

# Important For 4 Stroke Engine Formulas PDF



## Formulas Examples with Units

### List of 24 Important For 4 Stroke Engine Formulas

#### 1) Actual intake air volume per cylinder Formula

Formula

$$V_a = \frac{m_a}{\rho_a}$$

Example with Units

$$0.0049 \text{ m}^3 = \frac{0.28 \text{ kg}}{57.63 \text{ kg/m}^3}$$

Evaluate Formula

#### 2) Bmep given engine torque Formula

Formula

$$P_{mb} = \frac{2 \cdot \pi \cdot T \cdot N}{s_p}$$

Example with Units

$$350.9193 \text{ Pa} = \frac{2 \cdot 3.1416 \cdot 60 \text{ N} \cdot \text{mm} \cdot 400 \text{ rev/min}}{0.045 \text{ m/s}}$$

Evaluate Formula

#### 3) Brake Mean Effective Pressure of 4S Engines given Brake power Formula

Formula

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

Example with Units

$$349.0557 \text{ Pa} = \frac{2 \cdot 1.93 \text{ w}}{8.8 \text{ cm} \cdot 30 \text{ cm}^2 \cdot (400 \text{ rev/min})}$$

Evaluate Formula

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

Formula

$$BP = \frac{\pi \cdot D \cdot (N \cdot 60) \cdot (W_d - S)}{60}$$

Example with Units

$$1.9344 \text{ w} = \frac{3.1416 \cdot 0.0021 \text{ m} \cdot (400 \text{ rev/min} \cdot 60) \cdot (10 \text{ N} - 3 \text{ N})}{60}$$

Evaluate Formula

#### 5) Combustion efficiency Formula

Formula

$$\eta_c = \frac{Q_{in}}{m_f \cdot Q_{HV}}$$

Example with Units

$$0.6 = \frac{150 \text{ kJ/kg}}{0.005 \cdot 50000 \text{ kJ/kg}}$$

Evaluate Formula

## 6) Connecting Rod Length to Crank Radius Ratio Formula

Formula

$$R = \frac{r}{r_c}$$

Example with Units

$$1.0916 = \frac{150.1 \text{ mm}}{137.5 \text{ mm}}$$

Evaluate Formula 

## 7) Displaced volume in engine cylinder Formula

Formula

$$V_d = \frac{L_s \cdot \pi \cdot (B^2)}{4}$$

Example with Units

$$0.0005 \text{ m}^3 = \frac{0.100 \text{ m} \cdot 3.1416 \cdot (0.082 \text{ m}^2)}{4}$$

Evaluate Formula 

## 8) Frictional mean effective pressure Formula

Formula

$$P_{fme} = P_{ime} - P_{mb}$$

Example with Units

$$50 \text{ Pa} = 400 \text{ Pa} - 350 \text{ Pa}$$

Evaluate Formula 

## 9) Frictional power of engine Formula

Formula

$$FP = IP - BP$$

Example with Units

$$138.07 \text{ w} = 140 \text{ w} - 1.93 \text{ w}$$

Evaluate Formula 

## 10) Fuel conversion efficiency Formula

Formula

$$\eta_f = \frac{W}{m_f \cdot Q_{HV}}$$

Example with Units

$$0.4 = \frac{100 \text{ kJ}}{0.005 \cdot 50000 \text{ kJ/kg}}$$

Evaluate Formula 

## 11) Fuel conversion efficiency given thermal conversion efficiency Formula

Formula

$$\eta_f = \eta_c \cdot \eta_t$$

Example

$$0.3 = 0.6 \cdot 0.50$$

Evaluate Formula 

## 12) Horsepower of engine Formula

Formula

$$HP = \frac{T \cdot E_{rpm}}{5252}$$

Example with Units

$$0.006 = \frac{60 \text{ N*mm} \cdot 5000 \text{ rev/min}}{5252}$$

Evaluate Formula 

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

Formula

$$P_{ime} = \frac{P_{mb}}{\eta_m}$$

Example with Units

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

Evaluate Formula 



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

Formula

$$IP = \frac{k \cdot MEP \cdot L \cdot A_c \cdot (N)}{2}$$

Evaluate Formula 

Example with Units

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

#### 15) Intake air density Formula

Formula

$$\rho_a = \frac{P_a}{[R] \cdot T_a}$$

Example with Units

$$57.6385 \text{ kg/m}^3 = \frac{1.5 \text{e}5 \text{ Pa}}{8.3145 \cdot 313 \text{ K}}$$

Evaluate Formula 

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

Formula

$$m_a = \frac{m_{af} \cdot n_R}{E_{rpm}}$$

Example with Units

$$0.0034 \text{ kg} = \frac{0.9 \text{ kg/s} \cdot 2}{5000 \text{ rev/min}}$$

Evaluate Formula 

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

Formula

$$Q_{cond} = \frac{(K) \cdot A \cdot \Delta T}{\Delta X}$$

Example with Units

$$483450.225 \text{ J} = \frac{(235 \text{ W/(m}^\circ\text{C)}) \cdot 0.069 \text{ m}^2 \cdot 25^\circ\text{C}}{0.010 \text{ m}}$$

