Gear Roll Tester with Digital Readout

Snehal[1], Saleel[2], Shantanu[3], Rathul[4], Prof. Malave[5]

[1]*Snehal Wadgaonkar, Mechanical Department, SKNCOE, snehalw60@gmail.com*
[2]*Saleel Visal, Mechanical Department, SKNCOE, saleelum@gmail.com*
[3]*Shantanu Kulkarni, Mechanical Department, SKNCOE, spkulkarni95@gmail.com*
[4]*Rathul Sangma, Mechanical Department, SKNCOE, walgagring@yahoo.com*
[5]*Prof. S. K. Malave,Mechanical Department, SKNCOE,skmalave@sinhgad.edu*

ABSTRACT

Gear Roll (GRT) is used to measure and analyse the functional performance of gears. Composite errors in gears are a main parameter to evaluate the grade of the manufactured gears. Gear testing is a technique that has been used in the mechanical industry to identify the manufacturing defects in the gears. GRT is a practical, fast and effective screening tool that can identify when the gear manufacturing process has deviated from an ideal condition. Manufacturing defects can be run out errors and occurrence of high points which results in improper meshing of gears. This requires the existence of the master gear for each tested gear. In the present work a gear roller tester is developed to analyse effects of types of manufacturing defects in gears and to study effects of these manufacturing defects on its functional performance in terms of run out, pitch errors, profile errors with the help of Digital Dial gauge to automate the process. For the present work a spur gear is selected with the specifications matching with the availability of the master gear. A test rig has been designed and developed for the functional testing of gears. Steps have been taken to improve the conventional process of gear testing by automating the process and to make the GRT technologically advanced. Various components are designed and selected according to the requirement of the design procedure and empirical relations and the test rig is manufactured accordingly. Gears with different types of defects will be tested on the test rig and will be compared with tests from conventional method to ensure the accuracy and precision of it.In the present work effort has been made to reduce human induced errors and the process of gear testing has been made less time consuming.

Keywords*: Gear roller tester, double flank testing, Digital dial gauge, run out error, high point etc.*

---

1. INTRODUCTION

Gears are machine elements that transmit rotary motion and power by the successive engagements of teeth on their periphery. Defects are produced in the ideal shape of the gear due to inaccuracies in the manufacturing process used .Gear Roller Tester (GRT) is a practical, fast and effective tool that can identify when the gear manufacturing process has deviated from an ideal condition which can result in a run out error that is deviation of centre and occurrence of high points which results in improper meshing of gears. Gear Roller Tester can make the process of gear testing less time consuming. The manufacturing of such gear with high precision is very difficult and expensive especially when different sizes and types of gears are required to be inspected. The method is software-based is capable of measuring various errors including high point and run out error, which can be measured by the conventional methods but have low accuracy and are time consuming. The computerised GRT helps in correction of errors present in the conventional model in which the gears are mounted by the workers. The conventional GRT induces human errors. In the automated GRT, Digital dial gauge is used instead of dial gauge used in the conventional method. The conventional GRT is automated with help ofdigital dial gauge. Also a C++ program has been formulated to find out the offset and run out errors in the sample gears.The purpose of this article is to show how to deal with errors in measurement when designing for technologically advanced GRT.The present model of GRT works on the principle of Double flank testing. In this paper we have manufactured the gear

roller tester to measure various errors in the sample gears. Another aim is to compare the readings obtained in Conventional GRT with the Improved GRT. The successful use of GRT requires careful planning from product design, through master gear design and gage control methods in order to achieve the desired result in an application.

1.1 Objectives:

- Making process of gear testing using GRT less time consuming.
- To make compact model than available model.
- To minimize human induced errors.

Gear Roll Tester:

Gear Roll Tester is a simple workshop gear checking facility, designed to measure double flank error of Component Gear meshing with its Master. The results indicate size, hence backlash, run out, tooth damage, and some measure of individual tooth quality.The Tester is robust intended for workshop use where it may be placed next to gear generating machine or on the production line.

1.2Construction:

The improved GRT consists of the following components:

- Base
- Drive top
- Float Bottom
- Float top
- Shaft
- Induction motor with Gearbox
- Digital Dial Gauge

1.3 CONSTRUCTIONAL FEATURES

FLOATING CARRIAGE MECHANISM: It is essentially a mechanism having a base float plate mounted on the main body. This plate supports two CRW bearings. These CRW bearings further to support a top float plate. This top plate has a bush suitable for adapting the mandrels for the test Gear. This plate also has an actuator for actuating a dial gauge to read the variations in the gears. The actuator has a stopper mounted on it. The dial holder should be rested on this stopper and the dial loaded to approximately 1 mm. While changing the center distance for different gear pair, the float bottom plate can be shifted by sliding for range of 20mm and moved by removing bolts for higher distance. When the gears are finally engaged for testing the fixed saddle should be moved such that the load on the dial is approximately 0.3 mm to 0.5 mm.

