Exhibit C

Ricca Declaration

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF MISSOURI

AMSTED RAIL COMPANY, INC.,	)	
	)	
Plaintiff,	)	
	)	
v.	)	Case No. 4:22-cv-00445-AGF
	)	
HUM INDUSTRIAL TECHNOLOGY, INC., and BRENT WILSON,	)	
	)	
Defendants.	)	

EXPERT DECLARATION OF STEVEN RICCA

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I. INTRODUCTION

1. I, Steven Ricca, have been retained on behalf of Defendants Hum Industrial Technology, Inc. and Brent Wilson as an independent expert consultant in this proceeding before the United Stated District Court for the Eastern District of Missouri involving U.S. Patent Nos. 9,365,223 (the "'223 Patent"), 9,981,673 (the "'673 Patent"), and 10,137,915 (the "'915 Patent") (collectively the "Asserted Patents") assigned to Plaintiff Amsted Rail Company, Inc. ("Amsted"). I have been asked to offer my opinions regarding the claim constructions in the above captioned matter, including my opinions in opposition to Plaintiff's proposed constructions.

2. I am over the age of 18, competent to make this declaration, and have personal knowledge of the facts set forth below. If called to testify, I could and would testify honestly, under oath, to the matters set forth herein.

3. I am not an attorney, and I have not been asked to offer any legal opinions. I have been informed and understand the law to be applied for claim construction, which I explain in places below. I have applied the law told to me in developing my technical opinions in this Declaration.

II. BACKGROUND AND QUALIFICATIONS

A. Education and Work Experience

4. I have over 30 years of experience in electrical and systems engineering, including in the railroad industry specifically. I have direct experience within a variety of private companies and industries. I earned my B.S. and M.S. in Electrical Engineering from Ohio University in 1986 and 1988, respectively. My curriculum vitae attached to this declaration as Attachment 1 contains a detailed description of my work history and education.

5. At Toledo Scale (1988-1990) I was the lead firmware engineer for a new scale for

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railcars. Much of the work I did at Toledo Scale led to applications that were industry firsts. For example, I developed electronic systems and software that measured weight. This included railcar weight, and within that sector some of the first in-motion weighers and automated tank car fillers. Often the wayside communication systems were located near the weighing equipment due to electrical runs, so understanding the wayside communication systems in combination with the weighing equipment was critical.

6. At IRD Mechanalysis (1990-1995) I developed systems that measured all parameters of rotating machinery. This included all types of sensors within systems that monitored and analyzed data in real-time with authority to shut down or signal the system for a shutdown. Very complex systems involving hundreds of accelerometers, temperature sensors and other position detectors were typical. These systems often performed complex algorithms and comparisons on the data for shutdown analysis; as well as storing the compressed data for offloading to larger storage locations using a variety of communications methods. This company pioneered many of the concepts of predictive/preventive maintenance and communicating the system health to outside entities for scheduled service and maximum uptime.

7. At Dynalab, where I was senior electronic engineer from June 1997 to July 2002, I developed several test instruments used by the transportation and appliance industries to test cable and harness assemblies prior to final assembly into the vehicle or appliance This work included designing and developing microprocessor-based relay boards, a DC-DC power supply, and understanding the upcoming trends in transportation wiring. The cable analyzer testing equipment was programmable to check for the continuity of connections, splices and the presence of fuses and surge suppression devices. They also could analyze the signal path for high speed communication line.

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8. A few jobs and several years later, I worked at Invensys (2004-2006) as a Senior Electrical Engineer. I was responsible for overseeing the automotive climate controls products division. One of my responsibilities was to design a high-volume microcontroller based automotive product family to replace the existing laser trimmed controls which had become difficult to manufacture. Also, our engineering group developed controls for the HVAC industry which would measure and communicate system health to outside entities for preventive maintenance programs. We also developed thermostats and smoke alarms using mesh networking.

9. Since my job at Invensys in 2006, I have continued to work in the electrical and systems engineering industry, leading up to my current job as Lead Electrical Engineer with Vertiv Holdings. My responsibilities include electrical coordination and oversight of multiple product development programs carried out in four design centers worldwide. I also have my own consulting/product development company, Ricca Engineering, LLC, that I have operated since around 2002. Some of my projects have included embedded firmware, analog and digital hardware design, building prototypes, schematic circuit design, simulation and PCB layout, and motorized controls for museum exhibits among others.

10. I have held numerous other positions in my 30-plus years in the engineering field, as shown on my curriculum vitae. Not all have been discussed in detail in my declaration.

11. I have prepared numerous written documents over my career in the engineering field, including operating manuals, technical specifications, and internal research and development documents. With few exceptions, these documents have been kept confidential by the companies that own them, and have not been publicly disclosed or otherwise made available to competitors. For this reason, none of these documents are listed on my curriculum vitae

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(Attachment A).

12. My background demonstrates an expertise and strong understanding of railroad monitoring systems, as well as communications networks used in these systems.

B. Engagement

13. Specifically, I was asked to analyze the Asserted Patents and intrinsic and extrinsic evidence in this case and provide my independent opinions, from the perspective of a person of ordinary skill in the art at the time of the alleged invention, as to the proper understanding of certain disputed claim terms and limitations.

14. Although I am being compensated for my services in this matter at my standard consulting rate of $375 per hour, my compensation is not contingent upon the opinions I render or the outcome of this proceeding. I have no financial interest in any of the parties, and I have no other interest in this proceeding.

15. This report is based on information currently available to me. I reserve the right to amend or supplement my analysis in this report and/or to respond to any additional submissions prepared by or on behalf of Amsted. I also reserve the right to amend or supplement my opinions based on further discovery and information provided in the case.

16. I reserve the right to create any additional summaries, tutorials, demonstrations, charts, drawings, tables, and/or animations that may be appropriate to supplement and demonstrate my opinions as necessary.

17. All of the opinions stated in this report are based on my own personal knowledge and professional judgment.

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III. MATERIALS CONSIDERED

18. I have considered the following list of materials in formulating my opinions in this matter:

HUM0000001	HUM0061871	HUM0061953	HUM0062039	HUM0062123
HUM0000751	HUM0061874	HUM0061956	HUM0062042	HUM0062126
HUM0001411	HUM0061877	HUM0061959	HUM0062045	HUM0062129
HUM0002116	HUM0061880	HUM0061962	HUM0062048	HUM0062132
HUM0002143	HUM0061883	HUM0061965	HUM0062051	HUM0062135
HUM0002658	HUM0061886	HUM0061968	HUM0062054	HUM0062138
HUM0002770	HUM0061889	HUM0061971	HUM0062057	HUM0062141
HUM0002794	HUM0061892	HUM0061974	HUM0062060	HUM0062144
HUM0003936	HUM0061895	HUM0061977	HUM0062063	HUM0062147
HUM0004794	HUM0061898	HUM0061980	HUM0062066	HUM0062150
HUM0056485	HUM0061898	HUM0061983	HUM0062069	HUM0062153
HUM0059212	HUM0061901	HUM0061986	HUM0062072	HUM0062156
HUM0059358	HUM0061904	HUM0061989	HUM0062075	HUM0062159
HUM0061826	HUM0061907	HUM0061992	HUM0062078	HUM0062162
HUM0061829	HUM0061910	HUM0061996	HUM0062081	HUM0062165
HUM0061832	HUM0061913	HUM0062000	HUM0062084	HUM0062168
HUM0061835	HUM0061916	HUM0062003	HUM0062087	HUM0062171
HUM0061838	HUM0061919	HUM0062006	HUM0062090	HUM0062174
HUM0061841	HUM0061923	HUM0062009	HUM0062093	HUM0062177
HUM0061844	HUM0061926	HUM0062012	HUM0062096	HUM0062180
HUM0061847	HUM0061929	HUM0062015	HUM0062099	HUM0062183
HUM0061850	HUM0061932	HUM0062018	HUM0062102	HUM0062186
HUM0061853	HUM0061935	HUM0062021	HUM0062105	HUM0062190
HUM0061856	HUM0061938	HUM0062024	HUM0062108	HUM0062193
HUM0061859	HUM0061941	HUM0062027	HUM0062111	HUM0062196
HUM0061862	HUM0061944	HUM0062030	HUM0062114	HUM0062199
HUM0061865	HUM0061947	HUM0062033	HUM0062117	HUM0062202
HUM0061868	HUM0061950	HUM0062036	HUM0062120	

IV. OVERVIEW OF THE '223 PATENT

19. I have read and considered the '223 Patent, filed March 15, 2013, as well as its prosecution history.

20. It is my understanding that the '223 Patent relates, broadly speaking, to a system

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for wirelessly monitoring the operating parameters and/or conditions of a railcar. '223, (57) Abstract. The system includes one or more sensor units that communicate wirelessly with a "communication management unit," or "CMU," mounted on the railcar. *Id.* The sensor units or CMU applies heuristics to data collected by the sensors to determine whether actual or potential failures exist, make a determination of whether to raise an alarm, and transmit data and alarms to the locomotive or remote location. *Id.*

V. OVERVIEW OF THE '673 PATENT

21. I have read and considered the '673 Patent, filed on May 18, 2016, as well as its prosecution history.

22. It is my understanding that, like the '223 Patent, the '673 Patent relates, broadly speaking, to a system for wirelessly monitoring the operating parameters and/or conditions of a railcar. '673 Patent, (57) Abstract. The system includes one or more sensor units that communicate wirelessly with a "communication management unit," or "CMU," mounted on the railcar. *Id.* The sensor units or CMU applies heuristics to data collected by the sensors to determine whether actual or potential failures exist, make a determination of whether to raise an alarm, and transmit data and alarms to the locomotive or remote location. *Id.*

VI. OVERVIEW OF THE '915 PATENT

23. I have read and considered the '915 Patent, filed Dec. 24, 2014, as well as its prosecution history. '915 Patent. I have been told that the '915 Patent has a priority date of Dec. 24, 2013.

24. It is my understanding that the claims of the '915 Patent relate to a system for processing data in order to monitor the operation of railcars and trains. '915 Patent, Abstract. The claims disclose the processing of data at least three different levels within a wireless system. '915 Patent, 1:59-65, Fig. 1. The components in the wireless system can continuously collect

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data and communicate with each other in real-time, so to alert the user of issues promptly. '915 Patent, 1:13-17. Fig. 2 of the '915 Patent shows the structure of the disclosed wireless system.

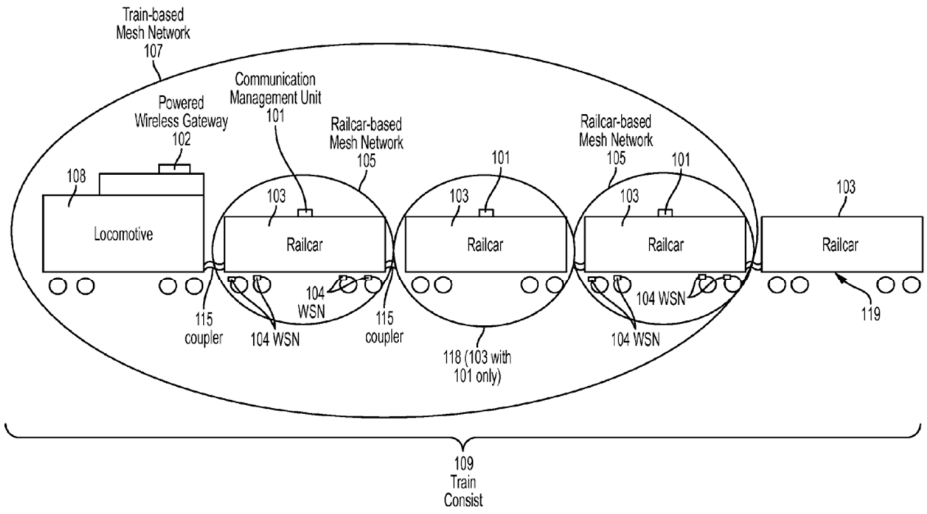

FIG. 2

25. Each railcar contains at least one wireless sensor, communication management unit ("CMU"), and a wireless network including a gateway. *Id.*, 1:66-2:4, Fig. 2. The CMU contains a processor, power source, global navigation system (i.e., GPS), and wireless communication capability. '915 Patent, 3:22-36. The system includes the sensors collecting the data (e.g. accelerations), the sensors sending the data to the CMU(s), which further filters and processes the data, detects trends and events indicative of an anomalous situation, and send the data and detected trends or events to the remote receiver—all part of a wireless network. '915 Patent, 1:59-2:25.

VII. LEGAL STANDARDS

26. I am not an attorney and will not offer opinions on the law. I have been informed by counsel of at least some of the legal standards for claim construction, identified below, which I have employed in forming my opinions that are recited in this declaration.

