



Various Sizes Of Sockets For Hand Crank Milling Machine

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ABSTRACT

The hand crank socket is a tool used to rotate nuts, bolts, or tighten and loosen the clamping components of workpieces manually. It consists of a handle or crank connected to a socket. In the Mechanical Engineering Department, Politeknik Seberang Perai, students typically use hand crank sockets during practical sessions in the grinding workshop for learning purposes. The use of sockets for existing hand crank handles in the workshop is of fixed size. Installing sockets on hand crank handles repeatedly for size changes is time-consuming. Therefore, a flexible socket for hand crank handles is produced to save handling and operating time to facilitate the teaching and learning process. Additionally, it is lightweight and user-friendly compared to conventional crank handles. This tool also comes with a special storage box for packing and safety purposes. The hand crank handle is designed with the same handle size but has four different socket sizes: 13mm, 15mm, 17mm, and 19mm. The process of smoothing and removing material from workpieces is done using a milling machine for finishing purposes. Meanwhile, the material cutting process is carried out using an 'EDM Wirecut machine. The hand crank uses durable soft steel material to produce quality designs. The threading process uses a threading tool to create threads on the crank handle before connecting it to the crankshaft. A survey was conducted by distributing questionnaires to 20 students using the Universal Milling Machine to assess the effectiveness of using crank sockets with various sizes in aiding the machine chuck tightening process. The results showed that 100% of the students agreed with this innovation because it saves time and facilitates the teaching and learning process. Equipment usage can be reduced, and issues such as storage problems, mixing up crank sizes, and unlabelled equipment can be effectively addressed.

1.0 Introduction

The hand tools used have specific functions and sizes in the field of Mechanical Engineering. The hand crank handle is a tool used to rotate nuts, bolts, or tighten and loosen clamps on workpiece components manually. It typically consists of a handle or knob mounted on a rotating crank, and when the handle is turned by hand, it provides mechanical motion to the connected system.

Hand crank handles typically include sockets of different sizes for use with various nuts and bolts. The socket size is determined by the diameter of its hole. The design and production of various sizes of hand crank handles aim to enhance efficiency and accuracy in their use, making

them more flexible according to the needs of milling machines in Mechanical Engineering workshops.

1.1 Problem Statement

In the Mechanical Engineering Department at Politeknik Seberang Perai, students use hand cranks during workshop practical sessions in the milling workshop for learning purposes. The courses that involve the use of hand cranks in the milling workshop are DJF21012 Manufacturing Workshop Practice 1 and DJJ30082 Mechanical Workshop Practice 3.

The use of sockets for existing hand crank handles in the workshop is fixed in size. Therefore, opening or tightening workpieces requires repetitive effort. Repeatedly changing socket sizes on hand crank handles consumes time. Additionally, the use of hand crank handles of various sizes is necessary according to the suitability of the thread sizes used. Consequently, issues such as storage, mix-up of crank sizes, and disorganized equipment become problems in teaching and learning.

The hand crank sizes provided by the manufacturer can only be used for the same size operating screw on the milling machine. Additionally, switching to using a different crank for operating screws of different sizes on the milling machine is necessary. The process of finding the right socket size while operating the milling machine typically takes time. As a result, time wastage occurs and disrupts the teaching and learning process in the workshop.

1.2 Objectives

The objective of having various sizes of sockets for hand crank handles is to offer an easy and portable solution for setting up and completing different tasks. Therefore, the objectives are:

- i. To save time in handling and operating, thus facilitating the teaching and learning process due to the flexibility of the sockets.
- ii. To produce lightweight and user-friendly socket sizes for hand crank handles.
- iii. To save storage space by being equipped with a special storage box for the purpose of organization and safety of the tools.

1.3 Scope

The limitations of this developed innovation are:

- i. The limitation of this developed innovation is that it only has one crank handle but features various sizes for operating screws.
- ii. The use of hand crank handles with various socket sizes is matched with the thread sizes in the milling machine workshop, Mechanical Engineering Department, Politeknik Seberang Perai.
- iii. Various sizes of hand crank sockets are used to tighten and loosen workpieces on the threads.

2.0 Literature review

A study on the design of hand tools heavily emphasizes efficiency of use, ergonomic factors, and comfort. The added value of designed hand tools lies in their variety of functions. According to Gulam, H. (2012), the criteria for selecting hand tools are based on their suitability for the materials used and the skills required to handle them. The main feature given attention is safety aspect.

2.1 Hand Crank

Hand crank is used to convert linear motion into rotational motion by transmitting power to drive something. (Jonathan, L., 2018). This tool is installed on the milling machine as the crank turner for the milling machine spindle to facilitate the milling process.

