Track IQ

RailBAM

Site Check 'As Run' Test Procedure

To be completed by the Test Engineer	
Job Number	**51A-13-0010**
Site	**NSC IRONTO, VA**
Date of Test	**04/05/2023**
Comments	
Performed By	**Ernesto A Mendiola**
Signature	
To be completed by the Quality Assurance Representative (QAR)	
Test Results (tick box)	☑ **All OK. No action required**
	☐ **Further action required**
QAR	
Signature	

Document No. 51P-14-0001-TPR-797070-4
24 April 2023

Track IQ
[redacted]

Track IQ
A Wabtec company

RailBAM Site Check 'As Run' Test Procedure

DOCUMENT NO:
51P-14-0001-TPR-797070-4

PREPARED BY:
Track IQ
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PREPARED BY: [redacted] Date: 18 February 2015

REVIEWED BY: [redacted] Date: 18 February 2015

AUTHORISED BY: [redacted] Date: 18 February 2015

REVISION HISTORY

Revision No.	Date Issued	Reason/Comments
0	18 February 2015	From 51R-05-5656-TPR-422561-2
1	10 February 2017	Update name & logo
2	28 March 2018	Minor mods / change to new template
3	24 October 2019	Minor layout / wording changes
4	26 February 2020	RP - Sensor checks moved back before tap tests, safety critical points highlighted, formatting

KEYWORDS: Site Check RailBAM

TABLE OF CONTENTS

1. INTRODUCTION

1.1. Scope

This document defines the procedure for undertaking the Site Check Test (CHK) for the RailBAM® specified on the cover page.

1.2. Requirements

1.2.1. Sensors

Correct operation of the following sensors (if fitted) is required:

- Wake-up sensors (2)
- Auxiliary speed sensors (2)
- Speed sensors (2)
- Shutter limit switches (4)

1.2.2. Acoustic Receiver Array

The criteria to be fulfilled for the correct operation of microphone array are:

- Microphone position test
- Transfer function tests
- Noise floor test
- Microphone array calibration
- Beam forming tests

1.2.3. Data Acquisition and Analysis

To ensure correct operation of the data analysis process, the following criteria must be met:

- Simulated train acquisition
- Actual train data acquisition and analysis

1.2.4. Subsystems

The following subsystems (if fitted) essential to the operation of the RailBAM® System must be tested:

- Tag Reader
- Power Distribution Unit (PDU)
- Communications
- System Backup
- Uninterruptible Power Supply (UPS)

2. APPLICABLE DOCUMENTS

AD/1 51R-05-5656-UMA-233002 RailBAM® System Operation Manual

AD/2 51P-09-0001-UMA-778335 - Calibration Unit User Manual ISS1 (or current model)

AD/3 51P-08-0045-TNT-791507 - Speed Sensor Calibration

AD/4 51R-05-5656-TNT-383072 - Wheel Detector install Procedure

3. EQUIPMENT

Most of the equipment required for these tests is contained within the RailBAM® System. This includes data acquisition and analysis tools.

In addition to this, a calibration unit will be used to position a random noise source at axle height for different locations in front of the RailBAM® system. A Sound Level Meter (SLM) will be used to measure noise levels of the calibration signal. This applies unless a calibrated TrackIQ Calibration Unit is used, in which case the SLM becomes optional.

General tools such as a tape measure and spanner are used in some tests.

4. PARTS AND MATERIALS

Not Applicable for this procedure.

5. TEST CONDITIONS

5.1. Location

- Tests will be at the site where the RailBAM® System has been installed.

5.2. Personnel

- RailBAM® System Operator
- Site Safety Personnel (if applicable)

5.3. Precautions

All personnel accessing the track must be appropriately qualified, as specified by the track owner.

5.4. Test Configuration

Refer to figures in Appendix A. System operation is defined in the RailBAM® System Operation Manual AD/1

5.5. Initial Conditions

- For sensor tests and alarm tests, the RailBAM® System will be set to ‘Monitor Sensors Only’.
- For beam-forming tests, calibration tests and noise floor tests, the RailBAM® System will be set to ‘Maintenance Options’.
- For train simulations and subsystem tests, the RailBAM® System will be set to ‘Normal Operation’ (waiting for trains).

6. PROCEDURE

6.1. Procedure Summary

The major steps in this test are:

- Check power supply, activation and deactivation for wake-up sensors, speed sensors and shutter limit switches.
- Measure the wheel sensor positions
- Check tag reader(s) are installed correctly.
- Check that all microphones are correctly connected to RailBAM® subsystems by using a microphone position ‘tap test’.
- Measure third octave noise levels using RailBAM® system, and compare with those measured by SLM to check microphone calibration.
- Verify acoustic beam forming by locating position of the calibration unit.
- Ensure noise floor is significantly less than calibration signal.
- Verify train sampling and results

6.2. Detailed Procedure

Refer to Appendix B: for the detailed procedure. This Appendix refers to other Appendices into which additional information has to be entered.

6.3. Test Results

All test results are to be entered directly into a hardcopy of this procedure in the table given in Appendix B. The completed document is to be scanned and stored on the Track IQ server.

RailBAM results from Appendix B are also to be stored on the RailBAM system being tested in C:\commissioning\CHK\ and on the Track IQ server.

Any additional data should be on the Track IQ server.

7. TEST ACCEPTANCE

7.1. Acceptance Checks

On completion of the detailed procedure, the completed test report must undergo a final check.

Any anomalies need to be resolved with the appropriate technical experts.

These checks should also ensure that:

1. Measured values are repeatable.
2. Test results are saved to an appropriate directory that will not be deleted by the 'Disk Clean-up' application. For example, C:\commissioning\CHK. These must be backed up on the Track IQ server.

7.2. Procedure Sign-Off

The table on the covering page of this document shall be completed as an indication that all required tasks/actions have been successfully completed.

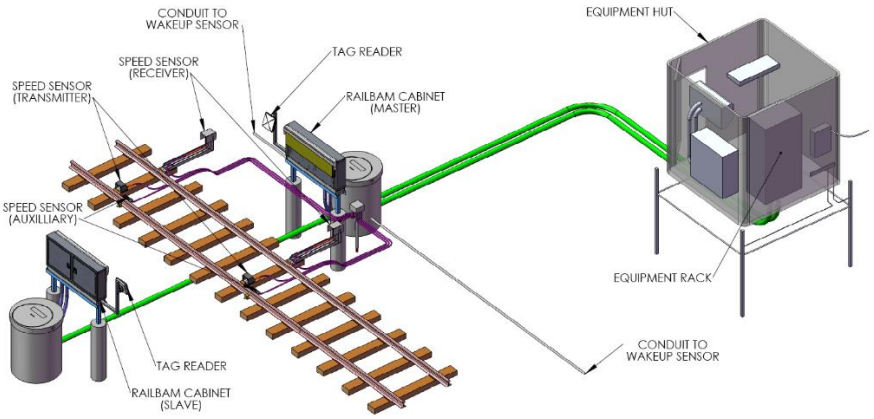
8. NOTES OF AUDIT OR FURTHER ACTIONS REQUIRED

Any notes of Audit or actions required shall be documented below:

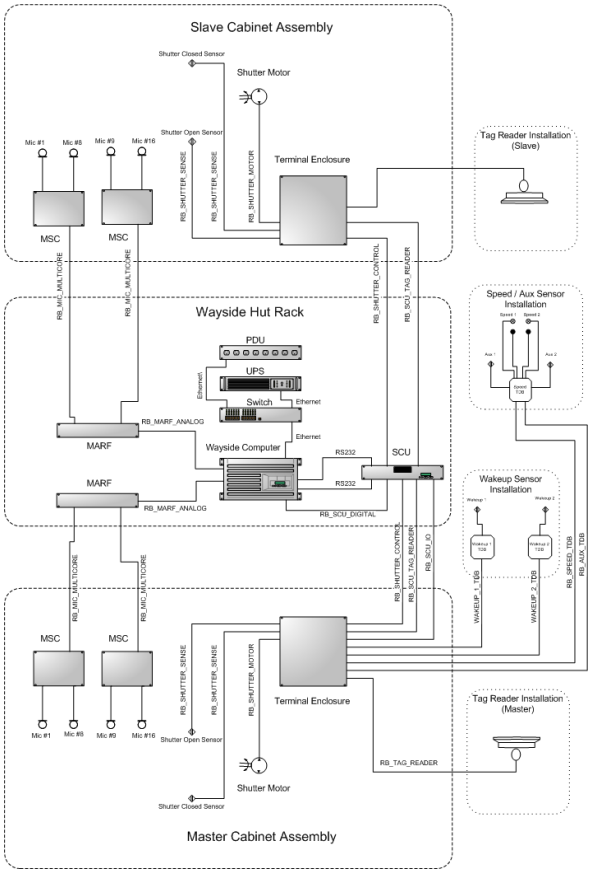
NONE

Appendix A: Test Set-up

A.1 Typical System



Typical Single Line RailBAM System Site.



