

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HUM INDUSTRIAL TECHNOLOGY, INC.

Petitioner

v.

AMSTED RAIL COMPANY, INC.

Patent Owner

Case IPR2023-00538

Patent No. 9,365,223

**PATENT OWNER'S MOTION TO AMEND
AND REQUEST FOR PRELIMINARY GUIDANCE**

Submitted Electronically via P-TACTS

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I. INTRODUCTION

Patent Owner, Amsted Rail Company, Inc. (“PO”), respectfully submits this Motion to Amend under 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121 contingent upon a finding of unpatentability with respect to the original challenged claims 1-10, 13-18, and 20-32 (the “Challenged Claims”) of U.S. Patent No. 9,365,223 (the “’223 Patent”) (Ex. 1001). PO requests that the Patent Trial and Appeal Board provide Preliminary Guidance in accordance with the pilot program. *See* 84 FR 9497 (March 15, 2019); *see also* Scheduling Order dated July 26, 2023, Paper No. 11, at 4-6 (section 6).

PO attaches the proposed substitute claims as Appendix A. Patent Owner proposes to substitute claims 1-10, 13-18, and 20-32 with claims 33 through 61, respectively. Substitute claims 33 through 61 include additional limitations not found in the prior art. The substitute claims are presented on a contingent basis in the event the Board finds that the original claims are unpatentable.

As this motion and the November 3, 2023 Declaration of Michael Shamos in support of Patent Owner’s Motion to Amend (Ex. 2158) ¶¶17-33 demonstrate, the substitute claims meet all of the requirements of 35 U.S.C. §316(d) and 37 C.F.R. §42.121. Namely, each amendment is responsive to a ground of unpatentability involved in this proceeding, none of the amendments seek to enlarge the scope of the claims or to introduce new subject matter, the amendment proposes a reasonable

number of substitute claims, and the motion shows the changes that are sought and the support in the original disclosure of the patent for each substitute claim.

Moreover, although the burden of persuasion with regard to unpatentability of the substitute claims is on Petitioner, *see Aqua Prods. v. Matal*, 872 F.3d 1290, 1296 (Fed. Cir. 2017) (*en banc*); *Bosch Automotive Serv. Solutions LLC v. Matal*, 878 F.3d 1027, 1040 (Fed. Cir. 2017), this motion and 2d Shamos Dec. submitted in support of this motion demonstrate that PO has met its burden under §42.121(d)(1) and that the substitute claims are patentable over the references of record in this trial involving the '223 Patent.

II. STATEMENT OF RELIEF REQUESTED

PO hereby moves to amend the '223 Patent contingent upon whether the Challenged Claims are found unpatentable in the present IPR proceeding. *See* 37 C.F.R. §42.121. If all Challenged Claims are found to be unpatentable, Patent Owner requests the Board order the following:

- The replacement of independent claim 1 with substitute claim 33;
- The replacement of independent claim 2 with substitute claim 34;
- The replacement of dependent claims 3-4 and 26-30 with substitute claims 35-41;
- The replacement of independent claim 5 with substitute claim 42;

- The replacement of dependent claims 6-10, 13-18, 20-22, and 31-32 with substitute claims 43-58;
- The replacement of independent claim 23 with substitute claim 59;
- The replacement of dependent claims 24-25 with substitute claims 60-61.

If Challenged Claims 1, 2, 5, or 23 are found unpatentable but any of dependent claims 3-4, 6-10, 13-18, 20-22, or 24-32 are found to be patentable, Patent Owner requests that the Board not substitute any such dependent claim, but order substitution of any of claims 3-4, 6-10, 13-18, 20-22, or 24-32 found to be unpatentable. No other changes are proposed. *See* 37 C.F.R. §42.22(a)(1); 35 U.S.C. §316(d).

III. THE SUBSTITUTE CLAIMS MEET ALL THE REQUIREMENTS OF 37 C.F.R. § 42.121

Under 35 U.S.C. §316(d)(1)(B), a patent owner may propose a reasonable number of substitute claims for each challenged claim. A patent owner must show that the amendment in the proposed substitute claims is responsive to a ground of unpatentability involved in the trial, does not seek to broaden a challenged claim, and is supported by the filed or earlier-filed disclosures. 35 U.S.C. §316(d)(3); 37 C.F.R. §42.121(a)(2). If a patent owner has met these statutory requirements, then the Board considers whether the substitute claims are unpatentable by a preponderance of the evidence, the burden of which a petitioner must establish. 35

U.S.C. §316(e); *Aqua Prods. Inc.*, 872 F.3d 1290, 1315; *Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 15 at 4-5 (Feb. 25, 2019) (precedential).

A. Reasonable Number of Substitute Claims

As shown in Appendix A, Patent Owner proposes only one substitute claim for each conditionally canceled claim and thus satisfies the general presumption that “only one substitute claim would be needed to replace each challenged claim.” 37 C.F.R. §42.121(a)(3).

B. The Proposed Claims Are Responsive to the Instituted Grounds

Substitute claims 33 through 61 are responsive to one or more grounds of unpatentability at issue in this proceeding. *See* 37 C.F.R. §42.121(a)(2)(i). Specifically, Petitioners have asserted that the prior art discloses the elements of original claims 1-10, 13-18, and 20-32, which this motion conditionally seeks to amend. (*See, e.g.*, Petition at 18-86). At least one added limitation in each substitute claim addresses a prior art ground at trial, as explained in more detail below.

C. The Proposed Claims Do Not Enlarge the Scope of the Original Claims

Proposed independent substitute claims 33, 34, 42, and 59 include additional limitations responsive to the instituted grounds that do not enlarge the scope of the claims. Instead, they further limit original independent claims 1, 2, 5, and 23.

Independent substitute claims 34 and 42 (corresponding to original claims 2 and 5, respectively) additionally recite at least one accelerometer configured to sample dynamic vibration data; calculating a numeric value based on the vibration data, wherein the calculated numeric value represents a condition of a bearing; and comparing the calculated numeric value with a plurality of defined parameter value ranges associated with the bearing, each of which represents one of a plurality of severity levels and from which a severity of the condition of the bearing can be determined.

Independent substitute claims 33 and 59 (corresponding to original claims 1 and 23, respectively) additionally recite a probe head external to the housing, the probe head including a temperature sensor electrically interfaced with a connector which is configured to connect to a corresponding electrical connector at the distal end of a cable whose proximal end is disposed in the housing.

IV. THE SUBSTITUTE CLAIMS DO NOT INTRODUCE NEW SUBJECT MATTER

The originally filed disclosure of the '223 Patent supports each proposed substitute claim. *See* 37 C.F.R. §42.121 (b)(1)-(2). The '223 patent issued from U.S. App. No. 13/842,427, filed on March 15, 2013 ("the '427 Application"), which claims priority to U.S. Provisional App. No. 61/661,661, filed on June 19, 2012 ("the '661 Prov. Application"). *See* Ex. 1001 at 1; Ex. 1013. U.S. App. No. 15/158,018 is

also a continuation-in-part of U.S. App. No. 12/861,713, filed on August 23, 2010 (“the ’713 Application”). Ex. 1014. Substitute claims 34-58 have a priority date of at least the provisional filing date, June 19, 2012. Claim 33 has a priority date of March 15, 2013. Patent Owner reserves the right to claim earlier priority based on prior invention should Petitioner raise new ¶102(a) or (e) art.

