Important Diesel Engine Power Plant Formulas PDF

Formulas
Examples
with Units

List of 28
Important Diesel Engine Power Plant Formulas

1) Area of Piston given Piston Bore Formula

Evaluate Formula

Formula

$$A = \left(\frac{\pi}{4}\right) \cdot B^2$$

Example with Units

$$0.1662\,\text{m}^2 = \left(\frac{3.1416}{4}\right) \cdot 460\,\text{mm}^2$$

2) Brake Mean Effective Pressure Formula

Evaluate Formula

Formula

$$BMEP = \eta_m \cdot IMEP$$

Example with Units

$$4.7645\,\text{Bar} = 0.733 \cdot 6.5\,\text{Bar}$$

3) Brake Mean Effective Pressure given Torque Formula

Evaluate Formula

Formula

$$BMEP = K \cdot \tau$$

Example with Units

$$4.7584\,\text{Bar} = 31.5 \cdot 15.106\,\text{kN*m}$$

4) Brake Power using Break Mean Effective Pressure Formula

Evaluate Formula

Formula

$$P_{4b} = \frac{BMEP \cdot A \cdot L \cdot \left(\frac{N}{2}\right) \cdot N_c}{60}$$

Example with Units

$$5531.12\,\text{kW} = \frac{4.76\,\text{Bar} \cdot 0.166\,\text{m}^2 \cdot 600\,\text{mm} \cdot \left(\frac{7000\,\text{rad/s}}{2}\right) \cdot 2}{60}$$

5) Brake Specific Fuel Consumption given Brake Power and Fuel Consumption Rate Formula

Evaluate Formula

Formula

$$BSFC = \frac{m_f}{P_{4b}}$$

Example with Units

$$0.2308\,\text{kg/h/kW} = \frac{0.355\,\text{kg/s}}{5537\,\text{kW}}$$

6) Brake Thermal Efficiency of Diesel Engine Power Plant Formula

Evaluate Formula

Formula

$$BTE = \frac{P_{4b}}{m_f \cdot CV}$$

Example with Units

$$0.3714 = \frac{5537\,\text{kW}}{0.355\,\text{kg/s} \cdot 42000\,\text{kJ/kg}}$$

7) Break Power given Bore and Stroke Formula

Evaluate Formula

Formula

$$P_{4b} = \frac{\eta_m \cdot IMEP \cdot A \cdot L \cdot \left(\frac{N}{2}\right) \cdot N_c}{60}$$

Example with Units

$$5536.349\,\text{kW} = \frac{0.733 \cdot 6.5\,\text{Bar} \cdot 0.166\,\text{m}^2 \cdot 600\,\text{mm} \cdot \left(\frac{7000\,\text{rad/s}}{2}\right) \cdot 2}{60}$$

8) Break Power given Mechanical Efficiency and Indicated Power Formula

Evaluate Formula

Formula

$$P_{4b} = \eta_m \cdot P_{4i}$$

Example with Units

$$5536.349\,\text{kW} = 0.733 \cdot 7553\,\text{kW}$$

9) Break Power of 2 Stroke Diesel Engine Formula

Evaluate Formula

Formula

$$P_{2b} = \frac{2 \cdot \pi \cdot \tau \cdot N}{60}$$

Example with Units

$$11073.2763\,\text{kW} = \frac{2 \cdot 3.1416 \cdot 15.106\,\text{kN*m} \cdot 7000\,\text{rad/s}}{60}$$

10) Break Power of 4 Stroke Diesel Engine Formula

Evaluate Formula

Formula

$$P_{4b} = \frac{2 \cdot \pi \cdot \tau \cdot \left(\frac{N}{2}\right)}{60}$$

Example with Units

$$5536.6382\,\text{kW} = \frac{2 \cdot 3.1416 \cdot 15.106\,\text{kN*m} \cdot \left(\frac{7000\,\text{rad/s}}{2}\right)}{60}$$