The idea to modify a single-size hand crank handle into multiple sizes, by using sockets of various sizes for all types of operating screws on milling machines, can be achieved through research studies conducted in workshops at polytechnics and community colleges. From the surveys conducted, most milling machines only have one hand crank handle, but for the predetermined size.

Each design of the hand crank handles found in both the milling and drilling workshops is observed to have a similar rounded design, including their handles. The distinguishing factor between the hand crank handles in the milling and fitting workshops lies in the size of each clamp on their heads. To address this issue, an idea emerged to modify the single-size hand crank handle by utilizing sockets of various sizes for all types of operating screws on milling machines. Several designs of hand crank handles available in the market were obtained to serve as standards for selecting the design to be applied to the modified hand crank handle idea. Figure 2.1 represents one of several examples of designs for the handle and body of the hand crank handle.



Figure 2.1: Hand Cranks Available in the Market

2.2 Socket

A socket is a type of tool or mechanism that is inserted into the hand crank. The use of a combination set of hand crank with socket wrenches consisting of various sizes like Figure 2.2 provides an idea for producing multiple sizes of sockets for hand cranks. The set contains 40 types of socket wrenches with different sizes and types of heads along with a wrench (Kejiyta, 2023). It is also stored in a container for easy storage. Furthermore, the storage method in this container can help identify any missing socket wrenches.



Figure 2.2: Combination Set of Hand Crank with Socket Wrenches

Various sizes of sockets for hand crank handles also originated from the hexagon socket screwdriver of multi-function hand tools as shown in Figure 2.3. These sockets are made of high-quality material, namely alloy steel. There are various sizes available ranging from the standard size, from H4 to H17, to choose from. The purpose of producing this set is to achieve precision in selection and save energy (Electronic Family, 2020).



Figure 2.3: Multi-Function Hand Tool Hexagon Socket Screwdriver

3.0 Methodology

The fabrication process begins gradually with the design, cutting, machining, and then packaging processes.

3.1 Design Process

The initial sketch related to design begins by fulfilling the requirements, preferences, and comfort without altering its function. After identifying the usual sizes used in the milling machine workshop, a design for a socket with a crank handle is produced. This innovative drawing is developed using Autodesk Inventor software as shown in Figure 3.1. A crank handle along with 4 different sizes of socket head diameters is illustrated.

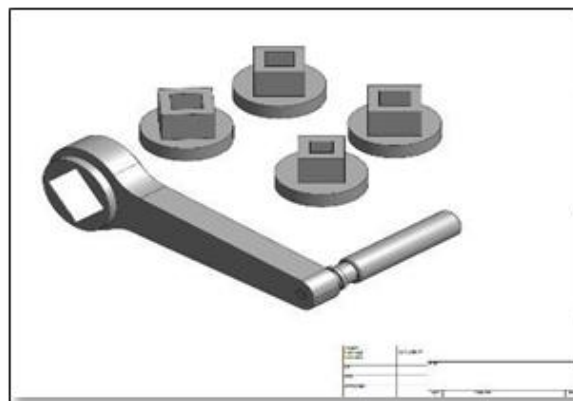


Figure 3.1: 3D Drawing

3.2 Cutting Process

The material cutting process is carried out using an EDM Wirecut machine in the CNC workshop as shown in Figure 3.2. This work material is used to create the crankshaft and will be combined with the socket head. The material used in the construction of this innovation is Mild Steel, which is known for its durability to produce quality designs. The easily formable and fabricable nature of mild steel, along with its rust-resistant properties, are key factors in its selection.

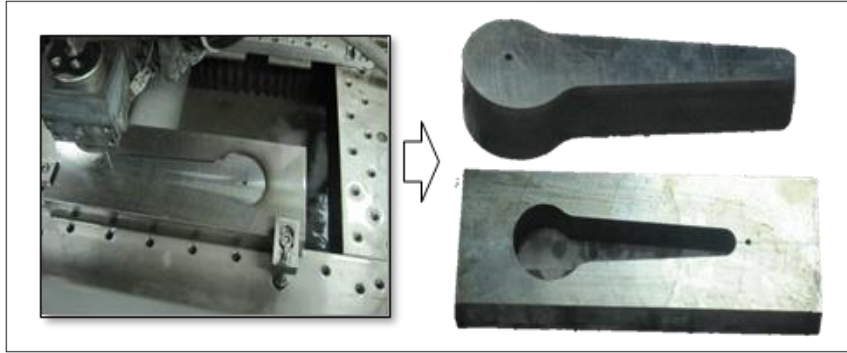


Figure 3.2: Material Cutting Process

3.3 Machining Process

Surface levelling and material removal operations have been performed in the milling machine workshop as depicted in Figure 3.3. To achieve the desired hole diameter size accurately and precisely, as well as ensuring smooth and satisfactory finishing, turning, grooving, and facing work are carried out.



