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# **The Innovation Breakthrough in Digital and Disruptive Era**

# Work Posture Analysis with REBA and RULA Method on Production Operators Repair and Maintenance of LPG 3Kg at PT. XYZ

Aminatus Suhra<sup>1\*</sup>, Rachmad Hidayat<sup>2</sup>, and Agung Firdausi Ahsan<sup>1</sup>

<sup>1</sup> Faculty of Science and Technology, University of KH. Bahaudin Mudhary Madura

<sup>2</sup> University of Trunojoyo Madura

**Abstrak.** Wrong posture while working has an impact on productivity. One of them is the operator's work position in the production department at PT. XYZ pays little attention to natural work attitudes and there are activities that have a fairly high ergonomic risk. As a result, complaints such as pain in the legs, shoulders, knees, neck and even the arms occur. At worst, it can lead to long-term sprains and fractures. It is necessary to analyze work posture using the Rapid Entire Body Assessment (REBA) and Rapid Upper Limb Assessment (RULA) methods to determine the level of musculoskeletal hazards and provide improvements to work methods or rearrangement of the work environment. The final score results in the application of REBA and RULA are on the working posture of the both painting sections with scores of 4 and 9, on screen printing on the bottom of the tube scores of 9 and 10, on ring painting results of scores of 10 and 9, on welding results of scores of 7 and 8, and on the installation of seal tape the results of scores 5 and 6 which need to be repaired immediately. Recommendations are given by changing work postures, adding tables and chairs. The operator's attitude and work position are calculated again using the REBA and RULA checksheets. The result is 3 and 3 both painting, 3 and 3 on tube bottom screen printing, 2 and 3 on ring painting, 2 and 3 on welding, 2 and 2 on seal tape installation, which are (acceptable) or acceptable. **Keywords:** Working Posture Error, REBA, RULA.

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\* Corresponding author: [aminatussuhra@unibamadura.ac.id](mailto:aminatussuhra@unibamadura.ac.id)

## 1 Introduction

Wrong work posture is often caused by work stations and facilities that are not suitable for workers, this problem is an important asset for the company. However, companies often pay less attention to the needs and interests of workers. Many companies whose production processes are not supported by standard operating procedures and adequate work facilities, causing workers to often experience discomfort in their body parts. The complaints that arise are due to the absence of ergonomic work facilities that are in accordance with the worker's posture, causing feelings of discomfort to the workers. Convenience at work is an important aspect of the production process at the Company. By paying close attention to the comfort of the workers, it will be able to minimize the existence of complaints.

Uncomfortable working conditions or wrong body position can result in work fatigue, emotional and can even result in injury which greatly affects the productivity of workers. If workers feel excessive fatigue, it can cause losses for the company. Because it causes a decrease in production capacity or an ineffective and efficient work system. Therefore, it is necessary to analyze the level of work fatigue and its risks, by improving work methods so that they are conducive and productive so that workers can concentrate and feel comfortable doing their jobs. This research is about certain body postures that often experience pain or injury such as the neck, shoulders, shoulders, upper arms, forearms, wrists, back, legs and other body parts due to non-ergonomic work postures.

Ergonomics is a science that studies the interaction between humans and the environment and work tools used so that they can play a role in solving problems of human incompatibility with the equipment used[1] Working conditions such as forcing workers to be in unnatural working positions and lasting for long periods of time can cause workers to feel tired quickly, causing pain in certain parts of the body, even disability[2].

Most of the complaints occur due to fatigue caused by static loads during the work process. In addition, work procedures and facility design that are less ergonomic have an impact on work productivity that is not optimal and has the potential to cause injury to certain body parts due to work activities that are not balanced with human limitations. There are several main factors that influence the emergence of symptoms of musculoskeletal disorders (MSDs), namely individual abilities, posture, repetitive movements, and duration of work[3].

