ERGONOMIC ANALYSIS OF WORKERS IN AUTOMOBILE INDUSTRY USING REBA TOOL

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ABSTRACT

The Common Occupational Problem of Workers in Industries is Musculoskeletal Disorder. Musculoskeletal Disorder are injuries or pain in the human Musculoskeletal System, including the joints, Ligaments, Muscles, Nerves, Tendons and Structures that Supports Limbs, Neck and Back etc., This Project mainly focuses on the automobile assembly line and the tasks involved are of complex in nature. Here the workers attain various postures, excerts forces and work continuously in cycle time to accomplish the assembly line task which leads to Musculoskeletal Disorder. Here the workers pain details have identified by using Nordic Questionnaire Checklist. And the various Postures involved by the workers have been assessed by using REBA worksheet. The Risk Score values have been obtained. Necessary Control Measures are been provided to reduce the risk based on the Engineering control and the Administrative Control. Such that the REBA risk score has been reduced.

INTRODUCTION

1.1 GENERAL

The automobile manufacturing industry is one of the biggest players in providing ergonomic mandates for their plant employees. Many automotive manufacturing companies use existing health and safety standards, such as OSHA to develop their own set of guidelines. In automobile industry there were many tasks are involved that require various postures. The tasks include, bending down, pulling up a box or product, lifting and placing onto another location, twisting when carrying boxes or product, pushing and pulling tasks when requires transporting a large quantity of product using carts or dollies, turning or bending wrists when using hand tools, hand vibration from using power tools, reaching overhead for work.

Ergonomics is a science concerned with the fit between people and their work. It aims to make sure that tasks, equipment, information and environment fit each worker. [1]

Ergonomics is important because when a worker is involved in a job he is stressed by awkward posture, extreme temperature, or repeated movement your musculoskeletal system is affected. These leads to symptoms like fatigue, discomfort and pain which can be the first signs of a musculoskeletal disorder.

Musculoskeletal Disorders are injuries and disorders of the muscles, nerves, tendons, ligaments, joints, cartilages and spinal disks etc., This project mainly focuses to evaluate the Musculoskeletal disorder risk of workers engaged in an engineering Industry. The study was conducted on workers by using the REBA (Rapid Entire Body Assessment Worksheet).

REBA it is a systematic process to evaluate whole body postural MSD and Risks associated with Job tasks. A single page worksheet is used to evaluate required body postures, forceful exertions, type of movements or actions, repetitions and coupling.[5]

ERGONOMICS

The term ergonomics is derived from the Greek ergo(work) and nomos (laws) to denote the science of work, ergonomics is a systems-oriented discipline, which now applies to all aspects of human activity.

Ergonomics is important because when a worker is involved in a job he is stressed by awkward posture, extreme temperature, or

repeated movement your musculoskeletal system is affected. These leads to symptoms like fatigue, discomfort and pain which can be the first signs of a musculoskeletal disorder.[5]

1.4.1 PHYSICAL ERGONOMICS

It is concerned with human anatomy, and some of the anthropometric, physiological and bio mechanical characteristics as they relate to physical activity. Physical ergonomic principles have been widely used in the design of both consumer and industrial products. Risk factors such as localized mechanical pressures, force and posture in a sedentary office environment lead to injuries attributed to an occupational environment. Physical ergonomics is important to those diagnosed with physiological ailments or disorders such as arthritis both chronic and temporary or carpal tunnel syndrome. Pressure that is insignificant or imperceptible to those unaffected by these disorders may be very painful, or render a device unusable, for those who are. Many ergonomically designed products are also used or recommended to treat or prevent such disorders, and to treat pressure-related chronic pain. Innovative workstations that are being tested include: sit-stand desks, treadmill desks, pedal devices and cycle ergometers. In multiple studies these new workstations resulted in decreased waist circumference and improved psychological well-being; however a significant number of additional studies have seen no marked improvement in health outcomes.[5]

1.4.2 COGNITIVE ERGONOMICS

Cognitive ergonomics is concerned with mental processes, such as perception, memory, reasoning, and motor response, as they affect inter actions among humans and other elements of a system.[5]

1.4.3 ORGANIZATIONAL ERGONOMICS

Organizational ergonomics is concerned with the optimization of socio-technical systems, including their organizational structures, policies, and processes.[5]

