Sonardyne
SOUND IN DEPTH

CAT-005

Customer Acceptance Test Ranger2 USBL

Single and Dual Independent Configuration

Vessel Name.....Neil...Armstrong.....

Operator.....Kyle Warren.....

Location.....Charleston, SC.....

Issue B Rev 1

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Amendment History

The amendment history records all amendments and additions made to this document.

Issue	Date	Comments
A0	07 Oct 2015	First issue
A3	03 Mar 2015	Updated for Ranger2 v4.2
A4	04 Mar 2015	DP stability test added Dual Independent check added
A5	20 Mar 2015	Minor changes
A6	25 Mar 2015	Explicit check for Survey Suite added
B1	11 Dec 2015	Formatting revised

Definitions

Abbreviation	Definition
CAT	Customer Acceptance Test
DP	Dynamic Positioning
DPTI	Dynamic Positioning Transponder Inclinometer
GNSS	Global Navigation Satellite System
HAT	Harbour Acceptance Test
INS	Inertial Navigation System
L/USBL	Long/Ultra Short Base Line
MRAMS	Marine Riser Angle Monitoring System
ROV	Remotely Operated Vehicle
SAT	Software Acceptance Test
Sonardyne	Sonardyne International Limited and its affiliates.

Related Documents

Document Reference	Document Title
UM-8250	Ranger 2 USBL Manual

1 Introduction

1.1 Purpose

The principal objective of this Customer Acceptance Test (CAT) is to complete functional 'in water' checks on the Ranger2 USBL acoustic positioning system in order to validate the correct installation and operation of the system.

1.2 Scope

This procedure outlines the functional system tests which should be performed to prove the correct installation and operation of a Ranger2 USBL acoustic positioning system. The tests will be performed whilst the vessel is at sea.

The following system features will be checked:

a. Signal response from each of the seabed Transponders used.

b. Positioning of mobile Transponders in USBL mode.

c. Vessel positioning using USBL.

d. Position output to the DP desk.

e. Simultaneous operation with another Marksman / Ranger2 acoustic positioning system (Dual Independent configuration) if applicable.

1.3 Prerequisites

The following checks should have been performed during the Setting to Work phase of the Commissioning process:

a. Installation settings

b. Interfacing to each Transceiver, attitude sensor, heading sensor, DP system.

Note

If the CAT is performed in shallow water depths, adverse acoustic conditions may prevent stated performance figures from being achievable.

2 Equipment

A minimum of one seabed Transponder will be required, preferably with suitable deployment and recovery method, i.e. weight and float or fixed in a tripod.

2.1 Transponders

Transponder Type	Serial Number	Address	UID
WMT	292388-001	2009	4300
C6	269825-001	2701	2458

2.2 Ranger2 USBL System

	Serial Number	Software / Firmware Version
Navigation Computer	293373-002	4.03.01
Navigation Sensor Hub (NSH)	294001 - 003	2.0.0.102

2.3 USBL Acoustic Transceiver

Type	Serial Number	Name	Firmware
HPT 7000	293029-002	Transceiver 1	3.05.01.07

2.4 Attitude Sensors

Type	Output Format	Data Rate
MRU (pitch roll Heading)	EM3000	100Hz, 19200 8-N-1
POSMV "	SIMRAD 3000 (TSS)	

2.5 Other Inputs

Type	Output Format	Data Rate

3 Installation Corrections and Offsets

It is likely that offsets will exist between the pitch and roll axes of the VRU(s) and each Transceiver, and that a rotational offset will exist between the fore/aft axis of the vessel and the fore/aft axis of each Transceiver. If absolute position accuracy is important (as distinct from good position repeatability) the most rigorous way to estimate these offsets is to carry out a CASIUS (Calibration of Attitude Sensors in USBL System) routine.

If a CASIUS is not performed, correction figures for Pitch, Roll and Heading should be left at zero.

Corrections determined for the individual Transceiver Heads should be entered into the database of the relevant system and recorded below:

3.1 Transceiver Corrections

Transceiver Serial Number / Name	Pitch Correction	Roll Correction	Heading Correction
293029-002 / TCVR 1	.06	-.33	.92

Where appropriate, the correct location offsets for all Transceivers and GNSS antennas in relation ***from*** the vessels CRP or Datum point should be entered into the system before positioning tests are performed. These offsets should be as accurately determined as possible.

