U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

Data Acquisition & Processing Report

Type of Survey: Hydrographic

Project No.: OPR-O168_FA-07

Time frame: October-November 2007

LOCALITY

State: Alaska

General Locality: Southeast Alaska

2007

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APPENDICES

INTRODUCTION

This hydrographic project was completed as specified by Hydrographic Survey Letter Instructions OPR-O168-FA-07, signed September 25, 2007. This Data Acquisition and Processing Report includes project level information common to sheet A (H11759) and sheet B (H11760).

All sheets have the general locality of Endicott Arm and are located in the state of Alaska.

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 *Standing Instructions for Hydrographic Surveys, April 3, 2006*, the NOAA *Hydrographic Survey Specifications and Deliverables Manual (HSSDM) April 2007*, and the *Field Procedures Manual (FPM), March 2007*. Hydrographic Surveys Technical Directives (HTD) 2004-1, and 2007-3 through 2007-9 were followed during the course of this project.

A EQUIPMENT

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

1.0 Hardware

The hardware listed in this section was used during project OPR-O168-FA-07.

1.1 Hardware Systems Inventory

Detailed hardware information, including installation dates and serial numbers, is included in Appendix I of this report. Manufacturer's product specifications are included in Appendix II.

1.2 Echo Sounding Equipment

1.2.1 Reson 8111ER Multibeam Echosounder (MBES)

FAIRWEATHER is equipped with a RESON SeaBat 8111 MBES with the Extended Range (ER) and snippet options. The 8111ER is a 100 kHz multibeam system with swath coverage of 150°. The swath is made up of 101 discrete beams with an along-track and across-track beamwidth of 1.5°. The typical operational depth range of the 8111ER on the FAIRWEATHER is 20 to 600 meters. No calibration information was provided by the manufacturer for the system.

The 8111ER 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. It has a specified depth range of 3 to 1200 meters.

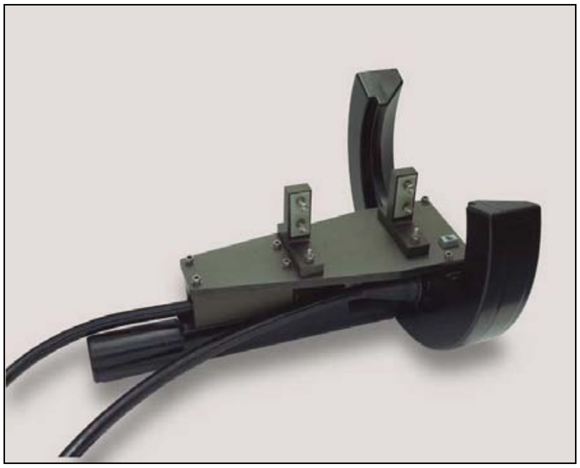


Figure 1: RESON SeaBat 8111ER MBES

Figure 2: RESON SeaBat 8111ER MBES on FAIRWEATHER

Figure 3: RESON SeaBat 8160

Figure 4: RESON SeaBat 8160 on FAIRWEATHER

1.2.2 RESON 8160 Multibeam Echosounder (MBES)

FAIRWEATHER is equipped with a RESON SeaBat 8160 MBES with the snippet option. The 8160 is a 50 kHz multibeam system with a swath coverage of greater than 4x water depth. Each swath is made up of 126 discrete beams with an along-track and across-track beamwidth of 1.5°. It has a specified depth range of 10 to 3000 meters. No calibration information was provided by the manufacture for the system.

The 8160 is hull-mounted within a reinforced projection that extends 13.6 inches below the keel. It is located 54 inches port of the centerline at approximately frame 29.

1.2.3 RESON 8101ER Multibeam Echosounder (MBES)

Survey Launches 1010 and 1018 are each equipped with a RESON SeaBat 8101 MBES with the Extended Range and snippet option. The 8101ER is a 240 kHz multibeam system with swath coverage of 150°. The swath is made up of 101 discrete beams with an along-track and across-track beamwidth of 1.5°. It has a specified depth range of up to 500 meters. The typical operational depth range of the 8101 on launches 1010 and 1018 in 2006 was 3 to 120 meters. Under optimal conditions with a hard bottom, high power and high gain, the depth range of the 8101 ER was observed to be as deep as 350 m producing a swath of ±45º from nadir. No calibration information was provided by the manufacturer for the system.

Each system is attached to a launch using a swing mount which is starboard of the keel and approximately centered fore and aft (see Figures 5 & 6).

Figure 5: Launch 1010 with 8101 extended

Figure 6: Launch 1010 with 8101 retracted

1.3 Manual Sounding Equipment – Lead Lines

Vessels 1010, 1018, 1706, and 2302 are each equipped with a lead line. Lead lines are mainly used for depth measurements near shore and for echosounder depth comparison.

Lead lines were created, measured and calibrated according to Section 1.5.3 of the FPM with the exception that the lines were calibrated to the meter instead of decimeter. Calibration was performed during March and April 2007. Calibration reports for the lead lines are included in Appendix V.

1.4 Positioning, Heading, and Attitude Equipment

1.4.1 TSS Positioning and Orientation System for Marine Vehicles (POS/MV)

FAIRWEATHER and her launches are each equipped with a TSS POS/MV 320 V4, configured with TrueHeave™ and Precise Timing. The POS/MV calculates position, heading, attitude, and vertical displacement (heave) of a vessel. It consists of a rack mounted version 2.12 POS Computer System (PCS), a strap down IMU-200 Inertial Measurement Unit (IMU), and two GPS antennas corresponding to GPS receivers in the PCS. The port side antenna is designated as the primary receiver, and the starboard side antenna is the secondary receiver. Differential correctors are supplied to the POS MV by a CSI wireless MBX-3S Automatic Differential GPS receiver. On May 6, 2007 (DN 126) FAIRWEATHER changed the POS MV firmware to version 3.41 and the controller software to version 3.4.0.0.

For all multibeam systems aboard FAIRWEATHER and her launches, timing between the sonar swath, position, heading and attitude information was synchronized by utilizing the TSS POS/MV 320 v.4's. A timing string was sent from the POS/MV to the RESON topside unit and to the ISIS computer recording the incoming data. Vessel wiring diagrams are included in Appendix III.

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

During acquisition, several IMU failures were noted. There were no actual IMU failures; instead, problems with the POS/MV PCS unit were detected. Due to the suspected hardware problem on the POS/MV PCS unit in launch 1018, it was swapped with the ship's POS/MV PCS on the evening of September 22, 2007. POS/MV PCS serial number 2411 was removed from the ship and installed on Launch 1018, while POS/MV PCS serial number 2560 was removed from Launch 1018 and installed on the ship. On October 29, 2007, two replacement POS/MV PCS's were obtained. The ship's original PCS was replaced, 2411. Launch 1010 received unit 2254 to replace unit 2564. Launch 1018 received unit 2438 to replace unit 2560. The POS/MV PCS serial number 2560 was later confirmed to be malfunctioning and was repaired by Applanix.

1.4.2 POS/MV GAMS Calibration

GAMS (GPS Azimuth Measurement Sub-system) calibrations were performed on each of the three POS/MV units. The GAMS calibration procedure was conducted in accordance with instructions in chapter 4 of the *POSMV V4 Installation and Operation Guide,* 2005. Results are included in the individual vessel reports and spreadsheets, with calibration details located in Appendix III-5.

Figure 7: POS/MV antennas on 1018

Figure 8: POS/MV antennas on 1010

1.4.3 CCSI Wireless MBX-3S DGPS Receiver

FAIRWEATHER is equipped with commercial grade CSI Wireless MBX-3S DGPS Receivers that are used in conjunction with TSS POS/MV to provide vessel positioning during 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. Beacons used for a given survey will be reported in individual descriptive reports. Vessel wiring diagrams are in Appendix III.

Differential GPS (DGPS) was the sole method of positioning. Differential corrections from the U.S. Coast Guard beacons at Annette Island (323 kHz), Gustavus (288 kHz) and Level Island (295 kHz) were used.

1.4.4 Trimble Backpack

FAIRWEATHER uses two GPS Pathfinder® Pro XRS receivers in conjunction with a field computer to acquire detached and generic positions during shoreline verification in the field. Data can also be collected with a handheld TSCe data collector. FAIRWEATHER's field computers consist of three Panasonic CF-18 Tuffbooks and one CF-29 Tuffbook. The receivers have integrated beacon/satellite differential antennas which allow access to digital real-time sub-meter accuracy solutions. Data quality assurance testing was conducted by FAIRWEATHER personnel in April 2007. The Trimble backpack GPS unit testing was combined with the Ashtech testing and the results are located in the Positioning Equipment Confidence Check file in Appendix V.

Figure 9: Trimble Backpack Unit

1.4.5 Impulse LR Hand-held Laser

The Impulse Laser Rangefinder and TruPulse 200 Laser Rangefinder are used in conjunction with the Trimble Backpack GPS unit to acquire distances and heights during shoreline verification. These data are entered directly into the TerraSync shoreline acquisition software and annotated on the detached position forms. The Impulse LR and TruPulse 200 Laser Rangefinder do not function properly in low light or in choppy seas when a feature is not distinguishable from surroundings.

Figure 10: IMPULSE LR laser

Figure 11: TruPulse 200 Laser Rangefinder

Data quality assurance testing was conducted on the Impulse LR on February 27, 2006 by FAIRWEATHER personnel. Comparison testing among the Laser Rangefinder, the TruPulse 200 Laser Rangefinder and the Trimble Backpack units was performed on March 3, 2006. Vertical and horizontal readings were taken with the laser level and compared to measurements taken with a fifteen meter steel tape and a graduated metric staff. Three marks were placed on the staff with SOLAS reflective tape in order to get a good fix. The laser level was set up on a bipod at 10, 20, 50 and 100 meter intervals from the staff. Three horizontal and three vertical readings were taken at each interval. The results of the testing are located in Appendix V.

The laser levels were tested less extensively in 2007 but their accuracy was verified by using them to obtain an offset to BM NO 37 at the USCG ISC Ketchikan facility in the horizontal positioning equipment check of the Trimble backpack units and the Ashtech Z-Xtreme receiver.

1.5 Sound Velocity Equipment

1.5.1 SBE 19*plus* SEACAT Profiler

FAIRWEATHER is equipped with three SBE 19*plus* SEACAT sound velocity profilers used to acquire conductivity, temperature, and depth (CTD) data in the water column to determine the speed of sound through water. Two of the SBE 19*plus* profilers have pressure sensors rated to 1000 meters. The third has a pressure sensor rated to 3,500 meters.

The SBE 19*plus* SEACAT sound velocity profilers were calibrated by the manufacturer and current calibration files were returned with the units. Calibration files for 2007 are located in Appendix V.

Periodic quality assurance checks include comparison casts between CTD instruments. Data quality assurance (DQA) checks include comparison casts between two instruments as per section 1.5.2.2 of the *FPM* for each survey. Results of the comparison casts are located in the *SV_Maintenance and Testing_2007.xls* file in Appendix VI.

1.5.2 SBE 45 Micro Thermosalinograph (TSG)

FAIRWEATHER is equipped with one SBE 45 MicroTSG. The SBE 45 uses continuously pumped sea water to measure conductivity and temperature near the ship's hull mounted transducers. The intake is located 9 feet below the DWL (13 ft) between frames 11 and 12.

The conductivity and temperature information is converted to sound velocity and output to the RESON 8160's and 8111's processing units. The 8160 requires sound velocity information for beam forming and pitch stabilization while the 8111 only requires it for pitch stabilization. The 8160 cannot be used to acquire data without real time sound velocity information. The calibration report is included in Appendix V.

1.5.3 Moving Vessel Profiler 200

A Brooke Ocean Technology, Ltd. (BOT) Moving Vessel Profiler 200 (MVP200) is mounted in the aft starboard corner of the fantail (see Figure 12). The MVP200 system is a self contained sound velocity profiling system capable of sampling water column profiles to 200m depth from a vessel moving up to 12 knots. The system is configured with a Single Sensor Free Fall Fish (SSFFF) outfitted with an Applied Microsystems Ltd. Sound Velocity and Pressure Smart Sensor. Deeper profiles can be obtained by reducing the vessel speed. When the vessel is holding station, the system is capable of recording casts over 600m in depth.

The MVP system consists of a winch, cable, fish (the towed unit with the sound velocity sensor), support assembly, and controlling hardware and software. During ship acquisition, the fish is deployed using the on-deck controller and towed with enough cable out to keep the fish 3-5 m below the water surface. A "messenger" (a short cable-thickening sleeve) is set to allow the system to keep the appropriate amount of cable out and is reset as needed when the ship acquisition speed is altered.

During SVP acquisition, the controlling computer application, BOT MVP version 2.26 is used to control the MVP system and to acquire SVP data. MVP allows for three acquisition modes: 1) automatic continuous multiple cast freefall casting while at speed, 2) single cast freefall casting while at speed, and 3) single cast winch speed casting while stationary. The user limits the depth to which the fish will fall by setting 1) the depth-off-bottom and 2) the maximum depth. Either single, individually initiated casts can be performed at the discretion of the Hydrographer or the auto deploy function can be enabled and set with varying intervals (every 2 minutes, for example) for deployment.

Periodic quality assurance checks include comparison casts between the MVP and one of the SBE 19*plus* SEACATs. Data quality assurance (DQA) checks include comparison casts among the instruments as per section 1.5.2.2 of the *FPM* for each survey. A record of the DQA tests performed aboard the ship is kept and is included in Appendix VI.

Figure 12: FAIRWEATHER's MVP200 sound velocity system

1.6 Vertical Control Equipment

1.6.1 Water Level Gauges

Three Sutron 8210 tide gauges are provided to FAIRWEATHER by the Center for Operational Oceanographic Products and Services (CO-OPS). These gauges are equipped with Paros Scientific Sensors (SDI-12) for pressure measurements. The tide gauges are checked annually by CO-OPS Field Operations Division personnel to ensure that their accuracy standards are being met.

CO-OPS does not provide calibration or quality assurance documentation to the FAIRWEATHER. FAIRWEATHER personnel are responsible for installation and removal of the water level gauges. CO-OPS is responsible for delivering final approved vertical correctors to the field unit or processing branch for application to the hydrographic data set. As FAIRWEATHER received new gauges, data quality assurance checks were conducted to ensure full functionality prior to deployment.

1.6.2 Leveling Equipment

FAIRWEATHER is equipped with four universal automatic levels (two Zeiss NI2 333 and two Leica NA2 100) and graduated metric staffs to assist in leveling tide gauges.

A Kukkamaki procedure is performed prior to leveling in order to verify the collimation error. Procedures were followed as described in the *User's Guide for the Installation of Bench Marks and Leveling Requirements for Water Level Stations,* October 1987. Kukkamaki results for 2007 are located in the Tides folder in Appendix V.

1.7 Horizontal Control Equipment

FAIRWEATHER is equipped with one Ashtech Z-Xtreme dual-frequency GPS receiver used for the positioning of tidal benchmarks, aids to navigation and portable DGPS reference stations (Fly-Away). The Ashtech Z-Xtreme 12 channel, L1/L2 receiver is connected to 4 Ashtech Geodetic GPS antennas.

The antennas can be equipped with an optional ground plane and mounted on fixed height Seco GPS tripods.

Data quality assurance testing of the Horizontal Control equipment was performed on 14 March 2007 (DN073) by FAIRWEATHER personnel. The Ashtech Z-Xtreme GPS receiver (SN ZE1200339016) was set up over

Benchmark No. 37 in Ketchikan, AK using a Seco fixed height tripod. Data was collected for 2 hours 30 minutes and submitted to OPUS which returned an ultra rapid solution position the same day. The OPUS position was less than a centimeter off the published NGS Control Point for BM No. 37. The OPUS solution and a map of the results of the test (Positioning Equipment Confidence Check) are located in Appendix V. Accuracy standards have been met according to NOAA Technical Memorandum NOS NGS-58.

Horizontal control equipment serial numbers and installation dates are located in the hardware section of Appendix I, System Tracking.

2.0 Software

2.1 Software Systems Inventory

An extensive software inventory with documentation, of the software systems used by the NOAA ship FAIRWEATHER, is maintained as a *Survey Software* spreadsheet and included in Appendix I. This spreadsheet includes specifics such as software applications, versions, and hot fixes, in addition to dates loaded on specific computers within the survey department.

2.2 Data Acquisition Software

2.2.1 Isis Sonar/ BathyPro/ DelphMap/ DelphNav

The FAIRWEATHER uses the Triton Imaging Inc. software packages Isis Sonar and Sonar Suite to acquire multibeam echo sounder and backscatter data on all of its multibeam platforms. Sonar Suite has two software packages, DelphNav and DelphMap, which work together along with Isis Sonar to produce real time data planning, acquisition, and execution.

Triton Imaging BathyPro is an add-on package for Isis Sonar which processes XTF data real-time to produce DTMs supported by DelphMap. Triton Imaging DelphNav is an add-on package to DelphMap used for line planning and vessel navigation. Triton Imaging DelphMap is a stand-alone GIS program which combines georeferenced bathymetric digital terrain models and reference files such as raster charts and vector shoreline files to display real-time bathymetric bottom coverage.

2.2.2 TerraSync/ Pathfinder Office

For GPS positioning and shoreline verification FAIRWEATHER uses two Trimble Navigation Limited software programs: TerraSync 2.41 and GPS Pathfinder 3.1.

GPS Pathfinder is run on a Microsoft Windows operating system and is used to manage and process Trimble GPS data, transfer files to and from GPS receivers and handheld data collectors, and export processed data.

Trimble TerraSync 2.41 supports a data dictionaries built with S57 objects and attributes and georeferenced TIFF images. The georeferenced TIFF images are used for reference and navigation purposes as well as for immediate S-57 attribution of positions in the field. TerraSync is installed and configured for data collection on all of the Tuffbook field computers, the TuffTab, and the TSCe handheld computer.

GPS precision masks in TerraSync using the following parameters:

- Horizontal Dilution of Precision (HDOP) ≤ 2.5
- Signal-to-Noise Ratio (SNR) ≥ 4
- Elevation Mask ≥ ~8°-15° (varies by location)

Differential GPS correction is applied in real-time, using the unit's integrated beacon as the first choice corrector, and specifying "wait for real-time" as the secondary option. Positions are filtered so that only those with a minimum of 4 satellites (3D position), and HDOP ≤ 2.5, and Positional Dilution of Precision (PDOP) ≤ 6 will be recorded.

2.3 Data Processing Software

2.3.1 NOAA Hydrographic Systems and Technology Programs (HSTP) Software

Sound velocity data is processed with Velocwin, in-house software produced and maintained by NOAA's Hydrographic Systems and Technology Programs (HSTP) division. Velocwin creates and archives water column profiles, performs quality assurance, and processes pressure based depth data. Velocwin creates a standard file format across NOAA's hydrographic fleet for sound velocity profiles applied to shallow water multibeam and single beam data.

Pydro, another NOAA program produced and maintained by HSTP, is used to process features such as detached positions (DP), generic positions (GP), and Automated Wreck and Obstruction Information System (AWOIS) contacts. PYDRO also converts and attributes features according to S-57 standards for insertion into CARIS Notebook.

2.3.2 CARIS

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

CARIS Notebook™ is used to compile and display source shoreline, shoreline updates and S-57 features imported from Pydro. The .hob files created in Notebook are the current shoreline deliverables.

2.3.3 Fledermaus™

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. As an additional data quality assurance check, Fledermaus ™ may be used to examine the CARIS surfaces prior to submission.

2.3.4 MapInfo™

MapInfo™ is used to review tables and workspaces associated with assigned projects received from Hydrographic Survey Division (HSD). MapInfo may also be used to produce scaled plots produced for public relation purposes. HydroMI, an HSTP produced MapBasic program, is used through MapInfo to convert tide and tidal zoning files into a format that is useable in CARIS HIPS, and obtain latitude/longitude coordinates for pre-survey planning.

3.0 Vessels

3.1 Vessel Inventory

The NOAA Ship FAIRWEATHER (S220) and her survey launches 1010 and 1018 are equipped to acquire multibeam echosounder (MBES) and sound velocity profile (SVP) data. Launch 1018 is also the primary vessel for dive operations. The AMBAR (2302) and Monarch (1706) are used during shoreline verification, bottom samples, and horizontal and vertical control operations. All vessels except the ship were used in support of tide gauge operations. See Appendix I for the complete vessel inventory.

3.2 Noise Analysis

The FAIRWEATHER sonar system RESON 8111ER underwent noise analysis testing on October 11, 2004. The results are used during acquisition to enhance data quality and are included in Appendix III-S220-7. Standard operating procedures utilizing the RESON 8111ER aboard the FAIRWEATHER have survey speeds set to minimize noise based on the noise analysis.

4.0 Data Acquisition

4.1 Horizontal Control

A complete description of horizontal control for the project can be found in the *OPR-O168-FA-07 Horizontal and Vertical Control Report (HVCR)*, submitted under separate cover.

The horizontal datum for this project is the North American Datum of 1983 (NAD83).

Multibeam and shoreline data were differentially corrected in real time using correctors provided by Coast Guard beacons at Gustavus (288 kHz) or Level Island (295 kHz). 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 survey.

Specific DGPS quality control checks were not performed during this project. Based on correspondence between personnel from the Hydrographic Systems and Technology Program and FAIRWEATHER, system checks were deemed unnecessary. Refer to correspondence included in Appendix VII.

4.2 Multibeam Echosounder Acquisition and Monitoring Procedures

Methods of acquisition took into consideration system performance limitations, the bottom topography, water depth, and the ability of the vessel to safely navigate the area.

All multibeam data were acquired in Triton Elic's extended transfer format (XTF) and monitored in real-time using the 2-D and 3-D data display windows and the on-screen displays for the RESON SeaBat 8101ER and 8111ER. Adjustable parameters that were used to control the RESON from the ISIS software include range scale, power, gain, and pulse width. Vessel speed was also adjusted as needed to eliminate noise from the data. These parameters were adjusted as necessary to ensure best data quality. Additionally, vessel speed was adjusted as necessary to ensure the required along-track coverage for object detection in accordance with the *HSSDM*. Survey personnel follow standard operating procedures documented aboard the FAIRWEATHER while setting and utilizing the RESON systems and Isis for acquisition of data.

Mainscheme multibeam sounding lines using the RESON SeaBat 8111ER were generally run parallel to the contours at a line spacing approximately three to four times the water depth. For discrete item developments, line spacing was reduced to 2 times water depth to ensure least-depth determination by multibeam near-nadir beams. Triton Elic's DelphMap Real Time Bathy was used in lieu of planned line files. The Real Time Bathy displayed the acquired multibeam swath during acquisition and was monitored to ensure overlap and full bottom coverage. If coverage was not adequate, additional lines were run while still in the area.

4.3 Shoreline Verification

FAIRWEATHER personnel conducted field shoreline verification at times near predicted low water, in accordance with the Standing Project Instructions, the FPM (March 2007), and HTD 2007-7. Standard operating procedures on the use of Trimble TerraSync and GPS Pathfinder for shoreline verification were followed by survey personnel.

CARIS Notebook 3.0 was used to review the project level composite source (.000) file supplied by HSD and described in HTD 2007-7. The composite source file for OPR-O168-FA-07 contained features from a sole source: Geographic Cell (GC), or Digital Data (DD), shoreline compiled by the Remote Sensing Division (RSD). The file was opened in Notebook and copied to a .hob file using the same name. The project level composite source .hob file was edited by the survey manager to include only features within the survey limits and renamed according to survey number, HXXXXX_Composite_Source.hob. A copy was made of the unedited survey level composite source .hob file and named HXXXXX_Original_Composite_Source.hob. All modifications to source shoreline features addressed during field verification were made in the HXXXXX_Composite_Source.hob, with the original composite source .hob file remaining unedited. These HOB files are submitted as shoreline deliverables.

No AWOIS were assigned to this project.

Shoreline verification was not conducted on this project due to lack of appropriate low water conditions.

No Detached positions (DPs) and generic positions (GPs) were acquired and no DP forms or boat sheets were utilized.

4.4 Shoreline Data Processing

Features imported into Pydro were given short descriptive comments listed under the Remarks tab in Pydro. Features were flagged as Primary, unless there were multiple DPs or GPs taken on the same feature. In that case, the most important DP was marked Primary and any associated DPs/GPs were flagged Secondary. All features were S57 attributed.

Significant features that deserved special attention or additional discussion, were flagged Report in Pydro and included in the Pydro feature report. Along with the hydrographer notes and investigation methods provided in the Remarks tab, the Hydrographer included recommendations to the cartographer in the Recommendations tab when warranted. All features were flagged according to section 4.4.4 of the FPM. All features flagged as “report” in Pydro were included in the Shoreline Feature Report.

Photos labeled and associated with a DP/GP number were included in the Pydro PSS session and stored in a folder with the PSS file.

HDCS_DATA lines associated with DPs were tide corrected in CARIS HIPS. GPs do not have heights associated with them and required no additional processing.

All primary and accepted DPs and GPs were exported from Pydro as an .xml to CARIS Notebook 3.0. Two separate stand alone .hob files were created from the Pydro .xml files. The files are named H#####_Updates.hob and H#####_Disprovals.hob.

An original composite source file (H#####_Original_Composite_Source.hob) was saved prior to being edited and will be submitted with the survey. No edits were applied to the H#####_Composite_Source.hob.

The SORIND and SORDAT S57 attribute fields for new features or modified source features were updated to reflect the information for their associated survey number and date. All unmodified source features retain their original SORIND and SORDAT values.

The CARIS Notebook files along with CARIS HIPS BASE surface(s) were viewed to compare soundings and features simultaneously. Standard operating procedures, for processing shoreline features in Pydro and CARIS Notebook, were followed by survey personnel as documented.

Final Shoreline Deliverables include the Pydro PSS, the Pydro Shoreline Feature Report, and up to four Notebook HOB files:

HXXXXX_Original_Composite_Source (without edits)
HXXXXX_Composite_Source (with edits)
HXXXXX_Updates (Pydro Data Import, if applicable)

HXXXXX_Disprovals (Pydro Data Import, if applicable)

5.0 Bottom Sample Acquisition

Bottom samples were conducted according to section 7.1 of the *HSSDM*. Bottom samples (GPs) were acquired with TerraSync 2.41. Data were imported into GPS Pathfinder 3.1 and were reviewed for quality. The line features were exported to a Microsoft Access Database file (.mdb) and NALL buffer lines were exported to ESRI shape files (.shp).

Bottom samples results are found in the Pydro PSS and the Notebook HOB deliverable layer, HXXXXX_Updates.

B QUALITY CONTROL

The 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

Error 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 Chapter 4 Appendix of the FPM.

Estimates for the error in measuring vessel offsets, multibeam system biases (timing, pitch, roll and yaw) and dynamic draft are the standard deviations of the set of values reached for each of these corrections resulting from several people processing the data.

In the specific case of MRU Alignment error; values were set after an email exchange between Rainier, Fairweather, HSTP and CO-OPS (see TPE_MRU Alignment.txt email messages in Appendix VII). The error value for MRU alignment deviated from that set in Chapter 4 Appendix of the FPM due to the directive's value for MRU alignment error being set too high (possibly due to a misinterpretation of what the alignment error represented). This error should represent the standard deviation of measurement of the error derived from multiple people processing the patch test. Based on this, the MRU alignment errors were significantly lower than the 1 degree value set in Chapter 4 Appendix of the FPM.

An estimate of the total error due to tides was not included in the Letter Instructions for the project, but a value of 0.09 meters (two sigma - 95% confidence level) was given by CO-OPS in the above noted email exchange. Using this value as a reference, tidal errors were set at 0.01 m for the gauge and 0.1 meters for zoning. The 0.01 meter estimate for the gauge is a conservative estimate that can be recalculated based on the sigma values in the final approved water levels. The 0.1 meter estimate for zoning is also a conservative one sigma value based on the total two sigma tide error of 0.09 meters.

The final uncertainty values for FAIRWEATHER and her launches, tides, and sound velocity, along with information on how the values were derived, are shown in the FA_TPE_Values.xls spreadsheet located in Appendix IV. Uncertainty values relating to vessels and survey systems were entered into the HIPS Vessel File (HVF) for each platform. Uncertainty values for tide and sound velocity were entered during the CARIS Compute TPE process.

2.0 Data Processing

2.1 Multibeam Echosounder Data Processing

Bathymetry processing followed section 4.2 of the *FPM* unless otherwise noted.

Raw XTF multibeam data were converted to Caris HDCS format using FAIRWEATHER documented settings. True heave, sound velocity and water level data were then applied to all lines and the lines merged. Once lines were merged Total Propagated Error (TPE) was computed.

Vessel heading, attitude, and navigation data were reviewed in HIPS navigation editor and attitude editor. Where necessary, fliers or gaps in heading, attitude, or navigation data were manually rejected or interpolated for small periods of time.

BASE surfaces were created using the Combined Uncertainty and Bathymetric Estimator (CUBE) algorithm and parameters contained in the Cubeparams.xml file. This file contains settings for “Deep” or “Shallow” surveys. As stated in HTD 2007-2, the “Deep” setting corresponds to NOAA “Complete” multibeam coverage and “Shallow” to NOAA “Object Detection” coverage. As the Letter Instructions for project OPR-O168-FA-07 require “complete” multibeam coverage, all BASE surfaces were created using the “Deep” configuration of CUBE parameters.

Multibeam data were reviewed and edited in HIPS swath editor and in subset mode as necessary.
The BASE surface was used for directed data editing in subset editor, to demonstrate coverage, and to check for errors resulting from tide, sound velocity, attitude and timing.

Table 1 lists the general resolution and depth ranges used by FAIRWEATHER. These values will be adjusted by sheet managers for individual surveys based on bathymetry and conditions in the survey area. A detailed listing of the actual resolutions and 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.

FAIRWEATHER			
Depth Ranges			**Resolutions**
Lo (m)	Hi (m)	Overlap (m)	Res. (m)
0	40		2
30	70	10	5
50	120	20	10
100	200	20	20
180	350+	20	35

Table 1: Resolutions and Depth Ranges

In areas of navigational significance where the BASE surface did not depict the desired depth for the given area, a designated sounding was selected. Designated soundings were selected as outlined in chapter 5 of the *HSSDM*.

3.0 DATA REVIEW

Specific procedures were 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 in Quality Control Check is preformed 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. The Data and Analog Submission checklists are used to ensure that all data and deliverables are complete and included upon submission. Documentation of these tasks are completed for every survey but only the final processing log, *HXXXXX_Data_Log,* is submitted with the individual survey data.

C Corrections to Echo Soundings

1.0 Vessel HVFs

CARIS HIPS Vessel Files (HVF) were created by FAIRWEATHER personnel and used to define a vessel's offsets and equipment uncertainty. The HVF is used for converting and processing data collected by each survey platform. For each survey platform, an *HVF Report*, listing specific HVF entries, was produced in the CARIS Vessel Editor and is included in Appendix III. The HVFs used for the current project are included with the digital separates submitted with the individual survey data.

2.0 Vessel Offsets

Sensor offsets were measured with respect to each vessel's reference point. The reference point for FAIRWEATHER and survey launches 1010 and 1018 is the IMU. Specific offset values were input into the POS/MV and the CARIS HIPS Vessel File (HVF).

A ship survey was completed for the FAIRWEATHER by Westlake Consultants, Inc on September 23, 2003 and a POS/MV component spatial relationship survey of the FAIRWEATHER was conducted by NGS in February, 2007. The results of both of these surveys were used to determine the offsets for ship. The reports from each survey are located in documents in Appendix III-S220-2, and the final values for FAIRWEATHER's offsets and explanations of how they were calculated are located in the S220_Offsets & Measurements spreadsheet in the same folder.

Permanent control points were established on launches 1010 and 1018 in July of 2004. Sensor offsets were measured by Fairweather personnel according to documented procedures. Total stations were utilized for positioning the permanent control points. The total station specifications are located in Appendix II-7, the calibration certificates for the *Nikon DTM 310* and the *Sokkia SET 5F* are included in Appendix V. A steel tape was used to verify and update specific vessel offsets in April 2007. The final offsets for survey launches 1010 and 1018 were derived from a combination of values from the original full survey and the values updated in the verification surveys. The measurements, derivations, descriptions of methodology used, diagrams, and coordinate system references are included in the respective vessel's *Offsets & Measurements* spreadsheet in Appendix III.

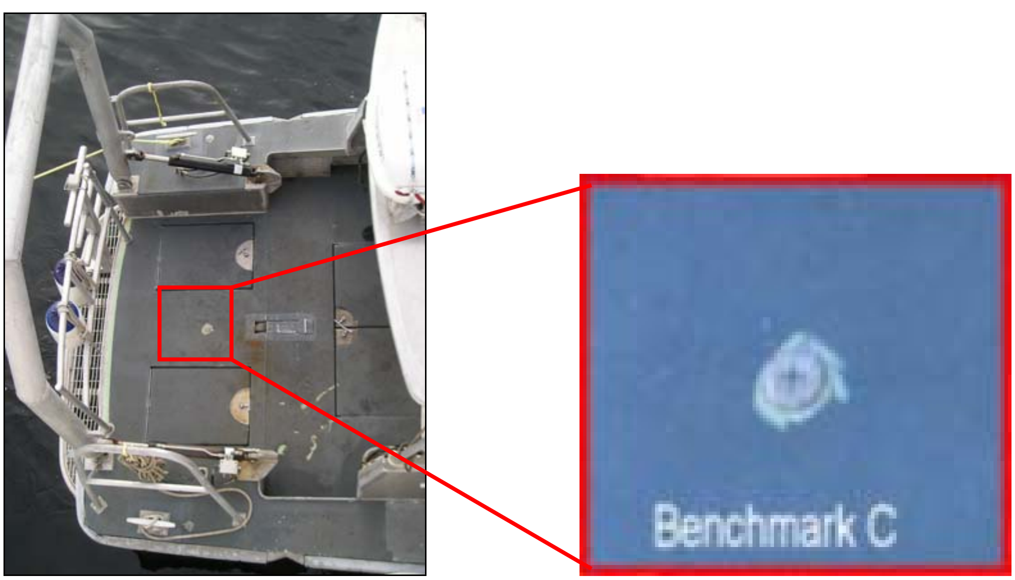


Figure 7: Permanent Control Point "Benchmark C" on launch 1018

3.0 Static and Dynamic Draft

Static draft (*Waterline Height* in the HVF) for launch 1010 and 1018 was calculated based on steel tape measurements of the distance from benchmarks on the port and starboard quarter of the vessel to the waterline. Although static draft tubes have been installed in launch 1010 and 1018 the tubes have not yet been calibrated, nor have procedures for the determination of loading been developed.

The bow and stern draft marks were used to perform a linear interpolation of the static draft at the FAIRWEATHER's IMU. The static draft was measured multiple times with the vessel under different loading conditions: with and without launches on board and with different amounts of fuel. The final value for the static draft was an average of the most likely loading conditions during survey operations.

The values and calculations for static draft are listed in each vessel's Offsets Measurement spreadsheet (Waterline to RP) located in Appendix III.

Dynamic Draft Settlement and Squat (DDSSM) tests were conducted for FAIRWEATHER and survey launches 1010 and 1018 in April 2007. The final DDSSM values are the average of results obtained from multiple individuals processing the DDSSM data. Detailed processing spreadsheets of DDSSM results for each vessel are located in the respective vessel's folder in Appendix III.

4.0 Patch Tests

Patch tests were conducted for the multibeam acquisition systems on FAIRWEATHER and survey launches 1010 and 1018 in April 2007. The results of the patch tests, along with the acquisition and processing logs, are included in the individual MBES Calibration Tables in Appendix III-3.

It was discovered during processing of the 2007 patch tests that the new POS/MV's for launches 1010 and 1018 were set to output GPS time instead of UTC time. This introduced a fourteen second error (the precise difference between GPS and UTC time) into the navigation time. To avoid time spent rerunning the patch tests, the tests were processed using a time correction value of fourteen seconds, which effectively canceled out the time error. An entry in the HIPS vessel files for launches 1010 and 1018 dated 2007-001 show the fourteen second correction in the "Time Correction(s)" column. The POS/MV units were subsequently changed to output UTC time and a second entry in the HIPS vessel files, removing the fourteen second navigation latency value, was entered on 2007-102. All data collected for the project took place after the POS/MV's were corrected to output UTC time.

Additional testing for adjustments were required throughout the field season on both Launch 1010 and 1018 due to the instability of the roll arm mount. Launch 1010 was retested on Dn252 prior to this project due to mount tightening. Launch 1018 was tested and had roll values updated on Dn236 prior to this project.

5.0 Attitude

All attitude corrections were generated by the POS/MV using data from the IMU-200 Inertial Measurement Unit (IMU). IMU values for uncertainty of heave, pitch and roll are included in the manufacturer specification in Appendix II and are included in the FA_TPE_Values_2007.xls spreadsheet located in Appendix IV. IMU failures noted during this project were actually attributed to faulty POS/MV PCS units as documented in section 1.4.1above. IMU correctors applied to the data were not affected and no additional patch testing was required.

5.1 True Heave

FAIRWEATHER and her launches are equipped with the POS/MV TrueHeave™ (TH) option. True Heave™ is a 'delayed' heave corrector as opposed to 'real time' heave corrector and is fully described in Section 6 of the *POS/MV Version 4 Installation and Operation Manual*. Daily TH files were logged through the Ethernet Logging function in the POS/MV controller software. To ensure proper calculation of TH, files were logged for at least three minutes past the end of each day's survey operations.

In cases where TrueHeave™ could not be applied, real time heave correctors were used. Real time heave data were recorded in Triton Elic's Isis software, stored in the .xtf format and applied as the heave corrector for multibeam data. Data that does not have TrueHeave™ applied will be listed in the individual Descriptive Report for the survey.

6.0 Sound Velocity

Seacat SBE 19*plus* sound velocity profilers were used to collect sound velocity data for survey launches 1010 and 1018's Reson 8101 multibeam systems. The Brooke Ocean Technology Moving Vessel Profiler (MVP) was used to collect sound velocity data to correct data collected with FAIRWEATHER's Reson 8111 and 8160 multibeam systems.

Daily sound velocity profiles from the SBE 19*plus* were processed with Velocwin and concatenated into a single .svp file for the sheet. Individual .svp files and the concatenated file for the survey will be submitted with each survey.

Sound velocity profiles acquired using the Brooke Ocean Technology Moving Vessel Profiler 200 (MVP) are stored in files labeled .001, .001c, .001d, and .001e (collectively called BOT files) where the number increments by one with each subsequent cast. The .00#c file for each cast was opened with Velocwin and converted into CARIS .svp file format. The individual .svp profiles were concatenated into a single .svp file for the sheet. Individual sound velocity profile files taken by the MVP will not be submitted due to the large number of casts acquired; however, the daily concatenated files are submitted.

The concatenated sound velocity files were applied to multibeam data in CARIS HIPS during data processing. CARIS HIPS uses one of four different algorithms to automatically apply a sound velocity profile stored in the concatenated sound velocity file. They are: "previous in time," "nearest in time," "nearest in distance" and "nearest in distance within time." In general, "previous in time" was the method used for applying sound velocity information in HIPS, but the other methods may have been used in certain situations. The method of applying sound velocity is included in the processing logs that are submitted with each survey.

7.0 Water Level

The vertical datum for this project is Mean Lower-Low Water (MLLW). Predicted water level correctors from the primary tide stations at Juneau, Alaska (945-2210) were downloaded from the CO-OPS website and used for water level corrections during the course of the project.

The files for the relevant days were collated into a tide station master file which was converted to CARIS .tid file format in MapInfo using HydroMI. Water level data in the .tid files were applied to data using the zone definition file (O168FA2007CORP.zdf) supplied by CO-OPS. Upon receiving final approved water level data, all data were reduced to MLLW using the final approved water levels (smooth tides) as noted in the Descriptive Report included with the survey data.

A complete description of vertical control for the project can be found in the *OPR-O168-FA-07 Horizontal and Vertical Control Report (HVCR)*, submitted under separate cover.

Appendix I

System Tracking

FA Hydrographic Vessel Inventory

FA Hardware Inventory

FA Computer Inventory

FA Personnel Inventory

FA Survey Software

- Software Systems
- ISIS Sonar
- Triton Suite
- TerraSync
- CARIS Licenses
- CARIS HIPS & SIPS
- CARIS Utilities
- CARIS GIS
- CARIS NOTEBOOK
- PYDRO
- Pathfinder
- Velocwin
- Fledermaus
- MapInfo
- Ashtech
- Acrobat Pro
- Other

Hydrographic Vessel Inventory

Field Unit: FAIRWEATER
Effective Date: June 1, 2006
Updated Through: April 30, 2007

SURVEY VESSELS						
Vessel Name	**FAIRWEATHER**	**Launch 1010**	**Launch 1018**	**Skiff**	**FRB**	**Ambar 700**
Vessel Image						
Hull Number	S 220	1010	1018	1706	2301	2302
Call Letters	WTEB					
Manufacturer	Aerojet-General Shipyards Jacksonville, FL	Jensen	Jensen	MonArk	Zodiak of North America	Marine Silverships, Inc
Year of Construction	1967	1973	1973		2004	1998
Type of Construction	Welded steel hull - ice strengthened	Aluminum hull	Aluminum Hull	Aluminum Hull	RHIB	RHIB
Length Overall	70.4 m (231 ft)	8.8 m (28ft 10in)	8.8 m (28ft 10in)	5.2 m (17 ft)	6.7 m (22 ft)	7.0 m (23 ft)
Beam	12.8 m (42 ft)	3.3 m (10ft 8in)	3.3 m (10ft 8in)	2.3 m (7ft 2in)	2.6 m (8ft 6in)	2.9 m (9ft 4in)
Draft	4.7 m (15ft 6in)	1.2 m (4 ft)	1.2 m (4 ft)	0.4 m (1ft 3in)	0.6 m (22 in)	0.4 m (17 in)
Date of Effective Full Vessel Static Offset Survey	Origninal Survey 9/2003 POS/MV Offsets Surveyed 2/2007	2004	2004			
Organization which Conducted the Effective Full Offset Survey	Original Survey - Westlake Consultants POS/MV Survey - NGS	NOAA Personnel (Wexler, Sampadian, Froelich)	NOAA Personnel (Wexler, Sampadian, Froelich)			
Date of Last Partial Survey or Offset Verification & Methods Used	April - 2007?	April-2007 Steel Tape	April-2007 Steel Tape			
Date of Last Static Draft Determination & Method Used	April-2007 Draft Marks on Hull	April-2007 Draft Marks on Hull	April-2007 Draft Marks on Hull			
Date of Last Settlement and Squat Measurements & Method Used	April-2007 Echosounder Method	April-2007 Echosounder Method	April-2007 Echosounder Method			

RED - info needs to be verified
ORANGE - info needs to be found
GREY - info not available

Hydrographic Hardware Inventory

Field Unit: FAIRWEATHER
Effective Date: 2/10/2007
Updated Through: 11/30/2007

SONAR & SOUNDING EQUIPMENT

Equipment Type	Manufacturer	Model	Serial Number	Firmware and/or Software Version	Version Install Date	Location	Date of last Calibration	Date of last Service	Additional Information
Processor	Reson	81-P (8111)	35652	N/A	May-04	S220	N/A		Bar Code : CD0001065312
Processor	Reson	81-P (8160)	35385	N/A	May-04	S220	N/A		Bar Code : CD0001065313
Transducer	Reson	8111ER	unknown	Dry: 8111-E209-6114 Wet: 8111-E101-AFAA	Apr-04	S220	4/20/2006		
Transducer	Reson	8160	unknown	Dry: 8160-2.09-7C6D Wet: 8160-1.00-E9E1	Apr-04	S220	incomplete		
Processor	Reson	81-P	34497	N/A	Jul-04	1010	N/A		Bar Code : CD0001065351
Transducer	Reson	8101 ER	2701011	Dry: 8101-2.09-E34D Wet: 8101-1.08-C215	Jul-04	1010	4/10/2006		removed 10/6/04 for repair; removed 10/1/05 for welding
Processor	Reson	81-P	35737	N/A	Jul-04	1018	N/A		Bar Code : CD0001065349
Transducer	Reson	8101 ER	3102026	Dry: 8101-2.09-E34D Wet: 8101-1.08-C215	Jul-04	1018	incomplete		
Lead Line	CST-FA	Traditional	10_01_05	N/A	N/A	any	3/14/2007		
Lead Line	CST-FA	Traditional	10_02_05	N/A	N/A	any	3/11/2005		
Lead Line	CST-FA	Traditional	20_01_05	N/A	N/A	any	3/20/2007		
Lead Line	CST-FA	Traditional	20_02_05	N/A	N/A	Ambar	4/10/2007		
Lead Line	CST-FA	Traditional	20_03_05	N/A	N/A	any	4/6/2007		
Lead Line	CST-FA	Traditional	30_01_05	N/A	N/A	any	4/9/2007		
Lead Line	CST-FA	V-100/Non-Traditional	pending	N/A	N/A	any	incomplete		in work
Lead Line	CST-FA	V-100/Non-Traditional	pending	N/A	N/A	any	incomplete		in work
Divers Least Depth Gauge	PTC	MODIII	68322	N/A	N/A	S220	unknown	unknown	*acquired 5/22/06; stopped working 9/1/06
*Klein 3000									*03/21 /07-not yet on the FA
Odom Echotrac CVM	Odom Hydrographic	ETCVM-A	26034	ET-CVM COM Ver 3.29 DSPDual Ver 3.28		any			ChartView Dongle (100.001.001.098)

POSITIONING & ATTITUDE EQUIPMENT									
Equipment Type	**Manufacturer**	**Model**	**Serial Number**	**Firmware and/or Software Version**	**Version Install Date**	**Location**	**GAMS Calibration**	**Date of last Service**	**Additional Information**
POS/MV PCS	Applanix	320 V.4	2411	HW2.9-7, SW03.22	Jun-06	S220	3/29/2007		Auth. No. 811025-00534537
POS/MV IMU	Applanix	LN200	292	N/A	Apr-04	S220			Bar Code : CD0001696450
POS/MV Port Ant.	Applanix	OEM2 3151R	SGN 98490013	HW1	Apr-04	S220			
POS/MV Stbd Ant.	Applanix	OEM2 3151R	CGN 9620009	HW1	Apr-04	S220			
DGPS Receiver	CSI Wireless	MBX-3S	0426- 16627- 0001	N/A	Jul-04	S220			
DGPS Ant.	CSI Wireless	MGL3		N/A	Apr-04	S220			
POS/MV PCS	Applanix	320 V.4	2564	HW 1.9.7, SW 03.26	Jul-06	1010	3/30/2007		
POS/MV IMU	Applanix	LN200	294	N/A	Jul-04	1010			Bar Code : CD0001696449
POS/MV Port Ant.	Applanix	OEM2 3151R	S/N 60162863	HW1	Mar-07	1010			
POS/MV Stbd Ant.	Applanix	OEM2 3151R	S/N 60145247	HW1	Mar-07	1010			
DGPS Receiver	CSI Wireless	MBX-3S	0331-12579-0008	N/A	Jul-04	1010			
DGPS Ant.	CSI Wireless	MGL3	0331-12579-0009	N/A	Jul-04	1010			
POS/MV PCS	Applanix	320 V.4	2560	HW 1.9.7, SW 03.26	Jul-06	1018	3/30/2007		
POS/MV IMU	Applanix	LN200	37	N/A	Feb-07	1018			Bar Code : CD0000832907
POS/MV Port Ant.	Trimble	39105-00 DC 4618	60145158	N/A	Feb-07	1018			
POS/MV Stbd Ant.	Trimbe	39105-00 DC 4604	60130644	N/A	Feb-07	1018			
DGPS Receiver	CSI Wireless	MBX-3S	0328-12362-0001	N/A	Jul-04	1018			
DGPS Ant.	CSI Wireless	MGL3	0328-12352-0002	N/A	Jul-04	1018			
Trimble Backpack 1	Trimble	Pathfinder Pro XRS	0224078543	N/A	N/A	S220			
Trimble Backpack 1: Antenna	Trimble	33580-50	0220341062	N/A	N/A	S220			
Trimble Backpack 2	Trimble	Pathfinder Pro XRS	0224090101	N/A	N/A	S220			
Trimble Backpack 2: Antenna	Trimble	33580-50	0220321059	N/A	N/A	S220			
Handheld data collector	Trimble	TSCe	37318	N/A	N/A	S220			
Laser	Laser Tech Inc.	Impulse Laser Rangefinder	i09290	N/A	N/A	S220			
Laser	Laser Tech Inc.	TruPulse 200 Laser Rangefinder	001481	N/A	N/A	S220			
Laser	Laser Tech Inc.	TruPulse 200 Laser Rangefinder	000676	N/A	N/A	S220			
Antenna cable	Trimble					S220			P/N22628
Camcorder Batteries	Trimble					S220			P/N17466
NMEA/RTCM cable	Trimble					S220			P/N30232-00
data/power cable	Trimble					S220			P/N30231-00
dual battery cable	Trimble					S220			P/N24333
GPS Pathfinder field device cable	Trimble					S220			P/N45052

SOUND SPEED MEASUREMENT EQUIPMENT									
Equipment Type	Manufacturer	Model	Serial Number	Firmware and/or Software Version	Version Install Date	Location	Date of last Calibration	Date of last Service	Additional Information
Moving Vessel Profiler winch	Brooke Ocean Technology Inc.	MVP-200-5	10328			S220			Calibration by ACME Velocimeters, not manufacturer. Brooke Ocean too backed up.
Moving Vessel Profiler fish	Brooke Ocean Technology Inc.	MVP-FFF-SS-32-1	Spare			S220			Spare Fish
Moving Vessel Profiler fish	Brooke Ocean Technology Inc.	MVP-FFF-SS-32-1	10329			S220			
Moving Vessel Profiler sensor	Brooke Ocean Technology Inc.	Smart SV +P	5229			S220			Spare Sensor
Moving Vessel Profiler sensor	Brooke Ocean Technology Inc.	AML SV +P	4986			S220			*26 June - lost one fish and sensor; 1-166
Penetrometer	Brooke Ocean Technology Inc.	FFCPT-35-2	10416			S220			
Penetrometer sensor	Brooke Ocean Technology Inc.	AML SV +P	191-3			S220			
SEACAT Profiler	Sea-Bird	SBE 19plus	19P36026-4585	1.4D		S220	Nov-06	N/A	CON files: 4585.con
SEACAT Profiler	Sea-Bird	SBE 19plus	19P36026-4617	1.4D		1010 or 1018	Nov-06	N/A	CON files: 4617.con; connector pin broke 25 Sept.
SEACAT Profiler	Sea-Bird	SBE 19plus	19P36026-4616	1.4D		1010 or 1018	Nov-06	N/A	CON files: 4616.con
Micro Thermosalinograph	Sea-Bird	SBE 45 (TSG)	4536628-0117	N/A	N/A	S220	Nov-06	N/A	P/N 4536628

TIDES & LEVELING EQUIPMENT									
Equipment Type	Manufacturer	Model	Serial Number	Firmware and/or Software Version	Version Install Date	Location	Date of last Calibration	Date of last Service	Additional Information
Level	Carl Zeiss	N12 333	100056	N/A	N/A	S220	Mar-07		
Level	Carl Zeiss	N12 333	103567	N/A	N/A	S220	Mar-07		
Level	Leica	NA2 100	5332739	N/A	N/A	S220			
Level	Lecia	NA2 100	5332747	N/A	N/A	S220			

HORIZONTAL AND VERTICAL CONTROL EQUIPMENT									
Equipment Type	**Manufacturer**	**Model**	**Serial Number**	**Firmware and/or Software Version**	**Version Install Date**	**Location**	**Date of last Calibration**	**Date of last Service**	**Additional Information**
Receiver	Ashtech	Z-Xtreme	ZE1200339016	ZE00	Apr-04	S220	Mar-07	obtained April 2004	
GPS Antenna	Ashtech	Geodetic 4	8365	N/A	N/A	S220	Mar-07	obtained April 2004	
Position Data Link High Powered Base Unit	Pacific Crest	PDL 4135	0424 0171	2.40	Apr-04	S220	Mar-07	obtained April 2004	
Position Data Link Rover	Pacific Crest	PDL 4100	04240154	2.4	Apr-04	S220	Mar-07	obtained April 2004	
Position Data Link Rover	Pacific Crest	PDL 4100	03473047	2.32	Apr-04	S220	Mar-07	obtained April 2004	
Position Data Link Rover	Pacific Crest	PDL 4100	04240155	2.4	Apr-04	S220	Mar-07	obtained April 2004	
Marine Deep Cycle Battery	Magnatron					S220		purchased July 2004	7 as of May 2006
Solar Panel	Uni-Solar	FLX-32	USF-32-14639	N/A	N/A	S220			
Solar Panel	Uni-Solar	FLX-32	USF-32-14634	N/A	N/A	S220			
Solar Panel	Uni-Solar	FLX-32	USF-32-14633	N/A	N/A	S220			
Solar Panel	Uni-Solar	FLX-32	USF-32-14529	N/A	N/A	S220			
Solar Panel	Uni-Solar	FLX-32	USF-32-14631	N/A	N/A	S220			
Solar Panel	Uni-Solar	FLX-32	USF-32-14625	N/A	N/A	S220			
Solar Panel	Uni-Solar	FLX-32	USF-32-14645	N/A	N/A	S220			
Solutions Dongles	Ashtech	600586 (A)	KEB2083	N/A	N/A	S220			
Solutions Dongles	Ashtech	600586 (A)	KEB2077	N/A	N/A	S220			
GPS Receiver	Trimble	DSM-232	22511661	3.5	Feb-07	S220			
GPS Receiver	Trimble	DSM-232RS	225111655	3.5	Feb-07	S220			DGPS Reference Station
DGPS Ant.	Trimble	33580-00	220395038	N/A	N/A	S220			
GPS Antenna	Trimble	Geodetic Reference Station Antenna	30325441	N/A	N/A	S220			

OTHER EQUIPMENT									
Equipment Type	**Manufacturer**	**Model**	**Serial Number**	**Firmware and/or Software Version**	**Version Install Date**	**Location**	**Date of last Calibration**	**Date of last Service**	**Additional Information**

FAIRWEATHER Computers

Machine Name	Location	Make/Model	Operationg System	Date Purchased	Date of Last Rebuild	Processor Speed	RAM (original)	RAM (checked March 2006)	Number of Video Outputs	Video RAM	Service Tag	Barcode	Comments
FA_Proc_1	Plot Room	DELL PWS 650	XP Pro 2002 SP2	~ March 2004	~ September 2005	2.8 GHz	1 GB	3 GB	2	128 MB	J5PSH31	CD0001354993	
FA_Proc_2	Plot Room	DELL PWS 360	XP Pro 2002 SP2	~ March 2004	~ September 2005	2.8 GHz	1 GB	2 GB	2	128 MB	6WYB451	CD0001741478	
FA_Proc_3	Plot Room	DELL PWS 360	XP Pro 2002 SP2	~ March 2004	~ September 2005	2.8 GHz	1 GB	3 GB	2	128 MB	GBBG451	CD0001741480	
FA_Proc_4	Plot Room	DELL PWS 360	XP Pro 2002 SP2	~ March 2004	~ September 2005	2.8 GHz	1 GB	3 GB	2	128 MB	CBBG454	CD0001741481	
FA_Proc_5	Plot Room	DELL PWS 450	2000 SP4	~ March 2004	~ September 2005	2. GHz	unknown	2 GB	2	64 MB	344RH31	CD0001354979	FA_Process_5 added & configured 10/11/05
FA_Proc_6	Plot Room	DELL PWS 450	XP Pro 2002 SP2	~ March 2004	~ September 2005	2.8 GHz	1 GB	2 GB	2	128 MB	356JG31	CD0001354468	
FA_Proc_7*	Plot Room	DELL PWS 360	XP Pro 2002 SP2	~ March 2004	~ September 2005	2.8 GHz	1 GB	3 GB	2	128 MB	7WYB451	CD0001741477	*Formerly known as S220_NAV FA_Process_7 added & configured 5/6/05
FA_Proc_8	Plot Room	DELL PWS 360	XP Pro 2002 SP2	~ March 2004	~ September 2005	2.8 GHz	1 GB	3 GB	2	128 MB	DBBG451	CD0001741482	
FA_Proc_9	Plot Room	DELL PWS 450	XP Pro 2002 SP2	~ March 2004	~ September 2005	2.8 GHz	1 GB	3 GB	2	128 MB	846JG31	CD0001354463	
FA_Proc_10	DP-2	DELL PWS 450	2000 SP4	~ March 2004	~ September 2005	2.4 GHz	1 GB	2 GB	2	64 MB	644RH31	CD0001354984	FA_Process_10 added & configured 8/28/05
FA_CST	Field Office	DELL PWS 360	XP Pro 2002 SP2	~ March 2004	~ September 2005	2.8 GHz	1 GB	2 GB	2	128 MB	FBBG451	CD0001741479	
FA_FOO	Field Office	DELL PWS 450	XP Pro 2002 SP2	~ March 2004	~ September 2005	2.8 GHz	1 GB	3 GB	2	128 MB	646JG31	CD0001354465	
FA_O-LAB*	O-LAB	DELL PWS 450	2000 SP4	~ March 2004	~ September 2005	2.4 GHz	unknown	3 GB	2	64 MB	144RH31	CD0001354980	*formerly FA_Process_8b
FA_Mobile1	Laptop	DELL Inspiron 1100	XP Pro 2002 SP2	~ March 2004	~ September 2005	2.4 GHz	2.5 GB	2.5 GB	1	64 MB	HGHWM41	CD0001272964	
FA_Mobile2	Laptop	DELL Inspiron 1101	XP Pro 2002 SP2	~ March 2004	~ September 2005	2.4 GHz	2.5 GB	2.5 GB	1	64 MB	GGHWM41	CD0001272965	
Toughbook 1	Laptop	Panasonic CF-18	XP Pro 2002 SP2	~ March 2004	~ July 2006	1.1 GHz	2.5 GB	N/A	1	64 MB	4HKSA59499	CD0001269860	*rebuilt after crash July 2006
Toughbook 2	Laptop	Panasonic CF-18	XP Pro 2002 SP2	~ March 2004	~ September 2005	1.1 GHz	2.5 GB	N/A	1	64 MB	4HKSA59560	CD0001269858	
Toughbook 3	Laptop	Panasonic CF-29	XP Pro 2002 SP2	March 2006	N/A	1.6 GHz	2.5 GB	N/A	1	128 MB	6AKSB06863	CD0001698251	
Toughtab 1	Laptop	Panasonic CF-18	XP Pro 2002 SP2	~ March 2004	~ September 2005	1.1 GHz	2.5 GB	N/A	1	64 MB	4GKSA55049	CD0001269589	
1010_ACQ	Launch 1010	DELL PWS 670	XP Pro 2002 SP3	~ March 2004	~ September 2005	2.8 GHz	2 GB	2 GB	3	64 MB	4JD0S61	CD0001696433	
1018_ACQ	Launch 1018	DELL PWS 670	XP Pro 2002 SP4	~ March 2004	~ September 2005	2.8 GHz	2 GB	2 GB	3	64 MB	71NKT61	CD0001696419	
S220_ACQ	Plot Room	Supermicro Xeon	XP Pro 2002 SP2	~ March 2004	N/A	2.8 GHz	896 MB	896 MB	3	128 MB	N/A	CD0001269853	
FA_MVP200	Plot Room	MVP-C1-2001	2000 SP4	~ March 2004	~ September 2005	2.4 GHz	230 MB	230 MB	1	64 MB	SN: 10330	CD0001269854	

External Hard Drives	Location	Make/Model	RAM (original)	Service Tag	Barcode	Comments
	Plot Room	Maxtor One Touch II	300 GB	S/N L618M19H	CD0001698248	
	Plot Room	Maxtor One Touch II	300 GB	S/N B60Y1QJH	CD0001474757	
	Plot Room	Maxtor One Touch II	300 GB	S/N L617HX5H	CD0001698245	
FA-SUBMISSION-UNIT4	Plot Room	Maxtor One Touch II	300 GB	S/N L60DP6TG	CD0001698250	
FA-SUBMISSION-UNIT1	Plot Room	WD1200B006-RNN	300 GB	S/N: WCAEK1371526	CD0001696434	
Western Digital 2	Plot Room	WD1200B008-RNN	120 GB	S/N: WCAES1181707	CD0001696417	
Western Digital 3	Plot Room	WD1200B008-RNN	120 GB	S/N: WCAES1182576	CD0001269837	
Western Digital 1	Plot Room	WD1200B011-RNN	120 GB	S/N: WCAES1181609	CD0001269824	
1010 Hard Drive	Plot Room	2.5" ION DRIVE GHD225U40		none	CD0001269826	
1018 Hard Drive	Plot Room	2.5" ION DRIVE GHD225U40		none	CD0001696418	
Net Disk	Plot Room	Ximeta Inc. ND Series Model: ND 10	80 GB	S/N: N4061100095	CD0001478894	

Hydrographic Personnel Roster

Field Unit: FAIRWEATHER S-220
Effective Date: 2/1/2007
Updated Through: 10/31/2007

OFFICERS

Name and Grade	Current Position	Years of Hydro Experience (calculated)	Hydro Experience Since	Notes
CDR Andrew L. Beaver	Commanding Officer	15 year(s) + 9 month(s)	January-87	Arrived June-06
LCDR Edward J. Van Den Ameele	Executive Officer	14 year(s) + 4 month(s)	June-93	Departed August-07
LCDR Richard Fletcher	Executive Officer	13 year(s) + 6 month(s)	April-94	Arrived August-07
LT Jennifer Dowling	Field Operations Officer	6 year(s) + 11 month(s)	November-00	Arrived February -06
LTjg Michael Gonsalves	Junior Officer	2 year(s) + 11 month(s)	November-04	Nav Officer; Departed July-07
LTjg Jonathan French	Junior Officer	2 year(s) + 11 month(s)	November-04	ECO Officer; Departed April-07
LTjg Guinevere Lewis	Junior Officer	2 year(s) + 4 month(s)	June-05	Tides Officer; Promoted to LTjg April-07
LTjg Allison Martin	Junior Officer	2 year(s) + 4 month(s)	June-05	DC Officer, Nav Officer; Promoted to LTjg April-07
ENS Matthew Glazewski	Junior Officer	1 year(s) + 11 month(s)	November-05	
ENS Llian Breen	Junior Officer	0 year(s) + 10 month(s)	December-06	
ENS Nick Morgan	Junior Officer	0 year(s) + 10 month(s)	December-06	ECO Officer
ENS Mark Andrews	Junior Officer	0 year(s) + 3 month(s)	July-07	
ENS Patrick Redmond	Junior Officer	0 year(s) + 3 month(s)	July-07	

SURVEY DEPARTMENT

Name and Rate	Current Position	Years of Hydro Experience	Hydro Experience Since	Notes
Lynnette Morgan	Chief Survey Technician	7 year(s) + 9 month(s)	January-00	departed August-06; return date tba
Grant Froelich	Chief Survey Technician	5 year(s) + 2 month(s)	August-02	
Stephanie Mills	Survey Technician	1 year(s) + 7 month(s)	March-06	Promoted to SST Sept 07
Dan Jacobs	Assistant Survey Technician	1 year(s) + 1 month(s)	September-06	Promoted to ST Sept 07
Brenna Campbell	Assistant Survey Technician	1 year(s) + 1 month(s)	September-06	Promoted to ST Sept 07
Adam Argento	Assistant Survey Technician	0 year(s) + 7 month(s)	March-07	
Andrew Evans	Assistant Survey Technician	0 year(s) + 4 month(s)	June-07	

DECK DEPARTMENT (involved in survey work)

Name and Rate	Current Position	Years of Hydro Experience	Deck Experience Since	Notes
Garry Guice	Chief Boatswain	N/A	April-82	
Eric Heiner	Third Mate	N/A	April-93	Promoted to Third Mate August -07
Ron Walker	BGL	N/A	June-84	
Kerri Curtin	AB	N/A	February-02	departed July 07
Emily Evans	DU	N/A	January-06	
Mills Dunlap	GVA	N/A	June-06	
Carter Terry	AB	N/A	February-07	
Chris Marcum	GVA	N/A	August-07	arrived Aug 07
Alex Davis	AB	N/A	January-07	

ROTATING HYDROGRAPHERS & VISITORS (involved in survey work)

Name and Rate	Current Position	Years of Hydro Experience	Hydro Experience Since	Notes & Dates Embarked
Sarah Wolfskehl	ERT			**P183, P909** Arr Apr-7, Dep Jun-27
Matt Foss	Physical Scientist			**P183, P909** Arr Apr-21, Dep Jun-27
Toshi Wozumi	Physical Scientist			**P183, P909, P903, P132** Arr Jul-7, Dep Sept-04
Katie Reser	Physical Scientist			**P183, P909, P903, P132** Arr Aug-06, Dep Sep -28
Matt Foss	Physical Scientist			**P903, P132** Arr Sep-5, Dep Oct-02
Dave Sinson	Physical Scientist			**P903, P132** Arr Sep-17, Dep Nov-03

NOTES:

FAIRWEATHER Survey Software Systems

Acquisition	Processing	Miscellaneous	Tracking
ISIS Sonar v7.0.2	CARIS HIPS & SIPS v6.0	Adobe Acrobat Professional	Microsoft Office
Triton Suite	CARIS HIPS & SIPS v6.1	Macromedia Dreamweaver 7.0.1	Corel Word Perfect Office 2002
POS MV Controller 3.3.2.2 (1010 and 1018)	CARIS Utilities	Snag It 7.1	McAffee
MV POS View 3.3.1 (S220)	CARIS GIS v4.4a	Paint Shop Pro v8	Computer Defragmentation
Brooke Ocean Technology MVP 2.26	CARIS Notebook v3.0	Global Mapper 7	
TerraSync 2.41	PYDRO v7.3	SevenCs - SeeMyDEnc	
	Pathfinder 3.1		
	Velocwin 8.8		
	Fledermaus 6.21		
	MapInfo 8.0		
	MapInfo 8.5		
	Ashtech Solutions v2.6		

ISIS Sonar

Version	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB (8b)	FA_DiveLab	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
v.6.5.0				d.u																d.u	d.u	d.u	
v6.5.1				d.u																d.u	d.u	d.u	
v6.6.0				d.u																d.u	d.u	d.u	
v6.7.0				10/1/04																10/1/04	10/1/04	9/20/04	ISIS removed 2/14/05
v6.7.193.0																							
v6.8				N/A																2/10/05	2/28/05	2/14/05	FA_Process_4 No longer back-up computer
v6.9				N/A	10/7/05*															9/10/05	9/10/05	8/5/05	FA_Process_5 needs to be uninstalled, was backup acq
v7.0				N/A																		1/11/06	
v7.0.2																				4/27/06	4/27/06	4/27/06	
v7.0.410																				3/22/06	3/21/06	3/22/06	Uninstalled due to nav problems
v7.0.414	4/20/06																			4/24/06	4/24/06	4/21/06	FA_Process_1 setup for Dual 8111/8160 acquistion Uninstalled due to datagram frequency issue
ISIS Dongle	TEI 03-1527																			TEI 03-1525	TEI 03-1527	TEI 03-1526	

d.u.=date unknown; exact intall date not documented

Triton Suite: DeplhMap, DelphNav, BathyPro, RT Bathy, 81XX Server, Mission Monitor																							
Version	**FA_Process_1**	**FA_Process_2**	**FA_Process_3**	**FA_Process_4**	**FA_Process_5**	**FA_Process_6**	**FA_Process_7**	**FA_Process_8**	**FA_Process_9**	**FA_Process_10**	**FA_CST**	**FA_FOO**	**FA_O-LAB (8b)**	**FA_DiveLab**	**FA_Mobile1**	**FA_Mobile2**	**Toughbook 1**	**Toughbook 2**	**ToughTab 1**	**1010 ACQ**	**1018 ACQ**	**S-220 ACQ**	**Comments**
v2.12																				2/10/05	2/28/05	2/14/05	
v2.13					10/7/05															9/10/05	9/10/05	8/5/05	
v3.1.410																				3/22/06	3/21/06	3/22/06	
v3.1.2																				4/27/06	4/27/06	4/27/06	
DelphMap Dongle																				TEI 03-1525	TEI 03-1527	TEI 03-1526	
DelphNav Dongle																							
SevenC's S57 Dongle																				U10930	U10933		

TerraSync

Version	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB (8b)	FA_DiveLab	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
v2.40	**NA**	**NA**	**NA**	**d.u**			**NA**	**NA**	**d.u.**			**NA**			d.u		**7/18/06**		d.u				
v2.41	**NA**	**NA**	**NA**				**NA**	**NA**				**NA**	3/21/06		10/6/2004		7/18/2006	10/13/2004	10/5/2004				also installed on TCSe
Product Serials	**498295-00110**																						
	unknown																						
Software Install Serials	**498295-00110-04309-7073A4A7**																						
	498295-00110-05068-EBD4EA8B																						

d.u.=date unknown; exact intall date not documented

CARIS Licenses							
Caris License #	**On**	**GIS**	**HIPS**	**Notebook**	**Expires**	**Type**	**Comments**
CW9604403	roving	**1**	**1**			Purple USB	replaces CW9604041
CW9604042	roving			**1**	12/31/07	Purple USB	
CW9604366	FADC3	**7**	**7**	**5**	10/31/07	Red USB	new key inst. 10/31/05

CARIS HIPS & SIPS 6.0

Version	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB (8b)	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
v6.0 full	04/23/06	04/23/06	10/04/05	10/04/05	03/08/06	04/23/06	04/23/06	10/03/05	04/23/06	04/26/06	08/05/06	8/24/2006		1/17/2006								
v6.0 HF1			10/04/05	10/04/05	03/08/06																	
v6.0 HF2			10/04/05	10/04/05	03/08/06																	
v6.0 SP1	4/23/2006	4/23/2006	12/14/05	4/23/2006	03/08/06	4/23/2006	4/23/2006	4/23/2006	4/23/2006	4/26/06	08/05/06	8/24/2006		01/17/06								
SP1 HF1			12/14/05		03/08/06									01/17/06								
SP1 HF2			12/14/05		03/08/06									01/17/06								
SP1 HF3			12/14/05		03/08/06									01/17/06								
SP1 HF4			12/14/05		03/08/06									01/17/06								
SP1 HF5			01/11/06		03/08/06									01/17/06								
SP1 HF6			01/11/06		03/08/06									01/17/06								
SP1 HF7			01/17/06		03/08/06									01/17/06								
SP1 HF8			03/08/06		03/08/06																	
SP1 HF9			03/08/06		03/08/06																	
SP1 HF10			03/08/06		03/08/06																	
SP1 HF11			03/08/06		03/08/06																	
SP1 HF12			03/08/06		03/08/06																	
SP1 HF13			03/08/06		03/08/06																	
SP1 HF14			03/08/06		03/08/06																	
SP1 HF 15			04/12/06		04/12/06																	
SP1 HF16			04/12/06		04/12/06																	
SP1 HF17			04/12/06		04/12/06																	
SP2	4/23/2006	4/23/2006	04/16/06	4/23/2006	4/23/2006	4/23/2006	4/23/2006	4/23/2006	4/23/2006	4/26/06	08/05/06	8/24/2006		4/16/2006								
SP2 HF1	4/23/2006	4/23/2006	4/23/2006	4/23/2006	4/23/2006	4/23/2006	4/23/2006	4/23/2006	4/23/2006	4/26/06	08/05/06	8/24/2006		4/25/2006								
SP2 HF2	5/7/2006	5/7/2006	5/7/2006	5/7/2006	5/7/2006	5/7/2006	5/7/2006	5/7/2006	5/7/2006	5/7/2006	08/05/06	8/24/2006		5/22/2006								
SP2 HF3	5/7/2006	5/7/2006	5/7/2006	5/7/2006	5/7/2006	5/7/2006	5/7/2006	5/7/2006	5/7/2006	5/7/2006	08/05/06	8/24/2006		5/22/2006								
SP2 HF4	7/8/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006		08/05/06	8/24/2006		5/22/2006								
SP2 HF5	7/8/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006		08/05/06	8/24/2006		5/22/2006								
SP2 HF6	7/8/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006		08/05/06	8/24/2006		5/22/2006								
SP2 HF7	7/8/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006		08/05/06	8/24/2006		5/22/2006								
SP2 HF8	7/8/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006		08/05/06	8/24/2006										
SP2 HF9	7/8/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006		08/05/06	8/24/2006										
SP2 HF10	7/8/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006		08/05/06	8/24/2006										
SP2 HF11	7/8/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006		08/05/06	8/24/2006										
SP2 HF12	7/8/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006	7/6/2006		08/05/06	8/24/2006										
SP2 HF13	7/14/2006	7/14/2006	7/14/2006	7/19/2006	7/14/2006	7/14/2006	8/23/2006	8/12/2006	7/14/2006		08/05/06	8/24/2006										
SP2 HF14	7/14/2006	7/14/2006	7/14/2006	7/19/2006	7/14/2006	7/14/2006	8/23/2006	8/12/2006	7/14/2006		08/05/06	8/24/2006										
SP2 HF15	8/23/2006	8/23/2006	8/23/2006	8/23/2006	8/23/2006	8/23/2006	8/23/2006	8/23/2006	8/23/2006		08/24/06	8/24/2006										
SP2 HF16	9/18/2006	9/18/2006	9/18/2006	9/18/2006	9/18/2006	9/18/2006	date unknown	9/18/2006	9/18/2006		09/18/06	09/18/06										
SP2 HF17	9/18/2006	9/18/2006	9/18/2006	9/18/2006	9/18/2006	9/18/2006	date unknown	9/18/2006	9/18/2006		09/18/06	09/18/06										
SP2 HF18	9/18/2006	9/18/2006	9/18/2006	9/18/2006	9/18/2006	9/18/2006	date unknown	9/18/2006	9/18/2006		09/18/06	09/18/06										
SP2 HF19	10/2/2006	10/2/2006	10/2/2006	10/2/3006	10/3/2006	10/3/2006	10/3/2006	10/3/2006	10/3/2006		10/2/2006	10/03/06										
	removed	removed	removed	removed	removed	removed	removed	removed	removed	removed	removed	removed										

CARIS HIPS & SIPS 6.1

Vesion	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB (8b)	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
v6.1 full	02/25/07	02/25/07	02/13/07	02/25/07	02/25/07	02/25/07	02/25/07	02/25/07	02/25/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF1	03/06/07	03/06/07	03/04/07	03/06/07	03/07/07	04/09/07	03/07/07	03/05/07	03/07/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF2	03/06/07	03/06/07	03/06/07	03/06/07	03/07/07	04/09/07	03/07/07	03/05/07	03/07/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF3	03/06/07	03/06/07	03/06/07	03/06/07	03/07/07	04/09/07	03/07/07	03/05/07	03/07/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF4	03/06/07	03/06/07	03/06/07	03/06/07	03/07/07	04/09/07	03/07/07	03/05/07	03/07/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF5	03/06/07	03/06/07	03/06/07	03/06/07	03/07/07	04/09/07	03/07/07	03/05/07	03/07/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF6	03/06/07	03/06/07	03/06/07	03/06/07	03/07/07	04/09/07	03/07/07	03/05/07	03/07/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF7	03/06/07	03/06/07	03/06/07	03/06/07	03/07/07	04/09/07	03/07/07	03/07/07	03/07/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF8	04/02/07	04/02/07	04/03/07	04/02/07	04/02/07	04/09/07	04/02/07	04/02/07	04/02/07	04/02/07	04/03/07	08/11/07	04/02/07									
v6.1 HF9	04/02/07	04/02/07	04/03/07	04/02/07	04/02/07	04/09/07	04/02/07	04/02/07	04/02/07	04/02/07	04/03/07	08/11/07	04/02/07									
v6.1 HF10	04/22/07	04/22/07	04/22/07	05/06/07	04/22/07	04/22/07	05/06/07	04/22/07	04/22/07	05/22/07	04/22/07	08/11/07	07/10/07									
v6.1 HF11	05/06/07	05/06/07	05/06/07	05/06/07	05/06/07	05/06/07	05/06/07	05/06/07	05/06/07	05/23/07	05/06/07	08/11/07	07/10/07									

v6.1 HF12	05/28/07	05/28/07	05/28/07	05/28/07	05/28/07	05/28/07	05/28/07	05/29/07	05/28/07	05/24/07	05/28/07	08/11/07	07/10/07
v6.1 HF13	05/28/07	05/28/07	05/28/07	05/28/07	05/28/07	05/28/07	05/28/07	05/29/07	05/28/07	05/25/07	05/28/07	08/11/07	07/10/07
v6.1 HF14	07/08/07	07/07/07	07/11/07	07/11/07	07/08/07	07/08/07	07/08/07	07/11/07	07/11/07	07/09/07	07/08/07	08/11/07	07/10/07
v6.1 HF15	07/08/07	07/07/07	07/11/07	07/11/07	07/08/07	07/08/07	07/08/07	07/11/07	07/11/07	07/09/07	07/08/07	08/11/07	07/10/07
v6.1 SP1	07/19/07	07/19/07	07/20/07	07/20/07	08/02/07	08/02/07		08/02/07	08/02/07	07/29/07	07/19/07	08/11/07	07/20/07

d.u.=date unknown; exact inxtall date not documented

CARIS HIPS & SIPS 6.1

Vesion	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB (8b)	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
v6.1 full	02/25/07	02/25/07	02/13/07	02/25/07	02/25/07	02/25/07	02/25/07	02/25/07	02/25/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF1	03/06/07	03/06/07	03/04/07	03/06/07	03/07/07	04/09/07	03/07/07	03/05/07	03/07/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF2	03/06/07	03/06/07	03/06/07	03/06/07	03/07/07	04/09/07	03/07/07	03/05/07	03/07/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF3	03/06/07	03/06/07	03/06/07	03/06/07	03/07/07	04/09/07	03/07/07	03/05/07	03/07/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF4	03/06/07	03/06/07	03/06/07	03/06/07	03/07/07	04/09/07	03/07/07	03/05/07	03/07/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF5	03/06/07	03/06/07	03/06/07	03/06/07	03/07/07	04/09/07	03/07/07	03/05/07	03/07/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF6	03/06/07	03/06/07	03/06/07	03/06/07	03/07/07	04/09/07	03/07/07	03/05/07	03/07/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF7	03/06/07	03/06/07	03/06/07	03/06/07	03/07/07	04/09/07	03/07/07	03/07/07	03/07/07	03/06/07	04/03/07	08/11/07	04/02/07									
v6.1 HF8	04/02/07	04/02/07	04/03/07	04/02/07	04/02/07	04/09/07	04/02/07	04/02/07	04/02/07	04/02/07	04/03/07	08/11/07	04/02/07									
v6.1 HF9	04/02/07	04/02/07	04/03/07	04/02/07	04/02/07	04/09/07	04/02/07	04/02/07	04/02/07	04/02/07	04/03/07	08/11/07	04/02/07									
v6.1 HF10	04/22/07	04/22/07	04/22/07	05/06/07	04/22/07	04/22/07	05/06/07	04/22/07	04/22/07	05/22/07	04/22/07	08/11/07	07/10/07									
v6.1 HF11	05/06/07	05/06/07	05/06/07	05/06/07	05/06/07	05/06/07	05/06/07	05/06/07	05/06/07	05/23/07	05/06/07	08/11/07	07/10/07									
v6.1 HF12	05/28/07	05/28/07	05/28/07	05/28/07	05/28/07	05/28/07	05/28/07	05/29/07	05/28/07	05/24/07	05/28/07	08/11/07	07/10/07									
v6.1 HF13	05/28/07	05/28/07	05/28/07	05/28/07	05/28/07	05/28/07	05/28/07	05/29/07	05/28/07	05/25/07	05/28/07	08/11/07	07/10/07									
v6.1 HF14	07/08/07	07/07/07	07/11/07	07/11/07	07/08/07	07/08/07	07/08/07	07/11/07	07/11/07	07/09/07	07/08/07	08/11/07	07/10/07									
v6.1 HF15	07/08/07	07/07/07	07/11/07	07/11/07	07/08/07	07/08/07	07/08/07	07/11/07	07/11/07	07/09/07	07/08/07	08/11/07	07/10/07									
v6.1 SP1	03/06/08	07/19/07	07/20/07	07/20/07	08/02/07	08/02/07	d.u.	08/02/07	08/02/07	07/29/07	07/19/07	08/11/07	07/20/07									
SP1 HF1	03/06/08	09/28/07	09/28/07	09/28/07	09/28/07	09/26/07	09/26/07	09/26/07	09/28/07	09/28/07	09/28/07	09/28/07	09/28/07									
SP1 HF2	03/06/08	09/28/07	09/28/07	09/28/07	09/28/07	09/26/07	09/26/07	09/26/07	09/28/07	09/28/07	09/28/07	09/28/07	09/28/07									
SP1 HF3	03/06/08	09/28/07	09/28/07	09/28/07	09/28/07	09/26/07	09/26/07	09/26/07	09/28/07	09/28/07	09/28/07	09/28/07	09/28/07									
SP1 HF4	03/06/08	09/28/07	09/28/07	09/28/07	09/28/07	09/26/07	09/26/07	09/26/07	09/28/07	09/28/07	09/28/07	09/28/07	09/28/07									
SP1 HF5	03/06/08	11/14/07*	11/20/07*	11/20/07*	11/21/07	12/03/07	12/03/07	12/03/07	12/03/07	d.u.	12/03/07	d.u.	03/11/08									New processing machines:
SP1 HF6	03/06/08	11/14/07	11/20/07	11/20/07	11/21/07	12/03/07	11/20/07	12/03/07	12/03/07	d.u.	12/03/07	d.u.	03/11/08									P1, P2, P3, P4, P5, P7 (P10)
SP1 HF7	03/06/08	01/14/08	01/22/08	01/22/08	01/22/08	01/22/08	02/11/08	01/22/08	01/22/08	02/13/08	01/22/08	01/22/08	03/11/08									
SP1 HF8	03/06/08	01/14/08	01/22/08	01/22/08	01/22/08	01/22/08	02/11/08	01/22/08	01/22/08	02/13/08	01/22/08	01/22/08	03/11/08									
SP1 HF9	03/06/08	01/16/08	01/22/08	01/22/08	01/22/08	01/22/08	02/11/08	01/22/08	01/22/08	02/13/08	01/22/08	01/22/08	03/11/08									
SP1 HF10	03/06/08	03/05/08	02/12/08	02/11/08	03/05/08	03/06/08	02/11/08	03/05/08	03/06/08	02/13/08	03/06/08	03/06/08	03/11/08									
SP1 HF11	03/06/08	03/05/08	03/06/08	03/05/08	03/05/08	03/06/08	03/11/08	03/05/08	03/06/08	03/05/08	03/06/08	03/06/08	03/11/08									

d.u.=date unknown; exact inxtall date not documented

CARIS Utilities

Utility	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB (8b)	FA_DiveLab	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
LUv2.1.0	05/05/04	08/02/04	05/05/04	08/02/04	~~10/11/05~~	09/11/04	05/06/05	08/02/04	08/02/04	08/28/05	08/04/04	08/13/04	10/12/05										
CPCR v2.0	06/14/04	08/02/04	08/02/04	08/02/04	~~10/11/05~~	09/11/04	05/06/05	08/02/04	08/02/04	08/28/05	08/04/04	08/11/04	10/12/05										
EasyENCv3.0	11/05/04	10/07/04	10/07/04	10/08/04	~~10/11/05~~	09/23/04	05/06/05	10/08/04	09/23/04	08/28/05	10/07/04	10/07/04	10/12/05										
ConvUtilityv2.0.0.2	2/9/2005	2/14/2005	2/9/2005	2/9/2005	~~10/11/05~~	2/10/2005	05/06/05	2/9/2005	2/9/2005	08/28/05	2/14/2005	2/15/2005	10/12/05										

