel

☑ **POS Files Processed in POS Pac**

Smartbase
Smartbase or Singlebase? Station used.

☑ **SBET Processed in Pydro Using the ERDDM Tool**

☑ **Graph and Table Values compared with previous year**

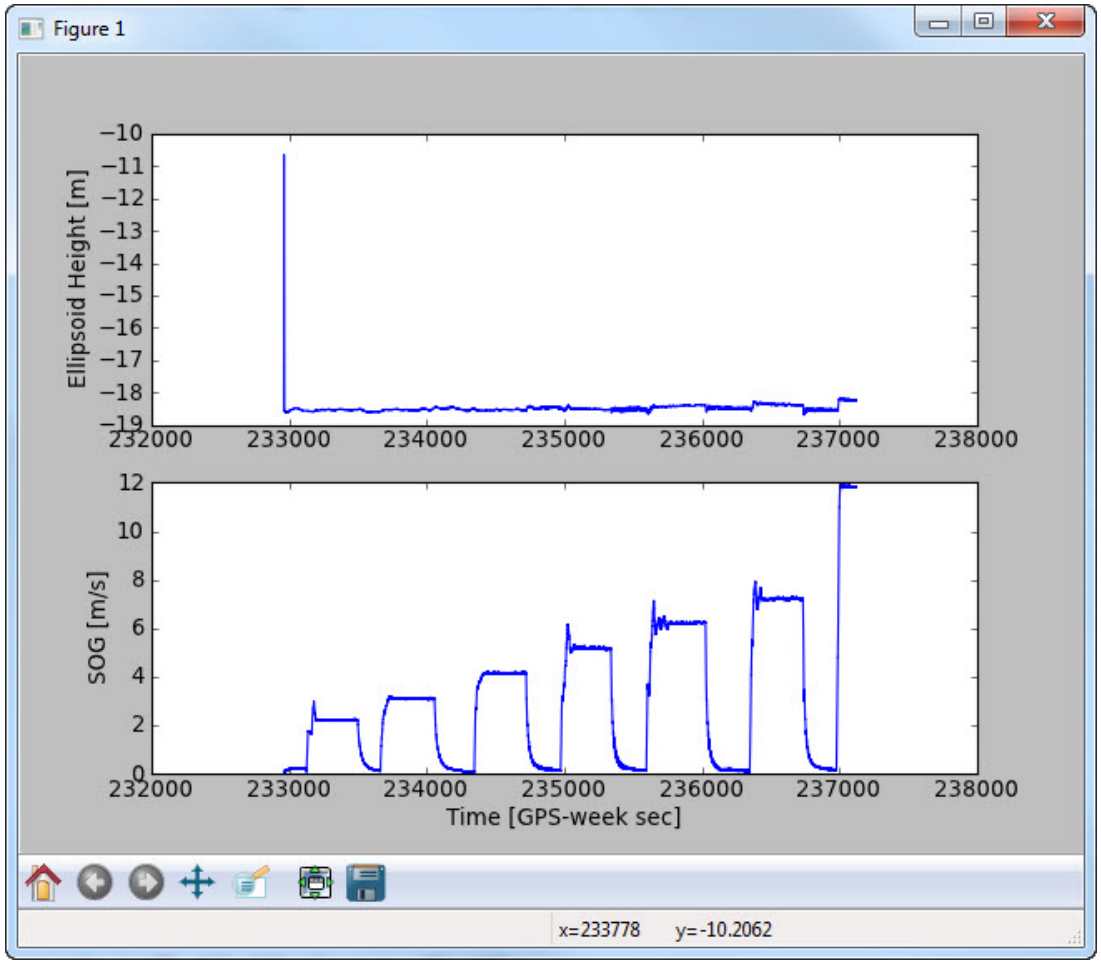
☑ **Documentaion Complete in DAPR Appendix**

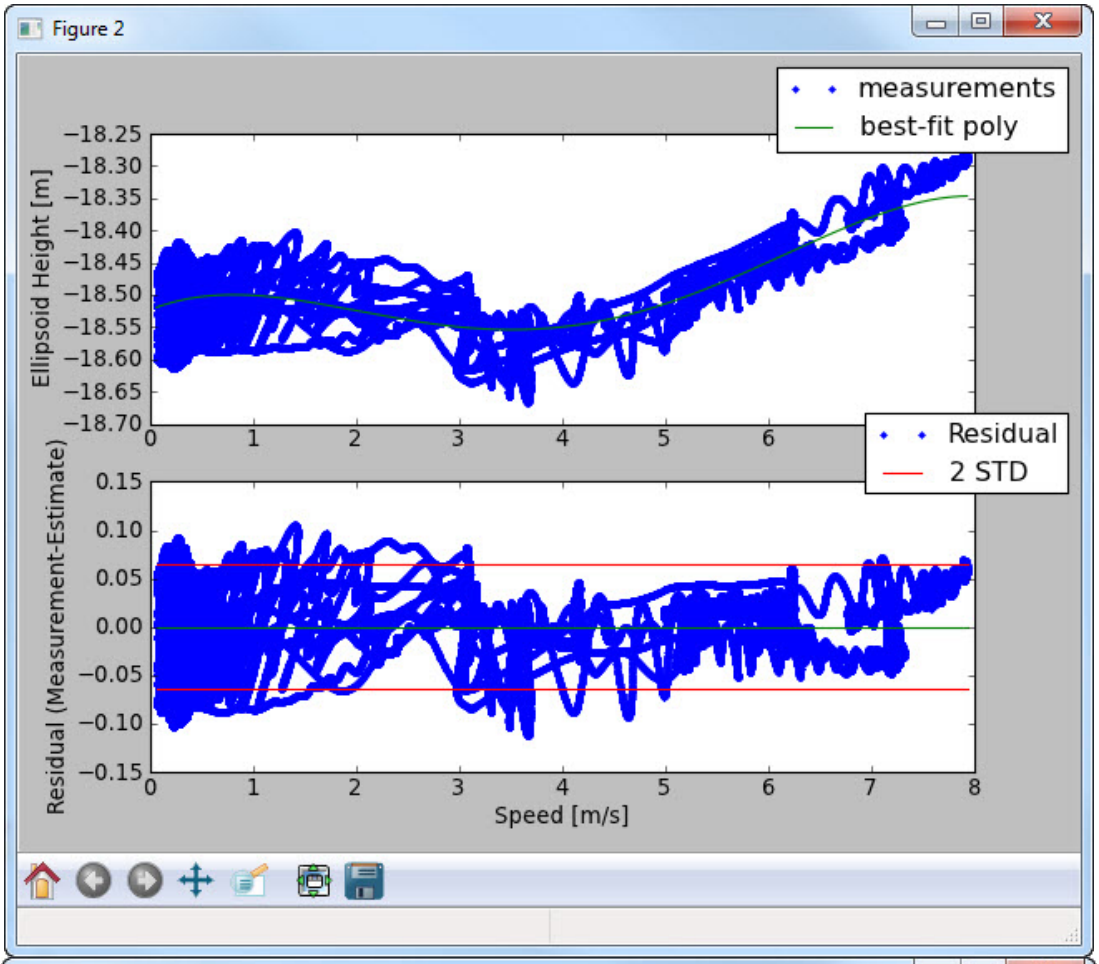
☑ **See OPS/CST for updating HVF with new values**

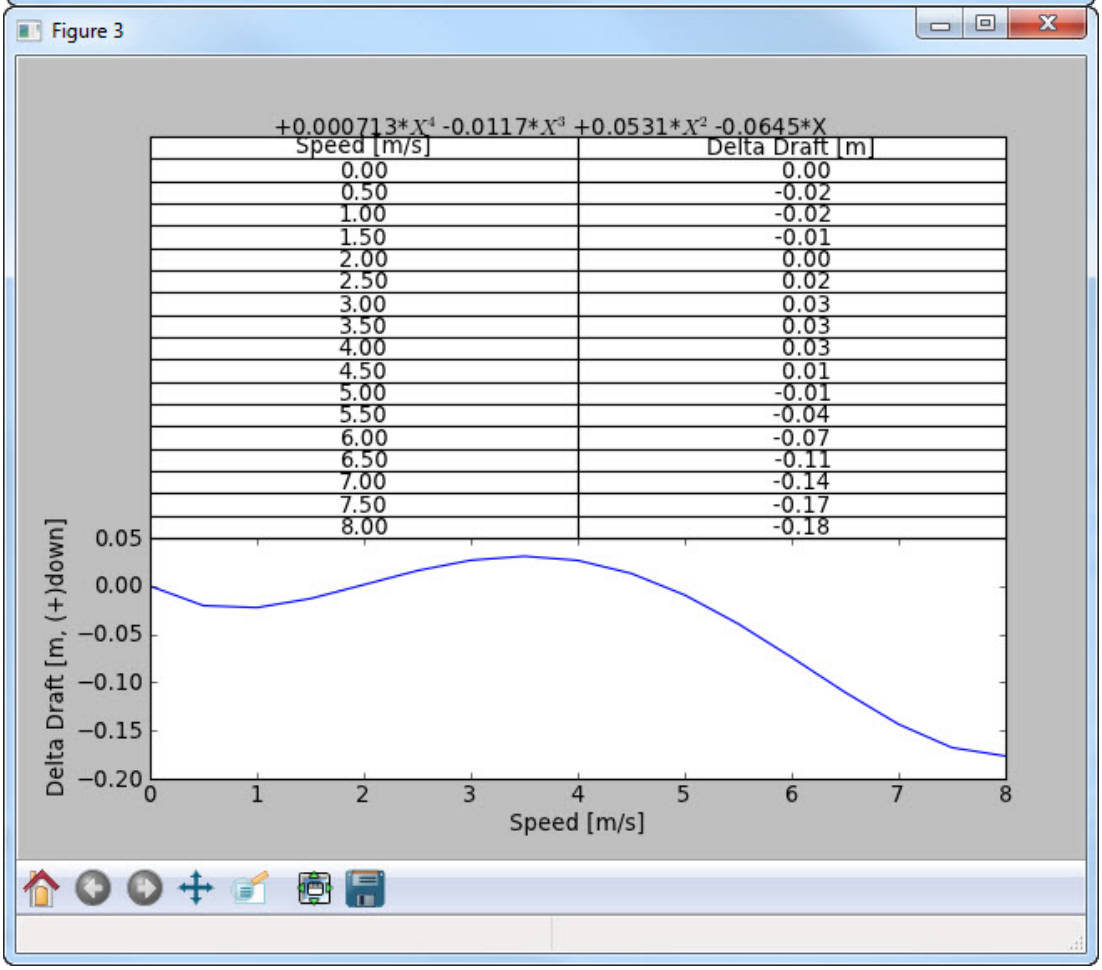
FA – 2808

2013- DN106

4th Order Ellipsoidally Referenced ERDDM







Speed [m/s]	Delta Draft [m]
0.00	0.00
0.50	-0.02
1.00	-0.02
1.50	-0.01
2.00	0.00
2.50	0.02
3.00	0.03
3.50	0.03
4.00	0.03
4.50	0.01
5.00	-0.01
5.50	-0.04
6.00	-0.07
6.50	-0.11
7.00	-0.14
7.50	-0.17
8.00	-0.18

Waterline Measurements

Fill in Yellow squares only!

Measuring Party: Francksen, Stuart, Pfundt, Smith

2808

Waterline measurements should be negative and cm!

	2808	
	Port Benchmark to Waterline	Stbd Benchmark to Waterline
Measure 1	-94.3	-98.3
Measure 2	-95.8	-97.1
Measure 3	-96.5	-98.4
Avg (cm)	-95.53	-97.93
Avg (m)	-0.9553	-0.9793
Stdev	0.01124	0.00723
BM Z-value (m)*	1.07600	1.04444
BM to WL (m)	0.121	0.065
Individual measurement	0.13300	0.06144
	0.11800	0.07344
StDev for TPU xls (of 6 #'s)	0.032	0.11100 0.06044

Date: 3/14/2011

Fuel Level: 62.6 GAL (about 1/2 full)

Draft Tube:

Port-to-Stbd Z-difference

Theoretical	Actual	Error
0.0316	-0.0240	-0.0556

RP to WL Average (m)

0.093 NGS Coordinate System (do not enter into CARIS directly)

(Add this value to VSSL_Offsets & Measurements_20XX.xls)

utilized in Offsets and Measurements and TPU spreadsheet

Measuring Party: Francksen, Pfundt, Abraham

Waterline measurements should be negative and cm!

	2808	
	Port Benchmark to Waterline	Stbd Benchmark to Waterline
Measure 1	-96.2	-97.1
Measure 2	-92.1	-96.1
Measure 3	-94.0	-96.8
Avg (cm)	-94.10	-96.67
Avg (m)	-0.9410	-0.9667
Stdev	0.02052	0.00513
BM Z-value (m)	1.07600	1.04444
BM to WL (m)	0.135	0.078
Individual measurement	0.11400	0.07344
	0.15500	0.08344
StDev for TPU xls (of 6 #'s)	0.034079	0.13600 0.07644

Date: 3/21/2011

Fuel Level: 100gal

Draft Tube:

Port-to-Stbd Z-difference

Theoretical	Actual	Error
0.0316	-0.0257	-0.0572

RP to WL Average (m)

0.106 NGS Coordinate System (do not enter into CARIS directly)

(or add this value to VSSL_Offsets & Measurements_20XX)

S220 Offsets and Measurements - Summary

Measurement Coord. Sys.	IMU to 7/8111 (MRU to Trans)	Port Ant to 7/8111 (Nav to Trans)	Waterline to RP*	Port Ant to Stbd Ant	IMU to Port Ant		IMU to Heave	
	Caris	Caris	Caris		Caris	Pos/Mv	Caris	Pos/Mv
x	2.868	2.071	n/a	Scaler Distance 1.997	0.797	-11.892	1.866	-7.028
y	8.252	20.144	n/a		-11.892	0.797	-7.028	1.866
z	4.752	17.821	0.081		13.068	-13.068	-2.086	-2.086

*Top of IMU is RP (Reference Pt)

Vessel Offsets for S220 7111 are derived from Westlake Survey Report NOAA Fairweather 09-23-03, Fairweather Centerline Survey (NGS) Report March 2009, and measurements by FA personnel in Measured Values 2010 and 2011.

