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

DATA ACQUISITION AND PROCESSING REPORT

Type of Survey: Basic Hydrographic

Project Number: OPR-H320-RU

Time Frame: 01 MAR - Present

LOCALITY

State: Florida

General Locality: North Atlantic Ocean

2007

CHIEF OF PARTY

LCDR Lawrence T. Krepp, NOAA

LIBRARY & ARCHIVES

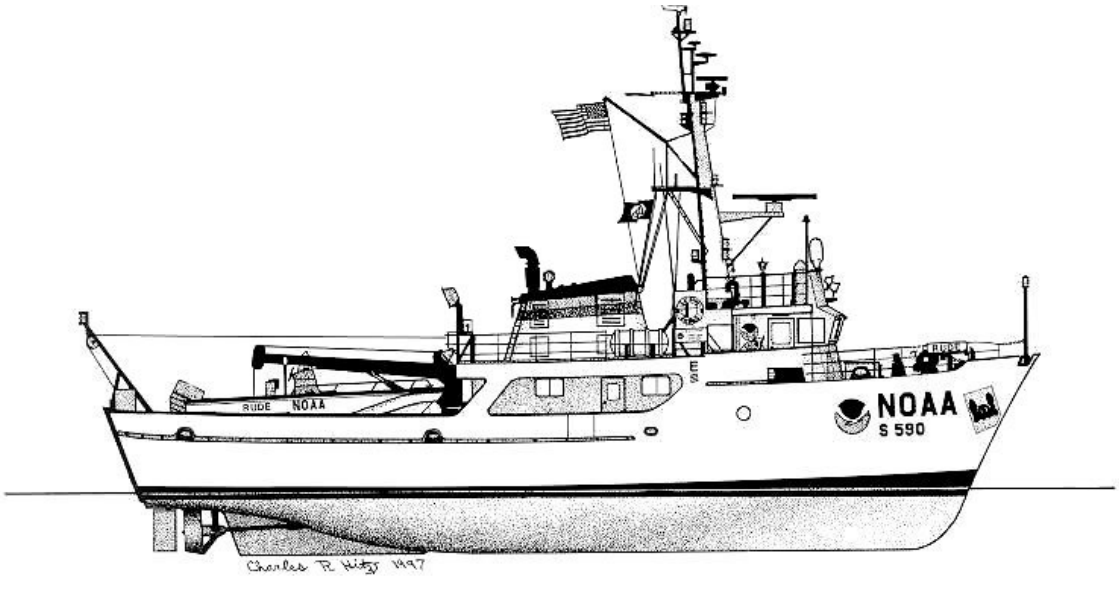
June 1st, 2007

DATE:_____

NOAA SHIP RUDE

2007 DATA ACQUISITION AND PROCESSING REPORT

OPR-H320-RU-07: APPROACHES TO PORT CANAVERAL, FL
S-F913-RU-07: ONSLOW BAY, NC



A. EQUIPMENT

A.1 Platform

All data are acquired from NOAA Ship *Rude* (S590, EDP #9040). *Rude* is a Class V Hydrographic Survey Ship, 90 feet in length overall, with a 22-foot beam and 7-foot draft. The ship acquires multibeam echosounder data, vertical beam echosounder data, side scan SONAR data, and bottom samples.

Refer to Appendix III for more detailed vessel descriptions and equipment positioning diagrams.

A.2 Sounding Instruments

A.2.1 Vertical Beam Echo Sounder

Rude is equipped with an Odom Echotrac DF3200 MKII Dual Frequency Vertical-Beam Echosounder (VBES). The Odom Echotrac DF3200 MKII is a dual frequency digital recording echosounder system with an analog paper recorder. The transducer of this system is thru-hull mounted to the vessel approximately 0.3m to port of the keel. The high frequency transducer operates at 200 kHz with a circular beam footprint of 7.5° at the -6 dB point. The low frequency transducer operates at 24 kHz with a rectangular beam of 27° (fore-aft) by 47° (athwartships) at the -6 dB point. Soundings in meters are acquired on both frequencies, with the high frequency usually selected for sounding data.

VBES data are logged by *HYPACK* software package (see section A.5 below), but paper records are acquired and retained for comparison with digitized depths during processing whenever the VBES is the primary sounding instrument.

The VBES data are acquired in conjunction with side scan SONAR or multibeam echo sounder acquisition. Side Scan SONAR line spacing is dictated by the acquisition requirements of the survey and the range scale used for a survey. Multibeam SONAR system is used for shoal developments and item investigations with typical line spacing of 10 meters.

A.2.2 Multibeam Echosounder

The RESON SeaBat 8125 multibeam echosounder is a single-frequency, digital-recording multibeam echosounder (MBES) with an operating frequency of 455 kHz. The RESON 8125 transducer consists of a flat transmitter array and solid cylindrical receiver array. The transducer unit is affixed to a swing-arm pole assembly, which is locked into vertical position for survey operations. Due to excessive pole vibration at high speeds, the maximum survey speed during MBES operation is 8 knots.

The RESON 8125 forms 240 beams each of which has a 0.5° across-track beam footprint for a maximum total swath width of 120°. Each beam has an along-track resolution of 1°. The ping rate is nominally 20-40 Hz, but may vary according to user specification. According to manufacturer specification, the RESON 8125 sonar is capable of bottom detection in depths from 3-120m.

The RESON 8125 performs active beam steering to correct for sound velocity at the transducer head using an ODOM Hydrographic Systems Digibar Pro sea surface sound velocity sensor. This sensor will be discussed in more detail in the Sound Velocity Equipment section (A.4).

While the primary use of the RESON 8125 is acquiring survey soundings, acoustic backscatter data from this sonar are recorded and archived. This data are recorded in RESON "snippet" format, where the acoustic backscatter strength for each ping/beam is measured over time (on the order of hundreds of microseconds). Backscatter snippet data is not used to generate hydrographic products; it is usually archived or used to generate end-user scientific products.

MBES data are monitored in real-time during data acquisition with TRITON ISIS software and RESON on-screen display. The RESON 8125 MBES system incorporates real time sound speed measurements from a sea surface sound velocimeter (refer to section A.4) for use in computing initial beam forming and beam steering. SONAR range scale, transmitter power, receiver gain, and pulse width are monitored and adjusted by the SONAR operator to optimize echosounder operation.

A.2.3 Side Scan Sonar

Rude is equipped with a Klein 5500 High Speed High Resolution Side Scan SONAR (HSHRSSS) system. This system is comprised of a KLEIN 5250 towfish, a T5100 network card, and Transceiver Processing Unit (TPU). The KLEIN 5250 towfish emits a single pulse with a central frequency of 455 kHz. The towfish is deployed using a deck-mounted winch spooled with armored coaxial cable. A slipring assembly traverses the length of the cable, connecting the 5250 towfish to the TPU. Cable out is monitored remotely at the acquisition station via an MD Totco Cable counter that measures the side scan towfish tow cable by counting revolutions of the towing block. The length of cable deployed is computed automatically and output to Hypack. From March 25th through the present, due to a serial cable failure between the Totco and Hypack computer, the person acquiring data manually enters the cable pay-out information into *Hypack*.

The minimum depth for *Rude*'s side scan SONAR surveying operations is 8 meters due to wake turbulence. The maximum towing speed is 10kt and typical towing speeds vary from 6 to 10 knots.

Side scan SONAR lines are planned to run parallel to bottom contours, spaced in accordance with the Side Scan SONAR Manual. Lines are planned with at least 15m of

overlap with adjacent swaths on either side. Range scales are determined primarily by water depth.

Vessel speed is adjusted to ensure that an object one meter in characteristic size would be detected and clearly imaged across the SONAR swath. Confidence checks are performed and noted frequently to ensure this standard of resolution is met.

A timing error correction of -3.500 seconds has been entered into the Caris hydrographic vessel file RU_SS_2007.hvf to correct for an along-track positioning error. Reprocessing of the HSRR SSS system check data with the timing correction active brought the contact correlation range to approximately ten meters, meeting specifications for towed SSS. Currently, the source of this error is under investigation.

A.2.4 Lead Line

A lead line test aboard *Rude* was conducted in March 2007 to confirm the calibration of *Rude*'s VBES and SWMB. This test showed that under the prevailing conditions at that time and location, *Rude*'s SONAR systems exceeded the International Hydrographic Organization "Special Order" specification for vertical soundings. See the attached Lead line report in Appendix IV.

A.2.5 Diver Least Depth Gauge

Dive investigations are primarily for contact/AWOIS verification and/or least depth confirmation of selected contacts. Diver Least-Depth Gauges (DLDG) are used by divers during item investigations to acquire least depths over selected contacts. The DLDG measures pressure, and together with a CTD cast, is processed using HSTP *Velocwin* software to compute a fully-corrected depth. These depths are compared to SWMB least depths processed in HSTP's *Pydro*.

A.3 Positioning and Attitude Instruments

A.3.1 RUDE

A.3.1.1 POS/MV 320

Rude's primary positioning and attitude sensor is an Applanix POS/MV Model 320 Version. 4. This system combines data from an inertial attitude sensor and carrier-phase GPS receivers to compute position, heading, heave, pitch, and roll to the accuracy required for shallow water multibeam sonar surveys. The three major components of the POS/MV are: an Inertial Measurement Unit (IMU) mounted close to the ship's center of motion; two GPS antennas on the ship's mast mounted perpendicular to the line of the ship; and a POS Computer System (PCS) processing unit on the bridge.

Differential GPS corrector input from an external source is required. These correctors are brought in with GPS data from the Trimble GPS system. A GPS receiver is directly connected to the POS/MV processor computer. *Rude*'s position and heading is calculated by measuring the phase difference of the GPS signals arriving at the two antennas and computing the vector between them. The resulting GPS position is corrected for the lever arm from the antennae to the center of motion. The GPS heading data and linear and angular acceleration values from the IMU are processed through a Kalman filter.

Precise timing is employed on both the POS and ISIS, and is thus being recorded in the .xtf data. In the Ethernet logging control of the POS control window, Group 102, Sensor 1 Data message, is enabled to allow this synchronized time stamping to occur. More information is discussed in Section A.5.1.2 ISIS of this document, as well as in Appendix III.

Heave is computed by double integration of acceleration in the vertical axis as measured by the IMU. Since this measurement is subject to long term drift, the data is high pass filtered with a rolloff frequency and damping coefficient selected to stabilize the measurement while preserving the phase and amplitude of the ship's vertical position in sea states anticipated in *Rude*'s area of operations. During MB operations, true heave information is recorded during the course of the entire survey day. Using the Ethernet Logging Control of the POS Controller, Groups 111 (Heave Data) and 113 (Heave Data Quality Control) are selected. The data is then loaded into *CARIS* pre-processing much the same way that tides or sound velocity is.

All vessel attitude and position data are corrected to the position of the IMU. The final position, heave, and attitude data are output to the Hypack and Isis data acquisition systems via RS-232 serial and Ethernet connections. This correction data is stored within the Hypack and Isis output data files. The POS/MV system is configured for 20 Hz output of the "TSS" Heave / Roll / Pitch message and 5 Hz output of the NMEA-0183 GGA and HDT messages. Refer to Appendix III for further discussion of POS/MV settings.

A.3.1.2 Trimble DSM-212L

Rude's auxiliary positioning system is a Trimble DSM-212L DGPS receiver. The DSM-212L is an integrated unit combining a 12 channel L1 C/A code receiver with a 2 channel Differential Beacon receiver. This unit is used primarily to receive USCG Differential Beacon messages, which are passed with GPS data to the POS/MV auxiliary input. Although the DSM-212L has the ability to automatically select stations based on signal strength or geographic proximity, the receiver is manually tuned to avoid unexpected and undocumented changes in the differential beacon in use.

Position, time, and velocity data from the Trimble unit is available in a 1 Hz NMEA message as an auxiliary input to the POS/MV. The DSM-212L is configured using the "TSIP Talker" software to suspend output in the event NOS Hydrographic Position Control specifications are not met.

A.4 Ancillary Instruments

A.4.1 Water Column Sound Speed

Water column sound speed profiles are calculated from electric conductivity, water temperature, and water pressure as measured by two Sea-Bird SBE 19 conductivity, temperature, and depth (CTD) profilers. The SBE-19 is a self-contained battery-powered unit with a serial interface for configuration and data download. The SBE 19 is equipped with a 300-psi pressure gauge to provide high-resolution data in the relatively shallow water typical of *Rude*'s areas of operations. Sound speed profiles in CARIS .SVP format are computed using the HSTP *Velocwin* software described in section A.5.

Sea surface sound speed is continuously monitored during multibeam acquisition with an Odom Hydrographic Digibar Pro sound velocimeter. The Digibar Pro is a real-time time-of-flight sea surface sound velocimeter. The manufacturer specified sound velocity accuracy is 0.3 ms^{-1}. Sea surface temperature and sound speed are output to the RESON 8125 system at 10 Hz. It is mounted just above the multibeam transducer head. During MBES data acquisition, a new CTD cast is taken if the surface sound speed is observed to have changed more than +/-5 m/s from its value at the last CTD cast.

Comparisons between the two CTDs and the Digibar Pro are conducted on a regular basis to ensure data quality.

A.4.2 Bottom Sampler

Where required by project instructions, *Rude* personnel acquire sediment samples from the sea floor in the survey area. The primary tool for this operation is a "clamshell" style gravity-closed sediment sampler, which penetrates approximately 0.05m into the bottom; sample volume is 2309 cm3 maximum. Bottom samples are evaluated for sediment type, color, texture, and particle size.

A.5 Data Acquisition and Processing Software

A.5.1 Acquisition

A.5.1.1 HYPACK

Coastal Oceanographics Hypack Max is a multi-function marine survey software package. *Hypack Max* is used for vessel navigation during sidescan and multibeam acquisition, and acquisition of vertical-beam echosounder data. Survey lines, vessel position with respect to lines, and various navigation parameters are displayed on a screen both at the acquisition station and on a repeater screen for the helmsman. During side scan SONAR operations, *Hypack* collects cable out data and computes towfish position, which, along with raw water depth from the VBES, is also passed to *ISIS.*

A.5.1.2 ISIS

Triton Imaging *Isis* is an acquisition software package providing imagery displays, area coverage displays, and real-time ping strength displays. *Isis* is used for both acquisition of side-scan SONAR imagery and MBES bathymetry on *Rude*. Data is logged in .XTF (eXtended Triton Format) file format.

Isis aboard *Rude* is equipped with Precise Timing, a multibeam sonar data acquisition configuration intended to improve the timing of sonar, attitude, and positiong data. A time stamp is applied at the point of acquisition and retained through the .XTF data. This time stamp is honored by *CARIS HIPS* during post-processing. A detailed description of Precise Timing, its effect on survey data, and calibration of a Precise Timing-equipped multibeam echosounder system can be found in the document "Upgrading NOAA Multibeam Acquisition Systems to Precise Timing," dated 10 May 2004, by LT Ben Evans.

A.5.2 Bathymetric Data Processing

A.5.2.1 CARIS HIPS and SIPS

CARIS HIPS and *SIPS* software is used to process all bathymetry and imagery data.

A.5.2.1 *CARIS HIPS* (Hydrographic Information Processing System) is used for all processing of multibeam and vertical beam echosounder bathymetry data, including tide, sound velocity, and vessel offset correction and data cleaning. CARIS *HIPS* 6.1 uses statistical modeling to create uncertainty-weighted grid surfaces (BASE surfaces) to assist the hydrographer in data cleaning and hydrographic product generation.

A.5.2.1.2 *CARIS SIPS* (Side-scan Information Processing System) version 6.1 is used for all processing of side-scan sonar imagery data, including cable layback correction, slant range correction, contact selection, and mosaic generation. Version 6.1 is also used for side scan SONAR lines.

A.5.2.2 Pydro

HSTP *Pydro* is a proprietary program for the classification of side-scan sonar and multibeam bathymetry contacts, report generation, chart comparison, and S-57 attribution.

A.5.2.3 Velociwin

HSTP *Velociwin* is a proprietary program for the processing of sound velocity casts. This program uses Sea-Bird Electronics *SeaSoft* software to convert hexadecimal SeaCat data into ASCII conductivity-temperature-depth data, and then converts the ASCII data into a

depth-binned sound velocity file. These sound velocity files are applied to the data in CARIS *HIPS*.

A.5.2.4 MapInfo Professional

MapInfo Professional is the Geographic Information System (GIS) software package used aboard *Rude*. *MapInfo* is used for final data analysis and creating end-user plots.

Refer to the *Rude* HSRR Appendix to this document for a list of data acquisition and processing hardware serial numbers and software versions.

B. QUALITY CONTROL

B.1 Bathymetry Data

B.1.1 Vertical beam Echosounder Data

When VBES soundings are the primary source of bathymetry, survey lines are converted from *Hypack* format to *CARIS* HDCS format using the *CARIS* Conversion Wizard (See Conversion Parameters Appendix II).

After conversion, the data is opened in *CARIS* Navigation Editor, Attitude Editor, and Single Beam Editor. Vessel navigation data is manually checked for speed jumps greater than 2 knots, which are rejected with interpolation. Attitude data (if present) are checked for errors or gaps. Following examination, water level correction, draft correction, and sound velocity correction are performed. The raw multibeam data is then merged with the vessel attitude and navigation data.

Survey personnel scan merged VBES soundings in CARIS Single Beam Editor. The digital data are compared with analog paper records to ensure that no valid depths are missed by the bottom detection algorithm or irregular pings are accepted. Low frequency soundings found to be shoaler than the corresponding high frequency depths can be manually "selected." Depth filters are applied as needed to reject both shoal and deep fliers. A crossline-to-mainscheme comparison is performed to ensure accuracy of the sounding data. Following crossline comparison, the VBES data are used to generate a shoal-biased binned depth grid using a resolution of 25 meters or coarser. This depth grid is used for quality control, assessment of data coverage and general bathymetric evaluation.

When VBES soundings are not the primary source of bathymetry, VBES survey lines are archived in raw *Hypack* format. These data should not be used for the creation of any data product.

B.1.2 Multibeam Echosounder Data

Multibeam sonar data is converted from *ISIS* XTF format to *CARIS* HDCS format using the *CARIS* Conversion Wizard (See Conversion Parameters Appendix II). After conversion, multibeam lines are examined in *CARIS* Navigation Editor and Attitude Editor for errors. Obvious blunders in the navigation or vessel attitude data ("fliers") are rejected by the hydrographer. Following examination, water level correction, draft correction, and sound velocity correction are performed. The raw multibeam data is then merged with the vessel attitude and navigation data. This processed data are analyzed by the hydrographer and used to generate hydrographic data products. Refer to the 2007 Field Procedures Manual (FPM) for a detailed description of hydrographic data products, including but not limited to BASE Surfaces, designated soundings, and CUBE surfaces, described in this section of this report.

When multibeam echosounder soundings are used for developments only and are not the primary source of bathymetry, the processed MBES lines are examined in *CARIS* Swath Editor and *CARIS* Subset Editor. Obvious blunders and fliers are rejected. Designated soundings are selected by the hydrographer for insertion into *Pydro*. These survey lines are added to a high-resolution, small-area BASE Surface to be submitted in addition to the shoal-biased binned VBES dataset.

When multibeam echosounder soundings are the primary source of bathymetry, Total Propagated Error (TPE) is computed for each data point prior to further processing. After computation of TPE, MBES lines are used to create a collection of BASE surfaces at resolutions appropriate to the depth of the survey. Under typical conditions, this resolution will be between 2 and 5 meters. At the discretion of the hydrographer, individual BASE Surfaces may or may not include child layers generated by the CUBE algorithm. Targeted data cleaning with filters, Swath Editor, and Subset Editor is performed using the Depth, Standard Deviation, Shoal, and CUBE child layers. Systematic biases in the surface are identified and alleviated if possible. Designated soundings are chosen to highlight significant features and to modify the surface model such that the best possible representation of the seafloor is achieved.

Each BASE Surface is then finalized and designated soundings are applied. The finalized BASE Surfaces are then combined to form a single-resolution BASE Surface over the entire survey area.

B.2 Side Scan SONAR Imagery

All side scan SONAR imagery is converted from XTF formats to *CARIS* format using *CARIS* converters (See conversion parameters Appendix II).

After conversion, the data are opened in *CARIS* Navigation Editor, Attitude Editor, and Side Scan Editor. Survey personnel check vessel attitude (if present), cable out, Gyro, and SONAR towfish height. Vessel navigation data is manually checked for speed jumps greater than 2 kts. Data showing these speed jumps are rejected with interpolation.

After confirming the validity of the vessel navigation, cable out, and towfish depth values, survey personnel then use the “recompute towfish navigation” function to calculate the towfish position. The *CARIS* towfish positioning is based on a smoothed course made good value from the towing vessel.

Side scan SONAR data is scanned in *CARIS* Side Scan Editor. Survey personnel correct errors in bottom tracking, slant range correct the imagery at default resolution (0.1m), and scan the data for significant contacts. Contacts deemed “significant” include, but are not limited to, contacts with a shadow indicating a contact height of 1 m or greater in water depths of 20m or less, or contact heights 10% of the water depth in water deeper than 20m. Other contacts considered significant by *Rude* personnel include smaller contacts, in particularly shoal areas or channels, cables and pipelines, large sand wave ridges, and contacts of possible historical significance.

Point feature contacts are picked using *CARIS* "single point contacts." Larger contacts and line features are picked using *CARIS* "multipoint contacts." All contacts are descriptively labeled and feature codes selected if conclusive identification is possible. TIF format images of all contacts are saved. After the initial SSS imagery scan, a check scan of all data is conducted.

Survey personnel assess SSS coverage by using *CARIS* to mosaic side scan data. These mosaics are drawn at 1 - 5m resolution, using the "autoseam" option.

B.3 Data Analysis

HSTP Pydro software package is the primary tool for sounding and feature integration and assessment. Side scan contacts and detached positions are inserted into the *Pydro* Preliminary Smooth Sheet (PSS). VBES bathymetry is inserted into *Pydro* in line-by-line format at a 15m by 15m bin, with default sounding excessing at 15m at 1:1000 scale. MBES bathymetry is imported into *Pydro* as either as shoal-biased binned lines or as a combined finalized BASE surface.

Pydro provides five flags for categorizing features: "Significant", "Chart", "Report", "Investigate", and "DTON". In addition, *Pydro* provides "Primary" and "Secondary" flags for grouping correlated features.

After insertion, SSS features are first categorized by significance. Contacts that meet the standard of significance described in section B.2. are marked as such; those contacts which are deemed insignificant are marked "Resolved" and not investigated further. Also, multiple contacts representing the same physical feature are grouped. The contact that the hydrographer believes best represents the feature (typically, the most clear SSS image) is selected as the "Primary" contact, while the rest are flagged as "Secondary."

Significant contacts are then reassessed to determine if additional investigation (typically MBES development) is required. Using the "bathymetry grid" feature of *Pydro,* the hydrographer checks the bathymetry coverage of the contact in question. If additional bathymetry is required, the "investigate" flag is checked. This can then be queried in *MapInfo* to select only those contacts requiring development for line planning.

After contacts are sufficiently investigated, they are further assessed to determine whether they require charting. Features that the hydrographer believes should be added or retained on the chart are marked as such. Features that will be reported in the survey Descriptive Report are flagged "Report." Features that pose a special threat to vessel traffic have their shoal soundings marked as "DTONS," and a Danger to Navigation Report is generated. Refer to the 2007 Field Procedures Manual (FPM) for a detailed description of each *Pydro* classification and the criteria used to meet that classification.

Contacts and bathymetry analyzed in *Pydro* may be imported into *MapInfo* for plotting and further contact development planning. Contact and sounding plots are printed at survey scale for final survey assessment.

C. CORRECTIONS TO ECHO SOUNDINGS

It is OCS and *Rude* policy that all data be acquired and logged in raw format without application of any corrections for vessel offsets, sensor alignment, sound speed profile, or tides. These factors are logged separately or contained in the *CARIS* "Vessel Configuration File" (VCF), and applied in post-acquisition data processing.

C.1 Vessel Offsets and Static Draft

A table of vessel offsets and static draft measurements for *Rude* is contained in Appendix III.

Static transducer offsets are applied to all bathymetry data during the *CARIS* "SVP Correct" operation. Horizontal offsets are applied during *CARIS* Merge.

C.2 Dynamic Draft

Settlement and squat tables for *Rude* are contained in Appendix IV.

Dynamic Draft corrections are applied to all bathymetry data in the *CARIS* SVP Correct operation.

C.3 Attitude and Heave

Heave, pitch, and roll corrections are applied to MBES and VBES bathymetry data in the *CARIS* SVP Correct operation. Yaw corrections are applied during *CARIS* Merge.

C.4 Sound Speed Correction

Rude carries two Seabird SBE-19 Conductivity, Temperature, and Depth profilers. These instruments are returned to the manufacturer yearly for calibration. Records of the latest calibrations are included in Appendix IV. During MBES data acquisition, CTD casts are conducted when starting work in an area and every 4 hours thereafter, or when the surface sound speed is observed to have drifted outside accepted limits as discussed below. For VBES data, casts are conducted at least once a week or when survey personnel suspect a significant change in the properties of the water column.

Rude personnel conduct CTD data quality assessments prior to a new sheet survey project by comparing CTD readings at the surface with Digibar Pro or with a simultaneous cast from the second CTD, in accordance with the 2007 FPM. This information is processed using HSTP *Velociwin* "comparison cast" feature.

As described in Section A.4, A.5, and B.1, raw conductivity, temperature and depth data are processed to produce sound speed files in *CARIS* format. These profiles are applied in *CARIS* "SVP Correct".

C.5 Water Levels

Soundings are corrected to Mean Lower Low Water using first Preliminary Unverified tides. Verified tides are applied where available and according to the procedure described in Section B.1. All raw tide data is corrected according to the zoning provided with the relevant project instructions prior to application to bathymetry data.

During bathymetric data collection, subordinate gauges included in the project instructions are monitored via the CO-OPS web site, "Tidebot" email, and the CORMS Morning Report. When water level measurement problems are suspected, *Rude* personnel bring them to the attention of CO-OPS staff before continuing bathymetric data acquisition.

Water level corrections are applied during *CARIS* Merge.

D. APPROVAL SHEET

LETTER OF APPROVAL

Data acquisition and processing is conducted under my direct supervision with frequent personal checks of progress and adequacy. All equipment is continuously monitored for proper operation during data acquisition and all supplemental and supporting records are reviewed in their entirety.

This Data Acquisition and Processing Report is adequate to accompany Descriptive Reports for surveys including data collected during NOAA Ship *Rude*'s 2007 Field Season.