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27. I have been informed by counsel that infringement is a two-step inquiry: first the meaning of the terms and scope of the patent must be determined, and only then can a factfinder apply the construed claims to the accused device or system. Counsel has also explained to me that the objective in claim construction is to determine what a given claim term would mean to a person of ordinary skill in the field at the time of the patent's earliest priority date. I further understand that the claims of an issued patent must be read in light of the patent specification, and that the specification is the single best guide to the meaning of a disputed term. I have also been informed that the prosecution history can inform the meaning of the claim language by demonstrating how the inventor and the United States Patent and Trademark Office understood the invention. I have also been informed that, if a claim term has a commonly understood meaning to those in the field, then that plain meaning is how the claim term should be construed in the absence of evidence to the contrary.

28. I have been informed by counsel that evidence to the contrary may be either intrinsic evidence (evidence contained within the prosecution history of the patent itself) or extrinsic evidence (everything else, such as dictionary definitions). I have been informed that the strongest evidence of a claim term's meaning is the words of the claim itself and the context in which the claim term is used, followed by any definition or explanation given in the patent's specification, followed by any definition or explanation given in the patent's prosecution history. I have been informed that other claims, either asserted or unasserted, can also be valuable sources for claim construction. For example, differences among claims can be a useful guide in understanding a claim term's meaning.

29. I have been informed by counsel that extrinsic evidence is evidence from outside the patent's prosecution history, which may include expert testimony, other literature defining

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the term or terms, and the like. I have been informed by counsel that dictionary definitions are also extrinsic evidence, although they may be used to inform what the plain and ordinary meaning of a claim term is.

30. I have been informed by counsel that a patent specification must conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his or her invention. To be definite, the boundaries of the claim, as construed by the court, must inform with "reasonable certainty" a PHOSITA about the scope of the invention, based on the language of the claim, the specification, and the prosecution history, as well as the PHOSITA's knowledge of the relevant field of art. If the meaning of a claim is discernable, even where reasonable persons may disagree, the claim is sufficiently clear to be definite.

VIII. STATE OF THE ART

31. Wheel damage in the railroad industry is responsible for significant maintenance costs related to the railcar wheels, railcar body, railcar components, rail tracks and rail ties. '915 Patent, 1:39-41. Even minor mechanical issues can lead to catastrophic failures. '223 Patent, 1:39-41; '673 Patent, 1:42-44. Because of these potential problems, railcar owners and operators desire a better understanding of how their cars are performing, and the ability to implement preventative maintenance to avoid failures in the field. '223 Patent, 1:24-44; '673 Patent, 1:26-48.

32. Before onboard monitoring systems, wayside monitoring systems were routinely used to monitor railcar operations. '915 Patent, 1:21-28; '223 Patent, 1:45-54; '673 Patent, 1:49-59. In these wayside monitoring systems, fixed detectors located throughout the rail system detect passing railroad cars and derive data (i.e., bearing temperature, vibration) that may indicate a problem with an individual railcar. *Id.* Another prior art approach to railcar

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performance monitoring was to use on-board instrumentation. '223 Patent, 1:55-56; '673 Patent, 1:60-61. In this type of system, instruments on different areas of a freight car are used to make measurements before being communicated to a central hub on the freight car. '223 Patent, 1:56-61; '673 Patent, 1:61-66. Wayside monitoring systems, however, lacked the benefits of wireless communication and continuous monitoring – which onboard monitoring systems attempted to address. '915 Patent, 1:29-38.

33. Innovations in railroad monitoring systems can take years in research and development. In 1999, the Federal Railroad Administration's Office of Research and Development (FRA) sponsored the development of onboard monitoring systems for trains. HUM0059212; HUM0059358. In June 1999, the multi-year project commenced and testing of prototypes started in November 2000. HUM0059212 at HUM0059212-13. In 2003, an onboard monitoring system was developed that used the latest wireless communications and bearing monitoring technology. HUM0059212 at HUM0059213. Several years later in 2007, a monitoring system called the "On-Board Monitoring and Control System" ("OBMCS") was under development. *Id*. Like the Asserted Patents, the primary objective of the OBMCS in 2007 was to improve railroad safety and efficiency through new technologies and continuous monitoring. HUM0059212 at HUM0059220-21.

34. Earlier onboard monitoring systems, while major improvements on wayside detection systems, did not address certain factors relevant for feasible, practical, and economical implementation—including requiring substantial amounts of electrical power. '915 Patent, 1:47-55. While onboard monitoring systems do not rely on particularly sophisticated technology, the various components of the systems were costly in the 90s and early-2000s, so these systems were not widely used in the industry. HUM0059358, ¶ [0021]. This changed in the mid-2000s, when

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the general progress of technology meant that electronic components—such as sensors, microprocessors, and wireless networking equipment—became cheap and widely available. HUM0059358, ¶ [0042].

IX. LEVEL OF ORDINARY SKILL IN THE ART

A. Legal Principles

35. I have been informed that patents are considered from the perspective of a person having ordinary skill in the art, and that this is a hypothetical person who is presumed to know the relevant prior art.

36. I have been informed that the following five factors inform the analysis for determining the level of ordinary skill in the art: (1) type of problems encountered in the art; (2) prior art solutions to those problems; (3) rapidity with which innovations are made; (4) sophistication of the technology; and (5) educational level of active workers in the field. I have also been informed that in a given case, every factor may not be present, and one or more factors may predominate. *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995).

B. Opinion as to the Level of a Person Having Ordinary Skill in the Art of the Asserted Patents

37. I have knowledge relevant to what a person having ordinary skill in the art at the time of the invention would understand and do. In 2012, at the priority date of the ’223 and ’673 Patent, and in 2013, at the priority date of the ’915 Patent, I had 24 and 25 years of experience in this field, respectively, and was a person having ordinary skill in the art.

38. In my opinion, a person of ordinary skill in the art at the time of the filing of the Asserted Patents would be a person with at least a B.S. degree in electrical or mechanical engineering or a related field with at least two years’ experience designing monitoring systems for railcar components, rotating equipment, or equivalent industrial equipment. It is my opinion

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that less work experience could be compensated by a higher level of education, such as a master's degree, and vice versa.

X. PROPOSED CONSTRUCTIONS

A. "housing"

Amsted's Proposed Construction	Defendants' Proposed Construction
"an enclosure"	"one or more parts that covers, encloses, supports, or protects other components"

39. The term "housing" appears in claim 2 of the '223 Patent. A PHOSITA would understand the plain and ordinary meaning of "housing" is "one or more parts that covers, encloses, supports, or protects other components."

40. The purpose of a housing is to support and protect mechanisms, including delicate electronic components. Housings in the electromechanical fields allow for easier handling, keep components in place, and protect components from debris and damage. In the context of a railcar, which is outdoors and subject to a wide variety of weather conditions (e.g., wind, dust, rain, and snow), a PHOSITA would understand that a housing serves to protect components from exposure to the harsh outdoor environment.

41. The specification discloses several types of housings, including: (1) embodiments shown in Figs. 1-5B (denoted as component 14); and (2) the "adapter pads" of U.S. Pat. Nos. 7,698,962 (HUM0002770) (the "'962 Patent") and 7,688,218 (HUM0003936) (the "'218 Patent") (collectively, the "LeFebvre Patents"). While the housing embodiments shown FIGS. 1-5B of the '223 Patent appear to be hollow enclosures, the '223 Patent explicitly states "housing" also encompasses the adapter pads of the LeFebvre Patents, which are *not* hollow enclosures:

> In another alternate embodiment of the invention, one or more motes may be housed in alternative housings or built into the railcar itself. In one such embodiment, motes can be built into the form of an

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> adapter pad similar to the type shown in U.S. Pat. Nos. 7,698,962 and 7,688,218, the disclosures of both of which are incorporated herein by reference, which could be adapted for use with the present invention.

'223 Patent, 15:18-24.

42. The '962 Patent "relates to elastomeric substrates positioned between relatively rigid objects to attenuate shock or vibration, prevent abrasion or control movement, the substrates containing embedded sensors to measure static or dynamic loads, load position, shear forces, temperature or other parameters of interest, as well as data processing and storage devices to interpret signals from the sensors and communication devices to transmit the data from the sensors to an end user for evaluation." '962 Patent, 1:6-16; *see also id,* 1:40-48 ("The object of this invention is to provide a deformable, load-bearing substrate which provides a compliant interface between relatively rigid objects and which contains embedded and enclosed within itself one or more sensors that can detect and communicate the conditions in the substrate, such as temperature and/or various stresses and the distributions thereof, thus, providing a means for monitoring, either continuously or periodically, the interactions between the solid objects and the conditions prevailing at or near their interface."); 6:7-19; 6:34-43. FIGS. 1 and 2 show sensor interface 10, which comprises a "flexible substrate 12." *Id.* 2:66-67. Sensors 22, 24 and 26, data processing unit 28, communication links 30, data storage device 32, communication device 34, and power source 38 are embedded within substrate 12. *Id.,* 3:16-67.

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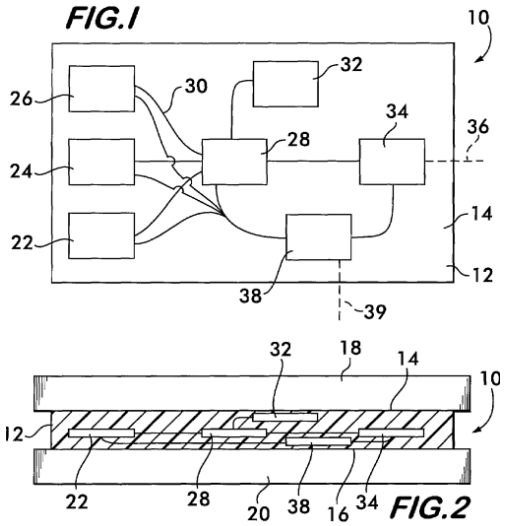

'962 Patent, FIGS. 1-2.

43. FIG. 4 of the '962 Patent illustrates the "sensor interface 10 positioned between a bearing adaptor 44 and the side frame 48 of the railcar truck or bogie …" *Id.* at 4:15-17. "The sensor interface comprises a load bearing pad 50 formed of a flexible, resilient polymer which damps vibration and vertical, horizontal and longitudinal loads between the bearing adapter 44 and the side frame 48." *Id.* at 4:21-25. "Sensors and electronic devices are embedded within fore and aft interface portions 52 and 54 which are shaped to accommodate the bearing adapter and side frame pocket." *Id.* at 4:27-29.

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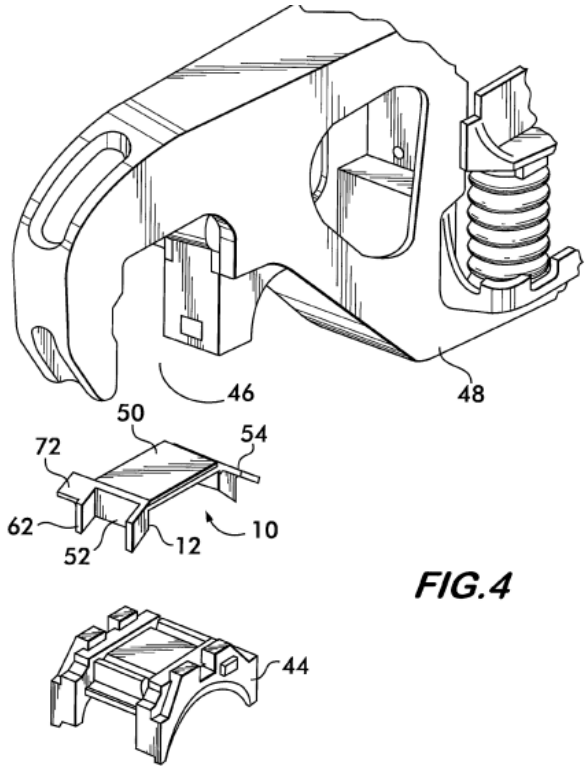

FIG.4

'962 Patent, FIG. 4.

44. FIG. 5 of the '962 Patent shows "pad portion 52 … compris[ing] a flexible, resilient substrate 12 in which the sensors and electronic components are embedded." *Id.* at 4:31-33. Data processing unit 28, data storage device 32, and communication device 34 "are embedded within an appendage 72," which is "a portion of the substrate 12 that extends outwardly and is not positioned between any relatively moving parts, and therefore, insulated from loads or deflections, thereby protecting the electronic devices embedded therein." *Id.*, 4:50-59.

