



Data Summary: Brake Health Truck

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Synopsis

Purpose

The Brake Health Truck data summary provides information on freight car braking effectiveness at the truck level using performance-based data from wheel temperature detector (WTD) systems.

Background

Wheel temperature detectors use mature infrared sensor technology to measure the rise in wheel temperatures as a result of a brake application on a moving train. Identifying wheels that are relatively cold compared to the temperature of other wheels in the train may indicate abnormal braking conditions.

The Inspection Quality system uses algorithms on train passings by a wheel temperature detector to determine if the train is in a braking condition. Determining if a train is braking requires both a function of “data scatter” and a minimum train-based temperature. The algorithm defined to establish the braking state includes the following:

- Interquartile Range (IQR) ≥ 50 °F
- Median at lower 95% confidence interval (LCL) ≥ 100 °F

If the algorithms determine that the train is braking, additional calculations are performed and are referred to as Brake Performance Tests (BPT). A wheel temperature ratio is calculated for each wheel. It represents the actual wheel temperature divided by the predicted wheel temperature from the third-order polynomial algorithm evaluated as a function of each rail. When the average of all the individual wheel temperature ratios for the truck is greater than or equal to the industry-defined threshold, the truck passes the Brake Performance Test.

The Brake Health Truck data summary identifies passings where the average truck ratio is greater or less than the industry-defined threshold.

Based on the number of timestamps of BPTs greater than or equal to the industry-defined threshold versus BPTs less than the industry-defined threshold, the system determines the Brake Health Indicator (BHI) for the truck component. The BHIs used are described in [“Appendix B – Brake Health Indicator Rules and Definitions”](#) on page 9.

Data Summary Elements

	Element Name	Element Text	Element Description	Format	Aggregation Method	Action
HEADER	Type	Type	Data Summary	TEXT		
	Format Version	Format Version	Version of the data summary definition	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
	DSType	Brake Health	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 [0-9999999999]		
	Location	Location	Location on equipment per EMIS nomenclature			
	ComponentType	Component type	TRUCK	TEXT		
	ComponentName	Part of the component location	TRUCK	TEXT		
	ComponentValue	Value for the component location		TEXT		
State	Data Summary state	Current status of Open	TEXT			
ELEMENTS	LAST_BPT_IN_BRAKING_CONDITION_TMST	Date of last BPT when train braking	Timestamp of the last Brake Performance Test when the train was in a braking condition	TIMESTAMP	LATEST	Update date when the train is in a braking condition
	LAST_ABT_DATE	Latest ABT Date	Latest ABT Date	Date	LATEST	Update date when Single Car ABT is reported in Umler
	TMST_1_TRUCK_AVG_GE_TSHD	Last date when truck passed BPT	Last timestamp of when the Brake Performance Test indicated the truck passed the cold wheel evaluation	TIMESTAMP	AUTOCLOSE 2	Update date when the train is in a braking condition and the truck average wheel temperature ratio is greater than or equal to 0.3, and move other timestamps down one position.

	Element Name	Element Text	Element Description	Format	Aggregation Method	Action
ELEMENTS	TMST_2_TRUCK_AVG_GE_TSHD	Second-to-last date when truck passed BPT	Second-to-last timestamp of when the Brake Performance Test indicated the truck passed the cold wheel evaluation	TIMESTAMP	AUTOCLOSE 2	Update with previous position timestamp when the train is in a braking condition and the truck average wheel temperature ratio is greater than or equal to 0.3, and move other timestamps down one position.
	TMST_3_TRUCK_AVG_GE_TSHD	Third-to-last date when truck passed BPT	Third-to-last timestamp of when the Brake Performance Test indicated the truck passed the cold wheel evaluation	TIMESTAMP	AUTOCLOSE 2	Update with previous position timestamp when the train is in a braking condition and the truck average wheel temperature ratio is greater than or equal to 0.3, and move other timestamps down one position
	TMST_4_TRUCK_AVG_GE_TSHD	Fourth-to-last date when truck passed BPT	Fourth-to-last timestamp of when the Brake Performance Test indicated the truck passed the cold wheel evaluation	TIMESTAMP	AUTOCLOSE 2	Update with previous position timestamp when the train is in a braking condition and the truck average wheel temperature ratio is greater than or equal to 0.3, and move other timestamps down one position
	TMST_5_TRUCK_AVG_GE_TSHD	Fifth-to-last date when truck passed BPT	Fifth-to-last timestamp of when the Brake Performance Test indicated the truck passed the cold wheel evaluation	TIMESTAMP	AUTOCLOSE 2	Update with previous position timestamp when the train is in a braking condition and the truck average wheel temperature ratio is greater than or equal to 0.3
	TMST_1_TRUCK_AVG_LT_TSHD	Last date when truck failed BPT	Last timestamp of when the Brake Performance Test indicated the truck failed the cold wheel evaluation	TIMESTAMP	AUTOCLOSE 3	Update date when the train is in a braking condition and the truck average wheel temperature ratio is less than 0.3, and move other timestamps down one position
	TMST_2_TRUCK_AVG_LT_TSHD	Second-to-last date when truck failed BPT	Second-to-last timestamp of when the Brake Performance Test indicated the truck failed the cold wheel evaluation	TIMESTAMP	AUTOCLOSE 3	Update with previous position timestamp when the train is in a braking condition and the truck average wheel temperature ratio is less than 0.3, and move other timestamps down one position
	TMST_3_TRUCK_AVG_LT_TSHD	Third-to-last date when truck failed BPT	Third-to-last timestamp of when the Brake Performance Test indicated the truck failed the cold wheel evaluation	TIMESTAMP	AUTOCLOSE 3	Update with previous position timestamp when the train is in a braking condition and the truck average wheel temperature ratio is less than 0.3, and move other timestamps down one position