Typical RailBAM System Interconnection

A.2 Cabinet Identification and Coordinate System

Master and Slave Cabinet Assemblies are identifiable via labelling directly above the trackside cabinet doors.

The labelling conforms to the following layout:

RailBAM Cabinet, Trackside <side>(<status>) – '<descriptive_name>' – <site_name>

<side>	R or L designates Right or Left
<status>	M or S designates Master or Slave
<descriptive_name>	An arbitrary string used to describe position, typically say, relative to the Wayside Hut or compass directions.``
<site_name>	The formal site name

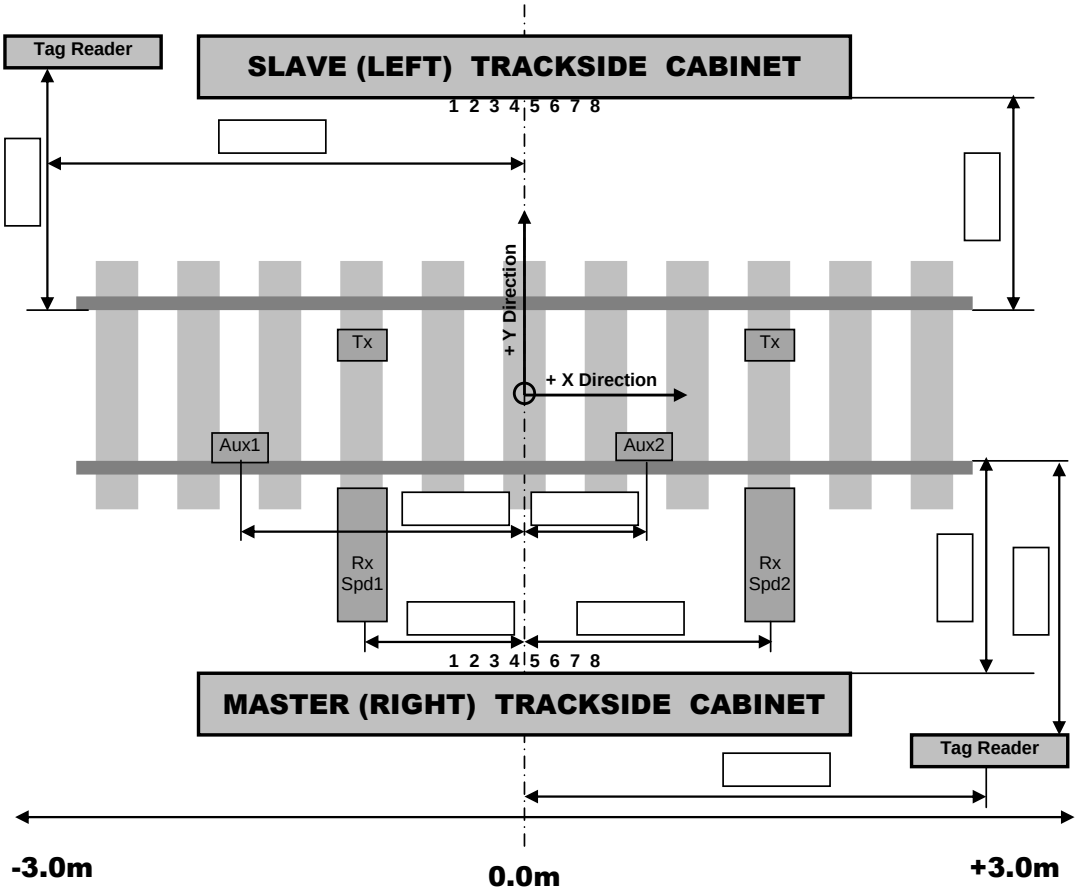
For example

RailBAM Cabinet, Trackside R(M) – 'Near' – Mundijong

This cabinet is the Master cabinet, therefore it is by definition on the 'Right' side; it is located near the wayside hut and situated at Mundijong.

The position of the Master Cabinet Assembly relative to the railway track defines the positive axis direction and the System Origin, as shown below. Thus the X direction and Y direction is defined and (X,Y) coordinates can be used to describe object positions.

The measurements identified by the boxes will be derived at various steps in Appendix B.



Definitions for positive direction, and microphone numbers

Appendix B: Detailed Procedure

B.1 PRELIMINARY CHECKS

Aim: Verify that the basic setup is correct.

STEP	DESCRIPTION	EXPECTED RESULTS	RESULTS
1	Record name of **Master** trackside Record name of **Slave** trackside Refer to Appendix A.2 and labels on cabinets	RailBAM Cabinet Trackside R(M) RailBAM Cabinet Trackside L(S)	
2	***Before powering up, determine the running voltage at the installation site***	***eg. 240V or 110V***	220 V ☐ 110 V ☑
3	Check if all equipment are set to the right input voltage (e.g. **Fan, Heater**)	Input voltage are all set to the 'result' value of Step 2	☑
4	Visually check that all cables are connected appropriately	OK	☑
5	Observe Power LEDs on **MSCs**	3 power LEDs on each **MSC** ('on' state)	☑
6	Observe Power LEDs on **SCU**	4 power LEDs on **SCU** ('on' state)	☑
7	Observe Power LEDs on **MARF**(s)	2 power LEDs on each **MARF** ('on' state)	☑
8	Check RailBAM® Wayside Computer is correctly set to UTC (without daylight savings)	For example, SA (no daylight savings) is 9.5 ahead of UTC	☑
9	Check RailBAM train time (local time)	On later software versions, computer time (UTC) and local time is displayed at startup in the RailBAM® command window.	Timezone: America / New York
10	Check RailBAM® analysis software version installed. Record the "**RailBAM-Algorithms**" version	Version is displayed in the RailBAM® command window.	Ver.: 5.6.5
11	Initial and Date	Initials: EAM Date: 04/05/2023	

B.2 WHEEL SENSOR and TAG READER CALIBRATION

Aim: Verify that the wheel sensors are correctly aligned and record relevant parameters for wheel sensors and tag readers.

STEP	DESCRIPTION	RESULTS
1	Record the measured parameters in the result tables	Also, enter the relevant locations into the boxes in the sketch of Appendix A.2. Enter N/A for sensors that are not installed.
2	Verify that the Speed Sensors are aligned and perform a calibration as per AD/3 Measure the location of the centre of each sensor relative to the centreline of the Master cabinet. All dimensions are in meters.	

	Spd1	Spd2	Expected
Location	-1955	1351	
Height	44	50	ideally 0.035 to 0.045
Hysteresis	5	5	< 0.010

Sensor type: ☑ Telco ☑ P&F ☐ IFM ☐ Other _____

3	Verify that Auxiliary and Wake-up sensors are aligned as per AD/4 Measure the location of the centre of each sensor head relative to the centreline of the Master cabinet. Location in meters and remaining dimensions are in mm. Count the number of 2mm and 5mm thick spacer plates used. This assumes Turck sensors. For Servo sensors mark the 2mm spacer fields as 'Servo'; adjust height and distance as per the Servo sensor installation procedure and edit Expected results to suit..

	Aux1	Aux2	Wkup1	Wkup2	Expected
Location	-2777	+1200	-	+	
Height below rail head	44	44	44	44	44
Distance to gauge face					4 to 14
No. of 2mm spacers					0 to 4-
No of 5mm spacers					0 to 4-

4	Measure the location of the centres of the tag readers (antennae) relative to the centreline of the master cabinet.

Tag Reader Location	Master (Right)	Slave (Left)
	N/A	N/A

STEP	DESCRIPTION	RESULTS	
5	Compare the values measured above against those in hndltrain_ini.txt, a shortcut to this file is on the screen. Note that the values in that file are in metres not mm. **Note:** Only modify hndltrain_ini.txt if you are adequately trained; otherwise request assistance from TrackIQ.	Location agrees within +/- 5mm Height and Hysteresis agree within +/- 1mm	☑
6	Initial and Date	Initials: EAM Date: 04/05/2023	

B.3 SENSOR TESTS

Aim: Verify that all sensors are functioning and are connected correctly, e.g. no mix-up between individual sensors or Master and Slave shutters.