Calculations

	IMU to 7/8111	Port Ant to 7/8111	Waterline to RP*	Port Ant to Stbd Ant	IMU to Port Ant	IMU to Heave
Coordinate Systems used as listed	Westlake IMU easting 0.000 Base northing 0.000 (ft/m) elevation 0.000	NGS Top of IMU x -11.892 to Port Ant y 0.797 (m) z 13.068	Westlake IMU Base to baseline at Keel (ft) elevation 12.856 IMU Base to baseline at Keel (m) elevation 3.919	NGS Phase Center x -11.892 Port Ant y 0.797 (m) z 13.068	NGS IMU Top (m) x 0.000 y 0.000 z 0.000	Westlake IMU to Bulkhd (Frame) 52 (ft) easting -11.638 (m) easting -3.547 IMU Base to baseline at Keel (ft) elevation 12.856 (m) elevation 3.919
	8111 (from IMU Base to sensor) easting 27.072 (ft) northing 9.410 elevation 15.042	CARIS Port x 0.797 Ant y -11.892 (m) z -13.068	Waterline to Keel (ft) elevation 13.67 Waterline to Keel (m) elevation 4.167	Top of old Stbd x -11.886 Ant (pre-2010) y 2.794 (m) z 13.051	Top of old Port x -11.892 Ant (pre-2010) y 0.797 (m) z 13.047	Frame 0 (FP) to Frame 52 (m) easting -27.737 IMU to Frame 0 (FP) (m) easting 24.190
	8111 (from IMU Base to sensor) easting 8.252 (m) northing 2.868 elevation 4.585	Westlake (m) easting 8.252 Top of IMU northing 2.868 to 8111 elevation 4.752	*See Ship's Draft Spreadsheet* Top of IMU to Base of IMU (m) elevation 0.168 Top of IMU to Keel (m) 4.086	Top to Base of Old (pre-2010) Ant measured (in) z 2.477 (m) z 0.0629	Top to Base of Old (pre-2010) Ant measured (in) z 2.477 (m) z 0.0629	Top of IMU to Base of IMU (ft) elevation 0.168 Top of IMU to Keel (m) elevation 4.086 Center of Gravity above baseline Heave Pt* to Frame 0 (FP) (ft) easting 102.42 Mean Metacentric height (m) easting 31.218 (ft) elevation 3.88
	Base of IMU to Top of IMU (m) elevation -0.168	CARIS (m) x 2.868 Top of IMU y 8.252 to 8111 z 4.752		Top of Stbd x -11.886 Ant Post y 2.794 (m) z 12.988	Top of Port x -11.892 Ant Post y 0.797 (m) z 12.984	IMU to Centerline (ft) northing 6.122 (m) northing 1.866 Heave Pt* to Centerline (m) northing 0 (*Heave Pt is Metacenter) (FP is Forward Perpendicular)
2010 value -> -0.322	Correction based on Ref Surface (m) elevation 0			Base to Phase Ctr New(2010) Ant listed on Ant(m) z 0.0843	Base to Phase Ctr New(2010) Ant listed on Ant (m) z 0.0843	

	IMU to 7/8111	Port Ant to 7/8111	Waterline to RP*	Stbd Antenna	IMU to Port Ant	IMU to Heave
	Westlake easting 8.252 Top-IMU northing 2.868 to 8111 (m) elevation 4.752	CARIS x 2.071 y 20.144 (m) z 17.821	Westlake easting N/A Waterline northing N/A to IMU (m) elevation 0.081	NGS (m) x -11.886 Top of IMU y 2.794 to Stbd Ant z 13.072 (aka Stbd Ant Phase Center)	NGS (m) x -11.892 Top of IMU y 0.797 to Port Ant z 13.068 (aka Port Ant Phase Center)	Westlake easting -7.028 Top-IMU to northing 1.866 Heave Pt* (m elevation -2.086 *(see Description Tab)*
	Coord Sys. CARIS x 2.868 y 8.252 z 4.752	Coord Sys. CARIS x 2.071 y 20.144 z 17.821	Coord. Sys CARIS x N/A y N/A z 0.081	Port Ant to Stbd Ant Scalar Distance (m) 1.997	Coord Sys. POS/MV x -11.892 y 0.797 z -13.068	Coord. Sys. POS/MV x -7.028 y 1.866 z -2.086

S220 Offsets and Measurements - Summary

Measurement Coord. Sys.	IMU to 8160 (MRU to Trans)		Port Ant to 8160 (Nav to Trans)		Waterline to RP*		Port Ant to Stbd Ant		IMU to Port Ant		IMU to Heave	
		Caris		Caris		Caris			Caris	Pos/Mv	Caris	Pos/Mv
x		0.493		-0.304		n/a	Scaler Distance	1.997	0.797	-11.892	1.866	-7.028
y		7.665		19.557		n/a			-11.892	0.797	-7.028	1.866
z		4.726		17.794		0.081			13.068	-13.068	-2.086	-2.086

*Top of IMU is RP (Reference Pt)

Vessel Offsets for S220 8160 are derived from Westlake Survey Report NOAA Fairweather 09-23-03, Fairweather Centerline Survey (NGS) Report March 2009, and measurements by FA personnel.

Derivations

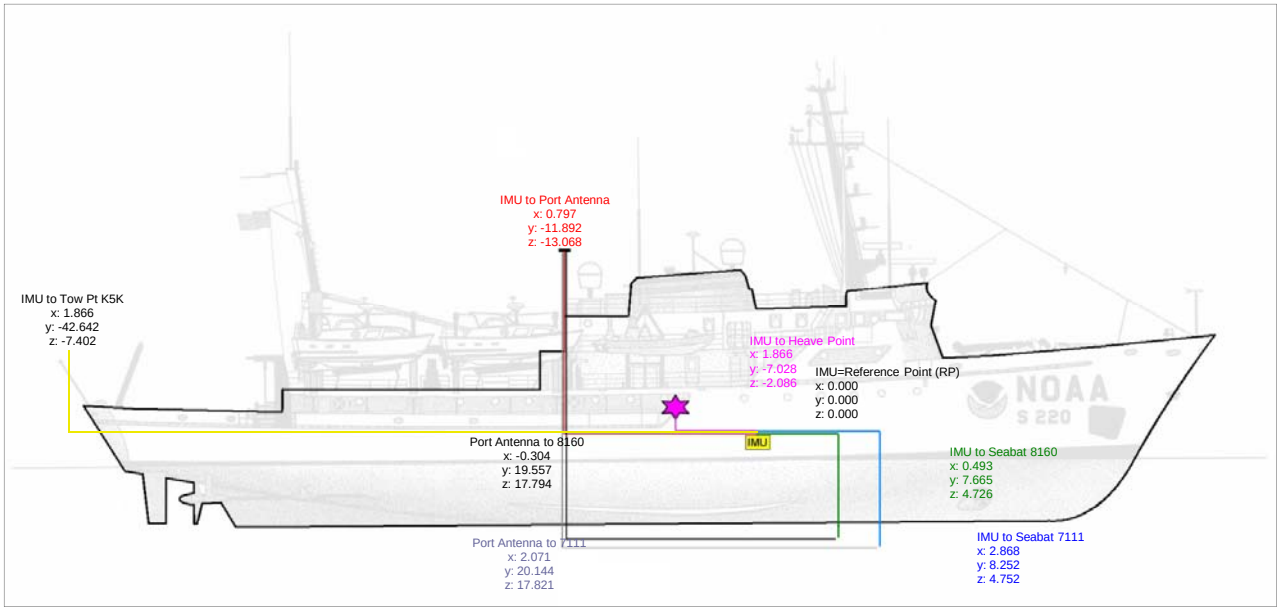
Coord. Sys.

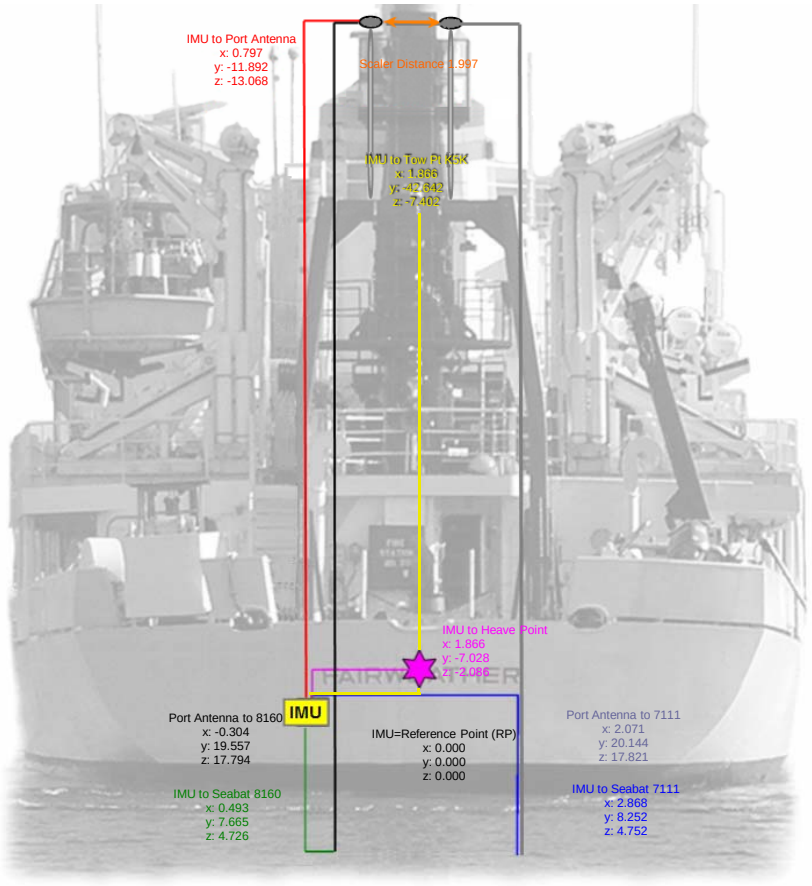
IMU to 8160			Port Ant to 8160		
Westlake			NGS 2009		
IMU	easting	0.000	Top of IMU	x	-11.892
Base	northing	0.000	to Port Ant	y	0.797
(ft/m)	elevation	0.000	(m)	z	13.068
8160 (from IMU Base to sensor)			CARIS		
	easting	25.149	Port	x	0.797
(ft)	northing	1.619	Ant	y	-11.892
	elevation	14.956	(m)	z	-13.068
8160 (from IMU Base to sensor)			Westlake		
	easting	7.665	(m)	easting	7.665
(m)	northing	0.493	Top of IMU	northing	0.493
	elevation	4.559	to 8160	elevation	4.726
Base of IMU to Top of IMU			CARIS		
(m)	elevation	-0.168	(m)	x	0.493
			Top of IMU	y	7.665
2010 value ->	Correction based on Ref Surface		to 8160	z	4.726
-0.206	(m) elevation	0			

IMU to 8160			Port Ant to 8160		
Westlake	easting	7.665	CARIS	x	-0.304
Top of IMU	northing	0.493		y	19.557
to 8160 (m)	elevation	4.726	(m)	z	17.794
Coord Sys CARIS			Coord Sys CARIS		
	x	0.493		x	-0.304
	y	7.665		y	19.557
	z	4.726		z	17.794

Description of Offsets for FAIRWEATHER S-220

All Values Shown are in CARIS Coordinates





IMU to 7/8111 (MRU to Trans)

x	y	z
2.868	8.252	4.752

The lever arms between the IMU and phase center of the 7111 transducer are taken from the Westlake report along with the the -0.168 m offset included for the height of the IMU.

IMU to 8160 (MRU to Trans)

x	y	z
0.493	7.665	4.726

The lever arms between the IMU and phase center of the 8160 transducer are taken from the Westlake report with the addition of the -0.168 m offset included for the height of the IMU.

IMU to TOW PT K5K

x	y	z
1.866	-42.642	-7.402

The offsets were determined using the NGS 2009 survey values for the A-Frame Stbd Pivot and measurements by FA personnel. Measurements between the A-Frame Pivot and the Tow point were made with a steel tape and digital level to determine the deployed angle of the A-Frame.

Port Ant to 7/8111 (Nav to Trans)

x	y	z
2.071	20.144	17.821

Relative positions obtained from Port Ant to 7/8111 via IMU.

Port Ant to 8160 (Nav to Trans)

x	y	z
-0.304	19.557	17.794

Relative positions obtained from Port Ant to 7/8111 via IMU.

Port Ant to Stbd Ant

Scaler Distance	1.997

Using the NGS 2009 survey values for the antennas, a calculated vector for antenna separation was determined. The distance from Top of Antenna to Phase Center does not affect this calculation and therefore was not included.

IMU to Port Ant

x	y	z
0.797	-11.892	13.068

This information comes from a combination of the Westlake, NGS surveys, and measurements by FA personnel. The NGS 2009 survey was to the top of the antenna, that distance (z-value) was measured in 2010 and subtracted to get the xyz of the antenna post. Then the distance (z-value) up to the phase center to the new 2010 antanna was added to obtain the xyz of the phase center of the newly installed (May2010) antenna.

Waterline to RP*

x	y	z
n/a	n/a	0.081

The height of the IMU above the keel comes from the Westlake survey value of 3.919 m plus the measured value of the top of the IMU to the base plate, to get an IMU height above the keel. The draft (waterline to keel) used for the FAIRWEATHER is based on observations, Ship's Draft spreadsheet. Differencing the value of IMU to keel and waterline to keel gives the waterline to RP distance.

