

# **Pilot Study Results of Body Part Discomfort during an Ironworker Physical Capacity Test Using the ERGOS Sapphire TM Work Simulation System**

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According to the U.S. department of labor (2012), the incidence rate of nonfatal injuries among construction workers resulting in days away from work (DAFW) is one of the highest, 143.4 per 10,000 full-time workers compared to 102.3 per 10,000 for the total private industry (<http://www.bls.gov>). Construction ironworkers are at high risk of musculoskeletal disorders due to their job demands, which include lifting, carrying heavy loads, and working at awkward postures (<http://www.onetonline.org>). This pilot study was a demonstration project aimed at evaluating the application of the ERGOS Sapphire TM Work Simulation Test Apparatus (<http://www.simwork.com>) in measuring simulated physical human work capacity performance for construction ironworker test protocol. Two major questions in conducting this project were: (1) Which body parts were most affected at the end of each work simulation task and (2) were there any work capacity decrements due to the use or non-use of ironworker personal protective equipment (PPE) which includes an integral tool belt and tools. One (1) male experienced ironworker and ten (10) convenience sample naïve, male college students completed the ERGOS Sapphire TM ironworker protocol. The O\*NET (U.S. Department of Labor Job Descriptions Database) job description for ironworkers and the knowledge and expertise of the experienced ironworker were used to define the test protocol (<http://www.onetonline.org>). Using the wall-mounted ERGOS Sapphire TM work simulator, participants were asked to take part in the experiment without personal protective equipment, with personal protective equipment loaded symmetrically, and asymmetrically (right side). Using upper extremities work simulator, participants were asked to perform the tests twice, with and without using gloves. The following tests were performed in order: touch panel, push, pull, static lift, dynamic lift, dynamic carry, lateral pinch, three point pinch and grip. Pre-recorded voice commands and photographs were incorporated in the ERGOS Sapphire TM for each test and participants were asked to mention their fatigue or discomfort levels by choosing the affected body part(s) on the screen and assigning a score on a scale of 1 to 10 with 10 being the greatest possible discomfort or fatigue after completing each task. The experienced ironworker did not identify any fatigue or body discomfort during the test. In contrast, most naïve participants indicated varying levels of fatigue and discomfort during the test. A total of 531 indicates of pain and fatigue were noted with 440 (83%) occurring during overhead reach, push, pull, lifting and carrying load tests and 91(17%) were related to upper extremity tests including lateral pinch, three point pinch, and grip strength. For upper extremities tests, three point pinch strength on left hand, right hand and grip strength of right hand tests had the most fatigue and discomfort. Using gloves reduced the number of fatigue and discomfort reports. The dynamic carrying (25 lbs. and 50 lbs.), dynamic lifting (50 lbs.), and Static lifting had the highest percentage of fatigue and discomfort reports for whole body tests. Back, shoulder and neck were the body parts most affected during the entire test. The number and level of fatigue and discomfort reports increased while using personal protective equipment and tool belt. The ERGOS Sapphire TM work simulation system appeared to accurately and efficiently measure iron worker job description physical work capacity for a pilot study human subject sample. The results of this pilot study indicate a need for further design and ergonomics improvements in ironworker PPE for increased comfort during work tasks. The ERGOS Sapphire TM System could be valuable in evaluating future ironworker PPE design changes using a repeated measures analysis.

**Key Words:** ERGOS Sapphire TM Work Simulation, Ironworker, PPE, Discomfort, Job Demands