



Data Summary: Acoustic Combined

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Synopsis

Purpose

The Acoustic Combined data summary is used to identify internal wheel bearing defects before reaching an industry condemnable level for the purpose of preventative maintenance planning. The data summary is opened and updated from acoustic bearing detectors from two vendors, RailBAM[®] and TADS[®].

Background

The Acoustic Combined data summary replaces two separate data summaries, Acoustic RailBAM and Acoustic TADS, providing a single view of potential wheel bearing degradation.

Acoustic bearing alerts (ABD) are opened from detector readings in Acoustic Combined data summaries. The readings must be from validated detectors to ensure that the alerts accurately reflect the condition of the wheel bearing in question. To support this, the Acoustic Combined data summary contains a set of attributes that are specifically from validated detectors. A second set of attributes, which are from both validated and non-validated detectors, is available for completeness.

For more information on RailBAM and TADS acoustic bearing detectors, see “[Appendix B – Acoustic Bearing Detectors](#)” on page 10.

Data Summary Elements

The Acoustic Combined data summary contains both validated, and a combination of validated and non-validated detector readings. Only validated readings are used to open ABD alerts. Either validated or non-validated readings are used to autoclose the data summary and the associated ABD alert. The Last Defect and Last Severity Level are used to open alerts.

	Element Name	Element Text	Element Description	Format	Aggregation Method	Action
	Type	Type		TEXT		
HEADER	Format Version	Format Version	Version of the format used to create the Data Summary	NUMBER [1.0-999.99]		
	CreationTMST	Date opened	GMT timestamp for when the data summary was created and the time zone offset of the originating data location.	TIMESTAMP	Earliest	Update when data summary created
	RR_DB_Key	Key from originating railroad	Database key from the originating railroad (or detector owner)	NUMBER [0 -999999999]		
	LastUpdateTMST	Date of last update	GMT timestamp for when the data summary was last updated (any change other than closing) and the time zone offset of the originating data location.	TIMESTAMP	Last	Update every time data summary is updated
	DSType	Type of Data Summary	Data summary type	TEXT		
	DS_Owner/Reporting_System	Who created the Data Summary	Company ID (from Railinc) of the owner/creator of data summary	TEXT		
	EquipmentMark	Equipment Mark	Current equipment initial	TEXT		
	EquipmentNumber	Equipment Number	Current equipment number	NUMBER [0 -999999999]		
	Location	Location	Location of the component			
	ComponentType	Component type		TEXT		
	ComponentName	Part of the component location		TEXT		
	ComponentValue	Value for the component location		TEXT		
	ComponentName	Part of the component location		TEXT		

	ComponentValue	Value for the component location		TEXT		
	State	Data Summary state	Current status of Open, Closed, Perpetual or Nullified	TEXT		Update when data summary state changes
	Validated and Non-Validated Detector Readings					
ELEMENTS	OPENING_DEFECT	Defect that opened DS	Bearing defect that opened the data summary	TEXT	Earliest	Created during data summary creation
	LAST_DEFECT	Last defect recorded	Last recorded bearing defect, if any	TEXT	Latest	Updated every read
	LAST_SEVERITY_LEVEL	Severity of last reported defect	Severity level of last recorded bearing defect	INTEGER	Latest	Updated every read
	CNT_ABD_READS	Count of readings	Total count ABD readings	INTEGER	Sum	Updated every read
	CNT_WITHOUT_DEF	Count without defects	Count of ABD readings where no defect was recorded	INTEGER	Sum	Updated when a reading indicates no defect
	CNT_EXTENDED_DEFECTS	Count of Large Area Spall defects	Count of Large Area Spall (LAS) defects	INTEGER	Sum	Updated when a large area spall defect is recorded
	MAX_EXTENDED_SEVERITY	Maximum severity of Large Area Spall defects	Maximum severity level of any LAS defects	INTEGER	Maximum	Updated when a large area spall defect is recorded
	CNT_MULTIPLE_DEFECTS	Count of Multiple Components defects	Count of Multiple Components defects	INTEGER	Sum	Updated when a Multiple Components defect is recorded
	MAX_MULTIPLE_SEVERITY	Maximum severity of Multiple Components defects	Maximum severity level of any Multiple Components defects	INTEGER	Maximum	Updated when Multiple Components defect is recorded
	CNT_ROLLER_DEFECTS	Count of Roller defects	Count of Roller defects	INTEGER	Sum	Updated when a Roller defect is recorded
	MAX_ROLLER_SEVERITY	Maximum severity of Roller defects	Maximum severity level of any Roller defects	INTEGER	Maximum	Updated when Roller defect is recorded
	CNT_CUP_DEFECTS	Count of Cup defects	Count of Cup defects	INTEGER	Sum	Updated when a Cup defect is recorded
	MAX_CUP_SEVERITY	Maximum severity of Cup defects	Maximum severity level of any Cup defects	INTEGER	Maximum	Updated when Cup defect is recorded
CNT_CONE_DEFECTS	Count of Cone defects	Count of Cone defects	INTEGER	Sum	Updated when a Cone defect is recorded	

