



# For 4 Stroke Engine Formulas

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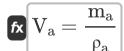




# List of 24 For 4 Stroke Engine Formulas

# For 4 Stroke Engine &

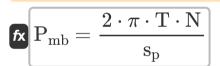
1) Actual intake air volume per cylinder 🗗



Open Calculator 🗗

$$oxed{ex} 0.004859 \mathrm{m}^{_3} = rac{0.28 \mathrm{kg}}{57.63 \mathrm{kg/m}^{_3}}$$

2) Bmep given engine torque



Open Calculator

- $= \frac{2 \cdot \pi \cdot 60 \text{N*mm} \cdot 400 \text{rev/min}}{0.045 \text{m/s}}$
- 3) Brake Mean Effective Pressure of 4S Engines given Brake power

$$extstyle P_{mb} = rac{2 \cdot BP}{L \cdot A_c \cdot (N)}$$

Open Calculator

$$=$$
  $\frac{2 \cdot 1.93 \mathrm{W}}{8.8 \mathrm{cm} \cdot 30 \mathrm{cm}^2 \cdot (400 \mathrm{rev/min})}$ 



#### 4) Brake power measured with dynamo meter 🗹

 $ext{BP} = rac{\pi \cdot ext{D} \cdot ( ext{N} \cdot 60) \cdot ( ext{W}_{ ext{d}} - ext{S})}{60}$ 

Open Calculator

### 5) Combustion efficiency

 $\eta_{
m c} = rac{
m Q_{in}}{
m m_f \cdot Q_{HV}}$ 

Open Calculator 🗗

=  $0.6 = rac{150 ext{kJ/kg}}{0.005 \cdot 50000 ext{kJ/kg}}$ 

## 6) Connecting Rod Length to Crank Radius Ratio

 $m R = rac{r}{r_c}$ 

Open Calculator 🚰

#### 7) Displaced volume in engine cylinder

 $ag{V_{
m d}} = rac{{
m L_s} \cdot \pi \cdot \left( {
m B}^2 
ight)}{4}$ 

Open Calculator 🖸

 $oxed{ex} 0.000528 \mathrm{m}^{_3} = rac{0.100 \mathrm{m} \cdot \pi \cdot \left( (0.082 \mathrm{m})^2 
ight)}{4}$ 







# 8) Frictional mean effective pressure

fx  $P_{\rm fme} = P_{\rm ime} - P_{\rm mb}$ 

Open Calculator 2

60 Pa = 400 Pa - 350 Pa

9) Frictional power of engine

fx | FP = IP - BP

Open Calculator 2

Open Calculator 2

138.07W = 140W - 1.93W

10) Fuel conversion efficiency

 $\eta_{
m f} = rac{
m W}{
m m_f \cdot Q_{HV}}$ 

 $0.4 = rac{100 ext{KJ}}{0.005 \cdot 50000 ext{kJ/kg}}$ 

11) Fuel conversion efficiency given thermal conversion efficiency

fx  $|\eta_{
m f}=\eta_{
m c}\cdot\eta_{
m t}|$ 

Open Calculator

 $0.3 = 0.6 \cdot 0.50$ 

12) Horsepower of engine

 $ext{HP} = rac{ ext{T} \cdot ext{E}_{ ext{rpm}}}{5252}$ 

Open Calculator 2

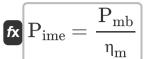
 $0.005982 = rac{60 ext{N*mm} \cdot 5000 ext{rev/min}}{2}$ 5252



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#### 13) Indicated mean effective pressure given mechanical efficiency



Open Calculator 🗗

 $437.5 Pa = \frac{350 Pa}{0.8}$ 

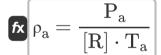
### 14) Indicated Power of Four-stroke Engine



Open Calculator 🗗

 $= \frac{138.2301 \text{W} = \frac{5000 \cdot 5 \text{Pa} \cdot 8.8 \text{cm} \cdot 30 \text{cm}^2 \cdot (400 \text{rev/min})}{2} }{2}$ 

## 15) Intake air density



Open Calculator 🚰

 $ext{ex} \left[ 57.63851 ext{kg/m}^{ ext{3}} = rac{1.5 ext{e}5 ext{Pa}}{[ ext{R}] \cdot 313 ext{K}} 
ight]$ 

