

Ergonomic Analysis and Improvements Proposal in the Labor Environment on C346 Area in Faurecia Exhaust Mexicana S.A. de C.V. Company in Hermosillo Sonora Plant.

¹M.C. Penélope Guadalupe Álvarez Vega, ²M.C. Jazmín Argelia Quiñonez Ibarra, ³M.C. Cristian Vinicio López Del Castillo, ⁴M.A. María del Carmen Ramírez Siquieros. ⁵Ing. Talía Del Socorro Solís Ayala.

División de Ingeniería y Tecnología, Universidad de la Sierra, Moctezuma, Sonora, México.

¹pgalvarez@hotmail.com, ²argeliaq@hotmail.com, ³vinciolopez77@hotmail.com, ⁴pamela_sonora2002@hotmail.com, ⁵talia_solis@hotmail.com

ABSTRACT

The purpose of this work is to identify ergonomic hazards presented in the workstations on C346 area inside Faurecia Exhaust Mexicana Company. Once possible risks are identified and analyzed in site, will be presented improvements to decrease them and contribute in a better adaptation to humans in their work, which include the care of health, the loads reduction and perfection of the labor conditions, among others. The main purpose of this work is the safety work into the work place, in which is covered at the time when carrying out their activities. The necessity to realize an ergonomic analysis is essential to define those representative elements in the progress of work and collect as much possible information about activities realized. With the development of the ergonomic analysis inside the company is planned to know the main ergonomic hazards associated with workstations and identify which are the jobs that must be analyzed in detail, also prioritize the action plans to contribute in the improvements on once mentioned before. The issues into this document give information about the necessities and workers' requirements to make their operations, which provides basis for analyze the stations and to know the current situations. It describes the used methods along ergonomic assessment, the developed processes and the criteria used to determine the ergonomic hazard level. Finally are presented the results from the research to the activities realized, the risk from each workstation prioritizing, proposing and arguing improvements to the founded troubles.

INTRODUCTION

Faurecia Exhaust Mexicana with the purpose of carry out with the necessities and market requirements has extended its production areas, by this has been implemented a new area called C346 in which was necessary to made an ergonomic analysis for its new line of production. Is really important to do an ergonomic analysis which allows us to detect the main factors of hazards presented on the workstations before mentioned took as a result of a lot of injuries and occupational diseases. According to (Obornde David, 1987) whose propose direct observation, is decided to use this method to detect the principal factors of occupational risk into labor areas. To achieve this objective, ergonomics criteria,

occupational safety and health will be followed. With the implementation of ergonomic analysis will be possible to detect the risks to which workers are exposed and look for administrative and engineering options to support a comfortable environment between workers and processes. Each time the processes demand to be more specific and with higher quality, the human factor and security are important to achieve. By that in Faurecia Exhaust Mexicana is necessary to make an ergonomic analysis on workstations, in order to contribute to get better labor conditions, know the possible illness, risk that may occur and propose solutions or improvements to such problems. Faurecia Exhaust Mexicana Hermosillo is a company specialized in design, production and distribution of exhaust system with engineering and production of autogroups. It has placed as a world leader of car's equipment. Its goal is to create and provide innovate products such as services and techniques solutions that provides quality, competitiveness and value added to constructors. In recent years has increased the importance of implementing an ergonomic analysis into the organizations, using a set of methods that help to know the conditions under workers operate, based on the systematic and specific description of current operations. As in many other companies on Faurecia Exhaust Mexicana processes previously registered injuries and occupational diseases caused by wrong positions, erroneous lifts and unfit machinery for the work done, by this is necessary to do an ergonomic analysis because the human factor is crucial in each process and is really important that do the work in an environment that ensures the physical, psychological and social wellness. With that implementation, the company hopes to achieve better optimization in its production and reduce the level of hazards for employees at the time they perform their duties.

General Objective

The objective of this project is to do an ergonomic analysis to know the main risk factors in C346 area in Faurecia Exhaust Mexicana Company to measure the impact these will have on operators and then reduce occupational risks.