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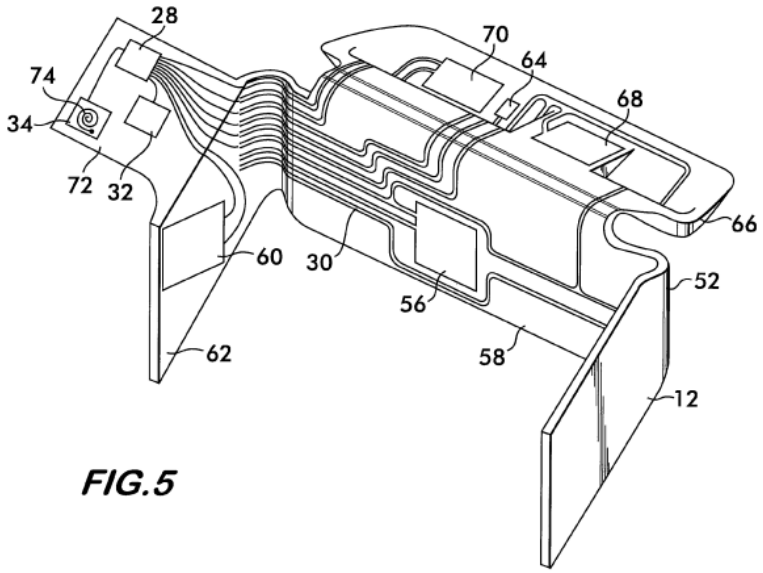

FIG.5

'962 Patent, FIG. 5.

45. Similarly, the adapter pads of the '218 Patent are "preferably comprised of a cast or injected molded elastomeric polymer" and "contain[] a plurality of sensors 5 which are preferably embedded into its upper, side and lower surfaces." '218 Patent, 3:19-20; 3:32-37. "In [the] preferred form, the pad 16 has an extended attachment portion 17 located so as to be relatively isolated from the forces transmitted through the adapter 16. The extended portion 17 contains a power source 18, an analog/signal conditioning means and analog to digital conversion means and an associate microprocessor unit 19 and a communications unit 20 …" *id.* at 37-43. FIG 4 of the '218 Patent shows an adapter pad that is nearly identical to the '962 Patent:

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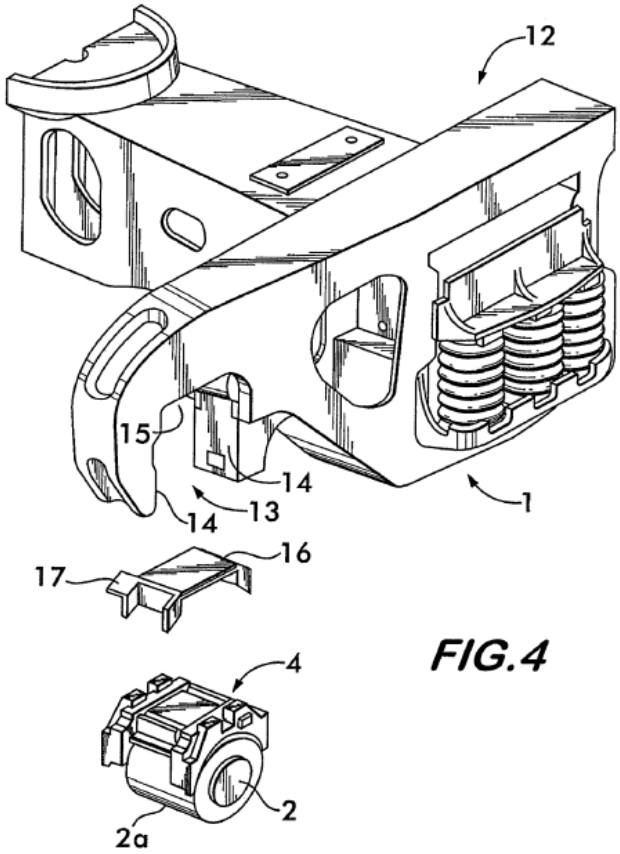

FIG.4

'218 Patent, FIG. 4.

46. A PHOSITA would therefore understand that the "housing" of Claim 2 of the '223 Patent is not limited to any particular housing and includes both hollow enclosures and those that are not hollow but generally cover, enclose, support, or protect sensors and other componentry of the sensor units and taught in the '962 and '218 Patents. In fact, the specification of the '223 Patent teaches the housing may include potting material within the housing taught in FIGS. 1-3A to protect the components from harsh railroad environments. '223 Patent, 4:10-22 ("After the various components are installed within the housing 14 as described below, a potting material (not shown) is provided through openings in the housing 14 to maintain, encapsulate and environmentally seal the components within. Any suitable electrical potting material capable of protecting the electric circuitry and components from the harsh railroad environment can be

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used, where harsh weather, UV exposure, humidity, vibration, mechanical impact, thermal shocks and abrasion might occur while the device is in operation. Such materials include epoxies, polyurethanes and silicone compounds. A flexible urethane suitable for electrical use and through which wireless signals of the frequencies to be used can be transmitted is preferred.") This potting material would fill some or all of the empty space within the housing, and would protect the components in the same way as the flexible, resilient polymer adapter pads of the '962 and '218 Patents.

47. The specification's description of "housing" is consistent with the plain meaning of "housing" and does not suggest a narrower meaning to housing than the plain and ordinary meaning. The specification's teachings are also consistent with general dictionary definitions of "housing". *See* HUM0061847 ("Something that covers, protects, or supports"); HUM0061889 ("something that covers or protects"); HUM0061965 ("anything that covers or protects"); HUM0062051 ("Something that covers, protects, or supports"); HUM0062180 ("That which serves to enclose, support, and protect. For example, such a housing utilized to contain an instrument.")

48. Amsted's proposed construction—"an enclosure"—is improperly narrow in view of the plain and ordinary meaning of housing and the specification's description of various types of "housings" described above. "An enclosure" may suggest a housing that comprises a container or casing wherein components are enclosed within an interior cavity of the container or casing. This, however, is only *one* housing embodiment taught by the '223 Patent, and it excludes the "alternative housings" of the LeFebvre Patents expressly incorporated by reference into the '223 Patent.

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B. "communication management unit"

Amsted's Proposed Construction	Defendants' Proposed Construction
"a single device capable of receiving and transmitting information"	"a device capable of receiving data and/or alarms from one or more motes (e.g. sensor units) and capable of transmitting data and alarm information to a remote receiver"

49. The term "communication management unit" appears in claims 2, 5, 10, 26, and 32 of the '223 Patent, claims 14 and 21 of the '673 Patent, and claims 1, 21, 25 and 30 of the '915 Patent.

50. The '223 and '673 Patents provide an explicit definition of "communication management unit." A PHOSITA would therefore know to apply that definition to the claims. The '223 and '673 Patents state "[t]he term 'Communication Management Unit' or 'CMU' as used herein means any device capable of receiving data and/or alarms from one or more motes 10 and capable of transmitting data and alarm information to a remote receiver." '223 Patent, 7:4-8; '673 Patent, 8:3-6. Because the claims of the '223, '673, and '915 Patents do not use the term "motes," and instead refer to the CMU receiving data from "sensors" (claims 1 and 30 of the '915 Patent), "sensor devices" (claim 2 of the '223 Patent), "sensor units" (claim 5 of the '223 Patent; claim 14 of the '673 Patent), and "sensing units" (claim 21 of the '673 Patent), the construction is more readily understood in the context of the claims if "10" is deleted and "(e.g., sensor units)" is added after "motes", i.e., "any device capable of receiving data and/or alarms from one or more motes (e.g., sensor units) and capable of transmitting data and alarm information to a remote receiver."

51. The claims, specification, and prosecution history are consistent with the explicit definition provided in the specification. In fact, it appears that "communication management unit" was defined to encompass various embodiments of the specification. *See, e.g.,* '223 Patent,

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2:55-64; 3:48-59; 4:66-5:23; 5:57-6:7; 6:65-8:10; 11:29-45. Specifically, this definition reflects embodiments wherein the CMU receives only data from the sensor motes/units and the CMU analyzes the data and generates alarms which are then communicated to a remote receiver *and* embodiments wherein the CMU receives *both* data and alarms from the sensor motes/units and communicates both to a remote receiver. In either event, the CMU is capable of transmitting alarms and alarm information to a remote receiver, whether the determination of whether to raise an alarm occurs at the sensor motes/units or the CMU.

52. "Communication management unit" also appears in claims 1, 21, 25, and 30 of the '915 Patent. Although the '915 Patent does not expressly define "communication management unit," the specification is consistent with the definition provided in the '223 and '673 Patents. "The CMU 101 is capable of receiving data and/or alarms from one or more WSNs 104 and is capable drawing inferences from this data or alarms regarding the performance of railcar 103, and of transmitting data and alarm information to a remote receiver." '915 Patent, 4:4-8; *see also* 4:47-53 ("A wireless sensor node ('WSN'), shown in the drawings as reference number 104, see, e.g., FIGS. 1 and 2, is located on a railcar 103, and provides the functions of collecting data from internal sensors and analyzing the data collected from the sensors to determine if the data needs to be transmitted immediately, held for later transmission, or aggregated into an event or alert."); 6:41-46 ("Main board 402*a,* daughter board 402*b* or the sensors may also include a processor executing firmware to provide intelligence sufficient to perform low-level analysis of the data, and may accept parameters from outside sources regarding when alarms should be raised, as described below.") 8:7-16 ("If an alert or event condition is detected by a WSN 104, as described in more detail below, a message is forwarded by WSN 104 to CMU 101 for further analysis and action, for example, to confirm or coordinate

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alert or event conditions reported by one WSN 104 with other WSNs 104 in the railcar-based mesh network 105. If an alert or event is confirmed by CMU 101, a message is sent to PWG 102 installed on an asset, preferably with access to a power source and/or to an off train monitoring and remote railroad operations center 120."); 9:8-13 ("Each WSN 104 is able to make a determination of when to report data that may indicate a possible event or alarm condition to CMU 101. CMU 101 is able to collect such notifications from each WSN 104 under its control and coordinate the data to make a final determination as to whether or not an event or alarm condition actually exists.").

53. Amsted's proposed construction is wrong for several reasons. First, it ignores the express definition provided in the specification. Second, it eliminates portions of the definition provided in the '223 and '673 Patent specifications. Specifically, it removes the CMU's capability of receiving alarms and transmitting ***alarm*** information. Third, it imports a limitation into the claim by limiting "communication management unit" to a "single" device. The specification of the '223 and '673 Patents state that "CMU 32 is preferably a single unit …" '223 Patent, 7:8-9. By stating the "communication management unit" is *preferably* a single unit indicates to a PHOSITA that the specification contemplates CMUs that are *not* a single unit.

C. "heuristics / a heuristic / heuristically analyzing"

Amsted's Proposed Construction	**Defendants' Proposed Construction**
"one or more rules to be applied to data"	Indefinite, or alternatively: "one or more rules to be applied to data to assist in drawing inferences from said data"

54. The term "heuristics," or a variant thereof, appears in claims 5 and 26 of the '223 Patent and claims 1, 14, and 21 of the '673 Patent. Specifically:

- Claims 5 and 26 of the '223 Patent require that the "communication management unit

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applies heuristics to analyze data";

- Claim 1 of the '673 Patent requires "**applying a heuristic** to said received data to determine deviations from nominal operating conditions";
- Claim 14 of the '673 Patent requires "**heuristically analyzing** said received data"; and
- Claim 21 of the '673 Patent requires "analyzing said collected data by **applying heuristics** thereto."

55. The shared specification of the '223 and '673 Patents does not expressly define the term "heuristics."[1]

56. In my experience, the term "heuristics" does not have a single, plain and ordinary meaning that would be understood by a PHOSITA. Instead, the term has multiple definitions, several of which are commonly used in the art.

57. Dictionaries most commonly define "heuristics" as a problem-solving technique that involves trial-and-error or learning from experience. *See* HUM0061844 ("Of or relating to a usu. speculative formulation guiding the investigation or solution of a problem; . . . *Computer Science* Relating to or using a problem-solving technique in which the most appropriate solution is selected at successive stages of a program for use in the next step of the program."), HUM0061929 ("*Computing* proceeding to a solution by trial and error"), HUM0061962 ("of, pertaining to, or based on experimentation, evaluation, or trial-and-error methods . . . *Computers, Math*. pertaining to a trial-and-error method of problem solving used when an algorithmic approach is impractical."), HUM0062006 ("of or relating to exploratory problem-solving

[1] For consistency, all my citations to the shared specification use to the column and line numbering as it appears in the '223 Patent.

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techniques that utilize self-educating techniques (as the evaluation of feedback) to improve performance"), and HUM0062177 ("An approach to problem solving which involves trial-and-error, and learning from experience. By employing directed procedures, the range of possible solutions for any given problem is continually reduced until the solution or answer is found. Any of various methods may be utilized, as opposed to a fixed sequence."). In my experience, this is a common meaning of "heuristics" used in the art. The '223 and '673 Patents, however, do not describe (or even suggest) the use of trial-and-error techniques. I therefore do not believe that this common definition of "heuristics" is applicable to the '223 and '673 Patents.

