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Drive Shaft Failures In Automobile

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ABSTRACT

The engine of a car cannot power all four wheels on its own. For the purpose of moving the vehicle, the propeller shaft is essential. Power from the engine must be transferred to the drive wheels via a drive shaft in order for the drive wheels to move (half shaft). Drive shaft failure results from torsional and shear stresses that the drive shafts experience while transmitting the engine's power to the wheels. Any drive shaft malfunction will stop the engine from powering the drive wheels. Analysis of the drive shaft is therefore essential.The drive shaft must have two qualities: toughness in the core to withstand deformation, which can be achieved through heat treatment, and the drive shaft surface wear to resist using hardness.

KEYWORDS: *road traffic accidents,car accident,drive shaft failures,causes of accident*

I. INTRODUCTION

When gasoline fuel and air are burned in the engine, heat energy is produced. This heat energy is then converted into mechanical energy, allowing it to move the vehicle forward.However, because of the engine's excessive torque and rotational power, which are both produced at the crankshaft, a car cannot be driven with them. We cannot propel the car at that speed because the crankshaft speed isaround10kto15k, which also depends on the type of engine, and thus the transmission has an important part in it, which tends to increase the power output arriving from engine as required and also varies the engine RPM via a transmission system.

Additionally, the drive wheels being assisted by the drive shaft receive the transmission's final output.It is necessary to take into account both engineering branches when conducting a failure analysis of a drive shaft. To perform failure analysis, however, it was necessary to study heat treatment, testing procedures, and material science, which is related to the metallurgical field and helps mechanical engineering understand the engine and transmission system.

The drive shaft, a mechanical component of the transmission system, aids in the transmission of engine power to the drive wheels. Because a drive shaft is less likely to jam or break than a Chain drive,using one as a power transmitter in an automobile is more convenient. In normal operation, the drive shaft is typically subjected to torsional and bending stress, which can lead to fatigue and fractural failures. Fatigue failure as a result of the drive shaft being continuously rotate d at an uneven speed, which places it in a loading unloading condition and contributes to fatigue failure in it. The drive shaft can also withstand

more torque because it serves as the vehicle's driving element. Manufacturing, design, maintenance, the use of subpar raw materials,

and user error are some common causes of failur es.Drive shaft failure must be prevented, so it's important to understand the causes of failure that the failure analysis will reveal.

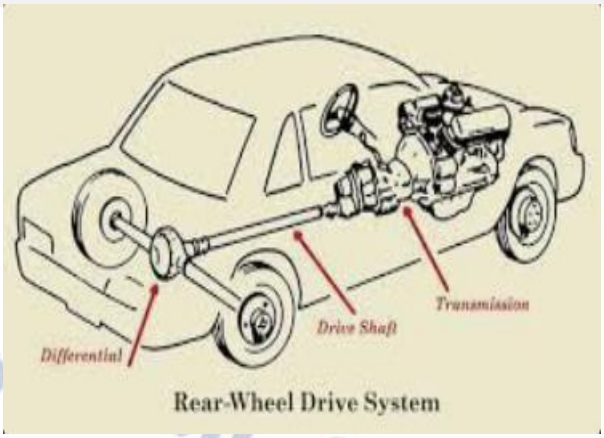
The most common heat treatment used to prevent drive shaft failure is hardening, which is followed by tempering, flame hardening, and induction hardening. This provides surface hardness and core toughness, allowing the drive shaft to survive in high torsional areas. And because marcasite layer is typically present at the surface and has a high hardness value, it provides better wear resistance.

2.THE FUNCTION OF DRIVE SHAFT

The engine of a car cannot drive every one of the wheels by itself. For instance, the engine mounted beneath the car's hood cannot move the rear wheels of a front-wheel drive vehicle.As a result, it is linked to a transmission underneath the hood. The transmission then needs to be connected to the vehicle's back wheel via a lengthy drive shaft that runs the entire length of the vehicle.

The final drive of the transfer, also referred to as the differential and located on the rear axle, is connected to this drive shaft, also referred to as a propeller shaft. The force from the engine is redirected 90 degrees in each direction to the opposing rear wheels by this rear differential. Additionally, it enables the wheels to rotate at various speeds. Although they are sometimes referred to as half shafts, the shafts connecting the rear differential to the rear wheels are actually drive shafts because they propel the wheels' rotation.

Any car's drive-train system, which contains the drive shaft, is a complicated component. Depending on the make, model, and mechanic, different names are given to the parts. No matter what its title or location, a drive shaft's primary purpose is to transfer rotational power over a distance under the vehicle.



Location of the vehicle's drive shaft

3.CAUSES OF THE FAILURE

- Drive shaft failure can occur for a variety of reasons. However, the main cause is that they experience significant torsional stress when transferring the engine's energy to the wheels.
- They are prone to shear fracture due to improper drive shaft assembly.
- They're going to break because the drive shaft didn't get the proper heat treatment.
- Drive shafts with improper designs are going to break down while in use.
- Availability of cyclic overloads.
- Stress-related focus. They could be the result of manufacturing or operational factors, such as undercuts, machining, traces, notches, etc.
- Incorrect bearing adjustment and insufficient clearances.

4.SOLUTIONS

- Make the drive shaft with proper design and manufacturing.
- The assembly of the drive shaft is a crucial factor, so it must be done correctly.
- Use the appropriate heat treatment for the material. And according to the necessary properties.
- Avoid concentrating under stress.
- Make sure the drive shaft's surface is free of cracks, which can lead to shaft fatigue failure.

5.ANALYSIS OF FAILURE

The process of gathering and analyzing data to ascertain a failure's cause is known as failure analysis. Numerous factors can contribute to any failure. To prevent further failure of that component, it is crucial to pinpoint the primary cause of failure.