CARIS GIS

Service Pack & HotFix	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB (8b)	FA_DiveLab	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
v4.4a	05/05/04	08/02/04	05/05/04	08/02/04	~~10/11/05~~	09/11/04	05/06/05	08/02/04	08/02/04	08/28/05	08/04/04	08/13/04	10/12/05										
SP4	05/05/04	08/02/04	05/05/04	08/02/04		09/11/04	05/06/05	08/02/04	08/02/04		08/04/04	08/13/04											
SP4+HF1	06/14/04	08/02/04	05/05/04	08/02/04		09/11/04	05/06/05	08/02/04	08/02/04		08/04/04	08/13/04											
SP4+HF2	06/14/04	08/02/04	05/05/04	08/02/04		09/11/04	05/06/05	08/02/04	08/02/04		08/04/04	08/13/04											
SP4+HF3	06/14/04	08/02/04	05/05/04	08/02/04		09/11/04	05/06/05	08/02/04	08/02/04		08/04/04	08/13/04											
SP4+HF4	06/17/04	08/02/04	05/05/04	08/02/04		09/11/04	05/06/05	08/02/04	08/02/04		08/04/04	08/13/04											
SP4+HF5	06/17/04	08/02/04	08/03/04	08/02/04		09/11/04	05/06/05	08/02/04	08/02/04		08/04/04	08/13/04											
SP4+HF6	08/03/04	08/02/04	08/03/04	08/02/04		09/11/04	05/06/05	08/02/04	08/02/04		08/04/04	08/13/04											
SP4+HF7	08/03/04	08/02/04	08/03/04	08/02/04		09/11/04	05/06/05	08/02/04	08/02/04		08/04/04	08/13/04											
SP4+HF8	08/03/04	08/02/04	08/03/04	08/02/04		09/11/04	05/06/05	08/02/04	08/02/04		08/04/04	08/13/04											
SP4+HF9	08/26/04	08/26/04	08/26/04	08/26/04		09/11/04	05/06/05	08/26/04	08/26/04		08/26/04	08/26/04											
SP4+HF10	08/31/04	08/31/04	08/31/04	08/31/04		09/11/04	05/06/05	08/31/04	09/01/04		08/31/04	09/01/04											
SP4+HF11	11/05/04	11/05/04	11/04/04	11/06/04		11/06/04	05/06/05	11/06/04	11/06/04		11/06/04	11/06/04											
SP4+HF12	11/05/04	11/05/04	11/04/04	11/06/04		11/06/04	05/06/05	11/06/04	11/06/04		11/06/04	11/06/04											
SP4+HF13	11/05/04	11/05/04	11/04/04	11/06/04		11/06/04	05/06/05	11/06/04	11/06/04		11/06/04	11/06/04											
SP4+HF14	11/05/04	11/05/04	11/04/04	11/06/04		11/06/04	05/06/05	11/06/04	11/06/04		11/06/04	11/06/04											
SP4+HF15	11/05/04	11/05/04	11/04/04	11/06/04		11/06/04	05/06/05	11/06/04	11/06/04		11/06/04	11/06/04											
SP4+HF16	01/10/05	01/10/05	01/13/05	01/12/05		01/12/05	05/06/05	01/04/05	01/06/05		01/14/05	01/12/05											
SP4+HF17	01/10/05	01/10/05	01/13/05	01/12/05		01/12/05	05/06/05	01/04/05	01/06/05		01/14/05	01/12/05											
SP4+HF18	01/10/05	01/10/05	01/13/05	01/12/05		01/12/05	05/06/05	01/04/05	01/06/05		01/14/05	01/12/05											
SP4+HF19	01/10/05	01/10/05	01/13/05	01/12/05		01/12/05	05/06/05	01/04/05	01/06/05		01/14/05	01/12/05											
SP4+HF20	01/10/05	01/10/05	01/13/05	01/12/05		01/12/05	05/06/05	01/04/05	01/06/05		01/14/05	01/12/05											
SP4+HF21	01/10/05	01/10/05	01/13/05	01/12/05		01/12/05	05/06/05	01/04/05	01/06/05		01/14/05	01/12/05											
SP4+HF22	2/9/2005	2/14/2005	02/09/05	02/09/05		2/9/2005	05/06/05	02/09/05	02/09/05		02/01/05	02/15/05											
SP4+HF23	2/9/2005	2/14/2005	02/09/05	02/09/05		2/9/2005	05/06/05	02/09/05	02/09/05		02/01/05	02/15/05											
SP4+HF24	2/9/2005	2/14/2005	02/09/05	02/09/05		2/9/2005	05/06/05	02/09/05	02/09/05		02/01/05	02/15/05											
SP4+HF25	2/9/2005	2/14/2005	02/09/05	02/09/05		2/9/2005	05/06/05	02/09/05	02/09/05		2/14/2005	02/15/05											
SP4+HF26	2/9/2005	2/14/2005	02/09/05	02/09/05		2/9/2005	05/06/05	02/09/05	02/09/05		2/14/2005	02/15/05											
SP4+HF27	2/9/2005	2/14/2005	02/09/05	02/09/05		2/9/2005	05/06/05	02/09/05	02/09/05		2/14/2005	02/15/05											
SP4+HF28	2/9/2005	2/14/2005	02/09/05	02/09/05		2/9/2005	05/06/05	02/09/05	02/09/05		2/14/2005	02/15/05											
SP4+HF29	2/9/2005	2/14/2005	02/09/05	02/09/05		2/9/2005	05/06/05	02/10/05	02/09/05		2/14/2005	02/15/05											
SP4+HF30	03/16/05	05/18/05	03/16/05	03/16/05		03/23/05	05/06/05	03/16/05	03/16/05		03/29/05	03/29/05											
SP4+HF31	05/24/05	05/18/05	04/25/05	04/25/05		05/24/05	05/06/05	05/23/05	05/23/05		05/24/05	05/24/05											
SP4+HF32	05/24/05	05/18/05	04/25/05	04/25/05		05/24/05	05/06/05	05/23/05	05/23/05		05/24/05	05/24/05											
SP4+HF33	05/24/05	05/18/05	05/06/05	05/24/05		05/24/05	05/06/05	05/23/05	05/23/05		05/24/05	05/24/05											
SP5					~~10/11/05~~				08/02/05	08/28/05			10/12/05										
SP5+HF1					~~10/11/05~~				08/02/05	08/28/05			10/12/05										
SP5+HF2					~~10/11/05~~				08/02/05	08/28/05			10/12/05										
SP5+HF3					~~10/11/05~~				08/02/05	08/28/05			10/12/05										

d.u.=date unknown; exact intall date not documented

CARIS Notebook

Service Pack & HotFix	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB (8b)	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
v2.1	05/14/04	08/06/04	08/09/04	08/06/04		09/11/04	05/06/05	08/02/04	08/06/04		08/06/04	08/13/04			01/23/05							
SP1	06/23/04	08/06/04	08/09/04	08/06/04		09/11/04	05/06/05	08/02/04	08/06/04		08/06/04	08/13/04			01/23/05							
SP1+HF1	08/06/04	08/06/04	08/09/04	08/06/04		09/11/04	05/06/05	08/06/04	08/06/04		08/06/04	08/13/04			01/23/05							
v2.2BETA	2/9/2005	02/14/05	2/9/2005	2/14/2005		01/31/05	05/06/05	2/9/2005	2/9/2005		02/01/05	02/15/05			01/23/05							
v2.2BETA2	03/25/05										03/25/05											
v2.2	07/11/05	07/12/05	07/12/05	07/12/05	03/23/06	07/11/05	07/12/05	07/12/05	07/12/05	08/28/05	07/11/05	08/24/06	10/12/05	01/17/06								
v2.2+HF1	09/02/05	09/02/05	09/02/05	09/02/05	03/23/06	09/02/05	09/02/05	09/02/05	09/02/05	08/28/05	08/01/05	don't need	10/12/05									
SP1	01/18/06	04/23/06	01/18/06	04/23/06	03/23/06	04/23/06	04/23/06	04/23/06	04/23/06	01/18/06	d.u.	08/24/06	05/11/06	01/17/06								
SP1+HF1	01/18/06	04/23/06	01/18/06	04/23/06	03/23/06	04/23/06	04/23/06	04/23/06	04/23/06	01/18/06	d.u.	08/24/06	05/11/06	01/17/06								
SP1+HF2	04/23/06	04/23/06	04/12/06	04/23/06	04/23/06	04/23/06	04/23/06	08/23/06	04/23/06	d.u.	d.u.	08/24/06	05/11/06									
SP1+HF3	04/23/06	04/23/06	04/12/06	04/23/06	04/23/06	04/23/06	04/23/06	04/23/06	04/23/06	04/26/06	d.u.	08/24/06	05/11/06									
SP1+HF4	08/23/06	06/06/06	08/23/06	06/18/06	06/18/06	08/23/06	08/23/06	08/23/06	08/23/06		08/24/06	08/24/06	08/24/06									
SP1+HF5	08/23/06	06/06/06	08/23/06	06/18/06	06/18/06	08/23/06	08/23/06	08/23/06	08/23/06		08/24/06	08/24/06	08/24/06									
SP1+HF6	08/23/06	08/23/06	08/23/06	08/23/06	08/23/06	08/23/06	08/23/06	08/23/06	08/23/06		08/24/06	08/24/06	08/24/06									
v3.0	04/02/07	04/02/07	03/15/07	04/02/07	04/02/07	04/09/07	04/02/07	04/02/07	04/02/07	04/02/07	04/03/07	d.u.	04/02/07				3/15/2007					
v3.0+HF1	04/02/07	04/02/07	04/02/07	04/02/07	04/02/07	04/09/07	04/02/07	04/02/07	04/02/07	04/02/07	04/03/07	08/11/07	04/02/07									

d.u.=date unknown; exact intall date not documented

PYDRO																						
Version	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB (8b)	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	**Comments**
v6.2.9HF1,2,3 S57 Cat	05/11/06	05/11/06		05/11/06		05/03/06		05/03/06	05/03/06		05/11/06	05/11/06	05/11/06									
v6.4.9	05/23/06	05/22/06	05/21/06	06/18/06	05/22/06	05/22/06	05/22/06	05/22/06	09/13/06	09/13/06	09/13/06	09/13/06	05/22/06									
v6.4.9HF1&2	05/31/06	05/26/06	06/16/06	06/18/06	05/31/06		05/26/06	05/26/06	09/13/06	09/13/06	09/13/06	09/13/06	05/31/06									
v6.4.9HF3&4	06/07/06	07/14/06	06/16/06	06/18/06	1/0/1900	07/14/06	6/8/2006	6/8/2006	09/13/06	09/13/06	09/13/06	09/13/06	6/8/2006									
v6.4.9HF6	06/08/06	07/14/06	06/16/06	06/18/06	6/8/2006	07/14/06	6/8/2006	6/8/2006	09/13/06	09/13/06	09/13/06	09/13/06	6/8/2006									
v6.4.9HF6pp	09/13/06	09/13/06	09/12/06	09/13/06	09/13/06	09/13/06	09/13/06	09/13/06	09/13/06	09/13/06	09/13/06	09/13/06	09/18/06									
v7.1.0 (r1940)	01/30/07	01/30/07	01/30/07	01/30/07	01/30/07	d.u.	01/30/07	01/30/07	01/30/07	01/30/07	01/30/07	n/a	01/30/07									
v7.2.0 (r1982)	03/04/07	03/04/07	03/04/07	02/27/07	03/07/07	03/14/07	03/07/07	03/07/07	03/07/07	03/05/07	03/07/07	08/11/07	03/05/07									
v7.2.0 (r1984)	03/04/07	03/04/07	03/04/07	02/27/07	03/07/07	03/14/07	03/07/07	03/07/07	03/07/07	03/05/07	03/07/07	08/11/07	03/05/07									patch update
v7.2.2 (r1991)	03/07/07	03/07/07	03/07/07	03/07/07	03/07/07	03/14/07	03/07/07	03/07/07	03/07/07	04/02/07	03/07/07	08/11/07	d.u.									
v7.3 (r2002)	04/02/07	04/02/07	04/16/07	03/20/07	04/02/07	04/09/07	04/02/07	04/02/07	04/02/07	04/02/07	04/03/07	08/11/07	d.u.									
v7.3 (r2014)	04/02/07	04/02/07	04/16/07	04/02/07	04/02/07	04/09/07	04/02/07	04/02/07	04/02/07	04/02/07	04/04/07	08/11/07	d.u.									
v7.3 (r2014_TCfix)	d.u.	04/16/07	04/16/07	04/16/07	d.u.	05/06/07	d.u.	04/16/07	d.u.	d.u.	d.u.	08/11/07	d.u.									
v7.3 (r2110)	07/07/07	07/07/07	d.u.		d.u.	d.u.		d.u.	d.u.	07/09/07	d.u.	08/11/07	07/10/07									
v7.3 (r2114)		07/12/07	d.u.	07/12/07	d.u.	d.u.		d.u.	d.u.	d.u.	d.u.	08/11/07	d.u.									
v7.3 (r2119)		d.u.	d.u.	07/20/07	08/02/07	08/02/07		d.u.	08/02/07	07/29/07	07/19/07	08/11/07	07/20/07									
v7.3 (r2143)				08/23/07		08/30/07																

d.u.=date unknown; exact install date not documented

2007-2008																						
Licenses	d3b9bf48d2ada4a1d4	19165d57445427510	19165d574432e27ab	0a2e1a24b44aa2e73	d3b9bf48ded331c78b	d3b9bf48d2aac21f17	0a2e1a24b42d3c99c	19165d574b44d10e0	d3b9bf48d317fc41e6	d3b9bf48d20a9b8aa7	19165d57469c003f25	d3b9bf48d8d1c38f34	d3b9bf48dec82f7b90									
License expires	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08									
License File updated?	Yes	Yes	Yes	Yes	Yes	yes	Yes	Yes	Yes	Yes	Yes		Yes									
MAC Address	00-0B-DB-5A-62-2B	00-11-11-0F-84-44	00-11-11-06-9D-42	00-01-02-69-5A-45	00-0b-db-c5-f7-ec	00-0B-DB-56-68-2B	00-01-02-69-56-43	00-11-11-06-A1-B5	00-0B-DB-56-68-30	00-0B-DB-5A-D1-2	00-11-11-06-A4-68	00-0B-DB-56-68-8C	00-0b-db-c5-f5-ed									

PYDRO

Version	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB (8b)	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
v7.1.0 (r1940)	01/30/07	01/30/07	01/30/07	01/30/07	01/30/07	d.u.	01/30/07	01/30/07	01/30/07	01/30/07	01/30/07	n/a	01/30/07									
v7.2.0 (r1982)	03/04/07	03/04/07	03/04/07	02/27/07	03/07/07	03/14/07	03/07/07	03/07/07	03/07/07	03/05/07	03/07/07	08/11/07	03/05/07									
v7.2.0 (r1984)	03/04/07	03/04/07	03/04/07	02/27/07	03/07/07	03/14/07	03/07/07	03/07/07	03/07/07	03/05/07	03/07/07	08/11/07	03/05/07									patch update
v7.2.2 (r1991)	03/07/07	03/07/07	03/07/07	03/07/07	03/07/07	03/14/07	03/07/07	03/07/07	03/07/07	04/02/07	03/07/07	08/11/07	d.u.									
v7.3 (r2002)	04/02/07	04/02/07	04/16/07	03/20/07	04/02/07	04/09/07	04/02/07	04/02/07	04/02/07	04/02/07	04/03/07	08/11/07	d.u.									
v7.3 (r2014)	04/02/07	04/02/07	04/02/07	04/02/07	04/02/07	04/09/07	04/02/07	04/02/07	04/02/07	04/02/07	04/04/07	08/11/07	d.u.									
v7.3 (r2014_TCfix)	d.u.	04/16/07	04/16/07	04/16/07	d.u.	05/06/07	d.u.	04/16/07	d.u.	d.u.	d.u.	08/11/07	d.u.									
v7.3 (r2110)	07/07/07	07/07/07	d.u.	d.u.	d.u.	d.u.	d.u.	d.u.	d.u.	07/09/07	d.u.	08/11/07	07/10/07									
v7.3 (r2114)	d.u.	07/12/07	d.u.	07/12/07	d.u.	d.u.	d.u.	d.u.	d.u.	d.u.	d.u.	08/11/07	d.u.									
v7.3 (r2119)	d.u.	d.u.	d.u.	07/20/07	08/02/07	08/02/07	d.u.	d.u.	08/02/07	07/29/07	07/19/07	08/11/07	07/20/07									
v7.3 (r2143)	d.u.	d.u.	d.u.	08/23/07	d.u.	08/30/07	d.u.	d.u.	09/28/07	09/28/07	d.u.	d.u.	d.u.									
v7.3 (r2180)	d.u.	d.u.	d.u.	11/02/07	d.u.		d.u.		11/02/07	03/11/08												
v7.3 (r2196)	11/20/07	11/14/07	11/20/07	11/20/07	11/20/07		11/20/07		11/02/07	03/11/08												
v7.3 (r2239)	12/03/07	12/03/07	12/03/07	12/04/07	12/03/07	12/03/07	12/03/07	12/03/07	12/03/07	03/11/08	12/03/07	12/03/07										
v7.3 (r2252)	03/11/08	03/11/08	03/11/08	02/28/08	02/26/08	03/11/08	03/11/08	03/11/08	03/11/08	03/11/08	03/11/08	03/11/08										

d.u.=date unknown; exact install date not documented

	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB (8b)	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
2008-2009																						
Licenses	a96fb9b9d4b4f3ff01	a96fb9b9d4afb102ed	a96fb9b9d68db20355	a96fb9b9dfeb032ebe	a96fb9b9d4895c41bc	d217461ea2aac21f17	a96fb9b9d0af0fa609	1873e42d0b44d10e02	d217461ea317fc41e6	1873e42d04c1ba4ecf	1873e42d069c003f25	1873e42d0432e27ab2	d217461eaec82f7b90									
License expires	Jan-09	Jan-09	Mar-09	Jan-09	Jan-08	Jan-09	Jan-08	Jan-08	Jan-08	Mar-09	Mar-09	Mar-09	Jan-08									
License File updated?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes										
MAC Address	00-1A-A0-BE-41-4A	00-1A-A0-BE-27-4B	00-1A-A0-BE-5C-69	00-1A-A0-BE-25-FF	00-1A-A0-BE-59-49	00-0B-DB-56-68-2B	00-1A-A0-BE-6C-0B	00-11-11-06-A1-B5	00-0B-DB-56-68-30	0011-11-29-91-4D	00-11-11-06-A4-68	00-11-11-06-9D-42	00-0b-db-c5-f5-ed									
2007-2008																						
Licenses	a81232e414b4f3ff01	a81232e414afb102ed	a81232e4168db20355	a81232e41feb032ebe	a81232e414895c41bc	d3b9bf48d2aac21f17	0a2e1a24b42d3c99d4	19165d574b44d10e02	d3b9bf48d317fc41e6	d3b9bf48d20a9b8aa7	19165d57469c003f25	d3b9bf48d8d1c38f34	d3b9bf48dec82f7b90									
License expires	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08	Jan-08									
License File updated?	n/a	yes	n/a	n/a	n/a	yes	Yes	Yes	Yes	Yes	Yes		Yes									
MAC Address		00-1a-a0-be-27-4b	00-1A-A0-BE-5C-69	00-1A-A0-BE-25-FF	00-1A-A0-BE-5C-69	00-0B-DB-56-68-2B		00-11-11-06-A1-B5	00-0B-DB-56-68-30	00-0B-DB-5A-D1-21	00-11-11-06-A4-68	00-0B-DB-56-68-8C	00-0b-db-c5-f5-ed									

2006-2007																						
Licenses	dc5c387302ada4a1d4	16b8d68174542751df	16b8d6817432e27ab2	05d0934ed44aa2e73d	dc5c38730ed331c78b	dc5c387302aac21f17	05d0934ed42d3c99d4	16b8d6817b44d10e02	dc5c38730317fc41e6	dc5c3873020a9b8aa7	16b8d681769c003f25	dc5c387308d1c38f34	dc5c38730ec82f7b90									
License expires	Jan-07	Jan-07	Jan-07	Jan-07	Jan-07	Jan-07	Jan-07	Jan-07	Jan-07	Jan-07	Jan-07	Jan-07	Jan-07									
License File updated?	Yes	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes			Yes									
MAC Address	00-0B-DB-5A-62-2B	00-11-11-0F-84-44	00-11-11-06-9D-42	00-01-02-69-5A-45	00-0b-db-c5-f7-ec	00-0B-DB-56-68-2B	00-01-02-69-56-43	00-11-11-06-A1-B5	00-0B-DB-56-68-30	00-0B-DB-5A-D1-21	00-11-11-06-A4-68	00-0B-DB-56-68-8C	00-0b-db-c5-f5-ed									

Pathfinder

Version	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB (8b)	FA_DiveLab	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
v3.0	3/22/2005	**NA**	**NA**	**d.u.**			**NA**	**NA**	**d.u.**	**NA**		**NA**	3/21/06		d.u		7/18/2006	10/13/2004	10/4/2004				
v3.02		**NA**	**NA**				**NA**	**NA**		**NA**		**NA**			3/10/2006		7/18/2006	3/10/2006	3/10/2006				
Product	**011746-00300**																						
Serials	**unknown**																						
Software	**024156-00300-05068-0E94DA58**																						
Install	**011746-00300-04309-3BAD03D2**																						

d.u.=date unknown; exact intall date not documented

Velocwin

Version	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB (8b)	FA_DiveLab	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S
v8.5.2													07/31/04									
v8.6.0													n/a									
v8.7.2													2/9/2005							2/11/2005	2/28/2005	
v8.7.3																						
v8.7.5	4/5/2005																					
v8.7.6	5/6/2005																					
v8.7.7	10/6/2005																					
v8.8	3/30/2006																					
v8.81	5/26/2006								5/26/2006				5/26/2006							5/26/2006	5/26/2006	
v8.83	4/11/2007												3/29/2007									

d.u.=date unknown; exact intall date not documented

S-220 ACQ Comments
doesn't apply directly to us
For mvp .bot file processing
received new CON files Dec 2004
Seaterm Win 32 V 1.30, Seabird 5.27a

FLEDERMAUS																							
Version	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB	FA_DiveLab	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
v6.1.0			07/28/04					07/28/04															
V6.1.1			08/03/04					08/03/04		08/13/04													
v6.1.2c			10/05/04					10/07/04		10/07/04													
v6.1.3			01/10/05					01/04/05		01/12/05													2 roving keys
v6.1.3i			03/07/05							03/29/05													What does this do? We don't know.
v6.1.4a			04/18/05																				
v6.1.4d	8/15/2005	08/13/05	08/13/05	08/15/05		08/13/05	08/13/05	08/13/05	08/13/05														1 local key on Proc 3 and 1 Network key on FADC1
v6.1.5			d.u.		10/11/05					10/12/05													
v6.2.0.a			03/06/06																				
v6.2.1			03/17/06																				
Lfledermaus FLEXid			9-65012FEB																				**9-6153BBA5 on FADC1 (network key)**
License			B18BA0DE2D3F																				**21DE819F1F03 on FADC1 (network key)**

MapInfo

Version	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB	FA_DiveLab	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
v7.5 (4)	~~06/15/04~~		07/30/04			10/07/04					~~08/04/04~~	09/01/04											Removed from FA_Process_1
v7.8			05/06/05				05/18/05				~~05/24/05~~	05/24/05											Upgrade
v8.0		~~10/12/05~~	~~10/05/05~~	3/6/2006		10/11/05	~~10/06/05~~	10/4/2005	3/10/2006		~~10/20/05~~	10/05/05	~~10/12/2005~~										3 new licenses and 4 upgrades
v8.5		10/09/06	10/10/06	10/19/2006																			7 copies to upgrade all 7 licenses
v9.0												08/16/07											
MapBasic Licenses			MBUWEU085001223																				
MapInfo Licenses		MIUWEU080003872	MIUWEU080003872	MIUWEU080003872		MIUWEU080003872		MIUWEU080003872	MIUWEU080003872			MIUWEU080003872											
MapInfo Licenses v8.5		MIUWEU0850038722	MIUWEU0850038720	MIUWEU0850038723		MIUWEU0850038724		MIUWEU0850038726	MIUWEU0850038725			MIUWEU0850038721											

Ashtech Solutions

Version	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB	FA_DiveLab	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
v2.6																							4 Licenses/Dongles available
Ashtech License			112267C0						112266D2														Not installed on any machines yet. To be installed on FA_Process_3, FA_Process_9, FA_O-lab, and the Toughbook 3. Two additional license numbers need to be verified.

Adobe Acrobat Professional 7.0

Version	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB (8b)	FA_DiveLab	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
v 7.0	3/30/06	3/30/06	3/20/06	3/20/06	3/22/06	3/30/06	3/20/06	3/22/06	3/31/06	3/22/06	3/31/06		3/22/06										Proc 9 is having install problems, pdf printer driver cannot be installed
Mfg Item	54016883IE (3 upgrades to Pro 7)																						
Mfg Item	5416725IE (10 Pro 7 licenses)																						
Install Serial	1118-1411-9394-8097-7071-5317																						13 licenses

Macromedia Dreamweaver MX 2004

Version	FA_Process_1	FA_Process_2	FA_Process_3	FA_Process_4	FA_Process_5	FA_Process_6	FA_Process_7	FA_Process_8	FA_Process_9	FA_Process_10	FA_CST	FA_FOO	FA_O-LAB (8b)	FA_DiveLab	FA_Mobile1	FA_Mobile2	Toughbook 1	Toughbook 2	ToughTab 1	1010 ACQ	1018 ACQ	S-220 ACQ	Comments
v7.0.1				12/1/2005																			
Activation Code				312125811569141000																			
Product Serial				DWD700-09955-92300-85366																			

Appendix II

Equipment Specifications

1_RESON

- 8101 Product Specs
- 8111 Product Specs
- 8160 Product Specs

2_POS/MV

- POSMV v320

3_DGPS

- MBX-3S

4_Shoreline

- Trimble Specs
- Trimble Accuracy
- Trimble TSCe
- Impulse 200LR Specs
- TruPulse 200LR Specs

5_SV

- MVP
- SBE 45
- Specs-19p-4585 (titanium)
- Specs-19p-4616 and -4617

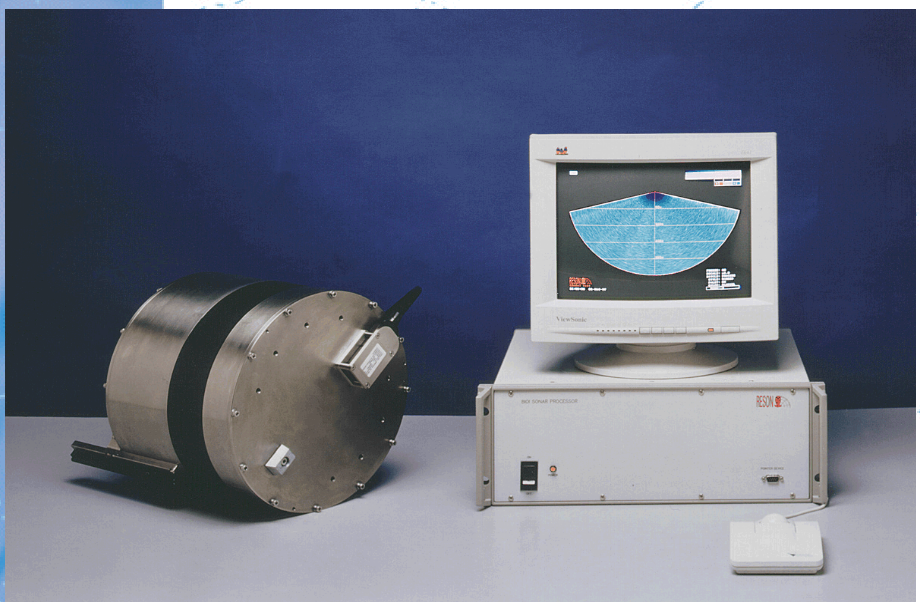
6_Control

- Leica NA2 level
- Zeiss NI2 level
- PDL Flyaway Specs
- ZXtreme Ashtech GPS

7_Total Stations

- Nikon DTM 310 Specs
- Sokkia set5f Specs

SeaBat 8101
PRODUCT SPECIFICATION
240kHz MULTIBEAM ECHO SOUNDER



- Phase and Amplitude Bottom Detection
- 150◦ Wide Swath Coverage
- 240 kHz Frequency
- Up to 500m Range Capability
- Portable Configuration
- Meets USACE Class 1 Standards
- Meets IHO Standards

The SeaBat 8101 Multibeam Echo Sounder measures discrete depths, enabling complex underwater features to be mapped with precision. Dense coverage is achieved utilizing up to 3,000 soundings per second for a swath that can be over 500 meters wide, even as the survey vessel travels at speeds of over 18 knots.

With high accuracy and a measurement rate up to 30 profiles per second, the SeaBat 8101 enables surveys to be completed faster and in greater detail than previously realized. The SeaBat is an integral part of the new, integrated bathymetry surveying systems.

The SeaBat transducer is available pressurized for depths from 100 to over 3,000 meters. Small and lightweight, it can be can be mounted on small un vehicles (ROV, AUV or towed) and taken to where accurate measure required.

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Fax : +44 1224 727 428
sales@reson.infotrade.co.uk

http://www.reson.com

SeaBat 8101 Built-In Test Environment ("BITE") Screen

SYSTEM SPECIFICATIONS

Operating Frequency: 240kHz
Range Scales: 5, 10, 15, 20, 25, 35, 50, 75, 100, 125, 150, 175, 200, 250, 300, 350, 400, 450, 500m.
Range Resolution: 1.25 cm
Number of Beams: 101
Horizontal Beamwidth: 1.5°
Horizontal Coverage: 150°
Vertical Beamwidth: 1.5°
Update Rate: Range-variable up to 30 times per second

SONAR HEAD SPECIFICATIONS

Power Requirement: 24VDC, 2 Amps max. (Power available from surface processor.)
Uplink: Digital, 76.8 Mbaud
Down Link Control: RS-232 or RS-422, 19,200 baud
Operating Depth: 100 meters (300m, 1500m, 3000m & 6000m avbl.)
Dimensions: 266x320mm W/Diam (does not include projector)
Temperature: Operating: -5° to +40°C
Storage: -30° to +55°C
Weight (aluminum): Dry: 26.8 kg (59 lbs)
Wet: 4.8 kg (10.6 lbs)
Weight (titanium): Dry: 40 kg (88 lbs)
Wet: 18 kg (39.6 lbs)

DISPLAY SPECIFICATIONS

Screen Size: 14 inch Diagonal
Input: SVGA (800x600, 72 Hz)
Display: High Resolution Color
Power Consumption: 62 W

PROCESSOR SPECIFICATIONS

Power Requirements: 115/230VAC, 50/60Hz, 100W max.
Data Output: Selectable, 300-155.2 Kbaud or Ethernet 10 base T or 10 base 2
Video Output: SVGA (800x600, 72 Hz) or NTSC or PAL video.
Graphics Colors: 256 colors (8-bit)
Display Mode: Sector Format
Display Arc: 150°
Input Device: 3-Button Trackball
Dimensions: 19" rack, 4U high (266x483x434mm HWD)
Temperature: Operating: 0° to +40°C
Storage: -30° to +55°C
Weight: 20 kg (44 lbs)

SeaBat 8101 Head with Optional Fairings

OPTIONS

Option 033: Side Scan Upgrade
Option 034: Mounting Plate Assembly
Option 035: Fairings (pictured above)
Option 036: Spares Kit
Option 037: Titanium Housing
Option 038: 210° Swath
Option 040: Extended-Range Projector
Option 049: Increase Transducer Depth Rating

Version 4.0
032399

SeaBat 8111

PRODUCT SPECIFICATION

MULTIBEAM ECHOSOUNDER

- **Phase and amplitude bottom detection**
- **100 kHz frequency**
- **150° swath coverage**
- **Real-time quality control**
- **Sidescan upgradeable**
- **Modular and portable**
- **Pitch stabilization**

The SeaBat 8111 is a modular multibeam echosounder system operating at 100 kHz. When installed on a vessel, it produces high-density, high-accuracy soundings on the seafloor over a 150° swath. Major system components include a transducer array, a transceiver unit, and a processor unit.

The SeaBat 8111 transducer array is comprised of a cylindrical receive array and a linear transmitter array, mounted together on a support cradle that provides mounting points to the vessel. Lightweight and portable, the array can be installed temporarily over the side of a vessel of opportunity—a first for a system in this frequency range.

The SeaBat 8111 transceiver features plug-in cards for easy maintenance and is controlled from the sonar processor.

The Seabat 8111 processor is compatible with other SeaBat sonar heads, can be updated in minutes to accommodate future requirements, and features a user-friendly point-and-click interface.

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SeaBat 8111 SYSTEM SPECIFICATIONS

SYSTEM PERFORMANCE

Frequency:	100 kHz
Range Resolution:	3.7 cm
Swath Coverage:	150º
Range:	3m to 1200m (with Option 040)
Number of Beams:	101
Along-Track Beamwidth:	1.5º 3.0º 4.5º 6.0º*
Across-Track Beamwidth:	1.5º
Stabilization:	Pitch stabilization within +/-15º
Projector Beam Control:	External motion sensor required
Accuracy:	IHO Compliant
Operational Speed:	Up to 20 knots
Max. Update Rate:	35 Hz
Transducer Pressure Rating:	100m

*operator selectable

INTERFACE

System Supply:	90 to 260VAC, 50/60 Hz, 200W max.
Video Display:	SVGA, 800 x 600, 72 Hz
System Control:	Trackball or from Ethernet
Data Output:	10 MB Ethernet or serial RS232C
Data Uplink:	High-speed digital coax with fiber-optic option
Temperature:	Operating: 0° to +40° C Storage: -30° to +55° C

RELATED PRODUCTS

- Option 040 Extended range capabilities
- Option 033 Sidescan upgrade
- Option 051 24DC power supply for SeaBat 81-P Processor

MECHANICAL INTERFACE

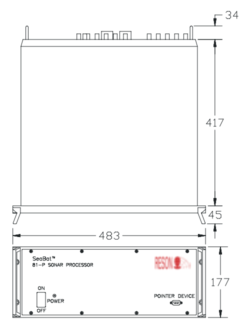
Dimensions (in mm):

Transducer Array:	
Hydrophone:	636 x 118 (Dia./Length)
Projector:	113 x 650 (Dia./Length)
Processor:	177 x 483 x 417
Transceiver:	267 x 483 x 489

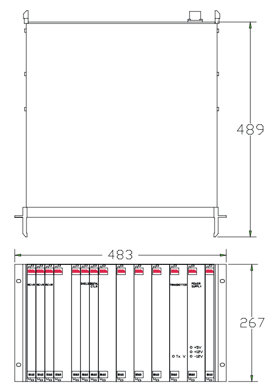
Weight:

Transducer Array:	72 kg (dry) / 59 kg (wet) with cables
Processor:	20 kg
Transceiver:	13.6 kg

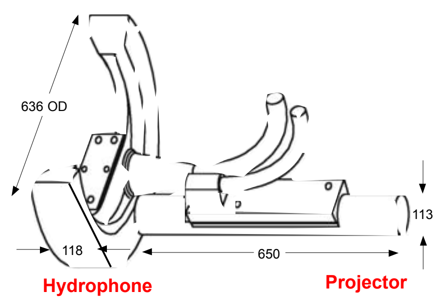
Cable Length: 15m



Processor



Transceiver



Transducer Array

SEAFLOOR COVERAGE

(with Extended Range option)

Bottom Depth (meters)	Swath Width (meters)
5 to 150	Up to 1110 (7.4 x water depth)
300	960 (3.2 x water depth)
450	810 (1.8 x water depth)
600	600 (1.0 x water depth)
750	450 (0.6 x water depth)
900	360 (0.4 x water depth)

RESON

Version: B006 030205

SeaBat 8160

PRODUCT SPECIFICATION

MULTIBEAM ECHOSOUNDER SYSTEM

- **Swath coverage greater than 4x water depth**
- **Operational depth: 10m to 3000m**
- **50 kHz frequency**
- **126 beams**
- **Hull-mount or portable**
- **Meets IHO accuracy**
- **Sidescan upgradable**

The SeaBat 8160 is a new addition to the 8100 series of multibeam echosounders. Operating at 50 kHz, the system ensonifies the whole swath in a single ping, generating 126 simultaneous high-resolution receive beams.

The SeaBat 8160 transducer array is comprised of a linear receive and transmit array mounted together on a support base. The T-shaped array geometry provides the basis for a compact, high-resolution sonar which is easily installed for portable or hull mounts—a first for a high-resolution system in this frequency range.

The system features a pitch-stabilized transmitter and an active roll-compensated receiver.

The SeaBat 8160 processor is compatible with other SeaBat sonar heads. It can be updated in minutes to accommodate future requirements, and features a user-friendly point-and-click interface.

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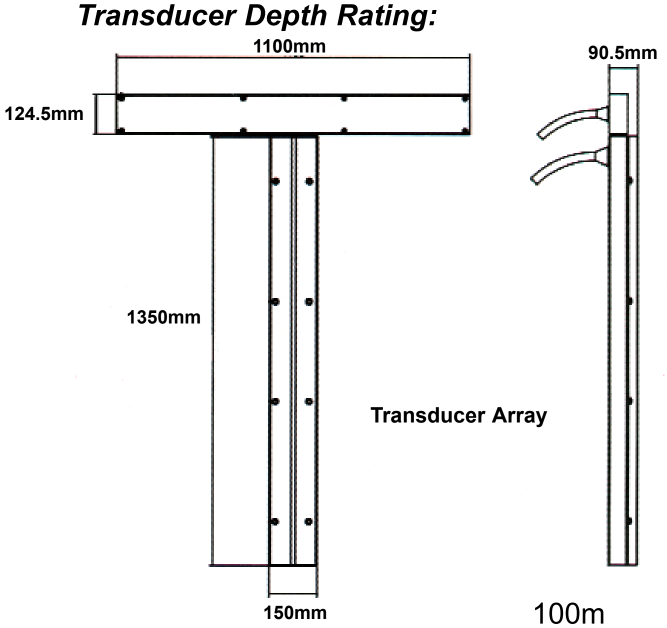
SeaBat 8160 SYSTEM SPECIFICATIONS

SYSTEM PERFORMANCE

Frequency:	50 kHz
Depth Resolution:	2.4 cm / 9.6 cm
Swath Coverage:	Greater than 4x water depth
Max Operational Depth:	3000 m
Number of Beams:	126
Along-Track Beamwidth:	1.5º
Across-Track Beamwidth:	1.5º
Pitch Stabilization:	±10º
Accuracy:	IHO Special Order
Operational Speed:	Up to 20 knots
Max. Update Rate:	15
Transducer Depth Rating:	100m



Mounting Frame
Option 034H

INTERFACE

System Supply:	115V/230V 50/60 Hz, 350W
Video Display:	SVGA, 800 x 600, 72 Hz
System Control:	Trackball or from Ethernet
Data Output:	10 MB Ethernet or serial RS232C
Data Uplink:	High-speed digital coax with fiber-optic option
Temperature:	Operating: 0° to +40° C Storage: -30° to +55° C

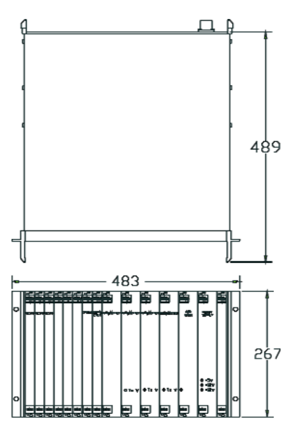
MECHANICAL INTERFACE

Dimensions (HWD in mm):

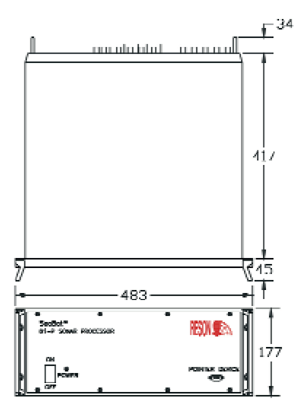
Transducer Array:	1474.5 x 1100 x 90.5
Processor:	177 x 483 x 417
Transceiver:	265 x 483 x 492

Weight:

Transducer Array:	50 kg (dry) / 30 kg (wet)
Processor:	20 kg
Transceiver:	13.6 kg



Transceiver



Processor

RESON

Version: B34-PDF-011009

POS MV™ 320

Performance

	RTK	DGPS
Position (m)	0.02 - 0.10	0.5 - 4.0
Velocity (m/s)	0.03	0.03
Roll and Pitch	0.01û	0.02û
True Heading	4m baseline: 0.01, 2m baseline: 0.02û	
Heave	5% of heave amplitude or 5cm	

Physical Specifications

Size	IMU	204 x 204 x 168mm
	PCS	441 x 111 x 346mm, 2.5U 19" rack mount
	Antenna	178 ∅ x 77mm (2x)
	Choke Ring	360 ∅ x 61mm (2x)
Weight	IMU	3.5 Kg
	PCS	7 Kg
Power		110/220 VAC, 60/50 Hz, 60W
Operating Temperature	IMU & Antennas	-40û to +60ûC
	PCS	0û to +60ûC
Humidity	IMU & Antennas	0 to 100%
	PCS	5 to 95% RH non-condensing
Cables	IMU	8m standard
	Antennas	15m standard (2x)

Interfaces

Ethernet Interface (10base-T)	Function	Operate POS MV™ & record data
	Data	Position, attitude, heading, velocity, track and speed, acceleration, status and performance, raw data. All data has time and distance tags
	UDP Ports	Display port - low rate (1Hz) data
		Data port - high rate (1-200Hz) data
	IP Ports	Control port - used by POS™ controller
RS232 Interface (DB9 males)	NMEA Port	GGA, HDT, VTG, GST, ZDA, PASHR, PRDID (1-50Hz), GGK
	High rate attitude data port	Roll, pitch, true heading and heave in all multibeam proprietary formats (1-200 Hz)
	Auxillary GPS input	GGA, GST, GSA, GSV from Auxilliary DGPS, P-code or RTK reciever
Options	Internal RTK GPS receiver; analog interface (roll, pitch & heave); field support kit	

All performance figures are RMS, unless otherwise noted. Specifications subject to change without notice.

APPLANIX™ MARINE

Applanix LLC 17461 Village Green Drive, Houston, TX, 77040
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POS MV™ marine vessels

DATASHEET

The New POS MV - Providing the Marine Industry with robust, reliable, and repeatable position and orientation solutions

The new POS MV V4 - a tightly-coupled system utilizing advanced Inertially-Aided Real-Time Kinematic (IARTK) technology designed to increase your operational capability and reduce downtime.

Tightly integrated inertial navigation – Continuous positioning data can be generated while surveying in areas where GPS reception is compromised by multipath effect and signal loss, such as close to offshore structures, or in ports, harbors, near-shore coastal waters and rivers. Raw GPS data from as few as one satellite can now be processed directly within the POS MV reducing position drift and RTK re-acquisition time.

The V4 Advantage

The Major Benefits

- Faster, more robust heading aiding from GPS Azimuth Measurement Subsystem (GAMS) when compared to V3
- Proprietary Inertially Aided RTK providing almost instantaneous reacquisition of RTK following a GPS outage
- Superior low elevation tracking performance using lighter, smaller Trimble Zephyr ™ geodetic antenna technology
- Faster initial system calibration
- Maintains heading accuracy longer when in a high multipath environment
- Increased component reliability
- Automatic identification and error estimation for lever arm distances and angles

The Latest Technology
V4 uses the latest Trimble BD950 receivers with the following attributes:

- Extremely fast response time
- Latency of less than 20 milliseconds (at 20 times per second)
- Very low noise L1 and L2 carrier phase measurements
- Uses the Maxwell 4 Custom Survey GPS chip for enhanced tracking capability

Straightforward Installation and Operation

- All components mounted and installed using a straightforward, one-time-only, systematic procedure.

Faster, More Reliable Networking Potential

- An improved Ethernet raw data logging capability for streamlined data acquisition of all motion variables with microsecond-accurate time stamping

Upgradeability*

- Convenient upgrade program for PCS and antennas, to allow for maximum interoperability when moving from L1 only to a full L1/L2 RTK unit

The Most Accurate Position and Orientation Solution
POS MV V4 maintains positioning accuracy under the most demanding conditions regardless of vessel dynamics. With its high data update rate, the system delivers a full six degree-of-freedom position and orientation solution to provide the following:

- Position (latitude, longitude and elevation)
- Velocity (north, east and vertical)
- Attitude (roll, pitch and true heading)
- Heave (real-time, delayed)
- Acceleration Vectors
- Angular Rate Vectors

** For detailed upgrade information please call your Applanix Marine office*

SYSTEM COMPONENTS

POS Computer System (PCS) – A rugged, compact computer system contains the core POS processor and IMU interface electronics, plus two GPS receivers and an optional removable PC-card disk drive. The PCS provides system timing, position and velocity aiding, together with GPS raw observables for use with GAMS.

POS Inertial Measurement Unit – The system's primary sensor allows for the continuous output of position and orientation data.

Primary GPS Receiver Antenna – A dual frequency antenna for use with GAMS.

Secondary GPS Receiver Antenna – A dual frequency antenna for use with GAMS.

APPLANIX
A TRIMBLE COMPANY

POS MV™ marine vessels

SPECIFICATIONS

Accuracy

POS MV 320 Main Specifications (with Differential Corrections)

Roll, Pitch accuracy:	0.02° (1 sigma with GPS or DGPS)
	0.01° (1 sigma with RTK)
Heave Accuracy:	5 cm or 5% (whichever is greater) for periods of 20 seconds or less
Heading Accuracy:	0.02° (1 sigma) with 2 m antenna baseline, 0.01 (1 sigma) with 4 m baseline
Position Accuracy:	0.5 - 2 m (1 sigma) depending on quality of differential corrections
	0.02 - 0.10 m (RTK) with input from auxiliary RTK or optional internal RTK receiver
Velocity Accuracy:	0.03 m/s horizontal

POS MV 320 during GPS Outages

Roll, Pitch accuracy:	0.02° (1 sigma)
Heave accuracy:	5 cm or 5% (whichever is greater) for wave periods of 18s or less
Heading accuracy:	Drift less than 1° per hour (negligible for outages < 60s)
Position accuracy degradation:	2.5 m (1 sigma) for 30 s outages <6 m (1 sigma) for 60 s outages

POS MV 220 Main Specifications (with Differential Corrections)

Roll, Pitch accuracy:	0.05° (1 sigma with GPS or DGPS)
	<0.05° (1 sigma with RTK)
Heave Accuracy:	5 cm or 5% (whichever is greater) for periods of 20 seconds or less
Heading Accuracy:	0.1° (1 sigma) with 2 m antenna baseline, 0.05° (1 sigma) with 4 m baseline
Position Accuracy:	0.5 - 4 m (1 sigma) depending on quality of differential corrections
	0.02 – 0.10 m (RTK) with input from auxiliary RTK or optional internal RTK receiver
Velocity Accuracy:	0.05 m/s horizontal DPGS, .03 m/s horizontal RTK

POS MV 220 during GPS Outages

Roll, Pitch accuracy:	0.05° (1 sigma)
Heave accuracy:	5 cm or 5% (whichever is greater) for wave periods of 18s or less
Heading accuracy:	Drift less than 3° per hour (negligible for outages < 60s)
Position accuracy degradation:	2.5 m (1 sigma) for 30 s outages <6 m (1 sigma) for 60 s outages

Physical Characteristics

Size

IMU:	204 mm X 204 mm X 168 mm	7.95 in X 7.95 in X 6.55 in
PCS:	432 mm X 89 mm X 356 mm	17.00 in X3.50 in X 14.05 in
	2.0U 19 in rack mount	
GPS Antenna (x2):	187 mm X 53 mm	7.4 in X 2.1 in

Weight

IMU:	3.5 kg	7.7 lb (international)
Processor:	5 kg	11.0 lb (international)
GPS Antenna:	<0.5 kg	<1.1 lb (international)

Power

Processor:	110/230 Vac, 50/60 Hz, auto-switching 80 Watt
IMU:	Power provided by PCS
GPS Antennas:	Power provided by PCS

Environmental

Temperature Range (Operating)

IMU:	-40 °C to +60 °C	-40 °F to +140 °F
Processor:	0 °C to +55 °C	+32 °F to +131 °F
GPS Antenna:	-40 °C to +70 °C	-40 °F to +158 °F

Temperature Range (storage)

IMU:	-40 °C to +60 °C	-40 °F to +140 °F
Processor:	-25 °C to +85 °C	-13 °F to +185 °F
GPS Antenna:	-50 °C to +70 °C	-58 °F to +158 °F

Humidity

IMU:	10 - 80% RH, Ingress Protection of 65
Processor:	10 - 80% RH, non-condensing
GPS Antenna:	0 - 100% RH

Shock & Vibration (IMU)

Operating:	90 g, 6 ms terminal saw tooth
Non-Operating:	220 g, 5 ms half-sine

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MBX-3S

The most popular commercial-grade Coast Guard Beacon Receiver

- Dual-channel Coast Guard beacon receiver
- Supplements GPS systems with free differential corrections, enhancing accuracy
- Fast signal acquisition
- Wide input voltage range for a variety of power sources
- Low power consumption extends battery life
- Automatic tuning mode for hands-free operation
- Integrated signal splitter outputs GPS signal from combined GPS /differential antennas
- Front-panel interface for easy configuration and status monitoring

ESRI Technology
AUTHORIZED BUSINESS PARTNER

csi wireless™
www.csi-wireless.com

MBX-3S

The most popular commercial-grade DGPS Beacon Receiver

Receiver Specifications

Channels:	2 independent channels
Channel Spacing:	500 Hz
Frequency Range:	283.5 to 325.0 Hz
MSK Bit Rates:	50, 100, 200 bps
Cold Start Time:	<1 min
Warm Start Time:	<2 seconds
Demodulation:	Minimum shift keying
Sensitivity:	2.5 µV/m for 6 dB SNR
Dynamic Range:	100 dB
Frequency Offset:	±8 Hz (27 ppm)
Adjacent Channel Rejection:	61 dB f_o ± 400 Hz
Correction Output Protocol:	RTCM SC-104
Input Status Protocol:	NMEA 0183

Communications

Interface:	RS-232C or RS-422
Baud Rates:	2400, 4800, 9600

Environmental Specifications

Operating Temperature:	-30°C to +70°C
Storage Temperature:	-40°C to +80°C
Humidity:	95% non-condensing
EMC:	EN 60945 EN 50081-1 EN 50082-1 FCC: Part 15, sub-part J, class A digital device

Power Specifications

Input Voltage Range:	9 to 40 VDC
Nominal Power:	2.5 W
Nominal Current:	210 mA
Antenna Voltage Output:	10 VDC (5 VDC optional)
Antenna Input Impedance:	50 Ω

Mechanical Specifications

Dimensions:	150 mm L x 125 mm W x 51 mm H (5.9" L x 4.9" W x 2.0" H)
Weight:	0.64 kg (1.4 lb)
Display:	2-line x 16-character LCD
Keypad:	3-key switch membrane
Power Connector:	2-pin circular locking
Data Connector:	DB9-S
Antenna Connector:	BNC-S
Optional GPS Output Port:	TNC-S

Operating Modes

MBX-3 Mode (Default):	RTCM SC-104 correction and NMEA status message output (Default Mode)
MBX-E Mode:	RTCM SC-104 correction and NMEA status message output and GPS NMEA message input for position and satellite status display

NMEA 0183 I/O

- Receiver Automatic and Manual tune command
- Frequency and data rate query
- Receiver performance and operating status queries
- Automatic search almanac queries (proprietary)
- Baud rate selection command
- Receiver tune command
- Force cold start command (proprietary)
- Software upgrade command (proprietary)
- Configuration up-load command (proprietary)

Accessories

Antenna:	Various
Power Cables:	Various
Antenna Cables:	Various
Data Cables:	Various
CSI Beacon Command Center:	MS Windows 95® beacon control software

Pin-out

RS, 232C (DB9 PIN#)

Pin 2	TXD, RTCM SC-104/Status Output
Pin 3	RXD, configuration input
Pin 5	Signal return

RS-422 (DB9 PIN#)

Pin 1	TXD +, RTCM SC-104 / Status Output
Pin 2	TXD -, RTCM SC-104 / Status Output
Pin 4	RXD -, configuration input
Pin 5	Signal return
Pin 7	RXD +, configuration input

Warranty: Each CSI Wireless product is covered by a limited one-year warranty on parts and labor.

CSI Wireless Dealer

Avery label #05260 (laser print)

Printed in Canada.

csi wireless™

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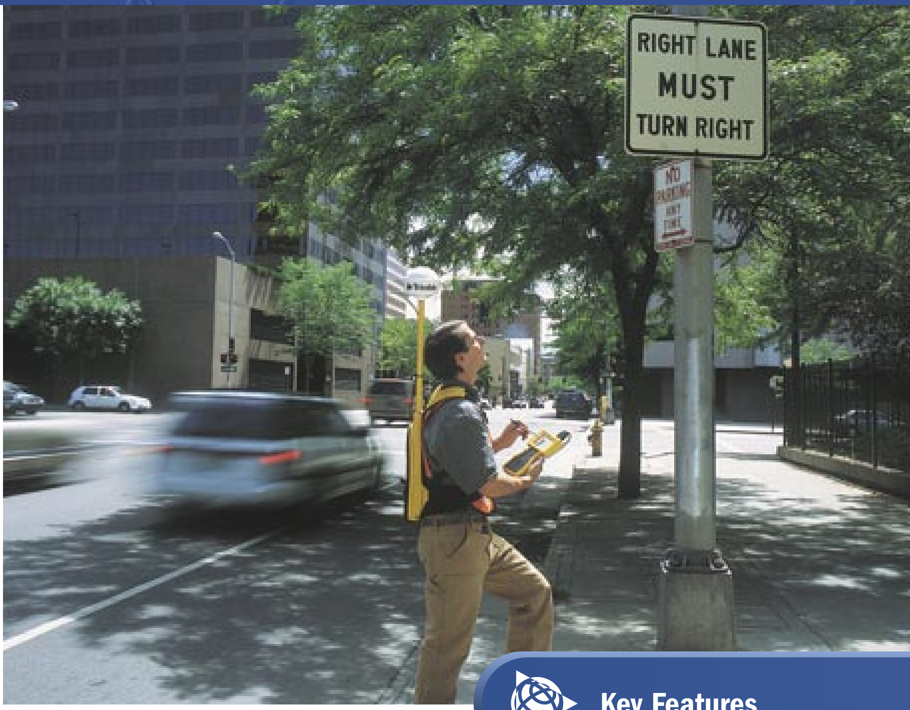
GPS Pathfinder Pro XRS



High-performance GPS with a world of real-time options

The versatile GPS Pathfinder® Pro XRS receiver is the thoroughbred of GPS receivers. Offering a full range of accurate real-time correction sources, great performance in all GPS conditions, and rugged design for the toughest environments, the Pro XRS is an essential tool for collecting and maintaining GPS data.

Built to meet your demands

With the Pro XRS, you don't have to worry whether your GPS receiver can stand up to harsh conditions. All its components are sealed in a robust casing. Waterproof, dustproof, and shock-resistant, the Pro XRS can work anywhere you can.

Just as tough is the custom-designed ergonomic backpack. But it's light and comfortable, so you can wear it all day.

You're spoiled for real-time choice

If you're navigating in the field, or finding your way back to a previously recorded feature, you've got all the real-time options covered. Corrections from a radiobeacon, a satellite differential service such as OmniSTAR, or a satellite-based augmentation system (SBAS) like WAAS[1] or EGNOS[2] are not just built in, they're seamlessly integrated into the receiver. Want the freedom to connect to an external correction source like a virtual reference station (VRS)? You've got it. This array of real-time sources makes the Pro XRS the most adaptable real-time GPS receiver around.

High quality, accurate data for your GIS

With the Pro XRS, you can be sure that the data you collect meets your high standards. Offering submeter accuracy in real time, and centimeter-level postprocessed accuracy, it's the obvious choice for collecting the high quality GPS data you need in your GIS. And it has advanced design features, like EVEREST™ multipath rejection technology, to ensure you get only the best positions.

Get the results you want

The GPS Pathfinder Pro XRS's advanced design gives you complete control over GPS quality. You can focus on productivity, to keep working even in adverse GPS conditions. Or you can configure the receiver to deliver only the most precise positions. It's up to you.

Flexible data collection options

Pick the field device and software that fits your workflow. The Pro XRS is ready to use with a variety of field computers, including Trimble's own range of handheld computers: the GIS TSCe™ field device, the Trimble® Recon™ handheld, and the GeoExplorer® series.

Choosing software? Try the TerraSync™ software, for a complete solution from the field to the office and back. Choose off-the-shelf GPS field software. Or use the GPS Pathfinder Tools SDK to build your own application that's totally customized to your needs.

Key Features

- Real-time submeter accuracy
- Integrated satellite, beacon, and WAAS/EGNOS differential receiver
- EVEREST multipath rejection
- Rugged design
- Ergonomic, comfortable backpack system
- Choice of field device and field software

All you need

You need equipment that's as adaptable and hard-working as you are. So when you're choosing GPS equipment, don't compromise. Get a GPS Pathfinder Pro XRS receiver and have it all.

Trimble®

What Can the GPS Pathfinder Systems Receivers Do?

The GPS Pathfinder Systems receivers, with Trimble controlling software, make an ideal system for all GIS data collection and maintenance projects. The system allows you to collect precise data for utility, urban, and natural resource databases. As the demand for accurate and up-to-date position and attribute information increases, the system allows you to update existing GIS data, ensuring that decisions made with the GIS are based upon the most accurate, current, and reliable data available.

The foundation of the GPS Pathfinder Systems receivers is precise GPS positioning technology. The GPS receivers feature 12 parallel channels for continuous satellite tracking. Using differential GPS, the GPS Pathfinder Systems receivers deliver differentially corrected C/A code positions to submeter accuracy on a second-by-second basis under the most challenging operating conditions.

Integrated Satellite Based Augmentation System (SBAS) receiver

Satellite Based Augmentation System (SBAS) support is integrated into the GPS Pathfinder Pro XR, Pro XRS, and Power receiver. It allows you free access to real-time solutions transmitted from geostationary SBAS satellites, such as the Wide Area Augmentation System (WAAS) in the United States and the European Geostationary Navigation Overlay Service (EGNOS) in Europe.

Integrated beacon receiver

The MSK beacon receiver is included in the GPS Pathfinder Pro XR and Pro XRS receivers. It allows you free access to real-time solutions transmitted from DGPS radiobeacons operating in the MF (medium frequency) band from 283.5 kHz to 325 kHz. The integrated MSK beacon receiver is an advanced dual-channel radiobeacon receiver. It tracks broadcasts from DGPS radiobeacons conforming to the IALA Standard. The beacon receiver uses its *all-digital signal processing* techniques to track and demodulate signals from DGPS radiobeacons.

For an up-to-date list of beacon stations, visit the following Web page:

- www.trimble.com/findbeacon.asp

Integrated satellite differential receiver

The integrated satellite differential capability of the GPS Pathfinder Pro XRS and Power receivers decodes and uses satellite differential corrections to provide submeter position accuracy. To receive and decode these satellite signals, you must subscribe to a satellite differential correction service. The GPS Pathfinder Pro XRS and Power receivers support the OmniSTAR satellite differential correction services. For information on obtaining a subscription, subscription rates, and satellite coverage maps, visit www.omnistar.com

Once you have a subscription, you activate the service through an on-the-air signal or an encrypted activation message entered into the controlling software.

Satellite differential signals provide valid corrections over a large area. Integrated virtual reference/base station (VRS/VBS) technology permits the satellite corrections to be uniformly accurate over the entire satellite coverage area, without the degradation in accuracy associated with increasing distance from fixed reference stations.

Satellite differential signals are line-of-sight and can be blocked by mountains, buildings, or tree canopy. Wet canopy, from a heavy rain, reduces the signals even more. The same environmental factors that affect the GPS signal, such as radar and microwave transmitters, can interfere with the satellite signal. Power lines usually have no effect.

External differential correction receiver

The GPS Pathfinder Systems receivers can also receive differential corrections from any external differential correction receiver that communicates in the standard RTCM SC-104 data format.

Standard GPS Pathfinder Pro XR and Pro XRS Features

The GPS Pathfinder Pro XR and Pro XRS receivers offer the following:

- 12-channel DGPS receiver with EVEREST™ multipath rejection technology, L1 C/A code tracking with carrier-phase smoothing, and instantaneous full-wavelength carrier-phase measurements.
- Submeter accuracy – Typically horizontal accuracy less than 50 cm RMS with GPS Pathfinder Office software postprocessing. This requires data to be collected with a minimum of 4 satellites, maximum PDOP of 6, minimum SNR of 4, minimum elevation of 15 degrees, and reasonable multipath conditions.
- Integrated WAAS/EGNOS differential corrections
- 1 Hz position and velocity update rate.
- Velocity computations incorporate carrier-phase data.
- Time to First Fix typically less than 30 seconds.
- Two RS-232 serial ports.
- NMEA-0183 output to external NMEA devices (supported messages are ALM, GGA, GLL, GSA, GSV, VTG, and ZDA).
- RTCM-SC 104 input from an external differential correction receiver.
- TSIP protocol to/from the field device.
- Fully automatic and manual beacon operating modes, fast acquisition of differential beacon signals.

- Immunity to MSK jamming signals, advanced techniques for combating atmospheric noise in the beacon receiver.
- Integrated GPS/MSK beacon antenna.
- User-upgradeable receiver firmware.
- Receiver manual.
- CE Mark compliance.

Additional GPS Pathfinder Pro XRS receiver features

The GPS Pathfinder Pro XRS GPS/MSK/beacon/satellite differential receiver offers the items previously listed, and also:

- Integrated L-band satellite differential correction receiver
- Combined L1 GPS/beacon/satellite differential antenna

Combined L1 GPS/beacon/satellite differential antenna

The GPS Pathfinder Pro XRS receiver integrated L1 GPS/beacon/satellite differential antenna (P/N 33580-50) features two antenna components:

- L1 GPS/satellite differential antenna

  This active antenna is designed to filter out unwanted signals and amplify the L1 GPS and satellite differential signals for transmission over the antenna cable to the receiver.

- MSK H-field loop beacon antenna

  This antenna features a pre-amplifier for filtering out signal interference such as AM radio broadcasts and noise from switching power supplies. After filtering, the pre-amplifier amplifies the MF signal for transmission over the same antenna cable to the beacon receiver.

The coaxial antenna cable also carries DC power to the pre-amplifier of both the L1 GPS/satellite differential and beacon antennas over the center conductor of the cable.

The antenna assembly integrates the L1 GPS/satellite differential antenna and a beacon antenna into a single antenna assembly, as shown in Figure 2.2. The antenna assembly is completely weatherproof and is designed to withstand harsh environmental conditions.

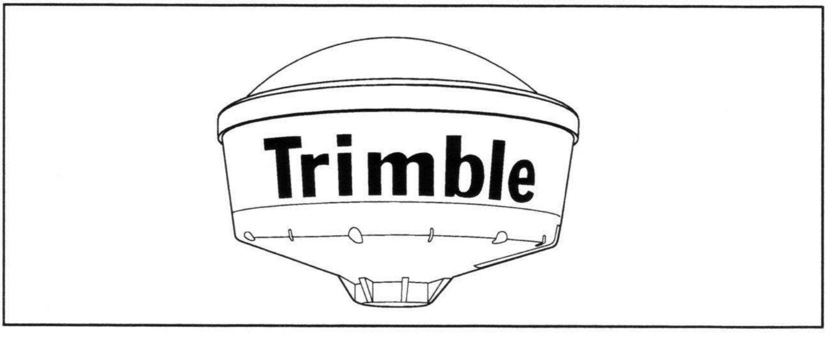


Figure 2.2 Combined L1 GPS/beacon/satellite differential antenna (for the GPS Pathfinder Pro XRS receiver)

Introduction

This appendix lists specifications for GPS Pathfinder Systems receivers and antennas, and pinouts for cables that are supplied with the receivers.

Specifications

Table B.1 lists specifications for the GPS Pathfinder Pro XR and Pro XRS receiver.

Table B.1 GPS Pathfinder Pro XR and Pro XRS receiver specifications

Parameter	Specification
General	12 channel, L1/CA code tracking with carrier phase filtered measurements and multibit digitizer
Update Rate	1 Hz
Time to First Fix	< 30 seconds, typical
Size	11.1 cm × 5.1 cm × 19.5 cm (4.4" × 2.0" × 7.7")
Weight	0.76 kg (1.68 lb)
Power	XR 6 W (maximum) XRS 7 W (maximum) both 10 to 32 VDC
Temperature	–20 °C to 65 °C (–4 °F to 149 °F) operating –30 °C to 85 °C (–22 °F to 185 °F) storage
Humidity	100% non-condensing
Casing	Dustproof, splashproof, shock-resistant, sealed to 5psi

Table B.3 lists specifications for the GPS Pathfinder Pro XRS antenna.

Table B.3 Combined L1 GPS/beacon/satellite differential antenna specifications

Parameter	Specification
General	Right-hand, circular polarized; omnidirectional; hemispherical coverage
Size	15.5 cm diameter × 14 cm high (6.1" × 5.5")
Weight	0.55 kg (1.2 lb)
Temperature	–20 °C to 65 °C (–4 °F to 149 °F) operating –40 °C to 85 °C (–40 °F to 185 °F) storage
Humidity	100% fully sealed
Casing	Dustproof, waterproof, shock resistant

Pinouts

Table B.5 lists the pinouts for the GPS Pathfinder Pro XR and Pro XRS receiver's data/power cable.

Table B.5 Data/power cable pinout (P/N 30231-00)

To GPS Pathfinder Pro XR and Pro XRS receiver				Field Device		Input Power		
Conn P1			**7 Cond Cbl #1**	**Conn P2 DE9-F**		**2 Conn Cbl #2**	**Conn P3 TA3-M**	
Event In	1	in	—	—		—	—	
TXD out	2		Orange	2	RXD	—	—	
RXD	3	in	Red	3	TXD	—	—	
Chg Ctrl	4	in	Black	4	DTR	—	—	
Sig Gnd in/out	5		Shield	5	Sig Gnd	—	—	
DSR out	6		Yellow	6	DSR	—	—	
Pwr On	7	in	Brown	7	RTS	—	—	
CTS out	8		Green	8	CTS	—	—	
Charge out	9		Blue	9	RI	—	—	
V+ In	10	in	—	—		White	1	V+ In
V– In	11	in	—	—		Black	2	V– Out
PPS —	12		—	—		—	—	

Table B.7 lists the pinouts for the GPS Pathfinder Pro XR and Pro XRS receiver's NMEA/RTCM cable.

Table B.7 NMEA/RTCM cable pinout (P/N30232-00)

To GPS Pathfinder Pro XR and Pro XRS receiver				NMEA/RTCM output connectors		
Conn P1			**9 Cond Cbl #1**	**Conn P2 DE9-M**	**7 Conn Cbl #1**	**Conn P3 DE9-F**
Event In	1	in	—	—	—	—
TX– (232)	2	out	—	—	Orange	2 TXD
RX– (232)	3	in	Red	2 RXD	—	—
Chg Ctrl	4	in	—	—	Shield	
Sig Gnd	5	in/out	Shield	5 Sig Gnd	—	5 Sig Gnd
TX+ (422)	6	out	—	—	—	
Pwr On	7	in	—	—	—	—
RX+ (422)	8	out	—	—	—	—
Charge	9	out	Yellow	9 Pwr	—	—
V+ In	10	in	—	—	—	—
V– In	11	in	—	—	—	—
PPS	12	—	—	—	Brown	4 DTR

Introduction

The GPS Pathfinder Systems receivers calculate very accurate GPS positions on a second-by-second basis. After postprocessed differential correction, the horizontal accuracy of each position for the GPS Pathfinder Pro XR and Pro XRS receivers is better than 50 cm (RMS) + 1 part per million (ppm) times the distance between the base and the rover. For the GPS Pathfinder Power receiver, the horizontal accuracy is submeter (RMS) + 1 ppm. Using real-time corrections, each position can be as accurate as submeter with the GPS Pathfinder Systems, but is subject to a number of operational conditions.

***Note –** RMS means that approximately 63% of the positions are within the specified value.*

Differential GPS Positioning Techniques

Differential GPS (DGPS) requires two or more receivers. One receiver, called the reference station, is located at a known point to determine the GPS measurement errors and compute corrections to these errors. An unlimited number of mobile GPS Pathfinder Systems receivers, commonly called *rovers*, collect GPS data at unknown locations within the vicinity of the reference station. Errors common at both the reference and rover receivers are corrected with DGPS either in real time or during postprocessing.

***Note –** For more information about GPS and DGPS, review the All About GPS tutorial on the Trimble website at www.trimble.com.*

The GPS Pathfinder Systems receivers, in combination with Trimble controlling software and the GPS Pathfinder Office software, provide three ways of obtaining submeter positions:

- Real-time DGPS
- Postprocessed DGPS
- Postprocessed real-time DGPS

The accuracy figures given in the sections below are obtained under the following conditions:

- Number of satellites used: ≥ 4
- PDOP: ≤ 6
- Signal-to-noise ratio: ≥ 4
- Satellite elevation mask: ≥ 15°
- Reference station receiver is a Trimble GPS Pathfinder Pro XL, Pro XR, Pro XRS, 4700, 4800, 5700, 5800, 4600 LS™, Series 4000 GPS receiver, DSM™, Reference Station, or equivalent.
- Synchronized measurements are logged at the reference station.
- The logging interval for the roving receiver is the same as, or a multiple of, the logging interval at the reference station.
- The reference station uses the correct antenna.

Real-Time DGPS

When using real-time DGPS, the reference station broadcasts the correction values to the rovers within coverage range, through a transmitter such as a radiobeacon (beacon DGPS) or a satellite (satellite DGPS). The rover applies the corrections to its position in real time.

The positions calculated by the GPS Pathfinder Systems receivers using real-time DGPS are of submeter accuracy + 1 ppm. If you use a provider of real-time DGPS that uses VRS/VBS techniques, there is no degradation associated with distance from the reference station, and the accuracy always stays at the submeter level (RMS).

GPS Pathfinder Systems also supports corrections from satellite-based augmentation systems (SBAS) such as WAAS and EGNOS.

For information on postprocessing GPS data collected with real-time DGPS, see Postprocessed real-time DGPS, page 20.

Postprocessed DGPS

When real-time DGPS is not available, or is available only part of the time, you have to postprocess the autonomous GPS data in your rover file to obtain the stated accuracy. When using postprocessed DGPS, the reference station stores the correction values in base data files on a computer.

Many reference station owners provide their base data to the community through the Internet or other means of communication. Often this means that you do not have to set up your own reference station for postprocessed DGPS, but can use an existing one. For a list of available reference stations, visit the Trimble website www.trimble.com/trs/findtrs.asp.

Postprocessed real-time DGPS

Postprocessed DGPS positions are generally more accurate than DGPS positions obtained in real time. If you collect SuperCorrect records as well as GPS positions using Trimble TerraSync or GPScorrect™ software, or applications developed using the GPS Pathfinder Tools SDK, you can use the SuperCorrect option in the GPS Pathfinder Office software to process the data if the accuracy of the real-time DGPS positions is not sufficient, provided that you have access to suitable reference station base files.

The accuracy using postprocessed real-time DGPS is the same as for postprocessed DGPS (see the previous section).

Factors Affecting Postprocessed DGPS Accuracy

The accuracy that you obtain after data collection depends on several factors, including:

- Number of visible satellites
- Multipath
- Distance between reference station and rover receivers

- Position Dilution of Precision (PDOP)
- Signal-to-noise ratio (SNR)
- Satellite elevations
- Occupation time at a point
- Receiver type at reference station
- Accuracy of the reference station position
- Synchronized measurements are logged at the reference station.
- The logging interval for the roving receiver is the same as, or a multiple of, the logging interval at the reference station.
- The reference station uses the correct antenna.

Number of visible satellites

Generally, you need a minimum of four satellites to get a good position. If you have five or more satellites, accuracy increases by a small amount. You can obtain positions from only three satellites by supplying a height value manually. However, Trimble recommends that you do not use this method, as an inaccurate height can significantly reduce horizontal accuracy.

***Note** – The TerraSync software always uses a minimum of four satellites. You cannot configure this setting.*

When the number of visible satellites drops below the required number, the controlling software stops logging positions and displays the message Too few satellites.

Multipath

GPS signals are sometimes reflected off nearby objects, particularly metallic objects, creating false or erroneous results. This phenomenon is known as *multipath*. Severe multipath may cause position errors of many meters, while mild multipath may cause small, undetectable errors. For optimal accuracy, collect data in an environment that is free of large reflective surfaces, such as buildings and trees. EVEREST multipath reduction technology in the receiver helps reduce the effects of multipath.

Distance between reference station and rover

When you postprocess GPS Pathfinder Pro XR and Pro XRS data using the GPS Pathfinder Office software Differential Correction utility, the horizontal accuracy of the positions received is 50 cm (RMS) at a 1 km base line (distance from reference station). For the GPS Power receiver, the horizontal accuracy of the positions received is submeter (RMS) at a 1 km base line.

Accuracy degrades by 1 ppm as the distance between the reference station and the rover increases. This means that 1 mm of degradation occurs for every kilometer between the reference station and the rover. For example, you must collect data within 500 km (310 miles) of your reference station to obtain submeter accuracy for the GPS Pathfinder Pro XR and Pro XRS receiver.

PDOP

PDOP (Position Dilution of Precision) is a unitless measure of the current satellite geometry. It indicates when the most accurate results are provided. When satellites are spread around the sky, the PDOP value is low, and the computed position is more accurate. When the satellites are grouped closely together, the PDOP value is high, and the computed position is less accurate. The lower the PDOP value, the more accurate the GPS positions.

You can configure the PDOP mask so that if the PDOP exceeds the mask value, the controlling software stops logging positions. A PDOP mask of 6 is required for submeter accuracy.

SNR

SNR (signal-to-noise ratio) is a measure of the satellite signal strength relative to the background noise. A strong signal with low noise provides better accuracy. You can raise the SNR mask so that weak signals with an SNR below the mask are excluded from the position computation. In areas of dense canopy, the SNR mask can be lowered so that you can collect GPS positions, although you may not achieve submeter accuracy. For best results, the recommended setting for the SNR mask is 4.

Elevation mask

When a satellite is low on the horizon, the GPS signals must travel further through the atmosphere, delaying reception by the receiver. To minimize noisy data, adjust the elevation mask. Satellites below the mask are excluded from the position computation. For best results, the recommended setting is 15°.

Occupation period

The GPS Pathfinder Systems receivers achieve the specified horizontal accuracy with a one-second occupation time.

***Note** – To achieve higher levels of accuracy using a GPS Pathfinder Systems receiver, collect carrier-phase data and postprocess using the GPS Pathfinder Office software.*

Receiver type

The following Trimble receiver models use Maxwell™ technology and, when used as the reference station, yield submeter accuracy with GPS Pathfinder Systems receivers:

- GPS Pathfinder Pro XRS
- GPS Pathfinder Pro XR
- GPS Pathfinder Pro XL

- 5800 GPS receiver
- 5700 GPS receiver
- 4800 GPS receiver
- 4700 GPS receiver
- 4600 LS Surveyor
- 4000 series receiver
- DSM Reference Station

Warning – If the GPS receiver at the reference station has fewer than 12 channels, you may be unable to differentially correct some of your data. If the reference station is not capable of logging data from all of the satellites the rover is using, the data collected by the rover cannot be differentially corrected using postprocessing.

Accuracy of the reference station position

Any inaccuracy in the reference station position is reflected in your rover position accuracy. For information on the accuracy of your local DGPS reference station coordinates, contact the provider of that service, and check the Integrity Index in the GPS Pathfinder Office version 3.00 Differential Correction utility when selecting a new base station provider.

The Integrity Index provides you with an indication as to the quality of available base data in comparison to other available sources. Poor base data can result from a number of factors, such as an incorrect reference position, bad environmental location, or a large distance between the base and rover receivers. Base data downloaded from each station is analyzed to formulate the quality indicator values and three key measures are taken into account:

- Bias (the measure of distance between an averaged GPS position and a specified reference position)
- Precision (the measure of the spread of actual GPS positions)
- The distance between the base and rover receivers

Use the Integrity Index to avoid selecting base data that may provide an inferior differential correction result. The quality indicator has a range of 0 to 100, where 0 represents low quality base data and 100 represents high quality base data. For more information, refer to the GPS Pathfinder Office 3.00 Differential Correction Help.

Synchronized measurements

To obtain optimal accuracy from differential correction, the reference station must record reference data (or output differential corrections) from synchronized measurements. Synchronized measurements occur when the reference station receiver and rover receivers simultaneously make measurements to all the satellites they are tracking.

When you use one of the receivers listed in Receiver type, page 23, as a reference station receiver, the data is always synchronized. When measurements are not synchronized, there is no equivalent reference station position measured at exactly the same time as the rover position. A simultaneous reference station position must be interpolated, which reduces accuracy.

Logging intervals

Ideally, the logging interval at the reference station should be the same as the logging interval at the rover. For example, if the reference station is using a 5-second logging interval, the rover logging interval should be 5 seconds. The rover logging interval can also be a direct integer multiple of the interval at the reference station. For example, if the reference station is logging every 5 seconds, the rover can log every 10 seconds.

If the rover logging interval is not synchronized with the reference station, the accuracy of the GPS positions logged by the rover may not be submeter. This is because the reference station measurements must be interpolated to correct the roving receiver's measurements. For more information, see Synchronized measurements, page 25.

If the synchronized measurement logging interval at the reference is 1 second, you can use any logging interval at the rover. However, this generates a large file at the reference station. If the computer or data collector at the reference station runs out of space, you cannot differentially correct any rover data collected after the base file ends.

When disk space is at a premium, the best option is a 5-second logging interval for synchronized measurement data at the reference station and a 5-second logging interval for positions at the rover. This is frequent enough to be practical at the rover and uses the default reference station logging interval, which results in base files that are not too large.

Table 3.1 gives examples of various reference station and rover intervals and their effect on accuracy. They are valid for both postprocessed and real-time corrections.

Table 3.1 Logging Interval Accuracy

Reference station interval (seconds)	Rover interval (seconds)	Base data interpolated?	Notes
1	1	No	Recommended for best accuracy.
5	5	No	Recommended if reference station disk space is at a premium.
1	3, or 5, or 6, etc.	No	The rover interval is a direct integer multiple of the reference station interval.
5	10	No	The rover interval is a direct integer multiple of the reference station interval.
5	1	Yes	Base data is interpolated at seconds 1, 2, 3, and 4. A slight degradation of accuracy occurs with interpolation. One in five of the rover positions is not interpolated.

Factors Affecting Real-Time DGPS Accuracy

Real-time DGPS offers similar accuracies to postprocessed GPS. However, in addition to the factors discussed in Factors Affecting Postprocessed DGPS Accuracy, page 20, there are other factors that affect the accuracy of real-time DGPS positions. These factors include:

- Update rate of the corrections
- Corrections based on a different datum

Update rate of the corrections

The frequency, or rate, at which the RTCM differential correction messages are output from the reference station affects the accuracy of the GPS positions recorded by the roving receiver. The latency of the corrections (that is, the time it takes for up-to-date information to get from the reference station to the rover) also affects the rover position accuracy.

Datum of corrections

Errors can occur if the reference stations use a datum other than WGS-84 as the basis for the DGPS corrections. The error introduced by using a reference station that transmits coordinates using a different datum is generally quite small. However, in some places the margin of error can be 5–10 meters. To avoid this type of error, set Trimble controlling software to collect SuperCorrect data. You can then postprocess the real-time DGPS positions if required.

Reference Materials

If you have a problem and cannot find the information you need in the product documentation, *contact your local Distributor*. Alternatively, go to the Trimble Support page at www.trimble.com/support.html, and then do one of the following:

- Browse the available online support resources.
- Request technical assistance from Trimble Support, click the submit an inquiry link, fill in the form, and then click **Send.**

Trimble: www.trimble.com/support.html

Survey Controller: www.trimble.com/tsce.html

Survey Pro: www.tdsway.com

GIS TSCe: www.trimble.com/gistsce.html

ActiveSync™: www.microsoft.com/windowsmobile/resources/downloads/pocketpc/default.mspx

Windows CE: www.microsoft.com/windows/embedded/ce.net

Hardware Specifications

Feature	**TSCe**
Processor	Intel StrongARM SA-1110, 206 MHz
Memory	64 MB low-power SDRAM
Storage	512 MB non-volatile flash disk
Screen	1/4 VGA transflective color LCD
Touch Screen	Passive - 87% transmissivity
Keyboard	57 key tactile action
9-Pin serial port	RS232 COM1
26-Pin MultiPort	RS232 COM2, Ethernet 10BaseT, USB client, power in/out and audio in/out
Infrared	IrDA Type1 COM3
Audio	Integrated speaker and microphone
Batteries	NiMH rechargeable pack, 3800 mAH, 18.5 W-h, 4.8 V
AC Adaptor	Line voltage: 100 - 240 V AC 47-63 Hz

Impulse 200 LR Laser

Our Impulse lasers are specifically designed for optimal performance under whatever conditions you might encounter in the field. They are lightweight, extremely rugged, completely waterproof and versatile. Use them as a handheld unit or mount them on a tripod for added stability.

Hardware Specifications:

Typical Target Accuracy & Range	IMPULSE 200 LR	
	(Imperial)	(Metric)
Accuracy (Typical)	0.1 - 0.2 ft	3 - 5 cm
Accuracy (Max)	0.5 ft	15 cm
Overhead cable / Stake	330 ft	100 m
Phone pole / Stockpile	655 ft	200 m
Tree / Tower	985 ft	300 m
Rock Face / Building	1640 ft	500 m
Max Distance	1885 ft	575 m
Range Resolution	.01 ft	0.01 m
Inclination Limits	+/- 90 deg	+/- 90 deg
Inclination Accuracy	+/- 0.1 deg	+/- 0.1 deg
Weight	2.2 lbs.	1 kg
Size	6 x 2.5 x 5 in.	15.2 x 6.4 x 12.7 cm
Power Supply	(2) AA batteries (20 hours of use)	
Environment	Waterproof to IP 67 and NEMA 6	
Temperature	- 22 to + 140 F	-30 to + 60 C

(Max distances are approximate)

Impulse Laser w/ 1.5 to 4 X Zoom Scope and Mounting Bracket

For 3-D data collection, integrate the Impulse with a MapStar System.

MapStar Angle Encoder

MapStar Compass Module

Key Features:

- Custom backlit LCD display
- Audible and visual indicators
- RS232 serial output for electronic data storage
- Selective range gating for positive target acquisition
- Built-in tilt sensor
- Filter system to discriminate reflective targets
- Cumulative distance capability
- Determines the distance between two in-line objects
- Integrates with GPS

Package Includes:

- Impulse laser
- Red-dot scope
- Hand strap
- Tripod / monopod mounting bracket
- (2) AA batteries
- Operator's manual
- Padded carrying case

Optional Accessories:

- 1.5 to 4 X zoom scope
- Yoke and staff
- Remote trigger data cable

Impulse Laser w/ Red-dot Scope and Hand Strap

LASER TECHNOLOGY INC
Redefining Measurement

7070 S. Tucson Way, Centennial, CO 80112 USA
Toll Free: 1 (800) 280-6113 | Local: 1 (303) 649-1000
Web Page: www.lasertech.com | E-mail: info@lasertech.com

* All specifications are subject to change without notice.
(Rev. 11/15/03)

Specifications for Laser Tech TruPulse 200 Laser Rangefinder

Dimensions	5" x 2" x 3.5" (12cm x 5cm x 9cm)
Weight	8 ounces (220 g)
Data Communication	Serial, via wired RS232 (standard)
Power	3.0 volts DC nominal
Battery Type	(2) AA or (1) CRV3
Battery Duration	AA: Approximately 7,500 measurements CRV3: Approximately 15,000 measurements
Eye Safety	FDA Class 1 (CFR 21)
Environmental	Impact, Water & Dust Resistant. NEMA 3, IP 64
Temperature	-4°F to +140°F (-20°C to +60°C)
Optics	7X Magnification (Field-of-view; 330 ft @ 1000 yards)
Display	In-scope LCD
Units	Feet, Yards, Meters, and Degrees
Monopod/tripod mount	¼ " - 20 female thread
Measurement Range	
Distance	0 to 3280 ft (1000 m) typical, 6560 ft (2000m) max to reflective target
Inclination	± 90 degrees
Accuracy	
Distance	±1 ft (± 30 cm) to high quality targets, ±1 yd (±1 m) to low quality targets
Inclination	±0.25 degrees
Measurement Modes	Horizontal Distance, Vertical Distance, Slope Distance and Inclination, and 3-point flexible height routine with auto sequencing
Target Modes	Standard, Closest, Farthest, Continuous, and Filter (requires reflector and foliage filter)

MVP200
OPERATION AND MAINTENANCE MANUAL

BROOKE OCEAN TECHNOLOGY LIMITED
50 Thornhill Drive
Dartmouth, Nova Scotia
Canada B3B 1S1

Phone: (902) 468-2928
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www.brooke-ocean.com

[OM-0449-04-010] **December 15, 2004**

1 SYSTEM DESCRIPTION

The MVP200 system is a self-contained profiling system capable of sampling water column profiles to 200m depth from a vessel moving at up to 12 knots, and deeper depths at slower speeds. The system provides vertical profiles of oceanographic data such as Sound Velocity, CTD, particle counts, etc. for various operations including the calibration of multi-beam sounder systems for hydrographic operations. The MVP200 is completely autonomous and can be controlled by computer without the requirement for personnel on deck. The system consists of a single or multi-sensor free-fall fish (fish), an integrated winch and hydraulic power unit, towing boom and a remotely located user interface controller. The MVP200 system is shown in Figure 1. The system block diagram is shown in Figure 2.

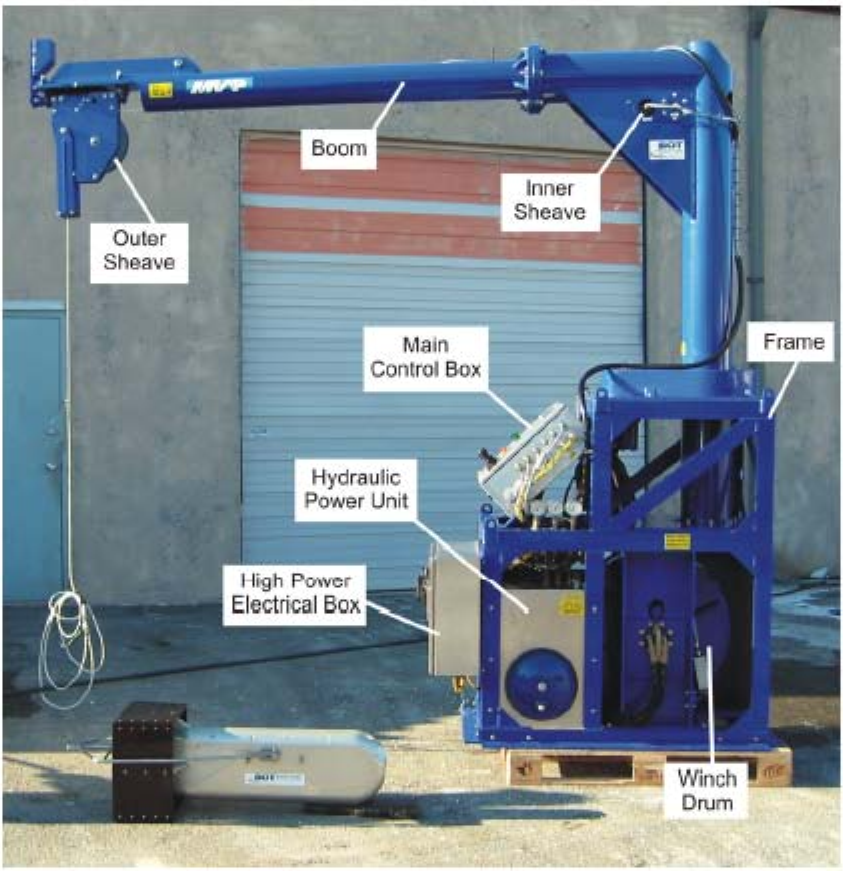


Figure 1: MVP200

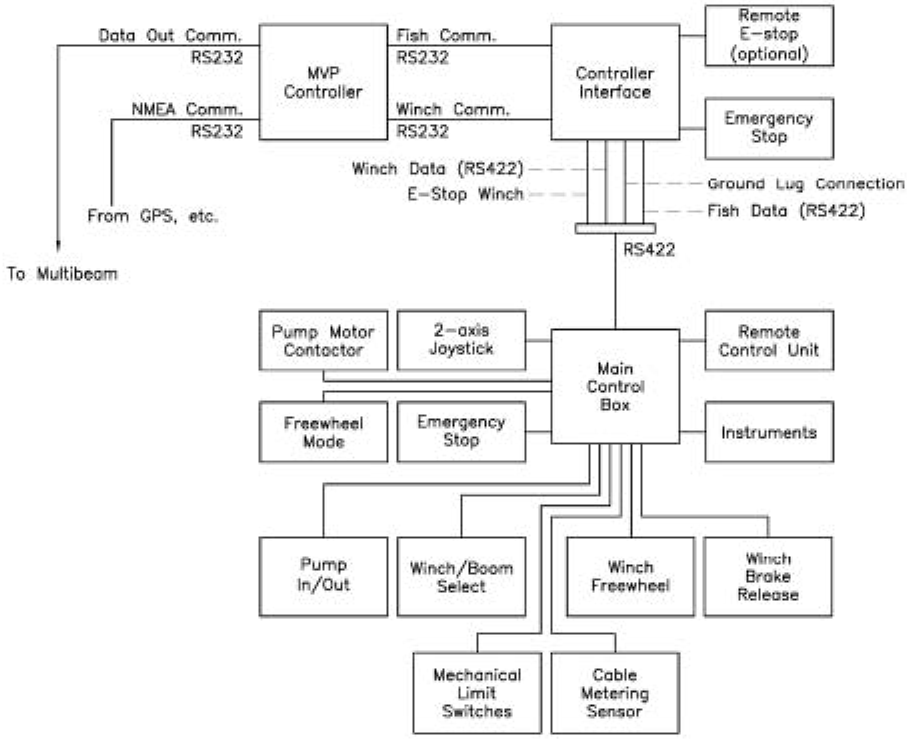


Figure 2: System Block Diagram

Upon actuation, the system deploys the fish from a towed position by setting the winch in 'freewheel' mode and releasing the brake. This allows the fish to free-fall almost straight down through the water at its terminal velocity of approximately 3 m/s. Once the (pre-set) depth limit is reached, the brake is applied to stop the cable pay-out. When the winch drum has stopped, the motor is engaged to haul in the cable until the fish is towed at the surface. Subsequent deployments occur from this position, either actuated by the operator or timed automatically with the automatic deployment setting.

The system operates in the automatic mode described above or in manual mode operated from controls at the winch. Manual mode is used as a convenient method to launch and recover the fish, but is not intended for moving vessel profiling.

1.1 FREE-FALL FISH

The free-fall fish can be either a single sensor or a multi sensor fish. The fish houses the main instrument, either a CTD or SV&P sensor. The instrument is normally configured for RS-485 serial communications.

The multi-sensor fish can support auxiliary sensors in addition to the main CTD/SV&P instrument. If auxiliary sensors are used, a DTM/Mux is required in the fish. The DTM/Mux is a data telemetry module with additional digitization and multiplexing circuitry. This allows data from various analog and digital sensors to be added to the main instrument's serial output stream, which is transmitted to the surface.

1.1.1 Single-Sensor Free-Fall Fish

The Single Sensor Free-Fall Fish (SSFFF) (see Figure 3) is machined from brass with a stainless steel towing bridle. The sensor guard at the tail of the fish is made from stainless steel. The shape of the fish allows minimal resistance while providing stability during free-fall and retrieval. The fish can be fitted with an Applied Microsystems Ltd. (AML) Sound Velocity and Pressure (SV&P) Smart Sensor or an AML CTD Micro Sensor. (A small plastic support is built into the sensor guard for use with the sound velocity sensor). An Impulse underwater connector allows the fish to be removed easily from the electromechanical cable.

The AML CTD Micro Sensor measures conductivity, temperature and pressure. The AML SV&P Smart Sensor measures sound velocity and pressure. The information is sent through the Electro-Mechanical cable to the main control box, through the deck cable to the Instrument Interface box where it then connects to the MVP Controller. If the sensor is a CTD, software in MVP Controller then computes sound velocity and salinity from the measured parameters using the UNESCO equations of state.

Figure 3: Single Sensor Free-Fall Fish

3 SPECIFICATIONS

3.1 OPERATING DEPTH

- 600 m @ 0 knots*
- 350 m @ 5 knots
- 200 m @ 12 knots

* **Ensure sensor(s) are rated for this depth before operations**

3.2 WINCH AND HYDRAULIC POWER UNIT

- Drum dimensions: 324 mm (12.7") barrel diameter
  99 mm (3.9") wide
  711 mm (28.0") flange OD
- Line Pull: Bare Drum - 410 kg (900 lbs.)
- Capacity: 660 m (2132 ft) of 6.0 mm (0.24") cable
- Cable: Jacketed Electro-Mechanical , 4 conductor,
  1089 kg (2400 lbs.) maximum break strength
- Hydraulic Winch Motor: Valmet Black Bruin # 403 040 2120
- Rotator Motor: White # 700540C8540ALAAA
- Slip Ring: Focal Technologies Model 180 ESR
- Hydraulic Pump: Rexroth #AA10VG18EP21/10R-NSC66-F004S
- Reservoir: 40 litre Stainless Steel Reservoir
- Maximum operating pressure: 3000 psi (207 Bar)
- Electric motor: 15 hp TEFC 230/460VAC 60 Hz, 208/416VAC 50 Hz, 3-phase
- Suction line filter: LHA Element #SPE-15-BTA-10
- Footprint: 1.22m x 0.71m (48" x 28") excluding boom
- Height: 3.18m (125")
- Approximate Weight: 680 kg (1500 lbs.)