58. The term "heuristics" can also mean "one or more rules to be applied to data to assist in drawing inferences from said data." This meaning is also reflected in dictionary definitions. For example, Webster's New World Dictionary has defined "heuristic" as a method that "proceeds along empirical lines, using rules of thumb, to find solutions or answers." *See* HUM0062099, HUM0062144.

59. In many instances, the shared specification of the '223 and '673 Patents uses the term "heuristics" in a manner consistent with "one or more rules to be applied to data to assist in drawing inferences from said data." In other instances, however, the specification describes "heuristics" that involve nothing more than *measuring* a property of interest. *See* '223 Patent, 8:11–11:28. These embodiments are not "heuristics" under any definition I have previously encountered. In fact, as I will discuss in detail below, the specification uses the term "heuristics" so inconsistently, and to describe such widely varying embodiments, that the term appears to have no ascertainable meaning or boundaries at all.

60. For example, the '223 Patent, col. 1, lines 14–22 defines the "invention" as follows:

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> This invention relates to a real-time monitoring and analysis system for railcars, and, more particularly, to a system that gathers data regarding various operating parameters and conditions from remote sensors and **applies heuristics to analyze the data to detect and/or predict operational failures**.

In other words, the system ***applies one or more rules to data*** (i.e., applies heuristics to analyze the data) to assist in ***drawing inferences from said data*** (i.e., detecting or predicting operational failures). The specification includes several other passages where "heuristics" is used to mean "one or more rules to be applied to data to assist in drawing inferences from said data." *See* '223 Patent, 1:65–2:9; 2:10–17; 2:55–64; and 2:65–3:7.

61. Other portions of the specification, however, use the term "heuristics" inconsistently. For example, the '223 Patent at col. 8, lines 5–10 states:

> 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. The chart below contains examples of the types of mote sensors **10** and high level descriptions of the heuristics applied to analyse the data.

This paragraph is followed by a lengthy chart, beginning at col. 8, line 11 and continuing through col. 11, line 28 of the '223 Patent. The chart identifies the following "heuristics" that can be applied by the CMU:

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Parameter Sensed	Sensor Type	Output	Heuristic
. . .			
Hatch Position	Reed Switch	Hatch open/close	Determine open/closed state dependent upon state of switch.
Pressure	Pressure Transducer	Brake pressure	The pressure transducer is fitted directly to the trainline for measuring pressure.
. . .			
Strain	Load Cell	Car Load	Load cell on multiple places of the truck.
Displ.	Reed Switch	Handbrake On/Off	Position of a handbrake chain is determined and correlated to On/Off Status.

62. These embodiments involve nothing more than *measuring* the property of interest. Specifically:

- The "heuristic" to determine the hatch position involves using a reed switch to directly measure whether the hatch is open or closed.
- The "heuristic" to determine the pressure in the brake line involves using a sensor "fitted directly to the trainline for measuring pressure."
- The "heuristic" to determine the car load involves using load cell sensors to directly measure the load.
- The "heuristic" to determine the position of the handbrake involves using a reed switch to directly measure the position of the handbrake chain.

Stated differently, these "heuristics" involve nothing more than *collecting data*. This is entirely

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inconsistent with the meaning of "heuristics" used elsewhere in the specification, which is "one or more rules to be applied to data to assist in drawing inferences from said data."

63. I am not aware of any commonly understood definition of "heuristics" that would be broad enough to encompass the embodiments listed above. If "heuristics" is broad enough to encompass simply *measuring* some property of a railcar component, then its scope is so broad as to be effectively meaningless. A PHOSITA would not be able to understand what is and, more importantly, what ***is not*** a "heuristic" in view of these examples.

64. For example, in view of the "brake pressure" embodiment, any conceivable method of determining the brake pressure would appear to be a "heuristic."

- Measuring the brake pressure *directly*, using a pressure sensor attached directly to the line, is expressly identified as a "heuristic" in the chart beginning at col. 8, line 11 of the '223 Patent.
- Determining the brake pressure *indirectly*—using one or more rules to infer or estimate the pressure—would be a "heuristic" under the apparent meaning of the term used in other portions of the specification.

65. It is therefore my opinion that "heuristics" and its related terms are indefinite, because a PHOSITA cannot determine with reasonable certainty what "heuristics" means—or what its scope and boundaries are—in the context of the '223 and '673 Patents.

66. I have also been asked, in the alternative, to consider the most plausible construction that could be given to the term "heuristics" in the context of the '223 and '673 Patents (in the event it is not indefinite). In my opinion, the meaning of "heuristics" that is most applicable to the subject matter disclosed in the '223 and '673 Patents is "one or more rules to be applied to data to assist in drawing inferences from said data." This definition, admittedly, does

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not encompass the disclosed embodiments for "hatch open/close," "brake pressure," "car load," and "handbrake on/off." *See* '223 Patent, 8:11–11:28. As I have explained above. I am not aware of *any* definition of "heuristics" that that could encompass these embodiments, which is a basis for my conclusion that "heuristics" is indefinite. Other portions of the specification, however, use "heuristics" to mean "one or more rules to be applied to data to assist in drawing inferences from said data," as I have detailed above. *See* '223 Patent, 1:14–22; 1:65–2:9; 2:10–17; 2:55–64; and 2:65–3:7.

67. Amsted's proposed construction, "one or more rules to be applied to data," is deficient for at least two reasons. ***First***, Amsted's proposed construction does not require drawing an inference, which is an important aspect of the meaning of "heuristics." A PHOSITA would understand that "heuristics" are used to obtain an estimate, a prediction, or a "best guess" based on the available data. Conversely, an algorithm that provides an exact answer would not ordinarily be called a "heuristic." This is an element of all commonly used definitions of "heuristics" that I am aware of. *See, e.g.,* HUM0061962 (defining "heuristic" as "pertaining to a trial-and-error method of problem solving used when an algorithmic approach is impractical"). HUM0062177 ("Any of various methods may be utilized, as opposed to a fixed sequence.").

68. A PHOSITA would understand that heuristics are useful in circumstances where it is impossible or impractical to directly observe or measure the property of interest. For example, it is impractical, as a matter of routine maintenance, to visually inspect the surface of every roller bearing on a railcar for damage or defects. However, it is known that damaged or defective bearings often exhibit an increased temperature while in use. This forms the basis for a well-known heuristic: if the bearing temperature is unusually high, one can *infer* that the wheel bearing is likely damaged or defective, without the need to make a direct observation.

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69. The asserted claims are also consistent with the PHOSITA's understanding that heuristics are used to *draw inferences* from data. For example, claims 5 and 26 of the '223 Patent and claims 1, 14, and 21 of the '673 Patent all require that heuristics are used (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—in other words, to *draw inferences* from the collected data.

70. ***Second***, I have been informed by counsel that there is a strong presumption against a claim construction that excludes a disclosed embodiment. Amsted's proposed construction does not encompass the embodiments for "hatch open/close," "brake pressure," "car load," and "handbrake on/off," which I discussed at length above. *See* '223 Patent, 8:11–11:28. These embodiments do not involve "one or more rules to be applied to data" and are therefore not included within Amsted's proposed construction.

71. Accordingly, for the reasons I have explained above, it is my opinion that "heuristics" and its related terms are indefinite.

D. "actual failure"

Amsted's Proposed Construction	**Defendants' Proposed Construction**
Plain and ordinary meaning, no construction necessary or provided.	"a state where the component is no longer capable of performing its intended function"

72. The term "actual failure" appears in claims 5 and 26 of the '223 Patent and claims 14 and 21 of the '673 Patent.

73. In my opinion, a PHOSITA would understand that the term "actual failure" in the context of the '223 and '673 Patents means "a state where the component is no longer capable of performing its intended function."

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74. Amsted has proposed that "actual failure" be given its plain and ordinary meaning. In my view, the definition proposed by Hum *is* the plain and ordinary meaning of "actual failure." I agree with Hum that the Court should expressly construe the term "actual failure" in order to clarify its meaning and to distinguish it from the term "potential or actual failures," which I will discuss in the following section.

75. A PHOSITA would understand that in the railroad industry, a component is considered to be "failed" only when it is completely unable to perform its intended function. Components that are merely worn, degraded, or operating below their peak efficiency are not considered to have "failed." This is for good reason—it would be completely impractical to replace railcar components at the first sign of wear or mechanical damage.

76. Railcars often run thousands of miles between scheduled maintenance intervals. And many components are designed to have extremely long lifetimes. Wheel bearings, in particular, can often run for 100,000 miles or more before they require replacement. It is therefore commonplace for railcars to have numerous components that have experienced mechanical wear or degradation, and which may be operating below their peak efficiency. In many cases, components can continue to operate for tens of thousands of miles before they ultimately fail (that is, cease to function) or are replaced.

77. Hum's proposed construction of "actual failure" is consistent with common dictionary definitions. For example, Webster's New World College Dictionary defines "actual" as "existing in reality or in fact; not merely possible, but real; as it really is," *see* HUM0062123, and defines "failure" as "a breakdown in operation or function." *See* HUM0062138. Other common dictionaries provide similar definitions, all of which are consistent with the definition proposed by Hum. For "actual," see HUM0061826 ("existing and not merely potential or

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possible"), HUM0061871 ("really existing"), HUM0061910 ("existing now"), HUM0061947 ("existing now; present; current"), HUM0061986 ("existing in act and not merely potentially"), HUM0062075 ("existing at present or at the time"). For "failure," see HUM0061838 ("a cessation of proper functioning or performance"), HUM0061886 ("an abrupt cessation of functioning"), HUM0061926 ("nonperformance; nonoccurrence; breaking down or ceasing to function"), HUM0062000 ("a state of inability to perform a normal function"), HUM0062042 ("a cessation of proper functioning"), HUM0062093 ("a breakdown in operation or function").

78. The shared specification of the '223 and '673 Patents is entirely consistent with the definition of "actual failure" proposed by Hum. For example, the '223 Patent, col. 1, lines 14–22 defines the "invention" as follows:

> This invention relates to a real-time monitoring and analysis system for railcars, and, more particularly, to a system that gathers data regarding various operating parameters and conditions from remote sensors and applies heuristics to analyze the data **to detect and/or predict operational failures**.

A PHOSITA would understand that an "operational failure" is the state where the component no longer operates, and that this term is synonymous with "actual failure." The specification also states that "[e]ven minor mechanical failures could lead very quickly to a catastrophic failure, not only of a single railcar, but of the entire train." '223 Patent, 1:39–41. "It is therefore an objective of this invention to provide a comprehensive system which allows the wireless collections of data and the analysis of that data to predict operational failures and to provide adequate warning of those failures to allow for human intervention before a catastrophic failure occurs." *Id.* at 3:8–13. These passages are, again, consistent with a PHOSITA's understanding that mechanical "failures" are circumstances wherein a component has ceased to function, and not merely circumstances where components have experienced some degree of wear or are

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operating below peak efficiency.

79. Additional evidence is provided by the prosecution history of the '673 Patent. For example, the publication EP2650191, which Amsted submitted on the July 6, 2017 Information Disclosure Statement and which appears in full at pages 259 to 266 (HUM0001669-HUM0001676) of the '673 Patent's prosecution history, clearly distinguishes between bearings that are merely "worn or damaged" and bearings that have actually failed.

> **[0002]** Safe and reliable operation of a railroad system may be dependent upon the integrity of the rolling mechanisms of the vehicles travelling over the rails, such as trains. Worn or damaged train wheel bearings may increase the rolling friction of the axle thereby increasing the power required to pull the train. In addition, worn or damaged bearings may cause excessive wear to the train axle and, in the case of failure of the bearing, may even cause the axle to lock up, preventing rotation of the wheel and thus resulting in a potential fire hazard due to the heat build up and potential sparking caused by friction of the locked wheel scraping along the rail.

'673 Prosecution History at 260 (HUM0001670). "Worn or damaged" bearings may increase the rolling friction of the axle, as compared to new or undamaged bearings, but still remain capable of performing their intended function. Failed bearings, in contrast, are no longer operational and may "cause the axle to lock up, preventing rotation of the wheel." This is consistent with a PHOSITA's understanding that a component has actually "failed" only when it is no longer capable of performing its intended function (e.g., allowing a wheel to rotate).

80. It is therefore my opinion that the term "actual failure" in claims 5 and 26 of the '223 Patent and claims 14 and 21 of the '673 Patent should be construed as "a state where the component is no longer capable of performing its intended function."

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E. "potential or imminent failures"

Amsted's Proposed Construction	Defendants' Proposed Construction
Plain and ordinary meaning, no construction necessary or provided.	"an increased likelihood of experiencing an actual failure in the future"

81. The term "potential or imminent failures" appears in claims 5 and 26 of the '223 Patent and claims 14 and 21 of the '673 Patent.

