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DESIGN OF JIG INSERT HOUSING TO PREVENT WORK ERRORS AT PT. PANGKALAN SUSU SEJAHTERA

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ABSTRACT

Growing industry in the world right now, then all the company continues to improve the quality of its products in the order to compete with other companies. One way the company is done by providing improved quality in the production process that aims to increase a better product without raising the cost of production. Improvement of product quality is done by creating a work tool that is easy to use and can reduce the number of errors on a production process to produce quality products that can compete in the global market.

KEY WORDS: *Jig, Growing Industry, Price, Production. Quality,*

NOMENCLATURE

1.0 INTRODUCTION

In the current era of intense competition, almost all companies strive to enhance the quality of their production to remain competitive. As the number of companies increases, it is essential for businesses to improve their financial and human resource capabilities to stay competitive. One of the ways to achieve this is by improving production processes to achieve better products without incurring significant production cost increases.

To anticipate this competition, improving production stages is seen as a critical factor that needs continuous enhancement. This requires innovative ideas for achieving efficiency in production time and costs without increasing overall expenses. The focus should also be on developing production outcomes. Expertise and production process stages tailored to a company's product needs are crucial for improving business progress.

Referring to the above, one production process at PT. Amber Karya significantly influencing product quality is the "Insert Housing" process. This process is carried out after the cable is crimped with a terminal according to a specific part number. The method involves inserting the crimped cable into the housing hole following the color specifications in the work diagram. However, errors often occur during this process, mainly because there is no supporting tool to prevent such errors. This process has a relatively high error rate and is time-consuming. The author concludes the following issues arise how can a jig insert housing be designed and what extent does the jig insert housing reduce operator errors. Contribution this study to design and manufacture a jig insert housing and to reduce operator errors with the jig insert housing by 100%. To ensure a focused discussion and to prevent deviations during preparation, how to manufacture a jig insert housing.

Contribution of this research plays a significant role in improving the production process of a product, particularly in the insert housing process. Understanding how to manufacture a jig insert housing, determining the extent to which the jig insert housing reduces work errors. Preventing errors in the insert housing process. Providing essential information to improve product quality especially in the insert housing process.

2.0 MHETOD

2.1 Machining Processes

Machining processes involve cutting or removing material to shape a desired product. Common machining processes in the manufacturing industry include shaping, drilling, turning, milling, sawing, broaching, and grinding.

2.1.1 Milling Machine

The milling machine is the most versatile tool compared to other machine tools. It can process both flat and curved surfaces with exceptional precision and smoothness. Milling also produces chips and achieves specified dimensions and surface quality. The milling process begins by clamping the workpiece, followed by cutting with a tool known as a cutter, which alters the size and shape of the workpiece. Additionally, the process requires a lubricant, such as oil, to cool the milling cutter and prevent wear.

2.1.2 Lathe Machine

A lathe is a machine tool used to cut rotating workpieces. The cutting process involves rotating the workpiece and applying a cutting tool moving parallel to the rotation axis. The relative cutting motion is achieved by the rotation of the workpiece, while the translational feed motion is achieved by moving the cutting tool. Adjusting the rotational speed of the workpiece and the feed rate of the cutting tool allows the production of threads with various pitches. Gearboxes are specially designed to create threads, with gear teeth counts ranging from 15 to 127. The gear with 127 teeth is particularly notable as it is used to convert metric threads to inch threads.

2.1.3 Grinding Machine

Grinding machines are used to smooth surfaces during the finishing stage, requiring highly robust construction to maintain precision with minimal tolerances.

2.2 Material Selection

Material selection is a critical step in the design process. Determining the appropriate material for a component often involves considering factors such as strength, corrosion resistance, density, and machinability. In this research, acrylic was chosen as the primary material for the jig insert housing. Acrylic is readily available, cost-effective, and easy to process using machine tools. Additionally, it is lightweight and highly durable, making it suitable for hand-held tools. Acrylic belongs to the polymer category, with a molecular weight exceeding 10,000 and complex structural properties due to the large number of atoms in its composition. Below are detailed explanations of polymer characteristics and properties.

