# Design and Detailing of Inspection Fixture

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Abstract- Various types of inspection method are being use in various industry from that quality of any product is to be check. The different types of inspection methods involves CMM (Coordinate Measuring Machine) and various type of gauges are use. Gauges are the tools which are used for checking the size, shape and relative position of various parts but not provided with graduated adjustable members. Gauges are therefore, understood to be single-size fixed-type measuring tool. The gauge is design as per standards that check the dimensions is concerned. A functional gauge is a gauge that verify functional requirement of part features as defined by the geometric tolerances. For example, if holes on a part are intended to fit over studs of a mating part, a function of the holes would be to assemble over the studs. To verify the location of the holes, a functional gauge that simulates the studs of the mating part could be used. A functional gauge does not provide a numerical reading of a part parameter. A functional gauge often provides a "fail" or "pass" assessment of a part feature. A functional gauge is often referred to as an attribute gauge or a fixed gauge because it checks attributes of a part FOS (location and orientation).

*Index Terms* - Receiving gauge, Inspection, Design, Manufacturing, Fixture

## 1. INTRODUCTION

Gauge or gauge, in science and engineering, is a device used to make measurements or in order to display certain information, like time. A wide variety of tools exist which serve such functions, ranging from simple pieces of material against which sizes can be measured to complex pieces of machinery. Depending on its usage, a gauge can be described as a device for measuring a physical quantity, for example to determine thickness, gap in space, diameter of materials.

Basic principles of gauging

a) Measurement- Measuring can be defined as the determination of a dimension.

b) Gauging- Gauging is defined as the acceptability of a given dimension whether it lies in its specified or allowable limits or not.

c) Gauge tolerance - 10% work tolerance

A clear distinction between measuring instruments and gauges is not always observed. Some tools that are called

gauges are used largely for measuring or layout work. Even some are used principally for gauging give definite measurement.

A functional gauge is a gage that verifies functional requirements of part features as defined by the geometric tolerances. For example, if holes on a part are intended to fit over studs of a mating part, a function of the holes would be to assemble over the studs. To verify the location of the holes, a functional gage that simulates the studs of the mating part could be used. A functional gage does not provide a numerical reading of a part parameter. A functional gage often provides a "pass" or "fail" assessment of a part feature. A functional gage is often referred to as an attribute gage or a fixed gage because it checks attributes of a part FOS (location and orientation).

## 2. LITERATURE REVIEW

**Paper 1**

"Gauge Repeatability and Reproducibility Study and Measurement System Analysis: A Multi method Exploration of the State of Practice"

By Mr**. Rathel R. (Dick) Smith, Dr. Steven W. M Crary & Dr. R. Neal Callahan**

The effectiveness of a measurement system depends upon accurate gauges and proper gauge use. Common measuring devices such as calipers and micrometers are of particular concern when used incorrectly (Hewson, O'Sullivan, & Stenning, 1996). Measuring equipment and processes must be well controlled and suitable to their application in order to assure accurate data collection (Little, 2001).

According to the MSA Reference Manual, MSA defines data quality and error in terms of "bias," "reproducibility," "reliability," and "stability" (AIAG, 2002). Further, MSA provides procedures to measure each term, however the phrase Gauge Repeatability and Reproducibility Studies (GRRS) has come to incorporate the procedures recommended for measurement of "bias," "reproducibility," and "reliability" (Foster, 2006).

In addition to reliance on physical measurements there is an additional and unavoidable reliance on human visual inspection processes, which rely very heavily on subjective judgment of specific product or process attributes.

**Paper2**

"A Review of Current Geometric Tolerancing Theories And Inspection Data Analysis Algorithms" Shaw C. Feng **Theodore H. Hopp** Factory Automation Systems Division National Institute of Standards and Technology Gaithersburg, MD 20899-0001 February 1991.

This report provides an overview of the state of the art in mechanical dimensioning and tolerancing theories and CMM inspection data analysis technology. We expect that the information included in this review will benefit CMM software developers, CMM users, and researchers of new CMM technology. This document is the results of a survey of published geometric dimensioning and tolerancing theories and post-inspection data analysis algorithms. Both traditional and modern theories have been reviewed. Principles on which current national and international standards are based have been stated. These geometric dimensioning and tolerancing principles are commonly used in mechanical design and part inspection. Post inspection data analysis algorithms, used for extracting features and evaluating tolerances, have also been reviewed. The effects of using different fitting criteria are discussed. From this theory and

algorithm review, we recommend directions for future development in these areas. The bibliography covers activities and accomplishments of the research in advancing inspection technology.

This paper provides an overview of current geometric dimensioning and tolerancing theories and post inspection data analysis algorithms. These theories and algorithms will be the basis of improved CMM technology in the future. As a review paper, we summarize current technology rather than propose solutions to problems in CMM software and engineering metrology.

### *3. Problem Statement*

As when there is manufacturing of components there is inspection of the same component and it means the requirement of measuring instrument exist. In industries various devices used to carry out inspection are based on principle such as mechanical, optical, electrical, pneumatic, etc. In mass production manufacturing of component is done in bulk quantity.

### *4. Objectives*

1. For obtaining high accuracy reliability and repeatability with strong focus on ergonomics.
2. To reduce measuring time and its cost.
3. For accurate and precise inspection.
4. Increase production rate.
5. Requires less cycle time.

