E-ISSN 2503 - 1430
ISSN 2541 - 3090

Journal Of Industrial Engineering Management
(JIEM Volume 8. No 3 Tahun 2023)

ANALYSIS OF WORKING POSTURE IN METAL DUCT WELDING USING THE REBA (RAPID ENTIRE BODY ASSESSMENT) METHOD AT PT XYZ

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Article history:
Submitted 25 Mei 2023
Revised 20 July 2023
Accepted 13 November 2023
Available online 31 December 2023

ABSTRACT

PT XYZ is a make-to-order private company engaged in fabrication, design, and construction. PT XYZ has received repetitive orders, especially for Metal Duct products. There are still many worker complaints in the production process, especially in the welding section that does not apply ergonomic work postures. This study aimed to determine the work posture score so that the action level category of workers in the metal duct welding section at PT. XYZ with the REBA (Rapid Entire Body Assessment) method and suggestions for correct working posture improvements in the welding section at PT. XYZ. The results showed that the highest REBA score was for welding worker 5, who got a REBA score of 11, where this value got an action level 4 value which is a very high risk, and there is a need for corrective action right now. Welding workers 3 get a REBA score of 9. This value gets an action level 3 score, which is a high risk, and immediate corrective action is needed. Welding workers 1, 2, and 4 get the same REBA score of 5. This value gets an action level 2 score, which is moderate risk and needs improvement. From the final value obtained, it can be proposed to improve work posture for welding workers who get a work posture risk value of 2, where this value is lower than the initial work posture risk value.

Keywords: Musculoskeletal Disorders, REBA, Work Posture.

Published By:
Fakultas Teknologi Industri
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DOI : http://dx.doi.org/10.33536/jiem.v8i3.1707

1. INTRODUCTION

In facing industrial competition, a company is required to be able to increase productivity. One of the factors that can reduce productivity is the occurrence of musculoskeletal disorders. Many companies want to create increased productivity, but not a few ignore essential factors that can interfere with the comfort of employees at work (Revadi, Gunawan and Rakasiwi, 2019). Workplace injuries and discomfort, also known as musculoskeletal disorders, result from a workplace environment that does not adhere to ergonomic principles (Cahyanto and Nugraha, 2023). Musculoskeletal Disorders can be caused by poor posture, long working hours, and repetitive movements (Agustin *et al.*, 2020). Working in conditions that are not ergonomic and repetitive can cause damage to muscle tissue, preventing workers from doing optimal work due to muscle pain and discomfort. Therefore, MSDs are a nuisance that threatens many workers worldwide (Yosineba, Bahar, and Adnindya, 2020).

Muscle complaints can be divided into 2, namely temporary complaints, which are muscle complaints that occur when the muscles receive a static load. However, these complaints will soon disappear when the loading is stopped. Then the second is persistent complaints, namely persistent muscle complaints. Even though the workload has been stopped, the muscle pain continues (Siska and Gunawan, 2019). Initially, MSDS complaints included aches, pains, numbness, tingling, swelling, stiffness, tremors, insomnia, and burning up to the inability of a person to make movements and coordinate body or limb movements, resulting in a decrease in productivity and loss of work time. Hence, labor productivity decreases (Margaretha, 2022).

In doing work, ergonomics is a significant concern (Shidiq, Andesta and Negoro, 2022). Ergonomics aims to ensure occupational health so that productivity can still be increased. The main benefits of ergonomics are reduced work accidents, reduced rates of work-related illnesses, reduced work-related stress, reduced medical and compensation costs, improved productivity, improved workflow, a sense of security because it is free from injury disturbances, increased job satisfaction (Hunusalela, Perdana and Dewanti, 2022). Ergonomics focuses on three main components, namely humans, machines, and the environment, which interact. This interaction produces a working system that cannot be separated from one another (Hudaningsih *et al.*, 2021).

