



Executive Summary:

The ergonomic performance of the Milwaukee Tool M12™ Rivet Tool was tested with a group of experienced users. Ergonomics data collection and measuring techniques included recordings of muscle effort through electromyography (EMG), postural analysis, and structured surveys of product performance, perceived exertion, and preference. Test subjects were required to apply the product in standard orientations using identical 1/8” rivets in a prefabrication work environment. The testing compared the market-leading rivet hand tool as a basis of comparison against the Milwaukee Tool M12™ Rivet Tool.

Muscle effort data was analyzed to obtain the average peak muscle effort and maximal voluntary contraction (MVC), for each muscle group of the following:

- Thumb
 - Abductor Pollicis Brevis (APB) Dominant
- Forearm
 - Brachioradialis Dominant/Non-dominant
 - Flexor Carpi Ulnaris Dominant
 - Flexor Carpi Radialis Dominant
 - Extensor Carpi Radialis Dominant
- Biceps
 - Biceps Brachii Dominant/Non-dominant

The testing revealed **measurable and significant ergonomic benefits** associated with the M12™ Rivet Tool in **every muscle group analyzed** and category assessed. These include decreased peak muscle efforts and percent of maximal voluntary contraction (% MVC), improved ease of use, and reduced force. This results in improved user comfort and **decreased risk for common high-risk injuries** such as carpal tunnel syndrome, the most commonly affected musculoskeletal disorder (MSD) for this type of work.

An executive summary of the key finding are as follows:

- **The M12™ Rivet Tool recorded a total of 22% MVC in peak muscle effort which is within acceptable ranges to allow oxygenated blood flow during muscle contractions, whereas the rivet hand tool recorded a 55% MVC which is above the acceptable ranges and will restrict oxygenated blood flow during muscle contractions, leading to increased risk for muscle fatigue and ergonomic injury. Results are as follows:**

0-20% (Oxygenated blood flow occurs)
21-60% (Impedes oxygenated blood flow)
61-100% (Restricts oxygenated blood flow)

- M12™ Rivet Tool 22% MVC
- Hand Tool 55% MVC

- **The M12™ Rivet Tool recorded an average percent decrease in peak muscle effort:**
 - 60% reduction compared against the hand tool
- **The M12™ Rivet Tool reduces the risk for many MSDs such as lateral elbow epicondylitis as well as carpal tunnel syndrome by lowering the muscle effort in the forearm extensor and flexor muscles, respectively.**



- The M12™ Rivet Tool can complete a rivet with one application of the rivet tool while using one hand whereas the hand tool needs to apply force two times while using both hands when trying to complete the rivet.

The hypothesis that, “The Milwaukee Tool M12™ Rivet tool will have force reduction, significant muscle effort reduction, and improved ergonomic design that reduces peak muscle effort on the upper extremities” was confirmed and validated.

The M12™ Rivet tool will likely decrease injuries and improve quality of life for worldwide users compared to the hand tool tested in this report.