82. In my opinion, a PHOSITA would understand that the term "potential or imminent failures" in the context of the '223 and '673 Patents means "an increased likelihood of experiencing an actual failure in the future."

83. As I have explained in detail above with respect to the term "actual failure," in the railroad industry, a component that is worn or degraded, but remains operational, has not experienced an "actual failure." The component, however, may be in a state of "potential or imminent failure" if there are indications that an actual failure is likely to occur soon. In contrast to an "actual failure," a "potential or imminent failure" is a failure that may occur at some point in the future, but has not yet actually occurred.

84. Hum's proposed construction of "potential or imminent failure" is consistent with common dictionary definitions. For example, Webster's New College Dictionary defines "potential" as "capable of being but not yet in existence," *see* HUM0062066, and defines "imminent" as "about to occur at any moment." *See* HUM0062054. "Failure" is defined as "a breakdown in operation or function," as I have discussed in the preceding section. *See* HUM0062138. Other common dictionaries provide similar definitions, all of which are consistent with the definition proposed by Hum. For "potential," see HUM0061865 ("capable of being but not yet in existence"), HUM0061901 ("existing in possibility : capable of becoming

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actual"), HUM0061941 ("capable of coming into being or action"), HUM0061977 ("possible, as opposed to actual"), HUM0062024 ("something that can develop or become actual"), HUM0062066 ("capable of being but not yet in existence"), HUM0062111 ("that can, but has not yet, come into being"). For "imminent," see HUM0061850 ("about to occur"), HUM0061932 ("about to happen"), HUM0062012 ("ready to take place"), HUM0062102, HUM0062147 ("likely to happen without delay; impending").

85. The shared specification of the '223 and '673 Patents is entirely consistent with the definition of "potential or imminent failures" proposed by Hum. For example, the '223 Patent, 1:32–35 states that "[c]ar owners increasingly seek to implement preventative maintenance programs to ***predict and avoid*** mechanical failures in the field and to efficiently schedule repairs at a facility and time of their choice." (emphasis added.) In other words, car owners are increasingly interested in making repairs when a component is nearing the end of its useful lifetime, but before a mechanical failure has ***actually*** occurred.

86. It is therefore my opinion that the term "potential or imminent failures" in claims 5 and 26 of the '223 Patent and claims 14 and 21 of the '673 Patent should be construed as "an increased likelihood of experiencing an actual failure in the future."

F. "alarm / alarm condition"

Amsted's Proposed Construction	**Defendants' Proposed Construction**
Plain and ordinary meaning, no construction necessary, in the alternative: a. alarm - "a warning or notice" b. alarm condition - "a status or occurrence giving rise to a warning or notice"	Alarm: "an audible or visual warning or alert intended to draw immediate attention" Alarm Condition: "a condition giving rise to an audible or visual warning or alert intended to draw immediate attention"

87. The term "alarm" appears in claim 22 of the '223 Patent. The term "alarm condition" appears in claims 1, 6, 15, 16 and 22 of the '673 Patent.

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88. Claim 22 of the ’223 Patent claims:

> The system of claim 5 wherein **an alarm** is raised based [on] 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.

89. “Alarm,” used as a noun in the claim, has a well-understood meaning in the art – a visual and/or audible warning or alert intended to draw immediate attention. Commonly used alarms, including, for example, fire alarms, burglar alarms, or car alarms, are generally understood to generate a visual or audible warning (like a flashing light or beeping noise) that serves to call immediate attention to a dangerous or potentially problematic situation. The purpose of an alarm is not just to provide a warning or notice of a particular event or condition, but to ensure the warning or notice is recognized as quickly as possible.

90. The language of claim 22 of the ’223 Patent is consistent with the commonly understood meaning of “alarm.” Claim 22 requires “[t]he system of claim 5 wherein ***an alarm is raised*** based [on] one or more of the following criteria” and then provides five criteria in which pre-determined percentages of data readings or a rate of change of data readings exceed some alarm threshold value. A PHOSITA would understand that “raising” an alarm indicates a warning sound or signal triggered by data that exceeds thresholds indicating a dangerous situation.

91. The specification of the ’223 and ’673 Patents is also consistent with the commonly understood meaning of “alarm.” The Background of the Invention explains “it is

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desirable to detect and report deviations from operational norms or predictions of impending failure to the locomotive or to a central data handling facility as *quickly as possible,* allowing for timely human intervention." '223 Patent, 1:41-44. It also explains that the claimed invention "provides regular assurance of proper performance and condition as well as necessary warnings of impending or actual failure in a *timely and useful manner* to the operators [] of the train" *Id.* at 2:25-28. These objectives of the claimed invention would not be achieved unless the claimed "alarm" is designed to gain the immediate attention of train operators in a locomotive or at a base station to ensure timely corrective measures are taken.

92. The specification repeatedly teaches the collection, communication and processing of sensor data, and raising or forwarding alarms when problems are detected. *Id.* at 2:51-54 ("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."); 3:54-55 ("The sensors monitor and/or collect data on particular parameters and conditions of the railcar. If a problem is detected, alarms can be forwarded for further action."); 5:4-10 ("Main board 28 may also include intelligence sufficient to perform low-level analysis of the data, and may accept parameters from outside sources regarding when alarms should be raised. For example, for the mote 10 shown in FIGS. 1 and 2, with a temperature sensor 20, may be programmed to raise an alarm when the sensed temperature exceeds a certain threshold for several consecutive readings."); 5:65-6:5 ("The ambient temperature sensor 10 will communicate the ambient temperature to the CMU, which provides this information to the sensors at the bearing adapters as they call for the information. This will allow the sensors 10 at the bearing adapter 12 to determine the bearing temperature and then determine if further action is required, such as communicating an alarm of high temperature.");

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11:52-54 ("Incoming alerts may appear on the display and are accompanied by an audible alarm, which must be acknowledged and cancelled by the driver.")

93. Whether alarms should be raised and where alarms are forwarded depends on the severity of the alarm and action required. For example, data readings that are slightly outside the normal range (e.g., a slightly elevated temperature or pressure reading) may indicate a minor or developing mechanical issue that warrants maintenance. In some situations, a report that lists or summarizes such minor deviations may be useful. For example, during a routine maintenance window, such a report could be used by maintenance technicians to identify components that may require maintenance. On the other hand, minor deviations generally do not warrant raising an ***alarm*** within the locomotive or the base station while the train is in motion. Instead, in my experience, alarms are used only to indicate serious or critical issues that require immediate action and, if left unaddressed, could result in damage to the train or injuries to its occupants. A PHOSITA would understand that sending an excessive number of minor "nuisance" alarms to the locomotive or base station would actually be counterproductive, as they may lead the train operators to ignore the alarms or treat them with less urgency, which could potentially lead to catastrophic consequences. For that reason, minor issues are properly presented as notices or reports—and not as alarms that require immediate attention.

94. Consistent with this understanding, the specification explains that "[s]etting locomotive alarm thresholds at values that are subcritical will likely lead to an excess of stoppages and delays. As such 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." *Id.* at 11:61-64. For example, a "Stage 1" "Bearing Temp Alarm" is sent to "base station only" and is "[u]sed for trending

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recommendations and repeat offender identifications." *Id.* at 13:6-9. The Bearing Temp Alarm is only sent to the base station because it is severe enough to warn the base station of a problem that needs attention but not severe enough to stop the train. In contrast, "Stage 2", "Stage 3", and "Stage 4" alarms indicate more severe problems requiring the train to be stopped, which necessarily means the alarm must be sent to the locomotive and draw the crew's attention to the problem immediately. *Id.* at 13:11-43. For a Stage 2 "Axle Differential Alarm" and a Stage 3 "Above Ambient Alarm", after the train is stopped to "check journal of alarm bearings" and "[l]ook for any signs that the bearing is 'walking off' the axle, grease is being purged or the bearing has been damaged", the train "[p]roceed[s] at a predetermined reduced maximum speed until stage [2 or 3] 'alarm clear' message is received at the locomotive terminal." *Id.* at 13:11-40. For a Stage 4 "Critical Alarm", the train must be stopped and the bearing removed. *Id.* at 13:41-43. In each of the Stage 1 through Stage 4 alarm situations, a mere warning or notice of a problem that is not designed to draw immediate attention from the locomotive crew or base station would not ensure the required corrective action occurs in a timely manner.

95. The specification is consistent with general dictionary definitions of "alarm." HUM0061829 ("A warning of danger"; "A device that serves to warn of danger by a sound of signal"; "The sounding mechanism of an alarm clock"); HUM0061913 ("A warning sound or device"); HUM0061950 ("any sound, outcry, or information intended to warn of approaching danger"; "an automatic device that serves to call attention, to rouse from sleep, or to warn of fire, smoke, an intruder, etc."; "a warning sound; signal for attention"; "to warn of danger; rouse to vigilance and swift measures for safety"); HUM0061989 ("a signal (as a loud noise or flashing light) that warns or alerts"); HUM0062033 ("A warning of imminent danger"; "A device that warns of danger by means of a sound or signal"; "The sounding mechanism of an alarm clock or

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watch"); HUM0062126 ("a signal, sound, cry, etc. that is a warning of danger"; "a mechanism designed to warn of danger or trespassing *[a burglar alarm]*"; "the bell, buzzer, etc. of an alarm clock"; "to warn of approaching danger"); HUM0062165 ("An electrical and/or mechanical device which serves to warn by means of a signal, such as sound and/or light").

96. The prosecution history of the '223 Patent also supports a construction of "alarm" that requires "an audible or visual warning or alert intended to draw immediate attention." During prosecution of the '223 Patent, the Examiner rejected the claims over U.S. Patent No. 8,244,411 to Baker (HUM0002794) ("Baker") in view of a non-patent publication to Lat-Lon. '223 Patent file history, November 4, 2014 Non-Final Rejection, HUM0000927. The Examiner found that Baker "does not explicitly disclose wherein said device determines an alarm condition based on collected data. Baker does disclose activating, monitoring, controlling and communicating based on sensed data, but does don't [sic] detail an alarm condition being communicated. However, Lat-Lon teaches sending an immediate message when temperature crosses your defined threshold." *Id.* at HUM0000929-930 (citing Lat-Lon, HUM0000950 ("Alarm thresholds can be configured to send an immediate message via e-mail or any mobile device. All alarms and alarm thresholds can be set-up and updated at any time from your computer. Examples of alarm messages include: Temperature-Sends immediate message when temperature crosses your defined threshold.")). Accordingly, the Examiner found "[i]t would have been obvious to one of ordinary skill in the art at the time the invention to modify the Bakers device, to incorporate sending an alarm, as taught by Lat-ton, for the purpose improving monitoring of railcars if an incident occurs, the device will alert needed personal." *Id.* HUM0000930.

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97. Baker teaches:

> The orientation-based sensing apparatus of the present invention includes a transmitter unit having a body housing a microprocessor, a transmitter, and one or more accelerometers sufficient to measure changes in the direction of the transmitter housing relative to gravity. The transmitter housing is mounted on an operable component of a feature of a vehicle for which it is desirable to monitor. The vehicle is preferably a railroad freight car, but may be any other similar type of vehicle. The transmitter will transmit orientation data at predetermined time intervals to a receiver on the vehicle, which will in turn process the information, add additional information such as GPS location, and wirelessly send the data to a database that is available to a customer over the Internet. A plurality of transmitters on the vehicle will monitor several features of the vehicle and periodically send transmissions to the receiver with the status of the monitored feature. The receiver includes a microprocessor with a database identifying the transmitters to be monitored, and may be powered down during the intervals between transmissions from the transmitters.

Baker, 1:65-2:17.

98. Baker further teaches "Referring once again to FIG. 1, receiver 10 is positioned on railcar 14 in any convenient location. Receiver 10 is a device capable of receiving data from a plurality of transmitters 12, adding additional data such as GPS location, time, other sensor data and housekeeping data, and sending that data through a secondary wide-area network such as GSM/GPRS, satellite, Wi-Fi or other means that will move the data on to the Internet for reception at a server computer." *Id.* at 5:5-12; *see also* 5:25-40 ("A microprocessor 88 receives various data and signals from receiver circuitry 90, and is powered by batteries which are charged from the solar panels 84. Receiver circuitry 90 includes a GPS receiver for receiving tracking information from various satellites of the GPS. This data is transmitted in digital form from the GPS receiver to the microprocessor 88. Data from the GPS is processed by the microprocessor 88 and formatted as a data packet. As noted above, the receiver 10 will also receive data from the various transmitters 12 and identify each transmitter 12 from a database in

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the microprocessor 88. Upon receipt of data from transmitters 12, receiver 10 will check the data packet for errors and add other data available to the receiver (such as GPS location and accurate time stamp). Receiver 10 will then use a wireless Internet connection to transmit the data to a web-site/database facility for customer access via the Internet.")

