



# Design of Engine Valves Formulas

Calculators!

Examples!

Conversions!

Bookmark calculatoratoz.com, unitsconverters.com

Widest Coverage of Calculators and Growing - 30,000+ Calculators!

Calculate With a Different Unit for Each Variable - In built Unit Conversion!

Widest Collection of Measurements and Units - 250+ Measurements!

Feel free to SHARE this document with your friends!

Please leave your feedback here...



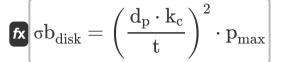


### List of 44 Design of Engine Valves Formulas

### Design of Engine Valves &

#### Valve Disk

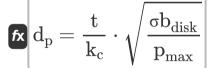
#### 1) Bending Stress in Valve Disk



Open Calculator

$$\mathbf{ex}$$
  $52.89256\mathrm{N/mm^2} = \left(rac{40\mathrm{mm}\cdot0.5}{5.5\mathrm{mm}}
ight)^2\cdot4\mathrm{MPa}$ 

#### 2) Diameter of Port given Thickness of Valve Disk



Open Calculator 🗗

$$ext{ex} \ 39.66106 ext{mm} = rac{5.5 ext{mm}}{0.5} \cdot \sqrt{rac{52 ext{N/mm}^2}{4 ext{MPa}}}$$

#### 3) Maximum Thickness of Valve Disk at Edges

fx 
$$t_{
m e} = 0.85 \cdot t$$

Open Calculator

$$\texttt{ex} \boxed{4.675 \text{mm} = 0.85 \cdot 5.5 \text{mm}}$$





#### 4) Minimum Thickness of Valve Disk at Edges

fx  $t_{
m e} = 0.75 \cdot {
m t}$ 

Open Calculator 🚰

 $4.125 \mathrm{mm} = 0.75 \cdot 5.5 \mathrm{mm}$ 

#### 5) Thickness of Valve Disk

 $t = k_c \cdot d_p \cdot \sqrt{rac{p_{max}}{\sigma b_{disk}}}$ 

Open Calculator 🗗

 $\mathbf{ex} \left[ 5.547002 \mathrm{mm} = 0.5 \cdot 40 \mathrm{mm} \cdot \sqrt{\frac{4 \mathrm{MPa}}{52 \mathrm{N/mm^2}}} 
ight]$ 

#### 6) Thickness of Valve Disk given Projected Width of Valve Seat

 $t = k_{c} \cdot rac{w}{0.06} \cdot \sqrt{rac{p_{max}}{\sigma b_{disk}}}$ 

Open Calculator 🚰

7) Thickness of Valve Disk Made of Cast Iron

 $oxed{ex} 6.933752 \mathrm{mm} = 0.5 \cdot rac{3 \mathrm{mm}}{0.06} \cdot \sqrt{rac{4 \mathrm{MPa}}{52 \mathrm{N/mm^2}}}$ 

$$t = 0.54 \cdot d_p \cdot \sqrt{rac{p_{max}}{\sigma b_{disk}}}$$

Open Calculator

 $= 5.990762 ext{mm} = 0.54 \cdot 40 ext{mm} \cdot \sqrt{rac{4 ext{MPa}}{52 ext{N/mm}^2}}$ 







#### 8) Thickness of Valve Disk Made of Steel

 $t = 0.42 \cdot d_p \cdot \sqrt{rac{p_{max}}{\sigma b_{disk}}}$ 

Open Calculator

 $= 4.659482 ext{mm} = 0.42 \cdot 40 ext{mm} \cdot \sqrt{\frac{4 ext{MPa}}{52 ext{N/mm}^2}}$ 

#### Valve Head

9) Diameter of Port given Diameter of Valve Head and Projected Width of Valve Seat

fx  $d_{
m p}=d_{
m v}-2\cdot {
m w}$ 

Open Calculator 🗗

 $44\text{mm} = 50\text{mm} - 2 \cdot 3\text{mm}$ 

10) Diameter of Port given Projected Width of Valve Seat

 $\mathbf{f}\mathbf{x} egin{aligned} \mathbf{d}_\mathrm{p} = rac{\mathrm{w}}{0.06} \end{aligned}$ 

