A Review on Geometric Alignment of Machine Tool

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Abstract- *Geometric alignment in machine tools is most important approach and frequently being applied to maintain accuracy of the machines and to produce accurate job.This paper is based on the analysis and development of new approach of geometric alignment. It is a new approach will be based on, how to make flatness ,straightness and roundness alignment in machine slides.*

Keywords- Alignment: .Flatness1, Straightness2 ,Roundness3, dial indicator,Laser

I. INTRODUCTION

The dimensions of a gauge, its surface finish and geometry are dependent upon the inherent quality and accuracy of the machine tool for its manufacture. Also in mass production the various components produced must be of such accuracy that they may be assembled on a non-selective basis. The accurate production of the component parts depends upon the accuracy of the machine tools.The continuously increasing demand for highly accurate machined components has led to considerable research towards means by which the geometric accuracy of machines may be improved and maintained. It is very important, therefore, that under static conditions, the alignment accuracy of the machine tools is checked by some geometric tests. The tests which check the alignment accuracy of the various parts of a machine tool are called static rests.A machine tool, at the same time must be able to display the desired behaviour and characteristics under normal operating conditions as operator is concerned with the actual working of machine tool. Therefore, some alignment tests are performed under dynamic loading conditions and these are referred to as dynamic tests. Thus it is obvious that the satisfactory working of a machine under static loading only is not sufficient but account should be taken of the vibration and deflection of various machine parts under actual dynamic loading also. In dynamic tests, the various members are actually loaded and alignment tests are carried out. Also various parts are excited at working frequency and behavior of machine observed. In other words it could be said that machine tools for the workshop must be able to produce work-pieces of given accuracy within prescribed limits consistently and without requiring artistic skill on the part of the operator and that the quality of work pieces depends upon : **(i)** Stiffness and rigidity of the machine tool and its componentsparts.**(ii)** The alignment of various machine parts in relation to one another. This is very important because the geometry of various shapes is based on the relative motion between various machine parts and hence on alignment of variousparts.**(iii)** The quality and accuracy of the control devices and the driving mechanism. Stiffness and rigidity are a matter for designer and once tests on a prototype of a certain design have given satisfactory results, there is no need to test the machine of same design over and over again.

II. TYPE OF ALIGNMENT

A. STRAIGHTNESS ALIGNMENT*:* Straightness is a term used when measuring the uniformity of a vertical surface. The straight line represents the path of all linear dimensions. Considering the premise that the shortest distance between two points is along a straight line, that path is not necessarily present in a physical sense on the part being measured for size, but it must be incorporated in the length measuring instrument.Straightness, which is a fundamental concept of linear measurements, is also a functionally important condition of many products.

B. **FLATNESS ALIGNMENT:** Flatness measurement is one of the key measurements for determining the uniformity of a surface.A surface is perfectly flat when all points on the surface lie in the same plane. This is only theoretically possible, therefore the first element to determine is the flatness tolerance, within which all measured points on a surface will lie.

C**. ROUNDNESS ALIGNMENT:**Roundness alignment is one of the key measurements for determining the round of a surface. .A surface is perfectly round when all points on the surface lie in the same plane.

III. METHOD USED for ALIGNMENT

A. DIAL INDICATOR*:* It operates on the principle, that a very slight upward pressure on the spindle at the contact point is multiplied through a system of gear and livers. It is indicated on the face of the dial by a dial finger. Dial indicators basically consist of a body with a round graduated

dial and a contact point connected with a spiral or gear train so that hand on the dial face indicates the amount of the movement of the contact point. They are designed for use on a wide range on a standard measuring device such as, dial box gauges, portal dial, hand gauge, dial depth gauge, diameter gauge and dial indicator snap gauge.Corresponds to a spindle movement of 1mm. the movement mechanism of the instrument is house in a metal case for its protection. The large dial scale is graduated into 100divisions. The indicator is set at 0 by the use of slip gauge representing the basic size of the part. Dial indicators typically measure ranges from 0.01 mm to 0.8 mm

Fig. dial indicator

B. **LASER**:Traditional alignment methods usually require days or even weeks to align a machine tool. That, combined with stack-up errors that can limit the machine's tolerance potential, makes aligning a machine tool to today's ever-tightening tolerances a very timeconsuming and difficult exercise. In fact, most companies rarely check alignment of their machines because it takes too much production time. Laser's alignment systems allow the time to align machines and keep pace with production. With accuracies down to ¼ arc second (0.000015"/ft or 0.001 mm/M), Laser's alignment systems will also help your machines cut better parts, reduce scrap rates and increase productivity

Fig. Alignment with laser equpments

IV. PRINCIPLE

It is also called sine error, describes the magnification of angular error over distance. For example, when one measures a point that is 1 meter away at 45 degrees, an angular error of 1 degree corresponds to a positional error of over 1.745 cm, equivalent to a distance-measurement error of 1.745%.