IMU to Heave

x	y	z
1.866	-7.028	-2.086

Key points on the IMU, from the Westlake survey, are its location with respect to the ship's reference frame. It is 4.087 m (3.919 m to base line + 0.168 m for IMU height above base plate) above the keel, 1.866 m port of centerline and 3.547 m forward of frame 52. This information is needed to reference the IMU to the ship's Heave Measurement Location (Heave Point). *

IMU to Heave

From pg 3 of the Westlake Survey

SUMMARY

- IMU foundation plate is level to within +/-0.001 feet.
- IMU foundation plate is located 12.856 feet above baseline established at the keel.
- IMU is parallel to ship's centerline to within +/- 0.001 feet.
  Location of scribed centerline intersection is 6.122 feet port of ship's centerline.
- IMU foundation plate centerline is located 11.638' feet forward of bulkhead 52.

IMU to Heave

* From the Art Anderson inclination experiment the position of the metacenter was used as the position of the ship's Heave Point. (There may be a better way to determine the Heave Point, but this decision was based upon available information). The metacenter is defined by the center of buoyancy. As a vessel inclines through small angles, the center of buoyancy moves through the arc of a circle whose center is at the metacenter.

Important numbers and information determined from the Art Anderson report are the location of the metacenter and how it is positioned with respect to the vessel. The longitudinal location of the metacenter is defined as 102.42 feet (31.217 m) aft of the forward perpendicular. The height of the metacenter is 20.25 feet (6.172 m) above the keel. There is an assumption of the metacenter being on the centerline of the vessel. Similar values for the RAINIER's metacenter are 32.52 m aft of the forward perpendicular and 5.2 m above the keel. The difference in the height of the metacenter can be attributed to the difference between the FA's and RA's average draft which is 13.12 feet as opposed to approximately 14.5 feet respectively.

Referencing the metacenter (Heave Point, HP) to the IMU information requires information about the frame spacing of the vessel. From the Westlake survey, the IMU is located 3.547 m forward of frame 52. From Inclination document, the HP is 31.217 m aft of the forward perpendicular. From engineering drawings of the ship frame spacing is approximately 21 inches. The calculation for the longitudinal location of the HP with respect to frame zero, the Forward Perpendicular (FP) is as follows:

52 (frame) * 21 (inches/frame)/12(inches/ft)*.3048(m/ft)-3.547 m = 24.190 m from frame 0.

31.217 m (HP aft of FP) – 24.190 m (IMU aft of FP) = 7.027 m (HP aft of IMU)

The calculation for the vertical separation between the IMU and the HP is based on the height of the metacenter being 6.172m and the height of the IMU being 4.087 m above the keel. Differencing yields the metacenter being 2.085 m above the IMU.

The calculation for the athwartship separation is based upon the assumption that the HP is on the centerline and the knowledge that the IMU is 1.866 m to port of the centerline.

Sources

Offset values for the ship were derived from three sources. Three static offset surveys, an inclination experiment, and values measured or approximated by ship's personnel.

On September 23, 2003 an offset survey of the NOAA Ship FAIRWEATHER was conducted by:
Westlake Consultants, Incorporated
15115 SW Sequoia Parkway, Suite 150
Tigard, Oregon 97224
Phone (503) 684-0652

The relocation of the POS M/V antenna forced a partial resurvey in Feb-2007 by Steven Breidenbach of NGS (values no longer utilized).

While in drydock, another NGS (Centerline) survey was conducted March, 2009.

These values relate the physical positions of one sensor to the next with the base plate of the IMU being the point of origin. All dimensions in the document are given in feet and decimal feet.

On July 16, 2004 an inclination experiment was conducted at MOC-P by:

Art Anderson Associates
202 Pacific Avenue
Bremerton, WA 98337-1932

Calculations

The values for the required lever arms are listed in the S220_Offsets and Measurements spreadsheet. The reference point and the IMU are identical. Difference in documentation between Westlake and FA calculations are based off of measuring up from the IMU base (Westlake's origin) and the top of the IMU. The top center of the IMU for the POS/MV is the defined origin for the POS/MV and the origin that is being used on all FAIRWEATHER vessels. The distance from the base plate to the top of the IMU is 0.168 m, a value measured by ship's complement. Conversions factor from feet to meters is 0.3048 m/ft.

As a requirement for the TPU, the standard deviation for each position is 3 mm. This value is based upon a conversation with Elaine McDonald of Westlake and is followed up by an Email documenting that fact. The email is located at the end of this document.

US DEPARTMENT OF COMMERCE
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
NATIONAL GEODETIC SURVEY
GEODETIC SERVICES DIVISION
INSTRUMENTATION & METHODOLOGIES BRANCH

NOAA SHIP FAIRWEATHER
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY
FIELD REPORT

Kendall Fancher
March , 2009

PRIMARY CONTACTS

Glen Rice NOAA 757-615-6465

NOAA SHIP FAIRWEATHER
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

PURPOSE

The primary purpose of the survey was to precisely determine the spatial relationship of various components of a POS MV navigation system aboard the NOAA ship FAIRWEATHER. Additionally, various reference points (bench marks) were re-established onboard the vessel to aid in future spatial surveys aboard the boat.

PROJECT DETAILS

This survey was conducted while the ship was in dry dock at the Lake Union dry dock in Seattle, WA. The weather conditions over the two days required to conduct this survey were windy, cool, with intermittent rain.

INSTRUMENTATION

The Leica TC2003 total station was used to make all measurements.

Technical Data:

Standard Deviation	
Horizontal angle	0.5 seconds
Vertical angle	0.5 seconds
Distance measurement	0.2mm + 2ppm

A Leica precision prism was used as a sighting target. This prism was configured to have a zero mm offset.

PERSONNEL

Kendall Fancher NOAA/NOS/NGS/GSD/I&M BRANCH
(540) 373-1243

Dennis Lokken NOAA/NOS/NGS/GSD/I&M BRANCH
(540) 373-1243

NOAA SHIP FAIRWEATHER
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

DEFINITION OF THE REFERENCE FRAME

To conduct this survey a local coordinate reference frame was established where the Northing (Y) axis runs along the centerline of the ship and is positive from the IMU towards the bow of the ship. The Easting (X) axis is perpendicular to the centerline of the ship and is positive from the IMU towards the right, when looking at the ship from the stern. The Up (Z) axis is positive in an upward direction from the IMU.

SURVEY METHODOLOGY

02/15/2009

Coordinates of 100.000N, 100.000E, and 100.000U were assumed for temporary control point 1. A distance and height difference were measured between temporary control points 1 and 3. These values were used to determine the coordinates at temporary control point 3. Temporary control points 1 and 3 were located along the top deck and on the north side of the dry dock vessel.

Temporary control point 1 was occupied and temporary control point 3 was observed for a backsight. After initialization, temporary control points 2 and 4(located on the top deck of the dry dock vessel), H1 (located on the bottom deck of the dry dock vessel), and BOW BM were observed in both direct and reverse.

Temporary control point 2 was occupied and temporary control point 3 was observed for a backsight. After initialization, temporary control point W1 (located on the top deck of the dry dock vessel) and D1 (located inside the ship on the D deck along the port side) were observed in both direct and reverse. Temporary control point 1 was also observed and yielded an inverse check of 0.001m horizontally and 0.001m vertically.

Temporary control point 4 was occupied and control point 1 was observed for a backsight. After initialization, temporary control point 5 (located on the south side and on the top deck of the dry dock vessel) was observed in both direct and reverse.

Temporary control point 5 was occupied and control point 4 was observed for a backsight. After initialization, temporary control point D2 (located inside the ship on the D deck along the starboard side) was observed in both direct and reverse.

Temporary control point H1 was occupied and control point 1 was observed for a backsight. After initialization, temporary control point H2 (located on the bottom deck of the dry dock vessel), and USBL BM were observed in both direct and reverse.

Temporary control point H2 was occupied and temporary control point H1 was observed for a backsight. After initialization, 8111 BM and 8160 BM were observed in both direct and reverse. Temporary control point W1 was also observed and yielded an inverse check of 0.019m horizontally and 0.033m vertically.

Temporary control point D1 was occupied and temporary control point D2 was observed for a backsight. After initialization, temporary control point D3 (located in the doorway leading to the mess hall on the D deck) was observed in both direct and reverse.

Temporary control point D3 was occupied and temporary control point D1 was observed for a backsight. After initialization, temporary control point C1 (located on the C deck near the IMU) was observed in both direct and reverse. Temporary control point D2 was also observed and yielded an inverse check of 0.026m horizontally and 0.0001m vertically.

Temporary control point C1 was occupied and temporary control point D3 was observed for a backsight. After initialization, IMU, IMU BOW PORT CORNER, IMU BOW STAR CORNER, IMU STERN STAR CORNER, and IMU STERN PORT CORNER were observed in both direct and reverse.

02/16/2009

Temporary control point 4 was occupied and control point 1 was observed for a backsight. After initialization, temporary control point 6 (located on the south side and on the top deck of the dry dock vessel) and BOW BM were observed in both direct and reverse. Temporary control point D2 was also observed and yielded an inverse check of 0.0004m horizontally and 0.083m vertically.

Temporary control point 6 was occupied and temporary control point 4 was observed for a backsight. After initialization, TRANSOM PIVOT POINT PORT, STERN BM, POS GPS ANT RAIL BM, POS IMU ANT DECK BM, POS GPS ANT STARBOARD, and POS GPS ANT PORT were observed in both direct and reverse.

Temporary control point 3 was occupied and temporary control point 1 was observed for a backsight. After initialization, TRANSOM PIVOT POINT STARBOARD, STERN BM, POS GPS ANT STARBOARD, and POS GPS ANT PORT were observed in both direct and reverse. Temporary control point 6 was also observed and yielded an inverse check of 0.0006m horizontally and 0.001m vertically.

The reference frame was rotated using STERN BM as the point of rotation. A zero degree azimuth was used during the rotation from STERN BM to BOW BM. The reference frame was then translated to relocate the origin of the reference frame to the IMU.

NOAA SHIP FAIRWEATHER
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

INVERSE RESULTS

Inverses were computed between the determined positions of those ship benchmarks and sensor points which were determined from two separate locations The results of these inverses are:

ID	Horizontal Dist.(m)	Elevation Diff(m)
BOW BM	0.0150	0.0240
STERN BM	0.0060	0.0010
POS GPS ANT STARBOARD	0.0100	0.0001
POS GPS ANT PORT	0.0100	0.0000

DISCUSSION

The Fairweather was in dry dock during this survey, however, the dry dock vessel was still subject to movement due to wave action. Conducting a survey such as this while the ship is moving requires that the automatic compensators in the survey instrument be turned off. The survey is therefore conducted with all survey instrumentation set up relative to the mean movement of the related level vials. While every effort was made to make the most precise measurements possible, some additional error accumulation cannot be avoided under these type observing conditions.

The POS GPS antenna coordinates were determined to the top center of the antennas. The Z value should be corrected to the Antenna Reference Point (ARP). In order to apply this correction, the mechanical height of the antenna should be determined and subtracted from the Z value determined during this survey for both of the POS GPS antennas.

NOAA SHIP FAIRWEATHER
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

Coordinate Listing using IMU as the Reference Frame Origin

ID	X(NORTHING)m	Y(EASTING)m	Z(UP)m
IMU CENTER	0.000	0.000	0.000
IMU STERN PORT CORNER	-0.071	-0.089	-0.001
IMU BOW PORT CORNER	0.070	-0.086	-0.001
IMU BOW STARBOARD CORNER	0.069	0.087	0.000
IMU STERN STARBOARD CORNER	-0.073	0.086	0.000
BOW BM	28.378	1.805	7.796
STERN BM	-40.306	1.805	2.255
USBL BM	-28.354	1.738	-4.204
8160 BM	8.407	0.395	-4.400
8111 BM	8.532	3.002	-4.666
POS GPS ANT RAIL BM	-12.011	1.785	10.381
POS IMU ANT DECK BM	-11.790	1.780	9.305
POS GPS ANT STARBOARD	-11.886	2.794	13.051
POS GPS ANT PORT	-11.892	0.797	13.047
TRANSOM PIVOT POINT STARBOARD	-39.727	3.366	2.385
TRANSOM PIVOT POINT PORT	-39.722	0.240	2.345

NOAA SHIP FAIRWEATHER
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

IMU Reference Points

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POS GPS ANTENNAS

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BOW CENTERLINE REFERENCE POINT

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CENTERLINE REFERENCE POINT ON G DECK

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POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

CENTERLINE REFERENCE POINT ON RAIL AT G DECK

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CENTERLINE STERN REFERENCE POINT

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TRANSOM REFERENCE POINT ON PORT SIDE

TRANSOM REFERENCE POINT ON STARBOARD SIDE

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8111 REFERENCE POINT

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8160 REFERENCE POINT

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POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

USBLE REFERENCE POINT

STABILITY TEST: **NOAA Ship FAIRWEATHER (16 Jul 2004)**

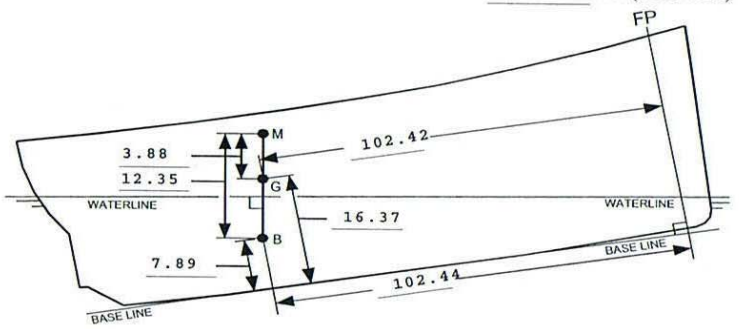
SHIP AT TIME OF STABILITY TEST--CONDITION 0

		FROM HYDROSTATIC CURVES	FROM INDEPENDENT CALCULATION
Corrected diaplacement		tons	1638.79 tons
Mean virtual metacentric height obtained from plot of inclining moments versus tangents of angles of heel	$\frac{\text{moment}}{\text{displacement x tangent}}$ = 5987.252 / 1638.790	feet	3.65 feet
Correction for free surface	= 374.0 / 1638.790	feet	0.23 feet
Mean metacentric height G.M. =		feet	3.88 feet
Transverse metacenter above base line corresponding to draft at LCF (corrected for hog or sag)		feet	
Transverse metacenter above base line corrected for trim, and hog or sag		feet	
C.G. above base line		feet	16.37 feet (from figure)
			16.36 feet (from GHS)
Longitudinal metacenter above C.G.		feet	
Moment to alter trim 1 foot, (Long GM x Δ) / L		ft-tons	
Trim by stern		feet	
Trimming lever = (Trim x moment to trim) / displacement		feet	
Longitudinal center of buoyancy (LCB) from origin		feet	
C.G. from origin		feet	102.44 feet (from figure)
			102.42 feet (from GHS)

Period of complete roll _____ seconds

Apparent radius of gyration of vessel $\alpha = \frac{T\,GM}{1.108}$ _____ feet

Rolling constant $C = \frac{T\,GM}{B}$ _____



Definitions and Basis for Dimensions/Locations

Northings

Northings (Port - Starboard) are with reference to the IMU Foundation Plate centerline scribe.
Positive values are starboard of the IMU.
Negative values are port of the IMU.
Calculated values are in italics.