A. Claim 33 (Substitute for claim 1, if found unpatentable)

Claim Limitation	Support
1. <u>33</u> . A sensor device for monitoring temperature on a railcar, comprising:	Ex. 1001 at 3:14-16 (“It is another object to provide specific sensor applications, such as temperature sensors that can monitor the temperature of various components and items on the railcar.”); Ex. 1013 at ¶16.
a housing <u>providing a first piece mountable</u> on a railcar;	Ex. 1001 at 3:60-62 (“In a preferred embodiment of the invention, the sensors are contained and deployed in a self-contained housing which generally includes the sensor, long-life batteries, a processor board and communications unit.”); 5:30-31 (“the individual notes 10 are mounted on the areas of interest on a railcar 38.”); Ex. 1013 at ¶¶109, 115.
a temperature sensor;	Ex. 1001 at 6:16-19 (“the note 10 is constructed ... with the temperature sensor 20 positioned in a probe 48 spaced from the housing 14.”); Ex. 1013 at ¶109.
electrical circuitry in communication with said temperature sensor <u>via a cable</u> for obtaining information regarding the temperature being sensed, <u>wherein</u> said electrical circuitry <u>is positioned within said housing, and said cable has a proximal end disposed in the housing and a distal end residing external to said housing;</u>	Ex. 1001 at 6:29-33 (“A corresponding electrical connector 58 b connected to corresponding connector 58 a connects temperature sensor 20 via wire 52, preferably a flexible PVC coated cable 62, to the note housing 14.”); 4:66-5:2, Figs. 1, 5, 5A (“The circuitry 26 includes a main board 28 which includes the communications circuitry, antennae and microprocessor and a daughter board 30 including the circuitry to read the data from the sensor 10”); Ex. 1013 at ¶112, Figs. 8, 8A.

a power source electrically connected to said electrical circuitry ~~to~~ [[for]] provide[[ing]] power thereto, said power source positioned within said housing;	Ex. 1001 at 5:24-25 (“Mote 10 also includes a long-term power source 34, preferably a military grade lithium-thionyl chloride battery.”); Ex. 1013 at ¶113.
a probe <u>providing a second piece external to and separated from the first piece provided by said housing, said second piece and which probe comprising a sensor probe head that (i) is spaced apart from the housing, (ii) has a body formed of a heat conductive material, (iii) has a connector electrically interfaced with said temperature sensor and configured to connect to a corresponding electrical connector at the distal end of the cable and includes said temperature sensor, and (iv) has a magnet positioned in the body adjacent to a portion of the connector extending inside the body, the magnet configured to magnetically attract the part of the railcar against which the sensor probe head will be placed; and</u>	Ex. 1001 at 6:17-33 (“the temperature sensor 20 positioned in a probe 48 spaced from the housing 14. The temperature sensor 20 sits within a sensor probe head 50 electrically attached to the housing 14 via wires 52. ... Fitting within a head body opening 56 is the temperature sensor 20 electrically attached to an electrical connector 58 a. A ring shaped magnet 60 with an opening in its center fits around the sensor 20 within the head 50. ... A corresponding electrical connector 58 b connected to corresponding connector 58 a connects temperature sensor 20 via wire 52, preferably a flexible PVC coated cable 62, to the mote housing 14.”)
a communication device <u>configured to</u> ~~capable of~~ broadcast[[ing]] information regarding the temperature sensed, said communication device positioned within said housing;	Ex. 1001 at 3:60-63, Figs. 1-2 (“In a preferred embodiment of the invention, the sensors are contained and deployed in a self-contained housing which generally includes the sensor, long-life batteries, a processor board and communications unit.”); Ex. 1013 at ¶109, Figs 8, 8A.
wherein the power consumption of said sensor device is managed by placing said sensor device in a standby state and periodically awakening said sensor device to collect readings from said temperature sensor and to transmit the	Ex. 1001 at 5:24-29 (“Daughter board 30 includes power conditioning and management circuitry and may include a feature to conserve battery life which keeps mote 10 in a standby state and periodically wakes mote 10

information regarding the temperature sensed via said communication <u>device circuitry</u> .	to deliver readings from sensor 20.”); Ex. 1013 at ¶¶44-45.
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B. Claim 34 (Substitute for claim 2, if found unpatentable)

Claim Limitation		Support
2. <u>34. A system for monitoring a railcar, comprising:</u>	Ex. 1001 at 3:48-49 (“a novel means for monitoring the performance and operation of a railcar is provided.”); Ex. 1013 at ¶1.	
a plurality of sensor devices located on <u>and mounted to a sidewall of a bearing adapter of the railcar for monitoring parameters or conditions related to one or more components of the truck of the railcar</u> , each of said sensor devices being separate from one another and including a sensor for monitoring one of said parameters or conditions <u>related to one or more components of the truck of the railcar</u> ;		Ex. 1001 at 3:50-54 (“The sensors monitor and/or collect data on particular parameters and conditions of the railcar.”); 5:30-34, Fig. 3 (“The individual notes 10 are mounted on the areas of interest on a railcar 38. As an example, FIGS. 3 and 3A show a temperature sensing note ... mounted to a bearing adapter.”); Ex. 1013 at ¶¶109-119, FIGs. 9, 10a.
said plurality of sensor devices including at least one temperature sensor device having: a housing <u>comprising a non-flexible durable material for protecting components positioned therein</u> ;	Ex. 1001 at 4:5-10, Figs. 1-2 (“The note 10 has a housing 14 having a first or lid section 16 and a second or base section 18. Preferably, the housing sections 16 and 18 are composed of a hard plastic resistant to environmental damage, such as a UV rated polymer, e.g., a polycarbonate/ABS blend, and when fully assembled is weatherproof.”); Ex. 1013 at ¶109, Figs. 8, 8A.	
a temperature sensor in thermal communication with <u>an item the sidewall of the bearing adapter of the railcar for which the temperature is being monitored, which item is external to said housing; at least one accelerometer configured to sample dynamic vibration data corresponding to accelerations of one or more components of the railcar</u> ;		Ex. 1001 at 4:43-48 (“Sensor 20 can be any type of sensor, including for example, a temperature sensor, a pressure sensor, a load cell, a strain gauge, a hall effect sensor, a vibration sensor, an accelerometer, a gyroscope, a displacement sensor, an inductive sensor, a piezio [sic]

	resistive microphone or an ultrasonic sensor.”);
electrical circuitry in communication with said temperature sensor for obtaining information regarding the temperature <u>and the accelerations</u> being ~~sensed~~ <u>monitored</u>, said electrical circuitry positioned within said housing; a power source electrically connected to said electrical circuitry for providing power thereto, said power source positioned within said housing; a communication device capable of broadcasting information regarding the temperature <u>and the accelerations</u> sensed via wireless communication, said communication device positioned within said housing;	Ex. 1001 at 3:60-63, Figs. 1-2 (“In a preferred embodiment of the invention, the sensors are contained and deployed in a self-contained housing which generally includes the sensor, long-life batteries, a processor board and communications unit.”); Ex. 1013 at ¶109, Figs. 8, 8A.
<u>wherein said information comprises a calculated numeric value based on the dynamic vibration data sampled by the at least one accelerometer and representing a condition of a bearing</u>; and	Ex. 1001 at Table spanning cols. 7-12. (in particular “Bearing Temp.: Adapter temperature is correlated to bearing cup temperature using empirical data.”; “Bearing Fault: An adapter mounted accelerometer can be used to sample dynamic bearing data. Kurtosis can be computed as an indicator of bearing damage. Kurtosis is measured in the time domain and requires computation of a probability density function.”; “Bearing Fault: Sampled acoustic data can be used for either an acoustic noise response or Acoustic Emission which is ring-down counts and amplitude. Empirical data from defective bearings is needed.”); 11:39-47 (“Data collected from motes 10 may be sent to base station 44 for analysis and further action. The heuristics shown in the chart above may be performed by either mobile base station 42 or land-based base station 44.”); Ex. 1013 at ¶¶64-76
a communication management unit, mounted on the railcar, capable of two way wireless communication with each of said plurality of sensor devices for receiving information therefrom, said communication management unit having a wireless	Ex. 1001 at 2:55-58 (“Each railcar also can be equipped with a communication management unit (CMU) which communicates with each of the motes deployed on the railcar. The CMU is capable of wirelessly collecting data from each of the motes.”); 11:28-32 (“As shown in FIG. 6, CMU 32 also communicates data and alarms

