

Semi Auto Work Aids (Jig) Manufacturing to Improve the Consistency of Crimping Cable Product Quality

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ABSTRAK

Alat bantu kerja (jig) untuk mempercepat proses pengerjaan *crimping cable* dengan tidak mengurangi kualitas serta meminimalisir kabel *reject* pada saat proses pengerjaannya. Alat bantu kerja (jig) *crimping cable* ini memberikan kemudahan dan kenyamanan bagi sipengguna/operator untuk meningkatkan konsistensi kualitas produk crimping kabel dan mengurangi atau menekan derajat kecacatan ikatan terminal dan kabel. Dalam pembuatan alat bantu kerja *crimping cable* ini menggunakan **Cylinder Pneumatik (Pneumatic Cylinder)**. System gerak yang memiliki optimalisasi atau efektifitas bila digunakan dalam batas-batas tertentu. Adapun batas-batas ukuran yang dapat menimbulkan optimalisasi penggunaan pneumatic antara lain: diameter piston antara 6 – 320 mm, panjang langkah 1-2000 mm, tenaga yang di perlukan 2-15 bar. Sedangkan untuk mempercepat proses perakitan/desain menggunakan alisa **Failure Mode and Effects Analysis (FMEA)**, serta menggunakan metode **Bill Of Material) BOM** sebagai bagian dari proses desain untuk menentukan item yang harus dibeli atau diproduksi. Dibawah ini merupakan keterangan yang dibuat dalam proses perakitan alat bantu kerja *crimping cable*.

Kata kunci: Perancangan, Cylinder Pneumatik (*Pneumatic Cylinder*), *Failure Mode and Effects Analysis (FMEA)*, *Bill Of Material) BOM*

ABSTRACT

*A work aid (jig) to speed up the cable crimping process without reducing quality and minimizing reject cables during the process. This cable crimping work aid (jig) provides ease and comfort for the user/operator to improve the consistency of the quality of cable crimping products and reduce or suppress the degree of defects in terminal and cable bonds. In the manufacture of this cable crimping work aid, a **Pneumatic Cylinder** is used. The motion system has optimization or effectiveness when used within certain limits. The size limits that can lead to optimal use of pneumatics include: piston diameter between 6 - 320 mm, stroke length 1-2000 mm, power required 2-15 bar. Meanwhile, to speed up the assembly/design process, using **Failure Mode and Effects Analysis (FMEA)** analysis, as well as using the **Bill of Materials (BOM)** method as part of the design process to determine items to be purchased or produced. Below is a description of what is made in the assembly process of the cable crimping work aid.*

Keywords: Design, *Pneumatic Cylinder*, *Failure Mode and Effects Analysis (FMEA)*, *Bill of Materials) BOM*

INTRODUCTION

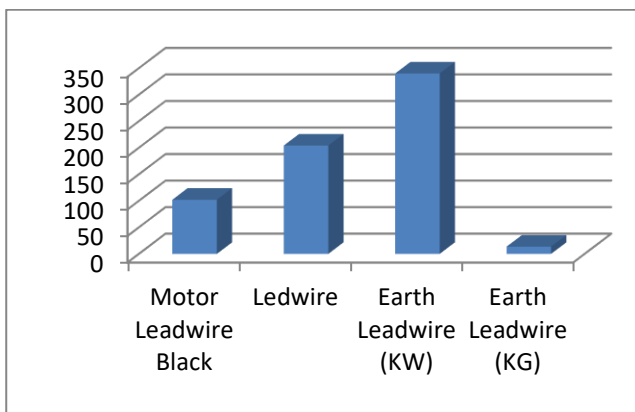
The role of humans as a source of labor is still dominant in carrying out the production process, especially manual activities. One form of human role is the process of making crimping cables using crimping tools. The advantage of crimping tools when compared to work aids in terms of joining between cables and terminals is the flexibility of movement that can be done repeatedly and continuously. However, crimping tool activities in industrial works are often identified as a great risk as the cause of high defective goods. In the design of the work system, it is necessary to pay attention to the procedures to create a work movement that meets the economic principles of the movement

and by taking into account the abilities and limitations of the workers. The workplace must adjust to the shape and size of the worker so that the operation of this crimping cable work aid is carried out freely.

