

Topics

- Review
- Mechanical Efficiency
- Mean Effective Pressure
- Examples

1. Review Questions.

- Explain the difference between power and torque.
- Explain the difference between indicated power and brake power.

2. The difference between indicated power and brake power is as follows.

First of all, by indicated power we mean GROSS indicated power, the total work done by gas on piston during compression and power strokes.

The brake power is the power available at the dynamometer. The difference is called friction power.

$$P_{ig} - P_b = P_f$$

Friction power is necessary to

- overcome friction in bearings
- drive accessories
- pump exhaust out and fresh charge into cylinder.

Mechanical Efficiency

It is defined as follows--

$$\eta_m = \frac{P_b}{P_{ig}} = 1 - \frac{P_f}{P_{ig}}$$

This has open throttle values for automotive engines of about 90% maximum. At max RPM it goes down to about 75%.

What is the effect of throttling?

What is η_m at idle?

Mean Effective Pressure

This interesting concept is not as familiar as power and torque to the man on the street, yet it tells a lot about the effectiveness of an engine design.

We divide the work per cycle by the cylinder volume displaced.

$$mep = \frac{P n_R}{N V_d}$$

Here are customized formulas for SI and English units.

$$mep(kPa) = \frac{P(kW) n_R \times 1000}{V_d(\text{liters}) N(\text{rev / sec})}$$

$$mep(\text{psi}) = \frac{P(\text{hp}) n_R \times 396000}{V_d(\text{in}^3) N(\text{RPM})}$$

See text p. 50 for other formulas relating mep to torque.
What's the meaning of mep?

It essentially divides out the effect of engine size. It indicates how effectively the engine designer uses the displaced volume.

If the power used in the mep formula is brake, then it is called bmep.

Well designed engines in various categories will have similar bmeps.

- Naturally aspirated SI engines -- 850 - 1050 KPa when engine is developing max torque. About 10-15% lower at max power.
- For turbocharged SI engines max bmep is 1250 - 1750 KPa, and 900-1400 KPa at max power.
- Naturally aspirated CI engines max bmep is 700-900 KPa, bmep at max power about 700 Kpa.
- Turbocharged CI max bmep is 1000-1200 Kpa, 1400 KPa with aftercooling. At max power bmep is 850 - 950 KPa.

Exercise

Engine/Displacement	Power/RPM	bmep
Chevy LS1 347 in ³	345 hp at 5600 rpm	
Ford SVT 2.5 liter (155 in ³)	195 hp at 6625 rpm	
Ford 5.4 liter SOHC Triton V8	235 hp at 4250 rpm	
Alfa Romeo Type 158/9 90.2 in ³	420 hp at 9600 rpm	
Minica Dangan 0.55 liters 33.6 in ³	63 hp at 7500 rpm	
BMW 2.5 liter DOHC I6 152 in ³	168 hp at 4400 rpm	

EES Example (2.4)

Let's work on the following problem with EES. Cummins diesel, bore = 125 mm, stroke 136 mm, and maximum power 246 kW at 2100 rpm. Calculate mean piston speed, bmep, and specific power. (Specific power is power over piston area.)

We'll work this with EES. Solution will be posted at the website.