

# Chair Design Work With Ergonomic Aspects to Reduce Musculoskeletal Complaints Pt Pinaco Main in Indonesia ( PUI )

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**Abstract----** Fire extinguisher recharging is a key activity in PT Pinaco Utama Indonesia . In these activities , the workers doing the work manually with ergonomic postures that can lead to complaints on the musculoskeletal system. In the preliminary study , a questionnaire used Nordic Body Map is used to identify specific problems in parts of the body and using REBA ( Rappid Entire Body Assisment ) to determine the level of risk working posture. This preliminary study shows that workers have a lot of complaints on the part of their body with a high level of risk and very high. For that we need a tool that can reduce complaints on musculoskeletal system. Aids in the form of working chair.

The research objective is to design ergonomic office chair and is equipped with several features to accommodate the needs and conditions in PT Pinaco Utama Indonesia. The first step of this research is to develop the expectations of the seat features work then the information is poured into a design concept. Furthermore , this concept is embodied in the design of more specific taking into account the anthropometric dimensions of the worker. Making the design and calculation of production costs made to conduct a feasibility analysis in this study. Results of this research is to produce a work chair that is portable , system settings on a table that can be advanced or reversed and there is also a driving wheel as well as a powder that serves as a reservoir. Based on the identification REBA , the posture of workers improved from a very high level of risk and high into medium and low risk level .

**Keywords----** Design, Ergonomic , Nordic Body Map , REBA anthropometry, Work Chairs

## I. INTRODUCTION

PT. PINACO UTAMA INDONESIA is a factory engaged in trade and services refilling of fire extinguishers as well as providing equipment / fire-fighting equipment brand PINA. In the process of refilling a fire extinguisher includes several stages of the process of making powder / powder and empty tubes, filling of powder / powder into the tube and filling nitrogen.

In terms of sales, reservations for refilling a fire extinguisher in PT PUI was erratic, but for the average sales per day can produce as many as 20 models of portable fire extinguisher fire extinguisher ( small fire extinguisher ). Tube Fire extinguisher APAR models ie tubes with a size of 1 kg - 9 kg.

Based on direct interviews of the four workers who perform the process of refilling a fire extinguisher, it was found that they had complaints on the musculoskeletal system such as pain in his back and waist. It happened because the position of the working posture bent upon making process powder / powder and powder filling process to tube. The impact of the bent position that does not directly felt, but gradually within  $\pm$  1 year will be felt in the back , waist and neck. The process can be seen in Figure 1 below:



Fig. 1 Initial conditions are charging a fire extinguisher

The interview results reinforced by the results of the questionnaire NBM ( Nordic Body Map ) against four people working fire extinguisher refilling. Based on the results of the questionnaire obtained NBM complaints in some segments of the worker's body. Of the four workers is known that the four complained of pain in the back and hip pain.

Based on observations during the process of refilling fire extinguishers are working posture that could potentially cause pain or muscle injury either at the top or bottom. Therefore, the identification work posture during the process of refilling a fire extinguisher using the REBA ( Rappid Entire Body Assisment ). From the results are expected to know REBA work postures that have problems to do further corrective action.

## II. RESEARCH PURPOSE

The objectives to be achieved after doing this research are: Can identify work postures draft results, Can design work chair in accordance with anthropometry workers and Can identify the test results after the draft .

### III. RESEARCH METHODS

The research methodology is described in the form of a flowchart as shown in Figure 2 :

