Establishing Error Proof Measurement System for Dimensional Check

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Abstract— In today's highly competitive environment, manufacturing scenario has undergone a rapid change in the last two decades, more so in the last few years. The advent of new materials, products and the changing needs of the customers have bought a lot of pressure on the organizations in developing countries especially in India to perform better in the coming days.

Error proofing is a concept related to the implementation of fail-safe mechanisms to prevent process from producing defects and thereby decreasing the inspection time and increasing the production rate.

1 INTRODUCTION

Metrology is the science of measurement that includes both experimental and theoretical determinations at any level of uncertainty in any field of science and technology. Metrology can be divided into three sub-fields: Scientific Metrology, Industrial Metrology and Legal Metrology. Scientific Metrology deals with the organization and development of measurement standards and with their maintenance at the highest level whereas Industrial Metrology deals with the ensuring of the adequate functioning of measuring instruments used in industry as well as in the production and testing process, and finally Legal Metrology is concerned with accuracy of measurement where these have influence on the transparency of economical transactions, health and safety. Tolerance is the total allowable amount by which a measurement may vary. It is the difference between the maximum and minimum limits.

In today's competitive world any organisation has to manufacture high quality, defect-free products at optimum cost. The new culture of the total quality management total productive management into the manufacturing as well as service sector gave birth to new ways to improve quality of products. By using various tools of Total Quality Management like KAIZEN, SIX SIGMA, JUST IN TIME, POKA-YOKE, FLEXIBLE MANUFACTURING SYSTEM and other techniques to improve their production and to decrease defects in products. Error proofing refers to the implementation of fail-safe mechanisms to prevent a process from producing defects. The Philosophy behind error proofing is that it is not acceptable to make even a very small number of defects, and the only way to achieve this goal is to prevent them from happening in the first place. In a essence, error-proofing becomes a method of 100% inspection at the source rather than down the line after the additional value has been added. Achieving extremely high levels of process capability requires the type of focus on prevention rather than detection. Even errors are done in your daily life but you may not realise those errors.

However, all measurements have some degree of uncertainty that may come from a variety of sources. The process of evaluating the error associated with a measurement result is often called uncertainty analysis or error analysis. The complete statement of a measured value should include an estimate of the level of confidence associated with the value. Properly reporting an experimental result along with its uncertainty allows other people to make judgments about the quality of the experiments, as it facilitates meaningful comparisons with other similar values or theoretical prediction. Without an uncertainty estimate, it is impossible to answer the basic scientific question. "Does my result agree with a theoretical prediction or results from other experiments?"This question is fundamental for deciding if a scientific hypothesis is confirmed or refused.

When we make a measurement, we generally assume that some exact value exists based on what we are measuring. While we may never know the true value exactly, we attempt to find this ideal quantity to the best of our ability with time and resources available. As we make measurements by different methods or even when making multiple measurements using the same method, we may obtain slightly different results. So there may be many errors while measuring and these errors are called Measurement errors.

The most common way to show the range of values that we believe includes the true value is:

Measurement= (best estimate (+or-) uncertainty) units

When analysing experimental data, it is important that you understand the difference between precision and accuracy. Precision indicates the quality of the measurement, without any guarantee that the measurement is "correct". Accuracy, on the other hand, assumes there is an ideal value, and tells how far your answer is from that ideal, "right" answer. This concept is directly related to random and systematic measurement errors.

2 Problem Statement

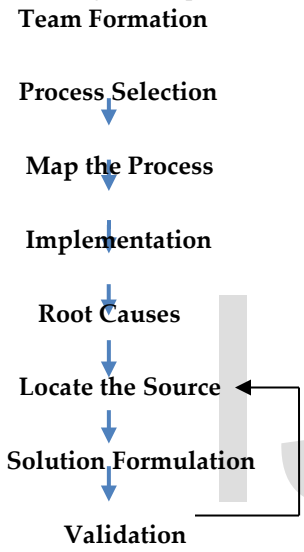
Increase in the inspection time is the major challenge faced in the manufacturing industry which hinders the overall growth and reduces the profit where this was the problem addressed in our project.

With the advancement in technology and increased in competition in the market, all the organisations are forced to reduce their profit to make sure they remain in the market.

These have forced organisations to provide the best at the least cost by eliminating unwanted movements and various unwanted activities. So organisations instead of increasing their investments are concerned with identifying the problems within the existing and eliminating unwanted wastages and thereby increasing their profits.

2.1 Methodology and Flow Chart

To address the above challenges an exclusive methodologies were designed which were user friendly, cost-efficient and easily available and also an effective method. With this, the motto of the project is to improve the quality and customer satisfaction by reducing rejections and rework thereby reducing waste and increasing the production rate and also increasing the profit by decreasing the inspection time.



2.2 To Find Insert Hole Diameter

Most of the tool cutting inserts have hole in the middle of the insert where the inserts are used in lathe, boring, milling and other cutting operations. The hole is made in middle of the insert in which the cutter portion is an indexable part clamped by a screw or brazed if the insert is not brazed or welded then they can be exchangeable and thus for easier tool fixture the insert have a hole in the middle of it.

Measuring hole diameter:-

Vernier calliper is an instrument used to check both inner diameter and the outer diameter where the outer diameter can be measured by external jaws of Vernier whereas the inner diameter can be measured by the internal jaws in which placing the internal jaws inside the inner diameter of the insert hole and by this the inner diameter can be determined if the diameter of the hole is small then this method may be difficult. If the diameter is small then it is possible to determine its radius by **Profile Projector** in which smaller diameter can be found by placing an insert on the work table of the profile projector and place the profile sheet and match the radius and thus the diameter of the hole can be measured.