Eastings

Eastings (Stern to Bow) are with reference to the IMU Foundation Plate centerline scribe.
Positive values are forward of the IMU.
Negative values are aft of the IMU.
Calculated values are in italics.

Elevations

Elevations are with reference to the IMU Foundation Plate centerline scribe = 0 elevation.
Positive values are below the IMU (toward the keel).
Negative values are toward the topside.

Dimensions

All dimensions are in feet and decimal feet. All dimensions provided are "offsets" to IMU centerline.

Ship's Centerline Data

At project initiation, control was established to define the ship's centerline
as a plane running from a point on the centerline of the keel at the stern through a
point on the centerline of the keel near the bow, to a point on the bow splitting the bow chock.

IMU Referenced Data - Procedure

All data was originally referenced to the ship's geometry.
Following location of the IMU, data was transformed to the IMU as point of origin for
Northings, Eastings, and Elevation. All dimensions provided with reference to the IMU are "offsets."

Ship's Centerline - Control Measurements

(Prior to location of IMU and referencing of data to IMU as point of origin (0,0,0)

Defined by measurements at the keel centerline

	longitude	transverse	elevation
near the bow	1190.674	1000.000	135.8672
at the stern (point of origin)	1000.000	1000.000	100.0000
along the keel (approx 180' forward)	1180.121	1000.000	116.6810

Ship's Baseline

Defined by measurements on the keel

	longitude	transverse	elevation
at the stern (point of origin)	1000.000	1000.000	100.0000
and approx. 129' forward of stern	1129.120	999.985	100.0022

IMU Foundation Plate

	EASTING	*NORTHING*	*ELEVATION*
Horizontal alignment per scribed lines on IMU foundation plate		**0.001**	
		0.000	
Scribed lines - intersection/centerline of IMU plate			
	0.000	**0.000**	**0.000**
Elevation checks near four corners of IMU Foundation plate *			
			0.001
			-0.001
			0.000
			-0.001

** elevation check adjusted for target that created 10 mm offset =.03281 feet*

SUMMARY

- IMU foundation plate is level to within +/-0.001 feet.
- IMU foundation plate is located 12.856 feet above baseline established at the keel.
- IMU is parallel to ship's centerline to within +/- 0.001 feet.
  Location of scribed centerline intersection is 6.122 feet port of ship's centerline.
- IMU foundation plate centerline is located 11.638' feet forward of bulkhead 52.

Granite Block

	EASTING	*NORTHING*	*ELEVATION*	
Horizontal alignment per scribed lines				
		1.584		
		1.583		
Scribed lines - intersection/centerline of granite block				
	-0.003	**1.583**		
				Deviation
Elevation checks near four corners of granite block				from level
** elevation check adjusted for target that created 10 mm offset = 0.03281 feet*			**-0.217**	-0.001
			-0.217	-0.001
			-0.216	0.001
			-0.215	0.001

SUMMARY

- Granite block is level to within +/-0.001 foot
  of average elevation = -0.21632 feet
- Granite block is parallel to ship's centerline to within 0.001 foot
  Location is 4.54 feet to port of ship's centerline and 1.583 feet starboard of IMU.
- Granite block is aligned with IMU to within 0.003 feet longitudinally.

Array Acoustical Centers - Referenced to IMU

	EASTING	*NORTHING*	*ELEVATION*
PORT ARRAY (81-60)	***25.149***	***1.619***	***14.956***

Explanation of Calculations

Acoustic center is defined as the center of the transmitter array with the elevation = 83 mm below mounting face of array.

Easting

Center of array is defined by the foundation plate bolt centerlines (1/2 distance between bolts)

27.008	Forward edge of foundation as measured
- 0.104	Forward edge of foundation to centerline of forward bolt hole
- 1.755	Distance from bolt hole centerline to center of array
25.149	feet forward of IMU

Northing

Center of array is defined as the mid-point between the bolt holes on the foundation.

1.369	Port edge of foundation as measured
+ 0.078	Port edge of foundation to centerline of bolt hole - per Cascade General
+ 0.172	Distance from bolt hole centerline to array center
1.619	feet starboard of IMU

Elevation

Per Reson drawing 2148M011_001 the elevation is 83 mm below array mounting surface

14.679	Array foundation elevation as measured.
0.005	Isolation "shim" added between foundation and array
0.272	83 mm below array mounting surface to acoustical center
14.956	feet below IMU

Array Acoustical Centers - Referenced to IMU

	EASTING	*NORTHING*	*ELEVATION*
STARBOARD ARRAY (81-11)	***27.072***	**9.41**	***15.042***

Explanation of Calculations

Acoustic center is defined as midpoint of the transmitter array in the longitudinal and transverse axes. The elevation is defined as the center of the receiving array.

Easting

Center of array is defined as 0.235' aft of the forward bolt centerlines on transmitter array foundation

28.563	Forward edge of foundation fixture plate as measured (receiving plate forward edge)
27.349	Forward edge of transmitter array foundation as calculated
- 0.042	Forward edge of foundation to centerline of forward bolt hole - per design
- 0.235	Distance from bolt hole centerline to center of array - per design
27.072	feet forward of IMU

Northing

Center of array is defined as the mid-point between the bolt holes on the transmitter array foundation.

9.410	Centerline of array foundation as measured on scribe - aft section of fixture plate
9.410	feet starboard of IMU

Elevation

Elevation is 0.401 feet above receiver array mounting surface

16.085	Mounting foundation fixture plate as measured.
15.447	Receiver foundation elevation - as calculated
+ 0.005	Isolation "shim" added between foundation and array
- 0.410	Design distance from mounting surface of array to acoustic center
15.042	feet below IMU

Longitudinal Array Foundation - Port Side

	EASTING	NORTHING	ELEVATION	
Horizontal alignment *measured* at port edge of array foundation				
		1.369		
		1.369		
Forward edge of array foundation - *measured*				
	27.008			
Horizontal alignment - *calculated* to array centerline				
Foundation edge is 0.25 feet port of		***1.619***		
array centerline		***1.619***		
				deviation from
Elevation checks near four corners of array foundation				level (average)
			14.680	0.001
			14.681	0.002
			14.678	-0.001
			14.677	-0.002

SUMMARY

- Port longitudinal array foundation average elevation is 14.679 feet.
  Variation in elevation is +0.002 to -0.002 feet.
- Port longitudinal array foundation is parallel to ship's centerline and 1.369 feet starboard of IMU.
  Calculated array centerline is 1.619 feet starboard of IMU

Longitudinal Array Foundation - Starboard Side

	EASTING	NORTHING	ELEVATION	deviation from parallel
Horizontal alignment *measured* on fixture plate scribe -				
Design location is 3.292 feet		**9.410**		0.002
starboard of ship centerline		**9.406**		-0.002
Forward edge of array foundation fixture plate - *measured*				
	28.563			
				deviation from
Elevation checks near four corners of array foundation "fixture plate"				*average*
			16.085	0.000
			16.085	0.000
			16.084	0.000
			16.085	0.000

Calculated locations of longitudinal and transverse array foundations

Forward edge	
Receiver (transverse)	**28.563**
Transmitter (longitudinal)	***27.349***
difference = 1.214	

NOTE: *On Transmitter array foundation - from forward edge to center of forward holes = 0.042'*
On Receiver array foundation distance from forward edge to center of forward holes = 0.076'

Calculated elevation of longitudinal and transverse array foundations

Receiver/Transverse Foundation	***15.446***
Transmitter/Longitudinal Foundation	***15.709***
difference = 0.263	

SUMMARY

- Starboard longitudinal array foundation (measured at fixture plate) average elevation is 16.085 feet.
  Deviation from level (average elevation) is less than 0.001 feet.
- Starboard longitudinal array foundation averages 9.408 feet starboard of IMU.
  Variation from parallel is from -0.002 feet to +0.002 feet from average.
- Starboard longitudinal array foundation forward edge is 28.563 feet forward of IMU.

Transverse Array Foundation - Port Side

	EASTING	NORTHING	ELEVATION	
Forward Edge - Transverse array foundation - *measured*				
	28.343			
	28.338			
Port edge - Transverse array - *measured*				
		-0.181		
Centerline of array - *calculated*				
Foundation forward edge minus	***28.093***			
0.25 feet to array centerline	***28.088***			
Port edge of foundation plus 1.806 feet		***1.624***		
to calculated array centerline				
				deviation from
Elevation checks near four corners of array foundation				level
			14.679	0.002
0.861 feet below baseline with 0.965			**14.675**	-0.001
foot offset = 98.180 feet average			**14.675**	-0.001
elevation			**14.677**	0.001

SUMMARY

- Transverse array foundation average measured elevation is 14.677 feet
  below IMU (0.006 feet above design location).
  Deviation from level (average elevation) is 0.003 to -0.001 feet
- Transverse array foundation centerline (calculated) averages 28.090 feet forward of IMU.
  Variation from parallel to ship's centerline is from -0.003 to 0.003 feet (from average).
- Transverse array centerline is calculated to be 1.624 feet starboard of IMU.

Transverse Array Foundation - Starboard Side

NOTE: Direct Measurements were not taken to the transverse array because a single "fixture plate" covered bo
transmitter and receiver foundations. The data provided here is primarily *"calculated".*

	EASTING	NORTHING	ELEVATION
Forward edge - as measured on fixture plate			
Receiver - (transverse)	**28.563**		
as measured			
Transmitter (longitudinal)	***27.349***		
difference = 1.214			

NOTE: *On Transmitter array foundation - from forward edge to center of forward holes = 0.042'*
On Receiver array foundation distance from forward edge to center of forward holes = 0.076'

Horizontal Alignment	**9.406**	
centerline scribe on fixture plate		
as measured - forward portion of plate		
(near receiver array)		
Average of measurements on fixture plate	***9.408***	
Elevation of longitudinal and transverse array foundations		
Receiver/Transducer Transverse Foundation		***15.446***
Transmitter/Longitudinal Foundation		***15.709***
difference = 0.263		

Based on measured elevations averaging 16.085 feet across fixture plate

SUMMARY

- Transverse array foundation is calculated to be 15.446 feet below IMU - calculated from measured elevation of 16.085 feet. Deviation in elevation measurements across the array fixture plate is less than 0.001 fe
- Transverse array foundation forward edge (measured) is 28.563 feet forward of IMU.
- Transverse array centerline is measured to be 9.406 feet starboard of IMU.

Variation from parallel of the fixture plate across entire starboard array is ± 0.002 feet (from average).

Antennae

	EASTING	*NORTHING*	*ELEVATION*
Stbd POS MV Antenna -Location	**-35.866**	**12.925**	**-38.209**
Port POS MV Antenna - Location	**-35.739**	**-0.409**	**-38.283**
Foundation Plate Stack Antenna Alignment		**7.677**	
Foundation Plate Stack Antenna Alignment		**7.677**	
Port GYRO Foundation Plate Alignment		**2.411**	
Port GYRO Foundation Plate Alignment		**2.411**	
Stbd GYRO Foundation Plate Alignment		**3.866**	
Stbd GYRO Foundation Plate Alignment		**3.867**	

SUMMARY

- Foundation plate stack antenna alignment is parallel to ship's centerline.
- Port GYRO Foundation Plate is aligned parallel to ship's centerline.
- Starboard GYRO Foundation Plate is aligned parallel to ship's centerline.

