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

DATA ACQUISITION AND PROCESSING REPORT

Type of Survey: Hydrographic

Project No.: OPR-N411-NRT3-07

Time Frame: June 2007 - April 2009

LOCALITY

State: Washington

General Locality: Tacoma

Sublocality: Commencement Bay

2007

CHIEF OF PARTY

Kathryn Simmons

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DATE

Data Acquisition and Processing Report

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Data Acquisition and Processing Report

OPR-N411-NRT3-07
Tacoma, Washington
Hydrographic Letter Instructions dated February 16, 2007
Team Leader: Kathryn Simmons

This report includes descriptions of equipment used and methods employed by Navigation Response Team 3 during acquisition and processing of hydrographic survey data. It does not necessarily apply to fast-track data – a separate report will accompany data submitted directly to the Marine Chart Division.

A. EQUIPMENT

NOAA Survey Launch S1212 is used to acquire single-beam and multibeam echosounder data, side scan sonar data, and detached positions.

Launch S1212, a 27-foot, SeaArk Commander (SAMA115510000), was acquired in January 2001. In August 2004 the hull was extended to 30 feet to accommodate the weight of the two 150-horsepower Yamaha four-stroke outboards which power the vessel. The launch is eight feet wide, displaces 4.8 tons, has a static draft of 0.4 meters and is equipped with a Dell Pentium IV PC which runs the primary acquisition software.

Trimble DGPS systems are used to position fixed aids to navigation and other high water features.

1. Sounding Equipment

a. Single-Beam Echosounder (SBES)

An Odom Echotrac CV vertical beam echosounder (VBES) employing a single-frequency transducer with beam width set at eight degrees is used for single beam data collection. The echosounder, which is operated at 200 kHz, records both analog and digital data which may be acquired in feet or meters. Soundings are acquired in meters with an assumed speed of sound through water of 1500 m/sec. During data collection the echosounder is controlled and the trace is monitored via an Ethernet driver connection to the HYPACK Survey program. The echosounder trace is recorded to .BIN files which are logged automatically alongside HYPACK line files during acquisition. These files are used for reference during digital data processing.

Leadline checks are performed periodically throughout the project to verify fathometer accuracy. A new leadline was fabricated and calibrated on February 23, 2007.

Coastal Oceanographic's HYPACK Max Survey Software is used for vessel navigation and line tracking during hydrographic data acquisition. The HYPACK software is also used to log "raw" VBES data and to record detached positions in the form of .tgt files.

b. Shallow Water Multibeam (SWMB)

In July 2006, installation of a Kongsberg Simrad EM3000 shallow water multibeam (SWMB) echosounder was completed. The system consists of a sonar head and a processing unit. The EM3000 operates at a single-frequency of 300 kHz; it has a maximum ping rate of 40 Hz and 127 beams per ping. Each beam has a fore-aft width of 1.5° and a port-starboard width of 1.5°+. Depth range from the sonar head is 1 to 150+ meters, depth resolution is 1 cm and depth accuracy is 5 cm RMS. Range sampling rate is 14 kHz.

The sonar head is fixed-mounted to the aft hull of the vessel at the keel, directly beneath inertial measurement unit (IMU). The head contains a flat-face transducer (Mills Cross configuration) and transmitter and receiver elements all encased in an acoustically transparent medium. The transmit beam is steerable to compensate for mounting angle and vessel pitch.

Beam forming and bottom detection are performed by the processing unit which controls the sonar head with respect to gain, ping rate and transmit angle. The processing unit also contains the interfaces for all time-critical external sensors such as attitude data, position, and the pulse per second (PPS) signal.

EM3000 controller software, operating on the HYPACK computer and communicating via Ethernet connection, is used to control adjustable parameters such as range scale, power, gain and pulse width. Real time sound velocity measurements are acquired by a Digibar Pro sound velocity probe mounted on the transom and are transmitted by the controller software to the processing unit for initial beamforming and steering.

Patch tests are performed periodically to determine residual biases of the system. The test results are included in Appendix V.

To verify proper operation of the MBES, lead line comparison tests are performed periodically.

Coastal Oceanographic's HYPACK Max Survey and Hysweep programs are used for vessel navigation and line tracking, as well as swath and coverage monitoring during SWMB data acquisition. Device parameters are monitored during acquisition with the EM3000 and POS controller software programs operating on the HYPACK computer. MBES data are logged in the HYPACK "raw" format, with files ending in the .HSX extension.

c. Side Scan Sonar (SSS)

The vessel is equipped with a Klein 3000 sonar system. The system includes:

- Dual frequency (100 kHz, 500 kHz) towfish with 300 PSI pressure sensor
- Topside Processing Unit (TPU)
- Workstation Display and Control Unit (WDCU)
- Thirty-five meters of Kevlar reinforced tow cable
- SonarPro software and VX Works TPU operating system

The horizontal beam widths for the low and high frequencies are 1° and 2°, respectively; vertical beam width is 40°. Maximum range scale for the Klein 3000 is 150 meters at high frequency, 500 meters at

low frequency. Only the high-frequency data are recorded and stored in the data base; the low frequency image is monitored during data collection but not converted separately.

A range scale of 100 meters is maintained except in very deep water, when the scale is increased to 150 meters, or in very shallow water or during development of submerged obstructions, when the scale may be reduced to 75 or 50 meters. The towfish height above the bottom is maintained at 8 to 20 percent of the range scale whenever possible. Exceptions occur in very shallow areas or in areas where rapidly changing terrain raises the risk of hitting the towfish on the bottom.

Side scan sonar lines are spaced according to the range scale appropriate for water depth to assure overlap of at least 25 meters and to assure 200% coverage.

Vessel speed is maintained at or below five knots to ensure that an object one meter square could be detected across the sonar swath. Confidence checks are performed by observing the outer edges of the sonargram while moving alongside pier faces or known submerged targets.

All SSS data collection is controlled with SonarPro software operating in a Microsoft Windows XP environment on the WDCU. Signals are sent to the towfish and data is received from the towfish via the TPU. The sonar data are recorded digitally and stored on the WDCU in the Klein SDF format.

Launch S1212 is equipped with a Dynapar cable counter that logs the length of deployed towfish cable to the WDCU via the HYPACK Delph signal. The measurements are made by counting revolutions of the towing block on the J-frame. Before each use, the cable counter is calibrated by adjusting the readout to reflect the measured marking on the towfish cable at the tow point.

A certification test of the system for object detection and positioning will be performed ASAP and the results will be included in Appendix V.

d. Diver Least-Depth Gauge

Not applicable

2. Positioning and Orientation Equipment

a. Trimble DSM212L

The launch is equipped with a Trimble DSM212L integrated 12-channel GPS receiver and a dual-channel DGPS beacon receiver. The beacon receiver can simultaneously monitor two independent U.S. Coast Guard (USCG) DGPS beacons. There are three modes: Auto-Range, which locks onto the beacon nearest the vessel; Auto-Power, which locks onto the beacon with the greatest signal strength; and Manual, which allows the user to select the desired beacon. Additionally, the DSM212L can accept differential correctors (RTCM messages) from an external source such as a user-established DGPS reference station.

The following parameters are monitored in real-time through Trimble's TSIP Talker software to ensure position data quality: 1) number of satellites used in the solution, 2) horizontal dilution of precision (HDOP), 3) latency of correctors, and 4) beacon signal strength. The DSM212L is configured to the auto-power mode, to go off-line if the age of DGPS correctors exceeds 20 seconds, and to exclude satellites with an altitude below eight degrees.

The Trimble DSM212L supplies only DGPS correctors to the POS-MV system.

b. Applanix Position and Orientation System for Marine Vessels (POS MV)

The POS MV includes the following components which work together to provide position and attitude information to the data acquisition systems on S1212:

- POS MV rack mount POS Computer System (PCS)
- Inertial Measurement Unit (IMU)
- Two Identical Trimble Zephyr GPS Antennas

The PCS contains the two GPS receivers, primary and secondary, along with interface cards to communicate with and process the IMU and GPS data.

The primary GPS receiver is a 24-channel Trimble BD950 which receives differential (RTCM) correctors through the PCS and provides position and velocity information. The secondary receiver provides the information necessary to compute heading using carrier phase differential measurements between the two receivers. Two Trimble Zephyr antennas, corresponding to the two receiver cards, are mounted 1.90 meters apart atop the launch cabin. The port side antenna is the primary antenna.

The IMU comprises three solid-state linear accelerometers and three solid state gyros which work together with electronics to provide digital measurements of acceleration in three directions and motion measurements around all three axes of the IMU.

The POS MV is operated and monitored with the POS MV Controller software operating on the HYPACK computer and sends position and orientation data through the Simrad EM3000 processing unit to the HYPACK data files.

Tables listing data acquisition hardware and software are included in Appendix I.

B. DATA PROCESSING AND QUALITY CONTROL

1. SBES and SWMB Data

Both SBES and SWMB raw data are converted from HYPACK to the CARIS HDCS format using the CARIS HIPS conversion wizard. Navigation and attitude data are examined using CARIS HIPS attitude and navigation editors. Evident fliers are rejected and the track line between good navigation points is either interpolated or rejected. The digital SBES depths are compared with the trace recorded in the echosounder .Bin files. The digital record is edited when warranted to ensure that peaks of shoals and abrupt changes in slope are properly depicted. SWMB swath data are examined and edited when necessary in Subset Editor and in Swath Editor.

Corrections to soundings (see Section C below) are applied during the final merge process in HIPS.

2. Side Scan Sonar (SSS) Data

Raw SSS data are also converted to the CARIS HDCS format using the CARIS HIPS conversion wizard and then reviewed with the attitude and navigation editors in the same manner as the sounding data. The CARIS Sensor Layout tool is used to examine the values of the active sensors, cleaning where necessary.

Towfish navigation is recomputed, bottom tracking (fish height) is corrected if necessary, and the sonargram is slant-range corrected. The sonargram is then examined for significant contacts (shadow height of 1.0 meter or greater). Contacts selected for development are exported to Mapinfo, where the HydroMI program is used to generate HYPACK target and line files. Assurance that adequate side scan coverage has been acquired is achieved through the generation of mosaics in a CARIS field sheet – one mosaic for the first 100% and one for the second 100%.

3. Processing Software

CARIS HIPS and SIPS software is used to convert, edit and analyze all sounding and side scan data and to apply vertical and horizontal correctors,

NOAA's Pydro software supplied by the Hydrographic Systems and Technology Program (HSTP) is used for analyzing sounding data and SSS contacts, for processing and editing detached positions, and for decimating data in the creation of preliminary smooth sheet (PSS) files.

HSTP's HydroMI Mapbasic program is used in combination with MapInfo software for a number of Pre and Post-Survey applications.

HSTP's VelocWin program is used to process sound velocity data obtained with Seacat SBE-19 and SBE 19 Plus CTD's and an Odom Digibar profiler.

4. Data Decimation and Field Sheet Production

If required to maintain manageable base surfaces sizes, the survey area is broken into multiple overlapping CARIS field sheets. See Section B4 in the Descriptive Report for this survey.

Weighted Grid Data are inserted into a Pydro Preliminary Smooth Sheet (PSS). Final Mapinfo data plots are created with the HydroMI Mapbasic tool.

Tables listing data processing hardware and software are included in Appendix I.

Data processing flow diagrams are included in Appendix II.

C. CORRECTIONS TO ECHO SOUNDINGS

1. Sound Velocity

The speed of sound through the water is determined by sound velocity casts conducted in accordance with the NOS Hydrographic Surveys Specifications and Deliverables (HSSD) Manual

Corrections for speed of sound through the water column are computed from data obtained with an SBE-19 Seacat, and SBE-19 Plus CTD. NOAA's VelocWin software is used to process casts and generate sound velocity files for CARIS HIPS. Sound velocity correctors are applied to sounding data in CARIS HIPS using the 'nearest in distance within time' sound velocity cast.

Calibration reports for the Odom Digibar, SBE-19 Seacat, and SBE-19 Seacat Plus are included in Appendix IV of this report. Dates and locations of the sound velocity casts are included in Separate II of the survey descriptive report.

2. Vessel Offsets, Dynamic Draft, and True Heave Correctors

a. Static Draft

New static draft measurements for the multibeam and single beam transducers were calculated on August 16, 2006 *(DN 228)* employing the following procedure.

First, the depth of each transducer face from the top of the blue paint line above the respective transducer was measured. Next, with the launch in the water, fuel tanks half full and two persons aboard, the distance from this reference mark to the waterline was measured. By subtracting the second measurement from the first a static draft of 0.5 meters was calculated for the SWMB transducer and 0.3 meters for the single beam transducer.

b. Dynamic Draft

New dynamic draft measurements were calculated on August 16, 2006 (DN 228), using the single beam echosounder and the method described in FPM 1.4.2.1. Data for the measurements were acquired over a region selected for minimum cross-track error.

Offsets measured from the reference point to the transducer, sensors and antenna were, together with static and dynamic draft correctors, incorporated into the 'vessel config' files and applied during the merge process in CARIS. Offset diagrams and CARIS vessel config files are included in Appendix III.

c. TPE

Measured sound speed TPE for OPR-N411-NRT3-07 were entered in CARIS as 4 m/s. This number is based on frequency of casts (one cast every four hours) acquired during data acquisition. Surface sound speed values were entered in CARIS as 0.2 m/s. Tide zoning uncertainty values were provided by CO-OPS in the project instructions and divided by 2 to approximate the required 1 sigma error level.

d. True Heave

During data collection, true heave corrections were logged through the POS MV Controller to a separate data file and applied to the hydro data during post-processing.

3. Tide Correctors

The operating National Water Level Observation Network (NWLON) station at Tacoma, WA (944-6484) served as datum control for the survey area.

Verified, six-minute water levels relative to Mean Lower Low Water were downloaded from the NOAA, NOS, Center for Operational Oceanographic Products and Services (CO-OPS) web site: (http://tidesandcurrents.noaa.gov/olddata). These were imported into a text file on a local computer and appended to the CARIS tide file, 9446484.tid.

There are three tide zones within the project limits. Time and range correctors, referenced to the tide station at Tacoma, WA, are provided in the zoning file N411NRT32007CORP.zdf which is included with the project data.

Using the CARIS HIPS Load Tide process, soundings are sorted into the appropriate tide zone; time and range adjustments are computed and applied to the verified tides in each zone.

All correctors are finally applied to the data using the CARIS "Merge" utility. The corrected depths are then used by Pydro for the generation of preliminary smooth sheets (PSS).

D. APPROVAL

As Chief of Party, I have ensured that standard field surveying and processing procedures were used during this project in accordance with the Hydrographic Manual, Fourth Edition; Hydrographic Survey Guidelines; Field Procedures Manual, and the NOS Hydrographic Surveys Specifications and Deliverables Manual.

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

Approved and Forwarded: _____

Kathryn Simmons
Navigation Response Team 3

N-N411-NRT3-07
Data Acquisition and Processing Report

APPENDICES

APPENDIX I
Software Versions and Hardware Serial Numbers

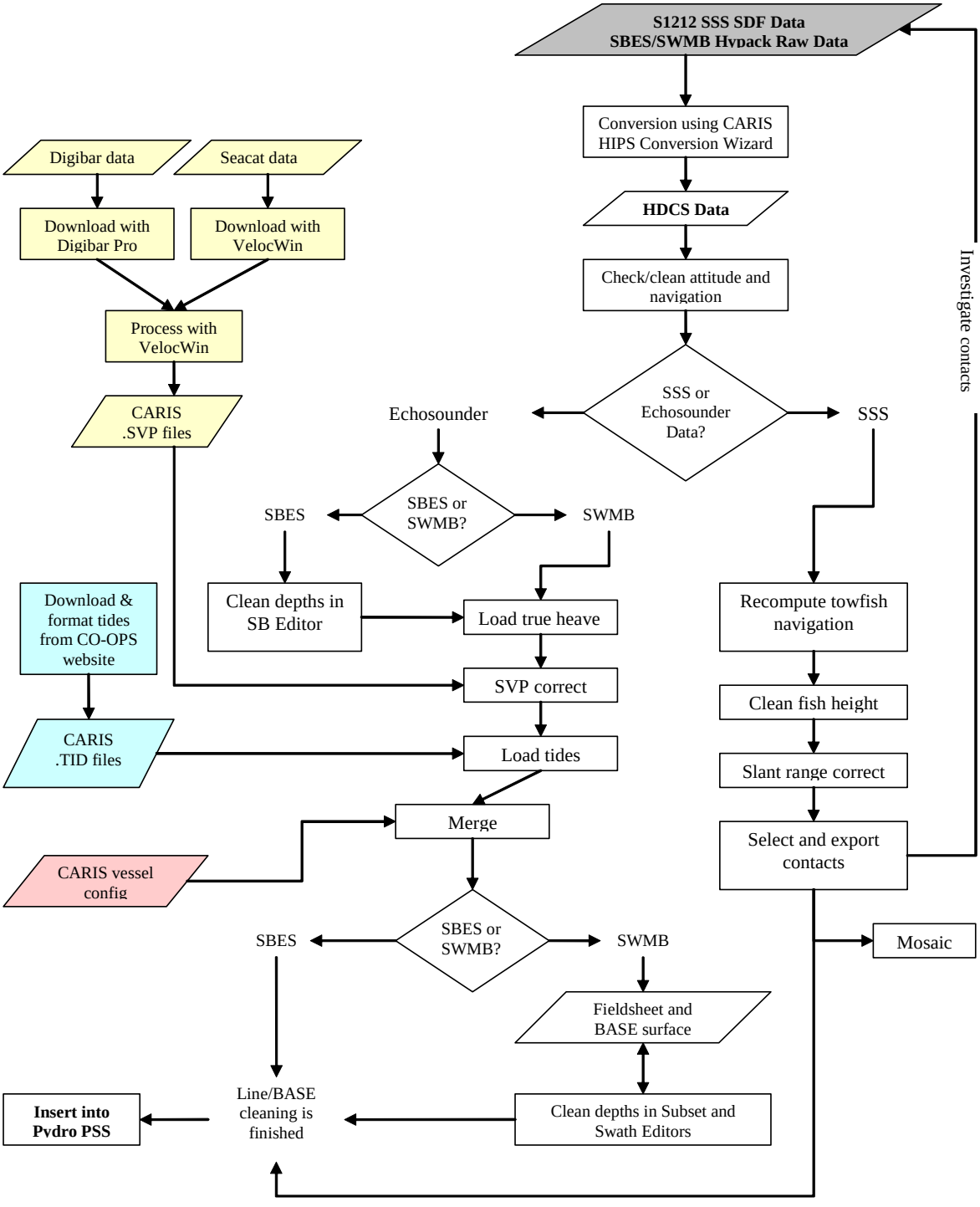
In-service date	Software	Version
	Acquisition	
05/18/2007 03/18/2008 05/01/2008	Hypack Max	6.2a 6.2b 2008
07/14/2005	Klein 3000 Sonar Pro	9.6
08/01/2006	TSIP Talker	2.0
08/01/2006	POS MV Controller	3.3.0.1
08/01/2006	EM3000 Controller	1.0.91
08/01/2006	Echotrac Control Software	3.08
	Processing	
05/07/2007 06/15/2008 08/08/2008	Pydro	7.3.0 8.6 8.7
08/01/2006	KapConv	5.7.3
08/01/2006 09/24/2007 10/15/2008	MapInfo	8.5 9.0 9.5
10/24/2006 01/29/2007	HydroMI	6.8.1 6.10.2
08/01/2006	Vertical Mapper	2.0
02/12/2007 07/16/2007 07/17/2008	Caris HIPS/SIPS	6.1 6.1, SP1 6.1, SP2
03/03/2004	CARIS GIS	4.4a
07/19/2007	Nobeltec Tides & Currents	3.5.107
	Sound Velocity	
05/21/2007	VelocWin	8.86
03/31/2005	Digibar Pro Log	2.3
05/01/2007	Sea Term	1.57