MAX_CONE_SEVERITY	Maximum severity of Cone defects	Maximum severity level of any Cone defects	INTEGER	Maximum	Updated when Cone defect is recorded
CNT_UNCLEAR_DEFECTS	Count of Unclear defects	Count of Unclear defects	INTEGER	Sum	Updated when a Unclear defect is recorded
MAX_UNCLEAR_SEVERITY	Maximum severity of Unclear defects	Maximum severity level of any Unclear defects	INTEGER	Maximum	Updated when Unclear defect is recorded
Validated Detector Readings					
OPENING_DEFECT_VALID	Defect that opened DS	Bearing defect that opened the data summary	TEXT	Earliest	Created during data summary creation
LAST_DEFECT_VALID	Last defect recorded	Last recorded bearing defect, if any	TEXT	Latest	Updated every read
LAST_SEVERITY_LEVEL_VALID	Severity of last reported defect	Severity level of last recorded bearing defect	INTEGER	Latest	Updated every read
CNT_ABD_READS_VALID	Count of readings	Total count ABD readings	INTEGER	Sum	Updated every read
CNT_WITHOUT_DEF_VALID	Count without defects	Count of ABD readings where no defect was recorded	INTEGER	Sum	Updated when a reading indicates no defect
CNT_EXTENDED_DEFECTS_VALID	Count of Large Area Spall defects	Count of Large Area Spall (LAS) defects	INTEGER	Sum	Updated when a large area spall defect is recorded
MAX_EXTENDED_SEVERITY_VALID	Maximum severity of Large Area Spall defects	Maximum severity level of any LAS defects	INTEGER	Maximum	Updated when a large area spall defect is recorded
CNT_MULTIPLE_DEFECTS_VALID	Count of Multiple Components defects	Count of Multiple Components defects	INTEGER	Sum	Updated when a Multiple Components defect is recorded
MAX_MULTIPLE_SEVERITY_VALID	Maximum severity of Multiple Components defects	Maximum severity level of any Multiple Components defects	INTEGER	Maximum	Updated when Multiple Components defect is recorded
CNT_ROLLER_DEFECTS_VALID	Count of Roller defects	Count of Roller defects	INTEGER	Sum	Updated when a Roller defect is recorded
MAX_ROLLER_SEVERITY_VALID	Maximum severity of Roller defects	Maximum severity level of any Roller defects	INTEGER	Maximum	Updated when Roller defect is recorded
CNT_CUP_DEFECTS_VALID	Count of Cup defects	Count of Cup defects	INTEGER	Sum	Updated when a Cup defect is recorded
MAX_CUP_SEVERITY_VALID	Maximum severity of Cup defects	Maximum severity level of any Cup defects	INTEGER	Maximum	Updated when Cup defect is recorded

CNT_CONE_DEFECTS_VALID	Count of Cone defects	Count of Cone defects	INTEGER	Sum	Updated when a Cone defect is recorded
MAX_CONE_SEVERITY_VALID	Maximum severity of Cone defects	Maximum severity level of any Cone defects	INTEGER	Maximum	Updated when Cone defect is recorded
CNT_UNCLEAR_DEFECTS_VALID	Count of Unclear defects	Count of Unclear defects	INTEGER	Sum	Updated when a Unclear defect is recorded
MAX_UNCLEAR_SEVERITY_VALID	Maximum severity of Unclear defects	Maximum severity level of any Unclear defects	INTEGER	Maximum	Updated when Unclear defect is recorded
Timestamps					
TMST_1_without_PROBLEM	Timestamp of last read without defects	Last timestamp of reading for which no defect was detected.	TIMESTAMP	Latest	Update timestamp if reading has no defect, and move other good reading timestamps down 1 position
TMST_2_without_PROBLEM	Timestamp of 2 nd to last read without defects	Second to last timestamp of reading for which no defect was detected.	TIMESTAMP	Latest	Update timestamp if reading has no defect, and move other good reading timestamps down 1 position
TMST_3_without_PROBLEM	Timestamp of 3 rd to last read without defects	Third to last timestamp of reading for which no defect was detected.	TIMESTAMP	Latest	Update timestamp if reading has no defect, and move other good reading timestamps down 1 position
TMST_4_without_PROBLEM	Timestamp of 4 th to last read without defects	Fourth to last timestamp of reading for which no defect was detected.	TIMESTAMP	Latest	Update timestamp if reading has no defect, and move other good reading timestamps down 1 position
TMST_5_without_PROBLEM	Timestamp of 5 th to last read without defects	Fifth to last timestamp of reading for which no defect was detected.	TIMESTAMP	Latest	Update timestamp if reading has no defect, and move other good reading timestamps down 1 position
TMST_6_without_PROBLEM	Timestamp of 6 th to last read without defects	Sixth to last timestamp of reading for which no defect was detected.	TIMESTAMP	Latest	Update timestamp if reading has no defect, and move other good reading timestamps down 1 position
LAST_TMST_with_PROBLEM	Timestamp of last read with any defect	Last timestamp of reading with any defect	TIMESTAMP	Latest	Updated each reading with defect

Data Summary Example

Attribute Name	Comment	Combined Validated and Non-Validated Detectors	Validated Detectors
Opening Defect	Bearing defect that opened the data summary	Cup	Cup
Count of Reads	Total count ABD readings	12	3
Count without Defects	Count of ABD readings where no defect was recorded	3	1
Last Defect	Last recorded bearing defect, if any	Multiple	LAS
Last Severity Level	Severity level of last recorded bearing defect	2	1
Count Extended Defects	Count of Large Area Spall (LAS) defects	2	1
Max Extended Severity	Maximum severity level of any LAS defects	1	1
Count Multiple Defects	Count of multiple defects in a single reading	1	
Max Multiple Severity	Maximum severity level of any Multiple defects	2	
Count Roller Defects	Count of roller defects	1	
Max Roller Severity	Maximum severity level of any Roller defects	1	
Count Cup Defects	Count of cup defects	2	1
Max Cup Severity	Maximum severity level of any Cup defects	1	1
Count Cone Defects	Count of cone defects	3	
Max Cone Severity	Maximum severity level of any Cone defects	2	
Count Unclear Defects	Count of defects of an unclear nature		
Max Unclear Severity	Maximum severity level of any Unclear defects		
Autoclose			
Date of Last Defect	Date of last defect read	12/15/2018 14:22	
Date of No Defect 1	Date of last reading without a defect	12/16/2018 11:15	
Date of No Defect 2	Date of second to last reading without a defect	12/18/2018 7:43	
Date of No Defect 3	Date of third to last reading without a defect	12/19/2018 1:12	
Date of No Defect 4	Date of fourth to last reading without a defect		
Date of No Defect 5	Date of fifth to last reading without a defect		

Opening Criteria

If a data summary creator does not have an open data summary for the asset and location, a new data summary will be opened if **either** of the following conditions are met:

- a) A wheel bearing defect is reported from either a RailBAM or a TADS detector. Readings from both validated and non-validated detectors will contribute to data summary opening.
- b) Another data summary creator has an open data summary for that asset and location

Closing Criteria

- a) Administrative -Opened in Error (due to detector error, AEI matching error, incorrect AEI tag placement). Message may come from web service or from EHMS website input.
- b) Deleted in UMLER. Message must come from the UMLER system.
- c) Autoclose logic: five sequential reads without a problem (for any open data summaries on a bearing). A problem is defined as any defect flag that is set. If there exists five consecutive timestamps after the last timestamp with a problem, a close message will be published effecting a close of all data summaries for that asset/location.

Additional Information

Note: Autoclose timestamps (e.g., TMST_n_without_PROBLEM) are reset to null when LAST_TMST_with_PROBLEM is greater. Autoclose timestamps (e.g., TMST_n_without_PROBLEM) are cascaded (when a more recent one is found, it takes #1 position and #1 moves to #2, etc.).

Appendix A - EHMS Display Information

Opening Criteria Display Text

A reading with any defect, including Cup, Cone, Roller, LAS, Multiple, and Unclear.

Autoclose Display Text

Five consecutive reads with no defects.

Appendix B – Acoustic Bearing Detectors

RailBAM

The RailBAM acoustic detection device records audio from a train passing and produces train and axle based files with four main descriptors: Prefixes, Types, Levels, and Suffixes. This data summary uses those descriptors as the vehicle for data exchange with the industry.

Goals of the data summary include:

- 1) Data summaries are only opened with a high confidence in a rolling surface fault.
- 2) Data summaries are to contain information suitable for prioritizing bearing removals.
- 3) Data summaries are to contain information suitable for indicating: remediation of a problem (support for autoclose) or a data integrity error that led to a false opening.
- 4) A good pass is considered a read without a problem (prefix) and has a severity level of 4.

Prefixes: Noisy, FBS (Flanging,Braking,Slamming), Shrkr (Shriek), Clpd (Clipped)

Prefixes are indicative of non-bearing faults, errors, or other external inputs that may diminish the reliability of the information produced. If there is a prefix, there is a likely error with the reading.

Types: RS (Running Surface), LF (Loose/Fretting), WHLFLT (Wheel Flat)

Fault types are indicative of a match using a particular algorithm to pinpoint a particular defect.