communication device for broadcasting information about the parameter or condition being monitored <u>to a land-based remote station,</u>	to a remote location, either a mobile base station 42 located on the train, usually in the locomotive, or to a stationary, land-based base station 44, or both.”); Ex. 1013 at ¶¶117-119.
<u>wherein at least one of the communication management unit or the remote station is configured to apply a heuristic to said information received from the plurality of sensor devices by comparing the calculated numeric value with a plurality of defined parameter value ranges associated with the bearing, each of which represents one of a plurality of severity levels and from which a severity of the condition of the bearing can be determined.</u>	Ex. 1001 at 11:63-12:31 (“alert messages are selected such that only actionable messages are sent to the locomotive 46, meaning that only those alarm levels that require the crew to take action are typically transmitted to the locomotive crew. In addition, ... some alerts could be addressed by putting operating restrictions in place. For example, speed restrictions can be placed on the operation of the train at tiered alarm levels....”); Ex. 1013 at ¶¶121-122 (“Each type of alert is accompanied by a recommended practice that the locomotive driver should take when an alert appears, based on the needs of the particular rail network. The action required to be taken by the locomotive driver varies based on the severity of the alert. As example of an alert appearing on a locomotive display unit 1310 is shown in Fig. 14. Alerts may also be sent via email or posted to a web site.”);

C. Claim 35 (Substitute for claim 3, if found unpatentable)

Claim Limitation	Support
~~3.~~ <u>35.</u> The system of ~~claim 2~~ <u>claim 34</u> , wherein said communication management unit can make a determination of an alarm condition based on data collected by two or more of said sensor devices.	Ex. 1001 at 2:57-60 (“The CMU is capable of wirelessly collecting data from each of the motes and performing higher-level analysis of the data to detect imminent or actual failures.”); 8:6-9 (“CMU 32 is capable of performing advanced data analysis, using data collected from multiple motes 10, and may apply heuristics to draw conclusions based on the analysis.”); Ex. 1013 at ¶¶117-119.

D. Claim 36 (Substitute for claim 4, if found unpatentable)

Claim Limitation	Support
4. ~~36.~~ The system of ~~claim 2~~ <u>claim 34</u> , wherein each of said plurality of sensor devices is capable of exchanging data with other of said plurality of sensor devices and with said communication management unit.	Ex. 1001 at 5:16-19 (“each mote 10 on a railcar is formed into an ad-hoc mesh network with other motes 10 on the same railcar and with a Communication Management Unit (CMU) 32.”); Ex. 1013 at ¶117.

E. Claim 37 (Substitute for claim 26, if found unpatentable)

Claim Limitation	Support
~~26.~~ <u>37.</u> The system of ~~claim 2~~ <u>claim 34</u> , wherein said communication management unit applies heuristics to analyze data collected from said one or more sensor devices (a) to determine if an actual failure exists and (b) to predict potential or imminent failures based on a statistical analysis of said collected data.	Ex. 1001 at 2:60-62 (“During such data analysis, heuristics may be applied to determine potential failures based on statistical models and empirical data”); Ex. 1013 at ¶¶117-118, 129.

F. Claim 38 (Substitute for claim 27, if found unpatentable)

Claim Limitation	Support
~~27.~~ <u>38.</u> The system of ~~claim 2~~ <u>claim 34</u> , further comprising a second temperature sensor located on said railcar for measuring ambient air temperature, wherein said system uses information obtained from said second temperature sensor about the ambient temperature to calibrate the temperature data received from said first sensor regarding the item of the railcar being monitored.	Ex. 1001 at 5:40-47 (“In addition, an ambient temperature sensor mote 10 may also be mounted on an area of the railcar 38 receiving free airflow. FIG. 4 shows a mote 10 mounted on the body of a railcar 38 for monitoring the ambient temperature. The device electrical circuitry 26 obtains information related to the temperature being monitored, e.g., a bearing or ambient.”); Ex. 1013 at ¶¶116-117.

G. Claim 39 (Substitute for claim 28, if found unpatentable)

Claim Limitation	Support for
~~28.~~ <u>39.</u> The system of ~~claim 2~~ <u>claim 34</u> , wherein said	Ex. 1001 at 11:28-32 (“As shown in FIG. 6, CMU 32 also communicates data and

communicating management unit is capable of communicating data and alarms to a remote location located off of the train of which the railcar is a part.	alarms to a remote location, either a mobile base station 42 located on the train, usually in the locomotive, or to a stationary, land-based base station 44, or both.”); Ex. 1013 at ¶¶130-131.
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H. Claim 40 (Substitute for claim 29, if found unpatentable)

Claim Limitation	Support
~~29.~~ <u>40.</u> The system of ~~claim 2~~ <u>claim 34</u> , wherein the power consumption of each of said sensor devices is managed by placing each said sensor device in a standby state and periodically awakening said sensor device to collect readings from said sensor device and to transmit the information regarding the parameter or condition being sensed via said communication circuitry.	Ex. 1001 at 5:36-42 (“Mote 10 also includes a long-term power source 34, preferably a military grade lithium-thionyl chloride battery. Daughter board 30 includes power conditioning and management circuitry and may include a feature to conserve battery life which keeps mote 10 in a standby state and periodically wakes mote 10 to deliver readings from sensor 20.”); Ex. 1013 at ¶¶44-45.

I. Claim 41 (Substitute for claim 30, if found unpatentable)

Claim Limitation	Support
~~30.~~ <u>41.</u> The system of ~~claim 2~~ <u>claim 34</u> , wherein said communication management unit and said plurality of sensor devices form a wireless mesh network for said railcar.	Ex. 1001 at 5:12-23 (“The main board 28 also includes circuitry for wireless communications. Preferably, each mote 10 on a railcar is formed into an ad-hoc mesh network with other motes 10 on the same railcar. ... The ad-hoc mesh network is preferably formed using the Time Synchronized Mesh Protocol, a communications protocol for self organizing networks of wireless devices.”); Ex. 1013 at ¶116.