In-service date	Equipment	Serial Number
	Survey Launch 1212	
03/03/2004	Klein 3000 Dual Frequency Towfish (Model 3210)	456
03/03/2004	Klein 3000 TPU	312
03/03/2004	Klein 3000 Workstation	22-291
03/03/2004	Trimble DSM212L	0220164491
03/03/2004	Trimble Antenna	0220330095
03/03/2004	Dynapar Max Count Cable Counter	N/A
03/31/2005	Odom Digibar Pro DB-200 Controller	98308
08/01/2007	Odom Digibar Pro DB-200 Probe	98314
05/18/2007 through 08/01/2007	Odom Digibar Pro DB-200 Probe	98206
10/24/2005	Odom ETCVX2 (Echotrac CV)	23015
08/01/2006 to 04/22/2008	POS MV Controller	2245
04/23/2008 to 09/29/2008	POS MV Controller	2254
12/08/2008 to 12/14/2008	POS MV Controller	A009170
08/01/2006	POS MV IMU	Unknown
08/01/2006	Trimble Zephyr Antennas	Port 60080830 Stbd 60069001
08/01/2006	Simrad EM 3000 Multibeam Sonar	358
08/01/2006	Simrad EM 3000 Controller	1534 Dongle 040131
08/01/2006	New Hypack Computer from PHB	B7F8M41
09/05/2006	SBE 19 Seacat	1913768-2039
10/10/2006	SBE 19 Plus Seacat	19P44126-4778
	NRT3 Office	
08/01/2006	NRT3-1 Data Processing CPU	9VQLKB1
08/01/2006	NRT3-2 Data Processing CPU	BVQLKB1
08/01/2006	NRT3-3 Data Processing CPU	H5TYT61
10/01/2008	NRT Data Processing CPU	1K5N2H1
	Trimble Backpack Units	
07/26/2006	Pro XRS 12 Channel DGPS Receiver #1	SN 0224062536 / PN 33302-51
07/26/2006	Combined L1 GPS/Beacon/Satellite Differential Antenna #1	SN 0220284591 / PN 33580-50
07/26/2006	Trimble TSC1 Datalogger #1	SN 0220262979 / PN 29673-50
07/26/2006	Pro XRS 12 Channel DGPS Receiver #2	SN 0224024875 / PN 33302-51
07/26/2006	Combined L1 GPS/Beacon/Satellite Differential Antenna #2	SN 0220257168 / PN 33580-50
07/26/2006	Trimble TSC1 Datalogger #2	SN 0220276706 / PN 29673-50
07/26/2006	GeoXT 12 Channel GPS Receiver/Handheld	SN 4428E01847 / PN 50950-20
07/26/2006	Beacon-on-a-Belt Differential Receiver/Antenna	SN 0440111069 / PN 38508-00

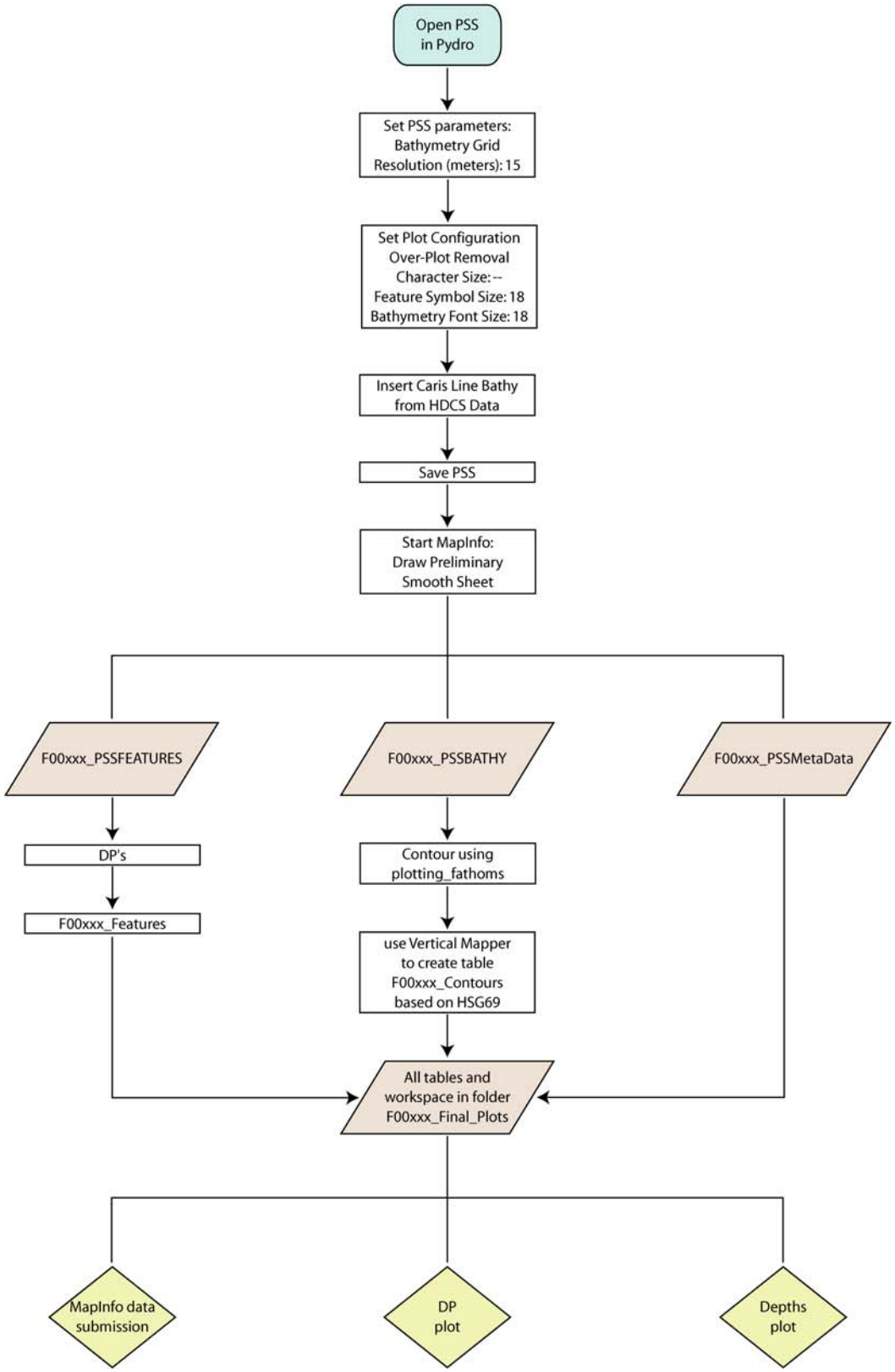
APPENDIX II

Processing Flow Diagrams

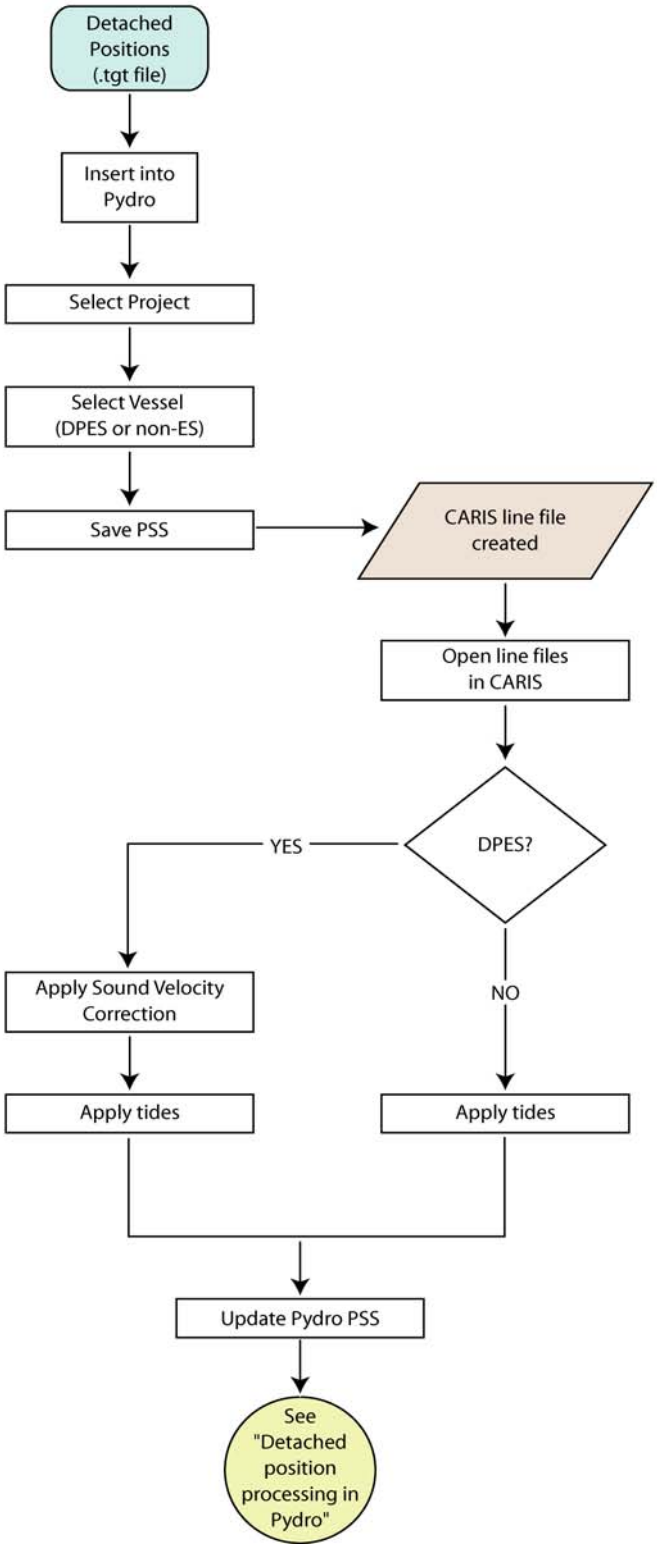
Raw SSS/Hypack Data to Pydro



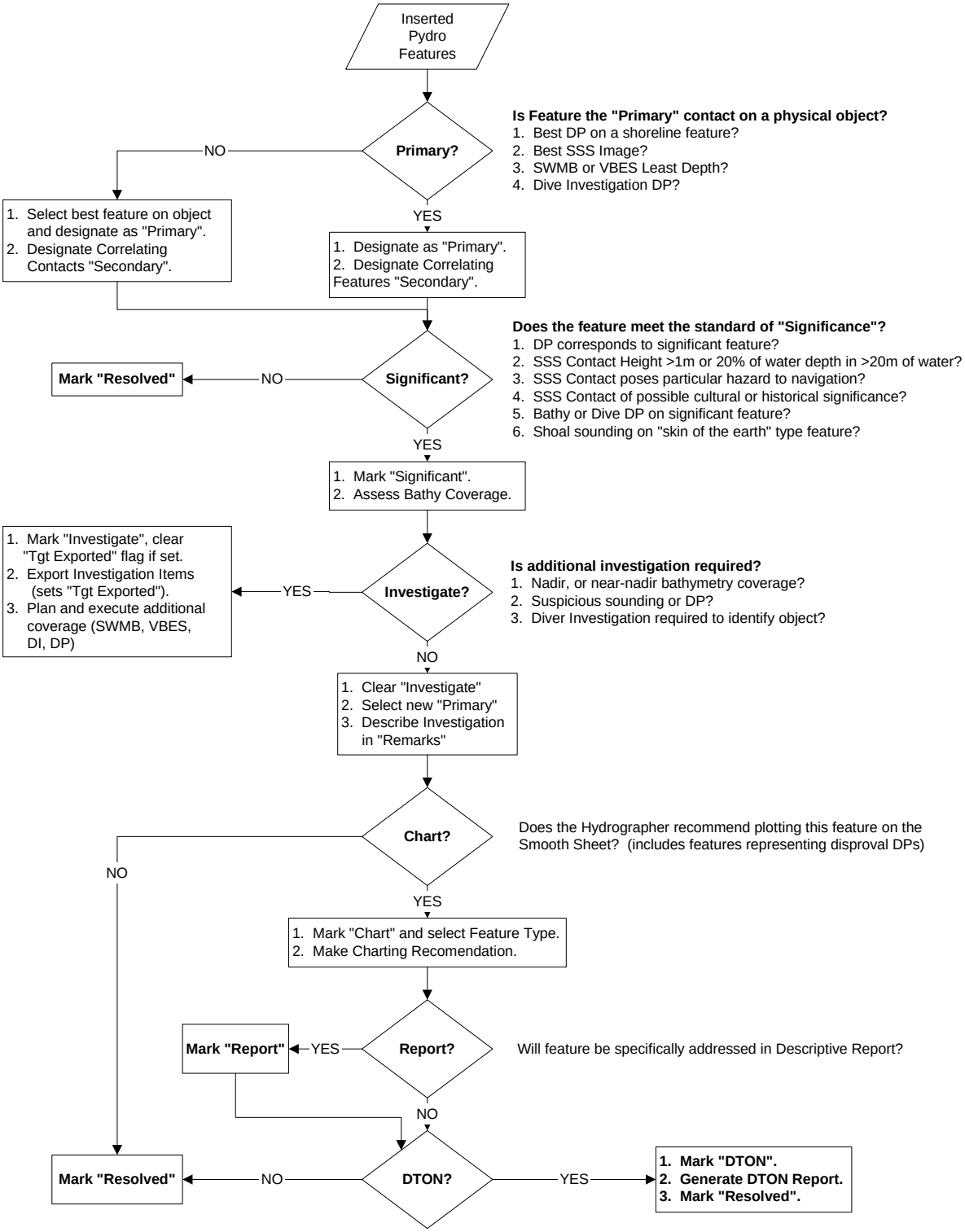
Caris Data to MapInfo Plot



Detached Position Processing

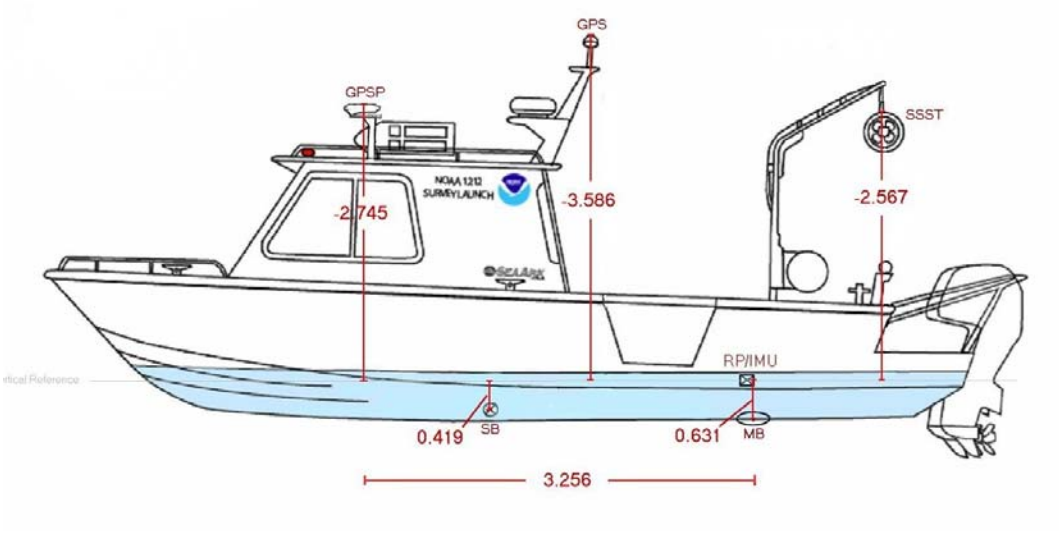


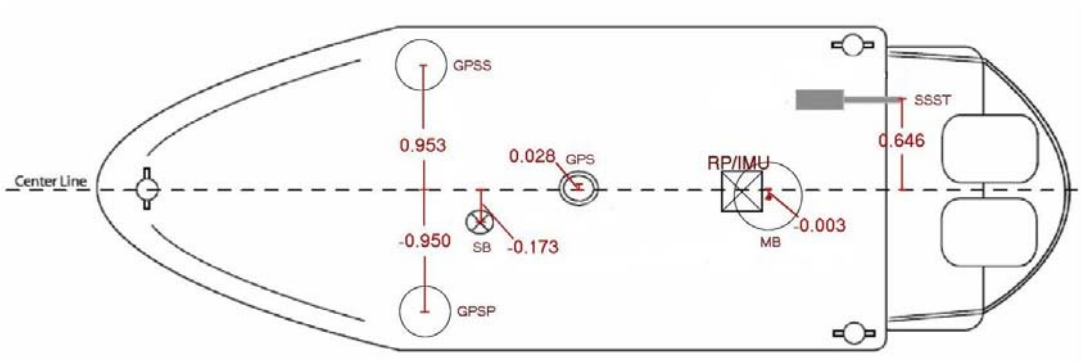
Detached Position processing in Pydro

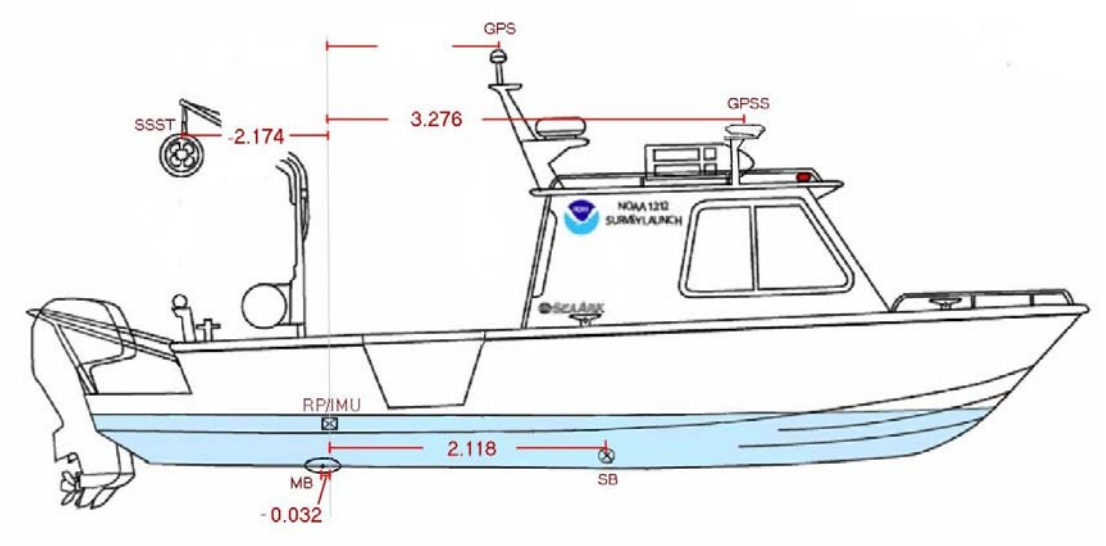


APPENDIX III

Vessel Offsets



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3.276
NOAA 1212
SURVEY LAUNCH
RP/IMU
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MB
SB
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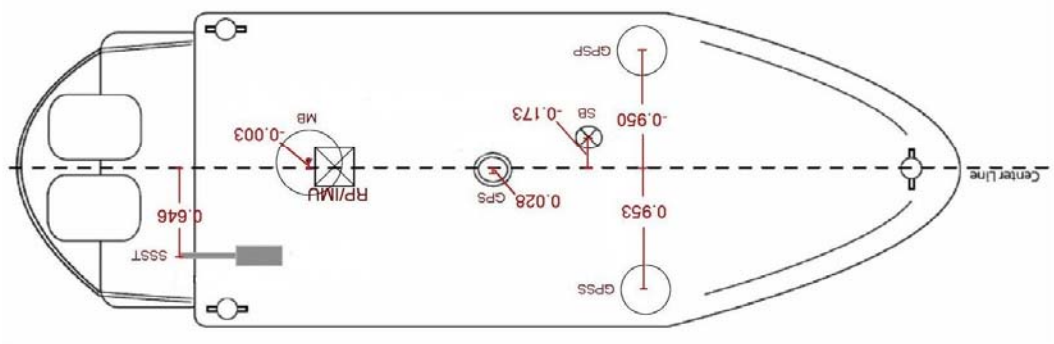
GPSP
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SB
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MB
-0.003
RP/IMU
GPS
0.028
0.953
0.646
SSST
GPSS
Center Line

