

DESIGN AND DEVELOPMENT OF SURFACE ROUGHNESS TESTER

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ABSTRACT— In almost all manufacturing processes, surface roughness plays an important role for the assessment of quality of the product. In any manufacturing process, an estimation of the surface roughness is especially important. Some of these methods have sunk without any trace, because of the inherent disadvantages. In other cases, some additional methods have been developed to deal with different measurement problems. The roughness of a surface cannot be easily defined by a single parameter or by any intrinsic property of the surface. The surface irregularity exists in two primary planes; one at the right angle of the surface, which is characterized by the some kind of height, and second in the plane of the surface, which is characterized by some kind of wavelength. Thus, there are two sets of limitations to each roughness measuring instrument or technique; (i) The largest and nominal difference of heights, which it will resolve and (ii) The longest and shortest wavelengths.

Keywords: Surface Roughness, Surface quality

I. INTRODUCTION

Surface metrology is the measurement of small scale features on surfaces, and is a branch of metrology. Surface primary form, surface flatness and surface roughness are the parameters most commonly associated with the field. It is important to many disciplines and mostly known for the machining of accuracy parts and assemblies which contain mating surfaces or which must operate with high internal pressures.[1,2,3,4,5]

Surface finish may be measured in two ways: contact and non-contact methods. Contact methods involve dragging a measurements stylus across the surface; these instruments are called as profilometers. Non-contact methods include: interferometer, digital holography, confocal microscopy, focus variation, structured light, electrical capacitance,

electron microscopy and photogrammetry. In contact profilometer a diamond stylus is moved vertically in contact with a sample and then across the sample for a specified distance and specified contact force. A profilometer can measure small surface variations in vertical stylus displacement as a function of position. [6,7,8,9]

Discussion on literature review

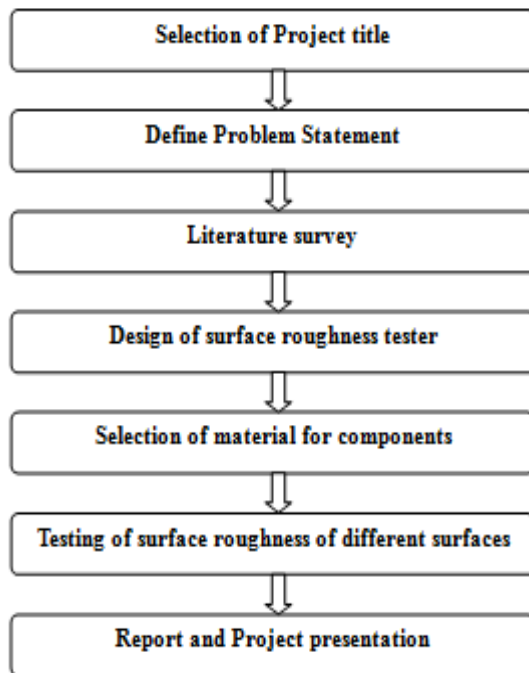
We have studied few research papers from that we conclude that

- A. We propose selection criteria for the stylus type radius to develop the reliability of measurement results.
- B. The measurement of roughness on machined surfaces is of significant importance manufacturing industries.
- C. Friction situation at contact interfaces can have a large control on the success off some sheet metal forming operations.
- D. The range of hardware components commonly used in combination with stylus instruments to obtain real surface roughness measurements.
- E. The surface roughness tester indicates clear wave profile and it can detect smaller roughness present on the object.

II. AIMS AND OBJECTIVES

- To achieve quality of production by improving its surface roughness.
- To achieve up to date production, knowledge of measurement required.
- To reduce rejection with help of quality control.

III. METHODOLOGY



IV. LIST OF COMPONENT

- Base
- Digital Dial indicator
- Lead screw
- Carriage

V. DESIGN OF LEAD SCREW

The Power selected for this application is a mild steel screw, M10 (P = 1.5 mm), which is a standard material available in market. To prove that our selected is material is safe we are going to measure the factor of safety available for our application.

$$\begin{aligned}
 W &= 80 \text{ N} \\
 S_{yc} &= S_{yt} = 330 \text{ N/mm}^2 \\
 d_c &= d - p = 10 - 1.5 = 8.5 \text{ mm} \\
 \sigma_c &= 56.75 \text{ N/mm}^2 \\
 \text{F.O.S.} &= 5.815
 \end{aligned}$$

This power screw is designed to slide the load of 50 N, its own weight & miscellaneous load i.e. 30 N considered.

