

Data Summary: RailBAM

Table of Contents

Synopsis	2
Purpose	2
Background	2
Data Summary Elements	4
Data Summary Roll Up Example	10
Opening Criteria	12
Closing / Reset Criteria	12
Additional Information	12
Appendix A - EHMS Display Information	13

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Synopsis

Purpose

The RailBAM Data Summary is used to identify internal wheel bearing defects before reaching an industry condemnable level for the purpose of preventative maintenance planning.

Background

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), Shrk (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.

<u>Suffixes</u>: _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)	Shrk(RS1_e)	Clpd(RS1_e)
RS1_m	RS2_r	RS3_r	LF2	WHLFLT2	NOISY(RS1_r)	FBS(RS1_m)	Shrk(RS1_m)	Clpd(RS1_m)
RS1_r	RS2_n	RS3_n	LF3		NOISY(RS1_n)	FBS(RS1_r)	Shrk(RS1_r)	Clpd(RS1_r)
RS1_n	RS2_p	RS3_p			NOISY(RS1_p)	FBS(RS1_n)	Shrk(RS1_n)	Clpd(RS1_n)
RS1_p	RS2	RS3			NOISY(RS1)	FBS(RS1_p)	Shrk(RS1_p)	Clpd(RS1_p)
RS1					NOISY(RS2_m)	FBS(RS1)	Shrk(RS1)	Clpd(RS1)
					NOISY(RS2_r)	FBS(RS2_m)	Shrk(RS2_m)	Clpd(RS2_m)
					NOISY(RS2_n)	FBS(RS2_r)	Shrk(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)

Data Summary Elements

Note that there are duplicate sets of elements for detector reads. The first set includes reads from both validated and non-validated detectors. The second set contains reads from validated detectors only. The second set of elements are responsible for opening acoustic bearing detector (ABD) alerts.

	Element Name	Element Text	Element Description	Format	Aggregation Method	Action
	Туре	Туре		TEXT		
	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, including when it is opened.
ER	DSType	Type of Data Summary	Data summary type	TEXT		
HEAD	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 - 99999999999]		
	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		

Element Name	Element Text	Element Description	Format	Aggregation Method	Action
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
The following eleme	nts are populated with	n values from both validated and non-	validated dete	ctors.	
OPENING_FULL_ DESCRIPTOR	Descriptor of read that opened DS	Full descriptor of the reading that opened the data summary in the format (PREFIX)(TYPE)(LEVEL) (SUFFIX). Examples: RS1_e, RS2_n	TEXT	Earliest	Update only when data summary is opened
LAST_FULL_ DESCRIPTOR	Descriptor of latest read	Full descriptor of the last reading in the format (PREFIX)(TYPE)(LEVEL) (SUFFIX). Examples: NOISYRS3, RS1_e, LF1	TEXT	Last	Update for each read, except when level is null.
CNT_RAILBAM_READS	Total RailBAM reads	Count of all RailBAM reads where the data summary was updated	NUMBER [0-999]	Sum	Update count for each read, except when level is null.
CNT_RS1_without_ SFFX	Total fault type RS level 1 reads without a suffix	Count of readings where the fault type is RS, the level is 1, no suffix is present, and with or without any prefix	NUMBER [0-999]	Sum	Update count when fault type is RS, level is 1, there is no SUFFIX, and with or without any of the PREFIXES
CNT_RS2_without_ SFFX	Total fault type RS level 2 reads without a suffix	Count of readings where the fault type is RS, the level is 2, no suffix is present, and with or without any prefix	NUMBER [0-999]	Sum	Update count when fault type is RS, level is 2, there is no SUFFIX, and with or without any of the PREFIXES
CNT_RS3_without_ SFFX	Total fault type RS level 3 reads without a suffix	Count of readings where the fault type is RS, the level is 3, no suffix is present, and with or without any prefix	NUMBER [0-999]	Sum	Update count when fault type is RS, level is 3, there is no SUFFIX, and with or without any of the PREFIXES
CNT_RS1	Total fault type RS level 1 reads	Count of readings where the fault type is RS and the level is 1. All prefix and suffix values are included.	NUMBER [0-999]	Sum	Update count when fault type is RS, level is 1, with or without any of the PREFIXES and SUFFIXES.
CNT_RS2	Total fault type RS level 2 reads	Count of readings where the fault type is RS and the level is 2. All prefix and suffix values are included.	NUMBER [0-999]	Sum	Update count when fault type is RS, level is 2, with or without any of the PREFIXES and SUFFIXES.
CNT_RS3	Total fault type RS level 3 reads	Count of readings where the fault type is RS and the level is 3. All prefix and suffix values are included.	NUMBER [0-999]	Sum	Update count when fault type is RS, level is 3, with or without any of the PREFIXES and SUFFIXES.