#### 16) Intake air mass of engine cylinder 🔽

$$\mathbf{m}_{\mathrm{a}} = rac{\mathrm{m}_{\mathrm{af}} \cdot \mathrm{n}_{\mathrm{R}}}{\mathrm{E}_{\mathrm{rpm}}}$$

Open Calculator

 $oxed{ex} 0.003438 ext{kg} = rac{0.9 ext{kg/s} \cdot 2}{5000 ext{rev/min}}$ 







#### 17) Rate of heat conduction of engine wall

fx  $Q_{
m cond} = rac{({
m K})\cdot{
m A}\cdot\Delta{
m T}}{\Delta{
m X}}$ 

Open Calculator

### 18) Ratio of cylinder bore to piston stroke

 $m R = rac{r}{r_c}$ 

Open Calculator &

=  $1.091636 = \frac{150.1 \mathrm{mm}}{137.5 \mathrm{mm}}$ 

## 19) Thermal efficiency of IC engine 🗗

 $\eta_{
m th} = rac{
m W}{
m Q_{
m in}}$ 

Open Calculator 🗗

 $ext{ex} \left[ 0.666667 = rac{100 ext{KJ}}{150 ext{kJ/kg}} 
ight]$ 

## 20) Total cylinder volume of IC engine

fx  $V_{
m t} = {
m n_C \cdot V_{
m cyl}}$ 

Open Calculator

ex  $0.0132 \mathrm{m}^{_3} = 4 \cdot 0.0033 \mathrm{m}^{_3}$ 





#### 21) Volumetric Efficiency for 4S engines 🗗

 $ext{VE} = \left(rac{2 \cdot ext{m}_{ ext{af}}}{
ho_{ ext{a}} \cdot ext{V}_{ ext{s}} \cdot ( ext{N})}
ight) \cdot 100$ 

Open Calculator

#### 22) Volumetric efficiency of IC engine

 $\eta_{
m v} = rac{m_{
m af} \cdot n_{
m R}}{
ho_{
m a} \cdot V_{
m te} \cdot N}$ 

Open Calculator

 $0.196224 = rac{0.9 ext{kg/s} \cdot 2}{57.63 ext{kg/m}^3 \cdot 0.0038 ext{m}^3 \cdot 400 ext{rev/min}}$ 

# 23) Volumetric efficiency of IC engine given actual volume of engine cylinder

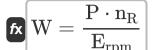
 $\eta_{
m v} = rac{{
m V}_{
m a}}{{
m V}_{
m te}}$ 

Open Calculator 🖒

$$\boxed{1.052632 = \frac{0.004 \text{m}^3}{0.0038 \text{m}^3}}$$



#### 24) Work done per cycle in ic engine



Open Calculator

$$=$$
  $100.8406 \mathrm{KJ} = rac{26400 \mathrm{kW} \cdot 2}{5000 \mathrm{rev/min}}$ 



#### Variables Used

- A Surface Area of Engine Wall (Square Meter)
- A<sub>c</sub> Area of Cross Section (Square Centimeter)
- B Engine Cylinder Bore in Meter (Meter)
- **BP** Brake Power (Watt)
- D Pulley Diameter (Meter)
- E<sub>rpm</sub> Engine RPM (Revolution per Minute)
- **FP** Frictional Power of Engine (Watt)
- HP Horsepower of Engine
- IP Indicated Power (Watt)
- k Number of Cylinders
- K Thermal Conductivity of Material (Watt per Meter per Degree Celsius)
- L Stroke Length (Centimeter)
- **L**<sub>s</sub> Piston Stroke (*Meter*)
- m<sub>a</sub> Mass of Air at Intake (Kilogram)
- m<sub>af</sub> Air Mass Flow Rate (Kilogram per Second)
- m<sub>f</sub> Mass of Fuel Added per Cycle
- MEP Mean Effective Pressure (Pascal)
- **N** Engine Speed (Revolution per Minute)
- n<sub>C</sub> Total Number of Cylinders
- n<sub>R</sub> Crankshaft Revolutions per Power Stroke
- P Indicated Engine Power (Kilowatt)
- Pa Intake Air Pressure (Pascal)