Respectfully Submitted:

Shawn Maddock
LT, NOAA
Field Operations Officer
NOAA Ship *Rude*

Approved:

Lawrence T. Krepp
I am approving this document
2007.06.04 09:47:04 -04'00'

Lawrence T. Krepp
LCDR, NOAA
Commanding Officer
NOAA Ship *Rude*

APPENDIX I

Data Acquisition Equipment Summary Table

Data Acquisition and Processing Software Summary Table

Summary Table of Data Acquisition Equipment

Equipment Description	Serial Number	Dates Used
RUDE		
RESON SeaBat 8125 SWMB	31562	all
RESON SeaBat 8125 SWMB SONAR head	4400007	all
Odom Echotrac Mk II VBES	9643	all
KLEIN 5500 Towfish	280	all
KLEIN TPU Series 5105	138	all
POS/MV 320	2320	all
Inertial Measurement Unit (IMU)	352	all
Trimble DSM-212L DGPS Receiver	0220227632	all
Furuno GP-90 GPS Navigator Receiver	4400-2299	all
Seabird Seacat SBE-19 CTD	284	all
Seabird Seacat SBE-19 CTD	1060	all
Odom Digibar Pro SV Sensor	98013	all

Summary Table of Data Acquisition and Processing Software

Software Description	Version	Dates Used
RUDE		
Coastal Oceanographics Hypack Max	2.12	All
Triton Elics International ISIS	6.6.136.0	all
Trimble TSIP Talker	2.00	all
HSTP HP Tools	11.5.1	all
HSTP Velociwin	8.85	all
CARIS HIPS and SIPS	6.0	01 Mar – 24 Apr
CARIS HIPS and SIPS	6.1	24 Apr - present
CARIS GIS	4.4a	all
HSTP Pydro	7.3	all
Mapinfo Professional	8.5	all
Vertical Mapper	2.5	all

APPENDIX II: Data Acquisition and Processing Flow Diagrams

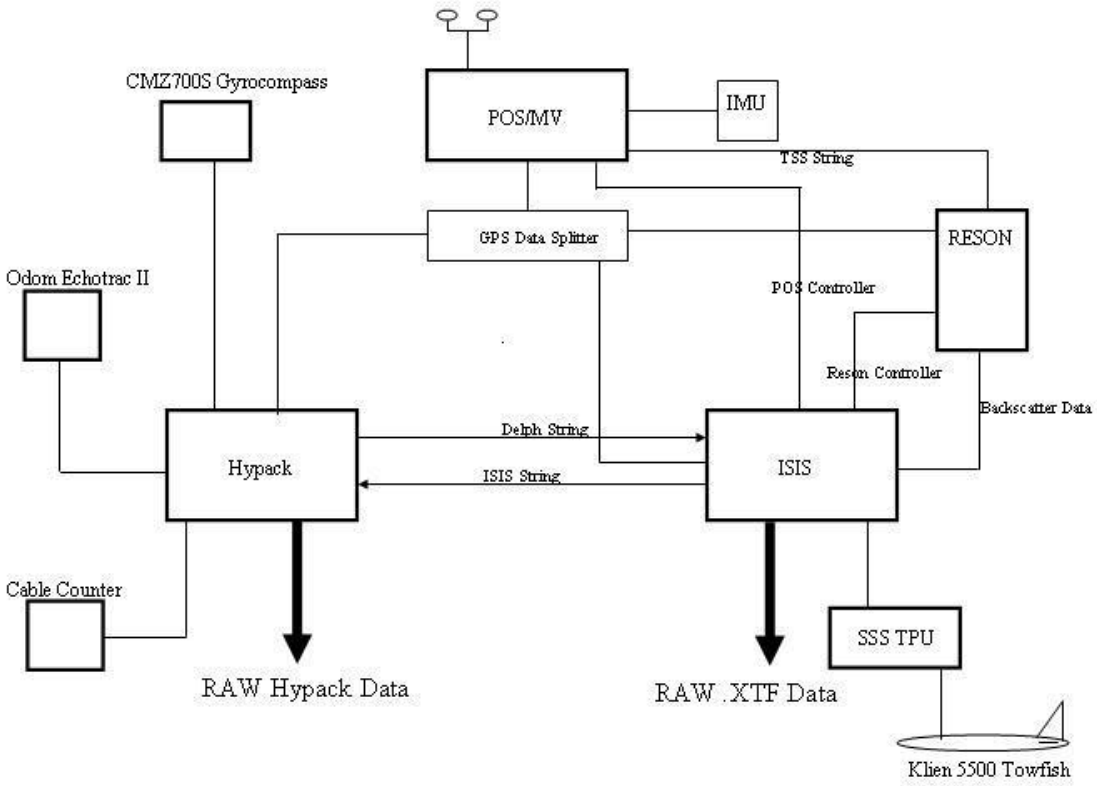
Rude Data Acquisition Setup

CARIS Data Processing Diagram

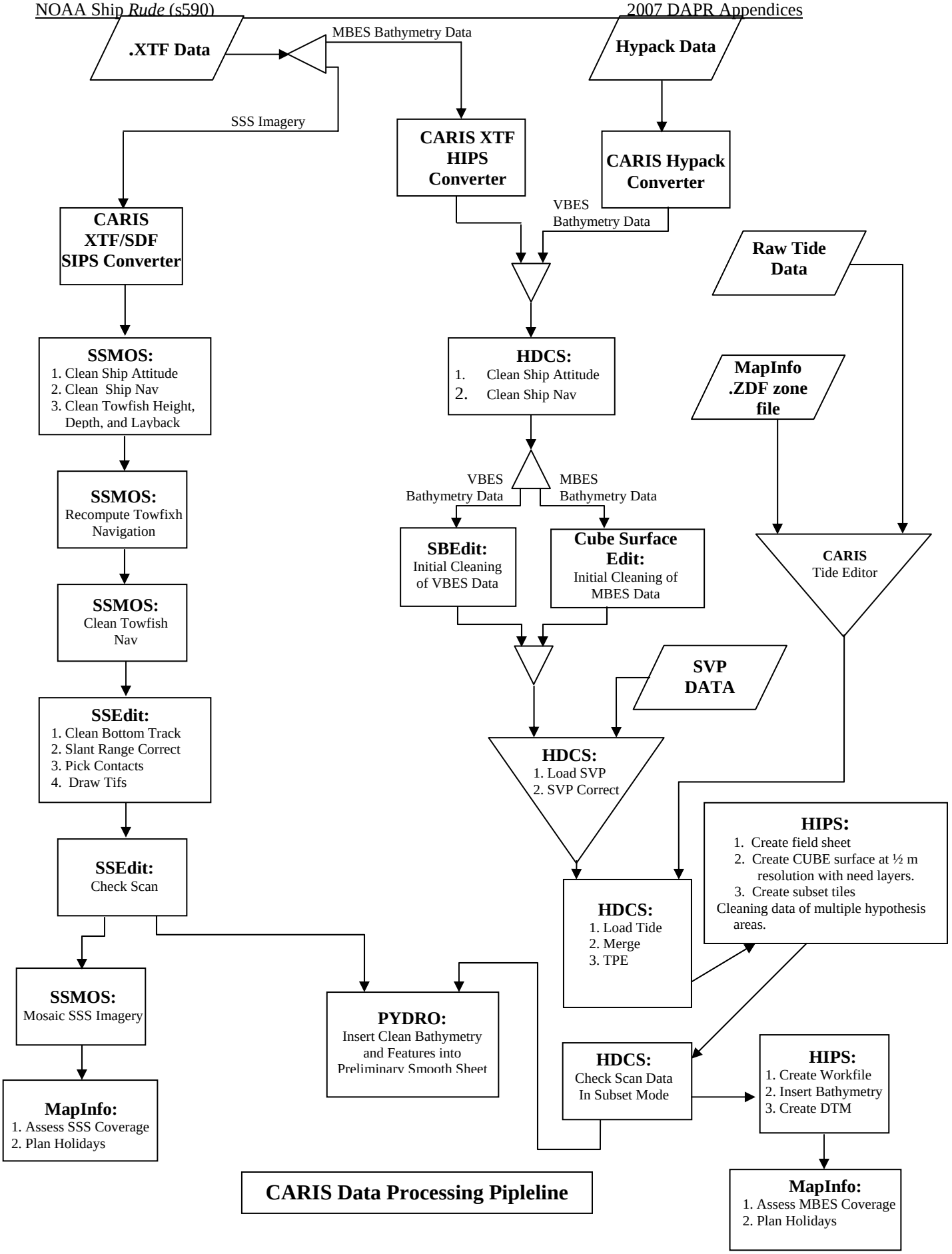
Pydro Data Processing Diagram

Data Conversion Parameters

RUDE 2007 Data Acquisition Setup

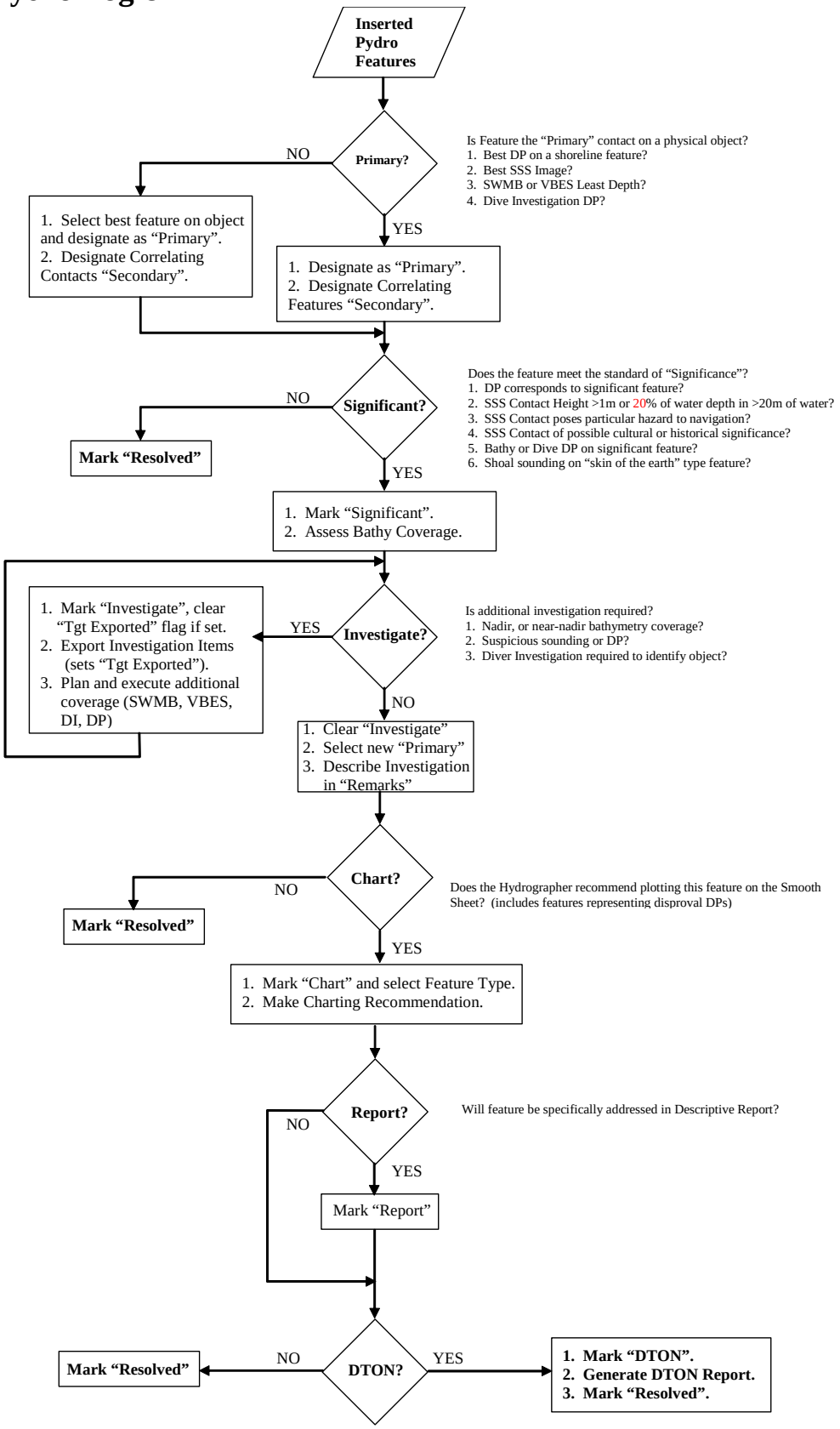


Rude 2007 Data Acquisition



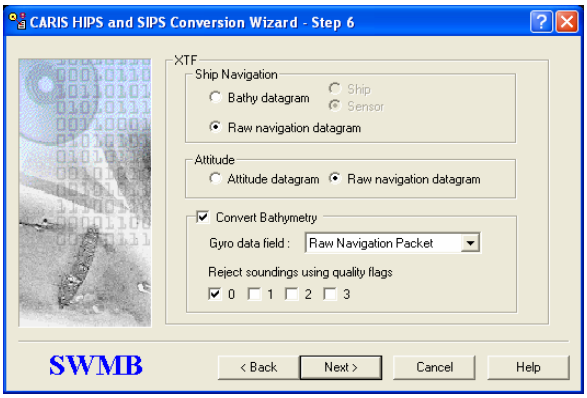
CARIS Data Processing Pipleline

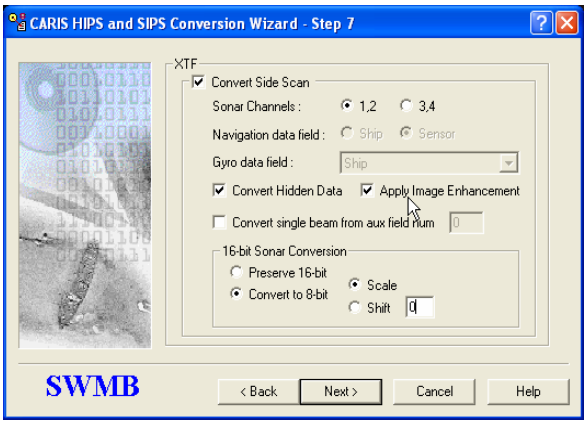
Pydro Logic

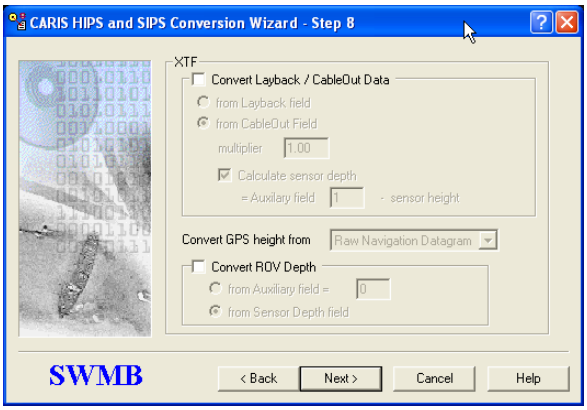

Inserted Pydro Features
Primary?
NO
YES
Is Feature the "Primary" contact on a physical object?
1. Best DP on a shoreline feature?
2. Best SSS Image?
3. SWMB or VBES Least Depth?
4. Dive Investigation DP?
1. Select best feature on object and designate as "Primary".
2. Designate Correlating Contacts "Secondary".
1. Designate as "Primary".
2. Designate Correlating Features "Secondary".
Significant?
NO
YES
Does the feature meet the standard of "Significance"?
1. DP corresponds to significant feature?
2. SSS Contact Height >1m or 20% of water depth in >20m of water?
3. SSS Contact poses particular hazard to navigation?
4. SSS Contact of possible cultural or historical significance?
5. Bathy or Dive DP on significant feature?
6. Shoal sounding on "skin of the earth" type feature?
Mark "Resolved"
1. Mark "Significant".
2. Assess Bathy Coverage.
Investigate?
YES
NO
Is additional investigation required?
1. Nadir, or near-nadir bathymetry coverage?
2. Suspicious sounding or DP?
3. Diver Investigation required to identify object?
1. Mark "Investigate", clear "Tgt Exported" flag if set.
2. Export Investigation Items (sets "Tgt Exported").
3. Plan and execute additional coverage (SWMB, VBES, DI, DP)
1. Clear "Investigate"
2. Select new "Primary"
3. Describe Investigation in "Remarks"
Chart?
NO
YES
Does the Hydrographer recommend plotting this feature on the Smooth Sheet? (includes features representing disproval DPs)
Mark "Resolved"
1. Mark "Chart" and select Feature Type.
2. Make Charting Recommendation.
Report?
NO
YES
Will feature be specifically addressed in Descriptive Report?
Mark "Report"
DTON?
NO
YES
Mark "Resolved"
1. Mark "DTON".
2. Generate DTON Report.
3. Mark "Resolved".

Conversion Parameters

The following three images are screen grabs from Caris conversion wizard for *Rude* SWMB conversion.

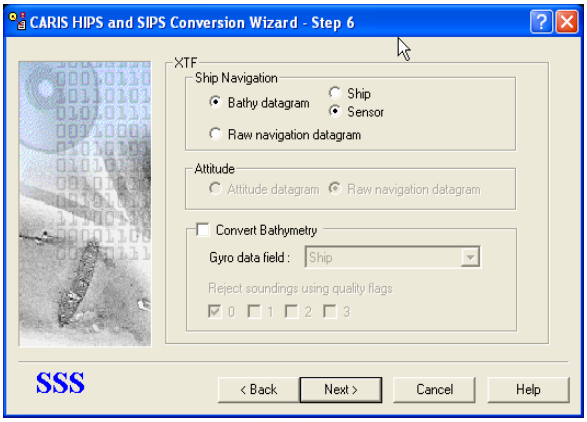


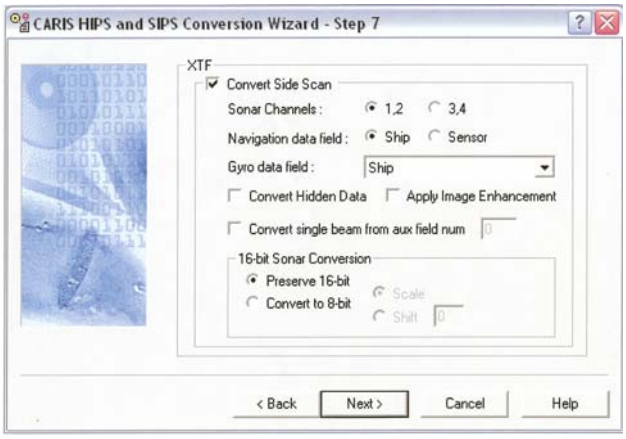


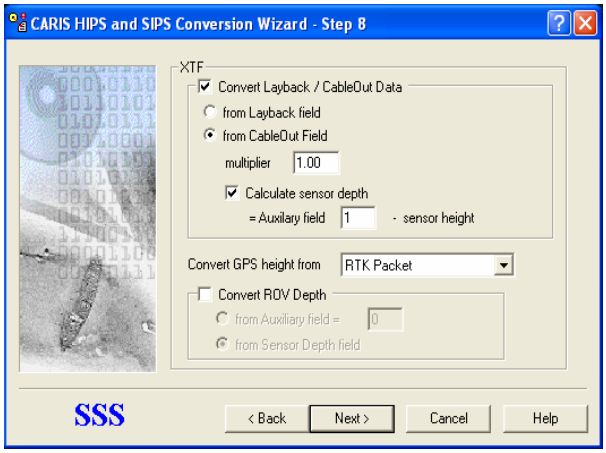


The following image is a screen grab from Caris conversion wizard for *Rude* VBES conversion.

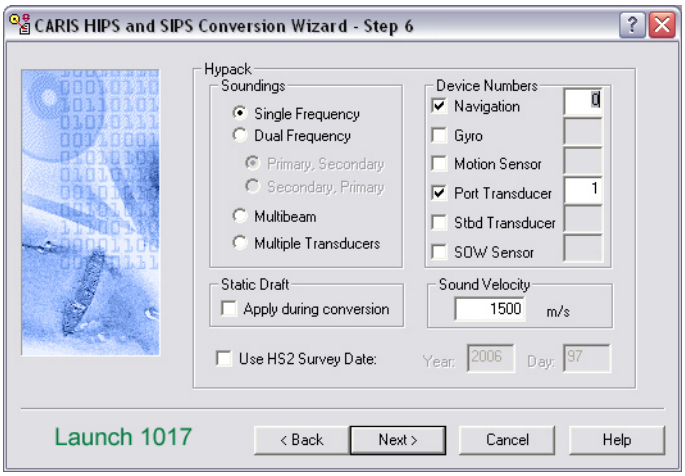
The following three images are screen grabs from Caris conversion wizard for *Rude* .XTF SSS conversion.

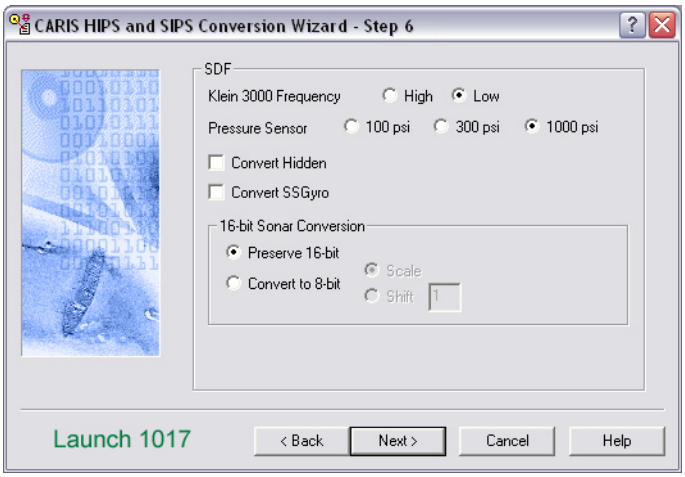






The following images are screen grabs from Caris conversion wizard for launch 1017 VBES and SSS conversions, respectively.





APPENDIX III

Rude Offset Measurements by NGS

Rude CARIS Vessel Configuration File Reports

POS/MV Configuration

RUDE Offsets

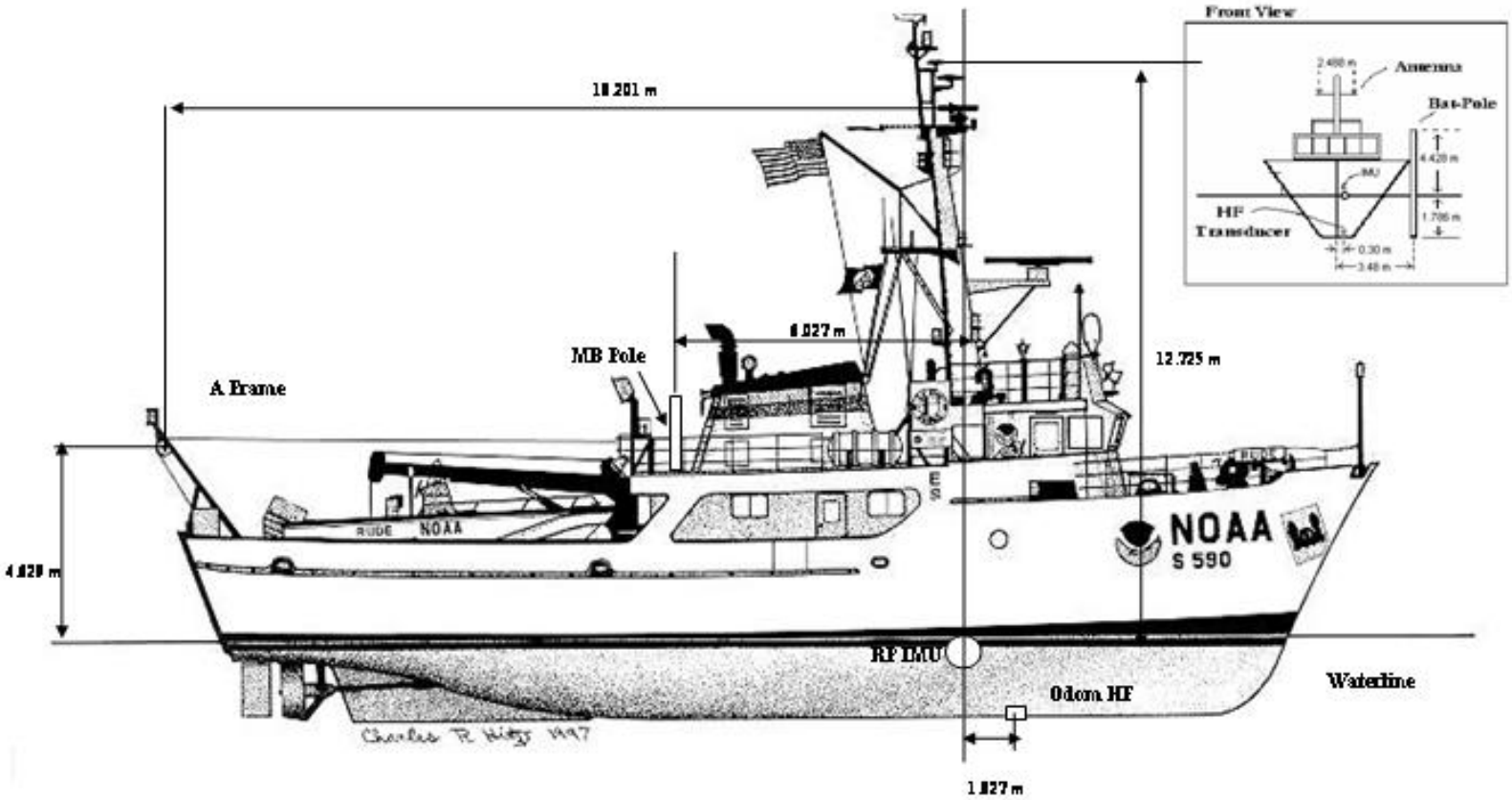
NOAA SHIP RUDE										
		Observed Position			Δ Reference Point BM4			Δ Reference Point IMU		
POINT	Name	e (m)	n (m)	u (m)	Δx (m)	Δy (m)	Δz (m)	Δx (m)	Δy (m)	Δz (m)
CL1	CENTERLINE POINT 1	100.000	100.000	100.000	3.499	0.412	5.799	3.268	0.259	5.249
CL2	CENTERLINE POINT 2	100.000	97.924	99.863	1.423	0.412	5.662	1.192	0.259	5.112
GPSS	IMU GPS ANTENNA STARBOARD	101.541	96.614	107.413	0.113	1.953	13.212	-0.118	1.800	12.662
GPSP	IMU GPS ANTENNA PORT	99.053	96.634	107.546	0.133	-0.535	13.345	-0.098	-0.688	12.795
FLGP	TOP OF FLAG POLE	100.065	106.220	100.832	9.719	0.477	6.631	9.488	0.324	6.081
BM1	BENCH MARK 1	100.347	82.773	96.221	-13.728	0.759	2.020	-13.959	0.606	1.470
MB1	MULTIBEAM REFERENCE POINT 1	96.174	87.242	96.875	-9.259	-3.414	2.674	-9.490	-3.567	2.124
MB2U	MULTIBEAM REFERENCE POINT 2 OUT H20	96.167	90.705	96.672	-5.796	-3.421	2.471	-6.027	-3.574	1.921
MB3U	MULTIBEAM REFERENCE POINT 3 OUT H2O	96.204	93.147	96.637	-3.354	-3.384	2.436	-3.585	-3.537	1.886
MB2D	MULTIBEAM REFERENCE POINT 2 IN H2O	96.168	90.650	96.735	-5.851	-3.420	2.534	-6.082	-3.573	1.984
MB3D	MULTIBEAM REFERENCE POINT 3 IN H2O	96.229	90.575	99.179	-5.926	-3.359	4.978	-6.157	-3.512	4.428
BM2	BENCH MARK 2	100.071	98.323	93.448	1.822	0.483	-0.753	1.591	0.330	-1.303
IMU	IMU	99.741	96.732	94.751	0.231	0.153	0.550	0.000	0.000	0.000
BM3	BENCH MARK 3	99.993	101.631	93.464	5.130	0.405	-0.737	4.899	0.252	-1.287
BM4	BENCH MARK 4	99.588	96.501	94.201	0.000	0.000	0.000	-0.231	-0.153	-0.550
AFRM	SIDE SCAN REFERENCE POINT 1	99.807	78.531	99.380	-17.970	0.219	5.179	-18.201	0.066	4.629
WTRL	WATERLINE REFERENCE POINT	96.710	95.816	95.111	-0.685	-2.878	0.910	-0.916	-3.031	0.360
SB1	SINGLE BEAM REFERENCE POINT 1	99.263	98.559	92.937	2.058	-0.325	-1.264	1.827	-0.478	-1.814

UNITS = METERS

Inversed length of Multibeam Sensor Arm 5.910 FROM MB1 TO MB3U **RHR**
Inversed length of the IMU GPS antenna seperation 2.492

		Observed Position			Δ Reference Point BM4			Δ Reference Point IMU		
POINT	Name	e (m)	n (m)	u (m)	Δy (m)	Δx (m)	Δz (m)	Δx (m)	Δy (m)	Δz (m)
CL1	CENTERLINE POINT 1	100.000	100.000	100.000	3.499	0.412	5.799	3.268	0.259	5.249
CL2	CENTERLINE POINT 2	100.000	97.924	99.863	1.423	0.412	5.662	1.192	0.259	5.112
GPSS	IMU GPS ANTENNA STARBOARD	101.541	96.614	107.413	0.113	1.953	13.212	-0.118	1.800	12.662
GPSP	IMU GPS ANTENNA PORT	99.053	96.634	107.546	0.133	-0.535	13.345	-0.098	-0.688	12.795
FLGP	TOP OF FLAG POLE	100.065	106.220	100.832	9.719	0.477	6.631	9.488	0.324	6.081
BM1	BENCH MARK 1	100.347	82.773	96.221	-13.728	0.759	2.020	-13.959	0.606	1.470
MB1	MULTIBEAM REFERENCE POINT 3	96.174	87.242	96.875	-9.259	-3.414	2.674	-9.490	-3.567	2.124
MB2U	MULTIBEAM REFERENCE POINT 2 OUT H20	96.167	90.705	96.672	-5.796	-3.421	2.471	-6.027	-3.574	1.921
MB3U	MULTIBEAM REFERENCE POINT 1 OUT H2O	96.204	93.147	96.637	-3.354	-3.384	2.436	-3.585	-3.537	1.886
MB2D	MULTIBEAM REFERENCE POINT 2 IN H2O	96.168	90.650	96.735	-5.851	-3.420	2.534	-6.082	-3.573	1.984
MB3D	MULTIBEAM REFERENCE POINT 1 IN H2O	96.229	90.575	99.179	-5.926	-3.359	4.978	-6.157	-3.512	4.428
BM2	BENCH MARK 2	100.071	98.323	93.448	1.822	0.483	-0.753	1.591	0.330	-1.303
IMU	IMU	99.741	96.732	94.751	0.231	0.153	0.550	0.000	0.000	0.000
BM3	BENCH MARK 3	99.993	101.631	93.464	5.130	0.405	-0.737	4.899	0.252	-1.287
BM4	BENCH MARK 4	99.588	96.501	94.201	0.000	0.000	0.000	-0.231	-0.153	-0.550
AFRM	SIDE SCAN REFERENCE POINT 1	99.807	78.531	99.380	-17.970	0.219	5.179	-18.201	0.066	4.629
WTRL	WATERLINE REFERENCE POINT	96.710	95.816	95.111	-0.685	-2.878	0.910	-0.916	-3.031	0.360
SB1	SINGLE BEAM REFERENCE POINT 1	99.263	98.559	92.937	2.058	-0.325	-1.264	1.827	-0.478	-1.814

		Δy (m)	Δx (m)	Δz (m)		
SB1	**SINGLE BEAM -> RP**	2.058	-0.104	-1.264		
GPSS	**IMU GPS ANTENNA STARBOARD**	0.113	1.953	13.282		
GPSP	**IMU GPS ANTENNA PORT**	0.133	-0.535	13.415		
IMU	**IMU**	0.231	0.153	0.55		
MB1	**MULTIBEAM RP 3 OUT H20 to Transducer**	-9.443	-3.414	2.674		
	MULTIBEAM RP 3 OUT H20 to acoustic center		-3.414	2.674		
SVP						
	BOW to RP BM4	10.1259127			8.684508	0.220586
	STBD side to RP BM4		4.25			-0.104
	WL to RP BM4			0.8369		


Front View
Antenna
Bat-Pole
HF
Transducer
18.201 m
8.027 m
MB Pole
A Frame
12.725 m
4.429 m
RUDE NOAA
NOAA
S 590
RP IMU
Odom HF
Waterline
Charles R Hitzs 1997
1.827 m

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

NOAA SHIP RUDE
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY
FIELD REPORT

Kendall L. Fancher
March 17, 2005

NOAA SHIP RUDE
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

PURPOSE

The primary purpose of the survey was to accurately determine the spatial relationship of various components of a POS MV navigation system aboard the NOAA ship Rude. Reference points were also established to determine the spatial location of a single beam sensor, a multibeam sensor, and a side scan sonar. Additionally, various reference points (bench marks) were established onboard the vessel to aid in future spatial surveys aboard the boat.

PROJECT DETAILS

This survey was conducted while the ship was docked at the Atlantic Marine Center in Norfolk, Virginia on the 9th of March, 2005. The weather was cool with a stiff breeze.

INSTRUMENTATION

The Leica (Wild) TC2002 precision total station was used to make all measurements.

Technical Data:

Angle Measurement

Smallest unit in display	0.1 seconds

Standard Deviation

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

A standard “peanut” prism was used as a sighting target. This prism was configured to have a zero mm offset.

PERSONNEL

Kendall Fancher	NOAA/NOS/NGS/GSD/I&M BRANCH (540) 373-1243
Steve Breidenbach	NOAA/NOS/NGS/GSD/I&M BRANCH (540) 373-1243
Robbie Merlini	NOAA/NOS/NGS/O&D/FIELD OPERATIONS BRANCH (757) 441-6265

NOAA SHIP RUDE
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

ESTABLISHING THE REFERENCE FRAME

A beginning reference point, CL1, was set on the centerline of the ship and near the physical center of the ship atop the wheel house. CL1 was set in line with two existing centerline marks (CL2-on top of the wheel house and near the mast - and a target located at the base of a flag pole near the bow of the ship). To conduct this survey a local coordinate reference frame was established where the X axis runs along the centerline of the boat and is positive from CL1 towards the bow of the boat. The Y axis is perpendicular to the centerline of the boat (X axis) and is positive from CL1 towards the right, when looking at the boat from the stern. The Z axis is positive in an upward direction from CL1. In this reference frame the IMU has the following coordinates;
X = 100.000(m)
Y = 100.000(m)
Z = 100.000(m)

A secondary reference point (CL2) had already been established on the centerline of the ship, near the mast. The Y value of CL2 was assumed to be 100.000. Determination of the X value for CL2 was accomplished by measuring the horizontal distance from CL1. Determination of the Z value for CL2 was accomplished by trigonometric leveling from CL1. The determined coordinates for CL2 are;
X = 97.924(m)
Y =100.000(m)
Z = 99.863(m)

ESTABLISHING ALL OTHER POINTS

While occupying CL1, a bearing of 180.0000 was input into the instrument and CL2 was use for initialization. After initialization was conducted, angular and distance measurements were taken to establish CL3. CL3 is a temporary point set near the bow of the boat. The established coordinates for CL3 were then stored internally in the instrument.

