

June 2011



KONGSBERG

Test Procedure: Sea Acceptance Test (SAT)	Part Number: 839-123154		
	Revision: Rev -		
Product: EM 122 Multibeam Echo Sounder Woods Hole Oceanographic Institution R/V Atlantis	Action	Date	Signature
	By:		
	Checked:		
	Approved:		

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1 DOCUMENT HISTORY

Date	Rev	Status
30 Dec 2008	-	Original issue

2 INTRODUCTION

The purpose of this procedure is to verify that the system as installed is fully functional at sea, and to serve as a record of the successful completion of the Sea Acceptance Test. It is to be followed to verify correct functioning of the multibeam echo sounder and the various external sensors or systems as an integrated mapping system. It will also verify that the system interfaces and peripherals are functional.

The sea trials shall establish that the:

- different EM 122 units work properly at sea
- heave, roll and pitch signals are correctly used
- heading signal is correctly used
- sound speed input data are correctly used
- positioning system data are correctly used
- system is capable of providing good depth data consistently
- system during operation produces digital data to its internal storage devices and, if available, to an external logging system connected via Ethernet

The Sea Acceptance Test shall consist of a verification of correct interfacing of external sensors, a calibration of external sensor offsets and time delays, a test survey, and assessment of the data from the test survey. In addition, as far as time and external conditions allow, limitations on system performance as a function of water depth, vessel speed and sea state shall be established.

3 REFERENCES

Factory and Harbor Acceptance Test records.

4 TEST EQUIPMENT

No special test equipment is required for the Sea Acceptance Test, but all sensors normally needed for surveying with a Multibeam echo sounder shall be available.

5 ITEMS TO BE TESTED

Item	Registration number	Equipment	Serial number
1		EM 122 Transceiver Unit 1x1	118
2		Hydrographic Workstation C3	0361
3		Heading Sensor <i>GYRO</i> *	5455 *
4		<i>SPERRY MK 37 MOD D/E</i> Motion Sensor <i>IXSRA PHIN3</i>	PH 3
5		Fixed Sound Speed Sensor <i>SBE THERMOSALINOGGRAPH</i>	4547129-0204
6		Sound Speed Profile Sensor <i>SIPPICAN MK 21 XBT</i> <i>SEABIRD 911+ CTD</i>	962301 09P9852-0383
7		Positioning System <i>CNAV</i> <i>SF-2050G</i>	5052
		<i>UPS EATON 9135U</i>	CC02/A0031

* S/N OF GYRO DIFFICULT TO READ -

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6 CONFIGURATION

The modules and circuit boards included in the system and their serial numbers were noted in the Factory and Harbor Acceptance tests. Any replacement modules or circuit boards since the HAT must be noted.

Replacement list			
Item	Equipment	Registration number	Serial number
1			
2			
3			
4			
5			
6			

7 SOFTWARE

The system software version must be noted, including the subsystems, and reflecting any changes made during the trials.

Item	Equipment	Version number	Version date
1	BSP 67B master version	2.2.3	090702
2	BSP 67B slave version	2.2.3	090702
3	CPU version	1.2.3	110321
4	DDS version	3.5.2	101013
5	RX 32 version	1.11	FEB 18 2010
6	TX 36 version LC	1.11	JUN 17 2008
7	SIS Software version (press the icon located on the bottom line in the SIS window)	3.8.3 BUILD 89	MAR 25 2011

8 INTERCONNECTION / ARRANGEMENT

The system shall have been installed according to the Installation Manual. Note the locations of the transducers, motion sensor(s) and positioning system(s) as entered on the Operator Station.

	X (forward pos)	Y (starboard pos)	Z (downwards)
TX transducer	-30.18129	-0.39007	0.42354
RX transducer	-25.71581	-0.01110	0.50488
Motion sensor no 1	-27.26953	0.45374	-2.85523
Motion sensor no 2	N/A	N/A	N/A
Positioning system no 1	-37.46223	-3.15760	-30.23494
Positioning system no 2	N/A	N/A	N/A
Positioning system no 3	N/A	N/A	N/A
Pos. system Ethernet	N/A	N/A	N/A
Waterline downward	NA	NA	-5.270

Note the transducer alignment angles as entered on the Operator Station:

	Roll	Pitch	Heading
TX transducer	-0.1469	0.0581	0.00568
RX transducer	-0.088	0.0277	359.86199

9 TEST PROCEDURE

The test will be documented through the tables on the following pages. The tests shall generally be done in the following order:

- Interface tests
- Calibration
- Survey
- Data assessment

Assessment of the survey data collected should preferably be done on board.