Specific Objectives

- Observe each one of the movements, positions and left of operators.
- Detect the ergonomic hazards of each workstation.
- Analyze the ergonomic hazards presented on workstations.
- Detect if exist a kind of relation between ergonomic hazards that have been presented and those that may occur according to the ergonomic hazard analysis.
- Propose administrative and engineering controls to ergonomic hazards and possible occupational illnesses that could be presented.

METHODS AND MATERIALS

For the development of the Ergonomic Analysis project in C346 area into Faurecia Exhaust Mexicana Company was divided in two steps:

1. Evaluation of the workstations by the Ergonomic Analysis.
2. Proposed improvements to the problems presented in the Ergonomic Analysis on C346 area workstations.

The First step was the evaluation on workstations, on the progress of the ergonomic analysis was used a company's software which has the intention of reduce the risk of accidents, help the employees work achieving with this the efficiency and do available stations to most possible number of operators. This software is basically based on produced hazard by repetitive movements, lifts and positions adopted at the time of doing an operation.

On the second step are proposed solutions to improve workstations by administrative and engineering techniques.

The software is formed by many elements which give a general vision of each workstation and their critical aspects.

RESULTS AND DISCUSSIONS

At the end of the ergonomic analysis development in which was planned identify the ergonomic hazards to which staff are exposed in C346 area, was obtained the results presented next and the proposals to the found problems during the project development: Shown below the results with the purpose of write down the ergonomic hazard level of each workstation.

Workstation	Cutting of Bender Addison C346 Supplier
TaskLoad Bender Addison	



BACK AND SHOULDERS

a) Effort

Real weight of load 4,40 kg.

Frequency by hour 60 pcs.

Risk level **L O W**

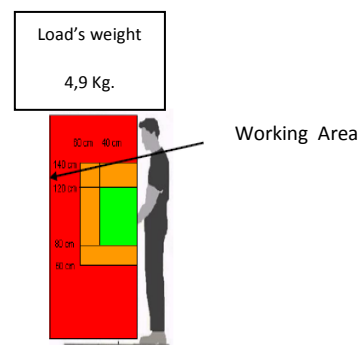
b) Grip point

Weight 4,40 Kg.





Vertical distance 1.50 m.

Horizontal distance 1.25 m.

Risk level **H I G H**



c) Position





Position	Frequency by hour
	120
	0
	0
	120
Level of risk	HIGH

Comments:

First operation at time to load the machine:





The effort that realize with the back and shoulders is into the permitted limits, the risk is in the zone where operations are realized which is out of recommended manipulation area, about the adopted position the worker is in a high risk as it shrinks to collect the raw material at 60° and stretch his arm to put it in the machine.

Neck

Position	Frequency by hour
	0
	0
	0
	0
Level of risk	LOW

Comments:Into the operations made by the worker in reference of neck, is out of ergonomic hazard.

UPPER EXTREMITIES

Position	Frequency by
	180
	0
	0
	0
Level of risk	MEDIUM

Comments:The risk level to load handling relating to upper extremities is medium as only one of movements realized is repeated with a frequency of 3 by minute at time to load themachine.

Based on station found risks is intended to get better the conditions according to the following arguments:

General situation of the station:The Ergonomic Hazard level on the station of Supplier cutting and formed in robotic cells is Medium and Effort level is high based on the guide to the election of manipulation's helps.

Unsafe condition: at time to place the raw materials the operator has to lift 1.50 m and stretch the arm 1 meter to fits perfect as the incitement of tube holder is 5 cm and doesn't reach to trapping point.

Current condition: Tube holder is so high and inclination is so little.

Injure risk: Tendinitis shoulder.

Condition required:

1. Lower machinery 30 cm. to operator works in the grip point safe area.
2. Reduce 60 cm. tube holder avoiding the operator is hit.
3. Rise the tube holder inclination then raw material would slide without requiring the operator stretch to place it.