One company that is the focus of researchers is PT. XYZ, a private company engaged in the maintenance of 3 kg gas cylinders. The company's main activities are retesting, repairing and repainting 3 Kg LPG cylinders, which employs approximately 30 people. In the production process there are activities that have a fairly high ergonomic risk where workers have to bend, neck extension, and twist the body in carrying out the process of ring painting, welding, installation of tape gaps, screen printing on the bottom of the tube, or both

painting. This non-ergonomic activity is carried out repeatedly, because production in a day is around 1,000-1,400 gas cylinders which will be sent to the two customer companies. In addition, there is a discrepancy between the operator and the work environment or the facilities used.

Preliminary observations made by researchers used the Nordic Body Map questionnaire to determine the level of pain complaints in workers' body parts. In assessing the level of ergonomic risk felt by workers, researchers used the RULA and REBA methods to analyze non-ergonomic work postures and provide recommendations for improvement.

## 2 Literature Review

### 2.1 Ergonomics

Ergonomics is a science that studies the interaction between humans, machines, and other influencing factors. Ergonomics is able to align a work station and the type of work with the capabilities of an operator[1]. The application of ergonomics properly can reduce the number of work accidents, work-related illnesses or injuries, increase productivity, improve workflow, and more.

Improvement of work in the field of ergonomics can be practiced by improving the interaction process that occurs, improving the work posture environment, designing jobs so that they match the characteristics of the human users and the organizational environment is designed according to the sociological and psychological needs of humans[4].

### 2.2 Unnatural Work Attitudes

An unnatural work attitude is one that can cause the position of body parts to move away from natural or forced positions, for example, bowing your head for a long time can cause stiff muscles and make your neck hurt. Legs that are not supported properly will gradually cause severe damage to the ankles, knees and even the hip joints with the result of knee pain, ankle pain, hip pain and leg pain. Lifting an arm can result in a pinched nerve which is caused by a bone or other tissue in the shoulder, neck or elbow pressing on a nerve, in addition to pain other symptoms include tingling or numbness, muscle weakness or sharp pain. a bent back can cause spinal abnormalities Kyphosis where the upper spine protrudes forward and so on[5].

In general, unnatural work attitudes usually occur because of the demands of tasks and work stations and work tools that are not in accordance with the limitations and abilities of workers. Unnatural work attitudes can lead to chronic diseases, namely musculoskeletal[6].

### 2.3 Rapid Entire Body Assessment (REBA)

The Rapid Entire Body Assessment (REBA) is a method in the field of ergonomics that is used to assess

the operator's working position which consists of the posture of the neck, back, arms, wrists and legs. This method examines ergonomic risk factors for the whole body being used, such factors as: static postures, dynamics, unstable postures or speed of change, lifting being carried out, and how often it is done, modifications to the workplace, equipment, training or worker behavior and can also provide a level of risk measures for musculoskeletal complaints[1].

### 2.4 Rapid Upper Limb Assessment (RULA)

The Rapid Upper Limb Assessment (RULA) method is a method in the field of ergonomics that is used to assess work position in the upper body. Calculation of the load level of Musculoskeletal Disorders (MSDs) is carried out in a job that has a risk for the operator's body parts from the stomach to the neck or upper limbs[7] Analysis of the REBA method is carried out if there are complaints in the operator's upper body caused by the operator's body posture being not ergonomic[8].

### 3 Metodology

This research is a quantitative descriptive study, with data collection techniques through direct observation of the production process at the Repair and Maintenance Workshop for 3 Kg Gas Cylinders at PT XYZ by recording operator activities, then determining the angle of the operator's body parts. In addition to conducting interviews to fill out the Nordic Body Map (NBM) questionnaire to measure muscle pain in operators. It also knows which parts of the operator's body experience complaints, ranging from no pain to very painful.