2.2.1 Polymers

Polymers are composed of repeating structural units held together by strong covalent bonds, where each atom contributes an electron pair. Intermolecular forces like hydrogen bonds and Van der Waals forces in polymers are weaker than covalent bonds. High molecular weight polymers display properties distinct from low molecular weight organic materials. Low molecular weight substances melt easily and evaporate when heated, whereas polymers melt with high viscosity and do not evaporate. Instead, they decompose into carbon under high heat without evaporation. Polymers are generally insoluble in solvents and, if soluble, exhibit high viscosity.

2.2.2 Acrylic

Acrylic was developed in 1928 in various laboratories and introduced to the market in 1933 by Rohm and Haas Company. It is a synthetic polymer of methyl methacrylate, known as polymethyl methacrylate (PMMA), and is transparent and thermoplastic. PMMA is marketed under trade names such as Limacryl, Plexiglas, Acrylite, Altuglas, Vitroflex, Perspex, Acrylplast, and Lucite.

The primary property of acrylic is its excellent transparency. Unlike glass, which absorbs light as thickness increases, acrylic maintains its transparency even as thickness grows. This makes it an ideal material for decorative and structural applications.

Key properties of Acrylic:

- Transparent and clear
- Strong, flexible, and durable
- Food-safe (resistant to microbial growth)
- Can be molded into various shapes and categories
- Lighter than glass
- Relatively cheaper than glass

2.3 Data Analysis Method

In this research, which focuses on the design and fabrication of a work aid (Jig) for insert housing, the stages of the study align with the steps involved in the design and production process of the Jig. The research phases play a critical role in determining the success of the design and manufacturing process.

The design and fabrication of the Jig insert housing cannot proceed effectively if the research stages deviate from the established procedures or methods that conform to research standards. Therefore, the research process for the Jig insert housing must be meticulously planned to ensure its execution aligns with recognized research methodologies. The design and planning stages are based on frameworks that adhere to standardized research practices.

The process begins with the initiation phase, where the objective and scope of the project are clearly defined. Following this, a literature review is conducted to gather information from various scientific sources, previous research, and technical documentation. This step ensures a deep understanding of the topic and helps identify existing solutions or gaps that need to be addressed. Once the foundational knowledge is established, the next step is observation. Here, practical issues in the field are closely examined to understand the challenges faced. This involves analyzing the limitations of the current machinery or processes, providing critical insights for the subsequent stages. Building on the insights gained, the design phase commences. In this step, technical drawings, models, or detailed plans are developed to conceptualize the solution. These designs aim to address the identified problems while ensuring feasibility and efficiency. After the design is finalized, the project moves into the manufacture phase. During this stage, the concept is transformed into a tangible product using appropriate materials and technologies. This is where the theoretical design takes physical form. Following production, the product undergoes a functional test. This crucial step ensures that the solution operates as intended and meets the specified requirements. If the product does not meet expectations, the process loops back to previous stages for refinement or redesign. If the product successfully passes all tests and is accepted, the next phase involves the creation of a comprehensive report. This report documents the entire process, from initial research to the final outcome, including evaluations and conclusions. Finally, the process concludes with the finish phase, where the completed project is presented, and all necessary documentation is finalized. This structured approach ensures that each step is methodical and contributes to the successful resolution of the problem.

3.0 RESULT

3.1 Design of Jig Insert Housing

Before starting the fabrication of the jig insert housing work tool, the design phase is the most crucial aspect. The design significantly impacts the jig's performance. The jig insert housing should be designed to meet the specific requirements. Since the jig insert housing is intended to be handheld, its design is rectangular to ensure ease of handling and comfort for production operators.

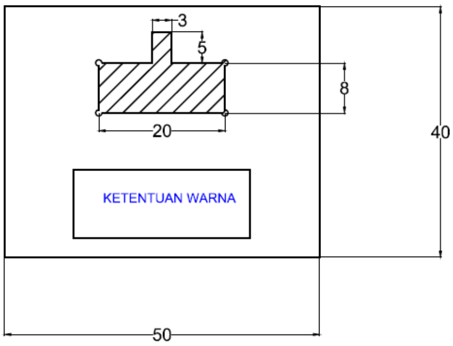

Figure 2. Design jig insert housing

3.2 Manufacturing Process of Jig Insert Housing

Cut the acrylic material using a grinder with dimensions of 50 mm in length and 40 mm in width. The material size is increased by 1 or 2 mm from the required size to allow for smoothing and leveling later.