$$\begin{aligned}
 \text{Length of Screw (L)} &= 600 \text{ mm} \\
 \text{Total Load (W)} &= 80 \text{ N} \\
 \text{Pitch (P)} &= 3 \text{ mm by Standard Value} \\
 \text{Nominal Diameter (d)} &= 12 \text{ mm by Standard Value} \\
 \text{Type of Thread} &= \text{Metric Thread} \\
 \text{Friction Factor } (\mu) &= 0.2 \\
 \text{Number of Starts (n)} &= 1 \\
 \text{Lead} &= n \times P = 1 \times 3 = 3 \text{ mm} \\
 \text{Collar Friction } (\mu_c) &= 0.15 \\
 \text{Motor RPM (N}_s) &= 30 \text{ RPM}
 \end{aligned}$$

Mean Diameter

$$(d_m) = d - \frac{p}{2} = 12 - \frac{3}{2} = 10.5 \text{ mm} \quad \dots(1.1)$$

Helix Angle

$$(\alpha) = \tan^{-1} \frac{1.5}{\pi d_m} = \tan^{-1} \frac{3}{\pi \times 10.5} = 5.18^\circ \quad \dots(1.2)$$

$$\begin{aligned}
 \text{Friction Angle} \\
 (\varphi) &= \tan^{-1}(\mu) = \tan^{-1}(0.2) = 11.3^\circ \quad \dots(1.3)
 \end{aligned}$$

$$\begin{aligned}
 \text{Effort Required to slide the plate against Thread Friction} \\
 (P_r) &= W \times \tan(\alpha + \varphi) = 80 \times \tan(5.18 + 11.3) \\
 &= 77.89 \text{ N.mm} \quad \dots(1.4)
 \end{aligned}$$

$$\begin{aligned}
 \text{Torque Required to slide the plate against Friction} \\
 (T_{tr}) &= P_r \times \frac{d_m}{2} \quad \dots(1.5) \\
 &= 77.89 \times \frac{10.5}{2} = 408.92 \text{ N.mm}
 \end{aligned}$$

$$\begin{aligned}
 \text{Torque Required to Overcome Collar Friction} \\
 (T_c) &= \mu_c \times W \times \frac{d_m}{2} \\
 &= 0.15 \times 80 \times \frac{10.5}{2} = 63 \text{ N.mm} \quad \dots(1.6)
 \end{aligned}$$

$$\begin{aligned}
 \text{Torque Required to raise the load} \\
 (T_r) &= 63 + 408.92 \\
 &= 471.92 \text{ N.mm} = 0.471 \text{ Nm} \quad \dots(1.7)
 \end{aligned}$$

Hence a 12 v D.C motor of torque rating 3 Nm and 30 rpm is used for the above application.

VI. CAD MODELLING

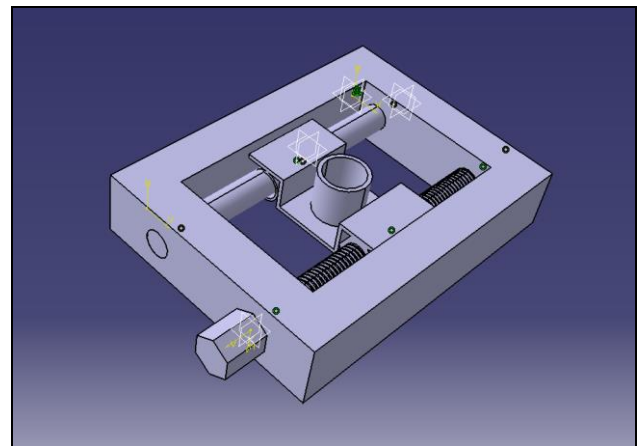


Figure 3. CAD Setup Diagram.

VII. ACKNOWLEDGMENT

We are very thankful for continuous encouragement in valuable supervision, timely suggestion and inspired guidance offered by our guide Prof. R.B. Ambare and project co-ordinator Prof. S.S. Dhore to successfully complete the paper. We are also thankful to our Principal, HOD, staff and our friends for help for accomplishing this undertaking.

VIII. CONCLUSION

It is concluded that, the surface roughness tester will helpful for small scale industrialists as it is easy to operate with less costs and indirectly it will save the labor cost. It also useful to reduce the rejection of work pieces and due to digital indicator we can get high accuracy of surface roughness measurement. Saving resulting from the use of tester will make it pay for itself with in short period of time and it can be great companion in any field dealing with any surfaces.

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