FAIRWEATHER

Multibeam Echosounder Calibration

S220 7111
Vessel

9/11/2013	254	Cordell
Date	Dn	Local Area

Froelich
Calibrating Hydrographer(s)

MBES System	MBES System Location	Date of most recent EED/Factory Check

Sonar Serial Number	Processing Unit Serial Number

Sonar Mounting Configuration	Date of current offset measurement/verification

Applanix POS/MV S/N:3628 IMU S/N:XXX	
Description of Positioning System	Date of most recent positioning system calibration

Acquisition Log

9/11/2013	254	Cordell Bank, CA	calm
Date	Dn	Local Area	Wx

Sand and rocks	100-30 m
Bottom Type	Approximate Water Depth

Personnel on board

Comments

2013_254_S220.004-007
POSMV Filename(s)

2013_254_212053.HEX	2120	038/01/13 N	123/28/03 W	79.28m	
SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
SV Cast #3 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

NAV TIME LATENCY view parallel to track, one line with induced roll (outerbeam) or same lines bounded slope (nadir) [same direction, different speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1				
2				
3				
4				
5				
6				
7				
8				

PITCH view parallel to track, same line (at nadir) [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	2013M_2541917.RAW	092	6.0	
2	2013M_25411931.RAW	271	6.0	
3	2013M_25411945.RAW	092	8.0	
4	2013M_25411956.RAW	270	8.0	
5				
6				
7				
8				

HEADING/YAW view parallel to track, offset lines (outerbeams) [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	2013M_2542012.RAW	092	6.0	
2	2013M_2542050.RAW	270	6.0	
3	2013M_2542026.RAW	270	8.0	
4	2013M_2542037.RAW	090	8.0	
5				
6				
7				
8				

ROLL view across track, same line [opposite direction, same speed]

Line Number	XTF Line Filename	Heading	Speed (kts)	Remarks
1	2013M_2541854.RAW	060	4.0	
2	2013M_2541906.RAW	225	4.0	
3				
4				
5				
6				
7				
8				

Processing Log

9/11/2013	254	Faulkes
Date	Dn	Personnel

☑ **Data converted --> HDCS_Data in CARIS**

☑ **TrueHeave applied** 2013_254_S220.000-2013_254_S220.007

☑ **SVP applied** NIDW3hr

☑ **Tide applied** zero tide

Zone file

Lines merged ☑

Data cleaned to remove gross fliers ☑

Compute correctors in this order

1. Precise Timing **2. Pitch bias** **3. Heading bias** **4. Roll bias**

Do not enter/apply correctors until all evaluations are complete and analyzed.

PATCH TEST RESULTS/CORRECTORS

Evaluators	Latency Lines Used	**Latency (sec)**	Pitch Lines Used	**Pitch (deg)**	Roll Lines Used	**Roll (deg)**	Yaw Lines Used	**Yaw (deg)**
Faulkes	1917&1945	0.07	1945&1956	-0.53	1854&1906	-0.14	2026&2037	-0.47
Froelich	1917&1945	0.00	1917&1931	-0.40	1854&1906	-0.17	2012&2050	-0.40
Wartick	1931&1956	0.00	1945&1956	-0.38	1854&1907	-0.13	2026&2037	-0.32
Beduhn	1917&1945	0.00	1917&1931	-0.44	1854&1906	-0.13	2026&2037	-0.38
Smith	1917&1945	0.00	1917&1931	-0.43	1854&1906	-0.14	2026&2037	-0.40

Averages	0.01	-0.44	-0.14	-0.39
Standard Deviation	0.03	0.06	0.02	0.05
FINAL VALUES	0.01	-0.44	-0.14	-0.39

Final Values based on

Resulting HVF File Name

MRU Align StdDev gyro 0.05 Value from standard deviation of Heading offset values

MRU Align StdDev Roll/Pitch 0.04 Value from averaged standard deviations of pitch and roll offset values

NARRATIVE

☑ **HVF Hydrographic Vessel File created or updated with current offsets**

Name: Tami Beduhn **Date:** 9/13/2013

NOAA POS/MV Calibration Report

Fill out all fields! See previous years as an example.

Yellow areas require screen grabs!

Ship: Fairweather **Vessel:** S220

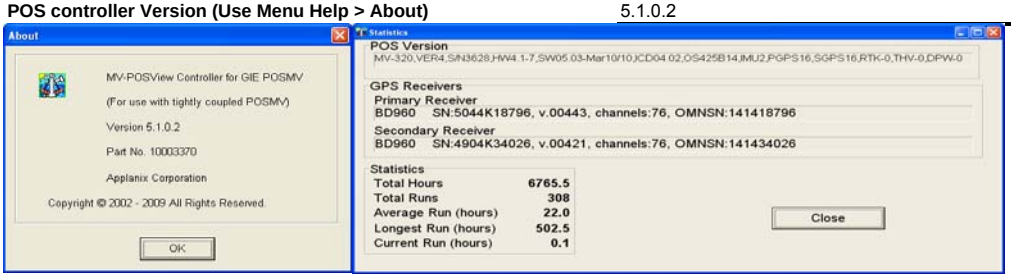
Date: 8/6/2013 **Dn:** 218

Personnel: LT Ryan Wartick, HSST Douglas Bravo

PCS Serial # 3628 **IMU Serial #** 292

IP Address: 129.100.1.231

POS controller Version (Use Menu Help > About) 5.1.0.2



POS Version (Use Menu View > Statistics)

GPS Receivers

Primary Receiver Serial #: 5044K18796

Secondary Receiver Serial #: 4904K34026

POSMV filename(s)

Calibration area

Location: Offshore Washington

Approximate Position:

Lat	48	49	7.55
Lon	125	30	0.12

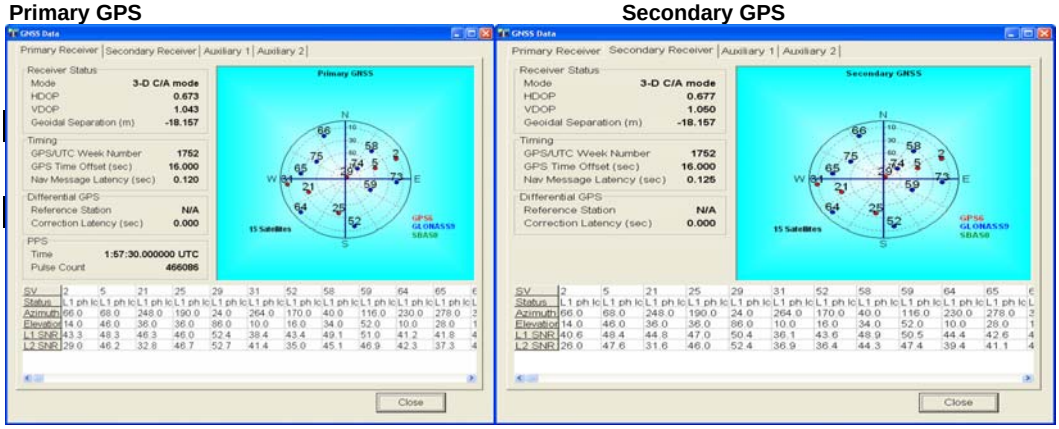
DGPS Beacon Station: Whidbey Island, WA **DGPS Receiver Serial#:** 0324-11969-0002

Frequency: 302 kHz

Satellite Constellation

(Use View> GPS Data)

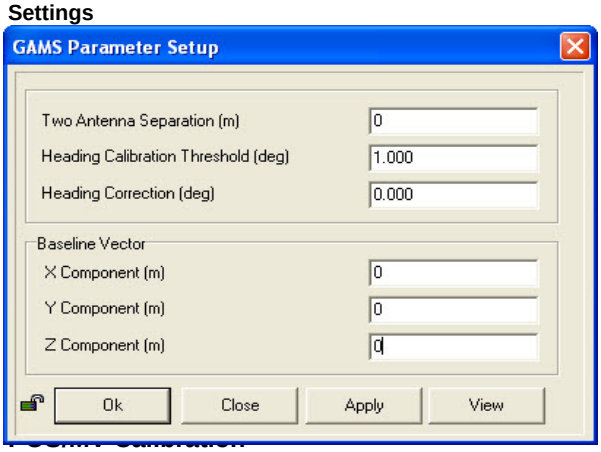
Primary GPS **Secondary GPS**



PDOP (Use View> GAMS Solution)

POS/MV Configuration

Settings



Calibration Procedure:

(Refer to POS MV V4 Installation and Operation Guide, 4-25)

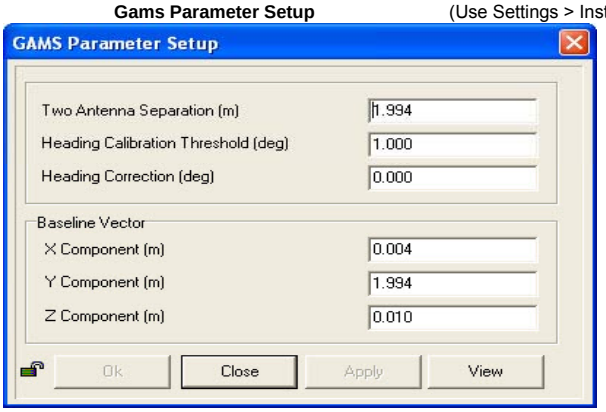
Start time: 0103

End time: 0203

Heading accuracy achieved for calibration: 0.469

Calibration Results:

Gams Parameter Setup (Use Settings > Installation > GAMS Intallation)



Save POS Settings on PC (Use File > Store POS Settings on PC)

File Name:

D:\HYPACK 2012\Projects\HSRR2012\Raw\Positioning

General Notes:

The POS/MV uses a Right-Hand Orthogonal Reference System

The right-hand orthogonal system defines the following:

- The x-axis is in the fore-aft direction in the appropriate reference frame.
- The y-axis is perpendicular to the x-axis and points towards the right (starboard) side in the appropriate reference frame.
- The z-axis points downwards in the appropriate reference frame.

The POS/MV uses a Tate-Bryant Rotation Sequence

Apply the rotation in the following order to bring the two frames of reference into complete alignment:

a) Heading rotation - apply a right-hand screw rotation θz about the z-axis to align one frame with the other.

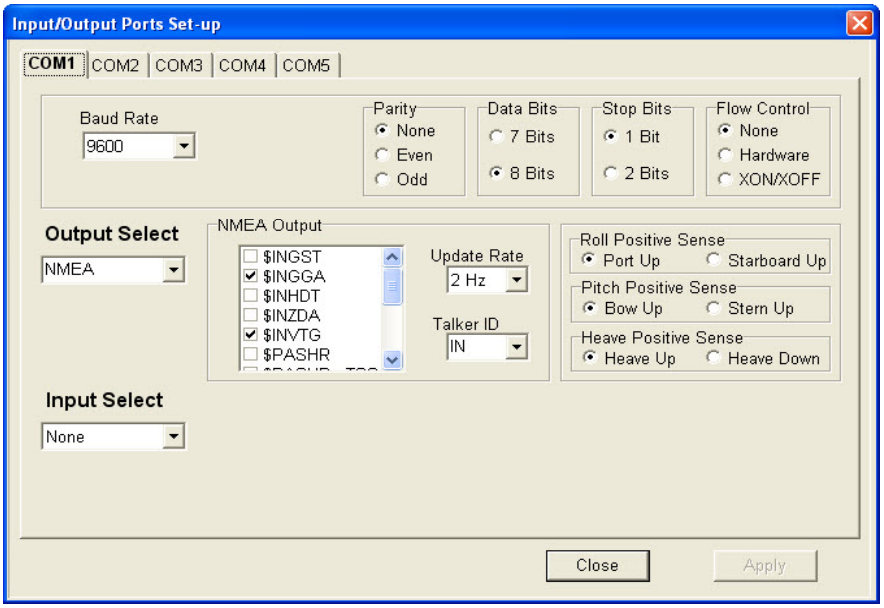
b) Pitch rotation - apply a right-hand screw rotation θy about the once-rotated y-axis to align one frame with the other.

c) Roll rotation - apply a right-hand screw rotation θx about the twice-rotated x-axis to align one frame with the other.

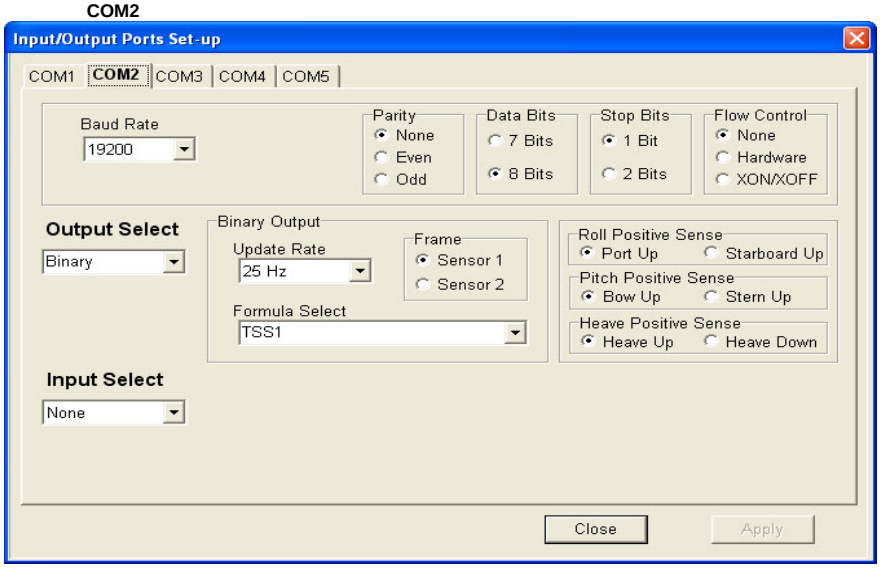
SETTINGS

Input/Output Ports (Use Settings > Input/Output Ports)