Figure 3. Material cutting process

Draw lines according to the housing shape.

Figure 4. Filming process

3.2 Machine Processing

After cutting, uneven material is leveled using a milling machine with a Ø10 mm cutter.

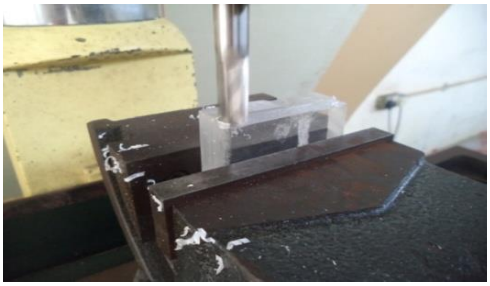

Figure 5. Acrylic leveling process

Measure the required drilling depth

Figure 6. Measurement

Replace the milling cutter with a Ø3 mm drill bit.

Figure 7. Drill bit Ø 3 mm

Position the drill bit on the surface of the acrylic clamped on the workbench.

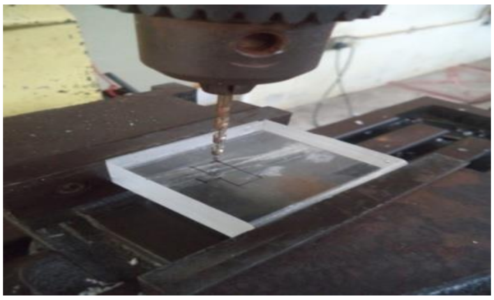

Figure 8. Attached drill bit tip

Drill to a depth of 10 mm at each corner

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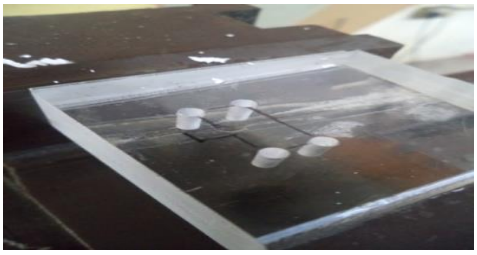
Figure 9. Results of the drilling process

Replace the milling cutter with one of the appropriate size Ø6 mm for 8 mm.


Figure 10. Milling blade Ø 6 mm.

Position the cutter in the center of the housing pattern. - Perform vertical and horizontal cuts to a depth of 10 mm, locking the spindle for consistency.

Test the results using a sample housing to ensure proper fit.


Figure 11. Locked spindle

- Perform cutting in both vertical and horizontal directions. Ensure the cutting process does not go beyond the pattern drawn on the acrylic surface.

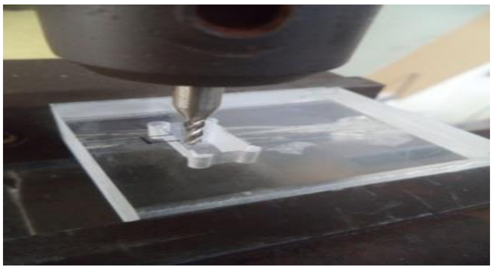
Figure 12. Vertical and horizontal feeding results

Conduct a trial using a sample housing by inserting it into the results of the vertical and horizontal cuts. This is done to ensure that the hole size matches the required dimensions.

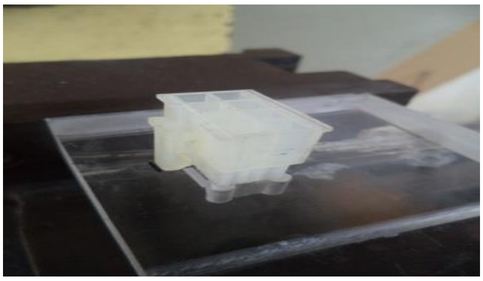
Figure 13. Housing insertion experiment

If the sample housing does not fit, repeat the cutting process until the housing fits into the hole that has been created. Replace the milling cutter with one of the required size, ensuring that the cutter's diameter does not exceed the width of the pattern on the acrylic surface. The width of the pattern on the acrylic surface for the head is 3 mm, and the milling cutter to be used should have a diameter of Ø2 mm.