STEP	DESCRIPTION	EXPECTED RESULTS				RESULTS
1	Start new RailBAM® session by selecting '**Maintenance/Setup and Abort**', '**Deadman Handle**' then '**Close**'. On SCU front panel, switch shutters to **'Close'** Once Process Monitor restarts RailBAM® select '**Monitor Sensors Only**' on the '**set_chkTTL_mode**' window. View RailBAM® command window, SCU front panel and sensor status LEDs.	See Appendix C.1 for an example of RailBAM® 'Sensor Status' and Command Window Display containing Wkup, Spd, Aux and Shutter sensor states. The Speed Sensor states are quoted for Pepperl+fuchs sensors. Alternative sensors will indicate a similar change.				-
	Note: Sensor colour refers to the status LED not the power LED	**State**	**RailBAM**	**SCU**	**Sensor (for Info only)**	
2	Observe 'Wake Up Sensor 1' (**Wkup1**)	Disengaged	wkup1	Green	Green	n/a
3	Place metal object near wake-up detector **Wkup1**	**Engaged**	WKUP1	Red	Orange	n/a
4	Remove metal object	Disengaged	wkup1	Green	Green	n/a
5	Observe 'Auxiliary Sensor 1' (**Aux1**)	Disengaged	aux1	Green	Green	☑
6	Place metal object near **Aux1**	**Engaged**	AUX1	Red	Orange	☑
7	Remove metal object	Disengaged	aux1	Green	Green	☑
8	Observe 'Speed Sensor 1' (**Spd1**) receiver	Disengaged	spd1	Green	Orange	☑
9	Break light beam on optical speed sensor **Spd1**	**Engaged**	SPD1	Red	Green	☑
10	'Un-break' light beam	Disengaged	spd1	Green	Orange	☑
11	Observe 'Speed Sensor 2' (**Spd2**) receiver	Disengaged	spd2	Green	Orange	☑
12	Break light beam on optical speed sensor **Spd2**	**Engaged**	SPD2	Red	Green	☑
13	'Un-break' light beam	Disengaged	spd2	Green	Orange	☑
14	Observe 'Auxiliary Sensor 2' (**Aux2**)	Disengaged	aux2	Green	Green	☑
	Note: Sensor colour refers to the status LED not the power LED	**State**	**RailBAM**	**SCU**	**Sensor (for Info only)**	

STEP	DESCRIPTION	EXPECTED RESULTS				RESULTS
15	Place metal object near **Aux2**	**Enagaged**	Aux2	Red	Orange	☑
16	Remove metal object	Disengaged	aux2	Green	Green	☑
17	Observe 'Wake Up Sensor 2' (**Wkup2**)	Disengaged	wkup2	Green	Green	n/a
18	Place metal object near wake-up detector **Wkup2**	**Engaged**	WKUP2	Red	Orange	n/a
19	Remove metal object	Disengaged	wkup2	Green	Green	n/a
20	Observe LED's on **Left (Slave)** shutter limit switches Shutters should be closed	Closed Left Shutter	LCLSD	Green	Off	☑
			Lopn	Off	Orange	☑
21	Observe LED's on **Right (Master)** shutter limit switches Shutters should be closed	Closed Right Shutter	RCLSD	Green	Off	☑
			Ropn	Off	Orange	☑
22	On SCU, set shutter switch to **'Open'** Observe LED's on **Left (Slave)** shutter limit switches	**Open Left Shutter**	Lclsd	Off	Orange	☑
			LOPN	Red	Off	☑
23	Observe LED's on **Right (Master)** shutter limit switches Shutters should be Open	**Open Right Shutter**	Rclsd	Off	Orange	☑
			ROPN	Red	Off	☑
24	On SCU, set shutter switch to **'Close'** Observe LED's on **Left (Slave)** shutter limit switches	Closed Left Shutter	LCLSD	Green	Off	☑
			Lopn	Off	Orange	☑
25	Observe LED's on **Right (Master)** shutter limit switches Shutters should be closed	Closed Right Shutter	RCLSD	Green	Off	☑
			Ropn	Off	Orange	☑
26	On SCU, set shutter switch to **'Open'**	**Both** Shutters are **Open**				☑
27	Disconnect the Motor Power Connector inside the **Right (Master)** cabinet. On SCU, set shutter switch to **'Close'**	**Master** Shutter remains **Open** SCU shows Right Shutter Red RailBAM shows ROPN__Rclsd				☑
		Slave Shutter is **Closed** SCU shows Left Shutter Green RailBAM shows Lopen__LCLSD				☑
28	On SCU, set shutter switch to **'Open'**	**Both** Shutters are **Open**				☑

STEP	DESCRIPTION	EXPECTED RESULTS	RESULTS
29	Disconnect the Motor Power Connector inside the **Left (Slave)** cabinet. On SCU, set shutter switch to **'Close'**, Observe shutters and SCU shutter indicators On SCU, set shutter switch to **'Open'**	**Both Shutters did not move**, i.e. stayed open **Note**: Do not reconnect the Motor Power Connectors, as this will be done during Train Simulation procedure.	☑
30	Close RailBAM® by selecting '**Maintenance/Setup and Abort**', '**Deadman Handle**' then '**Close**'. Initial and Date.	Record directory location of test results for sensor checks. C:\commissioning\CHK\04APR23 120144 SNSR TST Initials: EAM Date: 04/05/2023	

B.4 TAG READER TESTS

Aim: Verify that the tag reader(s) are functioning and are connected correctly, e.g. no mix-up between Master and Slave tag reader, or tag readers from different systems.

STEP	DESCRIPTION	EXPECTED RESULTS	RESULTS
1	Start new RailBAM® session by selecting '**Maintenance/Setup and Abort**', '**Deadman Handle**' then '**Close**'. Once RailBAM software has restarted Open RailBAM® ***web page***	Verify that the System Status display of the webpage shows that the installed tag reader(s) are **Ready**. Note: 10 minutes after a new RailBAM session tag reader(s) should indicate Check OK.	n/a
2	Disconnect the connector at the tag reader on the **Right (Master)** trackside. Start new RailBAM® session by selecting '**Maintenance/Setup and Abort**', '**Deadman Handle**' then '**Close**'.	Verify that the System Status display of the webpage shows that the Master tag reader initialisation has **failed**. If a second tag reader is installed (for the **Left (Slave)** trackside), it shall be shown as **Ready**.	n/a
3	Re-connect the connector at the tag reader on the **Right (Master)** trackside. Start new RailBAM® session by selecting '**Maintenance/Setup and Abort**', '**Deadman Handle**' then '**Close**'.	Verify that the System Status display of the webpage shows that the installed tag readers are **Ready**.	n/a
4	Initial and Date	Initials: Date:	

B.5 MICROPHONE POSITION TAP TEST

Aim: Verify that all microphones are functioning and are connected correctly, e.g. no mix-up between individual microphones or Master and Slave microphone arrays.