- Pfme Frictional Mean Effective Pressure (Pascal)
- P<sub>ime</sub> Indicated Mean Effective Pressure (Pascal)
- P<sub>mb</sub> Brake Mean Effective Pressure (Pascal)
- Q<sub>cond</sub> Rate of Heat Conduction of Engine Wall (Joule)
- Q<sub>HV</sub> Heating Value of the Fuel (Kilojoule per Kilogram)
- Qin Heat Added by Combustion per Cycle (Kilojoule per Kilogram)
- r Connecting Rod Length (Millimeter)
- R Connecting Rod Length to Crank Radius Ratio
- r<sub>c</sub> Crank Radius of Engine (Millimeter)
- S Spring Scale Reading (Newton)
- Sp Mean Piston Speed (Meter per Second)
- **T** Engine Torque (Newton Millimeter)
- T<sub>a</sub> Intake Air Temperature (Kelvin)
- Va Actual Volume of Intake Air (Cubic Meter)
- V<sub>cvI</sub> Total Volume of Engine Cylinder (Cubic Meter)
- **V**<sub>d</sub> Displaced Volume (Cubic Meter)
- V<sub>s</sub> Piston Swept Volume (Cubic Meter)
- V<sub>t</sub> Total Volume of an Engine (Cubic Meter)
- V<sub>te</sub> Theoretical Volume of Engine (Cubic Meter)
- VE Volumetric Efficiency
- **W** Work Done per Cycle in IC Engine (Kilojoule)
- W<sub>d</sub> Dead Weight (Newton)
- ΔT Temperature Difference across Engine Wall (Celsius)
- ΔX Thickness of Engine Wall (Meter)





- η<sub>c</sub> Combustion Efficiency
- **η** Fuel Conversion Efficiency
- η<sub>m</sub> Mechanical Efficiency of IC Engine
- η<sub>t</sub> Thermal Conversion Efficiency
- η<sub>th</sub> Thermal Efficiency of IC Engine
- η<sub>V</sub> Volumetric Efficiency of IC Engine
- ρ<sub>a</sub> Air Density at Intake (Kilogram per Cubic Meter)





### Constants, Functions, Measurements used

- Constant: pi, 3.14159265358979323846264338327950288
   Archimedes' constant
- Constant: [R], 8.31446261815324 Universal gas constant
- Measurement: Length in Centimeter (cm), Meter (m), Millimeter (mm)
   Length Unit Conversion
- Measurement: Weight in Kilogram (kg)
   Weight Unit Conversion
- Measurement: Temperature in Kelvin (K), Celsius (°C)
   Temperature Unit Conversion
- Measurement: Volume in Cubic Meter (m³)
   Volume Unit Conversion
- Measurement: Area in Square Centimeter (cm²), Square Meter (m²)
   Area Unit Conversion
- Measurement: Pressure in Pascal (Pa)
   Pressure Unit Conversion
- Measurement: Speed in Meter per Second (m/s)
   Speed Unit Conversion
- Measurement: Energy in Kilojoule (KJ), Joule (J)
   Energy Unit Conversion
- Measurement: Power in Watt (W), Kilowatt (kW)
   Power Unit Conversion
- Measurement: Force in Newton (N)
   Force Unit Conversion
- Measurement: Heat of Combustion (per Mass) in Kilojoule per Kilogram (kJ/kg)





Heat of Combustion (per Mass) Unit Conversion

 Measurement: Thermal Conductivity in Watt per Meter per Degree Celsius (W/(m\*°C))
 Thermal Conductivity Unit Conversion

• Measurement: Mass Flow Rate in Kilogram per Second (kg/s)

Mass Flow Rate Unit Conversion

- Measurement: Angular Velocity in Revolution per Minute (rev/min)

  Angular Velocity Unit Conversion
- Measurement: Density in Kilogram per Cubic Meter (kg/m³)
   Density Unit Conversion
- Measurement: Torque in Newton Millimeter (N\*mm)
   Torque Unit Conversion





#### **Check other formula lists**

• For 4 Stroke Engine Formulas

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