99. Baker also explains that "[b]ecause there are many different types of conditions on a railcar that it is desirable to monitor, including: (1) whether the car is loaded or empty, (2) whether a hatch is open or closed, (3) whether a handbrake is set or released, (4) whether a door is open or closed, etc., it is important that the detectors have the ability to sense a variety of different motions or positions of critical vehicle features." *Id*. at 1:44-50. The foregoing conditions are important to monitor because they may indicate intervention is required, e.g., closing a hatch or door or releasing a handbrake.

100. Baker, therefore, teaches sensor units (i.e., transmitters 12) that monitor conditions on a railcar and send sensor data to receiver 10, which processes the data and transmits the processed data over the Internet to a server, where that data can be further processed to detect conditions on the railcar that may require attention. As correctly noted by the Examiner, this transmission of processed sensor data to a server does not constitute an "alarm condition being communicated" or "sending an alarm." The Examiner correctly found that *Lat-Lon* teaches the transmission of alarm or alarm condition because it transmits "alarm messages" via e-mail or any mobile device, which are sent "immediate[ly]" when a threshold is exceeded or a "state changes, such as an open door or hatch." '223 Patent file history, November 4, 2014 Non-Patent Literature; November 4, 2014 Non-Final Rejection, HUM0000929-930. Thus, the immediacy of the alarm message is consistent with a PHOSITA's understanding of the customary meaning of "alarm."

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101. Similarly, it is my opinion a PHOSITA would understand the customary meaning of "alarm condition" is "a condition that triggers an audible or visual warning or alert intended to draw immediate attention." *See, e.g.,* HUM0062165 ("A circumstance, such as an emergency or malfunction, which triggers an alarm").

102. "Alarm condition" appears in claims 1, 6, 15, 16, and 22 of the '673 Patent. Independent claim 1 of the '673 Patent requires "assigning a severity level to said deviations from nominal operating conditions; and determining an alarm condition based on said assigned severity level." Claim 6 depends from claim 2, which depends from claim 1, and requires "transmitting said alarm condition to a location remote from said railcar." Claim 15 depends from claim 14, which requires "heuristically analyzing said received data to determine if an actual failure exists on said railcar or to predict potential or imminent failures based on a statistical analysis of said received data", and further requires "wherein each of the sensing units can make a determination of an alarm condition based on data collected by the sensing unit, said method further comprising the step of: a. wirelessly receiving notice of said alarm condition from said sensing unit; and b. communicating said alarm condition to an off-railcar location." Claim 16 also depends from claim 14 and further comprises the steps of "making a determination of an alarm condition based on data received from two or more of said sensing units; and communicating said alarm condition to an off-railcar location." Claim 22 depends from claim 21, which requires "analyzing said collected data by applying heuristics thereto to (i) determine if an actual failure exists and (ii) to predict potential or imminent failures based on a statistical analysis of said collected data", and further comprises the steps of "assessing the collected data to determine if an alarm condition exists; and wirelessly communicating said alarm condition to an off-railcar location."

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103. The only reference to an "alarm condition" in the '673 Patent specification aside from the claims is in the Abstract, which states "A system for monitoring operation of a railcar having one or more sensing units, mounted on the railcar, for monitoring operating parameters and or conditions of the railcar, and a communication management unit, in wireless communication with the sensing units, wherein the system can make a determination of an alarm condition based on data collected the sensing units." While this single reference to "alarm condition" provides little guidance, in addition to the discussion of "alarm" in the specification, the claims themselves show that an alarm condition necessarily triggers an alarm. For example, independent claims 14 and 21 require analyzing sensor data to determine if an actual or potential or imminent failure exists, but dependent claims 15, 16, and 22 *further* require determining if an "alarm condition" exists. A PHOSITA would understand that this means that not every actual, potential, or imminent failure necessarily results in an alarm condition, but only those severe enough to raise an alarm requiring timely intervention.

104. Dependent claim 8 of the '673 Patent, which depends from claim 2 which in turn depends from claim 1, also shows that an "alarm condition" necessarily gives rise to or triggers an alarm. Claim 8 requires "determining an alarm condition based on said assigned severity level" and "transmitting ***said raised alarm*** to a display unit on a train of which said plurality of railcars are a part." Because the only other reference to an "alarm" in claims 1, 2, and 8 is "alarm condition," a PHOSITA would understand that "said raised alarm" refers to "alarm condition." In this context, it is my opinion a PHOSITA would understand an "alarm condition" necessarily triggers an alarm.

105. Amsted's proposed constructions of "alarm" and "alarm condition" are overly broad, contrary to the customary meaning of "alarm," and inconsistent with the specification.

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The specification explains that an objective of the claimed invention "provides regular assurance of proper performance and condition as well as necessary warnings of impending or actual failures in a timely and useful manner to the operators [] of the train" *Id.* at 2:25-28. But merely providing a "warning or notice" in a manner that does not immediately draw attention to the warning or notice does *not* provide "warnings of impending or actual failure in *a timely and useful* manner."

106. Further, the specification makes clear that "data" is different than "alarms." *Id.* at 7:4-8 ("The term 'Communication management Unit' or 'CMU' as used herein means any device capable of receiving data and/or alarms from one or more motes 10 and capable of transmitting data and alarm information to a remote receiver."); 11:28-33 ("As shown in FIG. 6, CMU 32 also communicates data and 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 station 44, or both. Data and/or alarms may be relayed from land-based base station 44 to the mobile base station 42."). Data may provide notice or warning of a problem or potential failure (*see. e.g.* 12:46-61), but an alarm is intended to alert the locomotive or base station so that action is taken as soon as possible.

G. "assigning a severity level"

Amsted's Proposed Construction	**Defendants' Proposed Construction**
"assigning one from a plurality of known values indicating seriousness"	Plain and ordinary meaning, no construction needed

107. The term "assigning a severity level" appears in claim 1 of the '673 Patent. Claim 1 of the '673 Patent claims:

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> A method of monitoring operational characteristics of a railcar comprising the steps of:
>
> a. receiving data or processed information regarding said operational characteristic from one or more sensing units on said railcar, said sensing units monitoring an operational characteristic of said railcar;
> b. applying a heuristic to said received data to determine deviations from nominal operating conditions;
> c. ***assigning a severity level*** to said deviations from nominal operating conditions; and
> d. determining an alarm condition based on said assigned severity level.

108. Based on the context of the claim and in view of the specification, the term "assigning a severity level" to deviations from nominal operating conditions would be understood by a PHOSITA and requires no construction.

109. The claim language is straightforward. The system analyzes sensor data to determine deviations from nominal operating conditions, assesses the severity of the deviation, and based on that severity determination, determines whether an alarm condition exists. Because the claim only requires assigning *a* severity level, meaning *one* severity level, a PHOSITA would understand the severity level could be assigned from two or more levels.

110. A PHOSITA would understand that assigning a severity level to deviations from nominal operating conditions and determining an *alarm condition* based on said severity level would encompass a system that makes a binary assignment of severity, i.e., a deviation is either severe enough or not severe enough to raise an alarm, *and* a system that assigns various severity levels to raised alarms.

111. The specification is consistent with the plain and ordinary meaning. It explains that the claimed system "improves … the ability to determine the severity of detected conditions to determine if immediate alarms should be raised to facilitate human intervention." '673 Patent, 2:16-22. Thus, a PHOSITA would understand "assign a severity level" encompasses assigning a

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severity level selected from two options (i.e., severe enough to raise an alarm versus not severe enough to raise an alarm) *or* selected from more than two options (i.e., tiered levels of alarm severity).

112. During prosecution of the '673 Patent, Amsted distinguished U.S. Patent No. 6,339,397 to Baker (HUM0002658) ("Baker '397") on the basis that Baker '397 does not teach "assigning a severity level to said deviations from nominal operating conditions" and "determining an alarm condition based on said assigned severity level." '673 file history, October 13, 2017 Response to Office Action, HUM0001411 at HUM0002034. Amsted argued that in the claimed invention, "determining an alarm condition based on the assigned severity level avoids an excess of stoppages and delays that could result if an alarm was generated for every deviation that is detected." *Id.* at HUM0002035. Baker '397, in contrast, teaches a receiver transmitting "multiple alarm states, [and] high and low priority alarm alerts" to a microprocessor. *Id.* at HUM0002034-2035. "As such, Baker sends both high and low priority alarm alerts as part of the data that is transmitted from a receiver to a microprocessor" and therefore, according to Amsted, "does not teach or suggest assigning a severity level or determining an alarm condition based on that severity level." *Id.*

113. The specification and prosecution history make clear that a purpose of assigning severity levels and determining an alarm condition based on that severity level is to ensure only deviations severe enough to require immediate action by the locomotive crew or the base station should raise an alarm. Thus, a PHOSITA would understand that "assigning a severity level" includes assigning a level that is either (1) severe enough to raise an alarm; or (2) not severe enough to raise an alarm.

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114. Amsted's construction impermissibly narrows "assigning a severity level" to "assigning one from a plurality of known values indicating seriousness." But the claim language does not require a plurality; it only requires "assigning *a* severity level" and determining an alarm condition based on that severity level.

H. "a pre-determined percentage of current data readings"

Amsted's Proposed Construction	Defendants' Proposed Construction
Plain and ordinary meaning, no construction necessary, in the alternative: "a previously determined amount of data readings taken at a time or over a time span"	"a previously determined percentage calculated from two or more data points"

115. The term "**a pre-determined percentage** of current data readings" appears in Claim 22 of the '223 Patent.

116. In my opinion, a PHOSITA would understand the term "a pre-determined percentage" means "a previously determined percentage calculated from two or more data points."

117. I understand Amsted and Defendants agree "pre-determined" means "previously determined." In my opinion, this construction is consistent with the '223 Patent specification. '223 Patent, 13:11-42, 13:57-62, 14:38-41. I also understand this construction is also consistent with dictionary definitions for "pre-determined" and, in my opinion, is what a PHOSITA would understand the term to mean. *See* HUM0061980 ("to settle or decide in advance"), HUM0062069 ("to determine, decide, or establish ahead of time"), HUM0062114 ("to determine, decide, or decree beforehand").

118. A PHOSITA would understand a "percentage" calculation requires more than one data reading to calculate. Also, a PHOSITA would understand Amsted's proposed construction of "a previously determined amount of data readings taken at a time or over a time span" could

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encompass a single data reading (i.e., "taken at ***a*** time"). A PHOSITA would understand this is incorrect because the term requires more than one data reading – as the claim language itself explicitly calls for "data ***readings***" (plural). Therefore, in my opinion, Amsted's proposed construction for "a pre-determined percentage" is incorrect because it is entirely inconsistent with the explicit language in Claim 22 of the '223 Patent.

119. Amsted's construction is incorrect because it adds unnecessary and unsupported language to the claim. Specifically, Amsted's construction includes "taken at a time or over a time span" which is not supported by the claim language or specification.

120. In my opinion, the specification of the '223 Patent further supports Defendants' construction. For example, in the specification, any mention of "percentage" requires a comparison of ***values*** (plural). *See* '223 Patent, 13:57-14:2 ("percentage of temperature ***values***"); 14:38-52 ("percentage of bearing temperature ***values***").

121. Dictionary definitions for "percentage" are consistent with this construction. *See, e.g.,* HUM0061974 ("a rate or proportion *per hundred*"). A PHOSITA would understand a rate or proportion, by definition, must be calculated from at least two data points.

122. It is therefore my opinion that "a pre-determined percentage of current data readings" in claim 22 of the '223 Patent should be construed as "a previously determined percentage calculated from two or more data points."

I. "one or more software filters configured to isolate one or more types of accelerations"

Amsted's Proposed Construction	Defendants' Proposed Construction
"a computer program capable of processing and passing selected data"	"a software program executed by a processor programmed to decrease noise from unwanted acceleration frequencies and increase signals from acceleration frequencies of interest"

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123. The term "one or more software filters configured to isolate one or more types of accelerations" appears in Claim 25 of the '915 Patent.

124. In my opinion, a PHOSITA would understand the claimed "software filters configured to isolate one or more types of accelerations" means "a software program executed by a processor programmed to decrease noise from unwanted acceleration frequencies and increase signals from acceleration frequencies of interest."

125. The specification of the '915 Patent expressly discusses the "software filter" as a type of filter that performs filtering "by software executing on a processor." '915 Patent, 5:35-40. Therefore, a PHOSITA would understand a "software filter" requires a software program executed by a processor to filter accelerations data.