1.4.4 BENEFITS OF ERGONOMICS

- Decreased Injury Risk
- Increased Productivity
- Decreased Mistakes or Rework
- Increase Efficiency
- Decreased Lost Day Work
- Improved Morale etc.,[3]

1.4.5 MOST COMMON ERGONOMICS PROBLEMS AT THE WORK PLACE

- Without Operating in Neutral Position
- Repetitive Motions
- Awkward Positioning
- Without Moving Perfectly
- Pulling Injuries
- Vibrations
- Heavy Lifting etc.,[2]

1.4.6 IDENTIFYING ERGONOMICS RELATED PROBLEMS

We can identify the ergonomics problems in our workplace before they Result in the musculoskeletal disorders.

There are three components of the Identification Process as per OSHA,

- Review Injury Records
- Observe Work place Conditions
- Encourage Early Reporting

1.4.7 CORRECTIVE ACTION TOWARDS THE ERGONOMIC RELATED PROBLEMS

It is in general that the workstation should be designed to suit the individual employees comfort and safety such that to increase the productivity, control measures are based upon the hierarchy of control.

1.2 MUSCULOSKELETAL DISORDER

Musculoskeletal Disorder are related to high repetitive work processes and working in bad postures. Therefore to improve the efficiency of the worker and reduce the risks of musculoskeletal disorder their postures should be assessed and corrective measures are too adopted.

Work-related musculoskeletal disorders are a group of painful disorder of muscles, tendons, and nerves. Carpels tunnel Syndrome, tendonitis, thoracic outlet syndrome, and tension neck syndrome are examples.

This project mainly focuses on the injuries caused due to repeated working of the particular tasks.

Almost all works requires the use of the arms and hands. Therefore, most WMSD affects the hands, wrists, elbows, neck and shoulders. Work using the legs can leads to WMSD of the legs, hips, ankles and feet and problems related to backbones.[5]

FACTORS TO BE CONSIDERED FOR WMSD

- Physical Factor: Sustained or awkward postures, repetition of the same movements,

forceful exertions, hand-arm vibration, all body vibration, mechanical compression, and cold

- Psychosocial Factors: Work place, anatomy, work/rest cycle, tasks demands, social support from colleagues and management and job uncertainty.
- Individual factors: age, professional activities, sport activities, domestic activities, recreational activities, alcohol/tobacco consumption and previous WMSD.

Three types of Injuries caused by WMSD:

- Tend on Injury
- Neurovascular Disorders
- Muscle Injury[4]

1.5.1 TENDON INJURY

The tendon is a specialized type of tissue, which connects muscles to bones.

Tendons are surrounded by sheaths of fibrous tissue that protect the tissue from friction.

The sheath contains a synovial membrane which facilitates gliding of the tendon during mechanical actions. Minor disorders of tendons and their sheaths are very common. The Disorder are clearly stated in the Figure 2

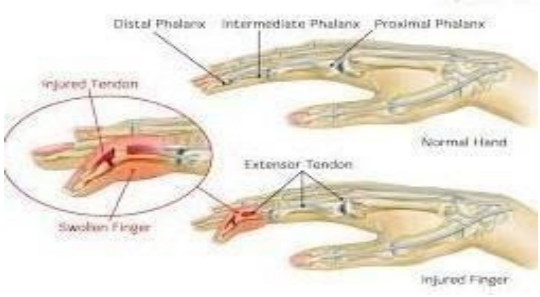


Figure 2 Tendon Injury[4]

1.5.2 NEUROVASCULAR DISORDERS

Neurovascular disorders are those cumulative trauma disorders which involve both the nerve and the adjacent blood vessels. Nerves are surrounded by muscles, tendons, and ligaments. With repetitive motions and awkward postures, the tissues surrounding nerves become swollen, and squeeze or compress nerves. Compression of a nerve causes muscle weakness, sensations of "pins and needles" and numbness. The Disorder are clearly stated in the Figure 3

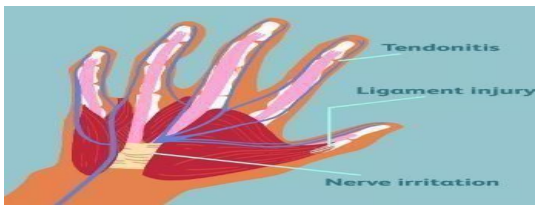


Figure 3 Neurovascular Disorder[4]