Figure 3.3: Material Surface Levelling Process

The sockets consist of different sizes, namely with diameters of 13mm, 15mm, 17mm, and 19mm. Turning operations on the sockets are carried out in both the lathe workshop and the milling machine workshop. According to Mohd Lazim, A (2013), lathe machines can produce more productive work with consistently accurate results. Moreover, the uniformity of the resulting products is of higher quality. Lathe machines produce cylindrical workpieces by gripping the workpiece in the chuck.

The facing process is carried out using a "parting tool" or facing tool bit in the machine workshop. The facing tool bit needs to be sharpened beforehand, as shown in Figure 3.4, to achieve a smooth and beautiful surface before the facing process is carried out. The facing process is performed on the crank handle holder before being attached to the hand crank.



Figure 3.4: Facing Process on the Hand Crank Holder

3.4 Finishing Process

The surface levelling and material removal process using a milling machine is carried out for finishing purposes. High skills are required in operating milling machines. This is to prevent any compromise in the size dimensions. The resulting innovations are stored in storage boxes to

save storage space, facilitate portability of the equipment to any location, and to avoid wasting time in the teaching and learning process by repeatedly fetching tools back and forth.

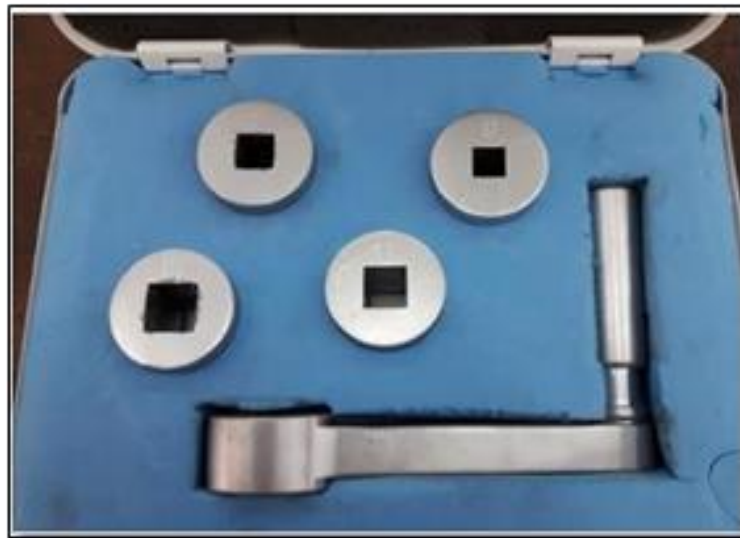


Figure 3.5: Storage of Hand Crank along with Various Sizes of Sockets

3.5 Testing Process

To assess the effectiveness and efficiency of the developed innovative product, testing was conducted with 20 students. These tests were carried out in the milling machine workshop while operating the 'Universal Milling Machine' and 'Vertical Milling Machine'. The Various Sizes of Sockets for Hand Crank Milling Machine has achieved the set objectives.



Figure 3.6: Testing Process

4.0 Discussion of analysis and findings

A questionnaire was distributed to 20 students after conducting tests on the use of the Various Sizes of Sockets for Hand Crank Milling Machine. Based on the findings obtained as shown in Table 1.0, it is evident that this innovative product has achieved the listed objectives.

Table 1.0: Questionnaire Data

Item: Various Sizes of Sockets for Hand Crank Milling Machine	Number of Students			
	Strongly Disagree	Disagree	Agree	Strongly Agree
1 Helpful during operating milling machines	0	0	8	12
2 Saves time by reducing the need to repeatedly fetch tools	0	0	1	19
3 Easy to handle	0	0	0	20
4 User-friendly	0	0	1	19
5 Easy to store	0	0	0	20
6 Saves time in storing tools	0	0	0	20
7 Saves space in organizing tools in the workshop	0	0	0	20

Based on the bar graph obtained as shown in Figure 4.1, time for handling and operating can be saved during the teaching and learning process. This is because students do not need to repeatedly go back and forth to obtain the appropriate size of hand crank sockets for tightening and loosening workpieces. The time available in the workshop can be utilized optimally in completing the given tasks.

The respondents strongly agree that the developed innovative product is lightweight and user-friendly. Handling this product can be done independently without requiring assistance from anyone else. The product's rust-resistant and lightweight nature makes it easy to handle. The mass for each socket produced is as shown in Table 2.0.

Table 2.0: Weight of Various Size Sockets

	Socket size	Mass
1	13 mm	610 g
2	15 mm	630 g
3	17 mm	650 g
4	19 mm	670 g

The respondents unanimously agree that the developed innovative product greatly saves storage space. This is because the Various Sizes of Sockets for Hand Crank Milling Machine is equipped with a special storage box for packaging and tool safety purposes.

