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Impact of Handle Position and Riveting Tools on Vibration and Muscle Fatigue in Riveters and Buckers

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Abstract

The prevalence of muscle fatigue among riveters and buckers in the aeronautical industry is predominantly linked to their significant exposure to excessive vibrations. Frequently surpassing the Daily Exposure Limit Value (DELV) of 5 m/s², these skilled workers are subjected to elevated vibrations. To address this concern, the present research investigates the influence of different riveting tools on vibration exposure and muscle fatigue. While prior studies have individually examined these factors, a notable gap remains regarding comprehensive and concurrent investigations. Therefore, further exploration is imperative to enhance our understanding of this critical issue and potentially inform the development of effective mitigation strategies. An experimental study with ten male participants equally divided between riveters and buckers was performed to achieve the objective of this study. The task consisted of setting five rivets in 30 seconds. Acceleration, EMG, heart rate, handle orientation, and perceived exertion data were recorded simultaneously from riveters and buckers. The perceived exertion (Borg scale) was used to measure participants' overall perceived exertion level. The results indicate that the combined spring dampener and tungsten bucking bar led to 24.46% less vibration than the tungsten or steel bucking bar. In addition, the riveter gun operator with a vertical handle position resulted in the highest mean % MVC of the bucker's biceps brachii muscle (61.11%) compared to the riveter using the gun in the horizontal handle position (30.84%). The results demonstrate the need to consider the type of gun and handle position in which the rivet gun operator performs the task to reduce the effects of vibration exposure and muscle fatigue experienced by the riveters and buckers.

Keywords
Fatigue, Vibration, Riveters, Buckers, and EMG.

Biographies

Dr. Fereydoun Aghazadeh is a Professor of the Industrial Engineering and Georgia Gulf Distinguished Professor of Engineering at Louisiana State University. He received his BSIE, MSIE, and Ph.D. degrees from Texas Tech University**.** He has devoted his entire professional career to reducing work-related musculoskeletal injuries and illnesses by performing extensive research and developing ways to perform manual jobs optimally. He pioneered the use of dynamic strength models for estimating manual material handling capacity. Dr. Aghazadeh received the IIE Fellow award from the Institute of Industrial and Systems Engineering in 2014. He was elected Fellow of the Institute

for Ergonomics and Human Factors (formerly the Ergonomics Society) for a significant contribution to the practice of teaching and research in ergonomics. He received the Distinguished Achievement Award from the International Society for Occupational Ergonomics and Safety. The Society of Automotive Engineers awarded him the Ralph R. Teeter Award for his significant contribution to teaching, research, and student development. He has been recognized as one of the top engineering educators in the U.S.

Lou T. Vi received an Industrial Engineer degree from the Mechanical and Industrial Engineering Department at Louisiana State University. She specializes in human factors and ergonomics. She also has an undergraduate degree in petroleum engineering from the University of Louisiana at Lafayette. She currently works at Deloitte and Touche LLP.

Dr. Anthony Banks is a Lockheed Martin senior fellow and corporate ergonomics lead with nearly two decades of experience in solving human factors issues. Dr. Banks has a doctoral degree and a master's degree in industrial engineering from Louisiana State University. He also has a bachelor's degree in electrical engineering from Southern University in Baton Rouge. He previously worked at Eastman Kodak company as a corporate ergonomist and worldwide safety specialist.

Vamsi Krishna Varma Pusapati received his doctoral degree in Industrial engineering from the Department of Mechanical and Industrial Engineering(MIE) at Louisiana State University, where he specializes in human factors and ergonomics. He received his master's degree in industrial engineering from Louisiana State University and has a bachelor's degree in mechanical engineering from JNTUK University in India.