	Element Name	Element Text	Element Description	Format	Aggregation Method	Action
ELEMENTS	TMST_4_TRUCK_AVG_LT_TSHD	Fourth-to-last date when truck failed BPT	Fourth-to-last timestamp of when the Brake Performance Test indicated the truck failed the cold wheel evaluation	TIMESTAMP	AUOCLOSE 3	Update with previous position timestamp when the train is in a braking condition and the truck average wheel temperature ratio is less than 0.3, and move other timestamps down one position
	TMST_5_TRUCK_AVG_LT_TSHD	Fifth-to-last date when truck failed BPT	Fifth-to-last timestamp of when the Brake Performance Test indicated the truck failed the cold wheel evaluation	TIMESTAMP	AUOCLOSE 3	Update with previous position timestamp when the train is in a braking condition and the truck average wheel temperature ratio is less than 0.3, and move other timestamps down one position
	TMST_6_TRUCK_AVG_LT_TSHD	Sixth-to-last date when truck failed BPT	Sixth-to-last timestamp of when the Brake Performance Test indicateone truck failed the cold wheel evaluation	TIMESTAMP	AUOCLOSE 3	Update with previous position timestamp when the train is in a braking condition and the truck average wheel temperature ratio is less than 0.3
	BHI	Truck Level Brake Health Indicator	Truck Level Brake Health Indicator	NUMBER	MAX	Update each time a new BPT is added to the data summary.

Data Summary Roll Up Example

	Element Name	Aggregation	RR1	RR2	RR3
HEADER	Tvøe	DS	DS	DS	DS
	Format Version	1	1	1	1
	CreationTMST	2013-01-24T09:57:40-05:00	2013-01-24T09:57:40-05:00	2013-01-25T10:57:40-05:00	2013-01-26T11:57:40-05:00
	RR_DB_Key		772762	657646	346545
	LastUpdateTMST	2013-02-02T15:12:00-05:00	2013-01-31T13:12:00-05:00	2013-02-01T14:12:00-05:00	2013-02-02T15:12:00-05:00
	DSType	Brake Health	Brake Health	Brake Health	Brake Health
	DS_Owner/Reporting_System		RR1	RR2	RR3
	EquipmentMark	CSXT	CSXT	CSXT	CSXT
	EquipmentNumber	610555	610555	610555	610555
	Location				
	ComponentType	TRUCK	TRUCK	TRUCK	TRUCK
	ComponentName	TRUCK	TRUCK	TRUCK	TRUCK
	ComponentValue	A	A	A	A
	State	O	O	O	O
ELEMENTS	LAST_BPT_IN_BRAKING_CONDITION_TMST	2014-04-20T10:05:10-05:00	2014-04-02T10:05:10-05:00	2014-04-15T10:05:10-05:00	2014-04-20T10:05:10-05:00
	LAST_ABT_DATE	10-27-2014		10-27-2014	
	TMST_1_TRUCK_AVG_GE_TSHD	2014-04-12T10:05:10-05:00	2014-04-02T10:05:10-05:00	2014-04-12T10:05:10-05:00	
	TMST_2_TRUCK_AVG_GE_TSHD	2014-04-02T10:05:10-05:00	2014-03-28T10:05:10-05:00	2014-04-01T10:05:10-05:00	
	TMST_3_TRUCK_AVG_GE_TSHD	2014-04-01T10:05:10-05:00	2014-03-16T10:05:10-05:00	2014-03-26T10:05:10-05:00	
	TMST_4_TRUCK_AVG_GE_TSHD	2014-03-28T10:05:10-05:00	2014-03-01T10:05:10-05:00		
	TMST_5_TRUCK_AVG_GE_TSHD	2014-03-26T10:05:10-05:00	2014-02-22T10:05:10-05:00		
	TMST_1_TRUCK_AVG_LT_TSHD	2014-04-20T10:05:10-05:00		2014-04-10T10:05:10-05:00	2014-04-20T10:05:10-05:00
	TMST_2_TRUCK_AVG_LT_TSHD	2014-04-10T10:05:10-05:00		2014-04-03T10:05:10-05:00	2014-03-29T10:05:10-05:00
	TMST_3_TRUCK_AVG_LT_TSHD	2014-04-03T10:05:10-05:00			2014-03-27T10:05:10-05:00
	TMST_4_TRUCK_AVG_LT_TSHD	2014-03-29T10:05:10-05:00			
	TMST_5_TRUCK_AVG_LT_TSHD	2014-03-27T10:05:10-05:00			
	TMST_6_TRUCK_AVG_LT_TSHD				
	BHI	1	1		

