Gearing for Today

By Jim Pepper

Most people are used to the quiet modern vehicles of today. Engine and vehicle speed can no longer be sensed by sound. In fact, my Ford diesel pickup truck is quieter inside than my Lark. Studebaker's average engine speed was for the most part, higher than that of today's cars, but not always. It is quite common for someone to think his or her engine is roaring, when in fact it is not. Speedometer and / or tachometer error can also contribute to this misconception. This leads people to change final drive ratio when it might not be necessary. What is the best or most efficient RPM for our engines to operate? That is a question not easily answered. You should realize that any choice you make will have compromises. A safe choice is one that puts the engine in the optimum RPM range to accomplish the task the vehicle is used for the majority of the time. During average use, the rear wheel horsepower required to drive a given car at highway speed is constant. If that car has a 6 cyl., it might use a 4.10 to 4.27 ratio. A 259 will use a 3.54 to 3.73 and a 289 will usually have a 3.31 to 3.54 ratio. Each successively larger engine makes the required power at a lower RPM, thus the change in ratios. Studebaker did build many cars using a 3.07 ratio behind a 259. They readily admitted it was not ideal but was an effort to achieve top fuel economy. Average use, as used above, is defined as 50% highway/city use, gross loads including occupants not exceeding 600 pounds, and at 3000 ft. or less elevation. Transmission selection, body weight and shape, and deviation from average use greatly influence ratio choice. Higher numerical ratios increase rear wheel power, but also increase engine speed and noise, can limit top speed, and can reduce fuel economy. Lower numerical ratios generally do the opposite with one exception. They can also hurt fuel economy. As an example, I once worked on a 1979 Ford F150 pickup. It had a 302 V8, 4-speed manual overdrive, and a 3.00 rear end. The truck achieved a best of 16.5 MPG using 3 rd gear. In OD, it registered 14MPG and struggled to maintain highway speed. After installing a 3.50 rear end, it cruised effortlessly on the highway in OD and got 22 MPG. When the load increased and 3 rd gear was needed, it still registered 16-17 MPG. Had I installed a 4.10 ratio, it would have had more pulling power. Engine noise would have increased and maximum fuel economy would have come close to equaling the original combination. My 1966 Avanti uses a Chevy 327 (short stroke) with a high performance 350 HP cam and 2 ½" exhaust. This engine will cruise efficiently at 3000 RPM. It gets 20 MPG at 65 MPH and performance is on par with an average R2. I'll isolate the cabin from engine noise before I'll change ratios. I would run a later Avanti with a 400 engine at about 2200 RPM and expect the same results. I once built a 1970 Nova using a 400 and a 3.07 rear end. It got 24 MPG and was pretty fast. Remember, all automaker-produced vehicles are engineered for the widest range of applications. As a result, they do not do anything real well. You have the opportunity to tailor your vehicle to your precise use and eliminate some of the compromises. Now that you have all this information, how do you calculate the final drive ratio once you determine your target RPM? A few simple formulas will do the job for you. Before you do any calculating, you need to measure the tire diameter. Diameter affects the revolutions per mile; thus it is a necessary bit of information.

The formulas are as follows. (RPM refers to engine RPM)

GEAR RATIO = (RPM x tire dia.) divided by (MPH x 336)

MPH = (RPM x tire dia.) divided by (gear ratio x 336)

RPM = (MPH x gear ratio x 336) divided by (tire dia.)

TIRE DIA. = (MPH x gear ratio x 336) divided by (RPM)

Let's use my Lark as an example. The known information is, 3.73 rear end, 215-70R15 tire (26 ½" dia.), and 4 th gear is direct (1 to 1). I'll use 65 MPH as a speed. RPM is the unknown.

(65 x 3.73 x 336) / (26.5) = (81463.2) / (26.5) = 3074 RPM

If I install a 235-75R15 (28" dia.), it looks like this.

(65 x 3.73 x 336) / (28) = (81463.2) / (28) = 2909 RPM

The tire change is nearly the same as a change to a 3.54 gear.

(65 x 3.54 x 336) / (26.5) = (77313.6) / (26.5) = 2917 RPM

A 3.31 gear will produce 2728 RPM with the 26.5” tire but will be back to 2892 RPM with a 25” (215-60R15) tire

To factor in the effect of overdrive, multiply the ratio times either the RPM or the gear ratio. The OD ratio of both the T-85 and T –96 is 0.7

3.73 x 0.7 = 2.61 final drive ratio. 3074 RPM x 0.7 = 2152 RPM

These and other useful formulas are available in the *Auto Math Handbook by John Lawlo*r available from HP Books. Good luck.