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# A REVIEW OF INSPECTION GAUGE AND INSTRUMENTS USED IN INDUSTRIES

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**Abstract -** *Nowadays there are so many methods being used to inspect the quality of products. But this process takes lots of time to inspect so we have to go for such an alternative which leads to reduce the time required for inspecting products. In the traditional method, there is a lot of rejection that comes from the end customers, to reduce this some of the industries use various inspection gauges for a quality product. This paper describes the different types of gauges used in the machine shop floor also provides detailed information about the design and development of the receiving gauge.*

***Key Words***: **Inspection Gauge, Receiving Gauge, Types of Gauge, Limit Gauge**

## 1. INTRODUCTION

The gauge plays an important role in the industries. A gauge is a tool or device used to determine and fix the actual dimensions, capacity, quality, and quantity. A wide range of inspection gauges is currently available in the market and every industry takes its own decision about which gauges to be used or how should be the gauges specification. It's an instrument that can be used to inspect ranging from small pieces of material that can be measured to the complicated product. In any mass production, scheme gauges perform a vital role. Generally, the gauge is a tool that is used for measuring part for its quality checking. Gauges have to be produced & tested concerning the length norm, which in effect is connected to a norm of fundamental length. The standard length is then transferred to the part through the gauge. To calculate the True value of Gauge we can use its accuracy & service life which depends on the manufacturing process & materials used in its manufacture. It will result in massive wear of gauges when working with it. High carbon steel & alloy tool steels are important materials for the manufacturing of inspection gauges.

## 2. LITERATURE REVIEW-

**Shubham Koparde** in the "Design and Manufacturing of Receiving Gauge" concludes that ' a gauge, in which is a tool used for measuring details, like time.
**Methodology:** location and pin method to check the ovality of drills and depth.
**Outcome:** Limit or Receiving Gauge is a time-saving and cost-effective method of inspection. [1]

**Rohit R. Hadbe** in the Development and Manufacturing of Inspection Gauge continues, "Inspection Gauge is those which can inspect the internal hole components without Using of plug gauges.
**Methodology:** By inserting pins and sliding pins.
**Outcome:** The gauge will increase productivity with higher accuracy. [2]

**Pandian A. Irudhayaraj R. Johnstephen R.** in the "Design and Development of Industrial Receiver Gauge in Co-Ordinate Measuring Machine for Reducing Inspection Time".
**Methodology:** Increasing the pin diameter by reducing the position tolerance from 100% to 50%.
**Outcome:** The inspection time of the co-coordinator measuring machine is reduced by position tolerance. [3]

**Wasim M. F. Al -Masri , Mamoun F. Abdel-Hafez, Member, IEEE, And A. Jaradat** in the **"**Inertial Navigation System of Pipeline Inspection Gauge".
**Methodology:** An experimental setup with a prototype of the in-pipe robot is designed and builds to test and validate the algorithm in a real pipe environment.
**Outcome:** The Inertial Navigation System in Pipeline Inspection Gauge is a key factor to reduce the cost [4]

**Hyung Seok Han, Jae Jong Yu, Chan Gook Park, Jang Gyu Lee** in their paper "Development of Inspection Gauge System for Pipeline".
**Methodology:** Strapdown Inertial Navigation System and Simulator for odometer test.
**Outcome:** In this experiment, reliability and performance is investigated finally the navigated error is less than 0.2m achieved [5]

**L.H. Leedham, M.I. Mech. E** in his study "Design, Construction, and Use of Some Inspection Gauges".
**Methodology:** Computer-aided fixture design **Outcome:** Computer-aided technology were used to improve design efficiency [6]

**Hang Zhang, Carlos Sanchez, Shuhai Liu, Shimin Zhang, Hong Liang** in their research named as "Wear of a polyurethane rubber used in the dry gas pipeline as inspection gauges"
**Methodology:** Finite Element Method and Wear test of polyurethane rubber.
**Outcome:** Abrasive wear has low contact stress and fatigue damage under high contact stress [7]

**Oluwafemi Ayodeji Olugboji, Adinoyi Abdulmajeed Sadiq, Oluwafemi Olorunsaiye, David Omeiza Peters** in their work on "Development of a Smart Pipe Inspection Gauge for Detection of Pipeline Defects"
**Methodology:** Smart PIG laboratory Tests and Behavioral study.
**Outcome:** Developed Smart PIG was capable of detecting changes in own behavior and defects in the pipeline [8]

**Lin-Zhen ZHOU, Cong-dong Ji, Qiang JING, Jie TAO** in their study "Research on the Design of Windshield Inspection Gauge Based on WAVE Technology"
**Methodology:** Computer-aided design and WAVE technology.
**Outcome:** Studies the realization process and prevent the repeated design [9]