The data analysis method used in this study is the REBA (Rapid Entire Body Assessment) and RULA (Rapid Upper Limb Assessment) methods. The researcher chose this method because it can assess the posture of an operator's whole body quickly and systematically in both static work and dynamic work to determine work posture in the production department. In calculating the REBA (Rapid Entire Body Assessment) value from the operator's work posture that has been obtained, it can be seen the level of risk and the need for actions that need to be taken to improve work in the Repair and Maintenance Workshop for 3 Kg Gas Cylinders. The RULA (Rapid Upper Limb Assessment) method will analyze the posture, style, and movement of an activity that can cause the level of risk generated by that activity.

### 4 Results and Discussions

Data collection was carried out from June to July 2023 in the production room of PT. XYZ by direct observation and interviews. The researcher analyzed 5 work postures in the production room that could have a high risk, including: the process of both painting,

printing the bottom of the tube, ring painting, welding and installing seal tape.

#### 4.1 Assessment of Body Posture in the Both Painting section

The following is a picture of the assessment of body posture in both painting sections.

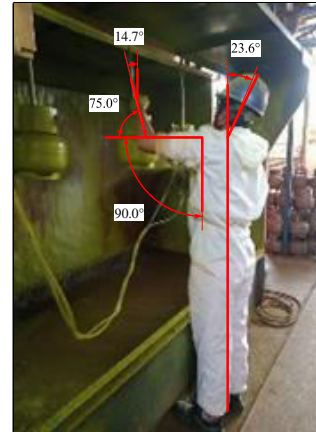


Figure 1. Posture Assessment for Both Painting

1) Assessment using the REBA method  
 a. Group A

Table 1. Group A Calculation of REBA

TABLE A												
Body	Neck											
	1				2				3			
	Foot				Foot				Foot			
	1	2	3	4	1	2	3	4	1	2	3	4
1	1	2	3	4	1	2	3	4	3	3	5	6
2	2	3	4	5	3	4	5	6	4	5	6	7
3	2	4	5	6	4	5	6	7	5	6	7	8
4	3	5	6	7	5	6	7	8	6	7	8	9
5	4	6	7	8	6	7	8	9	7	8	9	9
Burden												
	0			1			2			+3		
	< 5 Kg			5-11 Kg			> 10 Kg			Sudden addition		

b. Group B

Table 2. Group B REBA Calculation

TABLE B						
Upper arm	Forearm					
	1			2		
	Wrist			Wrist		
	1	2	3	1	2	3
1	2	2	1	2	3	
2	2	3	2	3	4	
3	4	5	4	5	5	
4	4	5	5	6	7	
5	6	7	8	7	8	
Handle						
+0	+1	+2	+3			
Nice Handle	Medium Handle	Good Handle	Ugly Handle			
The handle fits and is right in the middle, strong grip	Handrails are acceptable but not ideal	Hand holding is unacceptable even if possible	The grip is too forced to even be unsafe to grip			

c. Calculation of REBA Table Score C  
Table 3. REBA Calculation C Score

A SCORE	TABLE C											
	B SCORE											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	11	11	11	11
9	9	9	9	10	10	11	11	11	12	12	12	12
10	10	10	10	11	11	11	12	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

Grand final score C = Table C + activity score.  
Activity score +1 static work attitude for more than 1 minute + 1 work that repeats more than 4 times per minute =2. So, C= 2+2= 4. Action Level REBA score 4 is at level 2 (moderate) which needs improvement.

2) Assessment using the RULA method  
a. Group A

Table 4. Group A Calculation of RULA

Table A		Wrist Score							
Upper Arm	Lower Arm	1		2		3		4	
		Wrist Twist		Wrist Twist		Wrist Twist		Wrist Twist	
		1	2	1	2	1	2	1	2
1	1	1	2	2	2	3	3	3	3
	2	2	2	2	2	3	3	3	3
	3	2	3	3	3	3	3	4	4
2	1	2	3	3	3	3	4	4	4
	2	3	3	3	3	3	4	4	4
	3	3	4	4	4	4	4	5	5
3	1	3	3	3	4	4	4	5	5
	2	3	4	4	4	4	4	5	5
	3	4	4	4	4	4	5	5	5
4	1	4	4	4	4	4	5	5	5
	2	4	4	4	4	4	5	5	5
	3	4	4	4	5	5	5	6	6
5	1	5	5	5	5	5	6	6	7
	2	5	6	6	6	6	7	7	7
	3	6	6	6	7	7	7	7	8
6	1	7	7	7	7	7	8	8	9
	2	8	8	8	8	8	9	9	9
	3	9	9	9	9	9	9	9	9