<table>
<tr><th>STEP</th><th>DESCRIPTION</th><th>EXPECTED RESULTS</th><th>RESULTS</th></tr>
<tr><td>1</td><td>Check that shutters are fully open and that the Motor Power Connector inside the cabinets are disconnected.
With a new session of RailBAM® select ‘Maintenance/Setup and Abort’ on the ‘set_chkTTL_mode’ window.
Select ‘No Deadman Handle’</td><td>Shutters are fully open.</td><td>☑</td></tr>
<tr><td>2</td><td>Select ‘Mic Status’ button for the Slave trackside
Check that all microphones are serviceable and sampled
Select ‘Calibration Check…’
Set analysis type to ‘TimeHistories’
Select ‘Start’ button</td><td>Graph of time histories for each microphone in Slave array appears on screen</td><td>☑</td></tr>
<tr><td></td><td colspan="2">NOTE: For Slave (Left) array, microphone 1 is the first microphone from the left. (See Appendix A.2 for diagram)</td><td></td></tr>
<tr><td>3
  </td><td>Verify that the Slave Cabinet shutter motor is still disconnected, then have someone tap each Microphone (Mic) in sequence.
Watch the amplitude of time trace for that microphone increase and tick it off.
Microphones 9-16 are N/A for an 8 Microphone system.
Press ‘Stop’ on the ‘Cal Checks’ window during the last microphone tap. (e.g. 8 or 16)</td><td colspan="2"><table>
<tr><th>Mic</th><th>RESULTS OK</th><th>Mic</th><th>RESULTS OK</th></tr>
<tr><td>1</td><td>☑</td><td>9</td><td>☐</td></tr>
<tr><td>2</td><td>☑</td><td>10</td><td>☐</td></tr>
<tr><td>3</td><td>☑</td><td>11</td><td>☐</td></tr>
<tr><td>4</td><td>☑</td><td>12</td><td>☐</td></tr>
<tr><td>5</td><td>☑</td><td>13</td><td>☐</td></tr>
<tr><td>6</td><td>☑</td><td>14</td><td>☐</td></tr>
<tr><td>7</td><td>☑</td><td>15</td><td>☐</td></tr>
<tr><td>8</td><td>☑</td><td>16</td><td>☐</td></tr>
</table></td></tr>
<tr><td>4</td><td>Press ‘Store’ in the ‘Cal Checks’ window.
Modify file name to CalChk_SlaveTrksideName_Tap.fig
Close ‘Cal Checks’ window
Close ‘Mic Status’ window for the Slave trackside</td><td>Analysis stops, frozen time trace of last Microphone is stored
  </td><td>☑</td></tr>
</table>

<table>
<tr><th>STEP</th><th>DESCRIPTION</th><th>EXPECTED RESULTS</th><th>RESULTS</th></tr>
<tr><td>5</td><td>Select 'Mic Status' button for the Master trackside
Check that all microphones are serviceable and sampled
Select 'Calibration Check…'
Set analysis type to 'TimeHistories'
Select 'Start' button</td><td>Graph of time histories for each microphone in Master array appears on screen</td><td>☑</td></tr>
<tr><td></td><td colspan="2">NOTE: For Master (Right) array, microphone 1 is the first microphone from the right. (See Appendix A.2 for diagram)</td><td></td></tr>
<tr><td>6</td><td>Verify that the Master Cabinet shutter motor is still disconnected, then have someone tap each Microphone (Mic) in sequence.
Watch the amplitude of time trace for that microphone increase and tick it off.
Microphones 9-16 are N/A for an 8 Microphone System.
Press 'Stop' on the 'Cal Checks' window during the last microphone tap. (e.g. 8 or 16)</td><td colspan="2"><table>
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<tr><td>2</td><td>☑</td><td>10</td><td>☐</td></tr>
<tr><td>3</td><td>☑</td><td>11</td><td>☐</td></tr>
<tr><td>4</td><td>☑</td><td>12</td><td>☐</td></tr>
<tr><td>5</td><td>☑</td><td>13</td><td>☐</td></tr>
<tr><td>6</td><td>☑</td><td>14</td><td>☐</td></tr>
<tr><td>7</td><td>☑</td><td>15</td><td>☐</td></tr>
<tr><td>8</td><td>☑</td><td>16</td><td>☐</td></tr>
</table></td></tr>
<tr><td>7</td><td>Press 'Store' in 'Cal Checks' window
Modify file name to CalChk_MasterTrksideName_Tap.fig
Close 'Cal Checks' window
Close 'Mic Status' window for the Master trackside</td><td>Analysis stops, frozen time trace of last Microphone is stored, and window is closed
Store</td><td>☑</td></tr>
<tr><td>8</td><td>Close 'RailBAM® Maintenance' window.
Initial and Date</td><td colspan="2">Record directory location of microphone tap test
C:\commissioning\CHK\05APR23 132902 CAL CHK NEAR TAPTST
Initials: EAM Date: 04/05/2023</td></tr>
</table>

B.6 CALIBRATION UNIT LEVEL CHECK

Aim: Verify that the calibration unit is operating correctly and record the relevant part of the emitted noise spectrum.

<table>
<tr><th>STEP</th><th>DESCRIPTION</th><th colspan="4">EXPECTED RESULTS</th><th>RESULTS</th></tr>
<tr><td rowspan="6">1</td><td rowspan="6">Position calibration unit on track, approximately 5 metres to one side of the cabinets and activate as described in the specification sheet (packed with calibration unit).

Point the Sound Level Meter (SLM) directly at the calibration unit from a distance of 2.5 metres. SLM should be level with calibration unit. Measure Sound Pressure Level (SPL) for 6.3, 8, 10 and 12.5 kHz 3rd octave bands.

Repeat this check after calibration [Appendix B.7 and B.8] is complete.

(If using a TrackIQ Calibration Unit, record values from Calibration Unit User Manual – Calibration Data. In this case the Overall Value is not required; and the use of a SLM and the repeated check is optional.)</td><td colspan="4">Sound Pressure Levels.
Note: The calibration unit shall emit levels within the limits stated in brackets.</td><td rowspan="6"></td></tr>
<tr><td></td><td>Before Calibration</td><td>(dB)</td><td>After Calibration</td></tr>
<tr><td>6.3 kHz</td><td></td><td>(60 - 80)</td><td></td></tr>
<tr><td>8 kHz</td><td></td><td>(60 - 80)</td><td></td></tr>
<tr><td>10 kHz</td><td></td><td>(60 - 80)</td><td></td></tr>
<tr><td>12.5 khz</td><td></td><td>(60 - 80)</td><td></td></tr>
<tr><td>Overall</td><td></td><td>(60 - 80)</td><td></td></tr>
<tr><td>2</td><td>Record configuration or model of calibration unit</td><td colspan="4">20024-001</td><td>or N/A ☐</td></tr>
<tr><td>3</td><td>Record serial number of calibration unit - required if no SLM is used</td><td colspan="4">ISS1 003</td><td>or N/A ☐</td></tr>
<tr><td>4</td><td>Record calibration date of calibration unit - required if no SLM is used</td><td colspan="4">07/01/2022</td><td>or N/A ☐</td></tr>
<tr><td>5</td><td>Record make and model of SLM</td><td colspan="4"></td><td>or N/A ☐</td></tr>
<tr><td>6</td><td>Record serial number of SLM</td><td colspan="4"></td><td>or N/A ☐</td></tr>
<tr><td>7</td><td>Record calibration date of SLM</td><td colspan="4"></td><td>or N/A ☐</td></tr>
<tr><td>8</td><td>Initial and Date</td><td colspan="5">Initials: EAM Date: 04/05/2023</td></tr>
</table>

B.7 SLAVE CALIBRATION & BEAMFORMING

Aim: Verify that the microphone calibration of the Slave cabinet is correct, i.e. the indicated noise levels are correct and that the beam forming parameters are correct, i.e. the array can accurately locate a noise source.

STEP	DESCRIPTION	EXPECTED RESULTS	RESULTS
1	With a new session of RailBAM® select **'Maintenance/Setup and Abort'** on the '**set_chkTTL_mode**' window. Select **'No Deadman Handle'** Select '**Mic Status**' button for the **Slave** trackside List any microphones that are not serviceable and sampled Select **'Calibration Check…'** Set analysis type to **'ThirdOctaves'** Select **'Start'** button Record the value shown in the field dmic of the **'Adjust Mics'** window as $dmic_{precal}$.in the column to the right.	Shutters are still open from previous test Graph of third octave sound pressure levels for each microphone in **Slave** array appears on screen	$dmic_{precal}$ = 2.3 m
2	Measure the distance between the front face of the **Slave** cabinet and the gauge face of the rail, and enter it into the relevant box shown in in the sketch of Appendix A.2. Add 0.15m to this measurement and round the result up to the next 0.1m interval and record as $dmic_{actual}$ in the column to the left. Select **'Start'** button	This value should be the same as $dmic_{precal}$ recorded above, unless civil works required derivation from the original site layout drwg. If these values differ: • Select **'Stop'** button Enter the value of $dmic_{actual}$ into the field of the **'Adjust Mics'**window.	$dmic_{actual}$ = 2.3 m
3	Position the calibration unit on the track at position 0.0m (directly in front of **Slave** array). Speaker should be level with microphone array and aimed at the array. Activate the calibration unit as described in its accompanying documentation.	The calibration unit plays random noise directly in front of the **Slave** array.	☑

