

A REVIEW ON ZERO SHIFT GEAR TRANSMISSION

Mr. Karthik N

Department of Mechanical Engineering, Faculty of Engineering and Technology,

JAIN (Deemed-to-be University), Karnataka – 562112

Email id: n.karthik@jainuniversity.ac.in

Abstract

Zero shift technology makes it possible to change the gear in zero time by manual transmission. The automated manual transmission (AMT) from Zero shift is easy to produce and offers a cost-effective alternative to traditional torque. Automatic transmission based converters. Zero shift offers potential improvements in fuel economy from driveline efficiency and the best possible acceleration for vehicles. Zero shift offers an uninterrupted torque path from the engine to the vehicle compared to an existing AMT, allowing for a seamless gearshift. This paper, together with test data from a demonstrator vehicle, provides an introduction to technology.

Keywords: *AMT, Converter, Driveline, Torque, Transmission.*

I. INTRODUCTION

Two forms of transmission, manual transmission (MT) and automatic transmission, dominate the world (AT)[1]. While the AT uses wet clutches that are automatically controlled, the MT has a single dry clutch operated by the driver[2]. Both transmissions have pros and cons. The most efficient available transmission is the MT. This lends itself to the good fuel economy of the vehicles in which it is used. The efficiency of the MT depends on the applied load. Its efficiency can reach 97% over a standard drive cycle[3]. Having very few components, the MT is very easy to produce. It is reliable and simple to preserve. The main weakness is that, particularly in congested traffic, it is less easy to drive than an AT, as it requires the driver to operate the clutch for each gear shift. Gear shifts are not smooth sometimes, causing discomfort. Passengers who, when the transmission is between gears, notice an interruption of engine torque to the wheels. The interruption of torque can cause dynamic vehicle instability in severe situations, resulting in loss of control.

There are many advantages to the AT, including driving ease and very smooth shift efficiency. The choice of gear is determined by the transmission control unit (TCU) and this

means that, depending on whether the driver wants fuel economy or efficiency, the best gear is chosen for the vehicle's road speed. Although performance and fuel economy are lower, drivers are willing to pay a premium for this type of transmission. Owing to the lower efficiency of the transmission, a decreased output and fuel economy is evident. The hydraulic pump not only has parasitic losses to account for the operation, but significant quantities of slip in the torque converter produces heat loss that warms the transmission fluid rather than supplying the wheels with torque[4]. In recent years, for a large part of the trip, a lock-up clutch bypasses the torque converter, which can significantly increase the overall performance[5]. The efficiency of an AT can be as high as 86% over a given drive cycle. If a transmission could have both the advantages of the MT and the AT and the disadvantages of neither, a third alternative will be added to segment the market. The AMT has historically matched the MT for fuel economy, but has suffered from lower efficiency (compared to the MT) and poor consistency of shifts. These last two problems are corrected by Zeroshift, which simultaneously makes strong fuel economy, efficiency and consistency of shifts. In any other transmission, the combination of these has not been used previously. This paper is divided into the following sections: Firstly, the Zeroshift definition is presented[6]. Secondly, the advantages are demonstrated in terms of fuel efficiency, performance, and quality of change and ease of production. Finally, a Ford Mustang demonstrator vehicle conversion is identified.

II. ZEROSHIFT BENEFITS

The main benefits of Zero-shift are:

- A. fuel economy
- B. performance
- C. shift quality
- D. ease of manufacture

A. Fuel Economy

A vehicle's fuel economy is a feature of many parts, including its powertrain[7]. The motor and transmission are the two key components of the powertrain that decide fuel economy. More than one company has claimed that it is twice as cost-effective to improve the transmission rather than the engine in order to minimize CO₂. Having founded such a development in terms of technology, the increased production cost of engine technology is more than twice that of transmission technology for the same fuel economy gain. Therefore, it is advantageous both in terms of growth and in terms of production costs to first pursue an improvement in the fuel economy through transmission technology.