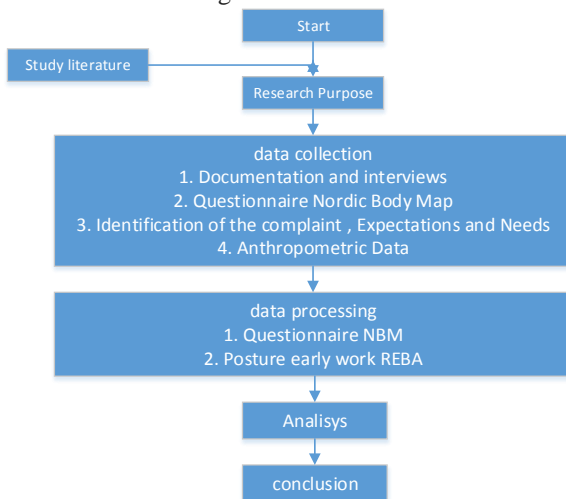


Fig. 2 Research methodes

### IV. RESULT AND DISCUSSION

#### A. Data Collection

Data collection phase is obtained from direct observation of the process of filling a fire extinguisher in PT Pinaco Utama Indonesia. Then the data collected will be used as the basis for designing a tool in the form of "work chair " that is expected to be able to cope with musculoskeletal complaints experienced by these workers.

uestionnaire Results Recap NBM ( Nordic Body Map )

Nordic Body Map questionnaires were given to four workers at PT Pinaco Utama Indonesia, aims to determine the complaints of the workers in the process of filling a fire extinguisher. This questionnaire Following are the results of the questionnaire in Table 1:

TABLE 1  
QUESTIONNAIRE NBM ( NORDIC BODY MAP)

No	Jenis keluhan bagian tubuh	Skor Operator 1		Skor Operator 2		Skor Operator 3		Skor Operator 4		Total				
		TS	AS	SS	SS	TS	AS	SS	SS		TS	AS	SS	SS
0	Neck section differences	1								0				3
1	Neck down	1			1			1		1			1	4
2	Part of the left shoulder	1		0			0			1				1
3	Part of right shoulder	1			1			1		0				3
4	Part of the left upper arm	0			0		0		1			0		0
5	Part dorsally		2			2			3				2	8
6	Part right upper arm	1			1			1				1		4
7	Part waist		2			2			2				2	8
8	Part the legs		2			1			1				1	5
9	Part the buttocks	0			0			0		1				0
10	Part of the left elbow	0			0			0		0				0
11	Part right elbow	0			0			1		0				1
12	Part the left forearm	1			0			0		0				1
13	Part of the right forearm	1			1			1		1			1	4
14	Part of the left wrist	0			0			0		0				0
15	Part right wrist	0			1			1		1			1	3
16	The left hand part	0			0			0		0				0
17	Right hand section	1			1			1		1			1	4
18	Part of the left thigh	1			0			1		0				2
19	Right thigh	1			0			1		1				2
20	Part of the left knee	0			0			0		0				0
21	Part right knee	0			0			0		0				0
22	Left calf section	1			1			1		1			0	3
23	Right calf section	1			1			1		1			1	4
24	Left ankle part	0			0			0		0				0
25	Part right ankle	0			0			0		0				0
26	Part of the left leg	0			0			0		0				0
27	Section on the right foot	0			0			0		0				0
Amount		12	6		10	4		13	4			7	4	60

#### B. Initial Work Postures

Working posture assessment is performed to determine the attitude / position working experience musculoskeletal complaints. Posture assessment work carried out by the method of REBA ( Rapid Entire Body Assisment ) . REBA method can be used to determine which parts of the body experience fatigue or pain.

Assessment posture PT Pui workers drawn from the current posture of the process of refilling fire extinguishers which consists of several processes including: the process took the powder and took the empty tubes to the area of work, the process of taking and pour the powder contents into an empty tube until fully charged according to the size of a standard charging later after the tube is fully charged, then the final step is filling nitrogen .

#### C. Complaints identification, Hope and Design Requirements

The identification is done with the interview, asking questions directly to four workers at PT Pinaco Utama Indonesia to get information directly from the workers or complaints regarding the difficulties experienced during the process of charging a fire extinguisher. Here is a question that is used to identify the complaints during the process of charging a fire extinguisher, namely : Complaints whatever you experienced while making the process of filling a fire extinguisher?, and any difficulties that you experienced while making the process of filling a fire extinguisher ?

Results of interviews with workers regarding complaints and difficulties in the process of filling a fire extinguisher.