Work posture is the attitude of the body when working (Malik *et al.*, 2021). Work posture is a determining point in analyzing the effectiveness of a job (Setiorini *et al.*, 2019). Ergonomics related to work posture can help get a comfortable working posture for workers, whether standing, sitting, lifting, or transporting work postures (Erliana and Amri, 2020). Working conditions like this force workers to always be in an unnatural working posture and last for a long time. This will result in workers getting tired quickly or even complaining of pain in the body (Hidjrawan and Sobari, 2018).

PT XYZ is a make-to-order private company that has been established since 1998 and is based in the city of Surabaya. The company is engaged in fabrication, design, and construction. This construction activity includes production activities with a high level of risk. The production process uses equipment and machines with potential hazards in each operation (Fathoni, 2020). These potential hazards can occur in the production process. PT XYZ has received repetitive orders, especially for Metal Duct products. A metal duct is a channel made of stainless steel metal material. The metal duct is part of the air management system, which forms the ducts in heating, ventilation, and air conditioning systems (HVAC systems) (Armansyah and Supriyadi, 2021).

There are still many worker complaints in the production process, especially in the welding section that does not apply ergonomic work postures. The type of work carried out in this welding section is in various positions, ranging from work done in a squatting place to work done in a standing position. From observations that have been made and questions and answers with the head of the Human and Environmental Safety section, employees of the welding division still experience complaints of pain in the upper back, left and right hips, and left and right ankles due to repetitive movements and movements when work is finished.

Research on work posture analysis has been carried out using several methods, such as The RULA (Rapid Upper Limb Assessment) method, Tiogana dan Hartono (2020) state that this

method is used to reduce the occurrence of risks associated with a person's work on the upper body only. This method is better when the job requires the worker to be silent in a specific place, such as typing. The QEC (Quick Exposure Checklist) method, according to Subakti dan Subhan (2021) states that the method only focuses on the physical factors of the workplace and does not go into detail in assessing work posture. This method only considers the limbs of the back, neck, shoulders, and wrists. The OWAS (Ovako Work Posture Analysis System) method, according to Fragastia dan Ramadhan (2022) states that this method only assesses the back of the body, arms, legs, and unspecified load categories.

This study used the REBA (Rapid Entire Body Assessment) method. The choice of work posture analysis using the REBA method is because it is a more specific method compared to other work posture measurement methods. REBA is a method in ergonomics that is used quickly to assess the posture of workers' necks, back, wrists, and legs. This method also has coupling factors, external loads, and work activities (Ansa and Marwah, 2022). With this research, it is hoped that later it will be able to find out the condition of working posture and propose improvements to the correct work posture for welding workers at PT. XYZ.

2. METHODS

2.1. Location and Time of Research

The research location was conducted in PT. XYZ. Meanwhile, the research was carried out in February 2023 until the required data was fulfilled.

2.2. Identification of Research Variables

Research variables were identified to determine the variables to be measured based on data from the company. There are two types of variables in this study, namely:

1. Dependent Variable

The dependent variable in this study is the value of work posture on the metal duct welding section with the REBA method.

2. Independent Variable

This study's independent variable is the movement of work postures on the metal duct welding section.

2.3. Data collection technique

The collection technique was carried out using primary data and secondary data. Primary data is data from actual conditions obtained from observations and research in the field (Salianto, Pramanda and Bunyamin, 2021). Preliminary data were obtained by distributing questionnaires, interviews, and direct observation at research locations (Ary and Sriathi, 2019). Meanwhile, secondary data is obtained from various literature and references related to the issues discussed and from companies (Mulyono, Indriyani and Ningtyas, 2020).

2.4. Data Analysis Technique

The data processing method used in this study is the REBA method. The identification process itself is carried out in several ways, as follows:

1. Divide observations of workers' bodies in the welding section into two groups, namely Group A, which consists of the trunk, neck, legs, and load/force. Group B consists of the upper arm, lower arm, wrist, and coupling.
2. Assess each working position of workers in the welding section using the REBA method into groups A and B.
3. Determine the REBA score obtained from a combination of calculating scores from groups A and B to find a score for C.
4. Add up the C score with the activity value.
5. Get the final score, namely the REBA score (REBA score).
6. Categorize the REBA final score into the action level.