While occupying CL3, the previously determined bearing to CL1 was recalled and initialization was conducted to CL1. After initialization was conducted, angular and distance measurements were taken to establish the following points; GPSS, GPSP, BM3, TOP REF, TP1. During these observations, coordinate checks were made to the following previously established points;
CL1
X = 0.000(m)
Y = 0.000(m)
Z = 0.000(m)

NOAA SHIP RUDE
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

CL1 was reoccupied. While occupying CL1, a bearing of 180.0000 was input into the instrument and CL2 was use for initialization. After initialization was conducted, angular and distance measurements were taken to establish the following points; FLGP, TP3, and TP2. The established coordinates for TP3 were then stored internally in the instrument. During these observations, coordinate checks were made to the following previously determined points;
CL3
X = 0.000(m)
Y = -0.002(m)
Z = -0.003(m)

While occupying TP03, the previously determined bearing to CL1 was recalled and initialization was conducted to CL1. After initialization was conducted, angular and distance measurements were taken to establish the following points; BM1, MB1, MB2D, MB3D, MB2U, MB3U, AFRM, and DOORWAY. The established coordinates for DOORWAY were then stored internally in the instrument. During these observations, coordinate checks were made to the following previously determined points;
TP1
X = -0.002(m)
Y = -0.026(m)
Z = 0.002(m)

TP2
X = 0.010(m)
Y = 0.008(m)
Z = -0.042 (m)

GPSS
X = -0.006(m)
Y = 0.044(m)
Z = -0.028(m)

GPSP
X = 0.002(m)
Y = 0.067(m)
Z = -0 .011(m)

While occupying DOORWAY, the previously determined bearing to TP3 was recalled and initialization was conducted to TP3. After initialization was conducted, angular and distance measurements were taken to establish TP4. The established coordinates for TP4 were then stored internally in the instrument. During these observations, coordinate checks were made to the following previously determined point;

NOAA SHIP RUDE
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

TP1
X = 0.000(m)
Y = -0.024(m)
Z = 0.006(m)

While occupying TP4, the previously determined bearing to DOORWAY was recalled and initialization was conducted to DOORWAY. After initialization was conducted, angular and distance measurements were taken to establish TP5. The established coordinates for TP5 were then stored internally in the instrument. During these observations, coordinate checks were made to the following previously determined point;
TOP REF
X = 0.012(m)
Y = -0.035(m)
Z = 0.000(m)

While occupying TP5, the previously determined bearing to TP4 was recalled and initialization was conducted to TP4. After initialization was conducted, angular and distance measurements were taken to establish TP6. The established coordinates for TP6 were then stored internally in the instrument. During these observations, coordinate checks were made to the following previously determined point;
TOP REF
X = 0.012(m)
Y = -0.035(m)
Z = 0.000(m)

While occupying TP6 the previously determined bearing to TP5was recalled and initialization was conducted to TP5 After initialization was conducted, angular and distance measurements were taken to establish the following points; IMU, WTRL, BM4 and BM2 The established coordinates for BM2 were then stored internally in the instrument. During these observations no coordinate checks were made to previously determined points.

While occupying BM2, the previously determined bearing to TP6 was recalled and initialization was conducted to TP6. After initialization was conducted, angular and distance measurements were taken to establish TP7. The established coordinates for TP7 were then stored internally in the instrument. During these observations, coordinate checks were made to the following previously determined point;
BM3
X = 0.017(m)
Y = -0.042(m)
Z = 0.004(m)

NOAA SHIP RUDE
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

While occupying TP7, the previously determined bearing to BM2 was recalled and initialization was conducted to BM2. After initialization was conducted, angular and distance measurements were taken to establish SB1. During these observations, coordinate checks were made to the following previously determined point;
BM2
X = 0.000(m)
Y = -0.001(m)
Z = -0.007(m)

DISCUSSION

All sensor/benchmark coordinates are contained in spreadsheet "rude.xls.

I recommend conducting the survey again, once the ship is put into dry dock. Conducting a survey such as this while the boat is in the water requires that the automatic compensators in the survey instrument be turned off. The survey is therefore conducted with all survey instrumentation set up relative to the mean movement of the related level vials. While every effort was made to make the most precise measurements possible, some additional error accumulation cannot be avoided under these type observing conditions. To further complicate the matter, the RUDE has a noticeable list. The windy weather encountered during data collection probably enhanced this list.

The positions given for either GPS antenna are to the center of a bolt, located directly below the center of the antennas. A measured distance of 6 cm was taken from the bottom of the bolt to the bottom of the ground plane for either antenna.. To correct the Z value contained in the spreadsheet for each antenna to the electronic phase center, I recommend the following steps be taken;

1) Investigate to find the electronic phase center offset for the antenna model. Be sure to get the phase center offset value for the antenna with the ground plane. This information is probably located on the antenna or with equipment documentation. This value may also be available at the NGS website for antenna modeling.
2) Add together the antenna phase center offset value plus the 6 cm offset value measured from the bottom of the bolt to the bottom of the ground plane.
3) Then add this total value to the Z value for either antenna located in the spreadsheet "rude.xls".

PRIMARY CONTACTS

TODD HAUPT	COMMANDING OFFICER/ NOAA SHIP RUDE
RICHARD EDMUNDSON	FIELD OPS OFFICER/NOAA SHIP RUDE
SHAWN MADDOCK	EAST COAST FIELD SUPPORT LIAISON/ HYDROGRAPHIC SYSTEMS & TECH PROGRAMS

NOAA SHIP RUDE
POINT DESCRIPTION

CL1 - CENTERLINE POINT 1

CL1 IS THE CENTER OF A STAINLESS STEEL DISC WELDED ATOP THE WHEEL HOUSE AND NEAR THE FORE RAILING FOR THE WHEELHOUSE.

NOAA SHIP RUDE
POINT DESCRIPTION

CL2 - CENTERLINE POINT 2

CL2 IS A PUNCH MARK SET NEAR THE CENTER OF A DIMPLE ATOP THE WHEEL HOUSE, JUST FORWARD OF THE MAST.

GPSS- IMU GPS ANTENNA STARBOARD

GPSS IS THE CENTER OF A BOLT HEAD THAT IS SECURING THE STARBOARD GPS ANTENNA TO A SUPPORT ARM. THIS BOLT HEAD IS BELOW THE LEVEL OF THE SUPPORT ARM AND IS IN LINE WITH THE CENTER OF THE ANTENNA.

GPSS- IMU GPS ANTENNA PORT

GPSS IS THE CENTER OF A BOLT HEAD THAT IS SECURING THE PORT SIDE GPS ANTENNA TO A SUPPORT ARM. THIS BOLT HEAD IS BELOW THE LEVEL OF THE SUPPORT ARM AND IS IN LINE WITH THE CENTER OF THE ANTENNA.

FLGP-TOP OF FLAG POLE

FLGP IS THE CENTER OF THE VERY TOP OF A METAL ROD, ATOP A FLAG POLE LOCATED AT THE BOW OF THE SHIP.

NOAA SHIP RUDE
POINT DESCRIPTION

BM1 - BENCH MARK 1

BENCH MARK 1 IS A PUNCH MARK, STAMPED “BM1”, SET IN THE TOP OF A SQUARE METAL PROTRUSION FROM THE MAIN DECK LOCATED NEAR THE CENTER AND REAR OF THE SHIP.

BM2 - BENCH MARK 2

BENCH MARK 2 IS A PUNCH MARK, STAMPED “BM2”, SET IN THE BOTTOM DECK LOCATED NEAR THE SINGLE BEAM SENSOR.

NOAA SHIP RUDE
POINT DESCRIPTION

BM3 - BENCH MARK 3

BENCH MARK 3 IS A PUNCH MARK, STAMPED “BM3”, SET IN THE BOTTOM DECK IN THE FORWARD MOST COMPARTMENT, DIRECTLY BELOW AN OVERHEAD HATCH.

BM4 - BENCH MARK 4

BENCH MARK 4 IS A PUNCH MARK, STAMPED “BM4”, SET IN THE TOP OF A CIRCULAR METAL PLATE NEAR THE IMU.

MB1U -MULTIBEAM REFERENCE POINT 1 (SUPPORT ARM OUT OF THE WATER)

MB1D -MUNLTIBEAM REFERENCE POINT 1(SUPPORT ARM IN THE WATER)

MB1 IS A PUNCH MARK, STAMPED “MB1”, LOCATED NEAR THE TOP END OF THE MULTIBEAM SENSOR SUPPORT ARM.

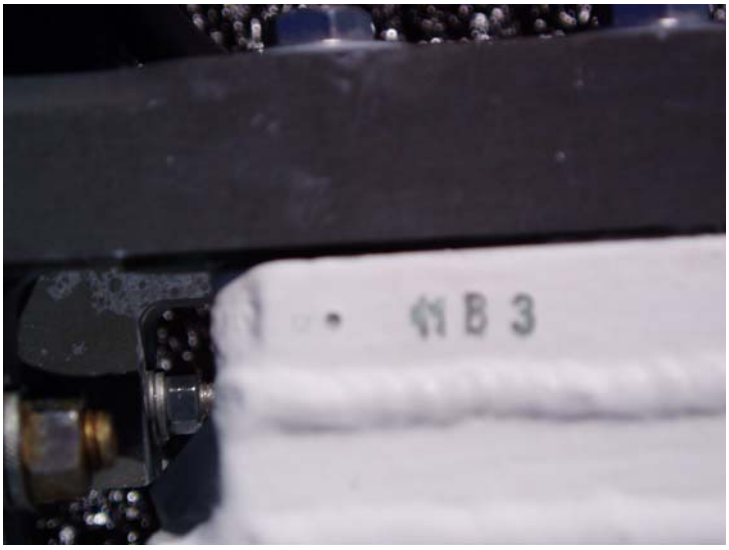
MB2U -MULTIBEAM REFERENCE POINT 1 (SUPPORT ARM OUT OF THE WATER)

MB2D -MUNLTIBEAM REFERENCE POINT 1(SUPPORT ARM IN THE WATER)

MB2 IS A PUNCH MARK, STAMPED “MB2”, LOCATED NEAR THE CENTER OF ROTATION OF THE MULTIBEAM SENSOR SUPPORT ARM.

MB3 -MULTIBEAM REFERENCE POINT

MB3 IS A PUNCH MARK, STAMPED “MB3”, LOCATED NEAR THE BOTTOM OF THE MULTIBEAM SENSOR SUPPORT ARM.



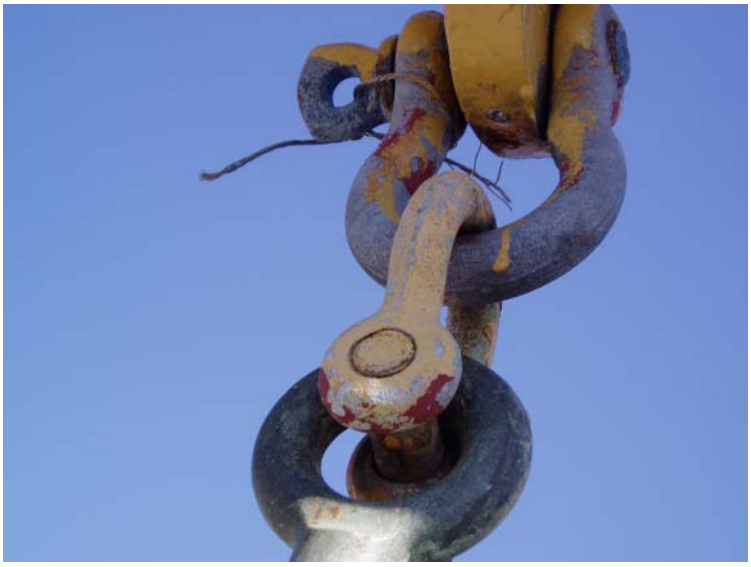
IMU

IMU IS THE CENTER OF AN EXISTING TARGET ATOP THE HOUSING FOR THE IMU.

NOAA SHIP RUDE
POINT DESCRIPTION

AFRM –SIDE SCAN REFERENCE POINT 1

AFRM IS A PUNCH MARK, NOT STAMPED, LOCATED DIRECTLY ABOVE THE CENTER OF ROTATION OF A PULLY USED IN DEPLOYING A SIDE SCAN SONAR SENSOR. THE PUNCH MARK IS SET IN THE BOTTOM OF A SUPPORT FLANGE LOCATED NEAR THE BOTTOM OF, THE TOP CENTER OF A METAL A-FRAME.



SB1 - SINGLE BEAM REFERENCE POINT 1

SB1 IS A PUNCH MARK, STAMPED “SB1”, LOCATED BELOW THE BOTTOM DECK NEAR THE SINGLE BEAM SENSOR.

WTRL –WATERLINE REFERENCE POINT

WTRL IS AN UNMARKED POINT IN A SEAM, AND DIRECTLY BELOW A RIVOT, NEAR THE CENTER OF A METAL PLATE. THIS METAL PLATE IS LOCATED IN THE GALLEY, ON THE PORT SIDE OF THE SHIP.

Rude Vessel Configuration Files

Rude Vessel Configuration files are submitted in both CARIS (.HVF) and plain text (.txt) digital format.

Vessel Name: RU_MB.hvf
Vessel created: The vessel file was not saved at the time this report was generated.

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2005-073 00:01

Transduer #1:

Pitch Offset: -6.200
Roll Offset: -1.970
Azimuth Offset: -3.850

DeltaX: -3.420
DeltaY: -5.851
DeltaZ: 1.451

Manufacturer: RESON
Model: sb8125
Serial Number: 31562

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2005-116 00:01

Transduer #1:

Pitch Offset: -0.600
Roll Offset: 1.155
Azimuth Offset: 2.600

DeltaX: -3.420
DeltaY: -5.851
DeltaZ: 1.451

Manufacturer: RESON
Model: sb8125
Serial Number: 31562

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2006-046 00:01

Transduer #1:

Pitch Offset: 1.000
Roll Offset: -1.780
Azimuth Offset: -1.700

DeltaX: -3.420
DeltaY: -5.851
DeltaZ: 1.236

Manufacturer: RESON
Model: sb8125
Serial Number: 31562

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2007-061 00:00

Transduer #1:

Pitch Offset: 0.950
Roll Offset: -1.700
Azimuth Offset: -1.700

DeltaX: -3.420
DeltaY: -5.851
DeltaZ: 1.236

Manufacturer: RESON
Model: sb8125
Serial Number: 31562

Navigation Sensor:

Time Stamp: 2005-073 00:01

Comments
Latency 0.550
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Novaltel
Model: POS/MV
Serial Number:

Time Stamp: 2005-116 00:01

Comments
Latency 0.100
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer:
Model:
Serial Number:

Time Stamp: 2006-046 00:01

Comments
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Novaltel
Model: POS/MV
Serial Number:

Time Stamp: 2007-061 00:00

Comments
Latency 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Novaltel
Model: POS/MV
Serial Number:

Gyro Sensor:

Time Stamp: 2005-073 00:01

Comments (null)
Latency 0.000

Time Stamp: 2005-116 00:01

Comments
Latency 0.100

Time Stamp: 2006-046 00:01

Comments
Latency 0.000

Time Stamp: 2007-061 00:00

Comments
Latency 0.000

Heave Sensor:

Time Stamp: 2005-073 00:01

Comments
Apply Yes
Latency 0.000
DeltaX: 0.153
DeltaY: 0.231
DeltaZ: -0.550

Manufacturer: TSS
Model: POS/MV
Serial Number:

Time Stamp: 2005-116 00:01

Comments
Apply Yes
Latency 0.100
DeltaX: 0.153
DeltaY: 0.231
DeltaZ: -0.550

Manufacturer:
Model:
Serial Number:

Time Stamp: 2006-046 00:01

Comments
Apply Yes
Latency 0.000
DeltaX: 0.153
DeltaY: 0.231
DeltaZ: -0.550

Manufacturer: TSS
Model: POS/MV
Serial Number:

Time Stamp: 2007-061 00:00

Comments
Apply Yes
Latency 0.000
DeltaX: 0.153
DeltaY: 0.231
DeltaZ: -0.550

Manufacturer:
Model:
Serial Number:

Pitch Sensor:

Time Stamp: 2005-073 00:01

Comments
Apply Yes
Latency 0.000
Pitch offset: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number:

Time Stamp: 2005-116 00:01

Comments
Apply Yes
Latency 0.100
Pitch offset: 0.000

Manufacturer:
Model:
Serial Number:

Time Stamp: 2006-046 00:01

Comments
Apply Yes
Latency 0.000
Pitch offset: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number:

Time Stamp: 2007-061 00:00

Comments
Apply Yes
Latency 0.000
Pitch offset: 0.000

Manufacturer:
Model:
Serial Number:

Roll Sensor:

Time Stamp: 2005-073 00:01

Comments
Apply Yes
Latency 0.000
Roll offset: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number:

Time Stamp: 2005-116 00:01

Comments
Apply Yes
Latency 0.100
Roll offset: 0.000

Manufacturer:
Model:
Serial Number:

Time Stamp: 2006-046 00:01

Comments
Apply Yes
Latency 0.000
Roll offset: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number:

Time Stamp: 2007-061 00:00

Comments
Apply Yes
Latency 0.000
Roll offset: 0.000

Manufacturer:

Model:
Serial Number:

Draft Sensor:

Time Stamp: 2005-073 00:01

Apply Yes
Comments
Entry 1) Draft: 0.002 Speed: 3.220
Entry 2) Draft: 0.022 Speed: 5.030
Entry 3) Draft: 0.098 Speed: 6.890
Entry 4) Draft: 0.170 Speed: 8.200
Entry 5) Draft: 0.212 Speed: 9.170
Entry 6) Draft: 0.307 Speed: 10.040

Time Stamp: 2006-046 00:01

Apply Yes
Comments
Entry 1) Draft: 0.025 Speed: 2.999
Entry 2) Draft: 0.088 Speed: 5.000
Entry 3) Draft: 0.165 Speed: 8.300
Entry 4) Draft: 0.220 Speed: 9.000

Time Stamp: 2007-061 00:00

Apply Yes
Comments
Entry 1) Draft: 0.058 Speed: 3.297
Entry 2) Draft: 0.072 Speed: 4.895
Entry 3) Draft: 0.136 Speed: 6.893
Entry 4) Draft: 0.213 Speed: 7.991
Entry 5) Draft: 0.232 Speed: 9.190
Entry 6) Draft: 0.296 Speed: 10.190

TPE

Time Stamp: 2005-073 00:01

Comments
Offsets

Motion sensing unit to the transducer 1
X Head 1 0.035
Y Head 1 0.012
Z Head 1 0.000
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 0.030
Y Head 1 0.002
Z Head 1 0.011
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 0.050'' of heave amplitude.
Measurement errors: 0.020
Motion sensing unit alignment errors
Gyro:0.000 Pitch:0.000 Roll:0.000
Gyro measurement error: 0.030
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 4.000
Transducer timing error: 0.000
Navigation timing error: 0.100
Gyro timing error: 0.010
Heave timing error: 0.010
PitchTimingStdDev: 0.010
Roll timing error: 0.010
Sound Velocity speed measurement error: 0.500
Surface sound speed measurement error: 0.500
Tide measurement error: 0.010
Tide zoning error: 0.100
Speed over ground measurement error: 0.250
Dynamic loading measurement error: 0.000
Static draft measurement error: 0.030
Delta draft measurement error: 0.037

Time Stamp: 2006-046 00:01

Comments
Offsets

Motion sensing unit to the transducer 1
X Head 1 0.035
Y Head 1 0.012
Z Head 1 0.000
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 0.030
Y Head 1 0.002
Z Head 1 0.011
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 0.050'' of heave amplitude.
Measurement errors: 0.020
Motion sensing unit alignment errors
Gyro:0.000 Pitch:0.000 Roll:0.000
Gyro measurement error: 0.030
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 4.000
Transducer timing error: 0.000
Navigation timing error: 0.100
Gyro timing error: 0.010
Heave timing error: 0.010
PitchTimingStdDev: 0.010
Roll timing error: 0.010

Sound Velocity speed measurement error: 0.500
Surface sound speed measurement error: 0.500
Tide measurement error: 0.010
Tide zoning error: 0.100
Speed over ground measurement error: 0.250
Dynamic loading measurement error: 0.000
Static draft measurement error: 0.030
Delta draft measurement error: 0.056

Time Stamp: 2007-061 00:00

Comments
Offsets

Motion sensing unit to the transducer 1
X Head 1 0.035
Y Head 1 0.012
Z Head 1 0.000
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 0.030
Y Head 1 0.002
Z Head 1 0.011
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 0.050'' of heave amplitude.
Measurement errors: 0.020
Motion sensing unit alignment errors
Gyro:0.000 Pitch:0.000 Roll:0.000
Gyro measurement error: 0.030
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 4.000
Transducer timing error: 0.000
Navigation timing error: 0.100
Gyro timing error: 0.010
Heave timing error: 0.010
PitchTimingStdDev: 0.010
Roll timing error: 0.010
Sound Velocity speed measurement error: 0.500
Surface sound speed measurement error: 0.500
Tide measurement error: 0.010
Tide zoning error: 0.100
Speed over ground measurement error: 0.250
Dynamic loading measurement error: 0.000
Static draft measurement error: 0.030
Delta draft measurement error: 0.037

Svp Sensor:

Time Stamp: 2005-073 00:01

Comments
Svp #1:

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

DeltaX: -3.420
DeltaY: -5.851
DeltaZ: 1.451

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:      2006-046 00:01

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

DeltaX: -3.420
DeltaY: -5.851
DeltaZ: 1.236

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:      2007-061 00:00

Comments (null)
Svp #1:
-------------
Pitch Offset:   0.000
Roll Offset:    0.000
Azimuth Offset: 0.000

DeltaX: -3.420
DeltaY: -5.851
DeltaZ: 1.236

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: 2007-061 00:01

Comments
Svp #1:

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

DeltaX: -3.420
DeltaY: -5.851
DeltaZ: 1.236

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: 2005-073 00:01

Comments
Apply Yes
WaterLine -0.840

Time Stamp: 2006-036 00:01

Comments
Apply Yes
WaterLine -0.840

Time Stamp: 2007-061 00:00

Comments
Apply Yes
WaterLine -0.840

Vessel Name: RU_SS.hvf
Vessel created: The vessel file was not saved at the time this report was generated.

Navigation Sensor:

Time Stamp: 1970-001 00:00

Comments (null)
Latency -3.500
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2002-115 00:00

Comments (null)
Latency 0.000
DeltaX: -0.120
DeltaY: 0.000
DeltaZ: 0.290

Manufacturer: (null)
Model: (null)
Serial Number: (null)

Time Stamp: 2003-001 00:00

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

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2005-073 00:01

Comments (null)
Latency -3.500
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2007-061 00:00

Comments (null)
Latency -3.500
DeltaX: 0.000

DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Gyro Sensor:

Time Stamp: 1970-001 00:00

Comments
Latency 0.000

Time Stamp: 2002-115 00:00

Comments
Latency 0.000

Entry 0) Draft: 0.000 Speed: 0.000

Time Stamp: 2003-001 00:00

Comments (null)
Latency 0.000

Entry 0) Draft: 0.000 Speed: 0.000

Time Stamp: 2005-073 00:01

Comments (null)
Latency 0.000

Entry 0) Draft: 0.000 Speed: 0.000

Time Stamp: 2007-061 00:00

Comments
Latency 0.000

Heave Sensor:

Time Stamp: 1970-001 00:00

Comments
Apply No
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer:
Model:
Serial Number:

Time Stamp: 2002-115 00:00

Comments
Apply No

Latency 0.000
DeltaX: -0.120
DeltaY: 0.000
DeltaZ: 0.290

Manufacturer: (null)
Model: (null)
Serial Number: (null)

Time Stamp: 2003-001 00:00

Comments (null)
Apply No
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2005-073 00:01

Comments (null)
Apply No
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2007-061 00:00

Comments
Apply No
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer:
Model:
Serial Number:

Pitch Sensor:

Time Stamp: 2002-115 00:00

Comments
Apply No
Latency 0.000
Pitch offset: 0.000

Manufacturer: (null)
Model: (null)

Serial Number: (null)

Time Stamp: 2003-001 00:00

Comments
Apply No
Latency 0.000
Pitch offset: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2005-073 00:01

Comments (null)
Apply No
Latency 0.000
Pitch offset: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2007-061 00:00

Comments
Apply No
Latency 0.000
Pitch offset: 0.000

Manufacturer:
Model:
Serial Number:

Roll Sensor:

Time Stamp: 2002-115 00:00

Comments
Apply No
Latency 0.000
Roll offset: 0.000

Manufacturer: (null)
Model: (null)
Serial Number: (null)

Time Stamp: 2003-001 00:00

Comments
Apply No
Latency 0.000
Roll offset: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2005-073 00:01

Comments (null)
Apply No
Latency 0.000
Roll offset: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2007-061 00:00

Comments
Apply No
Latency 0.000
Roll offset: 0.000

Manufacturer:
Model:
Serial Number:

Draft Sensor:

Time Stamp: 2002-108 00:00

Apply No
Comments
Entry 1) Draft: 0.005 Speed: 2.850
Entry 2) Draft: 0.031 Speed: 4.800
Entry 3) Draft: 0.085 Speed: 6.750
Entry 4) Draft: 0.110 Speed: 7.950
Entry 5) Draft: 0.185 Speed: 9.100
Entry 6) Draft: 0.238 Speed: 10.150
Entry 7) Draft: 0.278 Speed: 11.100

Time Stamp: 2003-001 00:00

Apply No
Comments
Entry 1) Draft: 0.010 Speed: 3.000
Entry 2) Draft: 0.050 Speed: 4.800
Entry 3) Draft: 0.090 Speed: 6.800
Entry 4) Draft: 0.140 Speed: 8.100
Entry 5) Draft: 0.230 Speed: 9.300
Entry 6) Draft: 0.270 Speed: 10.400
Entry 7) Draft: 0.280 Speed: 11.400

Time Stamp: 2005-073 00:01

Apply No
Comments (null)

Time Stamp: 2007-061 00:00

Apply No
Comments (null)

Tow Point:

Time Stamp: 1970-001 00:00

Comments (null)
Latency 0.000
DeltaX: 0.219
DeltaY: -17.970
DeltaZ: -5.179

Manufacturer: (null)
Model: (null)
Serial Number: (null)

Time Stamp: 2002-115 00:00

Comments
Latency 0.000
DeltaX: 0.000
DeltaY: -17.870
DeltaZ: -3.830

Manufacturer: (null)
Model: (null)
Serial Number: (null)

Time Stamp: 2003-001 00:00

Comments
Latency 0.000
DeltaX: 0.000
DeltaY: -18.000
DeltaZ: -3.990

Manufacturer: (null)
Model: (null)
Serial Number: (null)

Time Stamp: 2003-094 00:00

Comments (null)
Latency 0.000
DeltaX: 0.000
DeltaY: -18.010
DeltaZ: -4.480

Manufacturer: (null)
Model: (null)
Serial Number: (null)

Time Stamp: 2005-073 00:01

Comments (null)
Latency 0.000
DeltaX: 0.219
DeltaY: -17.970
DeltaZ: -5.179

Manufacturer: (null)
Model: (null)

Serial Number: (null)

Time Stamp: 2007-061 00:00

Comments (null)
Latency 0.000
DeltaX: 0.219
DeltaY: -17.970
DeltaZ: -5.179

Manufacturer: (null)
Model: (null)
Serial Number: (null)

WaterLine:

Time Stamp: 2002-115 00:00

Comments
Apply No
WaterLine 0.000

Time Stamp: 2003-001 00:00

Comments
Apply Yes
WaterLine -0.290

Time Stamp: 2005-073 00:01

Comments (null)
Apply Yes
WaterLine -0.840

Time Stamp: 2007-061 00:00

Comments (null)
Apply No
WaterLine 0.000

Vessel Name: RU_SB.hvf
Vessel created: The vessel file was not saved at the time this report was generated.