J. Claim 42 (Substitute for claim 5, if found unpatentable)

Claim Limitation	Support
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5. 42. A system for monitoring the operation of a railcar comprising:	Ex. 1001 at 3:48-49; Ex. 1013 at ¶1; <i>see</i> Claim 34, <i>supra</i> (incorporated here).	
a. one or more sensor units mounted <u>to a sidewall of a bearing adapter</u> on said railcar, each of said sensor units monitoring an operating parameter of said railcar	Ex. 1001 at 3:50-54; Fig. 3; 4:43-48; 5:30-34; Ex. 1013 at ¶¶109-119, FIGs. 9, 10a; <i>see</i> Claim 34, <i>supra</i> (incorporated here).	
wherein each of said sensor units comprises a sensor, a power source, a processor, memory, communications circuitry, and software, stored in said memory and executed by said processor, said software performing the functions of collecting data from said sensor at periodic intervals	Ex. 1001 at 3:60-63, Figs. 1-2; 5:36-42; Ex. 1013 at ¶¶44-45, ¶109, ¶¶118-119, Figs. 8, 8A; <i>see</i> Claim 33, <i>supra</i> , Claim 34 <i>supra</i> (both incorporated here).	
<u>and calculating a numeric value based on the dynamic vibration data sampled by the accelerometer, wherein the calculated numeric value represents a condition of a bearing; and</u>	Ex. 1001 at Table spanning cols. 7-12; 11:39-47; Ex. 1013 at ¶¶64-76; <i>see</i> Claim 34, <i>supra</i> (incorporated here)	
b. a communication management unit, mounted on said railcar, said communication management unit in wireless communication with said one or more sensor units;	Ex. 1001 at 2:55-58; Ex. 1013 at ¶¶117-119; <i>see</i> Claim 34, <i>supra</i> (incorporated here).	
wherein said communication management unit applies heuristics to analyze data collected from said one or more sensor units (a) to determine if an actual failure exists and (b) to predict potential or imminent failures based on a statistical analysis of said collected data	Ex. 1001 at 2:57-60; 8:6-9; Ex. 1013 at ¶¶117-119; <i>see</i> Claim 35, <i>supra</i> (incorporated here).	
<u>by comparing the calculated numeric value with a plurality of defined parameter value ranges associated with the bearing, each of which represents one of a plurality of severity levels and from which a severity of the condition of the bearing is determined, and communicating information about the condition being monitored to a land-based remote station.</u>	Ex. 1001 at 11:63-12:31; 11:28-38; Ex. 1013 at ¶¶121-122; <i>see</i> Claim 34, <i>supra</i> (incorporated here)	

K. Claim 43 (Substitute for claim 6, if found unpatentable)

Claim Limitation	Support
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6. <u>43. The system of ~~claim 5~~ claim 42, further comprising determining an alarm condition based on the severity of the condition of the bearing,</u> wherein said determination of an alarm condition can be made by one of said sensor units.	Ex. 1001 at 3:3-8 (“The analysis of the data collected can be carried out at any of the different event engines distributed among the various components in the present invention, including the sensor units, CMU, and mobile or land base stations.”); Ex. 1013 at ¶¶117-118.
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L. Claim 44 (Substitute for claim 7, if found unpatentable)

Claim Limitation	Support
7. <u>44. The system of ~~claim 5~~ claim 42, further comprising determining an alarm condition based on the severity of the condition of the bearing,</u> wherein said determination of an alarm condition can be made by said communication management unit based on data collected by two or more of said sensor units.	Ex. 1001 at 8:6-9 (“CMU 32 is capable of performing advanced data analysis, using data collected from multiple motes 10, and may apply heuristics to draw conclusions based on the analysis.”); Ex. 1013 at ¶¶117-119.

M. Claim 45 (Substitute for claim 8, if found unpatentable)

Claim Limitation	Support
8. <u>45. The system of ~~claim 5~~ claim 42, wherein each of said sensor units comprises:</u> <u>a. a the sensor, comprising one or more sensors, at least one of which sensors comprises an accelerometer configured to sample dynamic vibration data;</u> <u>b. a power source;</u> <u>c. a processor;</u> <u>d. memory;</u> <u>e. communications circuitry; and</u> <u>f. software, stored in said memory and executed by said processor, wherein said software performing the functions of collecting sampled dynamic vibration data from said sensor at periodic intervals, wherein the calculated numeric value is calculated from the sampled dynamic vibration.</u>	Ex. 1001 at 3:60-63, Figs. 1-2; 4:43-48; Ex. 1013 at ¶¶109, 118-119, Figs. 8, 8A; <i>see</i> Claim 33, <i>supra</i> ; Claim 34, <i>supra</i> ; Claim 42, <i>supra</i> (all incorporated here).

N. Claim 46 (Substitute for claim 9, if found unpatentable)

Claim Limitation	Support
~~9.~~ <u>46.</u> The system of ~~claim 8~~ <u>claim 45</u>, wherein said software further performs the function of: assessing the collected data to determine if an alarm condition exists; ~~and~~ communicating said alarm condition to said communication management unit via said communications circuitry; and managing the power consumption of said sensor unit by placing said sensor unit in a standby state and periodically awakening said sensor unit to collect data from said sensor and to transmit information regarding said operating parameter to said communication management unit via said <u>communications</u> circuitry.	Ex. 1001 at 3:3-8; 5:36-42; Ex. 1013 at ¶¶44-45, 117-118; <i>see</i> Claim 43, <i>supra</i> (incorporated here).

O. Claim 47 (Substitute for claim 10, if found unpatentable)

Claim Limitation	Support
~~10.~~ <u>47.</u> The system of ~~claim 5~~ <u>claim 42</u>, wherein said one or more sensor units and said communication management unit are in wireless communication with each other and form a local area wireless network for said railcar.	Ex. 1001 at 2:50-3:3 (“In some instances, a mote may also have the capability to perform low-level analysis of the data to determine if an alarm needs to be raised, and the ability to communicate the alarm to an external receiver. ... The CMU is capable of wirelessly collecting data from each of the motes and ... communicating both the data and the results of any analysis to a receiver remote from the railcar.”); Ex. 1013 at ¶¶117-119.

P. Claim 48 (Substitute for claim 13, if found unpatentable)

Claim Limitation	Support
~~13.~~ <u>48.</u> The system of ~~claim 5~~ <u>claim 42</u>, further comprising a <u>land-based remote</u> base unit, said base unit being in wireless communication with said communication management unit, said ~~based~~ <u>base</u> unit performing the functions of:	Ex. 1001 at 11:39-47: (“Data collected from motes 10 may be sent to base station 44 for analysis and further action. The heuristics shown in the chart above may be performed by either mobile base station 42 or

a. collecting data and alarms from said communication management unit; b. displaying alarm conditions raised by said communication management unit; and c. determining high level alarms based on data and alarms collected from said communication management unit <u>by comparing the calculated numeric value with a plurality of defined parameter value ranges associated with the bearing.</u>	land-based base station 44. In addition, either station 42, 44 may utilize train-wide heuristics to predict train-wide failures, or to spot train-wide trends, which a single CMU 32 may be unable to do with data from only a single railcar 38. When an alert is detected, it is preferably sent to a display unit in the locomotive 46 or at the land-based base station 44.”); Ex. 1013 at ¶¶117-121.
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Q. Claim 49 (Substitute for claim 14, if found unpatentable)

Claim Limitation	Support
~~14.~~ <u>49.</u> The system of ~~claim 13~~ <u>claim 48</u>, wherein said base unit is in wireless communication with multiple communication management units.	Ex. 1001 at 2:65-3:3 (“The remote receiver may also be able to perform higher-level analysis of the condition of the train by applying heuristics and statistical models to data collected from a plurality of CMUs, located on different railcars in the train.”); Ex. 1013 at ¶118.

R. Claim 50 (Substitute for claim 15, if found unpatentable)

Claim Limitation	Support
~~15.~~ <u>50.</u> The system of ~~claim 14~~ <u>claim 49</u>, wherein said base unit uses distributed event processing to perform trend analysis based on alarms and data collected from one or more communication management units to determine if a high level alarm should be raised.	Ex. 1001 at 3:3-8; Ex. 1013 at ¶¶117-118; <i>see</i> Claim 43, <i>supra</i>; Claim 46, <i>supra</i> (both incorporated here).