Evaluate Formula 

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

Formula

$$R = \frac{r}{r_c}$$

Example with Units

$$1.0916 = \frac{150.1 \text{ mm}}{137.5 \text{ mm}}$$

Evaluate Formula 

#### 19) Thermal efficiency of IC engine Formula

Formula

$$\eta_{th} = \frac{W}{Q_{in}}$$

Example with Units

$$0.6667 = \frac{100 \text{ kJ}}{150 \text{ kJ/kg}}$$

Evaluate Formula 

#### 20) Total cylinder volume of IC engine Formula

Formula

$$V_t = n_c \cdot V_{cyl}$$

Example with Units

$$0.0132 \text{ m}^3 = 4 \cdot 0.0033 \text{ m}^3$$

Evaluate Formula 



## 21) Volumetric Efficiency for 4S engines Formula

Evaluate Formula 

Formula

$$VE = \left( \frac{2 \cdot m_{af}}{\rho_a \cdot V_s \cdot (N)} \right) \cdot 100$$

Example with Units

$$37.2825 = \left( \frac{2 \cdot 0.9 \text{ kg/s}}{57.63 \text{ kg/m}^3 \cdot 0.002 \text{ m}^3 \cdot (400 \text{ rev/min})} \right) \cdot 100$$

## 22) Volumetric efficiency of IC engine Formula

Formula

$$\eta_v = \frac{m_{af} \cdot n_R}{\rho_a \cdot V_{te} \cdot N}$$

Example with Units

$$0.1962 = \frac{0.9 \text{ kg/s} \cdot 2}{57.63 \text{ kg/m}^3 \cdot 0.0038 \text{ m}^3 \cdot 400 \text{ rev/min}}$$

Evaluate Formula 

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

Evaluate Formula 

Formula

$$\eta_v = \frac{V_a}{V_{te}}$$

Example with Units

$$1.0526 = \frac{0.004 \text{ m}^3}{0.0038 \text{ m}^3}$$

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

Evaluate Formula 

Formula

$$W = \frac{P \cdot n_R}{E_{rpm}}$$

Example with Units














$$100.8406 \text{ kJ} = \frac{26400 \text{ kW} \cdot 2}{5000 \text{ rev/min}}$$



## Variables used in list of For 4 Stroke Engine Formulas above

- **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)
- **P<sub>a</sub>** Intake Air Pressure (Pascal)
- **P<sub>fme</sub>** 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)
- **Q<sub>in</sub>** Heat Added by Combustion per Cycle (Kilojoule per Kilogram)
- **r** Connecting Rod Length (Millimeter)
- **R** Connecting Rod Length to Crank Radius Ratio

## Constants, Functions, Measurements used in list of For 4 Stroke Engine Formulas above

- **constant(s):** pi, 3.14159265358979323846264338327950288  
*Archimedes' constant*
- **constant(s):** [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 (m<sup>3</sup>)  
*Volume Unit Conversion* 
- **Measurement: Area** in Square Centimeter (cm<sup>2</sup>), Square Meter (m<sup>2</sup>)  
*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)



- $r_c$  Crank Radius of Engine (Millimeter)
- $S$  Spring Scale Reading (Newton)
- $s_p$  Mean Piston Speed (Meter per Second)
- $T$  Engine Torque (Newton Millimeter)
- $T_a$  Intake Air Temperature (Kelvin)
- $V_a$  Actual Volume of Intake Air (Cubic Meter)
- $V_{cyl}$  Total Volume of Engine Cylinder (Cubic Meter)
- $V_d$  Displaced Volume (Cubic Meter)
- $V_s$  Piston Swept Volume (Cubic Meter)
- $V_t$  Total Volume of an Engine (Cubic Meter)
- $V_{te}$  Theoretical Volume of Engine (Cubic Meter)
- $VE$  Volumetric Efficiency
- $W$  Work Done per Cycle in IC Engine (Kilojoule)
- $W_d$  Dead Weight (Newton)
- $\Delta T$  Temperature Difference across Engine Wall (Celsius)
- $\Delta X$  Thickness of Engine Wall (Meter)
- $\eta_c$  Combustion Efficiency
- $\eta_f$  Fuel Conversion Efficiency
- $\eta_m$  Mechanical Efficiency of IC Engine
- $\eta_t$  Thermal Conversion Efficiency
- $\eta_{th}$  Thermal Efficiency of IC Engine
- $\eta_v$  Volumetric Efficiency of IC Engine
- $\rho_a$  Air Density at Intake (Kilogram per Cubic Meter)

Angular Velocity Unit Conversion 

- **Measurement: Density** in Kilogram per Cubic Meter ( $kg/m^3$ )

Density Unit Conversion 

- **Measurement: Torque** in Newton Millimeter ( $N^*mm$ )

Torque Unit Conversion 



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