3. FINDINGS AND DISCUSSION

3.1. Findings

The data workers used are data workers in the production process in the welding section of metal duct products at PT. XYZ. The number of workers successfully collected in the welding section was 5.

3.1.1. *Nordic Body Map*

The Nordic body map assesses subjective complaints of metal duct welding workers at PT XYZ. The Nordic Body Map questionnaire aims to determine which part of the workers' body feels pain while working at workstations (Azwar, 2020). This assessment was carried out as a support for the conduct of this research. It can be seen that the most common complaints felt by metal duct welding workers after carrying out their work can be seen in the table below:

Table 1. Recapitulation of the Most Complaints

Complaint Type	Amount	Percentage
Pain in the left shoulder	3	60%
Pain in the right shoulder	3	60%
Pain in the upper back	5	100%
Pain in the waist	5	100%
Pain in the left knee	5	100%
Pain in the right knee	5	100%
Pain in the left ankle	5	100%
Pain in the right ankle	5	100%

3.1.2. Worker Posture Data

The following are photos of 5 welding position workers, namely:

Figure 1. Work Posture for Assembling Metal Duct Components of Worker 1

Based on Figure 1 above, it can be seen that worker carry out the welding process for assembling components from metal duct in this activity. In this process, problems can be seen from the worker's slightly bent and tilted posture.

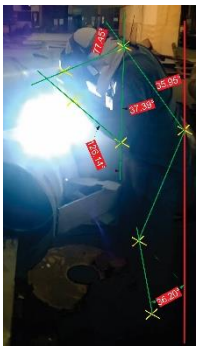

Figure 2. Work Posture for Assembling Metal Duct Components of Worker 2

Based on Figure 2 above, it can be seen that worker carry out the welding process for assembling components from metal duct in this activity. In this process, problems can be seen from the worker's slightly bent and tilted posture.

Figure 3. Work Posture for Assembling Metal Duct Components of Worker 3

Based on Figure 3 above, it can be seen that worker carry out the welding process for assembling components from metal duct in this activity. In this process, problems can be seen from the worker's posture, which looks slightly bent, and his hands are crooked.

Figure 4. Work Posture for Assembling Metal Duct Components of Worker 4

Based on Figure 4 above, it can be seen that worker carry out the welding process for assembling components from metal duct in this activity. In this process, some problems can be seen from the worker's posture, and it can be seen that the body position is slightly bent.

Figure 5. Work Posture for Assembling Metal Duct Components of Worker 5

Based on Figure 5 above, it can be seen that worker carry out the welding process for

assembling components from a metal duct in this activity. In this process, some problems can be seen from the worker's posture, which looks squat.

3.2. Discussion

3.2.1. Manual REBA Assessment

Based on the angle measurements obtained from Group A (Neck, Trunk, Legs) and Group B (Upper Arms, Lower Arms, Wrists). Then the results of the final REBA score were obtained, along with a recapitulation of the final REBA scores from 5 metal duct welding workers:

Table 2. Manual Reba Final Score Recapitulation

Welding Worker	Final Score
1	5
2	5
3	9
4	5
5	11

3.2.2. REBA Assessment Using The Ergofellow 3.0 Software

The ErgoFellow 3.0 application has 17 ergonomic methods to evaluate, improve and improve the quality of the workplace to reduce workplace risks and increase productivity (Firdaus, Kusnadi and Sujarno, 2023). Following are the results of the REBA assessment using the Ergofellow 3.0 software from 5 metal duct welding workers:

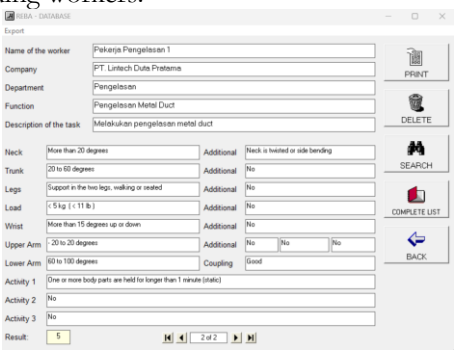

Figure 6. Result of REBA Assessment Worker 1

In Figure 6, it can be seen that the final score of welding worker 1 using the Ergofellow 3.0 software is 5.