S. Claim 51 (Substitute for claim 16, if found unpatentable)

Claim Limitation	Support
~~16.~~ <u>51.</u> The system of ~~claim 14~~ <u>claim 50</u>, wherein said base unit applies heuristics to data collected from said one or more communication	Ex. 1001 at 3:3-8; Ex. 1013 at ¶¶117-118; <i>see</i> Claim 43, <i>supra</i>; Claim 46, <i>supra</i>;

management units to determine if a high level alarm should be raised.	Claim 50, <i>supra</i> (all incorporated here).
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T. Claim 52 (Substitute for claim 17, if found unpatentable)

Claim Limitation	Support
~~17. 52.~~ The system of ~~claim 46~~ <u>claim 51</u> , wherein said base unit and said one or more communication management units communicate with each other via a satellite communications capability or a cellular network capability.	Ex. 1001 at 11:28-38 (“As shown in FIG. 6, CMU 32 also communicates data and alarms to a ... stationary, land-based base station 44. ... CMU 32 may be in constant wireless or wired communication with the mobile base station 42, which may communicate with the land-based base station 44 via the cellular network, via satellite, or via any number of other well known means.”); Ex. 1013 at ¶¶35, 120.

U. Claim 53 (Substitute for claim 18, if found unpatentable)

Claim Limitation	Support
~~18. 53.~~ The system of ~~claim 5~~ <u>claim 42</u> , wherein said sensor is selected from a group consisting essentially of temperature sensors, pressure sensors, strain sensors, load cell sensors, hand brake position sensors, magnetic sensors, vibration sensors, gyroscopes, acceleration sensors, hall effect sensors, piezio resistive microphones and switches.	Ex. 1001 at 3:50-54; 5:30-34; Ex. 1013 at ¶¶109-119, FIGs. 9, 10a; <i>see</i> Claim 34, <i>supra</i> ; Claim 42, <i>supra</i> (both incorporated here).

V. Claim 54 (Substitute for claim 20, if found unpatentable)

Claim Limitation	Support
~~20. 54.~~ The system of ~~claim 5~~ <u>claim 42</u> , further <u>comprising determining an alarm condition based on the severity of the condition of the bearing,</u> wherein said alarm is determined using distributed event processing based on a comparison between current data and statistical models of behavior.	Ex. 1001 at 3:3-8; 13:45-46; Ex. 1013 at ¶¶117-118, 129 <i>see</i> Claim 43, <i>supra</i> ; Claim 46, <i>supra</i> ; Claim 50, <i>supra</i> (all incorporated here).

W. Claim 55 (Substitute for claim 21, if found unpatentable)

Claim Limitation	Support
~~21-~~ <u>55</u> . The system of ~~claim 5~~ <u>claim 42</u> , further comprising determining alarms based on the severity of the condition of the bearing, wherein said alarms are determined based on a comparison of currently collected data versus data collected over a pre-determined preceding time period.	Ex. 1001 at 13:51-54 (“The Level 2 algorithms use temperature data that had been collected every minute while the railcar had been moving during a period of days directly preceding this analysis.”)

X. Claim 56 (Substitute for claim 22, if found unpatentable)

Claim Limitation	Support
~~22-~~ <u>56</u> . The system of ~~claim 5~~ <u>claim 42</u> , wherein an alarm is raised based one or more of the following criteria: a. a pre-determined percentage of current data readings exceeds allowable peak readings; b. a pre-determined percentage of current data readings exceeds a determined value; c. a pre-determined percentage of current data readings exceeds a standard deviation from readings from the same railcar; d. a pre-determined percentage of current data readings exceeds a standard deviation from all railcars in the fleet; or e. the rate of change of current data readings exceeds a pre-determined threshold.	Ex. 1001 at 13:57-15:16 (“Criteria 1—Peak Analysis: Count the percentage of bearing temperature values>a predetermined value ... Criteria 2—Above Ambient Analysis: Count the percentage of bearing temperature values>a defined value above ambient ... Criteria 3—Deviation from Wagon Average Analysis: Calculate the average bearing temperature and standard deviation of each bearing compared to the average of bearing temperatures for the rest of the wagon ... Criteria 4—Deviation from Fleet Average Analysis: Calculate the average bearing temperature and standard deviation of each bearing compared to the average of bearing temperatures for the rest of the fleet ... Criteria 5—Heating Rate of Change Analysis: Calculate the percent of operating time that a bearing is heating quickly.”);

Y. Claim 57 (Substitute for claim 31, if found unpatentable)

Claim Limitation	Support
~~31-~~ <u>57</u> . The system of ~~claim 5~~ <u>claim 42</u> , wherein the power consumption of each of said sensing units is managed by	Ex. 1001 at 5:36-42; Ex. 1013 at

placing each sensing unit in a standby state and periodically awakening said sensing unit to collect readings from said sensor and to transmit information via said communications circuitry.	¶¶44-45; <i>see</i> Claim 40, <i>supra</i> (incorporated here).
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Z. Claim 58 (Substitute for claim 32, if found unpatentable)

Claim Limitation	Support
~~32.~~ <u>58.</u> The system of ~~claim 5~~ <u>claim 42</u> , wherein said communication management unit is capable of communicating with a remote location located off of a train of which said railcar is a part.	Ex. 1001 at 11:28-32; Ex. 1013 at ¶¶117-119; <i>see</i> Claim 39, <i>supra</i> (incorporated here).

AA. Claim 59 (Substitute for claim 23, if found unpatentable)

Claim Limitation	Support
~~23.~~ <u>59.</u> A monitoring device for monitoring temperature on a railcar, comprising:	Ex. 1001 at 3:14-16; Ex. 1013 at ¶16; <i>see</i> Claim 33, <i>supra</i> (incorporated here).
A housing mountable on a railcar;	Ex. 1001 at 3:60-62; Ex. 1013 at ¶¶109, 115; <i>see</i> Claim 33, <i>supra</i> (incorporated here).
a temperature sensor configured to be in thermal communication with a portion of the railcar to be monitored for temperature, which portion is external to said housing, <u>the temperature sensor positioned within a probe head and interfaced with an electrical connector, the probe head configured to receive a cable having a corresponding electrical connector;</u>	Ex. 1001 at 6:16-19; 6:29-33; Ex. 1013 at ¶109; <i>see</i> Claim 33, <i>supra</i> (incorporated here).
electrical circuitry in communication with said temperature sensor <u>via the cable</u> for obtaining information regarding the temperature being sensed, said electrical circuitry positioned within said housing, <u>said electrical circuitry positioned within said housing, said cable having a proximal end disposed in the housing and a distal end residing external to said housing;</u>	Ex. 1001 at 4:66-5:2, Figs. 1, 5, 5A (“The circuitry 26 includes a main board 28 which includes the communications circuitry, antennae and microprocessor and a daughter board 30 including the circuitry to read the data from the sensor 10”); Ex. 1013 at ¶112, Figs. 8, 8A.

a power source electrically connected to said electrical circuitry for providing power thereto, said power source positioned within said housing; and	Ex. 1001 at 5:24-25; Ex. 1013 at ¶113; <i>see</i> Claim 33, <i>supra</i> (incorporated here).
a communication device capable broadcasting information regarding the temperature sensed, said communication device positioned within said housing;	Ex. 1001 at 3:60-63, Figs. 1-2; Ex. 1013 at ¶109, Figs 8, 8A; <i>see</i> Claim 33, <i>supra</i> ; Claim 34, <i>supra</i> ; Claim 42, <i>supra</i> ; Claim 45, <i>supra</i> (all incorporated here).
wherein the power consumption of said monitoring device is managed by placing said monitoring device in a standby state and periodically awakening said monitoring device to collect readings from said temperature sensor and to transmit the information regarding the temperature sensed via said communication circuitry.	Ex. 1001 at 5:24-29; Ex. 1013 at ¶¶44-45; <i>see</i> Claim 33, <i>supra</i> (incorporated here).

