



Fuel Injection in IC Engine Formulas

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Examples!

Conversions!

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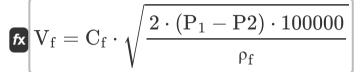




List of 16 Fuel Injection in IC Engine Formulas

Fuel Injection in IC Engine &

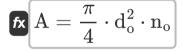
1) Actual Fuel Velocity of Injection Considering Orifice Flow Coefficient



Open Calculator 🗗

ex
$$138.0537 \mathrm{m/s} = 0.9 \cdot \sqrt{\frac{2 \cdot (140 \mathrm{Pa} - 40 \mathrm{Pa}) \cdot 1000000}{850 \mathrm{kg/m^3}}}$$

2) Area of all Orifices of Fuel Injectors



Open Calculator 🛂

$$= \frac{\pi}{4} \cdot (3\text{m})^2 \cdot 6$$

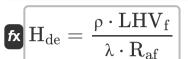
3) Compression Ratio given Clearance and Swept Volume

$$\left| \mathbf{r} = 1 + \left(rac{\mathrm{V_s}}{\mathrm{V_c}}
ight)
ight|$$

Open Calculator

ex
$$1.01178 = 1 + \left(\frac{1178 \mathrm{cm}^3}{0.10 \mathrm{m}^3}\right)$$

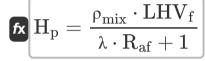
4) Energy Content per Unit Cylinder Volume of Mixture Formed in Cylinder of Diesel Engine



Open Calculator

$$\boxed{0.586395 \mathrm{MJ/m^3} = \frac{1.293 kg/m^3 \cdot 10 MJ/m^3}{1.5 \cdot 14.7}}$$

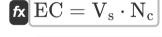
5) Energy Content Per Unit Cylinder Volume of Mixture Formed Prior to Induction into Cylinder



Open Calculator 🗗

$$ext{ex} \ 347.0716 ext{MJ/m}^{_3} = rac{800 ext{kg/m}^{_3} \cdot 10 ext{MJ/m}^{_3}}{1.5 \cdot 14.7 + 1}$$

6) Engine Capacity



Open Calculator 🗗

$$4712 \text{cm}^3 = 1178 \text{cm}^3 \cdot 4$$

7) Fuel Consumption Per Cycle

$$\mathrm{FC_c} = rac{\mathrm{FC}}{60 \cdot \mathrm{N_m}}$$

$$oxed{ex} 0.044444 ext{kg} = rac{400 ext{kg/s}}{60 \cdot 150}$$







8) Fuel Consumption per Cylinder

 $extbf{FC} = rac{ ext{FC}_{ ext{h}}}{ ext{n}_{ ext{o}}}$

Open Calculator 🗗

ex $0.000417 {
m kg/s} = {9 {
m kg/h} \over 6}$

9) Fuel Consumption Per Hour in Diesel Engine

 $FC_h = BSFC \cdot BP$

Open Calculator

 $ext{ex} \ 8.99505 ext{kg/h} = 0.405 ext{kg/h/W} \cdot 22.21 ext{W}$

10) Fuel Jet Velocity

 $V_{\mathrm{fj}} = C_{\mathrm{d}} \cdot \sqrt{\left(rac{2 \cdot \left(\mathrm{p_{in}} - \mathrm{p_{cy}}
ight)}{
ho_{\mathrm{f}}}
ight)}$

Open Calculator 🚰

11) Fuel Velocity at Time of Release into Engine Cylinder

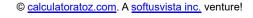
ex $123.9924 \text{m/s} = 0.66 \cdot \sqrt{\left(\frac{2 \cdot (200 \text{Bar} - 50 \text{Bar})}{850 \text{kg/m}^3}\right)}$

$$V_2 = \sqrt{2 \cdot \mathrm{v_f} \cdot (\mathrm{P_1} - \mathrm{P2})}$$

Open Calculator

 $ext{ex} 15.36229 ext{m/s} = \sqrt{2 \cdot 1.18 ext{m}^3/ ext{kg} \cdot (140 ext{Pa} - 40 ext{Pa})}$







12) Mass of air taken in each cylinder 🚰

 $\mathbf{m}_{\mathrm{a}} = rac{\mathrm{P_{a}\cdot(V_{c}+V_{d})}}{\mathrm{[R]\cdot T_{i}}}$

Open Calculator

 $\boxed{ 294.2446 \mathrm{kg} = \frac{1.5 \mathrm{e} 5 \mathrm{Pa} \cdot (0.10 \mathrm{m}^{_{3}} + 5.005 \mathrm{m}^{_{3}}) }{[\mathrm{R}] \cdot 313 \mathrm{K} } }$

13) Number of Fuel Injections Per Minute for Four Stroke Engine

 $N_{
m i}=rac{\omega_{
m e}}{2}$

Open Calculator

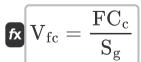
14) Total Time Taken for Fuel Injection in One Cycle

 $ext{fx} T_{
m f} = rac{ heta}{360} \cdot rac{60}{\omega_{
m e}}$

Open Calculator 🗗

= $2.9 \text{E}^-6 \text{s} = rac{30\degree}{360} \cdot rac{60}{288758.6 ext{rev/min}}$

