TESTING AND MANUFACTURING OF AIR RING GAUGE

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Abstract – *There are various types of inspection methods are being used in various industries, from that quality of any product is to be checked the different types of inspection methods and type of gauges are used. Gauges are the tools which are used for checking the size, shape and relative positions of various parts but not provided with graduated adjustable members. Gauges are, therefore, understood to be single size fixed type measuring tools, This study needs to focus on inspection of atoms and material of inspection gauges. Air ring gauge is a gauge is used to measuring outside diameter of shaft. The gauges are designed as per standards that check the dimensions is concerned.*

Key Words: *Air ring gauge, Testing, Inspection, Manufacturing, etc.*

1. INTRODUCTION

Gauge is an inspection tool use to check product dimension with reference to its maximum and minimum limit. It is generally used to segregate acceptable and non-acceptable product in mass production without exact knowing value of dimension. Nowadays, the dimensional accuracy of any manufacturing process became critical because of increased quality demands. That means the constant need for development of more accurate measuring methods and devices and minimization of expenses. Therefore, different types of gauges are used but we used only the types according to shapes and purpose for which each is used. According to shapes the gauges are

- Plug
- Ring
- Snap
- Taper
- Thread
- Form
- Thickness

1.1 Ring gauge

A ring gauge is a cylindrical ring of a thermally stable material, whose inside diameter is finished to gauge tolerance and is used for checking the external diameter of a cylindrical object. Ring gauges are used for comparative gauging as well as for checking, calibrating, or setting of gauges or other standards. Individual ring gauges or ring gauge sets are made to variety of tolerance grades in metric and English dimensions for master, setting, or working applications.
In this research paper air ring gauge is used to inspect the outer diameter of cylindrical object.

1.1.1 Air ring gauge

Air ring gauging depending on a law of physics that states flow and pressure are directly proportionate to clearance and react inversely to each other. As clearance increases, air flow also increases, and air pressure decreases proportionately. As clearance decreases, air flow also decreases, and air pressure increases.
This is accomplished by having a regulated air flow that travels through some type of restriction, such as a needle valve or jeweled orifice, and then through the nozzle in the air tool. As the workpiece is brought closer to the nozzle, air flow is reduced and the back pressure is increased. When the nozzle is completely obstructed, the flow is zero, and the back pressure is equal to the regulated air. Conversely, when the nozzle is open to the atmosphere, air flow is at a maximum, and the back pressure is at a minimum.

1.2 Working principle of air ring gauge

Air gauging relies on the laws of physics which state that flow and pressure are proportionate to clearance and are inversely proportional to each other. The regulated air flows through the restriction-needle valve, orifice and then through the nozzle. When the nozzle is open to the atmosphere, there is maximum flow through it and there is an obstruction is brought increasingly dose to the front of the nozzle, air flow from the nozzle. When the nozzle is completely obstructed, air flow is zero, and back-pressure reaches the pressure of minimum of pressure called 'back-pressure' between the restriction and the nozzle diminishes and back-pressure builds the regulated air supply. In this example, air flow moved from maximum to minimum, while back-pressure moved in opposite direction i.e. minimum to maximum. These values each can be plotted against the nozzle's clearance from obstruction.

Except for the extremes of both back-pressure and flow, the curves are straight-line, representing the linear proportions which establishes the basis of all air gauging. Thus measured decreases in flow provide an accurate co-relation of the distance of the nozzles in the air gauge tool to the obstruction (surface of the work piece being measured). Similarly, increase in back-pressure indicates less distance between the tooling nozzle and work piece.