CARIS HIPS Vessel Configuration Files

S1212 SBES HIPS Vessel File

Vessel Name: 1212sb.hvf
Vessel created: August 15, 2006

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2004-274 00:00

Transduer #1:

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

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer:
Model: Unknown
Serial Number:

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2006-103 00:00

Transduer #1:

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

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer:
Model: Unknown
Serial Number:

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2006-228 00:00

Transduer #1:

Pitch Offset: 0.000
Roll Offset: 0.000

Azimuth Offset: **0.000**

DeltaX: **-0.173**
DeltaY: **2.118**
DeltaZ: **0.419**

Manufacturer: **Odom**
Model: **Unknown**
Serial Number: **Echotrac CV--23015**

Navigation Sensor:

Time Stamp: **2004-274 00:00**

Comments
Latency 0.000
DeltaX: **0.170**
DeltaY: **-0.720**
DeltaZ: **-3.940**

Manufacturer:
Model:
Serial Number:

Time Stamp: **2006-103 00:00**

Comments
Latency 0.000
DeltaX: **0.170**
DeltaY: **-0.720**
DeltaZ: **-3.940**

Manufacturer:
Model:
Serial Number:

Time Stamp: **2006-228 00:00**

Comments RP to IMU
Latency 0.000
DeltaX: **0.000**
DeltaY: **0.000**
DeltaZ: **0.000**

Manufacturer: **Trimble/Applanix**
Model: **Zephyr/POSMV4**
Serial Number:

Gyro Sensor:

Time Stamp: **2004-274 00:00**

Comments
Latency 0.000

Time Stamp: **2006-103 00:00**

Comments
Latency 0.000

Time Stamp: **2006-228 00:00**

Comments
Latency 0.000

Heave Sensor:

Time Stamp: **2006-228 00:00**

Comments
Apply Yes
Latency 0.000
DeltaX: **0.000**
DeltaY: **0.000**
DeltaZ: **0.000**

Manufacturer: **Applanix**
Model: **POSMV4**
Serial Number:

Pitch Sensor:

Time Stamp: **2006-228 00:00**

Comments
Apply Yes
Latency 0.000
Pitch offset: 0.000

Manufacturer: **Applanix**
Model: **POSMV4**
Serial Number:

Roll Sensor:

Time Stamp: **2006-228 00:00**

Comments
Apply Yes
Latency 0.000
Roll offset: 0.000

Manufacturer: **Applanix**

Model: **POSMV4**
Serial Number:

Draft Sensor:

Time Stamp: **2004-274 00:00**

Apply Yes
Comments

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Entry 2) Draft: 0.045	**Speed: 4.900**
Entry 3) Draft: 0.099	**Speed: 5.500**
Entry 4) Draft: 0.149	**Speed: 6.300**
Entry 5) Draft: 0.128	**Speed: 7.000**
Entry 6) Draft: 0.117	**Speed: 7.600**
Entry 7) Draft: 0.098	**Speed: 8.100**
Entry 8) Draft: 0.091	**Speed: 8.300**
Entry 9) Draft: 0.079	**Speed: 8.700**
Entry 10) Draft: 0.043	**Speed: 9.400**
Entry 11) Draft: 0.029	**Speed: 10.100**
Entry 12) Draft: 0.025	**Speed: 10.800**
Entry 13) Draft: -0.023	**Speed: 11.800**
Entry 14) Draft: -0.063	**Speed: 12.900**
Entry 15) Draft: -0.058	**Speed: 13.800**
Entry 16) Draft: -0.073	**Speed: 15.000**
Entry 17) Draft: -0.044	**Speed: 15.800**

Time Stamp: **2006-103 00:00**

Apply Yes
Comments

Entry 1) Draft: 0.000	**Speed: 3.100**
Entry 2) Draft: 0.045	**Speed: 4.900**
Entry 3) Draft: 0.099	**Speed: 5.499**
Entry 4) Draft: 0.149	**Speed: 6.300**
Entry 5) Draft: 0.128	**Speed: 7.000**
Entry 6) Draft: 0.117	**Speed: 7.600**
Entry 7) Draft: 0.098	**Speed: 8.100**
Entry 8) Draft: 0.091	**Speed: 8.300**
Entry 9) Draft: 0.079	**Speed: 8.701**
Entry 10) Draft: 0.043	**Speed: 9.400**
Entry 11) Draft: 0.029	**Speed: 10.100**
Entry 12) Draft: 0.025	**Speed: 10.800**
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Entry 17) Draft: -0.044	**Speed: 15.800**

Time Stamp: **2006-228 00:00**

Apply Yes
Comments

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Entry 3) Draft: 0.029 Speed: 5.853
Entry 4) Draft: 0.028 Speed: 6.685
Entry 5) Draft: 0.044 Speed: 7.361
Entry 6) Draft: 0.014 Speed: 8.013
Entry 7) Draft: 0.032 Speed: 8.421
Entry 8) Draft: -0.013 Speed: 9.251
Entry 9) Draft: -0.064 Speed: 10.503
Entry 10) Draft: -0.048 Speed: 11.848
Entry 11) Draft: -0.140 Speed: 14.153

TPE

Time Stamp: 2004-274 00:00

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 -0.170
Y Head 1 0.720
Z Head 1 3.940
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: 0.000 or 0.000'' of heave amplitude.
Measurement errors: 0.020
Motion sensing unit alignment errors
Gyro:0.000 Pitch:0.000 Roll:0.000
Gyro measurement error: 0.000
Roll measurement error: 0.000
Pitch measurement error: 0.000
Navigation measurement error: 0.000
Transducer timing error: 0.000
Navigation timing error: 0.100
Gyro timing error: 0.000
Heave timing error: 0.000
PitchTimingStdDev: 0.000
Roll timing error: 0.000
Sound Velocity speed measurement error: 0.000
Surface sound speed measurement error: 0.000
Tide measurement error: 0.000
Tide zoning error: 0.000
Speed over ground measurement error: 0.030

Dynamic loading measurement error: 0.030
Static draft measurement error: 0.050
Delta draft measurement error: 0.010

Time Stamp: 2006-228 00:00

Comments
Offsets

Motion sensing unit to the transducer 1
- **X Head 1 -0.173**
- **Y Head 1 2.118**
- **Z Head 1 0.419**

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 -0.173**
- **Y Head 1 2.118**
- **Z Head 1 0.419**

Navigation antenna to the transducer 2
- **X Head 2 0.000**
- **Y Head 2 0.000**
- **Z Head 2 0.000**

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

Heave Error: 0.050 or 5.000'' of heave amplitude.
Measurement errors: 0.020
Motion sensing unit alignment errors
Gyro:1.000 Pitch:1.000 Roll:1.000
Gyro measurement error: 0.020
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 0.700
Transducer timing error: 0.010
Navigation timing error: 0.001
Gyro timing error: 0.001
Heave timing error: 0.001
PitchTimingStdDev: 0.001
Roll timing error: 0.001
Sound Velocity speed measurement error: 0.000
Surface sound speed measurement error: 0.000
Tide measurement error: 0.000
Tide zoning error: 0.000
Speed over ground measurement error: 0.030
Dynamic loading measurement error: 0.030
Static draft measurement error: 0.050
Delta draft measurement error: 0.010

Svp Sensor:

Time Stamp: 2004-274 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: 2006-103 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: 2006-228 00:00

Comments
Svp #1:

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

DeltaX: -0.173

DeltaY: 2.118
DeltaZ: 0.419

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: 2004-274 00:00

Comments
Apply Yes
WaterLine -0.400

Time Stamp: 2006-103 00:00

Comments
Apply Yes
WaterLine -0.400

Time Stamp: 2006-228 00:00

Comments RP to "mean water level" as surveyed
Apply Yes
WaterLine 0.022

S1212 SSS HIPS Vessel File

Vessel Name: S1212sss_100.hvf
Vessel created: September 14, 2006

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2002-084 00:00

Transduer #1:

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

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer:

Model: **Unknown**
Serial Number:

Depth Sensor:

Sensor Class: **Swath**
Time Stamp: **2004-147 00:00**

Transduer #1:

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

DeltaX: **0.000**
DeltaY: **0.000**
DeltaZ: **0.000**

Manufacturer:
Model: **Unknown**
Serial Number:

Depth Sensor:

Sensor Class: **Swath**
Time Stamp: **2004-274 00:00**

Transduer #1:

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

DeltaX: **0.000**
DeltaY: **0.000**
DeltaZ: **0.000**

Manufacturer:
Model: **Unknown**
Serial Number:

Depth Sensor:

Sensor Class: **Swath**
Time Stamp: **2006-103 00:00**

Transduer #1:

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

DeltaX: **0.000**
DeltaY: **0.000**
DeltaZ: **0.000**

Manufacturer:
Model: **Unknown**
Serial Number:

Depth Sensor:

Sensor Class: **Swath**
Time Stamp: **2006-228 00:00**

Transduer #1:

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

DeltaX: **-0.173**
DeltaY: **2.118**
DeltaZ: **0.419**

Manufacturer: **Odom**
Model: **Unknown**
Serial Number: **Echotrac CV--23015**

Navigation Sensor:

Time Stamp: **2002-084 00:00**

Comments
Latency 0.000
DeltaX: **0.170**
DeltaY: **-0.720**
DeltaZ: **-3.940**

Manufacturer:
Model:
Serial Number:

Time Stamp: **2004-147 00:00**

Comments
Latency 0.000
DeltaX: **0.170**
DeltaY: **-0.720**
DeltaZ: **-3.940**

Manufacturer:
Model:
Serial Number:

Time Stamp: **2004-274 00:00**

Comments
Latency 0.000

DeltaX: 0.170
DeltaY: -0.720
DeltaZ: -3.940

Manufacturer:
Model:
Serial Number:

Time Stamp: 2006-103 00:00

Comments
Latency 0.000
DeltaX: 0.170
DeltaY: -0.720
DeltaZ: -3.940

Manufacturer:
Model:
Serial Number:

Time Stamp: 2006-228 00:00

Comments RP to IMU
Latency 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Trimble/Applanix
Model: Zephyr/POSMV4
Serial Number:

Gyro Sensor:

Time Stamp: 2002-084 00:00

Comments
Latency 0.000

Entry 0) Draft: 0.000 Speed: 0.000

Time Stamp: 2004-147 00:00

Comments
Latency 0.000

Entry 0) Draft: 0.000 Speed: 0.000

Time Stamp: 2004-274 00:00

Comments
Latency 0.000

Time Stamp: **2006-103 00:00**

Comments
Latency 0.000

Time Stamp: **2006-228 00:00**

Comments
Latency 0.000

Heave Sensor:

Time Stamp: **2006-228 00:00**

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

Manufacturer: **Applanix**
Model: **POSMV4**
Serial Number:

Pitch Sensor:

Time Stamp: **2006-228 00:00**

Comments
Apply Yes
Latency 0.000
Pitch offset: 0.000

Manufacturer: **Applanix**
Model: **POSMV4**
Serial Number:

Roll Sensor:

Time Stamp: **2006-228 00:00**

Comments
Apply Yes
Latency 0.000
Roll offset: 0.000

Manufacturer: **Applanix**
Model: **POSMV4**
Serial Number:

Draft Sensor:

Time Stamp: 2002-084 00:00

Apply Yes
Comments
Entry 1) Draft: 0.000 Speed: 5.300
Entry 2) Draft: -0.100 Speed: 5.400
Entry 3) Draft: -0.200 Speed: 7.500
Entry 4) Draft: -0.300 Speed: 20.000

Time Stamp: 2004-147 00:00

Apply Yes
Comments
Entry 1) Draft: 0.017 Speed: 4.600
Entry 2) Draft: 0.000 Speed: 5.500
Entry 3) Draft: 0.032 Speed: 5.900
Entry 4) Draft: 0.026 Speed: 6.700
Entry 5) Draft: 0.041 Speed: 7.200
Entry 6) Draft: 0.110 Speed: 7.700
Entry 7) Draft: 0.007 Speed: 7.800
Entry 8) Draft: 0.020 Speed: 8.300
Entry 9) Draft: 0.011 Speed: 9.200
Entry 10) Draft: 0.030 Speed: 10.000
Entry 11) Draft: 0.010 Speed: 11.900
Entry 12) Draft: -0.012 Speed: 13.900
Entry 13) Draft: -0.047 Speed: 20.200

Time Stamp: 2004-274 00:00

Apply Yes
Comments
Entry 1) Draft: 0.000 Speed: 3.100
Entry 2) Draft: 0.045 Speed: 4.900
Entry 3) Draft: 0.099 Speed: 5.500
Entry 4) Draft: 0.149 Speed: 6.300
Entry 5) Draft: 0.128 Speed: 7.000
Entry 6) Draft: 0.117 Speed: 7.600
Entry 7) Draft: 0.098 Speed: 8.100
Entry 8) Draft: 0.091 Speed: 8.300
Entry 9) Draft: 0.079 Speed: 8.700
Entry 10) Draft: 0.043 Speed: 9.400
Entry 11) Draft: 0.029 Speed: 10.100
Entry 12) Draft: 0.025 Speed: 10.800
Entry 13) Draft: -0.023 Speed: 11.800
Entry 14) Draft: -0.063 Speed: 12.900
Entry 15) Draft: -0.058 Speed: 13.800
Entry 16) Draft: -0.073 Speed: 15.000
Entry 17) Draft: -0.044 Speed: 15.800

Time Stamp: 2006-103 00:00

Apply Yes
Comments

Entry 1) Draft: 0.000 Speed: 3.100
Entry 2) Draft: 0.045 Speed: 4.900
Entry 3) Draft: 0.099 Speed: 5.499
Entry 4) Draft: 0.149 Speed: 6.300
Entry 5) Draft: 0.128 Speed: 7.000
Entry 6) Draft: 0.117 Speed: 7.600
Entry 7) Draft: 0.098 Speed: 8.100
Entry 8) Draft: 0.091 Speed: 8.300
Entry 9) Draft: 0.079 Speed: 8.701
Entry 10) Draft: 0.043 Speed: 9.400
Entry 11) Draft: 0.029 Speed: 10.100
Entry 12) Draft: 0.025 Speed: 10.800
Entry 13) Draft: -0.023 Speed: 11.799
Entry 14) Draft: -0.063 Speed: 12.899
Entry 15) Draft: -0.058 Speed: 13.799
Entry 16) Draft: -0.073 Speed: 15.001
Entry 17) Draft: -0.044 Speed: 15.800

Time Stamp: 2006-228 00:00

Apply Yes
Comments
Entry 1) Draft: 0.000 Speed: 4.599
Entry 2) Draft: -0.003 Speed: 5.171
Entry 3) Draft: 0.029 Speed: 5.853
Entry 4) Draft: 0.028 Speed: 6.685
Entry 5) Draft: 0.044 Speed: 7.361
Entry 6) Draft: 0.014 Speed: 8.013
Entry 7) Draft: 0.032 Speed: 8.421
Entry 8) Draft: -0.013 Speed: 9.251
Entry 9) Draft: -0.064 Speed: 10.503
Entry 10) Draft: -0.048 Speed: 11.848
Entry 11) Draft: -0.140 Speed: 14.153

Tow Point:

Time Stamp: 2002-084 00:00

Comments
Latency 0.000
DeltaX: 0.760
DeltaY: -4.200
DeltaZ: -2.800

Manufacturer:
Model:
Serial Number:

Time Stamp: 2004-147 00:00

Comments
Latency 0.000
DeltaX: 0.760
DeltaY: -4.200
DeltaZ: -2.800

Manufacturer:
Model:
Serial Number:

Time Stamp: 2004-274 00:00

Comments
Latency 0.000
DeltaX: 0.760
DeltaY: -4.200
DeltaZ: -2.800

Manufacturer:
Model:
Serial Number:

Time Stamp: 2006-103 00:00

Comments
Latency 0.000
DeltaX: 0.760
DeltaY: -4.200
DeltaZ: -2.800

Manufacturer:
Model:
Serial Number:

Time Stamp: 2006-228 00:00

Comments
Latency 0.000
DeltaX: 0.646
DeltaY: -2.174
DeltaZ: -2.567

Manufacturer:
Model:
Serial Number:

Svp Sensor:

Time Stamp: 2002-084 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: 2004-147 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: 2004-274 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: 2006-103 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: 2006-228 00:00

Comments
Svp #1:

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

DeltaX: -0.173
DeltaY: 2.118
DeltaZ: 0.419

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: **2002-084 00:00**

Comments
Apply Yes
WaterLine -0.400

Time Stamp: **2004-147 00:00**

Comments
Apply Yes
WaterLine -0.400

Time Stamp: **2004-274 00:00**

Comments
Apply Yes
WaterLine -0.400

Time Stamp: **2006-103 00:00**

Comments
Apply Yes
WaterLine -0.400

Time Stamp: **2006-228 00:00**

Comments RP to "mean water level" as surveyed
Apply Yes
WaterLine 0.022

S1212 SSS HIPS Vessel File (Used to convert data with timestamp error. See Descriptive Report for details)

Vessel Name: S1212sss_100_time.hvf
Vessel created: May 21, 2008

Depth Sensor:

Sensor Class: **Swath**
Time Stamp: **1999-230 00:00**

Transduer #1:

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

DeltaX: **-0.173**
DeltaY: **2.118**
DeltaZ: **0.419**

Manufacturer: **Odom**
Model: **Unknown**

Serial Number: **Echotrac CV--23015**

Navigation Sensor:

Time Stamp: **1999-230 00:00**

Comments RP to IMU
Latency 0.000
DeltaX: **0.000**
DeltaY: **0.000**
DeltaZ: **0.000**

Manufacturer: **Trimble/Applanix**
Model: **Zephyr/POSMV4**
Serial Number:

Gyro Sensor:

Time Stamp: **1999-230 00:00**

Comments
Latency 0.000

Entry 0) Draft: 0.000 **Speed: 0.000**

Heave Sensor:

Time Stamp: **1999-230 00:00**

Comments
Apply Yes
Latency 0.000
DeltaX: **0.000**
DeltaY: **0.000**
DeltaZ: **0.000**
Offset: **0.000**

Manufacturer: **Applanix**
Model: **POSMV4**
Serial Number:

Pitch Sensor:

Time Stamp: **1999-230 00:00**

Comments
Apply Yes
Latency 0.000
Pitch offset: 0.000

Manufacturer: **Applanix**
Model: **POSMV4**
Serial Number:

Roll Sensor:

Time Stamp: **1999-230 00:00**

Comments
Apply Yes
Latency 0.000
Roll offset: 0.000

Manufacturer: **Applanix**
Model: **POSMV4**
Serial Number:

Draft Sensor:

Time Stamp: **1999-230 00:00**

Apply Yes
Comments

Entry 1) Draft: 0.000	**Speed: 4.599**
Entry 2) Draft: -0.003	**Speed: 5.171**
Entry 3) Draft: 0.029	**Speed: 5.853**
Entry 4) Draft: 0.028	**Speed: 6.685**
Entry 5) Draft: 0.044	**Speed: 7.361**
Entry 6) Draft: 0.014	**Speed: 8.013**
Entry 7) Draft: 0.032	**Speed: 8.421**
Entry 8) Draft: -0.013	**Speed: 9.251**
Entry 9) Draft: -0.064	**Speed: 10.503**
Entry 10) Draft: -0.048	**Speed: 11.848**
Entry 11) Draft: -0.140	**Speed: 14.153**

Tow Point:

Time Stamp: **1999-230 00:00**

Comments
Latency 0.000
DeltaX: **0.646**
DeltaY: **-2.174**
DeltaZ: **-2.567**

Manufacturer:
Model:
Serial Number:

Svp Sensor:

Time Stamp: **1999-230 00:00**

Comments
Svp #1:

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

DeltaX: **-0.173**
DeltaY: **2.118**
DeltaZ: **0.419**

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: **1999-230 00:00**

Comments RP to "mean water level" as surveyed
Apply Yes
WaterLine 0.020

S1212 SWMB HIPS Vessel File

Vessel Name: S1212_Simrad.hvf
Vessel created: July 17, 2007

Depth Sensor:

Sensor Class: **Swath**
Time Stamp: **2006-234 00:00**

Transduer #1:

Pitch Offset: **0.000**
Roll Offset: -0.060
Azimuth Offset: **0.000**

DeltaX: **-0.003**
DeltaY: **-0.032**
DeltaZ: **0.631**

Manufacturer: **Kongsberg**
Model: **em3000**
Serial Number:

Depth Sensor:

Sensor Class: **Swath**

Time Stamp: **2008-114 00:00**

Transduer #1:

Pitch Offset: **0.000**
Roll Offset: -0.060
Azimuth Offset: **0.000**

DeltaX: **-0.003**
DeltaY: **-0.032**
DeltaZ: **0.631**

Manufacturer: **Kongsberg**
Model: **em3000**
Serial Number:

Navigation Sensor:

Time Stamp: **2006-234 00:00**

Comments RP
Latency 0.000
DeltaX: **0.000**
DeltaY: **0.000**
DeltaZ: **0.000**

Manufacturer: **Applanix**
Model: **POS/MV4**
Serial Number: **(null)**

Gyro Sensor:

Time Stamp: **2006-234 00:00**

Comments (null)
Latency 0.000

Heave Sensor:

Time Stamp: **2006-234 00:00**

Comments (null)
Apply Yes
Latency 0.000
DeltaX: **0.000**
DeltaY: **0.000**
DeltaZ: **0.000**
Offset: **0.000**

Manufacturer: **Applanix**
Model: **POS/MV4**
Serial Number: **(null)**

Pitch Sensor:

Time Stamp: **2006-234 00:00**

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

Manufacturer: **Applanix**
Model: **POS/MV4**
Serial Number: **(null)**

Roll Sensor:

Time Stamp: **2006-234 00:00**

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

Manufacturer: **Applanix**
Model: **POS/MV4**
Serial Number: **(null)**

Draft Sensor:

Time Stamp: **2006-234 00:00**

Apply Yes
Comments (null)

Entry 1) Draft: 0.000	**Speed: 4.599**
Entry 2) Draft: -0.003	**Speed: 5.171**
Entry 3) Draft: 0.029	**Speed: 5.853**
Entry 4) Draft: 0.028	**Speed: 6.685**
Entry 5) Draft: 0.044	**Speed: 7.361**
Entry 6) Draft: 0.014	**Speed: 8.013**
Entry 7) Draft: 0.032	**Speed: 8.421**
Entry 8) Draft: -0.013	**Speed: 9.251**
Entry 9) Draft: -0.064	**Speed: 10.503**
Entry 10) Draft: -0.048	**Speed: 11.848**
Entry 11) Draft: -0.140	**Speed: 14.153**

TPE

Time Stamp: **2006-234 00:00**

Comments
Offsets

Motion sensing unit to the transducer 1
X Head 1 -0.003

Y Head 1 -0.032
Z Head 1 0.631
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 -0.947
Y Head 1 3.288
Z Head 1 3.376
Navigation antenna to the transducer 2
X Head 2 0.000
Y Head 2 0.000
Z Head 2 0.000

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

Heave Error: 0.050 or 5.000'' of heave amplitude.
Measurement errors: 0.020
Motion sensing unit alignment errors
Gyro:1.000 Pitch:1.000 Roll:1.000
Gyro measurement error: 0.020
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 0.700
Transducer timing error: 0.010
Navigation timing error: 0.001
Gyro timing error: 0.001
Heave timing error: 0.001
PitchTimingStdDev: 0.001
Roll timing error: 0.001
Sound Velocity speed measurement error: 0.000
Surface sound speed measurement error: 0.000
Tide measurement error: 0.000
Tide zoning error: 0.000
Speed over ground measurement error: 0.030
Dynamic loading measurement error: 0.030
Static draft measurement error: 0.050
Delta draft measurement error: 0.010
StDev Comment: 0>„J †J@3†Jp4†J 1†J0 …J .†J0^„J`}€J° †Ja

Svp Sensor:

Time Stamp: 2006-234 00:00

Comments
Svp #1:

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

DeltaX: -0.003
DeltaY: -0.032
DeltaZ: 0.631

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: 2006-248 00:00

Comments (null)
Svp #1:

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

DeltaX: -0.003
DeltaY: -0.032
DeltaZ: 0.631

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: 2008-114 00:00

Comments
Svp #1:

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

DeltaX: -0.003
DeltaY: -0.032
DeltaZ: 0.631

SVP #2:

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

DeltaX: 0.000

DeltaY: 0.000
DeltaZ: 0.000

WaterLine:

Time Stamp: 2006-234 00:00

Comments RP to WL as surveyed
Apply Yes
WaterLine 0.020

S1212 Non-Echosounder DP HIPS Vessel File

Vessel Name: 1212DPnonES.hvf
Vessel created: August 15, 2006

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2004-274 00:00

Transduer #1:

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

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Odom
Model:
Serial Number:

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2006-234 00:00

Transduer #1:

Pitch Offset: 0.000
Roll Offset: -0.060
Azimuth Offset: 0.000

DeltaX: -0.003
DeltaY: -0.032
DeltaZ: 0.631

Manufacturer: Kongsberg
Model: em3000
Serial Number:

Navigation Sensor:

Time Stamp: **2004-274 00:00**

Comments SB Xducer to Trimble
Latency 0.000
DeltaX: **0.170**
DeltaY: **-0.720**
DeltaZ: **-3.940**

Manufacturer:
Model:
Serial Number:

Time Stamp: **2006-234 00:00**

Comments RP to IMU
Latency 0.000
DeltaX: **0.000**
DeltaY: **0.000**
DeltaZ: **0.000**

Manufacturer: **Applanix**
Model: **POS/MV4**
Serial Number: **(null)**

Gyro Sensor:

Time Stamp: **2004-274 00:00**

Comments No POS
Latency 0.000

Time Stamp: **2006-234 00:00**

Comments (null)
Latency 0.000

Heave Sensor:

Time Stamp: **2004-274 00:00**

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

Manufacturer:
Model:

Serial Number:

Time Stamp: **2006-234 00:00**

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

Manufacturer: **Applanix**
Model: **POS/MV4**
Serial Number: **(null)**

Pitch Sensor:

Time Stamp: **2004-274 00:00**

Comments No POS
Apply No
Latency 0.000
Pitch offset: 0.000

Manufacturer:
Model:
Serial Number:

Time Stamp: **2006-234 00:00**

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

Manufacturer: **Applanix**
Model: **POS/MV4**
Serial Number: **(null)**

Roll Sensor:

Time Stamp: **2004-274 00:00**

Comments No POS
Apply No
Latency 0.000
Roll offset: 0.000

Manufacturer:
Model:
Serial Number:

Time Stamp: **2006-234 00:00**

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

Manufacturer: **Applanix**
Model: **POS/MV4**
Serial Number: **(null)**

Draft Sensor:

Time Stamp: **2004-274 00:00**

Apply No
Comments

Entry 1) Draft: 0.000	**Speed: 3.100**
Entry 2) Draft: 0.045	**Speed: 4.900**
Entry 3) Draft: 0.099	**Speed: 5.499**
Entry 4) Draft: 0.149	**Speed: 6.300**
Entry 5) Draft: 0.128	**Speed: 7.000**
Entry 6) Draft: 0.117	**Speed: 7.600**
Entry 7) Draft: 0.098	**Speed: 8.100**
Entry 8) Draft: 0.091	**Speed: 8.300**
Entry 9) Draft: 0.079	**Speed: 8.701**
Entry 10) Draft: 0.043	**Speed: 9.400**
Entry 11) Draft: 0.029	**Speed: 10.100**
Entry 12) Draft: 0.025	**Speed: 10.800**
Entry 13) Draft: -0.023	**Speed: 11.799**
Entry 14) Draft: -0.063	**Speed: 12.899**
Entry 15) Draft: -0.058	**Speed: 13.799**
Entry 16) Draft: -0.073	**Speed: 15.001**
Entry 17) Draft: -0.044	**Speed: 15.800**

Time Stamp: **2006-234 00:00**

Apply No
Comments (null)

Entry 1) Draft: 0.000	**Speed: 4.599**
Entry 2) Draft: -0.003	**Speed: 5.171**
Entry 3) Draft: 0.029	**Speed: 5.853**
Entry 4) Draft: 0.028	**Speed: 6.685**
Entry 5) Draft: 0.044	**Speed: 7.361**
Entry 6) Draft: 0.014	**Speed: 8.013**
Entry 7) Draft: 0.032	**Speed: 8.421**
Entry 8) Draft: -0.013	**Speed: 9.251**
Entry 9) Draft: -0.064	**Speed: 10.503**
Entry 10) Draft: -0.048	**Speed: 11.848**
Entry 11) Draft: -0.140	**Speed: 14.153**

TPE

Time Stamp: **2006-234 00:00**

Comments
Offsets

Motion sensing unit to the transducer 1
X Head 1 -0.003
Y Head 1 -0.032
Z Head 1 0.631
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 -0.947
Y Head 1 3.288
Z Head 1 3.376
Navigation antenna to the transducer 2
X Head 2 0.000
Y Head 2 0.000
Z Head 2 0.000

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

Heave Error: 0.050 or 5.000'' of heave amplitude.
Measurement errors: 0.020
Motion sensing unit alignment errors
Gyro:1.000 Pitch:1.000 Roll:1.000
Gyro measurement error: 0.020
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 0.700
Transducer timing error: 0.010
Navigation timing error: 0.001
Gyro timing error: 0.001
Heave timing error: 0.001
PitchTimingStdDev: 0.001
Roll timing error: 0.001
Sound Velocity speed measurement error: 0.000
Surface sound speed measurement error: 0.000
Tide measurement error: 0.000
Tide zoning error: 0.000
Speed over ground measurement error: 0.030
Dynamic loading measurement error: 0.030
Static draft measurement error: 0.050
Delta draft measurement error: 0.010

Svp Sensor:

Time Stamp: 2004-274 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: 2006-234 00:00

Comments
Svp #1:

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

DeltaX: -0.003
DeltaY: -0.032
DeltaZ: 0.631

SVP #2:

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

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

WaterLine:

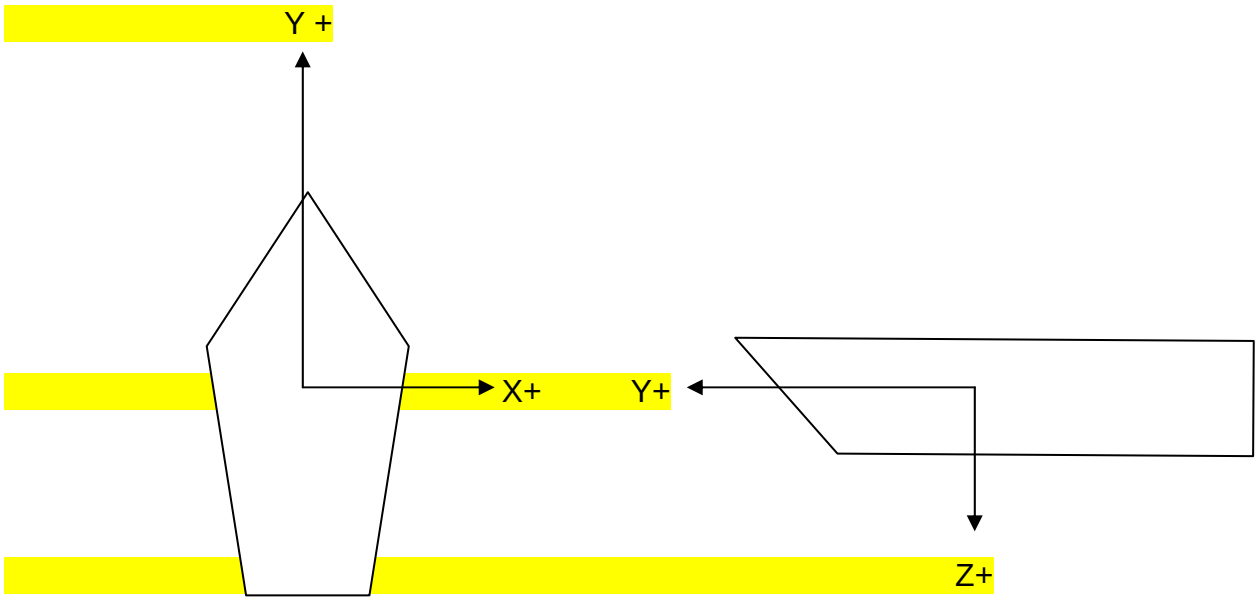
Time Stamp: 2004-274 00:00

Comments SB Xducer to WL
Apply No
WaterLine -0.400

Time Stamp: 2006-234 00:00

Comments RP to WL as surveyed
Apply No
WaterLine 0.022

CARIS Offset Sign Conventions



APPENDIX IV

Calibration Reports

Date:
Jun 27, 2007

Serial #:
98314-062707

DIGIBAR CALIBRATION REPORT

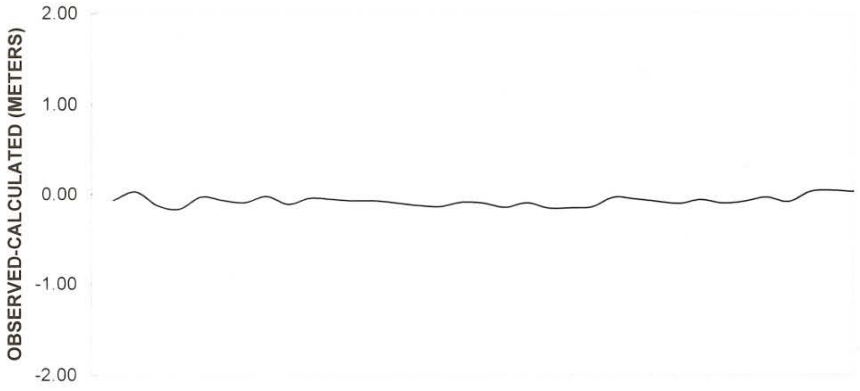
version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc

Burn these numbers to EPROM:

Gradient	**3402**
Intercept	**513**

Calibration Graph



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:
Jun 27, 2007

Serial #:
98314-062707

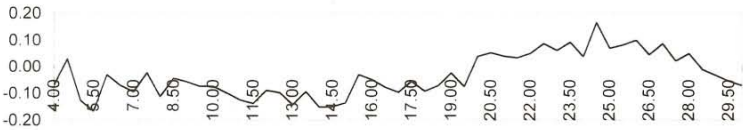
DIGIBAR CALIBRATION REPORT

version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.

STANDARD DEL GROSSO H^2O

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL	TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
4.00	1421.62	5541.73	1421.55	-0.07	17.50	1474.38	5740.30	1474.33	-0.05
4.50	1423.90	5550.68	1423.93	0.03	18.00	1476.01	5746.29	1475.92	-0.09
5.00	1426.15	5558.57	1426.03	-0.13	18.50	1477.62	5752.42	1477.55	-0.07
5.50	1428.38	5566.79	1428.21	-0.17	19.00	1479.21	5758.57	1479.18	-0.02
6.00	1430.58	5575.58	1430.55	-0.03	19.50	1480.77	5764.27	1480.70	-0.07
6.50	1432.75	5583.61	1432.68	-0.07	20.00	1482.32	5770.51	1482.36	0.04
7.00	1434.90	5591.60	1434.81	-0.09	20.50	1483.84	5776.30	1483.89	0.05
7.50	1437.02	5599.85	1437.00	-0.02	21.00	1485.35	5781.91	1485.38	0.04
8.00	1439.12	5607.40	1439.00	-0.11	21.50	1486.83	5787.47	1486.86	0.03
8.50	1441.19	5615.45	1441.14	-0.04	22.00	1488.29	5793.04	1488.34	0.05
9.00	1443.23	5623.10	1443.18	-0.06	22.50	1489.74	5798.61	1489.82	0.09
9.50	1445.25	5630.64	1445.18	-0.07	23.00	1491.16	5803.87	1491.22	0.06
10.00	1447.25	5638.15	1447.18	-0.07	23.50	1492.56	5809.27	1492.66	0.09
10.50	1449.22	5645.48	1449.13	-0.10	24.00	1493.95	5814.28	1493.99	0.04
11.00	1451.17	5652.71	1451.05	-0.12	24.50	1495.32	5819.90	1495.48	0.17
11.50	1453.09	5659.90	1452.96	-0.14	25.00	1496.66	5824.60	1496.73	0.07
12.00	1454.99	5667.23	1454.91	-0.09	25.50	1497.99	5829.64	1498.07	0.08
12.50	1456.87	5674.26	1456.77	-0.10	26.00	1499.30	5834.63	1499.40	0.10
13.00	1458.72	5681.06	1458.58	-0.14	26.50	1500.59	5839.28	1500.63	0.05
13.50	1460.55	5688.13	1460.46	-0.09	27.00	1501.86	5844.22	1501.95	0.09
14.00	1462.36	5694.71	1462.21	-0.15	27.50	1503.11	5848.69	1503.13	0.02
14.50	1464.14	5701.43	1464.00	-0.15	28.00	1504.35	5853.44	1504.40	0.05
15.00	1465.91	5708.11	1465.77	-0.14	28.50	1505.56	5857.79	1505.55	-0.01
15.50	1467.65	5715.05	1467.62	-0.03	29.00	1506.76	5862.22	1506.73	-0.03
16.00	1469.36	5721.44	1469.31	-0.05	29.50	1507.94	5866.58	1507.89	-0.05
16.50	1471.06	5727.71	1470.98	-0.08	30.00	1509.10	5870.89	1509.03	-0.07
17.00	1472.73	5733.93	1472.63	-0.10					



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

Date:
Oct 22, 2004

Serial #:
SN:dbp102204

DIGIBAR CALIBRATION REPORT

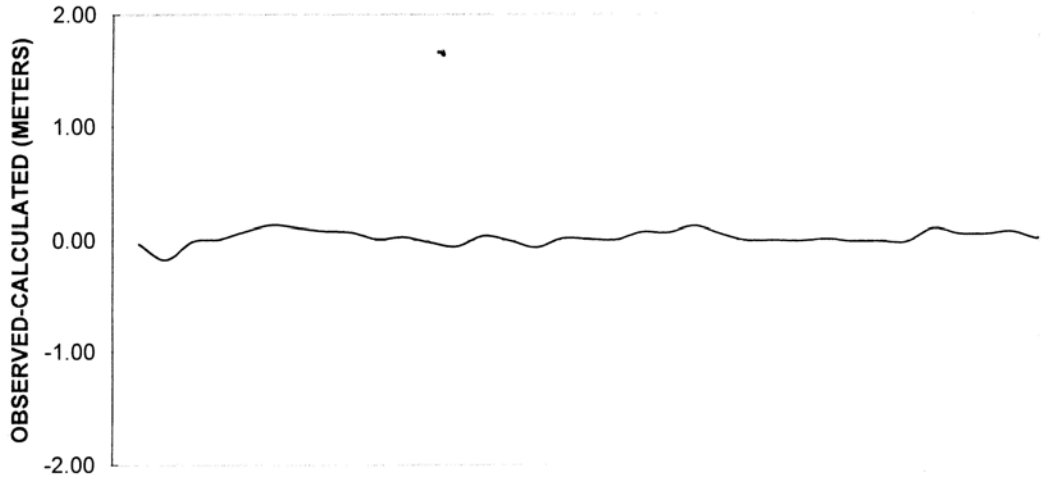
version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.