Opening Criteria

A new Brake Health Truck data summary will be created for equipment if a Brake Health Truck data summary does not already exist for the asset and location and a Brake Performance Test is performed.

Closing / Reset Criteria

A Brake Health Truck data summary does not close from data reads. Once opened, the data summary continues to aggregate passing timestamps from Brake Performance Tests. A data summary will close for the following administrative actions:

- Close condition: deleted in UMLER. Message must come from UMLER system.
- Close condition: 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.

Additional Information

Note: TMST_n_TRUCK_AVG_GE_TSHD and TMST_n_TRUCK_AVG_LT_TSHD are cascaded (when a more recent one is found, it takes #1 position and #1 moves to #2, etc.). Once all timestamps for a group are populated, the oldest timestamp for that group rolls off.

Appendix A – EHMS Display Information

Opening Criteria Display Text

Any wheel temperature detector passing when train is in a braking condition.

Reset Display Text

A Brake Health Truck data summary shall always remain open.

Appendix B – Brake Health Indicator Rules and Definitions

The Brake Health Indicator (BHI) is an index used to identify the effectiveness of brakes on a car from wheel temperature readings. The BHI shall be displayed on the truck level as well as car level. The car-level BHI is a summarization of truck-level BHIs.

The system shall determine the BHI for the truck component from the number of timestamps of BPTs greater than or equal to the industry defined threshold vs. BPTs less than the industry defined threshold. ABT reportings are also used in the calculation of the BHI.

The Brake Health Truck data summary uses the following definitions:

Term	Definition
Passed BPT	The average of all the individual wheel temperature ratios for the truck during a passing where the train is braking is greater than or equal to the industry defined threshold.
Failed BPT	The average of all the individual wheel temperature ratios for the truck during a passing where the train is braking is less than the industry defined threshold.
Reset	An ABT followed by a passed BPT <i>or</i> five sequential passed BPTs.

The following BHIs are used:

BHI	Category	Description
1	Qualified	No failed BPTs since last ABT & last passed BPT train passing is later than ABT, OR all BPTs passed and <10,000 miles since last passing.
5	Non-ABT Qualified	Last 5 BPTs passed and <10,000 miles since last passing, but it does not meet criteria for BHI 1
6	ABT Unverified	An ABT was reported since last BPT & it does not meet criteria for BHI 1 or 5.
7	ABT Unverified:Over 10k miles	No failed BPTs since last ABT & last passed BPT train passing is later than ABT, OR all BPTs passed and >= 10,000 miles since last passing
8	ABT Unverified:Over 10k miles	Last 5 BPTs passed and and >= 10,000 miles since last passing
15	1 Threshold Hit	Last BPT failed and (only 1 failed BPT since last reset or only one failed BPT exists if no reset exists)
14	1 Threshold Hit Plus 1 passed BPT	Last BPT passed and (only 1 failed BPT since last reset or only one failed BPT exists if no reset exists)
13	1 Threshold Hit Plus 2 passed BPTs	Last two BPTs passed and (only 1 failed BPT since last reset or only one failed BPT exists if no reset exists)
12	1 Threshold Hit Plus 3 passed BPTs	Last three BPTs passed and (only 1 failed BPT since last reset or only one failed BPT exists if no reset exists)