3.3 FREE-FALL FISH

3.3.1 Single Sensor Free-Fall Fish

- Weight: 32 kg (72 lbs.) with sensor, in air
- Body Length: 673 mm (26.5") excluding bridle
- Body Diameter: 114 mm (4.5")
- Sensors: - AML Sound Velocity and Pressure (SV&P) "Smart Sensor", or
  - AML SVP&T Micro Sensor
  - AML CTD Micro Sensor

3.3.2 Multi-Sensor Free-Fall Fish

- Weight: 88.5 kg (195 lbs.) with sensor, in air
- Body Length: 1041 mm (41") excluding bridle
- Body Section: 147 mm x 279 mm (5.8" x 11.0")

Sensors: - AML Sound Velocity and pressure (SV&P) "Smart Sensor"
- AML CTD Micro Sensor
- AML Dissolved Oxygen (DO) Sensor
- Wet Labs fluorometers (Wet star, FLF300, and ECO)
- Satlantic OCR-500 series digital optical sensors
- Brooke Ocean Technology Ltd. - Laser Optical Plankton Counter (LOPC)

3.4 MVP CONTROLLER

Minimum requirements (refer to system factory configuration for details)

- Operating system: Windows 2000 Professional
- Processor: Pentium 600 or higher
- Ram: 128 Mb
- Hard Disk: 5 GB Hard drive
- Video: 1024x768 SVGA with 64 thousand colors
- Pointing Device: Microsoft Wheel Mouse
- Serial ports: 4 serial (RS232) ports
- Drive: CD-ROM drive and a 1.44 Mb Floppy drive
- Monitor: 15" Video Monitor
- Keyboard: PS/2 Keyboard
- Hardware: Network Card

3.5 POWER REQUIREMENTS

Winch Power Ratings:

- Vessel circuit breaker value 90A at 230v and 45A at 460v, maximum setting
- Voltage: 3-phase, 4-wire
  - 230/460V ±10%, 34/17A at 60 Hz or
  - 208/416V ±10%, 42/21A at 50 Hz

(Note that system supply voltage must be selected at time of order. It is not a field configurable item)

- 50A main disconnect, circuit breaker
- 15 HP Motor, dual frequency rating with 110V anti-condensation heater
- Motor contactor with thermal overload.
- Includes internal 110V auxiliary distribution: 7A/120V/840W

MVP Controller (Lab Computer) Power Ratings:

- Voltage: 1-phase, 100-230 VAC
- Current: 5-8A
- Frequency: 50 or 60 Hz

MicroTSG (Thermosalinograph)

SBE 45

The SBE 45 MicroTSG Thermosalinograph is an externally powered, high-accuracy instrument, designed for shipboard determination of sea surface (pumped-water) conductivity and temperature. Salinity and sound velocity can also be computed. The MicroTSG is constructed of plastic and titanium to ensure long life with minimum maintenance.

OPERATION OVERVIEW

Communication with the MicroTSG is over an internal, 3-wire, RS-232C link, providing real-time data transmission. Commands can be sent to the MicroTSG to provide status display, data acquisition setup, data display and capture, and diagnostic tests. User-selectable operating modes include:

- **Polled sampling** – On command, the MicroTSG takes one sample and sends the data to the computer.
- **Autonomous sampling** – At pre-programmed intervals, the MicroTSG samples and sends the data to the computer. The MicroTSG does not enter quiescent (sleep) state between samples.
- **Serial Line Sync** – A pulse on the serial line causes the MicroTSG to wake up, sample, and enter quiescent state automatically.

Calibration coefficients stored in EEPROM allow the MicroTSG to transmit data in engineering units.

SENSORS

The MicroTSG retains the temperature and conductivity sensors used in the SBE 21 Thermosalinograph, but has improved acquisition electronics that increase accuracy and resolution, and lower power consumption. The MicroTSG's aged and pressure-protected thermistor has a long history of exceptional accuracy and stability (typical drift is less than 0.002 °C per year). Electrical isolation of the conductivity electronics eliminates any possibility of ground-loop noise.

The MicroTSG's internal-field conductivity cell is unaffected by external fouling, and uses expendable anti-foulant devices.

OPTIONAL PN90402 - SBE 45 POWER, NAVIGATION, and REMOTE TEMPERATURE INTERFACE BOX

An optional AC- or DC-powered Interface Box:

- Provides isolated DC power and an optically isolated RS-232 data interface.
- Contains a NMEA 0183 port for appending navigation information from a NMEA navigation device to the data stream.
- Contains an RS-232 port for appending the output of an optional remote temperature sensor (SBE 38), allowing for measurement of sea surface temperature with minimal thermal contamination from the ship's hull.
- Outputs the data stream (MicroTSG, NMEA navigation device, and SBE 38 data) to the computer over an RS-232 interface.

SOFTWARE

The MicroTSG is supplied with a powerful Win 95/98/NT/2000/XP software package, SEASOFT©-Win32. SEASOFT's modular programs include:

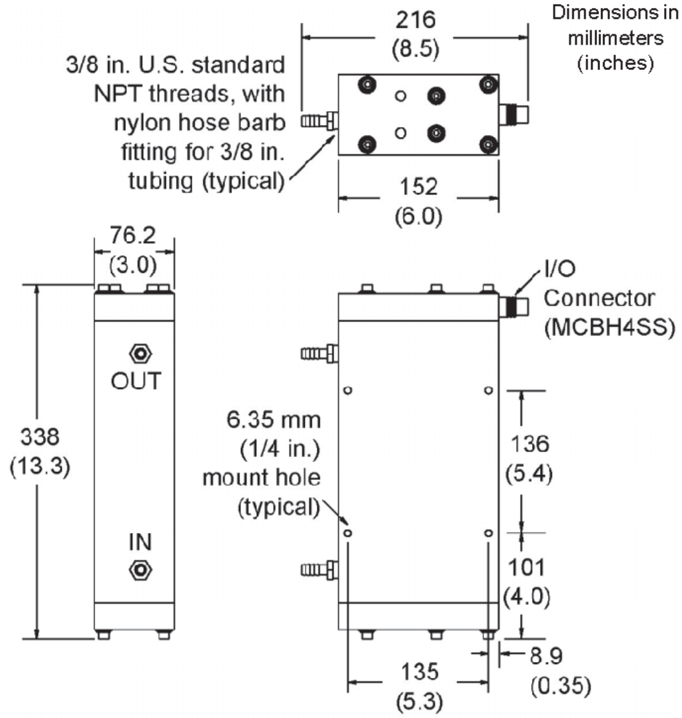
- SEATERM — terminal program for instrument setup and data display.
- SEASAVE — real-time data acquisition and display
- SBE Data Processing — filtering, aligning, averaging, and plotting of data and derived variables.

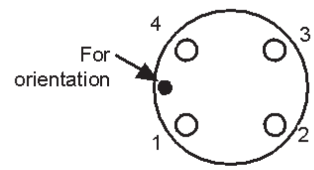
MicroTSG (Thermosalinograph) SBE 45

SPECIFICATIONS

Measurement Range	
Conductivity:	0-7 S/m (0-70 mS/cm)
*Temperature *:*	-5 to 35 °C
Initial Accuracy	
Conductivity:	0.0003 S/m (0.003 mS/cm)
*Temperature *:*	0.002 °C
Salinity:	0.005 PSU, typical
Typical Stability *(per month)*	
Conductivity:	0.0003 S/m (0.003 mS/cm)
*Temperature *:*	0.0002 °C
Salinity:	0.003 PSU, typical
Resolution	
Conductivity:	0.00001 S/m (0.0001 mS/cm)
*Temperature *:*	0.0001 °C
Salinity:	0.0002 PSU, typical
Calibration Range	
Conductivity:	0-6 S/m (60 mS/cm); physical calibration 2.6-6 S/m (26-60 mS/cm), plus zero conductivity (air)
*Temperature *:*	+1 to +32 °C
Time Resolution	1 second
Clock Stability	13 seconds/month
Input Power	8-30 VDC
Acquisition Current	34 mA at 8 VDC; 30 mA at 12-30 VDC
Quiescent Current	10 microamps
Acquisition Rate	1 Hz maximum
Operating Pressure	34.5 decibars (50 psi) maximum
Flow Rate	10 to 30 ml/sec (0.16 to 0.48 gal/min)
Materials	PVC housing
Weight	4.6 kg (10.2 lbs)

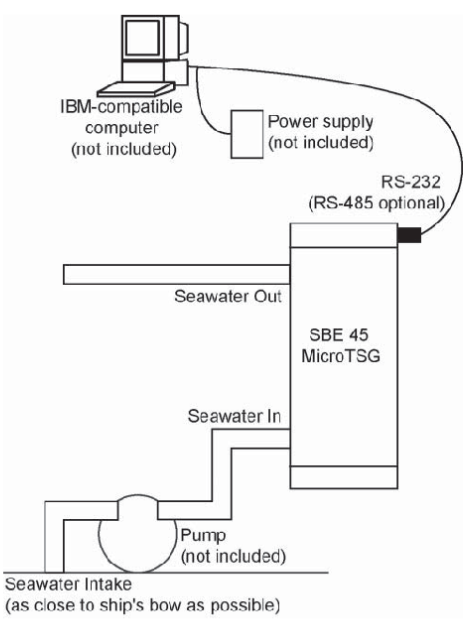
* For specifications for optional SBE 38 remote temperature sensor, see SBE 38 datasheet.



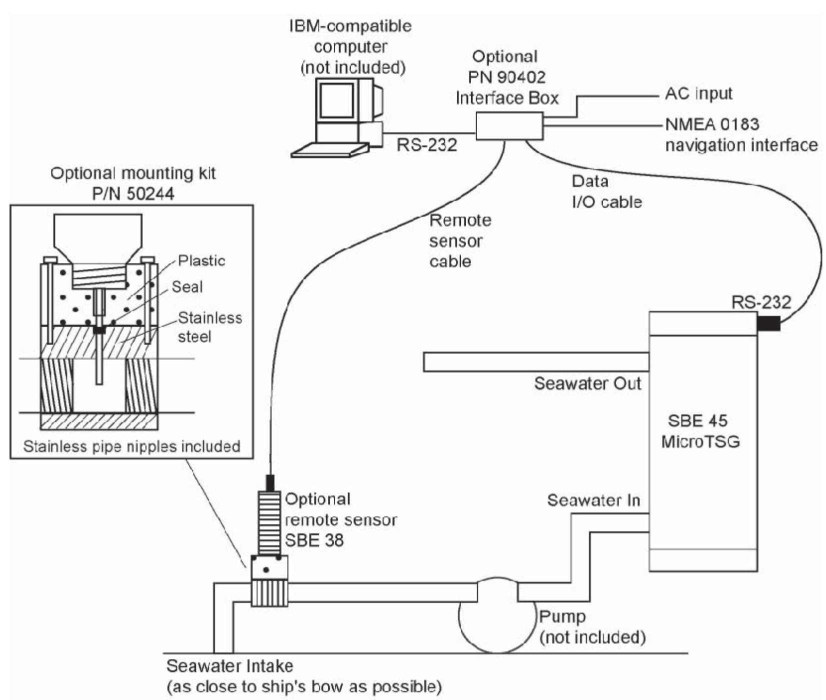


Pin	Signal
1	Common
2	RS-232 RX from computer
3	RS-232 TX to computer
4	External power in (8 - 30 VDC)

System Schematic: SBE 45



System Schematic: SBE 45 with Optional PN 90402 Interface Box and Remote Temperature Sensor



03/04

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SBE 19plus
SEACAT PROFILER

Conductivity, Temperature, and Pressure Recorder with RS-232 Interface

Serial Number: 19P36026-4585

Sea-Bird Electronics, Inc.
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Bellevue, Washington 98005 USA
Tel: 425/643-9866
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LIMITED LIABILITY STATEMENT

Extreme care should be exercised when using or servicing this equipment. It should be used or serviced only by personnel with knowledge of and training in the use and maintenance of oceanographic electronic equipment.

SEA-BIRD ELECTRONICS, INC. disclaims all product liability risks arising from the use or servicing of this system. SEA-BIRD ELECTRONICS, INC. has no way of controlling the use of this equipment or of choosing the personnel to operate it, and therefore cannot take steps to comply with laws pertaining to product liability, including laws which impose a duty to warn the user of any dangers involved in operating this equipment. Therefore, acceptance of this system by the customer shall be conclusively deemed to include a covenant by the customer to defend, indemnify, and hold SEA-BIRD ELECTRONICS, INC. harmless from all product liability claims arising from the use of servicing of this system.

WARNING !!

Do not submerge this instrument (S/N 19P36026-4585)
beyond the depth rating of the lowest rated component listed below!

Main Housing (Titanium)	7000 meters
Pressure Sensor (3500 dBar) Druck	**3500 meters**
Pump (SBE 5M)	10500 meters

SYSTEM CONFIGURATION 14 June 2004

Model SBE 19plus	**S/N 19P36026-4585**
Instrument Type	**SBE 19plus SeaCaT Profiler**
Firmware Version	**1.4D**
Communications	**9600 baud, 8 data bits, no parity, one stop bit**
Memory	**8192K**
Housing	**7000 meter (3AL-4V Titanium)**
0 Conductivity Raw Frequency	**2630.97 Hz**
Pressure Sensor	**Strain Gauge: 3500 dBar, S/N 5433**
Number of Voltages Sampled:	**0**
Serial RS-232C Sensor	**None**
Data Format:	
Count	**Temperature**
Frequency	**Conductivity**
Count	**Pressure, Strain gauge**
Pump (SBE 5M)	**050647**
Voltage Delay Setting (standard)	**(standard) 0 seconds**

IMPORTANT SOFTWARE & HARDWARE CONFIGURATION INFORMATION

Sea-Bird supplies two versions of our software package for communication, real-time data acquisition, and data analysis and display:

- SEASOFT-Win32 - Windows software for PC running Win 95/98/NT/2000/XP
- SEASOFT-DOS - DOS software for IBM-PC/AT/386/486 or compatible computer with a hard drive

Detailed information on the use of the **Windows** software follows:

SEASOFT-Win32

SEASOFT-Win32 software was supplied on a CD-ROM with your CTD. This software package is designed to run on a PC running Win 95/98/NT/2000/XP. The CD-ROM also contains software manuals that describe the appropriate applications for the various programs, the procedure for installing the software, and instructions on using the programs. There are three primary programs used with the CTD for setup, data collection and retrieval, data display, and data processing:

- SEATERM - terminal program for setup of the CTD and uploading of data from the CTD memory (**Note**: If using the CTD with the 90208 Auto Fire Module or SBE 17*plus* V2 SEARAM, use SeatermAF instead of SEATERM)
- SEASAVE - real-time data acquisition program
- SBE Data Processing - data processing program

Instructions for using the software are found in their Help files.

To communicate with the CTD to set it up or to upload data from the CTD memory to the computer hard drive, **SEATERM** must have information about the CTD hardware configuration (communication parameters, internal firmware, etc.) and about the computer. To communicate with the CTD, double click on Seaterm.exe:

1. In the Configure menu, select the CTD. The Configuration Options dialog box appears.
   A. On the COM Settings tab, select the firmware version (if applicable), baud rate, data bits, and parity to match the CTD's configuration sheet. If necessary, change the com port to match the computer you are using.
   B. On the Upload Settings tab, enter upload type (all as a single file, etc.) as desired.
   For the SBE 17 and 25 only: enter the serial number for the SBE 3 (temperature) and SBE 4 (conductivity) modular sensors, exactly as they appear in the configuration (.con) file.
   C. On the Header Information tab, change the settings as desired.
   Click OK when done. SEATERM saves the settings in a SEATERM.ini file.
2. On the Toolbar, click Connect to communicate with the CTD.
3. To set up the CTD prior to deployment:
   On the Toolbar, click Status. SEATERM sends the Status command and displays the response. Verify that the CTD setup matches your desired deployment. If not, send commands to modify the setup.
4. To upload data from the CTD:
   On the Toolbar, click Upload to upload data from the CTD memory to the computer.

Sea-Bird CTDs store and/or transmit data from their primary and auxiliary sensors in the form of binary or hexadecimal number equivalents of the sensors' frequency or voltage outputs. This is referred to as the *raw* data. The calculations required to convert from *raw* data to *engineering* units of the measured parameters (temperature, conductivity, pressure, dissolved oxygen, pH, etc.) are performed using the software, either in real time, or after the data has been stored in a file. SEASAVE creates the file in real time. As noted above, SEATERM uploads the recorded data and creates the file on the computer hard drive.

To successfully store data to a file on the computer and subsequently convert it to engineering units, the software must know the CTD type, CTD configuration, and calibration coefficients for the sensors installed on the CTD. This information is unique to each CTD, and is contained in a *configuration* file. The configuration file, which has a .con extension, was written onto a floppy disk and the CD-ROM shipped with the CTD. The .con file for a given CTD is named with the last four digits of the serial number for that CTD (e.g., 1234.con). The configuration file is created or modified (e.g., changing coefficients after recalibration, or adding another sensor) by using the Configure menu in **SEASAVE** or
SBE Data Processing. The configuration file is used by SEASAVE to convert raw data to engineering units when it acquires, stores, and displays real-time data. The configuration file is also used by some modules in SBE Data Processing (Data Conversion and Derive) that convert raw data to engineering units during data processing.

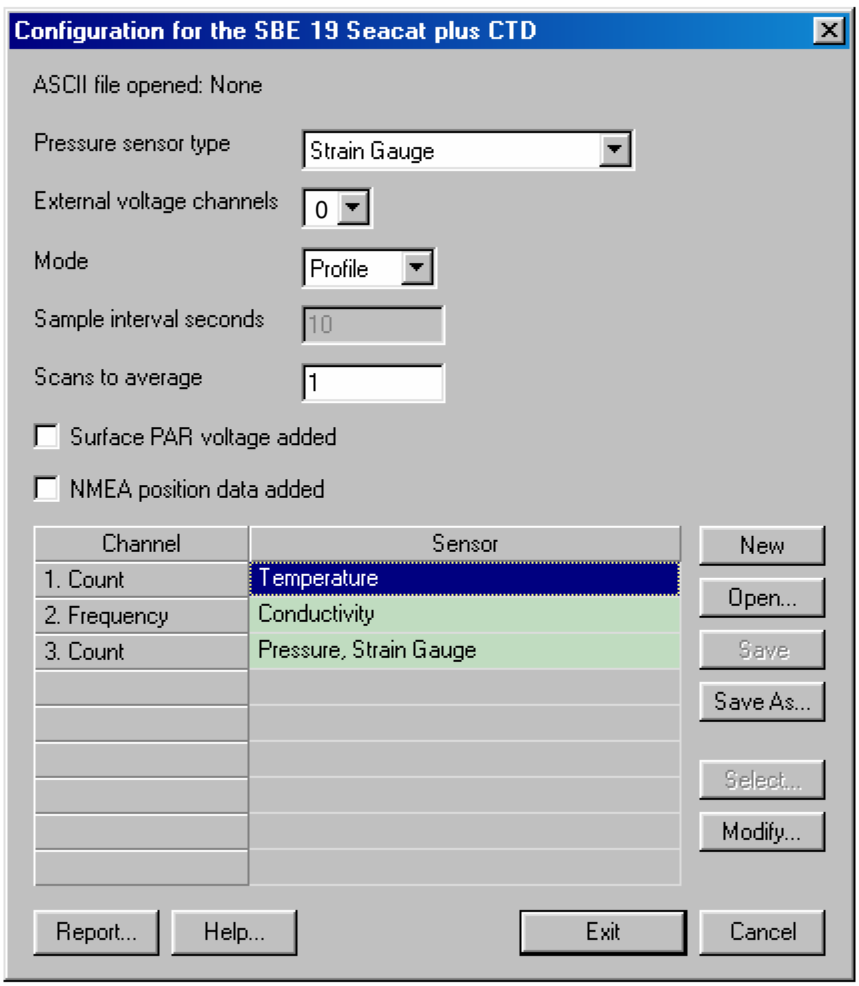
The instrument type and instrument configuration settings of the .con file and the required setup for the SEATERM.ini file for the CTD *as delivered* are documented below. The calibration coefficients for the CTD's sensors are contained in the calibration coefficient section of the CTD manual.

NOTE:

SEATERM will not upload data correctly without a properly configured SEATERM.ini file. SEASAVE and SBE Data Processing will not interpret the data correctly without the correct .con file.

SEASOFT CONFIGURATION:

The correct instrument type for your instrument is SBE 19plus SEACAT Profiler. The correct settings for the configuration of your instrument as delivered are documented below:



SPECIFICATIONS

SEACAT Profiler

SBE 19*plus*

The SBE 19*plus* is the next generation *Personal CTD*, bringing numerous improvements in accuracy, resolution (in fresh as well as salt water), reliability, and ease-of-use to the wide range of research, monitoring, and engineering applications pioneered by its legendary SEACAT predecessor. The 19*plus* samples faster (4 Hz vs 2), is more accurate (0.005 vs 0.01 in T, 0.0005 vs 0.001 in C, and 0.1% vs 0.25% — with *seven* times the resolution — in D), and has more memory (8 Mbyte vs 1). There is more power for auxiliary sensors (500 ma vs 50), and they are acquired at higher resolution (14 bit vs 12). Cabling is simpler and more reliable because there are four differential auxiliary inputs on two separate connectors, and a dedicated connector for the pump. All exposed metal parts are titanium, instead of aluminum, for long life and minimum maintenance.

The 19*plus* can be operated without a computer from even the smallest boat, with data recorded in non-volatile FLASH memory and processed later on your PC. Simultaneous with recording, real-time data can be transmitted over single-core, armored cable directly to your PC's serial port (maximum transmission distance dependent on number of auxiliary sensors, baud rate, and cable properties). The 19*plus'* faster sampling and pump-controlled TC-ducted flow configuration significantly reduces salinity spiking caused by ship heave, and allows slower descent rates for improved resolution of water column features. Auxiliary sensors for dissolved oxygen, pH, turbidity, fluorescense, PAR, and ORP can be added, and for moored deployments the 19*plus* can be set to *time-series* mode using software commands. External power and two-way real-time communication over 10,000 meters of cable can be provided with the SBE 36 CTD Deck Unit and Power and Data Interface Module (PDIM).

The 19*plus* uses the same temperature and conductivity sensors proven in 5000 SEACAT and MicroCAT instruments, and a superior new micro-machined silicon strain gauge pressure sensor developed by Druck, Inc. Improvements in design, materials, and signal acquisition techniques yield a low-cost instrument with superior performance that is also easy to use. Calibration coefficients, obtained in our computer-controlled high-accuracy calibration baths, are stored in EEPROM memory. They permit data output in ASCII engineering units (degrees C, Siemens/m, decibars, Salinity [PSU], sound velocity [m/sec], etc.). The 19*plus* can be factory-configured to emulate the .hex output format and 2 Hz data rate of old SEACATs for compatibility with existing software or instrument fleets.

Accuracy, convenience, portability, software, and support; compelling reasons why the 19*plus* is today's best low-cost CTD.

CONFIGURATION AND OPTIONS

A standard SBE 19*plus* is supplied with:
- Plastic housing for depths to 600 meters
- Strain-gauge pressure sensor
- 8 Mbyte FLASH RAM memory
- 9 D-size alkaline batteries
- Impulse glass-reinforced epoxy bulkhead connectors: 4-pin I/O, 2-pin pump, and two 6-pin (two differential auxiliary A/D inputs each)
- SBE 5M miniature pump and T-C Duct

Options include:
- Titanium housing for depths to 7000 meters
- Sensors for oxygen, pH, fluorescence, light (PAR), light transmission, and turbidity
- SBE 5T pump in place of SBE 5M for use with dissolved oxygen and/or other pumped sensors
- Stainless steel cage
- MCBH *Micro* connectors
- Ni-Cad batteries and charger

Shown with optional cage, SBE 5T pump, & SBE 43 DO sensor

SOFTWARE

SEASOFT©-Win32, our complete Windows 95/98/NT/2000/XP software package, is included at no extra charge. Its modular programs include:
- SEATERM© — communication and data retrieval
- SEASAVE© — real-time data acquisition and display
- SBE Data Processing© — filtering, aligning, averaging, and plotting of CTD and auxiliary sensor data and derived variables

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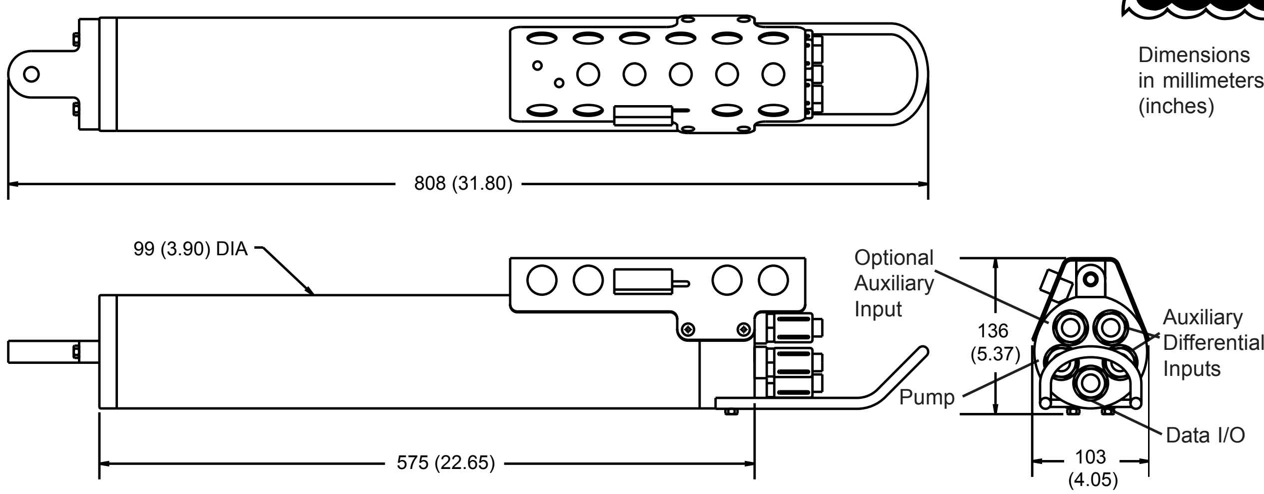
SEACAT Profiler

SBE 19*plus*



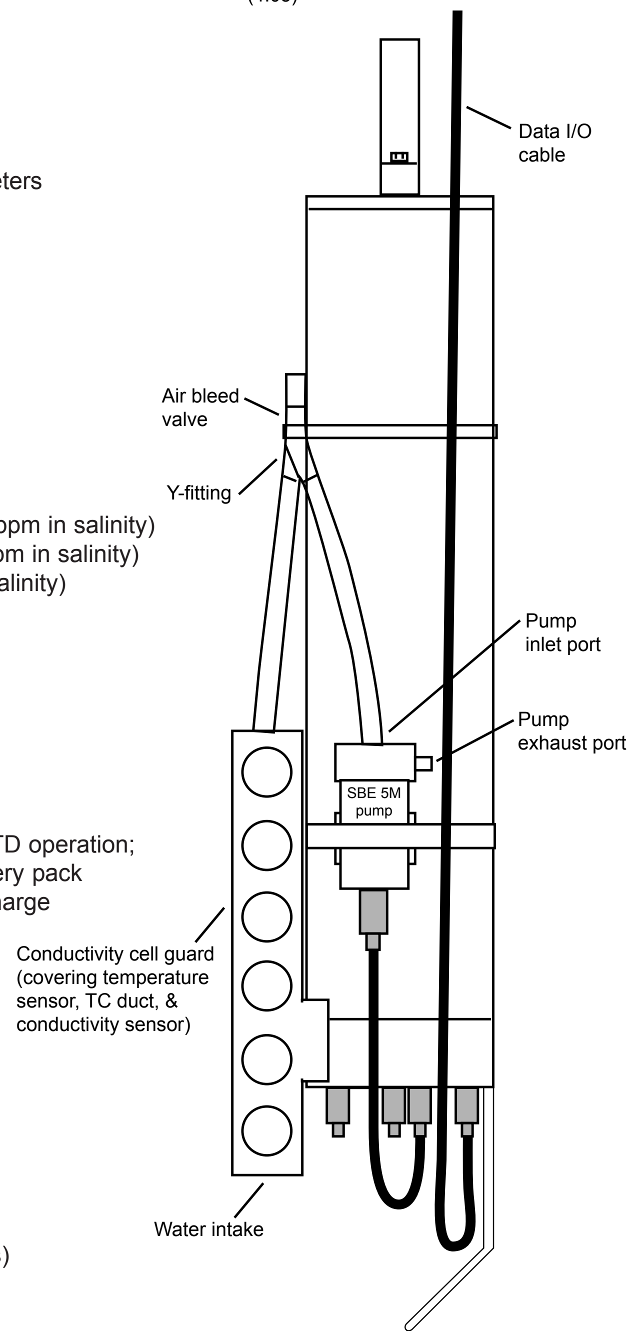
SPECIFICATIONS

Measurement Range	
Temperature	-5 to +35 °C
Conductivity	0 to 9 S/m
Pressure	0 to 20 / 100 / 350 / 1000 / 2000 / 3500 / 7000 meters
Initial Accuracy	
Temperature	0.005 °C
Conductivity	0.0005 S/m
Pressure	0.1% of full scale range
Typical Stability (*per month*)	
Temperature	0.0002 °C
Conductivity	0.0003 S/m
Pressure	0.004% of full scale range
Resolution	
Temperature	0.0001 °C
Conductivity	0.00005 S/m (most oceanic waters; resolves 0.4 ppm in salinity) 0.00007 S/m (high salinity waters; resolves 0.4 ppm in salinity) 0.00001 S/m (fresh waters; resolves 0.1 ppm in salinity)
Pressure	0.002% of full scale range
Memory	8 Mbyte non-volatile FLASH memory
Data Storage	Recorded Parameter — Bytes/Sample T + C — 6 pressure — 5 each external voltage — 2
Real-Time Clock	32,768 Hz TCXO accurate to ±1 minute/year
Internal Batteries	9 alkaline D-cells provide 60 hours continuous CTD operation; optional 9-cell rechargeable nickel-cadmium battery pack provides approximately 24 hours operation per charge
External Power Supply	9 - 28 VDC
Power Requirements	
Sampling	65 mA
SBE 5M pump	95 mA
Quiescent	30 μA
Auxiliary Voltage Sensors	
Auxiliary power out	up to 500 mA at 10.5 - 11 VDC
A/D resolution	14 bits
Input range	0 - 5 VDC

Housing Materials — Depth Rating — Weight

Acetal Copolymer *Plastic* housing — 600 meter (1950 feet) — 7.3 kg (16 lbs)

3AL-2.5V *Titanium* housing — 7000 meter (22,900 feet) — 13.7 kg (30 lbs)



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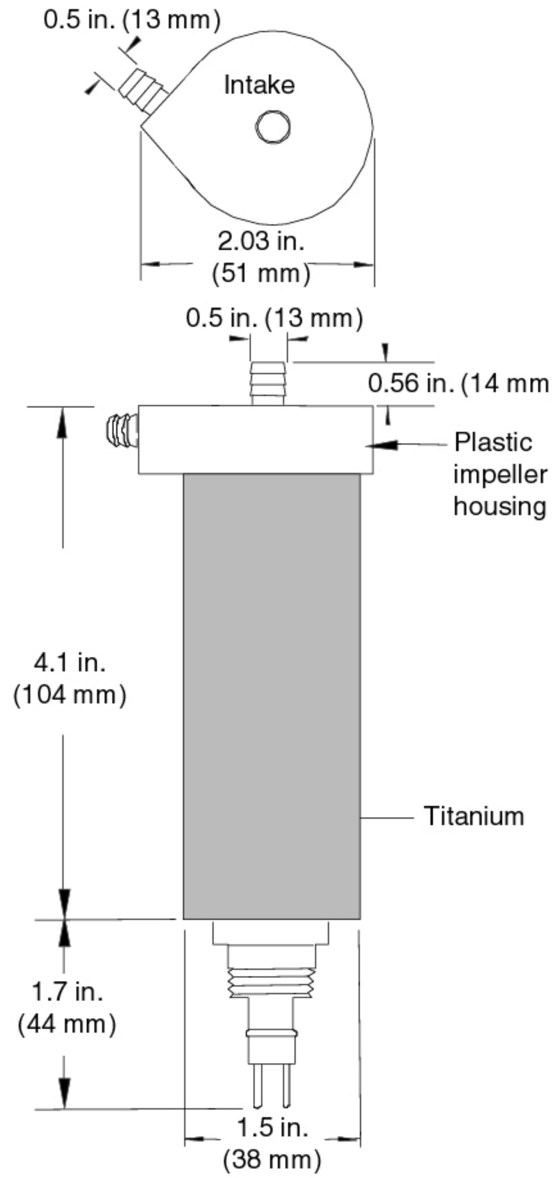
Mini Submersible Pump SBE 5M

The SBE 5M pump module consists of a centrifugal pump head and a long-life, DC ball bearing motor contained in a compact, titanium, pressure housing usable to 10,500 meters deep. The pump impeller and electric drive motor are coupled magnetically through the housing, providing high reliability by eliminating moving seals. Motor speed and pumping rate remain constant over the entire input voltage range. The motor drive electronics is intrinsically protected against accidental reversed polarity.



APPLICATIONS

The SBE 5M is standard on the SBE 19 and 19*plus* SEACAT Profiler CTD. It is optional on the SBE 16, 16*plus*, and 16*plus*-IM SEACAT C-T Recorder. The pump flushes water through the conductivity cell at a constant rate, independent of the CTD's motion, improving dynamic performance. For applications requiring pumping through additional sensors (for example, a dissolved oxygen sensor), use the SBE 5T pump instead.

Specify:

- Option 5M-1 for profiling (continuous duty) applications such as the SBE 19*plus*.
- Option 5M-2 for moored (pulsed duty) applications such as the SBE 16*plus* or 16*plus*-IM.

Contact Sea-Bird for use in other applications.

SPECIFICATIONS

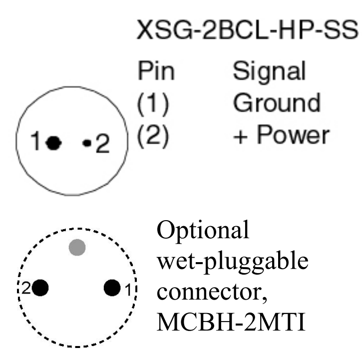
Option 5M-1 (continuous duty):
Input voltage range 9 - 18 VDC

Flow Rate 25 ml/s   supply current 95 ma

Note: Supply current is independent of operating voltage.

Option 5M-2 (pulsed duty):
Input voltage range 6 - 18 VDC

Pulse Duration	*Flow Volume*	*Electrical Charge*
0.5 seconds	15 ml	0.148 amp-seconds
1.0 seconds	21 ml	0.283 amp-seconds
1.5 seconds	31 ml	0.418 amp-seconds
2.0 seconds	40 ml	0.553 amp-seconds



Weight
In Air: 0.42 kg (0.91 lbs)
In Water: 0.28 kg (0.60 lbs)

06/03

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SBE 5M MINI SUBMERSIBLE PUMP CONFIGURATION SHEET

Serial Number: 0647

Job Number: 36026

Customer: NOAA/PMC

Delivery Date: 6/14/2004

Single Connector Housing with Titanium screws

Pressure Case: 10,500 meters (titanium)

Maxon Motor Type:

P/N 90337, Motor PN 20130 (Low power 6 VDC, 2000 RPM MAX) ☐

P/N 90335, Motor PN 20130 (Low power 9 VDC, 2000 RPM MAX) ☑

Vin 15V voltage across C2:	8.015	VDC	Current	7.73	mA
Vin 9V voltage across C2:	8.014	VDC	Current	7.4	mA
Vin 6V voltage across C2:	5.888	VDC	Current	7.61	mA

Pump submerged test, no load, Vin 12VDC Average current draw in water: 121 mA

SBE 19plus
SEACAT PROFILER

Conductivity, Temperature, and Pressure Recorder with RS-232 Interface

Serial Number: 19P36026-4616 and -4617

Sea-Bird Electronics, Inc.
1808 136th Place NE
Bellevue, Washington 98005 USA
Tel: 425/643-9866
Fax:425/643-9954

WARNING !!

**Do not submerge this instrument (S/N 19P36026-4616)
beyond the depth rating of the lowest rated component listed below!**

Main Housing (Plastic)	**600 meters**
Pressure Sensor (1000 dBar) Druck	1000 meters
Pump (SBE 5M)	10500 meters

WARNING !!

Do not submerge this instrument (S/N 19P36026-4617) beyond the depth rating of the lowest rated component listed below!

Main Housing (Plastic)	**600 meters**
Pressure Sensor (1000 dBar) Druck	1000 meters
Pump (SBE 5M)	10500 meters

SYSTEM CONFIGURATION 14 June 2004

Model SBE 19plus	**S/N 19P36026-4616**
Instrument Type	**SBE 19plus SeaCaT Profiler**
Firmware Version	**1.4D**
Communications	**9600 baud, 8 data bits, no parity, one stop bit**
Memory	**8192K**
Housing	**600 meter (Celcon plastic)**
0 Conductivity Raw Frequency	**2686.52 Hz**
Pressure Sensor	**Strain Gauge: 1000 dBar, S/N 5512**
Number of Voltages Sampled:	**0**
Serial RS-232C Sensor	**None**
Data Format:	
Count	**Temperature**
Frequency	**Conductivity**
Count	**Pressure, Strain gauge**
Pump (SBE 5M)	**050651**
Voltage Delay Setting (standard)	**(standard) 0 seconds**

SYSTEM CONFIGURATION 14 June 2004

Model SBE 19plus	**S/N 19P36026-4617**
Instrument Type	**SBE 19plus SeaCaT Profiler**
Firmware Version	**1.4D**
Communications	**9600 baud, 8 data bits, no parity, one stop bit**
Memory	**8192K**
Housing	**600 meter (Celcon plastic)**
0 Conductivity Raw Frequency	**2801.47 Hz**
Pressure Sensor	**Strain Gauge: 1000 dBar, S/N 5513**
Number of Voltages Sampled:	**0**
Serial RS-232C Sensor	**None**
Data Format:	
Count	**Temperature**
Frequency	**Conductivity**
Count	**Pressure, Strain gauge**
Pump (SBE 5M)	**050649**
Voltage Delay Setting (standard)	**(standard) 0 seconds**

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SBE 5M MINI SUBMERSIBLE PUMP CONFIGURATION SHEET for 4616

Serial Number: 0651

Job Number: 36026

Customer: NOAA/PMC

Delivery Date: 6/14/2004

Single Connector Housing with Titanium screws

Pressure Case: 10,500 meters (titanium)

Maxon Motor Type:

P/N 90337, Motor PN 20130 (Low power 6 VDC, 2000 RPM MAX) ☐

P/N 90335, Motor PN 20130 (Low power 9 VDC, 2000 RPM MAX) ☑

Vin 15V voltage across C2:	7.947	VDC	Current	11.8	mA
Vin 9V voltage across C2:	7.948	VDC	Current	11.0	mA
Vin 6V voltage across C2:	5.868	VDC	Current	10.2	mA

Pump submerged test, no load, Vin 12VDC Average current draw in water: 124 mA

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SBE 5M MINI SUBMERSIBLE PUMP CONFIGURATION SHEET for 4617

Serial Number: 0649

Job Number: 36026

Customer: NOAA/PMC

Delivery Date: 6/14/2004

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IMPORTANT SOFTWARE & HARDWARE CONFIGURATION INFORMATION

Sea-Bird supplies two versions of our software package for communication, real-time data acquisition, and data analysis and display:

- SEASOFT-Win32 - Windows software for PC running Win 95/98/NT/2000/XP
- SEASOFT-DOS - DOS software for IBM-PC/AT/386/486 or compatible computer with a hard drive

Detailed information on the use of the **Windows** software follows:

SEASOFT-Win32

SEASOFT-Win32 software was supplied on a CD-ROM with your CTD. This software package is designed to run on a PC running Win 95/98/NT/2000/XP. The CD-ROM also contains software manuals that describe the appropriate applications for the various programs, the procedure for installing the software, and instructions on using the programs. There are three primary programs used with the CTD for setup, data collection and retrieval, data display, and data processing:

- SEATERM - terminal program for setup of the CTD and uploading of data from the CTD memory (**Note**: If using the CTD with the 90208 Auto Fire Module or SBE 17*plus* V2 SEARAM, use SeatermAF instead of SEATERM)
- SEASAVE - real-time data acquisition program
- SBE Data Processing - data processing program

Instructions for using the software are found in their Help files.

To communicate with the CTD to set it up or to upload data from the CTD memory to the computer hard drive, **SEATERM** must have information about the CTD hardware configuration (communication parameters, internal firmware, etc.) and about the computer. To communicate with the CTD, double click on Seaterm.exe:

1. In the Configure menu, select the CTD. The Configuration Options dialog box appears.
   A. On the COM Settings tab, select the firmware version (if applicable), baud rate, data bits, and parity to match the CTD's configuration sheet. If necessary, change the com port to match the computer you are using.
   B. On the Upload Settings tab, enter upload type (all as a single file, etc.) as desired.
   For the SBE 17 and 25 only: enter the serial number for the SBE 3 (temperature) and SBE 4 (conductivity) modular sensors, exactly as they appear in the configuration (.con) file.
   C. On the Header Information tab, change the settings as desired.
   Click OK when done. SEATERM saves the settings in a SEATERM.ini file.
2. On the Toolbar, click Connect to communicate with the CTD.
3. To set up the CTD prior to deployment:
   On the Toolbar, click Status. SEATERM sends the Status command and displays the response. Verify that the CTD setup matches your desired deployment. If not, send commands to modify the setup.
4. To upload data from the CTD:
   On the Toolbar, click Upload to upload data from the CTD memory to the computer.

Sea-Bird CTDs store and/or transmit data from their primary and auxiliary sensors in the form of binary or hexadecimal number equivalents of the sensors' frequency or voltage outputs. This is referred to as the *raw* data. The calculations required to convert from *raw* data to *engineering* units of the measured parameters (temperature, conductivity, pressure, dissolved oxygen, pH, etc.) are performed using the software, either in real time, or after the data has been stored in a file. SEASAVE creates the file in real time. As noted above, SEATERM uploads the recorded data and creates the file on the computer hard drive.

To successfully store data to a file on the computer and subsequently convert it to engineering units, the software must know the CTD type, CTD configuration, and calibration coefficients for the sensors installed on the CTD. This information is unique to each CTD, and is contained in a *configuration* file. The configuration file, which has a .con extension, was written onto a floppy disk and the CD-ROM shipped with the CTD. The .con file for a given CTD is named with the last four digits of the serial number for that CTD (e.g., 1234.con). The configuration file is created or modified (e.g., changing coefficients after recalibration, or adding another sensor) by using the Configure menu in **SEASAVE** or
SBE Data Processing. The configuration file is used by SEASAVE to convert raw data to engineering units when it acquires, stores, and displays real-time data. The configuration file is also used by some modules in SBE Data Processing (Data Conversion and Derive) that convert raw data to engineering units during data processing.

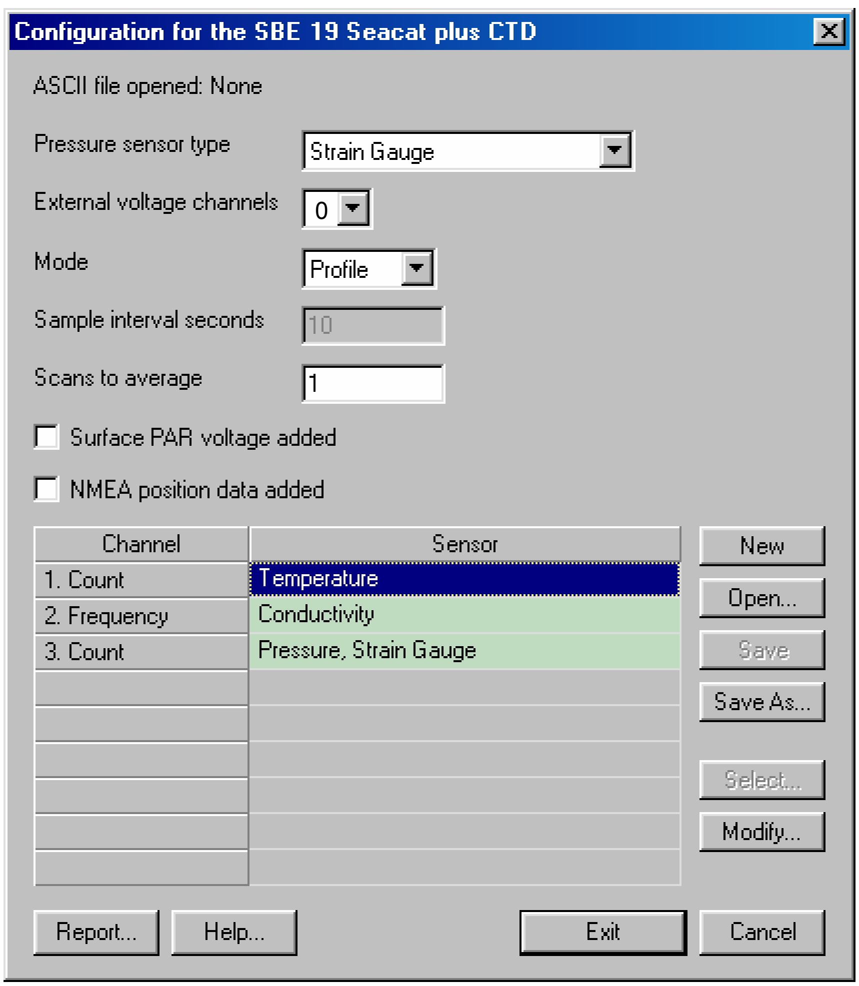
The instrument type and instrument configuration settings of the .con file and the required setup for the SEATERM.ini file for the CTD *as delivered* are documented below. The calibration coefficients for the CTD's sensors are contained in the calibration coefficient section of the CTD manual.

NOTE:

SEATERM will not upload data correctly without a properly configured SEATERM.ini file. SEASAVE and SBE Data Processing will not interpret the data correctly without the correct .con file.

SEASOFT CONFIGURATION:

The correct instrument type for your instrument is SBE 19plus SEACAT Profiler. The correct settings for the configuration of your instrument as delivered are documented below:



SPECIFICATIONS

SEACAT Profiler

SBE 19*plus*

The SBE 19*plus* is the next generation *Personal CTD*, bringing numerous improvements in accuracy, resolution (in fresh as well as salt water), reliability, and ease-of-use to the wide range of research, monitoring, and engineering applications pioneered by its legendary SEACAT predecessor. The 19*plus* samples faster (4 Hz vs 2), is more accurate (0.005 vs 0.01 in T, 0.0005 vs 0.001 in C, and 0.1% vs 0.25% — with *seven* times the resolution — in D), and has more memory (8 Mbyte vs 1). There is more power for auxiliary sensors (500 ma vs 50), and they are acquired at higher resolution (14 bit vs 12). Cabling is simpler and more reliable because there are four differential auxiliary inputs on two separate connectors, and a dedicated connector for the pump. All exposed metal parts are titanium, instead of aluminum, for long life and minimum maintenance.

The 19*plus* can be operated without a computer from even the smallest boat, with data recorded in non-volatile FLASH memory and processed later on your PC. Simultaneous with recording, real-time data can be transmitted over single-core, armored cable directly to your PC's serial port (maximum transmission distance dependent on number of auxiliary sensors, baud rate, and cable properties). The 19*plus'* faster sampling and pump-controlled TC-ducted flow configuration significantly reduces salinity spiking caused by ship heave, and allows slower descent rates for improved resolution of water column features. Auxiliary sensors for dissolved oxygen, pH, turbidity, fluorescense, PAR, and ORP can be added, and for moored deployments the 19*plus* can be set to *time-series* mode using software commands. External power and two-way real-time communication over 10,000 meters of cable can be provided with the SBE 36 CTD Deck Unit and Power and Data Interface Module (PDIM).

The 19*plus* uses the same temperature and conductivity sensors proven in 5000 SEACAT and MicroCAT instruments, and a superior new micro-machined silicon strain gauge pressure sensor developed by Druck, Inc. Improvements in design, materials, and signal acquisition techniques yield a low-cost instrument with superior performance that is also easy to use. Calibration coefficients, obtained in our computer-controlled high-accuracy calibration baths, are stored in EEPROM memory. They permit data output in ASCII engineering units (degrees C, Siemens/m, decibars, Salinity [PSU], sound velocity [m/sec], etc.). The 19*plus* can be factory-configured to emulate the .hex output format and 2 Hz data rate of old SEACATs for compatibility with existing software or instrument fleets.

Accuracy, convenience, portability, software, and support; compelling reasons why the 19*plus* is today's best low-cost CTD.

CONFIGURATION AND OPTIONS

A standard SBE 19*plus* is supplied with:
- Plastic housing for depths to 600 meters
- Strain-gauge pressure sensor
- 8 Mbyte FLASH RAM memory
- 9 D-size alkaline batteries
- Impulse glass-reinforced epoxy bulkhead connectors: 4-pin I/O, 2-pin pump, and two 6-pin (two differential auxiliary A/D inputs each)
- SBE 5M miniature pump and T-C Duct

Options include:
- Titanium housing for depths to 7000 meters
- Sensors for oxygen, pH, fluorescence, light (PAR), light transmission, and turbidity
- SBE 5T pump in place of SBE 5M for use with dissolved oxygen and/or other pumped sensors
- Stainless steel cage
- MCBH *Micro* connectors
- Ni-Cad batteries and charger

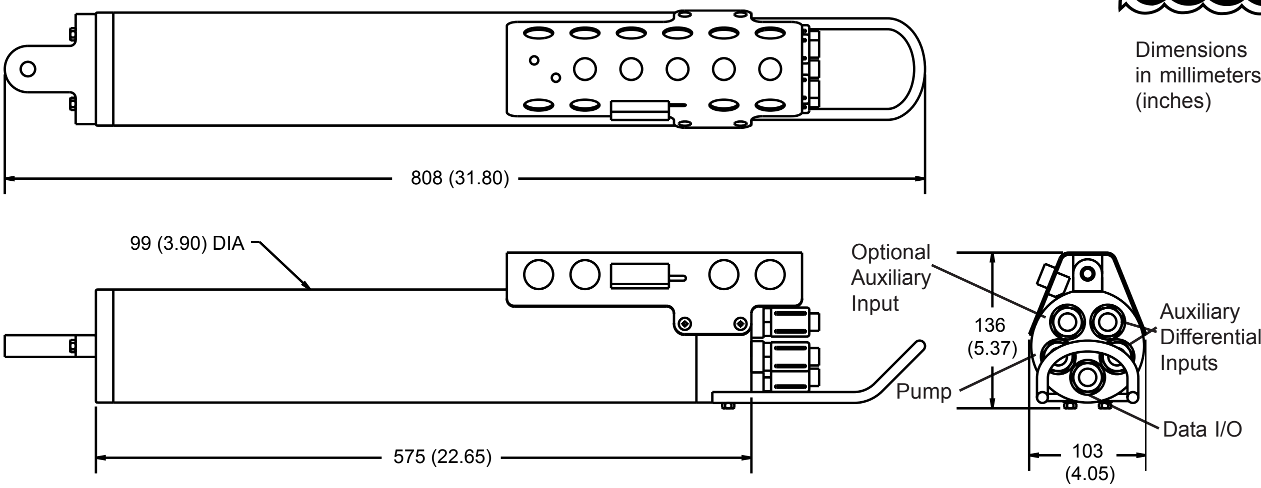
Shown with optional cage, SBE 5T pump, & SBE 43 DO sensor

SOFTWARE

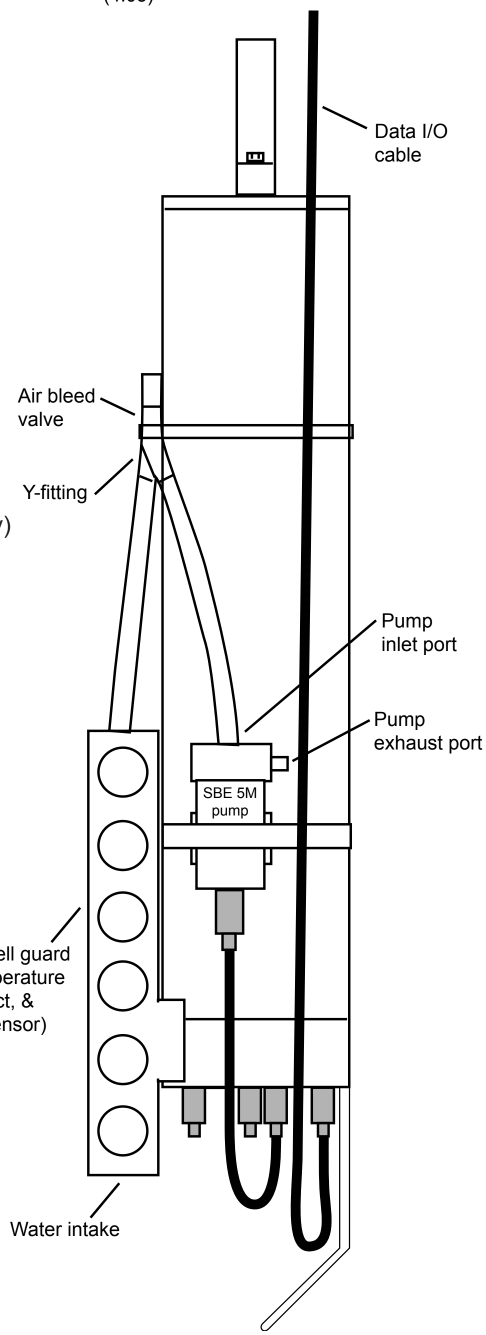
SEASOFT©-Win32, our complete Windows 95/98/NT/2000/XP software package, is included at no extra charge. Its modular programs include:
- SEATERM© — communication and data retrieval
- SEASAVE© — real-time data acquisition and display
- SBE Data Processing© — filtering, aligning, averaging, and plotting of CTD and auxiliary sensor data and derived variables

SEACAT Profiler

SBE 19*plus*



SPECIFICATIONS



Measurement Range		
Temperature	-5 to +35 °C	
Conductivity	0 to 9 S/m	
Pressure	0 to 20 / 100 / 350 / 1000 / 2000 / 3500 / 7000 meters	
Initial Accuracy		
Temperature	0.005 °C	
Conductivity	0.0005 S/m	
Pressure	0.1% of full scale range	
Typical Stability (*per month*)		
Temperature	0.0002 °C	
Conductivity	0.0003 S/m	
Pressure	0.004% of full scale range	
Resolution		
Temperature	0.0001 °C	
Conductivity	0.00005 S/m (most oceanic waters; resolves 0.4 ppm in salinity) 0.00007 S/m (high salinity waters; resolves 0.4 ppm in salinity) 0.00001 S/m (fresh waters; resolves 0.1 ppm in salinity)	
Pressure	0.002% of full scale range	
Memory	8 Mbyte non-volatile FLASH memory	
Data Storage	Recorded Parameter	Bytes/Sample
	T + C	6
	pressure	5
	each external voltage	2
Real-Time Clock	32,768 Hz TCXO accurate to ±1 minute/year	
Internal Batteries	9 alkaline D-cells provide 60 hours continuous CTD operation; optional 9-cell rechargeable nickel-cadmium battery pack provides approximately 24 hours operation per charge	
External Power Supply	9 - 28 VDC	
Power Requirements		
Sampling	65 mA	
SBE 5M pump	95 mA	
Quiescent	30 µA	
Auxiliary Voltage Sensors		
Auxiliary power out	up to 500 mA at 10.5 - 11 VDC	
A/D resolution	14 bits	
Input range	0 - 5 VDC	

Housing Materials — Depth Rating — Weight

Acetal Copolymer *Plastic* housing — 600 meter (1950 feet) — 7.3 kg (16 lbs)

3AL-2.5V *Titanium* housing — 7000 meter (22,900 feet) — 13.7 kg (30 lbs)

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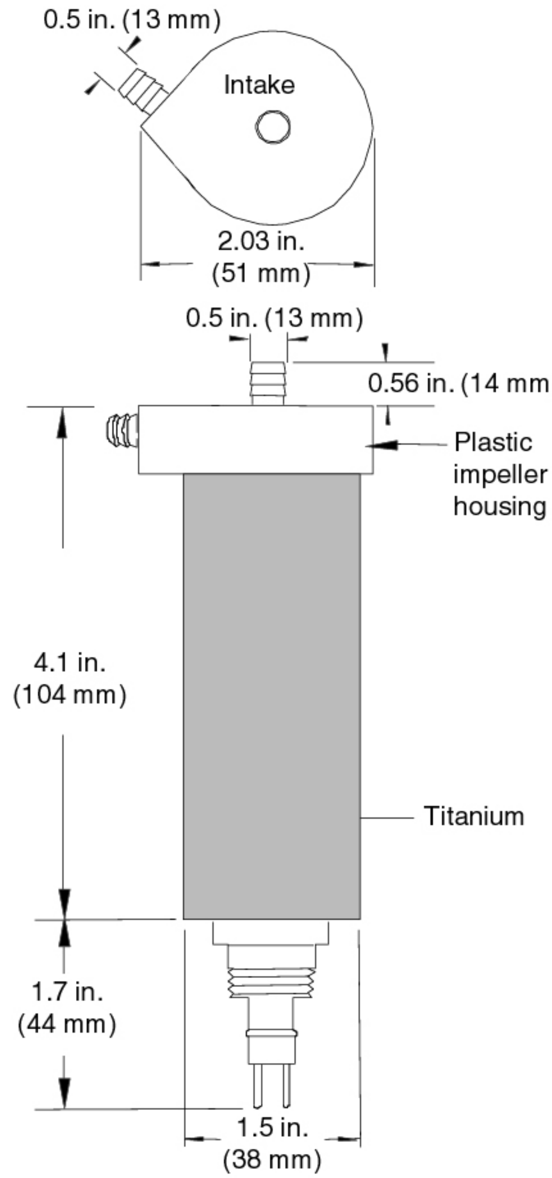
Fax: (425) 643-9954

Mini Submersible Pump SBE 5M

The SBE 5M pump module consists of a centrifugal pump head and a long-life, DC ball bearing motor contained in a compact, titanium, pressure housing usable to 10,500 meters deep. The pump impeller and electric drive motor are coupled magnetically through the housing, providing high reliability by eliminating moving seals. Motor speed and pumping rate remain constant over the entire input voltage range. The motor drive electronics is intrinsically protected against accidental reversed polarity.



APPLICATIONS

The SBE 5M is standard on the SBE 19 and 19*plus* SEACAT Profiler CTD. It is optional on the SBE 16, 16*plus*, and 16*plus*-IM SEACAT C-T Recorder. The pump flushes water through the conductivity cell at a constant rate, independent of the CTD's motion, improving dynamic performance. For applications requiring pumping through additional sensors (for example, a dissolved oxygen sensor), use the SBE 5T pump instead.

Specify:

- Option 5M-1 for profiling (continuous duty) applications such as the SBE 19*plus*.
- Option 5M-2 for moored (pulsed duty) applications such as the SBE 16*plus* or 16*plus*-IM.

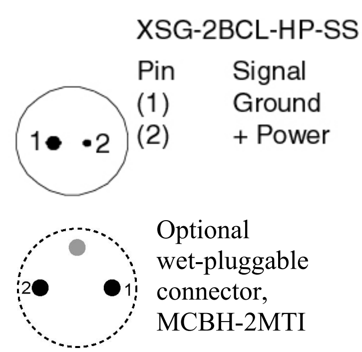
Contact Sea-Bird for use in other applications.

SPECIFICATIONS

Option 5M-1 (continuous duty):
Input voltage range 9 - 18 VDC

Flow Rate 25 ml/s supply current 95 ma

Note: Supply current is independent of operating voltage.



Optional wet-pluggable connector, MCBH-2MTI

Option 5M-2 (pulsed duty):
Input voltage range 6 - 18 VDC

Pulse Duration	*Flow Volume*	*Electrical Charge*
0.5 seconds	15 ml	0.148 amp-seconds
1.0 seconds	21 ml	0.283 amp-seconds
1.5 seconds	31 ml	0.418 amp-seconds
2.0 seconds	40 ml	0.553 amp-seconds

Weight
In Air: 0.42 kg (0.91 lbs)
In Water: 0.28 kg (0.60 lbs)

06/03

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LEICA NA2 · NAK2

Universal automatic level

Leica
Geosystems

LEICA NA2
The classical level from Leica Geosystems

The NA2 universal automatic level meets all requirements regarding precision, convenience and reliability.

It was designed by surveyors and development engineers with years of experience and who know what a field instrument has to be able to do.

The NA2 soon pays for itself, because it can be used for all types of surveying job; on building sites for routine levelling, in engineering projects, and for geodetic control at all levels of accuracy.

Universal application

- Levelling of all types and all orders of accuracy
- Precise levelling and settlement determinations on buildings
- Routine heighting for the construction of roads, railways, pipelines, tunnels and so forth
- Setting-out work and control measurements on the construction site
- Area levelling of high accuracy
- Tacheometric levelling with the K-version on flat terrain by combining stadia and angular measurements with height readings
- Deformation measurement and monitoring of bridges

Quickly set up, simple to use

Strong tripods

In principle, the NA2 can be set up on any Leica Geosystems tripod. In practice, for all-round purposes, we recommend the heavy-duty GST20 telescopic-leg tripod. For precise levelling the GST40 fixed-leg tripod is suitable because of its extreme rigidity.

The modular relationship between instrument and tripod is an advantage when transport space is limited.

Centring is easy

The circular level only needs to be centred approximately to bring the compensator well into its working range of ~30', and so setting-up goes quicker.

The bubble is viewed positively via a pentaprism and is monitored down the eyepiece.

Play-free footscrews

The pitch of the smooth-running and backlash-free footscrews is such that the bubble can be centred in a very short time.

Independent of temperature

Unlike the tubular level of a traditional instrument, the NA2 universal automatic level is relatively insensitive to direct solar radiation and an umbrella need only be considered for the most precise levelling.

Adjust the line of sight automatically

Easy to level up

The advantage of this instrument is that, as soon as the bubble is centred, the line of sight is horizontal for all pointings of the telescope. The observer is freed of the time-consuming centring procedure involved with the traditional tubular level, and can concentrate on the business of staff readings.

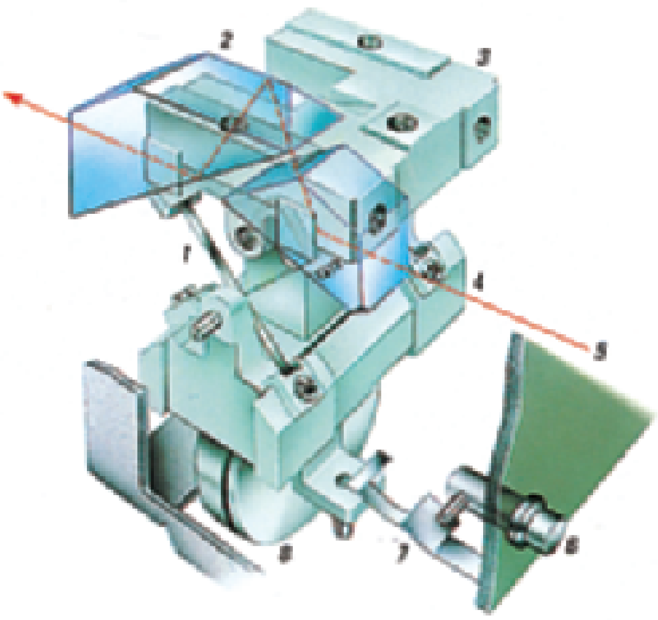
Robust and automatic

The compensator is essentially a pendulum with a prism (4).

The suspension system comprises four flexed tapes (1) made of a special alloy to ensure faultless functioning even at extreme temperatures. The compensator, which is located between the focusing lens and the crosshair reticle, is pneumatically damped against mechanical vibration and is screened against magnetic fields.

Minimum maintenance

In the unlikely event that the compensator is damaged (and this can only happen as a result of extremely harsh treatment) it is replaced easily, being held only by three screws.



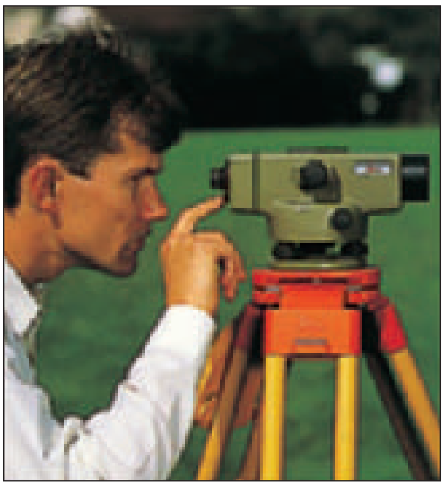
2/NAK2 compensator

uspension tapes
rism (fixed)
ompensator body
endulum with prism
ine of sight
ush-button
pring which taps pendulum
neumatic damping mechanism

Push-button control – added security

With most automatics one taps the tripod or instrument to check if the compensator is functioning. Leica Geosystems offers a far more sophisticated solution.

Pressing the button under the NA2 eyepiece gives the compensator a gentle tap, so that you see the staff image swing smoothly away and then float gently back to give the horizontal line of sight. This check, which takes less than a second, is technically perfect, as the pendulum itself is activated and swings through its full range. It is also immediately apparent if the bubble is not centred.



Top-class optics

Top-class optics

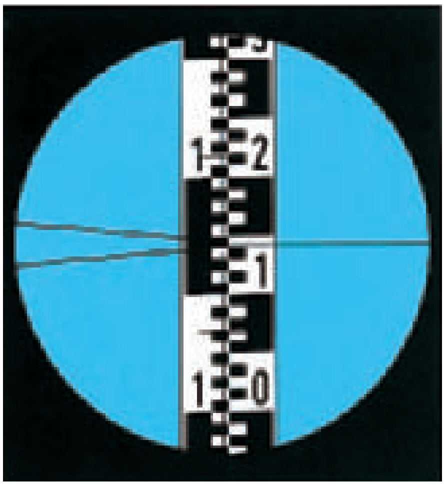
The telescope is of excellent quality and gives a bright, high-contrast, erect image, even in poor light – an essential for accurate levelling. With the standard eyepiece the magnification is 32×, the optimum for most applications of the instrument. Optional eyepieces are available; the 40× may be preferred for precise levelling, the 25× in hot, shimmer conditions. Eyepiece exchange takes only a second or so.

The focusing knob has a coarse/fine movement:
– coarse, for rapid setting with minimum turning
– fine, for the final delicate touch to give the perfect image.

Fatigue-free viewing

The reticle has:
– a single horizontal hair for reading normal staffs
– a wedge-shaped hair for use with invar staffs
– stadia hairs for distance measurement and three-wire levelling.

The general layout of the controls, the smooth friction-braked rotation of the instrument, and the endless horizontal drive with bilateral knobs, all combine to make the instrument easy to use.



NA2 field of view with metric levelling staff
Reading at horizontal hair: 1.143 m

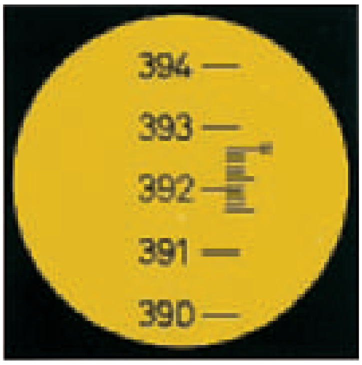
At an advantage on unstable ground

If a tubular level is used on unstable ground it tilts out of range and has to be continuously reset. By contrast, the pendulum of the NA2 "compensates" and keeps the line of sight horizontal.

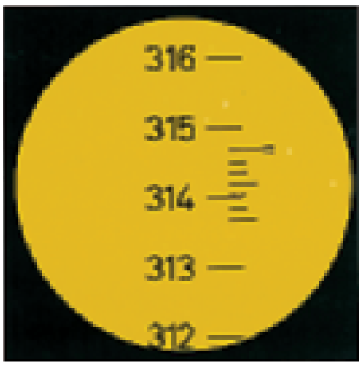
Angle measurement with the NAK2

Civil engineers and contractors often require a circle for angle measurement and setting-out work. Even simple detail surveys, by taking angle, distance and height, and plotting with the polar method, can be done with a level.

The model NAK2 has an internal glass circle which is read via a scale microscope and which can be set to any value by turning the rim around the base of the instrument.



NAK2
circle reading (400 gon)
392.66 gon



NAK2
circle reading (360°)
314°42'

High-performance accessories for precise levelling

GPM3 parallel-plate micrometer

This optional accessory slips over the telescope objective and blends perfectly with the smooth lines of the NA2. With a compensator setting accuracy of ±0.3“ (equivalent to 0.01 mm in 10 m) and a micrometer reading to 0.1 mm direct and 0.01 mm by estimation, the NA2 with GPM3 is an ideal combination for precise levelling, deformation studies, and even optical tooling. The micrometer drive for raising and lowering the line of sight is conveniently located and readings are taken on a glass scale viewed through an eyepiece just above the telescope eyepiece. This optical reading system, which is digital apart from the last and estimated figure in the metric and inch versions, is superior to the usual metal drum system.

GPM6 parallel-plate micrometer

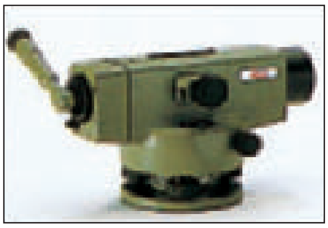
There are tasks for which a micrometer is needed, yet for which the very high accuracy of the GPM3 is not essential.

To meet this requirement, a simpler micrometer attachment, the GPM6 with drum reading, is available for the NA2.

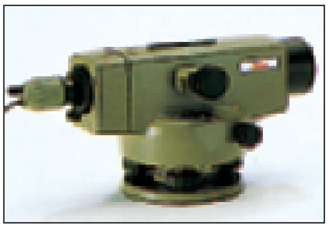
The GPM6 fits on to the telescope objective in the same manner as the GPM3, but the graduation is engraved on a metal drum.

Eyepiece accessories for specialized tasks

Because of the bayonet fastening of the interchangeable eyepiece, all theodolite eyepiece accessories can be used with the NA2.



- Diagonal eyepiece for observing from above, below, and from the side; useful in cramped spaces



- Eyepiece lamp for converting the NA2 into a horizontal collimator for laboratory work

- Autocollimation eyepiece for setting machine parts and instrument components precisely vertical

Compact

The rugged NA2 is indifferent to weather conditions and is extremely reliable in the rough world of the building site. The pendulum compensator is protected against knocks and shocks. There is a highly-effective vibration-damping mechanism.

Precise

The high setting accuracy ensures that the line of sight stays put. The attachable parallel-plate micrometer renders the NA2 ideal for precise fine levelling.

Reliable, automatic, maintenance-free

The instantaneous check facility with the push-button control not only makes work easier; it also promotes confidence.

Easy handling

The convenient, well-arranged controls are designed for maximum convenience. The bilateral, endless horizontal drive promotes rapid fine-pointing.

Quick levelling-up

The instrument is quickly set up with the three rapid-action footscrews. Their self-adjusting threads make subsequent resetting unnecessary.

Superb telescope

Telescope with excellently-corrected optics for bright, high-contrast images.
All optical components are coated on both sides.

Effortless focusing

The erect image seen down the telescope is quickly and accurately brought into focus with the convenient rapid and fine focusing knob.

Abundant accessories; many applications

Additional items such as the parallel-plate micrometer, the laser eyepiece, or theodolite eyepiece accessories, offer almost unlimited possibilities.

LEICA NA2 · NAK2
Proven reliability ensures precise results

Versatile accessories for demonstrable success

A comprehensive program of accessories enables you to expand the performance and applications range of each instrument. This way, you can match your equipment exactly to requirements.

The possibilities are described in brochure "Survey accessories" 710 883en.

Robust container for safe transport

The NA2 is supplied in a foam-padded container made of high performance synthetic material. The foam padding absorbs all jolts and shocks. The container provides perfect protection for the NA2.

Technical data

Standard deviation for 1 km double-run levelling, depending on type of staff and on procedure	up to 0.7 mm
With parallel-plate micrometer	0.3 mm
Telescope	erect image
Standard eyepiece	32×
FOK73 eyepiece (optional)	40×
FOK117 (optional)	25×
Clear objective aperture	45 mm
Field of view at 100 m	2.2 m
Shortest focusing distance	1.6 m
Multiplication factor	100
Additive constant	0
Working range of compensator	~30′
Setting accuracy of compensator (stand. dev.)	0.3"
Sensitivity of circular level	8′/2 mm
Glass circle (K version)	400 gon (360°)
Graduation diameter	70 mm
Graduation interval	1 gon (1°)
Reading by estimation to	10 mgon (1′)
Water- and dust resistance	IP53
Temperature range:	
Operation	–20°C to +50°C (– 4°F to 122°F)
Storage	–40°C to +70°C (–40°F to 158°F)

Parallel-plate micrometer (optional accessory)	Range	Interval	Estimation
GPM3, with glass scale	10 mm	0.1 mm	0.01 mm
GPM6, with metal drum	10 mm	0.2 mm	0.05 mm

TQM ISO 9001 / ISO 14001

Total Quality Management – Our commitment to total customer satisfaction

Ask your local Leica Geosystems agent for more information about our TQM program.

710 837en – V.03 – RDV

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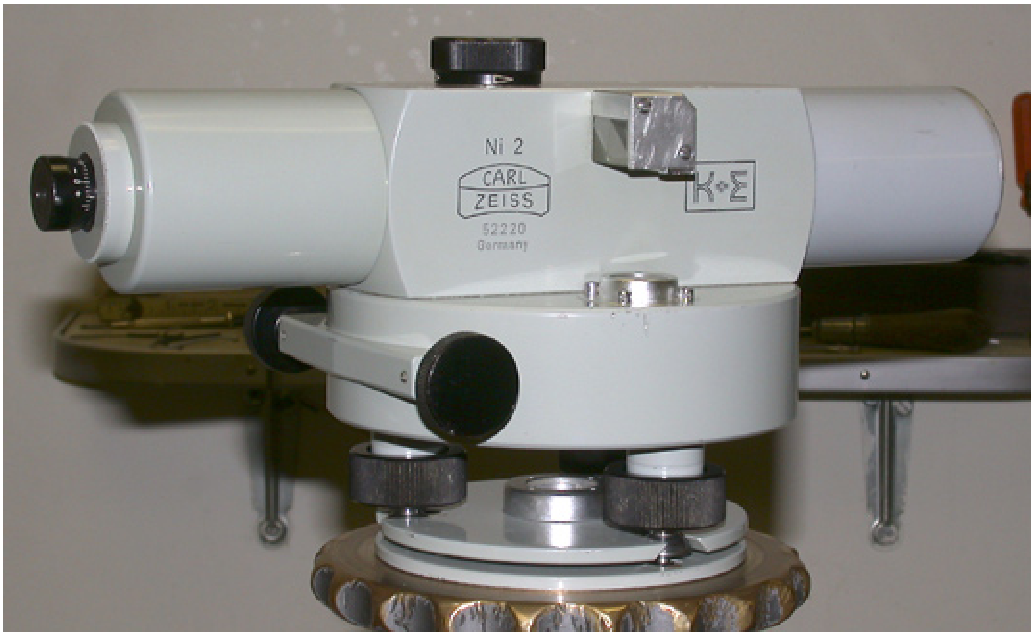
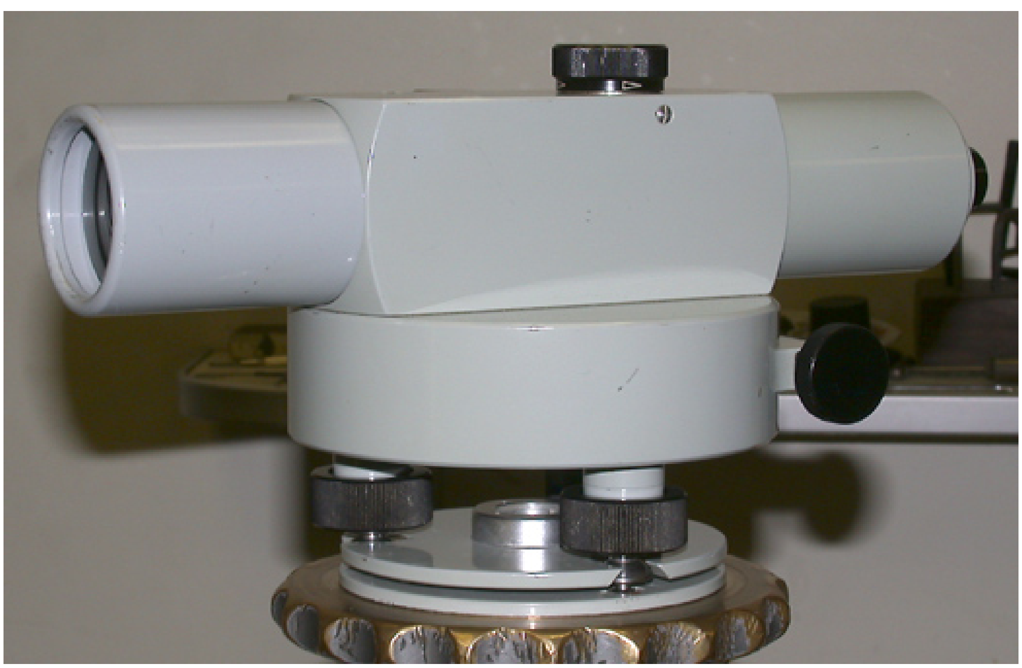
Carl Zeiss NI-2 Level





Contents

Optical Data

Telescope with Zeiss T-coating

Magnification	32 ×
Aperture	1 58 in (40 mm)
Shortest sighting distance	11 ft (3 3 m)
Field of view	23 ft at 1000 ft

Estimation of 1/1000 ft. on 1/100 ft. graduation up to 120 ft (1 mm on a 1 cm graduation up to 120 m)

Circular Level

Sensitivity	15 per 2 mm

Circle (on request)

Material	Glass
Diameter	2 95 in (75 mm)
Graduation	360° or 400^g
Graduation interval	1° or 1^g

Readings through reading microscope

Magnification	17 ×
Scale interval	10 or $0\,1^g$
Estimation to	1 or $0\,01^g$

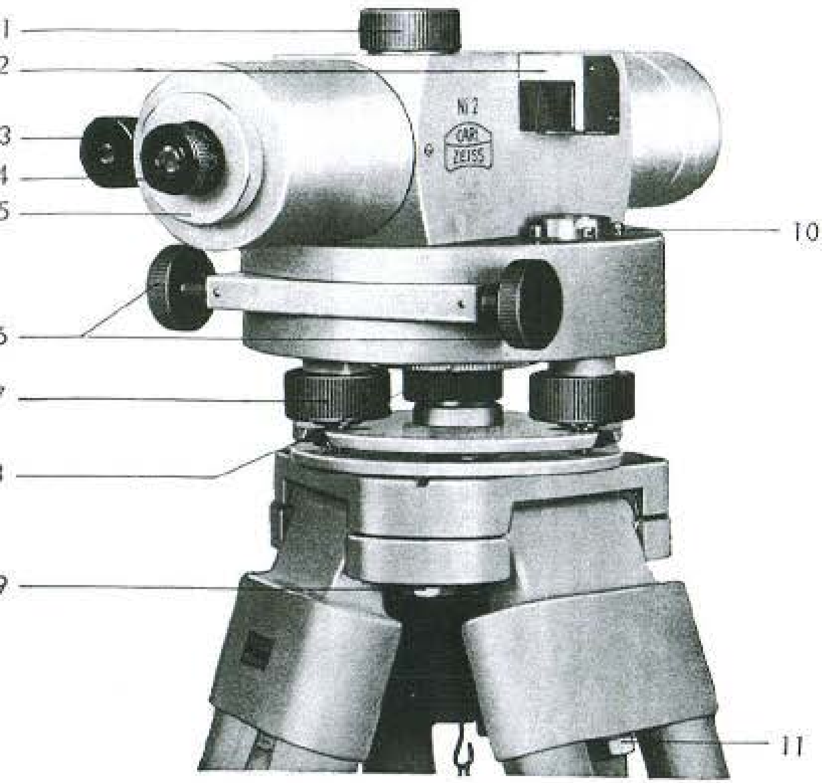


Fig. 1 Ni 2 with horizontal circle

(about 1/3 natural size)

1 Focus control with quick-fine movement
2 Viewing prism for circular level
3 Eyepiece of reading microscope for circle
4 Telescope eyepiece with dioptre scale
5 Screw cover over reticle adjusting screw
6 Lateral fine movement controls
7 Leveling screw
8 Knurled setting ring for circle orientation
9 Adjusting screw for tripod hinges
10 Adjusting screws for circular level
11 Clamping screw for tripod leg fitting

Mechanical Data

Dimensions:

Length of telescope	10.6 in. (27 cm.)
Height of instrument	5.1 in. (13 cm.)
Diameter of base	5.1 in. (13 cm.)
External dimensions of case	13×6.9×6.1 in. (33×17.5×15.6 cm.)
S 3 tripod extending from	3 ft. 5 in. to 5 ft. 7 in. (approx.) (102–170 cm.)
S 2 tripod extending from	3 ft. 5 in. to 5 ft. 7 in. (approx.) (102–170 cm.)

Weights:

Ni 2 without circle	4.6 lbs. (2.1 kg.)
Ni 2 with circle	5.3 lbs. (2.4 kg.)
Case for Ni 2 without circle	6.4 lbs. (2.9 kg.)
Case for Ni 2 with circle, with plumb bob	6.6 lbs. (3.0 kg.)
Parallel plate micrometer in leather case	1.3 lbs. (0.6 kg.)
Torch with supports	0.7 lbs. (0.3 kg.)
Leather case for torch	1.7 lbs. (0.7 kg.)
S 3 tripod	11.6 lbs. (5.3 kg.)
S 2 tripod	13.6 lbs. (6.2 kg.)
Leveling staff (03) 4 m. folding to 2 m.	12 lbs. (5.5 kg.)
Leveling staff (05) 3 m. folding to 1.5 m.	6.4 lbs. (2.9 kg.)
Invar staff (06) 3 m., rigid	9 lbs. (4.0 kg.)
"Scotch light" staves, additional weight	0.45 lbs. (0.2 kg.)

01 Tripod leg
only, not n
stiffness o
(1 m.) apar
tips moder

02 Lift instrum
secure tigh

03 Center circ
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the eyepiec

Caution: D
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of the cont

04 Aim telesc
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05 For fine se
the fine mo

06 Focus for
focus cont
matically in

07 Read staff
necessary
slightly tap
movement

ng for

or tripod

for circular

or tripod

Mechanical Data

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S 3 tripod	11.6 lbs. (5.3 kg.)
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Leveling staff (03) 4 m. folding to 2 m.	12 lbs. (5.5 kg.)
Leveling staff (05) 3 m. folding to 1.5 m.	6.4 lbs. (2.9 kg.)
Invar staff (06) 3 m., rigid	9 lbs. (4.0 kg.)
"Scotch light" staves, additional weight	0.45 lbs. (0.2 kg.)

Setting up, Reading

01 Tripod legs should be extended to a convenient height only, not necessarily to their maximum; observe correct stiffness of joints (see No. 43); spread legs about 3 ft. (1 m.) apart; level tripod head to eyesight; tread tripod tips moderately into ground.

02 Lift instrument slightly to find thread for center screw and secure tightly.

03 Center circular level with leveling screws. Focus cross-hairs on a bright background by turning the milled ring of the eyepiece (4, fig. 1).

Caution: Do not store wet instrument in the container over an extended period of time. Instrument should be dried with a cloth on the outside as soon as possible and allowed to get completely dry overnight (to be taken out of the container for that purpose).

04 Aim telescope roughly onto target by viewing along one edge of the telescope housing.

05 For fine setting observe through telescope and use one of the fine movement screws (6).

06 Focus for a parallax-free staff image with dual speed focus control (1). Reversing the sense of rotation automatically introduces a slow motion (range: ¼ turn).

07 Read staff graduation against horizontal crosshairs (if necessary also stadia lines, fig. 2). As a checking measure slightly tap the telescope with a pencil or operate the fine movement screw jerkily to and fro. After a small oscillat-

Positioning Data Link™

PDL™

High Performance Data Link

Designed for Survey Systems

19,200 Baud Rate
Higher Over-the-Air Link Rate
Extends Your Battery Life

Enhanced User Interface
Change Channels in the Field
View Status Information

Compatible with GPS RTK Equipment Worldwide
Complete Kit Solutions Available
for Your Application

Reliable
Rugged, All Season Operation

2 Year Warranty
Lower Cost of Ownership

Surveyors utilizing Global Positioning Systems require a rugged radio modem data link for precise positioning information. The PDL is compact and lightweight and offers power efficient operation. It is easy to use, and provides high performance and rugged dependability for the toughest survey environments.

PDL Products are designed to easily mount on all standard tripods and range poles. Complete kit solutions are available.

PACIFIC CREST
CORPORATION

Positioning Data Link™

<table>
<tr><th></th><th>High Power Base</th><th>Low Power Base</th><th>Rover</th></tr>
<tr><td colspan="4">General Specifications</td></tr>
<tr><td>DTE – DCE Interface</td><td colspan="3">3 Wire, RS-232, 38.4k Baud Maximum.</td></tr>
<tr><td>User Interface</td><td>On/Off Button.
Channel Button with AutoBase™ and AutoRover.™
Digital Display.
Modem/Power Status Indicators.
RF Power Select Toggle Switch.</td><td>On/Off Button.
Channel Button with AutoBase™ and AutoRover.™
Digital Display.
Modem/Power Status Indicators.</td><td>On/Off Button.
Channel Button with AutoBase™ and AutoRover.™
Digital Display.
Modem/Power Status Indicators.</td></tr>
<tr><td colspan="4">Power</td></tr>
<tr><td>External</td><td colspan="3">9 – 16 VDC.</td></tr>
<tr><td>Internal Battery</td><td>N/A</td><td>N/A.</td><td>Lithium Ion Battery Pack.</td></tr>
<tr><td>During TX (nominal)</td><td>110 Watts.</td><td>11 Watts.</td><td>N/A.</td></tr>
<tr><td>During RX (nominal)</td><td>1.9 Watts.</td><td>0.9 Watts.</td><td>0.3 Watts.</td></tr>
<tr><td colspan="4">Antenna</td></tr>
<tr><td>External</td><td>50 Ohm, BNC.</td><td>50 Ohm, NMO.</td><td>50 Ohm, NMO.</td></tr>
<tr><td colspan="4">Modem Specifications</td></tr>
<tr><td>Link Rate/Modulation</td><td colspan="3">19,200 bps/4 Level FSK.
9600 bps/4 Level FSK.
9600 bps/GMSK.
4800 bps/GMSK.</td></tr>
<tr><td>Link Protocols</td><td>Transparent, Packet Switched, Digipeater, TRIMTALK.™</td><td>Transparent, Packet Switched, Digipeater, TRIMTALK.™</td><td>Transparent, Packet Switched, TRIMTALK.™</td></tr>
<tr><td>Forward Error Correction</td><td colspan="3">Hamming Code (12, 8) with Data Interleaving.</td></tr>
<tr><td colspan="4">Radio Specifications</td></tr>
<tr><td>Frequency Bands</td><td colspan="3">Refer to price list for available frequency bands.</td></tr>
<tr><td>Frequency Control</td><td colspan="3">Synthesized 12.5k Hertz Resolution.
±2.5 ppm Stability.</td></tr>
<tr><td>RF Power Select</td><td>Low/High. Factory Programmable.</td><td>N/A.</td><td></td></tr>
<tr><td>RF Transmitter Output</td><td>3/35 Watts Maximum.</td><td>0.5 – 2 Watts.</td><td>0 Watt (Receive Only).</td></tr>
<tr><td>Sensitivity</td><td colspan="3">-116 dBm (12 dB SINAD).</td></tr>
<tr><td>Adjacent Channel Selectivity</td><td>>-60 dB.</td><td>>-70 dB at 9600 bps/GMSK.
>-60 dB at 19,000 bps/4 Level FSK.</td><td>>-60 dB.</td></tr>
<tr><td>Type Certification</td><td colspan="3">All models are type accepted and certified for operation in the U.S. and Canada.
For detailed information concerning your country's type certification, please contact your sales representative.</td></tr>
<tr><td colspan="4">Environmental Specifications</td></tr>
<tr><td>Operating Temperature</td><td colspan="2">-22° to +140° F (-30° to +60° C).</td><td>-4° to +140° F (-20° to +85° C).</td></tr>
<tr><td>Storage Temperature</td><td colspan="2">-67° to +185° F (-55° to +85° C).</td><td>-4° to +185° F (-20° to +85° C).</td></tr>
<tr><td>Vibration/Shock</td><td colspan="3">ANSI/ASAE EP455.</td></tr>
<tr><td>Enclosure</td><td colspan="3">IEC 60529 I.P. 66.
Water Tight and Dust Proof.</td></tr>
<tr><td colspan="4">Mechanical Specifications</td></tr>
<tr><td>Dimensions</td><td>6.23" W x 2.77" H x 6.58" L.</td><td>8.25" L x 2.40" Diameter.</td><td>8.25" L x 2.40" Diameter.</td></tr>
<tr><td></td><td>(15.8 cm W x 7.0 cm H x 16.7 cm L).</td><td>(21.0 cm L x 6.1 cm Diameter).</td><td>(21.0 cm L x 6.1 cm Diameter).</td></tr>
<tr><td>Weight</td><td>2.96 lbs. (1.34 Kg).</td><td>0.65 lbs. (0.30 Kg).</td><td>0.75 lbs. (0.34 Kg).</td></tr>
<tr><td>Data/Power Connector</td><td>5 Pin LEMO #1 Shell.</td><td>5 Pin LEMO #0 Shell.</td><td>5 Pin LEMO #0 Shell.</td></tr>
<tr><td>Mount</td><td>Tripod Bracket.</td><td>5/8" – 11 Range Pole.</td><td>5/8" – 11 Range Pole.</td></tr>
</table>

PACIFIC CREST CORPORATION

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Web: www.paccrst.com, E-mail: sales@paccrst.com

INSTANT-RTK TECHNOLOGY

Z-Xtreme Survey System

Z-Xtreme

The Ashtech® Z-Xtreme™ from Thales Navigation professional products is a rugged, weather-proof, dual-frequency GPS receiver designed to provide surveyors with cost-effective, centimeter-accurate positions in a variety of system configurations.

The Z-Xtreme receiver begins with state-of-the-art satellite electronics coupled with patented Z-Tracking™ to deliver the highest GPS signal reception level. A removable battery and flash memory card provide enough capacity to last all day for maximum utility. Components are completely integrated inside a weather-proof, high impact plastic housing, ensuring your investment is safe, rain or shine. Use the easy-to-operate interface on the front panel for important functions such as site information entry, survey status, and set-up of RTK base stations without the additional cost of a handheld controller. The result: Z-Xtreme with Instant-RTK® outperforms all other receivers in its class!