Burn these numbers to EPROM:

Gradient	**3370**
Intercept	**381**

Calibration Graph



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Telephone: (225)-769-3051. Facsimile: (225)-766-5122
E-mail: email@odomhydrographic.com. HTTP: www.odomhydrographic.com

Date:
Oct 22, 2004

Serial #:
SN:98314-102204

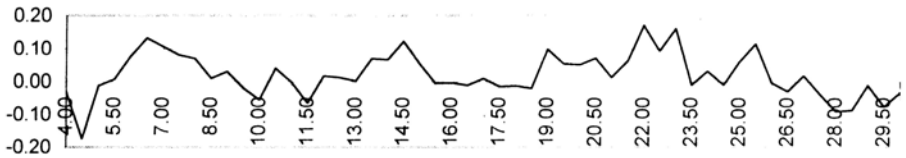
DIGIBAR CALIBRATION REPORT

version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc

STANDARD DEL GROSSO H^2O

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL	TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
4.00	1421.62	5545.09	1421.59	-0.03	17.50	1474.38	5745.58	1474.37	-0.01
4.50	1423.90	5553.21	1423.73	-0.17	18.00	1476.01	5751.78	1476.00	-0.01
5.00	1426.15	5562.38	1426.14	-0.01	18.50	1477.62	5757.86	1477.60	-0.02
5.50	1428.38	5570.91	1428.39	0.01	19.00	1479.21	5764.34	1479.30	0.10
6.00	1430.58	5579.53	1430.66	0.08	19.50	1480.77	5770.12	1480.83	0.06
6.50	1432.75	5588.00	1432.89	0.13	20.00	1482.32	5775.98	1482.37	0.05
7.00	1434.90	5596.06	1435.01	0.11	20.50	1483.84	5781.85	1483.91	0.07
7.50	1437.02	5604.02	1437.10	0.08	21.00	1485.35	5787.34	1485.36	0.01
8.00	1439.12	5611.94	1439.19	0.07	21.50	1486.83	5793.17	1486.89	0.06
8.50	1441.19	5619.58	1441.20	0.01	22.00	1488.29	5799.14	1488.47	0.17
9.00	1443.23	5627.43	1443.26	0.03	22.50	1489.74	5804.33	1489.83	0.10
9.50	1445.25	5634.92	1445.24	-0.02	23.00	1491.16	5810.00	1491.32	0.16
10.00	1447.25	5642.37	1447.20	-0.05	23.50	1492.56	5814.68	1492.56	-0.01
10.50	1449.22	5650.22	1449.26	0.04	24.00	1493.95	5820.10	1493.98	0.03
11.00	1451.17	5657.46	1451.17	0.00	24.50	1495.32	5825.13	1495.31	-0.01
11.50	1453.09	5664.53	1453.03	-0.06	25.00	1496.66	5830.51	1496.72	0.06
12.00	1454.99	5672.06	1455.01	0.02	25.50	1497.99	5835.76	1498.11	0.12
12.50	1456.87	5679.17	1456.88	0.01	26.00	1499.30	5840.28	1499.29	0.00
13.00	1458.72	5686.17	1458.73	0.00	26.50	1500.59	5845.08	1500.56	-0.03
13.50	1460.55	5693.38	1460.63	0.07	27.00	1501.86	5850.09	1501.88	0.02
14.00	1462.36	5700.23	1462.43	0.07	27.50	1503.11	5854.64	1503.08	-0.04
14.50	1464.14	5707.22	1464.27	0.12	28.00	1504.35	5859.13	1504.26	-0.09
15.00	1465.91	5713.65	1465.96	0.05	28.50	1505.56	5863.76	1505.48	-0.09
15.50	1467.65	5720.03	1467.64	0.00	29.00	1506.76	5868.60	1506.75	-0.01
16.00	1469.36	5726.56	1469.36	0.00	29.50	1507.94	5872.84	1507.87	-0.07
16.50	1471.06	5732.97	1471.05	-0.01	30.00	1509.10	5877.42	1509.07	-0.03
17.00	1472.73	5739.40	1472.74	0.01					



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Telephone: (225)-769-3051, Facsimile: (225)-766-5122
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Sea-Bird Electronics, Inc.
1808 136th Place NE
Bellevue, WA 98005
USA

Phone: (425) 643-9866
Fax: (425) 643-9954
E-mail: seabird@seabird.com
Web: www.seabird.com

APPLICATION NOTE NO. 42 **Revised September 2001**

ITS-90 TEMPERATURE SCALE

Beginning January 1995, Sea-Bird temperature calibration certificates list a new set of coefficients labeled *g, h, i, j,* and *F0*. These coefficients correspond to ITS90 (T90) temperatures and should be entered by those researchers working with SEASOFT-DOS Versions 4.208 and higher (and all versions of SEASOFT-Win32). For the convenience of users who prefer to use older SEASOFT versions, the new certificates also list *a, b, c, d,* and *F0* coefficients corresponding to IPTS68 (T68) temperatures as required by SEASOFT-DOS versions older than 4.208.

It is important to note that the international oceanographic research community will continue to use T68 for computation of salinity and other seawater properties. Therefore, following the recommendations of Saunders (1990) and as supported by the Joint Panel on Oceanographic Tables and Standards (1991), SEASOFT-DOS 4.200 and later and all versions of SEASOFT-Win32 convert between T68 and T90 according to the linear relationship:

$$T_{68} = 1.00024 * T_{90}$$

The use of T68 for salinity and other seawater calculations is automatic in all SEASOFT programs. However, when selecting **temperature** as a display/output variable, you will be prompted to specify which standard (T90 or T68) is to be used to compute temperature. SEASOFT recognizes whether you have entered T90 or T68 coefficients in the configuration (.con) file, and computes T90 temperature directly or calculates it from the Saunders linear approximation, depending on which coefficients were used and which display variable type is selected.

For example, if *g, h, i, j, F0* coefficients (T90) are entered in the .con file and you select temperature variable type as T68, SEASOFT computes T90 temperature directly and multiplies it by 1.00024 to display T68. Conversely, if *a, b, c, d,* and *F0* coefficients (T68) are entered in the .con file and you select temperature variable type as T90, SEASOFT computes T68 directly and divides by 1.00024 to display T90.

Note: The CTD configuration (.con) file is edited using the Configure menu (in SEASAVE or SBE Data Processing in our SEASOFT-Win32 suite of programs) or SEACON (in SEASOFT-DOS).

Also beginning January 1995, Sea-Bird's own temperature metrology laboratory (based upon water triple-point and gallium melt cell, SPRT, and ASL F18 Temperature Bridge) converted to T90. These T90 standards are now employed in calibrating *all* Sea-Bird temperature sensors, and as the reference temperature used in conductivity calibrations. Accordingly, all calibration certificates show T90 (g, h, i, j) coefficients that result directly from T90 standards, and T68 coefficients (a, b, c, d) computed using the Saunders linear approximation.

Sea-Bird Electronics, Inc.
1808 136th Place NE, Bellevue, Washington 98005 USA
Website: http://www.seabird.com

FAX: (425) 643-9954
Tel:(425)643-9866
Email: seabird@seabird.com

Service Report

SBE Job Number: 42655

Date: 19, April 2006

Customer: Atlantic Marine Center

Customer Identified Problem:

1. Calibrate SBE 19 SEACAT Profiler, S/N 1913768-2039.

Services Performed:

1. Calibrations and services performed on SBE 19 SEACAT Profiler, S/N 1913768-2039.
   Post calibrated the temperature and conductivity sensors.
   Calibrated the pressure sensor.
   Performed full diagnostic evaluation.

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: 2039
CALIBRATION DATE: 07-Apr-06

SBE19 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPRATURE SCALE

ITS-90 COEFFICIENTS

g = 4.17041229e-003
h = 5.93627062e-004
i = 2.55696272e-006
j = -2.19779670e-006
f0 = 2000.0

ITS-68 COEFFICIENTS

a = 3.64763453e-003
b = 5.84049201e-004
c = 8.42718145e-006
d = -2.19746316e-006
f0 = 2426.891

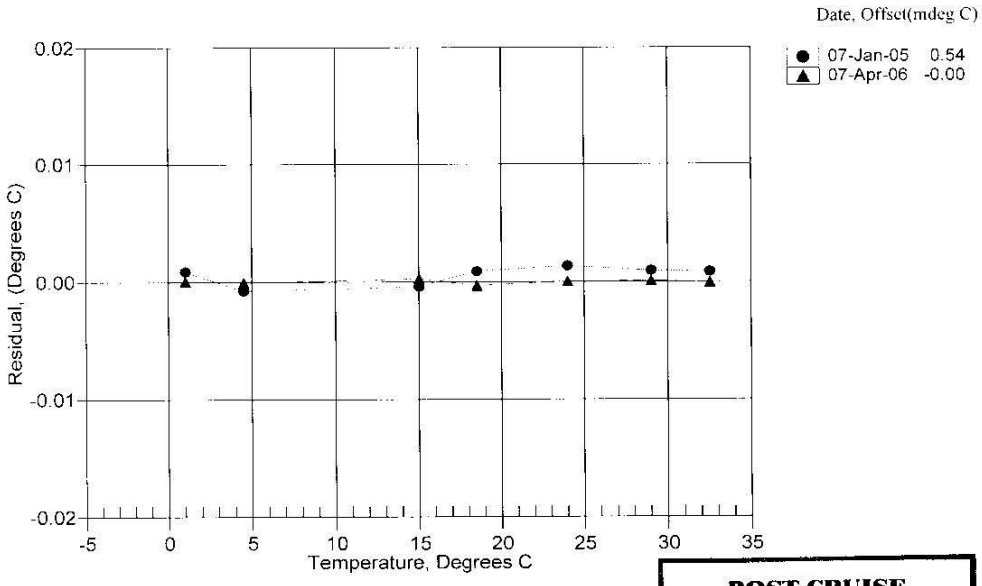
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	2426.891	1.0000	0.00003
4.4999	2625.956	4.4998	-0.00008
14.9999	3292.248	15.0002	0.00028
18.5000	3538.448	18.4997	-0.00032
23.9999	3951.072	23.9999	0.00004
29.0000	4354.363	29.0001	0.00010
32.5000	4653.159	32.4999	-0.00005

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



POST CRUISE CALIBRATION

SEA-BIRD ELECTRONICS, INC.
1808 - 136th Place Northeast, Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Temperature Calibration Report

Customer:	Atlantic Marine Center		
Job Number:	42655	Date of Report:	4/7/2006
Model Number:	SBE 19	Serial Number:	1913768-2039

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: 4/7/2006 Drift since last cal: -.00044 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: 2039
CALIBRATION DATE: 07-Apr-06

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

GHIJ COEFFICIENTS

g = -3.94380852e+000
h = 4.70247301e-001
i = 1.31269273e-003
j = -3.62813561e-005
CPcor = -9.5700e-008 (nominal)
CTcor = 3.2500e-006 (nominal)

ABCDM COEFFICIENTS

a = 4.84359493e-002
b = 4.18624542e-001
c = -3.93189662e+000
d = -1.41440217e-004
m = 2.1
CPcor = -9.5700e-008 (nominal)

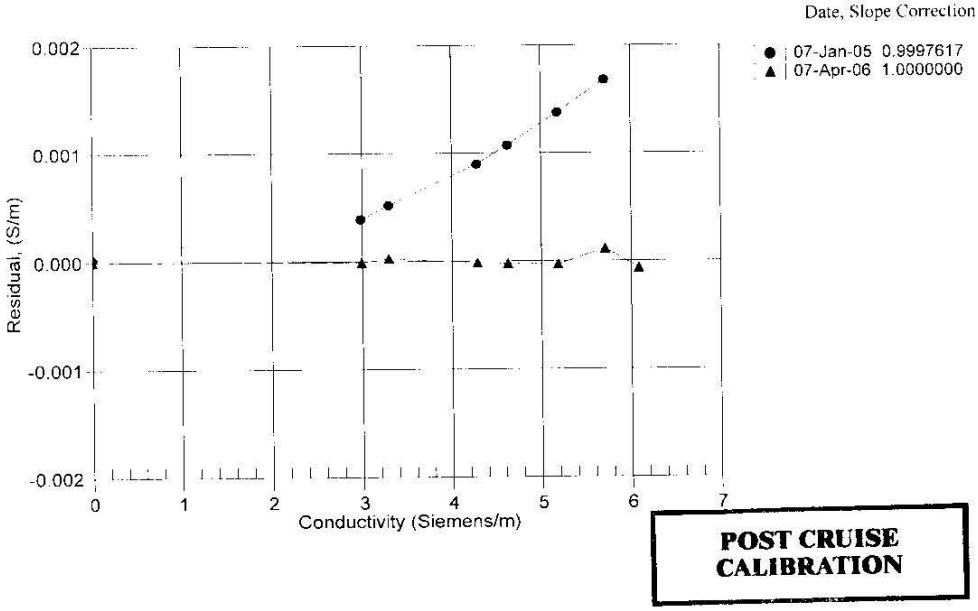
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2.88530	0.00000	0.00000
1.0000	34.9499	2.98629	8.40354	2.98628	-0.00001
4.4999	34.9298	3.29437	8.77583	3.29439	0.00003
14.9999	34.8870	4.27936	9.87120	4.27934	-0.00001
18.5000	34.8779	4.62566	10.22820	4.62563	-0.00002
23.9999	34.8682	5.18548	10.78011	5.18545	-0.00003
29.0000	34.8631	5.70912	11.27187	5.70923	0.00011
32.5000	34.8600	6.08275	11.60967	6.08268	-0.00006

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



POST CRUISE CALIBRATION

SEA-BIRD ELECTRONICS, INC.
1808 - 136th Place Northeast, Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Conductivity Calibration Report

Customer:	Atlantic Marine Center		
Job Number:	42655	Date of Report:	4/7/2006
Model Number:	SBE 19	Serial Number:	1913768-2039

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: 4/7/2006 Drift since last cal: -.00050 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.

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

SENSOR SERIAL NUMBER: 2039
CALIBRATION DATE: 10-Apr-06

SBE19 PRESSURE CALIBRATION DATA
300 psia S/N 133248 TCV: 489

QUADRATIC COEFFICIENTS:

PA0 = 1.484621e+002
PA1 = -3.905807e-002
PA2 = 2.490046e-008

STRAIGHT LINE FIT:

M = 3.905568e-002
B = 1.486022e+002

PRESSURE PSIA	INST OUTPUT(N)	COMPUTED PSIA	ERROR %FS	LINEAR PSIA	ERROR %FS
14.54	3437.0	14.51	-0.01	14.37	-0.06
59.67	2281.0	59.50	-0.06	59.52	-0.05
119.68	743.0	119.46	-0.07	119.58	-0.03
179.67	-795.0	179.53	-0.05	179.65	-0.01
239.67	2329.0	239.56	-0.03	239.56	-0.04
299.66	-3860.0	299.60	-0.02	299.36	-0.10
239.66	-2336.0	239.84	0.06	239.84	0.06
179.65	-804.0	179.88	0.08	180.00	0.12
119.65	735.0	119.77	0.04	119.90	0.08
59.66	2274.0	59.77	0.04	59.79	0.04
14.54	3434.0	14.63	0.03	14.48	-0.02

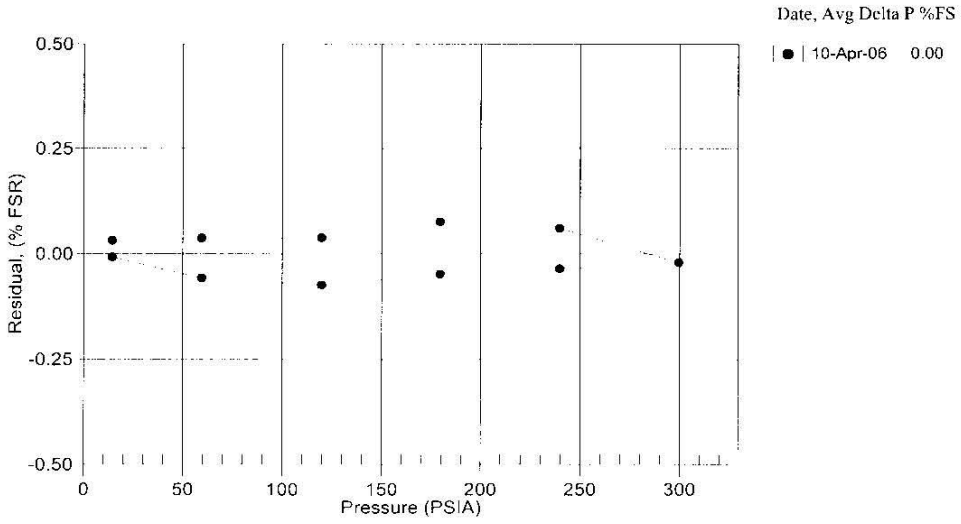
Straight Line Fit:

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



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Temperature Calibration Report

Customer:	NOAA / NRT3 Pier 7, port of Tacoma		
Job Number:	46660	**Date of Report:**	5/8/2007
Model Number	SBE 19	**Serial Number:**	1913768-2039

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: 5/8/2007 Drift since last cal: -0.00023 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: Degrees Celsius/year

Comments:

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Conductivity Calibration Report

Customer:	NOAA / NRT3 Pier 7, port of Tacoma		
Job Number:	46660	**Date of Report:**	5/8/2007
Model Number	SBE 19	**Serial Number:**	1913768-2039

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: 5/8/2007 Drift since last cal: -0.00030 PSU/month*

Comments:

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

Date: Drift since Last cal: PSU/month*

Comments:

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

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

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

SENSOR SERIAL NUMBER: 2039
CALIBRATION DATE: 08-May-07

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

GHIJ COEFFICIENTS

g = -3.94753303e+000
h = 4.70963940e-001
i = 1.19052102e-003
j = -3.04045119e-005
CPcor = -9.5700e-008 (nominal)
CTcor = 3.2500e-006 (nominal)

