

Electromyographic and Discomfort Analysis of a Confined-Space Welding Task

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Welders have been reported to experience musculoskeletal symptoms and pain in the shoulder, neck, and low back regions (Torner et al., 1991). Welding occupations involve prolonged static exertions with awkward postural stresses that may be exacerbated in confined spaces. This study examined a specific welding job at a shipyard where confined-space welding operations are prevalent. The process under investigation in this study requires the welders to weld the seams on the inside of "honeycombs" which form the underside of vessels. These honeycombs are approximately 0.61 m (width) x 0.61 m (height) x 4.88 m (length). Welding trials were conducted in a mock-up of this confined space with nine employee volunteers from the shipyard. Subjects welded a 1-m bead along the bottom corner of the honeycomb on the right followed by the left side, with each weld taking two to three minutes to complete. Subjective reports of regional discomfort and an overall general discomfort rating were obtained immediately following each trial. Surface electromyography (SEMG) was recorded from seven muscle groups on the welders' dominant hand side: trapezius, middle deltoid, anterior deltoid, latissimus dorsi, erector spinae, FDS, and EDC. The percent of the total SEMG spectral power in the 10-30 Hz frequency band was calculated by Fast Fourier Transform for each 1-s sample of SEMG from each muscle. A two-minute time series, extracted from the beginning of the welding trial, was partitioned into five, 24-s segments for which the percent of the total spectral power in the 10-30 Hz frequency band (PP_{10-30}) was averaged over 24 seconds. Shifts in the average PP_{10-30} were examined over the five segments. The hypothesis was that the use of a wire-fed welding process (FCAW) would result in less fatigue than a stick electrode welding process (SMAW). This hypothesis was generally supported as, for most muscles, the stick electrode welding process was associated with higher percentage increases in the average PP_{10-30} than the wire-fed welding process ($p < 0.05$). However, regional discomfort scores were not significantly affected by weld process. While the subjectively reported discomfort was generally low for both welding processes, the SEMG results show some evidence that the wire welding process may be preferable in terms of a reduction of muscle fatigue. This shipyard is considering implementing the wire-fed welding process to replace the traditional stick welding process.



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