ZX-Solutions

The Z-Xtreme survey system from Thales Navigation provides a range of solutions designed for the vast array of positioning needs – from entry level static or kinematic post-processed surveys, all the way up to real-time functions such as stake out. The entry level ZX-Solutions™ system dramatically increases your productivity for control surveys and other post-processed applications. Add an optional kinematic kit to make topographic feature collection more cost effective. Use Ashtech Solutions™ software to easily process the field data, export results and generate reports. Purchase only what you need for the job at hand because ZX-Solutions is fully upgradeable.

ZX-SuperStation

Eclipse the productivity of optical instrument stake out with a ZX-SuperStation™. The ZX-SuperStation is a field-to-finish GPS surveying system that combines the Z-Xtreme receiver with a powerful data collector and wireless modems for centimeter accuracy in real-time. Instant-RTK gives you the ability to initialize the centimeter solution in a fraction of the time of conventional RTK systems. Powerful data collection software gives you the ability to efficiently perform GPS surveying techniques and to interface seamlessly with optical total stations.

TECHNICAL SPECIFICATIONS

Ashtech Technology

- 12 channel all-in-view operation
- Full-wavelength carrier on L1 and L2
- Z-Tracking
- Multipath mitigation
- Dual-frequency smoothing for improved code differential
- Instant-RTK

Performance Figures[1]

Static, Rapid Static
- Horizontal: 0.005 m + 1 ppm (0.016ft+1ppm)
- Vertical: 0.010 m + 1 ppm (0.033ft + 1ppm)

Post-Processed Kinematic
- Horizontal: 0.010 m + 1 ppm (0.033ft + 1ppm)
- Vertical: 0.020 m + 1 ppm (0.065ft+1ppm)

Real-Time Code Differential Position
- <1 m (3.28 ft)

Real-Time Z Kinematic Position (Fine Mode)
- Horizontal: 0.010 m + 2 ppm (0.033ft + 2 ppm)
- Vertical: 0.020 m + 2 ppm (0.065ft + 2 ppm)
- Azimuth (arc sec): 0.4 + 2.0/baseline (km)

RTK Occupation Time
- 2 seconds (typical - sub-centimeter accuracy with longer occupation time)

Instant-RTK Initialization
- 99.9% reliability
- Typically <2 seconds with 6 or more satellites, PDOP <5, baseline length <7 km (4.35 mi), open sky and low multipath conditions

RTK Operating Range
- Recommended: 10 km (6.21 mi)
- Maximum: 40 km (24.85 mi)

Standard Features

- 16 MB PCMCIA removable memory card
- NMEA 0183 output
- Selectable update rate from 999 sec to 10 Hz
- Event marker
- Point positioning
- 1 PPS timing signal
- Session programming
- Wide array of coordinate transformations
- Removable internal battery
- 8-character alphanumeric LED display with 4-button interface
- 3 function LED display - Radio,Memory, Satellites/Power
- Multi-function audible alarm
- Quick reference card holder
- External mount capabilities
- External power input
- 4 RS-232 ports (115200 baud max, 3 external, 1 internal)
- 1-year warranty
- Free factory technical support

Standard Accessories

- Communications software
- Padded system bag and hard case
- RS-232 data cable
- Receiver operating manual
- Quick reference field card

Technical Data

Environmental

Z-Xtreme Receiver
- Meets MIL-STD 810E for wind driven rain and dust
- Operating temperature: -30° to +55°C (-22° to 131°F)
- Storage temperature: -40° to +85°C (-40° to 185°F)

Geodetic 4 Antenna
- Meets IPX7 specifications for submersion
- Operating temperature: -55 to +75°C (-40° to 149°F)
- Storage temperature: -55° to +75°C (-67° to 167°F)

Physical

Weight
- Receiver: 1.59 kg (3.50 lb)
- Antenna: 0.82 kg (1.81 lb)
- Battery: 0.43 kg (0.95 lb)

Dimensions
- 76.2 H x 196.85 W x 222.25 D mm
- (0.25 H x 0.646 W x 0.729 D ft)

Power
- 10 - 28 VDC, 6.0 W

Internal battery
- Capacity: 6000 mAh
- >9 hours (typical) @ 25°C (77°F)
- Operating temperature: -30° to +55°C (-22° to 131°F)
- Storage temperature: -40 to +60°C (-40° to + 140°F)

PC card
- ATA Type II PCMCIA memory card (16 MB standard)
- Temperature range: -40° to +85°C (-40° to 185°F)
- Data capacity: 4500 epochs per 2 MB*

** Based on one session, eight satellites' data and full measurements. This number can vary significantly depending on the conditions of the session.*

Optional Features

- Real-time kinematic (base and rover modes) for cm-accuracy
- RTCM 2.2 (Types 1, 2, 3, 9, 16, 18, 19, 20, 21, 22)
- Internal UHF or spread spectrum radio for RTK rover operations
- External UHF or spread spectrum radio for RTK base and rover operations
- Geodetic 4 antenna ground plane kit
- Kinematic antenna kit
- Aircraft antenna kit
- AC power cable
- Choke ring antenna
- Long haul backpack kit
- All-on-a-pole kit

Optional Application Software

GPS data processing
- Ashtech Solutions

Land Surveying and Construction
- TDS Survey Pro
- Carlson SurvCE
- Ashtech Survey Control II
- Ashtech GPS Fieldmate

Mining and Land Seismic
- Ashtech Mine Surveyor II
- Ashtech Seismark II

1 Specifications assume operation follows all the procedures recommended in the product manual utilizing Instant-RTK, post processing with Ashtech Solutions or Ashtech Office Suite for Survey. High-multipath areas, high PDOP values, low satellite visibility, and periods of adverse atmospheric conditions and/or other adverse circumstances will degrade system performance. All accuracy specifications are RMS values.

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Web site www.thalesnavigation.com

Thales Navigation follows a policy of continuous product improvement; specifications and descriptions are thus subject to change without notice. Please contact Thales Navigation for the latest product information.

THALES NAVIGATION

Nikon

TOP GUN®

DTM-310

ELECTRONIC TOTAL STATION

Valuable functions, superior cost-performance, longer battery life and enhanced software

Nikon has just taken the world-renowned Top Gun® DTM-300 total station to a whole new level. The new Top Gun® DTM-310's enhanced keyboard and on-board software enable easy code input in both alphabet and numbers, the way you've always wanted. It builds on existing features — such as the large four-line LCD and full numeric key pad — to improve overall convenience. And software upgrades make it easier to search and display data. In fact, the Top Gun® DTM-310 provides customers in any field — from civil construction to cadastral surveying and mapping — with greater ease of operation.

ENHANCED BASIC FUNCTIONS

- Large four-line display with full alphanumeric input on both faces
- Meets basic requirements for distance and angle measurement
- Resume function for quick startup and power management
- Enhanced, powerful built-in programs
- 500-point on-board data storage function
- 7.3 hours continuous measuring with one on-board battery
- Compact and lightweight
- Quick access to the 20 most recently stored codes

CONVENIENT ALPHANUMERIC INPUT

The inclusion of alphabetic input enables you to store codes in a combination of letters and numerals. Codes, target heights (HT) and point numbers are easily input for each new measurement. And codes can also be selected from the most recent 20 codes stored in the memory, eliminating the need to repeatedly input the same codes.

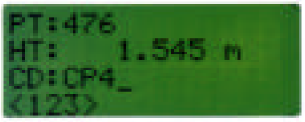
■ KEY DESCRIPTIONS

MSR: Distance measurement in normal measurement mode
DSP: Selects display item by scrolling display
TRK: Distance measurement in high-speed measurement mode
ANG: Horizontal angle zero-set, user-defined angle input or hold
XYZ: Coordinate measurement
RDM: Remote distance measurement (continuous or radial)
REM: Remote elevation measurement
STN: Station setup (known point, 2-point resection or 3-point resection)
S-O: Stakeout by inputting angle distance or coordinates
Illumination: Display illumination
REC: Data record to internal memory
ENT: Data entry or sending observation data to communication port in normal observation mode
FNC: Input of temperature and barometric pressure, prism constant, and height of target; simple COGO calculation; settings; view/edit stored data; communication (internal memory); vertical collimation correction

Enhanced, Powerful Built-in Programs

On-board data storage function

The DTM-310 memory stores up to 500 raw or coordinate records. Coordinate data can be manually input, measured or



uploaded from a PC. (Contact your Nikon distributor for download/upload and format conversion software.) Data can be instantly recalled and reviewed for station setup, stakeout and COGO.

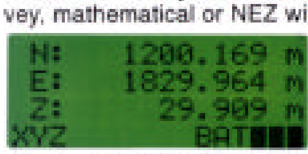
Station setup

For station setups, in addition to the known station setup obtained by inputting the coordinate of backsight or direction angles, a more simplified default station setup is also possible. This can be obtained by setting the station point coordinates at zero

while maintaining the prior orientation intact. Two- and three-point resections are also available. In the case of a three-point resection, it is possible to transfer the elevation from a bench mark.

XYZ coordinate measurement

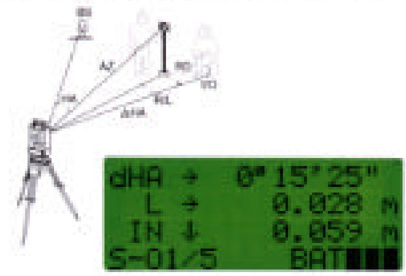
The coordinate system can be set to survey, mathematical or NEZ with indepen-



dent coordinate order settings. Azimuth zero-direction can be set to either north or south. Coordinate calculations are based on these settings. Point name, number, code and coordinate data can be stored in the data file. The target height can be changed at any time by pressing the FNC key.

Stakeout

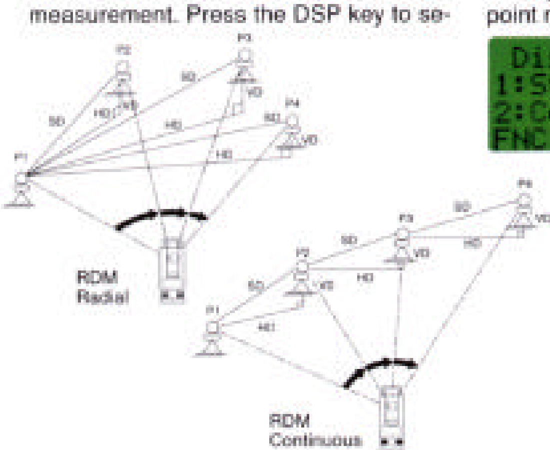
Lets you perform stakeouts by inputting angle and distances, or coordinates. Co-



ordinates can be searched and retrieved from the built-in memory. Zero-direction countdown and delta displays (Left/Right, In/Out, Cut/Fill) make for fast and simple stakeouts. Stakeout data can be also recorded in the internal memory.

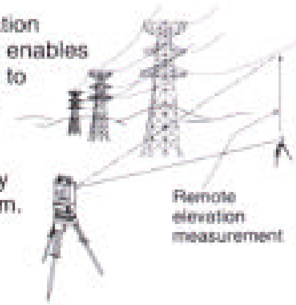
RDM

For continuous or radial remote distance measurement. Press the DSP key to select slope distance, elevation difference, horizontal distance, grade, legal grade ratio between two points, or azimuth from first to second points.



REM

Remote elevation measurement enables measurement to points (e.g., a power pole) where you cannot directly place the prism.

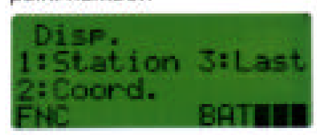


COGO calculation

Enables point-to-point inverse calculations, plus azimuth and distance calculations. Coordinates can be searched and retrieved from the on-board memory, and calculated coordinates can be saved.

Data display

The DTM-310 enables you to search data by tracing back from the most recent record, from specific station points, or from a simple point number.



7.3 Hours Continuous Operating Time

Internal battery BC-60 provides about 7.3 hours (with full charge, at 20°C, for distance/angle measurements) of continuous operation. The remaining battery power is indicated by the LCD. As Ni-MH battery BC-60 contains no harmful substance, recycling is not necessary. Quick recharge can be performed in about 2 hours with standard battery charger Q-70U/Q-70E. The Q-70U/Q-70E's discharging function preserves the batteries' minimum power and protects against deterioration.

Resume Function

This resume function can automatically revert to the orientation prior to power OFF, or automatically display the previous horizontal angle. It guarantees the safety of all previous data settings.

Basic Measurement Functions

- Built-in Automatic Vertical Compensation
- Vertical Angle Zero-Degree Set Handled in Three Modes
- Grade Display
- With Triple Prism, to 1.2km or 3,900 feet (under good conditions)
- ±(5 + 3ppm x D)mm Precision
- Automatic Environmental Compensation
- Selectable Angle Reading of 5/10", 0.5/1mgon, 0.02/0.05MIL
- Angle Measurement Accuracy of 5"/1.6mgon/ 0.02MIL (standard deviation based on DIN18723)

Standard Package

- DTM-310 main unit
- On-board battery BC-60
- Battery charger Q-70U/Q-70E
- Lens cap
- Plumb bob
- Tool set
- Plastic case
- Vinyl cover
- Instruction manual

Optional Accessories

- Diagonal eyepiece prism
- High-power (32x) and low-power (16x) eyepiece lenses
- Compass (tubular type) and compass adapter
- Zenith prism
- Solar filter
- Solar reticle
- External battery B4

On-board battery BC-60 and battery charger Q-70U/Q-70E

Specifications

Telescope	
Tube length	150mm/5.9 in.
Effective diameter of objective	36mm/1.41 in. (EDM aperture 40mm/1.57 in.)
Magnification	26x (standard)
Field of view	1°30'
Resolving power	3.5"
Minimum focusing distance	1.0m/3.3 ft.
Angle measurement	
Reading system	Incremental encoder
Unit of reading	Degree/Gon/6400MIL
Least count (selectable)	
(360°)	5" or 10"
(400G)	0.5mgon or 1mgon
(6400MIL)	0.02MIL or 0.05MIL
Accuracy (Standard deviation based on DIN 18723)	5"/1.6mgon/0.02MIL
Tilt sensor (Automatic Vertical Compensator)	Liquid type
Working range	±3'
Distance measurement	
Range (with Nikon prism)	
(Normal conditions: ordinary haze, visibility 20km/12.5 miles)	
with mini prism	380m/1,300 ft.
with single prism	800m/2,600 ft.
with triple prism	1,100m/3,700 ft.
(Good conditions: no haze, visibility 40km/25 miles)	
with mini prism	450m/1,500 ft.
with single prism	1,000m/3,300 ft.
with triple prism	1,200m/3,900 ft.
Accuracy	±(5 + 3ppm x D)mm, –10°C to +40°C/+14°F to +104°F ±(5 + 5ppm x D)mm, –20°C to +50°C/–4°F to +122°F
Maximum measurement display	1,230m/4,000 ft.
Least count	
Standard MSR mode	1mm/0.005 ft.
Tracking mode	10mm/0.05 ft.
Measuring intervals	
Standard MSR mode	4 sec.
Tracking mode	1.2 sec.
Measuring mode	Continuous/Single/Average (2 - 99)
Ambient temperature range	–20°C to +50°C (–4°F to +122°F)
Atmospheric correction range	
Temperature range	–40°C to +60°C (–40°F to +140°F)
Pressure range	400 to 999mmHg (1mmHg step) 15.8 to 39.3 in.Hg (0.1 in.Hg step) 533 to 1,332hPa (1hPa step)
Display	Dot-matrix LCD 16 characters x 4 lines
Level vial	
Sensitivity of plate level vial	30"/2mm
Sensitivity of circular level vial	10'/2mm
Leveling base	
Tribrach	Detachable
Optical plummet	
Image	Erect
Magnification	3x
Field of view	5°
Focusing range	0.5m/1.6 ft. to ∞
Power sources	
Type	Ni-MH 7.2V DC
Continuous operating time	7.3 hrs. or 8,760 measurements (for distance/angle measurement) 22 hrs. (for angle measurement only)
Quick battery charger (Q-70U/Q-70E)	
Input voltage	115V for Q-70U, 220/240V for Q-70E
Recharging time	1.5 hrs.
Dimensions (W x D x H)	
Main unit (with carrying handle)	164 x 177 x 335mm/6.5 x 7.0 x 13.2 in.
Weight	
Main unit w/battery	5.5kg/12.1 lbs.
Battery BC-60	0.5kg/1.1 lbs.
Carrying case	2.5kg/5.5 lbs.

These products (DTM-310 and battery charger Q-70U/E) are strategic products subject to Japanese/International export control regime. They should not be exported without authorization from the appropriate governmental authorities.

Specifications and equipment are subject to change without any notice or obligation on the part of the manufacturer. February 1997

ISO 9001 Certified

BVQI ISO 9001 Certificate No. 20242

NIKON CORPORATION Instruments Division Yokohama Plant

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V. SPECIFICATIONS

1. Main Unit

● Telescope

Image	: Erect/unreversed
Magnification	: 26×
Effective diameter of objective	: 36mm
Field of view	: 1°30′
Minimum focusing distance	: 1.0m
Resolving power	: 3.5″

● Distance Measurement

Distance range of Nikon prisms	: 450m with mini prism 1000m with single prism 1200m or longer with triple prism *With visibility 40km (25miles)
Precision	: $\pm(5mm + 3ppm \times D)$ *With accurate measurement mode, at $-10°C \sim +40°C / +14°F \sim +104°F$ D is measuring distance, mm unit $\pm(5mm + 5ppm \times D)$ at $-20°C \leqq t < -10°C / -4°F \leqq t < +14°F$ and $+40°C < t \leqq 50°C / +104°F < t \leqq +122°F$
Measuring time response	: [MSR] mode: About 4sec. (initial: about 5sec.) [TRK] mode (cm): About 1.2sec (initial: about 2.2sec.)
Least count	: 1mm
Display	: Up to 1230m
Display unit	: m/ft-INT/ft-US

● Angle Measurement

Accuracy	: 5″ (Standard deviation based on DIN 18723)
Reading system	: Photoelectric detection by incremental encoder single-sided reading
Display unit	: Degree/Gon/MIL

● Automatic Vertical Compensator

System	: Liquid-electric detection
Working range	: ±3′

● Optical plummet

Image	: Erect
Magnification	: 3×
Field of view	: 5°
Focusing range	: 0.5m～∞

● Clamps/tangent screws : Coaxial dual speed tangents

● Sensitivity of level vials

Plate level vial	: 30″/2mm
Circular level vial	: 10′/2mm

● Tribrach : Detachable

● Dimensions and weight

Main body	: 5.5kg (12lbs) including BC-6 battery pack
Case	: About 3.5kg (7.6lbs)

● Operating temperature range: −20°C～50°C/−4°F～+122°F

SURVEYING INSTRUMENTS

SOKKIA

SET5F

Version 01-00

TOTAL STATION

Enhanced software with 3,000-point data memory.

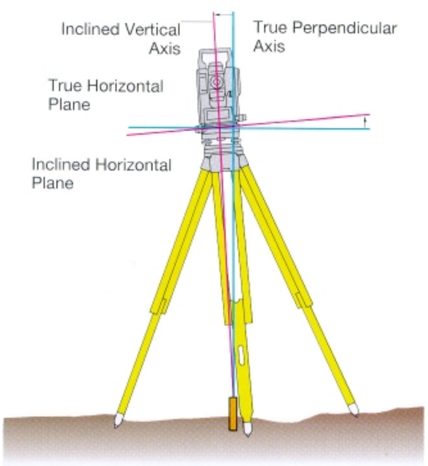
Flexible, Friendly and Featherweight

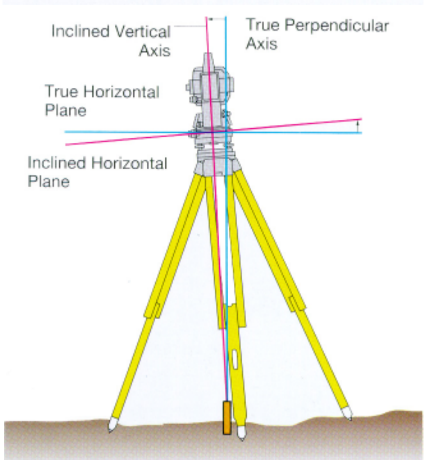
The SET5F's powerful EDM, dependable dual-axis compensator and 3,000-point data memory are conveniently packaged in a compact, lightweight body. Software [Version 01-00) has been enhanced for more effective survey work, and "softkey" assignments can be freely customized to suit all user needs.

Dependable Hardware

Proven Dual-axis Compensator

•Since its introduction with the Series C total station in 1989, Sokkia's dual-axis compensator has proven its reliability and accuracy at survey sites all over the world.
•The dual-axis tilt sensor monitors deviations of both the X and Y axes and the correct horizontal and vertical angle readings are automatically computed and applied. The result is easier and faster instrument leveling.





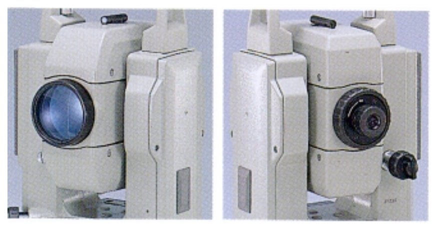
The High-performing EDM

•1,500m/4,900ft range with a single prism under good ambient conditions (40km/ 25miles visibility, with no haze, overcast, no scintillation).
•Outstanding precision; ±(3+2ppmxD)mm. This corresponds to a deviation of a mere ±3.2mm at a distance of 100m and ±5mm at 1,000m.
•Supreme speed; only 1.7 seconds initial measuring time in the rapid measurement mode.

	Average Conditions	Good Conditions
CP01 Compact Prism	700 m/2,300 ft.	
One AP01 Prism	1,200 m/3,900 ft.	1,500 m 4,900 ft.
Three AP01 Prisms	1,600 m/5,200 ft.	2,000 m 6,500 ft.

Powerful Telescope

•Highest magnification in its class: 30x
•Easy, accurate sighting of prisms or targets



Outstanding Mobility

•Total carrying weight (including instrument, tribrach, battery and hard case) is a mere 8 kg/18 lbs. The secret lies in the lightest and most compact carrying case of its kind (W390 x D255 x H220mm / W15.3 x D10.0 x H8.6in.), making the SET5F supremely portable.
•A convenient shoulder strap is provided as standard. An optional back pack (SC94) is ideal for longer day treks.

Enhanced Software

The SET5F can be easily customized to your preferred key assignments.

•The SET5F offers optimum keyboard flexibility. Any keyboard layout can be configured. For example, functions can be assigned to any key position on any page, and unused functions can be temporarily deleted.
•A powerful "softkey" feature facilitates input of coordinate values, feature codes, etc.

Key assignment mode

Spacious 3,000-point Internal Memory

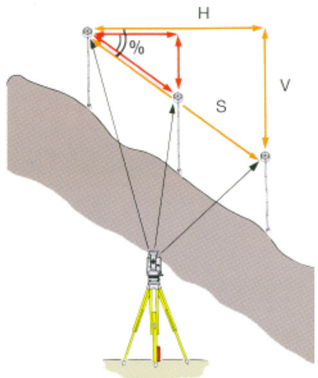
•The SET5F's internal memory is large—holding a full 3,000 data points—and secure. For optimum convenience, measurements can be performed and recorded at the touch of a key.
•Up to five (5) job files can be created to efficiently organize multiple survey tasks.
•Forty (40) feature codes (max.13 charac-ters each) can be kept in the memory for easy recall as needed.

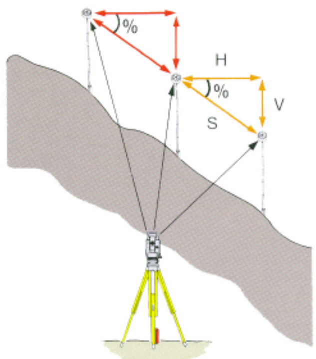
Sophisticated Application Software

Missing Line Measurement (MLM)

•The SET5F measures horizontal distance, slope distance, height difference, and slope in percent (%) between two prisms, all at the touch of a key.

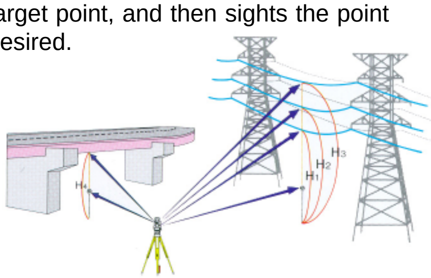
The SET5F brings full freedom to survey work.





Remote Elevation Measurement (REM)

•The SET5F can be used to easily determine the height of a point where a prism cannot be placed. The system sights a prism directly above or below the target point, and then sights the point desired.

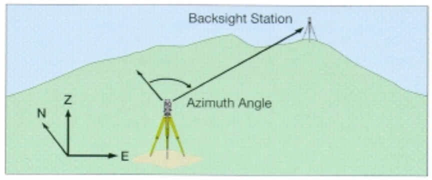


Angle Repetition

•For enhanced accuracy in the horizontal angle measurement, the SET5F can measure in repetition. It then calculates and displays the average of the multiple angle measurements.

Azimuth Angle Setting

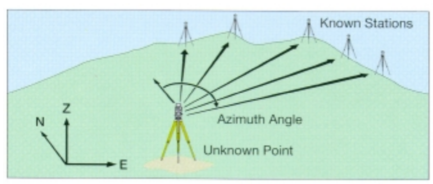
•Using the coordinates of the instrument station and a backlight point, the SET5F can automatically set the horizontal angle to the azimuth of the backlight.



Resection

•With 2 to 5 known points, the SET5F can be used to determine the azimuth and coordinates of the unknown instrument station.

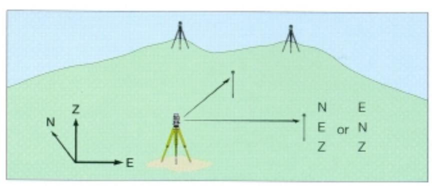
•When using 2 known points, both angles and distances are measured. When using 3 or more points, the distance does not always have to be measured.



3-D Coordinate Measurement

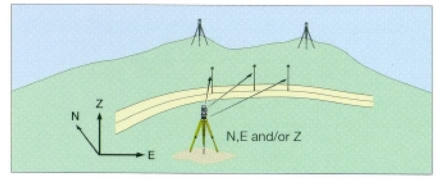
•The SET5F calculates 3-D coordinate values of measuring points.

•The operator may choose display settings either of "N, E, Z" or "E, N, Z."



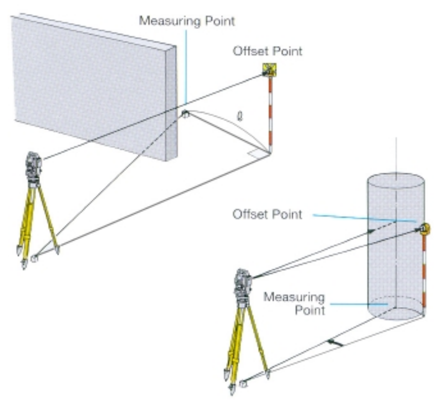
3-D Setting-out

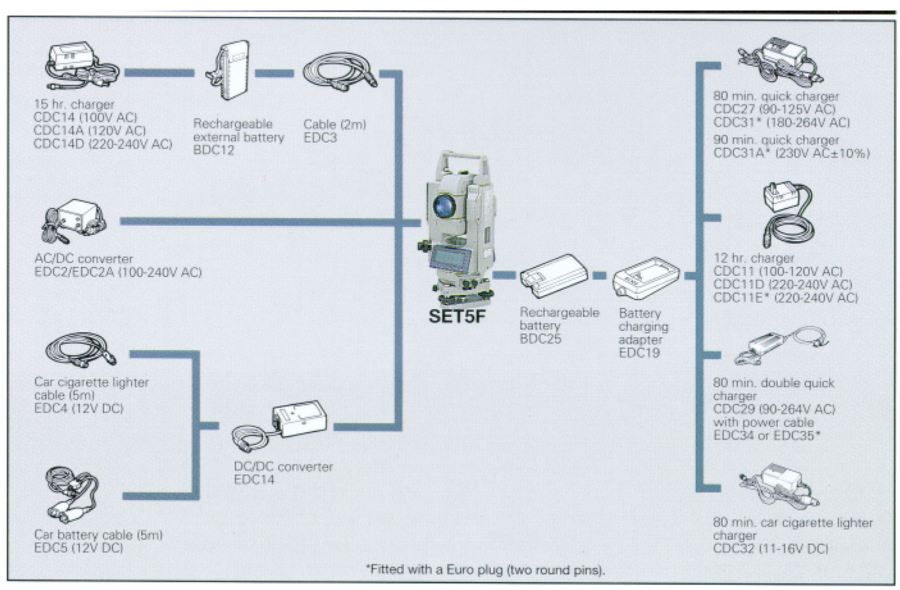
•The SET5F can be used to perform 3-dimensional setting-out with N, E and/or Z coordinates.



Offset Measurements

Two basic offset measurement methods are provided to measure the hidden points. One calls for input of the offset distance and the direction between the measuring point and the prism. The other uses a prism set on the left or right side of the measuring point at the same distance from the SET5F; the angles and distance to the prism are measured, and the measuring point is sighted. In both cases, the SET5F calculates the horizontal and vertical angles and distance, or the N, E, Z coordinates.





Standard Configuration

The SET5F comes with two (2) BDC25 rechargeable batteries EDC19 battery charging adapter CDC27, CDC31 or CDC31A quick charger, CP7 tubular compass, sunshade, lens cap, plumb bob, vinyl cover, tool kit, operator's manual, carrying case and shoulder strap.

Electronic Field Books (SDR33/SDR31)

Thanks to its advanced two-way communications port, the SET5F's functions can all be accessed by external controller. For example, by connecting one of the Sokkia's acclaimed Electronic Field Books (SDR33 or SDR31), complex field operations such as traverse adjustment, intersection, area calculations and roading can be carried out with remarkable ease.

Optional Accessories

DE17A	Diagonal Eyepiece
OF1/OF1A	Solar Filters
SC94	Back Pack

SET5F Specifications

Telescope		**Fully transiting, coaxial EDM**
Length		165mm (6.5in)
Objective aperture		45mm (1.8in)
Magnification, image		30x, Erect
Resolving power		3.0"
Field of view		1°30'(26m/1,000m)
Minimum focus		1.3m (4.3ft.)
Reticle illumination		Bright or Dim, selectable
Angle measurement		**Incremental encoder, diametrical detection**
Display resolution	H&V	1"/ 0.2 mgon/ 0.005 mil, 5"/1 mgon/ 0.02 mil
Angle unit	H&V	Degree/Gon/Mil
Accuracy	H&V	5" (1.5 mgon/ 0.02 mil) according to DIN18723
Dual-axis compensator		Liquid dual-axis tilt sensor, range: ±3' (±55 mgon)
Display mode	H	Clockwise/ Counterclockwise, Repetition, Oset, Hold available
	V	Zenith 0°/ Horizontal 0°/ Horizontal 0°±90°/ Slope%
Distance measurement		**Electro-optical with modulated infrared LED.**
Measuring range (slope distance)		A: Average conditions; slight haze, visibility about 20km(12 miles), sunny periods, weak scintillation. G: Good conditions; no haze, visibility about 40km (25 miles), overcast, no scintillation. Maximum ranges are achieved with Sokkia CP/AP prisms.
With CP01 compact prism		A: 1.3m (4.3ft.) to 700m (2,300ft.)
With one AP01 prism		A: 1.3m (4.3ft.) to 1,200m (3,900ft.), G: 1,500m (4,900ft.)
With three AP01 prism		A: 1.3m (4.3ft.) to 1,600m (5,200ft.), G: 2,000m (6,500ft.)
Distance unit		Meters or feet, selectable
Accuracy (Fine measurement)		±(3+2ppmxD)mm D=measuring range, unit=mm
Measuring unit and time (slope distance)	Fine	0.001 m Every 3.2 seconds (initial 4.7 seconds)
	Rapid	0.001 m 1.7 seconds
	Tracking	0.01 m Every 0.3 seconds (initial 1.4 seconds)
	Average	0.0001 m (average of 2 to 9 times measurement)
Atmospheric correction		Key-in the temperature and pressure, or -499 to +499ppm.
Prism constant		-99 to 0mm (1 mm steps)
Refraction & Earth-curvature correction		On/off selectable (K=0.142)
General		
Display		LCD dot matrix display (20 characters x 4 lines) on both faces with back light.
Keyboard		5 keys on both faces, free assignment of functions.
Resume function		On/off selectable
Sensitivity of levels		Plate level: 40"/2mm, Circular level: 10'/2mm (in tribrach)
Optical plummet		Image: erect, Magnification: 3x, Minimum focus: 0.5m (1.6ft.)
Interface		Asynchronous serial, RS-232C compatible, baud rate 1200/ 9600bps
2-way communication		Provided
Data storage		3,000-point data memory
Operating temperature		-20°C to +50°C (-4°F to +122°F)
Tilting/Trunnion axis height		236mm (9.3in) from tribrach bottom, 193mm (7.6in) from tribrach dish.
Size with handle and battery		W150 x D165 x H353mm, W5.9 x D6.5 x H13.9in.
Weight with handle and battery		5.4kg (11.9lbs)
Weight of parts		BDC25 battery: 240g (8.5oz.), Handle: 100g (3.5oz.), Tribrach: 740g (1.6 lbs), Case:2.4kg (5.3lbs)
Power supplies		
Battery level display		4 steps with warning message.
Automatic power cut-off		On/off selectable (30 minutes after the last operation)
Power source		BDC25 rechargeable battery, Ni-Cd 6V, 2 supplied as standard.
Working duration at 25°C (77°F) w/one BDC25 battery		Distance & angle measurement: about 5 hours, about 600 points (Fine & single measurement with 30 seconds intervals). Angle measurement only: about 9 hours.
Charging time		CDC27/31: about 80 minutes, CDC31A: about 90 minutes

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Sokkia is a sponsor of the International Federation of Surveyors.

ISO 9001 Certified
Certificate No. JQA-0557
ISO 9001/BS EN ISO 9001/EN 29001/JIS Z9901
SOKKIA CO.,LTD.

Appendix III

Vessel Reports, Offsets, and Diagrams

Launch 1010

Vessel Report

- 1_HVF
- 2_Offsets
- 3_Patch Test
- 4_DDSSM and Settlement & Squat
- 5_POS Gams Calibration
- 6_Wire Diagram

Launch 1018

Vessel Report

- 1_HVF
- 2_Offsets
- 3_Patch Test
- 4_DDSSM and Settlement & Squat
- 5_POS Gams Calibration
- 6_Wire Diagram

S220

Vessel Report

- 1_HVF
- 2_Offsets
- 3_Patch Test
- 4_DDSSM and Settlement & Squat
- 5_POS Gams Calibration
- 6_Wire Diagram
- 7_Correspondence

```
Vessel Name: FA_1010_Reson8101.hvf
Vessel created: December 19, 2006


Depth Sensor:

        Sensor Class:    Swath
        Time Stamp:      2006-001 00:00

        Transduer #1:
        -------------
        Pitch Offset:   -1.160
        Roll Offset:    2.250
        Azimuth Offset: 0.930

        DeltaX: 0.312
        DeltaY: -0.142
        DeltaZ: 0.397

        Manufacturer:    Reson
        Model:           sb8101
        Serial Number:   2701011

Depth Sensor:

        Sensor Class:    Swath
        Time Stamp:      2007-001 00:00

        Transduer #1:
        -------------
        Pitch Offset:   -0.280
        Roll Offset:    2.500
        Azimuth Offset: 0.600

        DeltaX: 0.247
        DeltaY: -0.138
        DeltaZ: 0.551

        Manufacturer:    Reson
        Model:           sb8101
        Serial Number:   2701011

Depth Sensor:

        Sensor Class:    Swath
        Time Stamp:      2007-119 00:00

        Transduer #1:
        -------------
        Pitch Offset:   -0.280
        Roll Offset:    3.000
        Azimuth Offset: 0.600

        DeltaX: 0.247
        DeltaY: -0.138
        DeltaZ: 0.551

        Manufacturer:    Reson
        Model:           sb8101
        Serial Number:   2701011

Depth Sensor:
```

```
        Sensor Class:    Swath
        Time Stamp:      2007-136 22:07

        Transduer #1:
        -------------
        Pitch Offset:   -0.280
        Roll Offset:    2.710
        Azimuth Offset: 0.600

        DeltaX: 0.247
        DeltaY: -0.138
        DeltaZ: 0.551

        Manufacturer:    Reson
        Model:           sb8101
        Serial Number:   2701011

Depth Sensor:

        Sensor Class:    Swath
        Time Stamp:      2007-150 00:00

        Transduer #1:
        -------------
        Pitch Offset:   -0.280
        Roll Offset:    3.000
        Azimuth Offset: 0.600

        DeltaX: 0.247
        DeltaY: -0.138
        DeltaZ: 0.551

        Manufacturer:    Reson
        Model:           sb8101
        Serial Number:   2701011

Depth Sensor:

        Sensor Class:    Swath
        Time Stamp:      2007-150 19:04

        Transduer #1:
        -------------
        Pitch Offset:   -0.280
        Roll Offset:    2.710
        Azimuth Offset: 0.600

        DeltaX: 0.247
        DeltaY: -0.138
        DeltaZ: 0.551

        Manufacturer:    Reson
        Model:           sb8101
        Serial Number:   2701011

Depth Sensor:

        Sensor Class:    Swath
        Time Stamp:      2007-151 00:00

        Transduer #1:
        -------------
        Pitch Offset:   -0.280
```

```
        Roll Offset:    3.070
        Azimuth Offset: 0.600

        DeltaX: 0.247
        DeltaY: -0.138
        DeltaZ: 0.551

        Manufacturer:    Reson
        Model:           sb8101
        Serial Number:   2701011

Depth Sensor:

        Sensor Class:    Swath
        Time Stamp:      2007-172 00:10

        Transduer #1:
        -------------
        Pitch Offset:   -0.280
        Roll Offset:    2.620
        Azimuth Offset: 0.600

        DeltaX: 0.247
        DeltaY: -0.138
        DeltaZ: 0.551

        Manufacturer:    Reson
        Model:           sb8101
        Serial Number:   2701011

Depth Sensor:

        Sensor Class:    Swath
        Time Stamp:      2007-176 00:00

        Transduer #1:
        -------------
        Pitch Offset:   -0.280
        Roll Offset:    2.890
        Azimuth Offset: 0.600

        DeltaX: 0.247
        DeltaY: -0.138
        DeltaZ: 0.551

        Manufacturer:    Reson
        Model:           sb8101
        Serial Number:   2701011

Depth Sensor:

        Sensor Class:    Swath
        Time Stamp:      2007-176 22:20

        Transduer #1:
        -------------
        Pitch Offset:   -0.280
        Roll Offset:    2.620
        Azimuth Offset: 0.600

        DeltaX: 0.247
        DeltaY: -0.138
        DeltaZ: 0.550
```

Manufacturer: Reson
Model: sb8101
Serial Number: 2701011

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2007-197 00:00

Transduer #1:

Pitch Offset: -1.040
Roll Offset: 2.910
Azimuth Offset: 0.890

DeltaX: 0.247
DeltaY: -0.138
DeltaZ: 0.550

Manufacturer: Reson
Model: sb8101
Serial Number: 2701011

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2007-252 00:00

Transduer #1:

Pitch Offset: -0.570
Roll Offset: 2.810
Azimuth Offset: 0.570

DeltaX: 0.247
DeltaY: -0.138
DeltaZ: 0.550

Manufacturer: Reson
Model: sb8101
Serial Number: 2701011

Navigation Sensor:

Time Stamp: 2006-001 00:00

Comments (null)
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Applanix
Model: POS/MV v320
Serial Number: 788

Time Stamp: 2007-001 00:00

Comments POS time mistakenly set to GPS time requiring a 14 sec time correction

Latency 14.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2564

Time Stamp: 2007-102 00:00

Comments Time changed in POS to UTC - 14 sec time correction deleted
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2564

Gyro Sensor:

Time Stamp: 2006-001 00:00

Comments (null)
Latency 0.000

Time Stamp: 2007-001 00:00

Comments POS time mistakenly set to GPS time requiring a 14 sec time correction
Latency 14.000

Time Stamp: 2007-102 00:00

Comments Time changed in POS to UTC - 14 sec time correction deleted
Latency 0.000

Heave Sensor:

Time Stamp: 2006-001 00:00

Comments True Heave Enabled
Apply Yes
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000
Offset: 0.000

Manufacturer: Applanix
Model: POS/MV v320
Serial Number: 788

Time Stamp: 2007-001 00:00

Comments True Heave Enabled / POS time mistakenly set to GPS time requiring a 14 sec time correctionPOS time mistakenly set to GPS time requiring a 14 sec time correction
Apply Yes
Latency 14.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000
Offset: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2564

Time Stamp: 2007-102 00:00

Comments Time changed in POS to UTC - 14 sec time correction deleted
Apply Yes
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000
Offset: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2564

Pitch Sensor:

Time Stamp: 2006-001 00:00

Comments (null)
Apply Yes
Latency 0.000
Pitch offset: 0.000

Manufacturer: Applanix
Model: POS/MV v320
Serial Number: 788

Time Stamp: 2007-001 00:00

Comments POS time mistakenly set to GPS time requiring a 14 sec time correction
Apply Yes
Latency 14.000
Pitch offset: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2564

Time Stamp: 2007-102 00:00

Comments Time changed in POS to UTC - 14 sec time correction deleted
Apply Yes
Latency 0.000
Pitch offset: 0.000

```
        Manufacturer:    Applanix
        Model:           POS/MV v4
        Serial Number:   2564
```

Roll Sensor:

```
        Time Stamp:      2006-001 00:00

        Comments (null)
        Apply Yes
        Latency 0.000
        Roll offset: 0.000

        Manufacturer:    Applanix
        Model:           POS/MV v320
        Serial Number:   788


        Time Stamp:      2007-001 00:00

        Comments POS time mistakenly set to GPS time requiring a 14 sec time
correction
        Apply Yes
        Latency 14.000
        Roll offset: 0.000

        Manufacturer:    Applanix
        Model:           POS/MV v4
        Serial Number:   2564


        Time Stamp:      2007-102 00:00

        Comments Time changed in POS to UTC - 14 sec time correction deleted
        Apply Yes
        Latency 0.000
        Roll offset: 0.000

        Manufacturer:    Applanix
        Model:           POS/MV v4
        Serial Number:   2564
```

Draft Sensor:

```
        Time Stamp:      2006-001 00:00

        Apply Yes
        Comments DDSSM
        Entry 1) Draft: 0.000   Speed: 0.000
        Entry 2) Draft: -0.070  Speed: 4.636
        Entry 3) Draft: -0.030  Speed: 6.230
        Entry 4) Draft: -0.020  Speed: 8.164
        Entry 5) Draft: -0.010  Speed: 9.846
        Entry 6) Draft: -0.030  Speed: 12.227

        Time Stamp:      2007-001 00:00

        Apply Yes
        Comments DDSSM
        Entry 1) Draft: 0.000   Speed: 0.000
```

```
        Entry 2) Draft: -0.041  Speed: 5.015
        Entry 3) Draft: -0.031  Speed: 6.026
        Entry 4) Draft: 0.023   Speed: 7.737
        Entry 5) Draft: 0.053   Speed: 8.942
        Entry 6) Draft: 0.102   Speed: 10.050
        Entry 7) Draft: 0.089   Speed: 10.438
```

TPE

```
        Time Stamp:      2006-001 00:00

        Comments
        Offsets

        Motion sensing unit to the transducer 1
                X Head 1 0.312
                Y Head 1 -0.142
                Z Head 1 0.397
        Motion sensing unit to the transducer 2
                X Head 2 0.000
                Y Head 2 0.000
                Z Head 2 0.000
        Navigation antenna to the transducer 1
                X Head 1 1.209
                Y Head 1 1.057
                Z Head 1 3.538
        Navigation antenna to the transducer 2
                X Head 2 0.000
                Y Head 2 0.000
                Z Head 2 0.000

        Roll offset of transducer number 1 0.000
        Roll offset of transducer number 2 0.000

        Heave Error: 0.050 or 5.000'' of heave amplitude.
        Measurement errors: 0.007
        Motion sensing unit alignment errors
        Gyro:0.250      Pitch:0.150     Roll:0.150
        Gyro measurement error: 0.020
        Roll measurement error: 0.020
        Pitch measurement error: 0.020
        Navigation measurement error: 0.500
        Transducer timing error: 0.005
        Navigation timing error: 0.005
        Gyro timing error: 0.005
        Heave timing error: 0.005
        PitchTimingStdDev: 0.005
        Roll timing error: 0.005
        Sound Velocity speed measurement error: 0.000
        Surface sound speed measurement error: 0.050
        Tide measurement error: 0.010
        Tide zoning error: 0.720
        Speed over ground measurement error: 0.030
        Dynamic loading measurement error: 0.000
        Static draft measurement error: 0.050
        Delta draft measurement error: 0.020
        StDev Comment: `éƒJ Ï…J`õ…JPõ…J°ð…J €…J@í…J°k€JàZ€J€Ó…Ja

        Time Stamp:      2007-001 00:00

        Comments
        Offsets
```

```
Motion sensing unit to the transducer 1
        X Head 1 0.247
        Y Head 1 -0.138
        Z Head 1 0.551
Motion sensing unit to the transducer 2
        X Head 2 0.000
        Y Head 2 0.000
        Z Head 2 0.000
Navigation antenna to the transducer 1
        X Head 1 1.144
        Y Head 1 1.061
        Z Head 1 3.667
Navigation antenna to the transducer 2
        X Head 2 0.000
        Y Head 2 0.000
        Z Head 2 0.000

Roll offset of transducer number 1 0.000
Roll offset of transducer number 2 0.000

Heave Error: 0.050 or 5.000'' of heave amplitude.
Measurement errors: 0.007
Motion sensing unit alignment errors
Gyro:0.100      Pitch:0.130     Roll:0.130
Gyro measurement error: 0.020
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 0.500
Transducer timing error: 0.005
Navigation timing error: 0.005
Gyro timing error: 0.005
Heave timing error: 0.005
PitchTimingStdDev: 0.005
Roll timing error: 0.005
Sound Velocity speed measurement error: 0.000
Surface sound speed measurement error: 0.050
Tide measurement error: 0.010
Tide zoning error: 0.720
Speed over ground measurement error: 0.030
Dynamic loading measurement error: 0.010
Static draft measurement error: 0.016
Delta draft measurement error: 0.007
StDev Comment: `éƒJ Ï…J`õ…JPõ…J°ð…J €…J@í…J°k€JàZ€J€Ó…Ja
```

```
Svp Sensor:

        Time Stamp:      2006-001 00:00

        Comments
        Svp #1:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 0.312
        DeltaY: -0.142
        DeltaZ: 0.397

        SVP #2:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
```

```
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000


Time Stamp:      2007-001 00:00

Comments
Svp #1:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.247
DeltaY: -0.138
DeltaZ: 0.551

SVP #2:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000


Time Stamp:      2007-119 00:00

Comments
Svp #1:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.247
DeltaY: -0.138
DeltaZ: 0.551

SVP #2:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000


Time Stamp:      2007-136 22:07

Comments
Svp #1:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000
```

```
DeltaX: 0.247
DeltaY: -0.138
DeltaZ: 0.551

SVP #2:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000


Time Stamp:      2007-150 00:00

Comments
Svp #1:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.247
DeltaY: -0.138
DeltaZ: 0.551

SVP #2:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000


Time Stamp:      2007-150 19:04

Comments
Svp #1:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.247
DeltaY: -0.138
DeltaZ: 0.551

SVP #2:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000
```

```
Time Stamp:      2007-150 23:23

Comments
Svp #1:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.247
DeltaY: -0.138
DeltaZ: 0.551

SVP #2:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000


Time Stamp:      2007-151 00:00

Comments
Svp #1:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.247
DeltaY: -0.138
DeltaZ: 0.551

SVP #2:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000


Time Stamp:      2007-172 00:10

Comments
Svp #1:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.247
DeltaY: -0.138
DeltaZ: 0.551

SVP #2:
```

```
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000


Time Stamp:      2007-176 00:00

Comments
Svp #1:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.247
DeltaY: -0.138
DeltaZ: 0.551

SVP #2:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000


Time Stamp:      2007-176 22:20

Comments
Svp #1:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.247
DeltaY: -0.138
DeltaZ: 0.550

SVP #2:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000


Time Stamp:      2007-197 00:00

Comments
Svp #1:
-------------
```

```
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 0.247
        DeltaY: -0.138
        DeltaZ: 0.550

        SVP #2:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 0.000
        DeltaY: 0.000
        DeltaZ: 0.000


        Time Stamp:      2007-252 00:00

        Comments
        Svp #1:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 0.247
        DeltaY: -0.138
        DeltaZ: 0.550

        SVP #2:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 0.000
        DeltaY: 0.000
        DeltaZ: 0.000
```

WaterLine:

```
        Time Stamp:      2006-001 00:00

        Comments
        Apply Yes
        WaterLine -0.240

        Time Stamp:      2007-001 00:00

        Comments
        Apply Yes
        WaterLine -0.243
```

1010 Offsets and Measurements - Summary

Measurement aka Coord. Sys.	IMU to RP* Caris	8101 to RP* Caris	IMU to 8101 (SWATH1 x,y,z & MRU to Trans) Caris	Port Ant to 8101 (Nav to Trans x,y,z) Caris	RP* to Waterline Caris
x	0.000	0.247	0.247	1.144	n/a
y	0.000	-0.138	-0.138	1.061	n/a
z	0.000	0.551	0.551	3.667	-0.243

*IMU is RP (Reference Pt)

Vessel Offsets for 1010_8101 are derived from the Horizontal, Vertical & XYZ worksheets in this spreadsheet.   2007 Measured Values

Calculations

Coord. Sys. **Theodolite**

8101 to RP*

IMU to 8101

IMU (m)	x	3.516
	y	0.011
	z	-1.183
BM H	x	3.271447
	y	0.425598
	z	-1.37667
IMU to BM H	x	-0.244
	y	0.415
	z	-0.194
BM H to Phase Ctr (cm) measured	x	10.6
	y	-16.8
	z	-35.7
BM H to Phase Ctr (m)	x	0.106
	y	-0.168
	z	-0.357

Port Ant to 8101

IMU (m)	x	3.516
	y	0.011
	z	-1.183
Port Antenna	x	2.317
	y	-0.886
	z	1.934
IMU to Port Antenna	x	-1.199
	y	-0.897
	z	3.117
IMU to Phase Ctr	x	-0.138
	y	0.247
	z	-0.551

RP to Waterline

IMU (m)	x	3.516
	y	0.011
	z	-1.183
BM C	x	0.000
	y	0.000
	z	0.000
BM C to IMU	x	n/a
	y	n/a
	z	-1.183
BM C to Waterline measured	x	n/a
	y	n/a
	z	-0.940

see

Coord. Sys. **Theodolite**

IMU to 8101

	IMU to 8101		Port Ant to 8101		RP to Waterline	
IMU to Phase Ctr	x	-0.138	x	1.061	x	n/a
	y	0.247	y	1.144	y	n/a
	z	-0.551	z	-3.667	z	0.243

	Coord. Sys. CARIS		Coord. Sys. CARIS		Coord. Sys. CARIS	
	x	0.247	x	1.144	x	n/a
	y	-0.138	y	1.061	y	n/a
	z	0.551	z	3.667	z	-0.243

1010 Offsets and Measurements - Summary

Port Ant to Stbd Ant		IMU to Port Antenna		IMU to Heave	
		Caris	Pos/Mv	Caris	Pos/Mv
Scalar Distance	1.840	-0.897	-1.199	-0.011	-1.176
		-1.199	-0.897	-1.176	-0.011
		-3.117	-3.117	-0.243	-0.243

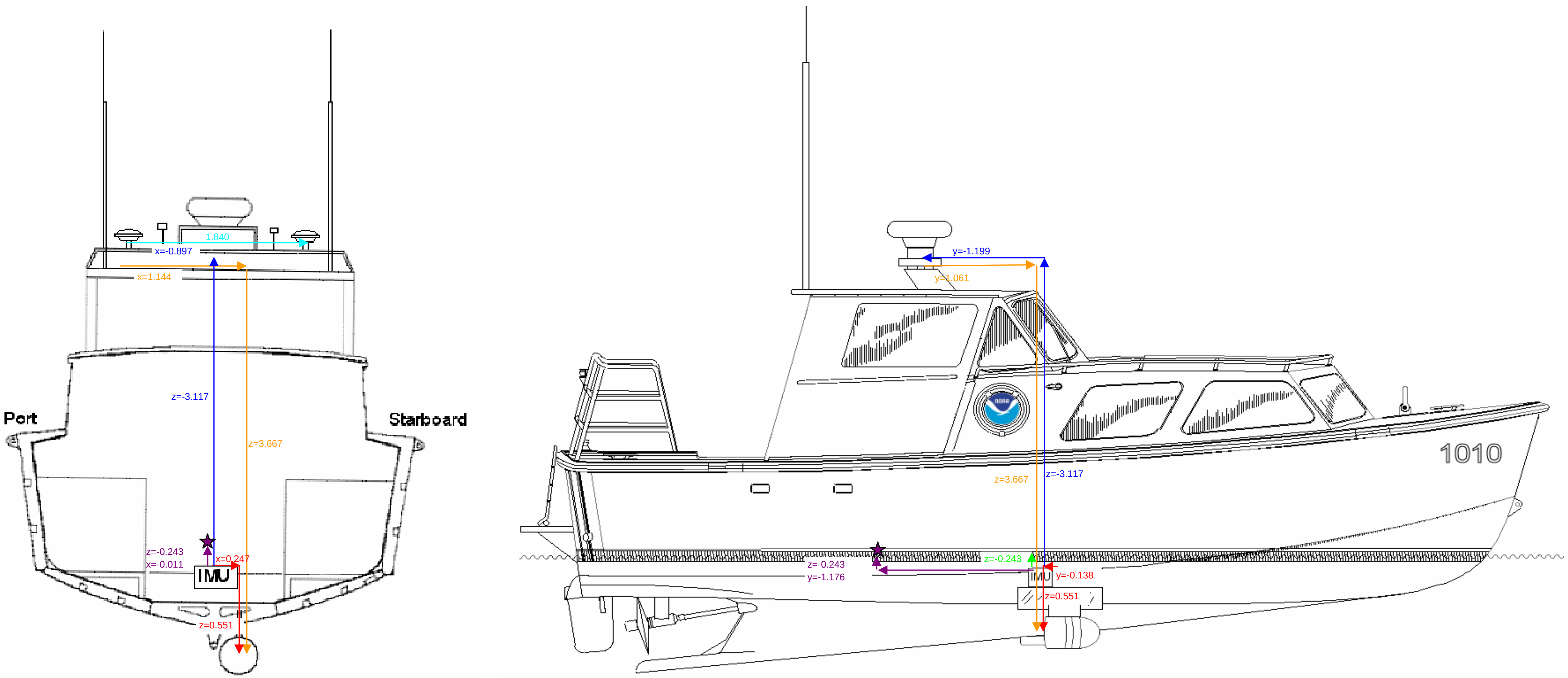
Port Ant to Stbd Ant			IMU to Port Antenna			IMU to Heave		
Port Ant (m)	x	2.317	IMU (m)	x	3.516	IMU (m)	y	0.011
	y	-0.886		y	0.011	x is n/a	z	-1.183
	z	1.934		z	-1.183			
						Heave Pt (m)		
Stbd Ant (m)	x	2.324	Port Ant (m)	x	2.317	(centerline)	y	0.000
	y	0.953		y	-0.886			
	z	1.878		z	1.934	BM C to Waterline (m)		-0.940
						measured scalar dist		
						BM C		
						x&y are n/a	z	0.000
						BM C to Waterline (m)		
						(Heave Pt)	z	-0.940
						IMU to LCG	x	-1.176
								See IMU to Heave tab

Port Ant to Stbd Ant		IMU to Port Antenna			IMU to Heave		
			x	-1.199		x	-1.176
Scalar Distance	1.840		y	-0.897		y	-0.011
			z	3.117		z	0.243
		Coord. Sys. Pos/Mv			Coord. Sys. Pos/Mv		
			x	-1.199		x	-1.176
			y	-0.897		y	-0.011
			z	-3.117		z	-0.243
					See IMU to Heave tab		

Description of Offsets for Launch 1010

All Values Shown are in CARIS Coordinates

The Ship Reference Frame (SRF) for Launch 1010 was based from benchmark (BM) C as the 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 8101		
x	y	z
0.247	-0.138	0.551

The physical positions of the IMU and the phase center of the 8101 with respect to the Ship Reference Frame were measured by NOAA personnel. These physical measurements were used to calculate the xyz offsets from the IMU to BM H. Measurements from BM H to the Phase Center of the 8101 were collected by NOAA personnel while the boat was secured in the davit and thought to be as level as possible. The measured offsets from BM H to the phase center were then added to the offset from the IMU to BM H. The result is the offset from the IMU to the phase center of the transducer. The values in the X and Y fields are transposed and the inverse of the Z value is used to give the offsets in CARIS coordinates.

Port Ant to 8101		
x	y	z
1.144	1.061	3.667

NOAA personnel calculated the distance between the port antenna and the phase center of the port antenna subtracting the IMU to Port Antenna value from the IMU to Phase Center value.

RP to Waterline		
x	y	z
N/A	N/A	-0.243

The vertical distance from BM A and B to the waterline was measured by FAIRWEATHER personnel using a steel tape and bubble level. With the knowledge of the two BMs height above the IMU, the waterline height above the IMU could be calculated. On launch 1010, the IMU is used as the reference point.

Port Ant to Stbd Ant
Scalar Distance
1.840

The location of the phase center of the port and starboard POS/MV antennas were measured by NOAA personnel with respect to the SRF. The scalar distance between the phase centers was then calculated.

IMU to Port Antenna		
x	y	z
-0.897	-1.199	-3.117

The location of the IMU and the location of the port antenna were measured by NOAA personnel with respect to the Ship Reference Frame (SRF). The xyz offsets from the IMU to the port antenna could be calculated from these physical locations.

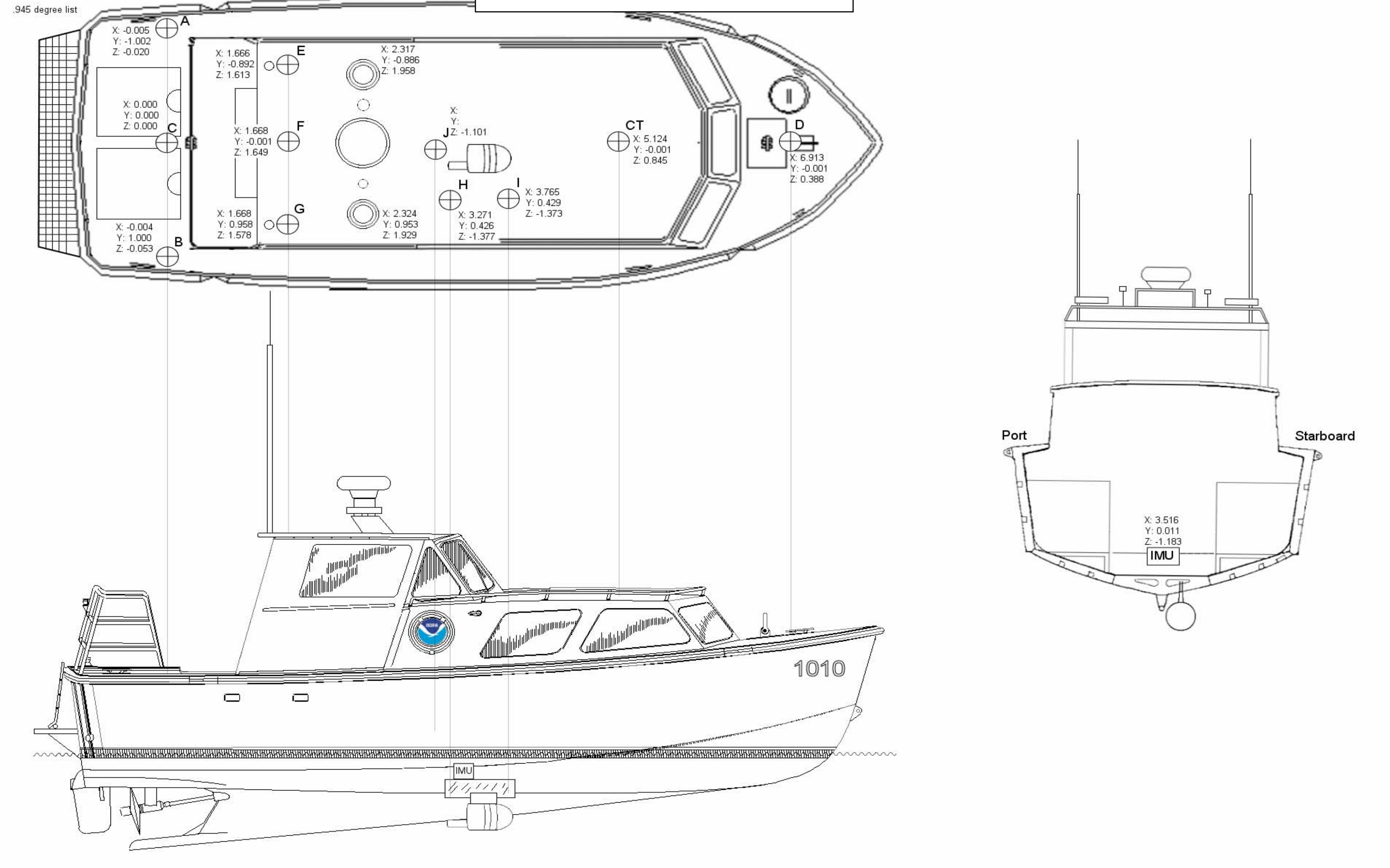
IMU to Heave		
x	y	z
-0.011	-1.176	-0.243

The heave point was positioned differently on each of the axes. The distance for the longitundinal axis was determined as described in the "IMU to Heave" tab in this workbook. The athwart ships axis was the vessel centerline. Lastly, the waterline was used as the height of the heave point, which was calculated earlier in 'RP to Waterline'.

1010 Vessel Diagram

All Values Shown are in Theodolite Coordinates

Note: Both antenna have been replaced for the POS V4. While their x-y values are not thought to have changed, the z-value has been remeasured.



FAIRWEATHER

Multibeam Echosounder Calibration

Launch 1010
Vessel

Date	Dn	Local Area
7/17/2007	197	Kodiak, Womans Bay

MBES System	MBES System Location	Date of most recent EED/Factory Check
8101		

Sonar Serial Number	Processing Unit Serial Number
2701011	

Sonar Mounting Configuration	Date of current offset measurement/verification

Description of Positioning System	Date of most recent positioning system calibration
POSMV v.4	

Acquisition Log

Date	Dn	Local Area	Wx
7/17/2007	197	Kodiak	Flat calm

Bottom Type	Approximate Water Depth
	10-40m

Personnel on board: Dowling, Argento, Morgan, Gonsalves

Comments:

TrueHeave filename: No Trueheave logged

SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
071971628	1628	57/43/38.3	152/31/23.73		22.8

(Cast#2 backtimed to 1

SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
071972105	2105	57/42/53.6	152/31/56.3		27.6

SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

ROLL

SV Cast #	XTF Line Filename	Hd	Speed (kts)	Remarks
1	197-1705, 1709	035/215	7.0	
1	197-1714, 1719	035/215	6.0	Waked out at beginning of line 1719 (use for timing)
1	197-1725, 1729	035/215	6.5	Acquired post hard starbord turns
1	197-1734, 1739	035/215	6.5	Acquired post hard starbord turns
1	Port_Turn_2, Port_Turn_3	035/215	7.0	Acquired post hard port turns
1	Port_Turn_4, Port_Turn_5	035/215	7.2	Acquired post hard port turns
1	Jen_Roll_1, Jen_Roll_2	035/215	6.3	Transducer cranked down by Dowling
1	Jen_Roll_3, Jen_Roll_4	035/215	6.3	Transducer cranked down by Dowling
1	Jen_Roll_5, Jen_Roll_6	035/215	6.4	Acquired post hard port turns
1	Jen_Roll_7, Jen_Roll_8	035/215	7.2	Acquired post hard port turns
1	Jen_Roll_9, Jen_Roll_10	035/215	7.1	Acquired post hard starbord turns
1	Jen_Roll_11, Jen_Roll_12	035/215	6.5	Acquired post hard starbord turns
1	Adam_Roll_1, Adam_Roll_2	035/215		Transducer leisurely cranked down

PITCH

SV Cast #	XTF Line Filename	Hd	Speed (kts)	Remarks
2	Pitch_2	247	5.5	
2	Pitch_4	066	5.5	
2	Pitch_5	245	5.3	
2	Pitch_6	065	5.3	

HEADING/YAW

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
2	z	245		
2	Pitch_8	065		
2	Pitch_9	242		
2	Pitch_10	066		

REFERENCE SURFACE

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks

Processing Log

7/17/2007	197	Argento
Date	Dn	Personnel

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

TrueHeave applied ☐ No trueheave logged

SVP applied ☑ previous in time

Tide applied ☑ Kodiak verified - foo

Zone file N/A

Lines merged ☑

Data cleaned to remove gross fliers ☑ **(mog)**

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.

Calibrating Hydrographer(s)

PATCH TEST RESULTS/CORRECTORS

Evaluators		Latency (sec)	Pitch (deg)	Roll (deg)		Yaw (deg)
adam/nick	A	0.00		2.85		0.80
matt	B	0.00	-1.10		2.97	0.94
brenna	C	0.00		2.85		
pat/allison	D	0.00	-1.05	2.94		0.93
mark/steph	E	0.00	-1.22	2.87		0.90
toshi/cathleen	F	0.00	-0.90		2.84	0.85
mog		0.00	-0.95	2.91		0.90
FOO (Post SmTide)		0.00		2.91		

Grayed out signifies outlier-not used in average

	Latency (sec)	Pitch (deg)	Roll (deg)	Yaw (deg)
Averages	0.00	-1.04	2.89	0.89
Standard Deviation	0.00	0.13	0.04	0.05
FINAL VALUES		-1.04	2.91	0.89

Final Values based on Average minus outliers (roll based on mog value based on dozens of roll lines)

Final Values analyzed/compiled by: mog/foo

Value from standard deviation of Heading offset values	0.05	**MRU Align StdDev Gyro**
Value from sum of squares standard deviations of pitch and roll offsets	0.13	**MRU Align StdDev Roll/Pitch**

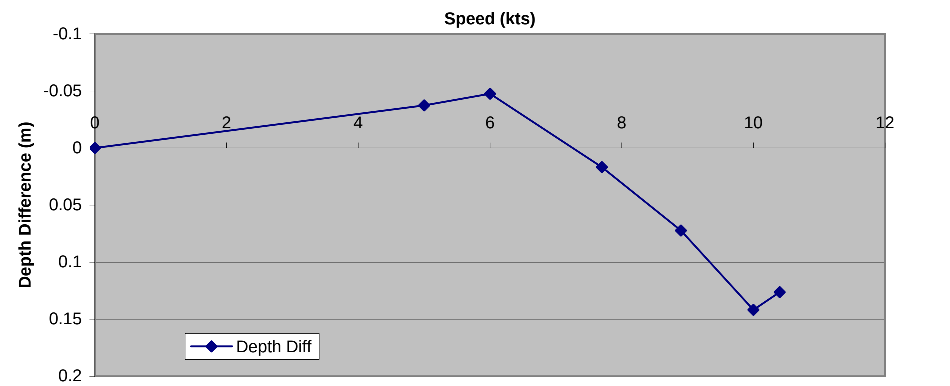
Results are for HVF File Named: FA_1010_Reson8101

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

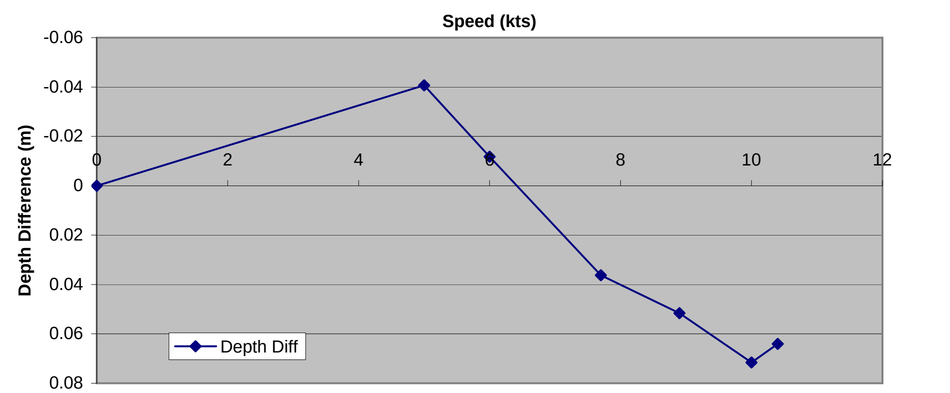
Name: **Date:**

NARRATIVE

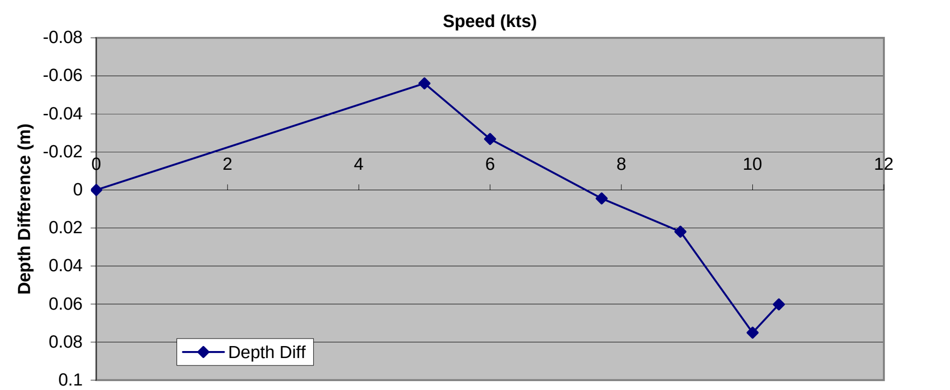
RPM	Speed (m/s)	Speed (knots)	mog-Ave	bj-Ave	kb-Ave	Std. Dev.	Average
0	0	0	0	0	0	0	0
620	2.58	5	-0.044685862	-0.040728915	-0.037282951	0.003704394	-0.040899243
790	3.10	6	-0.02870312	-0.039467254	-0.023804602	0.00801229	-0.030658325
1040	3.98	7.7	0.019162864	0.017309788	0.033217055	0.008698614	0.023229902
1235	4.60	8.9	0.048612724	0.048718001	0.060843062	0.007030995	0.052724596
1530	5.17	10	0.096159255	0.094792289	0.115960382	0.011846529	0.102303975
1696	5.37	10.4	0.083489759	0.080253529	0.101141624	0.011242583	0.088294971



S220 - Stop#1 DDSSM



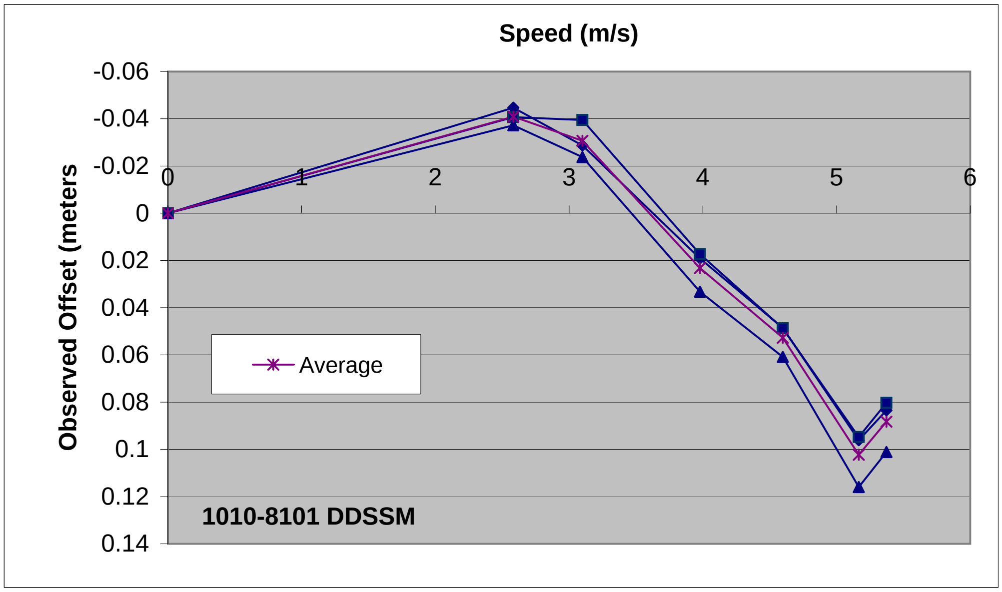
S220 - Stop#2 DDSSM



S220 - Stop#3 DDSSM

Blue cells used in computation of
Delta Draft StDev used in TPE

Ave. StDev 0.006862



NOAA POS/MV Calibration Report

Ship: FAIRWEATHER
Vessel: 1010
Date: 3/30/2007
Dn: 089

Personnel: Walker, Gonsalves, Mills

PCS Serial # 2564
IMU Serial # 294

IP Address: 129.100.1.231

POS controller Version (Use Menu Help > About) 3.3.2.2

POS Version (Use Menu View > Statistics) MV320 v4

GPS Receivers

Primary Receiver: BD950 SN:4624A70264

Secondary Receiver: BD950 SN:4622A68956

Calibration area

Location: Nichols Passage, AK

Approximate Position:

Lat	55	17	3
Lon	131	39	55

DGPS Beacon Station: Annette Island

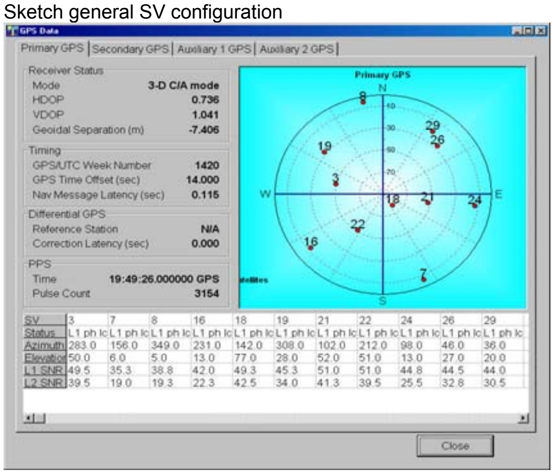
Frequency: 323

Satellite Constellation

(Use View> GPS Data)

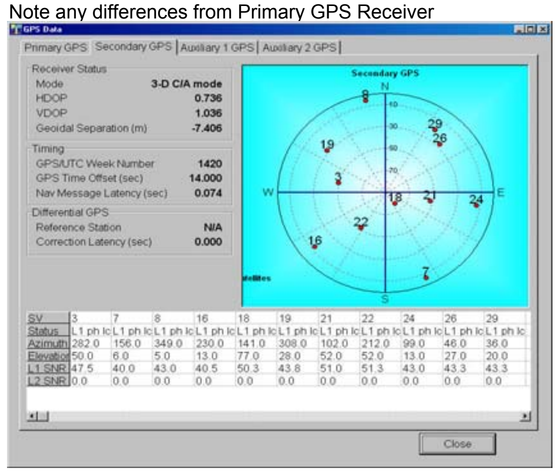
Primary GPS

Sketch general SV configuration



Secondary GPS

Note any differences from Primary GPS Receiver

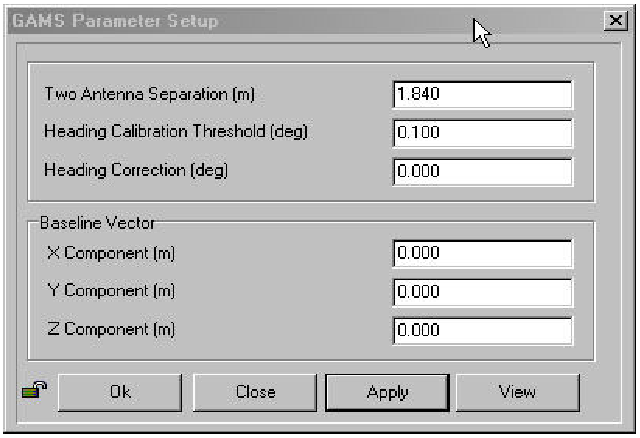


PDOP 1.600 (Use View> GAMS Solution)

POS/MV Configuration

Settings

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



Configuration Notes: ______________________

POS/MV Calibration

Calibration Procedure:

(Refer to POS MV V3 Installation and Operation Guide, 4-25)

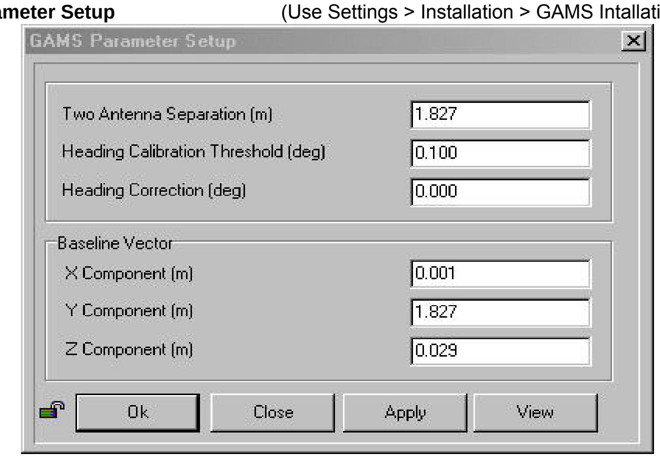
Start time: 1947

End time: 1948

Heading accuracy achieved for calibration: 0.1

Calibration Results:

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



GAMS Status Online: Yes

Save Settings: Yes

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

File Name: 1010_089_POSMV

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 othe

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

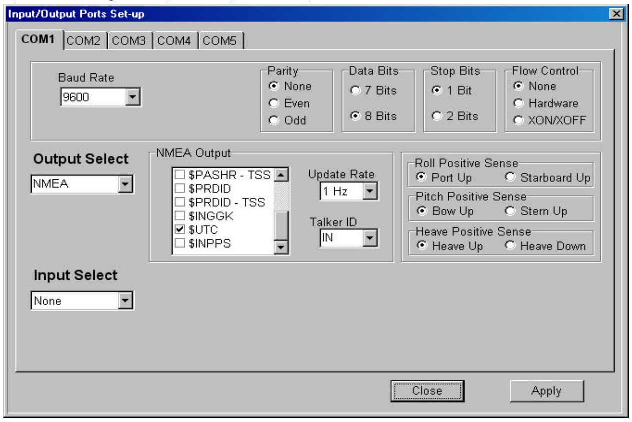
c) Roll rotation - apply a right-hand screw rotation θx about the twice-rotated x-axis to align one frame with the other.

SETTINGS

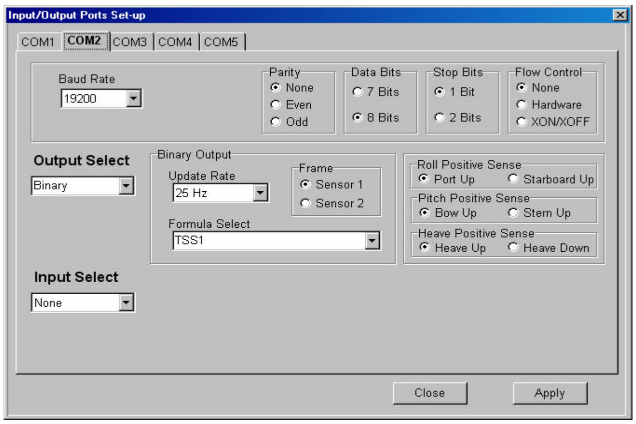
Input/Output Ports

(Use Settings > Input/Output Ports)

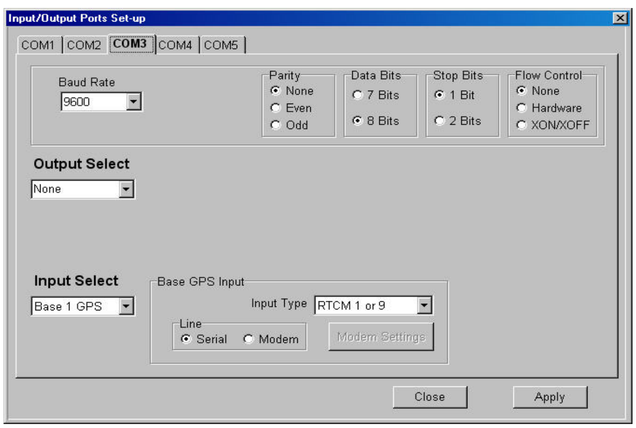
COM1



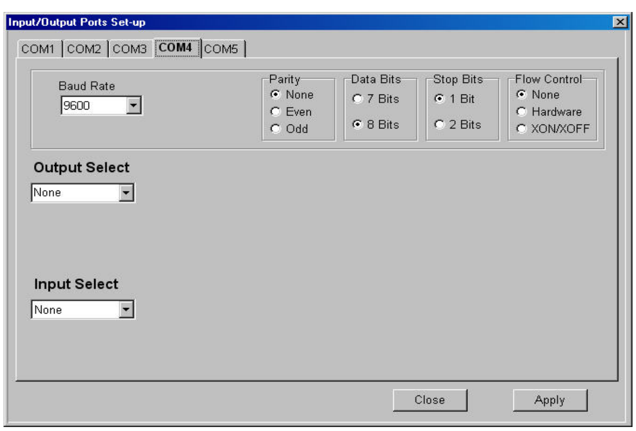
COM2



COM3

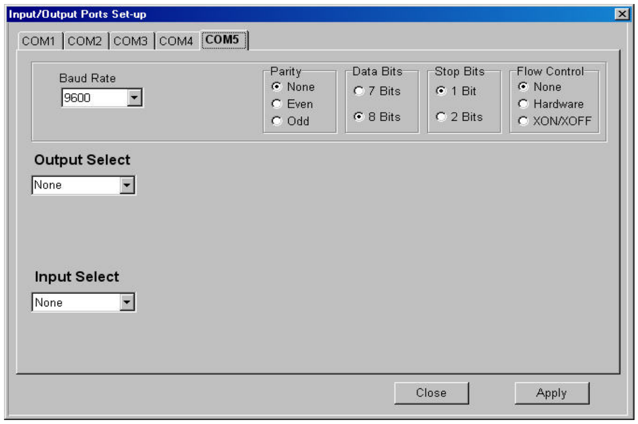


COM4



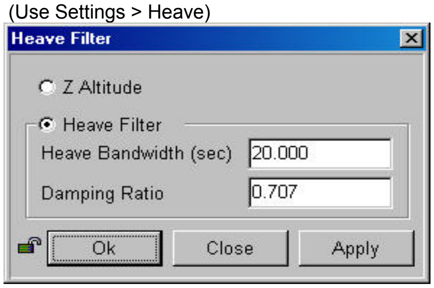
SETTINGS Continued

COM5



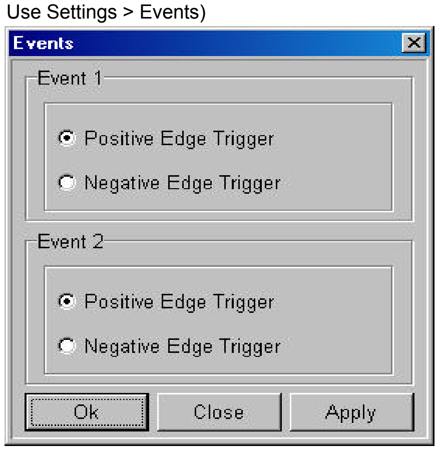
Heave Filter

(Use Settings > Heave)



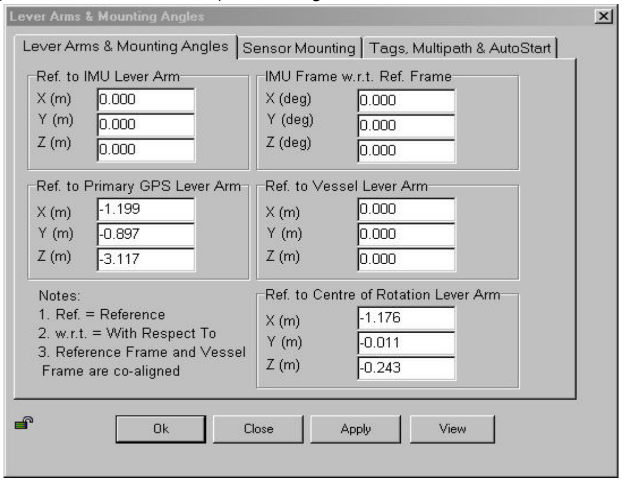
Events

Use Settings > Events)



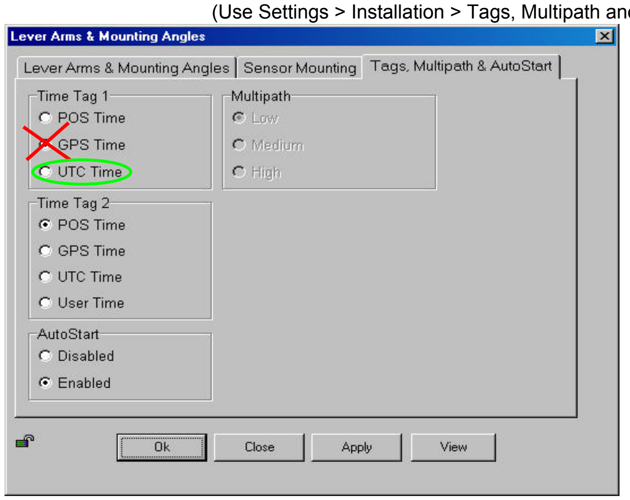
INSTALLATION (Use Settings > Installation)

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

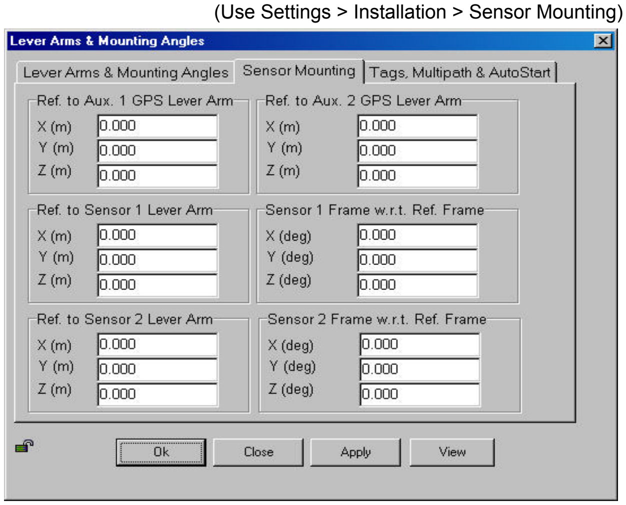


Tags, Multipath and Auto Start (Use Settings > Installation > Tags, Multipath and Auto Start)

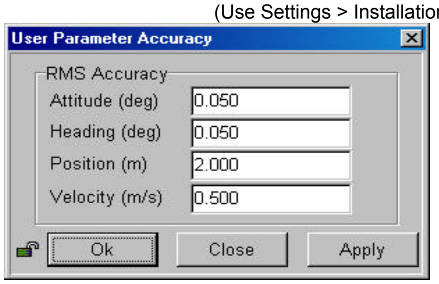
The Time Tag has since been shifted to UTC



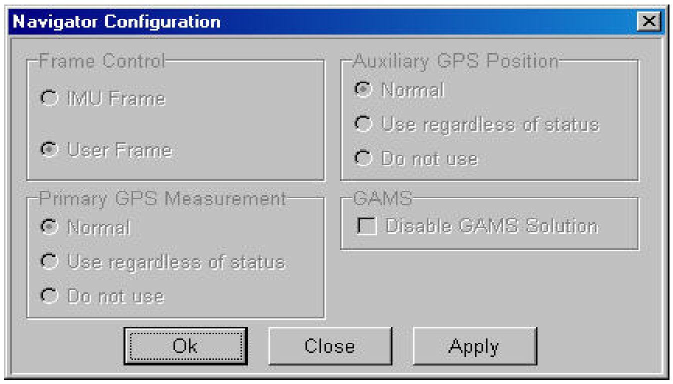
Sensor Mounting (Use Settings > Installation > Sensor Mounting)



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



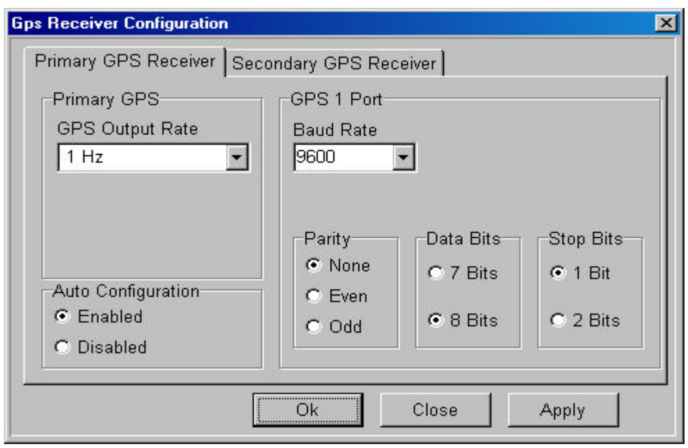
Frame Control (Use Tools > Config)



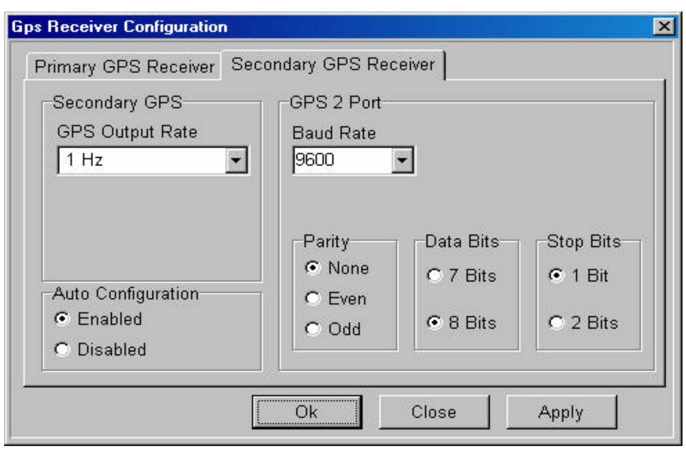
GPS Receiver Configuration

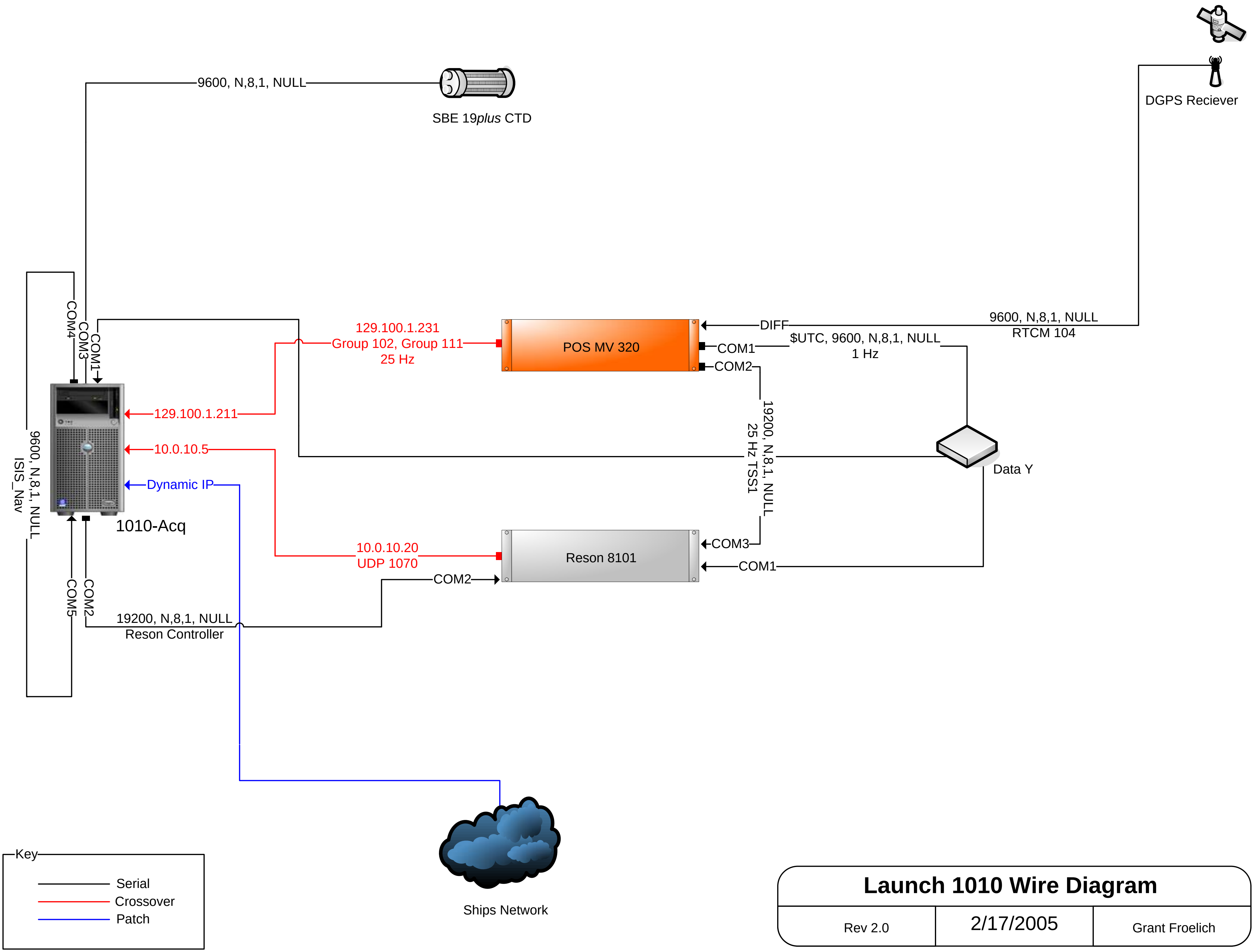
(Use Settings> Installation> GPS Receiver Configuration)

Primary GPS Receiver



Secondary GPS Receiver





Launch 1010 Wire Diagram		
Rev 2.0	2/17/2005	Grant Froelich

Vessel Name: FA_1018_Reson8101.hvf
Vessel created: December 19, 2006

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2007-001 00:00

Transduer #1:

Pitch Offset: -0.240
Roll Offset: 2.890
Azimuth Offset: 0.260

DeltaX: 0.286
DeltaY: -0.141
DeltaZ: 0.551

Manufacturer: Reson
Model: sb8101
Serial Number: 35737

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2007-224 00:00

Transduer #1:

Pitch Offset: -0.240
Roll Offset: 3.200
Azimuth Offset: 0.260

DeltaX: 0.286
DeltaY: -0.141
DeltaZ: 0.551

Manufacturer: Reson
Model: sb8101
Serial Number: 35737

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2007-236 00:00

Transduer #1:

Pitch Offset: -0.240
Roll Offset: 3.630
Azimuth Offset: 0.260

DeltaX: 0.286
DeltaY: -0.141
DeltaZ: 0.551

Manufacturer: Reson
Model: sb8101
Serial Number: 35737

Navigation Sensor:

Time Stamp: 2007-001 00:00

Comments POS time mistakenly set to GPS time requiring a 14 sec time correction
Latency 14.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2560

Time Stamp: 2007-102 00:00

Comments Time changed in POS to UTC - 14 sec time correction deleted
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2560

Gyro Sensor:

Time Stamp: 2007-001 00:00

Comments POS time mistakenly set to GPS time requiring a 14 sec time correction
Latency 14.000

Time Stamp: 2007-102 00:00

Comments Time changed in POS to UTC - 14 sec time correction deleted
Latency 0.000

Heave Sensor:

Time Stamp: 2007-001 00:00

Comments True Heave Enabled/POS time mistakenly set to GPS time requiring a 14 sec time correctionPOS time mistakenly set to GPS time requiring a 14 sec time correction
Apply Yes
Latency 14.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000
Offset: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2560

Time Stamp: 2007-102 00:00

Comments Time changed in POS to UTC - 14 sec time correction deleted
Apply Yes
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000
Offset: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2560

Pitch Sensor:

Time Stamp: 2007-001 00:00

Comments POS time mistakenly set to GPS time requiring a 14 sec time correction
Apply Yes
Latency 14.000
Pitch offset: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2560

Time Stamp: 2007-102 00:00

Comments Time changed in POS to UTC - 14 sec time correction deleted
Apply Yes
Latency 0.000
Pitch offset: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2560

Roll Sensor:

Time Stamp: 2007-001 00:00

Comments POS time mistakenly set to GPS time requiring a 14 sec time correction
Apply Yes
Latency 14.000
Roll offset: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2560

Time Stamp: 2007-102 00:00

Comments Time changed in POS to UTC - 14 sec time correction deleted
Apply Yes
Latency 0.000
Roll offset: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2560

Draft Sensor:

Time Stamp: 2007-001 00:00

Apply Yes
Comments DDSSM
Entry 1) Draft: 0.000 Speed: 0.000
Entry 2) Draft: 0.039 Speed: 5.015
Entry 3) Draft: 0.061 Speed: 6.026
Entry 4) Draft: 0.110 Speed: 7.425
Entry 5) Draft: 0.151 Speed: 8.242
Entry 6) Draft: 0.133 Speed: 9.350
Entry 7) Draft: 0.074 Speed: 10.341
Entry 8) Draft: 0.049 Speed: 11.955

TPE

Time Stamp: 2007-001 00:00

Comments
Offsets

Motion sensing unit to the transducer 1
X Head 1 0.286
Y Head 1 -0.141
Z Head 1 0.551
Motion sensing unit to the transducer 2
X Head 2 0.000
Y Head 2 0.000
Z Head 2 0.000
Navigation antenna to the transducer 1
X Head 1 1.184
Y Head 1 0.960
Z Head 1 3.711
Navigation antenna to the transducer 2
X Head 2 0.000
Y Head 2 0.000
Z Head 2 0.000

Roll offset of transducer number 1 0.000
Roll offset of transducer number 2 0.000

Heave Error: 0.050 or 5.000'' of heave amplitude.
Measurement errors: 0.007
Motion sensing unit alignment errors
Gyro:0.090 Pitch:0.060 Roll:0.060
Gyro measurement error: 0.020
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 0.500
Transducer timing error: 0.005
Navigation timing error: 0.005
Gyro timing error: 0.005
Heave timing error: 0.005
PitchTimingStdDev: 0.005
Roll timing error: 0.005
Sound Velocity speed measurement error: 0.007
Surface sound speed measurement error: 0.007

```
Tide measurement error: 0.007
Tide zoning error: 0.030
Speed over ground measurement error: 0.030
Dynamic loading measurement error: 0.010
Static draft measurement error: 0.016
Delta draft measurement error: 0.050
StDev Comment: `éƒJ Ï…J`õ…JPõ…J°ð…J €…J@í…J°k€JàZ€J€Ó…Ja
```

```
Svp Sensor:

        Time Stamp:      2007-001 00:00

        Comments
        Svp #1:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 0.286
        DeltaY: -0.141
        DeltaZ: 0.551

        SVP #2:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 0.000
        DeltaY: 0.000
        DeltaZ: 0.000


        Time Stamp:      2007-224 00:00

        Comments
        Svp #1:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 0.286
        DeltaY: -0.141
        DeltaZ: 0.551

        SVP #2:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 0.000
        DeltaY: 0.000
        DeltaZ: 0.000


        Time Stamp:      2007-236 00:00

        Comments
        Svp #1:
        -------------
```

```
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 0.286
        DeltaY: -0.141
        DeltaZ: 0.551

        SVP #2:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 0.000
        DeltaY: 0.000
        DeltaZ: 0.000
```

WaterLine:

```
        Time Stamp:      2007-001 00:00

        Comments
        Apply Yes
        WaterLine -0.280
```

1018 Offsets and Measurements
Summary

Measurement	IMU to RP*	8101 to RP*	IMU to 8101	Port Ant to 8101	RP* to Waterline
aka			*SWATH1 x,y,z & MRU to Trans*	*Nav to Trans x,y,z*	
Coord. Sys.	Caris	Caris	Caris	Caris	Caris
x	0.000	0.286	0.286	1.184	n/a
y	0.000	-0.141	-0.141	0.960	n/a
z	0.000	0.551	0.551	3.711	-0.276

*IMU is Reference Point

Vessel Offsets for 1018_8101 are derived from the Horizontal, Vertical & XYZ worksheets in this spreadsheet.