BB. Claim 60 (Substitute for claim 24, if found unpatentable)

Claim Limitation	Support
~~24- 60.~~ <u>60.</u> The monitoring device of ~~claim 23~~ <u>claim 59</u> , wherein at least a section of said temperature sensor is disposed outside of and spaced from said housing to be capable of contacting the surface of the railcar for which the temperature is to be monitored.	Ex. 1001 at 4:33-34 (“the heat transfer element 22 will contact the surface on which the mote is attached.”); 6:46-47 (“allowing the probe head 50 to be attached to the cleaned outside surface 78 of the vessel 70”); Ex. 1013 at ¶¶111.

CC. Claim 61 (Substitute for claim 25, if found unpatentable)

Claim Limitation	Support
~~25- 61.~~ <u>61.</u> The monitoring device of ~~claim 23~~ <u>claim 59</u> , wherein said circuitry is configured to apply heuristics to analyze data collected from said temperature sensor to determine if a problem exists.	Ex. 1001 at Table spanning cols. 7-12.; 11:39-47; Ex. 1013 at ¶¶64-76; <i>see</i> Claim 34, <i>supra</i> ; Claim 42, <i>supra</i> (both incorporated here).

**V. SUBSTITUTE CLAIMS 33 THROUGH 61 ARE PATENTABLE
OVER LEFEBVRE, ARMITAGE, BARONE, DENNY, OR
PROVASNIK, ALONE OR IN COMBINATION**

No prior art of record known to Patent Owner anticipates or renders obvious proposed substitute claims 34 through 58.

A. Independent substitute claims 33, 59

Independent substitute claim 33 (corresponding to claim 1 of the Challenged Claims) recites a sensor probe head that (i) is spaced apart from the housing, (ii) has a body formed of a heat conductive material, (iii) has a connector electrically interfaced with said temperature sensor and configured to connect to the distal end of the cable and includes said temperature sensor, and (iv) has a magnet positioned in the body adjacent to a portion of the connector extending inside the body. Claim 59 (corresponding to claim 23 of the Challenged Claims) includes similar recitations.

Support for these elements, as well as the remainder of the limitations of substitute claims 33 and 59 are provided at least in Ex. 1001 at 3:14-16; 3:60-63; 4:66-5:2; 5:24-31; 6:16-33; Figs. 1, 5, 5A, Ex 1013 at ¶¶16, 44-45, 109, 112-115, Figs. 8, 8A. For the reasons discussed below, these limitations are not taught or suggested by Levebre, Armitage, Denny, or Provasnik. Ex. 2158 at ¶¶20-21.

Petitioner cites Provasnik for the proposition that magnetic attachments were standard, commonly used components with well-understood advantages (e.g., *releasably* attaching a sensor to a metallic substrate). Petition at 85 (emphasis

added). Provasnik is directed to a temperature sensor which can readily be attached to and removed from an automobile engine and is well-suited for automotive garages and repair shops (e.g., in connection with an automotive engine analyzer). However, Provasnik does not disclose his magnet-based attachment being at all suited for the rigors of monitoring rail cars. Temporarily attaching a sensor to an automotive engine, in a repair shop, to perform an analysis, is profoundly different than continuous monitoring of rail cars. Ex. 2158 at ¶¶22. For example, if Provasnik's sensor were to become inadvertently detached, it could be simply reattached. In contrast, the specification of the '223 Patent discloses attaching the probe head 50 to the cleaned outside surface 78 of a liquid holding tank 70 of a rail tank car 38 using thermally conductive epoxy. Ex. 1001 at 6:40-48. The magnet 60 within the head 50 helps hold the probe 48 in place *while the epoxy cures*. *Id.* at 6:48-50. The magnet itself is not relied on to form a permanent attachment. A POSHITA would not have expected to be able to modify a rail-car monitoring system to use Provasnik's detachable sensor without undue experimentation. Ex. 2158 at ¶22.

Furthermore, claims 33 and 59 recite the temperature sensor electrically interfaced with a connector. A POSA would have understood that a connector allows for connecting or disconnecting electrical components without special tools or processes. *Id.* at ¶23. Provasnik discloses soldering the leads 12, 14 of his heat sensitive device 10 to the leads 16, 18 of his lead-out cable 20 at points 22, 24,

respectively. Thus, Provasnik fails to disclose at least this limitation of claims 33 and 59. *Id.* Petitioner cites Denny for the idea that the electronic components of a railcar temperature sensor should be “situated away from the outer surface of the wheel assembly so that the electronic circuit will not be subjected to heat from the wheel.” Petition, 54. Petitioner does not apply Denny for any other purpose. Denny does not disclose a magnetic sensor attachment or a connector, and thus does not remedy the deficiencies of LeFevbre, Armitage, or Provasnik. Petitioner does not apply Barone to Challenged Claims 1 or 23. Ex. 2158 at ¶¶24-25.

B. Independent substitute claims 34, 42

Independent substitute claims 34 and 42 (corresponding to claims 2 and 5 of the Challenged Claims) recite at least one accelerometer configured to sample dynamic vibration data; calculating a numeric value based on the dynamic vibration data sampled by the accelerometer; and applying a heuristic by comparing the calculated numeric value with a plurality of defined parameter value ranges associated with the bearing, each of which represents one of a plurality of severity levels and from which a severity of the condition of the bearing can be determined.

Support for these elements, as well as the remainder of the limitations of substitute claim 34 and 42 are provided at least in Ex. 1001 at 2:50-3:8; 3:48-54; 3:60-63; 4:5-10; 4:43-48; 5:12-23; 5:30-47; 8:6-9; 11:28-47; 11:63-12:31; 13:51-15:16; Figs. 1-3, Ex. 1013 at ¶¶1; 35; 44-45; 64-76; 109-119; 121-122; 129-131;

Figs. 8, 8A, 9, 10a. For the reasons discussed below, these limitations are not taught or suggested by Lefebvre, Armitage, or Barone. Ex. 2158 at ¶¶27-28.

A Person of Ordinary Skill in the Art (POSA) would have understood a calculated values to include, e.g., an FFT performed on the sampled data (e.g., to isolate known frequencies of interest); kurtosis or other statistical analysis of the sampled data; and so forth. Ex. 1001 at Table spanning cols. 7-12; Ex. 2158 at ¶29.

With respect to claim 5, Petitioners assert that LeFebvre's use of "frequency spectrum analysis" teaches the claimed application of a heuristic. Petition at 31-32. In support of this assertion, Petitioners cite portions of LeFebvre that disclose using a load sensor in the top of instrumented pad 16 to monitor vibrations emitted from the bearing. LeFebvre at ¶59. LeFebvre does not disclose comparing a calculated value against *defined* value ranges to determine a severity of the condition of the bearing. Ex. 2158 at ¶30.

Petitioner also asserts that Armitage's statistical analysis teaches the claimed application of a heuristic. Ex. 1001 at 65. In support of this assertion, Petitioner cites portions of Armitage that disclose the use of "moving average and trend analysis" and "time series analysis," the latter with respect to vibration monitoring. Armitage at ¶¶30, 45. Armitage does not disclose comparing such a calculated value against *defined* value ranges to determine a severity of the condition of the bearing. Armitage fails to cure the deficiencies of LeFebvre. Ex. 2158 at ¶31.

Petitioner relies on Barone merely for disclosing a plurality of railcars. Ex. 1001 at 45. Otherwise, Petitioner characterizes Barone as similar to LeFebvre. *Id.* at 41-42. Thus, Barone fails to teach these elements, just as LeFebvre and Armitage failed to do. Ex. 2158 at ¶32.