15) Volume of Fuel Injected Per Cycle



Open Calculator

 $= \frac{0.044 \mathrm{kg}}{0.85}$







16) Volume of Fuel Injected Per Second in Diesel Engine 🚰

Open Calculator

$$\mathbf{K} \left[\mathbf{Q}_{\mathrm{f}} = \mathbf{A} \cdot \mathbf{V}_{\mathrm{f}} \cdot \mathbf{T}_{\mathrm{f}} \cdot rac{\mathbf{N}_{\mathrm{i}}}{60}
ight]$$

$$=$$
 $4.22341 \mathrm{m}^{_3} = 42 \mathrm{m}^{_2} \cdot 138 \mathrm{m/s} \cdot 0.000167 \mathrm{s} \cdot rac{261.8}{60}$



Variables Used

- A Area of All Orifices of Fuel Injectors (Square Meter)
- **BP** Brake Power (Watt)
- BSFC Brake Specific Fuel Consumption (Kilogram per Hour per Watt)
- Cd Coefficient of Discharge
- Cf Flow Coefficient of Orifice
- d_o Diameter of Fuel Orifice (Meter)
- EC Engine Capacity (Cubic Centimeter)
- FC Fuel Consumption per Cylinder (Kilogram per Second)
- **FC**_c Fuel Consumption per Cycle (*Kilogram*)
- FC_h Fuel Consumption per Hour (Kilogram per Hour)
- H_{de} Energy Content per Unit Cylinder in Diesel Engine (Megajoule per Cubic Meter)
- H_p Energy Content per Unit Cylinder (Megajoule per Cubic Meter)
- LHV_f Lower Heating Value of Fuel (Megajoule per Cubic Meter)
- **m**_a Mass of Air Taken in Each Cylinder (*Kilogram*)
- N_c Number of Cylinders
- N_i Number of Injections per Minute
- N_m Number of Cycles per Minute
- no Number of Orifices
- P₁ Injection Pressure (Pascal)
- Pa Intake Air Pressure (Pascal)





- p_{cv} Pressure of charge inside the cylinder (Bar)
- p_{in} Fuel Injection Pressure (Bar)
- P2 Pressure in Cylinder during Fuel Injection (Pascal)
- **Q**_f Volume of Fuel Injected per Second (Cubic Meter)
- r Compression Ratio
- Raf Stoichiometric Air Fuel Ratio
- S_g Specific Gravity of Fuel
- Tf Total Time Taken for Fuel Injection (Second)
- **T**_i Intake Air Temperature (*Kelvin*)
- V₂ Fuel Velocity at Tip of Nozzle (Meter per Second)
- **V**_c Clearance Volume (Cubic Meter)
- V_d Displaced Volume (Cubic Meter)
- Vf Specific Volume of Fuel (Cubic Meter per Kilogram)
- **V**_f Actual Fuel Velocity of Injection (Meter per Second)
- V_{fc} Volume of Fuel Injected per Cycle (Cubic Meter)
- V_{fi} Fuel Jet Velocity (Meter per Second)
- V_s Swept volume (Cubic Centimeter)
- θ Time of Fuel Injection in Crank Angle (Degree)
- λ Relative Air Fuel Ratio
- p Density of Air (Kilogram per Cubic Meter)
- **P**_f Density of Fuel (Kilogram per Cubic Meter)
- ρ_{mix} Density of Mixture (Kilogram per Cubic Meter)
- ω_e Engine RPM (Revolution per Minute)





Constants, Functions, Measurements used

- Constant: pi, 3.14159265358979323846264338327950288
 Archimedes' constant
- Constant: [R], 8.31446261815324
 Universal gas constant
- Function: sqrt, sqrt(Number)

 A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: Length in Meter (m)
 Length Unit Conversion
- Measurement: Weight in Kilogram (kg)
 Weight Unit Conversion
- Measurement: **Time** in Second (s) *Time Unit Conversion*
- Measurement: Temperature in Kelvin (K)
 Temperature Unit Conversion
- Measurement: Volume in Cubic Centimeter (cm³), Cubic Meter (m³)
 Volume Unit Conversion
- Measurement: Area in Square Meter (m²)
 Area Unit Conversion
- Measurement: Pressure in Pascal (Pa), Bar (Bar)
 Pressure Unit Conversion
- Measurement: Speed in Meter per Second (m/s)
 Speed Unit Conversion
- Measurement: Power in Watt (W)
 Power Unit Conversion





- Measurement: Angle in Degree (°)
 Angle Unit Conversion
- Measurement: Mass Flow Rate in Kilogram per Second (kg/s), Kilogram per Hour (kg/h)
 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: Specific Volume in Cubic Meter per Kilogram (m³/kg)
 Specific Volume Unit Conversion
- Measurement: Energy Density in Megajoule per Cubic Meter (MJ/m³)
 Energy Density Unit Conversion
- Measurement: Specific Fuel Consumption in Kilogram per Hour per Watt (kg/h/W)
 - Specific Fuel Consumption Unit Conversion





Check other formula lists

• Air Standard Cycles Formulas • Fuel Injection in IC Engine Formulas •

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