

Automatic Gearboxes

The following comment has been prepared for the North East London & Essex Group (NELE) of the Institute of Advanced Motorists (IAM), and is not intended to be a definitive guide to the use of Automatic Gearboxes. It is intended for distribution to observers to assist in the preparation of candidates for the IAM driving test. The views expressed are those of the author.

Preamble.

Following test failures by candidates prepared for test by NELE, it has become apparent that there is some disparity in the advice offered by Observers, and the standard required for a successful test. These failures have been due to a misunderstanding of the use of the Automatic Gearbox. There are numerous publications that deal with the subject, and I will refer to these where relevant as they enhance an understanding of the principles. However, the IAM publication 'Pass Your Advanced Driving Test' is the accepted standard required for a successful candidate.

The Automatic Gearbox.

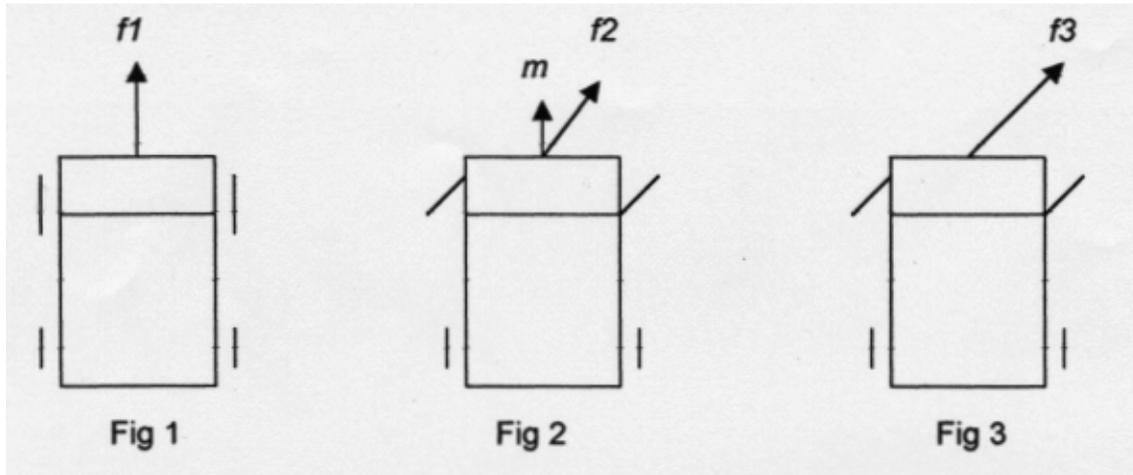
On British roads today, automatic gearboxes are less popular than the manual alternative. Having acknowledged this, the automatic gearbox does have certain advantages. It allows the driver, generally speaking, to keep both hands on the steering wheel for a larger proportion of the time, and without the use of a clutch, does tend to allow the driver to concentrate more on other control and planning aspects of the drive. It also reduces driver fatigue in heavy traffic. It should be noted that automatics vary in design and character. This comment deals only with standard type automatics, usually with three to five forward gears. This type is usually controlled through a hydraulic coupling and torque converter (1). Though I would not expect a candidate to know the intricacies of the automatic, I would expect the candidate to be aware of the type of gearbox and the number of gears it has. Without this awareness, a candidate could not possibly be able to apply the system of car control through the test.

Vehicle Stability.

The correct use of the automatic cannot be achieved without first understanding the principles of vehicle stability (2), and I will endeavour to simplify these.

- When a vehicle is moving in a straight line, at a constant speed, it is balanced. The output of the engine, $f1$, is just sufficient to overcome resistance forces acting on the vehicle. (Fig 1.)
- Once the front wheels are turned to change direction, the engine output is redirected, $f2$. However, the vehicle has a momentum, m , and will want to continue straight ahead. Because of this split, the road speed of the vehicle will slow, and the weight of the vehicle will shift away from the direction the wheels are turning. (Fig 2.) The available grip between the tyres and road surface is now split, and on a poor road surface the tyres may be at their adhesive limit (3).
- In order to negate this slowing and shifting of weight which will destabilise the vehicle, as the vehicle changes direction, the driver needs to increase the engine

output through the throttle, f_3 , such that the road speed is maintained, and the vehicle remains stable. (Fig 3) (4&5).



Effectively, to maintain stability through a bend in the road, the driver needs to be on the throttle as he or she turns into the bend. The speed of the vehicle will have been judged prior to this as the system of car control will have been implemented prior to reaching this point. This principle becomes more important as the speed of the vehicle builds.

Stability and Automatics.