**Palani Subbiah** explain his views "Inspection Time Reduction in Coordinate Measuring Machine using Receiver Gauge"
**Methodology:** Location And Pin method
**Outcome:** Successfully reduced the inspection time with help of position tolerance [10]

**G. Selvakumar, M. Naveen, A. Prakash, R. Ramkumar**, stated their opinion in "Quality Fixture for Final Cover Drive Using Receiving Gauge"
**Methodology:** Clamping and location.
**Outcome:** Time-saving and cost-effective inspection [11]

**Yueyang Ben, Jiaolong Yang, Donghan YinQian Li** in his study on "System reset of the strap down INS for pipeline inspection gauge"
**Methodology:** System reset technique and Simulation by ANSYS.
**Outcome:** Estimates the system error in the desired range to improve the accuracy of pipeline inspection [12]

**Ali Ahmadian Mazraeh, Firas B. Ismail Alnaimi** in their research work on **"Multi-Diameter Pipeline Inspection Gauge Lang Distance Industrial Application".**
**Methodology:** Signal processing technique, Simulation software such as CRIO, Solid works.
**Outcome:** Reduces pigging operational cost, It does both cleaning and inspection at a time, Having multi-purpose functioning ability. [13]

## 3. CLASSIFICATION OF LIMIT GAUGES & SPECIFICATION:-

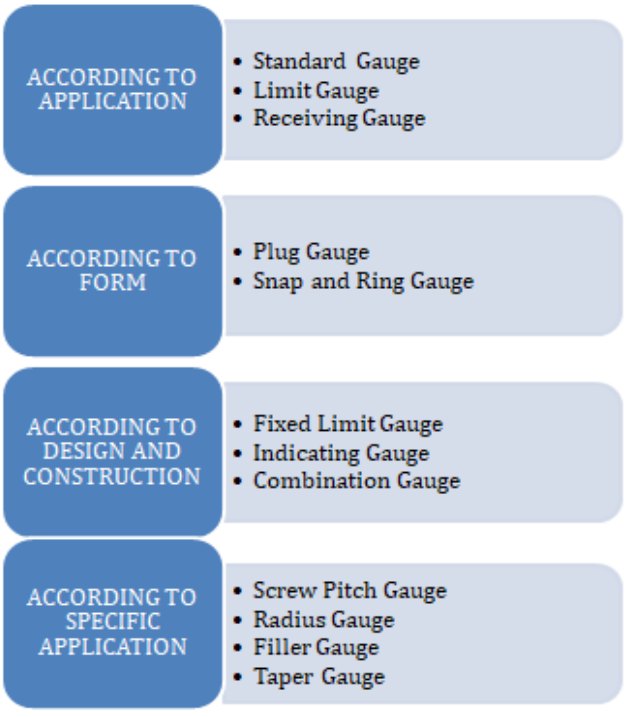


**FIG.1** Classification of Gauges

### 3.1 TYPES OF LIMIT GAUGES

#### 3.1.1 PLUG GAUGE-

They are generally constructed from standard parts, where the gauge section is compatible with other gauge pieces obtained from a pin type-set and a body that uses the selection principle to keep the gauges securely. Firstly one end is inserted into the component, and another end is again inserted depend on the test result.

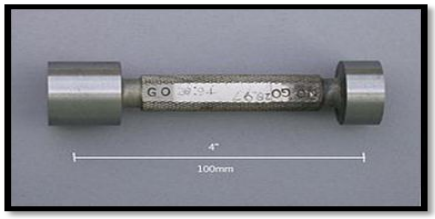


**FIG. 2** Plug Gauge

#### 3.1.2 SNAP GAUGE-

Used for both Non-Cylindrical and Cylindrical parts. We can say that GO snap gauge is the size of a shaft; which is a higher shaft limit and No-Go snap gauge is that size which is lower shaft limit.

**FIG. 3** Snap Gauge

#### 3.1.3 RADIUS GAUGE-

The internal and external radius curvature of the product radius gauge shall be measured and checked.


**FIG. 4** Radius Gauge

#### 3.1.4 TAPER GAUGE-

Taper Gauge is not used for measuring the measurement, but with the help of this gauge, we can measure the angle of tapered surfaces or components.

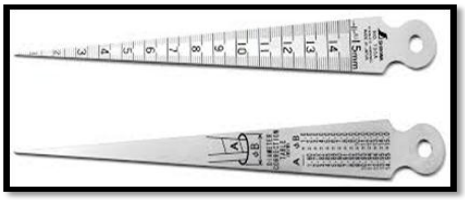

**FIG. 5** Taper Gauge

#### 3.1.5 FILLER GAUGE-

It is used to measure the small gap between surfaces of two mating parts. It contains various dimensional thickness strip for measurements.