The MT has produced better fuel economy to date than the AT. The AMT is a technology that has rarely shown much better fuel economy than the MT. This fuel economy is not due to the transmission's gear quality, as it is not more efficient than the MT, but due to the schedule

of gear changes. An AMT is able to switch to a larger gear earlier on a drive cycle. Although the MT has a compulsory gear schedule to stick with. An increase in fuel economy over the MT can be achieved in real driving with the AMT in automatic mode for the same purpose. The driver is unlikely to always be in the right gear for all conditions. The AMT would not be better than the MT on a highway cruise. If parasitic losses are present, it could be marginally worse to continuously operate a hydraulic pump.

Zero-shift is an AMT which, when in gear, has no significant parasitic losses. During gear shifting, a small amount of power is required. There is no hydraulic activation to run a hydraulic pump, so there are no parasitic losses. The standard 12V vehicle electrical system can electrically operate both the gear actuation and clutch control.

III. PERFORMANCE

The Zero shift principle allows gear changes to take place in zero time, compared to an MT. As the vehicle is never coasting in neutral, this has an immediate performance advantage. Each gearshift that would usually take approximately 0.5 seconds for a test driver to finish is carried out with Zeroshift technology in 0 seconds, Figure 1. The gearshift would have been greater than 1 second for most (non-test) drivers.

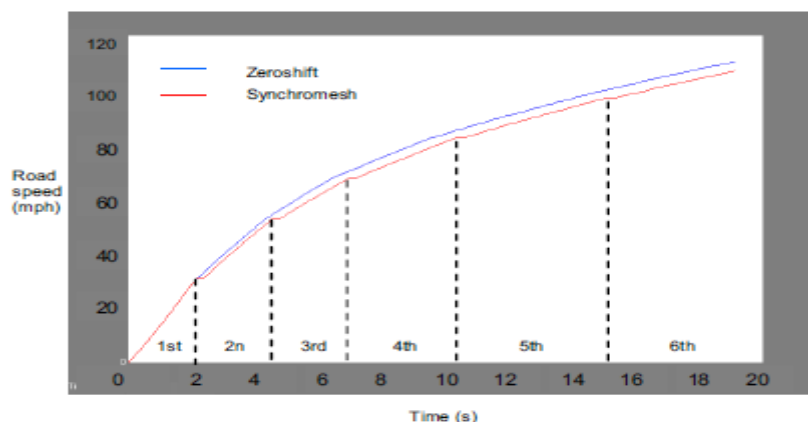


Fig. 1: Performance chart of Zero-shift vs Manual Transmission

B. Shift Quality

In several aspects, transmission shift efficiency is measured, some objectively and others subjectively. The longitudinal acceleration of a vehicle, which can be calculated both objectively and subjectively, is regarded here. Objectively, to calculate longitudinal acceleration, a vehicle may be designed to illustrate the deceleration and acceleration encountered during a gear shift. Subjectively, the occupants of the car feel this not only by noticing the pitch of the front of the vehicle, but also by what is known as the head nod. This is merely an inconvenience to the inhabitants in its mildest form. This can lead to vehicle instability, particularly during cornering, in its most extreme form. Because the torque variance during a gear shift is less undulating, the AT is less susceptible to this phenomenon.

IV. EASE OF FABRICATION

The materials used for all components are in compliance with industry requirements and do not require unusual care. Manufacturing techniques such as forging, sintering, stamping and casting with a given final finish are also common. The comparative cost at which standard components are replaced by Zero shift components, i.e. synchronizers, is reduced solely by a smaller number of components. In shift acting, the only extra cost is. This is consistent but less than AT with AMT. Inside an existing synchroniser envelope, a Zeroshift hub assembly may be packed and in some instances be less -an intrinsic vehicle packaging benefit with ever increasing engine torques and thus gear widths. For, Independent fork control is used using 2 actuators per hub for the maximum vehicle torque range, but with the shift forces being much less than those of comparable synchronisers, the actuator sizes are much smaller than those of AMTs.

V. CONCLUSION

A Zeroshift conversion has been demonstrated for an existing manual transmission. This has the advantages that follow:

- i. Automated change in gear
- ii. Improved fuel economy compared to automatic transmission by torque converter
- iii. Improved performance of acceleration relative to manual transmission
- iv. Enhanced efficiency of change compared to manual transmission
- v. Easy to produce

VI. REFERENCE

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