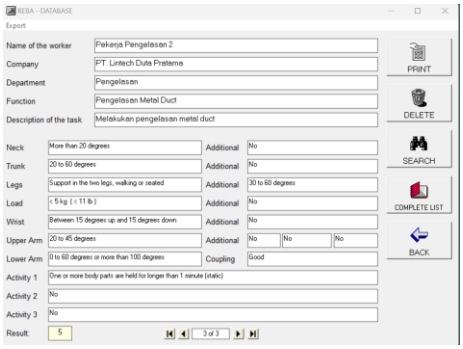

Figure 7. Result of REBA Assessment Worker 2

In Figure 7, it can be seen that the final score of welding worker 2 using the Ergofellow 3.0 software is 5.

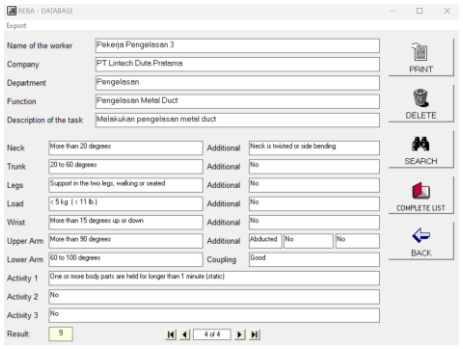

Figure 8. Result of REBA Assessment Worker 3

In Figure 8, it can be seen that the final score of welding worker 3 using the Ergofellow 3.0 software is 9.

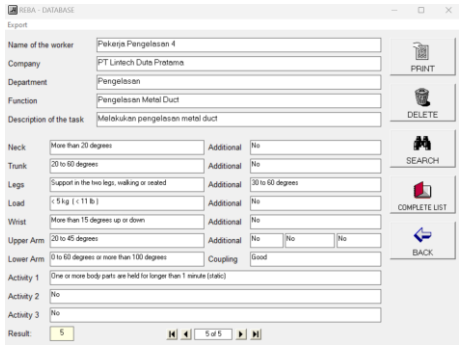

Figure 9. Result of REBA Assessment Worker 4

In Figure 9, it can be seen that the final score of welding worker 4 using the Ergofellow 3.0 software is 5.

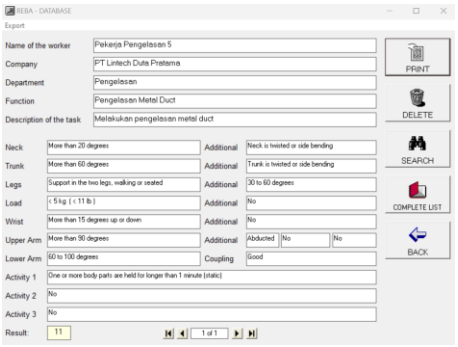

Figure 10. Result of REBA Assessment Worker 5

In Figure 10, it can be seen that the final score of welding worker 5 using the Ergofellow 3.0 software is 11.

3.2.3. Comparison of Manual REBA Scoring Results and Ergofellow 3.0 Software

Table 3 explains the results of the REBA score manually, and by using the Ergofellow 3.0 software, the following value comparison is obtained.

Table 3. Comparison of Manual REBA *Scoring* Results and ErgoFellow 3.0 *Software*

Welding Worker	Manual	Ergofellow 3.0
1	5	5
2	5	5
3	9	9
4	5	5
5	11	11

In Table 3. It can be seen that based on manual and software calculations, there is no difference.