126. A PHOSITA would understand the term "configured to" in the context of Claim 25 means "programmed to." Dictionary definitions confirm the common meaning to a PHOSITA of "configured to" in the computing field. *See, e.g.*, HUM0061959 ("to insert batch files into (a program) to enable it to run with a particular computer"), HUM0062087 ("the way in which a computer and peripheral equipment are interconnected and programmed to operate as a system").

127. A PHOSITA would have understood it is desirable to include a filter in any data collection and processing system to get rid of unwanted data, and/or to identify and amplify particularly relevant data. In any data collection analysis, data is almost always filtered in some manner. Therefore, the specification of the '915 Patent supports a PHOSITA's understanding that a software filter "isolat[ing] one or more types of accelerations" means the software filter "*decrease[s] noise from unwanted acceleration frequencies and increase signals from acceleration frequencies of interest*." '915 Patent, 5:40-42.

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128. In my opinion, Amsted's proposed construction reads out limitations from the claim. Claim 25 recites as follows:

> The system of claim 1, further comprising one or more wireless sensor nodes in communication with at least one of the communication management units, wherein the one or more sensors form part of the one or more wireless sensor nodes, wherein one or more of the wireless sensor nodes comprises a microprocessor configured to execute firmware to control operation of the one or more of the wireless sensor nodes, *wherein the firmware comprises one or more software filters configured to isolate one or more types of accelerations*.

129. Amsted's proposed construction of "a computer program capable of processing and passing selected data" ignores the definition of "software filter" explicitly set forth in the specification. '915 Patent, 5:35-40.

130. Amsted's construction also ignores the "types of accelerations" limitation. "Accelerations" is explicitly required by the claim limitation. '915 Patent, Claim 25. In my opinion, Amsted's construction which ignores "accelerations" and instead imports the ambiguous "selected data" language is not how a PHOSITA would have construed or understood the term. Specifically, Amsted's construction creates more confusion than clarity, by adding the language "passing selected data", which has no support in the claim language or relevant parts of the specification. A person reading the claim with Amsted's proposed construction would ask, "What does 'passing selected data' mean? How would a PHOSITA determine how to 'select' data?" In my opinion, a PHOSITA would not have construed or understood the term in this manner.

131. Amsted's proposed construction ignores the term "configured to." In my opinion, "capable of" is not correct in Amsted's proposed construction. A PHOSITA would understand to be "configured" means something is made for the purpose of accomplishing a specified

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objective, not simply that it *can* be made to perform those functions. A real-world example illustrates this point: a single piece of paper. A piece of paper is a substrate that is "configured to" bear writing, painting, printing, etc. But a piece of paper is also "capable of" being folded into the shape of an airplane and thrown in the air. A PHOSITA would understand the difference between the two.

132. Dictionary definitions also show the difference of being "configured to" carry out a particular function, versus being merely "capable of" something. For example, Webster's 2001 Dictionary defines "capable of" as: "having the ability or capacity for." *See* HUM0062193; *see also* HUM0062199 ("able or ready to"), HUM0062202 ("able or ready to"), HUM0062196 ("having ability or capacity"). I am not aware of any definition of "configure" that includes the term "capable." *See* HUM0061959 ("to insert batch files into (a program) to enable it to run with a particular computer"), HUM0061923 ("the interrelating or interconnecting of a computer system or elements of it so that it will accommodate a particular specification"), HUM0062087 ("the way in which a computer and peripheral equipment are interconnected and programmed to operate as a system"). Therefore, a PHOSITA would understand "capable of" is not synonymous with "configured to."

133. I understand Amsted may be relying on a particular portion of the '915 Patent specification for the phrase "passing selected data", describing a preferred embodiment: "These sensor sections *select the data* to be analyzed using a digital data filter 1204, 1210 or 1216, and *passes* this data on to a feature detector 1206, 1212 or 1218." '915 Patent, 13:11-24. Amsted's reliance on this preferred embodiment when the specification clearly defines this term elsewhere is incorrect.

134. Additionally, Amsted's construction confuses the functions being carried out by

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the "digital filter", "sensor sections", and "feature detectors" and imports this limitation onto the "software filter" of Claim 25 – which has no support in the specification.

135. In my opinion, Amsted's inclusion of "computer program" in its proposed construction improperly broadens the scope of the claim. A PHOSITA would understand a "computer program" can encompass many things other than software, so Amsted including "computer program" in its proposed construction is an improper broadening of the intended meaning of this claim term.

136. It is therefore my opinion that the term "one or more software filters configured to isolate one or more types of accelerations" in Claim 25 of the '915 Patent should be construed as "a software program executed by a processor programmed to decrease noise from unwanted acceleration frequencies and increase signals from acceleration frequencies of interest."

J. "one or more mechanical filters that include a resilient material configured to filter out undesirable accelerations"

Amsted's Proposed Construction	Defendants' Proposed Construction
Plain and ordinary meaning, no construction necessary, in the alternative: "at least one component made of a resilient material capable of suppressing or removing unwanted accelerations"	"a filter made of resilient material designed for the purpose of filtering high and low frequencies from the signal of interest"

137. The term "one or more mechanical filters that include a resilient material configured to filter out undesirable accelerations" appears in Claim 23 of the '915 Patent.

138. A PHOSITA would understand the claimed "one or more mechanical filters that include a resilient material configured to filter out undesirable accelerations" means "a filter made of resilient material designed for the purpose of filtering high and low frequencies from the signal of interest."

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139. The specification of the '915 Patent explicitly describes a "mechanical filter." '915 Patent, 5:23-40, 6:11. Amsted's proposed construction of "at least one component made of a resilient material capable of suppressing or removing unwanted accelerations" is entirely inconsistent with the definition of "mechanical filter" in the specification, and therefore, in my opinion, incorrect.

140. A PHOSITA would understand the term "configured to" in the context of Claim 23 means "designed for the purpose of." Dictionary definitions confirm the common understanding of "configured to" in the context of mechanical structures to a PHOSITA., For example, Webster's dictionary defines "configure" to mean: "***to design*** or adapt to form a specific configuration or ***for some specific purpose***." *See* HUM0061959; *see also* HUM0062087 ("to construct or arrange in a certain way").

141. Again, the specification of the '915 Patent describes "filter[ing] out undesirable accelerations" within the context of Claim 23 means "to mechanically filter high and low frequency types of accelerations that are considered noise which are preferably removed from the signal of interest." '915 Patent, 5:23-27. A PHOSITA would have understood it is desirable to include a filter in any data collection and processing system to get rid of unwanted data, and/or to identify and amplify particularly relevant data.

142. Amsted's proposed construction ignores the term "configured to." In my opinion, "capable of" is not correct in Amsted's proposed construction. As I previously discussed, a PHOSITA would understand to be "configured" means something is made for the purpose of accomplishing a specified objective, not simply that it *can* be made to perform those functions. A real-world example illustrates this point: a single piece of paper. A piece of paper is a substrate that is "configured to" bear writing, painting, printing, etc. But a piece of paper is also "capable

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of" being folded into the shape of an airplane and thrown in the air. A PHOSITA would understand the difference between the two.

143. Dictionary definitions also show the difference of being "configured to" carry out a particular function, versus being merely "capable of" something. For example, Webster's 2001 Dictionary defines "capable of" as: "having the ability or capacity for." *See* HUM0062193; *see also* HUM0062199 ("able or ready to"), HUM0062202 ("able or ready to"), HUM0062196 ("having ability or capacity"). I am not aware of any definition of "configure" that includes the term "capable." *See* HUM0061959 ("to insert batch files into (a program) to enable it to run with a particular computer"), HUM0061923 ("the interrelating or interconnecting of a computer system or elements of it so that it will accommodate a particular specification"), HUM0062087 ("the way in which a computer and peripheral equipment are interconnected and programmed to operate as a system"). Therefore, a PHOSITA would understand "capable of" is not synonymous with "configured to."

144. Further, Amsted's construction creates more confusion than clarity, by adding the language "suppressing or removing unwanted accelerations", which has no support in the claim language or specification. A person reading the claim would ask, "What does 'suppressing or removing unwanted accelerations' mean? How would a PHOSITA determine how to 'suppress' or 'remove' data?" A PHOSITA would not have construed or understood the term in this manner.

145. It is therefore my opinion that the term "one or more mechanical filters that include a resilient material configured to filter out undesirable accelerations" in Claim 23 of the '915 Patent should be construed as "a filter made of resilient material designed for the purpose of filtering high and low frequencies from the signal of interest."

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K. "one or more digital filters"

Amsted's Proposed Construction	Defendants' Proposed Construction
"a component capable of processing and passing selected data in a digital format"	Plain and ordinary meaning, no construction needed.

146. The term "one or more digital filters" appears in Claim 28 of the '915 Patent. A PHOSITA would have understood this term by its plain and ordinary meaning. A PHOSITA would have understood it is desirable to include a filter in any data collection and processing system to get rid of unwanted data, and/or to identify and amplify particularly relevant data. In any data collection analysis, data is almost always filtered in some manner. Therefore, a PHOSITA would understand a "digital filter" is a filter used in data collection and processing systems to decrease noise from unwanted digital signals and increase signals from digital signals of interest. A PHOSITA would understand a digital filter filters digital signals – not analog signals. Dictionaries further confirm the definition of "digital" does not include "analog." *See* HUM0062090 ("cf. ANALOG"), HUM0062135 (same).

147. A PHOSITA would not have understood this term to mean "a component capable of processing and passing selected data in a digital format." Additionally, Amsted's inclusion of "…passing selected data" in the proposed construction would, as explained further below, have been ambiguous and confusing to a PHOSITA.

148. Claim 28 recites: "The system of claim 1, wherein the one or more filters comprise *one or more digital filters*." '915 Patent, Claim 28. Amsted's proposed construction reads out limitations from the claim, and creates more confusion than clarity, by adding the language "passing selected data", which lacks sufficient support. A person reading the claim would ask, "What does 'passing selected data' mean? How would a PHOSITA determine how to

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'select' data?" In my opinion, a PHOSITA would not have construed or understood the term in this manner.

149. I understand Amsted may be relying on a part of the '915 Patent's specification for the phrase "passing selected data", which describes a preferred embodiment: "These sensor sections *select the data* to be analyzed using a digital data filter 1204, 1210 or 1216, and *passes* this data on to a feature detector 1206, 1212 or 1218." '915 Patent, 13:11-24. Amsted's reliance on this preferred embodiment when the specification clearly defines this term elsewhere is incorrect.

150. Further, Amsted's construction adds the language "digital format", which is redundant. As I previously noted, a PHOSITA would have understood the plain and ordinary meaning of the term "digital filters" to include only filtering of digital signals. In other words, a PHOSITA would understand, by definition, that "digital filters" process digital signals – not analog signals. Therefore, Amsted's proposed construction of "a component capable of processing and passing selected data *in a digital format*" is redundant.

151. In my opinion, the claim term "digital filter" needs no construction, because a PHOSITA would have had no difficulty in understanding this term in the context of data collection and processing systems. I agree with Defendants that "digital filter" does not require construction and should be given its plain and ordinary meaning, as discussed above.

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I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code.

March 31, 2023

Steven Ricca

STEVEN RICCA

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ATTACHMENT 1

STEVEN RICCA, MSEE

3092 Avalon Rd, Columbus, Ohio 43221
SteveRicca@Columbus.RR.Com / 614-915-4648

Electrical Engineer experienced developing new products, process control solutions, and providing leadership of engineering projects and teams.

Creating competitive advantages using Stage-Gate and Agile/Scrum methods as appropriate, I can develop products and solutions by designing custom electronics, using COTS industrial controls, and then develop the functionality and connectivity by programming software.

My project, program and group leadership skills are focused on establishing the objectives, planning, execution, and validation – with milestones, reporting and adjusting. Leading by example, I enable team members to demonstrate their talents while mentoring and developing skills throughout the team.

My field experience, customer and sales related interfacing skills allow me to translate customer needs, application realities, and regulatory requirements into engineering documents and ideas which communicate the project roadmap, engineering requirements, work packages and lead to better project estimating, competitive bidding and progress tracking.

These experiences allow me to analyze project risks and select the best approaches for success. I enjoy fast paced environments with lots of unknowns and projects with exposure to different challenges, people and applications. I have often interfaced and worked alongside the sales and marketing departments assisting to find the best strategies to win business and exceed customer expectations.

QUALIFICATIONS / EXPERIENCE OVERVIEW

BSEE / MSEE with many innovative design solutions, process improvements and achievements.

Areas of expertise include HVAC controls including gas heating, DX/CW and energy/humidity management, food processing, high-powered LED lighting, bulk material handling, rotating machinery predictive maintenance monitoring, medical equipment automation, solar energy, weighing applications, test systems, and oil/gas generation controls.