FIXED SADDLE - Fixed Saddle is provided on the other side of Floating Carriage the main body. Master Gear Mandrel is mounted on shaft on this, which is made flat and parallel to Master Gear Mandrel mounting face on Floating Carriage Mechanism. Fixed saddle also works as bearing housing for deep groove ball bearings, which guide the driving shaft below base plate.

DRIVING MECHANISM – Driving mechanism consists 90 watt 1440 rpm induction motor with gearbox having reduction ratio of 100 which is connected to the driving shaft with the help of lovejoy coupling. The motor is

mounted on a separate plate which is connected to base plate at bottom side, which allows the placement of base plate on table such that motor assembly is guided through cutout on the table.

Fig: Computerised Gear Roll Tester(Assembly)

2. METHOD OF OPERATION OF GEAR ROLL TESTER:

The Tester must be set up. This merely involves adjusting vertical level of both gears, and setting center distance to the required datum using gauge blocks or special setting discs. The operations are very simple. Floating Carriage is withdrawn to Disengage position. Component Gear is mounted and engaged with it's Master gear. Master gear is loaded on fixed saddle and is clamped with the help of washer and bolt to the driving mandrel. Component gear mounted on floating carriage is free to rotate transferring only radial displacement to the carriage assembly. When power is turned on master gear rotates the component gear through mesh, floating carriage is displaced when there is defect at the point of meshing. This deflection is displayed on the digital dial gauge as well as it is recorded on the computer using Data Acquisition System. Readings obtained from DAQ is fed into program to generate graph.

The following elements can be deduced from the results:

[1] **SIZE & BACKLASH** - If Component Gear is oversize, its close mesh center distance will be greater than desired, and will be reflected in dial indicator readings. An oversized gear will have a reduced backlash, resulting in tight running, overheating, excessive noise and possible physical damage. An undersize Component Gear will record lower than desired dial readings; will have more than desired backlash, which in turn may cause loss of tooth strength excessive noise on reversal and change pressure angle reducing transmission efficiency.

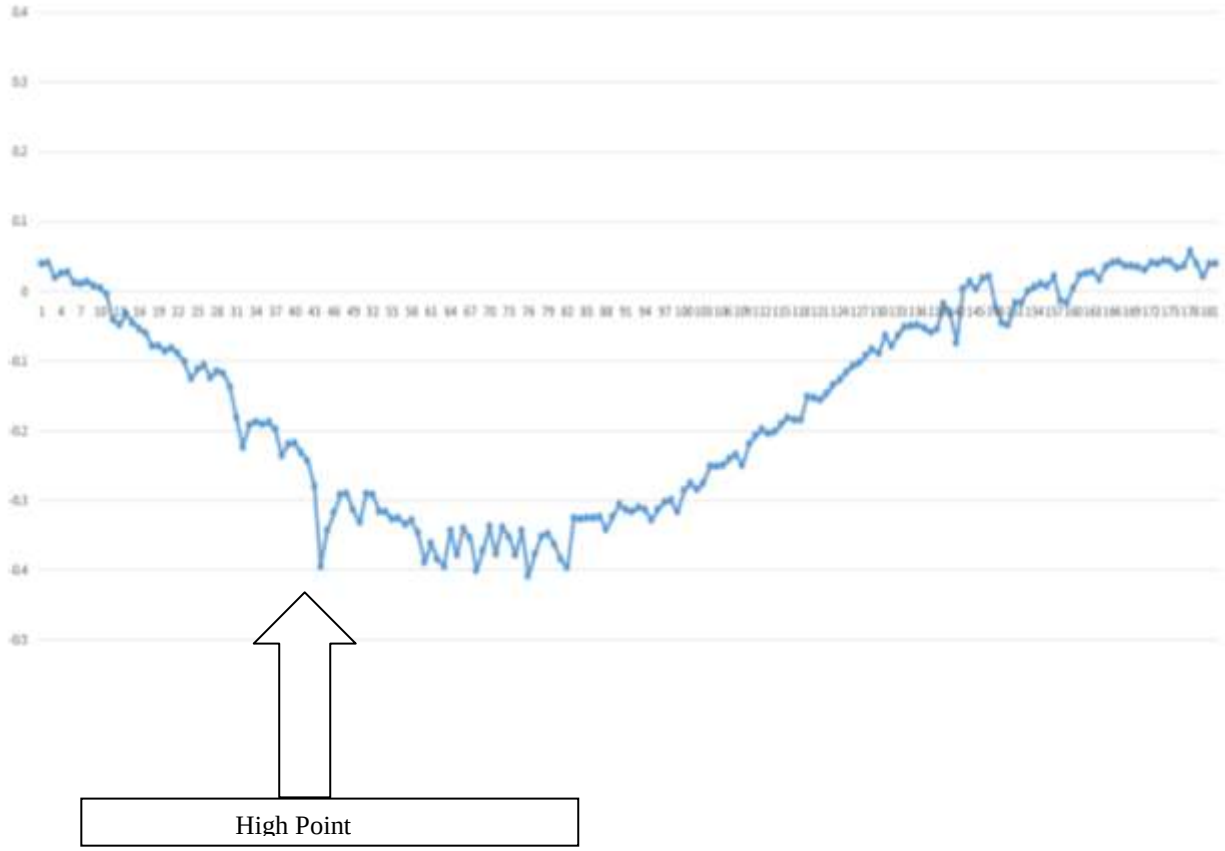
[2] **ECCENTRICITY** - Continuous measure of effective center distance during roll is indicated, as gears rotate. Run out is TIR (excluding localized defects registered as sudden flickers or kicks) on dial indicator. Run out will cause transmission errors & noise, and may cause harmful backlash either too great or too small.