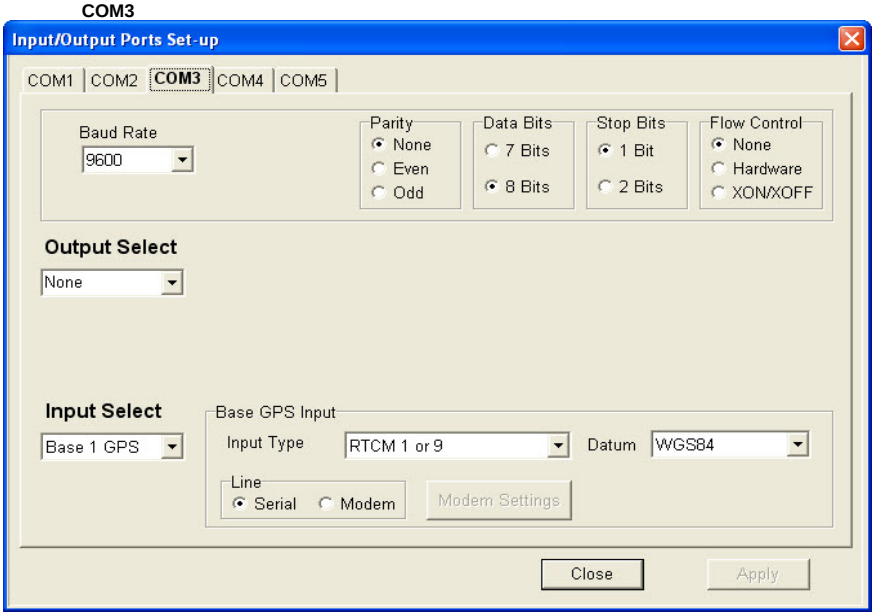
COM1



COM2

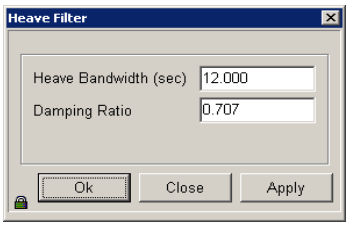


COM3

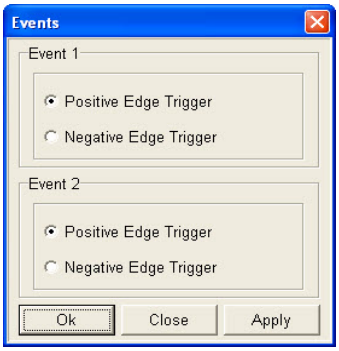


SETTINGS Continued

Heave Filter



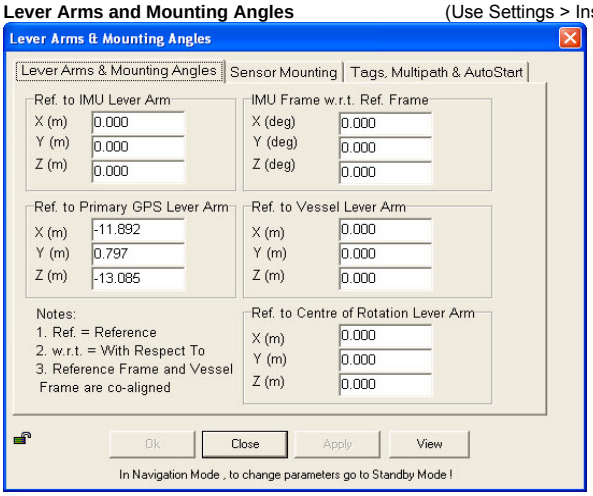
Events



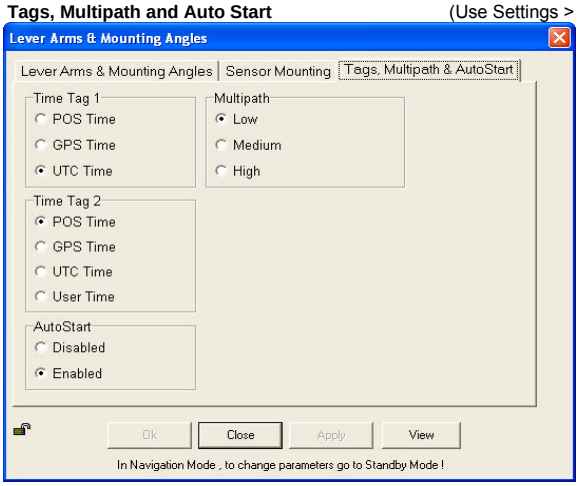
INSTALLATION

(Use Settings > Installation)

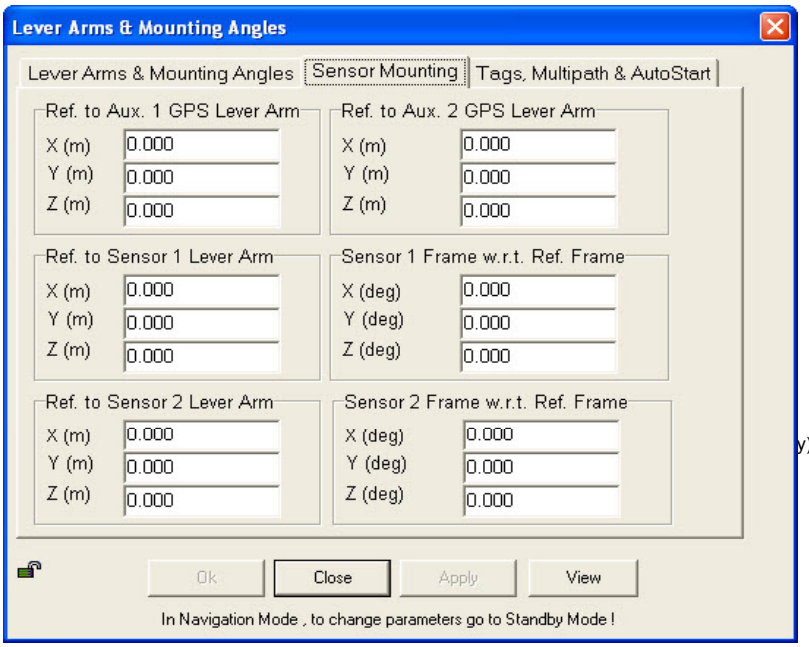
Lever Arms and Mounting Angles (Use Settings > Installation > Lever Arms and Offsets)



Tags, Multipath and Auto Start (Use Settings > Installation > Tags, Multipath and Auto Start)



Sensor Mounting (Use Settings > Installation > Sensor Mounting)



Frame Control (Use Tools > Config)

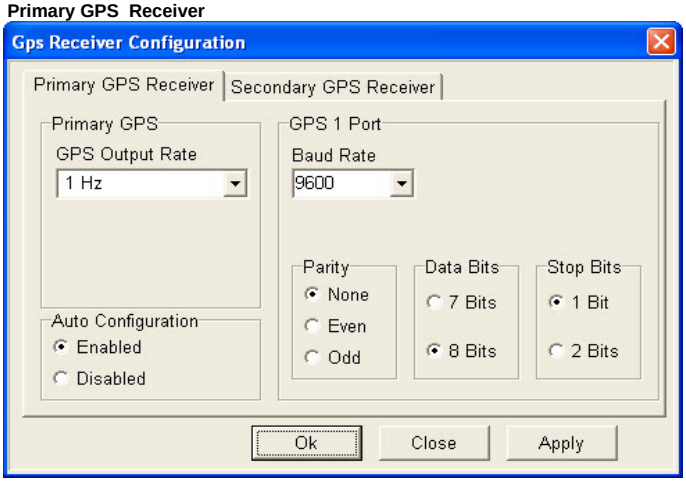
☐ User Frame
☐ IMU Frame

Primary GPS Measurement _____
Auxiliary GPS Measurement _____

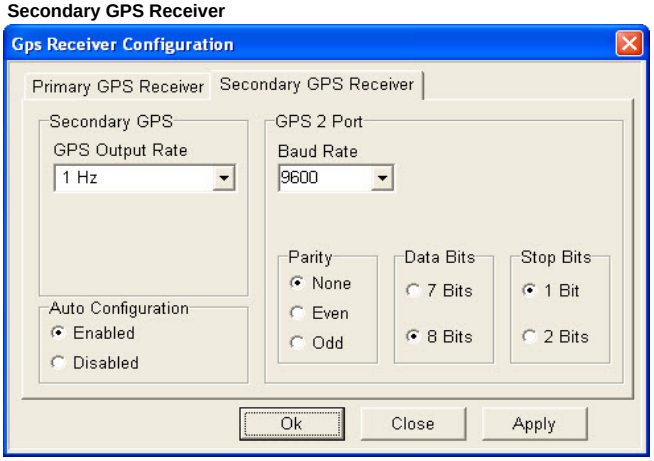
☐ **Use GAMS enabled**

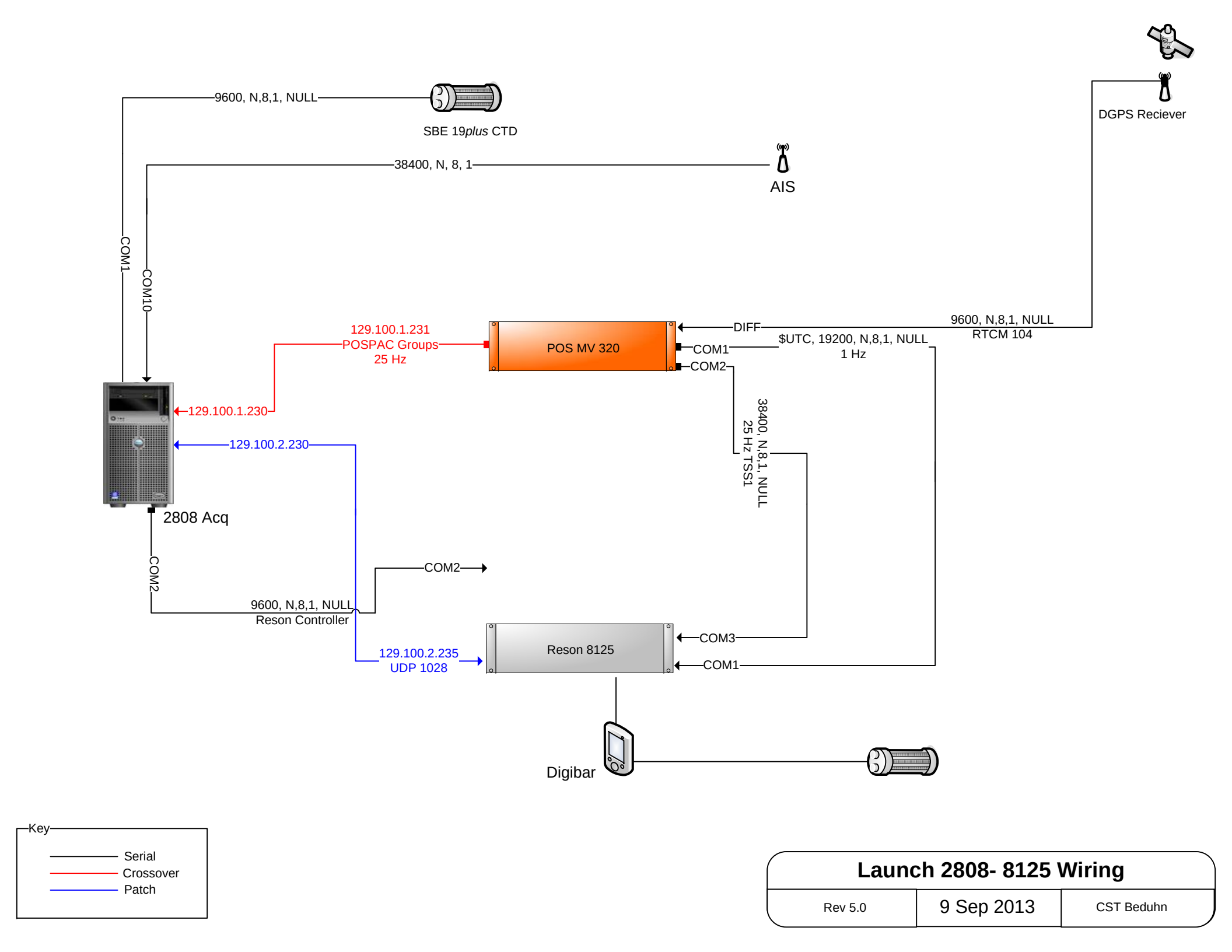
GPS Receiver Configuration (Use Settings> Installation> GPS Receiver Configuration)