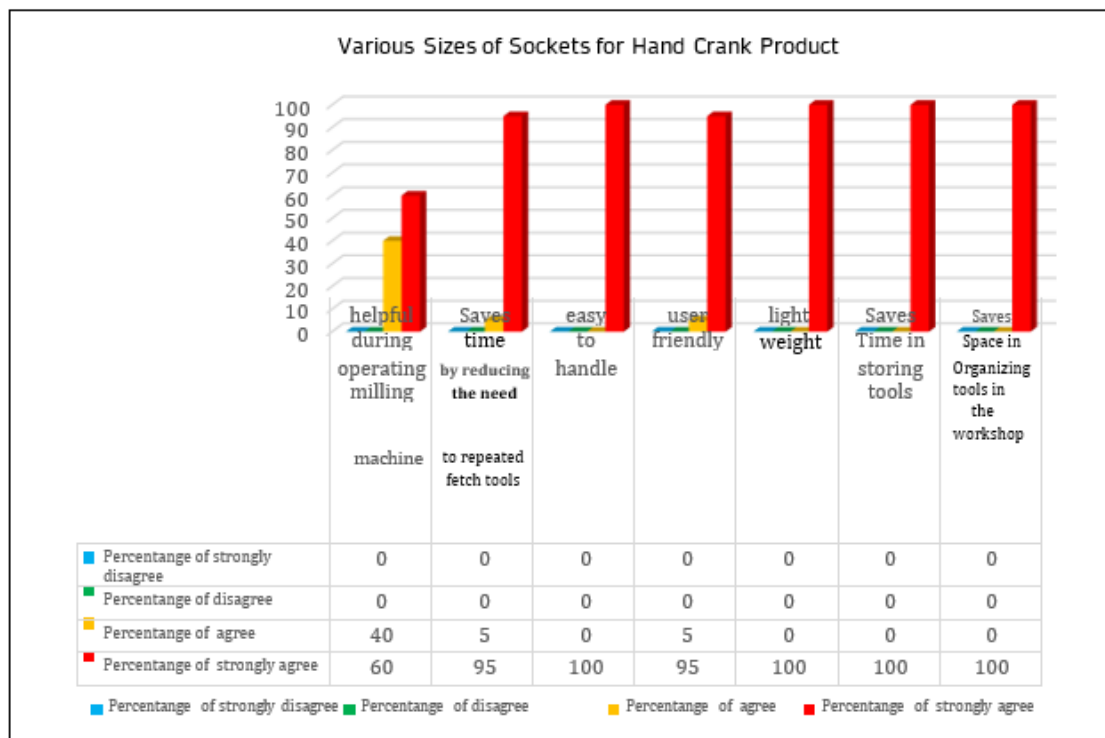


Figure 4.1: Percentage effectiveness graph of the innovative

5.0 Conclusion and future research

Overall, the innovative product of various sizes of sockets for hand crank handles has been successfully developed and has achieved the set objectives. This innovation is more flexible according to the needs and suitability found in the milling machine workshop, Mechanical Engineering Department, Politeknik Seberang Perai.

The developed innovative product has a positive impact on assisting users during the teaching and learning process in the workshop. It saves time in obtaining the appropriate hand crank handle size. By reducing the number of tools required, it not only saves storage space but

also makes various sizes of sockets for hand crank handles lighter and more portable. Additionally, the risk of losing tools can also be avoided.

Various sizes of sockets for hand crank handles can serve as a reference for redesign by making modifications without altering their function. Some suggestions for improvements that can be made to enhance their efficiency include:

- i. Designing adjustable sockets that can be customized according to the desired size requirements would result in a more user-friendly product. Users can easily adjust the socket to accommodate different sizes quickly and accurately. As a result, the product becomes more versatile, efficient, and user-friendly.
- ii. Designing a more ergonomic hand crank handle to enhance grip comfort during handling and use is a valuable improvement. Some features that can be modified include making the handle non-slip and contoured for a better grip.
- iii. Optimizing the design to minimize overall size and weight without compromising durability, strength, and functionality is essential. This would make the hand crank handle more portable and easier to use in confined spaces.

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Author Contributions

Nik Norazilah: Conceptualization, Methodology, Data Collection, Writing- Original Draft Preparation;
Nurhasliza: Sketching and Design, Data Collection, Writing-Reviewing and Editing Validation.

Conflicts of Interest

The manuscript has not been published elsewhere and is not under consideration by other journals. All authors have approved the review, agree with its Submission and declare no conflict of interest in the manuscript.

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