An engine's final drive receives power and rotational motion from a shaft, a rotating component that typically has a circular cross section. The majority of shafts experience varying loads of combined torsion and bending with varying levels of stress concentration.

Three major goals can be established for failure analysis.
1. Choosing modes
2. Reason for Failure
3. Base reasons.

Using techniques such as the formation of cracks, metallographic, macroscopic examination, and mechanical testing, failure modes can be identified on-site or in the lab. Laboratory tests and an understanding of the component, its loading, and its environment are used to identify the failure

cause. To identify the cause, comparative sampling or laboratory replication of the mode of failure may be required. Knowing the mode, the cause, and the specific process or system allows one to identify the root cause of a failure. The design, use, maintenance, history, and environment of the equipment must all be fully understood in order to identify the primary cause of failure.

Drive shaft failure while it is still operating

6.CASE RESEARCH

A 20mm-diameter and 320mm-long propeller shaft used in an FSAE car has failed while the vehicle is running.This leads us to the failure analysis.

- Statement of the Problem
- Hardness evaluation.
- A suitable heat treatment

7.STATEMENTS ABOUT PROBLEMS

- The 320mm long, 20mm diameter drive shaft shears free from the splines.
- Perform a shaft failure analysis
- Track down the answer.

Drive shaft used in FSAE Car

7.1 HARDNESS TESTING

Upon further investigation, it was discovered that the drive shaft's hardness had decreased as a result of normalization. It has been lowered to 17 HRC. It can be discovered by using a Rockwell hardness test machine to determine its hardness.

Rockwell hardness testing machine

The drive shaft failed for the main reason that the EN24 material's actual hardness, which was 26 HRC, had declined to 17 HRC due to improper heat treatment.

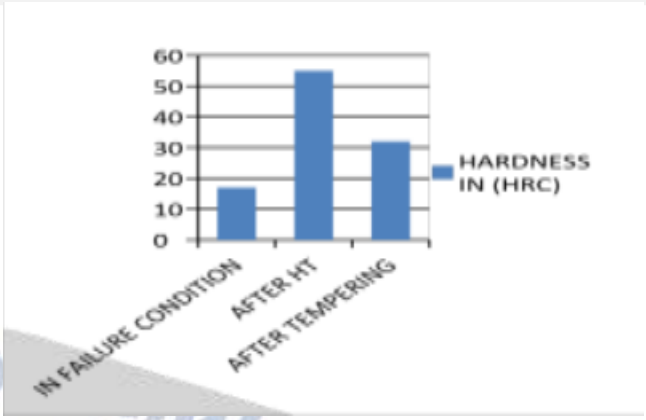
7.2 HEAT TREATMENT

It is discovered that the drive shaft's problem is that its hardness has dropped to 17 HRC. As a result, the drive shaft's hardness can be increased through proper and appropriate heat treatment. The process of tempering after the hardening heat treatment results in a 32HRC hardness rating. Any drive shaft must have a hardness between 30 and 35 HRC to function properly. That may be accomplished by using a heat-hardening process.

The heat treatment given to the defective component is called a hardening heat treatment. In this, the component is heated to its 880 C austenizing temperature and maintained there for 30 minutes before being quickly cooled in a water bath. This is essential for the formation of marcasite.55 HRC is the current hardness. This hardness is lessened by tempering at high temperatures.

Muffle furnace

High hardness offers good wear resistance, but too much hardness makes a material more brittle, which makes it unsuitable for drive shafts.



Heat treatment changes the hardness

It was decided to give the drive shaft a hardening heat treatment because the drive shaft's initial hardness (in a failure condition) was 17 HRC, which is too low. This results in a roughened surface of 55 HRC, which is too high because the hardening is also making the material more brittle.And following tempering, the hardness is reduced to 32 HRC, which is what the drive shaft needs.

In the first 90 laps on the track we designed, the propeller shaft with a 17 HRC failure occurred. This exhibits a very poor result.The drive shaft was then placed in a safe zone with 35 HRC at the surface and given the previously mentioned heat treatment (hardening followed by tempering). This drive shaft then completed approximately 320 laps on the same track.

For drive shafts, case hardening should always be chosen. The issue was that the first material, EN28, which was chosen for the propeller shaft based on its mechanical properties, did not respond well to case hardening because it already contains more carbon. As a result, we switched to AISI 8620, a new material that responds well to case hardening, particularly carburizing.The new drive shaft underwent carburizing heat treatment after being manufactured.

As a result, we continue to utilize that propeller shaft to propel our vehicle without experiencing any problems.

8.CONCLUSION

The shaft failed prematurely due to rising stress concentration at the edges of the shaft's wobbler, which ultimately resulted in crack growth, fatigue crack initiation and final fracture, it is concluded.
The misalignment of the shaft bearing holes and the combined effects of friction between the shaft and the bearing or bushing assembly may be to blame for it.Drive shaft failures can be caused by various factors, including excessive wear and tear, improper installation, and manufacturing defects. The failure of a drive shaft can lead to serious consequences, such as loss of control, damage to the vehicle, and injury to occupants.

To prevent drive shaft failures, it's important to follow proper maintenance procedures, including regular inspections and lubrication. Additionally, it's essential to ensure that the drive shaft is properly installed and balanced.

In cases where a drive shaft failure has occurred, it's important to identify the cause and address it promptly to prevent future failures. This may involve replacing the faulty component, improving maintenance procedures, or addressing issues with the vehicle's design or manufacturing process.

Overall, it's essential to take drive shaft failures seriously and take appropriate steps to prevent them from occurring. Regular maintenance and proper installation can go a long way in ensuring the safety and reliability of a vehicle.

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