BHI	Category	Description
11	1 Threshold Hit Plus 4 passed BPTs	Last four BPTs passed and (only 1 failed BPT since last reset or only one failed BPT exists if no reset exists)
25	2 Threshold Hit	Last BPT failed and (only 2 failed BPTs since last reset or only two failed BPTs exists if no reset exists)
24	2 Threshold Hit Plus 1 passed BPT	Last BPT passed and (only 2 failed BPTs since last reset or only two failed BPTs exists if no reset exists)
23	2 Threshold Hit Plus 2 passed BPTs	Last two BPTs passed and (only 2 failed BPTs since last reset or only two failed BPTs exists if no reset exists)
22	2 Threshold Hit Plus 3 passed BPTs	Last three readings are passed BPTs and (only 2 failed BPTs since last reset or only two failed BPTs exists if no reset exists)
21	2 Threshold Hit Plus 4 passed BPTs	Last four BPTs passed and (only 2 failed BPT since last reset or only two failed BPTs exists if no reset exists)
35	3 Threshold Hit	Last BPT failed and (only 3 failed BPTs since last reset or only three failed BPTs exists if no reset exists)
34	3 Threshold Hit Plus 1 passed BPT	Last BPT passed and (only 3 failed BPTs since last reset or only three failed BPTs exists if no reset exists)
33	3 Threshold Hit Plus 2 passed BPTs	Last two BPTs passed and (only 3 failed BPTs since last reset or only three failed BPTs exists if no reset exists)
32	3 Threshold Hit Plus 3 passed BPTs	Last three BPTs passed and (only 3 failed BPTs since last reset or only three failed BPTs exists if no reset exists)
31	3 Threshold Hit Plus 4 passed BPTs	Last four BPTs passed and (only 3 failed BPT since last reset or only three failed BPTs exists if no reset exists)
45	4 Threshold Hit	Last BPT failed and (only 4 failed BPTs since last reset or only four failed BPTs exists if no reset exists)
44	4 Threshold Hit Plus 1 passed BPT	Last BPT passed and (only 4 failed BPTs since last reset or only four failed BPTs exists if no reset exists)
43	4 Threshold Hit Plus 2 passed BPTs	Last two BPTs passed and (only 4 failed BPTs since last reset or only four failed BPTs exists if no reset exists)
42	4 Threshold Hit Plus 3 passed BPTs	Last three BPTs passed and (only 4 failed BPTs since last reset or only four failed BPTs exists if no reset exists)
41	4 Threshold Hit Plus 4 passed BPTs	Last four BPTs passed and (only 4 failed BPT since last reset or only four failed BPTs exists if no reset exists)
55	5 Threshold Hit	Last BPT failed and (only 5 failed BPTs since last reset or only five failed BPTs exists if no reset exists)
54	5 Threshold Hit Plus 1 passed BPT	Last BPT passed and (only 5 failed BPTs since last reset or only five failed BPTs exists if no reset exists)

BHI	Category	Description
53	5 Threshold Hit Plus 2 passed BPTs	Last two BPTs passed and (only 5 failed BPTs since last reset or only five failed BPTs exists if no reset exists)
52	5 Threshold Hit Plus 3 passed BPTs	Last three BPTs passed and (only 5 failed BPTs since last reset or only five failed BPTs exists if no reset exists)
51	5 Threshold Hit Plus 4 passed BPTs	Last four BPTs passed and (only 5 failed BPT since last reset or only five failed BPTs exists if no reset exists)
65	6 Threshold Hit	Last BPT failed and (only 6 failed BPTs since last reset or only six failed BPTs exists if no reset exists)
64	6 Threshold Hit Plus 1 passed BPT	Last BPT passed and (only 6 failed BPTs since last reset or only six failed BPTs exists if no reset exists)
63	6 Threshold Hit Plus 2 passed BPTs	Last two BPTs passed and (only 6 failed BPTs since last reset or only six failed BPTs exists if no reset exists)
62	6 Threshold Hit Plus 3 passed BPTs	Last three BPTs passed and (only 6 failed BPTs since last reset or only six failed BPTs exists if no reset exists)
61	6 Threshold Hit Plus 4 passed BPTs	Last four BPTs passed and (only 6 failed BPT since last reset or only six failed BPTs exists if no reset exists)
99	Unknown	Does not meet any other BHI definition