Thus, substitute claims 34 through 59 are patentable over Lefebvre, Armitage, or Barone, alone or in combination.

VI. CONCLUSION

Patent Owner has satisfied the requirements of 37 C.F.R. §42.121, and thus, the substitute claims should be entered into the record in this matter contingent upon a finding of unpatentability with respect to the Challenged Claims.

Should any Challenged Claim be found unpatentable, the respective substitute claim is patentable. Independent substitute claims 23, 33, 36 and 42 – each intended by Patent Owner to replace independent Challenged Claims 1, 10, 14 and 21, respectively, should those claims be determined by the Board to be unpatentable – include additional limitations not taught by LeFebvre, Armitage, or Barone and is therefore patentable over LeFebvre, Armitage, or Barone, alone or in combination.

Respectfully submitted,

Dated: November 3, 2023

By: / Ryan N. Miller /
Ryan N. Miller
Reg. No. 68,262
Counsel for Patent Owner
Amsted Rail Company, Inc.

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e), the undersigned certifies that on the 3rd day of November 2023 a complete and entire copy of “Patent Owner’s Motion to Amend and Request for Preliminary Guidance” was provided via email to the Petitioner by serving the following email addresses:

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Electronic service was used with Petitioner’s consent (*See* Petition, Paper 1 at 2; Patent Owner’s Mandatory Notice, Paper 5 at 5).

Dated: November 3, 2023

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CLAIMS APPENDIX A

Proposed substitute claims are shown in marked-up form below beginning with claim 33. Modifications to the corresponding original claim are shown in the substitute claim by underlining (added material) and strikethrough (deleted material).

Claim 33 (Substitute for claim 1, if found unpatentable)

~~1.~~ 33. A sensor device for monitoring temperature on a railcar, comprising:

a housing providing a first piece mountable on a railcar;

a temperature sensor;

electrical circuitry in communication with said temperature sensor via a cable for obtaining information regarding the temperature being sensed, wherein said electrical circuitry is positioned within said housing, and said cable has a proximal end disposed in the housing and a distal end residing external to said housing;

a power source electrically connected to said electrical circuitry ~~to~~[[for]] provide~~[[ing]]~~ power thereto, said power source positioned within said housing;

a probe providing a second piece external to and separated from the first piece provided by said housing, said second piece and which probe comprising a sensor probe head that (i) is spaced apart from the housing, (ii) has a body formed of a heat conductive material, (iii) has a connector electrically interfaced with said temperature sensor and configured to connect to a corresponding electrical connector at the distal end of the cable and includes said temperature sensor, and (iv) a magnet positioned in the body adjacent to a portion of the connector

extending inside the body, the magnet configured to magnetically attract the part of the railcar against which the sensor probe head will be placed; and

a communication device configured to ~~capable of~~ broadcast[[ing]] information regarding the temperature sensed, said communication device positioned within said housing;

wherein the power consumption of said sensor device is managed by placing said sensor device in a standby state and periodically awakening said sensor device to collect readings from said temperature sensor and to transmit the information regarding the temperature sensed via said communication device circuitry.

Claim 34 (Substitute for claim 2, if found unpatentable)

~~2.~~ 34. A system for monitoring a railcar, comprising:

a plurality of sensor devices located on and mounted to a sidewall of a bearing adapter of the railcar for monitoring parameters or conditions related to one or more components of a truck of the railcar, each of said sensor devices being separate from one another and including a sensor for monitoring one of said parameters or conditions related to one or more components of the truck of the railcar;

said plurality of sensor devices including at least one temperature sensor device having:

a housing comprising a non-flexible durable material for protecting components positioned therein;

a temperature sensor in thermal communication with an item consisting of the sidewall of the bearing adapter of the railcar for which the temperature is being monitored, which item is external to said housing;

at least one accelerometer configured to sample dynamic vibration data corresponding to accelerations of one or more components of the railcar;

electrical circuitry in communication with said temperature sensor for obtaining information regarding the temperature and the accelerations being sensed, said electrical circuitry positioned within said housing;

a power source electrically connected to said electrical circuitry for providing power thereto, said power source positioned within said housing;

a communication device capable of broadcasting information regarding the temperature and the accelerations sensed via wireless communication, said communication device positioned within said housing, wherein said information comprises a calculated numeric value based on the dynamic vibration data sampled by the at least one accelerometer and representing a condition of a bearing; and

a communication management unit, mounted on the railcar, capable of two way wireless communication with each of said plurality of sensor devices for receiving information therefrom, said communication management unit having a wireless communication device for broadcasting information about the parameter or condition being monitored to a land-based remote station, wherein at least one of the communication management unit or the remote station is configured to compare the calculated numeric value with a plurality of defined parameter value ranges associated with the bearing, each of which represents one of a plurality of severity levels, and determine a severity of the condition of the bearing.

Claim 35 (Substitute for claim 3, if found unpatentable)

~~3.~~ 35. The system of ~~claim 2~~ claim 34, wherein said communication management unit can make a determination of an alarm condition based on data collected by two or more of said sensor devices.

Claim 36 (Substitute for claim 4, if found unpatentable)

~~4.~~ 36. The system of ~~claim 2~~ claim 34, wherein each of said plurality of sensor devices is capable of exchanging data with other of said plurality of sensor devices and with said communication management unit.

Claim 37 (Substitute for claim 26, if found unpatentable)

~~26.~~ 37. The system of ~~claim 2~~ claim 34, wherein said communication management unit applies heuristics to analyze data collected from said ~~one or more~~ plurality of sensor devices (a) to determine if an actual failure exists and (b) to predict potential or imminent failures based on a statistical analysis of said collected data.

Claim 38 (Substitute for claim 27, if found unpatentable)

~~27.~~ 38. The system of ~~claim 2~~ claim 34, further comprising a second temperature sensor located on said railcar for measuring ambient air temperature, wherein said system uses information obtained from said second temperature sensor about the ambient temperature to calibrate the temperature data received from said first sensor regarding the item of the railcar being monitored.

Claim 39 (Substitute for claim 28, if found unpatentable)

~~28.~~ 39. The system of ~~claim 2~~ claim 34, wherein said communicating management unit is capable of communicating data and alarms to a remote location located off of the train of which the railcar is a part.

Claim 40 (Substitute for claim 29, if found unpatentable)

~~29.~~ 40. The system of ~~claim 2~~ claim 34, wherein the power consumption of each of said sensor devices is managed by placing each said sensor device in a standby state and periodically awakening said sensor device to collect readings from said sensor device and to transmit the information regarding the parameter or condition being sensed via said communication circuitry.

Claim 41 (Substitute for claim 30, if found unpatentable)

~~30.~~ 41. The system of ~~claim 2~~ claim 34, wherein said communication management unit and said plurality of sensor devices form a wireless mesh network for said railcar.

Claim 42 (Substitute for claim 5, if found unpatentable)

~~5.~~ 42. A system for monitoring the operation of a railcar comprising:

a. one or more sensor units mounted to a sidewall of a bearing adapter on said railcar, each of said sensor units monitoring an operating parameter of said railcar wherein each of said sensor units comprises a sensor, a power source, a processor, memory, communications circuitry, and software, stored in said memory and executed by said processor, said software performing the functions of collecting data from said sensor at periodic intervals and calculating a numeric

value based on the collected data, wherein the calculated numeric value represents a condition of a bearing; and

b. a communication management unit, mounted on said railcar, said communication management unit in wireless communication with said one or more sensor units;

wherein said communication management unit applies heuristics to analyze data collected from said one or more sensor units (a) to determine if an actual failure exists and (b) to predict potential or imminent failures based on a statistical analysis of said collected data by comparing the calculated numeric value with a plurality of defined parameter value ranges associated with the bearing, each of which represents one of a plurality of severity levels and from which a severity of the condition of the bearing is determined, and communicating information about the condition of the bearing to a land-based remote station.