STEP	DESCRIPTION	EXPECTED RESULTS		RESULTS
4	Allow sufficient time for display to stabilise then select **'Stop'** Record SPL for 6.3, 8, 10 and 12.5 kHz 1/3rd octave bands (read this from the graph in 'cal checks' window).		Measurement (dB)	
		6.3 kHz	53.8	
		8 kHz	58.7	
		10 kHz	70.9	
		12.5 kHz	74.5	
		Overall	77	
5	Select **'Store'**, modify file name to **CalChk_*SlaveTrksideName*_0mPreCal.fig**.	Figure stored [Store]		☑
6	Check the current **10 kHz** dB level is within +/-4dB of the 10 kHz entry from Step 1 of Appendix B.6.If not check set up and calibrator **before proceeding** to the next step.	Current 10 kHz dB level is within +/-4dB of the 10 kHz entry from Step 1 of Appendix B.6.		☑
7	If all microphone levels are within +/-2dB at 10 kHz, AND; the average microphone SPL at 10 kHz is within +/-2dB of the 10 kHz reading from the SLM in Step 1 of Appendix B.6 then – **no calibration adjustment is required.** Close the **'Cal Checks'** window Mark steps 8, 9, 10 and 11 as N/A and continue with step 12	The average microphone SPL and at 10 kHz should not have changed by more than 2 dB since the last calibration		☑
8	Select **'Start'** button Allow sufficient time for display to stabilise then select **'Stop'** Select **'Balance Overall'** on the '**Adjust Mics**' window	Third octave levels for random noise are measured and displayed on screen. Verify that; all microphone levels are within +/-2 dB at 10 kHz.		☑ or N/A ☐
9	Using the **'All'** slider on the **'Adjust Mics'** window, set average microphone SPL (thick blue line) at **10 kHz** to equal the 10 kHz reading from the SLM in Step 1 of Appendix B.6 Close the **'Cal Checks'** window (click **'yes'** to save calibration factors)	Microphones are calibrated.		☑ or N/A ☐

<table>
<tr><th>STEP</th><th>DESCRIPTION</th><th>EXPECTED RESULTS</th><th>RESULTS</th></tr>
<tr><td>10</td><td>Re-open the ‘Calibration Check…’ window
Set analysis type to ‘ThirdOctaves’
Select ‘Start’ button in the ‘Cal Checks’ window
Allow sufficient time for display to stabilise then select ‘Stop’
Record SPL for 6.3, 8, 10 and 12.5 kHz 3rd octave bands (read this from the graph in ‘cal checks’ window).</td><td>Graph of calibrated third-octave SPL stored to file.
Appendix C.1 shows typical 1/3rd octave SPLs.
Note: The recorded values below, at frequencies other than 10 kHz, will vary from those of Step 1 of Appendix B.5 due to the effects of reflector and MSCs
<table>
<tr><th></th><th>Measurement (dB)</th></tr>
<tr><td>6.3 kHz</td><td>52.0</td></tr>
<tr><td>8 kHz</td><td>57.0</td></tr>
<tr><td>10 kHz</td><td>69.2</td></tr>
<tr><td>12.5 kHz</td><td>72.5</td></tr>
<tr><td>Overall</td><td>75</td></tr>
</table></td><td>☑
Or N/A ☐</td></tr>
<tr><td>11</td><td>Select ‘Store’, modify file name to CalChk_SlaveTrksideName_0m.fig.</td><td>Figure stored Store</td><td>☑
or N/A ☐</td></tr>
<tr><td>12</td><td>Set analysis type to ‘TransferFunctions’
Check against Typical Plot [Appendix C.1]</td><td>Graphs of transfer function, time delay and coherence for each microphone appear.</td><td>☑</td></tr>
<tr><td>13</td><td>Set analysis type to ‘BeamForming’
Check the noise source estimated position at the top of the plot</td><td>Verify that the estimated position is within +/- 0.2m of the actual calibration unit location.</td><td>0.0 m</td></tr>
<tr><td>14</td><td>Deactivate the calibration unit.
Set analysis type to ‘ThirdOctaves’ - be patient, closing of the beamforming plot may take a moment - do not abort!</td><td>Graph of third octave sound pressure levels for each microphone in Slave array appears</td><td>☑</td></tr>
<tr><td>15</td><td>Select ‘Start’ button in the ‘Cal Checks’ window
Allow sufficient time for display to stabilise then select ‘Stop’</td><td>Third octave levels for noise floor are measured, displayed on screen and stored to file.
Maximum level at 10 kHz of average 1/3 octave spectrum should be below 30 dB.</td><td>Max: 22.4 dB</td></tr>
<tr><td>16</td><td>Select ‘Store’, modify file name to CalChk_SlaveTrksideName_Nsflr.fig.</td><td>Figure stored Store</td><td>☑</td></tr>
</table>

STEP	DESCRIPTION	EXPECTED RESULTS	RESULTS
17	Position the calibration unit on the track at position **+2.0m** to side of **Slave** array, aim speaker at array and activate (Positive direction is defined as forward when standing with right cabinet on your right, and left cabinet on your left - see diagram in Appendix A.2)	The calibration unit plays random noise	☑
18	Set analysis type to **'TransferFunctions'** Select **'Start'** button in **'Cal Checks'** window Allow sufficient time for display to stabilise then select **'Stop'.** Check against Typical Plot [Appendix C.1]	Graphs of transfer function, time delay and coherence for each microphone appear. Verify that time delays at 10kHz are negative.	☑
19	Set analysis type to **'BeamForming'** Check the noise source estimated position at the top of the plot	Verify that the estimated position is within +/- 0.5m of the actual calibration unit location.	2.0 m
20	Select **'Store'**, modify file name to **CalChk_*SlaveTrksideName*_2m.fig**.	Figure stored 	☑
21	Position the calibration unit on the track at position **-2.0m** to side of **Slave** array, aim speaker at array and activate	The calibration unit plays random noise	☑
22	Set analysis type to **'TransferFunctions'** Select **'Start'** button in **'Cal Checks'** window Allow sufficient time for data to be sampled then select **'Stop'.** Check against Typical Plot [Appendix C.1]	Graphs of transfer function, time delay and coherence for each microphone appear. Verify that time delays at 10kHz are positive.	☑
23	Set analysis type to **'BeamForming'** Check the noise source estimated position at the top of the plot	Verify that the estimated position is within +/- 0.5m of the actual calibration unit location.	-1.8 m
24	Select **'Store'**, modify file name to **CalChk_*SlaveTrksideName*_-2m.fig**.	Figure stored 	☑

STEP	DESCRIPTION	EXPECTED RESULTS	RESULTS
25	Close '**Cal Checks**' window Close '**Mic Status**' window for the **Slave** trackside Close **'RailBAM® Maintenance'** window. To ensure RailBAM session terminated correctly and calibration factors were saved, check that calibration directory does not have a file named 'DELETE_THIS_IF_ALL_IS_OK' Initial and Date	Record the MSC gain setting: ☑ 10dB ☐ 20dB ☐ 30dB Record directory locations of calibration C:\commissioning\CHK\ 04APR23 134325 CAL CHK FAR Initials: EAM Date: 04/05/2023	

B.8 MASTER CALIBRATION & BEAMFORMING

Aim: Verify that the microphone calibration of the Master cabinet is correct, i.e. the indicated noise levels are correct and that the beam forming parameters are correct, i.e. the array can accurately locate a noise source.

STEP	DESCRIPTION	EXPECTED RESULTS	RESULTS
1	With a new session of RailBAM® select **'Maintenance Setup and Abort'** on the '**set_chkTTL_mode**' window. Select **'No Deadman Handle'** Select '**Mic Status**' button for the **Master** trackside Select **'Calibration Check…'** Set analysis type to **'ThirdOctaves'** Select **'Start'** button Record the value shown in the field dmic of the **'Adjust Mics'** window as $dmic_{precal}$.in the column to the right.	Shutters are still open from previous test Graph of third octave sound pressure levels for each microphone in **Master** array appears on screen	$dmic_{precal}$ = 2.3 m
2	Measure the distance between the front face of the **Master** cabinet and the gauge face of the rail, and enter it into the relevant box shown in in the sketch of Appendix A.2. Add 0.15m to this measurement and round the result up to the next 0.1m interval and record as $dmic_{actual}$ in the column to the left. Select **'Start'** button	This value should be the same as $dmic_{precal}$ recorded above, unless civil works required derivation from the original site layout drwg. If these values differ: • Select **'Stop'** button • Enter the value of $dmic_{actual}$ into the field of the **'Adjust Mics'**window.	$dmic_{actual}$ = 2.3 m
3	Position the calibration unit on the track at position 0.0m (directly in front of **Master** array). Speaker should be level with microphone array and aimed at the array. Activate the calibration unit as described in its accompanying documentation.	The calibration unit plays random noise directly in front of the **Master** array.	☑