3.2 Transceiver Offsets

Transceiver Serial Number / Name	Starboard	Forward	Down
293029-002 / TCVR 1	.6m	-7.34m	3.78m

3.3 GNSS Antennae Offsets

GNSS	Starboard	Forward	Up
GNSS 1	-6.79	-8.83	21.86

4 In-Water Acoustic Tests

This section confirms the basic acoustic performance of the Ranger2 USBL system. It assumes that the system has already been setup appropriately and that all necessary instruments are interfaced and working correctly.

The Transponder(s) used will have been deployed to a suitable depth so that a reliable acoustic link can be established. Sonardyne recommends a minimum depth of 100m. A direct line of sight is required between the Transceiver and Transponder(s).

4.1 Environmental Settings

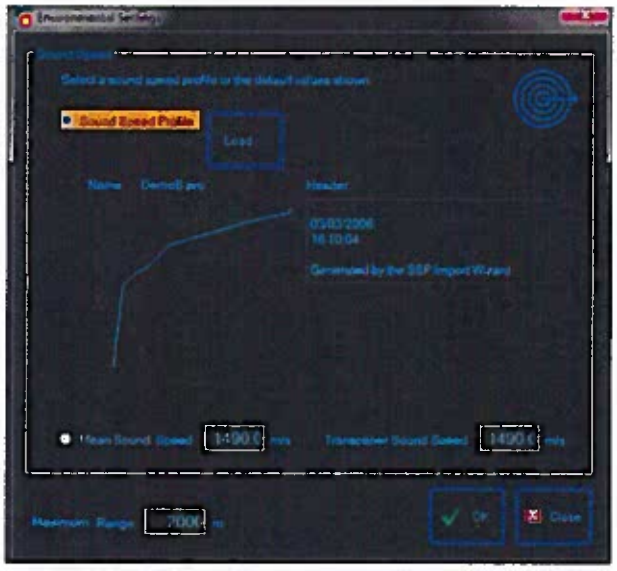
4.1.1 Speed of Sound

This section details two methods on how to enter a sound speed profile into the Ranger2 system. Ensure an accurate sound speed profile or fixed values are used.Sound Speed Profile

4.1.1.1 Sound Speed Profile

For increased positional accuracy, the correct sound velocity profile should be used. This is entered in the Environmental settings window. Ideally it will have been measured with a velocity profiler (not supplied by Sonardyne).

Figure 4-1 – Sound Speed Profile



4.1.1.2 Mean Fixed Values

For installations where the ability to accurately log and maintain a full water depth sound speed profile is not possible, Sonardyne recommend using the mean through-water sound speed and transceiver face sound speed. For this method it must be possible to accurately determine a Transponder depth, either by directly measuring, or knowing the water depth and any installation offsets for the deployed Transponder.

Figure 4-2 – Sound Speed Profile

To set the Mean Ranging Sound Speed and Transceiver Sound Speed values open the Environmental Settings window.

Input an appropriate value for the Transceiver Sound Speed.

To calculate the mean speed of sound through the water column it is recommended to use the depth sensor fitted to a Transponder, and compare to the USBL calculated depth.

Use the beacon Sensor Monitoring tool (Tools > Beacon Sensor Monitoring) to send the request for the Transponder depth.

Figure 4-4 – Transponder Depth Measurement

Figure 4-5 – USBL Calculated Depth

Compare the recorded depth to the USBL calculated Transponder depth.

Adjust the Mean Ranging Sound Speed in the Environmental; settings until the recorded and USBL depths match.

Method Used	Details
Profile	**Profile Name:** NA
Calculated	**Mean Ranging Sound Speed**.....1509.....**m/s** **Transceiver Sound Speed**.....1520.....**m/s**

4.2 Maximum Range

Ensure maximum operating range is set to an appropriate value.

Maximum operating range set to:.....2000m.....☑ Recorded

4.3 Vessel Noise Test

Select Tools, Advanced, Noise Plot from the top menu system. Select each USBL Transceiver in turn and use the system to measure the current, average and peak noise levels for the Transceiver. Review the noise test for approximately a minute and use the Alt / Print Screen option to record an electronic copy of typical noise levels for the Transceiver or print a hard copy and store with the CAT results. If any significant changes are seen with time, these should also be recorded.