#### D. Reparation Of Design Concept

Design concepts required in a design. Design concepts include basic shapes, the main dimensions of functional and working mechanism.This design concept gives a preliminary description of the chair to be made and how the mechanism of action taking into account the suitability of the operator or the worker who will use it.

#### E. BOM ( Bill of Material)

The design uses the BOM ( Bill of Materials ) is to determine the needs of the material making up the formation of a product. The following describes an image Bill of Materials of designing ergonomic office chair is as follows

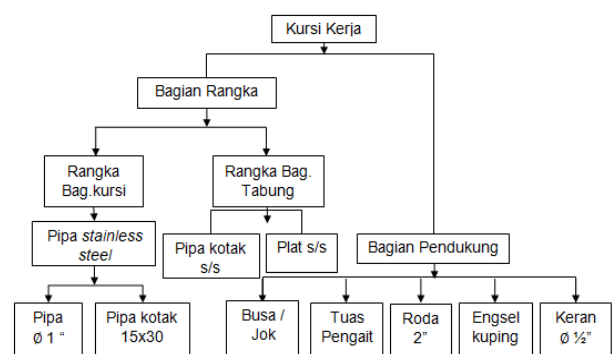


Fig. 3 Bill of material

### F. Concept Design

The design concept of the design office chair is a description in broad outline of the measures of the design office chair will be designed to simplify the design process . The specifications of the design of ergonomic office chair is :

- To determine the height of the seat , anthropometric data used are the dimensions of TDT ( High sitting upright ) using 95 % percentile is 93.73 cm rounded to 94 cm .
- In determining the height of the pedestal seat , anthropometric data used is the TPO dimensions (height popliteal ) using 95 % percentile is 47.13 cm rounded to 48 cm.
- To determine the length of the seat pad , anthropometric data used are the dimensions of PPO ( buttock popliteal ) using 5 % percentile is 41.92 cm rounded to 42 cm .
- To determine the width of the seat , anthropometric data used is the dimension LB ( shoulder width ) 95 % percentile is 47.66 cm rounded to 48 cm .
- To determine the range of the hand of the chair to field work , anthropometric data used is the dimension JTD ( reach arms forward ) using 50 % percentile is 79.73 cm rounded to 80 cm.
- To determine the distance of the chair to the table , anthropometric data used are the dimensions of PKL ( buttock to knee ) using 5% percentile is 50.47 cm by 4 cm tolerance is added, the total is rounded 54.47 cm to 55 cm.
- To determine the eye-level to the workpiece , anthropometric data used is TMD ( seated eye height ) by using a percentile 50 % in the amount of 76.46 cm rounded to 76 cm .

### G. Design Product

In the picture below can be explained that the results of anthropometric data processing used to benchmark size ergonomic office chair . Data - Data percentile is used as the reference of which TDT ( High Sit upright ) , TMD ( High Mata Sitting ) , TPO ( High popliteal ) , PPO ( Butt popliteal ) , PKL ( Ass To Knee ) , LB ( Shoulder Width ) , and JTD ( Reach Hands Forward ) . Here is a 2D and 3D images of ergonomic office chair design using AutoCAD 2007 software.