According to Abbe's principle the axis or line of measurement of the measured part should coincide with the measuring scale or the axis of measurement of the measuring instrument.

E= D. SIN A

E=ERROR
D=DISTANCE
A=ANGLE

V. IMPORTANT PARAMERERS

In machine tool alignment there are important parameter is

(1) **Dial indicator**:*This parameter is very useful to know the machine tool alignment in all directions.*
(2) **Hand grinder**:*Hand grinder is useful to remove the positive displacement material.*
(3) **Hand scrapper**:*It is used after the hand grinder because to get accurate result.*
(4) **Laser equipment:***Laser equipment is used to find out misalignment on the surface.*
(5) **Time & Accuracy:***Time and accuracy place vital role in machine alignment.*

VI. LITERATURE REVIEW

A.**Geometric error calibration of multi-axis machines using an auto-alignment laser interferometer , October,1999**:

An auto-alignment laser interferometer system for machine tool calibration has been demonstrated. The system is fully compatible with the commercial laser interferometersystems, but eliminates the difficult and time-consuming process of optic alignment for a displacement measurement

B. **Systematic Geometric Error Modeling for Workspace Volumetric Calibration of a 5-axis Turbine Blade Grinding Machine, October,2010:**

In the proposed machining test, a simple square-shaped step is finished by a straight (radius) end mill at given sets of Y- and Z-axis angular positions. By repeating the proposed machining test, time-dependent variation in geometric error parameters can be observed, which is mostly caused by thermal deformation induced by
spindle rotation or environmental change

C. **Geometric Errors in CNC Machine Tools , November 2012**:

Implementation of software compensations to the control systems of CNC machine tools is a way how to increase their geometric, work and manufacturing accuracy.This article discusses the increase in geometric accuracy of the machine using two selected compensations.

D**. A machining test to evaluate geometric errors of five-axis machine tools with its application to thermal deformation test september,2014**:

This modeling technique is quite simple, comprehensive ,robust, and easy to calculate, analyze and synthesize the geometric errors of 5-axis machine tools for finding the volumetric workspace errors without unnecessary calculation and free from errors and mistakes.

E. **Geometric error measurement and compensation of machine,2016*:***

The paper has reviewed the fundamentals of kinematicmodelling. Various technologies to measure the errors of machinesare reviewed and their basic characteristics are discussed. Directand indirect methods and their characteristics in the practicalapplication have been compared.

F. **Automatic compensation of alignment errors in machine tool alignment,2003**:

The main requirements for such a system is given—and includes derivation of geometrical formulae for relative positioning of reference planes and measuring probes, form of computation for total error and methods of inserting compensating signals into the servo-controlled feed drives. From an application to a proposed profiling machine, the accuracy requirements for some of the elements of a system are estimated.

G **.A new approach for mechanical machine tool,2017**:

In this paper a method to adapt a toolpath to a geometrical target to remove a constant thickness on a rough surface was proposed. This case is generally present in the production of knee prostheses.

H.**Precision Analysis of Geometric Parameters for Rotating Machines during Cold Alignment,2017:**

Accuracy analysis of “cold” alignment revealed that modern total stations (when choosing optimal measurement techniques) allow for reliable estimation of the machine state and providing its efficient adjustment. The time of measurement and adjustment will be reduced twice relative to the traditional method of alignment – leveling of tyres in four positions of the kiln.

VII. CONCLUSION

A long term use of machine tools results in wear, pits, tears and therefore misalignment in the surface straightness, flatness in machine tool bed as well as guide ways. The increasing cost of machine tools makes it very difficult to justify replacing it. This leads to need for retrofitting the machine tool. This project is based on surface alignment of slide ways of machine tools. Here the focus will be on the practice of finding out misalignments of the machine tools. It is observed that the wear, tear and vibration are main cause of misalignment. A quantitative measurement of such misalignments will be made and an approach to reduce or to remove this misalignment in the machine tools will be developed by using hand scraping methods or some other conventional approach.

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