There is a lot of difficulty in measuring the insert diameter as the shape of the insert and hole diameter varies in which we can use some physical methods and also technical methods to measure the insert hole diameter. But the accuracy and the time will differ from one technique to other.

It may be difficult for the workers in the company to measure the diameter as they should be trained well to measure the diameter.

Suggested method to find the diameter of hole in an insert:-

- Spherical ball fixed with an eye screw:-

Fig 1. Metallic spherical ball fixed to an Eye Screw

Standard of Procedure for Measuring the Diameter Using this Method:-

1. Selecting the Insert that to be measured.
2. Take the kit that has different spherical balls with different radius.
3. Now place the spherical ball inside the hole of an insert.
4. Continue with the previous step with different balls to get accurate result.
5. Check multiple times to make sure whether the result that you obtained is accurate.

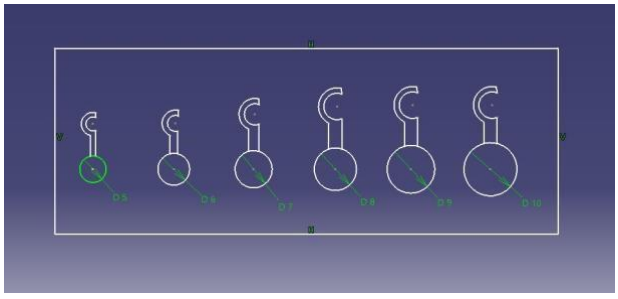


Fig. 2 Drawing of Box to place the metallic balls setup

2.3 To Find Nose Radius

The nose radius is a key factor in turning operations. Inserts are available in several sizes of nose radius. The selection depends on depth of cut and feed, and influences the surface finish, chip breaking and insert strength. Depth of cut and cutting forces:
The relationship between nose radius and depth of cut affects vibration tendencies. The radial forces that push the insert away

from the cutting surface become more axial as the depth of cut increases.

It is preferable to have more axial forces than radial. High radial forces can have a negative effect on the cutting action which can lead to vibration and bad surface finish.

As a general rule of thumb, choose a nose radius that is equal or smaller than the depth of cut.

Measuring the Nose Radius:-

- Collect the inserts to be measured.
- Place the inserts on the work table.
- Bring the probe near the insert and set the needle correctly on the one side of the inserts by using the decreasing and increasing buttons.
- When connected to an XY plotter, the contour profile can be checked with the display unit prior to output. Start measuring then the graph will be created on the desktop and adjust the points to be measured and note the reading and compare with standard one.
- When connected to a personal computer, the FORMPAK-1000 contour analysis program provides various modes of measurement and analysis.

Suggested Method to Find the Nose Radius:-

- Metallic slab with Dimensional Curves:-

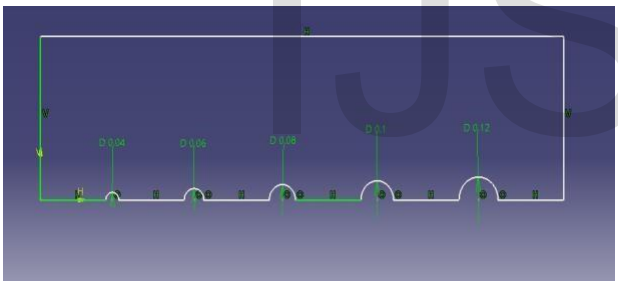


Fig. 3 Drawing of Metallic Slab with Dimensional curves to find the Nose Radius of an Insert

Fig. 4 Magnifier used to view the nose radius of an insert

How to Use:-

This shows how a new method of determining the nose radii of cutting inserts more accurately measured compared to the conventional methods, based on metallic slab with dimensional curves has been developed.

It's easy to find the nose radius of an insert by metallic slab method because as we mentioned above the curvature radius can be found by dimensional curves on metallic slab with the help of magnifier (10x).

When we place the insert in the dimension curves that are present in metallic slab with required radius so that with the help of magnifier lens we can find its nose radius. So we can get more accurate result.

3. Acknowledgement

The satisfaction and excitement that accompany the successful completion of any task would be incomplete without the mention of the people who made it possible, whose consistent guidance and encouragement crowned our efforts with success.

We consider ourselves proud to be a part of **REVA University** family, the institution which stood by our way in all our endeavors.

We express our sincere thanks to **Dr. K S Narayanaswamy** Director and Professor, School of Mechanical Engineering, for his support and encouragement.

We express profound thanks to **Prof. Vinod R**, Assistant Professor, School of Mechanical Engineering, for his valuable support & for his inspiration, guidance, constant supervision, direction and discussions in successful completion of this project.

We also convey our heartfelt gratitude to our external guide **Mr. Dinesh Gouda**, Quality Department, Kennametal India Ltd, Bengaluru for his entire Support and Encouragement. We are thankful to the project coordinators, teaching and nonteaching staff members of School of Mechanical Engineering for their co-operation extended towards this work.

4. Conclusion

Following are the conclusions that have been formulated:

- Easy method to find the radius of hole of an insert.
- Best method to find the nose radius of insert. Again from the inference from the analysis are mentioned as suggested improvements. By implementing those industry will be benefited as follows:
- Increases Revenue of the Industry
- Improves Efficiency
- Develops effective labours/workers
- Decreases rejections and rework thereby decreasing waste and scrap.

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