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2002-112 00:00

Transduer #1:

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

DeltaX: -0.420
DeltaY: 1.720
DeltaZ: 2.110

Manufacturer: ODOM
Model: odom
Serial Number:

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2003-001 00:00

Transduer #1:

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

DeltaX: -0.300
DeltaY: 1.720
DeltaZ: 1.820

Manufacturer: ODOM
Model: odom
Serial Number: 9812

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2005-073 00:01

Transduer #1:

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

DeltaX: -0.104
DeltaY: 2.058
DeltaZ: 1.264

Manufacturer: ODOM
Model: Unknown
Serial Number:

Depth Sensor:

```
        Sensor Class:    Swath
        Time Stamp:      2006-044 00:01

        Transduer #1:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: -0.104
        DeltaY: 2.058
        DeltaZ: 1.264

        Manufacturer:    ODOM
        Model:           Unknown
        Serial Number:

Depth Sensor:

        Sensor Class:    Swath
        Time Stamp:      2007-061 00:00

        Transduer #1:
        -------------
        Pitch Offset:   0.000
        Roll Offset:    0.000
        Azimuth Offset: 0.000

        DeltaX: -0.104
        DeltaY: 2.058
        DeltaZ: 1.264

        Manufacturer:    ODOM
        Model:           Unknown
        Serial Number:

_____________________________________________________________
Navigation Sensor:

        Time Stamp:      2002-112 00:00

        Comments (null)
        Latency 0.000
        DeltaX: -0.120
        DeltaY: 0.000
        DeltaZ: 0.290

        Manufacturer:    TSS
        Model:           POS/MV
        Serial Number:   (null)


        Time Stamp:      2003-001 00:00

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

        Manufacturer:    TSS
        Model:           POS/MV
        Serial Number:   (null)
```

Time Stamp: 2005-073 00:01

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

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2006-044 00:01

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

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2007-061 00:00

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

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Gyro Sensor:

Time Stamp: 2002-112 00:00

Comments
Latency 0.000

Entry 0) Draft: 0.000 Speed: 0.000

Time Stamp: 2003-001 00:00

Comments (null)
Latency 0.000

Entry 0) Draft: 0.000 Speed: 0.000

Time Stamp: 2005-073 00:01

Comments (null)
Latency 0.000

Time Stamp: 2006-044 00:01

Comments (null)
Latency 0.000

Time Stamp: 2007-061 00:00

Comments (null)
Latency 0.000

Heave Sensor:

Time Stamp: 2002-112 00:00

Comments
Apply Yes
Latency 0.000
DeltaX: -0.120
DeltaY: 0.000
DeltaZ: 0.290

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2003-001 00:00

Comments
Apply Yes
Latency -0.260
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2005-073 00:01

Comments (null)
Apply Yes
Latency 0.000
DeltaX: 0.153
DeltaY: 0.231
DeltaZ: -0.550

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2006-044 00:01

Comments (null)
Apply Yes
Latency 0.000
DeltaX: 0.153
DeltaY: 0.231

DeltaZ: -0.550

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2007-061 00:00

Comments (null)
Apply Yes
Latency 0.000
DeltaX: 0.153
DeltaY: 0.231
DeltaZ: -0.550

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Pitch Sensor:

Time Stamp: 2002-112 00:00

Comments
Apply Yes
Latency 0.000
Pitch offset: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2003-001 00:00

Comments
Apply Yes
Latency 0.000
Pitch offset: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2005-073 00:01

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

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2006-044 00:01

Comments (null)
Apply Yes

Latency 0.000
Pitch offset: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2007-061 00:00

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

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Roll Sensor:

Time Stamp: 2002-112 00:00

Comments
Apply Yes
Latency 0.000
Roll offset: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2003-001 00:00

Comments
Apply Yes
Latency 0.000
Roll offset: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2005-073 00:01

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

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2006-044 00:01

Comments (null)
Apply Yes
Latency 0.000

Roll offset: 0.000

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Time Stamp: 2007-061 00:00

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

Manufacturer: TSS
Model: POS/MV
Serial Number: (null)

Draft Sensor:

Time Stamp: 2002-112 00:00

Apply Yes
Comments
Entry 1) Draft: 0.000 Speed: 0.000
Entry 2) Draft: 0.005 Speed: 2.850
Entry 3) Draft: 0.030 Speed: 4.800
Entry 4) Draft: 0.090 Speed: 6.750
Entry 5) Draft: 0.110 Speed: 7.950
Entry 6) Draft: 0.185 Speed: 9.100
Entry 7) Draft: 0.238 Speed: 10.150
Entry 8) Draft: 0.278 Speed: 11.100
Entry 9) Draft: 0.278 Speed: 20.000

Time Stamp: 2003-001 00:00

Apply Yes
Comments
Entry 1) Draft: 0.006 Speed: 3.000
Entry 2) Draft: 0.054 Speed: 4.800
Entry 3) Draft: 0.090 Speed: 6.800
Entry 4) Draft: 0.140 Speed: 8.100
Entry 5) Draft: 0.230 Speed: 9.300
Entry 6) Draft: 0.270 Speed: 10.400
Entry 7) Draft: 0.280 Speed: 11.400

Time Stamp: 2004-044 00:00

Apply Yes
Comments (null)
Entry 1) Draft: 0.026 Speed: 3.150
Entry 2) Draft: 0.034 Speed: 4.800
Entry 3) Draft: 0.098 Speed: 7.000
Entry 4) Draft: 0.153 Speed: 8.250
Entry 5) Draft: 0.227 Speed: 9.300
Entry 6) Draft: 0.292 Speed: 10.200

Time Stamp: 2005-073 00:01

Apply Yes
Comments (null)
Entry 1) Draft: 0.002 Speed: 3.220

Entry 2) Draft: 0.022 Speed: 5.030
Entry 3) Draft: 0.098 Speed: 6.890
Entry 4) Draft: 0.170 Speed: 8.200
Entry 5) Draft: 0.212 Speed: 9.170
Entry 6) Draft: 0.307 Speed: 10.040

Time Stamp: 2006-044 00:01

Apply Yes
Comments (null)
Entry 1) Draft: 0.025 Speed: 3.000
Entry 2) Draft: 0.088 Speed: 5.000
Entry 3) Draft: 0.165 Speed: 8.300
Entry 4) Draft: 0.220 Speed: 9.000

Time Stamp: 2007-061 00:00

Apply Yes
Comments (null)
Entry 1) Draft: 0.058 Speed: 3.297
Entry 2) Draft: 0.072 Speed: 4.895
Entry 3) Draft: 0.136 Speed: 6.893
Entry 4) Draft: 0.213 Speed: 7.991
Entry 5) Draft: 0.232 Speed: 9.190
Entry 6) Draft: 0.296 Speed: 10.190

TPE

Time Stamp: 2005-039 00:01

Comments
Offsets

Motion sensing unit to the transducer 1
X Head 1 0.000
Y Head 1 0.000
Z Head 1 0.000
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 0.000
Y Head 1 0.000
Z Head 1 0.000
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 0.050'' of heave amplitude.
Measurement errors: 0.020
Motion sensing unit alignment errors
Gyro:0.000 Pitch:0.000 Roll:0.000
Gyro measurement error: 0.030
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 4.000
Transducer timing error: 0.000
Navigation timing error: 0.100

Gyro timing error: 0.010
Heave timing error: 0.010
PitchTimingStdDev: 0.010
Roll timing error: 0.010
Sound Velocity speed measurement error: 0.500
Surface sound speed measurement error: 0.500
Tide measurement error: 0.010
Tide zoning error: 0.100
Speed over ground measurement error: 0.250
Dynamic loading measurement error: 0.000
Static draft measurement error: 0.030
Delta draft measurement error: 0.075

Svp Sensor:

Time Stamp: 2002-100 00:00

Comments
Svp #1:

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

DeltaX: -0.420
DeltaY: 1.600
DeltaZ: 0.000

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: 2002-101 00:00

Comments
Svp #1:

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

DeltaX: -0.420
DeltaY: 1.720
DeltaZ: 2.110

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: 2002-112 00:00

Comments
Svp #1:

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

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

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: 2003-001 00:00

Comments
Svp #1:

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

DeltaX: -0.503
DeltaY: 2.058
DeltaZ: 1.264

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: 2005-073 00:01

Comments (null)
Svp #1:

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

DeltaX: -0.104
DeltaY: 2.058
DeltaZ: 1.264

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: 2006-044 00:01

Comments (null)
Svp #1:

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

DeltaX: -0.104
DeltaY: 2.058
DeltaZ: 1.264

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: 2007-061 00:00

Comments
Svp #1:

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

DeltaX: -0.104
DeltaY: 2.058
DeltaZ: 1.264

SVP #2:

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

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

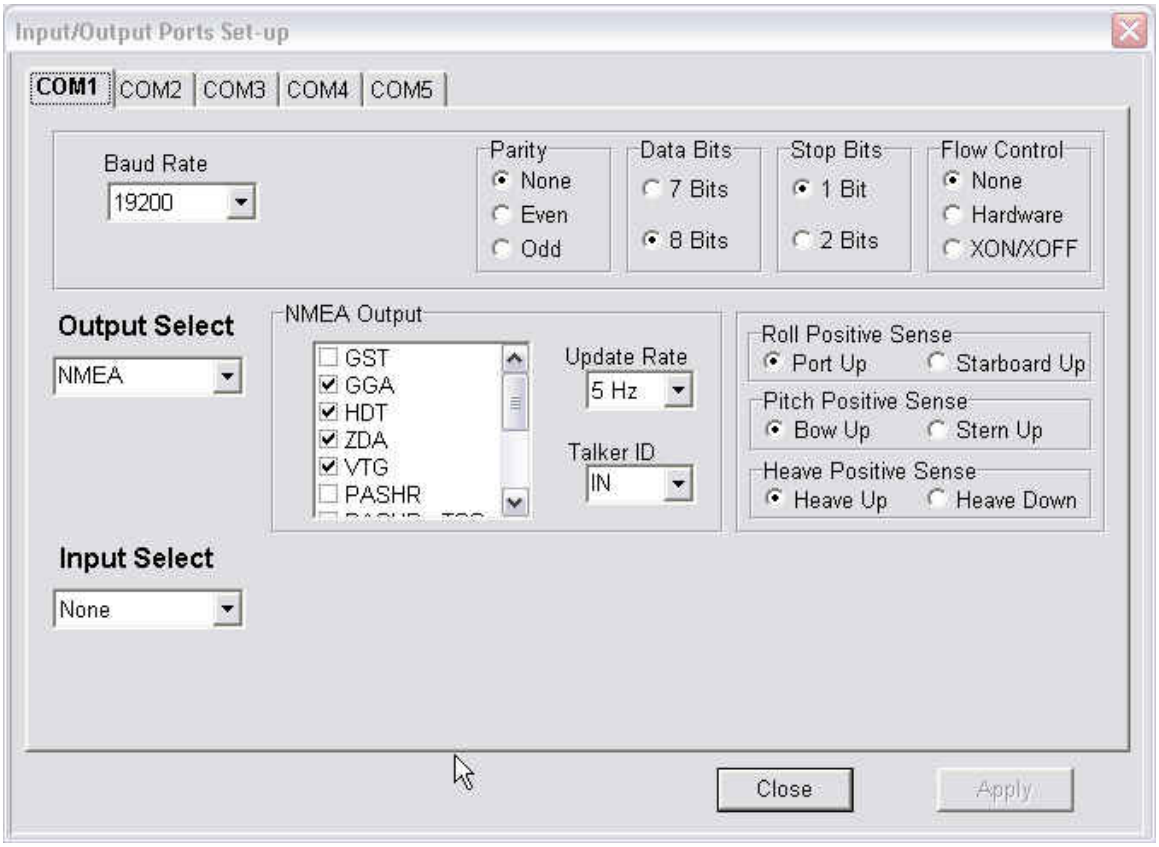
WaterLine:

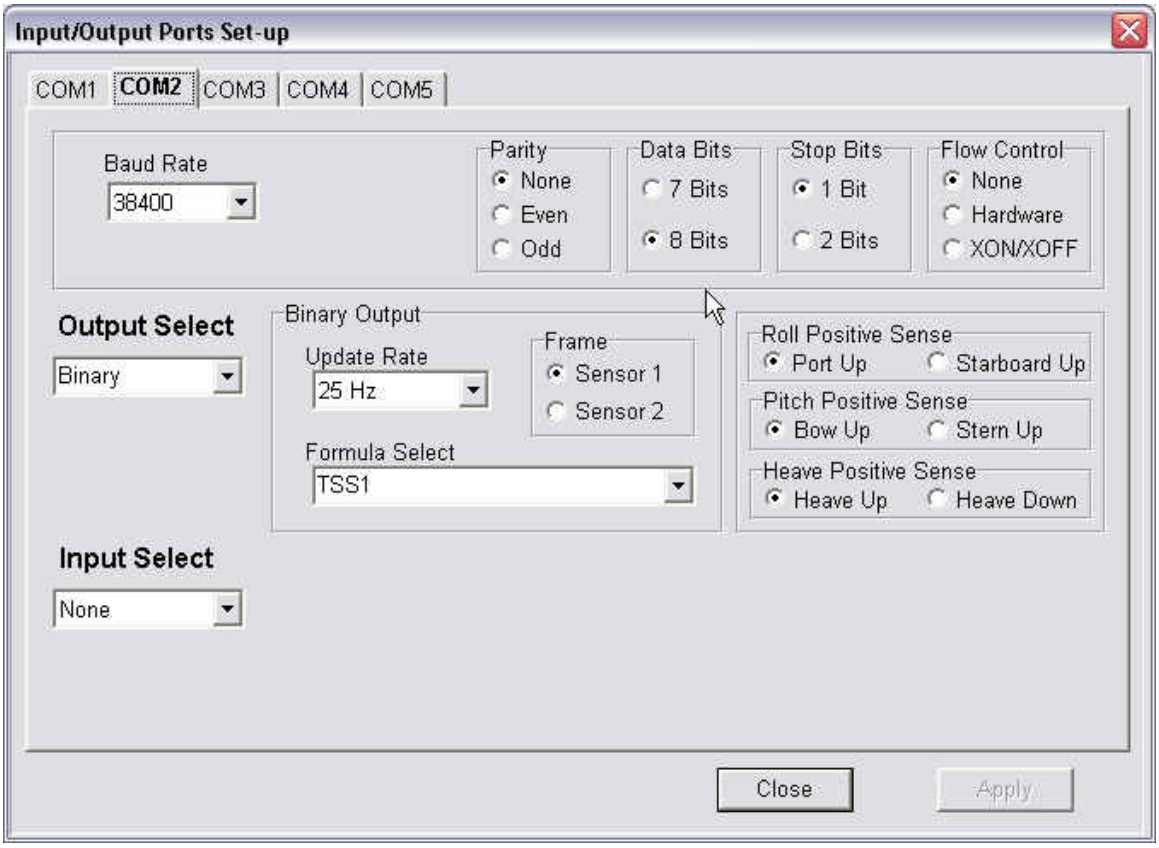
Time Stamp: 2002-112 00:00

Comments (null)
Apply No

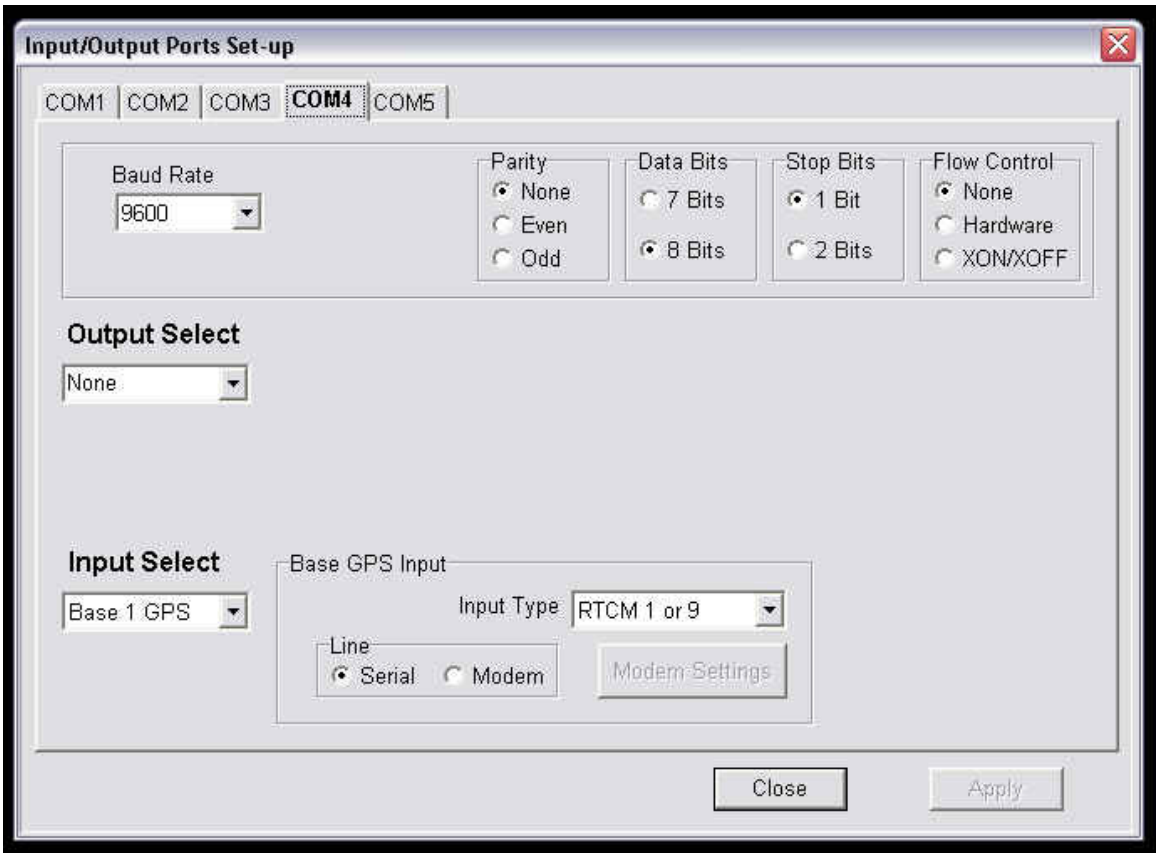
```
WaterLine 0.000

Time Stamp:      2003-001 00:00

Comments
Apply Yes
WaterLine -0.290

Time Stamp:      2005-073 00:01

Comments (null)
Apply Yes
WaterLine -0.837

Time Stamp:      2006-044 00:01

Comments (null)
Apply Yes
WaterLine -0.840

Time Stamp:      2007-061 00:00

Comments (null)
Apply Yes
WaterLine -0.840
```

Rude POS/MV Configuration

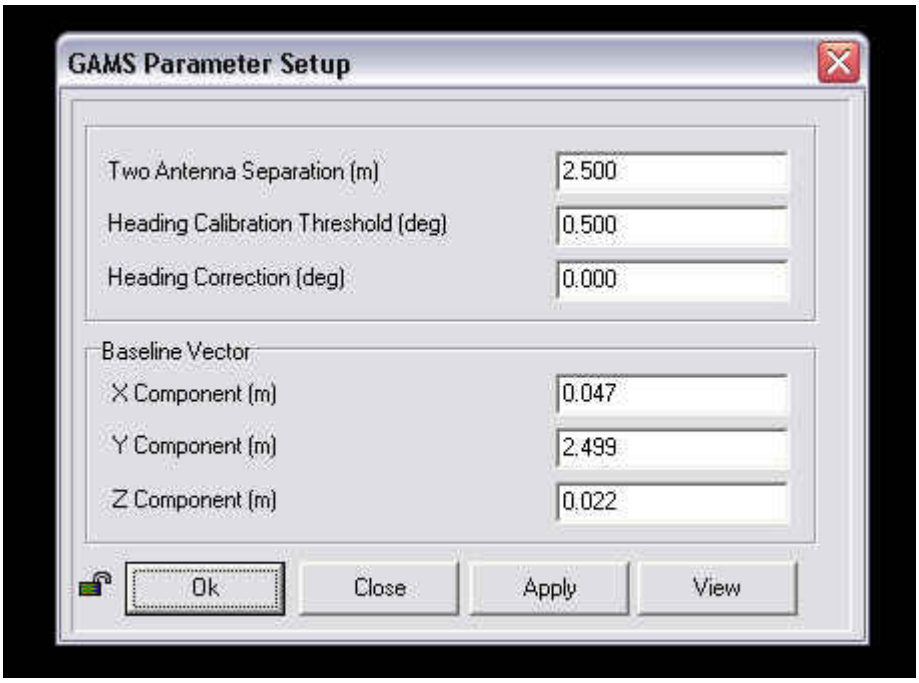


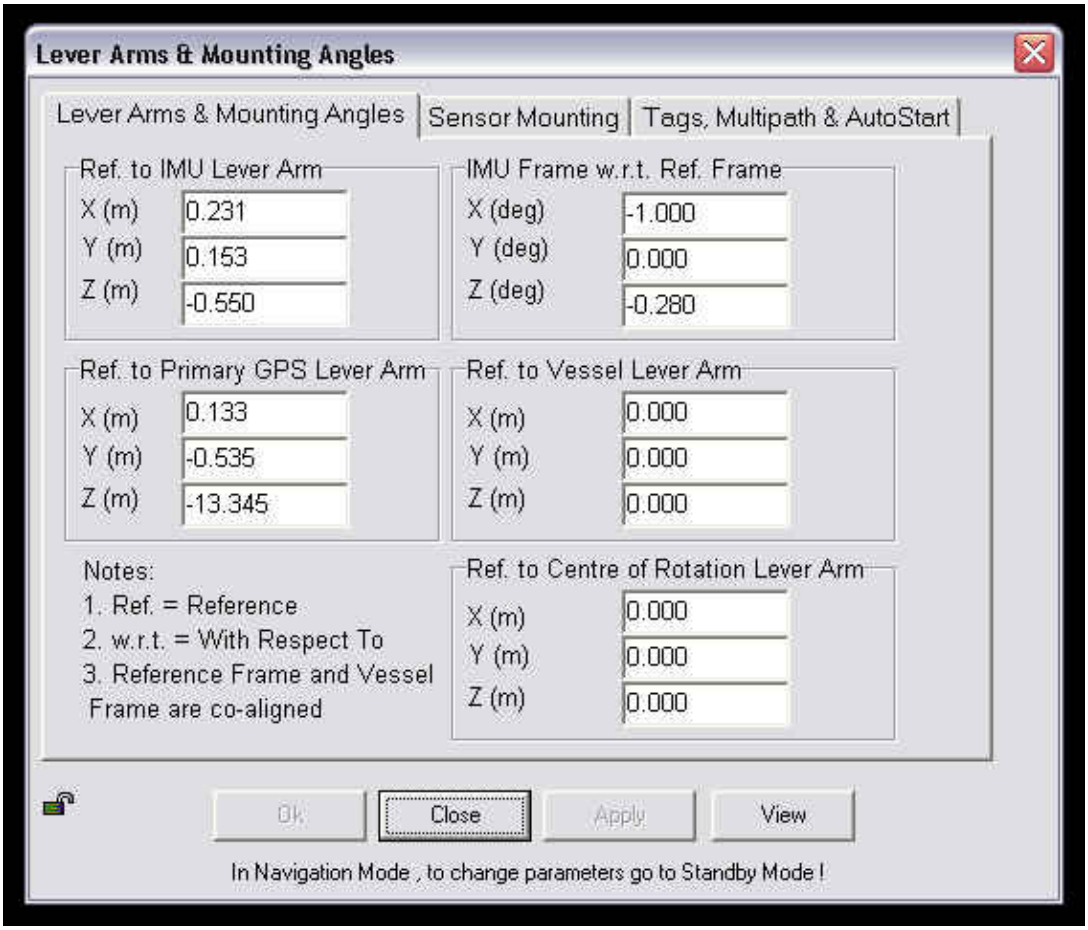


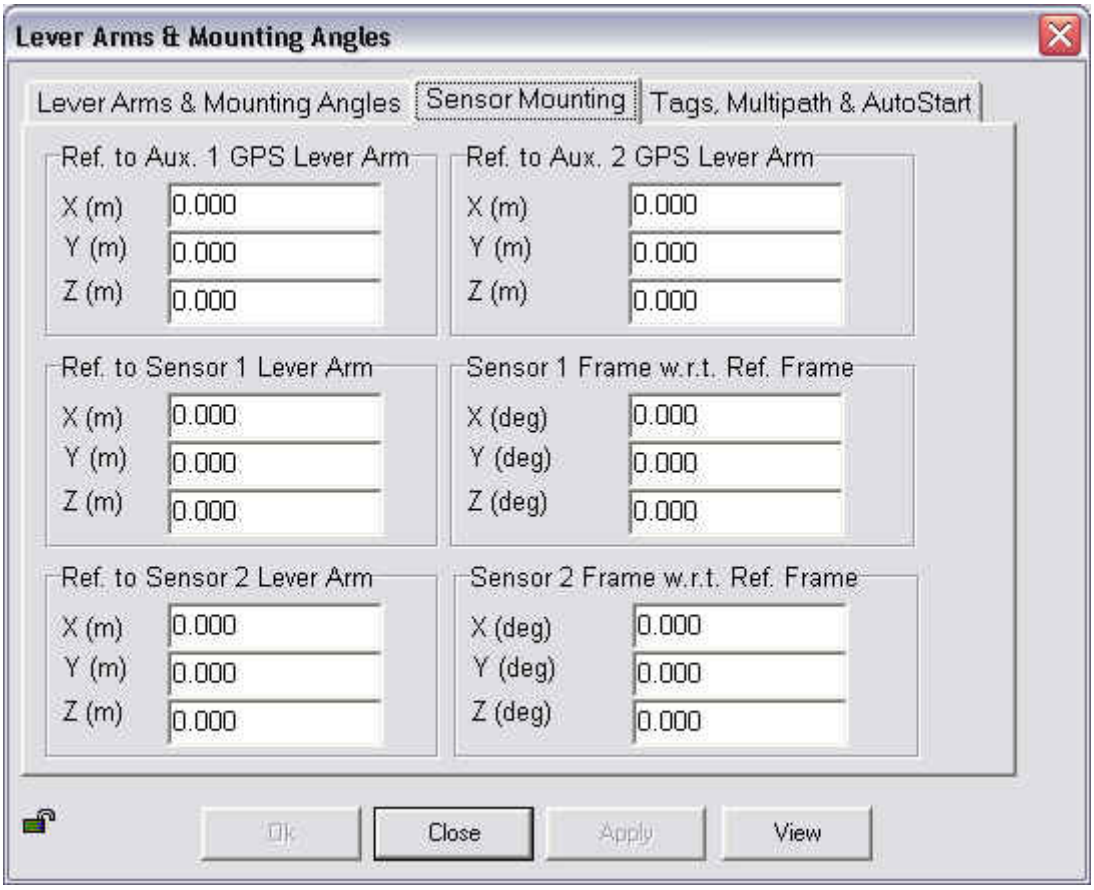
COMM 3 is not used.

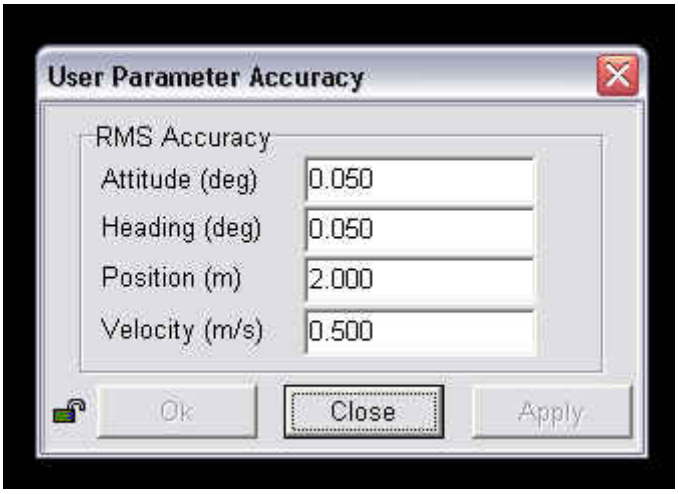


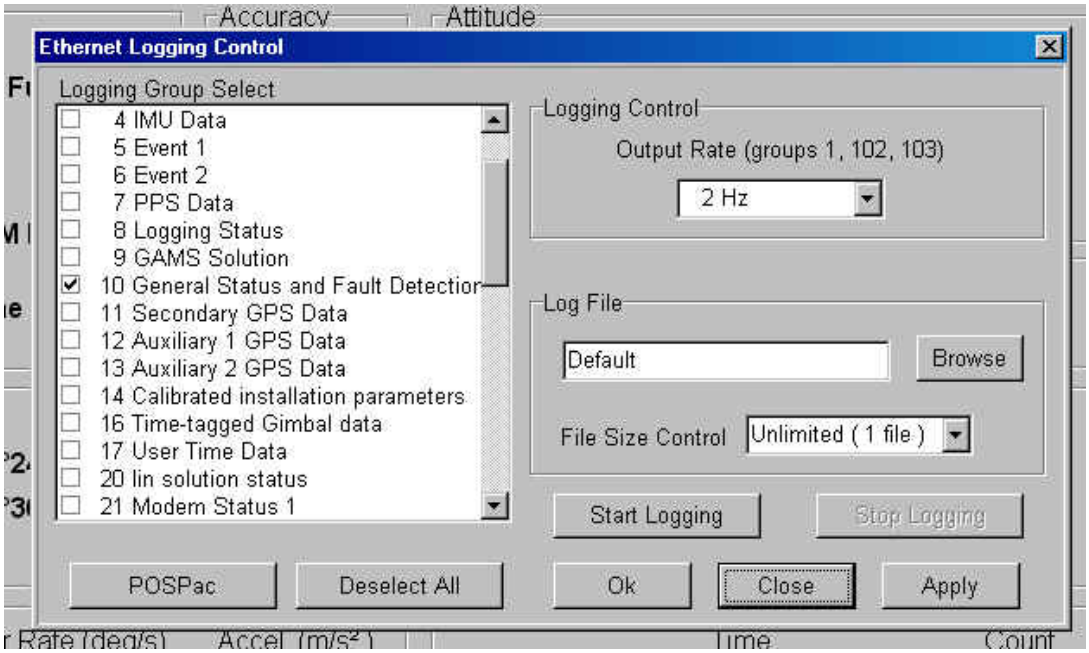
COMM 5 is not used.

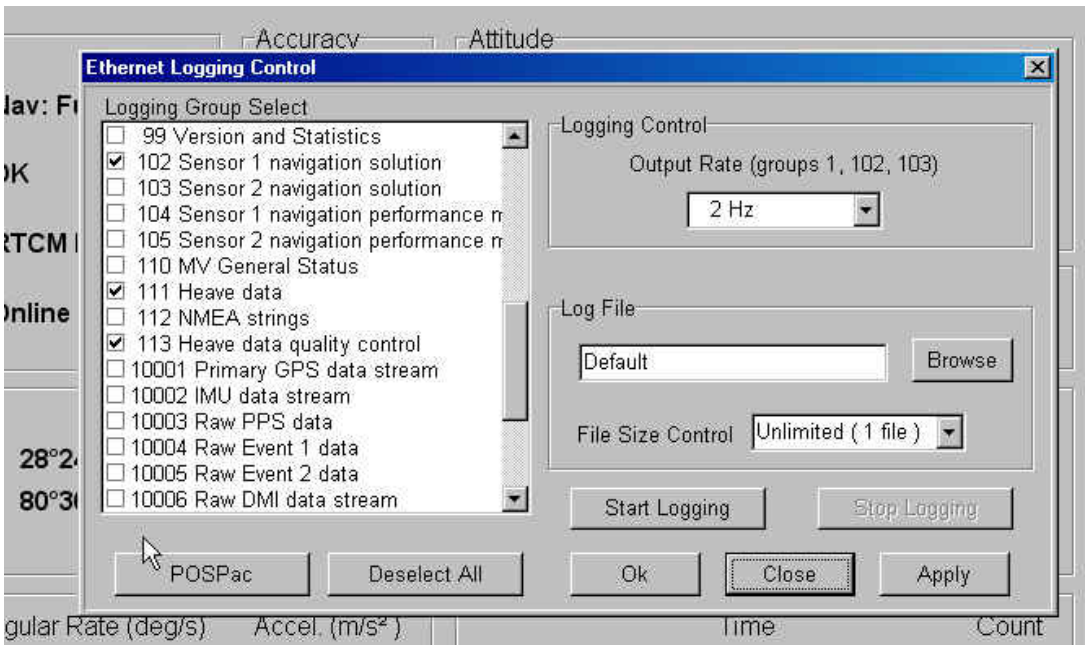

GAMS Parameter Setup
Two Antenna Separation (m)
2.500
Heading Calibration Threshold (deg)
0.500
Heading Correction (deg)
0.000
Baseline Vector
X Component (m)
0.047
Y Component (m)
2.499
Z Component (m)
0.022
Ok
Close
Apply
View

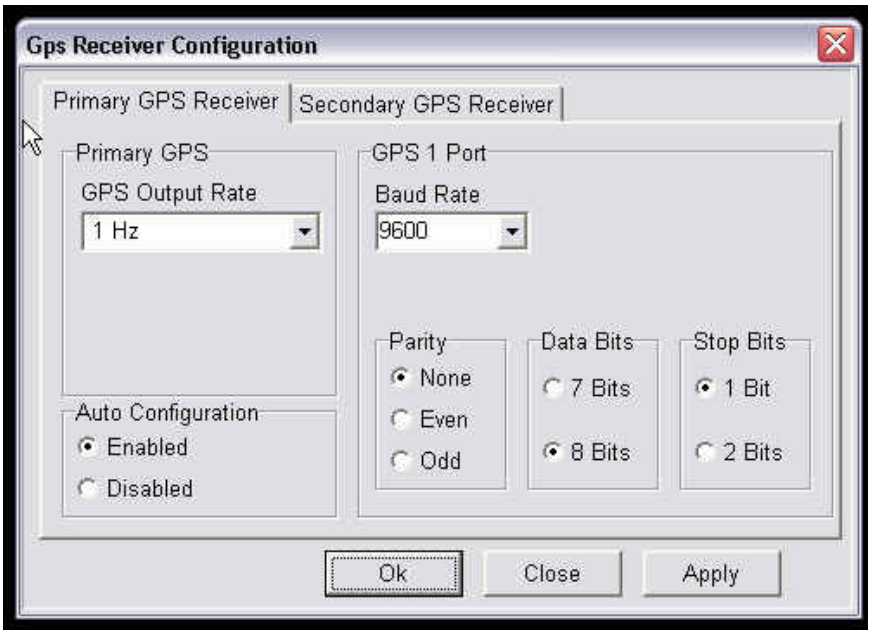

Lever Arms & Mounting Angles
Lever Arms & Mounting Angles
Sensor Mounting
Tags, Multipath & AutoStart
Ref. to IMU Lever Arm
X (m) 0.231
Y (m) 0.153
Z (m) -0.550
IMU Frame w.r.t. Ref. Frame
X (deg) -1.000
Y (deg) 0.000
Z (deg) -0.280
Ref. to Primary GPS Lever Arm
X (m) 0.133
Y (m) -0.535
Z (m) -13.345
Ref. to Vessel Lever Arm
X (m) 0.000
Y (m) 0.000
Z (m) 0.000
Notes:
1. Ref. = Reference
2. w.r.t. = With Respect To
3. Reference Frame and Vessel Frame are co-aligned
Ref. to Centre of Rotation Lever Arm
X (m) 0.000
Y (m) 0.000
Z (m) 0.000
Ok
Close
Apply
View
In Navigation Mode , to change parameters go to Standby Mode !