11) Friction Power of Diesel Engine Formula

Evaluate Formula

Formula

$$P_f = P_{4i} - P_{4b}$$

Example with Units

$$2016\,\text{kW} = 7553\,\text{kW} - 5537\,\text{kW}$$

12) Indicated Power of 2 Stroke Engine Formula

Evaluate Formula

Formula

$$P_{i2} = \frac{IMEP \cdot A \cdot L \cdot N \cdot N_c}{60}$$

Example with Units

$$15106\,\text{kW} = \frac{6.5\,\text{Bar} \cdot 0.166\,\text{m}^2 \cdot 600\,\text{mm} \cdot 7000\,\text{rad/s} \cdot 2}{60}$$

13) Indicated Power of 4 Stroke Engine Formula

Evaluate Formula

Formula

$$P_{4i} = \frac{IMEP \cdot A \cdot L \cdot \left(\frac{N}{2}\right) \cdot N_c}{60}$$

Example with Units

$$7553\,kW = \frac{6.5\,Bar \cdot 0.166\,m^2 \cdot 600\,mm \cdot \left(\frac{7000\,rad/s}{2}\right) \cdot 2}{60}$$

14) Indicated Power using Brake Power and Friction Power Formula

Evaluate Formula

Formula

$$P_{4i} = P_{4b} + P_f$$

Example with Units

$$7553\,kW = 5537\,kW + 2016\,kW$$

15) Mechanical Efficiency of Diesel Engine Formula

Evaluate Formula

Formula

$$\eta_m = \frac{P_{4b}}{P_{4i}}$$

Example with Units

$$0.7331 = \frac{5537\,kW}{7553\,kW}$$

16) Mechanical Efficiency using Break Power and Friction Power Formula

Evaluate Formula

Formula

$$\eta_m = \frac{P_{4b}}{P_{4b} + P_f}$$

Example with Units

$$0.7331 = \frac{5537\,kW}{5537\,kW + 2016\,kW}$$

17) Mechanical Efficiency using Indicated Power and Friction Power Formula

Evaluate Formula

Formula

$$\eta_m = \frac{P_{4i} - P_f}{P_{4i}}$$

Example with Units

$$0.7331 = \frac{7553\,kW - 2016\,kW}{7553\,kW}$$

18) Overall Efficiency of Diesel Engine Power Plant Formula

Evaluate Formula

Formula

$$BTE = ITE \cdot \eta_m$$

Example

$$0.3665 = 0.5 \cdot 0.733$$

19) Overall Efficiency or Brake Thermal Efficiency using Brake Mean Effective Pressure Formula

Evaluate Formula

Formula

$$BTE = \frac{BMEP \cdot A \cdot L \cdot \left(\frac{N}{2}\right) \cdot N_c}{m_f \cdot CV \cdot 60}$$

Example with Units

$$0.371 = \frac{4.76\,Bar \cdot 0.166\,m^2 \cdot 600\,mm \cdot \left(\frac{7000\,rad/s}{2}\right) \cdot 2}{0.355\,kg/s \cdot 42000\,kJ/kg \cdot 60}$$

20) Overall Efficiency or Brake Thermal Efficiency using Friction Power and Indicated Power Formula

Evaluate Formula

Formula

$$BTE = \frac{P_{4i} - P_f}{m_f \cdot CV}$$

Example with Units

$$0.3714 = \frac{7553\,kW - 2016\,kW}{0.355\,kg/s \cdot 42000\,kJ/kg}$$

21) Overall Efficiency or Brake Thermal Efficiency using Mechanical Efficiency Formula

Evaluate Formula

Formula

$$BTE = \frac{\eta_m \cdot P_{4i}}{m_f \cdot CV}$$

Example with Units

$$0.3713 = \frac{0.733 \cdot 7553\,kW}{0.355\,kg/s \cdot 42000\,kJ/kg}$$

22) Thermal Efficiency of Diesel Engine Power Plant Formula

Evaluate Formula

Formula

$$ITE = \frac{BTE}{\eta_m}$$

Example

$$0.5048 = \frac{0.37}{0.733}$$

23) Thermal Efficiency using Friction Power Formula

Evaluate Formula

Formula

$$ITE = BTE \cdot \left(\frac{P_f + P_{4b}}{P_{4b}}\right)$$

Example with Units

$$0.5047 = 0.37 \cdot \left(\frac{2016\,kW + 5537\,kW}{5537\,kW}\right)$$

24) Thermal Efficiency using Indicated Mean Effective Pressure and Break Mean Effective Pressure Formula