1.5.3. MUSCLE INJURY

Muscle injury is inflammation of the tendon occurring from repeated action of the muscle tendon unit. Since tendons have virtually no blood supply, they are Incapable of self-repair and damage. The accumulation of minor damage result in a roughened tendon, which may produce friction and irritation of its sheath. Ultimately, the tendon may become so weakened that it ruptures. Without rest or sufficient time for tissue to heal, the tendon may be permanently damaged. The most common tendon disorders of the shoulder are bicipital tendinopathy and rotator cuff tendinopathy.

Bicipital tendinopathy may be caused by inflammation of the tendon around the biceps muscle, or by degeneration of the tendon from repetitive overhead motion or from the normal aging process. Rotator cuff tendinopathy is also known as supraspinatus tendinitis, sub deltoid bursitis, sub acromial bursitis or partial tear of the rotator cuff.

The Disorder is clearly stated in the Figure 4.

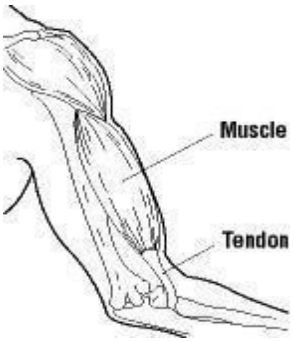


Figure 4 Muscle Injury

1.5.4 CODES FOR ERGONOMICS POSTURAL ANALYSIS

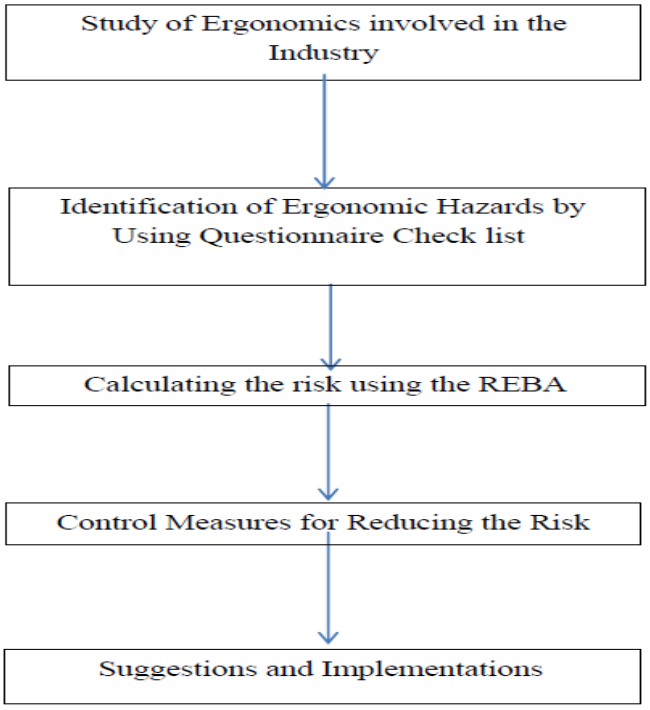
ISO 11226-2000 Evaluation of Static working Postures Pain, fatigue and disorders of the musculoskeletal system may result from sustained inadequate working postures that may be caused by poor work situations. Musculoskeletal pain and fatigue may themselves influence posture control which can increase the risk of errors and may result in reduced quality of work or production, and in hazardous situations. Good ergonomic design is a basic requirement to avoid these adverse effects. This International Standard contains an approach to determine the acceptability of static working postures. The content of the standard is based on current ergonomic knowledge, and is subject to changes according to future research.

LITERATURE REVIEW

N.A Ansari, P.N. Shende., (2013), published a paper on the title, "Study and Justification of body postures of workers working in SSI by using Reba", this paper evaluates REBA and RULA are techniques to quantize the fatigue experienced by the worker while manually lifting loads. These assessments were carried out by a procedural analysis of body postures involved. The fatigue involved in a particular operation was quantified and accordingly changes in work method for system improvement were suggested. These techniques helped in process refinement by identifying actions causing high fatigue.