Open Calculator 🚰

 $= 50 \text{mm} = \frac{3 \text{mm}}{0.06}$ 

11) Diameter of Valve Head given Diameter of Port and Projected Width of Valve Seat

fx  $d_{
m v} = d_{
m p} + 2 \cdot {
m w}$ 

Open Calculator

 $\texttt{ex} \ 46 \text{mm} = 40 \text{mm} + 2 \cdot 3 \text{mm}$ 







## 12) Diameter of Valve Head given Load on Exhaust Valve and Back

 $\mathbf{f}_{\mathbf{v}} = \sqrt{rac{4 \cdot \mathrm{P_g}}{\pi \cdot \mathrm{P_{back}}}}$ 

Open Calculator

 $= \sqrt{\frac{4 \cdot 1680 \text{N}}{\pi \cdot 0.8 \text{MPs}}}$ 

### 13) Diameter of Valve Head given Port Diameter

fx  $d_{
m v} = 1.12 \cdot d_{
m p}$ 

Open Calculator 🚰

 $| 44.8 \mathrm{mm} = 1.12 \cdot 40 \mathrm{mm}$ 

14) Diameter of Valve Head given Projected Width of Valve Seat

fx  $d_{
m v}=18.666\cdot{
m w}$ 

Open Calculator

 $= 18.666 \cdot 3$ mm

15) Maximum Projected Width of Valve Seat given Port Diameter

fx  $w = 0.07 \cdot d_p$ 

Open Calculator

 $= 2.8 \text{mm} = 0.07 \cdot 40 \text{mm}$ 

16) Minimum Projected Width of Valve Seat given Port Diameter

fx  $w = 0.05 \cdot d_p$ 

Open Calculator

 $2mm = 0.05 \cdot 40mm$ 





#### 17) Port Diameter given Diameter of Valve Head

 $d_p = \frac{d_v}{1.12}$ 

Open Calculator

 $= 44.64286 \text{mm} = \frac{50 \text{mm}}{1.12}$ 

### 18) Projected Width of Valve Seat given Diameter of Port and Diameter of Valve Head

 $\mathbf{fx} \mathbf{w} = rac{\mathrm{d_v} - \mathrm{d_p}}{2}$ 

Open Calculator

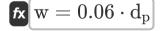
extstyle ext

#### 19) Projected Width of Valve Seat given Diameter of Valve Head

fx  $w=rac{d_{
m v}}{18.666}$ 

Open Calculator

#### 20) Projected Width of Valve Seat given Port Diameter



Open Calculator

 $2.4 \mathrm{mm} = 0.06 \cdot 40 \mathrm{mm}$ 





Open Calculator

Open Calculator

#### Valve Lift 🗗

 $\mathbf{f}\mathbf{x} \left[ \mathrm{d_p} = 4 \cdot \mathrm{h_{max}} \cdot \mathrm{cos}(lpha) 
ight]$ 

21) Diameter of Port given Maximum Lift of Valve

 $\alpha)$ 

 $\texttt{ex} \boxed{31.1127 \text{mm} = 4 \cdot 11 \text{mm} \cdot \cos(45°)}$ 

#### 22) Force Required to Lift Engine Valve

fx  $P_2 = \mathbf{k} \cdot \mathbf{h}_{max}$ 

#### 23) Lift of Engine Valve

 $h_{max} = rac{P_2}{k}$ 

Open Calculator 🗗

Open Calculator

 $oxed{26.88172 ext{mm}} = rac{250 ext{N}}{9.3 ext{N/mm}}$ 

#### 24) Maximum Lift of Valve for Flat Headed Valves

 $extstyle h_{ ext{max}} = rac{ ext{d}_{ ext{p}}}{4}$ 

**5** 

 $\boxed{10\text{mm} = \frac{40\text{mm}}{4}}$ 



#### 25) Maximum Lift of Valve given Diameter of Port and Valve Seat Angle 💪

 $\mathbf{f}_{\mathbf{k}} egin{aligned} \mathbf{h}_{\mathrm{max}} &= rac{\mathbf{d}_{\mathrm{p}}}{4 \cdot \cos(lpha)} \end{aligned}$ 