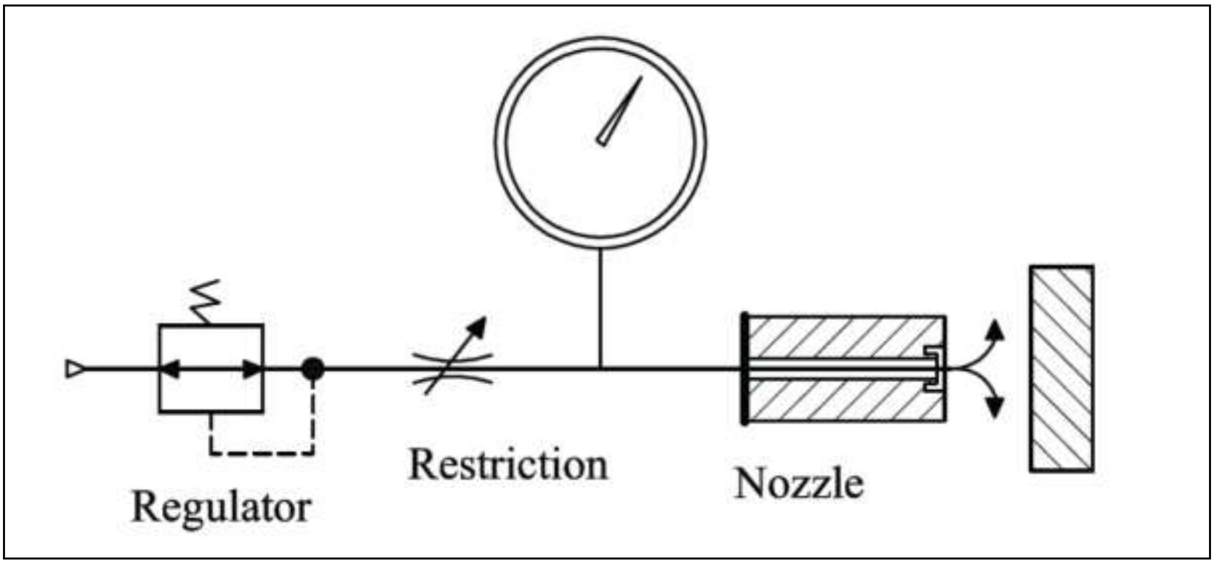
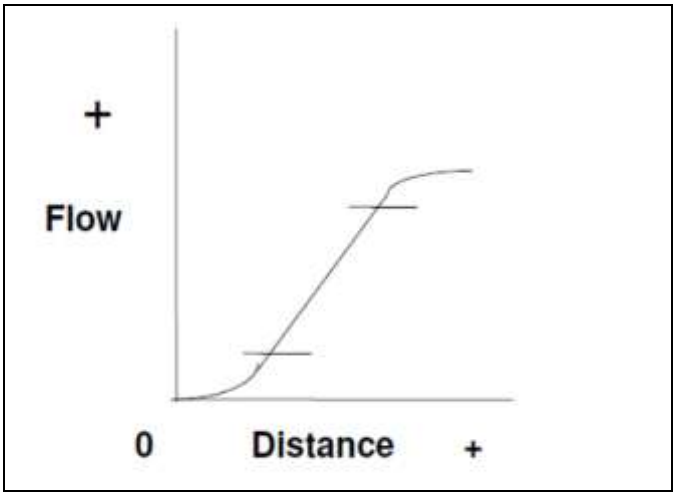


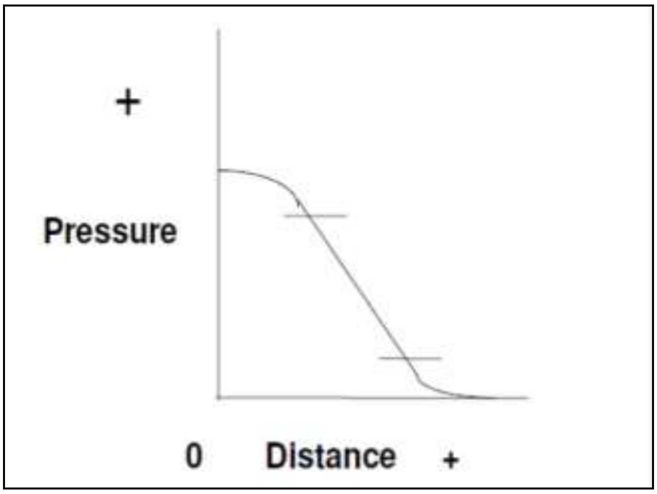
Fig.1.2.1 Simple air circuit.

1. Flow increases as the distance between the nozzle and restriction increases.



Graph-1: Flow versus Distance

2. Pressure increases as distance between the nozzle and restriction Decreases.



Graph-2: Pressure versus Distance

1.3 Purpose of Air ring gauges:

1. To reduce measuring time and its cost.
2. To give the accurate and precise inspection.
3. To increase production rate.

2. LITERATURE REVIEW

2.1 Paper 1:

"Air Gauging: Still Some Room for Development"
Jermak Cz. J. Poznan University of Technology, Institute of Mechanical Technology, Division of Metrology and Measurement Systems, Piotrowo 3, PL-60965 Poznan, Poland
Rucki M. Poznan University of Technology, Institute of Mechanical Technology, Division of Metrology and Measurement Systems, Piotrowo 3, PL-60965 Poznan, Poland.