Evaluate Formula

Formula

$$ITE = BTE \cdot \frac{IMEP}{BMEP}$$

Example with Units

$$0.5053 = 0.37 \cdot \frac{6.5\,Bar}{4.76\,Bar}$$

25) Thermal Efficiency using Indicated Power and Brake Power Formula

Evaluate Formula

Formula

$$ITE = BTE \cdot \frac{P_{4i}}{P_{4b}}$$

Example with Units

$$0.5047 = 0.37 \cdot \frac{7553\,kW}{5537\,kW}$$

26) Thermal Efficiency using Indicated Power and Fuel Consumption Rate Formula

Evaluate Formula

Formula

$$ITE = \frac{P_{4i}}{m_f \cdot CV}$$

Example with Units

$$0.5066 = \frac{7553\,kW}{0.355\,kg/s \cdot 42000\,kJ/kg}$$

27) Volumetric Efficiency of Diesel Engine Power Plant Formula

Evaluate Formula

Formula

$$VE = \frac{V}{V_c}$$

Example with Units

$$0.78 = \frac{1.794\,\text{m}^3}{2.3\,\text{m}^3}$$

28) Work Done per Cycle Formula

Evaluate Formula

Formula

$$W = IMEP \cdot A \cdot L$$

Example with Units

$$64.74\,\text{KJ} = 6.5\,\text{Bar} \cdot 0.166\,\text{m}^2 \cdot 600\,\text{mm}$$

Variables used in list of Diesel Engine Power Plant Formulas above

- **A** Piston Area *(Square Meter)*
- **B** Piston Bore *(Millimeter)*
- **BMEP** Brake Mean Effective Pressure *(Bar)*
- **BSFC** Brake Specific Fuel Consumption *(Kilogram per Hour per Kilowatt)*
- **BTE** Brake Thermal Efficiency
- **CV** Calorific Value *(Kilojoule per Kilogram)*
- **IMEP** Indicated Mean Effective Pressure *(Bar)*
- **ITE** Indicated Thermal Efficiency
- **K** Proportionality Constant
- **L** Stroke of Piston *(Millimeter)*
- m_f Fuel Consumption Rate *(Kilogram per Second)*
- **N** RPM *(Radian per Second)*
- N_c Number of Cylinders
- P_{2b} Brake Power of 2 Stroke *(Kilowatt)*
- P_{4b} Brake Power of 4 Stroke *(Kilowatt)*
- P_{4i} Indicated Power of 4 Stroke *(Kilowatt)*
- P_f Friction Power *(Kilowatt)*
- P_{i2} Indicated Power of 2 Stroke Engine *(Kilowatt)*
- **V** Volume of Air Induced *(Cubic Meter)*
- V_c Volume of Cylinder *(Cubic Meter)*
- **VE** Volumetric Efficiency
- **W** Work *(Kilojoule)*
- η_m Mechanical Efficiency
- **τ** Torque *(Kilonewton Meter)*

Constants, Functions, Measurements used in list of Diesel Engine Power Plant Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Volume** in Cubic Meter (m³)
  Volume Unit Conversion
- Measurement: **Area** in Square Meter (m²)
  Area Unit Conversion
- Measurement: **Pressure** in Bar (Bar)
  Pressure Unit Conversion
- Measurement: **Energy** in Kilojoule (KJ)
  Energy Unit Conversion
- Measurement: **Power** in Kilowatt (kW)
  Power Unit Conversion
- Measurement: **Heat of Combustion (per Mass)** in Kilojoule per Kilogram (kJ/kg)
  Heat of Combustion (per Mass) Unit Conversion
- Measurement: **Mass Flow Rate** in Kilogram per Second (kg/s)
  Mass Flow Rate Unit Conversion
- Measurement: **Angular Velocity** in Radian per Second (rad/s)
  Angular Velocity Unit Conversion
- Measurement: **Torque** in Kilonewton Meter (kN*m)
  Torque Unit Conversion
- Measurement: **Specific Fuel Consumption** in Kilogram per Hour per Kilowatt (kg/h/kW)
  Specific Fuel Consumption Unit Conversion

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