

## **CARR ENGINEERING, INC.**

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### **Technical Biography for Steven E. Kent**

I am a resident of the State of Texas and an employee of Carr Engineering, Inc. (CEI), a Texas corporation at 12500 Castlebridge Drive, Houston, Texas 77065. I received my bachelor's degree in Information Systems from The University of Redlands, in Redlands, California in 1995 while employed conducting product test and development in the computer industry.

The Information Systems degree is focused on electronic hardware, software and programming. Coursework includes, Systems Analysis & Design, Data Communications, computer programming languages (C+, Assembly, PERL, Pascal, COBOL, VBScript), Decision Support Systems, and Database Design. The degree provided the knowledge base to design and build as well as evaluate electrical, electronic and electromechanical systems.

Over the next seven years I was employed at top-tier manufacturers of electronic components such as Seiko-Epson, Toshiba America Information Systems, and Hewlett Packard Corporation. In total, I have compiled more than 20 years of engineering experience in product development, hardware test laboratories, and production facilities.

My experience in the computer industry began on the production floor. I was responsible for end-of-line test of mass storage components and troubleshooting of units that failed burn-in testing. These units were diagnosed, repaired and returned to the burn-in test fixtures. Test failure information was then compiled and sent back to engineering headquarters, frequently requiring me to prepare engineering change notices that were distributed to the field service organization.

I have experience working on a technical support line, handling computer reseller support requests, where we assisted authorized product service centers with problem customer repairs. Other experience includes evaluating engineering samples and prototypes for product management. Product test experience and work with prototype designs paved the way for my transition to the product engineering development lab.

Upon joining the engineering group, I worked in the operating system and network qualification group where I qualified new server, client and laptop PC hardware designs. For a major release of the Windows operating system, I developed automated scripting of operating system pre-install for all of our production PC's and portables. The whole qualification process consisted of four (basic) categories: hardware reliability testing, operating system qualification, compatibility testing, network certification testing and software application compatibility testing. Products were tested under a variety of conditions and any issues that were revealed in testing were further investigated. Certain top client sites received customer evaluation units under non-disclosure agreements for field testing. I was involved in laboratory and field testing that routinely resulted in hardware and/or firmware changes. I was involved in these types of changes as necessary to ensure product compliance.

Over time, my focus became more on hardware compatibility design issues. During my time working for an OEM that manufactured inkjet printer mechanisms, I was responsible for interfacing our printer control ASIC's (chips) into our customer's new retail products. My responsibilities in this area included design proposals to the schematic level and presenting those designs in face-to-face customer meetings with our clients, worldwide.

In 2002, I joined the team at Carr Engineering, Inc. (CEI) This opportunity has allowed me to meld two subjects that I am passionate about: automotive technology and electronics. Since 2002, I have been applying both my electronics industry experience and my hands-on understanding of automotive technology to the analysis of design and operation of vehicle electronic powertrain control systems, occupant retention and restraint control systems, the development of test and measurement hardware and software, data collection, data analysis, and motor vehicle crash reconstruction.

Over the past 15 years, I have performed hundreds of vehicle inspections, scene inspections, instrumented vehicle tests, and instrumented component tests. At CEI, I have designed custom electronic circuitry, software and electro-mechanical systems used for motor vehicle testing, data collection, and analysis. More specifically, the majority of the investigations that I have performed have focused on the analysis of the design and operation of motor vehicle powertrain control systems and braking systems. This has led to the development of hardware and software tools for evaluation of these specific systems.

I have performed both standardized (NHTSA, ISO, etc.) and case-specific vehicle evaluations to demonstrate and document motor vehicle design features, dynamic performance capacities, and the margins of safety. These evaluations have been performed using a combination of subject vehicles and/or exemplar vehicles, and have taken place both on public roads and at dedicated testing facilities. In certain cases, analysis of the system design and function included "fault testing" where tools were developed to introduce specific electronic faults in a system to determine its response, including evaluation of the overall vehicle performance and diagnostic system design and response.

I additionally have extensive experience performing "other similar incident" (OSI) vehicle investigations. These investigations generally include a complete system mechanical and electrical investigation as well as a cataloging of the electrical attributes of the vehicle's accelerator pedal, throttle body, powertrain control module, and restraint control module. Often times these investigations involve the instrumented evaluation of the vehicle as it is driven to demonstrate the vehicle's design features and dynamic performance capacities. Having previously developed a standardized protocol and data acquisition suite allows me the flexibility to perform such detailed inspections on extremely short notice, if required.

My experience also includes electrical system analyses of airbag performance in a wide variety of crash scenarios. This field of study has involved the analyzing of power circuits, deployment loop circuits, and diagnostic circuits leading into and out of various restraint control modules, as well as the microscopic inspection of indicator and warning lamps. In 2015, I coauthored a technical paper, "*EDR Pulse Component Vector Analysis*," which I helped present at the SAE Congress in Detroit, Michigan.

I am certified as a Crash Data Retrieval (CDR) analyst using the commercial Bosch CDR tool. I have developed advanced techniques for recovery of pre-crash and crash pulse data stored in electronic control modules that have been compromised by water, fire, and/or mechanical damage resulting from crashes. I have developed and can employ a variety of proprietary techniques that enable me to recover such data, beyond the capabilities of the existing commercial Bosch CDR tool. In addition, I have developed proprietary techniques to extract specific CAN (vehicle network) data, or messages, from the thousands of messages found on a typical vehicle's CAN bus.

I also have related expertise in the fields of powertrain control module calibration, engine performance calibration, computer programming, microcontrollers, engine data logging, and automobile racing.