Srikanth P Chakravarthya Subbaiah.K Shekar.G.L., (2015), published a paperonthetitle,"ErgonomicassessmentandRisk ReductionofAutomobileassembly tasks using Postural Assessment Tools", the paper mainly focuses on the different postures involved by the workers in the automobile industry. The postures are video tapped and the snapshots are obtained and they are analyzed by using the RULA and REBA. And ERGOGELLOW are used for calculating the different Body Postures.

METHODOLOGY



Methodology Flow Chart

CHAPTER 4 HAZARD IDENTIFICATION

4.1 IDENTIFICATION OF ERGONOMIC RELATEDHAZARDS

The various methods involved in the hazard identification related to ergonomics are,

- Conducting pre-start discussions on the works to be carried out
- Encouraging workers to recognize and highlight the hazard while performing
- Conducting the Walk through audit
- Questionnaire Check list etc.,

4.2 HAZARDS IDENTIFICATION AREAS

- ROTARY LINE
- DE-BURRING AREA

Here the workers are involved with the movements like,

- Repetitive movements
- Awkward and Static postures
- Both the twisting and bending takes place while in the work process
- Neck and truck is in awkward way of positioning which leads to musculoskeletal disorder

RAPID ENTIRE BODYASSESSSMENT

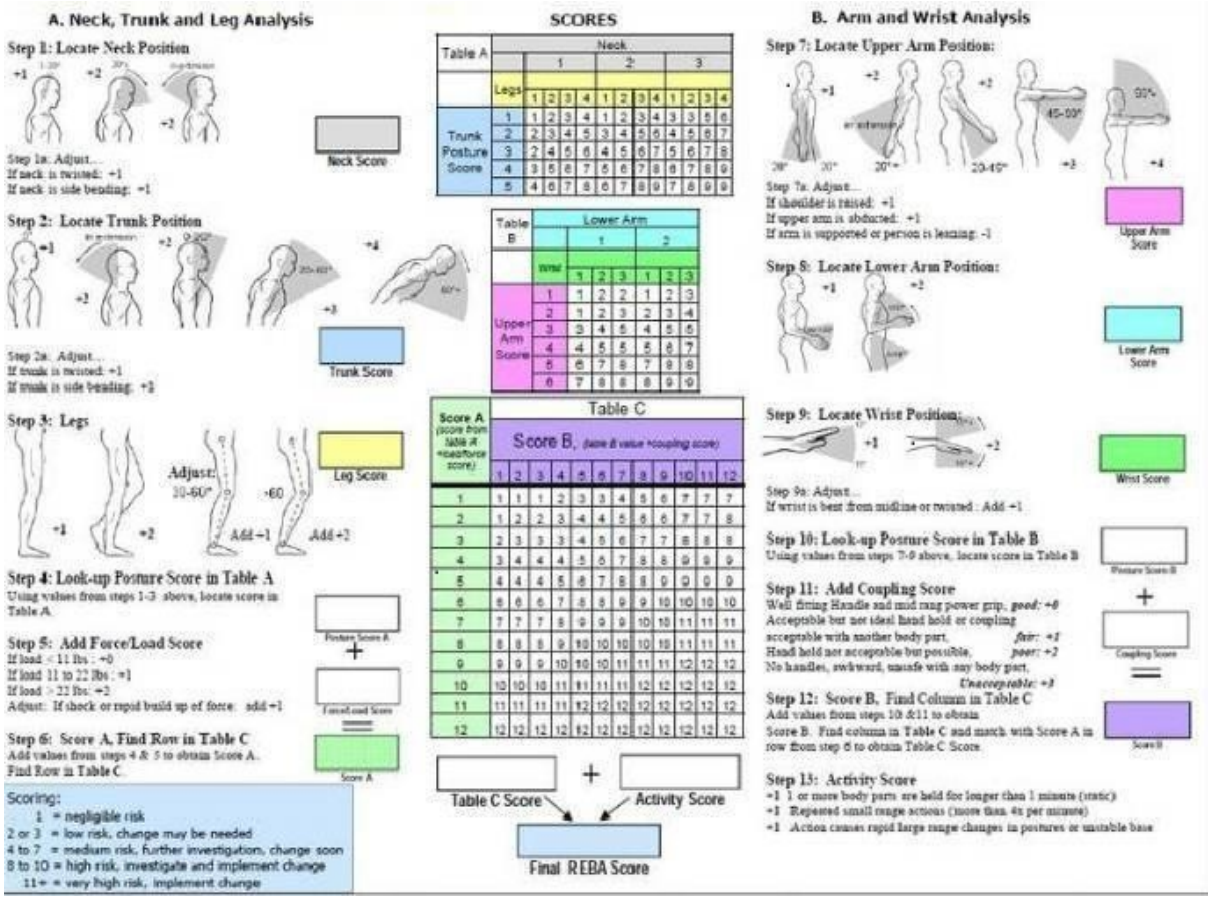
REBA it is a systematic process to evaluate whole body postural MSD and risks associated with job tasks. A single page worksheet is used to evaluate required body postures, for forcefulexertions, type of movements or actions, repetitions and coupling etc., The REBA sheet contains the risk score chart which is used to find the level of MSD risk and the sheet has been tabulated in the Table4,[4]