Work aids (jigs) themselves have the meaning of a production workpiece holding device that is used in order to make accurate repetition of components. The correct alignment and straightness between the press tool and other aids and the workpiece must be maintained. To do this, a work aid is used that is designed to hold, support and position each part so that each pressing process is carried out according to the specification limits. A work aid (jig) is not only seen as its form, but also from the function and usefulness of the work

tool (jig) itself. Not a few work aids are made with a very nice and luxurious shape but do not match their function and use. Work aids are made to lighten or to speed up a production process. The most basic reason for the purpose of making the design of this work aid (jig) is to speed up the crimping cable process by not reducing quality and minimizing cable rejection during the work process. With the design of this work aid, it is hoped that it can provide solutions and answers to several cases that have occurred, such as the long process of work and the frequent discovery of damaged cables (reject).

Below shows the product table of PT. X in one month. By using work aids to produce crimping cables, it is hoped that it can increase production.



Gambar 1. Hasil produksi PT. X dalam satu bulan

From the research conducted by Ahmad Syahirul Allan said that work aids have a great influence on product quality. The role of work aids can maximize the process of making crimping cables quickly and do not reduce the quality of the crimping cable.

Meanwhile, according to research conducted by Fajar Ramadhan[2] on Microcontroller-Based LAN Cable Testers, it is said that in a computer network, transmission media plays a role as a channel for sending and receiving data. In other words, communication within a single network will be disrupted if the transmission and receiving lines of data are damaged.

The main problem that will be discussed in this study is about improving the consistency of the quality of Crimping Cable Production by designing and making Semi Auto work aids (jigs).

To find out the root cause of the problem that arises because of the high degree of defects in producing crimping cables, researchers try an approach using the fishbone diagram method. The main function of the fishbone diagram is to identify and organize the causes that may arise from a specific effect and then separate the root cause, Kaoru Ishikawa [1].

By making crimping cables using semi-auto work aids (jigs), the operator's time efficiency and work are maximized. The production output of crimping cables will increase compared to previous ones that use manual equipment. In addition, overtime costs incurred by PT. X is reduced because the operation process is fast and effective.

RESEARCH METHODS

Abstraction 3

In this stage, we can transform quantitative data and reduce it to an important requirement. So the results obtained now are as follows:

1. The source of pressure obtained to lift and compress the crimping eye comes from the pneumatic cylinder
2. Operation is easy to do and the operator does not need any special skills
3. Safe in operation
4. Easy to maintain

Abstraction 4

Abstraction 4 here aims to establish the problem in a neutral manner so that the results obtained become a clear picture. So the results obtained are as follows.

1. This work aid is a semi-auto tool that is used to reduce the degree of defect during the process of joining cables and terminals. Where the amount of force given is 42 kgf which aims to bind/clamp crimping cable firmly.

Abstraction 5

This function is described using a block diagram that shows the relationship between input and output where the two things are in the form of energy, material and signal flow. The overall structure of the main function is an abstract formulation of tasks and is free of problem-solving. Figure 2. will show the overall functional structure of the crimping cable work aid.

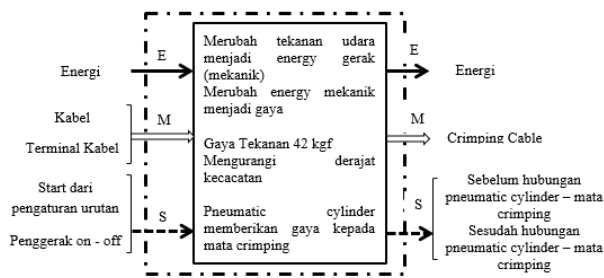


Figure 2. Overall Functions of Crimping Cable Work Aids

Solution Principle

The next step is to find the principle solution for the sub function. The method used is a combination method, which is by combining all existing solutions in the form of a matrix. The principle of the solution as seen in table 3.

Table 1. Matrix Principle Solution Cable Crimping Work Aids

No	Prinsip Solusi dan Sub Fungsi	1	2	3	4
A	Mengubah energy input menjadi energy ouput	Motor listrik	Motor bensin	Motor diesel	Manual
B	Penerus dan pereduksi gaya	PC kerja tunggal	PC kerja ganda		
C	Alat untuk menekan terminal dan kabel	Welding	Mata crimping	Manual	
D	Kontrol siklus (Pengukuran)	Tensile strenght test	Dilak		

Combining and establishing suitable working principles

The determination of the combination is determined by the selection table of the variation of the function structure for the replica of the cable crimping work aid, in the table below there is a selection of sub-functions so that it becomes the principle of the overall solution that is possible to be realized by choosing the selection criteria correctly. So that alternative solutions for designing crimping cable work aids will be obtained as follows:

VARIANT 1 = A1, B1, C2, D2; VARIANT 2 = A1, B2, C1, D1; VARIANT 3 = A1, B2, C2, D1; VARIANT 4 = A1, B1, C3, D2

So the alternative that is suitable for crimping cable work aids is variant 3.