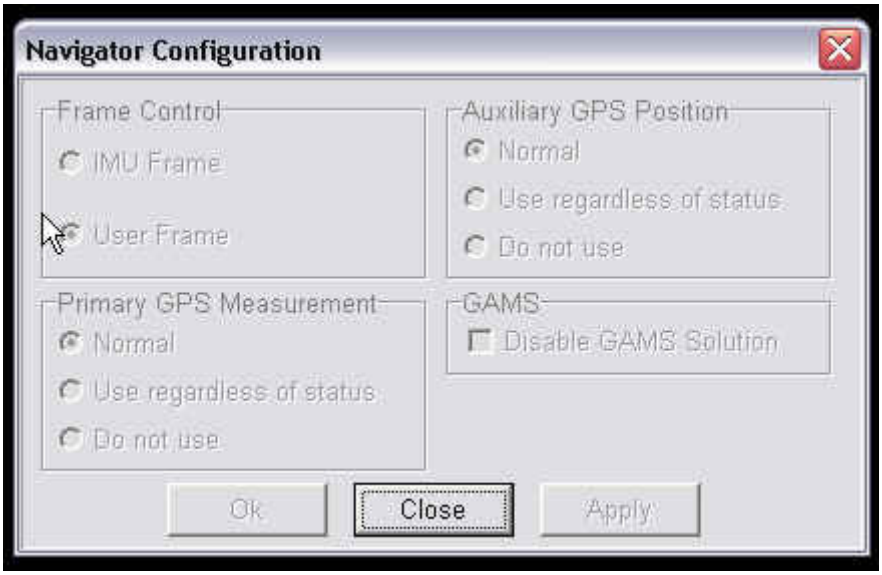

Lever Arms & Mounting Angles
Lever Arms & Mounting Angles
Sensor Mounting
Tags, Multipath & AutoStart
Ref. to Aux. 1 GPS Lever Arm
X (m) 0.000
Y (m) 0.000
Z (m) 0.000
Ref. to Aux. 2 GPS Lever Arm
X (m) 0.000
Y (m) 0.000
Z (m) 0.000
Ref. to Sensor 1 Lever Arm
X (m) 0.000
Y (m) 0.000
Z (m) 0.000
Sensor 1 Frame w.r.t. Ref. Frame
X (deg) 0.000
Y (deg) 0.000
Z (deg) 0.000
Ref. to Sensor 2 Lever Arm
X (m) 0.000
Y (m) 0.000
Z (m) 0.000
Sensor 2 Frame w.r.t. Ref. Frame
X (deg) 0.000
Y (deg) 0.000
Z (deg) 0.000
Ok
Close
Apply
View


User Parameter Accuracy
RMS Accuracy
Attitude (deg) 0.050
Heading (deg) 0.050
Position (m) 2.000
Velocity (m/s) 0.500
Ok
Close
Apply


Accuracy
Attitude
Ethernet Logging Control
Logging Group Select
4 IMU Data
5 Event 1
6 Event 2
7 PPS Data
8 Logging Status
9 GAMS Solution
10 General Status and Fault Detection
11 Secondary GPS Data
12 Auxiliary 1 GPS Data
13 Auxiliary 2 GPS Data
14 Calibrated installation parameters
16 Time-tagged Gimbal data
17 User Time Data
20 Iin solution status
21 Modem Status 1
Logging Control
Output Rate (groups 1, 102, 103)
2 Hz
Log File
Default
Browse
File Size Control
Unlimited (1 file)
Start Logging
Stop Logging
POSPac
Deselect All
Ok
Close
Apply
Rate (deg/s)
Accel. (m/s²)
Time
Count


Accuracy
Attitude
Ethernet Logging Control
Logging Group Select
99 Version and Statistics
102 Sensor 1 navigation solution
103 Sensor 2 navigation solution
104 Sensor 1 navigation performance m
105 Sensor 2 navigation performance m
110 MV General Status
111 Heave data
112 NMEA strings
113 Heave data quality control
10001 Primary GPS data stream
10002 IMU data stream
10003 Raw PPS data
10004 Raw Event 1 data
10005 Raw Event 2 data
10006 Raw DMI data stream
Logging Control
Output Rate (groups 1, 102, 103)
2 Hz
Log File
Default
Browse
File Size Control
Unlimited (1 file)
Start Logging
Stop Logging
POSPac
Deselect All
Ok
Close
Apply
gular Rate (deg/s)
Accel. (m/s²)
Time
Count


Gps Receiver Configuration
Primary GPS Receiver
Secondary GPS Receiver
Primary GPS
GPS Output Rate
1 Hz
GPS 1 Port
Baud Rate
9600
Parity
None
Even
Odd
Data Bits
7 Bits
8 Bits
Stop Bits
1 Bit
2 Bits
Auto Configuration
Enabled
Disabled
Ok
Close
Apply


Navigator Configuration
Frame Control
IMU Frame
User Frame
Auxiliary GPS Position
Normal
Use regardless of status
Do not use
Primary GPS Measurement
Normal
Use regardless of status
Do not use
GAMS
Disable GAMS Solution
Ok
Close
Apply

APPENDIX IV

Rude Settlement and Squat Report

Lead Line / Divers Least Depth Gauge Comparison Report

CTD Calibration Reports

Divers Least Depth Gauge Calibration Report

Settlement and Squat: NOAA Ship *Rude*

March 1, 2007

NOAA Ship *Rude*

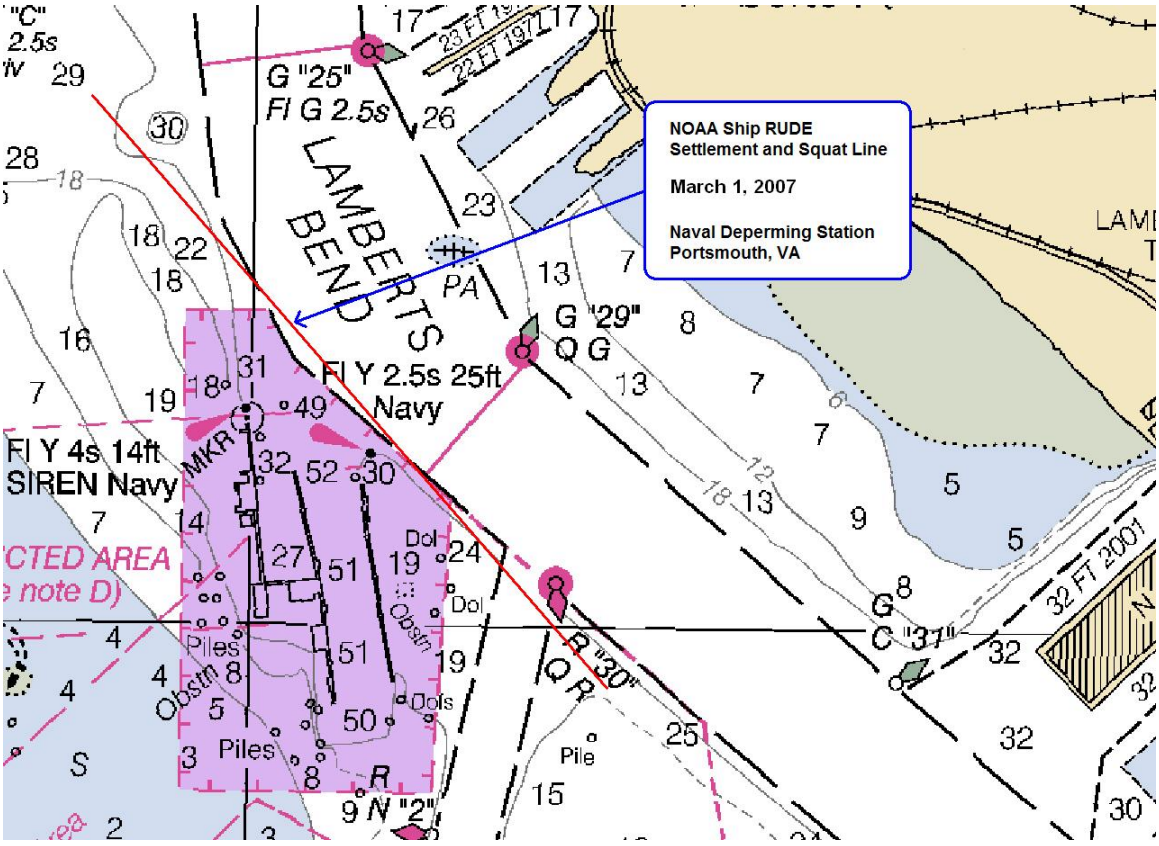
On March 1, 2007 settlement measurements were conducted off of the eastern side of the Naval Deperming Station in Portsmouth, VA. ENS Arnold and PS Kitt were positioned at the northeastern point of the deperming station. LT DeHart piloted the *Rude* while CB Pringle and AB Newton were rodmen. ENS Arnold took the shots while PS Kitt recorded. *Rude* was full of fuel and water.

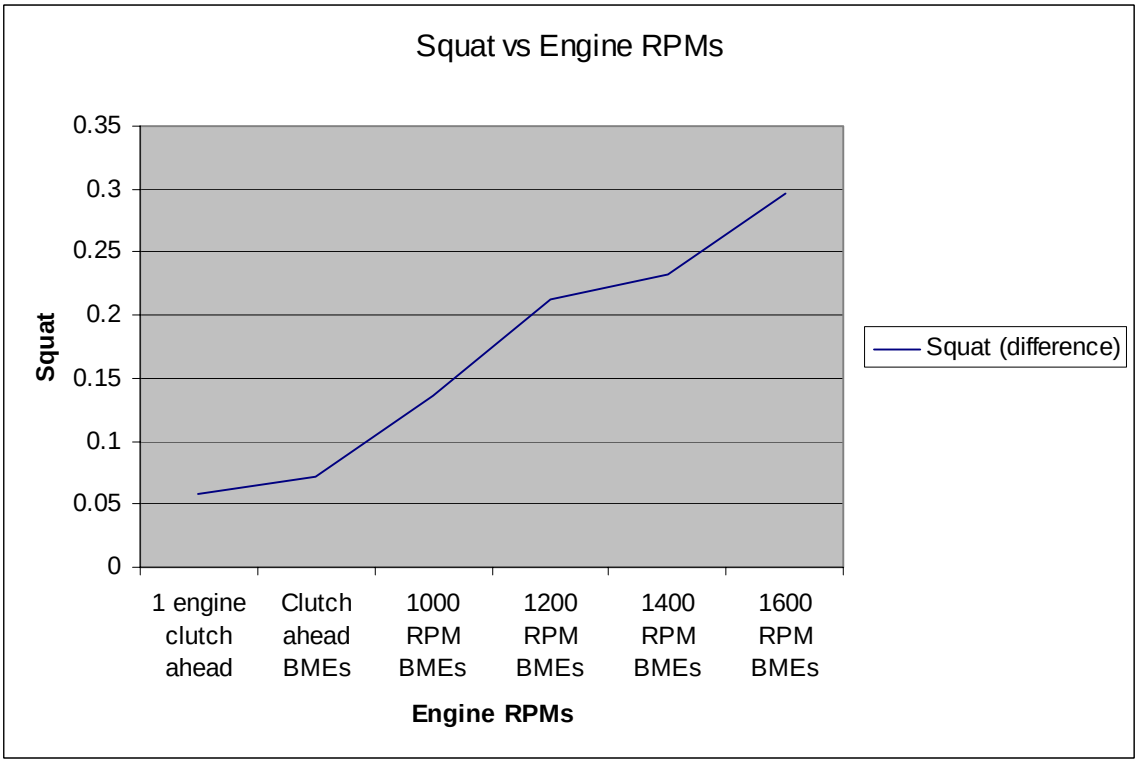
The ship made passes toward (*Rude*'s STBD) and away (*Rude*'s PORT) from the pier, coming no closer than 100 meters off the pier at its closest point. The ship's heading was approximately north-south for all passes. Rods were placed on bolts on both sides of the ship, and measurements were taken from an arbitrary vertical point since the difference between "at rest" and underway were being determined.

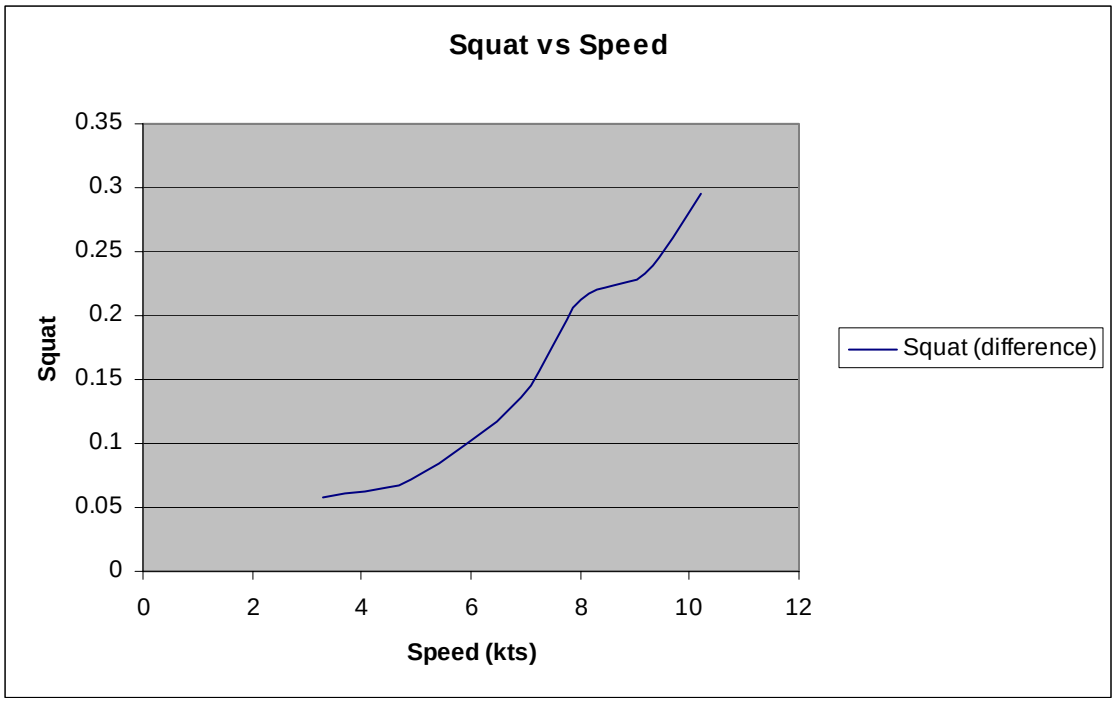
Shots were taken for passes of engine RPMs at one engine clutch ahead, both engines clutch ahead, 1000, 1200, and 1400. Between each run an "at rest" measurement was taken off the port and starboard sides. ENS Arnold and PS Kitt communicated via radio when a successful measurement had been taken.

To determine settlement, a difference between the "at rest" position and underway position was calculated. The "toward" and "away" measurements for underway were averaged. This negates any effect current may have on ship speed. The difference between the "at rest" average and underway average are then taken to determine the ship settlement. This settlement is then plotted as a function of ship speed.

Engine RPM	Speed	Squat (difference)	meters/second
1 engine clutch ahead	3.3	0.0575	1.695833333
Clutch ahead BMEs	4.9	0.0715	2.518055556
1000 RPM BMEs	6.9	0.1355	3.545833333
1200 RPM BMEs	8	0.213	4.111111111
1400 RPM BMEs	9.2	0.2325	4.727777778
1600 RPM BMEs	10.2	0.296	5.241666667


NOAA Ship RUDE
Settlement and Squat Line
March 1, 2007
Naval Deperming Station
Portsmouth, VA
LAMBERTS BEND
G "25"
Fl G 2.5s
G "29"
Q G
Fl Y 2.5s 25ft
Navy
Fl Y 4s 14ft
SIREN Navy
MKR
Piles
Obstn
Dol
Dols
Pile
R "30"
Q R
G
C "31"
R
N "2"
32 FT 2001
CTED AREA
note D)


Squat vs Engine RPMs
Squat
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1 engine clutch ahead
Clutch ahead BMEs
1000 RPM BMEs
1200 RPM BMEs
1400 RPM BMEs
1600 RPM BMEs
Engine RPMs
Squat (difference)


Squat vs Speed
Squat
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
2
4
6
8
10
12
Speed (kts)
Squat (difference)

Lead Line Comparison Report

NOAA Ship RUDE (s590)
March 12, 2007 (DN 071)

On Monday, March 12, 2007 (DN 071) at approximately 1623 UTC, NOAA Ship *Rude* conducted a lead line comparison check to confirm the performance of the ship's multibeam, the ship's singlebeam echosounder, and resolve questions regarding the accuracy of *Rude*'s diver least depth gauge.

The ship was in approximately 7 meters of water, 3400m west of the First Island of the Chesapeake Bay Bridge Tunnel in the C anchorage, South of Thimble Shoal Channel. After the ship stopped maneuvering and took off both engines, two CTD casts were taken to compare sound velocities between the two CTD casts and the digibar sound velocity probe on *Rude*'s multibeam system. Divers were deployed in a buddy pair with a diver's least depth gauge. Once the divers were in the water, the diver's least depth guage surface pressure was annotated, *Rude*'s single beam and *Rude*'s multi beam data acquisition was started. The lead line was deployed from the port rail forward of the *Rude*'s multi-beam sonar head. While sonar data were acquired, the divers dove to the bottom to read and annotate the gauge's pressure at the bottom. Personnel at the surface recorded the lead line readings.

Conditions at the test site were relatively calm with current speed at 0.3 knots and wave heights less than one foot with no observable swell. The bottom at the test site was a mud bottom type.

All data were acquired and processed according to standard *Rude* procedures. Lead line depths were obtained by observing water line indications on the line and converting to meters. Likewise, single- and multi-beam depths were obtained by averaging depths recorded at the time of the dive. Diver least depth gauge depths were processed in Velociwin 8.85. As the test was conducted at near low water and was complete within 2 minutes, tide correctors were not applied to the soundings.

Results of the test are tabulated on the Excel sheet labeled LeadLine07 (which was converted to PDF) accompanying this report in the *Rude*'s 2007 DAPR. These results confirmed that under the prevailing conditions at the time of the test, *Rude*'s survey systems meet the IHO S44 4th Edition "Order 1" standard for hydrographic survey depth sounding accuracy as specified in the NOAA Specifications and Deliverables.

NOAA Ship RUDE
Lead Line Calibration/Dive
March 12, 2007

Test Location-

3400 m West of Chesapeak Bay Bridge Tunnel In Anchorage C
latitude 36° 57' 86.00" N, longitude 76° 08' 41.42" W

Equipment-

Single Beam Echosounder:	Odom Echotrac DF3200 Mk II, SN 9643
Multi Beam Echosounder:	Reson Seabat 8125, SN 31562
RUDE Diver Least Depth Gauge:	SN 68336

Personnel-

Acquisition:	CST Kitt
Divers:	LT DeHart / ENS Arnold
Lead Line:	LT Maddock
Recorder:	CST Kitt

Results-

Time (UTC)	Lead Line Corr Depth (m)	Dive1 Depth	VBES Depth- RUDE	MBES Depth- RUDE
1623	8.72	7.87	8.281	8.152

PROJECT: E350 CHESAPEAK

SURVEY: H11603
DATE: 03-13-2007

FLAG = -1: Point flagged as 'bad' by EDIT program.
FLAG = 0: Point is 'good'.
FLAG = 1: Point is extrapolated using historical data.
FLAG = 2: Point is extended by operator input.
FLAG = 3: Point is extended using most probable slope algorithm.

NOAA UNIT: RUDE
YEAR .2007
DAY (UTC) 072
TIME (UTC) 13:10
LATITUDE 36/56/52.80 N
LONGITUDE 076/02/26.22 W
INSTRUMENT TYPE SBE19 SEACAT S/N:284 CD:1/26/2005

POINT	DEPTH (M)	SOUND VELOCITY (M/S)	EDIT FLAG
1	1.8	1462.3	0
2	1.9	1462.3	0
3	1.9	1462.4	0
4	4.2	1469.0	0
5	5.1	1469.2	0
6	5.9	1469.4	0
7	6.9	1469.6	0
8	8.0	1469.7	0
9	9.0	1469.7	0
10	10.0	1469.7	0
11	11.0	1469.7	0
12	11.9	1469.8	0
13	13.0	1469.8	0
14	13.7	1469.9	0
15	13.9	1469.9	0
16	18.1	1469.3	2

PROJECT: E350 CHESAPEAKE
SURVEY: HT1603
DATE: 03-13-2007

FLAG = -1: Point flagged as 'bad' by EDIT program.
FLAG = 0: Point is 'good'.
FLAG = 1: Point is extrapolated using historical data.
FLAG = 2: Point is extended by operator input.
FLAG = 3: Point is extended using most probable slope algorithm.

NOAA UNIT: RUDE
YEAR 2007
DAY (UTC) 072
TIME (UTC) 13:21
LATITUDE 36/56/52.80 N
LONGITUDE 076/02/26.22 W
INSTRUMENT TYPE SBE19 SEACAT S/N:1060 CD:12/3/2003

POINT	DEPTH (M)	SOUND VELOCITY (M/S)	EDIT FLAG
1	1.8	1463.1	0
2	1.8	1463.1	0
3	1.9	1463.2	0
4	4.2	1470.1	0
5	5.1	1470.5	0
6	5.9	1470.7	0
7	6.9	1470.8	0
8	8.0	1470.8	0
9	9.0	1470.8	0
10	10.0	1470.9	0
11	11.0	1470.9	0
12	11.9	1471.0	0
13	12.9	1471.0	0
14	13.5	1471.0	0
15	13.7	1471.0	0
16	17.8	1470.6	2

REFERENCE PROFILE: C:\velocity\SVFILES\07072131.RUQ
COMPARISON PROFILE: C:\velocity\SVFILES\07072132.RUQ

SYSTEM: SINGLEBEAM
MAXIMUM COMMON DEPTH = 17.82 M
DRAFT = 2.1 M

Travel Time Sec	Average Depth M	Depth Diff M	Percent Diff
0.002	5.03	0.00	0.04
0.004	7.97	0.00	0.06
0.006	10.92	0.01	0.06
0.008	13.86	0.01	0.07
0.010	16.80	0.01	0.07

RESULTS OK.

Percent depth difference is within recommended bounds.

SV FILE: \VELOCITY\SVFILES\07071154.RUQ VELOCITY, Version 8.72

CAST # 3
for Leadline Cal
DQA passed
12MAR07
DN071

PROJECT: HSRR
DATA SET IDENTIFIER: UNKNOWN
SURVEY: PATCH TEST
DATE: 03-12-2007

FLAG = -1: Point flagged as 'bad' by EDIT program.
FLAG = 0: Point is 'good'.
FLAG = 1: Point is extrapolated using historical data.
FLAG = 2: Point is extended by operator input.
FLAG = 3: Point is extended using most probable slope algorithm.

NOAA UNIT: RUDE
DAY (UTC) 071
LATITUDE 36/58/06.00 N
YEAR 2007
TIME (UTC) 15:46
LONGITUDE 076/08/54.00 W
INSTRUMENT TYPE SBE19 SEACAT S/N:284 CD:1/26/2005

POINT	DEPTH (M)	SOUND VELOCITY (M/S)	EDIT FLAG
1	1.2	1457.4	0
2	1.2	1457.3	0
3	2.9	1456.1	0
4	4.1	1456.1	0
5	5.0	1457.0	0
6	6.0	1458.8	0
7	7.1	1461.7	0
8	8.1	1463.2	0
9	8.4	1463.1	0
10	8.5	1462.9	0
11	11.0	1461.6	2

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:	Atlantic Marine Center		
Job Number:	45139	**Date of Report:**	1/2/2007
Model Number	SBE 19-02	**Serial Number:**	192472-0284

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: 12/30/2006 Drift since last cal: +.00009 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: Degrees Celsius/year

Comments:

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: 1060
CALIBRATION DATE: 23-Dec-06

SBE19 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPRATURE SCALE

ITS-90 COEFFICIENTS

g = 4.16525795e-003
h = 5.92201944e-004
i = 5.96661116e-006
j = -1.16687877e-006
f0 = 1000.0

ITS-68 COEFFICIENTS

a = 3.64763821e-003
b = 5.79068501e-004
c = 9.08280006e-006
d = -1.16636608e-006
f0 = 2418.802

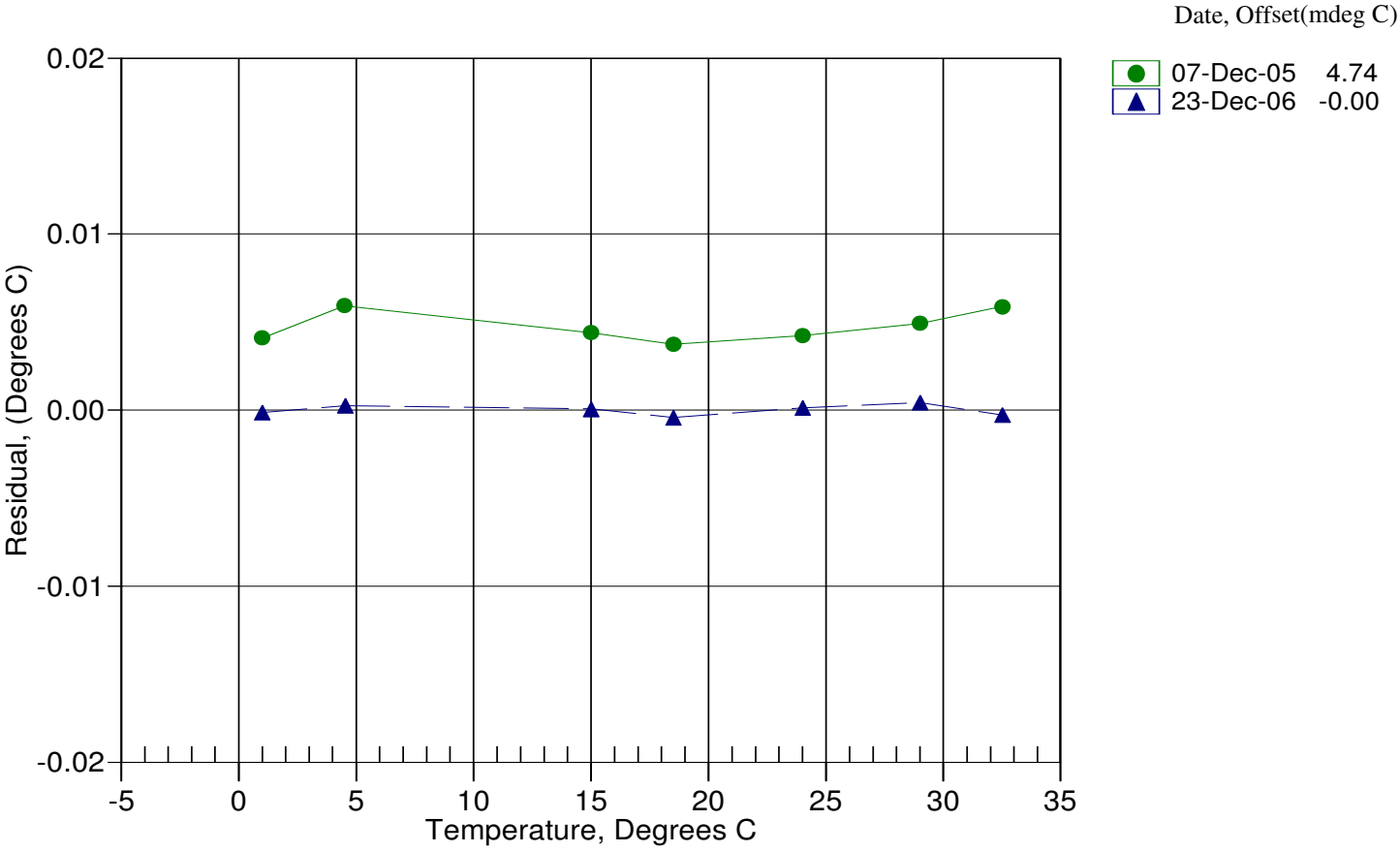
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
0.9999	2418.802	0.9998	-0.00014
4.5302	2620.818	4.5304	0.00024
15.0000	3290.177	15.0001	0.00007
18.5000	3538.509	18.4996	-0.00043
23.9999	3955.013	24.0000	0.00012
29.0000	4362.379	29.0004	0.00042
32.5000	4664.261	32.4997	-0.00028

Temperature ITS-90 = $1/\{g + h[ln(f_0/f)] + i[ln^2(f_0/f)] + j[ln^3(f_0/f)]\} - 273.15$ (°C)

Temperature ITS-68 = $1/\{a + b[ln(f_0/f)] + c[ln^2(f_0/f)] + d[ln^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C)

Residual = instrument temperature - bath temperature



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: 1060
CALIBRATION DATE: 18-Jan-07