In the paper, history, present state and perspectives of air gauging are presented. The dimensional measurement with pressured air is known for almost 100 years. Its rapid development has taken place mostly in the years of the World War II, and during the next three decades many research papers have been published throughout the World.
"As electronics are increasingly used as the 'brains' of automatic machining, so air-operated gauges will be chosen as the 'eyes,' to assess and signal or send impulses, according to how the process is running." With this sentence Tanner opened his review on history and future of the air gauging in 1958. Despite the incredible development of the measurement techniques, unimaginable 50 years ago, Tanner's introduction is still valid and actual, even though the principle of air gauging is known for a hundred years now.
Nowadays, the quality of the devices and other products sold annually for tens of billions Euro depends directly on the applied measurement techniques. Automation of the machining processes is closely connected with the development of the measurement methods and devices. The quality requirements of the final product force the manufacturers to develop measurement accuracy continually, which leads to the measurement performed in micro and nano scale and even subatomic measurement. It is obvious that the air gauges where the measured dimension is transformed into the characteristics of the air flow, are unable to perform such a measurement, but they still find their application in the industrial precise measuring tasks like automatic control, in-process inspection (both passive and active type), or untypical elements measurement, e.g. extremely long micro bores.

2.2 Paper 2:

"Optimization of Cutting Parameters and Fluid Application Parameters during Turning of OHNS Steel" R. Deepak Joel Johnsona, K. Leo Dev Winsb, Anil Rajc, B.Anuja Beatriced Department of Mechanical Engineering, M. Kumarasamy College of

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Optimization of Cutting Parameters and Fluid Application Parameters during Turning of OHNS Steel. Cutting fluids are widely used in metal cutting to perform two major functions namely cooling and lubrication. The most common method of application of cutting fluid is flood or deluge cooling which involves bulk application of cutting fluid in the cutting zone. The copious usage of cutting fluid not only increases the production cost but also creates serious environmental and health hazards. In this present study, an effort was made to reduce the quantity of usage of cutting fluid and to optimize the cutting parameters and fluid application parameters while turning of Oil Hardened Non shrinkable steel (OHNS) with a minimal cutting fluid application using Taguchi technique. The optimized results were compared with dry turning and conventional wet turning under similar cutting conditions.
The performance of cutting fluids in machining operation is of critical importance in order to improve the efficiency of any machining process. Apart from cooling and lubrication, it performs secondary functions such as temporary protection against oxidation, improves surface finish, provides longer tool life and improves dimensional accuracy of the workpiece.

2.3 Paper 3:

“Effect of steel hardness on soot wear” A. Kontoua, M. Southbyb, H.A. Spikesa Tribology Group, Department of Mechanical Engineering, Imperial College London, UK b Lubricants Discovery Hub, Shell Global Solutions, UK.

This paper shows the effect of steel hardness on soot wear. Due to incomplete combustion, high levels of soot can accumulate in engine lubricants between drain intervals. This soot can promote wear of engine parts such as timing chains and cam followers. One standard approach to reducing wear is to increase the hardness of the rubbing components used. According to the Arc hard wear equation, wear rate should be broadly inversely proportional to hardness. To explore this approach for controlling soot wear, wear tests have been conducted in a High Frequency Reciprocating Rig (HFRR) with HFRR steel discs of various hardness against a hard steel ball. Carbon black (soot surrogate) dispersions in model lubricants based on solutions of ZDDP and dispersant in GTL base oils have been studied. It is found that, while most oils show wear that reduces with increasing hardness, for blends that contain both ZDDP and carbon black, wear rate marked increases with disc hardness as the latter approaches the hardness of the ball. The results support the prevalence of a corrosive-abrasive wear mechanism when carbon black and ZDDP are both present in a lubricant and suggests that selection of very hard surfaces may not be a useful way to control soot.