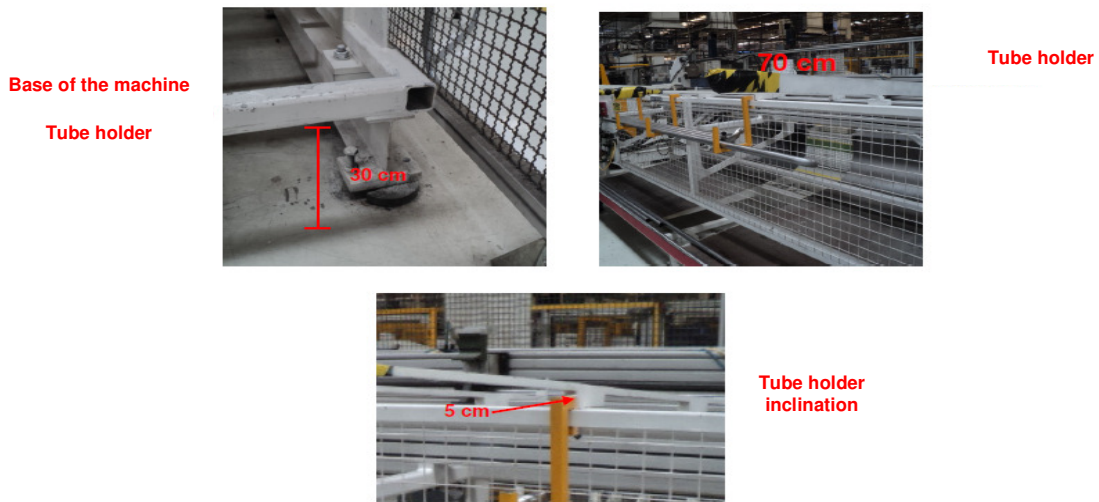


Figure 1. Bander Addison C346 Cutting Supplier with the Requested Changes

Workstation	Pipe form & cutting of C346 Bender
TaskLoad cell robot	



BACK AND SHOULDERS

a) Effort

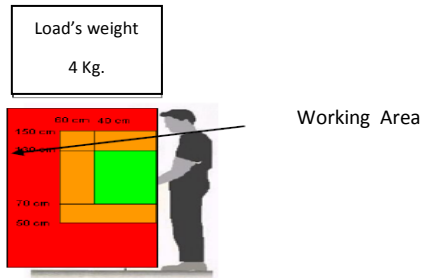
Real weight of load 0.26 kg.

Frequency by hour 60 pcs.

Risk level **LOW**

b) Grip point

Weight	0.26 Kg.
Vertical distance	1.18 m.
Horizontal distance	1.10 m.
Risk level	HIGH



c) Position

Position	Frecuency by hour
	180
	60
	0
	120
Level of risk	HIGH

Comments:In this load activity on the robotic cell the operator effort is little because the pieces are very small; the risk level comes from the grip point and the position, because the operator is working out of the safety area as the horizontal distance is very large. The position taken by the operator is so forced and it makes the operation is considered as high ergonomic hazard.

Neck

Position	Frecuency by hour
	120
	0
	0
	0
Level of risk	MEDIUM

Comments:At time to do operations in this area the operator tilts his head to place and pick up the piece he is working with, being found in a medium ergonomic hazard.

UPPER EXTREMITIES

Position	Frecuency by hour
	0
	0
	0
	0
	0
Level of risk	LOW

Comments:With upper extremities is not made any repetitive or inappropriate movement by what this activity is without ergonomic hazards.

Based on station found risks is intended to get better the conditions according to the following arguments:

General situation of the station:The Ergonomic Hazard level is medium into activities mentioned before as activities are so simple the risk is mainly at time to place the piece because the horizontal distance is 1.10 meters and the operator at time to put the piece introduces practically the top of his body to the robot cell.

Unsafe condition: To put the piece the operator gets his body into the robot cell, what can cause an accident if the on button is press by mistake and cause an injury on the back by the position in which is working for the robotic cell doesn't have light curtains to prevent this.

Current condition: Horizontal distance between operator and machine is 1.50 m.

Injure risk: Cervical spasm.

Condition required:

1. Install light curtains in the robotic cell to not activate the security guard when operator is putting the piece and occur an accident.
2. Use the tools to place the piece inside the robotic cell, be inserted into the cell and then prevent a hit or an accident by entrapment.
3. Reduce the distance between the guard and machine to avoid the operator to enter the upper body.