3.2.4. Recapitulation results of posture calculation using the REBA method

Based on the results of REBA scoring done manually and using Ergofellow 3.0 software which has been done and got the same results, it can be seen in Table 4. The action level recapitulation results from welding workers are as follows.

Table 4. Action Level Recapitulation of Welding Workers

Welding Worker	Action Level	Final Score	Risk Level	Corrective Action
1	2	5	Medium	Necessary
2	2	5	Medium	Necessary
3	3	9	High	Necessary Soon
4	2	5	Medium	Necessary
5	4	11	Very High	Necessary Now

3.2.5. Suggestion Improvement

In Figure 11. we get a suggestion to improve work posture using CATIA V5R20 software for welding workers when carrying out welding work to reduce the value of work posture risk by carrying out excellent and correct work postures. CATIA V5R20 is software that facilitates technical work such as design, electricity, construction, etc. This software can also analyze work postures through posture simulation (Yaqin, Rizqi and Hidayat, 2022), as shown in Figure 11 below.

Figure 11. Simulation of Proposed Work Posture for Welding Workers Using CATIA V5R20

Proposal to improve the work posture of metal duct welding operators to reduce the risk value of work postures when carrying out welding work, with the following suggestions:

1. The position of the neck forming an angle of >20° can be changed to include an angle between 0-20° and get a score of 1.
2. The position of the trunk in Worker 1, Worker 2, Worker 3, and Worker 4 has an angle of 20°-60° with a score of 3, and Worker 5 has an angle of >60° with a score of 4, so it needs attention. Suggestion improvements by changing the trunk angle to 0°-20° to obtain a score of 2.
3. The position of the legs on Worker 2, Worker 4, and Worker 5 has an angle of 30°-60° with a score of 2 which can be changed to form an angle between <30° and a score of 1.
4. The position of the upper arm in Worker 2 and Worker 4 has an angle of 20°-45° with a score of 2, and Worker 3 and Worker 5 has an angle of >90° with the arm rotating with a score of 5, so it needs attention. Suggestion improvement by changing the upper arm angle to 0°-20° to obtain a score of 1.
5. The lower arm position on Worker 3 and Worker 4 has an angle of >100° with a score

of 2, so it needs attention. Suggestion improvement by changing the lower arm angle to 60°-100° to obtain a score of 1.

6. The wrist position of Worker 1, Worker 3, Worker 4, and Worker 5 forms an angle of >15° and sideways with a score of 2. Suggestion improvements by changing the wrist angle to 0°-15° to obtain a score of 1.

The suggested improvement of work posture for welding workers gets a work posture risk value of 2, which is lower than the initial work posture risk value for Worker 1, who receives a score of 5. Worker 2 gets a score of 5, Worker 3 gets a score of 9, Worker 4 gets a score of 5, and Worker 5 gets a score of 11.

4. CONCLUSION AND SUGGESTION

4.1. Conclusion

It can be concluded from the results of the REBA assessment conducted on 5 welding workers in metal duct production. Welding workers 5 get a work posture risk score of 11, where this value gets an action level 4 value, which is a very high risk, and corrective action is needed right now. Welding workers 3 get a work posture risk score of 9, where this value gets an action level 3 score which is high risk and immediate corrective action is needed. Welding workers 1, 2, and 4 get the same work posture risk score of 5, where this value gets an action level 2 value which is a moderate risk and needs improvement. Proposed improvement of working posture to minimize the importance of work posture risk that arises with the proposed posture of the neck moving with a range of movement angles of 0°-20°, the trunk moving with a range of movement angles of 0°-20°, legs moving with a range of movement angles <30 °, the upper arm moves with a range of motion of 0°-20°, the lower arm moves with a range of movement of 60°-100°, and the wrist moves with a range of movement of 0°-15°. This proposed improvement of work posture received a REBA score of 2 where the risk value of the pose is reduced from the original posture risk value.

4.2. Suggestion

Companies pay more attention to the safety and health of employees when doing a job. Then the company should provide work aids to support the performance of employees.

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