Repeat the test for all other USBL Transceivers attached to the vessel.

Transceiver Serial No. / Name.....253025-002 / TRANSCEIVER 1.....☑ Recorded

Transceiver Serial No. / Name.....☐ Recorded

Transceiver Serial No. / Name.....☐ Recorded

Transceiver Serial No. / Name.....☐ Recorded

4.4 Transponder Setup

The following tests will demonstrate the correct automatic setup of beacons.

Setup each Transponder in turn through the beacon window and record the Transponder settings where appropriate in the following tables or by attaching screen shots to this document.

4.4.1 Transponder Main Settings

Transponder Name	Address	Interrogate Channel	Reply Channel	TAT	Battery Status
2009	2009	CIS 1600	IRS 2009	200	Unknown
2701	2701	CIS 1600	IRS 2701	120	64% 13.8v

4.4.2 Transponder Advanced Settings

Transponder Name	Address	Transceiver Power	Transceiver Rx Gain	Transponder Power	Transponder Rx Gain
2009	2009	—	—	—	—
2701	2701	Medium	Auto	Low	Low

4.4.3 Transponder Hardware Settings

Transponder Name	Address	Type	Transducer	UID	Firmware Version
2009	2009	WMT	[redacted]-OMNI	4300	[redacted] 3.05.00.05
2701	2701	C6	OMNI	2458	3.05.07.09

Confirm where applicable that Transponders are able to be commanded and configured automatically by the Ranger2 Software.

Pass ☑ Fail ☐

4.5 USBL Operation – Vessel Centred Navigation

1. Start the tracking of each Transponder by clicking on its icon at the bottom of the screen.
2. After a suitable amount of time to allow the system to lock onto each Transponder, select Zoom-to-Fit to view both the vessel graphics shape and the Mobile Transponder(s). The Transponder(s) should be labelled with its user defined name and address. Confirm that mobile Transponder positions are visually stable and in the expected position.

Pass ☐ Fail ☐ NA

5 DP Output

Ensure that a suitable DP output has been created. Open the Telegrams page and verify that a telegram is enabled for the USBL position of the Transponder.

Confirm that the DP Desk is receiving and accepting the vessel position from the Ranger2 system.

Output Telegram Type.....418 BCD.....Pass ☑ Fail ☐

Confirm that any other Third Party system (e.g. Survey Suite) is receiving and accepting the Transponder position(s) from the Ranger2 USBL system.

Pass ☑ Fail ☐

5.1 DP Stability Test

This section confirms that the Ranger2 system is providing a stable position that is accepted by the DP system. It ensures that the Ranger2 system can be used as the single source of positioning.

Note

The DP stability tests should only be performed on a fully calibrated system.

Do not proceed with the following stability test unless the test Transponders are deployed on the seabed and in a water depth that allows reliable and repeatable positioning.

5.1.1 Mobile DP Stability Test - Box

1. Track the Transponder.
2. Ensure that the acoustic positions are stable.
3. Confirm that the Ranger2 system is outputting a telegram via the comms viewer, and that the telegram is received and accepted in the DP system.
4. Disable all other inputs into the DP desk so that Ranger2 is providing the only reference.
5. Maneuver the vessel in a box shape around the beacon (box size can be <100m). Monitor the DP system for any drop-outs that occur. The Ranger2 system should be able to provide a constant positioning reference if thruster wash and other sources of noise are mitigated.
6. Make a record of the vessel track from both the DP desk and the Ranger2 system.

Ranger2 position accepted in DP desk during vessel manoeuvre..... Pass ☑ Fail ☐

5.1.2 Static DP Stability Test

1. Track the Transponder.
2. Ensure that the acoustic positions are stable.
3. Confirm that the Ranger2 system is outputting a telegram via the comms viewer, and that the telegram is received and accepted in the DP system.
4. Disable all other inputs into the DP desk so that Ranger2 is providing the only reference.
5. Maintain a static position for 30 minutes with a constant heading with the Ranger2 system providing the only position reference. The Ranger2 system should be able to provide a constant positioning reference if thruster wash and other sources of noise are mitigated.
6. Make a record of the vessel track from both the DP desk and the Ranger2 system.

Ranger2 position accepted during static operations Pass ☑ Fail ☐

6 Dual Independent Operation

This section of the CAT only needs to be performed if there are multiple systems on the same vessel.