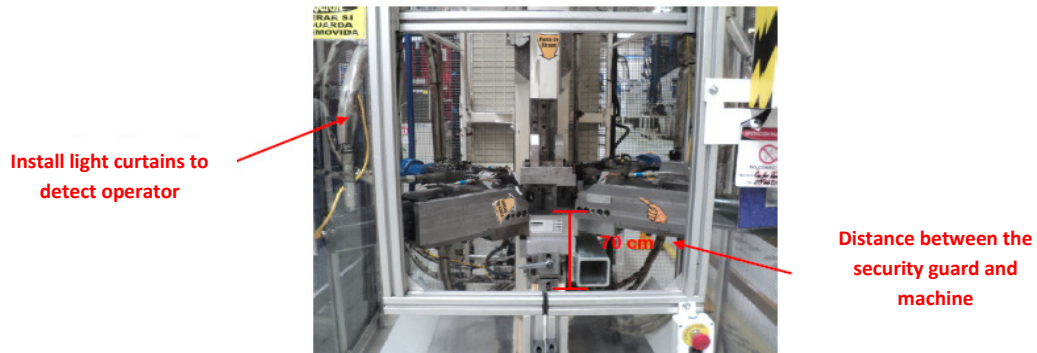


Figure 2. Formed & Cut of Pipe C346 Bender with Requested Changes

Workstation	Robotic cell 1 fixture 1 Manifold
Task Load robotic cell	



BACK AND SHOULDERS

a) Effort

Real weight of load 1.42 kg.

Frequency by hour 60 pcs.

Risk level O W

b) Grip point

Weight	1.42 Kg.
Vertical distance	1.25 m.
Horizontal distance	63.5 c m.
Risk level	HIGH



c) Position

Position	Frecuency by hour
	60
	0
	0
	0
Level of risk	MEDIUM

Comments: The level risk is medium based on fundamental positions as inclination the upper part of the body to pick up the piece on standby, this may cause back injuries.

Neck

Position	Frecuency by hour
	120
	0
	0
	0
Level of risk	LOW

Comments: The operator tilts his head at time to place the piece as time to remove it from the robotic cell.

UPPER EXTREMITIES

Position	Frecuency by hour
	0
	0
	240
	0
	0
Level of risk	HIGH

Comments: To fits the piece, the operator takes the handle which has to be taken by two hands repeating this movement with each piece by the station is a high ergonomic hazard.

Based on station found risks is intended to get better the conditions according to the following arguments:

General situation: The operations on the station written before show that they are in a medium level risk, with an exception with the pressure that operator performs at time to take the piece and the repetitive movements made by the neck, the effort level is accepted.

Unsafe condition: The operator has to hold the piece at time to place it and do repetitive movements with the left hand.

Current condition: The operator makes constant movements which can damage his arms.

Injure risk: Wrist tendinitis.

Condition required:

1. Place sensors to detect and hold the piece to keep away from such moments in operator.
2. Put light curtains for operator safety as operator or someone can press the on bottom by mistake and cause an accident.
3. At time to do the first activity and not to do constant movements the operator may place the first piece with the right hand and hold it with left hand, at time to place the second piece do it with the left hand and hold it with the right hand.

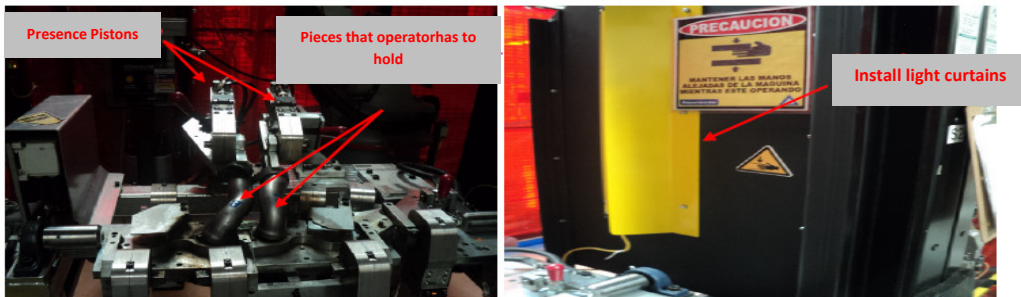


Figure 3. Robotic Cell 1 Fixture 1 Manifold with Changes Required

Workstation	leak and Inspection Maniverter test
Task	Load robotic cell



BACK AND SHOULDERS

a) Effort

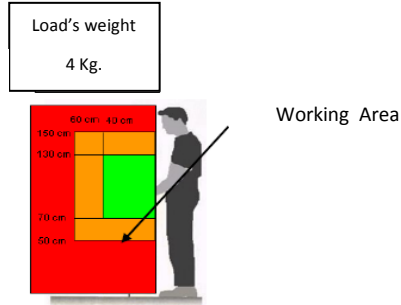
Real weight of load 6.27 kg.

