

**UNIVERSITI TEKNOLOGI MARA**

**ERGONOMICALLY DESIGNED  
WORKING ENVIRONMENT TO  
REDUCE THE EFFECTS OF HAND-  
ARM VIBRATION IN INDUSTRY**

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Thesis submitted in fulfillment  
of the requirements for the degree of  
**Master of Science**

**Faculty of Mechanical Engineering**

July 2015

## AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.


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## ABSTRACT

The research scope and objectives are to study the effects of hand-arm vibration, worker's risk and vibration impact on upper trapezius muscle. Then, ergonomic working environment will be designed to reduce the vibration effects among manufacturing workers. The data on musculoskeletal disorders (MSDs) symptoms of pain and the workers' risks of exposure to vibration were collected via questionnaire and Rapid Upper Limb Assessment (RULA). The muscle activity and muscle fatigue were measured using Electromyography (EMG). After implementing the ergonomic designed working environment, satisfaction survey was conducted to get feedback from workers as well as to verify and justify the ergonomic designs. The research outcome found that the ergonomic designs of hand-arm vibration exposure caused the workers to experience pain, especially on the right shoulder (60.7 percent). The RULA result found that 50 percent of the workers score 3 or 4, 28.6 percent score 5 or 6 and 21.4 percent score 7. The EMG result found that 67 percent of the workers are in fatigue condition. The  $EMG_{RMS}$  maximum peak value is  $305.49\mu V$ . It is then concluded that the muscle is in fatigue when the  $EMG_{RMS}$  value is increasing and  $EMG_{MPF}$  value is decreasing. The starting point of fatigue is generally found after 90 minutes to 120 minutes for both male and female workers. Therefore, six designs of ergonomic working environment were introduced and implemented for trial production: (a) standing block, (b) job rotation, (c) using fingerless anti-vibration glove, (d) nylon glove and rubber ring, (e) stretching program, and (f) using anti-fatigue mat. After implementing four designs of ergonomic environment, the percentage of pain occurring on the body parts was decreased, RULA score was reduced, and muscle no more in fatigue. Most of the workers are satisfied, they felt happy and comfortable. Overall, it raised the awareness of ergonomic among the workers and the organization.

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