Open Calculator 🗗

ex 14.14214mm =  $\frac{40$ mm  $4 \cdot \cos(45^{\circ})$ 

#### 26) Valve Seat Angle given Maximum Lift of Valve

 $lpha = \overline{ rccosigg(rac{\mathrm{d_p}}{4\cdot\mathrm{h_{max}}}igg)}$ 

Open Calculator 🚰

 $oxed{ex} 24.61998\degree = rccosigg(rac{40 \mathrm{mm}}{4 \cdot 11 \mathrm{mm}}igg)$ 

#### Valve Port

#### 27) Acceleration of Exhaust Valve

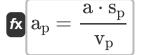
 $\mathbf{f}_{\mathbf{x}} = rac{\mathrm{Pa}_{\mathrm{valve}}}{\mathrm{m}}$ 

Open Calculator 🗗

 $m ex = 255.5556m/s^2 = rac{115N}{0.45kg}$ 



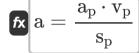
#### 28) Area of IC Engine Port given Cross-Section Area of Piston



Open Calculator 🚰

 $extbf{ex} 1318.5 ext{mm}^2 = rac{5860 ext{mm}^2 \cdot 4.5 ext{m/s}}{20 ext{m/s}}$ 

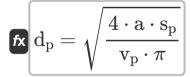
#### 29) Cross-Section Area of IC Engine Piston given Area of Port



Open Calculator

 $oxed{ex} 5511.111 \mathrm{mm^2} = rac{1240 \mathrm{mm^2 \cdot 20 m/s}}{4.5 \mathrm{m/s}}$ 

#### 30) Diameter of IC Engine Port

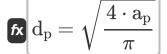


Open Calculator

 $ag{40.97275 ext{mm}} = \sqrt{rac{4\cdot5860 ext{mm}^2\cdot4.5 ext{m/s}}{20 ext{m/s}\cdot\pi}}$ 



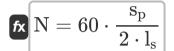
#### 31) Diameter of IC Engine Port given Area of Port



Open Calculator

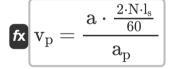
ex 
$$39.73433 \mathrm{mm} = \sqrt{\frac{4 \cdot 1240 \mathrm{mm}^2}{\pi}}$$

### 32) Engine Speed given Mean Velocity of Piston and Stroke Length



Open Calculator

### 33) Mean Velocity of Gas through IC Engine Port given Engine Speed, Stroke, Area of Piston and Port



Open Calculator

$$ext{ex} = rac{5860 ext{mm}^2 \cdot rac{2 \cdot 500 \cdot 275 ext{mm}}{60}}{1240 ext{mm}^2}$$



#### 34) Mean Velocity of Gas through IC Engine Port given Velocity of Piston

€.

$$\mathbf{v}_{\mathrm{p}} = rac{\mathbf{a} \cdot \mathbf{s}_{\mathrm{p}}}{\mathbf{a}_{\mathrm{p}}}$$

Open Calculator

$$\mathbf{ex} = 21.26613 \mathrm{m/s} = \frac{5860 \mathrm{mm^2 \cdot 4.5 m/s}}{1240 \mathrm{mm^2}}$$

### 35) Mean Velocity of IC Engine Piston given Engine Speed and Stroke Length

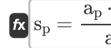


$$=rac{2\cdot\mathrm{N}\cdot\mathrm{l_s}}{60}$$

Open Calculator

$$= \frac{2 \cdot 500 \cdot 275 \text{mm}}{60}$$





$$oxed{4.232082 ext{m/s}} = rac{1240 ext{mm}^2 \cdot 20 ext{m/s}}{5860 ext{mm}^2}$$