REBA RISK SCORE CHART

SCORE	LEVEL OF MSD RISK
1	Negligible Risk, no action required
2-3	Low Risk, change may be needed
4-7	Medium Risk, further investigation change soon
8-10	High Risk, investigate and implement Change
11+	Very High Risk, implement change now

STEPS FOR CALCULATING THE REBASCORE

There are about 13 steps involved in this tool for analysis starting from Neck, Trunk, Leg, Upper and Lower Arm, Wrist etc., Such a single sheet is to evaluate whole body and risk related to job tasks. The various posture involved by the workers are observed and assessed with the help of this sheet. Scores were obtained from Score A and Score B tables and final REBA Score are obtained from Score C table and with the activity Score and REBA sheet is Provided in Figure6, [6]



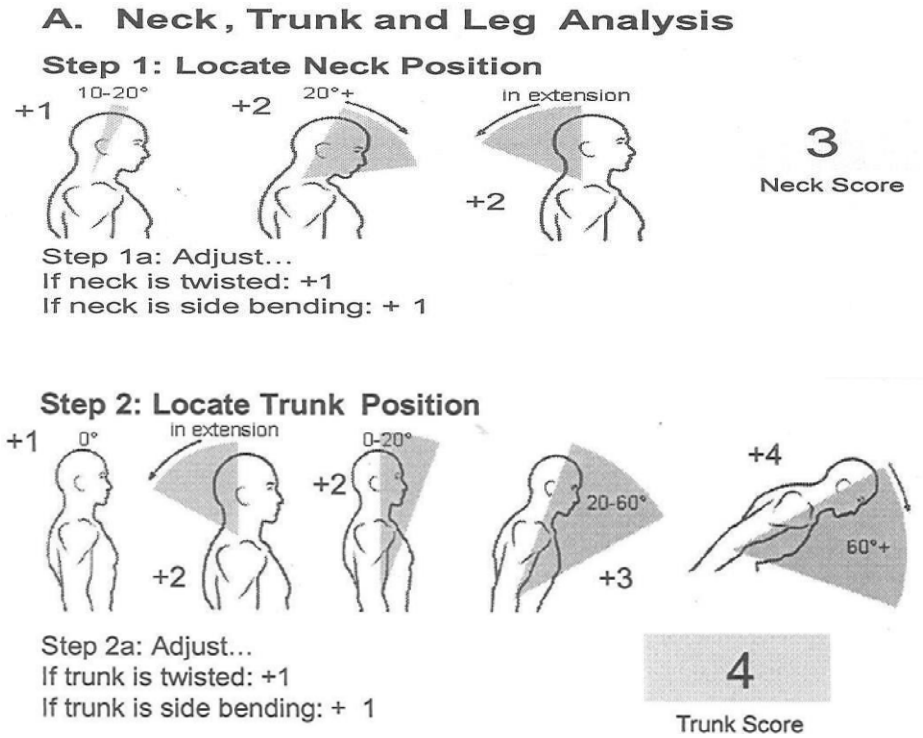
REBA Score Chart

AREA UNDER ASSESSMENT AND THE TOOLSUSED

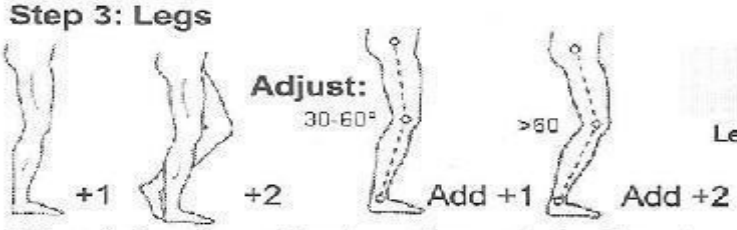
LINE	TYPE OF WORK	TOOL USED
ROTARY LINE	Here the engine is mounted in the frame and the fitting and tightening process in the frame takes place. Here the workers are bent in an improper posture and also they stretch their upper arm to catch and hold the pneumatic guns for tightening which lead to musculoskeletal disorder.	REBA
DE-BURRING AREA	Most of the De-burring work is associated in this area and here the workers are bent in an improper posture and neck and truck is in awkward way of positioning which leads to musculoskeletal disorder	REBA

ROTARY LINE ASSESSMENT USING REBA SHEET

The following REBA sheet is the sample of workers posture assessment in the Rotary line, every working postures from Neck to Wrist is observed, and Score is obtained from the Tables of the Score A,B and C and final REBA score is arrived with the activity Score