Element Name	Element Text	Element Description	Format	Aggregation Method	Action
CNT_RS_with_SFFX_e	Total fault type RS reads with extended faults	Count of readings where the fault type is RS, the level is 1, 2, or 3, with extended faults, and with or without any prefix	NUMBER [0-999]	Sum	Update count when fault type is RS, SUFFIX is _e (extended faults), level is 1 or 2 or 3 and with or without any of the PREFIXES. The count will not update if level is 4.
CNT_RS_with_SFFX_m	Total fault type RS reads with multiple faults	Count of readings where the fault type is RS, the level is 1, 2, or 3, with multiple faults, and with or without any prefix	NUMBER [0-999]	Sum	Update count when fault type is RS, SUFFIX is _m (multiple faults), level is 1 or 2 or 3 and with or without any of the PREFIXES. The count will not update if level is 4.
CNT_RS_with_SFFX_r	Total fault type RS reads with clear roller faults	Count of readings where the fault type is RS, the level is 1, 2, or 3, with clear roller faults, and with or without any prefix	NUMBER [0-999]	Sum	Update count when fault type is RS, SUFFIX is _r (clear roller faults), level is 1 or 2 or 3 and with or without any of the PREFIXES. The count will not update if level is 4.
CNT_RS_with_SFFX_n	Total fault type RS reads with clear cone faults	Count of readings where the fault type is RS, the level is 1, 2, or 3, with clear cone faults, and with or without any prefix	NUMBER [0-999]	Sum	Update count when fault type is RS, SUFFIX is _n (clear cone faults), level is 1 or 2 or 3 and with or without any of the PREFIXES. The count will not update if level is 4.
CNT_RS_with_SFFX_p	Total fault type RS reads with clear cup faults	Count of readings where the fault type is RS, the level is 1, 2, or 3, with clear cup faults, and with or without any prefix	NUMBER [0-999]	Sum	Update count when fault type is RS, SUFFIX is _p (clear cup faults), level is 1 or 2 or 3 and with or without any of the PREFIXES. The count will not update if level is 4.
CNT_RS_with_SFFX_s	Total fault type RS reads with extended faults	Count of readings where the fault type is RS, the level is 1, 2, or 3, with extended faults, and with or without any prefix	NUMBER [0-999]	Sum	Update count when fault type is RS, SUFFIX is _s (extended faults), level is 1 or 2 or 3 and with or without any of the PREFIXES. The count will not update if level is 4.
MAX_SEVERITY_SFFX_e	Highest severity of extended faults	Mininum severity number of extended faults	INTEGER [1-4]	Minimum	Updated on defect
MAX_SEVERITY_SFFX_m	Highest severity of multiple faults	Mininum severity number of multiple faults	INTEGER [1-4]	Minimum	Updated on defect