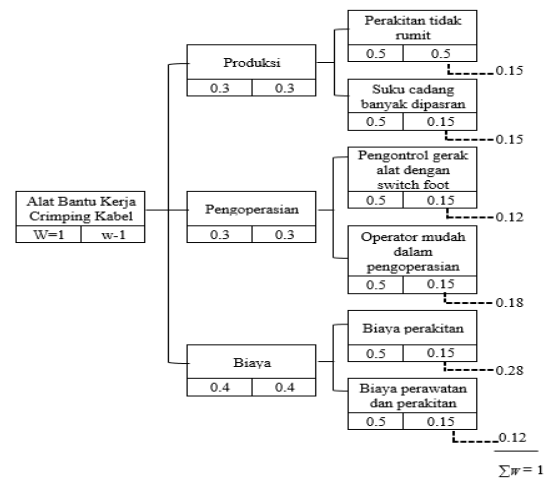
Table 2. Combination Matrix Solution (Variant 3)

No	Prinsip Solusi dan Sub Fungsi	1	2	3	4
A	Mengubah energy input menjadi energy ouput	Motor listrik	Motor bensin	Motor diesel	Manual
B	Penerus dan pereduksi gaya	PC kerja tunggal	PC kerja ganda		
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Design Evaluation According to VDI (Verein Deutscher Ingenieur) 2221

This stage refers to the previous stage, where after obtaining several combinations of working principles, the combination is selected again to be determined as the most profitable variant and will subsequently become a reference to be chosen as a reference in the design of the concept of this cable crimping work aid.

Table 3. Breakdown Tree Cable Crimping Work Aids



RESULTS AND DISCUSSION

Assembly of Crimping Cable Work Aids With FMEA Analysis

Based on the results of the research that has been carried out, the results of the research are presented in the form of data presentation in accordance with the results of the research methodology that was carried out previously. The next step is to analyze this crimping cable work tool using Failure Mode and Effects Analysis (FMEA). FMEA is carried out to analyze potential errors or failures in systems or processes, and the identified potentials

will be classified according to the magnitude of the potential failure and its effect on the process.

In addition, FMEA is also used to see which activity process is the most dominant in solving the failures of the operation process of this work aid. The next step to be taken is to create an FMEA table that functions to give weighting to the Severity, Occurrence and Detection values based on the potential effect of failure, the cause of the failure and the current control process to produce the Risk Priority Number (RPN) value. The table below will show the FMEA table. In general, FMEA is defined as a technique that identifies three things, namely: The potential causes of failures of the system, product design, and processes during its life cycle, the effects of such failures and the critical level of the effect of the failure on system functions, product design, and processes.

Bill Of Material (BOM)

The next process or step is to find out the list of items, materials or materials needed to assemble or produce crimping cable work aids, this term is often also called Bill Of Material (BOM). A BOM is created as part of the design process to determine which items should be purchased or manufactured. Below is a description made in the process of assembling crimping cable work aids.

1. Part name or other name that needs to be included (Description)
2. Quantity for Each Assembly
3. Part Size (Unit of Measure)
4. Decision to buy or manufacture the part (Decision)

There are several parts/materials that are decided to produce, such as the iron plate used for the lower frame of the work aid. This is because the material is already available in the company, so it only has to produce it yourself. The table below shows the total number of components needed to make one unit of crimping cable work aids. In the manufacturing process.

The assembly process of this crimping cable work aid needs to pay attention to three important parts, namely the bottom mount, the upper frame, and additional standard components. Because the assembly of crimping cable work aids is more dominant using recycled components, the funds or costs needed to assemble one unit of crimping cable work aids are not too expensive, only requiring a budget of Rp. 1,644,000,-.