Levels: 1,2,3,4

Levels are indicative of the level of noise decibels associated with a type of defect. Level 1 is the most severe with the highest decibels while level 4 is considered not to be a problem and counts towards autoclosing the data summary. A level with a null value indicates no reading could be made. All null level readings will be ignored.

Suffixes: _e (extended), _m (multiple), _r (roller), _n (cone), _p (cup)

Suffixes are indicative of a particular aspect associated with a type of defect. Suffixes are based on the speed of the wheel and are a quality indicator.

Locomotives are not analyzed and no values are sent for them. A locomotive is determined by the leading and trailing indicators (locomotives use F and R while cars use A and B indicators).

Important! A clear fault is indicated by a full descriptor that has no prefix but does have a suffix. For example, RS1_p is a clear cup fault.

All possible problem full descriptors for RailBAM

(PREFIX)(TYPE)(LEVEL)(SUFFIX) – in the format: Prefix(TypeLevel_Suffix)

RS1_e	RS2_m	RS3_m	LF1	WHLFLT1	NOISY(RS1_m)	FBS(RS1_e)	Shrkr(RS1_e)	Clpd(RS1_e)
RS1_m	RS2_r	RS3_r	LF2	WHLFLT2	NOISY(RS1_r)	FBS(RS1_m)	Shrkr(RS1_m)	Clpd(RS1_m)
RS1_r	RS2_n	RS3_n	LF3		NOISY(RS1_n)	FBS(RS1_r)	Shrkr(RS1_r)	Clpd(RS1_r)
RS1_n	RS2_p	RS3_p			NOISY(RS1_p)	FBS(RS1_n)	Shrkr(RS1_n)	Clpd(RS1_n)
RS1_p	RS2	RS3			NOISY(RS1)	FBS(RS1_p)	Shrkr(RS1_p)	Clpd(RS1_p)
RS1					NOISY(RS2_m)	FBS(RS1)	Shrkr(RS1)	Clpd(RS1)
					NOISY(RS2_r)	FBS(RS2_m)	Shrkr(RS2_m)	Clpd(RS2_m)
					NOISY(RS2_n)	FBS(RS2_r)	Shrkr(RS2_r)	Clpd(RS2_r)

NOISY(RS2_p)	FBS(RS2_n)	Shrk(RS2_n)	Clpd(RS2_n)
NOISY(RS2)	FBS(RS2_p)	Shrk(RS2_p)	Clpd(RS2_p)
NOISY(RS3_m)	FBS(RS2)	Shrk(RS2)	Clpd(RS2)
NOISY(RS3_r)	FBS(RS3_m)	Shrk(RS3_m)	Clpd(RS3_m)
NOISY(RS3_n)	FBS(RS3_r)	Shrk(RS3_r)	Clpd(RS3_r)
NOISY(RS3_p)	FBS(RS3_n)	Shrk(RS3_n)	Clpd(RS3_n)
NOISY(RS3)	FBS(RS3_p)	Shrk(RS3_p)	Clpd(RS3_p)
NOISY(LF1)	FBS(RS3)	Shrk(RS3)	Clpd(RS3)
NOISY(LF2)	FBS(LF1)	Shrk(LF1)	Clpd(LF1)
NOISY(LF3)	FBS(LF2)	Shrk(LF2)	Clpd(LF2)
NOISY(4)	FBS(LF3)	Shrk(LF3)	Clpd(LF3)
	FBS(4)	Shrk(4)	Clpd(4)

TADS

The TADS acoustic detection device records audio from a train passing and produces train and axle-based files with three main descriptors: Defect, Rank, and Type. This data summary uses those descriptors as the vehicle for data exchange with the industry.

Goals of the data summary include:

- 1) Data summaries are only opened with a high confidence in a rolling surface fault.
- 2) Data summaries are to contain information suitable for prioritizing bearing removals.
- 3) Data summaries are to contain information suitable for indicating: remediation of a problem (support for autoclose) or a data integrity error that led to a false opening.

Descriptors:

Defect: A yes/no field that existence of a defect based on the contents of the type field.

Defect Rank: The ranking of the detector defect. Values range 1-5, generated whenever a valid pass has been processed without error.

Defect Type: The type of the bearing defect. Type includes CUP, CONE, ROLLER, MULTIPLE, UNKNOWN, AND GROWLER.

Defect Common Names

The defect common names will be determined by the following map.

Common Name	RailBAM	TADS
LAS (large area spall)	Suffix _e	GROWLER
Multiple	Suffix _m	MULTIPLE
Roller	Suffix _r	ROLLER
Cup	Suffix _p	CUP
Cone	Suffix _n	CONE
Unclear	RS1, RS2, RS3	UNKNOWN
No defect	4	null value