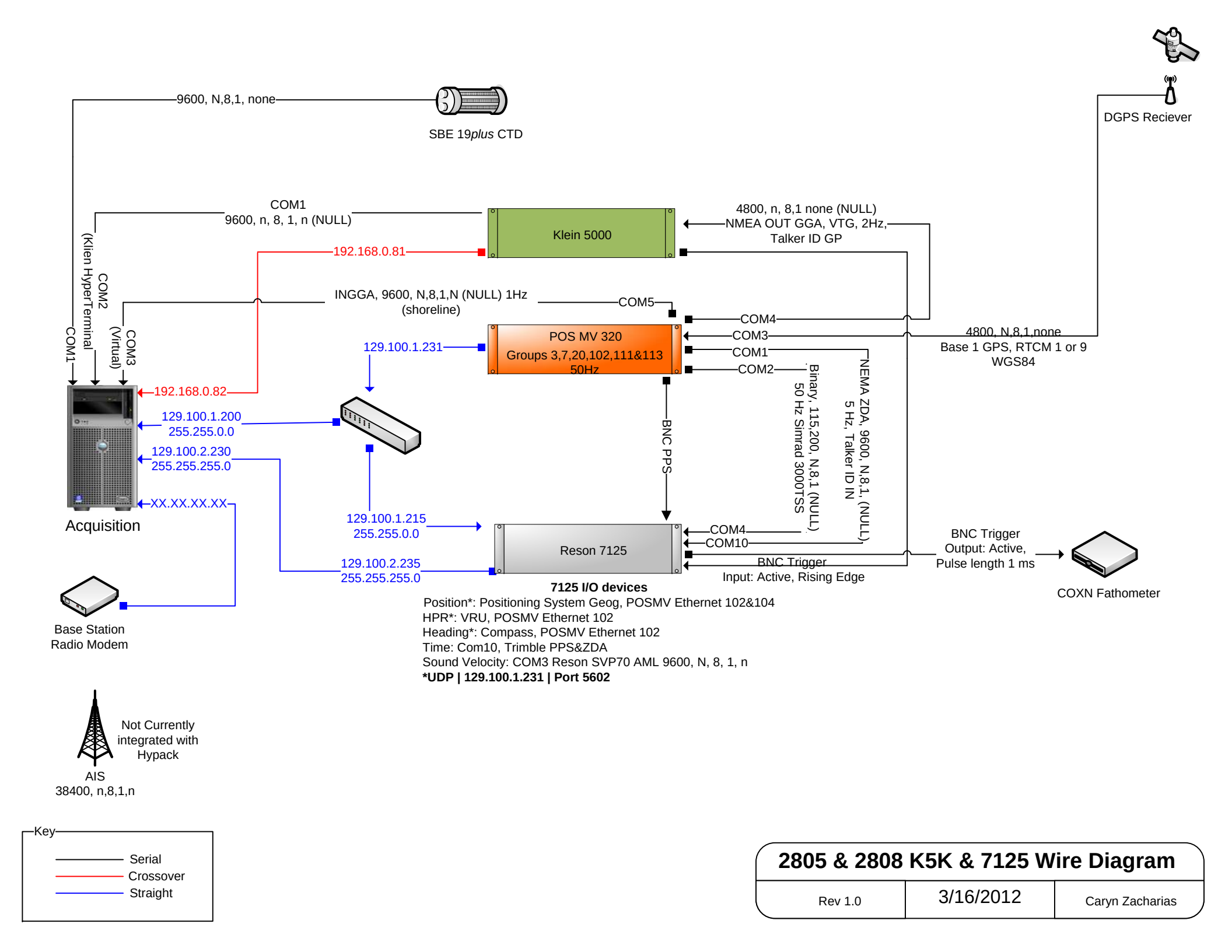
Primary GPS Receiver



Secondary GPS Receiver

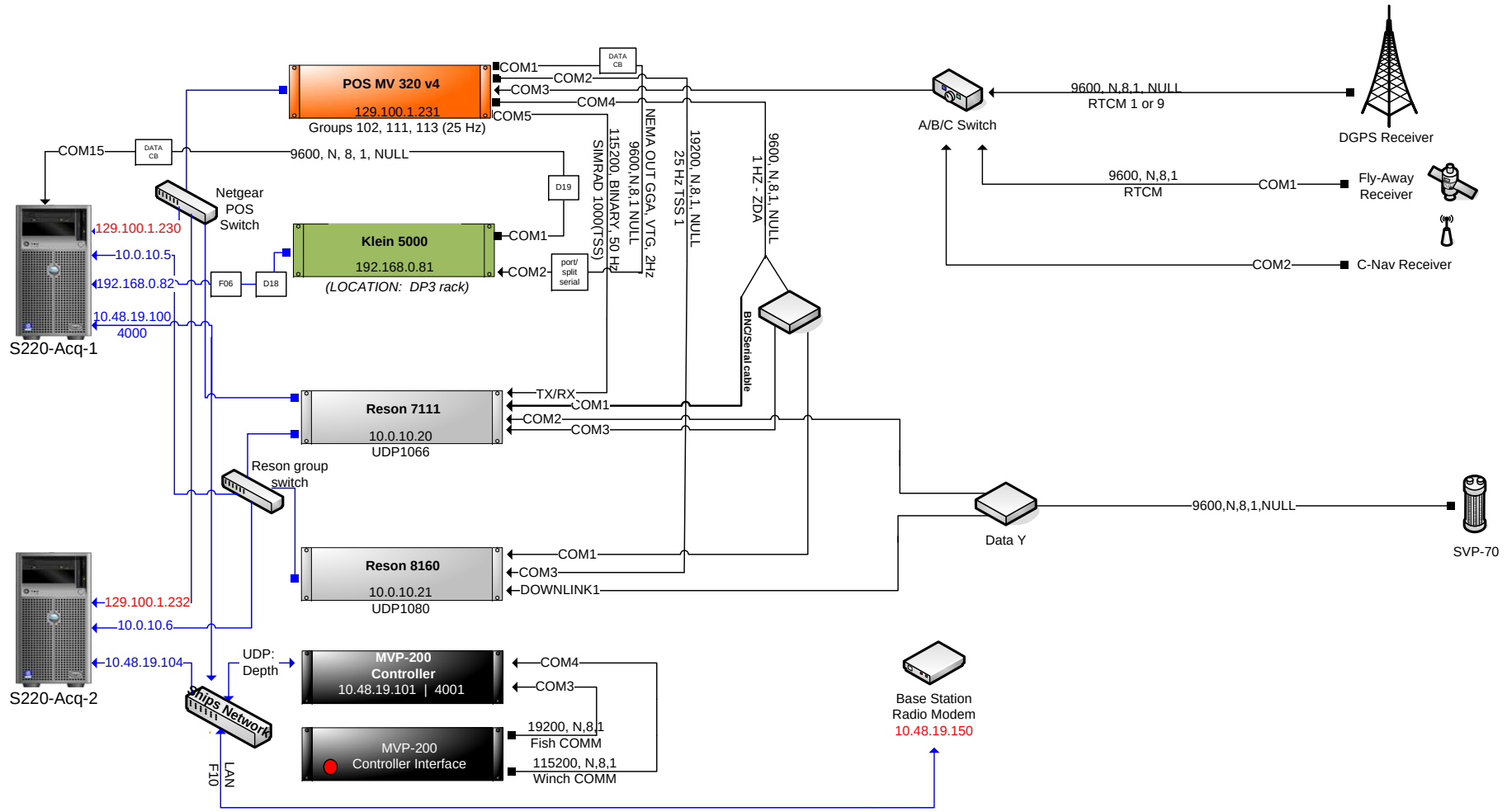



9600, N,8,1, NULL
SBE 19plus CTD
38400, N, 8, 1
AIS
DGPS Reciever
COM1
COM10
129.100.1.231
POSPAC Groups
25 Hz
POS MV 320
DIFF
9600, N,8,1, NULL
RTCM 104
$UTC, 19200, N,8,1, NULL
1 Hz
COM1
COM2
38400, N,8,1, NULL
25 Hz TSS1
129.100.1.230
129.100.2.230
2808 Acq
COM2
COM2
9600, N,8,1, NULL
Reson Controller
129.100.2.235
UDP 1028
Reson 8125
COM3
COM1
Digibar
Key
Serial
Crossover
Patch
Launch 2808- 8125 Wiring
Rev 5.0
9 Sep 2013
CST Beduhn



2805 & 2808 K5K & 7125 Wire Diagram

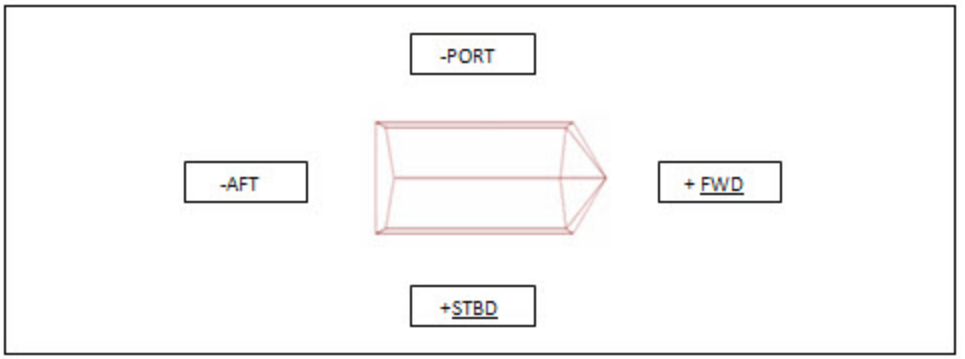
Rev 1.0	3/16/2012	Caryn Zacharias

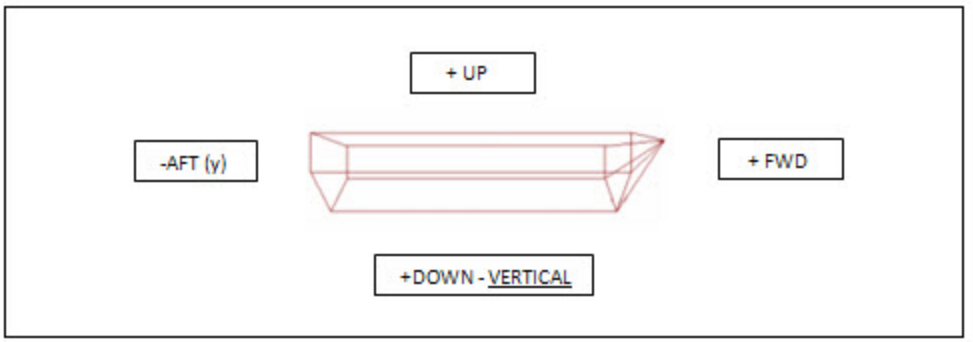


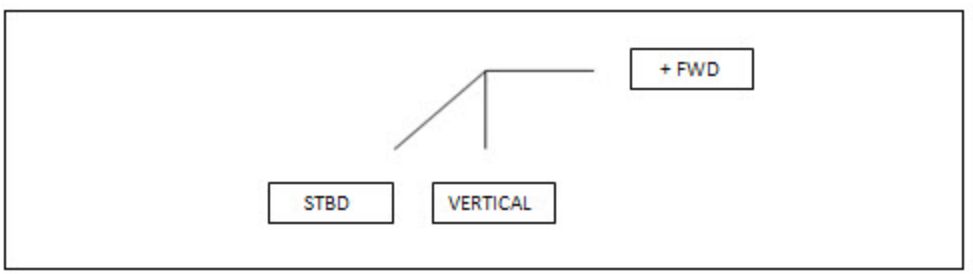
S220 FAIRWEATHER System Communication Wire Diagram