Step 3: Legs



3
Leg Score

Step 4: Look-up Posture Score in Table A
Using values from steps 1 -3 above,
Locate score in Table A

8
Posture Score A

Step 5: Add Force/Load Score
If load < 11 lbs. : +0
If load 11 to 22 lbs. : +1
If load > 22 lbs.: +2
Adjust: If shock or rapid build up of force: add +

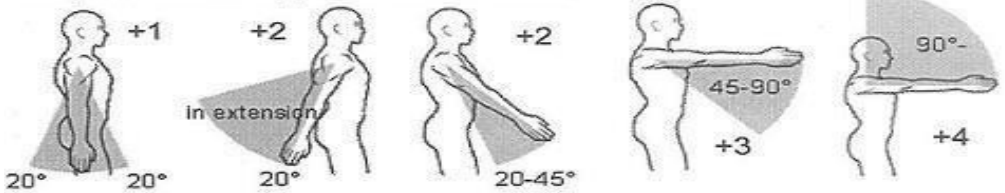
+
0
1 Force / Load Score

Step 6: Score A, Find Row in Table C
Add values from steps 4 & 5 to obtain Score A.
Find Row in **Table C**.

=
8
Score A

B. Arm and Wrist Analysis

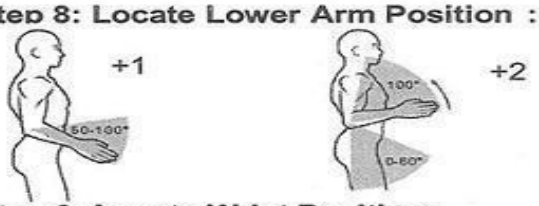
Step 7: Locate Upper Arm Position :



Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted : +1
If arm is supported or person is leaning : -1

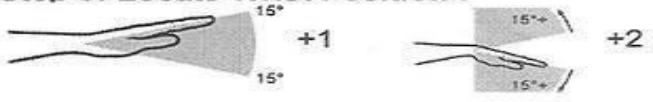
4
Upper Arm Score

Step 8: Locate Lower Arm Position :



2
Lower Arm Score

Step 9: Locate Wrist Position :



1
Wrist Score

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add + 1

Step 10: Look-up Posture Score in Table B
Using values from steps 7 -9 above, locate score in Table B

5

Posture Score B

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, *good: +0*
Acceptable but not ideal hand hold or coupling acceptable with another body part, *fair: +1*
Hand hold not acceptable but possible, *poor: +2*
No handles, awkward, unsafe with any body part , *Unacceptable: +3*

+

0

Coupling Score

=

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain Score B. Find column in **Table C** and match with Score A in row from step 6 to obtain Table C Score.

