

# Design and Development of Fixture for Extraction of Pinion Assembly with Bearing Unit of Drive Gear SE344

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**ABSTRACT:** The axle drive gear box is mounted on motor car axle. The bull gear of the axle drive gearbox is having interfernce fit on the axle. The Reaction rod is attached to axle drive gear box with the help of fasteners. On bogie transom, one side of axle drive gear box is fixed by the rubber bush of torque arm (reaction rod) while the other side is attached to axle by bull gear of driving gear.

The driving gear is the main component which transmits the traction effort from the Traction motor to bogie. The axle drive gear box is fitted on both of the bogie and the motor axle. The driving gear being overhauled at an interval of 08 years of service. During overhauling all the bearings are needs to be replaced. Due to the design of gear box housing, the bearing of pinion shaft is infringed with the housing during extraction of the pinion assembly with bearing unit. During extraction it can damaged the housing of the gear case. The main purpose of this research to design a fixture which can hold the bearing and pinion can be easily extracted without damaging the housing of driving gear.

## **INTRODUCTION:**

The driving gear box is used to transmit the tractive effort by the help of flexible coupling half. The tractive effort is generated by the Tration motor. The rotor shaft of traction motor and pinion shaft of the driving gear is connected by the flexible coupling half.

The axle drive gear box is mounted on motor car axle. The bull gear of the axle drive gearbox is having interfernce fit on the axle. The Reaction rod is attached to axle drive gear box with the help of fasteners. On bogie transom, one side of axle drive gear box is fixed by the rubber bush of torque arm (reaction rod) while the other side is attached to axle by bull gear of driving gear.



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Fig.1 Layout of Gearbox Assembly Without Axle



Fig.2 Motor car Whee lset with Gearbox Assembly

The driving gear being overhauled at an interval of 08 years of service. During overhauling all the bearings are replaced. For replacement, gearboxes are opened up and all the components are dismantled.

After dismantling all the bearings and wearable components are replaced. After replacement driving gear are assembled back and play measurements are being carried out for checking the proper functioning of gearbox.



Lot of extraction devices are available in market but none of them can be used for the extraction of pinion shaft from the housing for the purpose of bearing replacement.

Due to the design of gear box housing, the bearing of pinion shaft is infringed with the housing during extraction of the pinion assembly with bearing unit. During extraction it can damaged the housing of the gear case.



Fig 3. Gear case housing with Pinion shaft Showing Infringement with Bearing

To avoid damage of gear case housing during extraction of Pinion shaft, a fixture is needs to be developed which can hold the bearing and pinion can be easily extracted without damaging the housing of driving gear.

**EXPERIMENTAL DESIGN AND PROCEDURE:** For experimental design, First material of drive gear housing is identified in lab and results are tabulated below:

#### **Chemical Analysis:**

Chemical	Unit	Composition
С	(%)	3.70
Si	(%)	2.49
Mn	(%)	0.51
Р	(%)	0.01
S	(%)	0.008
Mg	(%)	0.042
Cu	(%)	0.26



### Table 1. Chemical properties of Drive Gear Housing

#### **Mechanical properties:**

Table 2.

Mechanical Properties	Minimum Requirement	Results
Tensile Strength (N/mm <sup>2</sup> )	500	676
0.2 Proof Strength (N/mm <sup>2</sup> )	320	418
Elongation (%)	7	11.4
Brinell Hardness		187

Mechanical properties of Drive Gear Housing

#### **Design of Fixture:**

Fixture is to be designed keeping in mind that it will holds the bearing unit to avoid damage of gear case housing during extraction of pinion shaft.

The 2- dimensional drawing of the fixture (Top view) for bearing holding is as shown below:



Figure 4 . The 2- dimensional drawing of the fixture (Top view) along with photograph Drawing of other accessories required for assist during removal of pinion unit are as follows:

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#### The details of material used for development of fixture is as follows:

#### A) Hollow Tube:

The hollow tube is provided over the pinion shaft over which a hydraulic jack is placed to lift up the pinion shaft , which can easily be seen through the space provided.



Figure 5. 2- dimensional drawing of the Hollow Tube

B) Spindle Rod:



Figure 6 . 2- dimensional drawing of the Spindle Rod

#### Details of material used for the development:

Chemical Properties: Chemical analysis of the available material is done and result is as follows:

Chemical	Weight	Composition
С	(%)	0.40
Si	(%)	0.20
Mn	(%)	0.70
Р	(%)	0.04
S	(%)	0.04

Table 3. Test

results of the Chemical Properties of Material Used for the development.



#### **Mechanical properties:**

Table	Mechanical Properties	Minimum	Results
		Requirement	
	Max. Stress (N/mm <sup>2</sup> )	700 N/mm <sup>2</sup>	750 N/mm <sup>2</sup>
	0.2 Proof Strength	465 N/mm <sup>2</sup>	485 N/mm <sup>2</sup>
	(N/mm <sup>2</sup> )		
	Elongation	16%	18
	(%)		
	Brinell Hardness	201	220

4. Test results of the Mechanical Properties of Material Used for the development.

The above tables shows the material properties of **EN8**.

**RESULT AND DISCUSSIONS:** Development of these fixtures as per drawing are done on the DRO milling machine and lathe machine.

Fixtures are used on trail basis for the removal of pinion extraction from the gearbox.



Fig. 7 Placement of Fixtures in the gear case housing.



Fig. 8 Set Up of Pinion extraction from the gear case housing.

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## CONCLUSION

The research work examines the feasibility of the removal of pinion extraction unit after development of these fixtures .

Pinion is safely extracted from the gear case housing without any damage at an pressure of 60 Bar. The objective of the research work have been successfully accomplished.

#### REFERENCES

- [1] Operation and Maintenance Manual, 2009, Volume 1
- [2] Operation and Maintenance Manual, 2009, Volume 3
- [3] Shailesh S.Pachbhai, 2014, A Review on Design of Fixtures
- [4] Operation and Maintenance Manual, 2009, Volume 3
- [5] www.google.com
- [6] https://karunadu.karnataka.gov.in/gttc/elearning/fixture%20design.pdf
- [7] https://www.sme.org/globalassets/sme.org/media/training-guides/dv07pub3\_e\_study\_guide.pdf
- [8] https://www.pre-scient.com/resources/knowledge-center/jigs-and-fixtures/design-principles-of-jigs-and-fixtures.html
- [9] https://www.researchgate.net/figure/Basic-steps-of-fixture-design\_fig1\_313252944
- [10] https://www.cnccookbook.com/fixture-design-fundamental/

[11] Nicholas Amaral, 2002, Development of a Finite Element Analysis Tool for Fixture Design Integrity Verification and Optimization

- [12] Shrikant v Peshatwar, 2013, Design and Development of Fixture for eccentric shaft: A Review
- [13] Guohua Qin, 2006, Analysis and Optimal Design of Fixture Clamping Sequence
- [14] Michael Stampfer, 2009, Automated setup and fixture planning system for box-shaped parts
- [15] Y. Wang, 2007, Surface error decomposition for fixture development