**FIG. 6** Filler Gauge

#### 3.1.6 THREAD PLUG GAUGE-

Thread gauge is used for testing thread pitch diameter. Plug thread gauge is used to check internal thread (nut, bush) while external thread (bolt) is checked. The gauge is made with a removable plug machined with a tag for large diam
eter.

**FIG. 7** Thread Plug Gauge

#### 3.1.7 RING GAUGE-

Ring gauges are used for comparative measurement, Also used to test a cylindrical object's outer diameter as well as for checking, calibration.

### 4. INTRODUCTION TO INSPECTION/ RECEIVING GAUGE SYSTEM-

The receiving indicator is specially designed and produced for inspection purposes. This gauge measures the part or say

component accurately and more accurately depending on the labor standards and skills. It plays important role in the metrological and manufacturing fields. Receiving indicator used specifically according to specifications for testing measurements. The recipient indicator refers to an inspection instrument used to inspect a workpiece against its permissible tolerances. It has two tests: the check allows the workpiece to pass one test (Go) and the other (No Go) to fail. The check is an integral component of a quality procedure used in the manufacturing industry to ensure the interchangeability of parts between processes or between different suppliers. It is also a result of a specific quality process. A Go, No Go is a measuring tool not returning a size in the conventional sense, but returning a state. The state is either acceptable (the part is tolerant and can be used) or inadmissible (and should be rejected).

## 5. PURPOSE OF USING INSPECTION/ RECEIVING GAUGES-

a. For checking several dimensions in a single go.
b. Able to check critical profiles by just placing components over the gauge.
c. Very Precise manufacturing according to the tolerance of the component.
d. Steady reading in high vibration area.
e. Easy to re-range and check components.
f. No expertise required in checking the component.
g. Fast checking (without using Height Gauge or CMM Machine)

## 6. DESIGN CONCEPT OF RECEIVING GAUGE-

1. The gauge design must be an exact copy of the gauge. It must include detailed information about the components which have to be checked like dimension, size, surface type, tolerances, etc.

2. The environment in which, the gauge is to be used should be taken into account when choosing the material, clamps, etc. to ensure that they remain functional throughout the product program.

3. All drawings should be full-size, and accurately represent the dimensions shown. Also:

I. Details shall be completed in all views and must be dimensioned to machined surfaces or body or work lines.

II. All designs must have an isometric view of the gauge on the design.

III. Drawings should include a representation of the part shown in its gauging position.

IV. Gauge design details should be drawn separately from the gauge assembly only when needed for build clarification.

V. Gauge designs must be generated utilizing customer approved software.

4. The datum scheme shall be applied to the gauge design. By using datum locators such as “primary,” “secondary,” and “tertiary” datum.

5. The datum that is located on or near parting lines, gates, ejector pins, welds, or any similar features must be brought to the attention of the responsible Design Engineer. Clearance shall be provided on the gauge when datum can’t be relocated.

6. Datum Hole Locators:

I. Gauge pins that are not used as datum locators shall not restrict part movement in any direction. This situation may be concord by utilizing movable details allowing movement in the non-datum direction.

II. For attribute gaging to take full advantage of allowable tolerances, the part should be checked in the gauge with datum locators made at Maximum Material Condition.

7. All datum surfaces and locators must be labeled on the design with the respective datum callout.

8. All designs must list all parts; that can be verified on the gage. Part numbers that are referenced must be the less finish part number without color designation.

9. The design must reflect the coordinate system of X, Y, Z system.

10. If the part is to be used in a different coordinate system than the CAD model, the design must be labeled accurately with the rotation points and angles to reflect the original position.

11. Consideration for maximum CMM access must be given when designing the clamp type and location. When CMM access is a priority, then the horizontal handle should be used.

12. All Pins and Blocks used for part inspection must be labeled on the design with their respective size as well as the calculation used to obtain that size.

13. The design must show the storage locations for removable detail and loose components. Also, when loose details are needed, a general note for tethering of the details should be provided on the design.

14. The design must show the appropriate clearance for dimensional layout inspection.

15. Due to design approval, it gives the authority to the supplier to order checking gauge materials. If materials ordered before the final design approval and changes are made to the gauge design that will affect these materials.

16. All changes in the design must be recorded in a separate column in the design sheet.

17. All gauge details must lie within the limits of the base, including details of that clamps.

## 7. CONCLUSION-

Any organization must try to control and improve their business quality. Quality is a competitive advantage.. 100% inspection of machining properties are not possible every time and it's costly so that affects the quality of the part so to avoid any failure to check part 100% for the machining properties with the help of An Inspection Gauge is a tool which is used to determine the exact dimensions, capacity, quantity. A wide variety of inspection gauges and tools exist which serve such functions. These inspection gauges have their advantages. We can reduce time, human efforts, and cost which involve the inspection by traditional methods. In the upcoming days, Inspection gauge will become a key factor of any industry.

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## 9. BIOGRAPHIES-

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