ABRIDGMENT

Claffey, Paul J. "Excess Fuel Consumed by a Passenger Car When Passing Another Car Moving in the Same Direction." Presented at the 45th Annual Meeting of the Highway Research Board, Washington, D. C., January 17-21, 1966.

An important factor affecting fuel economy on highways carrying moderately heavy traffic flows is the passing maneuver. Each time one vehicle passes a second vehicle moving in the same direction in the same lane, its speed will be changed since it must turn out, proceed past the other vehicle (probably accelerating continusouly) and return to a lane position in front of the passed vehicle. Values of the excess fuel consumption for typical passing maneuvers, both on level roads and on roads of moderate gradients are needed for estimating fuel costs for vehicle operation on roads where passings are common features of vehicle operation.

Data were obtained on the excess fuel consumed by a typical passenger car when passing another automobile moving in the same direction as compared to the fuel which would have been consumed if the vehicle had continued to operate at its initial speed without passing. Values of fuel consumption for the test vehicle used in the study were first obtained for operation at constant speed over a carefully measured course at each of a series of run speeds (25, 30, 35, 40 and 45 miles per hour). Then fuel consumption values were measured for the same vehicle operating over the same test course at the same run speeds but in addition, executing a passing maneuver around another automobile within the limits of the test section. The difference between the fuel consumed for uniform speed runs and for runs which included a passing maneuver constitutes the excess fuel consumed due to passing. It is the fuel which would not have been consumed if the passing operation had not taken place.

In addition to the fuel consumption and over-all time consumption data recorded for all test runs, the road distance traversed during each passing maneuver, the maximum rate of acceleration and the maximum speed attained while passing, the spot speed when returning to the travel lane in front of the passed vehicle and the elapsed time during passing were measured for each of the test runs in which a passing maneuver took place. Thus, information was recorded on all aspects of test vehicle operation that were related to fuel economy and which might explain variations in excess fuel consumption noted for different passing operations.

The test course was a section of four-lane divided highway having a high type paved surface. The section was 1,680 feet long with a constant plus grade of 0.5 percent in the southbound direction.

The excess fuel consumed by the typical passenger car when passing another automobile moving in the same direction in the same travel lane when the initial speed of the passed and passing vehicle is 25 miles per hour is 0.0049 gallons on a level road, 0.0043 gallons on a 0.5 percent upgrade and 0.0054 gallons on a 0.5 percent downgrade. The excess fuel consumed for passing is greatest on the downgrade because the fuel consumed with no passing is so small on the downgrade that the difference between this and the fuel consumed when passing is greater than that either for operation on a level road or on an upgrade. This pattern of excess fuel consumption for passing as affected by gradients was found to be true for all the run speeds used in the study.

The excess fuel consumed for each passing maneuver by the typical passenger car increases with increased speeds to a maximum at a particular speed then decreases at higher speeds. On a level road the excess fuel consumption increases from 0.0049 gallons for operation at 25 miles per hour to 0.0057 gallons at 35 miles per hour, and decreases to 0.0053 gallons at 45 miles per hour. A similar pattern of variation in excess fuel consumption by run speed was noted for operation on the 0.5 percent upgrade and on the 0.5 percent downgrade with a maximum at a speed of 35 miles per hour on the upgrade and at 40 miles per hour on the downgrade.

Associated data recorded for the passing maneuvers included maximum accelerations and speeds during passing and the distances and elapsed times for passing. Maximum passing acceleration rates on level road varied from 2.9 miles per hour per second at an initial speed of 25 miles per hour to 2.5 miles per hour per second at 40 miles per hour. The maximum speed during passing was 15 miles per hour in excess of the initial speed for each initial speed. The elapsed time during passing was 11 seconds regardless of the speed at which passing was initiated. The distance required for passing varied from 641 feet at 25 miles per hour to 1,000 feet at 45 miles per hour on level routes.

Information on the excess fuel consumed by highway vehicles for passing operations is important to fuel economy analyses for all highways where passings are prominent features of operation. For example, ten passings per mile at 25 miles per hour running speeds approximately double the fuel consumption of a motor vehicle. This investigation developed a comprehensive store of information on the fuel consumption during passing operations of one type of highway vehicle, the passenger car.