Frequency by hour 60 pcs.

Risk level O W

b) Grip point

Weight	6.27 Kg.
Vertical distance	48 c m.
Horizontal distance	27 c m.
Risk level	HIGH



c) Position

Position	Frecuency by hour
60°	120
45°	120
30°	0
15°	120
Level of risk	HIGH

Comments: In this process is made the leak test, at the same time the operator has to inspect 8 points of the piece which are behind it and has to incline to have access at these points because the base where the piece is placed is fixed.

Neck

Position	Frecuency by hour
45°	240
30°	0
15°	0
0°	240
Level of risk	HIGH

Comments: The movements made with neck are many by the manner to place the piece is inadequate, taken by this a bad position may cause hurt or back and neck injuries.

UPPER EXTREMITIES

Position	Frecuency by hour
60°	60
0°	0
60°	60
240°	240
0°	240
Level of risk	HIGH

Comments: The operator has movements with his upper extremities which can have repercussions in his health accumulating over time, representing an activity of high ergonomic hazard to the worker.

Based on station found risks is intended to get better the conditions according to the following arguments:

General situation: The leak test station has a really bad design; the operator has to do a big effort to inspect each one of the required points, representing a high ergonomic hazard area.

Unsafe condition: The position taken by the operator can cause big back and hands problems by movements and positions.

Current condition: Bad design of machine.

Injure risk: Low back pain.

Condition required:

The machine can't boost by the weight of the machine (6, 27 kg.) it should be.

- Add 30 degrees of inclination of the machine, by this the piece doesn't be horizontal but tilted and the operator wouldn't have to duck to make the inspection.
- Move the security guard throw the left approximately 1 meter like counterweight to best security of the operator.
- Place a piston to put the piece by horizontal manner and at time to do the inspection when the machine goes up, avoiding with that any unsecure position.

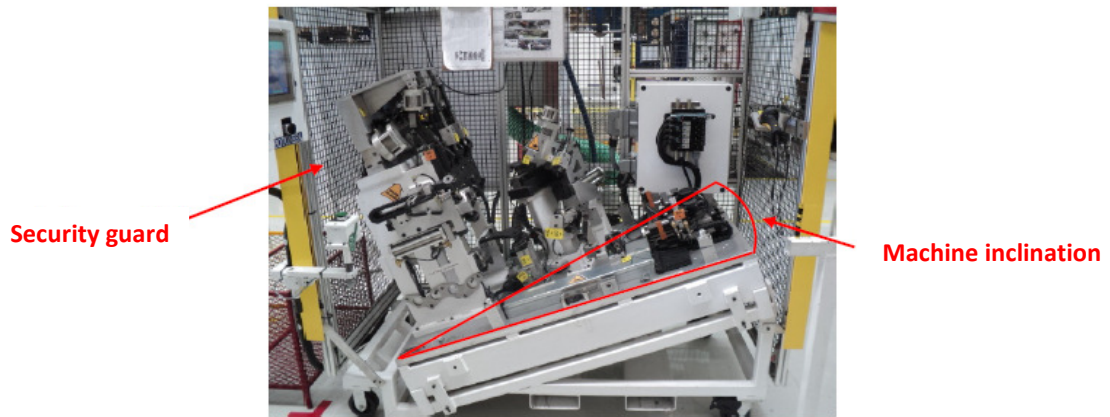
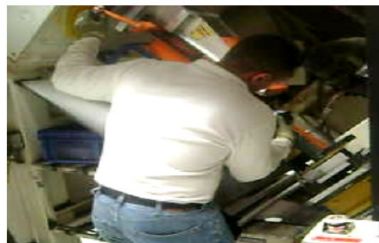


Figure 4. Leak and Maniverter Inspection Test with the Changes Requested

Workstation	Inverter welding cone
Task	Load robotic cell



BACK AND SHOULDERS

a) Effort

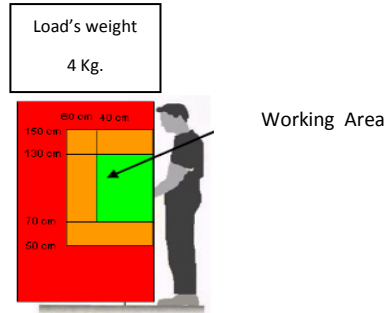
Real weight of load 1.36 kg.