### 37) Stroke Length of Piston given Mean Velocity of Piston and Engine Speed

 $\mathbf{f}_{\mathrm{s}} = rac{60 \cdot \mathrm{s_p}}{2 \cdot \mathrm{N}}$ 

Open Calculator 🚰

 $\boxed{\texttt{ex}} 270 \text{mm} = \frac{60 \cdot 4.5 \text{m/s}}{2 \cdot 500}$ 

#### Valve Stem

#### 38) Diameter of Port given Diameter of Valve Stem

 $\mathrm{d}_\mathrm{p} = rac{\mathrm{d}_\mathrm{s}}{1.5 \cdot \left(1 - rac{\sigma_\mathrm{t} \cdot \mathrm{t}^2}{1.4 \cdot \mathrm{P}_\mathrm{sp}}
ight)}$ 

Open Calculator 🗗

ex 40.73903mm =  $\frac{15$ mm  $1.5 \cdot \left(1 - \frac{2.2 \text{N/mm}^2 \cdot (5.5 \text{mm})^2}{1.4 \cdot 63 \text{N}}\right)$ 

#### 39) Diameter of Valve Stem

 $\left|\mathbf{f}_{\mathbf{k}}
ight|\mathbf{d}_{\mathrm{s}}=1.5\cdot\mathbf{d}_{\mathrm{p}}\cdot\left(1-rac{\sigma_{\mathrm{t}}\cdot\mathbf{t}^{2}}{1.4\cdot\mathrm{P_{sn}}}
ight)
ight|$ 

Open Calculator 🗗

 $\boxed{ 14.72789 \mathrm{mm} = 1.5 \cdot 40 \mathrm{mm} \cdot \left( 1 - \frac{2.2 \mathrm{N/mm^2} \cdot (5.5 \mathrm{mm})^2}{1.4 \cdot 63 \mathrm{N}} \right) }$ 



#### 40) Maximum Diameter of Valve Stem

 $\left|\mathbf{d}_{\mathrm{s}}
ight| \mathbf{d}_{\mathrm{s}} = rac{\mathrm{d}_{\mathrm{p}}}{\mathrm{g}} + 11$ 

Open Calculator

 $\boxed{\textbf{ex} 16\text{mm} = \frac{40\text{mm}}{8} + 11}$ 

#### 41) Minimum Diameter of Valve Stem

 $d_{
m s}=rac{{
m d}_{
m p}}{8}+6.35$ 

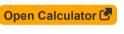
Open Calculator

=  $\frac{40 \mathrm{mm}}{8} + 6.35$ 

#### 42) Spring Force on Valve when Seated

 $extbf{F}_{ ext{sp}} = rac{rac{\sigma_{ ext{t}} \cdot ext{t}^2}{1 - rac{2 \cdot ext{d}_{ ext{s}}}{3 \cdot ext{d}_{ ext{p}}}}}{1.4}$ 

 $ext{ex} 63.38095 ext{N} = rac{rac{2.2 ext{N/mm}^2 \cdot (5.5 ext{mm})^2}{1 - rac{2 \cdot 15 ext{mm}}{3 \cdot 40 ext{mm}}}}{1.4}$ 





#### 43) Tensile Stress in Valve Stem due to Spring Force on Valve

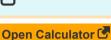


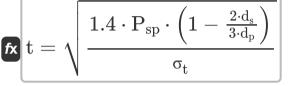
 $\sigma_{
m t} = 1.4 \cdot rac{{
m P}_{
m sp}}{{
m t}^2} \cdot \left(1 - rac{2 \cdot {
m d}_{
m s}}{3 \cdot {
m d}_{
m p}}
ight)$ 

Open Calculator 2

 $ext{ex} \left[ 2.186777 ext{N/mm}^2 = 1.4 \cdot rac{63 ext{N}}{\left( 5.5 ext{mm} 
ight)^2} \cdot \left( 1 - rac{2 \cdot 15 ext{mm}}{3 \cdot 40 ext{mm}} 
ight) 
ight]$ 