Element Name	Element Text	Element Description	Format	Aggregation Method	Action
MAX_SEVERITY_SFFX_r	Highest severity of roller faults	Mininum severity number of roller faults	INTEGER [1 – 4]	Minimum	Updated on defect
MAX_SEVERITY_SFFX_n	Highest severity of cone faults	Mininum severity number of Cone faults	INTEGER [1 – 4]	Minimum	Updated on defect
MAX_SEVERITY_SFFX_p	Highest severity of cup faults	Mininum severity number of cup faults	INTEGER [1 – 4]	Minimum	Updated on defect
MAX_SEVERITY_SFFX_s	Highest severity of unclear faults	Mininum severity number of unclear faults	INTEGER [1 – 4]	Minimum	Updated on defect
The following eleme	ents are populated with	n values from validated detectors only			
OPENING_FULL_ DESCRIPTOR_VALID	Descriptor of read that opened DS	Full descriptor of the reading that opened the data summary in the format (PREFIX)(TYPE)(LEVEL) (SUFFIX). Examples: RS1_e, RS2_n	TEXT	Earliest	Update only when data summary is opened
LAST_FULL_ DESCRIPTOR_VALID	Descriptor of latest read	Full descriptor of the last reading in the format (PREFIX)(TYPE)(LEVEL) (SUFFIX). Examples: NOISYRS3, RS1_e, LF1	TEXT	Last	Update for each read, except when level is null.
CNT_RAILBAM_ READS_VALID	Total RailBAM reads	Count of all RailBAM reads where the data summary was updated	NUMBER [0 – 999]	Sum	Update count for each read, except when level is null.
CNT_RS1_without_ SFFX_VALID	Total fault type RS level 1 reads without a suffix	Count of readings where the fault type is RS, the level is 1, no suffix is present, and with or without any prefix	NUMBER [0 – 999]	Sum	Update count when fault type is RS, level is 1, there is no SUFFIX, and with or without any of the PREFIXES
CNT_RS2_without_ SFFX_VALID	Total fault type RS level 2 reads without a suffix	Count of readings where the fault type is RS, the level is 2, no suffix is present, and with or without any prefix	NUMBER [0 – 999]	Sum	Update count when fault type is RS, level is 2, there is no SUFFIX, and with or without any of the PREFIXES
CNT_RS3_without_ SFFX_VALID	Total fault type RS level 3 reads without a suffix	Count of readings where the fault type is RS, the level is 3, no suffix is present, and with or without any prefix	NUMBER [0 – 999]	Sum	Update count when fault type is RS, level is 3, there is no SUFFIX, and with or without any of the PREFIXES
CNT_RS1_VALID	Total fault type RS level 1 reads	Count of readings where the fault type is RS and the level is 1. All prefix and suffix values are included.	NUMBER [0 – 999]	Sum	Update count when fault type is RS, level is 1, with or without any of the PREFIXES and SUFFIXES.
CNT_RS2_VALID	Total fault type RS level 2 reads	Count of readings where the fault type is RS and the level is 2. All prefix and suffix values are included.	NUMBER [0 – 999]	Sum	Update count when fault type is RS, level is 2, with or without any of the PREFIXES and SUFFIXES.