5

Score B

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Table A		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	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

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

Score A	Table C Score B											
	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

10	+	1	=	11
Table C Score		Activity Score		REBA Score

Scoring
1 = Negligible Risk
2-3 = Low Risk. Change may be needed.
4-7 = Medium Risk. Further Investigate. Change Soon.
8-10 = High Risk. Investigate and Implement Change
11+ = Very High Risk. Implement Change

CONTROL MEASURES IN ROTARY LINE

The Control measure for Rotary line has been provided based on the comfort and standard of posture,

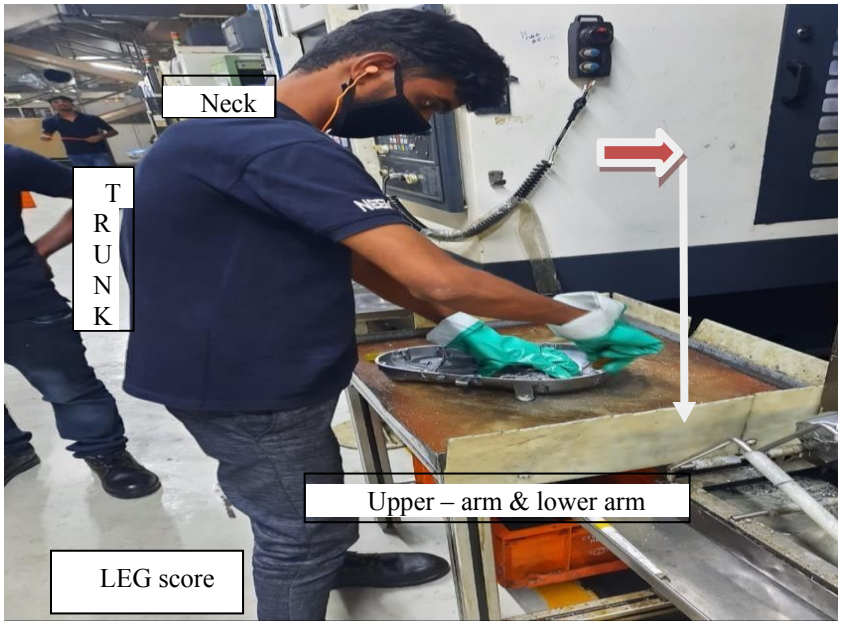
- In this line there is no ergonomically designed table to handle the work such that workers have to bend for the fitting and tightening.
- And as Per **OSHA** guidelines for standing posture analysis for the assembly line the elbow height can be below of **5-10cm** to the worktable.
- But here it is about more than 10cm such that the workers have to bend their back to tightening.
- The Scissor type of lift can be used such they can lower for loading it and the lifted to transfer to tightening and also easy to transfer.