Note that the noise measurements and test of performance with regard to depth and/or sea state are to be run in the order which best suits the conditions during the test period. It is not expected that many different conditions will be encountered during the limited time available for the sea acceptance test. However, it is strongly advised that as different conditions are encountered during later use of the system, the system performance as a function of external conditions is noted, for example in this record. This will be valuable for later use in survey planning and in ensuring the most efficient use of the system.

9.1 TEST OF INTERFACES

Tests of the external sensor interfaces should have been run during the Harbor Acceptance test. However, these tests were necessarily limited (static only), and may not even have been done due to non-availability or non-functionality of external sensors. Thus the data from the external sensors should be observed on the system display during vessel maneuvering, and verified for correctness (positions and clock) or correct sign and/or reasonable magnitude (heave, roll, pitch, heading and sound speed).

Data will be logged during the test, all connected hard-copy devices should be employed, and sound speed profiles loaded into the system. Observe that this is functional. Fill in the table below to record this.

Test no.	Function to be tested	Test result	Notes
1	Position input	OK	CNAV GGA
2	External clock input	OK	CNAV ZDA
3	Transducer depth sound speed input	OK	
4	Sound speed profile input	OK	
5	Heading input	OK	SPERRY MK 37
6	Motion data input	OK	IXSEA PHIN 3
7	Data output to internal storage	OK	
8	Data output to external storage		
9	Data output to external Ethernet		
10	Postscript printer		
11	Printer/plotter/recorder output		

9.2 SENSOR OFFSET/CALIBRATION

The offset or zero bias of the roll, pitch and heading sensors and the time delay of the position system(s) are to be measured or estimated before leaving port if possible (this is especially important with regard to the heading sensor). A calibration of these offsets shall be performed at sea as the second part of the test in accordance with the procedures given in the Operator Manual. Finally, these offsets shall be estimated from the final test survey. Fill in the table below with the offsets as entered into the Operator Station:

	Port Estimate	Calibration result	Final Estimate
Roll offset system 1	-	-0.09	-0.09
Roll offset system 2	N/A	N/A	N/A
Pitch offset system 1	-	-0.45	-0.45
Pitch offset system 2	N/A	N/A	N/A
Heading offset system 1	-	0.00	0.00
Heading offset system 2	N/A	N/A	N/A
Position time delay system 1	-	0.00	0.00
Position time delay system 2	N/A	N/A	N/A
Position time delay system 3	N/A	N/A	N/A

Note the positioning system type used during the sea acceptance test and its estimated accuracy:

Positioning system type 1:	CNAV SF-2050G
Estimated accuracy for position system:	
Positioning system type 2:	N/A
Estimated accuracy for position system:	N/A
Positioning system type 3:	N/A
Estimated accuracy for position system:	N/A

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9.3 SURVEY

The integrity of the total survey system consisting of the multibeam echo sounder as installed on the vessel, motion sensor, heading sensor, sound speed sensor(s), and positioning system(s) shall be assessed by doing a survey of a limited area and inspecting the collected data. The result should be compared against the specified accuracy of the echo sounder, taking into account the precision of the external sensors, and any limitations imposed by the vessel and its handling. Note that this test is **not** designed to measure the accuracy of the echo sounder itself, as this would require a much more extensive test period, and has been done on previous system installations.

The sea acceptance test's main part will be a sensor calibration followed by a system assessment survey in the calibration area. The area used for the sea trials should thus consist at least partly of a relatively flat bottom and partly of a significant slope as required for a calibration in accordance with the guidelines for calibration as given in the Operator Manual. In case this is not possible the calibration of the various sensors must be run in separate areas while the final assessment survey should be run in the flat part used for roll calibration. The depth should then ideally be in the 1000-3000 m range (not critical).

Five parallel lines should be run with line spacing equal to about one quarter of the achieved coverage in the actual area. Neighboring lines should be run in opposite directions. The line length should be in the order of twice the achieved coverage. A sixth line should be run perpendicular to and across the five previous lines.