Element Name	Element Text	Element Description	Format	Aggregation Method	Action
CNT_RS3_VALID	Total fault type RS level 3 reads	Count of readings where the fault type is RS and the level is 3. All prefix and suffix values are included.	NUMBER [0 – 999]	Sum	Update count when fault type is RS, level is 3, with or without any of the PREFIXES and SUFFIXES.
CNT_RS_with_SFFX_ e_VALID	Total fault type RS reads with extended faults	Count of readings where the fault type is RS, the level is 1, 2, or 3, with extended faults, and with or without any prefix	NUMBER [0 – 999]	Sum	Update count when fault type is RS, SUFFIX is _e (extended faults), level is 1 or 2 or 3 and with or without any of the PREFIXES. The count will not update if level is 4.
CNT_RS_with_SFFX_m _VALID	Total fault type RS reads with multiple faults	Count of readings where the fault type is RS, the level is 1, 2, or 3, with multiple faults, and with or without any prefix	NUMBER [0 – 999]	Sum	Update count when fault type is RS, SUFFIX is _m (multiple faults), level is 1 or 2 or 3 and with or without any of the PREFIXES. The count will not update if level is 4.
CNT_RS_with_SFFX_ r_VALID	Total fault type RS reads with clear roller faults	Count of readings where the fault type is RS, the level is 1, 2, or 3, with clear roller faults, and with or without any prefix	NUMBER [0 – 999]	Sum	Update count when fault type is RS, SUFFIX is _r (clear roller faults), level is 1 or 2 or 3 and with or without any of the PREFIXES. The count will not update if level is 4.
CNT_RS_with_SFFX_ n_VALID	Total fault type RS reads with clear cone faults	Count of readings where the fault type is RS, the level is 1, 2, or 3, with clear cone faults, and with or without any prefix	NUMBER [0 – 999]	Sum	Update count when fault type is RS, SUFFIX is _n (clear cone faults), level is 1 or 2 or 3 and with or without any of the PREFIXES. The count will not update if level is 4.
CNT_RS_with_SFFX_ p_VALID	Total fault type RS reads with clear cup faults	Count of readings where the fault type is RS, the level is 1, 2, or 3, with clear cup faults, and with or without any prefix	NUMBER [0 – 999]	Sum	Update count when fault type is RS, SUFFIX is _p (clear cup faults), level is 1 or 2 or 3 and with or without any of the PREFIXES. The count will not update if level is 4.
CNT_RS_with_SFFX_ s_VALID	Total fault type RS reads with extended faults	Count of readings where the fault type is RS, the level is 1, 2, or 3, with extended faults, and with or without any prefix	NUMBER [0 – 999]	Sum	Update count when fault type is RS, SUFFIX is _s (extended faults), level is 1 or 2 or 3 and with or without any of the PREFIXES. The count will not update if level is 4.
MAX_SEVERITY_SFFX_ e_VALID	Highest severity of extended faults	Mininum severity number of extended faults	INTEGER [1 – 4]	Minimum	Updated on defect

Element Name	Element Text	Element Description	Format	Aggregation Method	Action
MAX_SEVERITY_SFFX_ m_VALID	Highest severity of multiple faults	Mininum severity number of multiple faults	INTEGER [1 – 4]	Minimum	Updated on defect
MAX_SEVERITY_SFFX_ r_VALID	Highest severity of roller faults	Mininum severity number of roller faults	INTEGER [1 – 4]	Minimum	Updated on defect
MAX_SEVERITY_SFFX_ n_VALID	Highest severity of cone faults	Mininum severity number of Cone faults	INTEGER [1 – 4]	Minimum	Updated on defect
MAX_SEVERITY_SFFX_ p_VALID	Highest severity of cup faults	Mininum severity number of cup faults	INTEGER [1 – 4]	Minimum	Updated on defect
MAX_SEVERITY_SFFX_ s_VALID	Highest severity of unclear faults	Mininum severity number of unclear faults	INTEGER [1 – 4]	Minimum	Updated on defect
The following eleme	ents indicate whether a	autoclose is in progress.			
LAST_TMST_with_ PROBLEM	Date of last problem read	GMT time stamp and the time zone offset of the originating data location for the last reading that had a severity level 1, 2, or 3.	TIMESTAMP	Last	Update date if severity level <= 3
TMST_1_without_ PROBLEM	Date of last good read	GMT time stamp and the time zone offset of the originating data location for a reading that had a severity level 4.	TIMESTAMP	Last	Update date if severity level is 4, and move other good reading timestamps down 1 position
TMST_2_without_ PROBLEMDate of 2 nd to last good read		GMT time stamp and the time zone offset of the originating data location for a reading that had a severity level 4.	TIMESTAMP	Last	Update date if severity level is 4, and move other good reading timestamps down 1 position
TMST_3_without_ PROBLEM	Date of 3 rd to last good read	GMT time stamp and the time zone offset of the originating data location for a reading that had a severity level 4.	TIMESTAMP	Last	Update date if severity level is 4, and move other good reading timestamps down 1 position
TMST_4_without_ PROBLEM	Date of 4 th to last good read	GMT time stamp and the time zone offset of the originating data location for a reading that had a severity level 4.	TIMESTAMP	Last	Update date if severity level is 4, and move other good reading timestamps down 1 position
TMST_5_without_ PROBLEM	Date of 5 th to last good read	GMT time stamp and the time zone offset of the originating data location for a reading that had a severity level 4.	TIMESTAMP	Last	Update date if severity level is 4, and move other good reading timestamps down 1 position