ABCDM COEFFICIENTS

a = 4.82130545e-002
b = 4.18964246e-001
c = -3.93262169e+000
d = -1.21007322e-004
m = 2.1
CPcor = -9.5700e-008 (nominal)

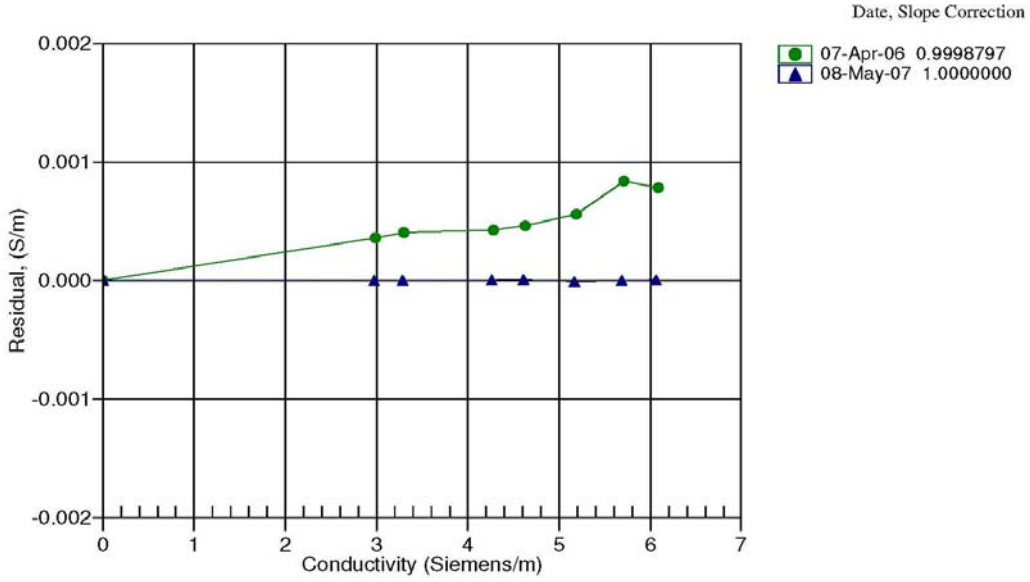
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREO (kHz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2.88541	0.00000	0.00000
1.0000	34.7715	2.97250	8.38604	2.97250	-0.00000
4.5487	34.7514	3.28357	8.76258	3.28357	-0.00000
14.9999	34.7091	4.25984	9.85026	4.25985	0.00000
18.4999	34.7001	4.60460	10.20640	4.60461	0.00001
23.9999	34.6903	5.16194	10.75694	5.16193	-0.00001
29.0000	34.6850	5.68323	11.24731	5.68323	-0.00000
32.5000	34.6817	6.05517	11.58439	6.05517	0.00000

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



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

SENSOR SERIAL NUMBER: 2039
CALIBRATION DATE: 08-May-07

SBE19 PRESSURE CALIBRATION DATA
300 psia S/N 133248 TCV: 489

QUADRATIC COEFFICIENTS:

PA0 = 1.482382e+002
PA1 = -3.904937e-002
PA2 = 2.654662e-008

STRAIGHT LINE FIT:

M = -3.904727e-002
B = 1.483877e+002

PRESSURE PSIA	INST OUTPUT(N)	COMPUTED PSIA	ERROR %FS	LINEAR PSIA	ERROR %FS
14.57	3433.0	14.49	-0.02	14.34	-0.08
59.88	2268.0	59.81	-0.02	59.83	-0.02
119.87	731.0	119.71	-0.05	119.84	-0.01
179.86	-807.0	179.77	-0.03	179.90	0.01
239.86	-2341.0	239.80	-0.02	239.80	-0.02
299.86	-3872.0	299.84	-0.01	299.58	-0.09
239.87	-2345.0	239.95	0.03	239.95	0.03
179.87	-814.0	180.04	0.06	180.17	0.10
119.89	725.0	119.94	0.02	120.08	0.06
59.91	2263.0	60.01	0.03	60.02	0.04
14.57	3429.0	14.65	0.03	14.49	-0.02

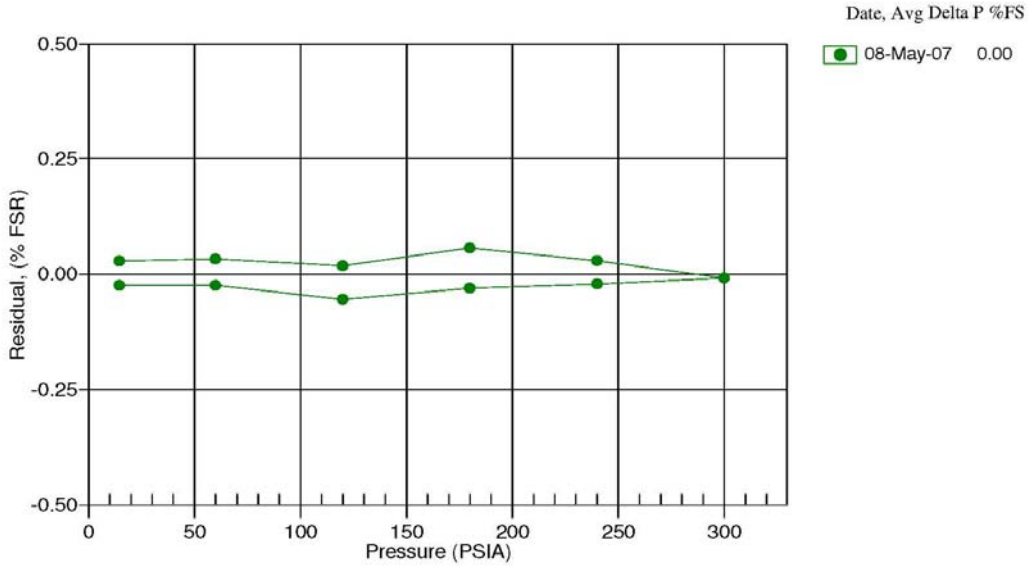
Straight Line Fit:

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



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

SENSOR SERIAL NUMBER: 2039
CALIBRATION DATE: 08-May-07

SBE19 TEMPERATURE CALIBRATION DATA
ITS-90 TEMPRATURE SCALE

ITS-90 COEFFICIENTS

g = 4.17042034e-003
h = 5.93802538e-004
i = 2.76765585e-006
j = -2.13607946e-006
f0 = 1000.0

ITS-68 COEFFICIENTS

a = 3.64763727e-003
b = 5.83997402e-004
c = 8.47341018e-006
d = -2.13574158e-006
f0 = 2426.776

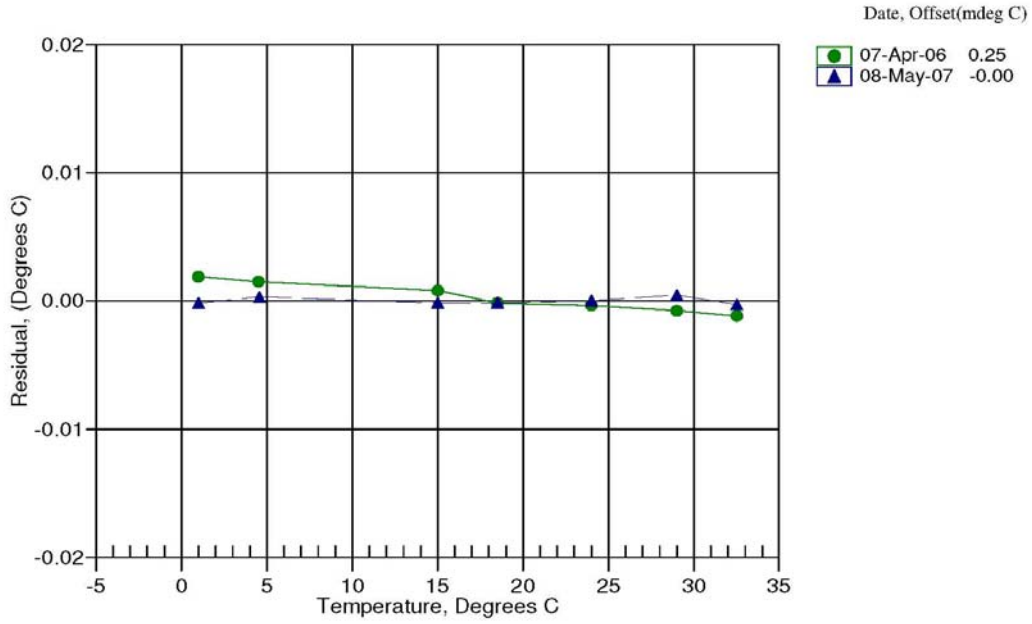
BATH TEMP (ITS-90)	INSTRUMENT FREQ (Hz)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	2426.776	0.9998	-0.00017
4.5487	2628.741	4.5490	0.00031
14.9999	3292.182	14.9997	-0.00016
18.4999	3538.442	18.4997	-0.00015
23.9999	3951.102	23.9999	0.00002
29.0000	4354.463	29.0004	0.00044
32.5000	4653.237	32.4997	-0.00028

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



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Service Report

RMA Number 49199

Customer Information:

Company	NOAA / NRT3 Pier 7, port of Tacoma	**Date**	1/30/2008
Contact	Kurt Mueller		
PO Number	TBD		

Serial Number	19P44126-4778
Model Number	SBE 19Plus

Services Requested:

1. Evaluate/Repair Instrumentation.
2. Perform Routine Calibration Service.

Problems Found:

Services Performed:

1. Performed initial diagnostic evaluation.
2. Performed "Post Cruise" calibration of the temperature & conductivity sensors.
3. Calibrated the pressure sensor.
4. Performed complete system check and full diagnostic evaluation.

Special Notes:

SEA-BIRD ELECTRONICS, INC.
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Service Report

RMA Number 49199

Customer Information:

Company	NOAA / NRT3 Pier 7, port of Tacoma	**Date**	1/30/2008
Contact	Kurt Mueller		
PO Number	TBD		

Serial Number	05M0853
Model Number	SBE 05MT

Services Requested:

1. Evaluate/Repair Instrumentation.

Problems Found:

Services Performed:

1. Performed initial diagnostic evaluation.

Special Notes:

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

Temperature Calibration Report

Customer:	NOAA / NRT3 Pier 7, port of Tacoma		
Job Number:	49199	**Date of Report:**	1/15/2008
Model Number	SBE 19Plus	**Serial Number:**	19P44126-4778

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: 1/15/2008 Drift since last cal: +0.00050 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: Degrees Celsius/year

Comments:

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Conductivity Calibration Report

Customer:	NOAA / NRT3 Pier 7, port of Tacoma		
Job Number:	49199	**Date of Report:**	1/15/2008
Model Number	SBE 19Plus	**Serial Number:**	19P44126-4778

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: 1/15/2008 Drift since last cal: +0.00020 PSU/month

Comments:

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

Date: Drift since Last cal: PSU/month

Comments:

***Measured at 3.0 S/m**

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

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

SENSOR SERIAL NUMBER: 4778
CALIBRATION DATE: 15-Jan-08

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

COEFFICIENTS:

```
g = -1.024672e+000
h =  1.567020e-001
i = -5.292530e-004
j =  6.413526e-005

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

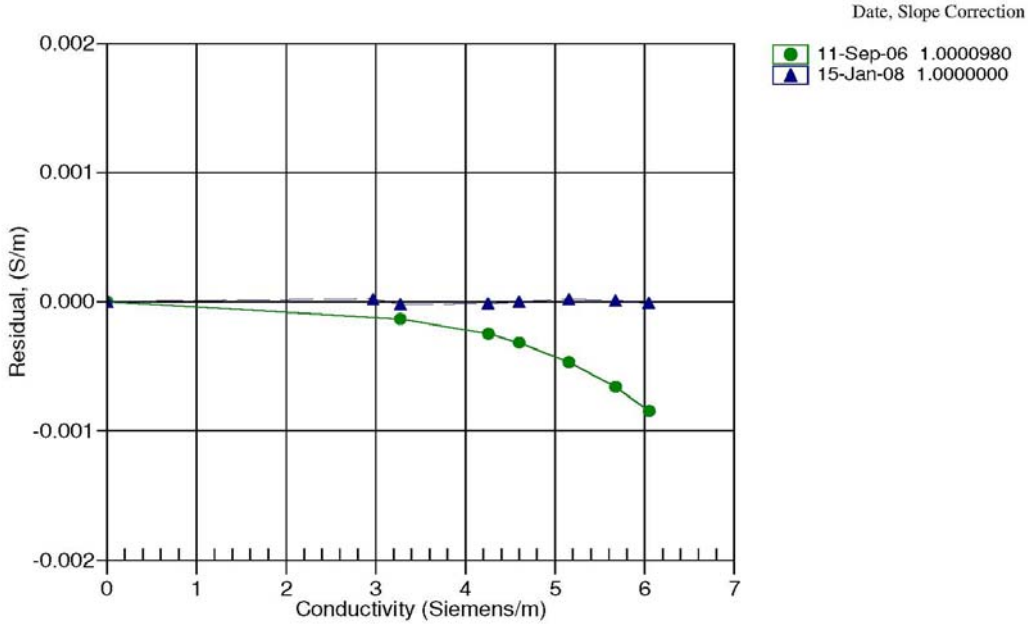
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2564.81	0.0000	0.00000
0.9998	34.6999	2.96694	5063.82	2.9670	0.00002
4.5000	34.6804	3.27316	5254.04	3.2731	-0.00002
15.0000	34.6369	4.25193	5819.82	4.2519	-0.00002
18.5001	34.6273	4.59600	6005.79	4.5960	-0.00000
24.0000	34.6158	5.15209	6294.42	5.1521	0.00002
29.0000	34.6074	5.67194	6552.40	5.6720	0.00001
32.5000	34.6005	6.04260	6730.08	6.0426	-0.00001

f = INST FREQ / 1000.0

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

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

Residual = instrument conductivity - bath conductivity



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

SENSOR SERIAL NUMBER: 4778
CALIBRATION DATE: 14-Jan-08

SBE19plus PRESSURE CALIBRATION DATA
508 psia S/N 6975

COEFFICIENTS:

PA0 =	-3.100982e-001	PTCA0 =	5.334035e+005
PA1 =	1.550723e-003	PTCA1 =	-7.084050e+000
PA2 =	6.252893e-012	PTCA2 =	-1.340383e-001
PTEMPA0 =	-7.443083e+001	PTCB0 =	2.569000e+001
PTEMPA1 =	4.866190e+001	PTCB1 =	-2.000000e-004
PTEMPA2 =	-3.675094e-001	PTCB2 =	0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE PSIA	INST OUTPUT	THERMISTOR OUTPUT	COMPUTED PRESSURE	ERROR %FSR
14.64	542852.0	2.0	14.66	0.00
211.52	669717.8	2.0	211.54	0.00
309.50	732789.8	2.0	309.49	-0.00
408.01	796187.4	2.0	408.00	-0.00
506.39	859456.9	2.0	506.37	-0.00
408.09	796260.2	2.0	408.12	0.01
309.78	732996.9	2.0	309.82	0.01
211.40	669618.7	2.0	211.38	-0.00
112.58	605926.8	2.0	112.52	-0.01
14.63	542851.3	2.0	14.66	0.01

THERMAL CORRECTION

TEMP ITS90	THERMISTOR OUTPUT	INST OUTPUT
32.50	2.23	542968.89
29.00	2.16	543025.90
24.00	2.06	543090.51
18.50	1.94	543159.59
15.00	1.86	543208.86
4.50	1.64	543303.22
1.00	1.57	543333.08

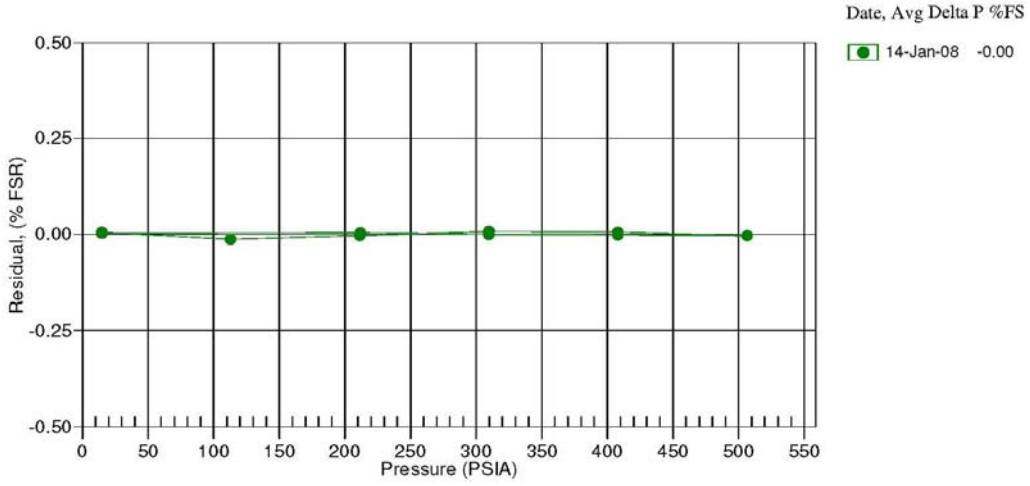
TEMP(ITS90)	SPAN(mV)
-5.00	25.69
35.00	25.68

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

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

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

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



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

SENSOR SERIAL NUMBER: 4778
CALIBRATION DATE: 15-Jan-08

SBE19plus TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

a0 = 1.255717e-003
a1 = 2.602865e-004
a2 = 2.387165e-007
a3 = 1.399553e-007

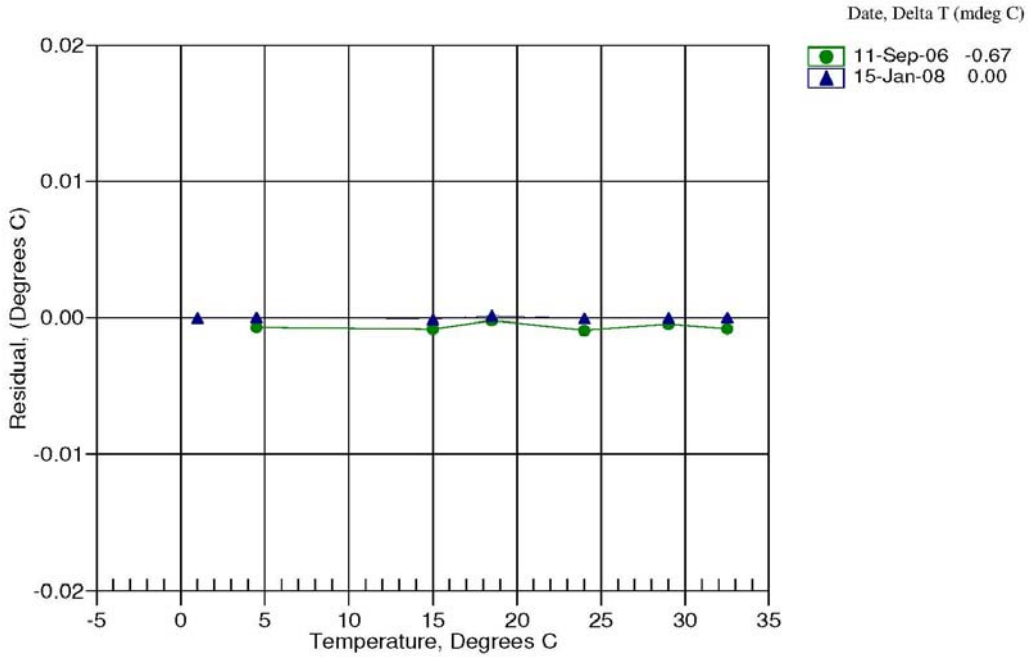
BATH TEMP (ITS-90)	INSTRUMENT OUTPUT(n)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
0.9998	631220.810	0.9998	-0.0000
4.5000	560956.508	4.5000	0.0000
15.0000	386188.143	14.9999	-0.0001
18.5001	339163.492	18.5002	0.0001
24.0000	275271.651	24.0000	-0.0000
29.0000	226589.016	29.0000	-0.0000
32.5000	197165.778	32.5000	0.0000

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

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

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

Residual = instrument temperature - bath temperature



CALIBRATION SHEETS

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: 4778
CALIBRATION DATE: 10-Sep-06

SBE19plus TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

ITS-90 COEFFICIENTS

a0 = 1.250842e-003
a1 = 2.621755e-004
a2 = -4.488681e-009
a3 = 1.503449e-007

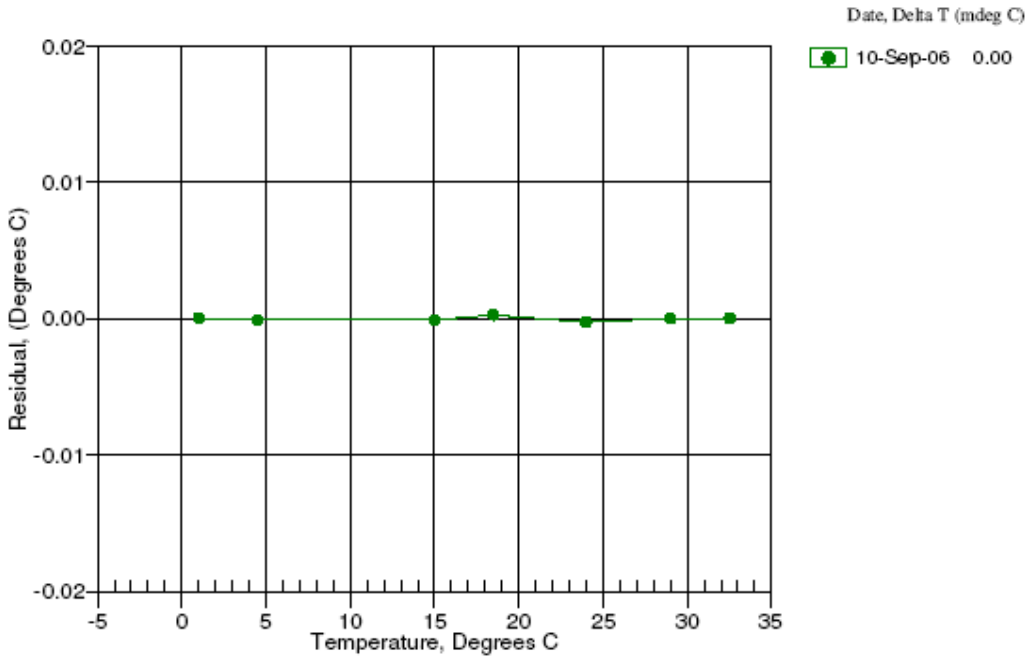
BATH TEMP (ITS-90)	INSTRUMENT OUTPUT(n)	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	631225.746	1.0000	0.0000
4.5000	560971.339	4.4999	-0.0001
15.0000	386199.407	14.9999	-0.0001
18.5000	339172.729	18.5003	0.0003
24.0001	275279.085	23.9999	-0.0002
29.0000	226593.186	29.0000	0.0000
32.5001	197168.339	32.5001	0.0000

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

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

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

Residual = instrument temperature - bath temperature



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: 4778
CALIBRATION DATE: 10-Sep-06

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

COEFFICIENTS:

g = -1.025110e+000
h = 1.569021e-001
i = -5.943965e-004
j = 7.001325e-005

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

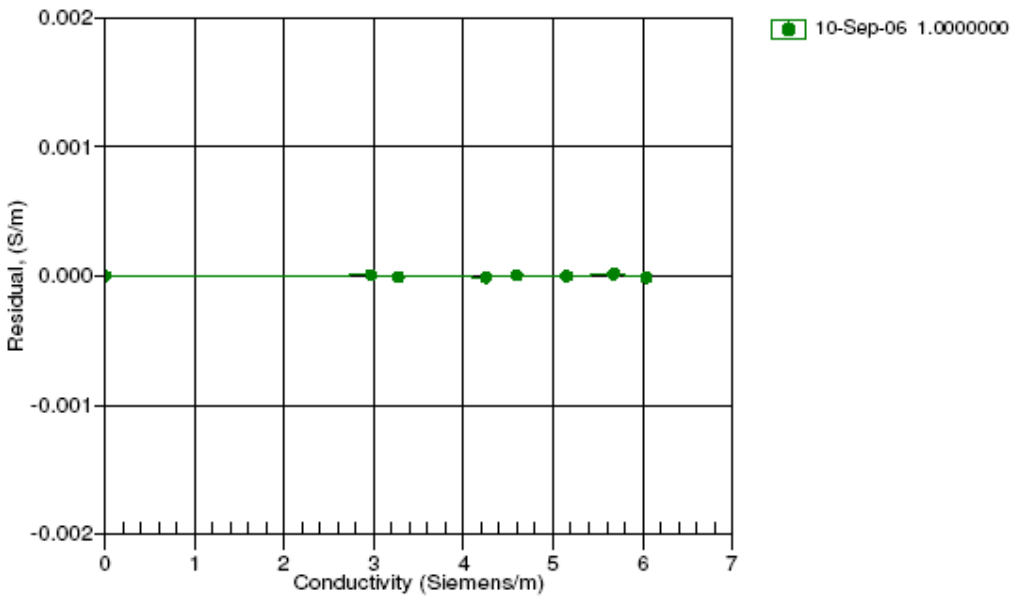
BATH TEMP (ITS-90)	BATH SAL. (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2564.77	0.0000	0.00000
1.0000	34.7000	2.96697	5063.77	2.9670	0.00001
4.5000	34.6799	3.27312	5253.95	3.2731	-0.00001
15.0000	34.6370	4.25194	5819.70	4.2519	-0.00001
18.5000	34.6279	4.59607	6005.66	4.5961	0.00000
24.0001	34.6181	5.15240	6294.33	5.1524	-0.00000
29.0000	34.6125	5.67268	6552.44	5.6727	0.00001
32.5001	34.6088	6.04390	6730.30	6.0439	-0.00001

f = INST FREQ / 1000.0

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

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

Residual = instrument conductivity - bath conductivity



SEA-BIRD ELECTRONICS, INC.

1808 136th Place N.E., Bellevue, Washington, 98005 USA
Phone: (425) 643 - 9866 Fax (425) 643 - 9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4778
CALIBRATION DATE: 22-Sep-06

SBE19plus PRESSURE CALIBRATION DATA
508 psia S/N 6975

COEFFICIENTS:

PA0 =	-1.988874e-001	PTCA0 =	5.333997e+005
PA1 =	1.549568e-003	PTCA1 =	-5.771611e+000
PA2 =	9.048674e-012	PTCA2 =	-1.700249e-002
PTEMPA0 =	-7.403048e+001	PTCB0 =	2.569000e+001
PTEMPA1 =	4.823344e+001	PTCB1 =	-2.000000e-004
PTEMPA2 =	-2.462597e-001	PTCB2 =	0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE PSIA	INST OUTPUT	THERMISTOR OUTPUT	COMPUTED PRESSURE	ERROR %FSR
14.77	542928.0	2.0	14.77	-0.00
104.87	601022.0	2.0	104.85	-0.01
204.87	665452.0	2.0	204.82	-0.01
304.83	729838.0	2.0	304.80	-0.01
404.81	794179.0	2.0	404.78	-0.00
504.78	858480.0	2.0	504.78	-0.00
404.79	794206.0	2.0	404.82	0.01
304.81	729858.0	2.0	304.83	0.00
204.78	665465.0	2.0	204.84	0.01
104.84	601034.0	2.0	104.87	0.00
14.77	542934.0	2.0	14.78	0.00

THERMAL CORRECTION

TEMP ITS90	THERMISTOR OUTPUT	INST OUTPUT
32.50	2.23	542995.20
29.00	2.16	543023.75
24.00	2.05	543057.64
18.50	1.94	543091.22
15.00	1.86	543108.85
4.50	1.64	543178.10

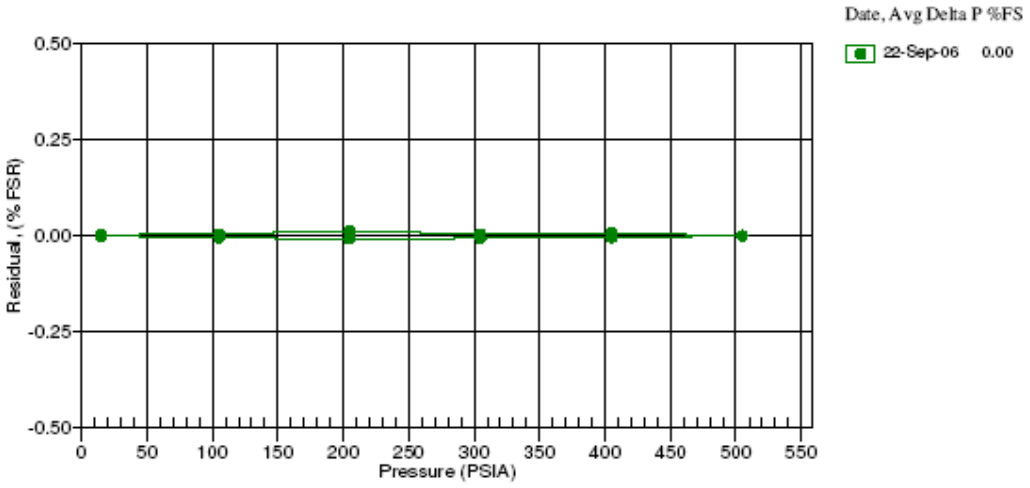
TEMP (ITS90)	SPAN (mV)
-5.00	25.69
35.00	25.68

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

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

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

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



Sea-Bird Electronics, Inc.
1808 136th Place NE, Bellevue, Washington 98005 USA
Website: http://www.seabird.com
FAX: (425) 643-9954
Tel: (425) 643-9866
Email: seabird@seabird.com

SBE 5M MINI SUBMERSIBLE PUMP CONFIGURATION SHEET

Serial Number: **0853**

Job Number: **44126**

Customer: **NOAA/GLERL**

Delivery Date: **10/6/2006**

Single Connector Housing with Titanium screws

Pressure Case: 10,500 meters (titanium)

Maxon Motor Type:

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

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

Vin 15V voltage across C2: ***8.004*** VDC Current ***16.1*** mA

Vin 9V voltage across C2: ***8.006*** VDC Current ***15.4*** mA

Vin 6V voltage across C2: ***5.705*** VDC Current ***11.3*** mA

Pump submerged test, no load, Vin 12VDC Average current draw in water: ***123*** mA

PRESSURE TEST CERTIFICATES

Sea-Bird Electronics, Inc.
1808 136th Place NE, Bellevue, Washington 98005 USA
Website: http://www.seabird.com

Phone: (425) 643-9866
FAX: (425) 643-9954
Email: seabird@seabird.com

SBE Pressure Test Certificate

Test Date: 9/25/2006 Description SBE-19 SeaCat Profiler

Job Number: 44126 Customer Name NOAA/GLERL

SBE Sensor Information:

Model Number: 19P
Serial Number: 4778

Pressure Sensor Information:

Sensor Type: Druck
Sensor Serial Number: 6975
Sensor Rating: 508

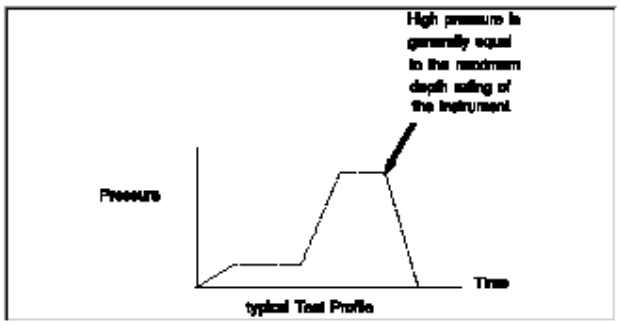
Pressure Test Protocol:

Low Pressure Test: 40 PSI Held For 15 Minutes

High Pressure Test: 500 PSI Held For 15 Minutes

Passed Test: ☑

Tested By: PC



Sea-Bird Electronics, Inc.
1808 136th Place NE, Bellevue, Washington 98005 USA
Website: http://www.seabird.com
Phone: (425) 643-9866
FAX: (425) 643-9954
Email: seabird@seabird.com

SBE Pressure Test Certificate

Test Date: 7/20/2006 Description SBE-5M Mini-Submersible Pump

Job Number: 44126 Customer Name NOAA/GLERL

SBE Sensor Information:

Model Number: 5M
Serial Number: 0853

Pressure Sensor Information:

Sensor Type: None
Sensor Serial Number: None
Sensor Rating: 0

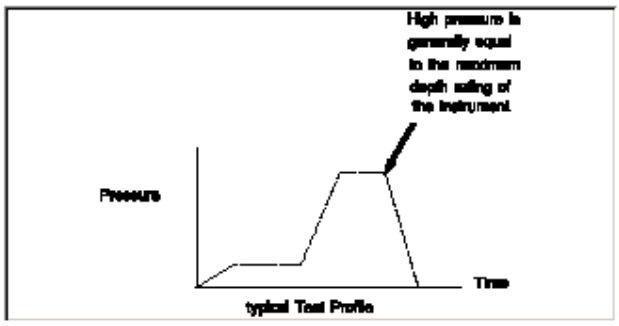
Pressure Test Protocol:

Low Pressure Test: 40 PSI Held For 15 Minutes

High Pressure Test: 10000 PSI Held For 15 Minutes

Passed Test: ☑

Tested By: nd



APPENDIX V

MBES and POS-MV Calibrations

Multibeam Echosounder Calibration
Field Unit: NRT3
Date of Test: 04/23/2008
Calibrating Hydrographer(s): K. Simmons, K. Mueller, P. Sparr
MULTIBEAM SYSTEM INFORMATION
Multibeam Echosounder System: Kongsberg EM3000
System Location: NOAA Survey Launch S1212
Sonar Serial Number: 358
Processing Unit Serial Number: 1534
Date of Most Recent EED / Factory Checkout:
VESSEL INFORMATION
Sonar Mounting Configuration: Fixed hull mount
Date of Current Vessel Offset Measurement / Verification:
Description of Positioning System: POS/MV version 4 w/ TrueHeave
Date of Most Recent Positioning System Calibration: 04/23/2008
TEST INFORMATION
Test Date(s) / DN(s): 04/23/2008 - DN114
System Operator(s): K. Simmons, K. Mueller, P. Sparr
Wind / Seas / Sky: 5 knts/ <1ft / partly cloudy
Locality: Puget Sound
Sub-Locality: Commencement Bay
Bottom Type: mud
Approximate Average Water Depth: 25m

DATA ACQUISITION INFORMATION

Line Number	Heading	Speed
002_1727.114 -- Nav&Pitch_4knts_E	075	4
002_1730.114 -- Nav&Pitch_4knts_W	255	4
002_1734.114 -- Nav&Pitch_8knts_E	075	8
001_1740.114 -- Roll_4knts_1	129	3.5
001A_1744.114 -- Roll_4knts_2	309	3.5
012_1755.114 -- Heading_5knts_N	349	5
011_1800.114 -- Heading_5knts_S	169	5
015_1803.114 -- Heading_5knts_N_2	349	5
012_1803.114 -- Heading_5knts_S_2	169	5

TEST RESULTS

Navigation Timing Error: 0.000

Pitch Timing Error: 0.000

Roll Timing Error: 0.000

Pitch Bias: 0.000

Roll Bias: -0.060

Heading Bias: 0.000

Resulting CARIS HIPS HVF File Name: S1212_Simrad.hvf

NARRATIVE

Briefly and succinctly summarize the MBES Certification Test, focusing on those aspects of the test. Particular attention shall be paid to interpretation of test results, with discussion on residual biases in roll, pitch, heading, and navigation timing error. Any changes to configuration made based on these results shall be described.

Errors are low and were expected to be low because the MBES sonar head is fixed-mounted directly beneath the IMU sensor.

Multibeam Echosounder Calibration

Field Unit: NRT3

Date of Test: 09/05/2006