2007 Measured Value

Calculations

Coord. Sys. **Theodolite**

8101 to RP*

IMU to 8101

IMU (m)	x	3.54587
	y	-0.01516
	z	-0.85883
BM H	x	3.30204
	y	0.43081
	z	-1.0485
IMU to BM H	x	-0.244
	y	0.446
	z	-0.190
BM H to Phase Ctr measured (cm)	x	10.3
	y	-16.0
	z	-36.1
BM H to Phase Ctr (m)	x	0.103
	y	-0.160
	z	-0.361

Port Ant to 8101

IMU (m)	x	3.545867
	y	-0.01516
	z	-0.85883
Port Ant (m)	x	2.445
	y	-0.913
	z	2.302
IMU to Port Antenna	x	-1.101
	y	-0.898
	z	3.161
IMU to Phase Ctr	x	-0.141
	y	0.286
	z	-0.551

RP to Waterline

IMU (m)	x	3.546
	y	-0.015
	z	-0.859
BM C	x	0.000
	y	0.000
	z	0.000
BM C to IMU	x	n/a
	y	n/a
	z	-0.859
BM C to Waterline (m)	z	-0.583

see

Coord. Sys. **Theodolite**

IMU to 8101

	IMU to 8101		Port Ant to 8101		RP to Waterline	
IMU to Phase Ctr	x	-0.141	x	0.960	x	n/a
	y	0.286	y	1.184	y	n/a
	z	-0.551	z	-3.711	z	0.276

Coord. Sys. CARIS		Coord. Sys. CARIS		Coord. Sys. CARIS	
x	0.286	x	1.184	x	n/a
y	-0.141	y	0.960	y	n/a
z	0.551	z	3.711	z	-0.276

1018 Offsets and Measurements
Summary

Port Ant to Stbd Ant		IMU to Port Ant		IMU to Heave	
		Caris	Pos/Mv	Caris	Pos/Mv
Scaler Distance	1.834	-0.898	-1.101	0.015	-1.114
		-1.101	-0.898	-1.114	0.015
		-3.161	-3.161	-0.276	-0.276

Port Ant to Stbd Ant			IMU to Port Ant			IMU to Heave		
Port Ant (m)	x	2.445	IMU (m)	x	3.546	IMU (m)	y	-0.015
	y	-0.913		y	-0.015	x is n/a	z	-0.859
	z	2.302		z	-0.859			
						Heave Pt (m)		
Stbd Ant (m)	x	2.445	Port Ant(m)	x	2.445	(centerline)	y	0.000
	y	0.921		y	-0.913			
	z	2.275		z	2.302	BM C to Waterline (m)		-0.583
						measured scalar dist		
						BM C		
						x&y are n/a	z	0.000
						BM C to Waterline (m)		
						(Heave Pt)	z	-0.583
						IMU to Hv	x	-1.114

See IMU to Heave tab.

Port Ant to Stbd Ant		IMU to Port Ant		IMU to Heave	
		x	-1.101	x	-1.114
Scalar Distance	1.8342	y	-0.898	y	0.015
		z	3.161	z	0.276

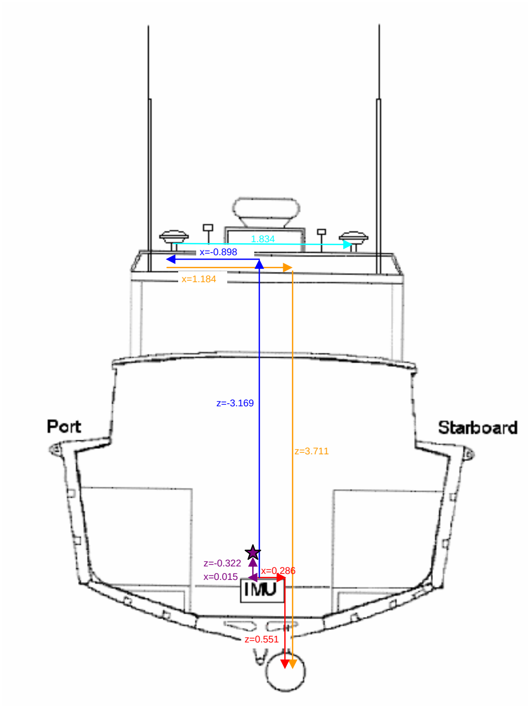
Coord. Sys. Pos/Mv		Coord. Sys. Pos/Mv	
x	-1.101	x	-1.114
y	-0.898	y	0.015
z	-3.161	z	-0.276

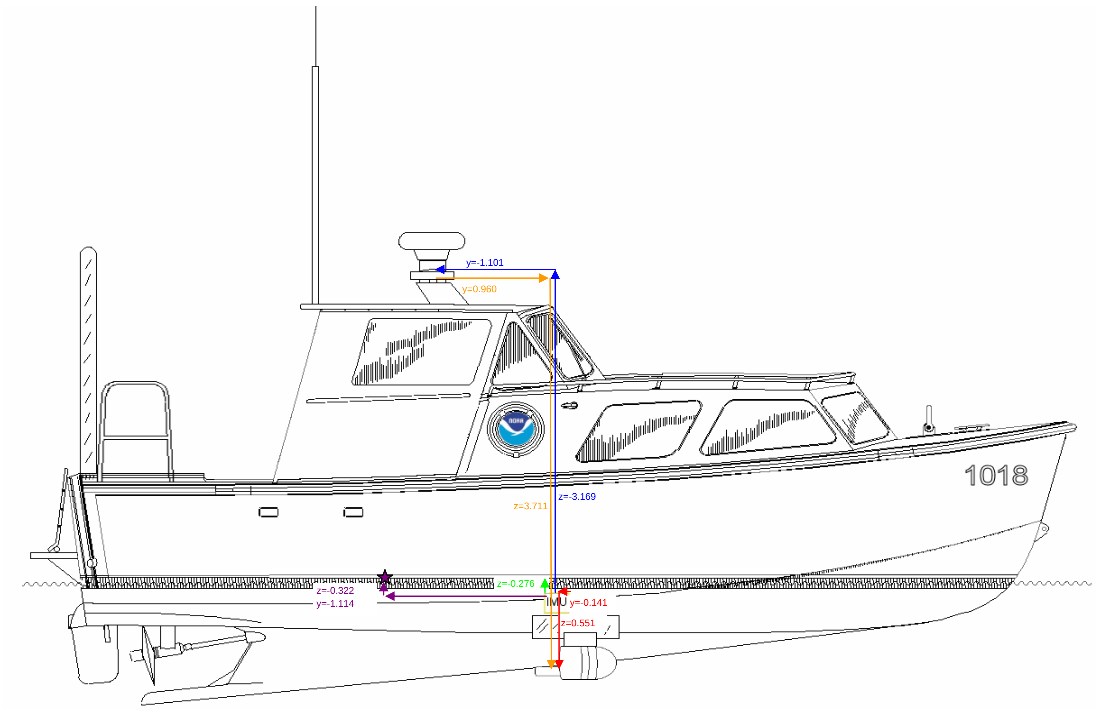
See IMU to Heave tab.

Description of Offsets for Launch 1018

All Values Shown are in CARIS Coordinates

The Ship Reference Frame (SRF) for Launch 1018 was based from benchmark (BM) C as the 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 8101		
x	y	z
0.286	-0.141	0.551

The physical positions of the IMU and the phase center of the 8101 with respect to the Ship Reference Frame were measured by NOAA personnel. These physical measurements were used to calculate the xyz offsets from the IMU to BM H. Measurements from BM H to the Phase Center of the 8101 were collected by NOAA personnel while the boat was secured in the davit and thought to be as level as possible. The measured offsets from BM H to the phase center were then added to the offset from the IMU to BM H. The result is the offset from the IMU to the phase center of the transducer. The values in the X and Y fields are transposed and the inverse of the Z value is used to give the offsets in CARIS coordinates.

Port Ant to 8101		
x	y	z
1.184	0.960	3.711

NOAA personnel calculated the distance between the port antenna and the phase center of the port antenna subtracting the IMU to Port Antenna value from the IMU to Phase Center value.

RP to Waterline		
x	y	z
N/A	N/A	-0.276

The vertical distance from BM A and B to the waterline was measured by FAIRWEATHER personnel using a steel tape and bubble level. With the knowledge of the two BMs height above the IMU, the waterline height above the IMU could be calculated. On launch 1010, the IMU is used as the reference point.

Port Ant to Stbd Ant
Scalar Distance
1.834

The location of the phase center of the port and starboard POS/MV antennas were measured by NOAA personnel with respect to the SRF. The scalar distance between the phase centers was then calculated.

IMU to Port Antenna		
x	y	z
-0.898	-1.101	-3.169

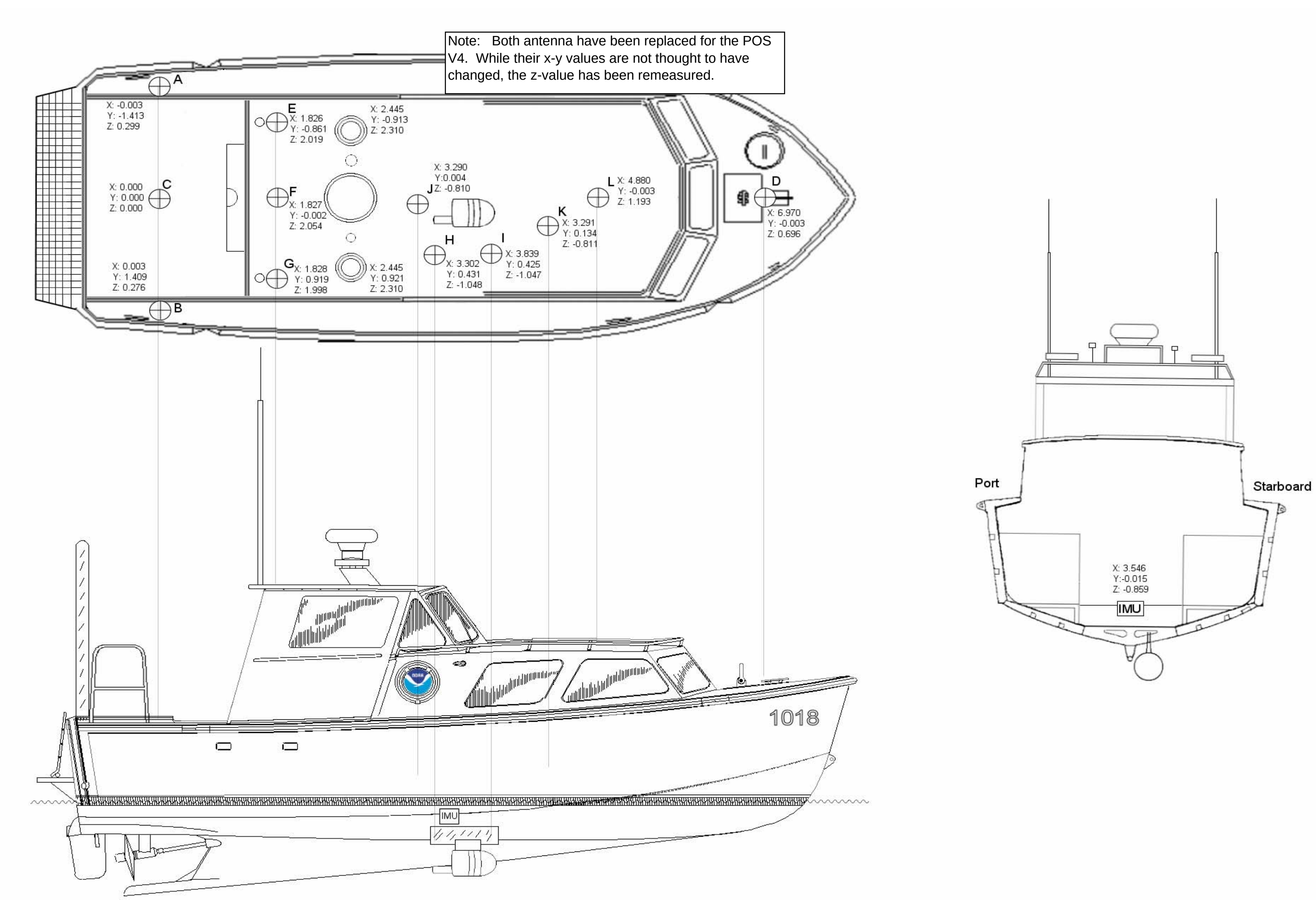
The location of the IMU and the location of the port antenna were measured by NOAA personnel with respect to the Ship Reference Frame (SRF). The xyz offsets from the IMU to the port antenna could be calculated from these physical locations.

IMU to Heave		
x	y	z
0.015	-1.114	-0.276

The heave point was positioned differently on each of the axes. The distance for the longitundinal axis was determined as described in the "IMU to Heave" tab in this workbook. The athwart ships axis was the vessel centerline. Lastly, the waterline was used as the height of the heave point, which was calculated earlier in 'RP to Waterline'.

1018 Vessel Diagram

All Values Shown are in Theodolite Coordinates



FAIRWEATHER

Multibeam Echosounder Calibration

Launch 1018
Vessel

Date	Dn	Local Area
4/9/2007	099	Ketchikan

Calibrating Hydrographer(s): Gonsalves, Johnston, Brown, Froelich

MBES System	MBES System Location	Date of most recent EED/Factory Check
Reson 8101		

Sonar Serial Number	Processing Unit Serial Number
35737	

Sonar Mounting Configuration	Date of current offset measurement/verification

Description of Positioning System	Date of most recent positioning system calibration
POSMV4	

Acquisition Log

Date	Dn	Local Area	Wx
4/9/2007	099	Ketchikan	Calm

Bottom Type	Approximate Water Depth
	40m

Personnel on board: Gonsalves, Johnston, Brown, Froelich

Comments:

TrueHeave filename: TH_1018_DN099

SV Cast filename	UTC Time	Lat	Lon	Ext. Depth	Bk time to	For lines
SV Cast #1: 07099171	17:11	55/19/59	-131/37/52	57.1		
SV Cast #2: 07099185	18:51	55/16/28	-131/40/26	77.2		
SV Cast #3: 07099203		55/11/29	-131/37/36	81.1		

ROLL

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
70991851.ex	Roll1	270	4.8	Kurt's
	Roll2	090	4.6	Kurt's
	Roll3	270	4.8	Bonnie's
	Roll4	090	4.6	Bonnie's
	Roll5	270	4.7	Mike's
	Roll6	090	4.6	Mike's

PITCH

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
070991711.ex	pitch1	100	4.5	
	pitch2	292	4.5	
	pitch3	BAD	BAD	
	pitch4	292	4.5	
	pitch5	100	4.5	
	pitch6	295	4.5	

HEADING/YAW

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
070991711.ex	HEADING1	120	4.5	
	HEADING2	295	4.5	
	HEADING3	117	4.5	
	HEADING4	295	4.5	

REF SURFACE

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
70992033	099-2053			Reference surface on 11fm shoal
70992033	099-2055 to 2101			

Processing Log

Date	Dn	Personnel

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

☑ **TrueHeave applied** TH_1018_DN099.000 (kb)

☑ **SVP applied** kb

☑ **Tide applied** kb - No zoning used for patch lines over wreck - outside zoning file

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 (sec)	Pitch (deg)	Roll (deg)	Yaw (deg)
mog	14.00	-0.25	2.90	0.20
keb	14.00	-0.30	2.87	0.22
blj	14.00	-0.18	2.90	0.36
Averages	14.00	-0.24	2.89	0.26
Standard Deviation	0.00	0.06	0.02	0.09
FINAL VALUES	14.00	-0.24	2.89	0.26

Final Values based on Group Average

Resulting HVF File Name FA_1018_Reson8101

MRU Align StdDev gyro 0.09 Value from standard deviation of Heading offset values

MRU Align StdDev Roll/Pitch 0.06 Value from sum of squares standard deviations of pitch and roll offset v

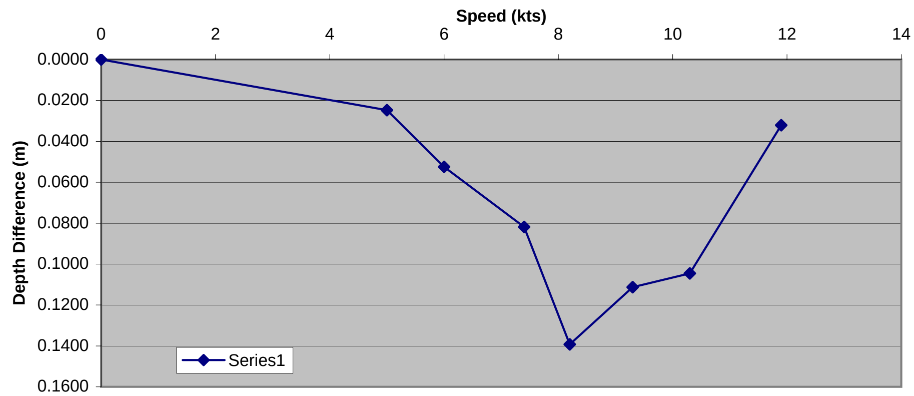
NARRATIVE

Time on the POSMV was mistakenly set to GPS time on launches for all data acquired prior to DN100. This resulted in a latency value of 14.00 seconds which is equivalent to the time difference between GPS and UTC time. GPS time is ahead 14 seconds. Following this discovery the POSMV was corrected to log UTC time on both launches. Two lines of offset values have been added to the HVFs for 1018. The first set of offsets include 14 seconds entered into the time correction field for Navigation, Gyro, Heave, Ptich, and Roll, and should be used for all data collected on and before DN100. The second set has the time correction field set to zero and should be used for all data collected on and after DN102. Values for Pitch, Roll and Yaw in both set of offsets were taken from the average bias values shown above.

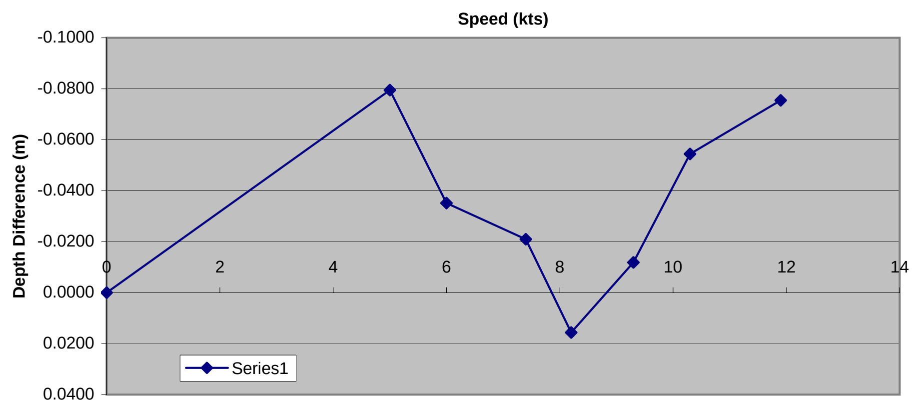
☑ **HVF Hydrographic Vessel File created or updated with current offsets**

Name: Kurt Brown **Date:** 04/12/2007

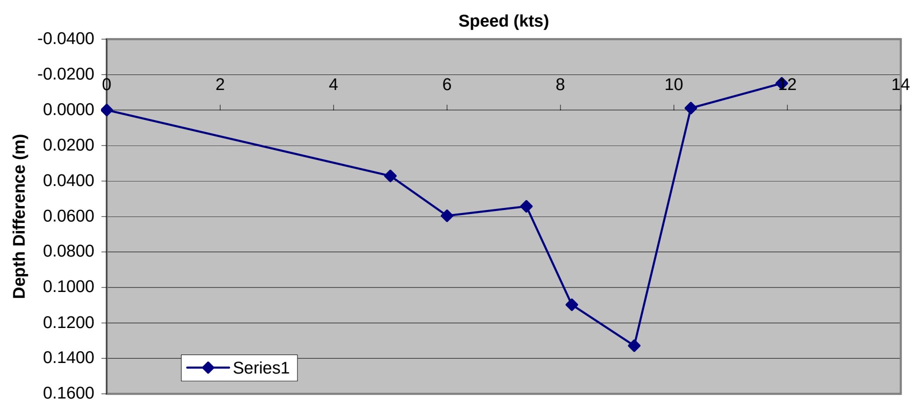
RPM	Speed (m/s)	Speed (knots)	mog-Ave	bj-Ave	kb-Ave	Std. Dev.	Average
	0	0	0	0	0	0	0
	2.58	5	-0.00585794	0.079715319	0.043122636	0.042935813	0.038993338
	3.10	6	0.025614878	0.079009483	0.076973913	0.030256894	0.060532758
	3.82	7.4	0.03839154	0.148848379	0.144137953	0.062456925	0.110459291
	4.24	8.2	0.08821736	0.151215298	0.214475233	0.063128982	0.15130263
	4.81	9.3	0.077429894	0.200576308	0.121471387	0.062399627	0.133159196
	5.32	10.3	0.016338694	0.109102998	0.095486417	0.050091565	0.073642703
	6.15	11.9	-0.01948801	0.099463807	0.0659994	0.061342615	0.048658399



1018 - Stop#1 DDSSM



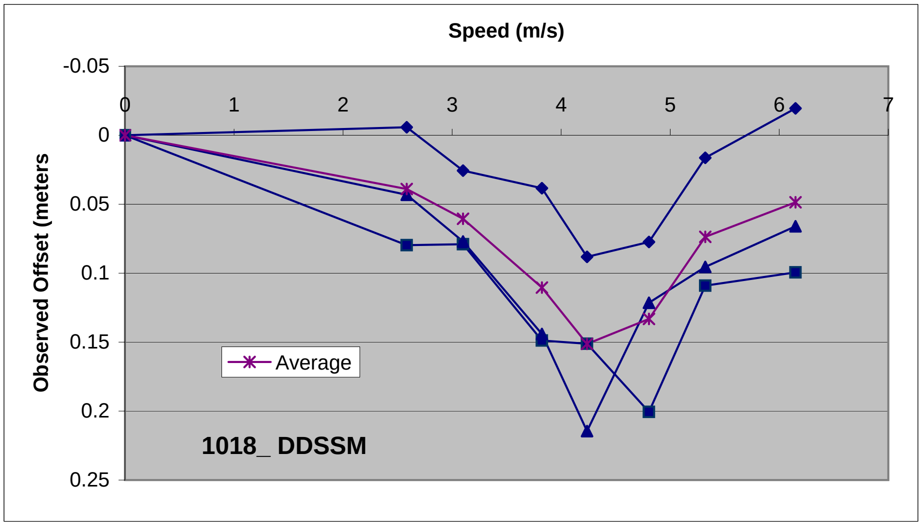
1018 - Stop#2 DDSSM



1018 - Stop#3 DDSSM

Blue cells used in computation of Delta Draft
StDev used in TPE

Ave StDev 0.052236



NOAA POS/MV Calibration Report

Ship: FAIRWEATHER **Vessel:** 1018

Date: 3/30/2007 **Dn:** 89

Personnel: Froelich, Lewis, Campbell

PCS Serial # 2560 **IMU Serial #** 37

IP Address: 129.100.1.231

POS controller Version (Use Menu Help > About) 3.3.2.2

POS Version (Use Menu View > Statistics) MV320 v4

GPS Receivers

Primary Receiver SN:4624A70243

Secondary Receiver SN:4624A70263

Calibration area

Location: Bostwick Inlet, AK

Approximate Position:

Lat	55	13	30
Lon	131	43	30

DGPS Beacon Station: Annete Island

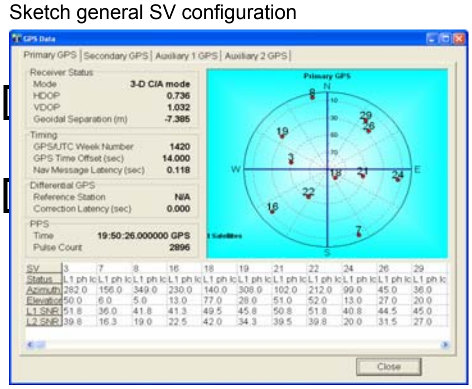
Frequency: 323 kHz

Satellite Constellation

(Use View> GPS Data)

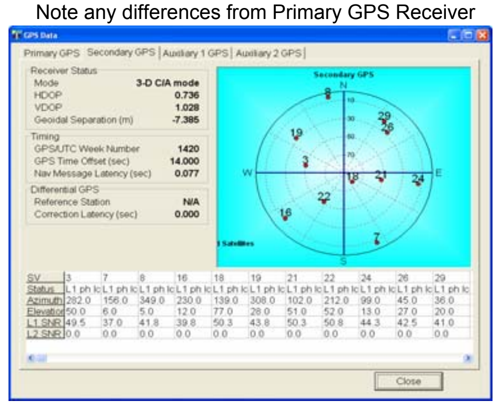
Primary GPS

Sketch general SV configuration



Secondary GPS

Note any differences from Primary GPS Receiver

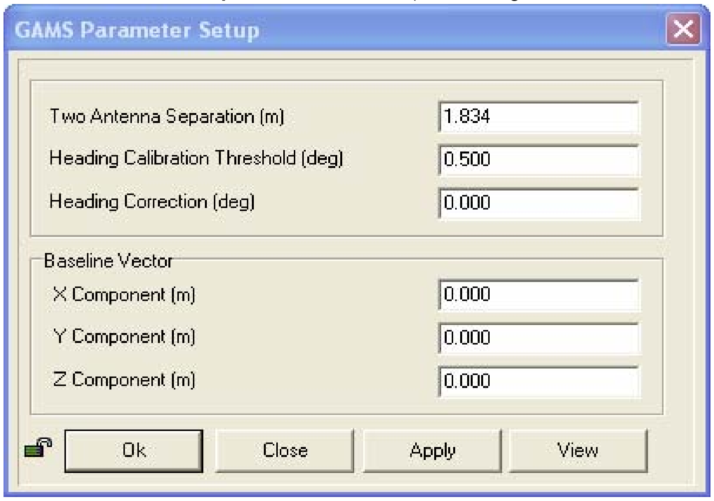


PDOP 1.7 (Use View> GAMS Solution)

POS/MV Configuration

Settings

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



Configuration Notes: ______________________________

POS/MV Calibration

Calibration Procedure:

(Refer to POS MV V3 Installation and Operation Guide, 4-25)

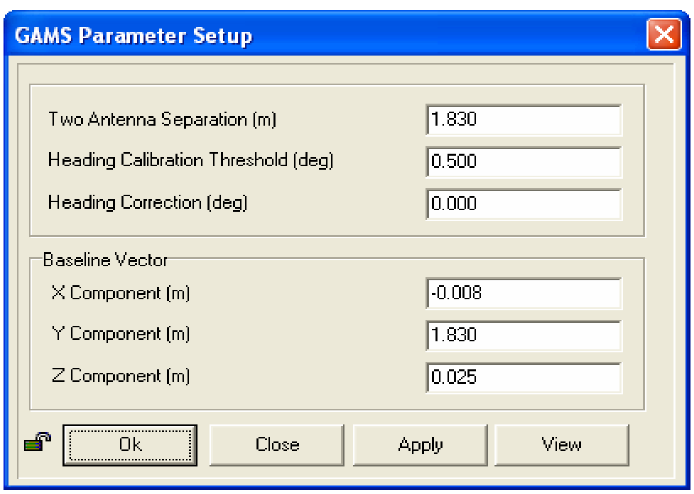
Start time: 1130

End time: 1135

Heading accuracy achieved for calibration: 0.085

Calibration Results:

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



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.

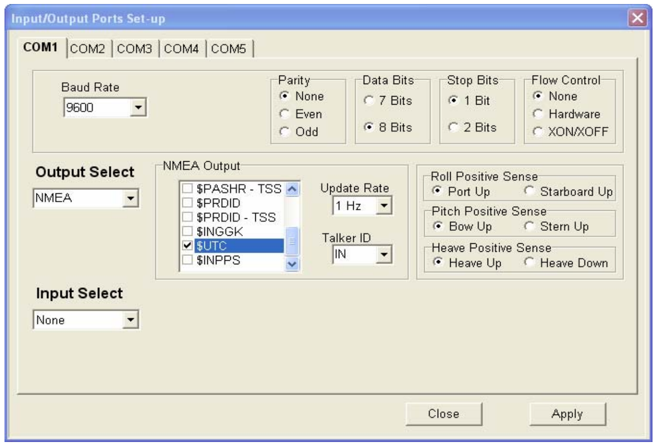
b) Pitch rotation - apply a right-hand screw rotation θy about the once-rotated y-axis to align one frame with the other.

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

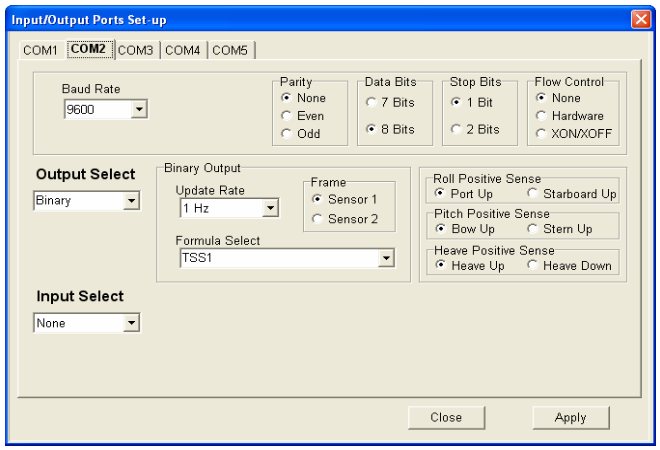
SETTINGS

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

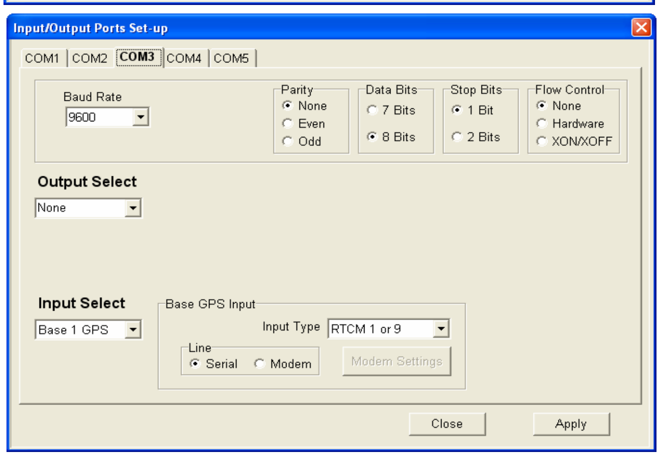
COM1



COM2

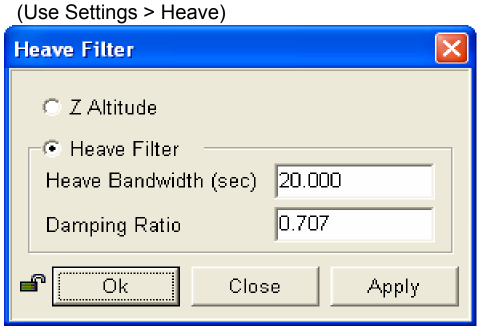


COM3

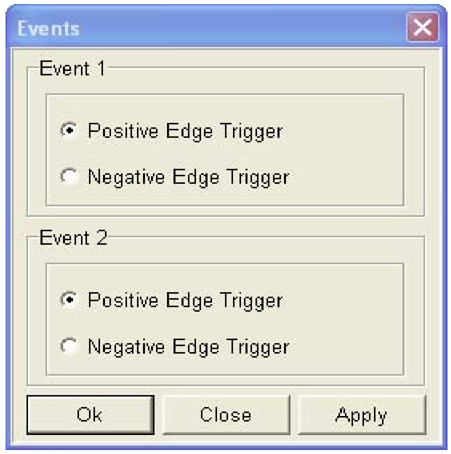


SETTINGS Continued

Heave Filter (Use Settings > Heave)

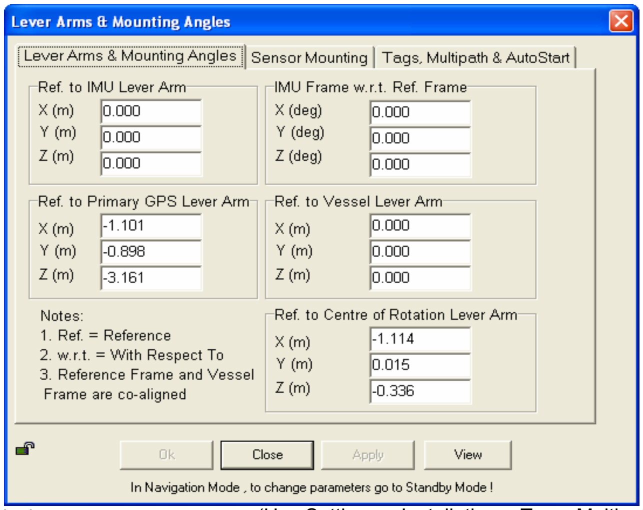


Events Use Settings > Events)



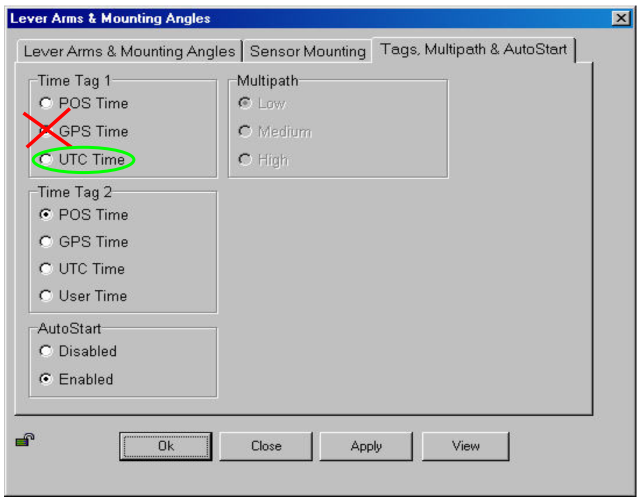
INSTALLATION (Use Settings > Installation)

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

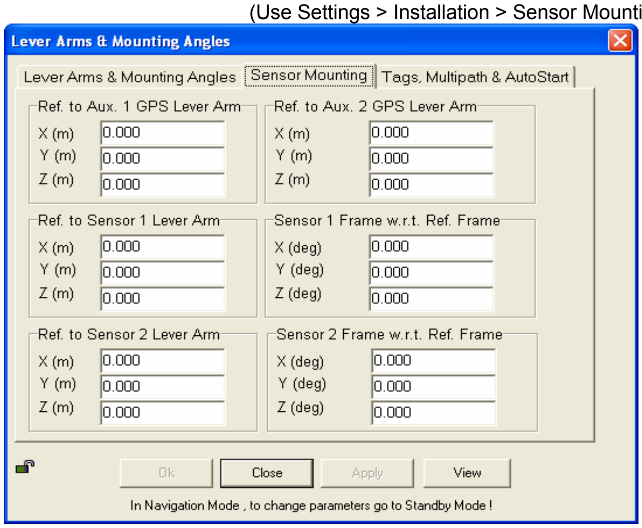


Tags, Multipath and Auto Start (Use Settings > Installation > Tags, Multipath and Auto Start)

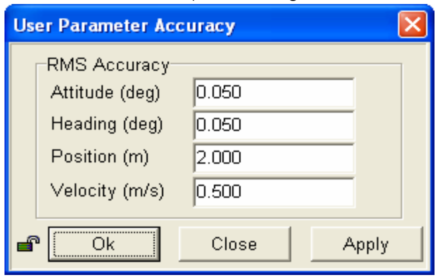
Time Tag 1 has been shifted to UTC time.



Sensor Mounting (Use Settings > Installation > Sensor Mounting)



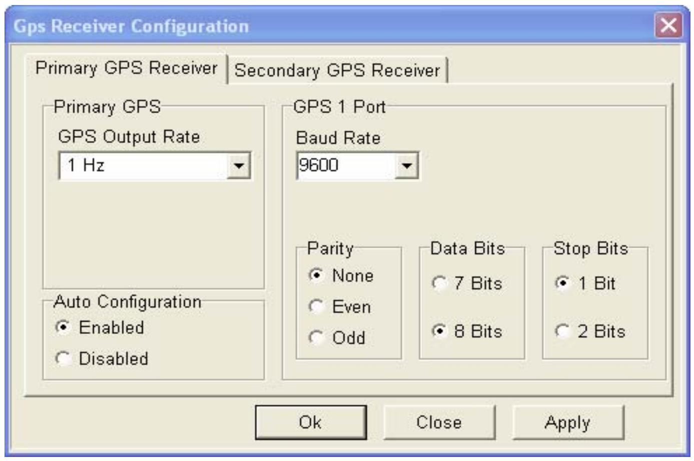
User Parameter Accuracy (Use Settings > Installation > User Accuracy)



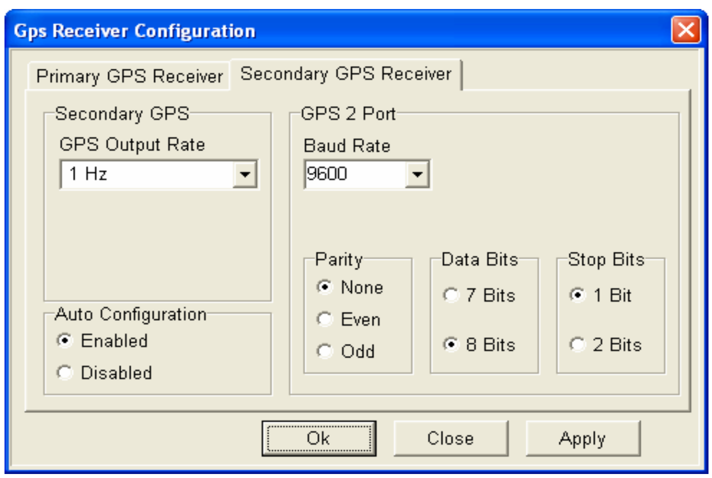
GPS Receiver Configuration

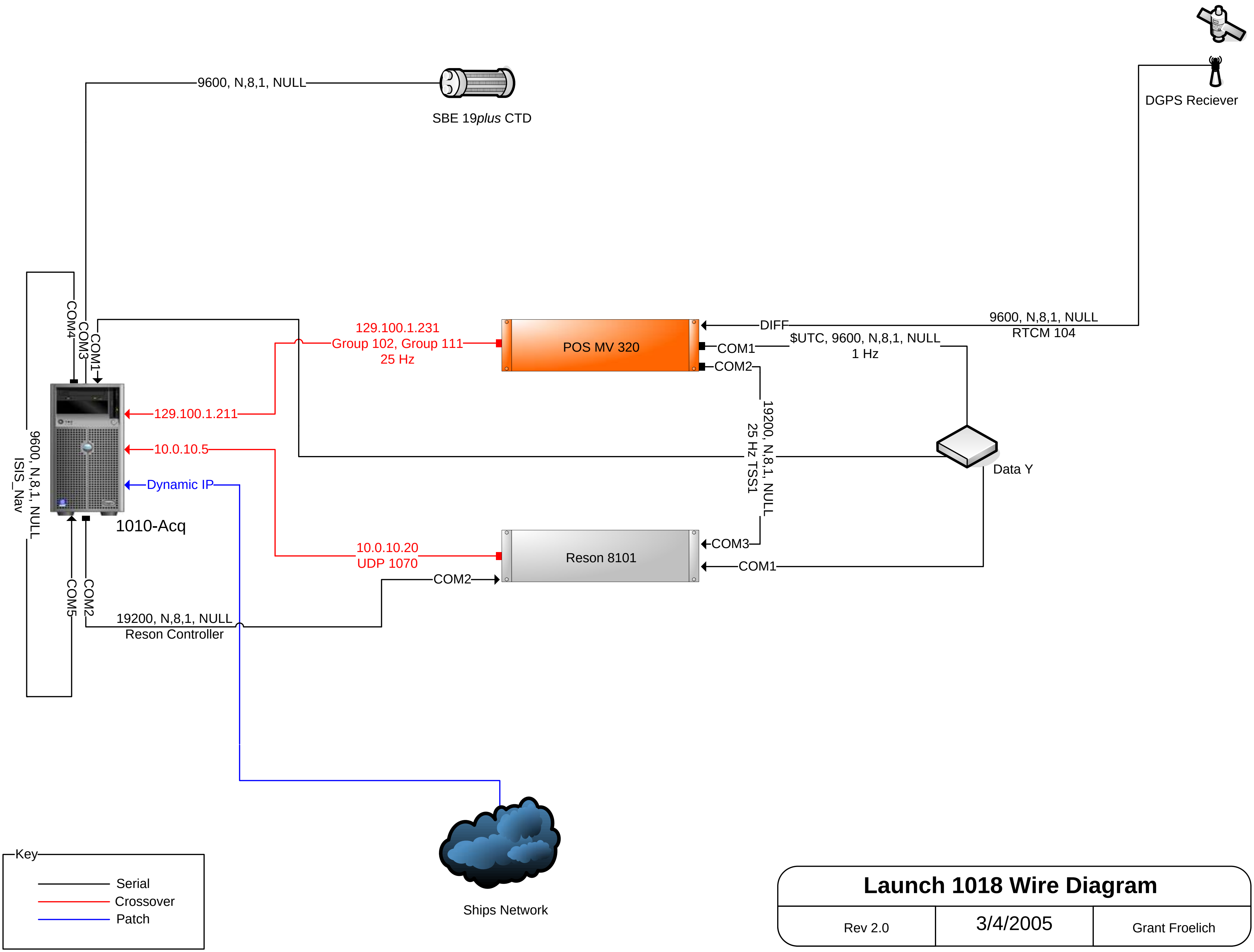
(Use Settings> Installation> GPS Receiver Configuration)

Primary GPS Receiver



Secondary GPS Receiver





Launch 1018 Wire Diagram

Rev 2.0	3/4/2005	Grant Froelich

```
Vessel Name: FA_S220_Reson8111.hvf
Vessel created: December 19, 2006


Depth Sensor:

        Sensor Class:    Swath
        Time Stamp:      2006-001 00:00

        Transduer #1:
        -------------
        Pitch Offset:   -0.630
        Roll Offset:    -0.010
        Azimuth Offset: -0.520

        DeltaX: 2.868
        DeltaY: 8.252
        DeltaZ: 4.753

        Manufacturer:    Reson
        Model:           sb8111
        Serial Number:

Depth Sensor:

        Sensor Class:    Swath
        Time Stamp:      2006-216 00:00

        Transduer #1:
        -------------
        Pitch Offset:   -0.630
        Roll Offset:    -0.010
        Azimuth Offset: -0.520

        DeltaX: 2.868
        DeltaY: 8.252
        DeltaZ: 4.753

        Manufacturer:    Reson
        Model:           sb8111
        Serial Number:

Depth Sensor:

        Sensor Class:    Swath
        Time Stamp:      2007-001 00:00

        Transduer #1:
        -------------
        Pitch Offset:   -0.590
        Roll Offset:    -0.020
        Azimuth Offset: -0.380

        DeltaX: 2.868
        DeltaY: 8.252
        DeltaZ: 4.752

        Manufacturer:    Reson
        Model:           sb8111
        Serial Number:

___________________________________________________________
Navigation Sensor:
```

Time Stamp: 2006-001 00:00

Comments (null)
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Applanix
Model: POS/MV v320
Serial Number: 846

Time Stamp: 2007-001 00:00

Comments (null)
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2411

Gyro Sensor:

Time Stamp: 2006-001 00:00

Comments (null)
Latency 0.000

Time Stamp: 2007-001 00:00

Comments (null)
Latency 0.000

Heave Sensor:

Time Stamp: 2006-001 00:00

Comments True Heave Enabled
Apply Yes
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000
Offset: 0.000

Manufacturer: Applanix
Model: POS/MV v320
Serial Number: 846

Time Stamp: 2007-001 00:00

Comments True Heave Enabled
Apply Yes
Latency 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000
Offset: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2411

Pitch Sensor:

Time Stamp: 2006-001 00:00

Comments (null)
Apply Yes
Latency 0.000
Pitch offset: 0.000

Manufacturer: Applanix
Model: POS/MV v320
Serial Number: 846

Time Stamp: 2007-001 00:00

Comments (null)
Apply Yes
Latency 0.000
Pitch offset: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2411

Roll Sensor:

Time Stamp: 2006-001 00:00

Comments (null)
Apply Yes
Latency 0.000
Roll offset: 0.000

Manufacturer: Applanix
Model: POS/MV v320
Serial Number: 846

Time Stamp: 2007-001 00:00

Comments (null)
Apply Yes
Latency 0.000
Roll offset: 0.000

Manufacturer: Applanix
Model: POS/MV v4
Serial Number: 2411

Draft Sensor:

```
        Time Stamp:      2006-001 00:00

        Apply Yes
        Comments
        Entry 1) Draft: 0.000   Speed: 0.000
        Entry 2) Draft: 0.090   Speed: 4.704
        Entry 3) Draft: 0.075   Speed: 6.104
        Entry 4) Draft: 0.064   Speed: 7.192
        Entry 5) Draft: 0.046   Speed: 8.106
        Entry 6) Draft: 0.095   Speed: 9.097
        Entry 7) Draft: 0.170   Speed: 11.605
        Entry 8) Draft: 0.189   Speed: 12.907

        Time Stamp:      2007-001 00:00

        Apply Yes
        Comments
        Entry 1) Draft: 0.000   Speed: 0.000
        Entry 2) Draft: -0.032  Speed: 4.024
        Entry 3) Draft: 0.002   Speed: 5.618
        Entry 4) Draft: 0.023   Speed: 8.339
        Entry 5) Draft: 0.142   Speed: 10.400
        Entry 6) Draft: 0.159   Speed: 11.857
        Entry 7) Draft: 0.232   Speed: 13.860
```

TPE

```
        Time Stamp:      2006-001 00:00

        Comments
        Offsets

        Motion sensing unit to the transducer 1
                X Head 1 2.868
                Y Head 1 8.252
                Z Head 1 4.753
        Motion sensing unit to the transducer 2
                X Head 2 0.000
                Y Head 2 0.000
                Z Head 2 0.000
        Navigation antenna to the transducer 1
                X Head 1 2.993
                Y Head 1 19.145
                Z Head 1 16.253
        Navigation antenna to the transducer 2
                X Head 2 0.000
                Y Head 2 0.000
                Z Head 2 0.000

        Roll offset of transducer number 1 0.000
        Roll offset of transducer number 2 0.000

        Heave Error: 0.050 or 5.000'' of heave amplitude.
        Measurement errors: 0.003
        Motion sensing unit alignment errors
        Gyro:0.230      Pitch:0.160     Roll:0.160
        Gyro measurement error: 0.020
        Roll measurement error: 0.020
        Pitch measurement error: 0.020
        Navigation measurement error: 0.500
        Transducer timing error: 0.005
        Navigation timing error: 0.005
```

Gyro timing error: 0.005
Heave timing error: 0.005
PitchTimingStdDev: 0.005
Roll timing error: 0.005
Sound Velocity speed measurement error: 0.003
Surface sound speed measurement error: 0.003
Tide measurement error: 0.003
Tide zoning error: 0.030
Speed over ground measurement error: 0.030
Dynamic loading measurement error: 0.030
Static draft measurement error: 0.050
Delta draft measurement error: 0.020
StDev Comment: `éƒJ Ï…J`õ…JPõ…J°ð…J €…J@í…J°k€JàZ€J€Ó…Ja

Time Stamp: 2007-001 00:00

Comments
Offsets

Motion sensing unit to the transducer 1
        X Head 1 2.868
        Y Head 1 8.252
        Z Head 1 4.752
Motion sensing unit to the transducer 2
        X Head 2 0.000
        Y Head 2 0.000
        Z Head 2 0.000
Navigation antenna to the transducer 1
        X Head 1 1.691
        Y Head 1 20.172
        Z Head 1 17.756
Navigation antenna to the transducer 2
        X Head 2 0.000
        Y Head 2 0.000
        Z Head 2 0.000

Roll offset of transducer number 1 0.000
Roll offset of transducer number 2 0.000

Heave Error: 0.050 or 5.000'' of heave amplitude.
Measurement errors: 0.007
Motion sensing unit alignment errors
Gyro:0.050   Pitch:0.110   Roll:0.110
Gyro measurement error: 0.020
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 0.500
Transducer timing error: 0.005
Navigation timing error: 0.005
Gyro timing error: 0.005
Heave timing error: 0.005
PitchTimingStdDev: 0.005
Roll timing error: 0.005
Sound Velocity speed measurement error: 0.003
Surface sound speed measurement error: 0.003
Tide measurement error: 0.003
Tide zoning error: 0.030
Speed over ground measurement error: 0.030
Dynamic loading measurement error: 0.020
Static draft measurement error: 0.022
Delta draft measurement error: 0.075
StDev Comment: `éƒJ Ï…J`õ…JPõ…J°ð…J €…J@í…J°k€JàZ€J€Ó…Ja

```
Svp Sensor:

        Time Stamp:      2006-001 00:00

        Comments
        Svp #1:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 2.868
        DeltaY: 8.252
        DeltaZ: 4.753

        SVP #2:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 0.000
        DeltaY: 0.000
        DeltaZ: 0.000


        Time Stamp:      2006-216 00:00

        Comments
        Svp #1:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 2.868
        DeltaY: 8.252
        DeltaZ: 4.753

        SVP #2:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 0.000
        DeltaY: 0.000
        DeltaZ: 0.000


        Time Stamp:      2007-001 00:00

        Comments
        Svp #1:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 2.868
        DeltaY: 8.252
        DeltaZ: 4.752
```

```
        SVP #2:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: 0.000
        DeltaY: 0.000
        DeltaZ: 0.000
```

WaterLine:

```
        Time Stamp:      2006-001 00:00

        Comments
        Apply Yes
        WaterLine -0.010

        Time Stamp:      2007-001 00:00

        Comments
        Apply Yes
        WaterLine 0.000
```

```
Vessel Name: FA_S220_Reson8160_5to750.hvf
Vessel created: December 19, 2006


Depth Sensor:

        Sensor Class:    Swath
        Time Stamp:      2007-001 00:00

        Transduer #1:
        -------------
        Pitch Offset:   -0.290
        Roll Offset:    -0.040
        Azimuth Offset: 0.100

        DeltaX: 0.493
        DeltaY: 7.665
        DeltaZ: 4.726

        Manufacturer:    Reson
        Model:           sb8160a
        Serial Number:

_________________________________________________________
Navigation Sensor:

        Time Stamp:      2007-001 00:00

        Comments (null)
        Latency 0.000
        DeltaX: 0.000
        DeltaY: 0.000
        DeltaZ: 0.000

        Manufacturer:    Applanix
        Model:           POS/MV v4
        Serial Number:   2411

_________________________________________________________
Gyro Sensor:

        Time Stamp:      2007-001 00:00

        Comments (null)
        Latency 0.000

_________________________________________________________
Heave Sensor:

        Time Stamp:      2007-001 00:00

        Comments True Heave Enabled
        Apply Yes
        Latency 0.000
        DeltaX: 0.000
        DeltaY: 0.000
        DeltaZ: 0.000
        Offset: 0.000

        Manufacturer:    Applanix
        Model:           POS/MV v4
        Serial Number:   2411
```

Pitch Sensor:

```
        Time Stamp:      2007-001 00:00

        Comments (null)
        Apply No
        Latency 0.000
        Pitch offset: 0.000

        Manufacturer:    Applanix
        Model:           POS/MV v4
        Serial Number:   2411
```

Roll Sensor:

```
        Time Stamp:      2007-001 00:00

        Comments (null)
        Apply No
        Latency 0.000
        Roll offset: 0.000

        Manufacturer:    Applanix
        Model:           POS/MV v4
        Serial Number:   2411
```

Draft Sensor:

```
        Time Stamp:      2007-001 00:00

        Apply Yes
        Comments DDSSM
        Entry 1) Draft: 0.000   Speed: 0.000
        Entry 2) Draft: -0.031  Speed: 4.024
        Entry 3) Draft: 0.002   Speed: 5.618
        Entry 4) Draft: 0.022   Speed: 8.339
        Entry 5) Draft: 0.136   Speed: 10.400
        Entry 6) Draft: 0.153   Speed: 11.857
        Entry 7) Draft: 0.223   Speed: 13.860
```

TPE

```
        Time Stamp:      2007-001 00:00

        Comments
        Offsets

        Motion sensing unit to the transducer 1
                X Head 1 0.493
                Y Head 1 7.665
                Z Head 1 4.726
        Motion sensing unit to the transducer 2
                X Head 2 0.000
                Y Head 2 0.000
                Z Head 2 0.000
        Navigation antenna to the transducer 1
                X Head 1 1.691
                Y Head 1 20.172
                Z Head 1 17.756
        Navigation antenna to the transducer 2
```

X Head 2 0.000
Y Head 2 0.000
Z Head 2 0.000

Roll offset of transducer number 1 0.000
Roll offset of transducer number 2 0.000

Heave Error: 0.050 or 5.000'' of heave amplitude.
Measurement errors: 0.007
Motion sensing unit alignment errors
Gyro:0.030 Pitch:0.260 Roll:0.260
Gyro measurement error: 0.020
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 0.500
Transducer timing error: 0.005
Navigation timing error: 0.005
Gyro timing error: 0.005
Heave timing error: 0.005
PitchTimingStdDev: 0.005
Roll timing error: 0.005
Sound Velocity speed measurement error: 0.500
Surface sound speed measurement error: 0.100
Tide measurement error: 0.010
Tide zoning error: 0.000
Speed over ground measurement error: 0.030
Dynamic loading measurement error: 0.020
Static draft measurement error: 0.030
Delta draft measurement error: 0.075
StDev Comment: `éƒJ Ï…J`õ…JPõ…J°ð…J €…J@í…J°k€JàZ€J€Ó…Ja

Svp Sensor:

Time Stamp: 2007-001 00:00

Comments
Svp #1:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.493
DeltaY: 7.665
DeltaZ: 4.726

SVP #2:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

WaterLine:

Time Stamp: 2007-001 00:00

Comments
Apply Yes

WaterLine -0.002

S220_8111 Measurements

Measurement	IMU to 8111 (MRU to Trans)		Port Ant to 8111 (Nav to Trans)		Waterline to RP*		Port Ant to Stbd Ant		IMU to Port Ant		IMU to Heave	
Coord. Sys.		Caris		Caris		Caris			Caris	Pos/Mv	Caris	Pos/Mv
x		2.868		2.993		n/a	Scaler Distance	4.064	-0.125	-10.893	1.866	-7.028
y		8.252		19.145		n/a			-10.893	-0.125	-7.028	1.866
z		4.753		16.253		-0.010			-11.501	-11.501	-2.085	-2.085

*Top of IMU is RP (Reference Pt)

Vessel Offsets for S220_8111 are derived from Westlake-Survey-Report-NOAA-Fairweather-09-23-03.pdf

2006 Measured Values

Calculations

Coord. Sys. Westlake

IMU to 8111

IMU Base	easting	0.000
	northing	0.000
(ft/m)	elevation	0.000
8111	easting	27.072
(ft)	northing	9.410
	elevation	15.042
8111	easting	8.252
(m)	northing	2.868
	elevation	4.585
Base of IMU to Top of IMU (inverse of measured value)		
(m)	elevation	-0.168

Port Ant to 8111

Port Ant	easting	-35.739
	northing	-0.409
(ft)	elevation	-38.283
8111	easting	27.072
(ft)	northing	9.410
	elevation	15.042
Port Ant to 8111		
(ft)	easting	62.811
	northing	9.819
	elevation	53.325

Waterline to RP*

IMU Base to baseline at Keel		
(ft)	elevation	12.856
IMU Base to baseline at Keel		
(m)	elevation	3.919
Waterline to Keel		
(ft)	elevation	13.375
Waterline to Keel		
(m)	elevation	4.077
Top of IMU to Base of IMU		
(m)	elevation	0.168
Top of IMU to Keel		
(m)		4.087

Port Ant to Stbd Ant

Port Ant	easting	-35.739
	northing	-0.409
(ft)	elevation	-38.283
Stbd Ant	easting	-35.866
	northing	12.925
(ft)	elevation	-38.209

IMU to Port Ant

IMU Base	easting	0.000
	northing	0.000
(ft/m)	elevation	0.000
Port Ant	easting	-35.739
	northing	-0.409
(ft)	elevation	-38.283
Port Ant	easting	-10.893
	northing	-0.125
(m)	elevation	-11.669
Base of IMU to Top of IMU (inverse of measured value)		
(m)	elevation	-0.168

IMU to Heave

IMU to Bulkhd (Frame) 52		
(ft)	easting	-11.638
(m)	easting	-3.547
Frame 0 (FP) to Frame 52		
(m)	easting	-27.737
IMU to Frame 0 (FP)		
(m)	easting	24.1898
Heave Pt* to Frame 0 (FP)		
(ft)	easting	102.42
(m)	easting	31.218
IMU to Centerline		
(ft)	northing	6.122
(m)	northing	1.866
Heave Pt* to Centerline		
(m)	northing	0

IMU Base to baseline at Keel		
(ft)	elevation	12.856
(m)	elevation	3.919
Top of IMU to Base of IMU		
(m)	elevation	0.168
Top of IMU to Keel		
(m)	elevation	4.087
Center of Gravity above baseline		
(ft)	elevation	16.37
Mean Metacentric height		
(ft)	elevation	3.88
Heave Pt* to baseline at Keel		
(ft)	elevation	20.25
(m)	elevation	6.172

(*Heave Pt is Metacenter)
(FP is Forward Perpendicular)

IMU to 8111

(m)	easting	8.252
Top of IMU	northing	2.868
to 8111	elevation	4.753

Coord Sys. CARIS

x	2.868
y	8.252
z	4.753

Port Ant to 8111

(m)	easting	19.145
	northing	2.993
	elevation	16.253

Coord Sys. CARIS

x	2.993
y	19.145
z	16.253

Waterline to RP*

(m)	easting	N/A
Waterline	northing	N/A
to IMU	elevation	-0.010

Coord. Sys. CARIS

x	N/A
y	N/A
z	-0.010

see Description Tab

Port Ant to Stbd Ant

Scalar Distance (ft)	13.335
Scalar Distance (m)	4.064

IMU to Port Ant

(m)	easting	-10.893
Top of IMU	northing	-0.125
to Port Ant	elevation	-11.501

Coord Sys. Pos/Mv

x	-10.893
y	-0.125
z	-11.501

IMU to Heave

(m)	easting	-7.0282
Top of IMU	northing	1.866
to Heave Pt*	elevation	-2.085

Coord. Sys. Pos/Mv

x	-7.028
y	1.866
z	-2.085

see Description Tab

S220_8160 Measurements

Measurement	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	
Coord. Sys.		Caris		Caris		Caris			Caris	Pos/Mv	Caris	Pos/Mv
x		0.493		-0.684		n/a	Scaler Distance	1.995	1.177	-11.920	1.866	-7.028
y		7.665		19.585		n/a			-11.920	1.177	-7.028	1.866
z		4.726		17.730		-0.002			-13.004	-13.004	-2.086	-2.086

*Top of IMU is RP (Reference Pt)

Vessel Offsets for S220_8111 are derived from Westlake-Survey-Report-NOAA-Fairweather-09-23-03.pdf
and Fairweather_NGS_Report_Feb_2007.doc

Derivations

Coord. Sys.

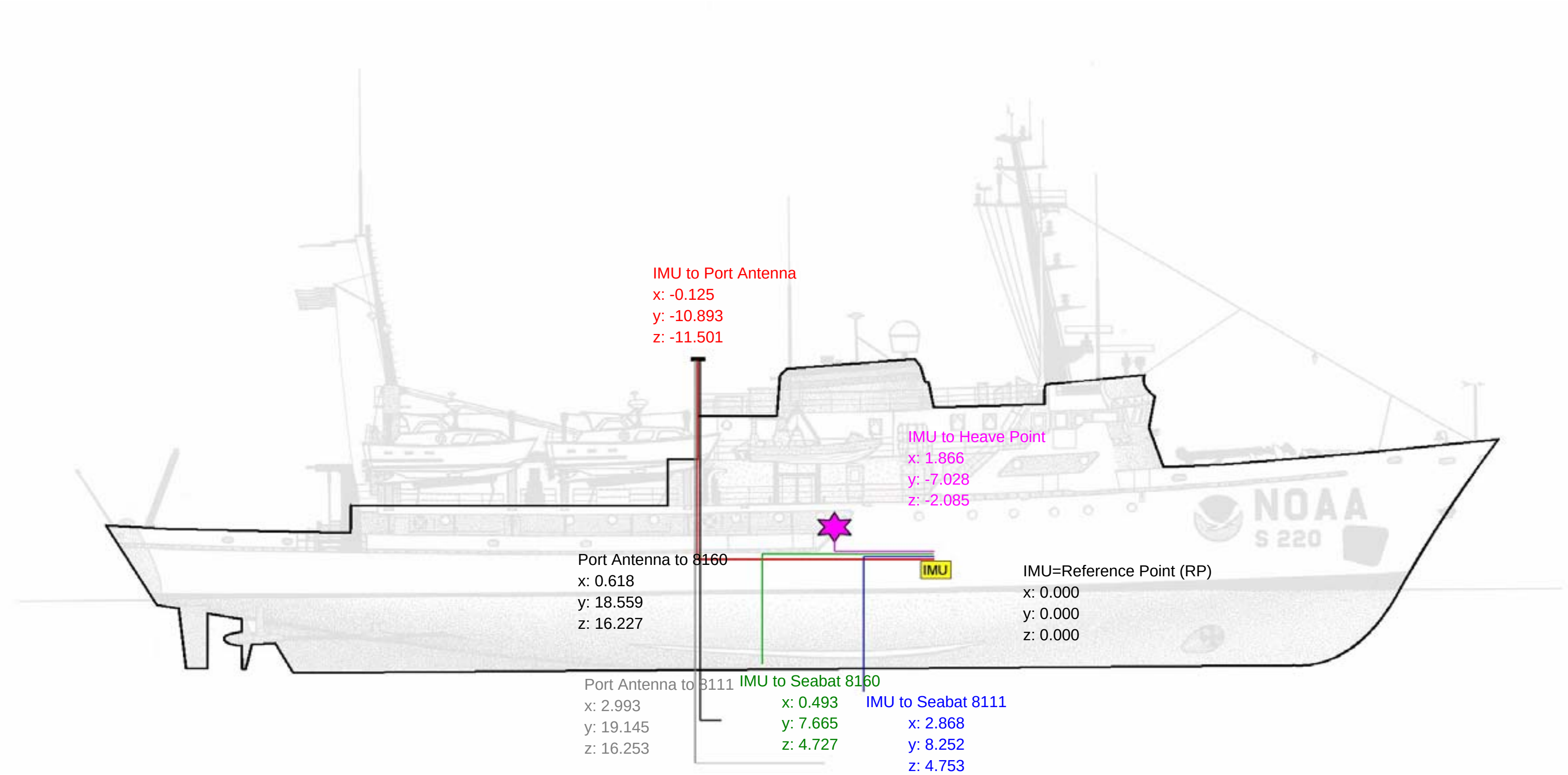
IMU to 8160				Port Ant to 8160			
Westlake				**NGS**			
IMU		easting	0.000	Port		easting	-11.920
Base		northing	0.000	Ant		northing	1.177
	(ft/m)	elevation	0.000		(m)	elevation	-13.004
Westlake				**Westlake**			
8160		easting	25.149	8160		easting	7.665
	(ft)	northing	1.619		(m)	northing	0.493
		elevation	14.956			elevation	4.559
Westlake				**NGS**			
8160		easting	7.665		8160 (as calculated)		
	(m)	northing	0.493		(m)	easting	7.665
		elevation	4.559			northing	0.493
						elevation	4.726
Base of IMU to Top of IMU							
	(m)	elevation	-0.168				

IMU to 8160				Port Ant to 8160			
	(m)	easting	7.665		(m)	easting	19.585
Top of IMU		northing	0.493			northing	-0.684
to 8160		elevation	4.726			elevation	17.730

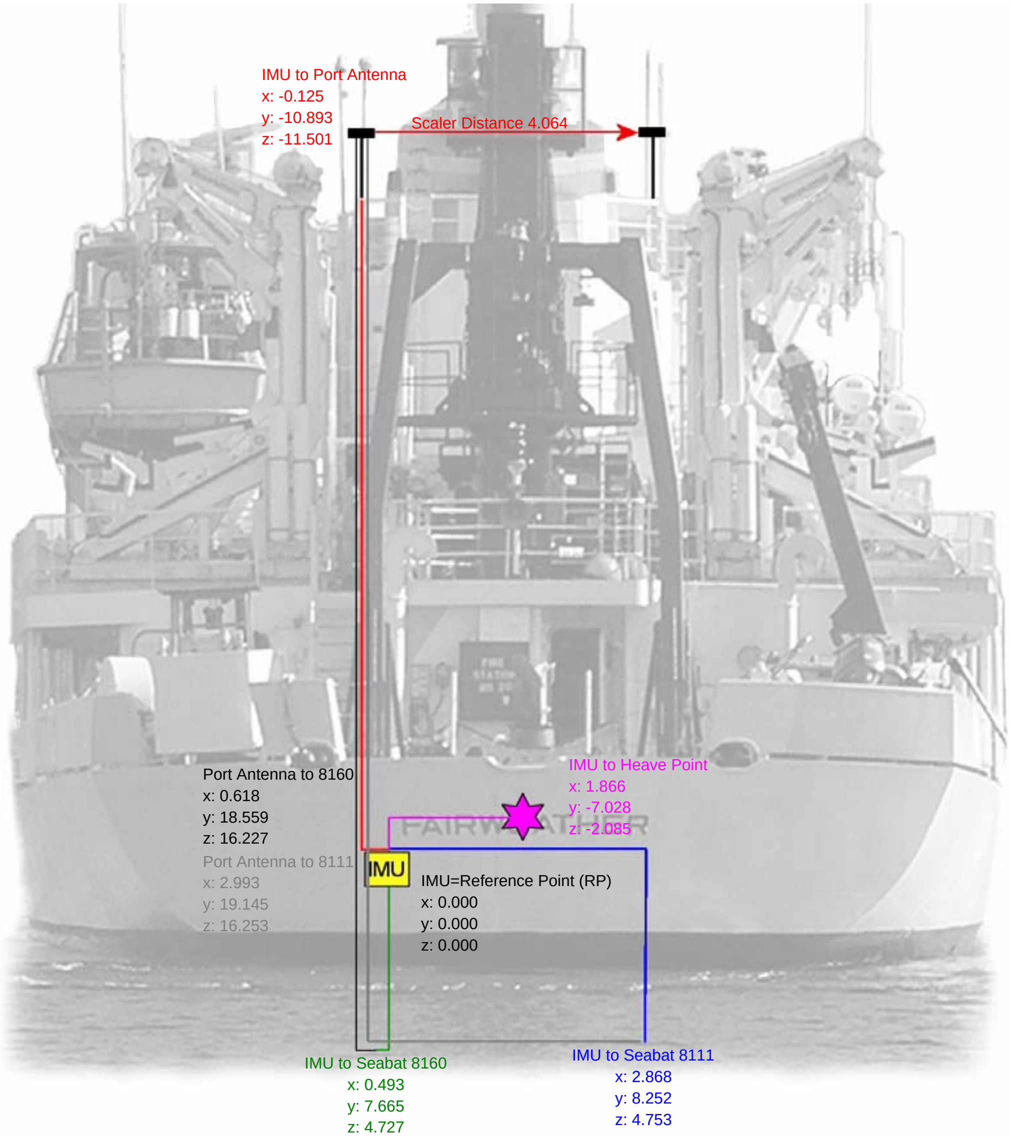
Coord Sys Caris		Coord Sys Caris	
x	0.493	x	-0.684
y	7.665	y	19.585
z	4.726	z	17.730

Description of Offsets for FAIRWEATHER S-220

All Values Shown are in CARIS Coordinates



S220 Offset Descriptions



S220 Offset Descriptions

IMU to 8111 (MRU to Trans)		
x	y	z
2.868	8.252	4.753

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 8160 (MRU to Trans)		
x	y	z
0.493	7.665	4.727

The lever arms between the IMU and phase center of the 8111 transducer are taken from the Westlake report with the addition of the 0.168 m offset included for the height of the IMU.

Port Ant to 8111 (Nav to Trans)		
x	y	z
2.993	19.145	16.253

This information comes directly from the Westlake survey.

Port Ant to 8160 (Nav to Trans)		
x	y	z
0.618	18.559	16.227

This information comes directly from the Westlake survey.

S220 Offset Descriptions

Port Ant to Stbd Ant	
Scaler Distance	4.064

From the Westlake survey it was determined that the vector for antenna separation was 4.064 m.

IMU to Port Ant		
x	y	z
-0.125	-10.893	-11.501

This information comes directly from the Westlake survey.

Waterline to RP*		
x	y	z
n/a	n/a	-0.010

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 repeated observations. Differencing the value of IMU to keel and waterline to keel gives the waterline to RP value.

IMU to Heave		
x	y	z
1.866	-7.028	-2.085

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. A static offset survey, 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

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:

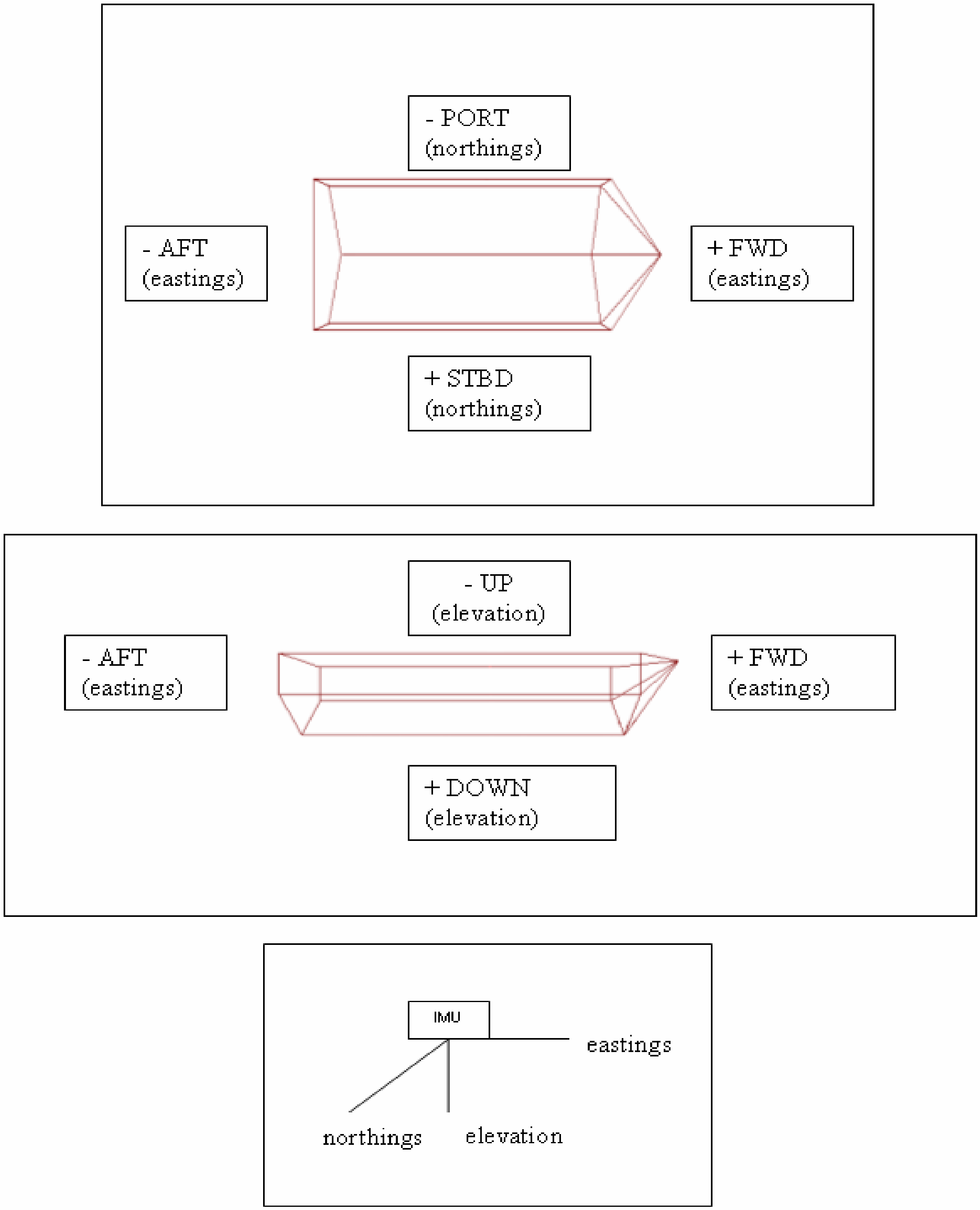
Art Anderson Associates
202 Pacific Avenue
Bremerton, WA 98337-1932

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.

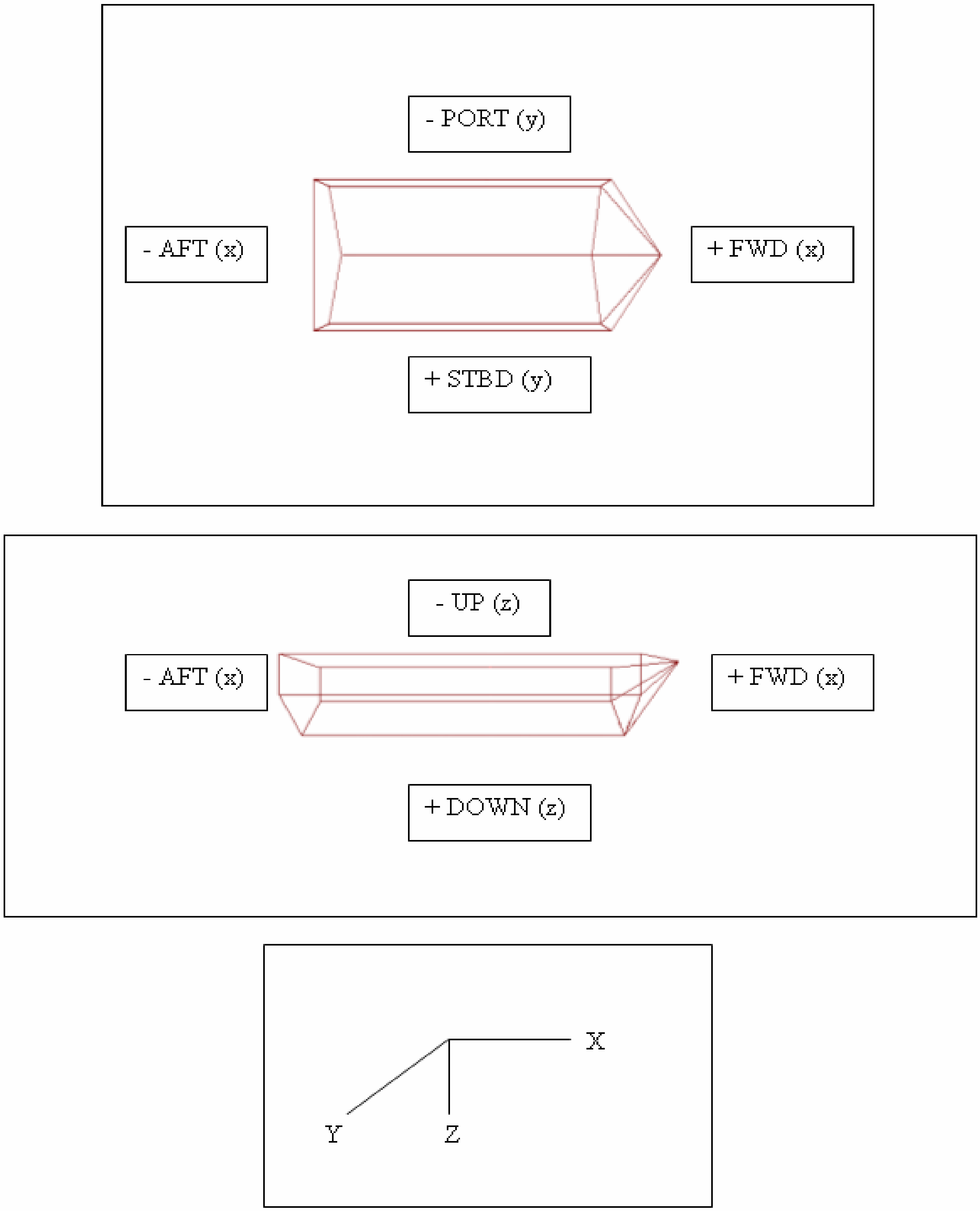
As a requirement for the TPE, the standard deviation for each position is 3 mm. This value is based upon a conversation with Elaine McDonald of Westlake and is followed up by an Email documenting that fact. The email is located at the end of this document.