This optional section of the CAT confirms the correct setup of the Ranger2 USBL system working simultaneously with another Marksman / Ranger2 acoustic positioning system.

Both systems should be time synchronized via GNSS or an inter-system link so that both systems can be set to take turns to interrogate their respective reference beacon.

In the case of a GNSS setup, confirm that there is a valid timing string and trigger being accepted by the Ranger2 system by looking in the System Setup / System / TOD function. On the Main tab the correct port and settings should be set up. In the status window the correct UTC time should be displayed next to the **Received Time** and the **Trigger In** indicator should be flashing green every 1 second which indicates the reception of the 1 PPS trigger.

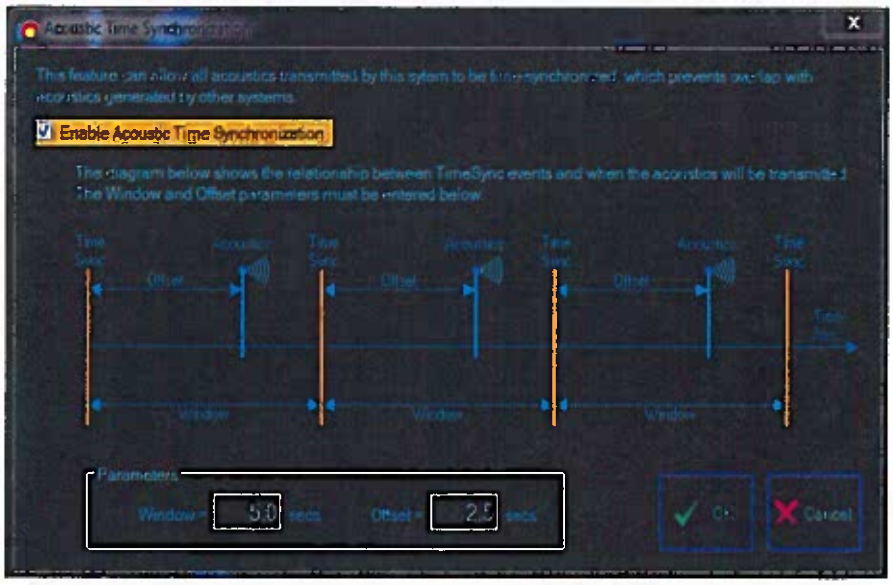
NA ☑ Pass ☐ Fail ☐

In the case of an inter-system link, confirm that the correct ports have been setup to export the system time from one system, and to receive this time on the second system. On the receiving system, the Main tab should show the correct port and settings set up. In the Status window the matching system time should be displayed next to the Received Time. 1PPS is not required for inter-linked systems.

NA ☑ Pass ☐ Fail ☐

By selecting Tools / Advanced / Acoustic Synchronization the setup page can be configured to match the specific job. Ensure the "Enable Acoustic Time Synchronization" is selected.

Figure 6-1 – Acoustic Synchronisation Settings



Ensure that the timing synchronization method has been setup and the correct timing offsets have been applied for the depth of water.

System No.	Window	Offset
1		
2		

Pass ☐ Fail ☐ NA

6.1 Navigation

If sharing an array between two or more systems, ensure that the Transponder configuration is correct for each system.

If using separate Transponders it is recommended to differentiate the interrogation frequency of each array.

Once setup is complete both systems should be able to provide accurate and reliable positioning to the DP desk without significant mutual interference.

6.2 Loss of Timing

Disconnect the GNSS timing signal (including the 1PPS signal) or time synchronisation connection and confirm that both systems continue to run without interference. Both systems should continue to provide accurate and reliable positioning to the DP desk without significant mutual interference.

Pass ☐ Fail ☐ NA

This concludes the Customer Acceptance Test

7 Approval and Acceptance

The Ranger2 USBL system onboard the .....Neil Armstrong..... has been tested to this procedure and has met the specified requirements, unless stated below..

Ref No:	Details

Comments Cont. (on separate sheet) YES / NO

Approval and Acceptance

Sonardyne _____ **Date:** 2/17/16

Print: Kyle Warren

_____ **Date:** 2/17/16

Print Robert Laird

_____ **Date:** _____

Print _____

Approval and Acceptance (Additional Comments)

Appendix A Screen Plots

A.1 Noise Plots

A.2 Transponder Tables