Frequency by hour 60 pcs.

Risk level LOW

b) Grip point

Weight	1.36 Kg.
Vertical distance	1.15 m.
Horizontal distance	37.6 c m.
Risk level	LOW



Neck

Position	Frequency by hour
	60
	0
	0
	120
Level of risk	MEDIUM

Comments: The movements made by neck are medium level of risk by the frequency which is made.

c) Position

Position	Frequency by hour
	120
	60
	0
	120
Level of risk	HIGH

Comments: The position taken by the worker at time to place the piece is so anti-ergonomic and is a high risk inside the workstation as the position taken to place the piece is so forced.

UPPER EXTREMITIES

Position	Frequency by hour
	0
	0
	0
	0
	240
Level of risk	HIGH

Comments: The operator makes repetitive movements with the wrist that can cause an injury.

Based on station found risks is intended to get better the conditions according to the following arguments:

General situation: The level of risk in where is the station is high by the position in which the operator has to work which several anti-ergonomic motions resulting therefore as difficult to the operator work here in the station.

Unsafe condition: At time to work on this station the operator has to flex to one side, place the piece with the right hand and with left hand take a handle to secure the piece.

Current condition:The machinery is in an inappropriate position.

Injure risk:Contraction of column, low back.

Condition required:Machinery currently at a height of 1.70 meters with an inclination of 45 degrees, what is necessary to low the machinery at a height of 1.30 meters and placed at 180 degrees so the machinery should be horizontal.

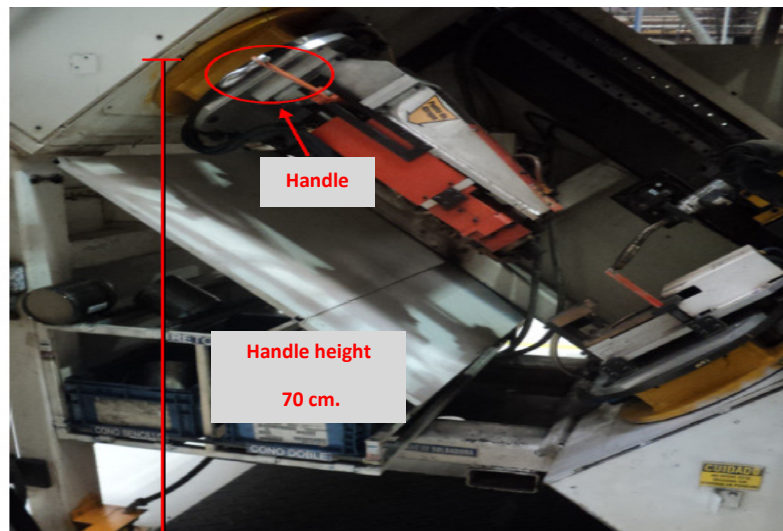


Figure 5. Inverter Welding Cone with Changes Requested

Workstation	Final Maniverter inspection
Task	Perform final inspection



BACK AND SHOULDERS

a) Effort

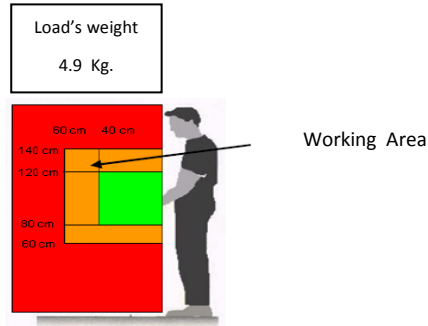
Real weight of load 6.87 kg.

Frequency by hour 60 pcs.