Crimping Cable Work Aid Assembly

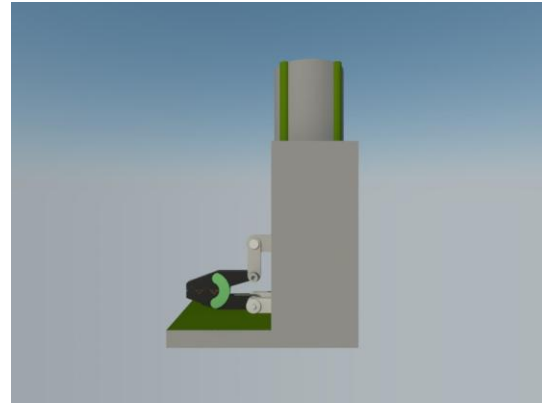


Figure 3. Pneumatic cylinder Whole Assembly

From the results of the analysis carried out, a decision can be made to design this work aid. The picture above shows that the crimping cable work aid has reached 90%. It appears that the position of the pneumatic cylinder type pneumatic cylinder type with SMC type CDQ2B63-25D specifications and a maximum pressure of 1.0 Mpa or 10 Bar (145 psi) is in the top position to apply pressure to the crimping tool. Pneumatic cylinder is an actuator or mechanical device that uses the force of compressed air (compressed air) to generate force in the linear alternating motion of the piston (in-and-out movement). The way the pneumatic cylinder works converts air pressure or potential energy of air into motion energy or kinetic on the right side, showing the overall shape of this work aid.

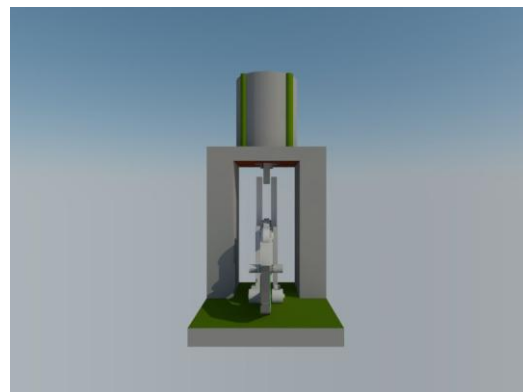


Figure 4. Pneumatic cylinder Whole Assembly

The picture above shows the steps to assemble or install the Bent Type Link with the Standard Type Link (MISUMI Code LND55-10-L-W13-T50), accompanied by the installation of the Pillar Plate. When assembling, the parts of this Crimping Cable work aid must be as accurate as possible. This is because it is to produce work aids with good quality, as well as to make it easier to repair if there

is a damaged part. The front view image above shows that the shape of this work aid is so simple and light to move and easy to use by the operator. So that from the results of the analysis applied before designing, all parts can be formed with perfect precision.

Crimping Cable Product Testing Process

Pulling is done on crimping cable products, then the results obtained from the tensile test are depicted in the picture. The graph below shows the strength of crimping in connecting cables to cable terminals.

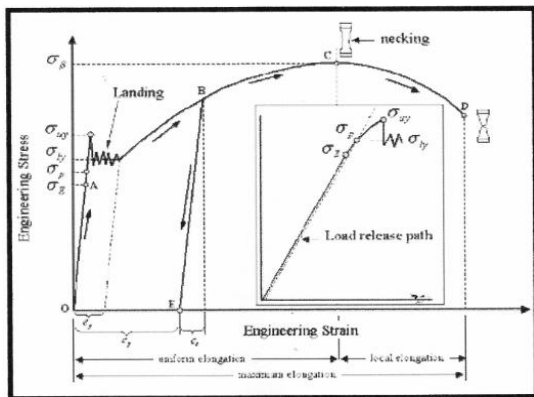


Figure 5. Graph of Tensile Test Results on Crimping Cable

From the picture above, you can read the strength that crimping has in connecting or uniting the cable with the cable terminals. The strength possessed by crimping is found at the top of the curved point on the graph, if the graph shows a curved point, the crimping results are in good condition.

Advantages and Advantages of JIG Crimping Cable Semi Auto

There are several advantages that will be obtained if you use this crimping cable work aid, such as:

1. The process of use is very easy and does not take long so that the production process is fast. In addition, the form of this work aid is simple and simple so that when operating it does not take up space.
2. The cost is not expensive because all materials used in making these work aids use used materials that are still suitable for use and are still of good quality.
3. The way this work aid works is very easy to operate so that it makes it easier for the operator to use it.

In addition to some of the advantages above, there are also advantages to using work aids in making crimping cable products, such as:

1. Simplify the process of making Crimping Cable.
2. Minimize Lost Time during the production process.
3. Reject the product at the time of production becomes less after the availability of this work aid.
4. The production process of crimping cable has increased, as evidenced by the data issued by the company PT. X.

From the data above, it shows that there is a difference before using this work aid and after using it. Many changes were felt after using this work aid so that the company PT. X is greatly helped by this work aid.

CONCLUSION

This Crimping Cable work aid (JIG) is made from used materials that still have good quality, so the cost of manufacturing is very low. With the use of this work aid, the production process of crimping cable products at PT. X becomes smooth and more efficient with constant quality. The manufacture of crimping cable work aids is made in-house at PT. X and can work well in accordance with the existing standards at PT. X.

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