SBE19 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPRATURE SCALE

ITS-90 COEFFICIENTS

g = 4.16369459e-003
h = 5.87949224e-004
i = 2.20260173e-006
j = -2.25904887e-006
f0 = 1000.0

ITS-68 COEFFICIENTS

a = 3.64763764e-003
b = 5.78908533e-004
c = 8.21277986e-006
d = -2.25875278e-006
f0 = 2418.842

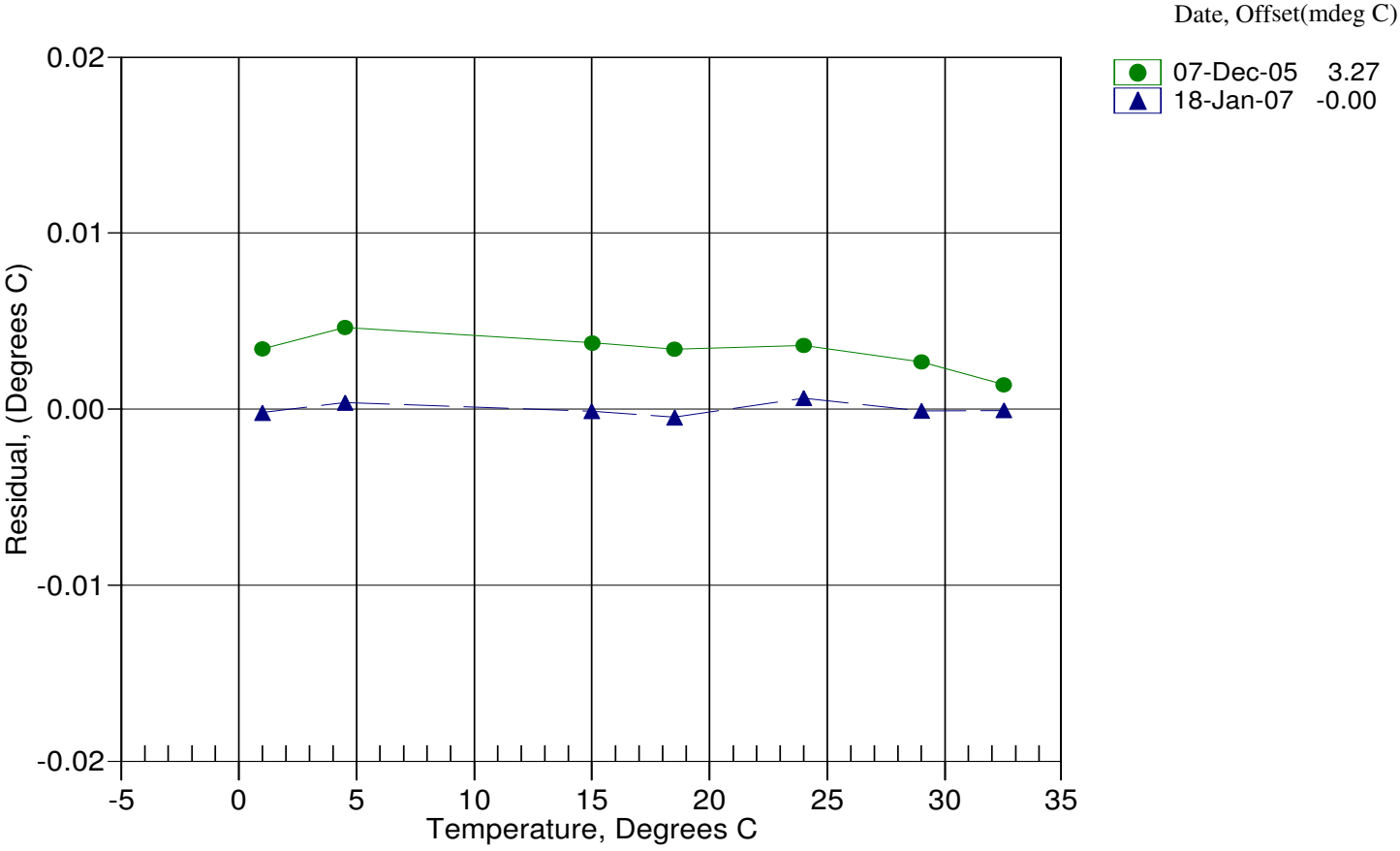
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	2418.842	0.9998	-0.00020
4.4999	2619.118	4.5003	0.00036
14.9999	3290.200	14.9998	-0.00013
18.5000	3538.531	18.4995	-0.00046
24.0000	3955.109	24.0006	0.00062
28.9999	4362.515	28.9998	-0.00011
32.5000	4664.675	32.4999	-0.00008

Temperature ITS-90 = $1/\{g + h[ln(f_0/f)] + i[ln^2(f_0/f)] + j[ln^3(f_0/f)]\} - 273.15$ (°C)

Temperature ITS-68 = $1/\{a + b[ln(f_0/f)] + c[ln^2(f_0/f)] + d[ln^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C)

Residual = instrument temperature - bath temperature



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: 0284
CALIBRATION DATE: 30-Dec-06

SBE19 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPRATURE SCALE

ITS-90 COEFFICIENTS

g = 4.18845542e-003
h = 5.87904343e-004
i = 4.48644307e-006
j = -1.47813130e-006
f0 = 1000.0

ITS-68 COEFFICIENTS

a = 3.64763708e-003
b = 5.75887341e-004
c = 8.62759167e-006
d = -1.47769992e-006
f0 = 2530.697

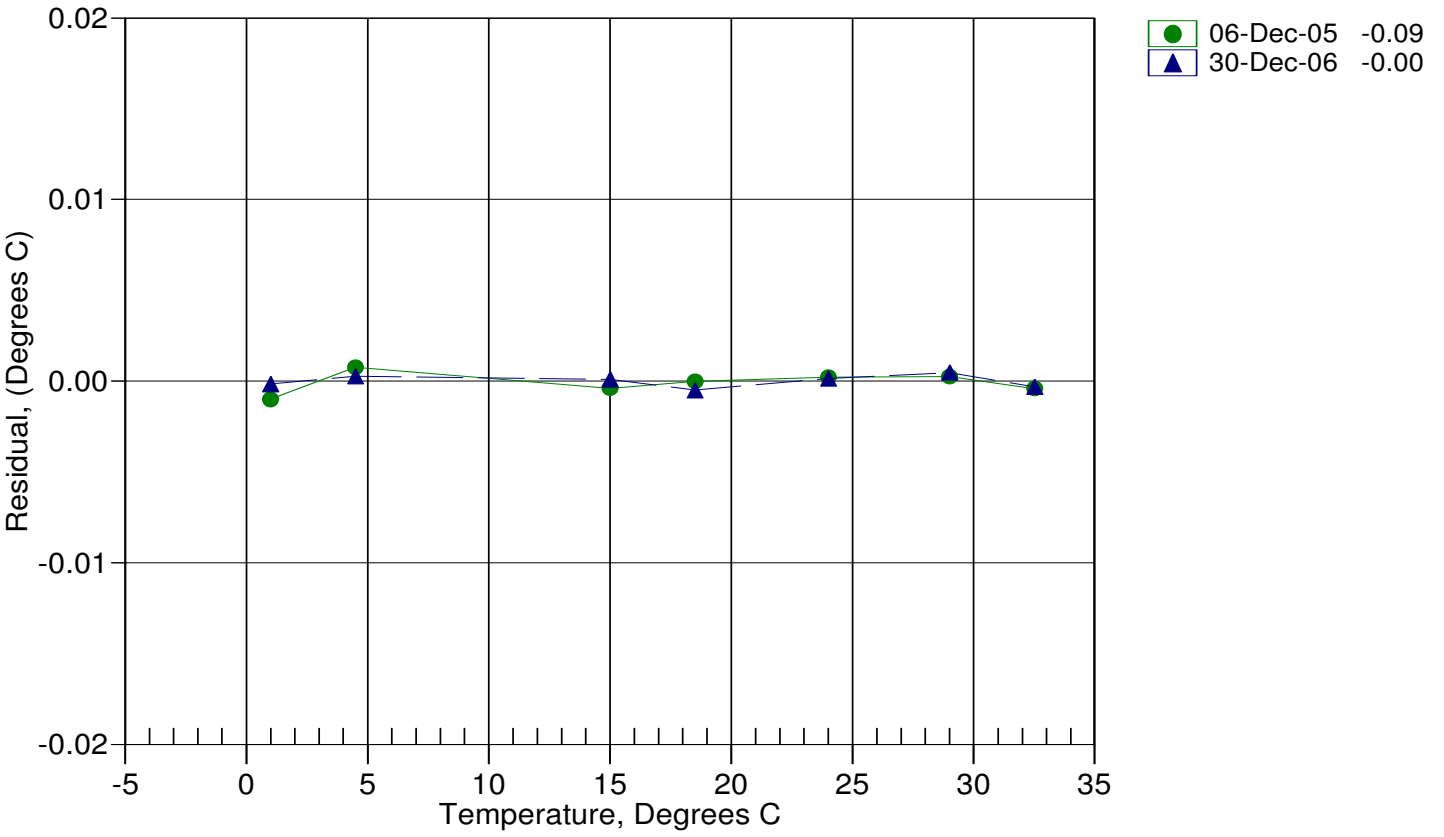
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	2530.697	0.9998	-0.00016
4.4999	2741.383	4.5002	0.00027
15.0000	3448.086	15.0001	0.00009
18.5000	3709.759	18.4995	-0.00049
24.0000	4148.886	24.0001	0.00014
29.0000	4578.617	29.0005	0.00047
32.5000	4897.231	32.4997	-0.00031

Temperature ITS-90 = $1/\{g + h[ln(f_0/f)] + i[ln^2(f_0/f)] + j[ln^3(f_0/f)]\} - 273.15$ (°C)

Temperature ITS-68 = $1/\{a + b[ln(f_0/f)] + c[ln^2(f_0/f)] + d[ln^3(f_0/f)]\} - 273.15$ (°C)

Following the recommendation of JPOTS: T_{68} is assumed to be 1.00024 * T_{90} (-2 to 35 °C)

Residual = instrument temperature - bath temperature



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: 1060
CALIBRATION DATE: 09-Jan-07

SBE19 PRESSURE CALIBRATION DATA
300 psia S/N 195086 TCV: 218

QUADRATIC COEFFICIENTS:

PA0 = 1.500897e+002
PA1 = -3.954739e-002
PA2 = 3.491582e-008

STRAIGHT LINE FIT:

M = -3.954128e-002
B = 1.502812e+002

PRESSURE PSIA	INST OUTPUT(N)	COMPUTED PSIA	ERROR %FS	LINEAR PSIA	ERROR %FS
14.62	3437.0	14.58	-0.01	14.38	-0.08
59.90	2291.0	59.67	-0.08	59.69	-0.07
119.89	772.0	119.58	-0.10	119.76	-0.04
179.89	-750.0	179.77	-0.04	179.94	0.01
239.88	-2264.0	239.80	-0.03	239.80	-0.03
299.87	-3773.0	299.80	-0.02	299.47	-0.13
239.86	-2269.0	240.00	0.05	240.00	0.05
179.88	-760.0	180.17	0.10	180.33	0.15
119.89	761.0	120.01	0.04	120.19	0.10
59.93	2280.0	60.10	0.06	60.13	0.06
14.61	3433.0	14.74	0.04	14.54	-0.03

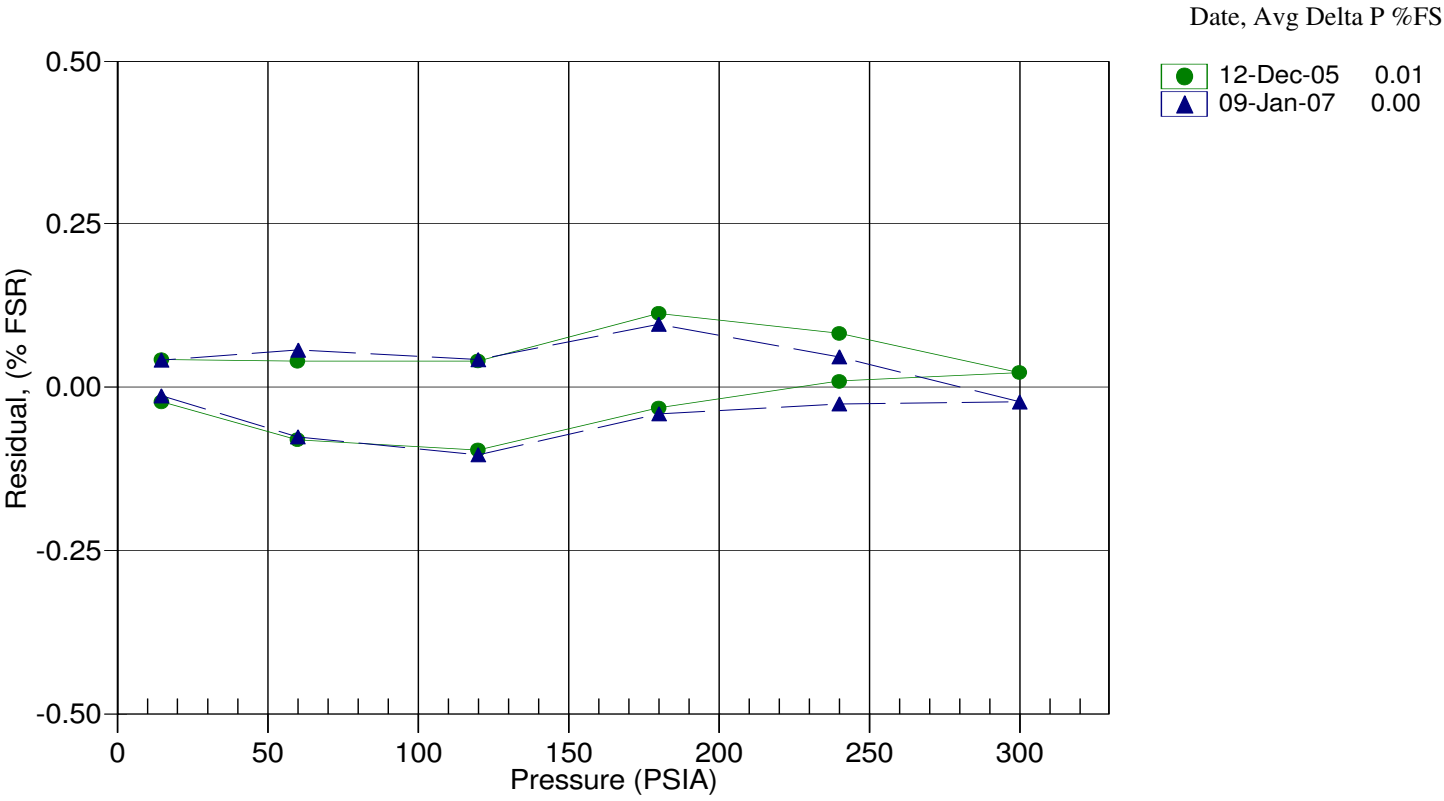
Straight Line Fit:

Pressure (psia) = M * N + B (N = binary output)

Quadratic Fit:

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

Residual = (instrument pressure - true pressure) * 100 / Full Scale Range



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: 0284
CALIBRATION DATE: 09-Jan-07

SBE19 PRESSURE CALIBRATION DATA
500 psia S/N 187674 TCV: 715

QUADRATIC COEFFICIENTS:

PA0 = 2.493530e+002
PA1 = -6.504156e-002
PA2 = 5.930355e-008

STRAIGHT LINE FIT:

M = -6.502416e-002
B = 2.496959e+002

PRESSURE PSIA	INST OUTPUT(N)	COMPUTED PSIA	ERROR %FS	LINEAR PSIA	ERROR %FS
14.51	3624.0	14.42	-0.02	14.05	-0.09
99.80	2310.0	99.42	-0.07	99.49	-0.06
199.79	771.0	199.24	-0.11	199.56	-0.04
299.77	-773.0	299.67	-0.02	299.96	0.04
399.76	-2304.0	399.52	-0.05	399.51	-0.05
499.74	-3835.0	499.66	-0.02	499.06	-0.14
399.74	-2311.0	399.98	0.05	399.97	0.04
299.76	-782.0	300.25	0.10	300.54	0.16
199.78	760.0	199.96	0.04	200.28	0.10
99.80	2299.0	100.14	0.07	100.21	0.08
14.49	3620.0	14.68	0.04	14.31	-0.04

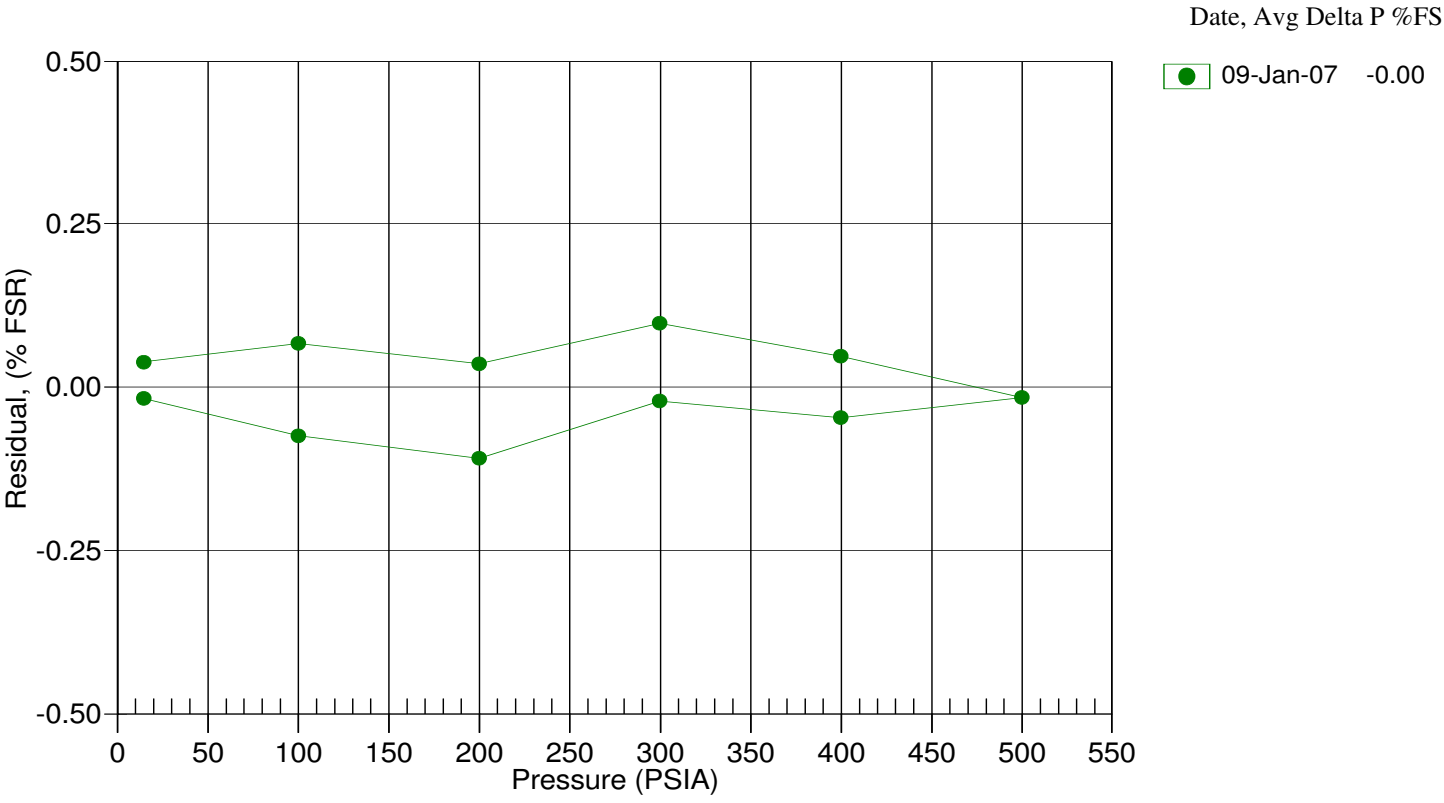
Straight Line Fit:

Pressure (psia) = M * N + B (N = binary output)

Quadratic Fit:

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

Residual = (instrument pressure - true pressure) * 100 / Full Scale Range



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: 1060
CALIBRATION DATE: 23-Dec-06

SBE19 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Seimens/meter

GHIJ COEFFICIENTS

```
g = -4.17404277e+000
h =  4.91607143e-001
i =  1.05771267e-003
j = -2.56662805e-005
CPcor = -9.5700e-008 (nominal)
CTcor =  3.2500e-006 (nominal)
```

ABCDM COEFFICIENTS

```
a =  4.52100603e-002
b =  4.42527771e-001
c = -4.15826598e+000
d = -1.07622701e-004
m =  2.1
CPcor = -9.5700e-008 (nominal)
```

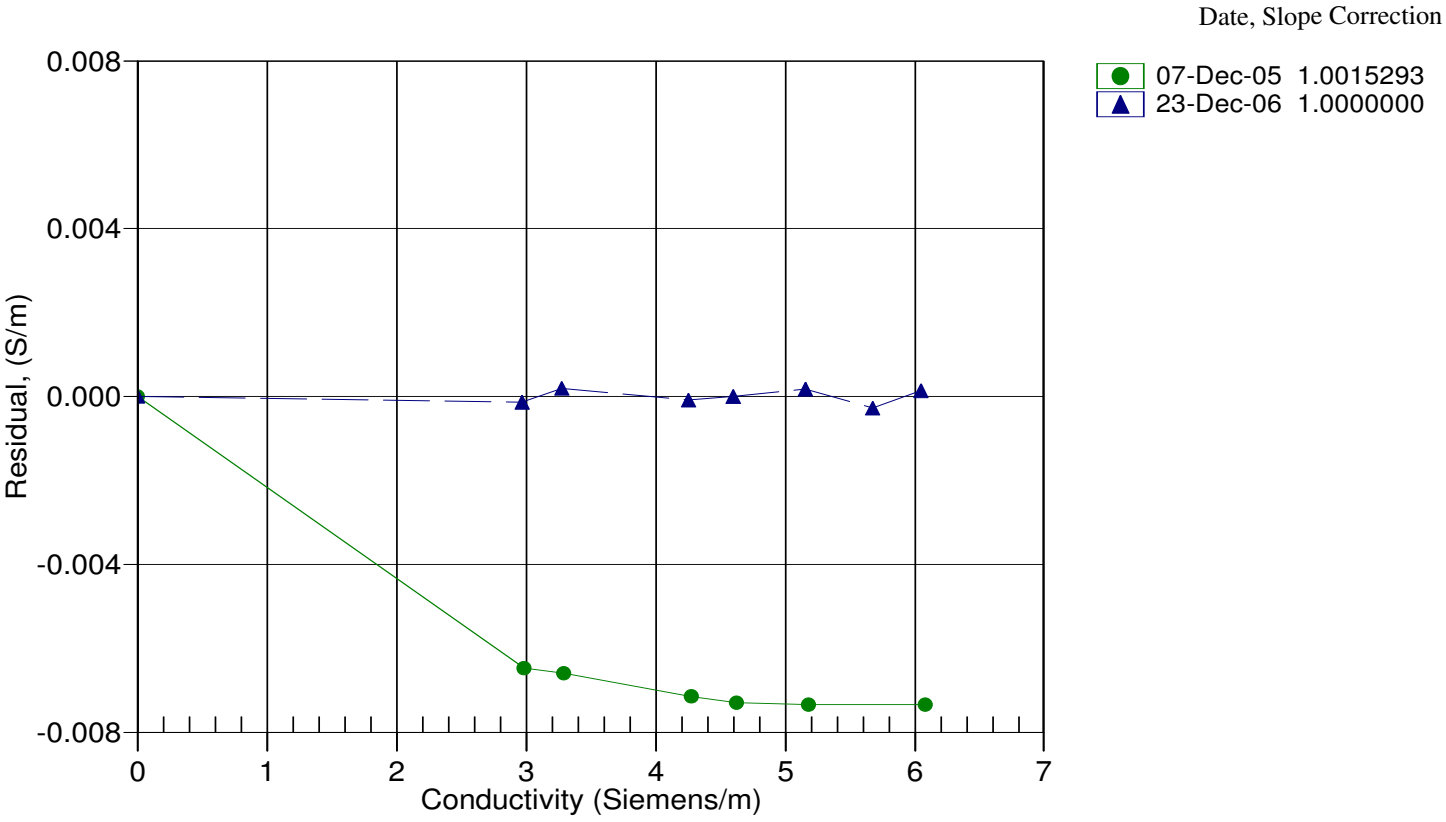
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREO (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2.90544	0.00000	0.00000
0.9999	34.6823	2.96559	8.23712	2.96545	-0.00014
4.5302	34.6619	3.27429	8.60321	3.27448	0.00019
15.0000	34.6195	4.25002	9.66730	4.24993	-0.00009
18.5000	34.6101	4.59396	10.01538	4.59396	-0.00000
23.9999	34.5998	5.14996	10.55360	5.15013	0.00017
29.0000	34.5933	5.66989	11.03241	5.66962	-0.00027
32.5000	34.5893	6.04087	11.36224	6.04100	0.00013

Conductivity = $(g + hf^2 + if^3 + jf^4) / 10(1 + \delta t + \varepsilon p)$ Siemens/meter

Conductivity = $(af^m + bf^2 + c + dt) / [10 (1 + \varepsilon p)$ Siemens/meter

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

Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



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: 1060
CALIBRATION DATE: 18-Jan-07

SBE19 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Seimens/meter

GHIJ COEFFICIENTS

```
g = -4.00655730e+000
h =  4.77160847e-001
i =  1.58152054e-003
j = -5.26348887e-005
CPcor = -9.5700e-008 (nominal)
CTcor =  3.2500e-006 (nominal)
```

ABCDM COEFFICIENTS

```
a =  4.34994730e-002
b =  4.32899735e-001
c = -4.00593425e+000
d = -2.00602691e-004
m =  2.1
CPcor = -9.5700e-008 (nominal)
```

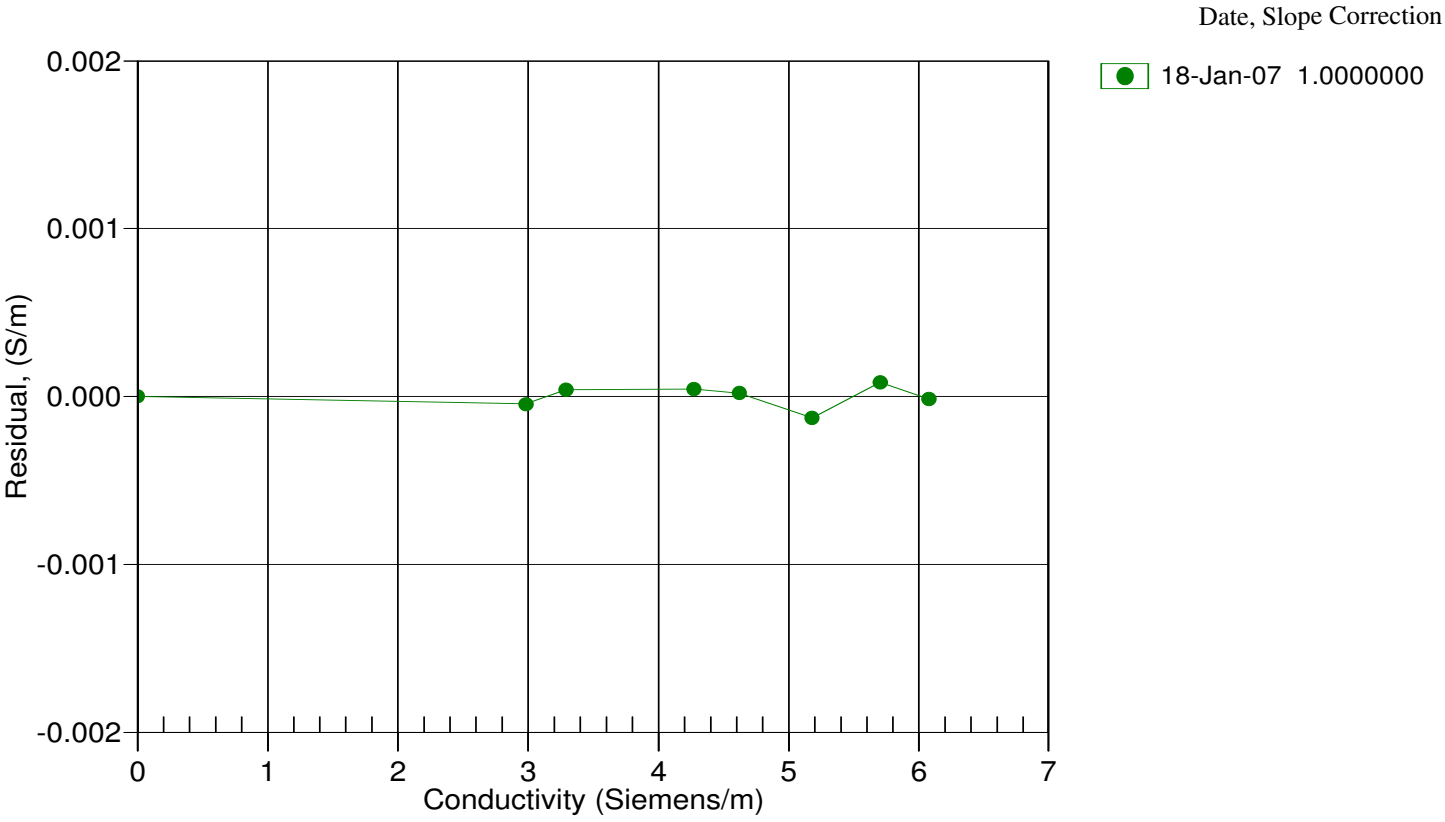
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREO (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2.88526	0.00000	0.00000
1.0000	34.8974	2.98224	8.33713	2.98219	-0.00004
4.4999	34.8773	3.28990	8.70589	3.28994	0.00004
14.9999	34.8344	4.27359	9.79119	4.27363	0.00004
18.5000	34.8252	4.61942	10.14501	4.61944	0.00002
24.0000	34.8147	5.17841	10.69198	5.17829	-0.00013
28.9999	34.8079	5.70109	11.17949	5.70117	0.00008
32.5000	34.8029	6.07392	11.51442	6.07390	-0.00002

Conductivity = $(g + hf^2 + if^3 + jf^4) / 10(1 + \delta t + \varepsilon p)$ Siemens/meter

Conductivity = $(af^m + bf^2 + c + dt) / [10 (1 + \varepsilon p)$ Siemens/meter

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

Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



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: 0284
CALIBRATION DATE: 30-Dec-06

SBE19 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Seimens/meter

GHIJ COEFFICIENTS

```
g = -3.95472366e+000
h =  4.72049769e-001
i =  1.09179738e-003
j = -1.69314269e-005
CPcor = -9.5700e-008 (nominal)
CTcor =  3.2500e-006 (nominal)
```