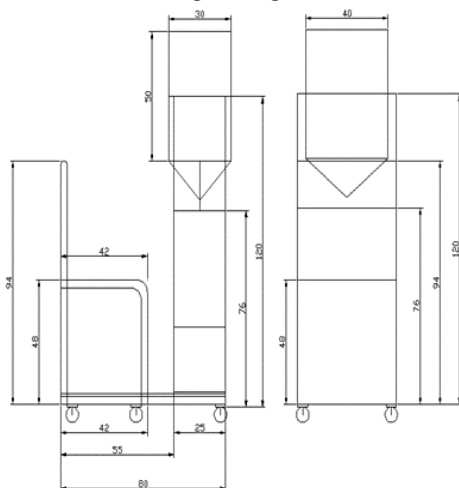


Fig. 4 Ergonomic work chair 2d images appear side and front

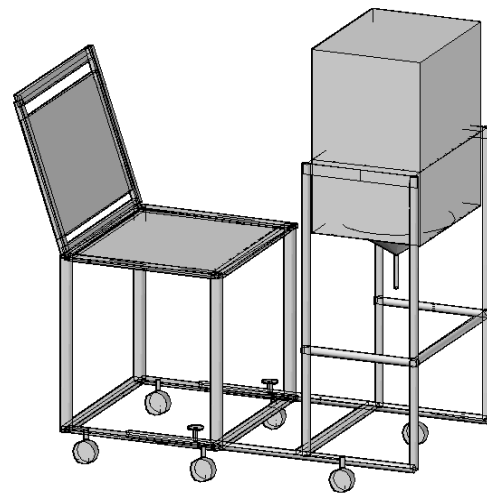


Fig. 5 figure 3d design ergonomic work chair side view

### H. Results After Design

#### 1) Questionnaire Results After Designing

Once the design has been finished , then the next trials conducted by distributing questionnaires designed by NBM after the draft to the four workers. Here is a table recapitulation questionnaire after the draft.

TABLE II  
QUESTIONNAIRE NBM ( NORDIC BODY MAP) AFTER DESIGNING

No	Jenis keluhan bagian tubuh	Slur Operator1			Slur Operator2			Slur Operator3			Slur Operator4			Total
		TS	AS	SS	TS	AS	SS	TS	AS	SS	TS	AS	SS	
0	Neck/neck of the neck	1			1			1			0			3
1	Neck/neck	1			1			1			0			3
2	Pair of the left shoulder	0			0			0			0			0
3	Pair of the right shoulder	0			0			1			0			1
4	Pair of the left upper arm	0			0			0			0			0
5	Pair of the right upper arm	1			1			1			1			4
6	Pair of the left elbow	1			1			1			1			4
7	Pair of the right elbow	1			1			1			1			4
8	Pair of the left forearm	1			1			1			1			4
9	Pair of the right forearm	0			0			0			0			0
10	Pair of the left wrist	0			0			0			0			0
11	Pair of the right wrist	0			0			0			0			0
12	Pair of the left hand	1			0			0			0			1
13	Pair of the right hand	1			1			1			1			4
14	Pair of the left foot	0			0			0			0			0
15	Pair of the right foot	0			0			1			1			2
16	The left hand part	0			0			0			0			0
17	The right hand part	0			1			0			1			2
18	Pair of the left thigh	1			0			0			0			1
19	Pair of the right thigh	1			0			0			0			1
20	Pair of the left knee	0			0			0			0			0
21	Pair of the right knee	0			0			0			0			0
22	Left calf/leg	0			0			0			0			0
23	Right calf/leg	0			0			0			0			0
24	Left ankle/leg	0			0			0			0			0
25	Right ankle/leg	0			0			0			0			0
26	Pair of the left leg	0			0			0			0			0

### IV. CONCLUSION

The conclusion that can be drawn from this study, as follows:

- Based on the identification using REBA after designing a decline in the level of risk. For the powder-making process has a score of 12 with a very high level of risk becomes a score of 5 with moderate risk level, to the process of filling the tube has a score of 10 with a high level of risk becomes a score of 3 with a low risk level and for nitrogen charging process no change in score.

- The results of the design workbench worker refers to anthropometric data, body dimensions and the percentile were used for the design is the TDT (High sitting upright) with a percentile of 95%, TMD (seated eye height) with a percentile of 50%, TPO (popliteal height) with a percentile 5%, PPO (Ass popliteal) with 5% percentile, PKL (buttock to knee) with 5% percentile, LB (Shoulder Width) with a percentile of 95%, and JTD (Reach hands forward) with 5% percentile.
- Based on the identification test using a questionnaire designed degan Nordic Body Map decline in complaints, which previously there were 60 complaints to 34 complaints after the draft. But the results of the questionnaire Nordic Body Map after the design is fully felt by investigators less than perfect or can not fully be a strong reference. This is because the process of distribution of the questionnaire after the design is taken within a short time of around  $\pm 30$  days of the draft was completed in design.

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