Designs of industrial systems using industry standard equipment such as PLC and HMI controls, sensors, programming, power distribution/switchgear and MCC's, motor starters, VFD's, electro-mechanical and pneumatic/hydraulic devices. Systems developed using standard communications to BMS/BAS, and cloud/edge topologies.

Higher volume OEM product development skills include circuit design, schematic capture and PCB layout. Analog and digital hardware design using microcontrollers, FPGAs, simulations, serial communication, embedded firmware/software in assembler, scripting languages and 'C'. Power supply design, BLDC/servo drivers, data acquisition, sensor interfacing, design for manufacturing and test (DFM/DFT), approvals/certifications, and FMEAs,

Project and people management skills include risk analysis, road mapping, budgeting, troubleshooting, reporting, mentoring, excellent communication and presentation skills. Experience in both Stage-Gate and Agile/Scrum engineering design environments. Designs for the aerospace, medical, food and other regulated fields including many designs requiring certifications (UL / ETL / CSA / TUV / CE) .

Work History

Vertiv - Delaware, Ohio Mar 2021 - Present

Lead Electrical Engineer, Single Phase UPS Global Division

- Lead global team of 45 electrical engineers developing uninterruptible power supplies for single-phase applications in high volume markets.
- Established design standards, templates, process and documentation controls for electrical designs including schematics, PCB layout, FW development, and design reviews.
- Mentor EE associates through design challenges, work with PMs on progress and schedules.
- Optimize existing designs for cost reductions and proper operation with Lithium batteries.
- Named #3 top innovator company-wide in August 2022

Ricca Engineering, LLC – Columbus, OH **Owner / Lead Engineer** Jan 2020 - Present

- Development of electronic controller for use in an agricultural application.. Design features touch screen, embedded PLC and custom electronics development to control a 100HP generator towed behind large equipment. Built electronics for 40 field trial units including 7 PCBs each.
- Provided technical opinions, reports and testimony for legal firms in patent infringement cases.
- Designed test/calibration equipment for a robotic surgery OEM's manufacturing cells.

EDG, Inc – Consulting Engineers - Westerville, Ohio Sept 2018 – Nov 2019

Senior Instrumentation and Controls Engineer

- Designed electrical controls for bulk material handling involving many types of conveyor technologies, pumps and compressors for land based sites, oil/gas fracking stations and off-shore platforms.
- Electrical load sizing, 3-phase power distribution with motor control centers (MCC), variable frequency drives (VFD), and over-current protection coordination studies, flow diagrams, sequence of operation, one-line diagrams, and PLC / HMI programming specification documents.
- Several large contracts fell through which resulted in a lack-of-work layoff ending this position.

Henny Penny Corporation – Eaton, Ohio Oct 2016 – June 2018

Lead Automation Controls Engineer - Contractor

- Key architect and technical originator on team developing automated equipment involving fryers, freezers, and packaging solutions for fast food chains. Performed all programming of PLCs, HMI, and servo motors.
- Developed hardware and software system architecture, selected all electrical components including sensors, VFDs, PLC, HMI, conveyors, pumps and vision recognition sensors.
- Lead team through brainstorming, specifications, prototyping, experimentation, customer acceptance tests, refinements and presentations to stakeholders.
- Named inventor on three patents related to automated cooking equipment.

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Ricca Engineering, LLC – Columbus, OH **Owner / Lead Engineer** Feb 2016 – Jan 2017

Projects and contract roles during this time:

- Chief Technical Officer for a mid-stage start-up company manufacturing high volume high-power LED lighting for highways, parking lots, stadiums, indoor farming, and airport apron lighting applications.
- Developed system architecture for an automated beverage dispensing product for a start-up company.
- Designed and programmed PLC controls for several motorized interactive museum exhibits.
- Generated a report and provided expert testimony for an automotive patent infringement case.
- Developed automated PLC controls with HMI for a manufacturing test cell.

Hughey and Phillips – Urbana, Ohio Jan 2014 – Feb 2016

Director of Engineering

- Managed engineering group developing critical aerospace obstruction lighting devices.
- Developed system platform architecture and product roadmap planning to take products to LEDs.
- Highly involved in electronic circuitry and software design of analog/digital/microprocessor products.
- Named inventor of US patent # 10,106,276, “Obstruction lighting system configured to emit visible and infrared light” and US patent # 9,572,223, “Precision color-controlled light source” .
- Marketing, sales and engineering departments moved to Florida after acquiring another company.
- Continued to assist as technical consultant to company after leaving position.

Ricca Engineering, LLC – Columbus, OH **Owner / Lead Engineer** June 2013 – Jan 2014

- Assisted local company with high volume microprocessor controlled electric heat controller for semi-conductor and precision process heating applications.

ADB Airfield Solutions (Now ADB-Safegate) – Gahanna, Ohio Feb 2010 – May 2013

Electrical Engineering Group Leader

- Managed electrical engineering group designing aerospace airfield lighting products.
- Introduced Stage-Gate design methods, design reviews, FMEAs and other process improvements.
- Highly involved with NPI / NPD R&D, change orders, cost reduction and marketing and sales efforts.
- Coordinated efforts between engineering and other departments: logistics, quality, sales, tech services, marketing, and manufacturing production.
- Key technical contributor on redesign of microprocessor controlled 4KW to 30KW power supplies.
- Trained and worked with service personnel to troubleshoot and overcome field issues and then used these experiences to improve products. Made many trips to field for new product introductions, troubleshooting and discussions with industry influencers regarding new products.
- Interfaced and presented highly technical matters to outside customers and the FAA.
- Appointed member on the FAA’s “Electrical Infrastructure Requirements for Tomorrow” technical test team comprised of engineering leaders in the airfield lighting industry - reporting to the FAA.

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Ricca Engineering, LLC – Columbus, OH **Owner / Lead Engineer** Nov 2008 – Mar 2010

Projects and contract roles during this time:

- Lead electrical engineer for a start-up company developing a solar concentrating photovoltaic and thermal energy system. Produced a functioning system of proprietary sun tracking hardware/software controls including custom PCBs, and software. Selection and qualification of solar inverters as well as power distribution and heat exchanger components. Technical oversight of field installations in Ohio including at several utility testing sites. Company sold to Chinese firm.
- Development of a portable measurement and data collection system for a US Air Force program to optically measure water content in hydraulic fluids using IR Pyroelectric detectors. Developed custom microprocessor electronics, PCB layouts, and software.
- Development of a high-volume consumer motion detector LED light with solar power recharging.
- Reverse engineered a competitor's product and provided a detailed report for a client which allowed them to justify a larger redesign project to stay competitive.
- Designed, wired, and programmed PLC controls for several motorized interactive museum exhibits.
- Performed expert analysis for several legal firms and cases involving medical, automotive and consumer product liabilities and patent infringement cases.

Battelle Memorial Institute – Columbus, OH March 2006 – Nov 2008

Principal Electrical Engineer – Medical Development Solutions Group

- Lead Electrical Engineer on a project developing a clinical diagnostic product to optically identify bacterial strains at high speed. Developed system architecture, servo motor controls, sensors, custom PCBs, isolation strategies, custom UPS controls and wiring harness designs.
- Performed high-voltage research and development for an electrostatic sprayer that can apply pesticides or sanitizers from greater distances yet the particles self-attach to all sides of the target.
- Improved reliability of an OEM's motorized hospital bed product line featuring an electromechanical mattress inflation control system with a six stepper motor valve body.

Invensys Controls (Now Schneider Electric) – Plain City, OH June 2004 – March 2006

Senior Electrical Engineer – HVAC Equipment Controls / Lead EE Automotive Climate Controls

- Lead Electrical Engineering for high-volume gas fired heating control products used in furnace, fireplace, appliances, water heaters, building automation systems and residential climate controls.
- Performed FMEA's, circuit and software design reviews of hundreds of control products for latest safety compliance including other product divisions at this Engineering center – namely Refrigeration Controls, Smoke Detectors, HVAC Zoning Controls, Automotive Controls and Thermostats.
- Lead Electrical Engineer for the automotive climate control group and interfaced with OEMs to develop cabin zoning controls involving motorized blending doors, and multi-port water valves.
- Developed a new automotive product family to replace an older condenser freeze protection control.

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Ricca Engineering, LLC – Columbus, OH **Owner / Lead Engineer** July 2002 – June 2004

Projects and contract roles during this time:

- Served as Director of Engineering for a start-up medical electronics diagnostics company. Named inventor on a patent - "Zero Corrected Optical Blood Glucose Analyte Detector" (US #7039448).
- Researched issues and redesigned the PCB layout for several large LED price signs for a high-volume gas station sign chain OEM to solve heat distribution issues that were warping boards.
- Designed a golf putting input sensor prototype using high-speed optical sensing for video gaming.
- Consultant to a start-up company developing a urine collection bag with very accurate level sensing printed on the side with conductive ink. Led to patent application.
- Performed expert technical testing and report generation for two legal firms.

Dynalab Test Systems - Reynoldsburg, OH June 1997 - July 2002

Senior Electronic Engineer

- Developed microprocessor and FPGA based high-speed cable and harness testing analyzers used by automotive, aerospace, medical and appliance manufacturers.
- Development of custom PCBs, cost reductions and innovative expansion methods to grow the product line.

Danninger Medical Technology - Dublin, OH Nov 1995 - June 1997

Senior Electronic Engineer

- Developed products, designed circuits and wrote embedded software for motorized medical rehabilitation products.
- Redesigned BLDC/servo motor drive circuitry and PCB for manufacturing cost reduction.
- Developed solid-state heating/cooling therapy products used during patient recovery.
- Assisted in transfer of intellectual property to acquiring company.

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IRD Mechanalysis (Now part of Allen-Bradley) - Worthington, OH Sept 1990 - Dec 1995

Senior Project Engineer

- Developed rotating machinery vibration and sensor data acquisition systems for predictive monitoring applications. Industries served included power generation (make-up air fans, boiler and oil-feed pumps, turbines), transportation systems (railcar wheels and tunnel fans), machining centers to gauge tool wear, paper mills (pumps and web break detection), petrochemical processing plants (crackers, compressors), and HVAC control interface (pumps, chillers, cooling tower fans and compressors).
- Developed control cabinets and equipment to measure bearing vibration and temperature in critical fans and pumps used to decommission stockpiles of military chemical weapons at eight US sites.
- Designed semi-automated end-of-line test stations for General Motors transmission, alternator, starter and electric accessory motor divisions. These typically used PLCs and a LabVIEW operator interface.
- Coordinated all project cycle engineering functions: design, costing, scheduling, project management, selecting and supervising sub-vendors, testing, training and managing field service staff.

Toledo Scale (Now Mettler-Toledo) – Worthington, OH July 1988 - Sept 1990

Engineer

- System design and new product development including embedded programming of retail scales, truck and rail scales, food batching controls, industrial controls and package sorters. Many of these applications were industry firsts (CAT truck scales, shingle and keg weighers, RPS scan/sort system).
- Lead firmware engineer for new retail scale which included an integrated printer and three microprocessors. This product was a huge success and sold over 100K units/yr for several years.

Other Useful Knowledge, Experiences and Skills

- Experience with batteries of various chemistries (Ni-Cad, NiMH, LIO, LFP, more)
- Experience with EMI/ESD, shielding, grounding, and surge protection.
- PLC controls – Koyo/GE Fanuc, Allen-Bradley, Automation-Direct, Velocio and HMI's.
- Working knowledge of Carel, Labview, Omron, Siemens, and Modicon programmable controls.
- Programming languages include 'C', assembly language(s), Verilog / VHDL, other script based.
- PCB layout tools – Altium Designer, PCAD, Eagle, KiCad, Mentor.
- Circuit simulation with LT Spice and vendor specific tools, EasyPower.
- Mechanical CAD programs: DesignCad 3-D, AutoCad, Navisworks, Visio Pro, Lucid Chart.
- Best practices and requirements for many standards: UL, CSA, ETL, NEC, FAA, FDA, NFPA.
- Product designs using TE cooling modules, cartridge, strip, immersion and flex heaters.
- HVAC designs with DX and CW cooling systems, ERVs, economizers, UV purifiers, condensing boilers, water-to-air heat exchangers, humidity controls, and BAS / BMS systems.
- Experience with air and hydraulic controls and actuators.
- Excellent understanding of combustion engines and mechanical systems of many types.
- Familiarity with several manufacturing ERP / MRP systems, DOORS, PDM Works.
- Experience with many company quality systems and manufacturing methods.
- Experienced in light construction design and MEP, building methods plus national codes.

Formal Education		**Completion Date**
Ohio University, Athens, OH	Master of Science in Electrical Engineering	June 1988
Ohio University, Athens, OH	Bachelor of Science in Electrical Engineering	November 1986
FE / EIT - Fundamentals of Engineering		June 1986

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