3. DESIGN DATA

3.1 Diagram

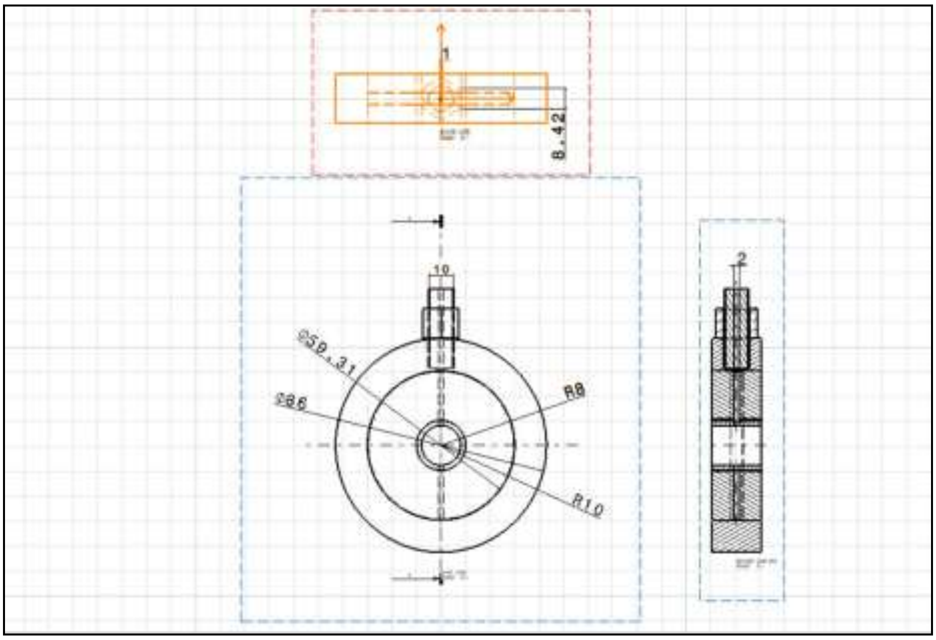

Fig 3.1.1 Drafting of air ring gauge

4. TESTING ON MATERIALS

This test is conducted to select the appropriate materials for manufacturing of air ring gauge. This test is conducted on mild steel and OHNS material which are used for manufacturing air ring gauges. As we know EN31 material is not appropriate for manufacturing of ring gauge as it gets damaged or crack forming while hardening process. So we are not going conduct test on EN31 material.

We are going to conduct two different test on inner ring

- Chemical analysis
- Hardness test

4.1 Chemical Analysis

For identifying chemical composition and its percentages we are going to use Optical Emission Spectrometer.

[1] On M.S. materials

Sample description – Dia. 45mm round bar
Std specification – SAE 1018 (MS)
Testing method – ASTM E 415:2017 /IS 8811:1998
Date- 06/05/2019

Table-4.1.1: Chemical composition of mild steel

Elements	**Standard value**	**Observed values**
C% - Carbon	0.15-0.20	0.18
Si% - Silicon		0.19
Mn%- Manganese	0.60-0.90	0.72
P% - Phosphorus	0.04max	0.012
S% - Sulphur	0.05max	0.006

Remark –Chemical composition confirms to SAE 1018 (MS) specified as per above element analysed.

[2] On OHNS material

Sample description – Dia. 16mm round bar
Std. Specification – ASTM A 681 Gr.01 (OHNS)
Testing method – JIS G 1253:2013
Date- 06/05/2019

Table-4.1.2: Chemical composition of OHNS

Element	**Standard value**	**Observed value**
C% - Carbon	0.85-1	0.95
Si% - Silicon	0.10-0.50	0.45
Mn% - Manganese	1-1.40	1.65
P% - Phosphorus	0.03max	0.041
S% - Sulphur	0.030max	0.044
Cr% - Chromium	0.40-0.70	0.42
V% - Vanadium	0.30max	0.004
W% - Tungsten	0.40-0.60	0.36

Remark –Chemical composition doesn't confirms to ASTM A 681 Gr.01 (OHNS) specified as per above element analysed.

4.2 Hardness Test

[1] On M.S. material

Test method – ASTM E18:2014 /IS1586 (part1):2012
Hardness test – Rockwell
Test force – 100kg.f

Date – 07/05/2019

Table-4.2.1: Hardness of mild steel

Value	**1**	**2**	**3**	**Average**
Reading in HRB	90	90	89	89.33

Remark –The micro Rockwell hardness of the given M.S. is 89.33 HRB.

[2] On OHNS material

Test method – ASTM E18:2014 /IS1586 (part1):2012
Hardness test – Rockwell
Test force – 100kg.f
Date – 07/05/2019

Table-4.2.1: Hardness of OHNS

Value	**1**	**2**	**3**	**Average**
Reading in HRB	93	94	94	93.33

Remark – The micro Rockwell hardness of the given OHNS is 93.33 HRB.

5. RESULTS

By comparing the Chemical analysis test of Mild steel and OHNS materials, we observed the percentage of carbon in OHNS material is higher than Mild steel. Due to the higher carbon percentage in OHNS material the hardness of OHNS material is higher than Mild steel. So, Industry preferred OHNS material for manufacturing of air ring gauges.

Also by observing the hardness of these two materials from hardness test the OHNS material is better selection for manufacturing of air ring gauge.

6. CONCLUSIONS

By testing the OHNS material and mild steel we conclude that OHNS material is better selection for air ring gauge. Due to better selection the life of tool also increased and production rate also increases.

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