Claim 43 (Substitute for claim 6, if found unpatentable)

~~6.~~ 43. The system of ~~claim 5~~ claim 42, further comprising determining an alarm condition based on the severity of the condition of the bearing, wherein said determination of an alarm condition can be made by one of said sensor units.

Claim 44 (Substitute for claim 7, if found unpatentable)

~~7.~~ 44. The system of ~~claim 5~~ claim 42, further comprising determining an alarm condition based on the severity of the condition of the bearing, wherein said determination of an alarm condition can be made by said communication management unit based on data collected by two or more of said sensor units.

Claim 45 (Substitute for claim 8, if found unpatentable)

8. ~~45.~~ The system of ~~claim 5~~ claim 42, wherein ~~each of said sensor units~~ comprises:

- ~~a. a~~ the sensor, comprising is one or more sensors, at least one of which
sensors comprises an accelerometer configured to sample dynamic vibration data;
- ~~b. a power source;~~
- ~~c. a processor;~~
- ~~d. memory;~~
- ~~e. communications circuitry; and~~
- ~~f. software, stored in said memory and executed by said processor, wherein~~
said software performing the functions of collecting sampld dynamic vibration
data from said sensor at periodic intervals, wherein the calculated numeric value is
calculated from the sampled dynamic vibration.

Claim 46 (Substitute for claim 9, if found unpatentable)

9. ~~46.~~ The system of ~~claim 8~~ claim 45, wherein said software further performs the function of:

- assessing the collected data to determine if an alarm condition exists; ~~and~~
- communicating said alarm condition to said communication management unit via said communications circuitry; and
- managing the power consumption of said sensor unit by placing said sensor unit in a standby state and periodically awakening said sensor unit to collect data from said sensor and to transmit information regarding said operating parameter to said communication management unit via said communications circuitry.

Claim 47 (Substitute for claim 10, if found unpatentable)

~~10.~~ 47. The system of ~~claim 5~~ claim 42, wherein said one or more sensor units and said communication management unit are in wireless communication with each other and form a local area wireless network for said railcar.

Claim 48 (Substitute for claim 13, if found unpatentable)

~~13.~~ 48. The system of ~~claim 5~~ claim 42, further comprising a land-based remote base unit, said base unit being in wireless communication with said communication management unit, said ~~based~~ base unit performing the functions of:

- a. collecting data and alarms from said communication management unit;
- b. displaying alarm conditions raised by said communication management unit; and
- c. determining high level alarms based on data and alarms collected from said communication management unit by comparing the calculated numeric value with a plurality of defined parameter value ranges associated with the bearing.

Claim 49 (Substitute for claim 14, if found unpatentable)

~~14.~~ 49. The system of ~~claim 13~~ claim 48, wherein said base unit is in wireless communication with multiple communication management units.

Claim 50 (Substitute for claim 15, if found unpatentable)

~~15.~~ 50. The system of ~~claim 14~~ claim 49, wherein said base unit uses distributed event processing to perform trend analysis based on alarms and data collected from one or more communication management units to determine if a high level alarm should be raised.

Claim 51 (Substitute for claim 16, if found unpatentable)

~~16. 51.~~ The system of ~~claim 14~~ claim 50, wherein said base unit applies heuristics to data collected from said one or more communication management units to determine if a high level alarm should be raised.

Claim 52 (Substitute for claim 17, if found unpatentable)

~~17. 52.~~ The system of ~~claim 16~~ claim 51, wherein said base unit and said one or more communication management units communicate with each other via a satellite communications capability or a cellular network capability.

Claim 53 (Substitute for claim 18, if found unpatentable)

~~18. 53.~~ The system of ~~claim 5~~ claim 42, wherein said sensor is selected from a group consisting essentially of temperature sensors, pressure sensors, strain sensors, load cell sensors, hand brake position sensors, magnetic sensors, vibration sensors, gyroscopes, acceleration sensors, hall effect sensors, piezoelectric resistive microphones and switches.

Claim 54 (Substitute for claim 20, if found unpatentable)

~~20. 54.~~ The system of ~~claim 5~~ claim 42, further comprising determining an alarm condition based on the severity of the condition of the bearing, wherein said alarm condition is determined using distributed event processing based on a comparison between current data and statistical models of behavior.

Claim 55 (Substitute for claim 21, if found unpatentable)

~~21. 55.~~ The system of ~~claim 5~~ claim 42, further comprising determining alarms based on the severity of the condition of the bearing, wherein said alarms are

determined based on a comparison of currently collected data versus data collected over a pre-determined preceding time period.

Claim 56 (Substitute for claim 22, if found unpatentable)

~~22.~~ 56. The system of ~~claim 5~~ claim 42, wherein an alarm is raised based one or more of the following criteria:

- a. a pre-determined percentage of current data readings exceeds allowable peak readings;
- b. a pre-determined percentage of current data readings exceeds a determined value;
- c. a pre-determined percentage of current data readings exceeds a standard deviation from readings from the same railcar;
- d. a pre-determined percentage of current data readings exceeds a standard deviation from all railcars in the fleet; or
- e. the rate of change of current data readings exceeds a pre-determined threshold.

Claim 57 (Substitute for claim 31, if found unpatentable)

~~31.~~ 57. The system of ~~claim 5~~ claim 42, wherein the power consumption of each of said sensing units is managed by placing each sensing unit in a standby state and periodically awakening said sensing unit to collect readings from said sensor and to transmit information via said communications circuitry.

Claim 58 (Substitute for claim 32, if found unpatentable)

~~32.~~ 58. The system of ~~claim 5~~ claim 42, wherein said communication management unit is capable of communicating with a remote location located off of a train of which said railcar is a part.

Claim 59 (Substitute for claim 23, if found unpatentable)

~~23.~~ 59. A monitoring device for monitoring temperature on a railcar, comprising:

a housing mountable on a railcar;

a temperature sensor configured to be in thermal communication with a portion of the railcar to be monitored for temperature, which portion is external to said housing, the temperature sensor positioned within a probe head and interfaced with an electrical connector, the probe head configured to receive a cable having a corresponding electrical connector;

electrical circuitry in communication with said temperature sensor via the cable for obtaining information regarding the temperature being sensed, said electrical circuitry positioned within said housing, said cable having a proximal end disposed in the housing and a distal end residing external to said housing;

a power source electrically connected to said electrical circuitry for providing power thereto, said power source positioned within said housing; and

a communication device capable of broadcasting information regarding the temperature sensed, said communication device positioned within said housing;

wherein the power consumption of said monitoring device is managed by placing said monitoring device in a standby state and periodically awakening said monitoring device to collect readings from said temperature sensor and to transmit the information regarding the temperature sensed via said communication circuitry.

Claim 60 (Substitute for claim 24, if found unpatentable)

~~24.~~ 60. The monitoring device of ~~claim 23~~ claim 59, wherein at least a section of said temperature sensor is disposed outside of and spaced from said housing to be capable of contacting the surface of the railcar for which the temperature is to be monitored.

Claim 61 (Substitute for claim 25, if found unpatentable)

~~25.~~ 61. The monitoring device of ~~claim 23~~ claim 59, wherein said circuitry is configured to apply heuristics to analyze data collected from said temperature sensor to determine if a problem exists.