b. Group B

Table 5. Group B Calculation of RULA

Neck Posture Score	Table B: Trunk Posture Score											
	1		2		3		4		5		6	
	Legs		Legs		Legs		Legs		Legs		Legs	
	1	2	1	2	1	2	1	2	1	2	1	2
1	3	2	3	3	4	5	5	6	6	7	7	
2	3	2	3	4	5	5	5	6	7	7	7	
3	3	3	4	4	5	5	6	6	7	7	7	
4	5	5	6	6	7	7	7	7	7	8	8	
5	7	7	7	7	7	8	8	8	8	8	8	
6	8	8	8	8	8	8	8	9	9	9	9	

c. Calculation of RULA Score Table C  
Table 6. RULA Calculation C Score

A Score	Table C											
	B Score											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

The grand final RULA score in the process of both painting is 9. Action Level RULA score 9 is at level 4 (high) which requires corrective action right now.

This posture in the long term will result in neck injuries and pain in the upper arms which require immediate repair.

### 4.2 Posture Assessment of Tube Bottom Printing

The following is a picture of the assessment of body posture on the screen printing section at the bottom of the tube.

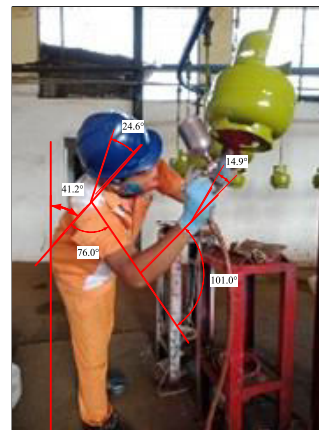


Figure 2. Assessment of Body Posture for Printing at the Bottom of the Tube

The grand final score of C in the screen printing process at the bottom of the tube is table C + activity. Activity score +1 static work attitude for more than 1 minute + 1 work that repeats more than 4 times per minute =2. Then the score C = 7+2 = 9. Action level REBA score 9 is at level 3 high risk, so it needs to be repaired immediately.

The grand final RULA score on the printing process at the bottom of the tube is 10. Action Level

RULA score 10 is at level 4 (high) which requires corrective action right now.

Posture in the process of printing the bottom of the tube over a long period of time will result in pain in the neck due to the extension and twisting position, pain in the back due to a bent and twisted position, pain in the forearm due to the position of the forearm out of the body.

### 4.3 Ring Painting Posture Assessment

The following is a picture of the assessment of body posture in the ring painting section.

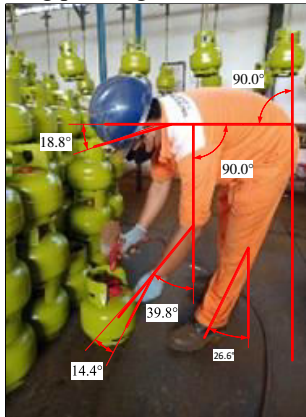


Figure 3. Ring Painting Posture Assessment

The grand final score of C in the ring painting process is table C + activity. Activity score + 1 work repeated more than 4 times per minute = 1. Then the score C = 9 + 1 = 10. Action level REBA score 10 is at level 3 high risk, so it needs to be repaired immediately.

The grand final RULA score in the ring painting process was 9. Action Level RULA score 9 is at level 4 (high) which requires corrective action right now.

Posture in the ring painting process over a long period of time will result in back pain due to body bending, neck pain due to neck flexion and knee pain due to leg extension.