WESTLAKE Coordinate System



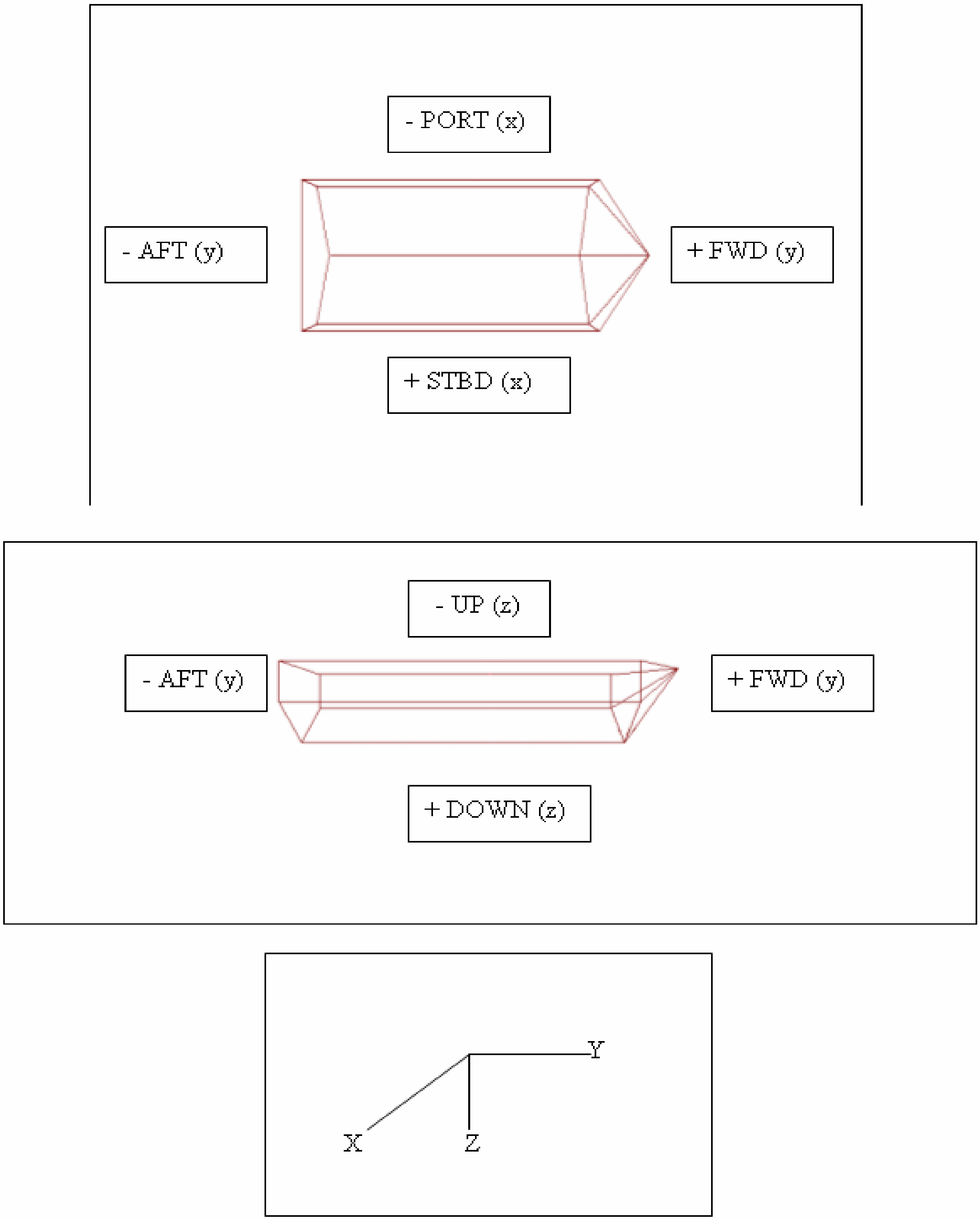
Bottom Center of IMU is origin of Westlake Coordinate System

POS/MV Coordinate System



Top Center of IMU is origin of POS/MV Coordinate System

CARIS Coordinate System



Top Center of IMU is origin of CARIS Coordinate System

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 *			
** elevation check adjusted for target that created 10 mm offset =.03281 feet*			0.001
			-0.001
			0.000
			-0.001

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
Horizontal alignment *measured* on fixture plate scribe -				*parallel*
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'

	ELEVATION
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'

	EASTING	NORTHING	ELEVATION
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.

Email regarding Standard Deviation of Westlake Survey

Subject: Precision of Measurements - NOAA Fairweather (1109-11 and 12)
Date: Thu, 12 Aug 2004 12:06:45 -0700
From: "Elaine McDonald" <emcdonald@westlakeconsultants.com>
To: <mark.wetzler@noaa.gov>
CC: "Derek Colclough" <dcolclough@westlakeconsultants.com>,
"Mike Hargrave" <mhargrave@westlakeconsultants.com>,
"Judi Haney" <jhaney@westlakeconsultants.com>,

Greetings Mark -

As promised I am writing to document our conversation of late yesterday afternoon regarding the reliability of measurements on the NOAA Fairweather.

We discussed your question here at Westlake and possible interpretations.

We believe the you can comfortably use plus/minus 3 mm as the standard error of any given distance between 2 measured/located points on the vessel. We are confident that given the same circumstances, were we to repeat the measurements, our inter-point distances would be within plus/minus 3 mm of data reported (standard error).

If the measurements were taken from a single instrument set up within a fairly close range the distance would be reliable to nearly plus/minus 1 mm. However, we had to take many measurements from a number of setups around, on, and inside the vessel, and we then tied all of these measurements to a common coordinate system. Consequently, it is not realistic to expect a 1 mm error.

As we discussed yesterday, there are many other factors that will impact the location of each point and, consequently, the distance between two or more points. Temperature, sun light, deformation of the vessel when it is in and out of the water, movement of the drydock, settlement, definition of the actual point to be measured relative to the identified structure etc. all impact the reliability or repeatability of measurements.

Nonetheless we appear to be in agreement that the 3 mm value will work in your software without introducing significant, additional variability.

If you have questions or require additional information, please give me a call - or email.

Best wishes,

Elaine for Derek Colclough, Director, Industrial Measurement Division

Elaine McDonald
Director of Marketing
Westlake Consultants, Inc.
15115 SW Sequoia Parkway (150)
Tigard, Oregon 97224

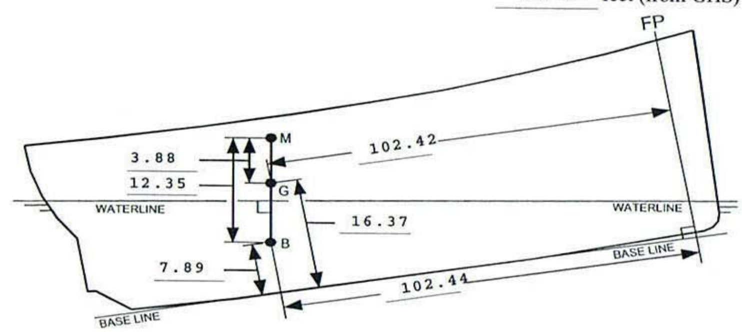
phone 503-684-0652
fax 503-624-0157
toll-free 800-523-8750
email emcdonald@westlakeconsultants.com

We invite you to visit our website www.westlakeconsultants.com

SHIP AT TIME OF STABILITY TEST--CONDITION 0

Item	Formula	Computation	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)

Item	Formula	Value	Unit
Period of complete roll			seconds
Apparent radius of gyration of vessel	$\alpha = \frac{T\ GM}{1.108}$		feet
Rolling constant	$C = \frac{T\ GM}{B}$		



TRU-STONE Technologies

ISO 9002 Certified

Certificate of Accuracy

Customer Name: MCMASTER-CARR SUPPLY CO. **Customer PO#:** TA-28173060
Customer Address: 200 AURORA IND. PARKWAY
AURORA,OH 44202

Date of Calibration: 8/23/02
Product Description: GRANITE SURFACE PLATE
Size: 8" X 12" X 2"
Serial Number: 36961
Accuracy: Actual: .000075" Allowed: .0002"
Repeatability: Actual: .000055" Allowed: .00010"
Grade: B
Uncertainty of Measurement: 5.2√D
M.O.E.: 7.5 x 10 6
Laboratory Conditions: Temperature: 69 °F Humidity: 51%

This product was inspected under environmentally controlled conditions. The electronic and optical gauging equipment used in inspecting this item has been calibrated and is traceable to the National Institute of Standards and Technology (NIST). Our calibration system is in compliance with ISO 10012-1.

Calibration Equipment Used in the Inspection of this Product:

Type of Equipment	*ID Number*	*Instrument Uncertainty*	*NIST Traceability Number*	*Cal. Due Date*
Autocollimator	IP 040	±0.5 arc sec	821/259488-97	6-03
.000020 Mahr Dial I	20990	50 µin	25894-1	6-03

Laboratory Manager Signature: [signature]
Donald Schirmers, Lapping Manager
Robert Golla, Accessories Supervisor

REWORK / RECALIBRATION *(This section is completed for recertification orders only - accuracies upon receipt)*

Date of Receipt:
Accuracy of Incoming Product:
Repeat Measurement of Incoming Product:

☐ ***Was unable to read upon receipt due to poor condition of product***

The results on this Certificate of Accuracy apply only to the item described above. This report shall not be reproduced except in full and with the written authorization of our laboratory.

Measurement Uncertainty is expressed at a confidence level of 95% (coverage factor k=2)

Procedure Number: QP 4.10.1

1101 Prosper Drive • Box 430 • Waite Park, MN 56387• PH: 320-251-7171 • Fax 320-259-5073

FINAL INSPECTION REPORT

Laboratory Name

TRU-STONE Technologies
1101 Prosper Drive • Box 430
Waite Park, MN 56387
PH: 320-251-7171 • FAX: 320-259-5073

Final Inspection

(1) Inspection Number: 0200851

(2) Inspection Date: 8-23-02

(3) Date of Receipt (rework items): ______

(4) Repeat Reading of Received Item: ______

(5) Accuracy of Received (rework) Item: ______

☐ Unable to Inspect – product in too poor of condition

(6) Customer Name: NEWPORT-Corp

(7) Serial Number: 36961

(8) P.O. Number: TA-2813060

(9) Print/Part Number: ______

(10) Description of Item: 8x12x2 CB

(11) Granite Type: Impala

(12) Conditions at Time of Inspection: Temperature: 69 °F Humidity: 51

(13) Test Equipment:

Autocollimator Mirror Size: 3"

Type of Equipment	Serial Number	Calibration Due Date	Uncertainty of IMTE
Autocollimator ☑ Repeat-o-meter ☑	IP040	6-03	± 0.5 arc sec
Electronic Level ☐ Height Check ☐	2990	6-03	50 μin
Amp & Gauge Head ☐ Surfometer ☐			
Penta Prism ☐ Mikrokator ☐			
Other ______			

(14) Grade: (B) A AA N/A

(15) Overall Accuracy / Flatness (actual): .000075 (allowed): .0002

(16) Repeat Measurement (actual): .000055 (allowed): (.00010" B) .000050" A .000025" AA N/A

(FIM: Full Indicator Movement)

(17) Final Inspector Signature: [signature]

(18) Opinion / Interpretation (if applicable): ______

(21) Thread Size, Quantity & Location to Print: Yes ______ No ______

(22) Insert / Hole / Slot Size, Quantity & Location to Print: Yes ______ No ______

19-23 Are Not Applicable – No Inserts ☑

(23) Inspector Signature: ______

Existing inserts are not inspected on reworks and/or calibration items.

 Measurement uncertainty is expressed at a confidence level of 95% (coverage factor k=2).

Shipping

(19) Threaded Inserts: Yes ______ No ______ (20) Clean: Yes ✓ No ______

Packaging Conforms to Company and Customer Requirements: Yes ✓ No ______

TRU-STONE Technologies

Save **IMPORTANT DOCUMENT** Save

Tru-Stone Technologies
Instructions for Care of Granite Surface Plates

1. **Cleaning and Moisture:** Plates shall be cleaned thoroughly and given adequate time to dry before testing for tolerance. Water based cleansers that have not dried will cause iron parts to rust if they are left in contact with the wet surface for an extended period of time. It is recommended that plates undergo drying time in a room with less than 50 percent relative humidity. Temperature and dirt have a direct correlation with measurement accuracy. Personal cleanliness will aid in eliminating one source of contamination.
2. **Temperature Soaking Time:** Before granite surface plates are measured for work surface flatness, the granite should remain in the calibration area until it has reached room temperature, which may require 2 to 3 days. Large plates require more soak-out time than smaller ones.
3. **Scratches and Nicks**: Whenever scratches and nicks appear on granite plates, the resulting rough edges should be removed with a flat granite dressing plate. Any bump that shatters the surface raises fractured material at the rim of the crater.
4. **Rotation of Plates:** When a specific work surface area receives prolonged usage, it is suggested that the plate and stand be rotated 180 degrees on a periodic basis to increase the wear life of the plate. The production of a contour map during calibration is particularly helpful in locating the parts of the plate that should be given the most use. This can be accomplished by requesting a long form certification when ordering the new surface plate or when the plate is being sent in for recalibration.
5. **Periodic Recalibration:** Periodic recalibration of granite surface plates is recommended to determine resurfacing or replacement needs. The interval between calibrations will vary with the grade of plate and the wear resistance of the granite. TRU-STONE CONFORMS TO ISO 9000 CERTIFICATION REQUIREMENTS FOR VENDORS. Frequent monitoring of the work surface by scanning it with the repeat gage is desirable. When these results differ from those marked on the replaceable sticker, you should recalibrate the plate. In addition to measuring the overall accuracy of a surface, smaller areas can be checked for localized variations often missed by the calibrating methods. Remember precision measurements are only as accurate as the measuring tools used.
6. **Torque on THREADED Inserts:** Do not exceed the following maximum torque values when using a torque wrench to limit distorting the work surface and pulling the insert. The following torque values are the maximum level permissible by the Federal Specification GGG-P-463c.

PERMISSIBLE TORQUE CLAMPING ON THREDED INSERTS

Thread Size	*Torque*
.250 inch	7 ft. lbs.
.3125 inch	15 ft. lbs.
.375 inch	20 ft. lbs.
.500 inch	25 ft. lbs.

7. **Clamping Ledges on Grade AA Surface Plates:** There is danger of distorting the work surface flatness beyond tolerance when a heavy item rests on the ledge or an item is clamped to the ledge. Ledges are not only expensive, but a great cause of inaccuracy. Experimentation and research reveal that no-ledge plates retain their accuracy better than ledged plates.
8. **Supports:** There are working and loading conditions where the standard three point supports are not satisfactory. These cases should be individually engineered. When four or more supports are used, shims or adjusting screws are necessary for proper support. The supports could be spotted under the loading points and set to approximately equal the loading. Sometimes the work surface flatness can be improved by shifting support positions. Fulcrum, air and hydraulic supports are available. Whenever nonstandard supports are used, the surface plate shall be calibrated at the site for compliance to the flatness tolerance.

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9. **Care:**
   - Utilize the full surface of a plate so the wear is distributed and not concentrated in one area.
   - The surface plate should not be overloaded.
   - Use extreme care in moving the item being measured and the gages being used.
   - Place on the surface ONLY what is required.
   - Particularly avoid heavy contact with the edges.
   - Don't leave metal objects on the surface longer than necessary.
   - Clean the surface before and after use.

Remember that the condition of this accurate plane is an integral factor in the measurement being made.

NOTE:

Surface plate cleaner can be purchased through your local Tru-Stone distributor or directly from Tru-Stone Technologies. Call for pricing and delivery information.

When the need for recalibration or rework of your surface plates and precision granite accessories arises, contact a Tru-Stone representative or call us directly for more details on restoring your inspection item to a "like new" condition. This service comes with new certification and plate labels.

One advantage of having your granite inspection equipment recalibrated by a manufacturer is the manufacturer's ability to take the time required to ensure the proper repeatability and overall shape of the inspection surface. Tru-Stone allows the item to normalize overnight prior to taking the final readings to indicate whether it is a good enough quality to certify and return to you.

Should you have any questions, please contact our customer service representatives at 320/251-7171 or fax us at 320/259-5073.

Important Notice

Any streaks of color in the granite are not defects. These are created by the molten lava mixing with minerals prior to evolving into the granite you see today. Black streaks or spots are the result of a magnetite (black iron oxide) concentration. White streaks or spots are areas where the granite is lacking magnetite. The levels of magnetite in granite vary considerably, however the color of the granite in no way affects the functionality or quality of it.

Our products are UNCONDITIONALLY Guaranteed

Please refer to the Federal Specification GGG-P-463c, which is followed by NIST (National Institute of Standards & Technology) for Granite Surface Plates.

- "3.7 Seams or Color Streaks: *Seams are cause for rejection. Color streaks have no affect on the serviceability of the granite."*
- "4.5.8 Seams or Color Streaks: *Test for a seam is to wet the smooth surface of the granite where the color streak appears; then dry it off. If the streak remains wet or damp, it is a seam."*

FAIRWEATHER

Multibeam Echosounder Calibration

S220 8111
Vessel

3/29/2007	088	Nichols Passage
Date	Dn	Local Area

Calibrating Hydrographer(s)

8111	S220	
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
POS MV version 4	29 March 2007
Description of Positioning System	Date of most recent positioning system calibration

Acquisition Log

3/29/2007	088	Nichols Passage	Sunny, near calm seas
Date	Dn	Local Area	Wx

Bottom Type	Approximate Water Depth

Personnel on board

Comments

TH_S220_088
TrueHeave filename

Batch #	BOT Files (botXXX.???-???)	Day SV Filename	Append to day SV file	Copy files to network
1				
2				

SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

ROLL

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks

PITCH

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	PITCH1	359	3.9	18m shoal observed
	PITCH2	179	4.3	
	PITCH3	359	4.0	Good line
	PITCH4	168	4.0	Good line

HEADING/YAW

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
	HEADING1	359	4.1	
	HEADING2	179	5.1	
	HEADING3	179	4.3	
	HEADING4	359	4.0	Good line

NAV TIME LATENCY

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks

Processing Log

Date	Dn	Personnel
4/2/2007	092	Froelich

- [x] **Data converted --> HDCS_Data in CARIS**
- [ ] **TrueHeave applied** Trueheave file was corrupted -- not applied to calibration lines
- [x] **SVP applied** Testing_s220_088.svp
- [x] **Tide applied** 9450460.tid

Zone file patch_test.zdf

Lines merged [x]

Data cleaned to remove gross fliers [x]

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)
Froelich	0.00	-0.70	-0.10	-0.40
Gonsalves	0.00	-0.55	0.00	-0.40
Brown	0.00	-0.50	0.05	-0.30
Johnston		-0.60	-0.04	-0.40
Averages	0.00	-0.59	-0.02	-0.38
Standard Deviation	0.00	0.09	0.06	0.05
FINAL VALUES	0.00	-0.59	-0.02	-0.38

Final Values based on Group Average

Resulting HVF File Name FA_S220_Reson8101.hvf

MRU Align StdDev gyro 0.05 Value from standard deviation of Heading offset values
MRU Align StdDev Roll/Pitch 0.11 Value from sum of squares standard deviations of pitch and roll offset v

NARRATIVE

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

Name: gonsalves **Date:** 14-Apr-07

FAIRWEATHER

Multibeam Echosounder Calibration

S220 8160
Vessel

4/16/2007	106	Ernest Sound
Date	Dn	Local Area

French, Froelich, Gonsalves, Mills
Calibrating Hydrographer(s)

Reson 8160	Hull mount	
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

4/16/2007	106	Ernest Sound	Calm
Date	Dn	Local Area	Wx

	65 Fathoms
Bottom Type	Approximate Water Depth

Froelich, Martin, CO, Gonsalves, French
Personnel on board

Comments

TH_s220_106_2.000 (use for pitch lines); TH_8160_106_3 (use for heading)
TrueHeave filename

SV Cast #1 filename	UTC Time	Lat	Lon	Depth	Ext. Depth
SV Cast #2 filename	UTC Time	Lat	Lon	Depth	Ext. Depth

ROLL

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
				Use pitch lines…

PITCH

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
bot_106.001	*PITCH1*	*207*	*5.5*	
	PITCH2	*032*	*4.8*	
	PITCH3	*207*	*5.6*	
	PITCH4	*035*	*4.7*	*Computer crashed near end of line.*

HEADING/YAW

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks
bot_106.001	*HEADING1*	*210*	*5.7*	*missed the target - do not use*
	HEADING2	*029*	*4.8*	*may have been too far from target*
	HEADING3	*211*	*5.7*	
	HEADING4	*029*	*4.8*	*operator error, I may have blown out near the target (of all places)*
	HEADING5	*211*	*5.7*	

NAV TIME LATENCY

SV Cast #	XTF Line Filename	Heading	Speed (kts)	Remarks

Processing Log

4/18/2007	*108*	*Brown, Johnston, Gonsalves, Froelich*
Date	*Dn*	*Personnel*

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

☑ **TrueHeave applied** *TH_s220_106_2 and TH_8160_106_3*

☑ **SVP applied** *bot_106_8160.svp*

☑ **Tide applied** *predicted - 09450460.tid*

Zone file *O119FA2007CORP.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)
keb	*0.00*	*-0.30*	*-0.06*	*-0.15*
blj	*0.00*	*-0.26*	*-0.03*	*0.35*
mog	*0.00*	*-0.28*	*-0.06*	*0.30*
gdf	*0.00*	*-0.31*	*-0.02*	*-0.11*
Averages	*0.00*	*-0.29*	*-0.04*	*0.10*
Standard Deviation	*0.00*	*0.02*	*0.02*	*0.26*
FINAL VALUES	*0.00*	*-0.29*	*-0.04*	*0.10*

Final Values based on *group average*

Resulting HVF File Name *FA_S220_Reson8160_5to750 and …1000to1500 and …1750to5000*

MRU Align StdDev gyro *0.26* *Value from standard deviation of Heading offset values*

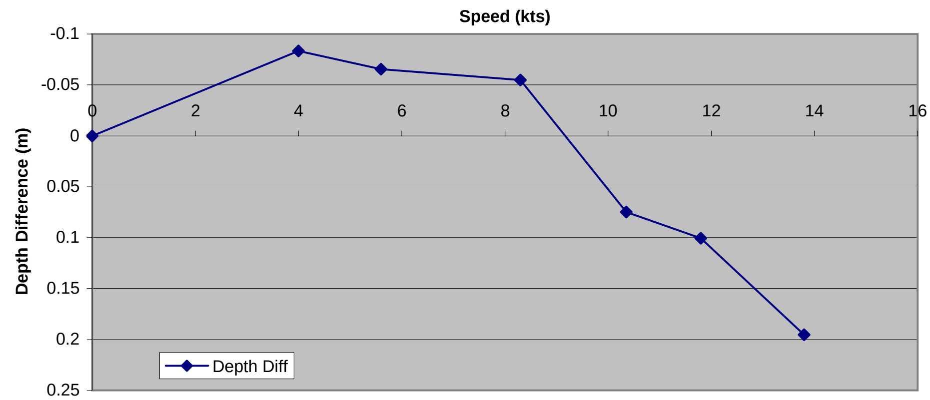
MRU Align StdDev Roll/Pitch *0.03* *Value from averaged standard deviations of pitch and roll offset values*

NARRATIVE

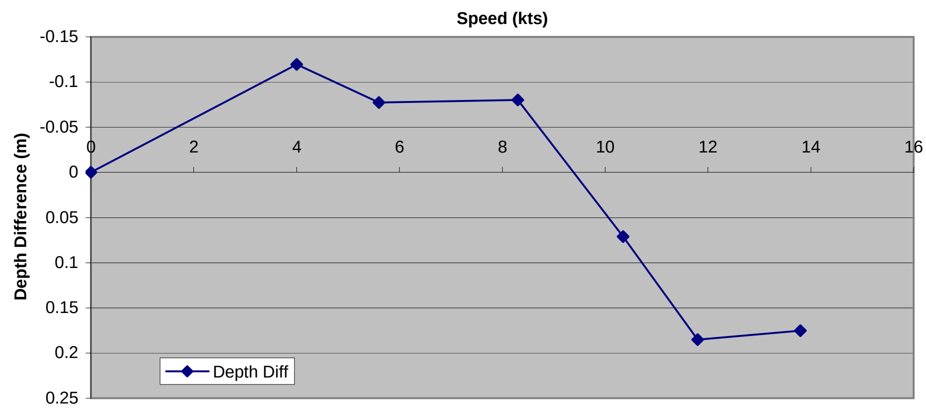
☑ **HVF Hydrographic Vessel File created or updated with current offsets**

Name: *FA_S220_Reson8160_5to750* **Date:** *19-Apr-07*

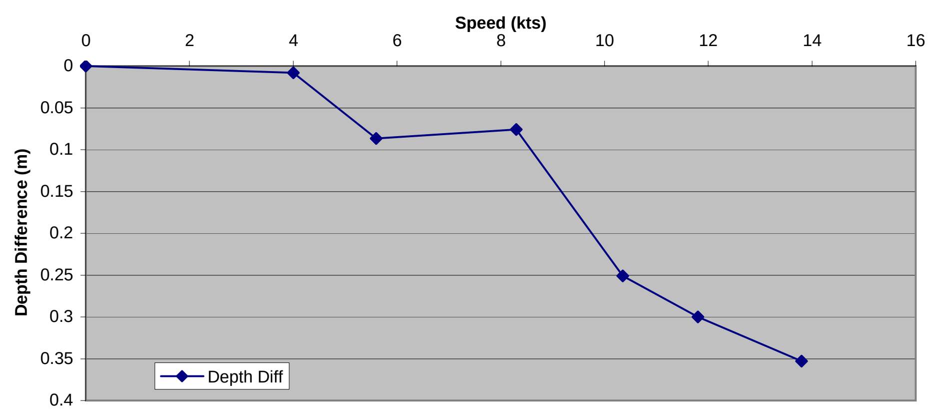
RPM/Pitch	Speed (m/s)	Speed (knots)	mog-Ave	bj-Ave	kb-Ave	Std. Dev.
0	0	0	0	0	0	0
145/40%	2.07	4	-0.064982971	-0.013021726	-0.018728741	0.028495599
150/40%	2.89	5.6	-0.01867823	0.001391433	0.022948255	0.02081767
150/80%	4.29	8.3	-0.019780177	0.001593794	0.086367291	0.056140712
150/90%	5.35	10.35	0.132309505	0.045112313	0.247795069	0.101669862
155/100%	6.10	11.8	0.195134109	0.02426495	0.258779328	0.121273779
185/100%	7.13	13.8	0.241202363	0.09212141	0.361192291	0.134797288



S220 - Stop#1 DDSSM



S220 - Stop#2 DDSSM



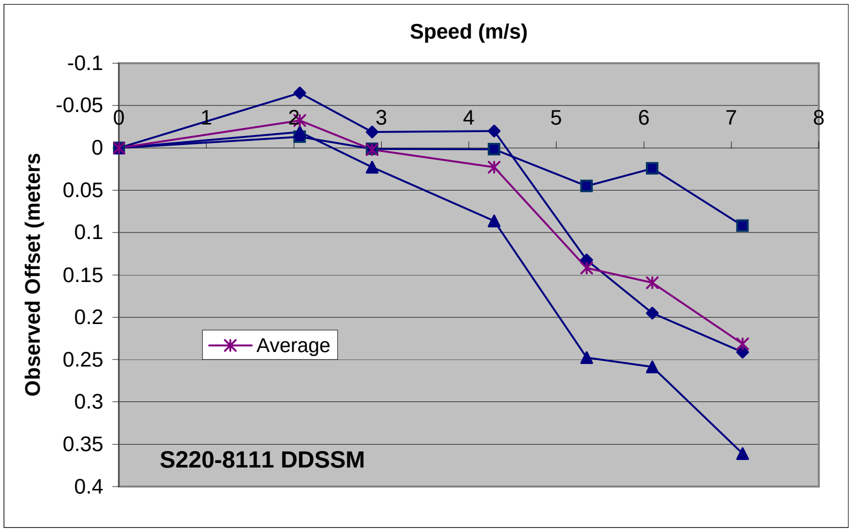
S220 - Stop#3 DDSSM

Average	8160 Depth
0	0
-0.032244479	-0.0310205
0.001887152	0.00181552
0.022726969	0.0218643
0.141738962	0.13635882
0.159392796	0.15334255
0.231505354	0.22271785

Heave to 8111(m)	15.28
Heave to 8160(m)	14.7
Lever arm ratio	0.962042

Blue cells used in computation of Delta Draft
StDev used in TPE

Ave Stdev 0.059543



NOAA POS/MV Calibration Report

Ship: FAIRWEATHER **Vessel:** S220

Date: 3/29/2007 **Dn:** 088

Personnel: Lewis, Evans, Mills, Froelich

PCS Serial # 2411 **IMU Serial #** 292

IP Address: 129.100.1.231

POS controller Version (Use Menu Help > About) 3.3.2.2

POS Version (Use Menu View > Statistics) Version 4

GPS Receivers

Primary Receiver	BD950 SN:4611A66708 v.00211
Secondary Receiver	BD950 SN:4602A62806 v.00211

Calibration area

Location: Nichols Passage

Approximate Position:

Lat	55	14	26
Lon	131	38	31

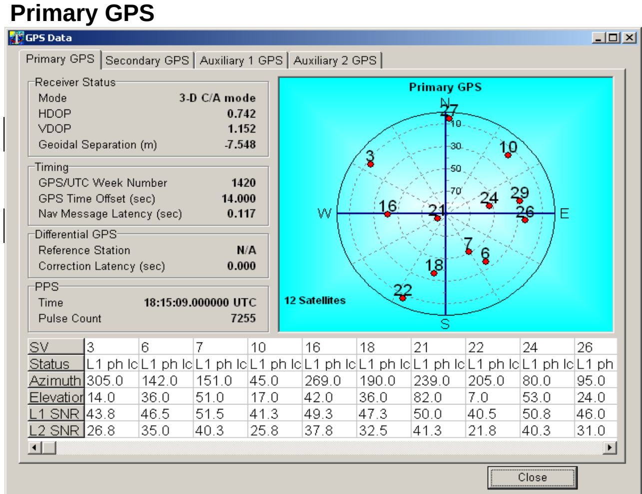
DGPS Beacon Station: Annette Island

Frequency: 323

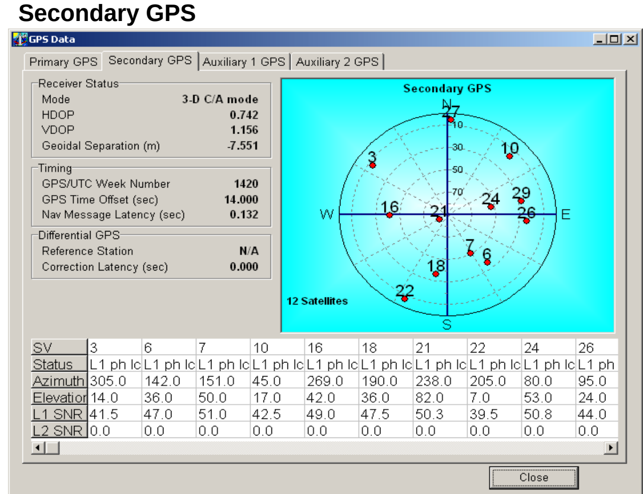
Satellite Constellation

(Use View> GPS Data)

Primary GPS



Secondary GPS

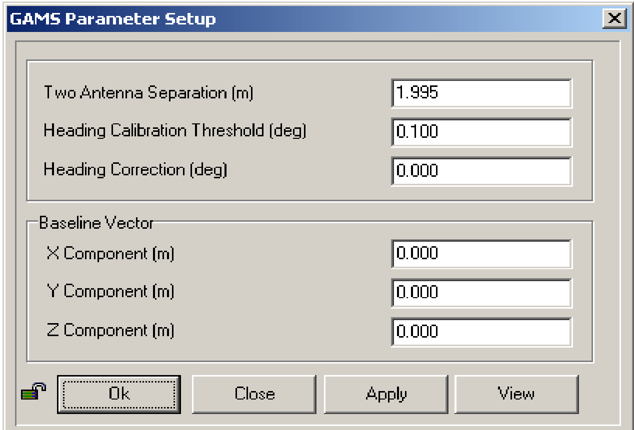


PDOP 1.904 (Use View> GAMS Solution)

POS/MV Configuration

Settings

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



Configuration Notes: ____

POS/MV Calibration

Calibration Procedure:

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

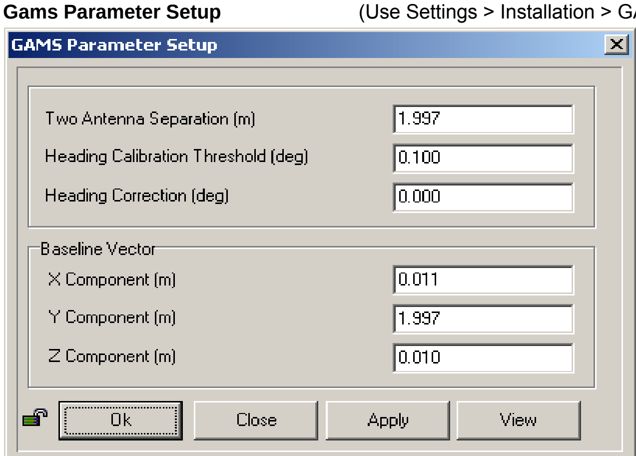
Start time: 1810

End time: 1812

Heading accuracy achieved for calibration: 0.352

Calibration Results:

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



GAMS Status Online Yes

Save Settings Yes

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

File Name: S220_032907_POSMV

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.

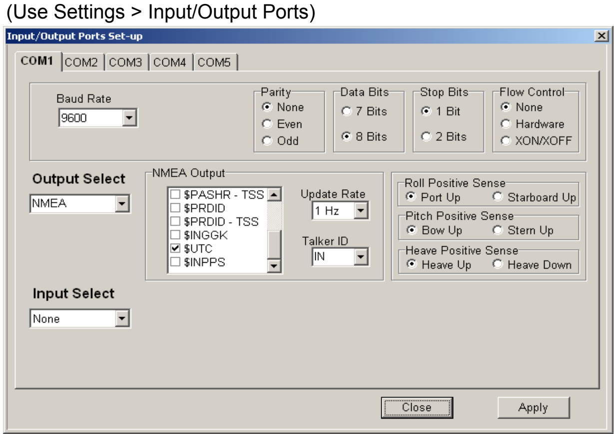
b) Pitch rotation - apply a right-hand screw rotation θy about the once-rotated y-axis to align one frame with the other.

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

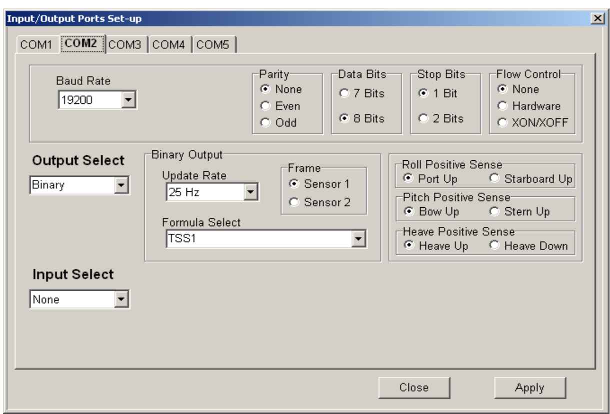
SETTINGS

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

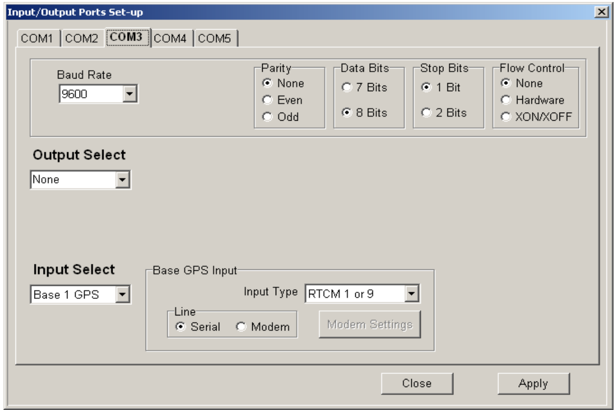
COM1



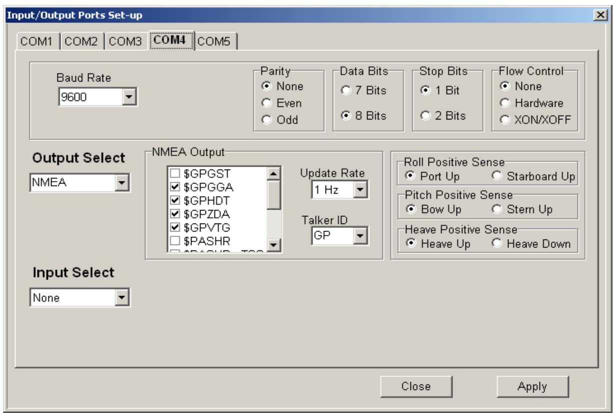
COM2



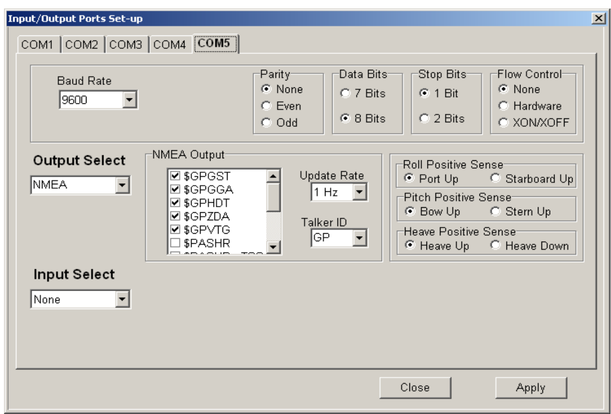
COM3



COM4

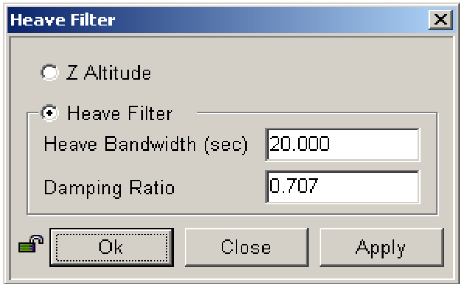


COM5

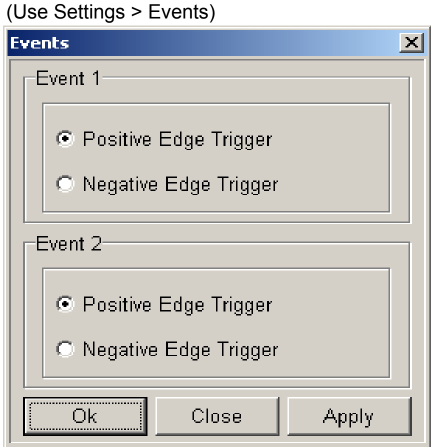


SETTINGS Continued

Heave Filter (Use Settings > Heave)



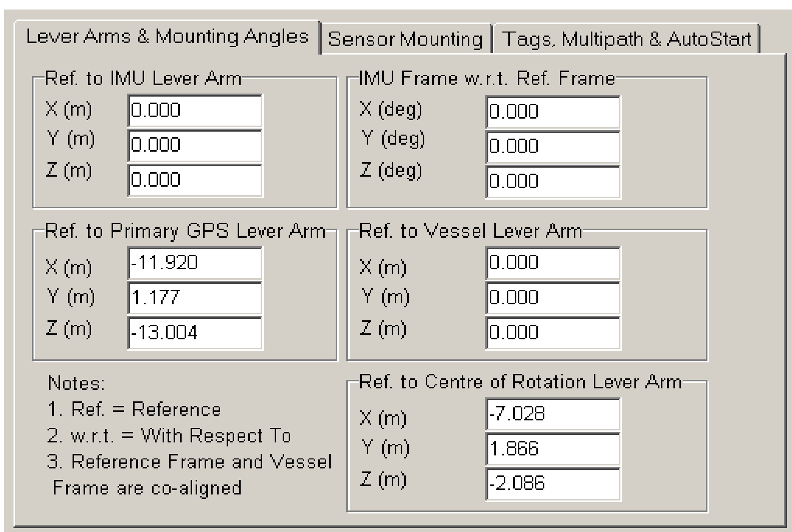
Events (Use Settings > Events)



INSTALLATION

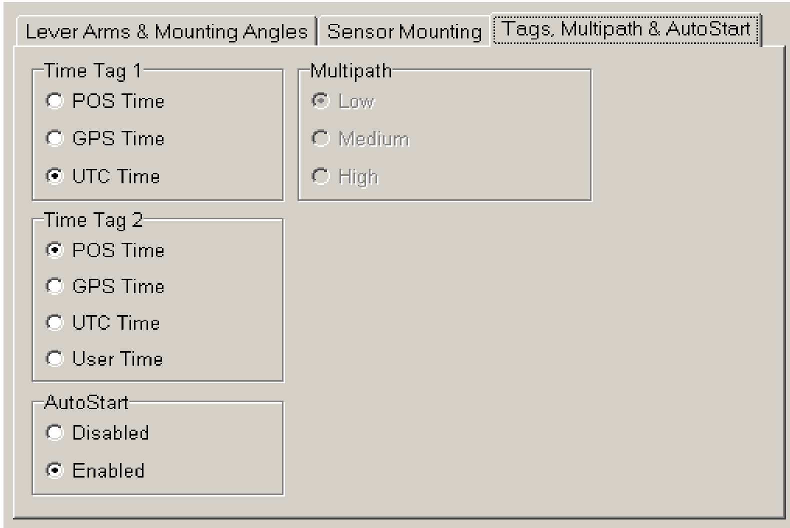
(Use Settings > Installation)

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

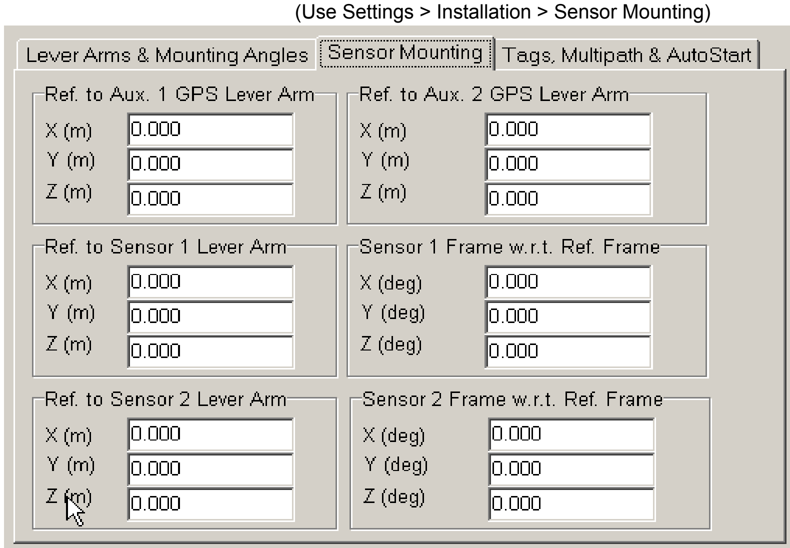


INSTALLATION Continued

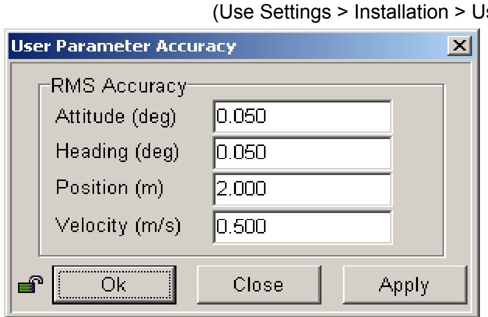
Tags, Multipath and Auto Start (Use Settings > Installation > Tags, Multipath and Auto Start)



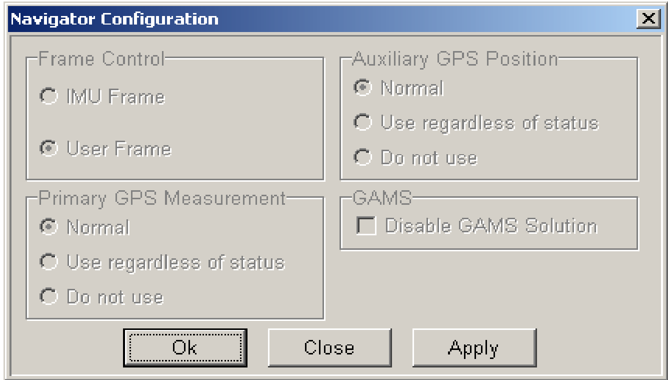
Sensor Mounting (Use Settings > Installation > Sensor Mounting)



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

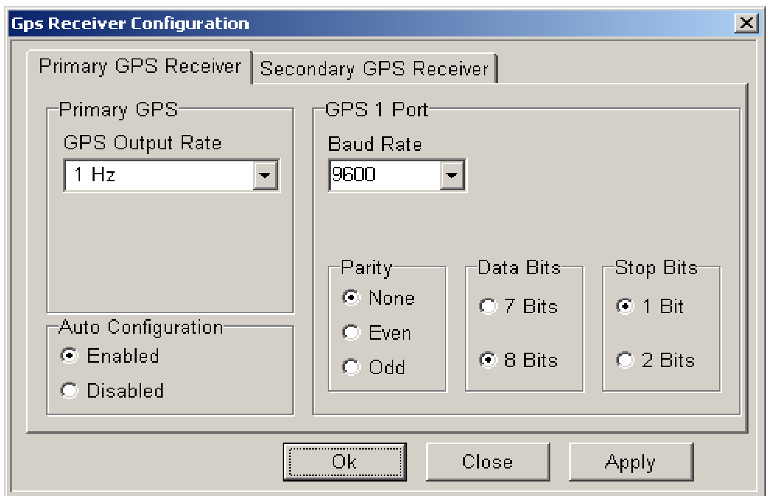


Frame Control (Use Tools > Config)

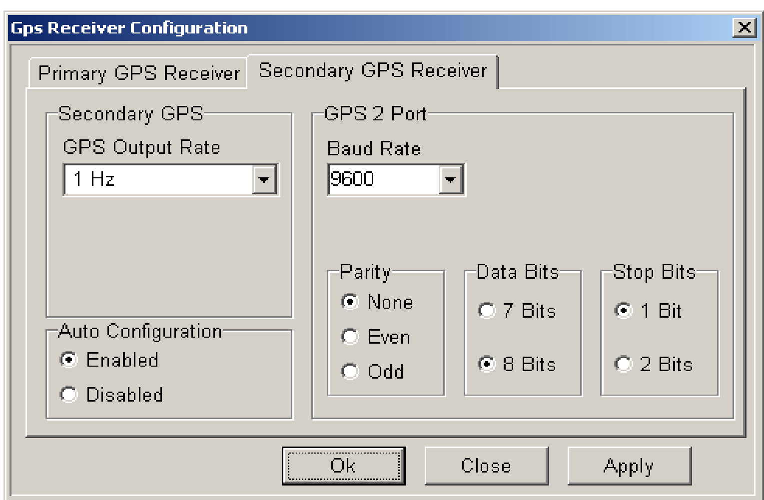


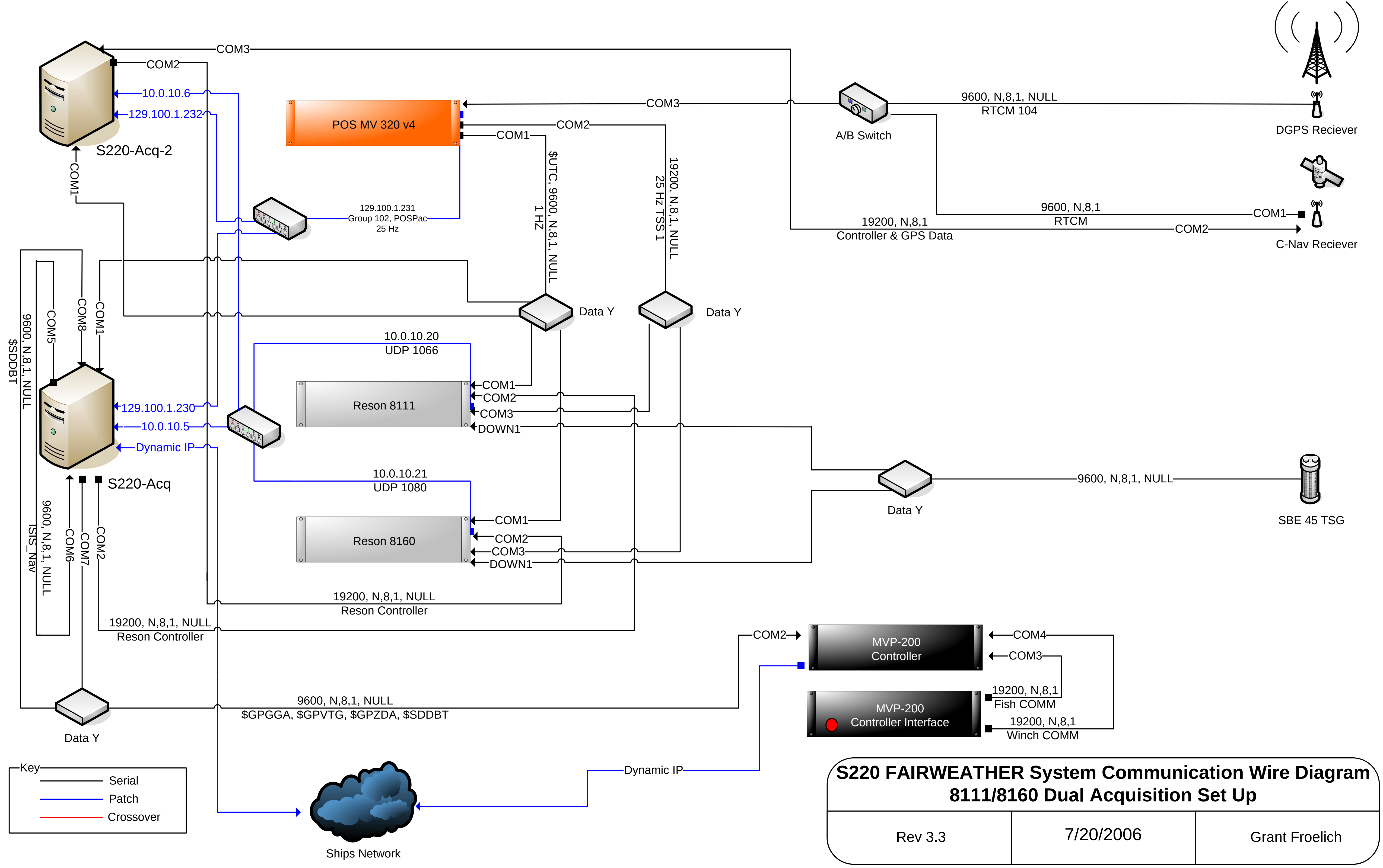
GPS Receiver Configuration

Primary GPS Receiver



Secondary GPS Receiver




S220 FAIRWEATHER System Communication Wire Diagram
8111/8160 Dual Acquisition Set Up
Rev 3.3
7/20/2006
Grant Froelich
S220-Acq-2
S220-Acq
POS MV 320 v4
Reson 8111
Reson 8160
A/B Switch
DGPS Reciever
C-Nav Reciever
SBE 45 TSG
MVP-200 Controller
MVP-200 Controller Interface
Ships Network
Data Y
COM1
COM2
COM3
COM4
COM5
COM6
COM7
COM8
DOWN1
10.0.10.6
129.100.1.232
129.100.1.230
10.0.10.5
Dynamic IP
129.100.1.231
Group 102, POSPac
25 Hz
9600, N,8,1, NULL
RTCM 104
9600, N,8,1
RTCM
19200, N,8,1
Controller & GPS Data
$UTC, 9600, N,8,1, NULL
1 HZ
19200, N,8,1, NULL
25 Hz TSS 1
10.0.10.20
UDP 1066
10.0.10.21
UDP 1080
9600, N,8,1, NULL
$SDDBT
9600, N,8,1, NULL
ISIS_Nav
19200, N,8,1, NULL
Reson Controller
19200, N,8,1, NULL
Reson Controller
9600, N,8,1, NULL
$GPGGA, $GPVTG, $GPZDA, $SDDBT
19200, N,8,1
Fish COMM
19200, N,8,1
Winch COMM
Key
Serial
Patch
Crossover

SeaBat 8111 Noise Analysis

1.0 Overview

For mid and deep water sonar systems, noise emanating from the vessel on which the sonar is mounted is a major determinant in the performance of the sonar. In addition to sources such as echosounders and other acoustic devices, such as doppler logs, mechanical noise from the engines and drive trains, and flow noise will also affect performance, with the magnitude of the noise varying with vessel speed.

This document describes the noise analysis test done on the RESON SeaBat 8111 installed on the NOAA S/V Fairweather, on 11 October 2004.

2.0 Test Conduct

The following is a description of the system setup and test protocol used to test the SeaBat 8111 multibeam sonar.

2.1 Sonar Setup

To determine the amount of in-band noise seen by the sonar, the system was configured as follows:

Setting	Value
Power	Off
Gain	Manual Fixed 20
Range	100 meters

Data collection was done using a RESON engineering utility, which collects the full amplitude and phase time series data from the sonar. Figure 1 shows a sample screen capture, in this case one of the data sets taken at six knots, with a shaft speed of 140 RPM. At least ten (10) collections were done for each test case, and the results for first 10 measurements each test case were averaged for the report.

2.2 Vessel Operation

Normal survey speed for the vessel is approximately 10 knots. To bracket this range, and to check at possible lower survey speeds, the test protocol was defined to cover the range of 2 to 12 knots, in 2 knot steps. The tests were conducted at shaft speeds of 120 to 170 RPM, in 10 RPM steps, with the speed adjusted by changing the pitch on the propellers. For each RPM value, the speeds that could be achieved at that shaft speed were tested. A log of data collections for the tests is provided in Appendix A.

All the underway data collections were done in water depths of 120 to 160 fathoms. The zero speed data collections, with the engines on, were done at anchor in about 30 meters of water, and out in the bay, at water depths of about 130 fathoms.

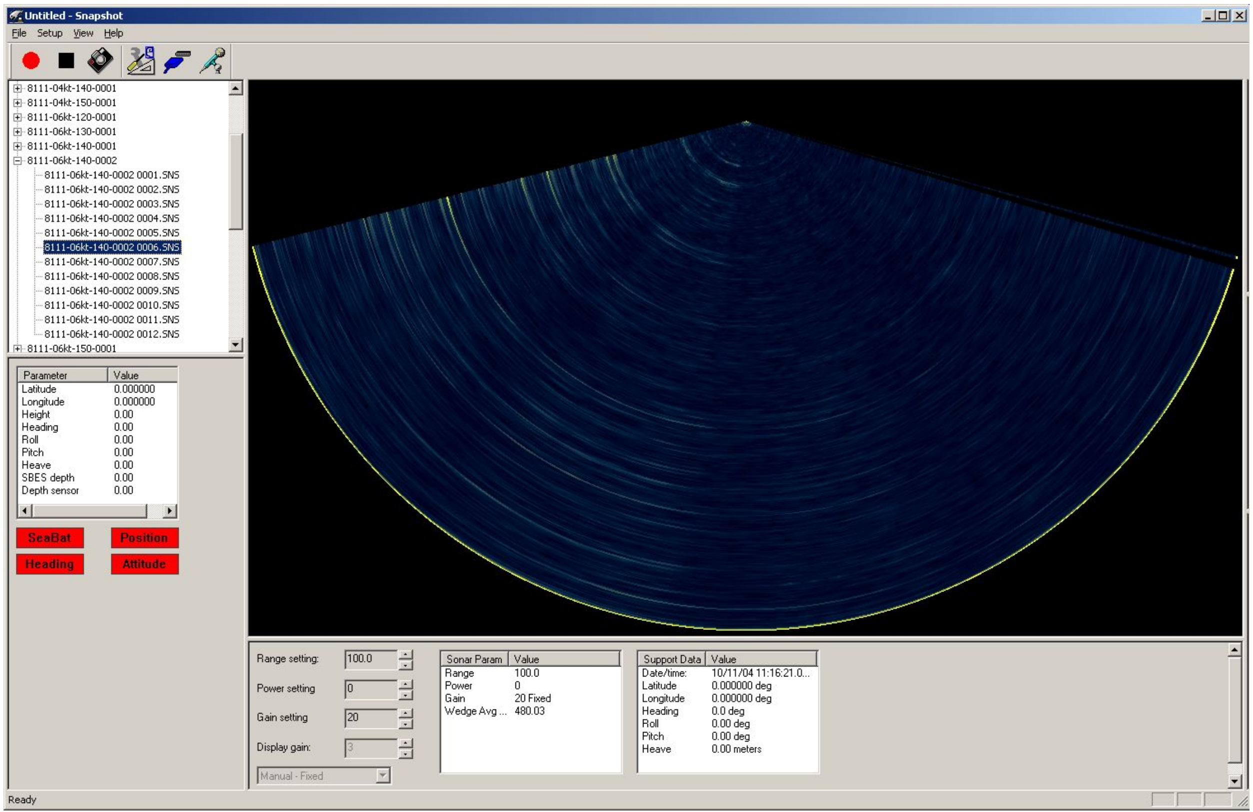


Figure 1 - Snapshot Utility Screen Capture

2.3 Data Analysis

The data from each of the test cases were collated in an Excel spreadsheet, shown in Appendix B. A graph of the measured noise levels, as a function of vessel speed and shaft RPM is shown in Figure 2. The noise level is a unitless value that represents the average of all the amplitude samples, from all the beams for the sampled sonar ping. This value represents a combination of the electrical noise in the sonar, and the response to all acoustic energy, within the bandwidth of the sonar, impinging on the receive array.

For each the tests, the plot shows the noise level as a function of vessel speed. Again, the tests were run at the speeds that could be achieved at the selected shaft RPM.

In an effort to resolve the cause of the high noise levels at anchor seen in the 8160 tests, noise tests with the engines at idle (110 shaft RPM, 0 pitch) in both shallow and deep water. In deeper water, much lower noise levels were observed, apparently due to the greater attenuation of the noise from the various acoustic sources on the ship over the greater range.

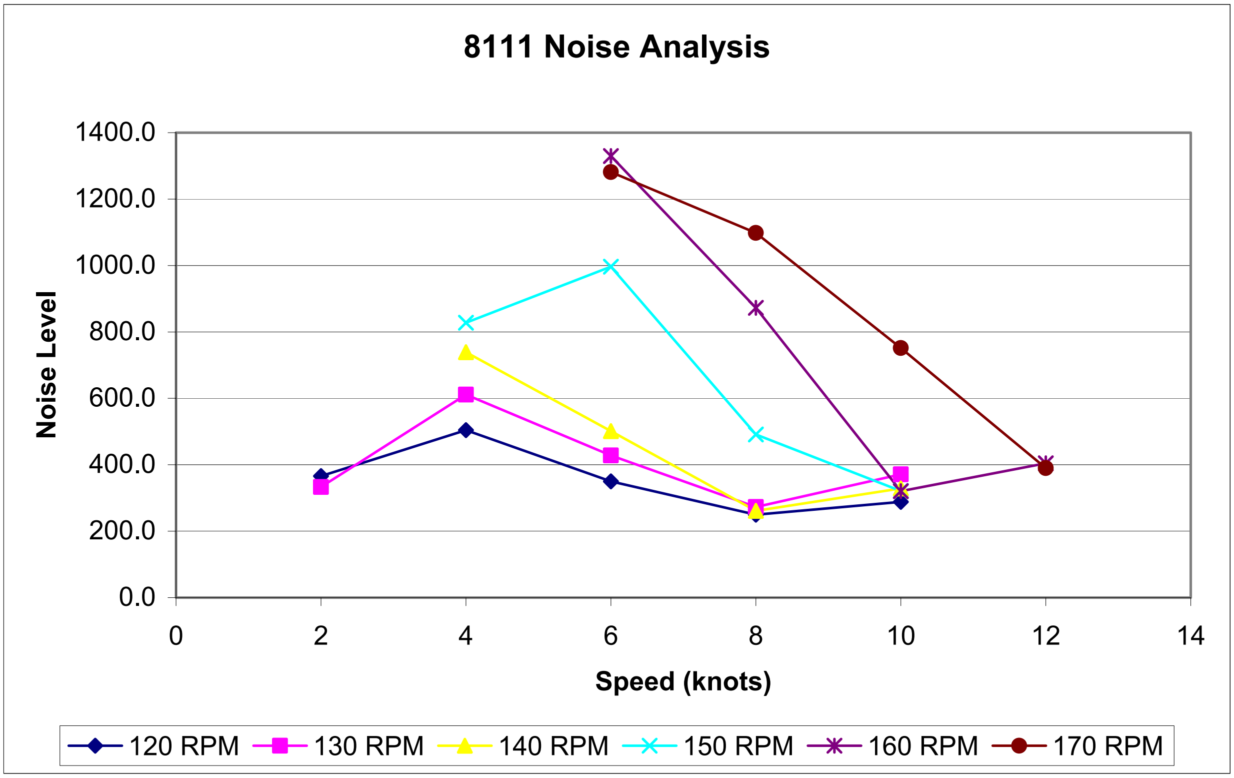


Figure 2 - Noise Plot

3.0 Conclusions

a. It appears that the best survey speed for the 8111, from a noise perspective, is in the range of 8 to 10 knots. Both lower and higher speeds correlate with higher noise levels.
b. It would be desirable to use shaft speeds of 140 RPM, or lower, to minimize the noise level seen by the sonar.
c. Significantly increased levels of reverberation from acoustic sources on the vessel are seen in shallower water. If this causes any degradation in the quality of the soundings in the 8111, increased power levels, higher than those recommended in the sonar settings guide, should be used to compensate.

Appendix A – Test Logs

Survey Log - 8111 Noise Test.xls

RESON Inc.

Date:	10/11/2004	**Survey Area:**	Rudyerd Bay, AK	**Page / Pages:**	1 of 2
Survey Name:	8111 Noise Test	**Surveyors:**	B Bridge	**TimeZone:**	-9
Survey Vessel:	NOAA Fairweather	**Client:**	NOAA		

Offset Information

	X	Y	Z	Latency	Roll	Pitch	Yaw
Sounder							
DGPS							
Motion Sensor							
Other							

SVP File:

Tide File

Date of Patch Test

Total Pole minus Dry Pole

Draft (Z)

Start	Stop	Line	Dir.	Speed	COMMENTS
		8111-00kt-EngOn-0001		0	Gain MF20, Power 0, Range 100, at anchor, 110 RPM
		8111-00kt-0001		0	110 RPM 0 Pitch
		8111-02kt-120-0001		2	120 RPM 1.0 Pitch 0.4 Doppler
		8111-04kt-120-0001		4	120 RPM 3.0 Pitch 2.8 Doppler
		8111-06kt-120-0001		6	120 RPM 6.0 Pitch 4.6 Doppler
		8111-08kt-120-0001		8	120 RPM 8.5 Pitch 6.7 Doppler
		8111-10kt-120-0001		9	120 RPM 10.0 Pitch 7.2 Doppler
		8111-10kt-130-0001		10	130 RPM 10.0 Pitch 8.2 Doppler
		8111-08kt-130-0001		8	130 RPM 7.0 Pitch 6.2 Doppler
		8111-06kt-130-0001		6	130 RPM 5.0 Pitch 4.5 Doppler
		8111-04kt-130-0001		4	130 RPM 3.0 Pitch 2.2 Doppler
		8111-02kt-130-0001		2	130 RPM 1.5 Pitch 0.5 Doppler
		8111-04kt-140-0001		4	140 RPM 2.5 Pitch 2.5 Doppler
		8111-06kt-140-0001		6	140 RPM 4.75 Pitch 4.3 Doppler Too Shallow
		8111-06kt-140-0002		6	140 RPM 5.3 Pitch 5.2 Doppler
		8111-08kt-140-0001		8	140 RPM 7.4 Pitch 6.5 Doppler
		8111-10kt-140-0001		10	140 RPM 9.0 Pitch 8.5 Doppler

Survey Manager: Client Representative:

Signature: Signature:

Sheet1 / Sheet2 / Sheet3

RESON

Survey Log - 8111 Noise Test Pg2.xls

RESON Inc.

Date:	10/11/2004	**Survey Area:**	Rudyerd Bay, AK	**Page / Pages:**	2 of 2
Survey Name:	8111 Noise Test	**Surveyors:**	B Bridge	**TimeZone:**	-9
Survey Vessel:	NOAA Fairweather	**Client:**	NOAA		

Offset Information

	X	Y	Z	Latency	Roll	Pitch	Yaw
Sounder							
DGPS							
Motion Sensor							
Other							

SVP File:
Tide File

Date of Patch Test

Total Pole
minus Dry Pole
Draft (Z)

Start	Stop	Line	Dir.	Speed	COMMENTS
		8111-10kt-150-0001		10	Gain MF20, Power 0, Range 100, 150, 8.2, 7.4
		8111-08kt-150-0002		8	150 RPM 6.1 Pitch 6.3 Doppler
		8111-06kt-150-0001		6	150 RPM 4.3 Pitch 4.4 Doppler
		8111-04kt-150-0001		4	150 RPM 3.0 Pitch 2.8 Doppler
		8111-06kt-160-0001		6	160 RPM 4.0 Pitch 5.2 Doppler
		8111-08kt-160-0001		8	160 RPM 6.1 Pitch 6.5 Doppler
		8111-10kt-160-0001		10	160 RPM 8.2 Pitch 8.8 Doppler
		8111-12kt-160-0001		11.7	160 RPM 10. Pitch 9.9 Doppler
		8111-12kt-170-0001		12	170 RPM 9.0 Pitch 10.4 Doppler
		8111-06kt-170-0001		6	170 RPM 4.0 Pitch 4.8 Doppler
		8111-08kt-170-0001		8	170 RPM 5.9 Pitch 6.8 Doppler
		8111-10kt-170-0001		10	170 RPM 7.0 Pitch 8.3 Doppler

Survey Manager: Client Representative:
Signature: Signature:

Sheet1 / Sheet2 / Sheet3

Appendix B – Noise Analysis Spreadsheet

8111 Noise Test Results

Test Condition	Speed	Pitch (ft)	Test Case										Average
			1	2	3	4	5	6	7	8	9	10	
Eng On Shallow	0	0	707.5	740.2	754.1	711.4	728.1	710.6	691.5	747.9	813.7	722.1	732.7
Eng On Deep	0	0	209.0	208.4	208.6	207.2	205.6	211.2	206.3	208.8	210.9	210.0	208.6
120 RPM	2.0	1.0	382.8	363.0	363.6	330.6	447.5	315.2	389.0	322.1	371.9	371.1	365.7
	4.0	3.0	552.7	431.0	555.9	480.0	517.9	448.0	472.8	500.7	583.6	499.2	504.2
	6.0	6.0	325.5	332.9	302.5	322.9	324.8	364.2	325.8	384.3	409.1	407.4	349.9
	8.0	8.5	253.8	244.0	250.3	253.0	248.4	241.0	241.7	252.4	253.5	259.1	249.7
	9.0	10.0	298.8	296.8	277.4	306.1	284.1	274.0	274.1	290.1	287.5	291.9	288.1
130 RPM	2.0	1.5	316.9	363.0	366.1	429.6	317.1	313.9	303.7	315.5	315.5	289.4	333.1
	4.0	3.0	671.0	657.4	700.4	632.7	602.6	631.0	552.5	605.8	537.9	523.7	611.5
	6.0	5.0	488.2	471.1	410.9	497.2	387.7	390.9	431.0	448.9	361.3	393.5	428.1
	8.0	7.0	285.2	279.1	276.7	266.2	287.8	268.3	271.0	262.5	283.4	249.9	273.0
	10.0	10.0	362.8	396.1	378.8	378.2	370.2	391.7	354.6	369.9	334.3	374.0	371.1
RPM 140	4	2.5	763.9	725.6	669.0	723.3	759.5	751.5	773.5	750.6	689.0	785.7	739.2
	6	5.3	487.1	551.5	605.3	596.4	444.3	480.0	416.2	500.0	452.6	478.9	501.2
	8	7.4	261.5	257.6	260.7	273.1	259.8	274.8	255.0	252.1	248.7	270.6	261.4
	10	9.0	301.5	365.3	328.4	360.1	359.9	328.4	326.2	315.0	302.7	300.4	328.8
RPM 150	4	3.0	775.2	766.3	916.9	809.7	815.4	860.6	710.5	801.1	892.1	928.6	827.6
	6	4.3	1058.7	926.7	737.5	1015.6	1028.1	1086.3	1048.8	1133.8	997.3	931.8	996.5
	8	6.1	507.8	567.2	535.4	486.4	507.3	443.4	460.9	537.6	461.0	406.4	491.3
	10	8.2	299.2	294.1	315.8	306.5	308.4	323.2	348.8	336.8	332.8	344.5	321.0
160 RPM	6	4.0	1488.4	1551.6	1328.3	1454.8	1456.9	1518.9	1256.4	1146.3	1089.5	1005.8	1329.7
	8	6.1	740.7	777.4	926.5	904.7	851.6	817.7	886.5	801.0	1005.7	1015.9	872.8
	10	8.2	339.9	330.9	335.0	329.4	300.6	326.7	316.9	311.6	313.7	300.9	320.6
	12	10.0	581.4	396.6	351.5	360.6	344.6	410.5	466.2	357.1	389.6	386.4	404.5
170 RPM	6	4.0	1240.1	1173.3	1016.2	1346.1	1301.8	1391.5	1520.2	1327.6	1320.2	1176.3	1281.3
	8	5.9	961.9	1096.9	1229.4	1017.2	1041.2	1168.9	1176.6	1060.5	1117.9	1112.2	1098.3
	10	7.0	756.2	751.3	747.9	640.1	769.5	844.8	714.6	795.6	787.4	709.4	751.7
	12	9.0	396.2	360.1	552.7	339.9	348.5	339.3	352.6	356.5	502.1	351.7	390.0

Appendix IV

Total Propagated Error (TPE)

TPE Values

- Standard Deviation

	FAIRWEATHER SURVEY	*Doc. No.* REP-6XX	*Appendix IV*	*Process Owner* Survey
	Documents Title **FA_TPE_Values_2007**	*Last update* Apr 23, 2007	*Version* *2006.2*	*Approval Date*

Offsets

	Vessel	**FAIRWEATHER-S220**	**FAIRWEATHER-S220**	**1010**	**1018**
	Sonar System	**Reson 8111**	**Reson 8160**	**Reson 8101**	**Reson 8101**
	Positioning System	**POS/MV Model 320**	**POS/MV Model 320**	**POS/MV Model 320**	**POS/MV Model 320**
Offsets	MRU to Trans X	2.868	0.493	0.247	0.286
	MRU to Trans Y	8.252	7.665	-0.138	-0.141
	MRU to Trans Z	4.752	4.726	0.551	0.551
	Nav to Trans X	1.691	-0.684	1.144	1.184
	Nav to Trans Y	20.172	19.585	1.061	0.96
	Nav to Trans Z	17.756	17.730	3.667	3.711
	Trans Roll	0.00	0.00	0.00	0.00

Standard Deviation

	Vessel	**FAIRWEATHER-S220**	**FAIRWEATHER-S220**	**1010**	**1018**		
	Sonar System	**Reson 8111**	**Reson 8160**	**Reson 8101**	**Reson 8101**		
	Positioning System	**POS/MV Model 320 V4**	**POS/MV Model 320 V4**	**POS/MV Model 320 V3**	**POS/MV Model 320 V3**		**Status**
Motion Sensor	Motion Gyro (deg)	0.02	0.02	0.02	0.02	**Vessel Configuration File**	Finalized
	Heave% Amp	5	5	5	5		Finalized
	Heave (m)	0.05	0.05	0.05	0.05		Finalized
	Roll (deg)	0.02	0.02	0.02	0.02		Finalized
	Pitch (deg)	0.02	0.02	0.02	0.02		Finalized
	Position Nav (m)	0.5*	0.5	0.5	0.5		Finalized
	Vessel Speed (m/s)	0.03	0.03	0.03	0.03		Finalized
Latency	Timing Trans (s)	0.005	0.005	0.005	0.005		Finalized
	Nav Timing (s)	0.005	0.005	0.005	0.005		Finalized
	Gyro Timing (s)	0.005	0.005	0.005	0.005		Finalized
	Heave Timing (s)	0.005	0.005	0.005	0.005		Finalized
	Pitch Timing (s)	0.005	0.005	0.005	0.005		Finalized
	Roll Timing (s)	0.005	0.005	0.005	0.005		Finalized
Vessel Offsets	Offset X (m)	0.007	0.007	0.007	0.007		Finalized
	Offset Y (m)	0.007	0.007	0.007	0.007		Finalized
	Offset Z (m)	0.008	0.008	0.007	0.007		Finalized
Waterline	Loading	0.02	0.02	0.01	0.01		Finalized
	Draft (m)	0.022	0.022	0.016	0.016		Finalized
	DeltaDraft (m)	0.075	0.075	0.007	0.05		Finalized
MRU Alignment	MRU alignStdev gyro	0.05	0.26	0.10	0.09		Finalized
	MRU align roll/pitch	0.11	0.03	0.13	0.06		Finalized
Tides	Tide Meas (m)	0.01	0.01	0.01	0.01	**Compute TPE Dialog Box**	Project Dependent
	Tide Zoning (m)	0.1	0.1	0.1	0.1		Project Dependent
Sound Velocity	SV Meas (m/s)	0.5	0.5	1.0	1.0		Finalized
	Surface SV (m/s)	0.5	0.5	1.0	1.0		Finalized

*Position Nav adjusted in the HVF to 5m when acquiring in Coarse Acquisition mode, additional information will be submitted in the DAPR and/or the DR.

Appendix V

Additional Calibration Reports

Control

- Ashtech
  - Positioning Equipment Confidence Check
  - OPUS solution
- Tides
  - Kukkamakis 2006
  - Vertical Control Equipment Testing
- Trimble
  - Positioning Equipment Confidence Check
  - OPUS solution
  - *See* SAND1.ssf *attached in digital separates*

Diver Least Depth Gauge (DLDG)

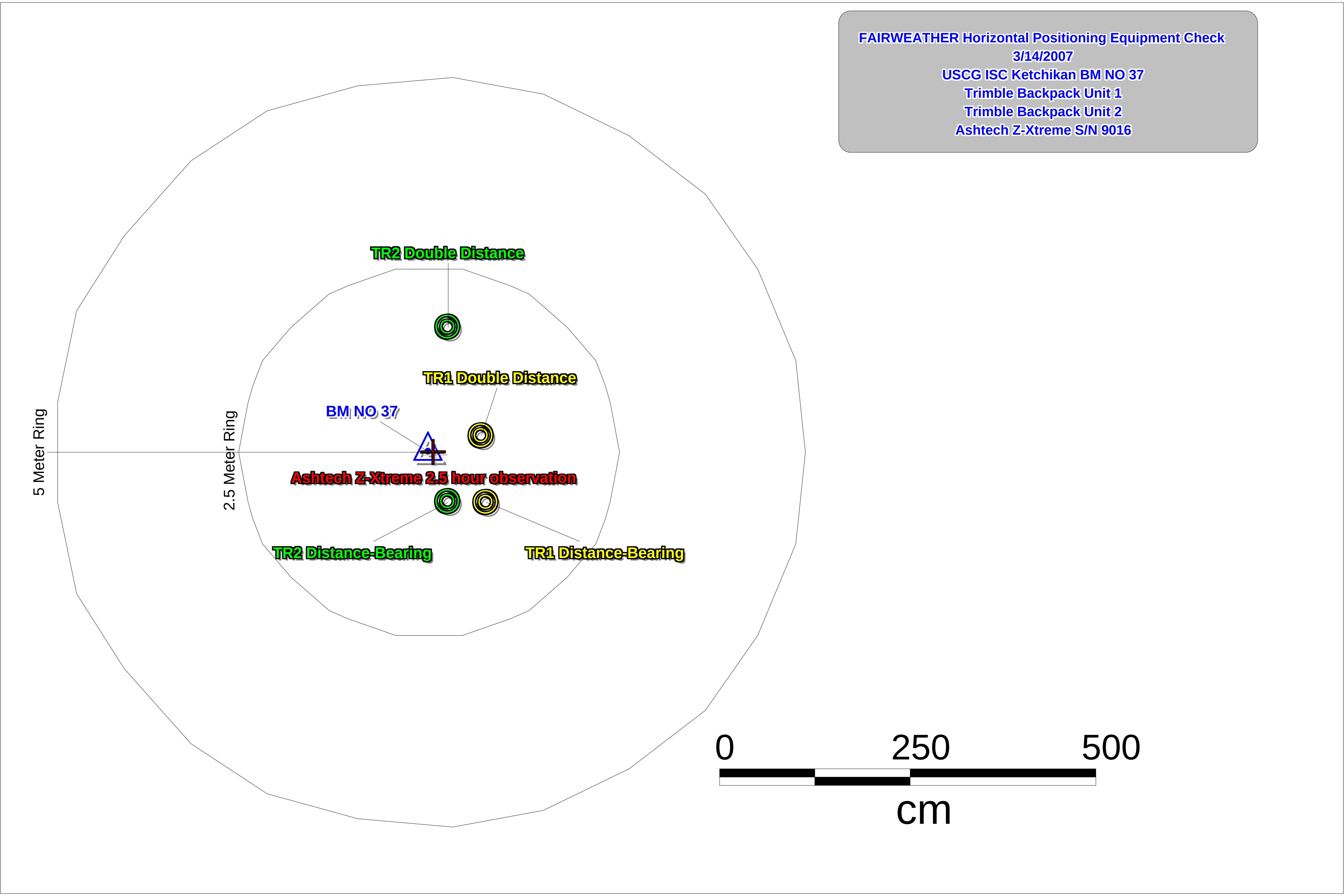
- *See cal files attached in digital separates*

Laser Level

Leadlines

SV

- MVP
  - Penetrometer
- SBE
  - SBE 19*plus*
    - SBE 19*plus* 4585
    - SBE 19*plus* 4616
    - SBE 19*plus* 4617
  - SBE 45 TSG


FAIRWEATHER Horizontal Positioning Equipment Check
3/14/2007
USCG ISC Ketchikan BM NO 37
Trimble Backpack Unit 1
Trimble Backpack Unit 2
Ashtech Z-Xtreme S/N 9016
TR2 Double Distance
TR1 Double Distance
BM NO 37
Ashtech Z-Xtreme 2.5 hour observation
TR2 Distance-Bearing
TR1 Distance-Bearing
5 Meter Ring
2.5 Meter Ring
0
250
500
cm

Subject:
OPUS solution : USCG0732.07O 000106232
From:
opus@ngs.noaa.gov
Date:
Mon, 02 Apr 2007 12:07:31 -0400 (EDT)
To:
horcon.fairweather@noaa.gov

```
 FILE: USCG0732.07O 000106232

                              NGS OPUS SOLUTION REPORT
                              ========================

      USER: horcon.fairweather@noaa.gov             DATE: April 02, 2007
RINEX FILE: uscg073s.07o                            TIME: 16:07:30 UTC


  SOFTWARE: page5  0612.06 master29.pl             START: 2007/03/14  18:06:00
 EPHEMERIS: igs14183.eph [precise]                  STOP: 2007/03/14  20:36:00
  NAV FILE: brdc0730.07n                        OBS USED:  6385 /  6511   :  98%
  ANT NAME: ASH701975.01AGP NONE              # FIXED AMB:    30 /    32   :  94%
ARP HEIGHT: 2.0                               OVERALL RMS: 0.018(m)


 REF FRAME: NAD_83(CORS96)(EPOCH:2003.0000)            ITRF00 (EPOCH:2007.1995)

         X:     -2415358.884(m)   0.013(m)          -2415359.692(m)   0.013(m)
         Y:     -2718046.175(m)   0.012(m)          -2718045.070(m)   0.012(m)
         Z:      5222559.312(m)   0.016(m)           5222559.510(m)   0.016(m)

       LAT:   55 19 58.66133      0.010(m)       55 19 58.67266      0.010(m)
     E LON:  228 22 28.18023      0.007(m)      228 22 28.10433      0.007(m)
     W LON:  131 37 31.81977      0.007(m)      131 37 31.89567      0.007(m)
    EL HGT:            3.781(m)   0.023(m)                 3.780(m)   0.023(m)
 ORTHO HGT:            9.656(m)   0.034(m) [Geoid06 NAVD88]

                        UTM COORDINATES    STATE PLANE COORDINATES
                         UTM (Zone 09)         SPC (5001 AK 1)
Northing (Y) [meters]     6134983.221              0.000
Easting (X)  [meters]      333464.469              0.000
Convergence  [degrees]    -2.15989540          0.00000000
Point Scale                0.99994023          0.00000000
Combined Factor            0.99993963          0.00000000

US NATIONAL GRID DESIGNATOR:  9UUB3346434983(NAD 83)



                              BASE STATIONS USED
PID       DESIGNATION                        LATITUDE    LONGITUDE DISTANCE(m)
AI5022 BIS1 BIORKA ISLAND 1 CORS ARP       N565116.162 W1353221.387  296620.8
AJ4430 LEV1 LEVEL ISLAND 1 CORS ARP        N562756.438 W1330533.935  155968.5
AF9530 AIS1 ANNETTE ISLAND 1 CORS ARP      N550408.647 W1313558.255   29425.1

                 NEAREST NGS PUBLISHED CONTROL POINT
AI4914      BM NO 37                       N551958.659 W1313731.820       0.0
```

BASE STATION INFORMATION

```
STATION NAME: bis1  a    5 (BIORKA ISLAND 1; Biorka Island, Alaska, U.S.A.)
 ANTENNA: ASH700829.3     SNOW                             S/N=xxxx
XYZ  -2494921.0213  -2448390.9324   5317113.5289  MON @ 1997.0000 (M)
XYZ        -0.0164         0.0037         0.0005  VEL (M/YR)
NEU         0.0000         0.0000         0.0000  MON TO ARP (M)
NEU        -0.0000         0.0000         0.0877  ARP TO L1 PHASE CENTER (M)
NEU        -0.0000         0.0000         0.0598  ARP TO L2 PHASE CENTER (M)
XYZ        -0.1673         0.0377         0.0051  VEL TIMES 10.1982 YRS
XYZ         0.0000         0.0000         0.0000  MON TO ARP
XYZ        -0.0342        -0.0336         0.0734  ARP TO L1 PHASE CENTER
XYZ  -2494921.2228  -2448390.9283   5317113.6074  L1 PHS CEN @ 2007.1995
XYZ        -0.0001         0.0014         0.0005  + XYZ ADJUSTMENTS
XYZ  -2494921.2228  -2448390.9269   5317113.6080  NEW L1 PHS CEN @ 2007.1995
XYZ  -2494921.1886  -2448390.8933   5317113.5345  NEW ARP @ 2007.1995
XYZ  -2494921.1886  -2448390.8933   5317113.5345  NEW MON @ 2007.1995
LLH  56 51 16.17228  224 27 38.53267     66.6787  NEW L1 PHS CEN @ 2007.1995
LLH  56 51 16.17228  224 27 38.53267     66.5910  NEW ARP @ 2007.1995
LLH  56 51 16.17228  224 27 38.53267     66.5910  NEW MON @ 2007.1995

STATION NAME: lev1  a    8 (Level Island 1; Level Island, Alaska  USA)
 ANTENNA: ASH700829.3     SNOW                             S/N=CG11936
XYZ  -2412828.4670  -2579056.1235   5293283.3535  MON @ 1997.0000 (M)
XYZ        -0.0190         0.0003        -0.0044  VEL (M/YR)
NEU         0.0000         0.0000         0.0000  MON TO ARP (M)
NEU        -0.0000         0.0000         0.0877  ARP TO L1 PHASE CENTER (M)
NEU        -0.0000         0.0000         0.0598  ARP TO L2 PHASE CENTER (M)
XYZ        -0.1938         0.0031        -0.0449  VEL TIMES 10.1982 YRS
XYZ         0.0000         0.0000         0.0000  MON TO ARP
XYZ        -0.0331        -0.0354         0.0731  ARP TO L1 PHASE CENTER
XYZ  -2412828.6939  -2579056.1558   5293283.3817  L1 PHS CEN @ 2007.1995
XYZ        -0.0002         0.0006         0.0002  + XYZ ADJUSTMENTS
XYZ  -2412828.6941  -2579056.1552   5293283.3819  NEW L1 PHS CEN @ 2007.1995
XYZ  -2412828.6610  -2579056.1198   5293283.3088  NEW ARP @ 2007.1995
XYZ  -2412828.6610  -2579056.1198   5293283.3088  NEW MON @ 2007.1995
LLH  56 27 56.44916  226 54 25.98578     25.2831  NEW L1 PHS CEN @ 2007.1995
LLH  56 27 56.44916  226 54 25.98578     25.1954  NEW ARP @ 2007.1995
LLH  56 27 56.44916  226 54 25.98578     25.1954  NEW MON @ 2007.1995

STATION NAME: ais1  a    7 (ANNETTE ISLAND 1; Annette Island, Alaska, U.S.A.)
 ANTENNA: ASH700829.3     SNOW                             S/N=11276
XYZ  -2430153.7846  -2737192.8996   5205816.6147  MON @ 1997.0000 (M)
XYZ        -0.0151         0.0008        -0.0082  VEL (M/YR)
NEU         0.0000         0.0000         0.0000  MON TO ARP (M)
NEU        -0.0000         0.0000         0.0877  ARP TO L1 PHASE CENTER (M)
NEU        -0.0000         0.0000         0.0598  ARP TO L2 PHASE CENTER (M)
XYZ        -0.1540         0.0082        -0.0836  VEL TIMES 10.1982 YRS
XYZ         0.0000         0.0000         0.0000  MON TO ARP
XYZ        -0.0333        -0.0376         0.0719  ARP TO L1 PHASE CENTER
XYZ  -2430153.9719  -2737192.9290   5205816.6030  L1 PHS CEN @ 2007.1995
XYZ         0.0001        -0.0001        -0.0000  + XYZ ADJUSTMENTS
XYZ  -2430153.9718  -2737192.9291   5205816.6030  NEW L1 PHS CEN @ 2007.1995
```

```
 XYZ  -2430153.9385  -2737192.8915   5205816.5311  NEW ARP @ 2007.1995
 XYZ  -2430153.9385  -2737192.8915   5205816.5311  NEW MON @ 2007.1995
 LLH  55  4  8.65871  228 24  1.66998     32.2471  NEW L1 PHS CEN @ 2007.1995
 LLH  55  4  8.65871  228 24  1.66998     32.1594  NEW ARP @ 2007.1995
 LLH  55  4  8.65871  228 24  1.66998     32.1594  NEW MON @ 2007.1995
```

REMOTE STATION INFORMATION

```
 STATION NAME: uscg       1
  ANTENNA: ASH701975.01AGP NONE                             S/N=UNKNOWN
 XYZ  -2415360.3793  -2718045.5588   5222561.1762  MON @ 2007.1993 (M)
 NEU         0.0000        -0.0000         2.0000  MON TO ARP (M)
 NEU        -0.0000         0.0000         0.0637  ARP TO L1 PHASE CENTER (M)
 NEU        -0.0000         0.0000         0.0440  ARP TO L2 PHASE CENTER (M)
 XYZ        -0.7557        -0.8504         1.6449  MON TO ARP
 XYZ        -0.0241        -0.0271         0.0524  ARP TO L1 PHASE CENTER
 XYZ  -2415361.1590  -2718046.4363   5222562.8735  L1 PHS CEN @ 2007.1995

 BASELINE NAME:   bis1  uscg
 XYZ         0.6817         0.4813        -1.6607  + XYZ ADJUSTMENTS
 XYZ  -2415360.4774  -2718045.9549   5222561.2128  NEW L1 PHS CEN @ 2007.1995
 XYZ  -2415360.4533  -2718045.9278   5222561.1604  NEW ARP @ 2007.1995
 XYZ  -2415359.6976  -2718045.0775   5222559.5155  NEW MON @ 2007.1995
 LLH  55 19 58.67251  228 22 28.10438      5.8533  NEW L1 PHS CEN @ 2007.1995
 LLH  55 19 58.67251  228 22 28.10438      5.7896  NEW ARP @ 2007.1995
 LLH  55 19 58.67251  228 22 28.10438      3.7896  NEW MON @ 2007.1995

 BASELINE NAME:   lev1  uscg
 XYZ         0.6864         0.4936        -1.6609  + XYZ ADJUSTMENTS
 XYZ  -2415360.4727  -2718045.9427   5222561.2127  NEW L1 PHS CEN @ 2007.1995
 XYZ  -2415360.4486  -2718045.9156   5222561.1603  NEW ARP @ 2007.1995
 XYZ  -2415359.6929  -2718045.0652   5222559.5153  NEW MON @ 2007.1995
 LLH  55 19 58.67284  228 22 28.10412      5.8462  NEW L1 PHS CEN @ 2007.1995
 LLH  55 19 58.67284  228 22 28.10412      5.7825  NEW ARP @ 2007.1995
 LLH  55 19 58.67284  228 22 28.10412      3.7825  NEW MON @ 2007.1995

 BASELINE NAME:   ais1  uscg
 XYZ         0.6951         0.4928        -1.6769  + XYZ ADJUSTMENTS
 XYZ  -2415360.4639  -2718045.9435   5222561.1967  NEW L1 PHS CEN @ 2007.1995
 XYZ  -2415360.4398  -2718045.9164   5222561.1443  NEW ARP @ 2007.1995
 XYZ  -2415359.6842  -2718045.0660   5222559.4993  NEW MON @ 2007.1995
 LLH  55 19 58.67268  228 22 28.10452      5.8300  NEW L1 PHS CEN @ 2007.1995
 LLH  55 19 58.67268  228 22 28.10452      5.7663  NEW ARP @ 2007.1995
 LLH  55 19 58.67268  228 22 28.10452      3.7663  NEW MON @ 2007.1995
```

G-FILES

```
Axx2007 314   7 314
B2007 31418 5   7 3142035 1 page5 v0612.06IGS     222 1 2 27NGS   2007 4 2IFDDFX
Iant_info.003        NGS   20070320
C00090001 -795614910   19 2696541842   21  945540190   39 X0737AUSCGX0737ABIS1
D  1  2  7550588  1  3 -9307589  2  3 -7806480

Axx2007 314   7 314
B2007 31418 5   7 3142035 1 page5 v0612.06IGS     222 1 2 27NGS   2007 4 2IFDDFX
Iant_info.003        NGS   20070320
C00090002   25310319   17 1389889454   20  707237935   38 X0737AUSCGX0737ALEV1
```

```
D  1  2  8189618  1  3 -9202066  2  3 -7448116

Axx2007 314   7 314
B2007 31418 5   7 3142035 1 page5 v0612.06IGS     222 1 2 27NGS   2007 4 2IFDDFX
Iant_info.003        NGS   20070320
C00090003 -147942543   19 -191478255   22 -167429683   36 X0737AUSCGX0737AAIS1
D  1  2  9369495  1  3 -7883557  2  3 -7554607
```


POST-FIT RMS BY SATELLITE VS. BASELINE

```
            OVERALL     03     06     07     10     16     18     19     21
 bis1-uscg|  0.017  0.018  0.016  0.018  0.014  0.019  0.013  0.015    ...
                22     24     25     26     29     30
 bis1-uscg|  0.018  0.015    ...  0.022  0.019    ...

            OVERALL     03     06     07     10     16     18     19     21
 lev1-uscg|  0.018  0.017  0.018  0.019  0.017  0.022  0.017  0.015    ...
                22     24     26     29     30
 lev1-uscg|  0.018  0.013  0.018  0.021    ...

            OVERALL     03     06     07     10     16     18     19     21
 ais1-uscg|  0.018  0.020  0.018  0.018  0.012  0.022  0.016    ...    ...
                22     24     26     29     30
 ais1-uscg|  0.015  0.017  0.015  0.016    ...
```

OBS BY SATELLITE VS. BASELINE

```
            OVERALL     03     06     07     10     16     18     19     21
 bis1-uscg|   2148    155    203    279    102    296    245     28    ...
                22     24     25     26     29     30
 bis1-uscg|    118    284    ...    200    238    ...
            OVERALL     03     06     07     10     16     18     19     21
 lev1-uscg|   2087    155    182    225    106    296    247     28    ...
                22     24     26     29     30
 lev1-uscg|    117    284    200    247    ...
            OVERALL     03     06     07     10     16     18     19     21
 ais1-uscg|   2150    152    207    284    105    295    239    ...    ...
                22     24     26     29     30
 ais1-uscg|    119    283    213    253    ...
```

```
 Covariance Matrix for the xyz OPUS Position (meters2).
    0.0000022467     0.0000002159    -0.0000004052
    0.0000002159     0.0000029444    -0.0000004008
   -0.0000004052    -0.0000004008     0.0000094689

 Covariance Matrix for the enu OPUS Position (meters2).
    0.0000023402    -0.0000002845     0.0000001534
   -0.0000002845     0.0000044782     0.0000029060
    0.0000001534     0.0000029060     0.0000078416

 Horizontal network accuracy =    0.00458 meters.
 Vertical network accuracy   =    0.00549 meters.
```

Derivation of NAD 83 vector components

Position of reference station ARP in NAD_83(CORS96)(EPOCH:2003.0000).