ABCDM COEFFICIENTS

```
a =  4.83201603e-003
b =  4.65882878e-001
c = -3.94470315e+000
d = -9.47892269e-005
m =  2.5
CPcor = -9.5700e-008 (nominal)
```

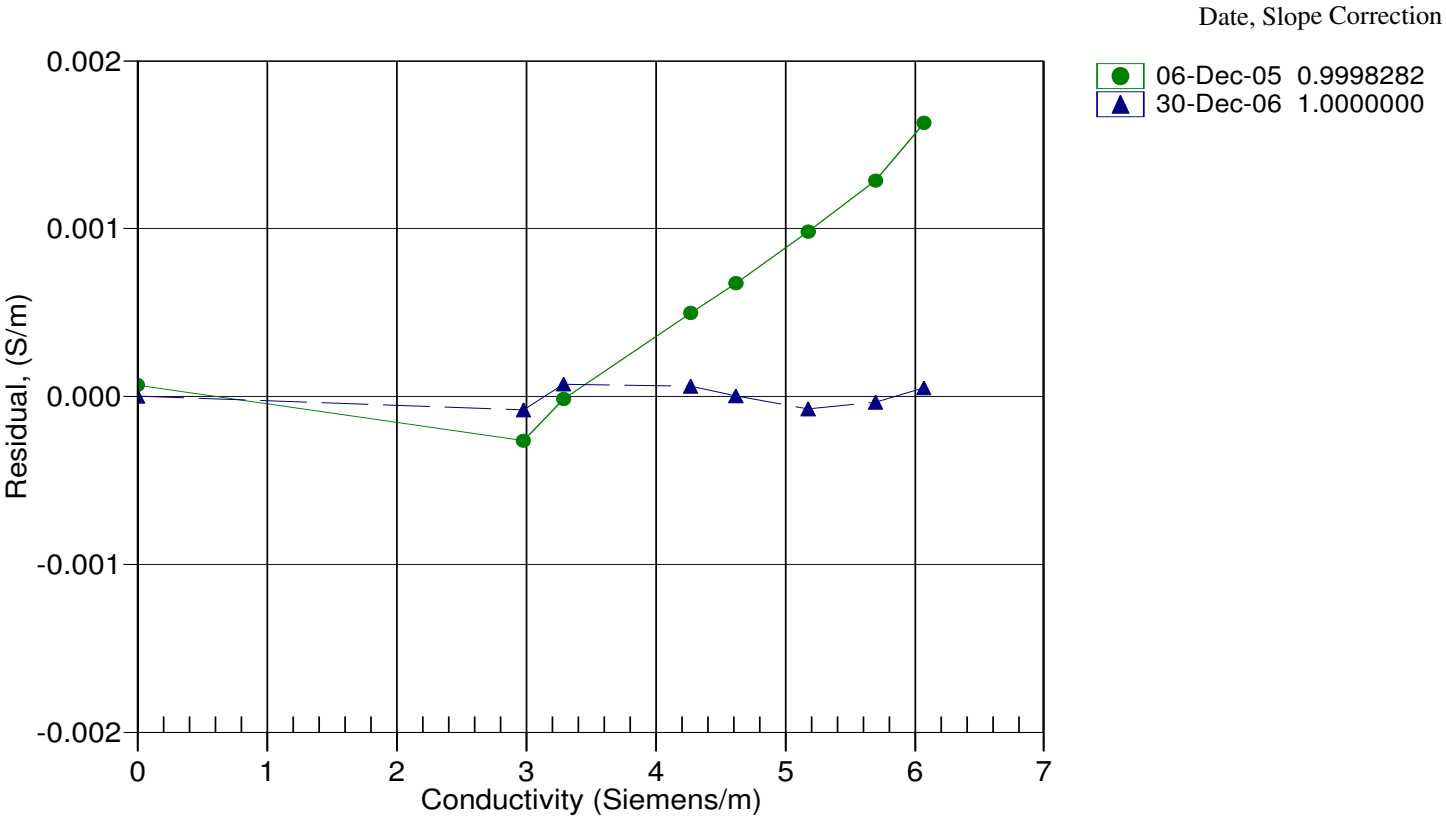
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREO (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2.88526	0.00000	0.00000
1.0000	34.8321	2.97719	8.38216	2.97711	-0.00008
4.4999	34.8132	3.28445	8.75318	3.28452	0.00007
15.0000	34.7768	4.26728	9.84442	4.26734	0.00006
18.5000	34.7686	4.61272	10.19973	4.61273	0.00000
24.0000	34.7605	5.17124	10.74894	5.17117	-0.00007
29.0000	34.7559	5.69354	11.23793	5.69350	-0.00003
32.5000	34.7530	6.06620	11.57401	6.06625	0.00005

Conductivity = $(g + hf^2 + if^3 + jf^4) / 10(1 + \delta t + \varepsilon p)$ Siemens/meter

Conductivity = $(af^m + bf^2 + c + dt) / [10 (1 + \varepsilon p)$ Siemens/meter

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

Residual = (instrument conductivity - bath conductivity) using g, h, i, j coefficients



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:	Atlantic Marine Center		
Job Number:	45139	**Date of Report:**	1/19/2007
Model Number	SBE 19-02	**Serial Number:**	196093-1060

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: 12/23/2006 **Drift since last cal:** +.00370 **PSU/month***

Comments:
One end of the conductivity cell was found cracked.

'CALIBRATION AFTER REPAIR' ☑ Performed ☐ Not Performed

Date: 1/18/2007 **Drift since Last cal:** N/A **PSU/month***

Comments:
The conductivity cell was replaced.

****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 Northeast, Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Conductivity Calibration Report

Customer:	Atlantic Marine Center		
Job Number:	45139	**Date of Report:**	1/2/2007
Model Number	SBE 19-02	**Serial Number:**	192472-0284

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: 12/30/2006 Drift since last cal: -.00040 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 Northeast, Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Temperature Calibration Report

Customer:	Atlantic Marine Center		
Job Number:	45139	**Date of Report:**	1/19/2007
Model Number	SBE 19-02	**Serial Number:**	196093-1060

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: 12/23/2006 Drift since last cal: -.00454 Degrees Celsius/year

Comments:

'FINAL CALIBRATION' ☑ Performed ☐ Not Performed

Date: 1/18/2007 Drift since 07 Dec 05 -.00293 Degrees Celsius/year

Comments:

DLDG_12Mar07

LEAST DEPTH REPORT, VELOCITY PROGRAM, Version 8.72

PROJECT: HSRR SURVEY: PATCH TEST DATE OF DIVE: 03-12-2007

NOAA UNIT: RUDE YEAR 2007
AWOIS NUMBER: NONE FIX NUMBER: NONE CONTACT NUMBER: NONE

CAST INSTRUMENT: SBE19 SEACAT S/N:284 CD:1/26/2005
DAY OF CAST (UTC): 071 TIME OF CAST (UTC): 15:46

DIVER GAUGE SERIAL NUMBER: 68336
DAY OF DIVE (UTC): 071 TIME OF LD MEASUREMENT (UTC): 15:46
LATITUDE OF DIVE: 36/58/06.00 N
LONGITUDE OF DIVE: 076/08/54.00 W
PREDIVE GAUGE PRESSURE (psia): 14.88
GAUGE PRESSURE AT DESIGNATED LEAST DEPTH (psia): 26.13

RESULTS
COMPUTED LEAST DEPTH (m): 7.87
TIDE CORRECTOR (m): 0.00
CORRECTED LEAST DEPTH (m): 7.87

COMMENTS AND RECOMMENDATIONS:

Subject: New Calibration File for Diver Gauge
From: Ruby Becker <ruby.becker@noaa.gov>
Date: Wed, 17 Jan 2007 11:33:18 -0500
To: FOO.Rude@noaa.gov
CC: Richard T Brennan <Richard.T.Brennan@noaa.gov>

```
Hi from HSTP:

Attached is file 68336.CAL which contains the new PTC calibration data plus extended data
for your Diver Least Depth Gauge.

PTC Calibration Date: 12/15/2006

I am also posting the file on the FTP site:  205.156.4.84 under
HSTPsoftware/DiverGaugeCalibrationFiles.

Best wishes,
Ruby
```

```
13.64   13.62
14.64   14.64
15.64   15.64
16.64   16.62
17.64   17.62
18.64   18.64
19.64   19.62
20.64   20.63
21.64   21.62
26.64   26.63
31.64   31.60
36.64   36.60
41.64   41.61
46.64   46.60
51.64   51.60
56.64   56.59
61.64   61.59
```

68336.CAL	**Content-Type:** text/plain **Content-Encoding:** 7bit

HSRR APPENDIX

Hydrographic Vessel Inventory

Hydrographic Personnel Roster

Hydrographic Hardware Inventory

Hydrographic Software Inventory

***Rude* Wiring Diagram**

***Rude* Offset Diagrams**

2007 Multibeam Patch Test

Multibeam Echosounder Calibration

Sounding Systems Comparison

Lead Line & Sounding Pole Calibration Report

2007 Side Scan SONAR Calibration Report

2007 Side Scan SONAR Calibration

Digibar Calibration Reports

Hydrographic Vessel Inventory

Field Unit: NOAA Ship RUDE

Effective Date: 3/13/07

Updated Through: 3/13/07

SURVEY VESSELS

Vessel Name	NOAA Ship RUDE					
Hull Number	s590					
Call Letters	WTET					
Manufacturer	Jackobson Shipyard, Oyster Bay, New York					
Year of Construction	1966					
Type of Construction	Welded steel hull					
Length Overall	Length (LOA): 27.4 m (90 ft.)					
Beam	Breadth (moulded): 6.7 m (22 ft.)					
Draft	Draft, Maximum: 2.2 m (7.2 ft.)					
Date of Effective Full Vessel Static Offset Survey	9-Mar-05					
Organization which Conducted the Effective Full Offset Survey	NGS					
Date of Last Partial Survey or Offset Verification & Methods Used	15-Dec-05					
Date of Last Static Draft Determination & Method Used	01 Mar 07 Optical Level					
Date of Last Settlement and Squat Measurements & Method Used	01 Mar 07 Optical Level					
Additional Information						

Hydrographic Personnel Roster

Field Unit: NOAA Ship RUDE

Effective Date: 4/13/07

Updated Through: 4/13/07

OFFICERS

Name and Grade	Current Position	Years of Hydrographic Experience	Notes
LCDR Lawrence T. Krepp	Commanding Officer	10	
LT Holly DeHart	Executive Officer	7.5	
LT Shawn Maddock	Field Operations Officer	2.75	
ENS Caryn Arnold	Navigator	0.75	

SURVEY DEPARTMENT

Name and Rate	Current Position	Years of Hydrographic Experience	Notes
Joshua Gunter	Survey Technician	0.1	

DECK DEPARTMENT (involved in survey work)

Name and Rate	Current Position	Years of Hydrographic Experience	Notes
Gordon Pringle	Chief Boatswain	16	

ROTATING HYDROGRAPHERS & VISITORS (involved in survey work)

Name and Rate	Current Position	Years of Hydrographic Experience	Notes & Dates Embarked
Wes Kitt	Physical Scientist	16	

NOTES:

Hydrographic Hardware Inventory

Field Unit: NOAA Ship RUDE

Effective Date: 3/13/07

Updated Through: 3/13/07

SONAR & SOUNDING EQUIPMENT

Equipment Type	Manufacturer	Model	Serial Number	Firmware and/or Software Version	Date of last Calibration	Date of last Service	Additional Information
Multibeam Echosounder TPU	Reson	8125	31562	unknown	unknown	unknown	
Multibeam Echosounder HEAD	Reson	8125	4400007	unknown	unknown	unknown	240 Beams 1° x 0.5° Resolution
Side Scan Sonar TPU	Klein	System 5000	138	V 4.17.2320	unknown	unknown	
Side Scan Sonar FISH	Klein	System 5000	280	N/A	1/17/2007	1/17/2007	
OdomVBES	Odom Hydrographic Systems INC.	Echotrac DF3200 MKII	9843	8.26	unknown	unknown	
Divers Least Depth Gauge	PTC Electronics	MODIII	68336	unknown	12/15/2006	12/15/2006	
Lead Line	CB Pringle	Traditional	N/A	N/A	3/24/2007	2/15/2006	

POSITIONING & ATTITUDE EQUIPMENT

Equipment Type	Manufacturer	Model	Serial Number	Firmware and/or Software Version	Date of last Calibration	Date of last Service	Additional Information
GPS Aided Inertial Naviation (box)	Applanix	POS/MV 320	2320	V 4	2/8/2006	new	Roll/Pitch Accuracy: 0.02° Heave Accuracy: the greater of 5cm or 5% for periods of 20s or less
GPS Aided Inertial Naviation (tophat)	Applanix	POS/MV 320 LN200	352	V 4	2/8/2006	new	Roll/Pitch Accuracy: 0.02° Heave Accuracy: the greater of 5cm or 5% for periods of 20s or less
DGPS Reciever	Trimble	DSM 12/212	220227632	unknown	unknown	unknown	

SOUND SPEED MEASUREMENT EQUIPMENT

Equipment Type	Manufacturer	Model	Serial Number	Firmware and/or Software Version	Date of last Calibration	Date of last Service	Additional Information
Sound Speed Profiler	Sea-Bird	SeaCat SBE 19-02	192472-0284	N/A	12/5/2006	12/5/2006	

Sound Speed Profiler	Sea-Bird	SeaCat SBE 19-01	196093-1060	N/A	12/5/2006	12/5/2006	
Surface Sound Speed Profiler	Odom	Digibar Pro	98130-010907	1.0	1/9/2007	1/9/2007	
TIDES & LEVELING EQUIPMENT							
Equipment Type	**Manufacturer**	**Model**	**Serial Number**	**Firmware and/or Software Version**	**Date of last Calibration**	**Date of last Service**	**Additional Information**
N/A							
HORIZONTAL AND VERTICAL CONTROL EQUIPMENT							
Equipment Type	**Manufacturer**	**Model**	**Serial Number**	**Firmware and/or Software Version**	**Date of last Calibration**	**Date of last Service**	**Additional Information**
N/A							
OTHER EQUIPMENT							
Equipment Type	**Manufacturer**	**Model**	**Serial Number**	**Firmware and/or Software Version**	**Date of last Calibration**	**Date of last Service**	**Additional Information**
Bottom Sampler	unknown, modified by CB Pringle	unknown	unknown	N/A	N/A	N/A	Sample size is 2309 cm^3
Optical Level	Carl Zeiss	unknown	43450	N/A	2/14/2007	2/14/2007	

Hydrographic Software Inventory

Field Unit: NOAA Ship RUDE

Effective Date: 4/28/07

Updated Through: 4/28/07

COMPUTERS

Machine Name	ADMIN_PC	SURVEY 2	PROCESSING	SONARCLIENT	HYPACK
Location	FIELD OFFICE	FIELD OFFICE	FIELD OFFICE	BRIDGE	BRIDGE
Make/Model	DELL PRECISION 450	DELL PRECISION 650	DELL PRECISION 650	DELL PRECISION 450	DELL PRECISION 450
Date Purchased	3/4/2004	3/4/2004	3/4/2004	3/4/2004	3/4/2004
Date of Last Rebuild	N/A	11/1/2005	N/A	N/A	N/A
Processor	Intel(R) Xeon(TM) CPU 2.80GHz	Intel(R) Xeon(TM) CPU 2.80GHz	Intel(R) Xeon(TM) CPU 2.80GHz	Intel(R) Xeon(TM) CPU 2.80GHz	Intel(R) Xeon(TM) CPU 2.80GHz
RAM	2 GB	2GB	4 GB	1 GB	2 GB
Video Card	NVIDIA Quadro FX 1000	NVIDIA Quadro FX 1000	NVIDIA Quadro FX 1000	NVIDIA Quadro FX 1000	NVIDIA Quadro FX 1000
Video RAM	128 MB	128 MB	128 MB	128 MB	128 MB
Comments	CARIS bogs down on this machine.	CARIS bogs down on this machine. Mapinfo 8.0 crashes this machine.	CARIS bogs down on this machine. Mapinfo 8.0 crashes this machine.	Isis data acquisition machine.	Hypack data acquisition machine. CARIS bogs down on this machine.

OPERATING SYSTEM PACKAGE: Windows XP

	Machine Name	ADMIN_PC	SURVEY 2	PROCESSING	SONARCLIENT	HYPACK
Operating System Installations & Updates (Date)	Version 5.1.2600 Install	7/21/2003	7/21/2003	7/21/2003	7/21/2003	7/21/2003
	SP 2	7/21/2003	7/21/2003	7/21/2003	7/21/2003	7/21/2003

ACQUISITION SOFTWARE PACKAGE: HypackMAX

	Machine Name	HYPACK				
Software Installations & Updates (date)	Version 2.12A	2/10/2004				
	Note:	Version 6.2a was installed 4/24/07, but will not be used until surveying is complete on sheet H11534				

ACQUISITION SOFTWARE PACKAGE: Triton ISIS						
	Machine Name	SONARCLIENT				
Software Installations & Updates (date)	Version 6.6.1.3.6	6/30/2004				

PROCESSING SOFTWARE PACKAGE: CARIS HIPS/SIPS						
	Machine Name	ADMIN_PC	SURVEY 2	PROCESSING	HYPACK	
Software Installations & Updates (date)	Version 6.1 Install	4/24/2007	4/24/2007	4/24/2007	4/24/2007	
	Hotfixes 1-11	4/24/2007	4/24/2007	4/24/2007	4/24/2007	

PROCESSING SOFTWARE PACKAGE: CARIS GIS						
	Machine Name	ADMIN_PC	SURVEY 2	PROCESSING	HYPACK	
Software Installations & Updates (date)	Version 4.4a Install	Unknown	Unknown	Unknown	Unknown	
	SP5	9/15/2006	9/15/2006	9/15/2006	9/15/2006	
	Hotfixes 1-24	9/15/2006	9/15/2006	9/15/2006	9/15/2006	
	Hotfixes 25-34	4/24/2007	4/24/2007	4/24/2007	4/24/2007	

PROCESSING SOFTWARE PACKAGE: Pydro						
	Machine Name	ADMIN_PC	SURVEY 2	PROCESSING	HYPACK	
Software Installations & Updates (date)	Version 7.3.0 Install	8/23/2005	4/12/2007	4/9/2007	8/23/2005	

PROCESSING SOFTWARE PACKAGE: MapInfo

	Machine Name	ADMIN_PC	SURVEY 2	PROCESSING	HYPACK	
Software Installations & Updates (date)	Version 8.5 Install	12/11/2006	12/11/2006	12/11/2006	4/23/2007	
	SP					
	Hotfixes 1-					

SUPPORT SOFTWARE PACKAGE: MS Office

	Machine Name	ADMIN_PC	SURVEY 2	PROCESSING	SONARCLIENT	HYPACK
Software Installations & Updates (date)	V 10.0.6	2/2/2004	2/2/2004	2/2/2004	2/2/2004	2/2/2004

SUPPORT SOFTWARE PACKAGE: Adobe Acrobat Professional

	Machine Name	ADMIN_PC	SURVEY 2	PROCESSING	SONARCLIENT	HYPACK
Software Installations & Updates (date)	Version 6.0	6.0		6.0		
	SP1	1/30/2004		1/30/2004		
	Version 7.0		7.0.2 (date unknown)		7.0	7.0
	SP1				12/14/2004	12/14/2004

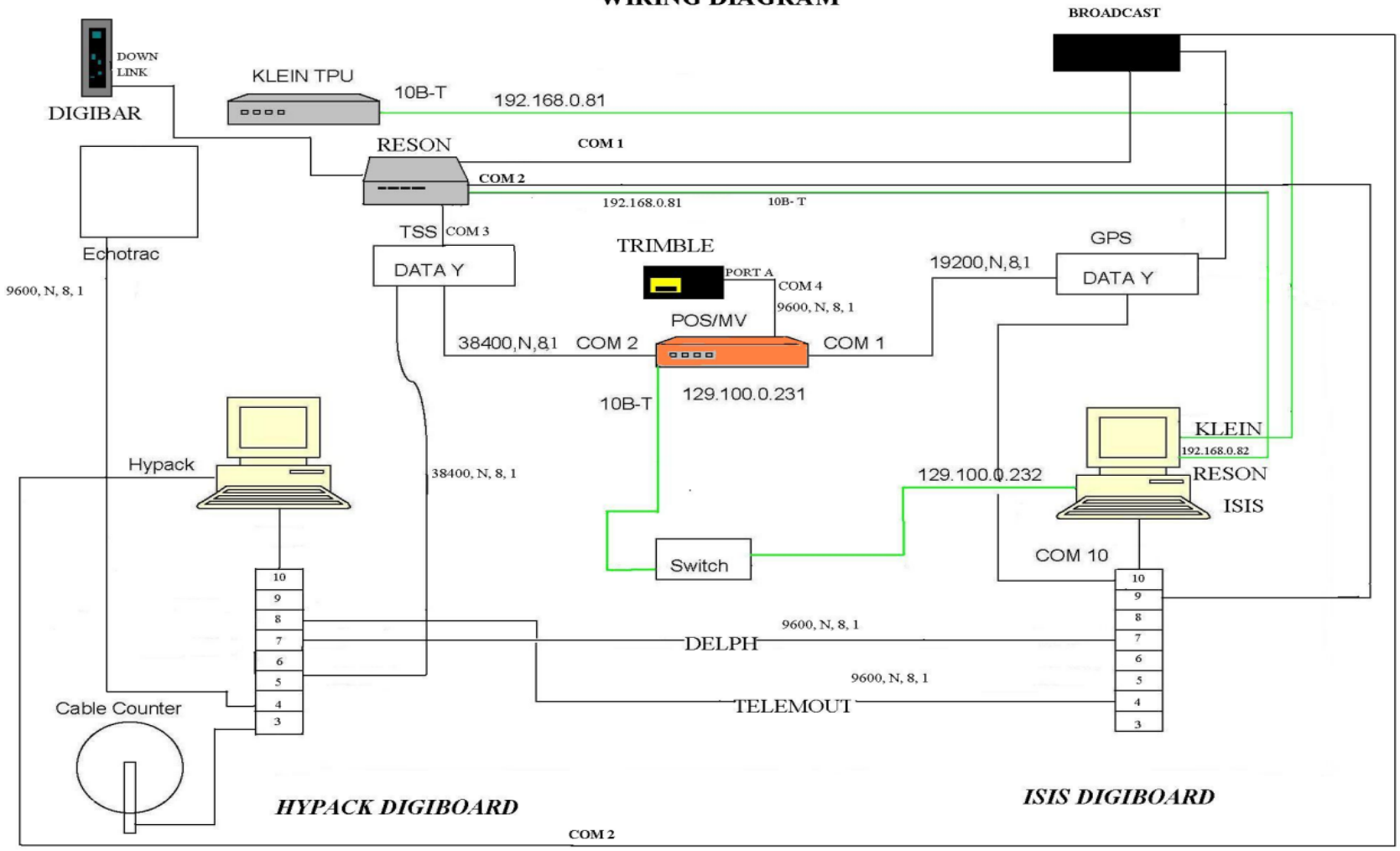
SUPPORT SOFTWARE PACKAGE: Velociwin

	Machine Name	ADMIN_PC				
Software Installations & Updates (date)	Version 8.85	3/16/2005				

SUPPORT SOFTWARE PACKAGE: Trimble TSIP Talker

	Machine Name	HYPACK				
Software Installations & Updates (date)	Version 2.0	2/3/2004				

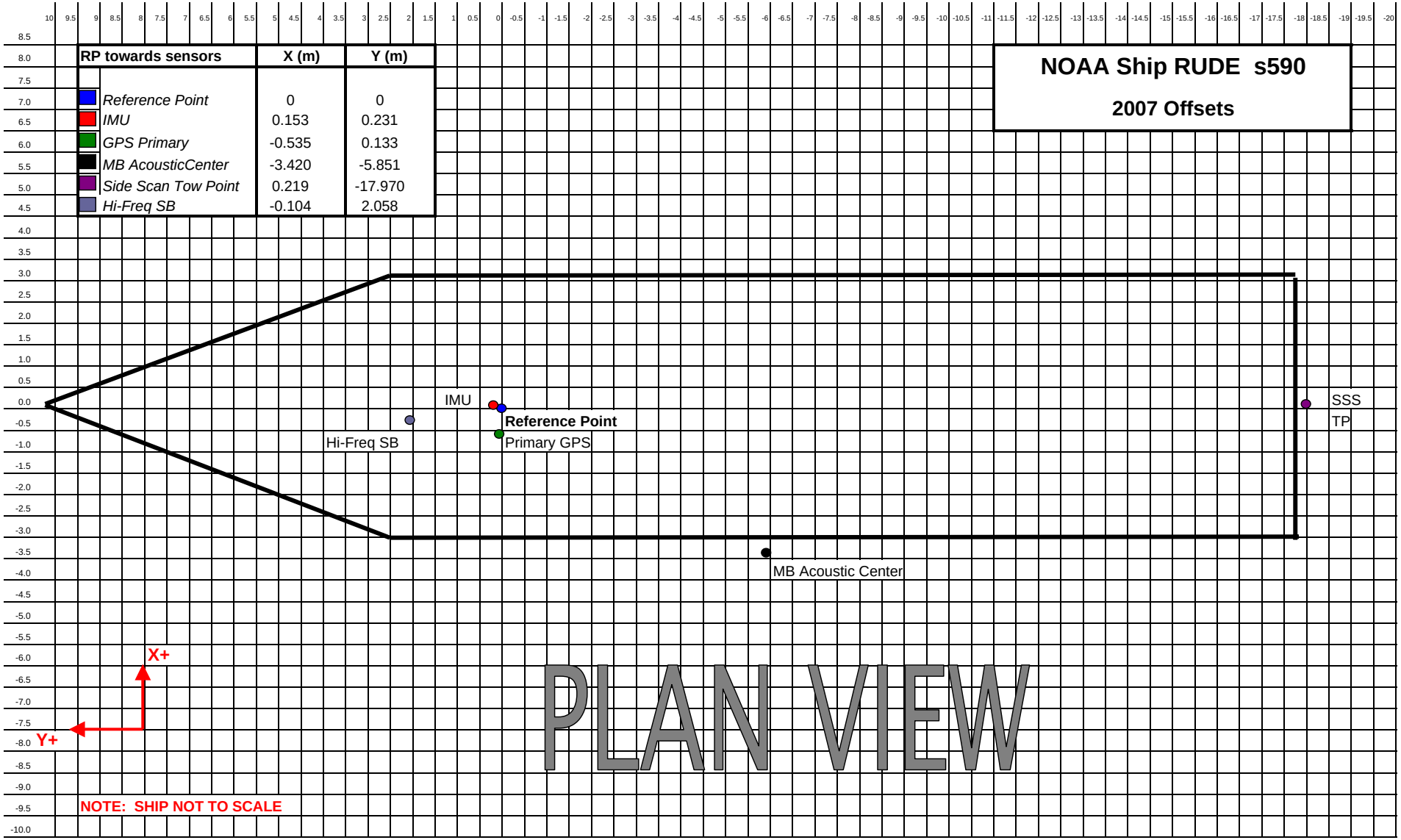
RUDE SURVEY
WIRING DIAGRAM



NOAA Ship RUDE s590

2007 Offsets

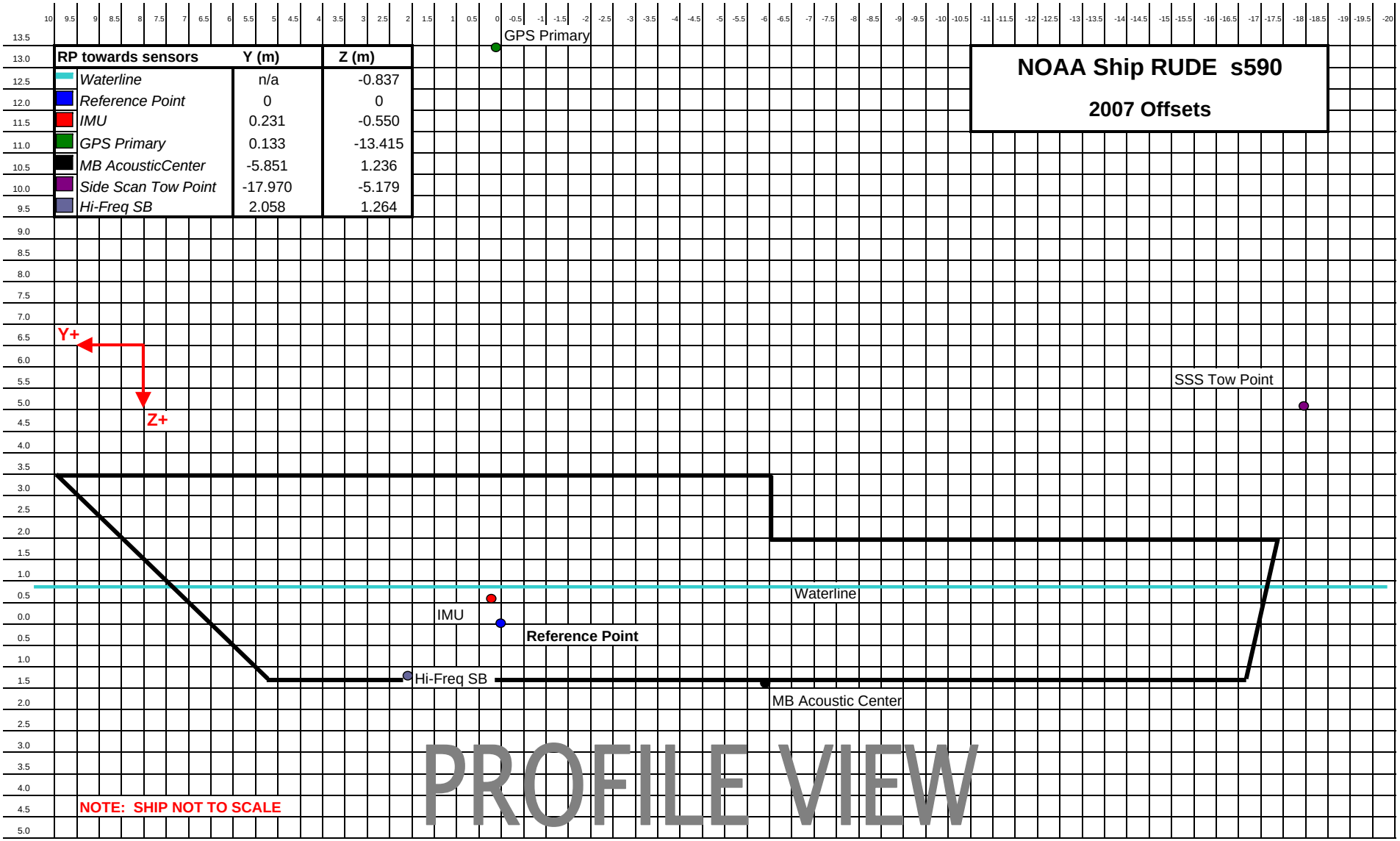
RP towards sensors	X (m)	Y (m)
Reference Point	0	0
IMU	0.153	0.231
GPS Primary	-0.535	0.133
MB AcousticCenter	-3.420	-5.851
Side Scan Tow Point	0.219	-17.970
Hi-Freq SB	-0.104	2.058



NOAA Ship RUDE s590

2007 Offsets

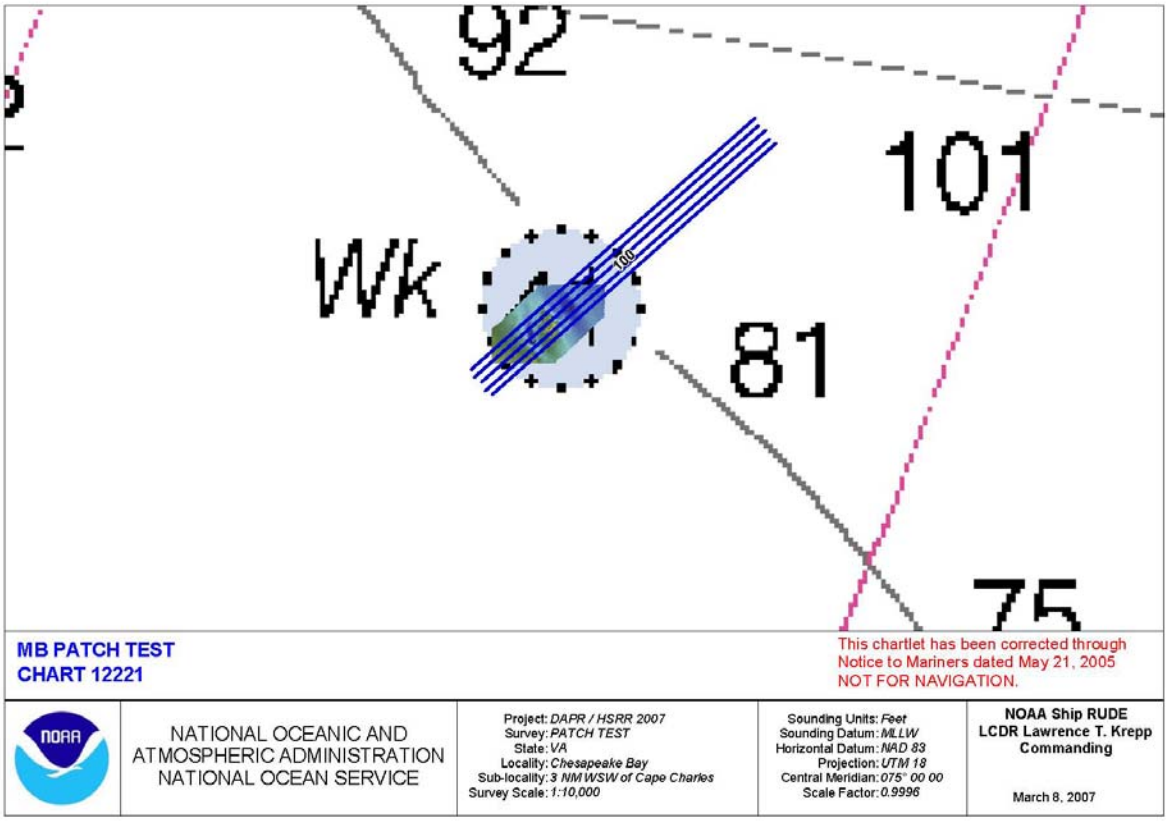
RP towards sensors	Y (m)	Z (m)
Waterline	n/a	-0.837
Reference Point	0	0
IMU	0.231	-0.550
GPS Primary	0.133	-13.415
MB AcousticCenter	-5.851	1.236
Side Scan Tow Point	-17.970	-5.179
Hi-Freq SB	2.058	1.264



***Rude* 2007 Multibeam Patch Test**

On March 8th, 2007 the *Rude* performed its annual MB patch test. The multibeam data were collected using a RESON 8125 MBES. The patch test was conducted over the Texeco wreck located at 37^0 14' 58.272" N -076^0 5' 4.668" W, 3nm West SW of Cape Charles, Virginia. Survey lines were run in a SW-NE direction. The test consisted of five lines spaced 30m apart. Line 1 was surveyed three times at various speeds and opposite directions for Navigation timing and Pitch error. Lines 2, 3, 4, & 5 were used for Yaw error.

