Useful Formulas

Here are some useful formulae that may be of assistance.

ENGINE CAPACITY

$\pi r^2 \times h \times 4$
$\pi = 3.142$
r = radius of bore (half bore diameter)
h = stroke

Example: Bore = 70.64 Stroke =81.33

3.142 x (35.32 x 35.32) x 81.33 x 4
=1275cc

COMPRESSION RATIO

$$CR = \frac{\text{swept vol.} + \text{unswept volume}}{\text{unswept volume}}$$

Swept volume =
Volume of bore ($\pi r^2 \times h$) or engine capacity divided by 4.

Unswept Volume =
Total of combustion chamber volume, piston dish volume, gasket volume, distance piston is down the bore, valve cut outs in block if any, ring and (although this is not usually used to leave a small safety margin).

Example:1275cc engine (bore capacity)

Head capacity	21.00cc
Piston dish	6.6cc
Volume of bore	4.0cc
Gasket volume	3.4cc
Unswept volume	35

$$\text{Compression Ratio} = \frac{318.75 + 35}{35}$$

$$\text{Compression Ratio} = \frac{353.75}{35}$$

Compression Ratio = 10.1:1

FORMULA FOR DETERMINING EFFECT OF LIGHTENING ROTATING ENGINE COMPONENT

$$\frac{0.5 \times n^2 \times r^2 + R^2}{R^2}$$

n = Total gear ratio (gear ratio x diff ratio)
r = Radius of gyration
R = Radius of wheel/tyre used

This formula's result gives what accelerative weight the engine sees of the car per lb.

Radius of gyration of a transverse engine's flywheel is approximately 3.75". So to determine "weight loss" for a flywheel from a standard weight of say 18lb to 10lb, the engine would see an overall weight loss of the car to accelerate in first gear of 3.33 = 1st gear of 4 syn 'S' box, 3.44 = diff ratio

$$\frac{0.5 \times (3.33 \times 3.44) \times (3.75) + (9.5)}{9.5}$$

$$= \frac{0.5 \times 131.1 \times 14.06 + 90.25}{90.25}$$

$$= \frac{1011.88}{90.25} = 11.21 \text{ lbs}$$

So for every 1lb removed from the flywheel, the engine sees 11.21lb less to accelerate off of the total car. Therefore by lightening the flywheel by 8 lb, the engine sees a total reduction of the cars accelerative weight of 89.68lb.

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GEARBOX RATIOS AND TRANSMITTED ENGINE RPM

The basic rule to remember when computing gear ratios is the driven gear is always divided by the driver, and that to determine gearbox ratios it is necessary to work out what the constant input ratio is. This is worked out by dividing the number of teeth on the first motion shaft into the number of teeth on its corresponding end of the laygear. This is NOT the fourth gear ratio, as in essence fourth gear does not really exist; once in top gear the first motion shaft drives the mainshaft directly, hence it is always a 1 to 1 ratio.

Example:
On the four syncro 'S' gearbox the 1st motion shaft has 18 teeth, the corresponding gear on laygear has 29 teeth. Therefore the "constant" ratio for the box is: 29 / 18 = 1.61

First gear has 31 teeth and is the driven gear. The driver is its corresponding gear on the laygear. This has 15 teeth. So to work out the first gear ratio • 31/15 = 2.066 x 1.61 (constant ratio)= 3.3

$$\text{Input gear speed in RPM} = \frac{\text{Engine RPM}}{\text{Drop gear ratio}}$$

$$\text{Pinion speed in RPM} = \frac{\text{Input speed (RPM)}}{\text{Actual gear ratio}}$$

$$\text{Output shaft speed in RPM} = \frac{\text{Pinion speed}}{\text{Crown wheel \& pinion ratio}}$$

COMPUTING VEHICLE SPEED FOR DIFFERENT FINAL DRIVE RATIOS

It is necessary to work out how many revolutions per mile your particular wheel and tyre combination does. For this you will need to know its rolling radius when inflated to the correct pressure.

This table shows some typical tyre sizes and their corresponding wheel revs per mile.

The formula for vehicle speed in MPH per 1,000 RPM for a particular diff ratio can then be worked out:-

$$\frac{60{,}000}{\text{Diff ratio} \times \text{wheel revs per mile/30mph}}$$

So for 3.44 with 165/70/10 tyre -

$$\frac{60{,}000}{3.44 \times 1059} = \frac{60{,}000}{3642.96} = 16.47 \text{ mph}$$

To estimate KPH/1,000 rpm =

$$\frac{96.56}{\text{Diff ratio} \times \text{wheel revs per mile/30mph}}$$