	Xa(m)	Ya(m)	Za(m)	
BIS1	-2494920.37852	-2448391.99956	5317113.26406	2003.00
LEV1	-2412827.84636	-2579057.21856	5293283.07789	2003.00
AIS1	-2430153.14737	-2737194.00189	5205816.33593	2003.00

Position of reference station monument in NAD_83(CORS96)(EPOCH:2003.0000).

	Xr(m)	Yr(m)	Zr(m)	
BIS1	-2494920.37852	-2448391.99956	5317113.26406	2003.00
LEV1	-2412827.84636	-2579057.21856	5293283.07789	2003.00
AIS1	-2430153.14737	-2737194.00189	5205816.33593	2003.00

Velocity of reference station monument in NAD_83(CORS96)(EPOCH:2003.0000).

	Vx (m/yr)	Vy (m/yr)	Vz (m/yr)
BIS1	0.00490	0.00450	0.00990
LEV1	0.00220	0.00120	0.00480
AIS1	0.00580	0.00170	0.00110

Vectors from unknown station monument to reference station monument in NAD_83(CORS96)(EPOCH:2003.0000).

	Xr-X= DX(m)	Yr-Y= DY(m)	Zr-Z= DZ(m)	
BIS1	-79561.49452	269654.17544	94553.95206	2003.00
LEV1	2531.03764	138988.95644	70723.76589	2003.00
AIS1	-14794.26337	-19147.82689	-16742.97607	2003.00

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

Kukkamaki March 13 & 14, 2007

On March 13, 2007 (Dn072) LTJG Lewis, ST Mills and ENS Morgan performed a Kukkamaki on both Carl Zeiss NI2 (stadia: 333) levels (S/N 103267 and S/N 100056).

The Kukkamaki course was set up at the NOAA base in Ketchikan, AK in the early afternoon. The sky was overcast with occasional snow showers passing intermixed with occasional rain. A 40 meter straight line was set up on relatively level ground and divided into 10 meter intervals. The level was then set up on the 30 meter mark and a backsight and foresight were shot to the 20 and 40 meter marks respectively. Next, the level was set up at the 0 meter mark, and a backsight and foresight were shot to the 20 and 40 meter marks, respectively. (See *fig. 1*)

The Carl Zeiss level S/N 103267 had a collimation error of 0.0066, which is within tolerance. The Carl Zeiss level S/N 100056 had a collimation error of -0.176, which is not within tolerance. The kukkamaki was run 2 more times on that level and still did not pass within tolerance. An adjustment was made to the level to calibrate it for the error recorded during the kukkamaki. After the level S/N 100056 was re-calibrated, another kukkamaki was run on March 14, 2007 (Dn073) and the level was within tolerance with a collimation error of 0.02.

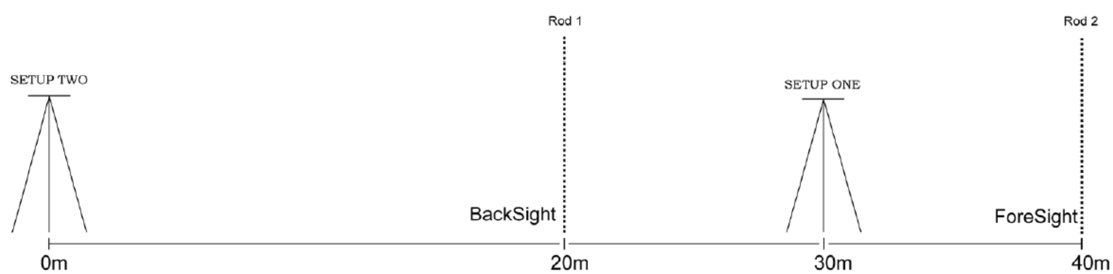


Fig 1. Diagram of Kukkamaki setup.

NOAA FORM 75-29 (12-75) | **U.S. DEPARTMENT OF COMMERCE** NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

PRECISE LEVELING

THREE-WIRE

FORWARD RUN *(See reverse for BACKWARD RUN)*

TIDE STATION	NUMBER / SHEET / OF
FROM B.M.	TO B.M.
Kukkamaki	TIME / DATE: DN 072, 13 March 2007
WEATHER Overcast with snow showers	

Setup	BACKSIGHTS THREAD READING	MEAN	THREAD INTERVAL	SUM OF INTERVALS	ROD TEMP	FORESIGHTS THREAD READING	MEAN	THREAD INTERVAL	SUM OF INTERVALS	REMARKS (___3____ ORDER, CLASS ___1____)	
	1558	BS1				1602	FS1			C = (Δh1 - Δ2) - 0.2mm	
1	1543	1543				1588	1587.67			20 m	
	1528					1573				where BS1 - FS1 = Δh1	
	4629					4763				BS2 - FS2 = Δh2	
	1220	20mS				1295	40mS			Δh1-	-44.67
2	1190	1190				1235	1235			Δh2	-45
	1160					1175				Δh1-Δh2 =	0.33
	3570					3705				- 0.2 (CR)	0.13
										÷20m	0.00666667
										C =	0.00666667

Fill in YELLOW shaded cells.

"C" must be < + 0.05mm/m

Instrument SN: 103267
Rod SN: B
Party Chief: Beaver
Observer: Mills
Recorder: Lewis
Rod Person: Morgan

NOAA FORM 75-29 (12-75)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

PRECISE LEVELING

THREE-WIRE

FORWARD RUN *(See reverse for BACKWARD RUN)*

TIDE STATION	NUMBER	SHEET	OF
FROM B.M.	TO B.M.		
Kukkamaki	TIME	DATE DN 072, 13 March 2007	
WEATHER Overcast with snow showers			

BACKSIGHTS | **FORESIGHTS** | **___3____ ORDER, CLASS ___1____**

Setup	THREAD READING	MEAN	THREAD INTERVAL	SUM OF INTERVALS	ROD TEMP	THREAD READING	MEAN	THREAD INTERVAL	SUM OF INTERVALS	REMARKS	
	1588	BS1				1634	FS1			C = (Δh1 - Δ2) - 0.2mm	
1	1573	1573.33				1618	1618.67			20 m	
	1559					1604				where BS1 - FS1 = Δh1	
	4720					4856				BS2 - FS2 = Δh2	
	1278	20mS				1350	40mS			Δh1-	-45.33
2	1248	1248				1290	1290			Δh2	-42
	1218					1230				Δh1-Δh2 =	-3.33
	3744					3870				- 0.2 (CR)	-3.53
										÷20m	-0.17666667
										C =	-0.17666667

Fill in YELLOW shaded cells.

"C" must be < + 0.05mm/m

Instrument SN: 100056
Rod SN: B
Party Chief: Beaver
Observer: Lewis
Recorder: Mills
Rod Person: Morgan

NOAA FORM 75-29 (12-75)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	TIDE STATION	NUMBER	SHEET	OF
PRECISE LEVELING *THREE-WIRE*		FROM B.M.	TO B.M.		
		Kukkamaki	TIME	DATE DN 072, 13 March 2007	
FORWARD RUN *(See reverse for BACKWARD RUN)*		WEATHER Overcast with snow showers			

	BACKSIGHTS					**FORESIGHTS**				___3___ ORDER, CLASS ___1___	
Setup	THREAD READING	MEAN	THREAD INTERVAL	SUM OF INTERVALS	ROD TEMP	THREAD READING	MEAN	THREAD INTERVAL	SUM OF INTERVALS	REMARKS	
	1587	BS1				1631	FS1			C = (Δh1 - Δ2) - 0.2mm	
1	1572	1572				1617	1616.33			20 m	
	1557					1601				where BS1 - FS1 = Δh1	
	4716					4849				BS2 - FS2 = Δh2	
	1307	20mS				1380	40mS			Δh1-	-44.33
2	1277	1277				1320	1320			Δh2	-43
	1247					1260				Δh1-Δh2 =	-1.33
	3831					3960				- 0.2 (CR)	-1.53
										÷20m	-0.07666667
										C =	-0.07666667
	Fill in YELLOW shaded cells.									"C" must be < + 0.05mm/m	
										Instrument SN: 100056	
										Rod SN: B	
										Party Chief: Beaver	
										Observer: Lewis	
										Recorder: Mills	
										Rod Person: Morgan	

NOAA FORM 75-29 (12-75)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	TIDE STATION	NUMBER	SHEET	OF
PRECISE LEVELING *THREE-WIRE*		FROM B.M.	TO B.M.		
FORWARD RUN *(See reverse for BACKWARD RUN)*		**Kukkamaki** WEATHER Overcast with snow showers	TIME	DATE DN 072, 13 March 2007	

Setup	BACKSIGHTS THREAD READING	MEAN	THREAD INTERVAL	SUM OF INTERVALS	ROD TEMP	FORESIGHTS THREAD READING	MEAN	THREAD INTERVAL	SUM OF INTERVALS	___3____ ORDER, CLASS ___1____ REMARKS	
	1585	BS1				1630	FS1			C = (Δh1 - Δ2) - 0.2mm	
1	1570	1570				1615	1615			20 m	
	1555					1600				where BS1 - FS1 = Δh1	
	4710					4845				BS2 - FS2 = Δh2	
	1278	20mS				1350	40mS			Δh1-	-45.00
2	1248	1248				1290	1290			Δh2	-42
	1218					1230				Δh1-Δh2 =	-3.00
	3744					3870				- 0.2 (CR)	-3.20
										÷20m	-0.16
										C =	-0.16
	Fill in YELLOW shaded cells.									"C" must be < + 0.05mm/m	
										Instrument SN: 100056	
										Rod SN: B	
										Party Chief: Beaver	
										Observer: Lewis	
										Recorder: Mills	
										Rod Person: Morgan	

NOAA FORM 75-29 (12-75)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	TIDE STATION	NUMBER	SHEET	OF
PRECISE LEVELING *THREE-WIRE*		FROM B.M.	TO B.M.		
		Kukkamaki	TIME	DATE DN 072, 13 March 2007	
FORWARD RUN *(See reverse for BACKWARD RUN)*		WEATHER Overcast with snow showers			

	BACKSIGHTS					FORESIGHTS				___3____ ORDER, CLASS ___1____	
Setup	THREAD READING	MEAN	THREAD INTERVAL	SUM OF INTERVALS	ROD TEMP	THREAD READING	MEAN	THREAD INTERVAL	SUM OF INTERVALS	REMARKS	
	1480	BS1				1700	FS1			C = (Δh1 - Δ2) - 0.2mm	
1	1465	1465				1685	1685			20 m	
	1450					1670				where BS1 - FS1 = Δh1	
	4395					5055				BS2 - FS2 = Δh2	
	2210	20mS				2462	40mS			Δh1-	-220.00
2	2180	2180				2402	2402			Δh2	-222
	2150					2342				Δh1-Δh2 =	2.00
	6540					7206				- 0.2 (CR)	1.80
										÷20m	0.09
										C =	0.09
	Fill in YELLOW shaded cells.										
										"C" must be < + 0.05mm/m	
										Instrument SN: 100056	
										Rod SN: B	
										Party Chief: Beaver	
										Observer: Lewis	
										Recorder: Mills	
										Rod Person: Morgan	

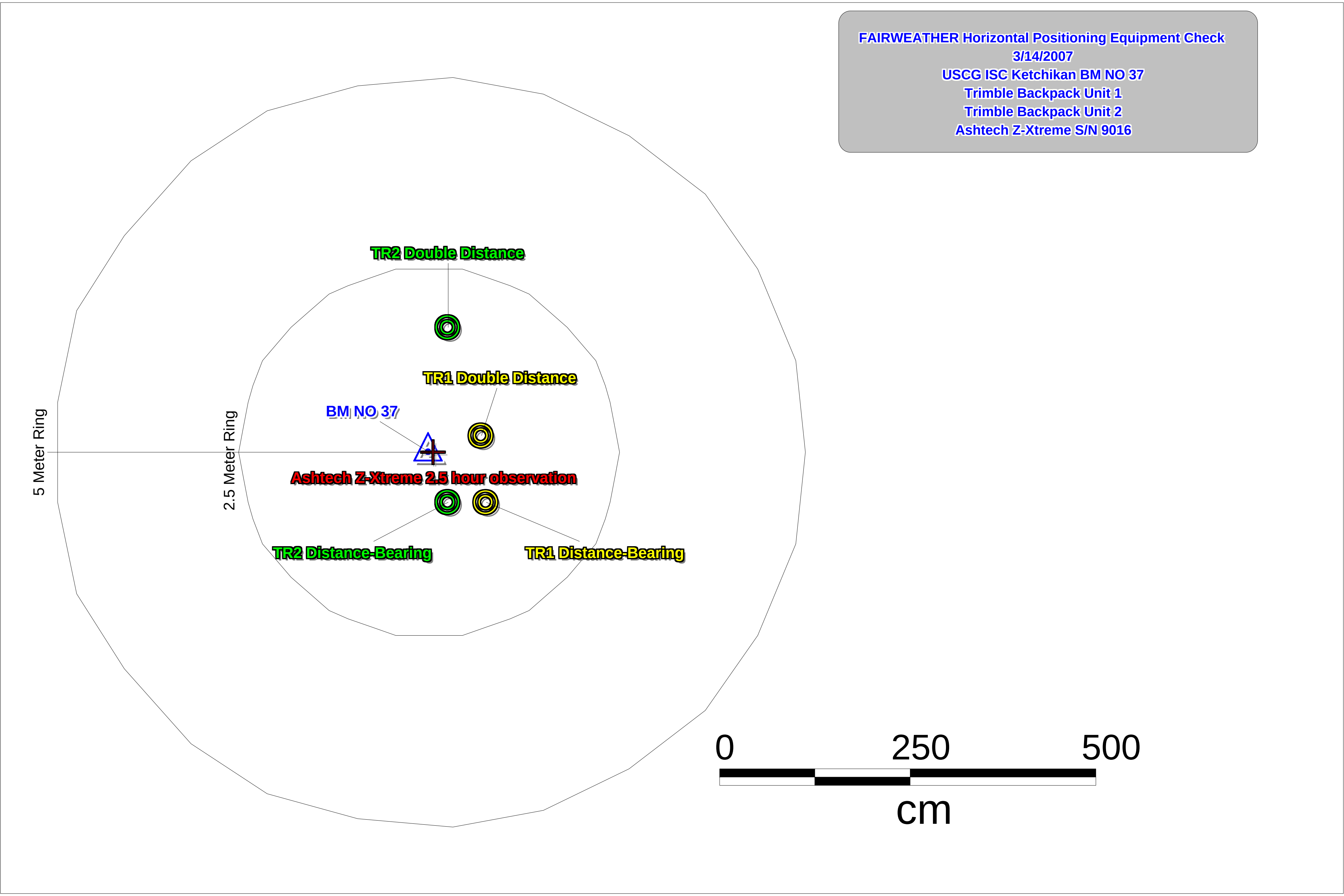
NOAA FORM 75-29 (12-75)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	TIDE STATION	NUMBER	SHEET	OF
PRECISE LEVELING *THREE-WIRE*		FROM B.M.	TO B.M.		
		Kukkamaki	TIME	DATE DN 072, 13 March 2007	
FORWARD RUN *(See reverse for BACKWARD RUN)*		WEATHER Overcast with snow showers			

BACKSIGHTS						FORESIGHTS				___3____ ORDER, CLASS ___1____	
Setup	THREAD READING	MEAN	THREAD INTERVAL	SUM OF INTERVALS	ROD TEMP	THREAD READING	MEAN	THREAD INTERVAL	SUM OF INTERVALS	REMARKS	
	1483	BS1				1705	FS1			C = (Δh1 - Δ2) - 0.2mm	
1	1469	1468.67				1689	1689.33			20 m	
	1454					1674				where BS1 - FS1 = Δh1	
	4406					5068				BS2 - FS2 = Δh2	
	2234	20mS				2485	40mS			Δh1-	-220.67
2	2204	2203.67				2425	2425			Δh2	-221.333333
	2173					2365				Δh1-Δh2 =	0.67
	6611					7275				- 0.2 (CR)	0.47
										÷20m	0.02333333
										C =	0.02333333
	Fill in YELLOW shaded cells.									"C" must be < + 0.05mm/m	
										Instrument SN: 100056	
										Rod SN: B	
										Party Chief: Beaver	
										Observer: Lewis	
										Recorder: Mills	
										Rod Person: Morgan	

NOAA FORM 75-29 (12-75)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	TIDE STATION	NUMBER	SHEET	OF
PRECISE LEVELING *THREE-WIRE*		FROM B.M.	TO B.M.		
		Kukkamaki	TIME	DATE DN 356, 2005	
FORWARD RUN *(See reverse for BACKWARD RUN)*		WEATHER Overcast with occasional rain showers			

	BACKSIGHTS					FORESIGHTS				___3____ ORDER, CLASS ___1____	
Setup	THREAD READING	MEAN	THREAD INTERVAL	SUM OF INTERVALS	ROD TEMP	THREAD READING	MEAN	THREAD INTERVAL	SUM OF INTERVALS	REMARKS	
	1544	BS1				1538	FS1			C = (Δh1 - Δ2) - 0.2mm	
1	1559	1559				1554	1553.67			20 m	
	1574					1569				where BS1 - FS1 = Δh1	
	4677					4661				BS2 - FS2 = Δh2	
	1584	20mS				1550	40mS			Δh1-	5.33
2	1615	1614.67				1609	1609.67			Δh2	5
	1645					1670				Δh1-Δh2 =	0.33
	4844					4829				- 0.2 (CR)	0.13
										÷20m	0.00666667
										C =	0.00666667
										"C" must be < + 0.05mm/m	
										Instrument SN: 100056	
										Rod SN: B	
										Party Chief: Beaver	
										Observer: Morgan	
										Recorder: Mills	
										Rod Person: Lewis	

Fill in YELLOW shaded cells.



FAIRWEATHER Horizontal Positioning Equipment Check
3/14/2007
USCG ISC Ketchikan BM NO 37
Trimble Backpack Unit 1
Trimble Backpack Unit 2
Ashtech Z-Xtreme S/N 9016
TR2 Double Distance
TR1 Double Distance
BM NO 37
Ashtech Z-Xtreme 2.5 hour observation
TR2 Distance-Bearing
TR1 Distance-Bearing
5 Meter Ring
2.5 Meter Ring
0
250
500
cm

Subject:
OPUS solution : USCG0732.07O 000106232
From:
opus@ngs.noaa.gov
Date:
Mon, 02 Apr 2007 12:07:31 -0400 (EDT)
To:
horcon.fairweather@noaa.gov

```
 FILE: USCG0732.07O 000106232

                              NGS OPUS SOLUTION REPORT
                              ========================

      USER: horcon.fairweather@noaa.gov            DATE: April 02, 2007
RINEX FILE: uscg073s.07o                           TIME: 16:07:30 UTC


  SOFTWARE: page5  0612.06 master29.pl            START: 2007/03/14  18:06:00
 EPHEMERIS: igs14183.eph [precise]                 STOP: 2007/03/14  20:36:00
  NAV FILE: brdc0730.07n                       OBS USED:  6385 /  6511   :  98%
  ANT NAME: ASH701975.01AGP NONE             # FIXED AMB:    30 /    32   :  94%
ARP HEIGHT: 2.0                              OVERALL RMS: 0.018(m)


 REF FRAME: NAD_83(CORS96)(EPOCH:2003.0000)            ITRF00 (EPOCH:2007.1995)

         X:     -2415358.884(m)   0.013(m)          -2415359.692(m)   0.013(m)
         Y:     -2718046.175(m)   0.012(m)          -2718045.070(m)   0.012(m)
         Z:      5222559.312(m)   0.016(m)           5222559.510(m)   0.016(m)

       LAT:   55 19 58.66133      0.010(m)        55 19 58.67266      0.010(m)
     E LON:  228 22 28.18023      0.007(m)       228 22 28.10433      0.007(m)
     W LON:  131 37 31.81977      0.007(m)       131 37 31.89567      0.007(m)
    EL HGT:            3.781(m)   0.023(m)                 3.780(m)   0.023(m)
 ORTHO HGT:            9.656(m)   0.034(m) [Geoid06 NAVD88]

                        UTM COORDINATES    STATE PLANE COORDINATES
                         UTM (Zone 09)         SPC (5001 AK 1)
Northing (Y) [meters]     6134983.221             0.000
Easting (X)  [meters]      333464.469             0.000
Convergence  [degrees]    -2.15989540          0.00000000
Point Scale                0.99994023          0.00000000
Combined Factor            0.99993963          0.00000000

US NATIONAL GRID DESIGNATOR:  9UUB3346434983(NAD 83)



                              BASE STATIONS USED
PID       DESIGNATION                        LATITUDE    LONGITUDE DISTANCE(m)
AI5022 BIS1 BIORKA ISLAND 1 CORS ARP       N565116.162 W1353221.387  296620.8
AJ4430 LEV1 LEVEL ISLAND 1 CORS ARP        N562756.438 W1330533.935  155968.5
AF9530 AIS1 ANNETTE ISLAND 1 CORS ARP      N550408.647 W1313558.255   29425.1

                 NEAREST NGS PUBLISHED CONTROL POINT
AI4914      BM NO 37                       N551958.659 W1313731.820       0.0
```

BASE STATION INFORMATION

```
STATION NAME: bis1  a    5 (BIORKA ISLAND 1; Biorka Island, Alaska, U.S.A.)
 ANTENNA: ASH700829.3     SNOW                             S/N=xxxx
XYZ  -2494921.0213  -2448390.9324   5317113.5289  MON @ 1997.0000 (M)
XYZ        -0.0164         0.0037         0.0005  VEL (M/YR)
NEU         0.0000         0.0000         0.0000  MON TO ARP (M)
NEU        -0.0000         0.0000         0.0877  ARP TO L1 PHASE CENTER (M)
NEU        -0.0000         0.0000         0.0598  ARP TO L2 PHASE CENTER (M)
XYZ        -0.1673         0.0377         0.0051  VEL TIMES 10.1982 YRS
XYZ         0.0000         0.0000         0.0000  MON TO ARP
XYZ        -0.0342        -0.0336         0.0734  ARP TO L1 PHASE CENTER
XYZ  -2494921.2228  -2448390.9283   5317113.6074  L1 PHS CEN @ 2007.1995
XYZ        -0.0001         0.0014         0.0005  + XYZ ADJUSTMENTS
XYZ  -2494921.2228  -2448390.9269   5317113.6080  NEW L1 PHS CEN @ 2007.1995
XYZ  -2494921.1886  -2448390.8933   5317113.5345  NEW ARP @ 2007.1995
XYZ  -2494921.1886  -2448390.8933   5317113.5345  NEW MON @ 2007.1995
LLH  56 51 16.17228  224 27 38.53267     66.6787  NEW L1 PHS CEN @ 2007.1995
LLH  56 51 16.17228  224 27 38.53267     66.5910  NEW ARP @ 2007.1995
LLH  56 51 16.17228  224 27 38.53267     66.5910  NEW MON @ 2007.1995

STATION NAME: lev1  a    8 (Level Island 1; Level Island, Alaska  USA)
 ANTENNA: ASH700829.3     SNOW                             S/N=CG11936
XYZ  -2412828.4670  -2579056.1235   5293283.3535  MON @ 1997.0000 (M)
XYZ        -0.0190         0.0003        -0.0044  VEL (M/YR)
NEU         0.0000         0.0000         0.0000  MON TO ARP (M)
NEU        -0.0000         0.0000         0.0877  ARP TO L1 PHASE CENTER (M)
NEU        -0.0000         0.0000         0.0598  ARP TO L2 PHASE CENTER (M)
XYZ        -0.1938         0.0031        -0.0449  VEL TIMES 10.1982 YRS
XYZ         0.0000         0.0000         0.0000  MON TO ARP
XYZ        -0.0331        -0.0354         0.0731  ARP TO L1 PHASE CENTER
XYZ  -2412828.6939  -2579056.1558   5293283.3817  L1 PHS CEN @ 2007.1995
XYZ        -0.0002         0.0006         0.0002  + XYZ ADJUSTMENTS
XYZ  -2412828.6941  -2579056.1552   5293283.3819  NEW L1 PHS CEN @ 2007.1995
XYZ  -2412828.6610  -2579056.1198   5293283.3088  NEW ARP @ 2007.1995
XYZ  -2412828.6610  -2579056.1198   5293283.3088  NEW MON @ 2007.1995
LLH  56 27 56.44916  226 54 25.98578     25.2831  NEW L1 PHS CEN @ 2007.1995
LLH  56 27 56.44916  226 54 25.98578     25.1954  NEW ARP @ 2007.1995
LLH  56 27 56.44916  226 54 25.98578     25.1954  NEW MON @ 2007.1995

STATION NAME: ais1  a    7 (ANNETTE ISLAND 1; Annette Island, Alaska, U.S.A.)
 ANTENNA: ASH700829.3     SNOW                             S/N=11276
XYZ  -2430153.7846  -2737192.8996   5205816.6147  MON @ 1997.0000 (M)
XYZ        -0.0151         0.0008        -0.0082  VEL (M/YR)
NEU         0.0000         0.0000         0.0000  MON TO ARP (M)
NEU        -0.0000         0.0000         0.0877  ARP TO L1 PHASE CENTER (M)
NEU        -0.0000         0.0000         0.0598  ARP TO L2 PHASE CENTER (M)
XYZ        -0.1540         0.0082        -0.0836  VEL TIMES 10.1982 YRS
XYZ         0.0000         0.0000         0.0000  MON TO ARP
XYZ        -0.0333        -0.0376         0.0719  ARP TO L1 PHASE CENTER
XYZ  -2430153.9719  -2737192.9290   5205816.6030  L1 PHS CEN @ 2007.1995
XYZ         0.0001        -0.0001        -0.0000  + XYZ ADJUSTMENTS
XYZ  -2430153.9718  -2737192.9291   5205816.6030  NEW L1 PHS CEN @ 2007.1995
```

```
 XYZ  -2430153.9385  -2737192.8915   5205816.5311  NEW ARP @ 2007.1995
 XYZ  -2430153.9385  -2737192.8915   5205816.5311  NEW MON @ 2007.1995
 LLH  55  4  8.65871  228 24  1.66998     32.2471  NEW L1 PHS CEN @ 2007.1995
 LLH  55  4  8.65871  228 24  1.66998     32.1594  NEW ARP @ 2007.1995
 LLH  55  4  8.65871  228 24  1.66998     32.1594  NEW MON @ 2007.1995

                        REMOTE STATION INFORMATION

 STATION NAME: uscg       1
  ANTENNA: ASH701975.01AGP NONE                             S/N=UNKNOWN
 XYZ  -2415360.3793  -2718045.5588   5222561.1762  MON @ 2007.1993 (M)
 NEU         0.0000        -0.0000         2.0000  MON TO ARP (M)
 NEU        -0.0000         0.0000         0.0637  ARP TO L1 PHASE CENTER (M)
 NEU        -0.0000         0.0000         0.0440  ARP TO L2 PHASE CENTER (M)
 XYZ        -0.7557        -0.8504         1.6449  MON TO ARP
 XYZ        -0.0241        -0.0271         0.0524  ARP TO L1 PHASE CENTER
 XYZ  -2415361.1590  -2718046.4363   5222562.8735  L1 PHS CEN @ 2007.1995

 BASELINE NAME:   bis1  uscg
 XYZ         0.6817         0.4813        -1.6607  + XYZ ADJUSTMENTS
 XYZ  -2415360.4774  -2718045.9549   5222561.2128  NEW L1 PHS CEN @ 2007.1995
 XYZ  -2415360.4533  -2718045.9278   5222561.1604  NEW ARP @ 2007.1995
 XYZ  -2415359.6976  -2718045.0775   5222559.5155  NEW MON @ 2007.1995
 LLH  55 19 58.67251  228 22 28.10438      5.8533  NEW L1 PHS CEN @ 2007.1995
 LLH  55 19 58.67251  228 22 28.10438      5.7896  NEW ARP @ 2007.1995
 LLH  55 19 58.67251  228 22 28.10438      3.7896  NEW MON @ 2007.1995

 BASELINE NAME:   lev1  uscg
 XYZ         0.6864         0.4936        -1.6609  + XYZ ADJUSTMENTS
 XYZ  -2415360.4727  -2718045.9427   5222561.2127  NEW L1 PHS CEN @ 2007.1995
 XYZ  -2415360.4486  -2718045.9156   5222561.1603  NEW ARP @ 2007.1995
 XYZ  -2415359.6929  -2718045.0652   5222559.5153  NEW MON @ 2007.1995
 LLH  55 19 58.67284  228 22 28.10412      5.8462  NEW L1 PHS CEN @ 2007.1995
 LLH  55 19 58.67284  228 22 28.10412      5.7825  NEW ARP @ 2007.1995
 LLH  55 19 58.67284  228 22 28.10412      3.7825  NEW MON @ 2007.1995

 BASELINE NAME:   ais1  uscg
 XYZ         0.6951         0.4928        -1.6769  + XYZ ADJUSTMENTS
 XYZ  -2415360.4639  -2718045.9435   5222561.1967  NEW L1 PHS CEN @ 2007.1995
 XYZ  -2415360.4398  -2718045.9164   5222561.1443  NEW ARP @ 2007.1995
 XYZ  -2415359.6842  -2718045.0660   5222559.4993  NEW MON @ 2007.1995
 LLH  55 19 58.67268  228 22 28.10452      5.8300  NEW L1 PHS CEN @ 2007.1995
 LLH  55 19 58.67268  228 22 28.10452      5.7663  NEW ARP @ 2007.1995
 LLH  55 19 58.67268  228 22 28.10452      3.7663  NEW MON @ 2007.1995

                                  G-FILES

Axx2007 314   7 314
B2007 31418 5   7 3142035 1 page5 v0612.06IGS     222 1 2 27NGS   2007 4 2IFDDFX
Iant_info.003        NGS   20070320
C00090001 -795614910   19 2696541842   21  945540190   39 X0737AUSCGX0737ABIS1
D  1  2  7550588  1  3 -9307589  2  3 -7806480

Axx2007 314   7 314
B2007 31418 5   7 3142035 1 page5 v0612.06IGS     222 1 2 27NGS   2007 4 2IFDDFX
Iant_info.003        NGS   20070320
C00090002   25310319   17 1389889454   20  707237935   38 X0737AUSCGX0737ALEV1
```

```
D  1  2  8189618  1  3 -9202066  2  3 -7448116

Axx2007 314   7 314
B2007 31418 5   7 3142035 1 page5 v0612.06IGS     222 1 2 27NGS   2007 4 2IFDDFX
Iant_info.003        NGS   20070320
C00090003 -147942543   19 -191478255   22 -167429683   36 X0737AUSCGX0737AAIS1
D  1  2  9369495  1  3 -7883557  2  3 -7554607
```

POST-FIT RMS BY SATELLITE VS. BASELINE

```
             OVERALL     03     06     07     10     16     18     19     21
 bis1-uscg|  0.017  0.018  0.016  0.018  0.014  0.019  0.013  0.015    ...
                 22     24     25     26     29     30
 bis1-uscg|  0.018  0.015    ...  0.022  0.019    ...

             OVERALL     03     06     07     10     16     18     19     21
 lev1-uscg|  0.018  0.017  0.018  0.019  0.017  0.022  0.017  0.015    ...
                 22     24     26     29     30
 lev1-uscg|  0.018  0.013  0.018  0.021    ...

             OVERALL     03     06     07     10     16     18     19     21
 ais1-uscg|  0.018  0.020  0.018  0.018  0.012  0.022  0.016    ...    ...
                 22     24     26     29     30
 ais1-uscg|  0.015  0.017  0.015  0.016    ...
```

OBS BY SATELLITE VS. BASELINE

```
             OVERALL     03     06     07     10     16     18     19     21
 bis1-uscg|   2148    155    203    279    102    296    245     28    ...
                 22     24     25     26     29     30
 bis1-uscg|    118    284    ...    200    238    ...
             OVERALL     03     06     07     10     16     18     19     21
 lev1-uscg|   2087    155    182    225    106    296    247     28    ...
                 22     24     26     29     30
 lev1-uscg|    117    284    200    247    ...
             OVERALL     03     06     07     10     16     18     19     21
 ais1-uscg|   2150    152    207    284    105    295    239    ...    ...
                 22     24     26     29     30
 ais1-uscg|    119    283    213    253    ...
```

```
 Covariance Matrix for the xyz OPUS Position (meters2).
    0.0000022467     0.0000002159    -0.0000004052
    0.0000002159     0.0000029444    -0.0000004008
   -0.0000004052    -0.0000004008     0.0000094689

 Covariance Matrix for the enu OPUS Position (meters2).
    0.0000023402    -0.0000002845     0.0000001534
   -0.0000002845     0.0000044782     0.0000029060
    0.0000001534     0.0000029060     0.0000078416

 Horizontal network accuracy =    0.00458 meters.
 Vertical network accuracy   =    0.00549 meters.
```

Derivation of NAD 83 vector components

Position of reference station ARP in NAD_83(CORS96)(EPOCH:2003.0000).

	Xa(m)	Ya(m)	Za(m)	
BIS1	-2494920.37852	-2448391.99956	5317113.26406	2003.00
LEV1	-2412827.84636	-2579057.21856	5293283.07789	2003.00
AIS1	-2430153.14737	-2737194.00189	5205816.33593	2003.00

Position of reference station monument in NAD_83(CORS96)(EPOCH:2003.0000).

	Xr(m)	Yr(m)	Zr(m)	
BIS1	-2494920.37852	-2448391.99956	5317113.26406	2003.00
LEV1	-2412827.84636	-2579057.21856	5293283.07789	2003.00
AIS1	-2430153.14737	-2737194.00189	5205816.33593	2003.00

Velocity of reference station monument in NAD_83(CORS96)(EPOCH:2003.0000).

	Vx (m/yr)	Vy (m/yr)	Vz (m/yr)
BIS1	0.00490	0.00450	0.00990
LEV1	0.00220	0.00120	0.00480
AIS1	0.00580	0.00170	0.00110

Vectors from unknown station monument to reference station monument in NAD_83(CORS96)(EPOCH:2003.0000).

	Xr-X= DX(m)	Yr-Y= DY(m)	Zr-Z= DZ(m)	
BIS1	-79561.49452	269654.17544	94553.95206	2003.00
LEV1	2531.03764	138988.95644	70723.76589	2003.00
AIS1	-14794.26337	-19147.82689	-16742.97607	2003.00

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

NOTE

Trimble – Additional Calibration Reports

See SAND1.ssf *attached as digital separates*

NOAA Ship FAIRWEATHER
LASER LEVEL Accuracy test
3.8 **sn# 000676**
Laser Technology, Inc. Impulse 200 laser ranging instrument

Testing date: 02/27/2006

Trial	Actual Distance	LL Distance	Actual Height	LL Height
1	10	10.0	2.0	2.0
2	10	10.0	2.0	2.0
3	10	10.0	2.0	2.0
4	20	20.0	2.0	1.9
5	20	19.9	2.0	2.0
6	20	20.0	2.0	2.0
7	50	50.1	2.0	2.0
8	50	50.1	2.0	2.1
9	50	50.1	2.0	2.1
10	100	100.1	2.0	2.1
11	100	100.1	2.0	1.9
12	100	100.1	2.0	1.8

LL = Laser Level
all distances are measured in meters

Comparison Testing Lasers 000676 and i0929 and Trimble

Testing date: 03/03/2006

	Trial	Trimble Distance	000676 Distance	i0929 Distance	000676 Height	i0929 Height	Actual Height		
	1.0	30.0	32.8	33.0	2.1	2.4	2.0	2.8	
	2.0	23.5	27.3	27.8	2.0	1.9	2.0	3.8	
	3.0	20.2	24.0	24.2	2.2	2.0	2.0	3.8	
	4.0	34.0	31.9	32.4	2.6	2.3	2.0	2.1	
	5.0	26.8	26.2	25.8	2.1	2.0	2.0	0.6	
	7.0	30.6	28.5	28.5	2.0	2.4	2.0	2.1	
	6.0	51.9	38.7	38.5	2.0	2.3	2.0	13.2	
sum		217.0	209.4	210.2	15.0	15.3	14.0	28.4	15.2
mean		31.0	29.9	30.0	2.1	2.2	2.0	4.1	2.5
standard deviation		10.3	5.0	4.9	0.2	0.2	0.0		

Lead Line & Sounding Pole Calibration Report

Field unit: FA

Lead Line / Sounding Pole Identification Number: Leadline 10_01_05
(Unique Identifier, with equipment type, date made, etc.)

Date of Calibration: 3/6/2007

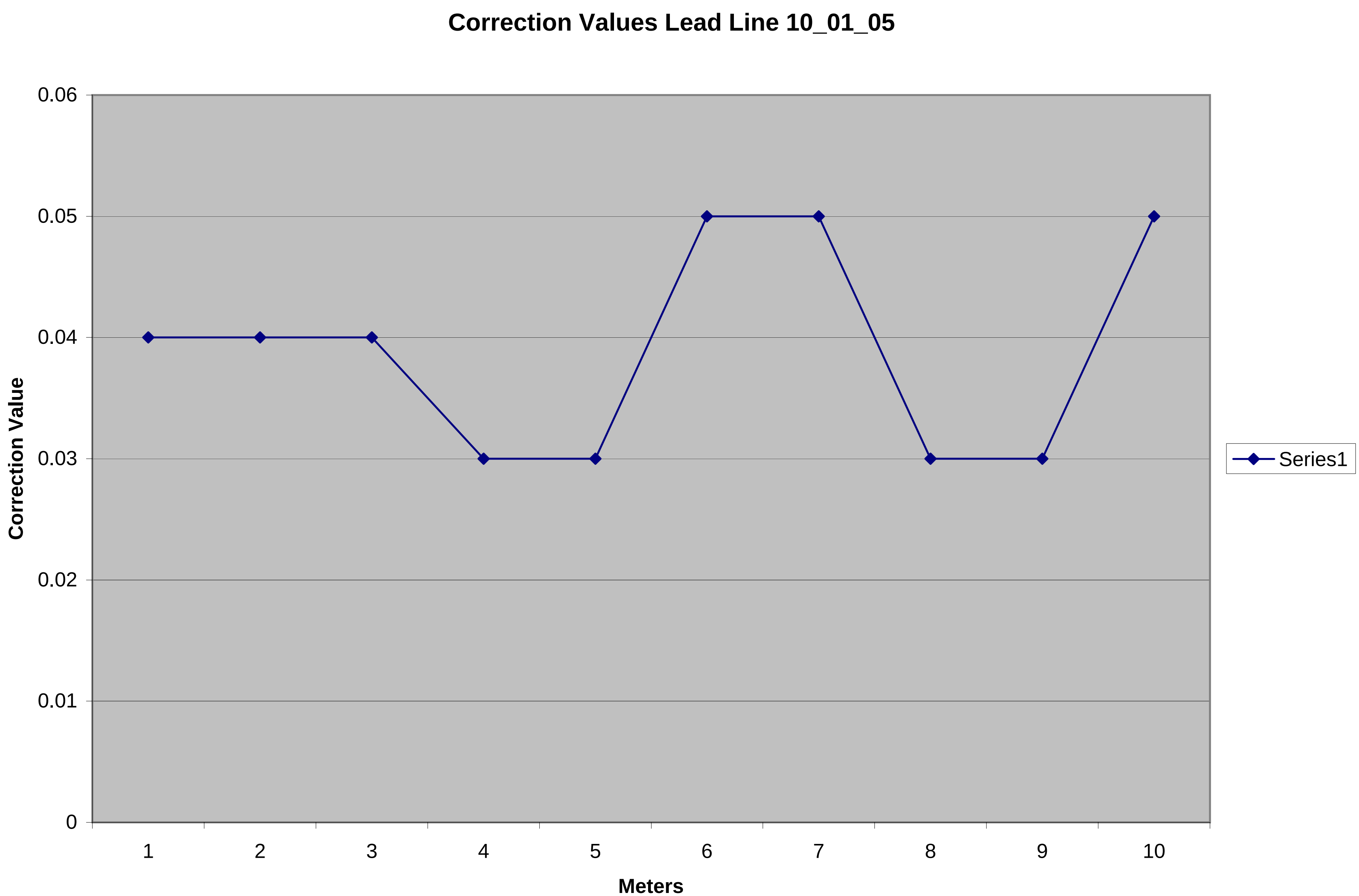
Method of Calibration: X Steel tape Permanent graduation marks Other

Location: Ketchikan, Alaska

Chief of Party: Cdr. Andrew Beaver, NOAA, FA

Lead Line / Sounding Pole Unit of Measure: Meters

Measured by: BC	**Recorded by: BC**	**Checked by: BC**
Graduated Marking (a)	**Calibration Measurement (b)**	**Lead Line Corrector (c = b - a)**
1	0.96	0.04
2	1.96	0.04
3	2.96	0.04
4	3.97	0.03
5	4.97	0.03
6	5.97	0.05
7	6.95	0.05
8	7.97	0.03
9	8.97	0.03
10	9.95	0.05
	Average Correction	0.039
	Standard Deviation	0.0088



Correction Values Lead Line 10_01_05
0.06
0.05
0.04
0.03
0.02
0.01
0
Correction Value
1
2
3
4
5
6
7
8
9
10
Meters
Series1

Lead Line & Sounding Pole Calibration Report

Field unit: FA

Lead Line / Sounding Pole Identification Number: Leadline 20_01_05
(Unique Identifier, with equipment type, date made, etc.)

Date of Calibration: 3/20/2007

Method of Calibration: **X Steel tape** **Permanent graduation marks**
Other

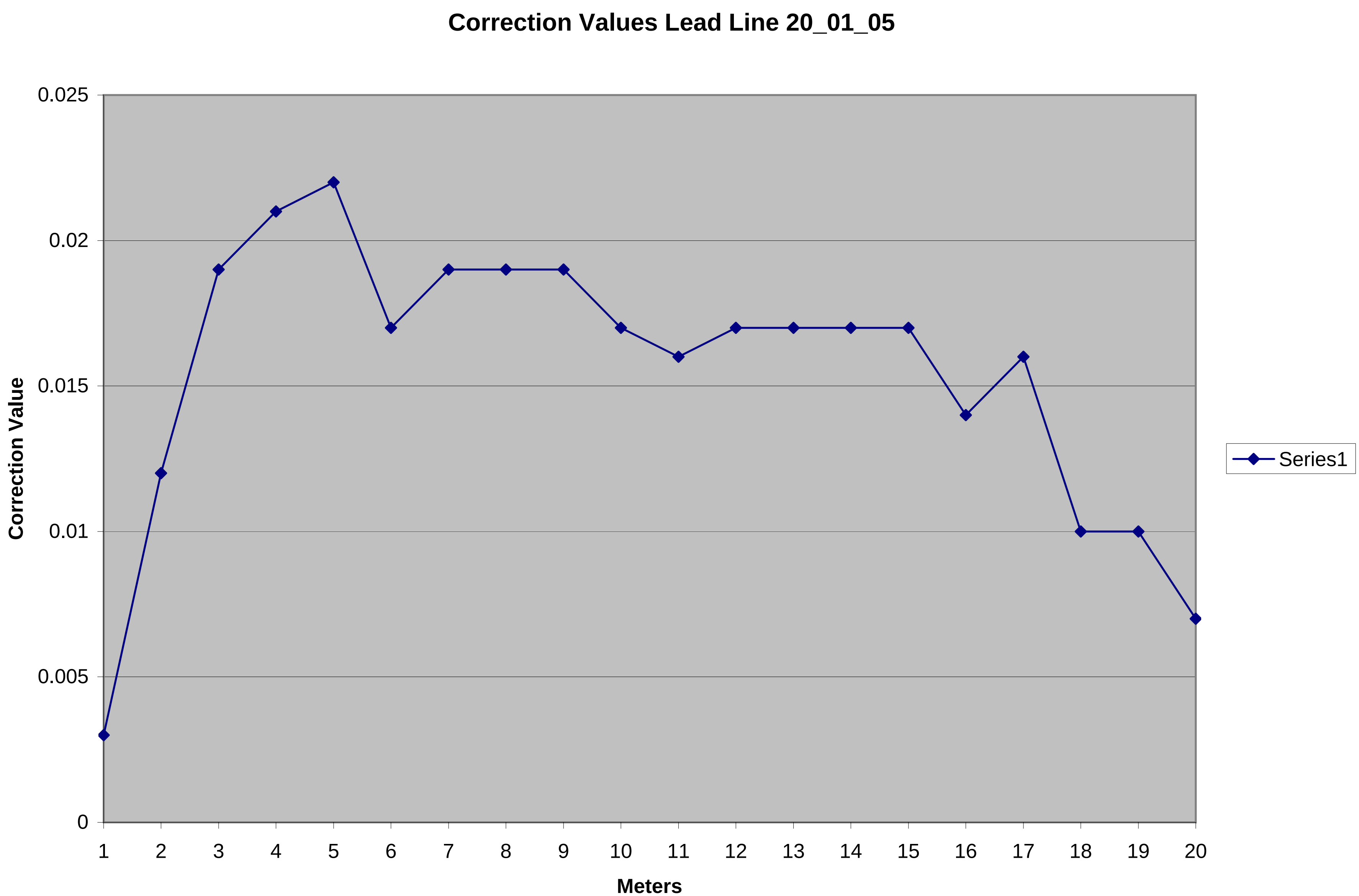
Location: Ketchikan, Alaska

Chief of Party: Brenna Campbell

Lead Line / Sounding Pole Unit of Measure: Meters

Measured by: BC/DJ	Recorded by: BC	Checked by: BC

Graduated Marking (a)	Calibration Measurement (b)	Lead Line Corrector (c = b - a)
1	1.003	0.003
2	1.988	0.012
3	2.981	0.019
4	3.979	0.021
5	4.978	0.022
6	5.983	0.017
7	6.981	0.019
8	7.981	0.019
9	8.981	0.019
10	9.983	0.017
11	10.984	0.016
12	11.983	0.017
13	12.983	0.017
14	13.983	0.017
15	14.983	0.017
16	15.986	0.014
17	16.984	0.016
18	17.99	0.01
19	18.99	0.01
20	19.993	0.007
	Average Correction	0.015
	Standard Deviation	0.005



Correction Values Lead Line 20_01_05
Correction Value
0.025
0.02
0.015
0.01
0.005
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Meters
Series1

Lead Line & Sounding Pole Calibration Report

Field unit: FA

Lead Line / Sounding Pole Identification Number: Leadline 20_02_05
(Unique Identifier, with equipment type, date made, etc.)

Date of Calibration: 4/09/2007

Method of Calibration: **X Steel tape** **Permanent graduation marks**
Other

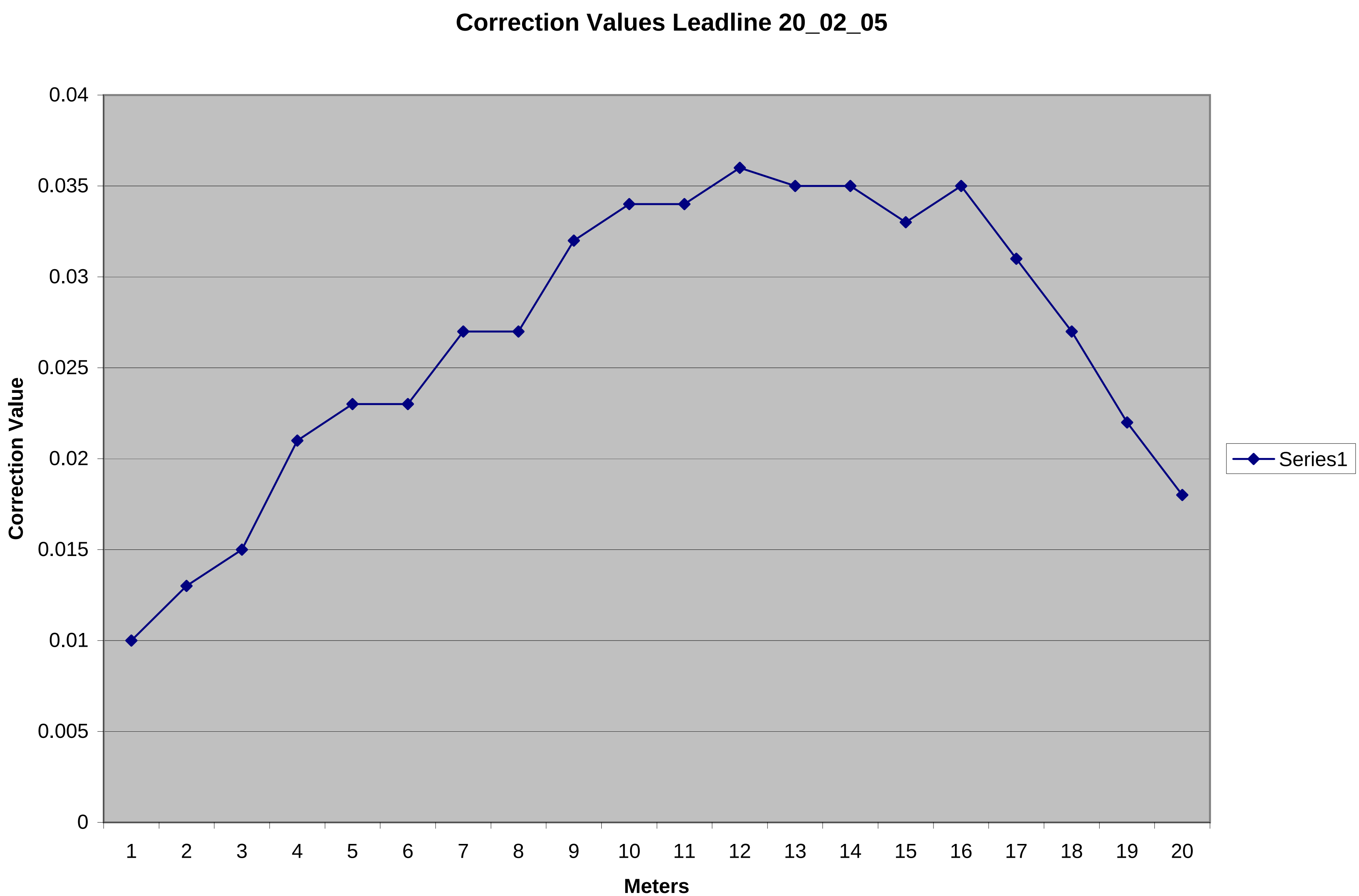
Location: Ketchikan, Alaska

Chief of Party: CDR Andrew Beaver/NOAA Ship Fairweather

Lead Line / Sounding Pole Unit of Measure: Meters

Measured by: BC/DJ	Recorded by: BC	Checked by: BC

Graduated Marking (a)	Calibration Measurement (b)	Lead Line Corrector (c = b - a)
1	0.99	0.01
2	1.987	0.013
3	2.985	0.015
4	3.979	0.021
5	4.977	0.023
6	5.977	0.023
7	6.973	0.027
8	7.973	0.027
9	8.968	0.032
10	9.966	0.034
11	10.966	0.034
12	11.964	0.036
13	12.965	0.035
14	13.965	0.035
15	14.967	0.033
16	15.965	0.035
17	16.969	0.031
18	17.973	0.027
19	18.978	0.022
20	19.982	0.018
	Average Correction	0.02655
	Standard Deviation	0.00810117


Correction Values Leadline 20_02_05
Correction Value
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Meters
Series1

Lead Line & Sounding Pole Calibration Report

Field unit: FA

Lead Line / Sounding Pole Identification Number: Leadline 20_03_05
(Unique Identifier, with equipment type, date made, etc.)

Date of Calibration: 3/26/2007

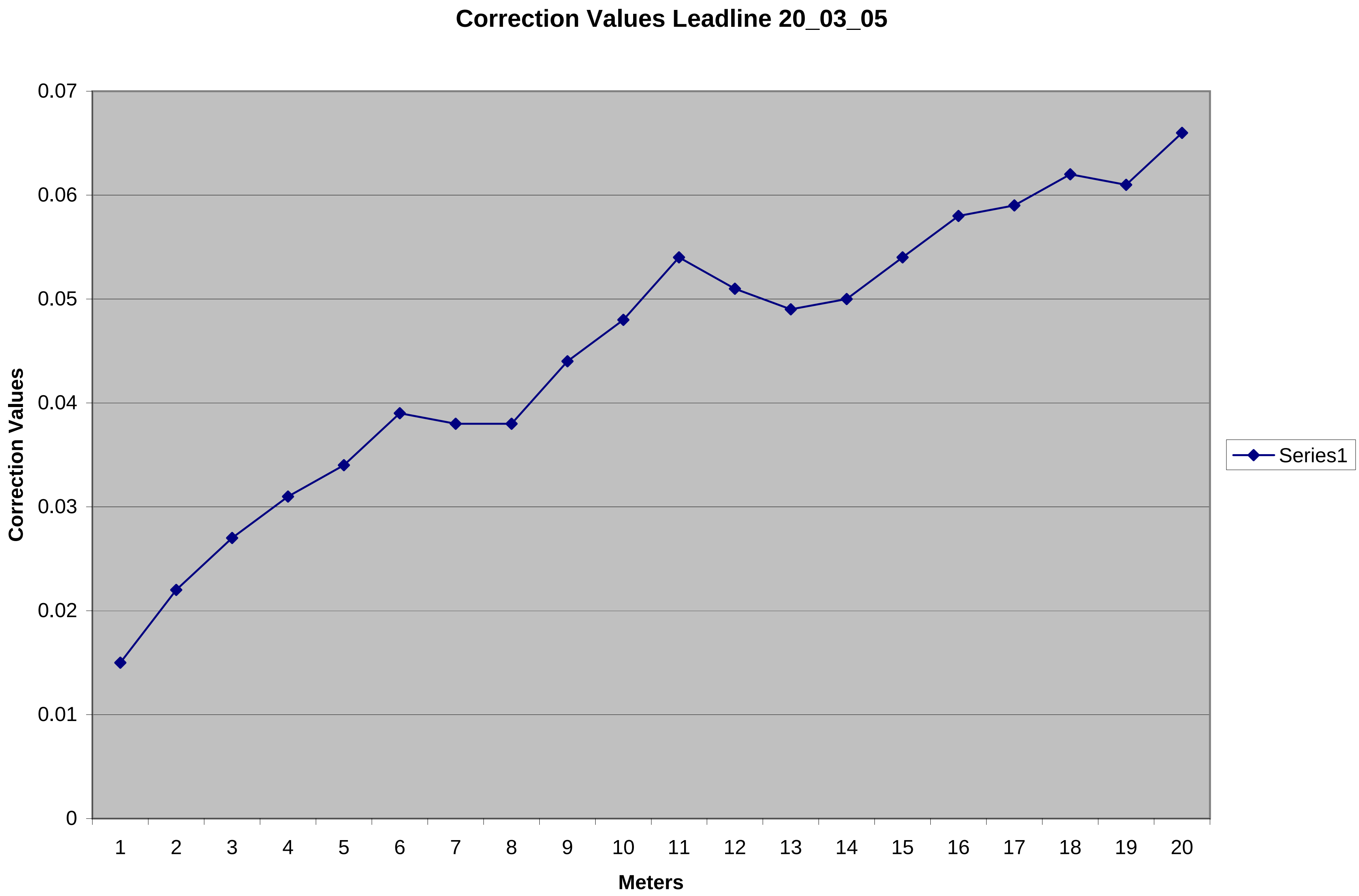
Method of Calibration: **X Steel tape** **Permanent graduation marks**
Other

Location: Ketchikan, Alaska

Chief of Party: Cdr. Andrew Beaver/NOAA Ship Fairweather

Lead Line / Sounding Pole Unit of Measure: Meters

Measured by: BC/DJ	Recorded by: BC	Checked by: BC
Graduated Marking (a)	**Calibration Measurement (b)**	**Lead Line Corrector (c = b - a)**
1	0.985	0.015
2	1.978	0.022
3	2.973	0.027
4	3.969	0.031
5	4.966	0.034
6	5.961	0.039
7	6.962	0.038
8	7.962	0.038
9	8.956	0.044
10	9.952	0.048
11	10.946	0.054
12	11.949	0.051
13	12.951	0.049
14	13.95	0.05
15	14.946	0.054
16	15.942	0.058
17	16.941	0.059
18	17.938	0.062
19	18.939	0.061
20	19.934	0.066
	Average Correction	0.045
	Standard Deviation	0.014


Correction Values Leadline 20_03_05
Correction Values
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Meters
Series1

Lead Line & Sounding Pole Calibration Report

Field unit: FA

Lead Line / Sounding Pole Identification Number: Leadline 30_01_05
(Unique Identifier, with equipment type, date made, etc.)

Date of Calibration:

Method of Calibration: **X Steel tape** **Permanent graduation marks** **Other**

Location: Ketchikan, Alaska

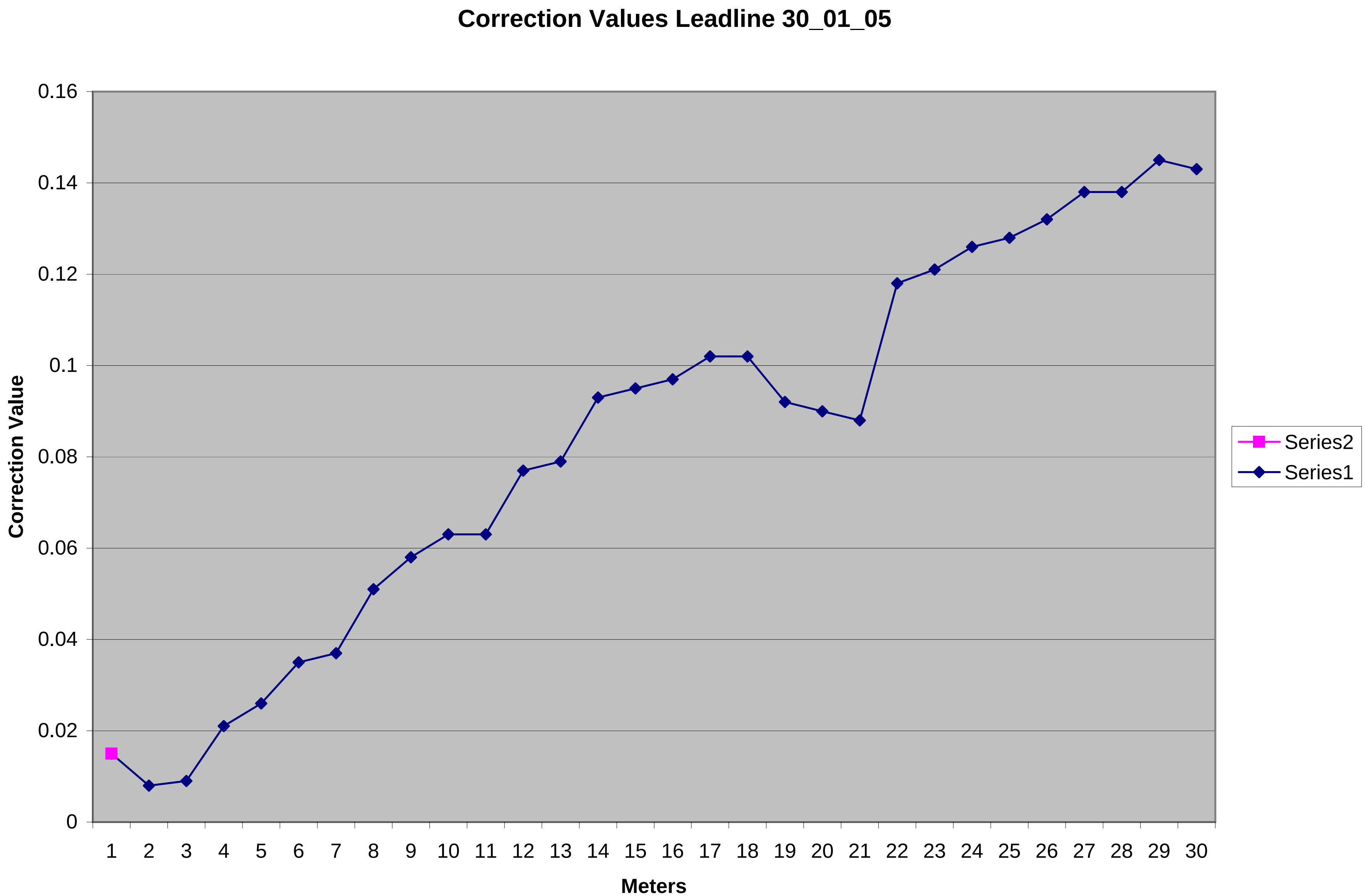
Chief of Party: CO Andrew Beaver/NOAA Ship Fairweather

Lead Line / Sounding Pole Unit of Measure: Meters

Measured by: BC/ACA | **Recorded by: BC** | **Checked by: BC**

Graduated Marking (a)	Calibration Measurement (b)	Lead Line Corrector (c = b - a)
1	1.015	0.015
2	1.992	0.008
3	2.991	0.009
4	3.979	0.021
5	4.974	0.026
6	5.965	0.035
7	6.963	0.037
8	7.949	0.051
9	8.942	0.058
10	9.937	0.063
11	10.937	0.063
12	11.923	0.077
13	12.921	0.079
14	13.907	0.093

Graduated Marking (a)	Calibration Measurement (b)	Lead Line Corrector (c = b - a)
15	14.905	0.095
16	15.903	0.097
17	16.898	0.102
18	17.898	0.102
19	18.908	0.092
20	19.91	0.09
21	20.912	0.088
22	21.882	0.118
23	22.879	0.121
24	23.874	0.126
25	24.872	0.128
26	25.868	0.132
27	26.862	0.138
28	27.862	0.138
29	28.855	0.145
30	29.857	0.143
	Average Correction	0.083
	Standard Deviation	0.043



Correction Values Leadline 30_01_05
Correction Value
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Meters
Series2
Series1

APPLIED MICROSYSTEMS Because it's not just H_2O

4986 Certificate of Calibration

Customer: NOAA - Pacific Marine Center

Instrument Serial Number: INS-04986

Instrument Type: Smart SV&P

Instrument Description: Real-time instrument with sound velocity (invar) and pressure

Calibrated Pressure Range: 1000 dBar

Certification Date: 19/01/2007

Certified By:

Robert Haydock,
General Manager
Applied Microsystems

Applied Microsystems certifies that the equipment described above has been calibrated with equipment referenced to traceable standards. Any repairs / calibrations completed on this instrument were approved by the instrument owner under purchase order.

This instrument has been recalibrated. Please be sure to update your records. Please also ensure that you update the instrument's coefficient values in any post-processing software (ie. Smart Talk) that you use. Instrument configuration files are available at our Client Service & Support Portal (see web address below).

For a complete service history of this instrument, please consult our on-line Client Service & Support Portal at http://www.appliedmicrosystems.com/customers/index.htm

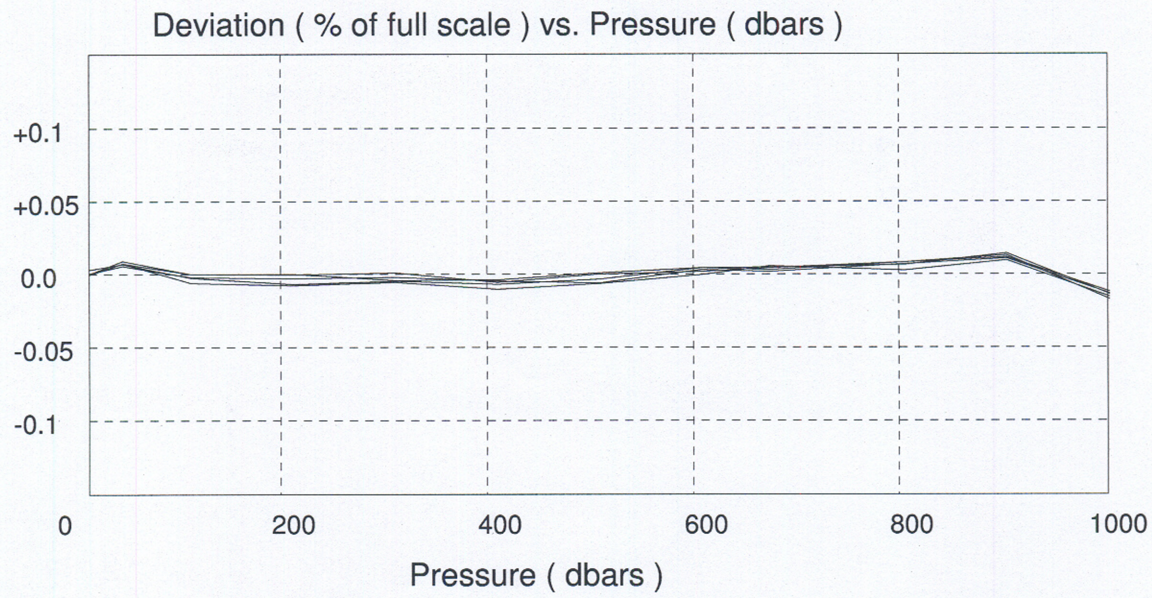
Applied Microsystems
2071 Malaview Avenue
Sidney, B.C. V8L 5X6 CANADA
Tel: +1-250-656-0771 Fax: +1-250-655-3655

Smart SV & Pressure 4986

Smart Pressure Calibration

Job Information

Date	01-17-2007
Job Number	12248
Calibrated By	MT
Standards	Budenburg Deadweight



Coefficients

A = -1.578895E+03
B = -3.793436E-01
C = -6.679759E-03
D = 3.750816E-04
E = 4.827961E-02
F = 1.544050E-05
G = 6.851992E-07
H = -2.105453E-08
I = 5.505038E-08
J = -3.405464E-11
K = -1.314064E-11
L = 2.652975E-13

=A+B*T+C*T^2+D*T^3+(E+F*T+G*T^2+H*T^3)*Raw+(I+J*T+K*T^2+L*T^3)*Raw^2

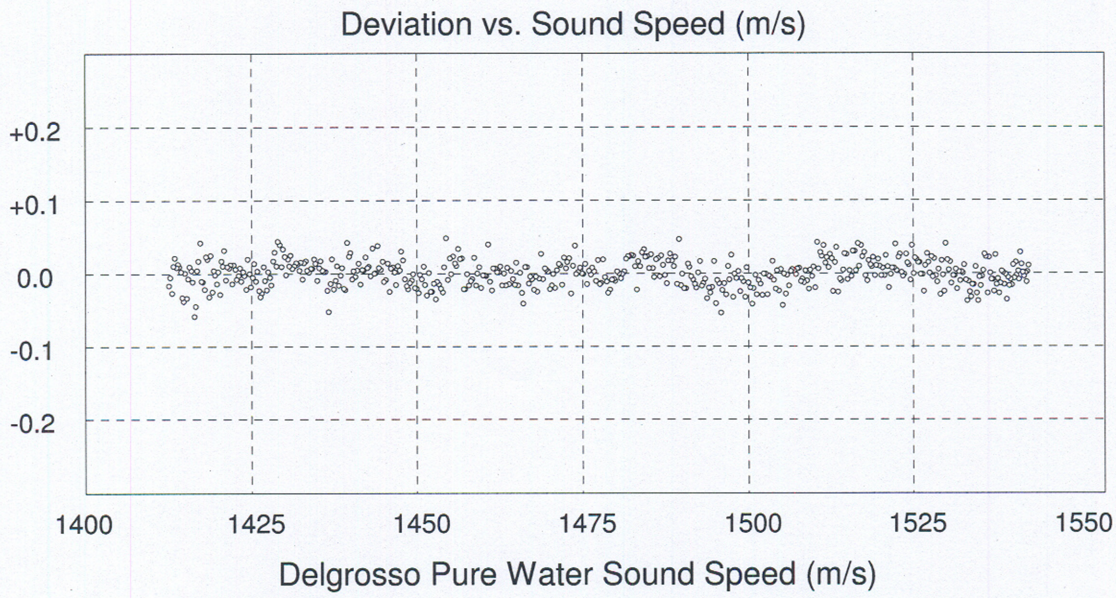
Applied Microsystems Ltd.
2071 Malaview Ave West, Sidney, British Columbia, Canada V8L 5X6
Phone: (250) 656-0771 Fax: (250) 655-3655
Canada & USA: 800-663-8721
Email: info@AppliedMicrosystems.com Web: http://www.aml.bc.ca

Smart SV & Pressure 4986

Smart SV Calibration

Job Information

Date	01-19-2007
Job Number	12248
Calibrated By	MT
Standards	Smart T 9998



Coefficients

A = 1.532222E+03
B = -1.176191E+02
C = 1.035936E+01
D = -1.211003E+00

=A+B*((N-NL)/(NH-NL))+C*((N-NL)/(NH-NL))^2+D*((N-NL)/(NH-NL))^3

RMS = 0.0186

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APPLIED MICROSYSTEMS Because it's not just H_2O

Certificate of Calibration

Customer: Brooke Ocean Technology Ltd.

Reference: Job#: 11232 PO#: credit card

Part No: Smart SV & Pressure

Serial No: 4986

Comments: New invar rods for SV sensor, new zinc, re-calibration of sound velocity and pressure.

Jeff Bosma

Electronics Technologist

Date: Jan 13/06

APPLIED MICROSYSTEMS LTD. CERTIFIES THAT THE ABOVE DESCRIBED EQUIPMENT HAS BEEN CALIBRATED WITH EQUIPMENT REFERENCED TO TRACEABLE STANDARDS. ANY REPAIRS/CALIBRATIONS PERFORMED ON THIS INSTRUMENT WERE APPROVED BY THE CONTRACT/PURCHASE ORDER NAMED ABOVE.

AML Calibration Equipment

Temperature Calibrations

Performed using either of two Hart Scientific "Black Stack" Model 1560 Power Bases with attached Hart Scientific Model 2563 Thermistor Modules connected to a Thermometrics AS125 4 Wire Thermistor Standard

1: Hart Scientfic Power Base 1560 S/N 79263 / Thermistor Module 2563 S/N 79039 / Thermometrics AS125 4 Wire Thermistor Standard S/N 2131
2: Hart Scientfic power Base 1560 S/N A05690 / Thermistor Module 2563 S/N A05693 / Thermometrics AS125 4 Wire Thermistor Standard S/N 2128

Temperature calibration equipment is calibrated yearly and verified bi-monthly as per Applied Microsystems Ltd. Calibration Schedule T11.2 utilizing a Hart Scientific Model 5901 Triple Point of Water Cell. All temperature calibrations and verifications are ITS-90 and NIST traceable

Pressure Calibrations

Performed using a Budenburg Model 380D S/N 18564 Range 0-8000 psi Deadweight Tester. Calibrations and verifications are implemented as per Applied Microsystems Ltd. Calibration Schedule T11.2. All pressure calibrations and verifications are NIST traceable.

Conductivity Calibrations

Performed using either of two Guildline 8400B S/N 59251 or Guildline 8400 S/N 43385 Autosals. Both Conductivity Calibrators are calibrated and verified using Ocean Scientific International IAPSO Standard Seawater as per Applied Microsystems ltd. Calibration Schedule T11.2. All Conductivity Calibrations and verifications are NIST traceable

Battery Channel Calibrations

Performed using a Precision Fluke Model 45 Multimeter S/N 4720162. Calibrations and verifications are implemented as per Applied Microsystems Ltd. Calibration Schedule T11.2 All calibrations and verifications are NIST traceable.

Sound Velocity Calibrations

Performed using an Applied Microsystems Ltd Temperature Standard S/N 9998 in distilled water, <5 ppm TDS, and sound velocity reference is Del Grosso and Mader's Pure Water Equation. Calibrations and verifications are implemented as per Applied Microsystems Ltd. Calibration Schedule T11.2 All temperature calibrations and verifications are ITS-90 and NIST traceable.

Calibration Coefficients
Smart SV & Pressure 4986

01-13-2006

Brooke Ocean Technology Ltd.

NOTE: This instrument has been re-calibrated. Please update your records and any post-processing software you may be using.

Applied Microsystems Ltd.

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Email: info@AppliedMicroSystems.com Web: http://www.aml.bc.ca

Smart SV & Pressure 4986

Smart SV Calibration

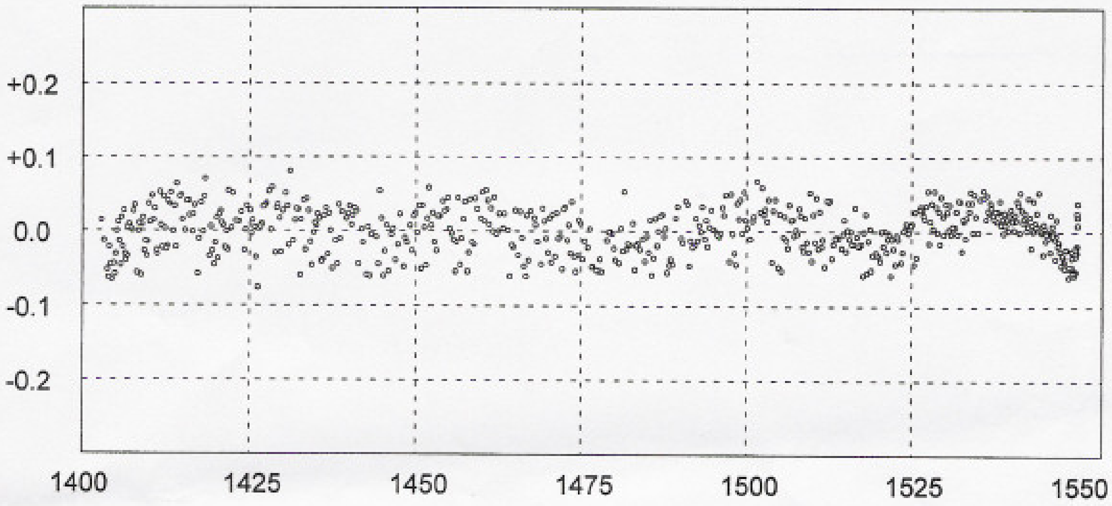
Job Information

Date	01-12-2006
Job Number	11232
Customer	Brooke Ocean Technology Ltd.

Sensor Information

Manufacturer	AML
Model Number	Time of Flight
Serial Number	166-1
Range	1400 to 1550 m/s
Channel	1
Calibrated By	JB
Standards	Smart T 9998

Deviation vs. Sound Speed (m/s)



Delgrosso Pure Water Sound Speed (m/s)

Coefficients

A = 1.531487E+03
B = -1.180287E+02
C = 1.109943E+01
D = -1.563130E+00

=A+B*((N-NL)/(NH-NL))+C*((N-NL)/(NH-NL))^2+D*((N-NL)/(NH-NL))^3

RMS = 0.0309

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Smart SV & Pressure 4986

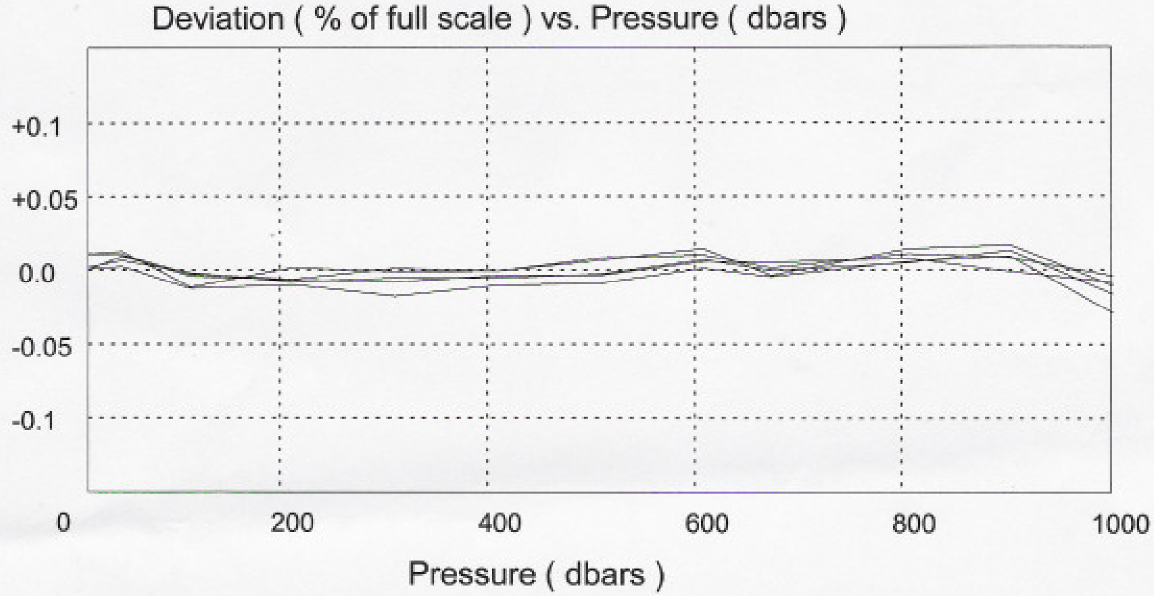
Smart Pressure Calibration

Job Information

Date	01-06-2006
Job Number	11232
Customer	Brooke Ocean Technology Ltd.

Sensor Information

Manufacturer	Keller
Model Number	PA-10TAB/100BAR/8838.4
Serial Number	YZ138
Range	1000 DBar
Channel	2
Calibrated By	JB
Standards	Budenburg Deadweight



Coefficients

A = -1.579256E+03
B = -2.580430E-01
C = -2.195250E-03
D = 1.946878E-04
E = 4.830338E-02
F = 1.009788E-05
G = 3.142047E-07
H = -8.879073E-09
I = 5.500886E-08
J = 1.850377E-11
K = -7.771046E-12
L = 1.030000E-13

=A+B*T+C*T^2+D*T^3+(E+F*T+G*T^2+H*T^3)*Raw+(I+J*T+K*T^2+L*T^3)*Raw^2

RMS = 0.0920

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APPLIED MICROSYSTEMS Because it's not just H_2O

Conformity Certificate

Customer: Brooke Ocean Technology Ltd.
50 Thornhill Drive, Unit 11
Dartmouth

Reference: Job#: 4337 PO#: 04653-0449M

Part No: Smart SV & Pressure

Serial No: 4987

Description: Direct measurement of sound velocity and pressure.

Comments: This stainless steel, right angle end cap instrument operates as a stand alone unit with a fixed 19200 baud rate, RS-485 communications interface. Maximum depth, 1000 meters.

Certification Date: 12-08-2004

Justin Romito
Technologist

APPLIED MICROSYSTEMS LTD. CERTIFIES THAT THE ABOVE DESCRIBED EQUIPMENT HAS BEEN TESTED IN ACCORDANCE WITH THE CONDITIONS AND REQUIREMENTS OF THE CONTRACT/PURCHASE ORDER. UNLESS OTHERWISE NOTED ABOVE, THE EQUIPMENT CONFORMS IN ALL RESPECTS TO THE SPECIFICATIONS AND/OR RELEVANT DRAWINGS.

Smart SV & Pressure 4987

Smart SV Calibration

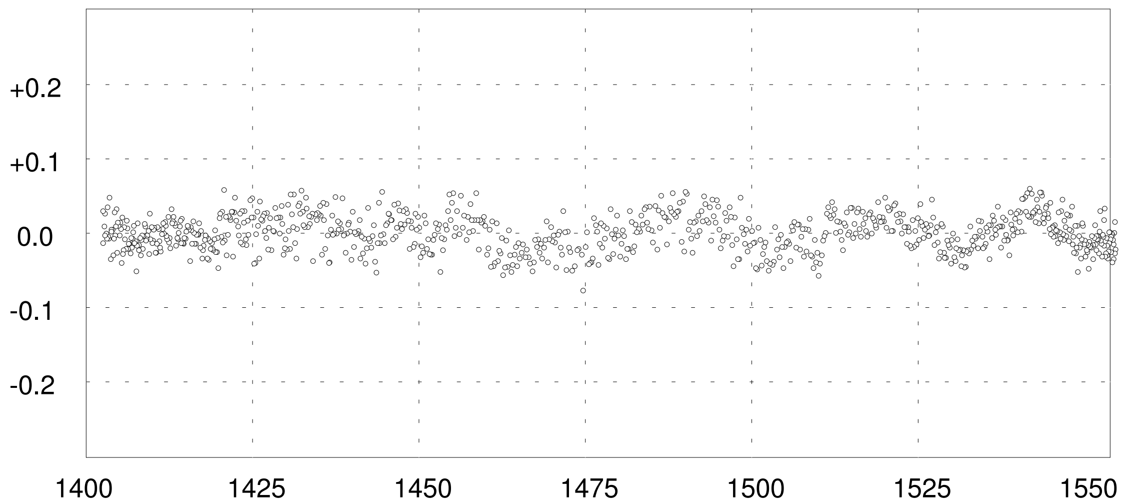
Job Information

Date	11-30-2004
Job Number	4337
Customer	Brooke Ocean Technology Ltd.

Sensor Information

Manufacturer	AML
Model Number	Time of Flight
Serial Number	166-2
Range	1400 to 1550 m/s
Channel	2
Calibrated By	JR
Standards	Smart T 9998

Deviation vs. Sound Speed (m/s)



Delgrosso Pure Water Sound Speed (m/s)

Coefficients

A = 1.532314E+03
B = -1.179385E+02
C = 1.073808E+01
D = -1.335136E+00

=A+B*((N-NL)/(NH-NL))+C*((N-NL)/(NH-NL))^2+D*((N-NL)/(NH-NL))^3

RMS = 0.0244

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Smart SV & Pressure 4987

Smart Pressure Calibration

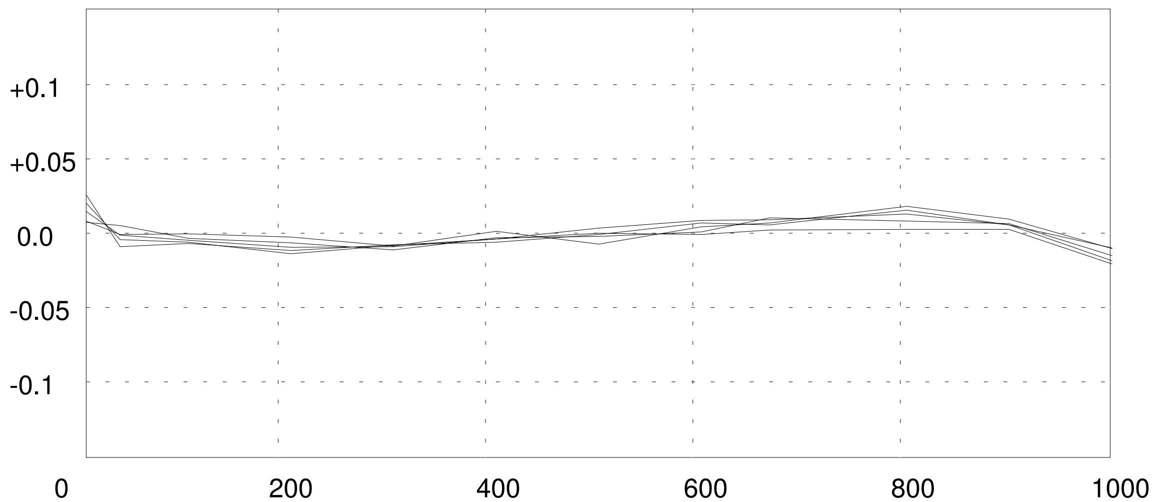
Job Information

Date	12-06-2004
Job Number	4337
Customer	Brooke Ocean Technology Ltd.

Sensor Information

Manufacturer	Keller
Model Number	PA-10TAB/100BAR/8838.4
Serial Number	YZ136
Range	1000 Dbar
Channel	1
Calibrated By	JR
Standards	Budenburg Deadweight

Deviation (% of full scale) vs. Pressure (dbars)



Pressure (dbars)

Coefficients

A = -1.529758E+03
B = -4.856953E-01
C = -3.189672E-03
D = 3.215278E-04
E = 4.733318E-02
F = 2.070545E-05
G = 4.684017E-07
H = -1.831440E-08
I = 3.933418E-08
J = -1.141085E-10
K = -9.489968E-12
L = 2.280363E-13

=A+B*T+C*T^2+D*T^3+(E+F*T+G*T^2+H*T^3)*Raw+(I+J*T+K*T^2+L*T^3)*Raw^2

RMS = 0.0963

Applied Microsystems Ltd.
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Canada & USA: 800-663-8721
Email: info@AppliedMicrosystems.com Web: http://www.aml.bc.ca

Subject: [Fwd: Re: AML SV+P .cfg file]
Date: Tue, 18 Apr 2006 15:49:46 +0000
From: "grant froelich" <grant.froelich@noaa.gov>
To: chiefst fairweather <chiefst.fairweather@noaa.gov>,
foo fairweather <foo.fairweather@noaa.gov>,
mike castle <mike.castle@noaa.gov>

--

Grant Froelich
Senior Survey Technician
NOAA Ship FAIRWEATHER
(907)254-2842 Cell
(808)659-0054 At Sea

Subject: RE: AML SV+P .cfg file
Date: Tue, 18 Apr 2006 09:45:18 -0300
From: Murray Eisan <meisan@brooke-ocean.com>
To: "'grant froelich'" <grant.froelich@noaa.gov>
CC: "'Darrell Groom'" <dgroom@brooke-ocean.com>

Hi Grant,

The calibration coefficients have been applied to the sensor at AML. The MVP software logs the corrected data being outputted from the sensor. The AML configuration file does not need to be applied to the MVP software.

Regards,

Murray Eisan

From: grant froelich [mailto:grant.froelich@noaa.gov]
Sent: Monday, April 17, 2006 2:02 PM
To: support@brooke-ocean.com
Subject: AML SV+P .cfg file

Hello,

We recently sent our AML SV+P sensor out for calibration and when it returned we also received a .cfg file. Is this something that the MVP software needs to correct the sound velocity files produced? If so, how is that done?

thanks
grant

--

ENVIRONMENTAL SIMULATION LABS

Division of Composites Atlantic Limited

HYDROSTATIC PRESSURE TEST REPORT

JOB/REPORT #: ESL-06-025

DATE: February 20, 2006

CLIENT: Brooke Ocean Technology LTD.
50 Thornhill Drive, Unit 11
Dartmouth, Nova Scotia B3B 1S1

PO #: 06261-0578
CONTACT: Mark Smith

TEST ARTICLE DESCRIPTION: Free Fall Cone Penetrator
Model No: FFCPT-35-1

STANDARD USED: Autoclave Engineers 0-5000 PSIG Pressure Transducer
MODEL #: TSW-6-5000-PE30 **INVENTORY #:** 1127-TF1
CALIBRATION DUE: July 4, 2006

The IUT was placed in the 1,200 PSIG Pressure Vessel, Inventory # 1142-TF1. The pressure was increased to 1,000 psig and maintained for one (1) hour. The pressure was then relieved and the IUT removed for inspection. Brooke Ocean Technology personnel performed an onsite inspection for any signs of water infiltration, none was found. The IUT was returned to Brooke Ocean Technology for final inspection.

THIS IS TO CERTIFY THAT THE ABOVE TESTING WAS PERFORMED ACCORDING TO REQUIREMENTS SET FORTH IN THE REFERENCED PURCHASE ORDER IN A MANNER CONSISTENT WITH STANDARD PRACTICES AND ANY SPECIFICATIONS REFERENCED HEREIN.