### 4.4 Welding Posture Assessment

The following is a picture of the assessment of body posture in the welding process.

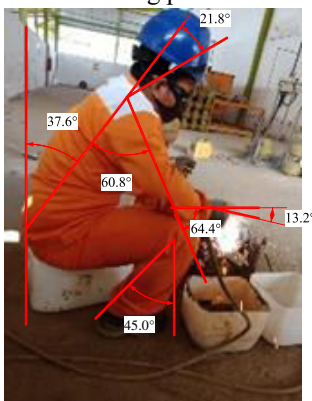


Figure 4. Assessment of Welding Posture

Grand final score C in the welding process is table C + activity. Activity score + 1 static work. Then the

score C = 6 + 1 = 7. Action level REBA score 7 is at level 2 of moderate risk, so it needs to be repaired.

The grand final RULA score in the ring painting process was 8. Action Level RULA score 8 is at level 4 (high) which requires corrective action right now.

Posture during the welding process over a long period of time will result in pain in the neck due to flexion, pain in the back due to bending, pain in the legs because the feet form an angle of >30° and pain in the upper arms.

### 4.5 Body Posture Assessment Seal tape installation

The following is a picture of the assessment of body posture in the process of installing the seal tape.



Figure 5. Posture Assessment for Seal Tape Installation

Grand final score C in the seal tape installation process is table C + activity. Activity score + 1 work repeated more than 4 times in 1 minute. Then the score C = 4+1 = 5. Action level REBA score 5 is at level 2 of moderate risk, so it needs to be repaired.

Posture in the process of installing seal tape over a long period of time will result in back pain due to bending, pain in the upper arm, pain in the legs and pain in the neck.

Posture in the process of installing seal tape over a long period of time will result in back pain due to bending, pain in the upper arm, pain in the legs and pain in the neck.

The following table compares work posture scores before and after repairs.

Table 7. Comparison of Work Posture Scores Before and After the REBA Method

Work Element	REBA Scores and Action Levels	
	Before	After
Both Painting	4 (action level 2)	3 (action level 1)
Screen Printing at the Bottom of the Tube	9 (action level 3)	3 (action level 1)
Ring Painting	10 (action level 3)	2 (action level 1)
Welding	7 (action level 2)	2 (action level 1)
Installation of sealing tape	5 (action level 2)	2 (action level 1)

Table 8. Comparison of Work Posture Scores Before and After the RULA Method

Work Element	RULA Scores and Action Levels	
	Before	After
Both Painting	9 (action level 4)	3 (action level 2)
Screen Printing at the Bottom of the Tube	10 (action level 4)	3 (action level 2)
Ring Painting	9 (action level 4)	3 (action level 2)
Welding	8 (action level 4)	2 (action level 1)
Installation of sealing tape	6 (action level 3)	2 (action level 1)

Work posture scores before repair using the REBA and RULA methods, the five work positions need to be repaired immediately both in work position, work environment improvements or facilities used by production operators. After making improvements, it is found that the risk is small, so this proposal is acceptable.

## 5 Conclusion

The results of measuring the risk level of the REBA and RULA methods in the process of both painting are 4 and 9 need to be repaired immediately because in the long term it can cause pain in the upper arms, neck. In the process of printing the bottom of tubes 9 and 10, repairs are needed immediately because in the long term it can cause pain in the upper and lower arms. In the ring painting process 10 and 9 it is necessary to repair it immediately because it can cause pain in the back, neck, upper and lower arms. Welding processes 7 and 8 need to be repaired immediately because they can cause pain in the back, neck, legs and forearms. In the process of installing seal tape 5 and 6 it is necessary to repair it because it can cause pain in the arms, back of the legs and neck.

After repairs were made to the process of both painting 3 and 3, printing the bottom of the tube 3 and 3, ring painting 2 and 3, welding 2 and 3, installing seal tape 2 and 2, the risk was small so the proposal was acceptable.

The suggestions taken by the author are improving body posture and adding work facilities such as chairs and tables.

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