#### 44) Thickness of Valve Disk given Force of Spring on Valve





$$extbf{ex} 5.483446 ext{mm} = \sqrt{rac{1.4 \cdot 63 ext{N} \cdot \left(1 - rac{2 \cdot 15 ext{mm}}{3 \cdot 40 ext{mm}}
ight)}{2.2 ext{N/mm}^2}}$$



#### Variables Used

- a Cross Section Area of Piston (Square Millimeter)
- a<sub>p</sub> Area of Port (Square Millimeter)
- a<sub>v</sub> Acceleration of Valve (Meter per Square Second)
- d<sub>p</sub> Diameter of Port (Millimeter)
- d<sub>S</sub> Diameter of Valve Stem (Millimeter)
- **d**<sub>v</sub> Diameter of Valve Head (Millimeter)
- h<sub>max</sub> Lift of Valve (Millimeter)
- **k** Stiffness of Valve Spring (Newton per Millimeter)
- k<sub>c</sub> Material Constant
- I<sub>S</sub> Stroke Length (Millimeter)
- m Mass of Valve (Kilogram)
- N Engine Speed in rpm
- P<sub>2</sub> Force to Lift Engine Valve (Newton)
- P<sub>hack</sub> Back Pressure on Engine Valve (Megapascal)
- P<sub>q</sub> Gas Load on Exhaust Valve (Newton)
- p<sub>max</sub> Maximum Gas Pressure inside Cylinder (Megapascal)
- P<sub>sp</sub> Spring Force on Seated Valve (Newton)
- Pavalve Inertia Force on Valve (Newton)
- **S**<sub>D</sub> Mean Piston Speed (Meter per Second)
- t Thickness of Valve Disk (Millimeter)
- t<sub>e</sub> Thickness of Valve Disk at Edges (Millimeter)





- V<sub>p</sub> Velocity of Gas through Port (Meter per Second)
- **w** Projected Width of Valve Seat (Millimeter)
- α Valve Seat Angle (Degree)
- σ<sub>t</sub> Tensile Stress in Valve Stem (Newton per Square Millimeter)
- σb<sub>disk</sub> Bending Stress in Valve Disk (Newton per Square Millimeter)





#### Constants, Functions, Measurements used

- Constant: pi, 3.14159265358979323846264338327950288
   Archimedes' constant
- Function: arccos, arccos(Number)

  Inverse trigonometric cosine function
- Function: cos, cos(Angle)

  Trigonometric cosine function
- Function: sqrt, sqrt(Number)
   Square root function
- Measurement: Length in Millimeter (mm)
   Length Unit Conversion
- Measurement: Weight in Kilogram (kg)
   Weight Unit Conversion
- Measurement: Area in Square Millimeter (mm²)
   Area Unit Conversion
- Measurement: Pressure in Megapascal (MPa)
   Pressure Unit Conversion
- Measurement: Speed in Meter per Second (m/s)
   Speed Unit Conversion
- Measurement: Acceleration in Meter per Square Second (m/s²)

  Acceleration Unit Conversion
- Measurement: Force in Newton (N)
   Force Unit Conversion
- Measurement: Angle in Degree (°)
   Angle Unit Conversion
- Measurement: Stiffness Constant in Newton per Millimeter (N/mm)
   Stiffness Constant Unit Conversion





• Measurement: Stress in Newton per Square Millimeter (N/mm²)

Stress Unit Conversion





#### Check other formula lists

- Design of Engine Valves
   Design of Valve Spring Formulas
  - Formulas (
- Design of Push Rod Formulas Engine Cylinder Formulas •
- Design of Rocker Arm Formulas

Feel free to SHARE this document with your friends!

#### PDF Available in

English Spanish French German Russian Italian Portuguese Polish Dutch

11/22/2023 | 2:55:24 PM UTC

Please leave your feedback here...