All data collected was processed using Caris HIPS and SIPS 6.0, SP1 (Note: *Rude* installed CARIS 6.1 and all applicable hotfixes on April 24th). After conversion and processing, the data were used to adjust the ships sensor settings to provide the best overall settings for future data acquisition. All patch test data were reviewed by ENS Arnold. Several off-set settings were attempted before the final offsets were decided upon. These were an average of the values achieved. These settings for the RESON 8125 will be used at the start of the 2007 field season.



PATCH TEST 2007			
PRECISE			
TIME	PITCH	YAW	ROLL
0.080	**0.950**	**-1.700**	**-1.700**

Multibeam Echosounder Calibration

Field Unit: NOAA Ship RUDE

Date of Test: 08 March, 2007

Calibrating Hydrographer(s): PS Kitt, ENS Arnold

MULTIBEAM SYSTEM INFORMATION

Multibeam Echosounder System: RESON 8125

System Location: Bridge

Sonar Serial Number: 4400007

Processing Unit Serial Number: 31562

Date of Most Recent EED / Factory Checkout: unknown

VESSEL INFORMATION

Sonar Mounting Configuration: pole-mount on port side of vessel

Date of Current Vessel Offset Measurement / Verification: March 9, 2005

Description of Positioning System: POS/MV version 4 w/ Precise Timing

Date of Most Recent Positioning System Calibration: 8 Mar, 2007

TEST INFORMATION

Test Date(s) / DN(s): 08 March, 2007

System Operator(s): PS Kitt

Wind / Seas / Sky: 7-10 knots / 1-2 ft / clear

Locality: Chesapeake Bay

Sub-Locality: 3 nm WSW from Cape Charles

Bottom Type: sandy

Approximate Average Water Depth:16 meters

DATA ACQUISITION INFORMATION

Line Number	Heading (deg)	Speed (m/s)
100_1628	229	9.5
100_1634	49	10.2
100_1641	229	3.2
101_1653	49	8.0
101_1659	229	8.0
104_1705	49	8.0
104_1711	229	8.0
103_1716	49	8.0
103_1723	229	4.5
102_1731	49	4.5
102_1738	229	4.5

TEST RESULTS

Navigation Timing Error: -0.08

Pitch Timing Error: 0.0

Roll Timing Error: 0.0

Pitch Bias: 0.95

Roll Bias: -1.70

Heading Bias: -1.70

Resulting CARIS HIPS HVF File Name: RU_MB_2007

NARRATIVE

Five parallel lines were run over a known wreck (these same lines were used last year). A brief description with the purpose of each line and the wreck's location can be found in the PDF called "Multibeam Patch Test." From last year, there is little change in the pitch, roll or heading biases. Last year's values were: -0.050, -1.74 and -2.00, respectively. There is a significant improvement in the Nav Time Error, from last year's +0.20, to this year's -0.08.

Sounding Systems Comparison

Field Unit: RUDE

Date & Time	Location (Lat, Lon)	Sounding System Models & Serial Numbers	Processed Depth (m)	System Operator	Comments
3/12/2007	Latitude 36° 57' 58.86" N, Longitude 76° 08' 41.42" W	Traditional lead line	8.72	LT Maddock	Annual Systems Certification comparison. Sea conditions calm, 1/2 ft swell.No corrections necessary
3/12/2007	Latitude 36° 57' 58.86" N, Longitude 76° 08' 41.42" W	Reson 8125	8.152	CST Kitt	Annual Systems Certification comparison. Sea conditions calm, 1/2 ft swell.No corrections necessary.
3/12/2007	Latitude 36° 57' 58.86" N, Longitude 76° 08' 41.42" W	Echotrac Singlebeam	8.281	CST Kitt	Annual Systems Certification comparison. Sea conditions calm, 1/2 ft swell.No corrections necessary.
3/12/2007	Latitude 36° 57' 58.86" N, Longitude 76° 08' 41.42" W	DLDG MODIII	7.87	LT DeHart / ENS Arnold	Annual Systems Certification comparison. Sea conditions calm, 1/2 ft swell.No corrections necessary.

Lead Line & Sounding Pole Calibration Report

Field unit: NOAA Ship RUDE

Lead Line / Sounding Pole Identification Number:
(Unique Identifier, with equipment type, date made, etc.)

Date of Calibration: 24 Mar 2007

Method of Calibration: ☐ **Steel tape** ☐ **Permanent graduation marks**
■ **Other (Fiberglass Tape Line)**

Location: In transit to Cape Canaveral, FL

Chief of Party: LCDR Lawrence T. Krepp

Lead Line / Sounding Pole Unit of Measure: Meters

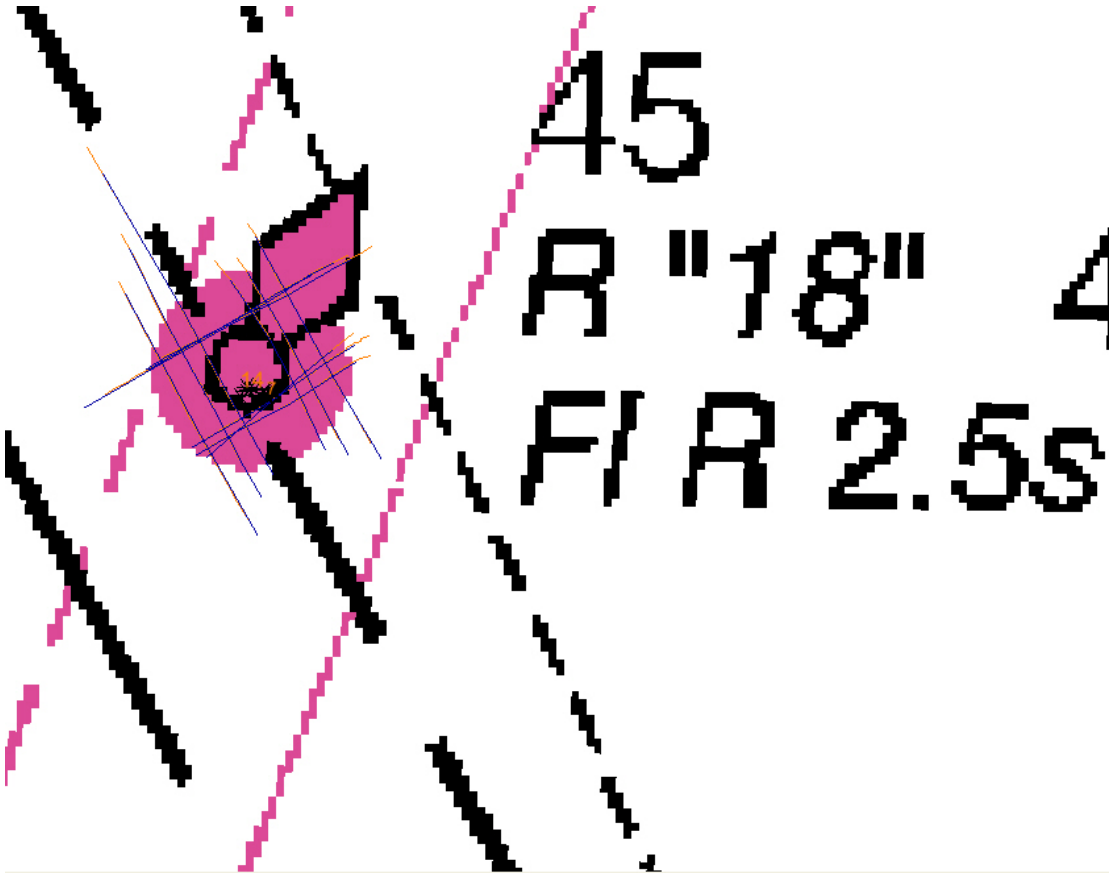
Measured by:	**Recorded by:**	**Checked by:**
LT Maddock	LT Maddock	ENS Arnold

Graduated Marking (a)	Calibration Measurement (b)	Lead Line Corrector (c = b - a)
1	0.970	-0.030
2	1.970	-0.030
3	2.992	-0.008
4	3.980	-0.020
5	4.980	-0.020
6	5.960	-0.040
7	6.970	-0.030
8	7.950	-0.050
9	8.960	-0.040

***Rude* 2007 Side Scan SONAR Calibration**

On March 8th, 2007 the *Rude* performed its annual SSS Calibration. The data were collected using a Klein 5000 towfish. The patch test was conducted in Chesapeake Channel at red buoy "18," located at 37° 05.76' N 076° 06.74' W, 7NM WSW of Cape Charles, Virginia. Survey lines were run in accordance with the FPM. The test consisted of twelve lines spaced in such a way to use both channels of the towfish with the 50, 75 and 100-meter range scale to detect the buoy block on the seafloor. Due to the current, and the buoy's position with respect to the block, the three lines on the north side almost lay on top of each other, even though each range scale was used.

All data collected was processed using *Caris HIPS and SIPS* 5.4 (Note: *Rude* installed *Caris* 6.1 and all applicable hotfixes on April 24th). After conversion and processing, the data were used to adjust the ship's sensor settings to provide the best overall settings for future data acquisition. All patch test data were reviewed by PS Kitt and PS Owens of AHB. As with 2006, there is enough spread between the "hits" to keep our position quality from being within the 10 meters required of towed systems by the FPM. AHB and HSTP are investigating the source of this problem. As in 2006, entering a –3.5 second value in the timing error for *Caris* brought the grouping to within the position requirement. However, without knowing the actual cause, entering this time difference does not serve as a proper solution. A different amount of cable out might not produce the same result, thus requiring a different time value.



Side Scan Sonar Calibration

Field Unit: NOAA Ship RUDE
Date of Test: March 8, 2007
Calibrating Hydrographer(s): PS Kitt

SIDE SCAN SYSTEM INFORMATION

Side Scan System: Klein System 5000
System Location: RUDE Bridge
TPU Serial Number: 138
Towfish Serial Number: 280
Cable Type: stainless steel armored w/ termination
Date of Most Recent EED / Factory Checkout: N/A
Date of Most Recent Pressure Sensor Verification (if applicable): N/A

VESSEL INFORMATION

Sonar Configuration: towed
Cable Measurement System (if applicable): M/D TOTCO cable counter
Date of Current Vessel Offset Measurement / Verification: 3/9/05
Date of Current Cable Measurement / Verification (if applicable): N/A

TEST INFORMATION

Test Date(s) / DN(s): 3/08/07
System Operator(s): PS Kitt
Wind / Seas / Sky: 7-10 knots / 1-2 ft / clear
Locality: Cesapeake Bay
Sub-Locality: R "18" Bouy of the Chesapeake Channel, approx.6.4 NM West of Fishermans Island.
Description of Bathymetry: flat
Bottom Type: mud
Approximate Water Depth: 45 ft
Description of Target: bouy block target
Approximate Target Size: 1m L x 1m W x 1m H

TEST INFORMATION (continued)

Target Position: 37° 05.76' N - 076° 06.74'W
Description of Positioning Method: Average from contact positions
Estimated Target Position Error: +/- 1m
Approximate Survey Speed: 4.6 knots
Approximate Towfish Altitude: 7.5 m

DATA ACQUISITION INFORMATION

Line Number	Heading (deg)	Speed (knots)
105_2015	151	5
102_2007	150	4.9
106_2028	241	4.4
104_2024	150	5
109_2003	238	4.5
106_1953	241	4.4
106_2011	241	4.4
107_1945	230	4.4
111_2019	240	4.4
100_1938	150	4.9
101_1948	149	4.8
103_1958	152	4.8

TEST RESULTS

Number of Passes on Target: 12
Succesful Target Detections: 11
Mean Detected Position: 37° 05' 44" N - 076° 06' 44" W
Distance from Mean Position to True Position: 23m
Approximate 95% Confidence Radius: 23m

NARRATIVE

Twelve lines were run, in accordance with the FPM, to acquire data on both channels of the towfish at the 50- 75- and 100-meter ranges. A brief description of the lines can be found as part of this DAPR (HSRR appendix) document, which is also a stand-alone PDF titled "2007 SSS Calibration."

Read Me regarding Digibar Serial No.txt

Paperwork for Digibar probe 98207 is really for probe 98013.

During the winter in-port period of 2006-2007, RUDE sent its Digibar probe (S/N 98013) to Odom for calibration via the Norfolk ET's. It was sent in with a small section of cable still attached. In addition to the calibration, a special connector was to be fitted to the bare end of this cable, to allow for disconnection of the probe in the future without having to pull all the cable from the deck unit in the bridge.

When the cal report came back as a PDF via e-mail from the ET's, it was with an entirely different serial number. The survey department got in touch with the ET's about this, and asked them to send the calibration report for S/N 98013...the probe that RUDE documentation (DAPR, HSRR, etc.) shows having been on the ship in 2006, and the one installed after the 2006-2007 calibration. Correspondence between the ET's and the ship became confusing, since the ET's knew that the probe sent for calibration/alteration is the same one that came back - and RUDE personnel physically looking at the probe could see that the same one truly came back (# 98013). Since the ET's didn't need to inspect the serial number on the probe when it returned from Odom, they had every reason to believe that the included paperwork was correct, and figured that the ship had whatever S/N the report stated (# 98207). They even asked RUDE to verify the probe's S/N again.

Upon investigation and a couple of phone calls to Odom from the ET's, it turns out that a clerical error was made on the cal report from Odom. They put the wrong S/N on the paperwork with RUDE's probe. RUDE did indeed get the correct probe back. The report, as well as the work order (attached to this same document) are all supposed to be for S/N 98013. This is being supported by the fact that the cable modification, with the special connector, was a one-of-a-kind alteration.

December 13th 2006

Odom Hydrographic Systems
Attn: Ken Spivey
1450 Seaboard Avenue
Baton Rouge, Louisiana 70810

NOAA MOC Atlantic
Ken Nadeau
439 West York St.
Norfolk, VA 23510
508-415-8014

Hello Ken,

Enclosed is a Digibar Pro probe, SN 98013. Please perform the following operations;

1) Check out and annual calibration. Was working properly before removal.

2) On the cable, you will find a red tag and red tape. Cut the cable and add a water tight connector in the line so we can disconnect the cable from the main unit at that point. Please make sure that both connectors have caps.

3) Payment – when you are ready to ship back, please call me so I can provide my credit card info to you and give you shipping instructions.

4) Questions – please direct your questions to me at the above telephone number or email address above.

Thank you,

Ken Nadeau

Date:
Jan 12, 2007

Serial #:
98207-011207

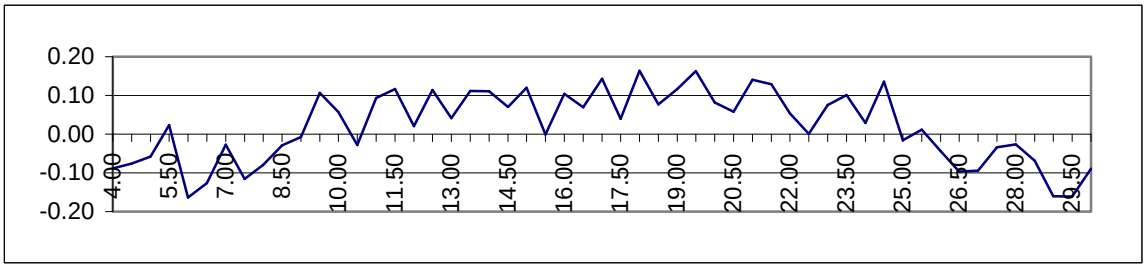
DIGIBAR CALIBRATION REPORT

version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.

STANDARD DEL GROSSO H^2O

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
4.00	1421.62	5546.29	1421.53	-0.09
4.50	1423.90	5555.07	1423.82	-0.08
5.00	1426.15	5563.77	1426.09	-0.06
5.50	1428.38	5572.61	1428.40	0.02
6.00	1430.58	5580.32	1430.41	-0.16
6.50	1432.75	5588.79	1432.62	-0.13
7.00	1434.90	5597.40	1434.87	-0.03
7.50	1437.02	5605.19	1436.90	-0.12
8.00	1439.12	5613.36	1439.04	-0.08
8.50	1441.19	5621.49	1441.16	-0.03
9.00	1443.23	5629.41	1443.23	-0.01
9.50	1445.25	5637.59	1445.36	0.11
10.00	1447.25	5645.05	1447.31	0.06
10.50	1449.22	5652.28	1449.19	-0.03
11.00	1451.17	5660.21	1451.26	0.09
11.50	1453.09	5667.67	1453.21	0.12
12.00	1454.99	5674.58	1455.02	0.02
12.50	1456.87	5682.13	1456.99	0.11
13.00	1458.72	5688.95	1458.77	0.04
13.50	1460.55	5696.23	1460.67	0.11
14.00	1462.36	5703.15	1462.47	0.11
14.50	1464.14	5709.83	1464.22	0.07
15.00	1465.91	5716.77	1466.03	0.12
15.50	1467.65	5722.97	1467.64	0.00
16.00	1469.36	5729.95	1469.47	0.10
16.50	1471.06	5736.31	1471.13	0.07
17.00	1472.73	5743.00	1472.87	0.14
17.50	1474.38	5748.93	1474.42	0.04
18.00	1476.01	5755.65	1476.17	0.16
18.50	1477.62	5761.48	1477.70	0.08
19.00	1479.21	5767.71	1479.32	0.12
19.50	1480.77	5773.89	1480.93	0.16
20.00	1482.32	5779.50	1482.40	0.08
20.50	1483.84	5785.25	1483.90	0.06
21.00	1485.35	5791.33	1485.49	0.14
21.50	1486.83	5796.97	1486.96	0.13
22.00	1488.29	5802.29	1488.35	0.05
22.50	1489.74	5807.62	1489.74	0.00
23.00	1491.16	5813.36	1491.24	0.08
23.50	1492.56	5818.84	1492.67	0.10
24.00	1493.95	5823.87	1493.98	0.03
24.50	1495.32	5829.51	1495.45	0.14
25.00	1496.66	5834.09	1496.65	-0.02
25.50	1497.99	5839.28	1498.00	0.01
26.00	1499.30	5844.08	1499.25	-0.04
26.50	1500.59	5848.82	1500.49	-0.10
27.00	1501.86	5853.70	1501.76	-0.09
27.50	1503.11	5858.73	1503.08	-0.03
28.00	1504.35	5863.49	1504.32	-0.03
28.50	1505.56	5867.99	1505.49	-0.07
29.00	1506.76	5872.23	1506.60	-0.16
29.50	1507.94	5876.75	1507.78	-0.16
30.00	1509.10	5881.48	1509.01	-0.09



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

Date:
Jan 12, 2007

Serial #:
98207-011207

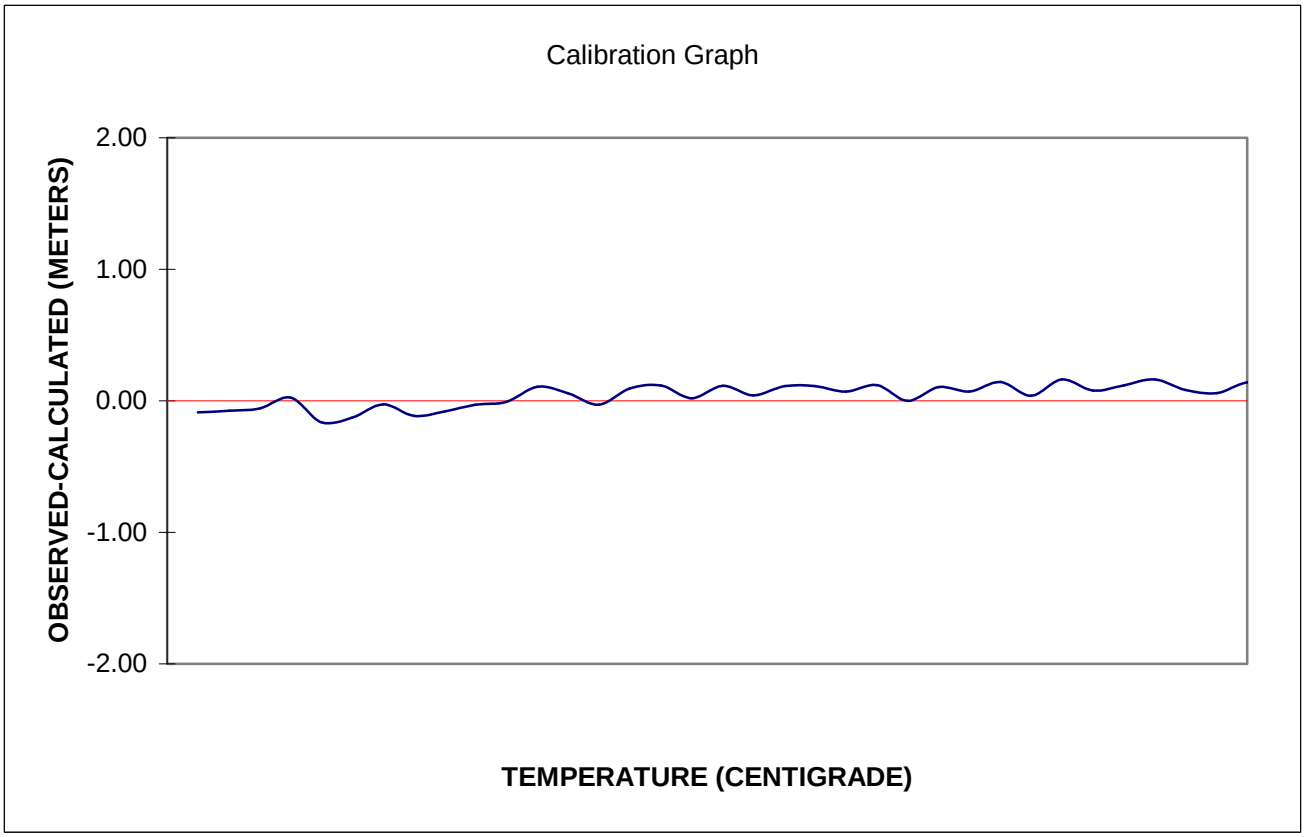
DIGIBAR CALIBRATION REPORT

version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.

Burn these numbers to EPROM:

Gradient	**3341**
Intercept	**261**



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

odom
HYDROGRAPHIC SYSTEMS

Order Number 8595-A

Customer **NOAA49**

1450 Seaboard Avenue * Baton Rouge, Louisiana 70810-6261 USA
E-mail: email@odomhydrographic.com * http://www.odomhydrographic.com
Telephone: (225) 769-3051 * Facsimile: (225) 766-5122

Bill To:

NOAA MOCA
439 W. York St
Norfolk, VA 23510
U.S.A

Ship To:

NOAA MOCA
Attn: Ken Nadeau
439 W. York St
Norfolk, VA 23510
U.S.A

THIS IS A REVISED ORDER

Order Date	Ship Via	F.O.B.	Terms
01/10/07	FedEx st o/n	ORIGIN	Net 30 Days

Purchase Order Number	Req Date	Salesperson	Our Order Number
Gov VISA-see comment	01/10/07	KESP	NONE

Quantity Req.	Quantity Ship	Quantity B.O.	Item Number / Description	Required Date	Unit of Measure	Tax	Unit Price	Amount
1	0		3300-0012-0000 Repairs to Digibar Pro - S/N:98207 Cleaned sounding cage, calibrated probe, tested ok. Installed water tight connectors at customer's location on cable.	01/10/07	EACH	N	0.00	0.00
1	0		0800-0002-0000 Connector UnderWater 5p FEMALE	01/10/07	EACH	N	84.40	84.40
1	0		0800-0003-0000 Connector UnderWater 5p MALE	01/10/07	EACH	N	76.00	76.00
1	0		0800-0004-0000 SLEEVE, FEMALE LOCKING	01/10/07	EACH	N	10.80	10.80
1	0		0800-0005-0000 SLEEVE, MALE LOCKING	01/10/07	EACH	N	10.80	10.80
1	0		0800-0006-0000 DUMMY PLUG - MALE	01/10/07	EACH	N	57.20	57.20
1	0		0800-0015-0000 DUMMY PLUG - FEMALE	01/10/07	EACH	N	58.20	58.20

(Continued)

Customer Original

odom
HYDROGRAPHIC SYSTEMS

Order Number 8595-A

Customer **NOAA49**

1450 Seaboard Avenue * Baton Rouge, Louisiana 70810-6261 USA
E-mail: email@odomhydrographic.com * http://www.odomhydrographic.com
Telephone: (225) 769-3051 * Facsimile: (225) 766-5122

Bill To:

NOAA MOCA
439 W. York St
Norfolk, VA 23510
U.S.A

Ship To:

NOAA MOCA
Attn: Ken Nadeau
439 W. York St
Norfolk, VA 23510
U.S.A

THIS IS A REVISED ORDER

Order Date	Ship Via	F.O.B.	Terms
01/10/07	FedEx st o/n	ORIGIN	Net 30 Days

Purchase Order Number	Req Date	Salesperson	Our Order Number
Gov VISA-see comment	01/10/07	KESP	NONE

Quantity Req.	Quantity Ship	Quantity B.O.	Item Number / Description	Required Date	Unit of Measure	Tax	Unit Price	Amount
2	0		82A1 Kit, 3M Cable Splice	01/10/07	EACH	N	50.00	100.00
1	0		3312-0002-0000 Calibrate Digibar Pro Velocimeter	01/10/07	EACH	N	300.00	300.00
3.0	0.0		3300-0000-0000 Repair & Service	01/10/07	HOURS	N	100.00	300.00

FedEx Acct # : 150813522
Charge to Government VISA
Ken Nadeau
4486-7000-0014-9724, exp. 05/09
Email invoice to ken.nadeau@noaa.gov

Nontaxable Subtotal	997.40
Taxable Subtotal	0.00
Tax	0.00
Total Order	997.40

ODOM HYDROGRAPHIC SY
1450 SEABORD AVENUE
BATON ROUGE, LA 70810
225-769-3051
1678407835

Phone/Web

ID: SR20361183001
02/15/07 12:17:54
Batch #: 0715

VISA

xxxxxxxxxxxx9724M

Appr Code: 038745 Invoice#: 008595

Ref #: 04615001

Amount:	$ 997.40
Tax:	$ 0.00
Total:	$ 997.40

Customer Copy
THANK - YOU
PLEASE COME AGAIN

odom
HYDROGRAPHIC SYSTEMS

(225) 769-3051
(225) 766-5122 FAX

email@odomhydrographic.com
www.odomhydrographic.com

1450 Seaboard Ave.
Baton Rouge, LA 70810 - 6261 (USA)