[3] **COMPOSITE ERRORS** - Center distance between gears under roll change, as each pair of teeth move into & out of contact. The change is registered on dial indicator. This is known as `Tooth-to-Tooth Composite Error (TTCE). Total Composite Error (TCE) is the difference between minimum & maximum reading on the dial indicator.

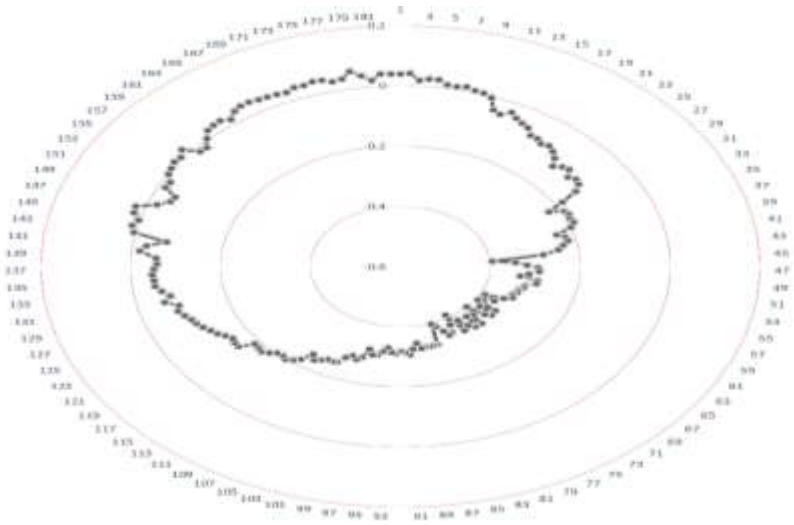
[4] **DAMAGE** - Sharp flicker on dial indicator is generally caused by some localized defects, viz. bruising, raised burrs or dent on tooth profile. 'ZERO BACKLASH - DOUBLE FLANK' Roll Test between Component Gear & its Master is the quickest and satisfactory method to determine all the above four parameters, in a single pass.

3.OUTPUT ON DESIGNED SYSTEM :

Following graphs are obtained from a program made in Dev C++ using the readings obtained from the present model of GRT.



Graph no. 1 : High point



Graph no. 2

OUTPUT ON CONVENTIONAL SYSTEM:
While testing on the conventional system only flickers are noted which depends on the speed and skill of operation of worker.

4.CONCLUSION:

- More number of readings can be taken.
- Readings can be taken at the smallest deflection.
- Improves accuracy over conventional system.
- Human errors and interference avoided.

ACKNOWLEDGEMENT

We would like to place our sincere thanks to the Mechanical Engineering Department of Smt. KashibaiNavale Collegeof Engineering and all the staff members of the department for their constant encouragement and kind help during our project.

REFERENCES

[1] Design and Development of Gear Roll Tester
1Omkar B Agashe., 2Mohit H Adgaonkar, 3Dhawal D Chandegra, 4Akkshey P Bomble
1,2,3,4 Student, Mechanical Engg Department, RajarshiShahu School of Engineering & Research, Narhe, Pune University, Pune, India.

[2] Practical Considerations for the Use of Double-Flank Testing for the Manufacturing Control of Gearing - Part Ernie Reiter and Fred Eberle.

[3] Practical Considerations for the Use of Double-Flank Testing for theManufacturing Control of Gearing - Part II Ernie Reiter and Fred Eberle.

[4] Minimizing Backlash in Spur Gears
Richard L. ThcenConsultant,Minneapolis. MN

[5] Calibration of Two-Flan Roll Testers.
Richard L. Thoen