Score Value for Rotary Line after control measures

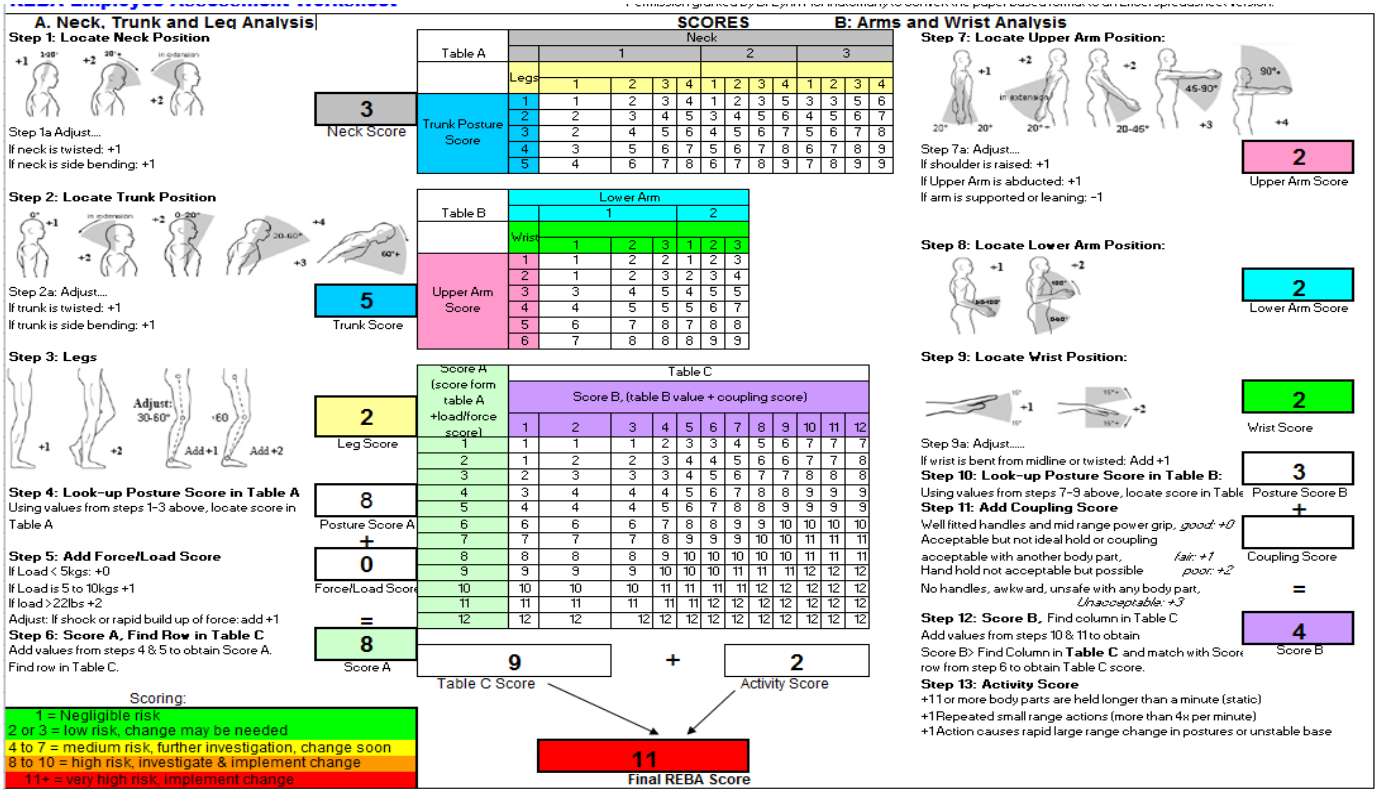
The REBA Score for the Rotary Line has been obtained as **5,** after Control Measure and it is found to be in very Medium Risk. Further Investigation and the Change to be done.

DEBURRING AREA ASSESMENT

- Working posture of the workmen in deburring area



DEBURRING ASSESSMENT USING REBA SHEET



CONTROL MEASURES OF DEBURRING AREA

• Proper working table with rotating fixture & working table height increased as per Ergonomical standards

• Proper fixture is attached in the work table for easy handling of the material also Neck & Trunk posture is minimized in this work after this control measure

• Fitted working table for the job is provided for the comfortable work to the worker to avoid the awkard postures & bending & twisting

• The control measure is very effective because it gives a minimum ergonomic hazard.

Deburring area after Control Measure

SCORE VALUE FOR DE-BURRING AREA

The REBA Score for the De-burring area has been obtained as **5**, after Control Measure and it is found to be in very Medium Risk.

SI.No	LINE AREA	REBA SCORE OF EMPLOYEESBEFORE CONTROLMEASURE		REBA SCORE OF EMPLOYEESAFTER CONTROLMEASURE	
		RISK SCORING	LEVELOF MSDRISK	RISK SCORING	LEVELOF MSDRISK
1	Rotary Line	11 (12 workers)	Very High Risk	5 (16 workers)	Medium Risk
		10 (4 workers)	High Risk		
2	Deburring area	7 (44 workers)	Medium Risk	5 (66 workers)	Medium Risk
		8 (22 workers)	High Risk		

RESULTS AND DISCUSSION

•The Risk Score have Been Reduced Based on theControlMeasuresProvidedfromtheHighRisk ToMediumRiskintheRotaryLineandFurtherinvestigation to made and changed soon.

•The Risk Score have Been Reduced Based on the Control Measures Provided and the Risk Score has been reduced in the De-burring area and the Risk remains Medium Risk Further investigation to made and changed soon.

CONCLUSION

The workers work postures involved during the process in the Rotary line and de-burring area are carried out by using the REBA tool, and it is concluded that the workers are working with the uncomfortable and painful postures due to repetitive tasks in the process, and here there is a lack of awareness about the ergonomics related problems. And the results of risks found to be in the Very High, High and Medium in both the Rotary and de-burring Lines. And this project recommends immediate implementation of the control measures like in all areas such that to lower the level of MSD risks of workers. Which can help to over come the MSD related problems and this in turn increase the productivity.

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