Figure 14. Milling blade Ø 2 mm.

Perform cutting in both vertical and horizontal directions. Ensure that the cutting process does not extend beyond the pattern on the acrylic surface.

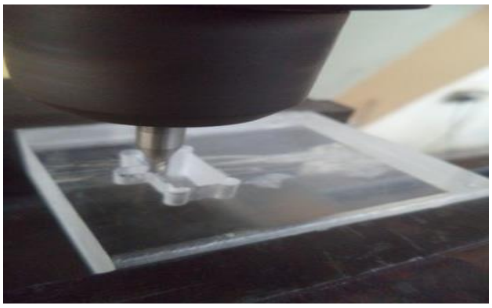
Figure 15. Vertical and horizontal feeding results

Conduct another trial using a sample housing by inserting it into the results of the vertical and horizontal cuts. This is done to ensure that the hole size matches the required dimensions. If the sample housing does not fit, repeat the cutting process until the housing fits properly into the hole that has been created.

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Figure 16. Completed work process

4. DISCUSSION

The positive aspects or advantages of the jig insert housing are as follows:

1. Ease of use.
   The jig insert housing is very easy to use. It is handheld and does not require much time, making the production process, especially the insert housing process, faster.
2. Low manufacturing cost.
   The production of the jig insert housing is cost-effective as the raw materials are already available at PT Pangkalan Susu Sejahtera, and the cost is relatively low. Additionally, its production utilizes existing tools.
3. Simple design.
   The jig insert housing has a very simple design and does not require much space for storage.

4.1 Benefits of Jig Insert Housing

Here are the benefits of using the jig insert housing:

- Simplifies the insert housing process.
- Reduces the time required for the insert housing process, making it faster.
- Decreases the operator error rate during the insert housing process.

Time required for Insert Housing Process for Part No. 74-50-3804.

Table 1. Comparation time with and without jig

Trial	Without Jig	With Jig
1	26 seconds	11 seconds
2	28 seconds	9 seconds
3	25 seconds	9 seconds
Average	**26.33 seconds**	**9.66 seconds**

From the table above, it is clear that there is a significant difference in the time required to perform the insert housing process using the jig versus without the jig.

Calculation:

Average time without jig – Average time with jig:
$26.33-9.66=16.672$ seconds saved per process.

In three trials, the time difference reached up to 16.67 seconds. If calculated per process, using the jig can be nearly three times faster than not using it:
$26.33/9.66=2.72$.

From the time calculation, it can be concluded that the insert housing process using the jig is significantly faster than the process without the jig.

Table 2. Work errors in insert housing process

Month	Without Jig	With Jig
Errors	13	2
Products	350	400

Error rate calculation:

- Without Jig: $13/350\times100=3.71\%$
- With Jig: $2/400\times100=0.5\%$
- Improvement:
  $3.71\%-0.5\%=3.21\%$

With the implementation of the jig insert housing, the operator error rate decreased by 3.21%, showing its effectiveness in reducing work errors. This improvement indicates that future processes could potentially achieve zero operator errors in the insert housing process.

5. CONCLUSION

From the implementation of this research and thesis preparation, the following conclusions can be drawn:

1. The jig insert housing work tool created at PT Pangkalan Susu Sejahtera functions effectively.
2. The jig insert housing was made using materials already available at PT Pangkalan Susu Sejahtera, specifically acrylic, and utilized existing machine tools, ensuring no additional costs were incurred during production.
3. The jig insert housing significantly speeds up the insert housing process, reducing the time from 26.3 seconds to 9.66 seconds per process.
4. The jig insert housing reduces work errors in the insert housing process, decreasing from 12 errors to 2 errors per month.

5.1 Recommendations

Research should be grounded in the knowledge gained during academic studies to ensure a strong theoretical foundation. This will validate the theories applied and enhance the research's credibility. The application of academic theories is often evident in the workplace, where they can be directly implemented as tools or ideas to improve efficiency and product quality. The design of the jig insert housing exemplifies this, aiming to prevent work errors while applying the knowledge gained during academic studies. When determining a research topic or thesis title, do not overly focus on the title itself. Instead, identify common issues in the surrounding environment and work on finding solutions.

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