Rev 3.1	10/24/2013	Ryan Wartick

Hypack Coordinate System

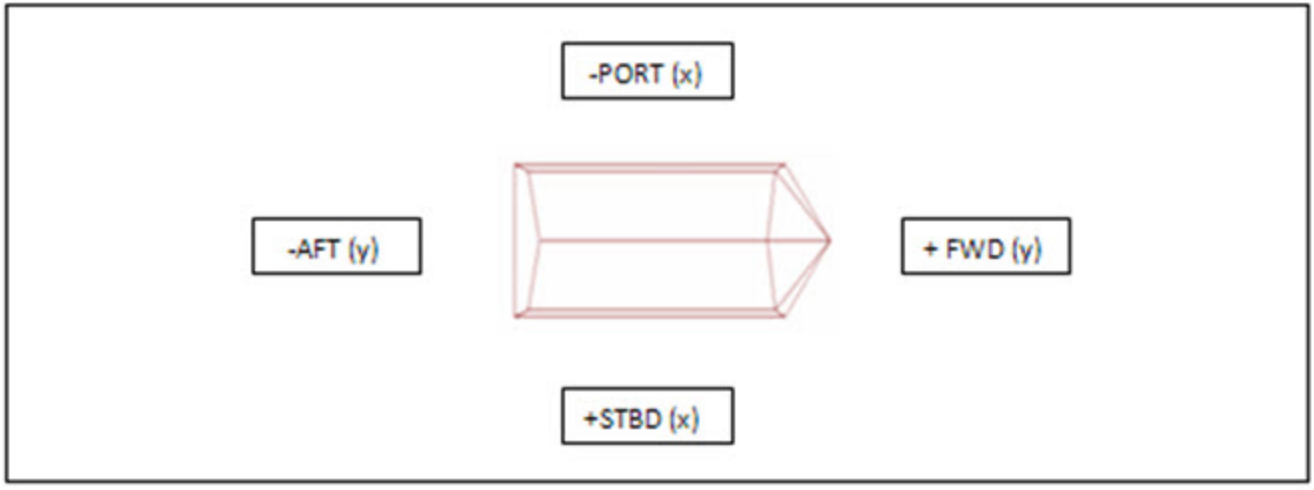


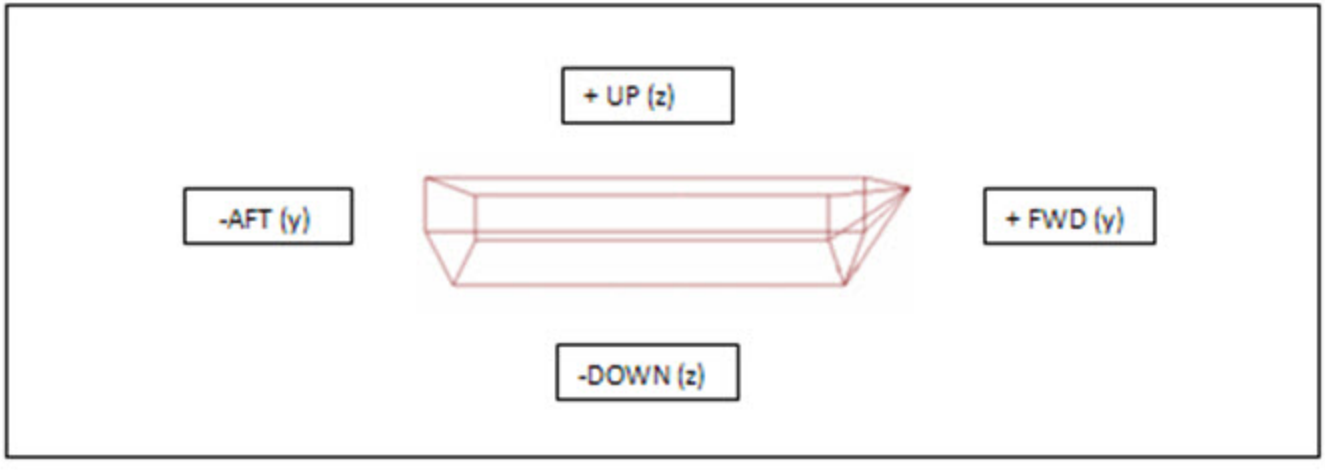


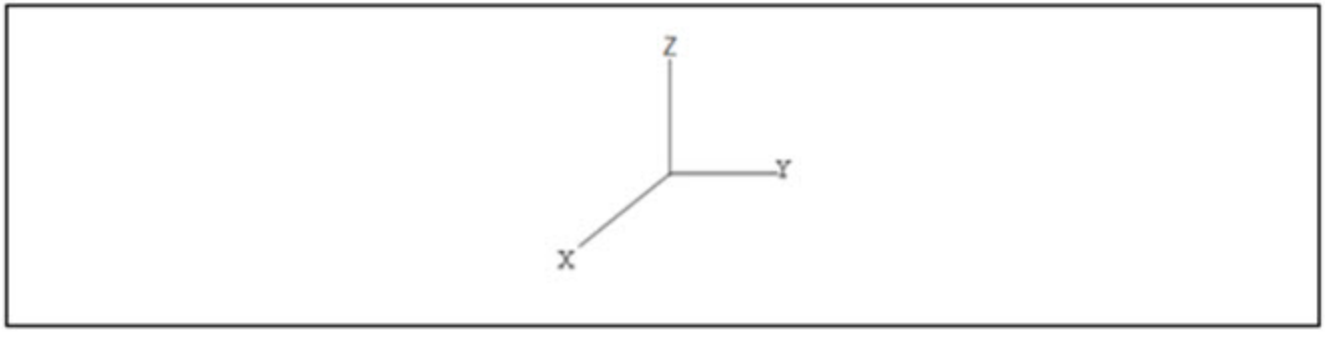


Top Center of IMU is origin of Hypack Coordinate System

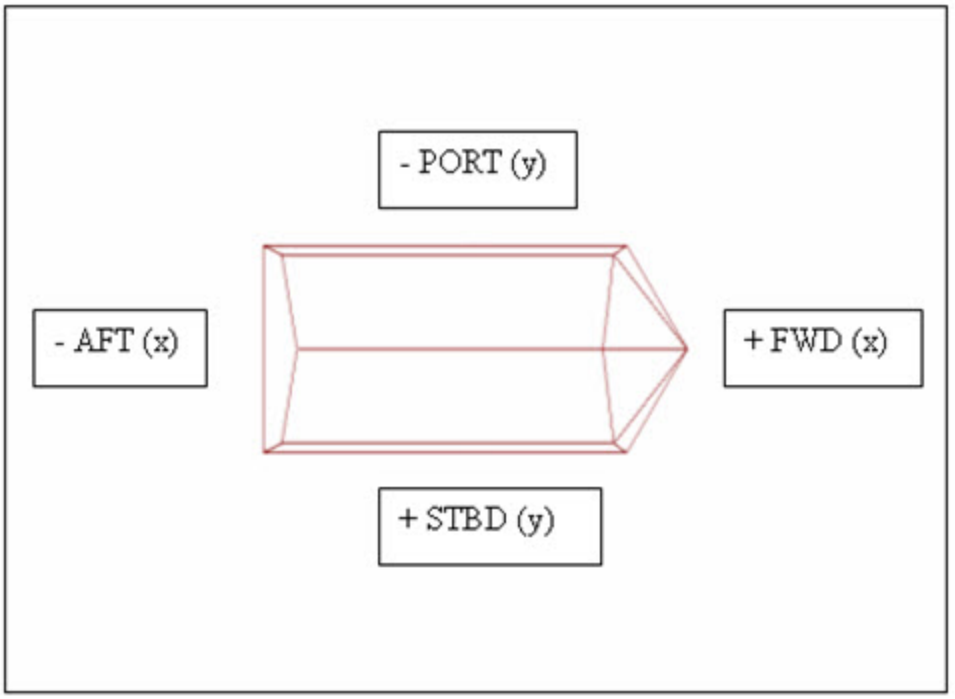
NGS/ RESON Coordinate System

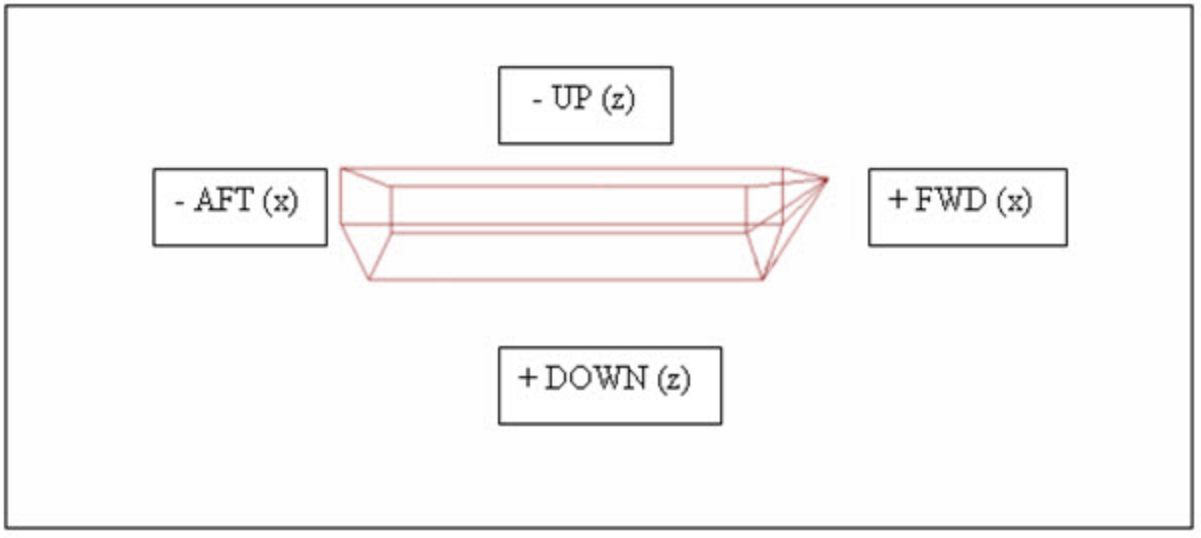


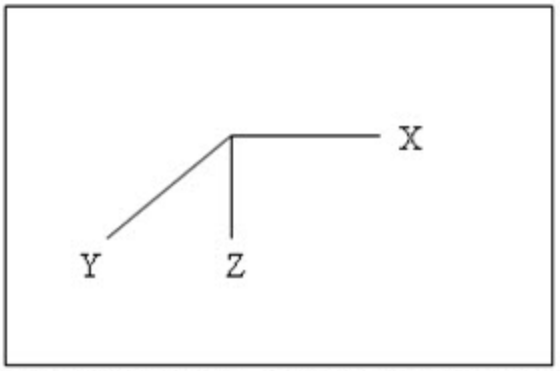




POS/MV Coordinate System

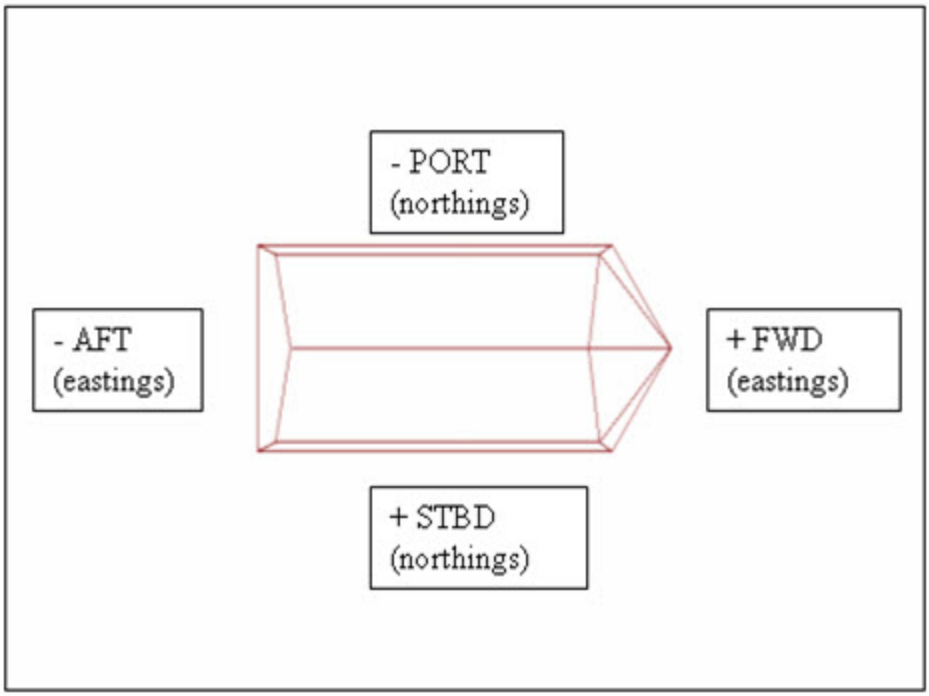


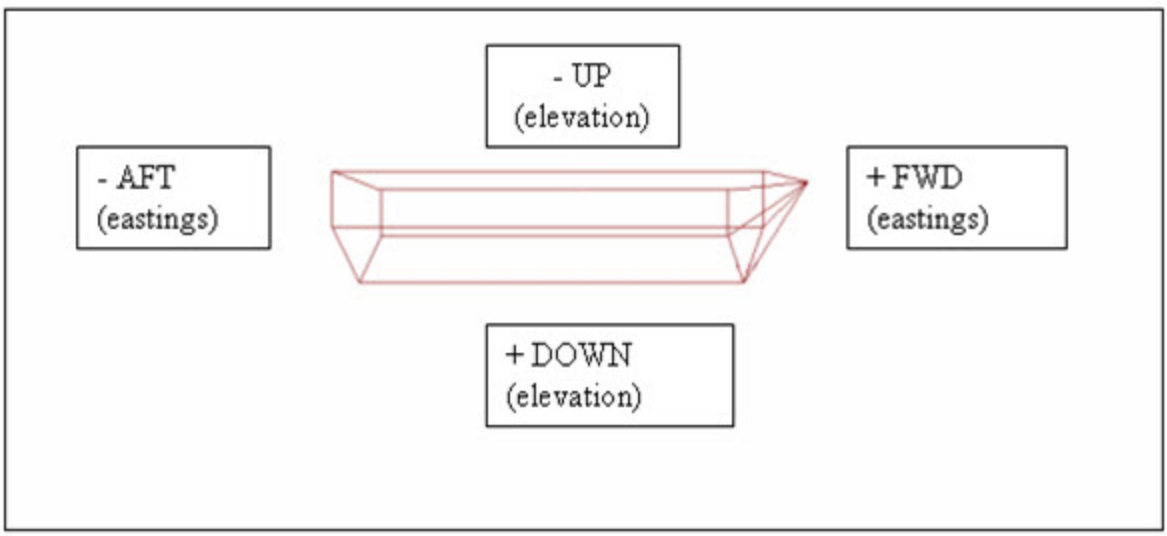


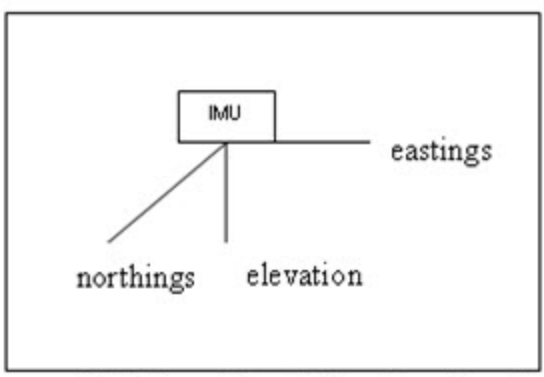


Top Center of IMU is origin of POS/MV Coordinate System

WESTLAKE Coordinate System







Bottom Center of IMU is origin of Westlake Coordinate System

Appendix III

Total Propagated Uncertainty (TPU)

Fairweather TPU Values

TIDE and SOUND SPEED - COMPUTE TPE VALUES

PROJECT	Tide Measurement (m) (Use in CARIS)	Tide Zoning 95% Provided by CO-OPS)	Tide Zoning (m) - 1 sigma (Use in CARIS)	SYSTEM	SV Measured (m/s) (Use in CARIS)	SV Surface (m/s) (Use in CARIS)
DEFAULT	0.01	0.2	0.10	7125	2	0.5
non-TCARI				7111/8160	1	0.5
DEFAULT	0	0	0.00	7125	2	0.5
TCARI				7111/8160	1	0.5
OPR-N395-FA-13	0	0	0.097	7125	2	0.5
Central Puget Sound			VDATUM	7111/8160	1	0.5
OPR-L318-FA-13	0.01	0.15	0.08		2	0.5
Approaches LA Long Beach CA					2	0.5

Tide zoning uncertainty values at the 95% confidence level for discrete zoning are provided by CO-OPS in the tide requirements document on the project CD. All error value components entered in CARIS for TPE calculation are assumed to be 1 sigma; therefore, the value provided by CO-OPS should be divided by 1.96.

Tides	
Measured:	Range (0.01m - 0.05m) dependent on gauge accuracy and duration of deployment
Zoning (discrete):	Range (0.01m - 0.40m) dependent on distance from gauge, range of tide, rate of tide change, and meteorological factors. Value provided by CO-OPS in the tide document in the project instructions package.
Zoning (TCARI):	*TCARI automatically calculates the error associated with water level interpolation. This error is incorporated into the residual/harmonic solutions and included in the Total Propagated Error(TPE) for the survey.*
Sound Speed	
Measured:	Range (0.5m/s to 4 m/s) dependent on spatial and temporal variability Use 1 m/s for casts every 15 min or less Use 4 m/s for casts every 4 hours
Surface:	Range (0.2 m/s to 2 m/s): dependent on surface sound speed gradient

Appendix IV

Additional Correspondence

None