Design and Analysis of a Micrometer

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CHAPTER ANALYSIS AND DISCUSSION

4.1 Component Design

The micrometer is a precise measuring instrument, mostly used by engineers each part of the micrometer was designed with the ideas and variables that were set forth at concept design. The interchangeable micrometer was developed in order to reach the goal of improving the older models of micrometers in order to make it more efficient and affordable. The dimensions of the tools and functionality of the tool were chosen with the idea of not having to replace micrometers at different points where different sizes were needed.

After selection of the materials that are going to be used, in this instance steel was chosen as the material the micrometer will be made from, the overall design of the micrometer was finalized. Materials selected can be just as important to the finished product as the overall design of the tool. The micrometers sustainability was kept in mind throughout the entire design process as the tool had to be functional and the quality had to last for years to come. Having a sustainable and quality design saves the company money by not having to redesign the tool in the future and not having to keep replacing the tool.

The design of the micrometer consist of a “U” shaped structure made up of metal (steel) which will be attached to the cylindrical tube at one end. The U shape metal structure will be the frame of the micrometer. The objects that are needed to be measured will be placed in between the anvil and the spindle.

The eight main parts of a micrometer are:

Micrometer sleeve scale

The ruler on the cover of the micrometer is the tool’s primary gauging scale. Collected with the thimble gauge, the sleeve scale shows the dimensions taken.

Micrometer thimble scale

The secondary gauging scale is the thimble scale that delivers the two outstanding significant numbers of an observation. This part of the dimension is the value on the scale that brings into line with the index line on the sleeve gauge.

Micrometer index line

The index line, which goes beside the sleeve of the micrometer, is used to designate the significance exposed on the thimble scale.

Micrometer thimble

When the thimble is curved, the spindle swaps and changes the distance between the gauging faces of the micrometer. Some micrometer covers join a friction drive. This allows measuring more accurate readings mainly when used by the inexpert user.

Micrometer ratchet speeder

The ratchet speeder raises the speed of the spindle's rotation so that the space between the anvil and the spindle is condensed further rapidly than it would be if the thimble were used. Using the ratchet speeder decreases the period it takes to use the micrometer. The ratchet joins a sliding grasp mechanism that stops over-compression and benefits the user by relating a constant gauging force to the spindle. This helps to guarantee trustworthy measurements.

Micrometer locking device

The locking instrument safeguards the spindle and reserves the measurement so that the micrometer can be detached from the work part before compelling the reading. Some micrometers have a padlock nut while others may have a locking lever.

Micrometer frame

The U designed frame is planned to be inflexible and steady. It maintains the anvil and the sleeve of the micrometer. The frame is detained by the user whilst measurements are being taken. ("What are the parts of a micrometer?" n.d.)

4.2 Weight and Load Analysis

The most important consideration in engineering design is a material selection. This greatly helps in achieving the desired weight and load that the design can take. The material selection is very important while designing a strong and multi-purpose micrometer. This is very important due to the possibility of having to otherwise compromise on factors such as strength and safety. In order to have a micrometer that can support the function of our design, the material selected is steel. We chose this metal because it is very strong and, at the same time, relatively inexpensive. By using this material, we ensured that the micrometer can withhold the accuracy when it is fully extended. The load analysis is very important in order to establish the maximum load our micrometer can undergo. It is important to determine the maximum load because it can affect the accuracy of the tool and also the safety of the user.

Steel can withstand heavy loads due to its hard body. The designed micrometer will be able to withstand heavy loads. The primary scales and secondary scales will be able to hold more than 20kg of weight. The micrometer will be able to tighten and hold the object for up to 20 kg of weight and measurements can be easily taken. (“Engineering Analysis,” 2015).

4.3 Cost Analysis

Cost analysis is the very important consideration in any engineering design, for it can affect the overall cost of the equipment that is being designed. The material selection is very helpful and crucial in making sure that the equipment is within budget. Some materials are very expensive while others are relatively cheap and can still serve the same purpose. In designing our product, we were particular that we kept the cost at the minimum without compromising on important aspects such as strength, accuracy, and safety.

The progress of advanced goods needs organizations a lot of energy. The formation of a suitable plan growth, environment, shield of incomes and making a promotion classification is the main trial. Doubts and dangers that escort invention needs the approaches and tactics to design innovation are designed precisely and it will assure of success. Accomplishing success is mainly reliant on the efficiency of the conclusions in the application of the placement process. Amongst related standards which stimulate conclusions making are costs. The method that allows approximating the cost of the preparation, growth and working actions. This makes it possible to evaluate the cost efficiency of the procedure in terms of attaining the future benefits and creating active choices. (Chwastyk & Kołosowski, 2014).