STEP	DESCRIPTION	EXPECTED RESULTS	RESULTS
4	Allow sufficient time for display to stabilise then select **'Stop'** Record SPL for 6.3, 8, 10 and 12.5 kHz 1/3rd octave bands (read this from the graph in 'cal checks' window).	<table><tr><td></td><td>Measurements(dB)</td></tr><tr><td>6.3 kHz</td><td>53.7</td></tr><tr><td>8 kHz</td><td>58.4</td></tr><tr><td>10 kHz</td><td>70.3</td></tr><tr><td>12.5 kHz</td><td>73.4</td></tr><tr><td>Overall</td><td>76</td></tr></table>	
5	Select **'Store'**, modify file name to **CalChk_*MasterTrksideName*_0mPreCal.fig**.	Figure stored 	☑
6	Check the current **10 kHz** dB level is within +/-4dB of the 10 kHz entry from Step 1 of Appendix B.6. If not check set up and calibrator **before proceeding** to the next step.	Current 10 kHz dB level is within +/-4dB of the 10 kHz entry from Step 1 of Appendix B.6.	☑
7	If all microphone levels are within +/-2dB at 10 kHz, AND; the average microphone SPL at 10 kHz is within +/-2dB of the 10 kHz reading from the SLM in Step 1 of Appendix B.6 then – **no calibration adjustment is required.** Close the **'Cal Checks'** window Mark steps 8, 9, 10 and 11 as N/A and continue with step 12	The average microphone SPL and at 10 kHz should not have changed by more than 2 dB since the last calibration	☑
8	Select **'Start'** button Allow sufficient time for display to stabilise then select **'Stop'** Select **'Balance Overall'** from '**Adjust Mics**' window	Third octave levels for random noise are measured and displayed on screen. Verify that; all microphone levels are within +/-2 dB at 10 kHz.	☑ or N/A ☐
9	Using the **'All'** slider in **'Adjust Mics'** window, set average microphone SPL (thick blue line) at **10 kHz** to equal the 10 kHz reading from the SLM in Step 1 of Appendix B.6 Close **'Cal Checks'** window	Microphones are calibrated.	☐ or N/A ☑

<table>
<tr><th>STEP</th><th>DESCRIPTION</th><th>EXPECTED RESULTS</th><th>RESULTS</th></tr>
<tr><td>10</td><td>Re-open ‘Calibration Check…’ window
Set analysis type to ‘ThirdOctaves’
Select ‘Start’ button in ‘Cal Checks’ window
Allow sufficient time for display to stabilise then select ‘Stop’
Record SPL for 6.3, 8, 10 and 12.5 kHz 3rd octave bands (read this from the graph in ‘cal checks’ window).</td><td>Graph of calibrated third-octave SPL stored to file.
Appendix C.1 shows typical 1/3rd octave SPLs.
Note: The recorded values below, at frequencies other than 10 kHz, will vary from those of Step 1 of Appendix B.5 due to the effects of reflector and MSCs
<table>
<tr><th></th><th>Measurement (dB)</th></tr>
<tr><td>6.3 kHz</td><td></td></tr>
<tr><td>8 kHz</td><td></td></tr>
<tr><td>10 kHz</td><td></td></tr>
<tr><td>12.5 kHz</td><td></td></tr>
<tr><td>Overall</td><td></td></tr>
</table></td><td>☐
or N/A ☐</td></tr>
<tr><td>11</td><td>Select ‘Store’, modify file name to CalChk_MasterTrksideName_0m.fig.</td><td>Figure stored Store</td><td>☐
or N/A ☑</td></tr>
<tr><td>12</td><td>Check that these levels are similar (within +/-3dB) to those from Step 10 of Appendix B.8.</td><td>Levels are similar (within +/-3dB), if not check set up and calibrator before proceeding to the next step.</td><td>☑</td></tr>
<tr><td>13</td><td>Set analysis type to ‘TransferFunctions’
Check against Typical Plot [Appendix C.1]</td><td>Graphs of transfer function, time delay and coherence for each microphone appear.</td><td>☑</td></tr>
<tr><td>14</td><td>Set analysis type to ‘BeamForming’
Check the noise source estimated position at the top of the plot</td><td>Verify that the estimated position is within +/- 0.2m of the actual calibration unit location.</td><td>0.0 m</td></tr>
<tr><td>15</td><td>Deactivate the calibration unit.
Set analysis type to ‘ThirdOctaves’ - - be patient, closing of the beamforming plot may take a moment - do not abort!</td><td>Graph of third octave sound pressure levels for each microphone in Master array appears</td><td>☑</td></tr>
<tr><td>16</td><td>Select ‘Start’ button in ‘Cal Checks’ window
Allow sufficient time for display to stabilise then select ‘Stop’</td><td>Third octave levels for noise floor are measured, displayed on screen and stored to file.
Maximum level at 10 kHz of average 1/3 octave spectrum should be below 30 dB.</td><td>Max: 21.3 dB</td></tr>
<tr><td>17</td><td>Select ‘Store’, modify file name to CalChk_MasterTrksideName_Nsflr.fig.</td><td>Figure stored Store</td><td>☑</td></tr>
</table>

STEP	DESCRIPTION	EXPECTED RESULTS	RESULTS
18	Position the calibration unit on the track at position **+2.0m** to side of **Master** array, aim speaker at array and activate (Positive direction is defined as forward when standing with right cabinet on your right, and left cabinet on your left – see Appendix A.2)	The calibration unit plays random noise	☑
19	Set analysis type to **'TransferFunctions'** Select **'Start'** button in **'Cal Checks'** window Allow sufficient time for display to stabilise then select **'Stop'.** Check against Typical Plot [Appendix C.1]	Graphs of transfer function, time delay and coherence for each microphone appear. Verify that time delays at 10kHz are negative.	☑
20	Set analysis type to **'BeamForming'** Check the noise source estimated position at the top of the plot	Verify that the estimated position is within +/- 0.5m of the actual calibration unit location.	2.0 m
21	Select **'Store'**, modify file name to **CalChk_*MasterTrksideName*_2m.fig**.	Figure stored 	☑
22	Position the calibration unit on the track at position **-2.0m** to side of **Master** array, aim speaker at array and activate	The calibration unit plays random noise	☑
23	Set analysis type to **'TransferFunctions'** Select **'Start'** button in **'Cal Checks'** window Allow sufficient time for data to be sampled then select **'Stop'.** Check against Typical Plot [Appendix C.1]	Graphs of transfer function, time delay and coherence for each microphone appear. Verify that time delays at 10kHz are positive.	☑
24	Set analysis type to **'BeamForming'** Check the noise source estimated position at the top of the plot	Verify that the estimated position is within +/- 0.5m of the actual calibration unit location.	-1.8 m
25	Select **'Store'**, modify file name to **CalChk_*MasterTrksideName*_-2m.fig**.	Figure stored 	☑

STEP	DESCRIPTION	EXPECTED RESULTS	RESULTS
26	Close **'Cal Checks'** window Close '**Mic Status**' window for the **Master** trackside Close **'RailBAM® Maintenance'** window. To ensure RailBAM session terminated correctly and calibration factors were saved, check that calibration directory does not have a file named 'DELETE_THIS_IF_ALL_IS_OK' Initial and Date	Record the MSC gain setting: ☑ 10dB ☐ 20dB ☐ 30dB Record directory locations of calibration C:\commissioning\CHK\04APR23 132902 CAL CHK NEAR Initials: EAM Date: 04/05/2023	

B.9 TRAIN SIMULATION

Aim: Verify that the system is triggered by a wakeup signal and that shutters are operating after tests.

STEP	DESCRIPTION	EXPECTED RESULTS	RESULTS
1	With a new session of RailBAM® ensure the '**set_chkTTL_mode**' window is set to **'Normal Operation'**. Reconnect the Motor Power Connector inside the cabinets. (Which were disconnected at the end of the sensors tests [Appendix B.3] and which was verified before carrying out the tap tests [Appendix B.5] – for safety.) Set switch on SCU front panel to **'Auto'** and wait for 35 secs Pass metal object (e.g. spanner) by a wake up sensor.	Both Shutters start closed, then Both Shutters close Both Shutters open 'Train' is sampled RailBAM® does not terminate *during* analysis **Warning:** No axles found-skipped last 'train' RailBAM® terminates *after* analysis.	☑
2	Initial and Date.	Record directory location of simulated train C:\commissioning\CHK\04APR23 135013 SIM TRAIN Initials: EAM Date: 04/05/2023	

B.10 ACTUAL TRAIN ANALYSIS

Aim: Verify that trains are sampled and analysed correctly, which proofs that all sensor parameters are correct.