Calibrating Hydrographer(s): K. Simmons, J. Landsfeld, M. Foss, M. Van Waes

MULTIBEAM SYSTEM INFORMATION

Multibeam Echosounder System: Kongsberg EM3000

System Location: NOAA Survey Launch S1212

Sonar Serial Number: 358

Processing Unit Serial Number: 1534

Date of Most Recent EED / Factory Checkout:

VESSEL INFORMATION

Sonar Mounting Configuration: Fixed hull mount

Date of Current Vessel Offset Measurement / Verification:

Description of Positioning System: POS/MV version 4 w/ TrueHeave

Date of Most Recent Positioning System Calibration: 08/16/2006

TEST INFORMATION

Test Date(s) / DN(s): 09/05/2006 - DN248

System Operator(s): M. Foss

Wind / Seas / Sky: calm / <1ft / overcast

Locality: Puget Sound

Sub-Locality: Shilshole Bay

Bottom Type: mud

Approximate Average Water Depth: 25m

DATA ACQUISITION INFORMATION

Line Number	Heading	Speed
001_1744.248 -- roll	068	6
001_1748.248 -- roll	248	6
002_1801.248 -- heading 1	201	6
003_1803.248 -- heading 2	021	6
004_1804.248 -- heading 3	201	7
002_1806.248 -- heading 4	021	6
003_1808.248 -- heading 5	201	6
004_1810.248 -- heading 6	021	6
005_1814.248 -- pitch (extra)	110	6
005_1816.248 -- pitch (extra)	290	6
007_1822.248 -- heading (wide)	021	6
008_1828.248 -- heading (wide)	201	6
002_1833.248 -- roll timing	042	4

TEST RESULTS

Navigation Timing Error: 0.000

Pitch Timing Error: 0.000

Roll Timing Error: 0.000

Pitch Bias: 0.000

Roll Bias: -0.060

Heading Bias: 0.000

Resulting CARIS HIPS HVF File Name: S1212_Simrad.hvf

NARRATIVE

Briefly and succinctly summarize the MBES Certification Test, focusing on those aspects of the test. Particular attention shall be paid to interpretation of test results, with discussion on residual biases in roll, pitch, heading, and navigation timing error. Any changes to configuration made based on these results shall be described.

Errors are low and were expected to be low because the MBES sonar head is fixed-mounted directly beneath the IMU sensor.

POS/MV Calibration Report

Field Unit: Navigation Response Team 3

SYSTEM INFORMATION

Vessel: S1212

Date: 4/23/2008 **Dn:**

Personnel: K. Simmons, K. Mueller, P. Sparr

PCS Serial # 2245

IP Address: 129.100.1.231

POS controller Version (Use Menu Help > About) 3.4.0.0

POS Version (Use Menu View > Statistics) MV320 Ver4

GPS Receivers

Primary Receiver Serial # 4435A43230

Secondary Receiver Serial # 9500000010

CALIBRATION AREA

Location: Tacoma, WA

Approximate Position:

	D	M	S
Lat	47	16	48
Lon	-122	25	36

DGPS Beacon Station: Auto Power

Frequency:

Satellite Constellation

(Use View> GPS Data)

Primary GPS (Port Antenna)

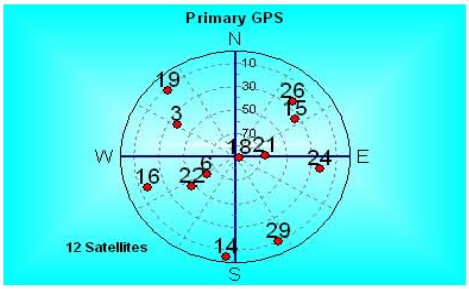
HDOP: 0.827

VDOP: 1.153

*DOPs monitored while performing calibration, stayed below 0.9

Sattelites in Use: 3,6,15,16,18,19,21,22,24,26,29

PDOP 1.405 (Use View> GAMS Solution)



POS/MV CONFIGURATION

Settings

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

User Entries, Pre-Calibration		Baseline Vector	
1.903	Two Antenna Separation (m)	**0.000**	X Component (m)
0.500	Heading Calibration Threshold	**0.000**	YComponent (m)
0.000	Heading Correction	**0.000**	Z Component (m)

Configuration Notes: Two antenna separation taken from previous POSMV configuration.

POS/MV CALIBRATION

Calibration Procedure:

(Refer to POS MV4 Installation and Operation Guide)

Start time: 17:30 UTC
End time: 17:34 UTC
Heading accuracy achieved for calibration: 0.050

Calibration Results:

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

POS/MV Post-Calibration Values		Baseline Vector	
1.901	Two Antenna Separation (m)	**0.018**	X Component (m)
0.500	Heading Calibration Threshold	**1.900**	YComponent (m)
0.000	Heading Correction	**0.019**	Z Component (m)

GAMS Status Online? X
Save Settings? X

Calibration Notes: This is a GAMS calibration of a borrowed unit from Applanix. Original unit was sent to Applanix for repair.

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

GENERAL GUIDANCE

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

The right-hand orthogonal system defines the following:

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

The POS/MV uses a Tate-Bryant Rotation Sequence

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

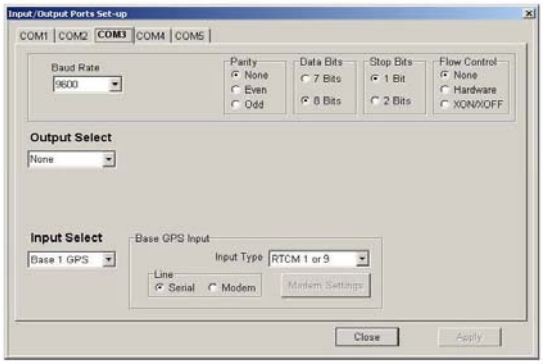
a) Heading rotation - apply a right-hand screw rotation θz about the z-axis to align one frame with the other.

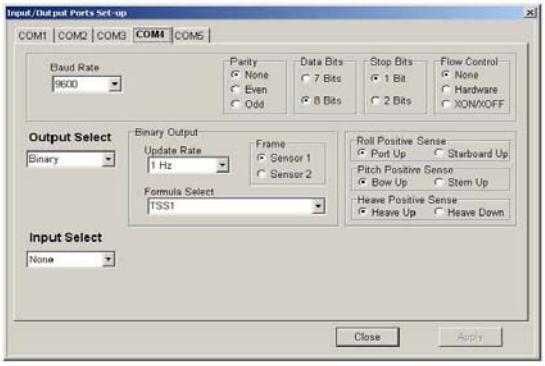
b) Pitch rotation - apply a right-hand screw rotation θy about the once-rotated y-axis to align one frame with the other.

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

SETTINGS (insert screen grabs)

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

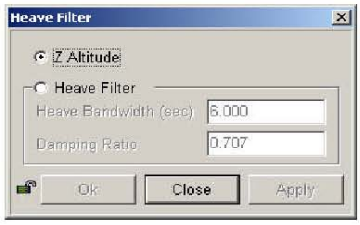

Input/Output Ports Set-up
COM1 | COM2 | COM3 | COM4 | COM5
Baud Rate
9600
Parity
None
Even
Odd
Data Bits
7 Bits
8 Bits
Stop Bits
1 Bit
2 Bits
Flow Control
None
Hardware
XON/XOFF
Output Select
None
Input Select
Base 1 GPS
Base GPS Input
Input Type
RTCM 1 or 9
Line
Serial
Modem
Modem Settings
Close
Apply


Input/Output Ports Set-up
COM1 | COM2 | COM3 | COM4 | COM5
Baud Rate
9600
Parity
None
Even
Odd
Data Bits
7 Bits
8 Bits
Stop Bits
1 Bit
2 Bits
Flow Control
None
Hardware
XON/XOFF
Output Select
Binary
Binary Output
Update Rate
1 Hz
Frame
Sensor 1
Sensor 2
Formula Select
TSS1
Roll Positive Sense
Port Up
Starboard Up
Pitch Positive Sense
Bow Up
Stern Up
Heave Positive Sense
Heave Up
Heave Down
Input Select
None
Close
Apply

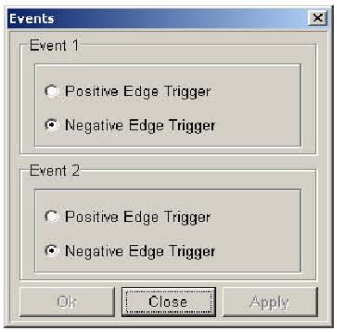

Input/Output Ports Set-up
COM1 | COM2 | COM3 | COM4 | COM5
Baud Rate
9600
Parity
None
Even
Odd
Data Bits
7 Bits
8 Bits
Stop Bits
1 Bit
2 Bits
Flow Control
None
Hardware
XON/XOFF
Output Select
None
Input Select
None
Close
Apply

NOTE:

Heave Filter (Use Settings > Heave)

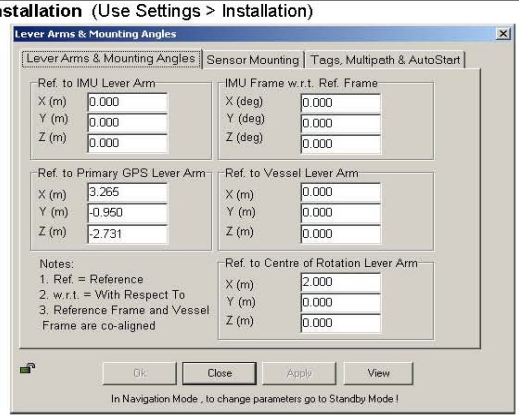


Events (Use Settings > Events)

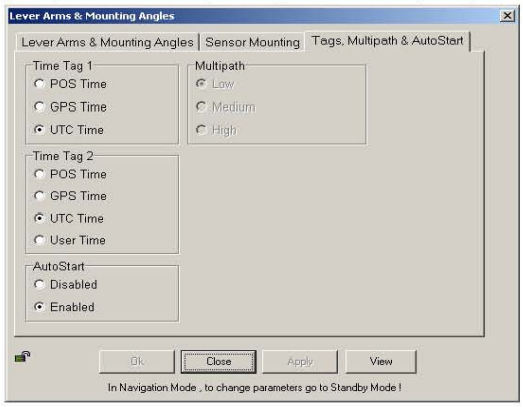


Time Sync (Use Settings > Time Sync)

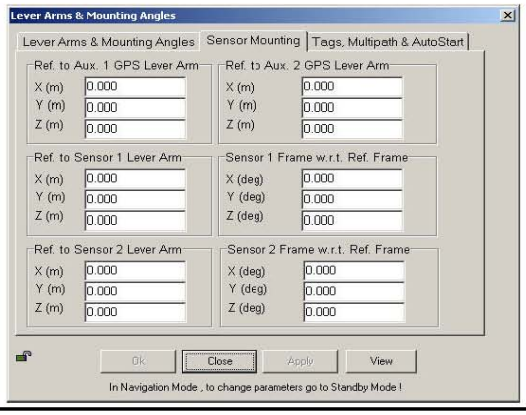
Installation (Use Settings > Installation)



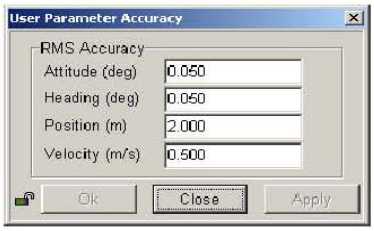
Tags, Multipath and Auto Start (Use Settings > Installation > Tags, Multipath and Auto Start)



Sensor Mounting (Use Settings > Installation > Sensor Mounting)



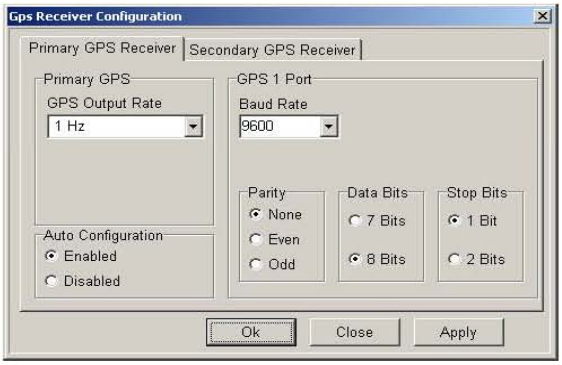
User Parameter Accuracy (Use Settings > Installation > User Accuracy)



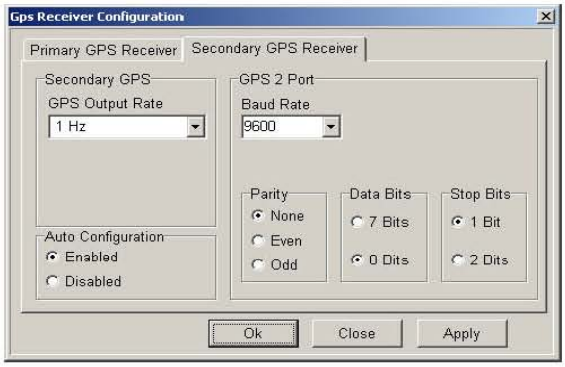
Frame Control (Use Tools > Config)

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

Primary GPS Receiver



Secondary GPS Receiver



POS/MV Calibration Report

Field Unit: Navigation Response Team 3

SYSTEM INFORMATION

Vessel: S1212

Date: 8/16/2006 **Dn:** 228

Personnel: K. Simmons, J.Lansdfeld, M.Foss, M. Van Waes

PCS Serial # 2245

IP Address: 129.100.1.231

POS controller Version (Use Menu Help > About) 2.10d

POS Version (Use Menu View > Statistics) MV320 Ver4

GPS Receivers

Primary Receiver Serial # 60080830

Secondary Receiver Serial # 60069001

CALIBRATION AREA

Location: Seattle, WA

Approximate Position:

	D	M	S
Lat	47	42	15
Lon	122	16	9

DGPS Beacon Station: Auto Power

Frequency:

Satellite Constellation

(Use View> GPS Data)

Primary GPS (Port Antenna)

HDOP:

VDOP:

*DOPs monitored while performing calibration, stayed below 0.9

Sattelites in Use:

PDOP (Use View> GAMS Solution)

POS/MV CONFIGURATION

Settings

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

User Entries, Pre-Calibration		Baseline Vector	
1.903	Two Antenna Separation (m)	**0**	X Component (m)
0.500	Heading Calibration Threshold	**0**	YComponent (m)
0.000	Heading Correction	**0**	Z Component (m)

Configuration Notes: Two antenna separation calculated from recent NGS survey.

POS/MV CALIBRATION

Calibration Procedure:

(Refer to POS MV4 Installation and Operation Guide)

Start time: 15:30 UTC
End time: 15:32 UTC
Heading accuracy achieved for calibration: 0.050

Calibration Results:

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

POS/MV Post-Calibration Values		Baseline Vector	
1.900	Two Antenna Separation (m)	**0.022**	X Component (m)
0.500	Heading Calibration Threshold	**1.900**	YComponent (m)
0.000	Heading Correction	**0.018**	Z Component (m)

GAMS Status Online? X
Save Settings? X

Calibration Notes: This is the first GAMS calibration conducted since system installation.

Save POS Settings on PC (Use File > Store POS Settings on PC)
File Name: POSMV_08162006.nvm

GENERAL GUIDANCE

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

The right-hand orthogonal system defines the following:

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

The POS/MV uses a Tate-Bryant Rotation Sequence

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

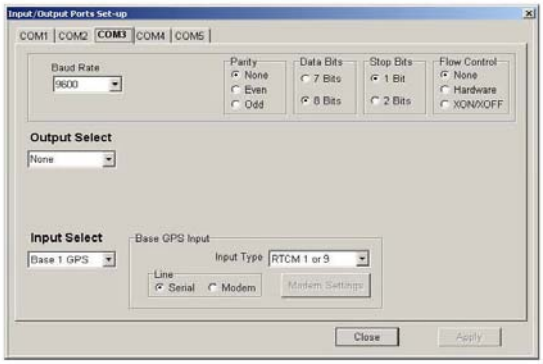
a) Heading rotation - apply a right-hand screw rotation θz about the z-axis to align one frame with the other.

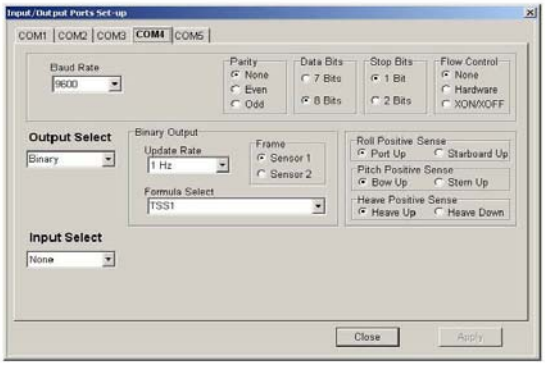
b) Pitch rotation - apply a right-hand screw rotation θy about the once-rotated y-axis to align one frame with the other.

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

SETTINGS (insert screen grabs)

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

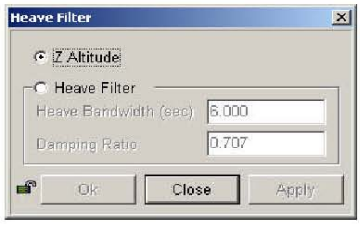

Input/Output Ports Set-up
COM1 | COM2 | COM3 | COM4 | COM5
Baud Rate
9600
Parity
None
Even
Odd
Data Bits
7 Bits
8 Bits
Stop Bits
1 Bit
2 Bits
Flow Control
None
Hardware
XON/XOFF
Output Select
None
Input Select
Base 1 GPS
Base GPS Input
Input Type
RTCM 1 or 9
Line
Serial
Modem
Modem Settings
Close
Apply


Input/Output Ports Set-up
COM1 | COM2 | COM3 | COM4 | COM5
Baud Rate
9600
Parity
None
Even
Odd
Data Bits
7 Bits
8 Bits
Stop Bits
1 Bit
2 Bits
Flow Control
None
Hardware
XON/XOFF
Output Select
Binary
Binary Output
Update Rate
1 Hz
Frame
Sensor 1
Sensor 2
Formula Select
TSS1
Roll Positive Sense
Port Up
Starboard Up
Pitch Positive Sense
Bow Up
Stern Up
Heave Positive Sense
Heave Up
Heave Down
Input Select
None
Close
Apply

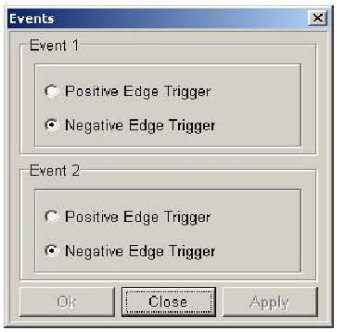

Input/Output Ports Set-up
COM1 | COM2 | COM3 | COM4 | COM5
Baud Rate
9600
Parity
None
Even
Odd
Data Bits
7 Bits
8 Bits
Stop Bits
1 Bit
2 Bits
Flow Control
None
Hardware
XON/XOFF
Output Select
None
Input Select
None
Close
Apply

NOTE:

Heave Filter (Use Settings > Heave)

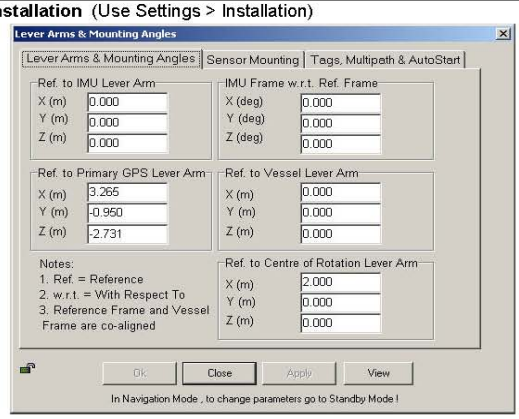


Events (Use Settings > Events)

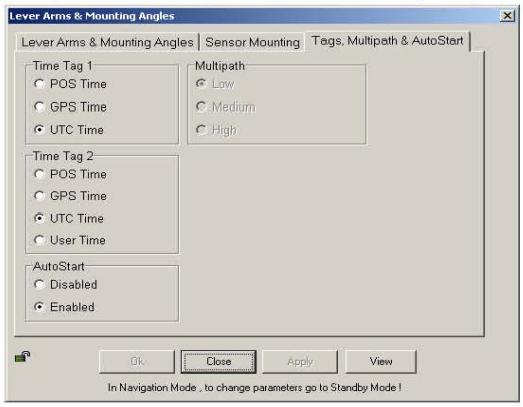


Time Sync (Use Settings > Time Sync)

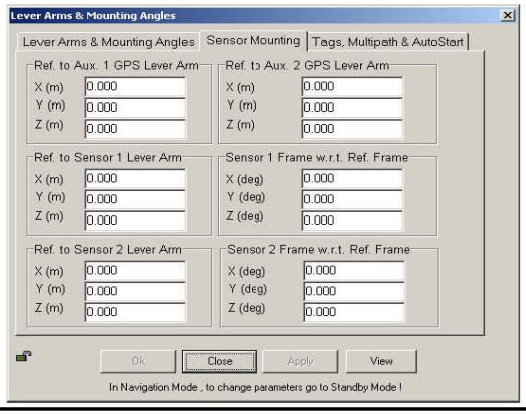
Installation (Use Settings > Installation)



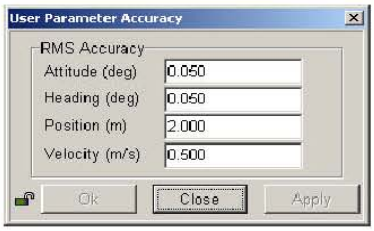
Tags, Multipath and Auto Start (Use Settings > Installation > Tags, Multipath and Auto Start)



Sensor Mounting (Use Settings > Installation > Sensor Mounting)



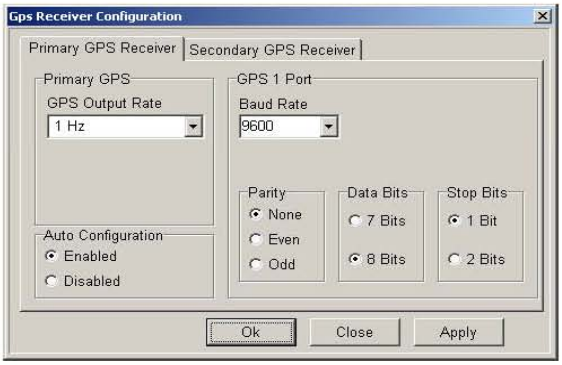
User Parameter Accuracy (Use Settings > Installation > User Accuracy)



Frame Control (Use Tools > Config)

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

Primary GPS Receiver



Secondary GPS Receiver