After careful consideration and cost analysis, the decision to design the micrometer with the idea it will be made out of steel was decided. Steel not only is affordable but also serves as a dependable and strong material to make the tool out of. The cost of redesigning the micrometer has to be taken into consideration, and all things must be kept within the budget.

When replacing a tool, an engineer must think about two questions. “How is this better than the last model?” and “How does this save us money/is it worth it to change?” Having one tool to replace multiple tools was always the goal. Having it serve the same purpose and function the same as having multiple tools would save money over the long haul. Purchasing one tool versus a whole set answers these questions. Not only will this save companies money with equipment costs, but not having to change tools repeatedly will save time and increase efficiency. The new and improved micrometer, however, has to stay within budget without losing its functionality. The balance between cost and quality has to be optimal.

4.4 Bill of Materials (BOM)

A bill of materials (BOM) is a widespread list of raw resources, apparatuses, and products that are needed to produce, manufacture or overhaul a product. A bill of materials seems in a graded arrangement, with the uppermost level showing the completed product and the lowest level displaying separate apparatuses and resources. There are diverse types of bills of materials precise to engineering, which is used in the project process and definite to industrial used in the assembling procedure (Staff, 2010).

The bill of materials refers to the list of requirements for a certain manufacturing process or an assembly process. This is normally used in the industry to enhance organization as well as to prepare the budget for the entire process. This helps managers to know what requisitions to make within the planned budget. In the design of our micrometer, the materials were estimated to cost less than $ 100 per unit. The budget shows that we were able to stay within the predicted budget, which is important for the manufacturing process.

Steel is easily available in the market and is quite cheap and most of the parts of the micrometer will be made from steel. This will significantly reduce the price of the micrometer. The low cost will result in the mass production of the micrometer, which can even be further exported to the other countries.

4.5 Drawings/Solid Works Design

The design of the micrometer was developed on the CAD software Solid Works. Both wireframe and solid 3D models have been developed to show the tool’s capabilities and for manufacturers to use to produce the tool. After careful discussion, all variables were taken into account, and multiple designs were developed. With everything being considered one design stood out and was chosen to further complete the micrometer.

A micrometer usually consists of two scales that are the main scale and the secondary scale. The secondary scale will be placed on the thimble in the design, and the secondary scale will measure the pitch of the screw. This will ensure that the reading on the secondary scale will measure the correct and precise distance that is moved by the thimble per rotation. The ruler on the thimble is distributed

into 50 equal portions and measures a hundred times a millimeter distance. In the design, the thimble scale will be able to rotate on the spindle or on the main scale. The main scale will have a millimeter scale that will be further divided into equal portions with a distance of half a millimeter distance. The object that needs to be measured will be placed in among the anvil and spindle. Measurements from both scales are observed to precisely measure the length of an object ("Micrometer Screw Gauge: Parts of a Micrometer Screw & Functions," n.d.).

A micrometer is a dedicated measuring instrument, and it needs special care to handle it; it is also very important that the micrometer is fully calibrated to avoid any kind of error in the final readings.

Every circling of the ratchet will move the spindle face 0.5mm near to the anvil face. The object whose measurement is needed will be placed between the anvil and the spindle. The ratchet will be able to turn clockwise till the object is confined among these two exteriors, and the ratchet will make a clicking noise. This clicking noise means that the ratchet cannot be squeezed any longer, and at this point, the measurement can be taken.

The micrometer design was developed in SolidWorks using wireframe and three-dimensional models to evaluate component geometry, assembly, and movement. The original CAD drawings are not reproduced in this article.

4.6 Considerations/Conclusion

As previously stated our target throughout the design process was to replace the older models of micrometers and eliminating the need to switch out different sizes of micrometers with being able to use one tool for all different sizes. The thought behind this would be one fully functional micrometer to replace six or seven micrometers needed on the job. This not only would cut cost but also save an engineer time and increase efficiency. This would mean the cost of our tool would have to be cheaper than what it costs for a set of micrometers. The design of the micrometer had to be adjusted to make sure these goals were met but at the same time, not lose any of its functionality. The designed product will be highly successful and less expensive.

References

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