Risk level LOW

b) Grip point

Weight	6.87 Kg.
Vertical distance	1.20 m.
Horizontal distance	68.4 c m.
Risk level	MEDIUM



c) Position

Position	Frecuency by hour
	60
	360
	0
	0
Level of risk	HIGH

Comments: This station has a high risk to operator as do this work form a bad position to inspect each necessary point to guarantee the piece quality.

Neck

Position	Frecuency by hour
	60
	0
	0
	60
Level of risk	MEDIUM

Comments: The operator has to tilt and rotate the neck to both sides being forced to fit at the workstation, which is in a medium risk to the worker.

UPPER EXTREMITIES

Position	Frecuency by hour
	0
	0
	0
	0
	360
Level of risk	HIGH

Comments: The operator makes 360 turns with wrist at each piece inspection which is a high risk to operator who is working on this activity.

Based on station found risks is intended to get better the conditions according to the following arguments:

General situation: The station has a high index of dangers to operator who is doing the final inspection of the piece, considered a high ergonomic hazard station by the tasks performed.

Unsafe condition: The position taken by the worker at time to inspect each one of the points of the piece, the repetitive movements made and the interaction between the operator and the tools used (inspection table, tools, manual to check inspect points) impact directly on worker's labor conditions.

Current condition: The forced position of the worker and repetitive movements during 8 hours at day affects directly to operator, having as consequence muscle aches and labor injuries.

Injure risk: Wrist tendinitis, neck contracture.

Condition required:

1. Put a device to the final inspection table that is adaptable according to each height's operator, avoiding with this the operator takes forced and anti-ergonomic position.
2. Install guides to the table so the piece is fixed and the operator doesn't have to hold the piece whit his hands to make the inspection.
3. Use of tire tools with die controlled to detect the possible burrs on the nut.
4. To not repeat the operation on inspected points, install solid copper into the nut using this device could reduce 360 to 180 wrist turns by piece.



Figure 6. Final Maniverter Inspection with Changes Requested

CONCLUSIONS AND RECOMMENDATIONS

Based on data obtained during the advance of the ergonomic analysis project was found that the stations of C346 area inside the company, represent an ergonomic hazard to workers, the results given by the analysis helped as the beginning to give improvements to found problems, which are expected be useful to the company in obtain more safety on employees.

Is important to say that with the labor environment improvement will be benefited other situations inside the company such as the productivity grows thanks to reduce absenteeism, at the same time increase the quality on work and products. The method used to develop the ergonomic analysis satisfy all planned expectations as is based on main aspects in which may affect operators giving the risk of each activity, is highly recommended as the same manner where studied the ergonomic hazards and where looked the improvements to founded problems, monitoring the ergonomic hazards in other areas of the company to guarantee the wellness and security of all workers, could be simple solutions and give a lot of benefits to the company.

REFERENCES

1. Wright Paul. *Introducción a la Ingeniería*. 2004. Third Edition. Editorial Limusa. Mexico. 297 Pages
2. Konz Stephan. *Diseño de Sistemas de Trabajo*. 2000. First Edition. Editorial Limusa. Mexico. 673 Pages
3. De Montmollin Maurice. *Introducción a la Ergonomía*. 2004. First Edition. Editorial Limusa. Mexico. 209 Pages
4. Mondelo R. Pedro. *Ergonomía 1*. 2000. Third Edition. Editorial Alfaomega. Barcelona, Spain. 185 Pages
5. Osborne David. *Ergonomía en Acción*. 1987. Second Edition. Editorial Trillas. Mexico. 401 Pages
6. Ramírez Cavassa. *Ergonomía y Productividad*. 2001. First Edition. Editorial Limusa. Mexico. 415 Pages
7. Osha. *Información sobre seguridad industrial*.
www.osha.gov/OshDoc/data_General.../ppe-factsheet-spanish.pdf (último acceso 26 de SEPTIEMBRE de 2010)
8. Ideal. Información sobre niveles de iluminación.
<http://waste.ideal.es/ergonomia.pdf> (último acceso: 15 de OCTUBRE de 2010).
9. Salas Saragon. Información sobre niveles de ruido.
<http://www.salasaragon.com.ar/wordpress/wpcontent/uploads/2009/07/ruido.jpg> (último acceso 08 de SEPTIEMBRE de 2010)