So how does this relate to the use of the automatic? The automatic gearbox fitted to any vehicle can only react to the prevailing conditions at any one point in time.. It does not know what the driver can see, and cannot anticipate changes in direction or other hazards. It is therefore imperative that the driver should know how best to intervene in the gear selection (6). There are two methods of controlling the automatic. One is the throttle, the other being manual intervention.

- By depressing the throttle to the floor, kickdown will usually engage, and the vehicle will accelerate.
- By gently depressing the throttle, the vehicle may gently accelerate, or it may not. This will depend upon the engine fitted, the vehicle speed, the gear the automatic has engaged, as well as other outside factors such as gradient.
- By reducing the throttle, the vehicle may slow down, or may not. This is again dependent on several factors as previously mentioned. The vehicle may also gain speed. (See automatic overrun below.)
- Finally the automatic may be controlled by the manual selector. Most manufacturers do not produce a 'pure' automatic. The driver is still given the choice of overriding the automatic selection, to select a lower gear range.

The system of car control includes a 'gear' phase, in which the driver, having utilised information, taken the correct position, and considered the speed of the vehicle on the approach to a hazard, then considers the gear the vehicle is travelling in, prior to entering the hazard (7). The fact that the driver is driving and automatic vehicle does not negate the consideration of the gear phase.

I have commented on how the gears are controlled in relation to an automatic, and this must now be considered in relation to planning prior to a hazard. It must be stressed that there is no fixed rule that says a certain hazard must be negotiated in a certain gear. Such a rule would obviously be nonsense, as each hazard must be judged and executed on its own merits and the prevailing conditions at any particular time (7). However, in order to maintain vehicle stability and related tyre adhesion, it may be necessary for a driver to take manual control of an automatic gearbox by selecting a more appropriate gear on entering a hazard. This will ensure that the hazard is negotiated without losing road speed, and that vehicle is under 'drive' as it changes direction.

Automatic 'Overrun'.

One aspect of the automatic, which often catches the untrained driver unawares, is the overrun characteristic. The automatic will generally select the highest gear it can for the prevailing conditions at any one time. By lifting the foot from the throttle, this may often have the effect of changing the gear to the next highest. If the vehicle is already travelling in the highest gear, reducing the throttle may have little or no effect on the engine or road speed at all. If the vehicle is travelling down a gradient, the vehicle may continue to gain speed.

This characteristic often leads to the untrained driver using 'comfort braking' through hazards, or continually braking on a long descent. There are several disadvantages of this. Firstly, it will destabilise the vehicle (8), it will noticeably increase wear and tear on the braking system, and finally it will mislead following road users who are continually shown brake lights for no logical reason. This can be avoided by manually selecting a lower gear range.

Automatic 'Hunting'.

As previously mentioned, an automatic will generally try to attain the highest gear it can in any given circumstances. In certain vehicles, certain speeds may fall within a range where the automatic continually changes up and down between two gears. This is known as 'Hunting'. For example, at 30mph a 3000cc vehicle fitted with a five speed automatic transmission may continually change between 4th and 5th gears. In such circumstances it may be necessary to manually select the lower range to stop this and maintain a smooth ride.

Final Analysis.

As can be seen from the above comment, there is much more to driving an automatic than simply engaging 'drive' and pointing the car in the right direction. A simplified understanding of the gearbox is necessary, as are the principles of vehicle stability. It should be stressed that manual intervention should not be overused, as the automatic will generally select a correct gear range for the prevailing conditions. Indeed there will be very few occasions in town driving where this intervention is warranted. However, on the open road the candidates may find themselves on the approach to a hazard where manual intervention will allow greater flexibility & control through a hazard. Again, it should be used only where warranted. This will be dependent on a multitude of factors, and is part of the judgement skills being appraised during the test.

The IAM publication 'Pass Your Advanced Driving Test' succinctly emphasises the correct use of an automatic gearbox in its 'What the examiner looks for' section, page 27. It states, "If your car has automatic transmission, do you make full use of it, with proper appreciation of the intermediate 'holds'?"

Acknowledgements.

1. Fundamentals Of Motor Vehicle Technology, Hillier, 1995, Chapter 41.
2. Roadcraft, TSO, 1999, Pg. 110, Cornering Forces.
3. Roadcraft, TSO, 1999, Pg. 56, Weight Distribution.
4. Roadcraft, TSO, 1999, Pg. 59, Accelerating on bends.
5. Pass Your Advanced Driving Test, IAM, 1998, Pg. 29, Accelerating on bends.
6. IAM Examiner manual, 2002, D10.0
7. Pass Your Advanced Driving Test, IAM, 1998, Pg. 16, The planned system of
8. driving.
9. Pass Your Advanced Driving Test, IAM, 1998, Pg32, Brake in a straight line.