STEP	DESCRIPTION	EXPECTED RESULTS	RESULTS
1	With a new session of RailBAM® ensure the '**set_chkTTL_mode**' window is set to **'Normal Operation'**.	System on standby waiting for trains Wait until a train passes the system	☑
2	Train Passes	Data Acquisition initiated by train RailBAM® terminates *after* analysis.	☑
3	After the train has passed, Open All Msgs history link on the desktop or alternatively, Load the RailBAM® web page and select Messages. Locate the "Prefix" **msg** (Pass-by event) or **al** (Pass-by event) and click on timestamp of train to open the train directory (note the path) Open and examine analysis.log.	Number of valid axles counted is consistent with train control or physical count. Verify that the Number of high/low going flanks is commensurate with the number of valid axles, except for optical Spd sensors, where loco sand pipes and the like can lead to additional pulses that are processed out later.	Wkup2 - Wkup1 - Spd2 432 Spd1 432 Aux2 432 Aux1 432 Axles: 432
4	If both Spd and Aux sensors are fitted, verify that the number of valid axles between Spd and Aux sensors tallies	Spd and Aux sensors tallies and that the **Average speed difference between Aux and Spd** is: < 1km/h.	61 km/h
5	If optical Spd sensors are fitted:	Verify that the **Average wheel diameter difference between Spd2 and Spd1** is: < 20mm; Verify that the **Std. Dev. of wheel diameter difference between Spd1 and Spd2** is: < 20mm.	-7 mm 6 mm
6		Assuming the median wheel dia should be 940 mm, h should be [0.051 , 0.057] - currently h=[0.044 , 0.050] Assuming the median wheel dia should be 870 mm (whl_paras.stndrddia), h should be [0.051 , 0.057] - currently h=[See above] Assuming that h is OK, the median wheel dia should be 862 mm with a 34 mm high flange	

STEP	DESCRIPTION	EXPECTED RESULTS	RESULTS	
7	Click “Back” on the web browser to return to the train folder. Scroll down to the bottom of the page and locate and click on the TMR file. Verify the local time of train passing is correct Verify the location and direction of train passing is correct Verify the ID, TAG field for the train consist	Correct local date of train passing	04/05/2023	
		Correct local time of train passing	14:00:18	
		Correct system location of train passing	IRONTO, VA	
		Correct train travelling direction	EASTBOUND	
		Train consist is consistent with train control/physical count i.e. verify number of L_* for loco, C _* for wagons and P_* for Passenger	2	L_*
			105	C_*
			-	P_*
8	Verify axle spacing [m] within bogie is consistent with expectation	Typically: 1.6 to 1.9m for freight bogies in Australia, America, China, South Africa; 1.8 to 2.1m for freight bogies in the UK, India.	☑	
9	Locate a Level 1 fault and following the links to the graphs and sound file	Verify graphs are shown and that there is audible sound.	☑	
10	Select **‘Maintenance Setup and Abort’** on the ‘**set_chkTTL_mode**’ window. Select **‘No Deadman Handle’** Select **‘Show Wheel Info’** and browse to the train directory noted above and select the whldets.mat file.	Figure plots will be generated for the train that was selected. Figures will usually be displayed in the order listed in the next steps.	☑	
11	Figure with labels; Axel Speed, Axel Spacing, Wheel Diameter. Usually the last plot (on top the others)	Verify that these are commensurate with the actual train, e.g. speed increase or decrease during pass-by.	☑	
12	Figure with label; ‘Locations’ of Tags Indicating: train axles and vehicles (as gray boxes) with tag locations (green for Master and red for Slave side tag readers)	Verify that tags are consistently located relative to axles and information tally with expectations for that train.	☑	

STEP	DESCRIPTION	EXPECTED RESULTS	RESULTS
13	Figure with labels; Aux1, Aux2 (If these sensors are installed) Pulse width (in samples) vs. sample number. Note: Pulse width will somewhat scale with speed, e.g. will increase as train slows down.	Verify that the pulse widths are consistent, i.e. no pulses less than 2/3 of the width of the majority; otherwise check sensor alignment. Appendix C.1 shows an example of unsatisfactory Aux pulses.	☑
14	Figure with labels; Spd1, Spd 2 (If these sensors are installed) Pulse width (in samples) vs. sample number.	Verify that the pulse widths should be consistent. But it can be expected that there are short pulses due to loco sand pipes and the like.	☑
15	Figure with labels; Wkup1, Wkup2 Pulse width (in samples) vs. sample number. **Note1:** Pulse width will somewhat scale with speed, e.g. will increase as train slows down. **Note2:** The incoming Wkup will typically have a few less pulses than the actual number of axles, as it was used to switch from 'waiting for train' to 'train data acquisition' which takes a fraction of a second. **Note3:** If UDP messaging is used for waking up, then these plots will be empty.	Verify that the pulse widths are consistent, i.e. no pulses less than 2/3 of the width of the majority; otherwise check sensor alignment. Appendix C.1 shows an example of unsatisfactory Aux pulses, which is simular to unsatisfactory Wkup pulses. **Note:** If a train presence detector, e.g. Zepic, is fitted, the pulses will be regularly spaced as they are generated by the SCU (Adaptor) and their width will not scale with speed.	☐ Wkup ☑ Presence Detector ☐ UDP
16	Close analysis.log, messages and web page.		☑
17	Initial and Date.	Record directory location of actual train C:\commissioning\CHK\05Apr23SAMPLE TRAIN Initials: EAM Date: 04/05/2023	

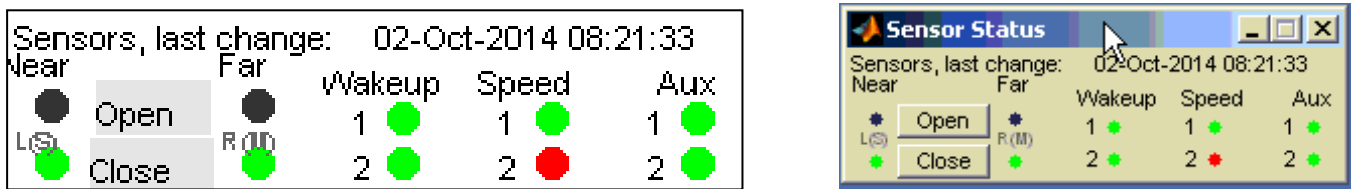
B.11 PERFORM POST SITE CHECK TASKS

Aim: Ensure that all installation tasks including 'house-keeping' has been performed.

STEP	DESCRIPTION	EXPECTED RESULTS	RESULTS
1	Photos for site condition:	Site View, Hut, Tag Reader / Pole, Cabinets, Spd Assembly, Aux Assembly, Wkup Assembly, Rack	☑
2	List of spares kept on site and quantity. Also note location if not in the rack.	Speed sensors Aux/wakeup sensors Bracket spacer plates SCU TC-32 MARF Microphone Etc.	☑
3	Rubbish removed / pickup arranged	Clean Site	☑
4	On SCU front panel, switch shutters to **'Open'** Wait 5 seconds, then switch shutters to **'Auto'** Observe the cabinets until the shutters close automatically	Shutters open, then automatically close	☑
5	Initial and Date.	Initials: EAM Date: 04/05/2023	