Data Summary Roll Up Example

	Element Name	Aggregation	RR1	RR2	RR3
	Туре	DS	DS	DS	DS
	Format Version	1	1	1	1
	CreationTMST	2010-01-24T09:57:40-05:00	2010-01-24T09:57:40-05:00	2010-01-25T10:57:40-05:00	2010-01-26T11:57:40-05:00
	RR_DB_Key		772762	657646	346545
	LastUpdateTMST	2010-02-02T15:12:00-05:00	2010-01-31T13:12:00-05:00	2010-02-01T14:12:00-05:00	2010-02-02T15:12:00-05:00
	DSType	Acoustic RailBAM	Acoustic RailBAM	Acoustic RailBAM	Acoustic RailBAM
	DS_Owner/Reporting_System		RR1	RR2	RR3
DER	EquipmentMark	CSXT	CSXT	CSXT	CSXT
НЕА	EquipmentNumber	610555	610555	610555	610555
	Location				
	ComponentType	BEARING	BEARING	BEARING	BEARING
	ComponentName	AXLE	AXLE	AXLE	AXLE
	ComponentValue	4	4	4	4
	ComponentName	SIDE	SIDE	SIDE	SIDE
	ComponentValue	L	L	L	L
	State	0	0	0	0
	OPENING_FULL_DESCRIPTOR	RS2_n	RS2_n	RS2_n	RS2_n
	LAST_FULL_DESCRIPTOR				
	CNT_RAILBAM_READS	6	3	1	2
	CNT_RS1_without_SFFX	0	0	0	0
	CNT_RS2_without_SFFX	0	0	0	0
	CNT_RS3_without_SFFX	0	0	0	0
NTS	LAST_TMST_with_PROBLEM	2010-01-26T11:57:40-05:00	2010-01-24T09:57:40-05:00	2010-01-25T10:57:40-05:00	2010-01-26T11:57:40-05:00
EME	TMST_1_without_PROBLEM				
ELE	TMST_2_without_PROBLEM				
	TMST_3_without_PROBLEM				
	TMST_4_without_PROBLEM				
	TMST_5_without_PROBLEM				
	CNT_RS1	0	0	0	0
	CNT_RS2	3	1	1	1
	CNT_RS3	0	0	0	0

RailBAM Data Summary

Element Name	Aggregation	RR1	RR2	RR3
CNT_RS_with_SFFX_e	0	0	0	0
CNT_RS_with_SFFX_m	0	0	0	0
CNT_RS_with_SFFX_r	0	0	0	0
CNT_RS_with_SFFX_n	3	1	1	1
CNT_RS_with_SFFX_p	0	0	0	0
CNT_RS_with_SFFX_s	0	0	0	0

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) All of the following conditions are met:
 - 1. BEARING_FAULT_SEVR_PREFIX must not have a value
 - 2. BEARING_FAULT_SEVR_CATE must be RS
 - 3. BEARING_FAULT_SEVR_LEVEL must be 2 or 1 (1 being the most severe)
 - 4. BEARING_FAULT_SEVR_DESC must have a value
- b) Another data summary creator has an open data summary for that asset and location

Closing / Reset 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 UMLER system.
- c) Autoclose logic: Five sequential reads without problem (for any open data summaries on a bearing). A problem is defined as a read that has a severity level of 1, 2, or 3. A good reading is defined as a reading that has a severity level of 4. If there exists 5 consecutive timestamps *after* the last timestamp with problem, a close message will be published effecting a close of all data summaries for that bearing.

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 #

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

"Prefix" must not have a value, "Fault Type" must be RS, "Severity Level" must be 1 or 2 and "Descriptor" must have a value.

Autoclose Display Text

Five sequential reads with a severity level of 4.