Tested by:

Conrad Tulk CET
Lab Technologist

Approved By:

Neil Richter P.Eng,
Manager, ESL

BOT Brooke Ocean Technology Ltd

Brooke Ocean Technology
50 Thornhill Drive, Unit 11
Dartmouth, Nova Scotia.
Canada. B3B 1S1

Free Fall Cone Penetrometer and MVP Upgrades
NOAA Field Acceptance Test
Project No.: 0578
Homer, Alaska, June 9 – 13, 2006

1 Line Puller Installation

	Test	Result	Accept
1.1 Confirm Specifications			
Danfoss Hydraulic Motor OMM8:151G00493	Check ID Tag	OK	BM
Relief valve setting of 1,500 psi	Check Pump B Gauge	1600 cold	BM
Verify Line Speed of 12 – 13 m/s	RPM Gauge	13 m/s	BM
1.2 Installation			
Hydraulic System Upgrades	Check for leaks	OK	BM
Sheave wheel alignment	Wheel driven in outboard direction	OK	BM
1.3 Performance and Operation			
Verify proper line puller operation	Observe that line puller is throwing line over-the-side after impact and that no slack cable has occurred on the drum.	OK	BMZ
Verify FFCPT terminal velocity	Confirm from data that it is in the 7.5 – 11 m/s range in no more than 100m of water	6.3 – 7.8 m/s ↑ w/depth	BM
Verify that standard SVP fish operations are unaffected by line puller installation	Conduct deployments and check data.	OK	BM for FA

2 Inner Sheave Load Cell Installation

	Test	Result	Accept
Confirm load cell installation			BMZ
Confirm proper calibration and functioning	Load cell reads approximately 115 lbs with FFCPT hanging or use calibration load cell and come- along to generate loads.	(1) $R^2 = .99$ (2) $R^2 = 1$ (3) $R^2 = 1$	BM

3 Free Fall Cone Penetrometer (FFCPT)

	Test	Result	Accept
Overall Instrument Quality (fit and finish)	Visual inspection	OK	BM
3.1 Confirm physical specifications	Diameter of 3.47"	OK	BM
	Length of 73"	OK	BM
	Weight of 115 lbs in-air	OK	BM
	Material of 316 Stainless	OK?	BM
3.2 Confirm System Specifications			
Rated Depth of 660m	BOT pressure test record		
Data Sampling rate of 2,000 HZ	Check data files	OK	BM
Battery Voltage	Verify fully charged voltage of 13.5V	14.4 unloaded 14.4	BM
Accelerometers: [+3g/-2g]; [+20g/-5g]; [+90g/-10g]	Confirm through data the presence of 3 accelerometers.	OK	BM
Drop Capacity of ~200 Drops on a 128 mb flash		~ 600KB ea	BM

3.3 Confirm Function of Principal Components			Accept
Accelerometers	Check data to confirm proper operation and verify saturation points (if high enough peak acceleration has occurred)	Low clipped @ 3G Mid clipped @ 20 G	BM
Pressure Sensors	Compare output in water column with independent measure of depth	2 - ok	BM
Optical Mudline Sensor	View mudline output using low speed data and trigger on mudline.	OK	BM
Sound Velocity Sensor	Compare SV data with highly calibrated CTD or other independent measure of SV.	OK	BM
FfcptView Features and Functionality	Software demo and post-processing analysis.	OK	BM
Communications Interface Box	Verify connectivity and communications between PC and FFCPT.	OK	BM
Instrument Status LED	Confirm LED is working flashes regularly when instrument is armed (bench top test)	OK	BM

4 MVP200/FFCPT Integration and Deployment

	Test	Result	Accept
Deployment and Recovery	Deployment and recovery in soft mud (2.5m penetration).	OK	BM
Multi-drop Capability	Complete multiple drops and verify collection of data.	OK	BM
Asymmetrical tail fin	Confirm that cable twisting is minimized.	OK	BM
Log Single Drop Mode	Demonstrate and log a single drop	N/A	BM

5 Evaluate Geotechnical Performance

	Test	Result	Accept
5.1 Penetration Depth			
Typical Penetrations (2.5 in soft mud, 1m in silt, 0.25 – 0.5 m in gravel/sand)	Check penetration depth in various sediment types through post-processed data and through physical observation of FFCPT.	2.3 - clay 11-14 cm - gravel 1-1.3 - sandy silt	BM
5.2 Sediment Classification			
Consistency	Demonstrate consistent SBT classifications at one site.	OK	BM
Discrimination	Demonstrate ability to distinguish between variable sediment types at different locations.	OK	BM
Independent Validation	Compare SBT classification to core of grab samples.	OK	BM

6 Final Deliverables Verification

Deliverable	Check	Action
FFCPT with 660m depth rating for on-station work	✓	
Communications interface box	✓	
Data processing and presentation software (FfcptView)	✓	
Shipping Crate	✓	
Service Tools and spares (see attached packing list)	✓	
Wire rope extension (mechanical)	✓	
Electrical extension	✓	send longer extension
Users manual and documentation	✓	
Line Puller and associate MVP upgrades	✓	
Load Cell	✓	

FAT Test Action Items

1. Replace faulty dummy plug.
2. BOT to provide software upgrade by July 15, 2006 with full operations manual.
3. BOT to provide communication interface box schematic.
4. BOT to send longer E/M cable extension.
5. FFCPT Quick Start Guide (cheat sheet).
6. BOT to provide appendices drawings as PDFs (Manual and appendices already provided, with the exception of drawings).
7. BOT to provide pressure test record.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.

BOT Representative: Dan Cunningham Signed: [signature] Date: 6/14/06

NOAA Representative: Bob McConnaughey Signed: Bob McConnaughey Date: 6/14/06

SBE 19plus
SEACAT PROFILER

Conductivity, Temperature, and Pressure Recorder with RS-232 Interface

Serial Number: 19P36026-4585

Sea-Bird Electronics, Inc.
1808 136th Place NE
Bellevue, Washington 98005 USA
Tel: 425/643-9866
Fax:425/643-9954

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4585
CALIBRATION DATE: 28-Nov-06

SBE19plus TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

a0 = 1.152047e-003
a1 = 2.774008e-004
a2 = -1.305731e-006
a3 = 1.956257e-007

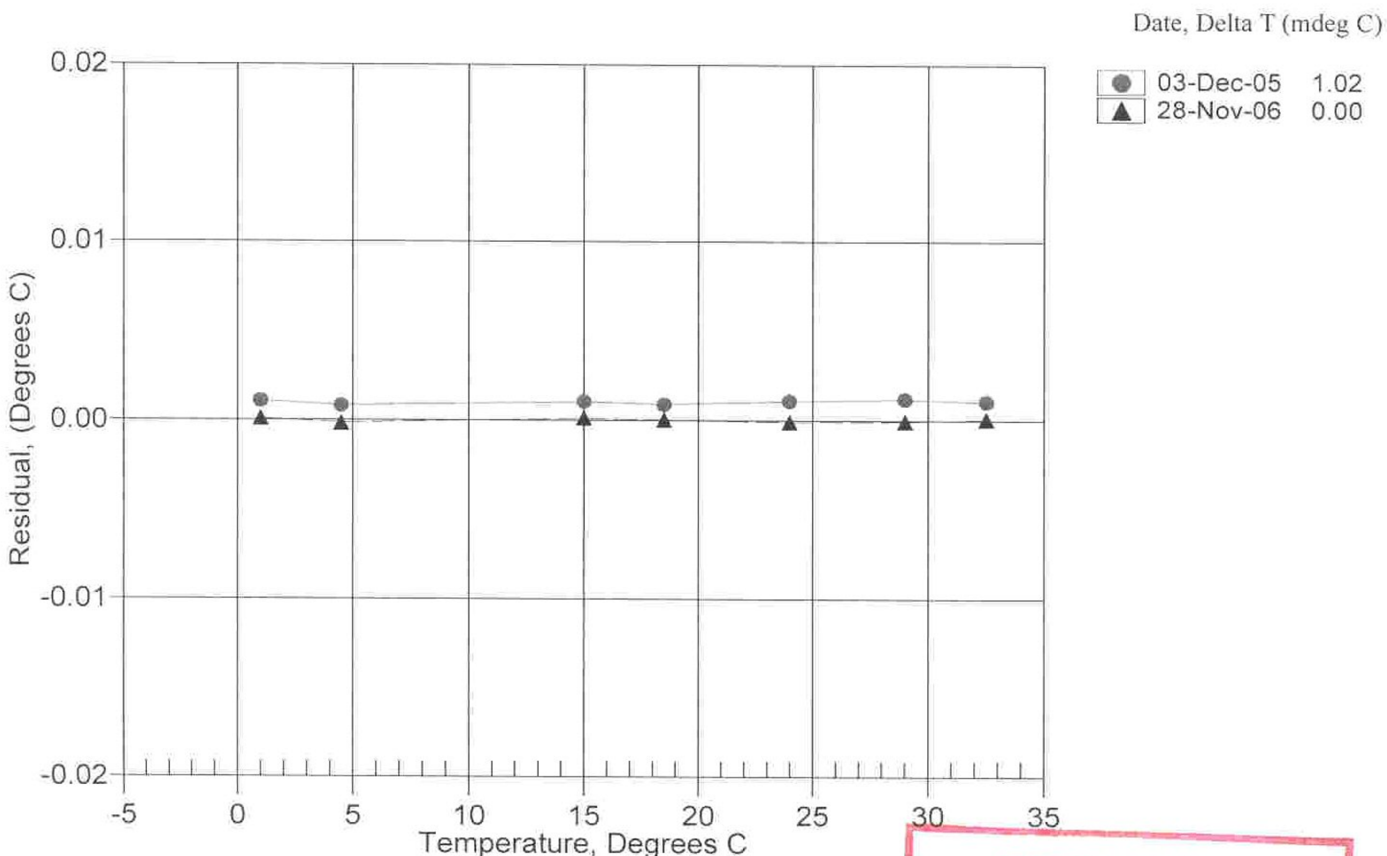
BATH TEMP (ITS-90)	INSTRUMENT OUTPUT(n)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	686658.716	1.0001	0.0001
4.5000	613981.973	4.4998	-0.0002
15.0000	430447.473	15.0001	0.0001
18.4999	380354.081	18.4999	0.0000
24.0000	311743.365	23.9999	-0.0001
29.0000	259025.784	28.9999	-0.0001
32.5000	226964.392	32.5001	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



POST CRUISE CALIBRATION

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4585
CALIBRATION DATE: 28-Nov-06

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

COEFFICIENTS:

g = -1.030197e+000
h = 1.491063e-001
i = -1.948610e-004
j = 3.642440e-005

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

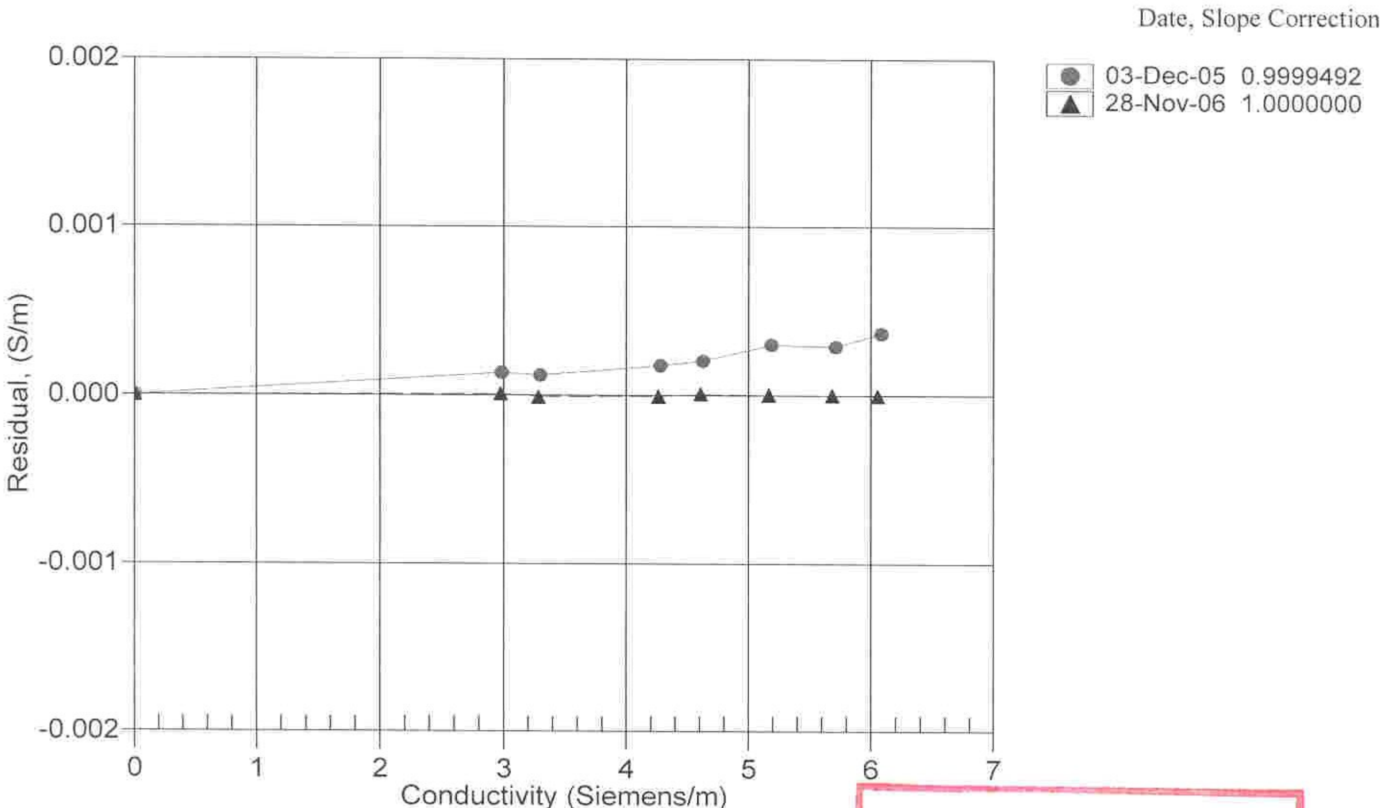
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2630.82	0.0000	0.00000
1.0000	34.7657	2.97205	5181.45	2.9721	0.00001
4.5000	34.7458	3.27873	5375.65	3.2787	-0.00001
15.0000	34.7032	4.25920	5953.51	4.2592	-0.00001
18.4999	34.6940	4.60388	6143.50	4.6039	0.00001
24.0000	34.6839	5.16110	6438.51	5.1611	0.00000
29.0000	34.6777	5.68217	6702.35	5.6822	0.00000
32.5000	34.6738	6.05395	6884.23	6.0539	-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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1808 136th Place N.E., Bellevue, Washington, 98005 USA

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

SENSOR SERIAL NUMBER: 4585
CALIBRATION DATE: 16-Nov-06

SBE19plus PRESSURE CALIBRATION DATA
5076 psia S/N 5433

COEFFICIENTS:

PA0 = 5.395719e-001	PTCA0 = 5.087765e+005
PA1 = 1.544973e-002	PTCA1 = -1.437990e+000
PA2 = -6.597195e-010	PTCA2 = 1.066827e-001
PTEMPA0 = -6.655452e+001	PTCB0 = 2.398063e+001
PTEMPA1 = 5.245122e+001	PTCB1 = -2.075000e-003
PTEMPA2 = -5.873641e-001	PTCB2 = 0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE PSIA	INST OUTPUT	THERMISTOR OUTPUT	COMPUTED PRESSURE	ERROR %FSR
14.62	509685.9	1.6	14.46	-0.00
1026.60	575274.6	1.7	1026.49	-0.00
2039.16	641253.6	1.7	2038.83	-0.01
3051.47	707615.1	1.7	3051.25	-0.00
4063.65	774362.2	1.7	4063.70	0.00
5075.85	841475.1	1.7	5075.75	-0.00
4063.51	774357.9	1.7	4063.66	0.00
3051.17	707619.8	1.7	3051.38	0.00
2038.70	641248.6	1.7	2038.81	0.00
1026.22	575271.0	1.7	1026.47	0.00
14.63	509708.3	1.7	14.76	0.00

THERMAL CORRECTION

TEMP ITS90	THERMISTOR OUTPUT	INST OUTPUT
32.50	1.93	509747.27
29.00	1.86	509725.26
24.00	1.76	509699.82
18.50	1.65	509690.89
15.00	1.58	509683.62
4.50	1.38	509674.14
1.00	1.31	509676.42

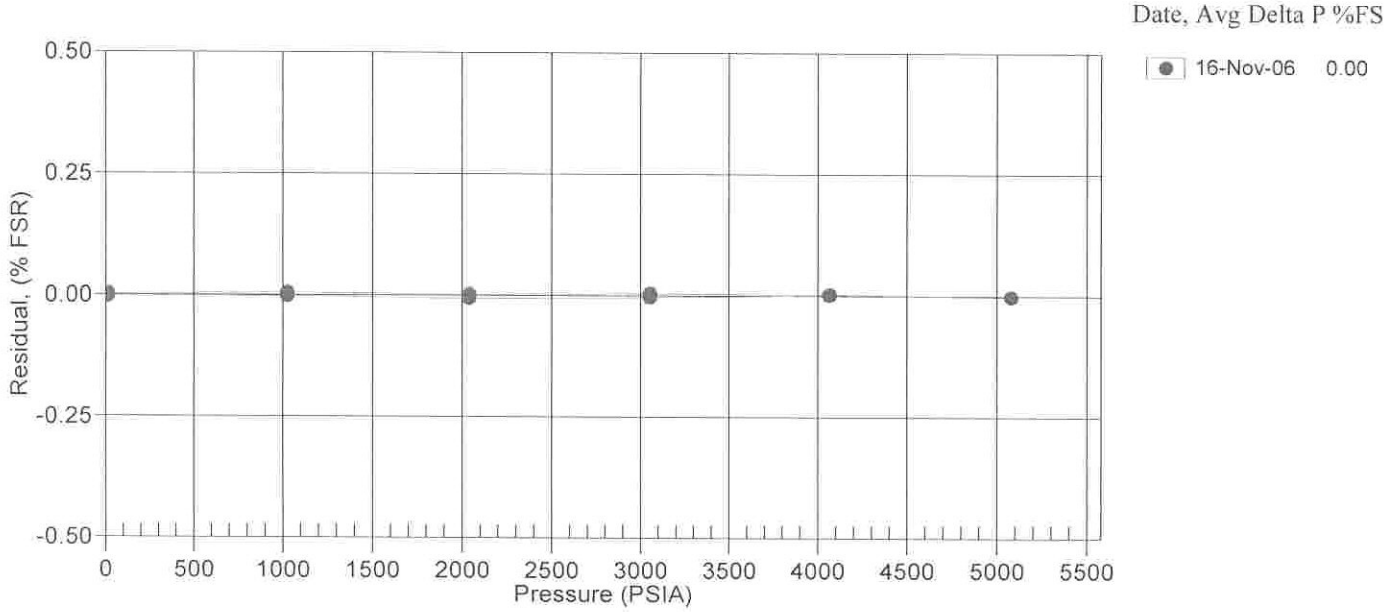
TEMP(ITS90)	SPAN(mV)
-5.00	23.99
35.00	23.91

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) = $PA0 + PA1 * n + PA2 * n^2$



SBE SEA-BIRD ELECTRONICS, INC.
1808 - 136th Place Northeast, 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:	44764	Date of Report:	11/29/2006
Model Number	SBE 19Plus	Serial Number:	19P36026-4585

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 using the program SEACON. 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: 11/28/2006 Drift since last cal: -.00103 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: Degrees Celsius/year

Comments:

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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:	44764	**Date of Report:**	11/29/2006
Model Number	SBE 19Plus	**Serial Number:**	19P36026-4585

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 using the program SEACON. 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: 11/28/2006 Drift since last cal: -.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.

SBE 19plus
SEACAT PROFILER

Conductivity, Temperature, and Pressure Recorder
with RS-232 Interface

Serial Number: 19P36026-4616

Sea-Bird Electronics, Inc.
1808 136th Place NE
Bellevue, Washington 98005 USA
Tel: 425/643-9866
Fax:425/643-9954

SBE SEA-BIRD ELECTRONICS, INC.
1808 - 136th Place Northeast, 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:	44765	**Date of Report:**	11/29/2006
Model Number	SBE 19Plus	**Serial Number:**	19P36026-4616

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 using the program SEACON. 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: 11/28/2006 Drift since last cal: -.00276 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: Degrees Celsius/year

Comments:

SEA-BIRD ELECTRONICS, INC.

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

SENSOR SERIAL NUMBER: 4616
CALIBRATION DATE: 28-Nov-06

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

COEFFICIENTS:

g = -1.045668e+000
h = 1.453942e-001
i = -2.957046e-004
j = 4.199194e-005

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

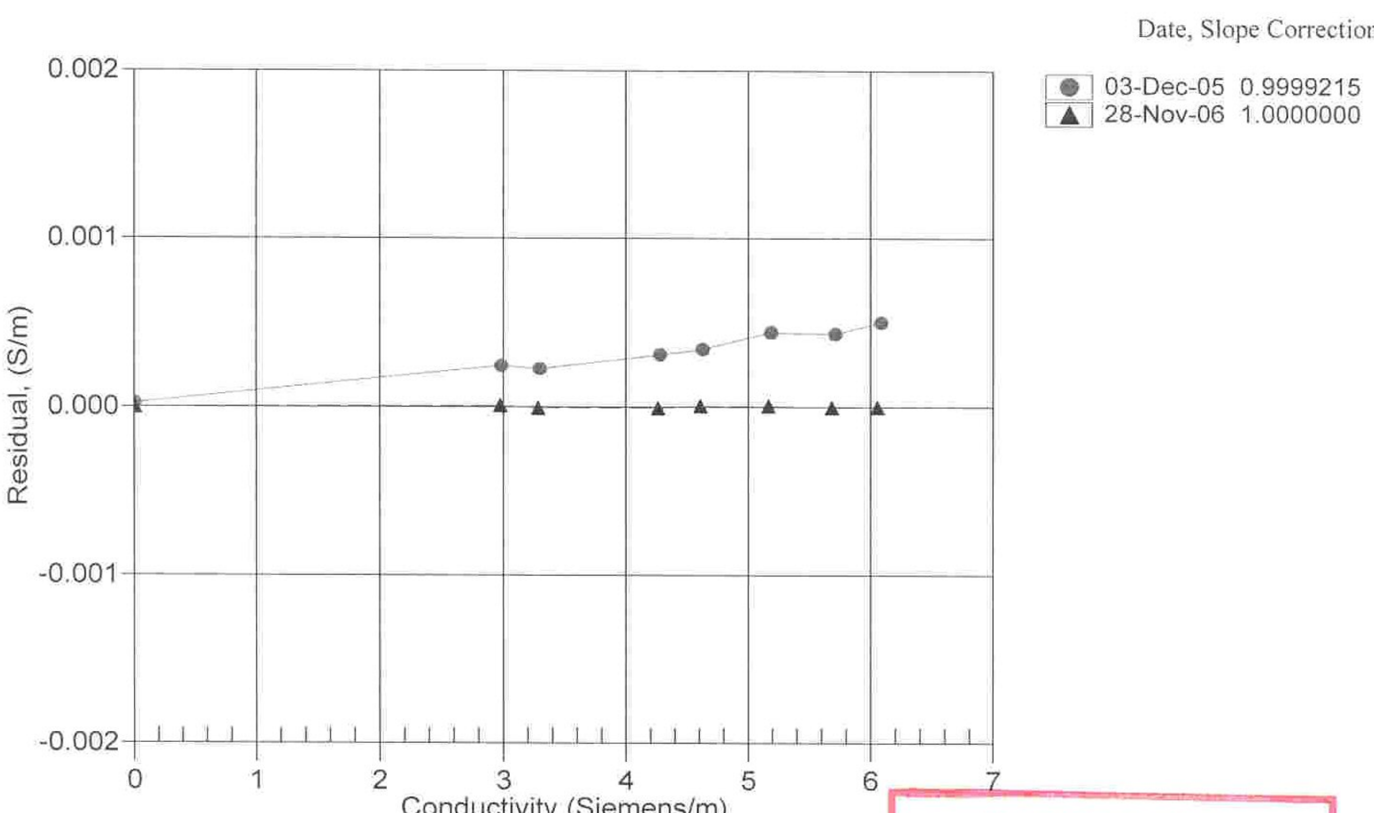
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2686.32	0.0000	0.00000
1.0000	34.7657	2.97205	5263.87	2.9721	0.00001
4.5000	34.7458	3.27873	5460.51	3.2787	-0.00001
15.0000	34.7032	4.25920	6045.75	4.2592	-0.00001
18.4999	34.6940	4.60388	6238.19	4.6039	0.00001
24.0000	34.6839	5.16110	6537.03	5.1611	0.00001
29.0000	34.6777	5.68217	6804.29	5.6822	-0.00000
32.5000	34.6738	6.05395	6988.55	6.0539	-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



POST CRUISE CALIBRATION

SEA-BIRD ELECTRONICS, INC.

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

SENSOR SERIAL NUMBER: 4616
CALIBRATION DATE: 20-Nov-06

SBE19plus PRESSURE CALIBRATION DATA
1450 psia S/N 5512

COEFFICIENTS:

PA0 = 6.815264e-001
PA1 = 4.425295e-003
PA2 = -1.202469e-011
PTEMPA0 = -7.701795e+001
PTEMPA1 = 4.989890e+001
PTEMPA2 = -4.248617e-001

PTCA0 = 5.204411e+005
PTCA1 = 1.323211e+001
PTCA2 = -2.756389e-001
PTCB0 = 2.473825e+001
PTCB1 = 5.000000e-005
PTCB2 = 0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE PSIA	INST OUTPUT	THERMISTOR OUTPUT	COMPUTED PRESSURE	ERROR %FSR
14.60	523731.0	2.0	14.55	-0.00
301.14	588511.0	2.0	301.15	0.00
587.96	653320.7	2.0	587.79	-0.01
874.50	718131.9	2.0	874.32	-0.01
1161.10	782945.4	2.0	1160.77	-0.02
1447.47	847858.4	2.0	1447.56	0.01
1160.85	783006.0	2.0	1161.04	0.01
874.07	718109.8	2.0	874.22	0.01
587.12	653216.1	2.0	587.32	0.01
300.59	588415.5	2.0	300.73	0.01
14.59	523729.7	2.0	14.54	-0.00

THERMAL CORRECTION

TEMP ITS90	THERMISTOR OUTPUT	INST OUTPUT
32.50	2.24	523800.43
29.00	2.17	523810.10
24.00	2.06	523813.00
18.50	1.95	523803.73
15.00	1.87	523798.40
4.50	1.66	523724.90
1.00	1.59	523661.67

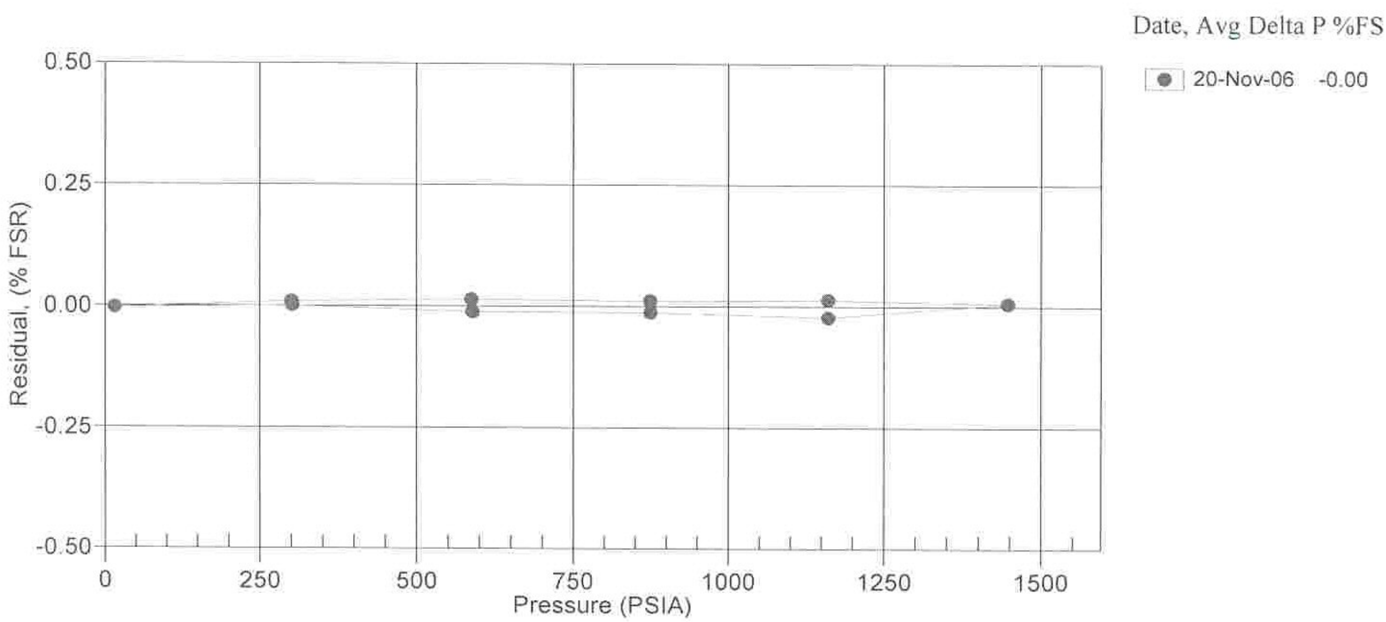
TEMP(ITS90)	SPAN(mV)
-5.00	24.74
35.00	24.74

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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SENSOR SERIAL NUMBER: 4616
CALIBRATION DATE: 28-Nov-06

SBE19plus TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

a0 = 1.270073e-003
a1 = 2.575893e-004
a2 = 5.463437e-007
a3 = 1.270161e-007

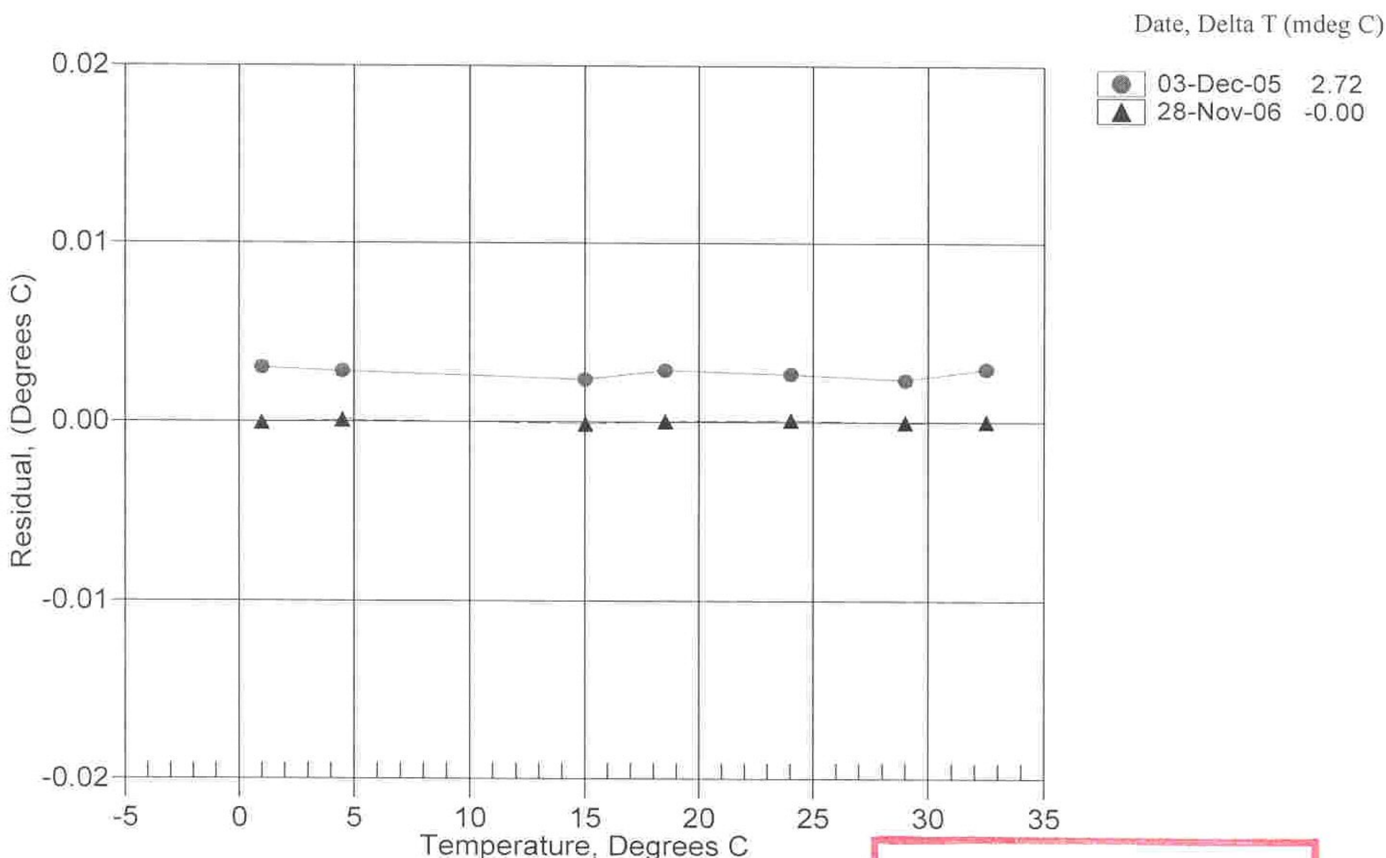
BATH TEMP (ITS-90)	INSTRUMENT OUTPUT(n)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	622362.833	1.0000	-0.0000
4.5000	552569.850	4.5001	0.0001
15.0000	379385.467	14.9999	-0.0001
18.4999	332894.733	18.4999	0.0000
24.0000	269791.750	24.0001	0.0001
29.0000	221775.083	29.0000	-0.0000
32.5000	192778.933	32.5000	-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



POST CRUISE CALIBRATION

SBE SEA-BIRD ELECTRONICS, INC.
1808 - 136th Place Northeast, 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:	44765	Date of Report:	11/29/2006
Model Number	SBE 19Plus	Serial Number:	19P36026-4616

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 using the program SEACON. 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: 11/28/2006 Drift since last cal: -.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.

SBE 19plus SEACAT PROFILER

Conductivity, Temperature, and Pressure Recorder with RS-232 Interface

Serial Number: 19P36026-4617

Sea-Bird Electronics, Inc.
1808 136th Place NE
Bellevue, Washington 98005 USA
Tel: 425/643-9866
Fax:425/643-9954

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA

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

SENSOR SERIAL NUMBER: 4617
CALIBRATION DATE: 20-Nov-06

SBE19plus PRESSURE CALIBRATION DATA
1450 psia S/N 5513

COEFFICIENTS:

PA0 =	-6.818889e-001	PTCA0 =	5.192316e+005
PA1 =	4.441786e-003	PTCA1 =	-1.293709e+001
PA2 =	-1.461601e-011	PTCA2 =	2.841324e-001
PTEMPA0 =	-7.808315e+001	PTCB0 =	2.460838e+001
PTEMPA1 =	4.830529e+001	PTCB1 =	6.750000e-004
PTEMPA2 =	-1.963775e-001	PTCB2 =	0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE PSIA	INST OUTPUT	THERMISTOR OUTPUT	COMPUTED PRESSURE	ERROR %FSR
14.60	522522.3	2.1	14.57	-0.00
301.14	587037.6	2.1	300.91	-0.02
587.96	651734.5	2.1	587.92	-0.00
874.50	716289.7	2.1	874.19	-0.02
1161.10	780935.2	2.1	1160.73	-0.03
1447.47	845673.7	2.1	1447.55	0.01
1160.85	781013.3	2.1	1161.07	0.02
874.07	716327.5	2.1	874.35	0.02
587.12	651602.8	2.1	587.33	0.01
300.59	587008.6	2.1	300.78	0.01
14.59	522526.1	2.1	14.59	0.00

THERMAL CORRECTION

TEMP ITS90	THERMISTOR OUTPUT	INST OUTPUT
32.50	2.31	522606.59
29.00	2.24	522606.93
24.00	2.13	522594.90
18.50	2.02	522596.96
15.00	1.94	522599.38
4.50	1.72	522670.83
1.00	1.65	522733.56

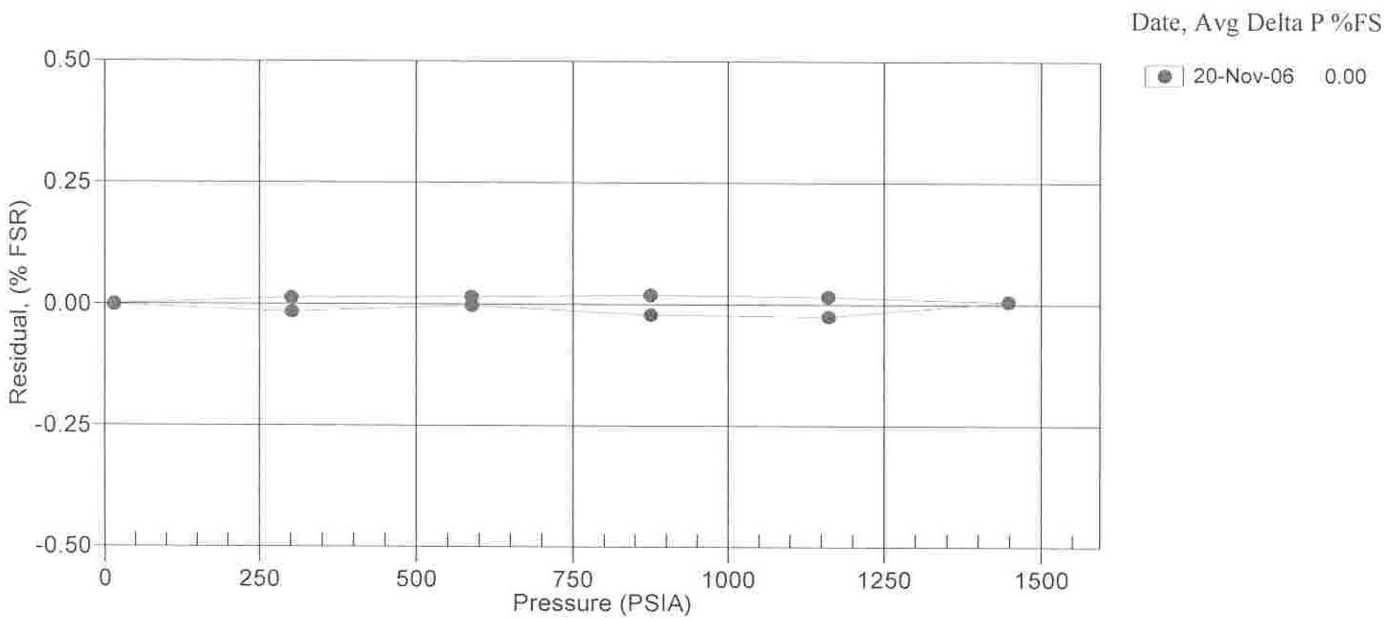
TEMP(ITS90)	SPAN(mV)
-5.00	24.61
35.00	24.63

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

$x = \text{pressure output} - PTCA0 - PTCA1 * t - PTCA2 * t^2$

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

$\text{pressure (psia)} = PA0 + PA1 * n + PA2 * n^2$



SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA

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

SENSOR SERIAL NUMBER: 4617
CALIBRATION DATE: 28-Nov-06

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

COEFFICIENTS:

g = -9.992894e-001
h = 1.278604e-001
i = -2.890367e-004
j = 3.593846e-005

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

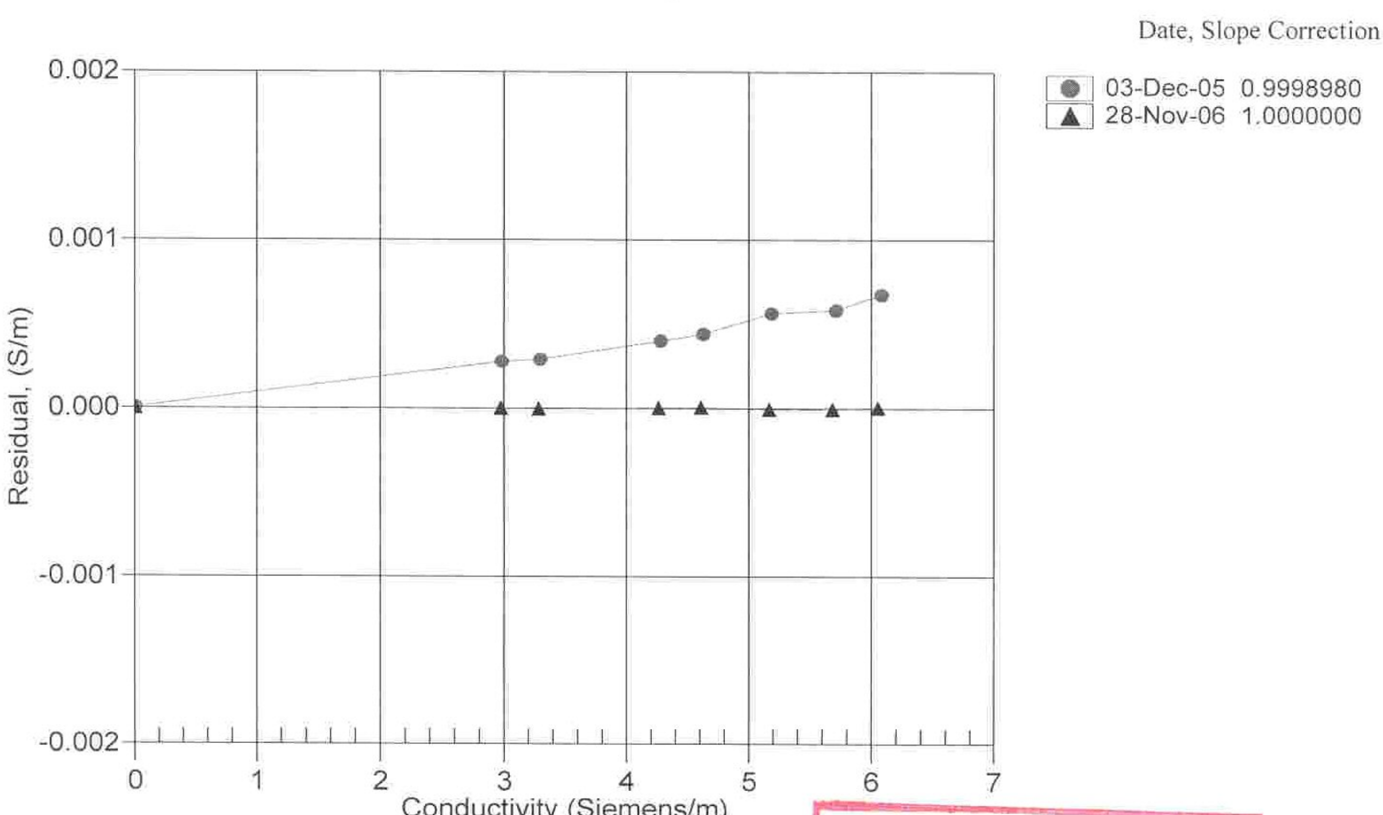
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2801.40	0.0000	0.00000
1.0000	34.7657	2.97205	5583.94	2.9721	0.00000
4.5000	34.7458	3.27873	5794.98	3.2787	-0.00000
15.0000	34.7032	4.25920	6422.55	4.2592	0.00000
18.4999	34.6940	4.60388	6628.77	4.6039	0.00001
24.0000	34.6839	5.16110	6948.88	5.1611	-0.00001
29.0000	34.6777	5.68217	7235.05	5.6822	-0.00000
32.5000	34.6738	6.05395	7432.30	6.0539	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



POST CRUISE CALIBRATION

SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4617
CALIBRATION DATE: 28-Nov-06

SBE19plus TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

a0 = 1.263742e-003
a1 = 2.634287e-004
a2 = 7.176289e-008
a3 = 1.504204e-007

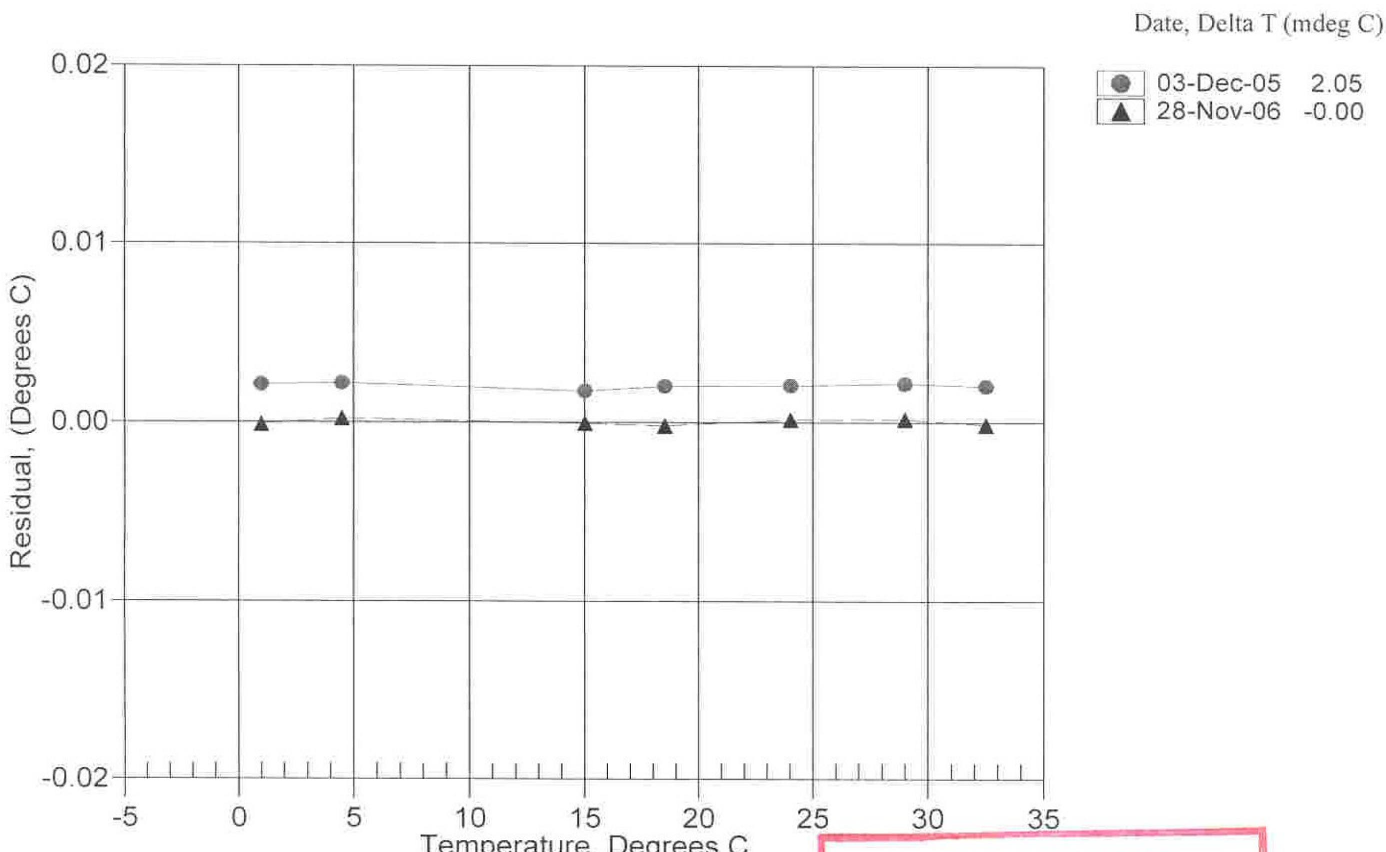
BATH TEMP (ITS-90)	INSTRUMENT OUTPUT(n)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	585629.732	0.9999	-0.0001
4.5000	518787.915	4.5002	0.0002
15.0000	354141.070	14.9999	-0.0001
18.4999	310213.634	18.4997	-0.0002
24.0000	250743.845	24.0001	0.0001
29.0000	205605.662	29.0002	0.0002
32.5000	178392.789	32.4999	-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



POST CRUISE CALIBRATION

SBE SEA-BIRD ELECTRONICS, INC.
1808 - 136th Place Northeast, 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:	44636	**Date of Report:**	11/29/2006
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 using the program SEACON. 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: 11/28/2006 Drift since last cal: -.00207 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: Degrees Celsius/year

Comments:

SBE SEA-BIRD ELECTRONICS, INC.
1808 - 136th Place Northeast, 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:	44636	Date of Report:	11/29/2006
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 using the program SEACON. 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: 11/28/2006 Drift since last cal: -.00030 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.
1808 136th Place NE
Bellevue, WA 98005
USA

Phone: (425) 643-9866
Fax: (425) 643-9954
E-mail: seabird@seabird.com
Web: www.seabird.com

APPLICATION NOTE NO. 42 **Revised September 2001**

ITS-90 TEMPERATURE SCALE

Beginning January 1995, Sea-Bird temperature calibration certificates list a new set of coefficients labeled *g*, *h*, *i*, *j*, and *F0*. These coefficients correspond to ITS90 (T90) temperatures and should be entered by those researchers working with SEASOFT-DOS Versions 4.208 and higher (and all versions of SEASOFT-Win32). For the convenience of users who prefer to use older SEASOFT versions, the new certificates also list *a*, *b*, *c*, *d*, and *F0* coefficients corresponding to IPTS68 (T68) temperatures as required by SEASOFT-DOS versions older than 4.208.

It is important to note that the international oceanographic research community will continue to use T68 for computation of salinity and other seawater properties. Therefore, following the recommendations of Saunders (1990) and as supported by the Joint Panel on Oceanographic Tables and Standards (1991), SEASOFT-DOS 4.200 and later and all versions of SEASOFT-Win32 convert between T68 and T90 according to the linear relationship:

$$\mathbf{T_{68} = 1.00024 * T_{90}}$$

The use of T68 for salinity and other seawater calculations is automatic in all SEASOFT programs. However, when selecting **temperature** as a display/output variable, you will be prompted to specify which standard (T90 or T68) is to be used to compute temperature. SEASOFT recognizes whether you have entered T90 or T68 coefficients in the configuration (.con) file, and computes T90 temperature directly or calculates it from the Saunders linear approximation, depending on which coefficients were used and which display variable type is selected.

For example, if *g, h, i, j, F0* coefficients (T90) are entered in the .con file and you select temperature variable type as T68, SEASOFT computes T90 temperature directly and multiplies it by 1.00024 to display T68. Conversely, if *a, b, c, d,* and *F0* coefficients (T68) are entered in the .con file and you select temperature variable type as T90, SEASOFT computes T68 directly and divides by 1.00024 to display T90.

Note: The CTD configuration (.con) file is edited using the Configure menu (in SEASAVE or SBE Data Processing in our SEASOFT-Win32 suite of programs) or SEACON (in SEASOFT-DOS).

Also beginning January 1995, Sea-Bird's own temperature metrology laboratory (based upon water triple-point and gallium melt cell, SPRT, and ASL F18 Temperature Bridge) converted to T90. These T90 standards are now employed in calibrating *all* Sea-Bird temperature sensors, and as the reference temperature used in conductivity calibrations. Accordingly, all calibration certificates show T90 (g, h, i, j) coefficients that result directly from T90 standards, and T68 coefficients (a, b, c, d) computed using the Saunders linear approximation.

SEA-BIRD ELECTRONICS, INC.
1808 136th Place N.E., Bellevue, Washington, 98005 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 0117
CALIBRATION DATE: 03-Dec-05

SBE 45 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

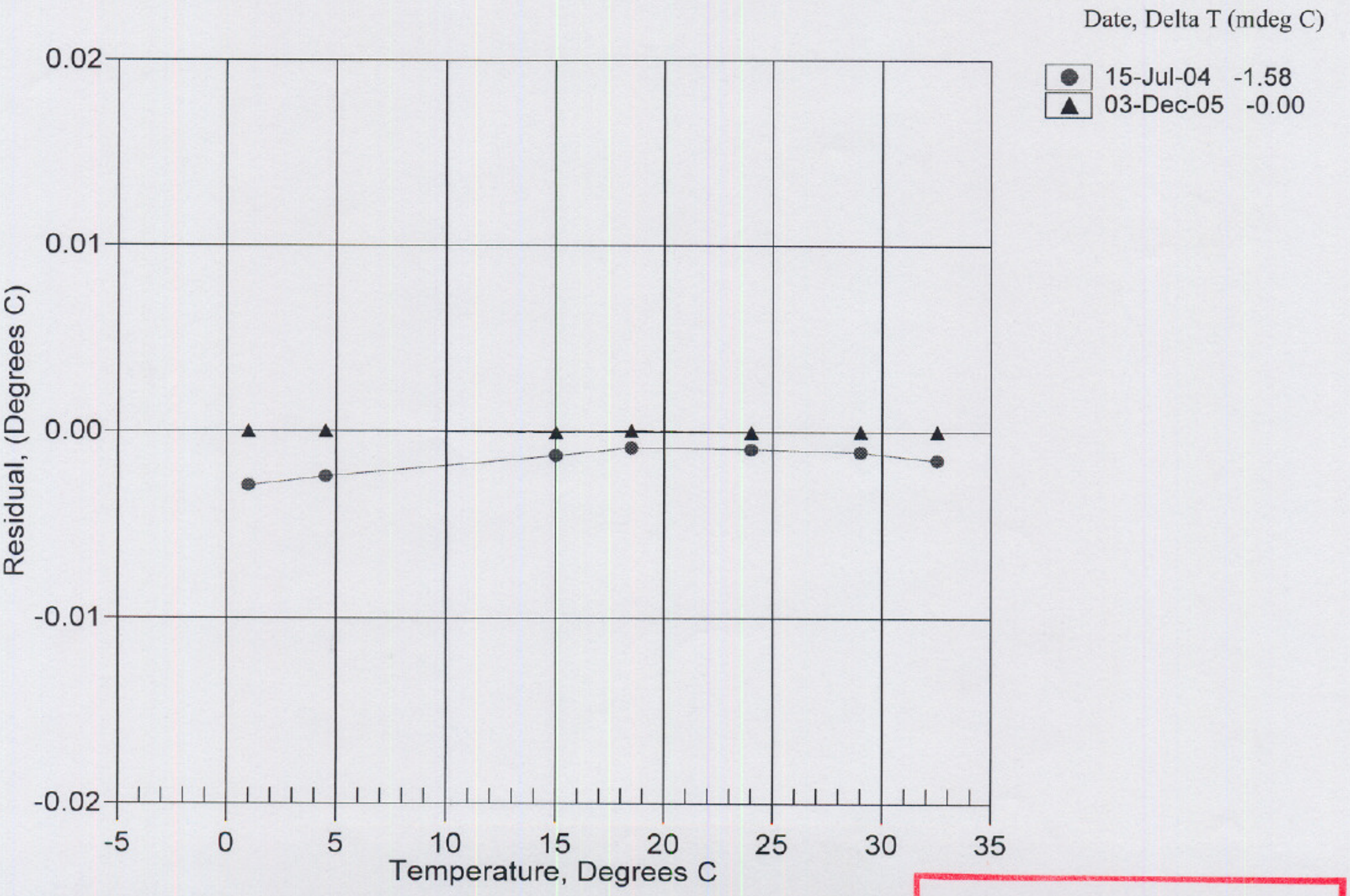
ITS-90 COEFFICIENTS

a0 = -2.052604e-004
a1 = 3.017581e-004
a2 = -4.020330e-006
a3 = 1.929919e-007

BATH TEMP (ITS-90)	INSTRUMENT OUTPUT	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	825534.5	1.0000	-0.0000
4.5000	707891.5	4.5000	0.0000
15.0000	454957.4	15.0000	-0.0000
18.5000	395012.3	18.5000	0.0000
24.0000	318215.6	24.0000	-0.0000
29.0000	262997.6	29.0000	-0.0000
32.5000	230900.3	32.5000	0.0000

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

Residual = instrument temperature - bath temperature



POST CRUISE CALIBRATION

SEA-BIRD ELECTRONICS, INC.
1808 - 136th Place Northeast, 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:	41336	**Date of Report:**	12/5/2005
Model Number:	SBE 45	**Serial Number:**	4536628-0117

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 using the program SEACON. 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: 12/3/2005 Drift since last cal: +.00114 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: Degrees Celsius/year

Comments:

SEA-BIRD ELECTRONICS, INC.

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

SENSOR SERIAL NUMBER: 0117
CALIBRATION DATE: 03-Dec-05

SBE 45 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

```
g = -1.029977e+000
h =  1.264651e-001
i = -1.493348e-004
j =  2.835643e-005

CPcor = -9.5700e-008
CTcor =  3.2500e-006
WBOTC = -3.1803e-006
```

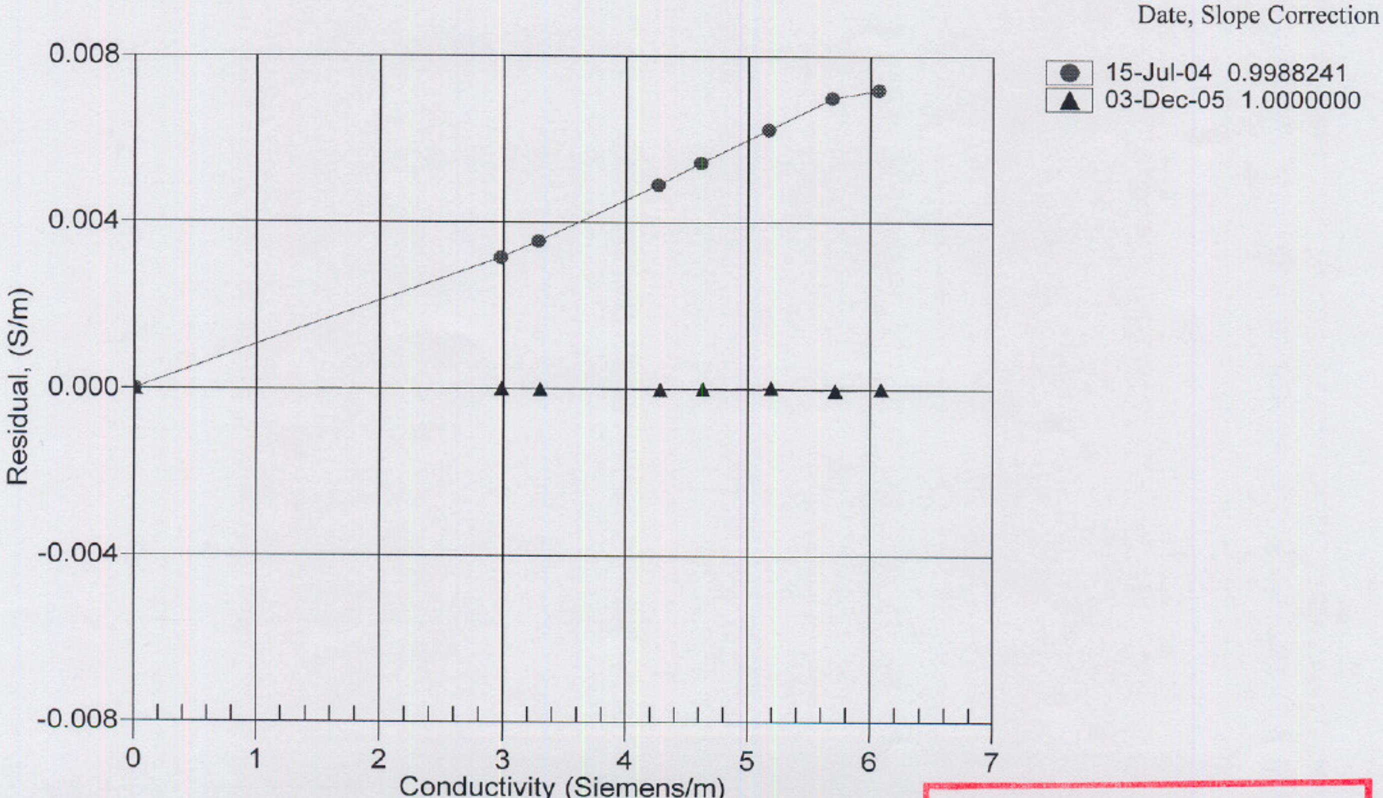
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2856.14	0.00000	0.00000
1.0000	34.9437	2.98581	5633.80	2.98582	0.00001
4.5000	34.9237	3.29386	5845.07	3.29385	-0.00001
15.0000	34.8803	4.27863	6473.56	4.27862	-0.00001
18.5000	34.8714	4.62489	6680.21	4.62489	0.00000
24.0000	34.8613	5.18458	7001.01	5.18461	0.00003
29.0000	34.8563	5.70813	7287.93	5.70810	-0.00003
32.5000	34.8533	6.08171	7485.76	6.08172	0.00001

f = INST FREQ * sqrt(1.0 + WBOTC * t) / 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



POST CRUISE CALIBRATION

SBE SEA-BIRD ELECTRONICS, INC.
1808 - 136th Place Northeast, 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:	41336	Date of Report:	12/5/2005
Model Number:	SBE 45	Serial Number:	4536628-0117

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 using the program SEACON. 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: 12/3/2005 Drift since last cal: -.00210 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.

SBE SEA-BIRD ELECTRONICS, INC.
1808 - 136th Place Northeast, Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Pressure Test Certificate

Customer	Pacific Marine Center / NOAA
Job Number	41336
Date	12/6/2005
Technician	JS

Serial Number 4536628-0117

Low Pressure (PSI)	45	PSI
Time (Minutes)	45	Minutes
High Pressure (PSI)	N/A*	PSI
Time (Minutes)		Minutes

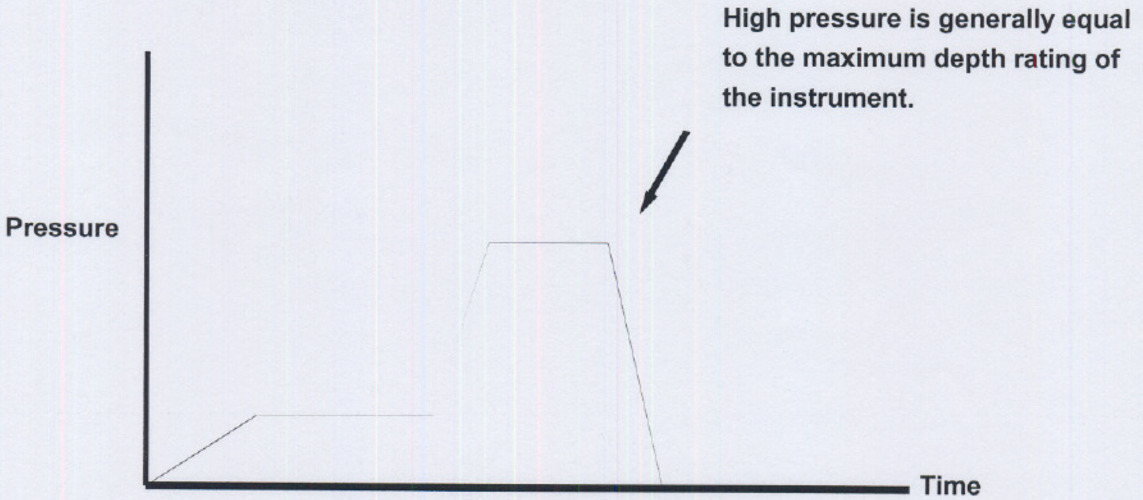
Pass ☑

Fail ☐

Comments

Replaced the main piston "O"-Rings.

*This unit is not designed for high pressure applications.



Typical Test Profile

```
S>ds
SBE45 V 1.1  SERIAL NO. 0117508, 1.52891,  10.3145, 1489
not logging data
sample interval = 1 seconds898,  10.3150, 1489.601
output conductivity with each sample18.5508, 1.52905,  10.3155, 1489.601
output salinity with each sample
 18.5509, 1.52912,  10.3160


S>dc
SBE45 V 1.1  0117
temperature:  03-dec-05
    TA0 = -2.052604e-04
    TA1 = 3.017581e-04
    TA2 = -4.020330e-06
    TA3 = 1.929919e-07
conductivity:  03-dec-05
    G = -1.029977e+00
    H = 1.264651e-01
    I = -1.493348e-04
    J = 2.835643e-05
    CPCOR = -9.570000e-08
    CTCOR = 3.250000e-06
    WBOTC = -3.180305e-06

S> 18.5870, 1.52912,  10.3071, 1489.703
 18.5872, 1.52913,  10.3071, 1489.704
 18.5874, 1.52914,  10.3072, 1489.705
 18.5875, 1.52919,  10.3075, 1489.706
 18.5876, 1.52920,  10.3076, 1489.706
 18.5874, 1.52920,  10.3076, 1489.705
 18.5870, 1.52919,  10.3076
```

Certificate of Calibration

Model: Nikon DTM310

Serial Number: 842575

This certifies that the above instrument has been inspected and calibrated by the GeoLine Positioning Systems Inc. Service Department. At the time of completion of this service, GeoLine Positioning Systems, Inc. certifies that the above stated product meets all factory specifications and tolerances for product parameters and performance of this product model.

All product calibration and specification parameters were tested and/or adjusted using applicable factory calibration jigs, precision optical collimation systems and electronic test equipment. All collimation systems have been properly checked and calibrated according to industry standard practices. All electronic test equipment used have had current calibration.

Date of Calibration: 6/28/04

Next Recommended Calibration Date: 12/28/04

Signed: [signature] Date: 6/28/04

Title: Service Technician

GeoLine Positioning Systems, Inc.
1331 118th Avenue SE, Suite 400
Bellevue, WA 98005
425.452.2711 • 425.452.2703 fax

Certificate of Calibration

Model: Sokkia SET 5F

Serial Number: 16288

This certifies that the above instrument has been inspected and calibrated by the GeoLine Positioning Systems Inc. Service Department. At the time of completion of this service, GeoLine Positioning Systems, Inc. certifies that the above stated product meets all factory specifications and tolerances for product parameters and performance of this product model.

All product calibration and specification parameters were tested and/or adjusted using applicable factory calibration jigs, precision optical collimation systems and electronic test equipment. All collimation systems have been properly checked and calibrated according to industry standard practices. All electronic test equipment used have had current calibration.

Date of Calibration: 7/19/04

Next Recommended Calibration Date: 7/19/05

Signed: Sean Valer Date: 7/19/04

Title: Service Technician

GeoLine Positioning Systems, Inc.
1331 118th Avenue SE, Suite 400
Bellevue, WA 98005
425.452.2711 • 425.452.2703 fax

Appendix VI

Maintenance and Periodic Testing

CTD Care, Maintenance and Testing

DLDG Daily DQA

SV Maintenance & Testing 2007

Date	Project	Maintenance	Notes	Results	Location
3/29/2007	HSRR	Performed DQA between 4616 and 4617	Velocwin 8.83 installed on O-lab computer and 1010	OK	Blank Inlet - Ketchikan Shakedown
4/14/2007	O119 Ernest Sound	Performed DQA between 4585 and MVP		OK	Fools Inlet
4/25/2007	O119 Ernest Sound	Performed DQA between 4585 and 4617		OK	Menefee Inlet
5/2/2007	O119 Ernest Sound	DQA between 4585 and 4617		OK	Seward Passage
5/2/2007	O119 Ernest Sound	Attempted DQA with MVP and 4616	see note in folder	n/a	Seward Passage
5/12/2007	O119 Ernest Sound	DQA between 4585 and MVP		OK	S of Sunny Bay
5/14/2007	O119 Ernest Sound	DQA between 4617 and 4616		OK	S of Sunny Bay
5/22/2007	O119 Ernest Sound	DQA between 4616 and 4585		OK	S of Sunny Bay
5/22/2007	O119 Ernest Sound	DQA between 4617 and MVP	Failed. Reattempt on 5/24, Results OK	N/A	S of Sunny Bay
5/24/2007	O119 Ernest Sound	DQA between 4617 and MVP		OK	Warm Springs Bay
6/2/2007	P183 Shumagin Is	DQA b/w MVP and 4585		OK	Big Koniuji
6/2/2007	P183 Shumagin Is	DQA b/w 4617 and 4616		OK	Big Koniuji
6/19/2007	P183 Shumagin Is	DQA between 4616 and 4585		OK	Big Koniuji
7/27/2007	P183 Shumagin Is	DQA between 4617 and 4585		OK	Sand Point
7/27/2007	P183 Shumagin Is	DQA between 4616 and MVP	BOT file processed OK; Seacat error (too few points); reattempt	failed	Sand Point
7/30/2007	P183 Shumagin Is	DQA reattempted for 4616 and MVP	vbatt low on Seacat, changed out D batteries	OK	Bendel Is
8/15/2007	P183 Shumagin Is	4617 and MVP		OK	Mist Harbor
8/15/2007	P183 Shumagin Is	4616 and 4585		OK	Mist Harbor
8/24/2007	P132 NE PWS	4585 and MVP	POSMV wasn't on so BOT files did not have positions and could not be processed	failed	Two Moon Bay
8/27/2007	P132 NE PWS	4616 and 4617		OK	Two Moon Bay
8/27/2007	P132 NE PWS	4585 and MVP		OK	Two Moon Bay
9/12/2007	P132 NE PWS	4617 and 4585		OK	Two Moon Bay
9/12/2007	P132 NE PWS	4616 and MVP		OK	Two Moon Bay
9/20/2007	P132 NE PWS	4616 and 4585		OK	Two Moon Bay
9/20/2007	P132 NE PWS	4617 and MVP		OK	Two Moon Bay
10/8/2007	P132 NE PWS	4585 and MVP		OK	Sunny Bay
10/8/2007	P132 NE PWS	4616 and 4617		OK	Two Moon Bay
10/25/2007	O168 Endicott Arm	4616 and MVP		OK	Sanford Cove
10/25/2007	O168 Endicott Arm	4617 and 4585			Sanford Cove

Subject: [Fwd: [Fwd: DGPS: P-checks & Nav DQA]]
Date: Mon, 12 Sep 2005 18:22:20 -0800
From: "foo fairweather" <foo.fairweather@noaa.gov>
To: chiefst.fairweather@noaa.gov

Subject: [Fwd: DGPS: P-checks & Nav DQA]
Resent-Date: Mon, 12 Sep 2005 20:17:27 GMT
Resent-From: FOO.Fairweather@noaa.gov
Date: Mon, 12 Sep 2005 20:29:01 +0100
From: "FOO Rainier" <foo.rainier@noaa.gov>
To: _NMAO MOP FOO Fairweather <FOO.Fairweather@noaa.gov>,
abigail higgins <abigail.higgins@noaa.gov>

Abigail,

I assume you're checking FOO-FA now, so sorry if you get this twice. Anyway, here's the email from Gerd from the spring about P-checks. Looks like it was a question from Lynn which prompted it in the first place.

Ben

-------- Original Message --------
Subject: DGPS: P-checks & Nav DQA
Date: Wed, 25 May 2005 17:01:38 -0400
From: Gerd Glang <Gerd.Glang@noaa.gov>
Organization: NOAA Hydro Systems & Technology Programs (301-713-2653, x152)
To: holly.dehart.atsea@noaa.gov
CC: Jack Riley <Jack.Riley@noaa.gov>, "Lynnette V. Morgan" <Lynnette.V.Morgan@noaa.gov>, "Holly A. Dehart" <Holly.A.Dehart@noaa.gov>, Benjamin K Evans <Benjamin.K.Evans@noaa.gov>, Guy Noll <Guy.Noll@noaa.gov>
References: <793c68e7.68e7793c@fairweather.nmao.noaa.gov>

Hi Holly (I hear my train leaving),

Your "atsea" e-mail keeps getting bounced back...so I'm copying Lynn on this.

Short answer - No.

USCG Beacons are subject to their own rigorous integrity monitoring. If the beacon signal is being received w/ good signal strength, it should be valid for correcting your position (simple answer). The Specs and Deliverables requirements assume this.

What we need to do is check that our receivers are working properly and no bogus antenna offsets were entered. Probably adequate to do this once per season as part of the system cert, or when you suspect a problem. Our MB data (and side scan data) are spatially dense enough that any problems would be apparent in the data right away. Also, the several GPS failures we've experienced this year have all been pretty catastrophic, i.e., there was no doubt the POS GPS had failed. Bottom line, it's not in the current draft FPM, its not in the Specs and Deliverables. Should be a reqt for the System Cert process.

So the two things I would require:

1) During data acquisition, conscientious monitoring of all sensor data (POS controller window, POS CPU lights, USCG Beacon Receiver display/lights, Isis display, etc).
2) During daily post-processing, a systematic and careful review of the data - treat as a directed editing problem.

Of course, we often fiddle with acquisition system configurations, both hardware and software, for one reason or another (or some gremlin gets into the system). It would be prudent to have a system cert-like checklist to run thru on Monday mornings after a long inport to prompt the briefly-befuddled or newly-trained OIC and chase Mr. Murphy away. Sort of like a pre-flight checklist. You may recall, we once had a case on the WH where an entire launch day (+4 hrs OT) of data was hosed because the Isis config was messed up the night before, and the JO's (who shall remain nameless but were nevertheless well qualified) didn't pay attention to #1.

(The complacent hydrographer will soon go aground - GFG).

BTW - RA has SonarPro for SSS (haven't used it much lately). NRTs use SonarPro.

G2

Holly DeHart atsea wrote:

> Hi Gerd,
>
> Lynn was asking me about comparing differential beacons, where you
> take coincident positions w/ two systems on different beacons. Sounds
> like WH's old p-check system. Do we still need to do these? If so at
> what frequency? They've been doing it weekly all season w/ no errors,
> is this still necessary?
>
> Holly
>
>

--
LT Ben Evans, NOAA
Field Operations Officer
NOAA Ship RAINIER (s221)
NOAA Marine Operations Center, Pacific
1801 Fairview Ave. E
Seattle, WA 98102

Thank you so much - this was indeed the project we were discussing. Could you tell me, is that 0.14 total tide error is a one-sigma or two-sigma error estimate?

Thank you for your time.

~~ mike.g.

Monica Cisternelli wrote:

> I computed an error estimation for OPR-O119-FA-2007, between historic
> Thoms Point and Ketchikan, and the total tide error came out to be 0.14
> m (including datum error). I am not sure if this is even the project
> you are concerned about, but it is the only one where we did not include
> an error estimation in our project instructions. So I guessed this is
> the one your talking about. So please use this value rather than a 0.4.
> Thanks
>
> Monica

Thank you for the info Rick, it was ~exactly~ what I was looking for..

While it is a shame to watch our data collapse in the face of IHO Order 1, it might just be the sad truth of Alaskan surveying: given the tidal uncertainties, a definitive depth cannot be ascertained without an appreciable error envelope.

I wish we could re-create your 14m IHO error in the field. As I mentioned earlier, we were unable to survey past 48m and maintain IHO Order 1. We'd used the exact error values suggested for the POS M/V and time latency suggested in HSTD-2; Our offset erors are on the order of 7 mm; Loading and Draft 3 and 4cm respectively; we low-balled the SV at 1 m/s and left the Delta Draft, and MRU align errors as zero (since we had yet to compute the patch test). This configuration blanked our swath in waters shoaler than 48m when filtered against IHO - but then, as you suggested, perhaps it is unrealistic to be expected to survey to IHO order 1 under these conditions. If that's the case, I feel like there should have been a disclaimer presented to everyone during the west coast hydro training, "Hey gang, while we strive to satisty IHO, the reality is you won't be able to get there while surveying in the shallow waters. How shallow? Well, anything shoaler than the Statue of Liberty is tall (46.84m - base to torch)."

The picture will not improve when the delta draft and MRU errors are added to the model.

I have attached a copy of our TPE spread sheet. Do any of the values appear inordinately high to you that keeps us from reaching your 14m glass ceiling (or would it be a glass floor)?

Is RAINIER having better luck than we?

Thank you for your time, all.

Regards,

~~ mike.g.

Richard T Brennan wrote:

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> the shape of the tide curve across the survey area (i.e. diurnal to
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> the rate an area floods and ebbs, uncertainties in the datum, and
> inaccuracies induced by the interpolation method itself. While CO-OPS
> may not be able to supply a definitive zoning error value for your
> survey area, they do use some judgment based on experience, and
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> particularly in Alaska. While 0.4m for zoning error is not unheard
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> is indeed the correct value. While your data may appear to be
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>> of 0.40 is also too large, it makes it impossible to acquire IHO
>> Order 1 data in waters shoaler than ~45m), I propose 0.10 as a
>> better upper bound until CO-OPS commits to something better.
>> ...and now for the message -- mog **
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>> Wait, we can haggle over HSTD 2007-2?
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>> calibrating for pitch (and so on). Such a simultaneous approach is
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>> By the end of the field season, FA had settled on MRU align values
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>> "poor" data being rejected while retaining the "good" is a step in
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>> The redundancy in having multiple eyes view a patch test can only be
>> taken so far however. Sea state, speed of the vessel, validity of
>> sound velocity profile, whether that pitch line was run ~exactly~ on
>> top of the sonar-conspicious target will dictate how valid a given
>> set of patch lines are for accurately determining the sonar
>> calibration. It's like we're trying to calculate the average weight
>> of any given Oreo by having a dozen people measure the weight of one
>> specific Oreo. Sure, you'll get a great estimate of the weight of
>> Oreo-X, and sure Nabisco strives to make all Oreos equal -- but can
>> that single (though repeated) measurement ~really~ be extrapolated
>> to all cookies? In magnitude, I would say yes (your single set of
>> patch test values are valid), but I would say the error estimates of
>> the patch values will be smaller than they really are. Anyone feel
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>> found during the patch test and those should give you a good low-end
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>> accurately conduct a patch test.
>>
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>> I'm curious how the field units are coping with the errors
>> associated with tide measured and tide zoning. The tide measured
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>> observed data (looking at past FA projects, 0.01m is a reasonable
>> median). However I feel the tidal zoing error of 0.01 to 0.40 is
>> too large. HSTD 2007-2 claims we will be given values in the Letter
>> Instructions, but the reality of Alaskan survey work is there will

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>> seldom be enough historic data for CO-OPS to commit to a zoning
>> error.  Speaking with the CST, we elected to high ball the error and
>> use 0.40m when computing TPE (the thought process being, "Well ...
>> it sure is a long way to the primary tide gauge."
>>
>> I do not know the exact equations involved when it comes to the
>> assimilation of the various components of error in the TPE model,
>> but a qualitative comparison can be made by varying the zoning error
>> (ZE) and examining the changes in the Dp TPE for a subset of pings.
>> Incrementally increasing the ZE causes the vertical TPE (Dp TPE) of
>> a given ping at nadir to converge on twice the value of the ZE,
>> regardless of the initial Dp TPE.  See attached picture.
>>
>> It is worth repeating:  regardless of the Dp TPE of a given sounding
>> with a zero ZE, inputting a ZE of 0.40 will lead to a Dp TPE for
>> that same sounding to change to 0.80.
>>
>> Using the IHO error estimate (Sqrt[a^2 + bd^2]), this would imply
>> all soundings collected in waters shoaler than 48m will
>> automatically be rejected as having not satisfied IHO Order 1.  I
>> wish I had a cookie analogy I could insert here.
>>
>> As of now, FA is proceeding with a zoning error of 0.10, since the
>> pings still appear to retain an essence of the other uncertainties
>> associated with the pings (alignment, POS/MV, precise timing,
>> etc.).  Once we begin acquiring data in earnest, we will likely
>> re-evaluate if we're again suffereing from a lack of "IHO-ness".
>>
>> SUMMARY #2 - A zoning estimate of 0.40m is harsh and will render a
>> surveying platform incapable of acquiring data in waters shoaler
>> than 48m that will satisfy IHO Order 1.  FA is proceeding with a
>> value of 0.10m and is standing by for changes.  Likely someone from
>> CO-OPS would be in a better position to provide such an estimate
>> vice a group of JO's with their fingers orange from eating Cheetos.
>> Thus far, CO-OPS has punted claiming lack of data - but that doesn't
>> help our error model.
>>
>> This e'mail is long and I have a sudden urge for junk food.  I will
>> close with also stating I believe sound speed error estimates
>> suggested in HSTD 2007-2 are larger than necessary; however, since
>> it does not result in greater than half of my data being deleted ...
>> I will champion that cause another day.
>>
>> Opinions?  I would love to hear them (I've got a hundred screen
>> shots I'm ~dying~ to share).
>>
>> ~~ mike.g.
>>
>> foo fairweather wrote:
>>
>> > -------- Original Message --------
>> >

         Subject: MRU allignment error estimates
     Resent-Date: Wed, 11 Apr 2007 18:40:18 GMT
     Resent-From: FOO.Fairweather@noaa.gov
            Date: Wed, 11 Apr 2007 18:32:59 +0000
```

From: FOO Rainier <foo.rainier@noaa.gov>
To: hydro.geek@noaa.gov
CC: ChiefST Rainier <chiefst.rainier@noaa.gov>, Jake Yoos <Jake.Yoos@noaa.gov>, Olivia Hauser <olivia.hauser@noaa.gov>, Samuel Greenaway <samuel.greenaway@noaa.gov>, CO Rainier <co.rainier@noaa.gov>, _NMAO MOP FOO Fairweather <FOO.Fairweather@noaa.gov>, _NMAO MOA FOO Thomas Jefferson <FOO.Thomas.Jefferson@noaa.gov>, _OMAO MOA FOO Rude <FOO.Rude@noaa.gov>, Mark Van Waes <Mark.Vanwaes@noaa.gov>

>> >
>> > Good morning,
>> >
>> > I believe that the MRU alignment error estimates recommended by
>> > HSTD 2007-2 are too high. The directive suggests that the MRU
>> > alignment fields in the TPE section of the HVF be set to a values
>> > with "similar magnitude to patch test values," with recommended
>> > default values of 1 degree for both gyro and roll/pitch alignment.
>> > In accordance with this guidance, RA set the gyro MRU alignment
>> > error estimate to 0.5 degrees, and the Roll/Pitch estimate to 1
>> > degree for all Reson-equipped launches prior to the beginning of
>> > data acquisition. We immediately found that ~2/3 of our swath
>> > width was rejected by the IHO Order 1 TPE filter.
>> >
>> > I've attached an Excel worksheet showing examples of this effect
>> > for a Reson 8101 operating in 15-20m of water. The left-hand plot
>> > shows a representative example of TPE values as a function of beam
>> > number with MRU alignment errors set to 0.5 and 1.0 degree as
>> > described above. The right-hand plot shows a similar sample (not
>> > the exactly the same soundings, but the same line and depth regime)
>> > with the MRU alignment error estimates values set to 0 (which is
>> > what we previously used).
>> >
>> > Obviously, zero error for alignment measurement is unrealistic;
>> > however, the recommended values appear to result in absurdly high
>> > depth measurement error estimation. It seems that the HSTD was
>> > written with the understanding that the MRU alignment error
>> > estimate should be an estimate of the alignment error itself, not
>> > an estimate of the error in the measurement of that alignment. I
>> > believe this interpretation is incorrect. The alignment error
>> > estimate is already taken care of by the patch test bias values in
>> > the Swath entry. High bias values, if carefully measured, are not
>> > necessarily incorrect. Thus, entering the alignment errors as
>> > alignment measurement errors can result in incorrect TPE
>> > estimation, as in the example attached.
>> >
>> > It's certainly difficult to estimate the quality of a patch test,
>> > but it seems to me that a more accurate estimate would be to use
>> > the standard deviation of the values computed by the various
>> > personnel computing the test. This would decouple alignment
>> > measurement precision from the alignment accuracy itself, and
>> > assign each to its correct place in the data reduction and error
>> > estimation process. On RAINIER, we have ~6 people looking at each
>> > vessel's patch test, so that gives us a reasonable sample size.
>> > Preliminary results of our patch testing indicate that this will
>> > produce much smaller (though non-zero) alignment measurement error

>> > estimates. At this point, I plan to use these values instead of
>> > those recommended in HSTD 2007-2; we will, of course, document
>> > this in the reports of those patch tests included with the affected
>> > DAPRs. However, I wanted to make others aware this potential
>> > problem- it took us a while to figure out why our swath width had
>> > mysteriously shrunk. I also recommend that HSD consider re-wording
>> > the HSTD to suggest this approach to the estimation of this value.
>> >
>> > Thanks,
>> >
>> > Ben
>> >
>> >
>> > --
>> > LT Ben Evans, NOAA
>> > Field Operations Officer
>> > NOAA Ship RAINIER (s221)
>> > NOAA Marine Operations Center, Pacific
>> > 1801 Fairview Ave. E
>> > Seattle, WA 98102
>> >
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>> >
>> > --
>> >
>> > ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
>> > LT Jennifer Dowling, NOAA
>> > Field Operations Officer
>> > NOAAS FAIRWEATHER
>> > 1010 Stedman Street
>> > Ketchikan, Alaska 99901
>> >
>> > 907 255-1807 or 1809 Ketchikan phone
>> > 907 255-1808 Ketchikan fax
>> >
>> > 808 659 0054 at sea phone
>> >
>> > foo.fairweather@noaa.gov
>> > at sea email size limit: 200k
>> >
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>>   ---
>>   [Image]
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> --
>
> --
> LCDR Richard Brennan, NOAA
>   Chief, Hydrographic Systems and Technology Program
> 1315 East-West Highway,SSMC3
> N/CS11, Station 7853
> Silver Spring, MD, 20910
> Work: 301-713-2653 x152
> Cell: 443-994-3301
>

Thank you for the info Rick, it was ~exactly~ what I was looking for..

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Using the IHO error estimate (Sqrt[a^2 + bd^2]), this would imply all soundings collected in waters shoaler than 48m will automatically be rejected as having not satisfied IHO Order 1. I wish I had a cookie analogy I could insert here.

As of now, FA is proceeding with a zoning error of 0.10, since the pings still appear to retain an essence of the other uncertainties associated with the pings (alignment, POS/MV, precise timing, etc.). Once we begin acquiring data in earnest, we will likely re-evaluate if we're again suffereing from a lack of "IHO-ness".

SUMMARY #2 - A zoning estimate of 0.40m is harsh and will render a surveying platform incapable of acquiring data in waters shoaler than 48m that will satisfy IHO Order 1. FA is proceeding with a value of 0.10m and is standing by for changes. Likely someone from CO-OPS would be in a better position to provide such an estimate vice a group of JO's with their fingers orange from eating Cheetos. Thus far, CO-OPS has punted claiming lack of data - but that doesn't help our error model.

This e'mail is long and I have a sudden urge for junk food. I will close with also stating I believe sound speed error estimates suggested in HSTD 2007-2 are larger than necessary; however, since it does not result in greater than half of my data being deleted ... I will champion that cause another day.

Opinions? I would love to hear them (I've got a hundred screen shots I'm ~dying~ to share).

~~ mike.g.

foo fairweather wrote:

-------- Original Message --------

Subject: MRU allignment error estimates
Resent-Date: Wed, 11 Apr 2007 18:40:18 GMT
Resent-From: FOO.Fairweather@noaa.gov
Date: Wed, 11 Apr 2007 18:32:59 +0000
From: FOO Rainier <foo.rainier@noaa.gov>
To: hydro.geek@noaa.gov
CC: ChiefST Rainier <chiefst.rainier@noaa.gov>, Jake Yoos <Jake.Yoos@noaa.gov>, Olivia Hauser <olivia.hauser@noaa.gov>, Samuel Greenaway <samuel.greenaway@noaa.gov>, CO Rainier <co.rainier@noaa.gov>, _NMAO MOP FOO Fairweather <FOO.Fairweather@noaa.gov>, _NMAO MOA FOO Thomas Jefferson <FOO.Thomas.Jefferson@noaa.gov>, _OMAO MOA FOO Rude <FOO.Rude@noaa.gov>, Mark Van Waes <Mark.Vanwaes@noaa.gov>

Good morning,

I believe that the MRU alignment error estimates recommended by HSTD 2007-2 are too high. The directive suggests that the MRU alignment fields in the TPE section of the HVF be set to a values with "similar magnitude to patch test values," with recommended default values of 1 degree for both gyro and roll/pitch alignment. In accordance with this guidance, RA set the gyro MRU alignment error estimate to 0.5 degrees, and the Roll/Pitch estimate to 1 degree for all Reson-equipped launches prior to the beginning of data acquisition. We immediately found that ~2/3 of our swath width was rejected by the IHO Order 1 TPE filter.

I've attached an Excel worksheet showing examples of this effect for a Reson 8101 operating in 15-20m of water. The left-hand plot shows a representative example of TPE values as a function of beam number with MRU alignment errors set to 0.5 and 1.0 degree as described above. The right-hand plot shows a similar sample (not the exactly the same soundings, but the same line and depth regime) with the MRU alignment error estimates values set to 0 (which is what we previously used).

Obviously, zero error for alignment measurement is unrealistic; however, the recommended values appear to result in absurdly high depth measurement error estimation. It seems that the HSTD was written with the understanding that the MRU alignment error estimate should be an estimate of the alignment error itself, not an estimate of the error in the measurement of that alignment. I believe this interpretation is incorrect. The alignment error estimate is already taken care of by the patch test bias values in the Swath entry. High bias values, if carefully measured, are not necessarily incorrect. Thus, entering the alignment errors as alignment measurement errors can result in incorrect TPE estimation, as in the example attached.

It's certainly difficult to estimate the quality of a patch test, but it seems to me that a more accurate estimate would be to use the standard deviation of the values computed by the various personnel computing the test. This would decouple alignment measurement precision from the alignment accuracy itself, and assign each to its correct place in the data reduction and error estimation process. On RAINIER, we have ~6 people looking at each vessel's patch test, so that gives us a reasonable sample size. Preliminary results of our patch testing indicate that this will produce much smaller (though non-zero) alignment measurement error estimates. At this point, I plan to use these values instead of those recommended in HSTD 2007-2; we will, of course, document this in the reports of those patch tests included with the affected DAPRs. However, I wanted to make others aware this potential problem- it took us a while to figure out why our swath width had mysteriously shrunk. I also recommend that HSD consider re-wording the HSTD to suggest this approach to the estimation of this value.

Thanks,

Ben

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at sea email size limit: 200k
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Diver Least Depth Gauge DQA 2006

OPR-P158-FA-06 Approaches to Cordova, Alaska

Date	UTC Time	DLDG reading	Sea Level Pressure	Gauge ID	Results
08-31-2006	20:44:14	14.39	993	68332	Good
09-01-2006	21:46:49	14.51	1007	68332	Good
09-05-2006	19:14:18	14.67	1020	68332	Good

Gauge 68322 stopped working after the 5 September reading and no new DLDG were obtained prior to the end of the field season

Appendix VII

Correspondence

Shoreline Guidance

Tides – Gravina River

Courtesy Letters

System Check Correspondence

Launch 1018 IMU Tumble Test