### *5. Scope*

*Receiving / In process / Final Checking Gauge*

The receiving gauge is specially designed and manufactured for inspection purpose. It measures the job very accurately and precisely as per the job standards and specification. It can be used in metrology area as well as production floor. They give the operator the possibility to perform dimensional inspection of the part without having to rely on a coordinate measuring system.

Receiving gauge used for checking dimensions precisely as per the standards/ drawing / cad.

*Purpose of Receiving/ In process / Final Checking Gauge*

The basic purpose of using receiving gauge in mass production industries are

1. For accuracy, reliability and repeatability with strong focus on ergonomics.
2. To reduce measuring time and its cost.
3. For accurate and precise inspection.
4. Increase production rate.
5. Initial cost low.
6. Requires less cycle time.

F. G D &T SYMBOL

| **TYPE OF FEATURES** | **TYPE OF TOLERANCE** | **CHARACTERISTICS** | **SYMBOL** |
|---|---|---|---|
| INDIVIDUAL (NO Datum Reference) | FORM | FLATNESS |  |
| | | STRAIGTNESS |  |
| | | CIRCULARITY |  |
| | | CYLINDRICITY |  |
| INDIVIDUAL ORRELATED FEATURES | PROFILE | LINE PROFILE |  |
| | | SURFACE PROFILE |  |
| | | | |
| RELATED FEATURES ( Datum Reference Required ) | ORIENTATION | PERPENDICULARITY |  |
| | | ANGULARITY |  |
| | | PARALLELISM |  |
| | RUNOUT | CIRCULAR RUNOUT |  |
| | | TOTAL RUNOUT |  |
| | | CONCENTRICITY |  |
| | LOCATION | POSITION |  |
| | | SYMMETRY |  |

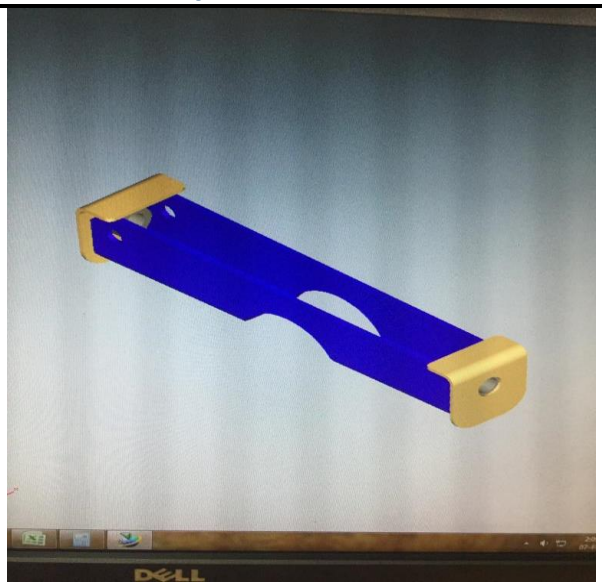
### *6. Gauge Material Selection Criteria*

1. The environment where the gauge will be used
2. Gauge features that will, or will not, make contact with the part
3. Intended use of gauge
4. Frequency of use of then gauge
5. Specific gauge features that will be used the most
6. The part material
7. Moving versus non-moving Gauge material

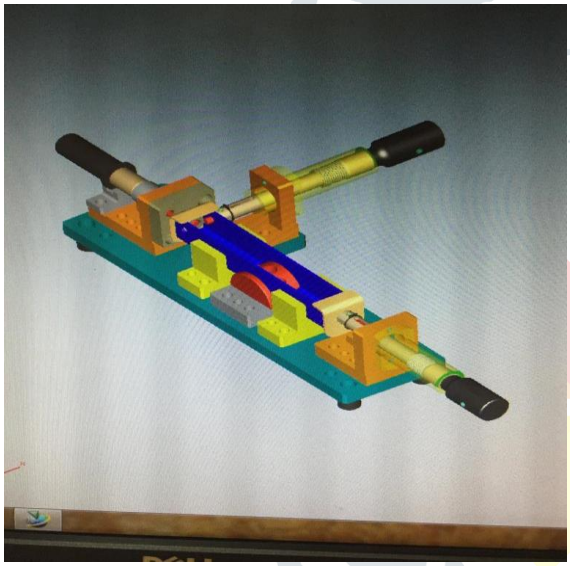
### *7. Gauge Maker's Tolerance and Wear Allowance*

1. Functional Gauges are supposed to reject borderline good product.
2. If too of the part tolerance is consumed, they will reject too many good products.
3. 10% or less stack up is the standard rule(e.g. old Mill-Std-120)
4. The complexity and cost of the gauge depends largely on part tolerance and machinability rating.
5. Functional Gauges cannot be designed to accept bad product.

8.Assembly of fixture parts and part located on it-



Component to be Inspect



Inspection Fixture with Component

*9. Advantages*

1. Fast functional inspection
2. Represents the actual interface
3. Gauges the virtual boundary
4. Easy to use
5. Will not accept bad products

*10. Disadvantages*

1. Must be reworked if part drawing changes
2. Cost prohibitive
3. Reject borderline good products
4. Cannot get quantifiable results

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