Appendix C: Typical Results

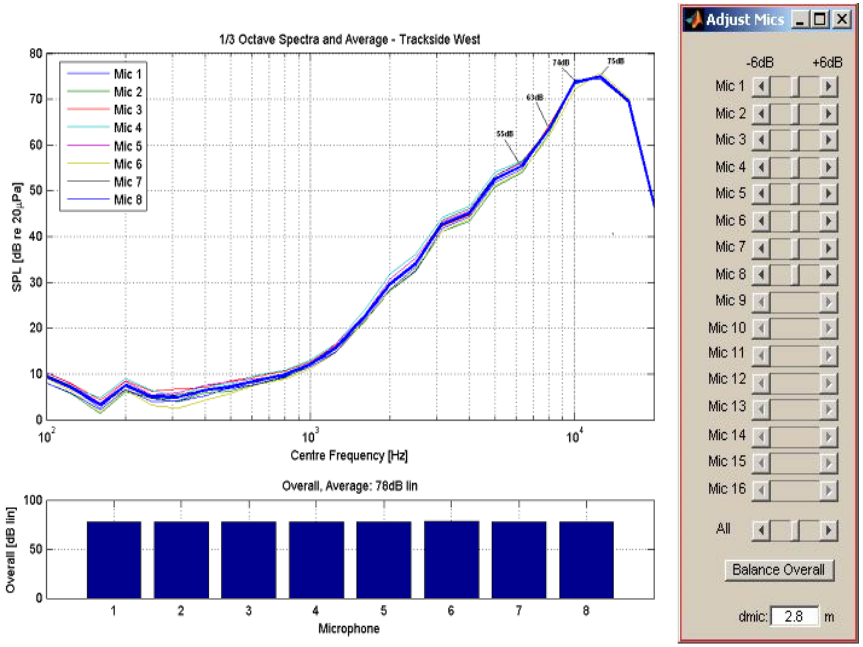
C.1 Graphs and Figures



Sensor status window from RailBAM® web page and GUI, showing 'Speed Sensor 2' engaged

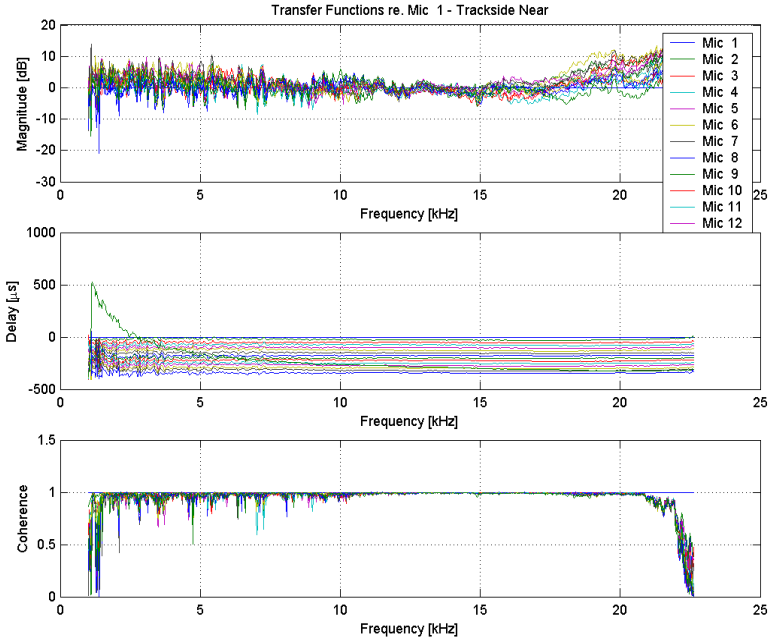
```
********************** Swaythling Up ********************** 6:45:30  2-Oct-2014
Track IQ (C) RailBAM-Algorithms 5.6.3c (R2007b)
NOTE: System clock is set to GMT (no daylight saving) - times in html reports, alarms etc. are converted to local time with daylight saving if appropriate.
Current Time:  06:45:29 02-Oct-2014 GMT (which is 07:45:29 02-Oct-2014 in local DLS time for Europe/London)
Current Working Directory:  D:\Server\trains\2014\1002\064526
 Preparing DAQ for Tracksides,  6:45:30  2-Oct-2014
 Preparing Tag Reader Far,  6:45:31  2-Oct-2014
 No Tag Reader Near installed,  6:45:31  2-Oct-2014
 Waiting for Train,  6:45:32  2-Oct-2014
 6:45:32  2-Oct-2014 :_wkup1_wkup2_spd1__Spd2__aux1__aux2__Ropn__RCLSD_Lopn__LCLSD_swopn_swcls_
 6:45:33  2-Oct-2014 :  Set to Normal Operation
 6:47:30  2-Oct-2014 :_wkup1_WKUP2_spd1__Spd2__aux1__aux2__Ropn__RCLSD_Lopn__LCLSD_swopn_swcls_
 6:47:30  2-Oct-2014 :_wkup1_wkup2_spd1__Spd2__aux1__aux2__Ropn__RCLSD_Lopn__LCLSD_swopn_swcls_
 Finished Waiting for Train, 02-Oct-2014 06:47:30  (Train detected on 02-Oct-2014 07:47:30 local time)
 Sampling Train,  6:47:31  2-Oct-2014
   All data was saved to HDD during sampling,  6:47:51  2-Oct-2014
 Finished Sampling (Far: 29MB, 2 Tags; Near: 0MB, 0 Tags),  6:47:51  2-Oct-2014
 Starting Analysis,  6:47:52  2-Oct-2014
```

Typical RailBAM® Command Window Display, showing 'Wake Up Sensor 2' Triggering the system to sample a train.
The displayed text is also saved as *analysis.log* **in the** *Current Working Directory*



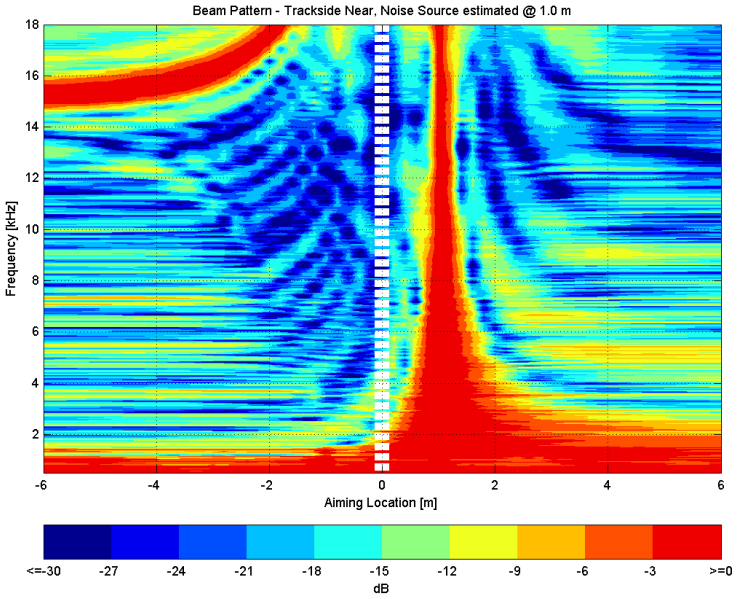
Typical Third Octave Spectra Graph

for Random Noise and Adjust Mics window



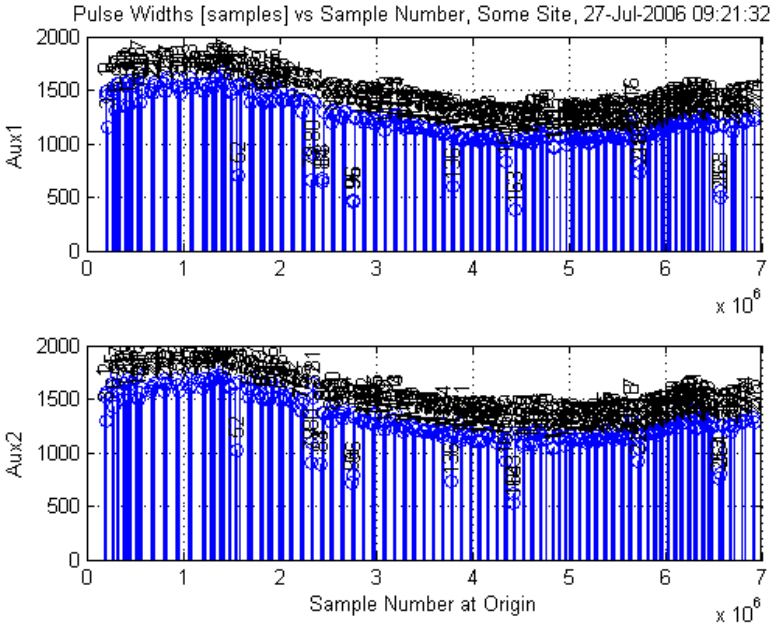
Typical Transfer Functions

Time Delay and Coherence at +1.0m.



Typical 'beam forming'

Source location plot for source at +1.0m



Unsatisfactory Aux pulse widths

Many short pulses. Therefore, wheels may be missed completely. The general variation in pulse width is due to speed changes – here speeding up and slowing down again.