A metallurgical analysis of a cracked Weld-Repaired High-Performance Wheel

Abstract: Sports cars with large diameter, low profile, performance, and run flat tires typically have light weight, racing inspired wheels. Recently it has been identified through various consumer product recalls, literature, research and the authors' experiences that these types of wheels are susceptible to radial cracking on the in-board side of the wheel. Radial cracks are safe, as they lead to a loss of tire pressure and do not normally lead to sudden fracture of the wheel or rapid loss of pressure from the tire [1]; however consumer complaints and cost of wheel replacements has led to alternative means for salvaging cracked wheels, which include weld repairs. The weld repair consists of visually identifying the crack tip, drilling a hole at the end of the crack tip as to blunt it, and grinding a slot through the plane of the crack. The slot and hole are then filled with a butt-weld, with material selected to closely match the parent alloy of the wheel material. Finally, the surfaces of the wheel near the weld are to be ground and sanded. The costs associated with each weld repair can be upwards of $200 or more, as opposed to complete OEM wheel replacement which can be upwards of $1500 or more per wheel. No current standards exist with SAE, ASTM or ASME as to the weld repair methodology, selection of weld materials, inspection or quality control of these type of wheel weld repairs, which can make the weld repaired wheel susceptible to cracking from continued road use. Janarthathan et al evaluated failure types in wheel wheels by factors governing flash butt weld and subsequent cold forming processes in light and medium commercial vehicles [2]. Bhattacharya et al looked at low carbon steel wheels for light and medium commercial vehicles specifically examining cracks in the HAZ that occurred during the manufacturing process [3]. Rumiche et al found that preferential crack nucleation occurred in the weld bead at the stress concentrator in the low hardness zone in a welded drive beam of a vibrating screen [4]. Repair welding is a known solution and used in various industries, however surface preparation, joint selection, deposition techniques, post weld heat treatment, and verification of repair weld quality are all considerations which can have serious ramifications if performed improperly as discussed in [5]. This case study is the first of its kind, in that it examines cracking in a weld repaired high performance wheel that showed evidence of cracking after foreseeable road use shortly after repair.

Biography: Dr. Kar's expertise is in the fields of mechanical engineering, metallurgy, materials science, failure analysis, mechanical & material behavior, laboratory testing, contamination analysis, and equipment component function to determine cause(s) of failure. His consulting projects include failure analysis of consumer products, plumbing products, structural component failures/fractures, bicycles, aviation, automotive, industrial, and machine components, and medical or foreign object implants as related to personal injury, product liability, premise liability, construction defect and water loss or fire

matters. He also consults on patent infringement matters and is a licensed Professional Engineer in California in both the mechanical and metallurgical/materials disciplines. As a former adjunct assistant professor of engineering practice, Dr. Kar has taught undergraduate and graduate courses for the Viterbi School of Engineering at the University of Southern California. He has qualified as an expert witness in State and Federal Court.