Assess the data with the system's grid display using a grid cell size giving about 10-20 soundings per cell. Using the various display options, investigate the frequency and magnitude of outliers, discrepancies between lines, and depth differences within cells. Use also the calibration profile displays to assess any remaining errors due to roll offset or sound speed profile problems. If the performance of the system is not according to expectation, describe the results in the Comment section below, otherwise note that the system performance is accepted. Any un-resolvable performance problems should be further investigated and quantified with a post-processing system such as Neptune from Kongsberg.

Note the area with positions and depths where the Sea Acceptance Test has been performed:

SAT area:	OREGON COAST	
SAT position:	N 42.25	W 125 25
SAT depth:	3080	

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9.4 NOISE AND SEA CONDITIONS PERFORMANCE ASSESSMENT

During the sea acceptance test, the performance of the whole system shall be assessed. The important factors limiting achievable accuracy and coverage are noise (vessel and environmental) and sea state. With heavy seas it is to be expected that the performance will also depend upon vessel heading with respect to wave direction. On some vessels the noise level at particular speeds and propeller revolutions may also affect coverage. It is recommended to assess achieved coverage as a function of environmental parameters both during the sea acceptance test and later operation. The results should be entered in the table below, both to document conditions during the test and later to have a record of the system's performance according to external conditions.

The noise experienced by the system may be measured from the Operator Station as described in the Operator Manual. Several measurements should be taken and the result averaged before noting it in the table below:

Date	Depth (m)	Sea State	Heading Against Waves	Speed	RPM	Noise	Comments
6/17	3000	3	0	11		50.5	AVG OF 15 BIST
6/21					0	41	AVG OF 20 BIST
6/21					250	43	AVG OF 20 BIST
6/21					300	44	AVG OF 20 BIST
6/21					350	48	AVG OF 20 BIST TRANSIENTS
6/21					400	44	AVG OF 20 BIST
6/21					450	45	AVG OF 20 BIST
6/21					500	46	AVG OF 20 BIST
6/21					550	50	AVG OF 20 BISTS TRANSIENTS
6/21					600	48	AVG OF 20 BIST
6/21					650 750	51 54	AVG OF 20 BIST

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The coverage is assessed by observing the swath width on the Operator Station on a reasonably flat bottom. The average of several pings and any occurrence of missed pings should be noted in the table below:

Date	Depth (m)	Sea State	Heading Against Waves	Speed (kn)	RPM	Abs. coeff.	Coverage (m)	Missing Pings, Comments
6/17	1100	1	0	11			6524	75/75
6/18	400	1	0	11			2145	72/74
6/18	3790	2	0	12			18022	69/71
6/22	3080	2	90°	10		1.286	16500	72/70
6/22	1918	2	015	11		1.375	10000	67/74
6/22	1215	2	015	11		1.375	8200	74/75 RUNNING ALONG A SLOPE
6/22	760	2	015	10			4700	75/75 RUNNING ALONG A SLOPE
6/23	500	2	015	10			3100	75/75
6/23	250	2	015	10			1650	75/75
6/23	207	2	015	10			1250	75/75

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10 ACCEPTANCE SIGNATURES

SEA ACCEPTANCE TEST for the EM 122 with SIS for **R/V ATLANTIS**
has been performed according to the test procedure.

The test is: Accepted / Not Accepted (Circle as appropriate)

Remarks

- The test result sites for Heading and Timing calibrations were not ideal, and thus the calculated offsets may need further review.
- HEAVE ARTIFACTS WERE OBSERVED ESP. DURING THE SAT SURVEY AND REQUIRE FURTHER INVESTIGATION.
- THERE WERE A FEW INSTANCES OF THE TRU LOSING SYNC WITH SIS AFTER RUNNING EXTENDED RX NOISE BISTS.
- THERE WAS ONE INSTANCE OF DATA DEGRADATION DURING ONE LINE. REBOOT OF TRU CLEARED THIS.

Test performed by (print name)

Position

Date

CHUCK HOHNE

SONAR FIELD ENGINEER

6/23/11

Test accepted by (print name)

Position

Date

Peter Lemmond

Research Associate/WHOI

6/23/11

Signature:



Signature:

