



# Sheet Metal Operations Formulas

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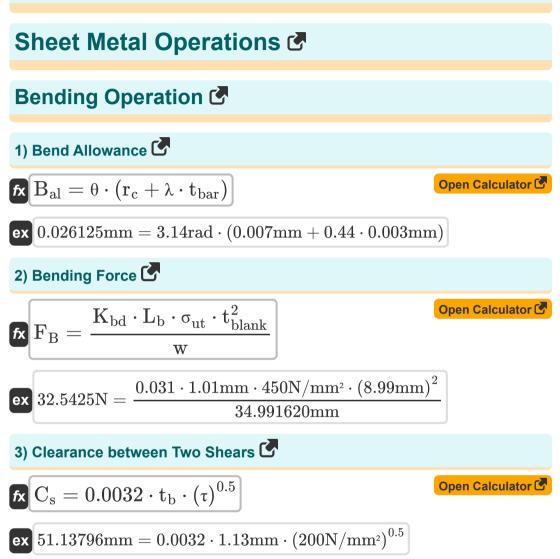
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## **List of 26 Sheet Metal Operations Formulas**





Sheet Metal Operations Formulas... 3/13 4) Length of Bent Part in Bending Operation  $\mathbf{fx} \left[ \mathrm{L_{b}} = rac{\mathrm{F_{B}} \cdot \mathrm{w}}{\mathrm{K_{bd}} \cdot \sigma_{\mathrm{ut}} \cdot \mathrm{t_{stk}^{2}}} 
ight]$ Open Calculator ex  $1.007757 \text{mm} = \frac{32.5425 \text{N} \cdot 34.991620 \text{mm}}{0.031 \cdot 450 \text{N/mm}^2 \cdot (9 \text{mm})^2}$ 5) Stock Thickness used in Bending Operation 🗹 Open Calculator fx  $t_{\mathrm{stk}} = \sqrt{rac{\mathrm{F}_{\mathrm{B}}\cdot\mathrm{w}}{\mathrm{K}_{\mathrm{bd}}\cdot\mathrm{L}_{\mathrm{b}}\cdot\sigma_{\mathrm{ut}}}}$ ex  $8.99 \text{mm} = \sqrt{\frac{32.5425 \text{N} \cdot 34.991620 \text{mm}}{0.031 \cdot 1.01 \text{mm} \cdot 450 \text{N/mm}^2}}$ 6) Width between Contact Points during Bending 🕑 Open Calculator  $w = \frac{K_{bd} \cdot L_b \cdot \sigma_{ut} \cdot t_{blank}^2}{F_B}$ ex  $34.99162 \text{mm} = \frac{0.031 \cdot 1.01 \text{mm} \cdot 450 \text{N/mm}^2 \cdot (8.99 \text{mm})^2}{(8.99 \text{mm})^2 \cdot (8.99 \text{mm})^2}$ 32.5425N



Open Calculator 🕑

#### Drawing Operation C

#### 7) Blank Diameter from Percent Reduction 🕑

fx 
$$D_{\mathrm{b}} = \mathrm{d_s} \cdot \left(1 - rac{\mathrm{PR}_\%}{100}
ight)^{-1}$$

$$84.21053 \mathrm{mm} = 80 \mathrm{mm} \cdot \left(1 - rac{5}{100}
ight)^{-1}$$

#### 8) Blank Size for Drawing Operation 子

fx 
$$\mathrm{D_b} = \sqrt{\mathrm{d}_\mathrm{s}^2 + 4 \cdot \mathrm{d}_\mathrm{s} \cdot \mathrm{h_{shl}}}$$

ex 84.19026mm = 
$$\sqrt{(80 \text{mm})^2 + 4 \cdot 80 \text{mm} \cdot 2.15 \text{mm}}$$

#### 9) Drawing Force for Cylindrical Shells 🕑

fx 
$$\mathbf{P}_{\mathrm{d}} = \pi \cdot \mathbf{d}_{\mathrm{s}} \cdot \mathbf{t}_{\mathrm{b}} \cdot \mathbf{\sigma}_{\mathrm{y}} \cdot \left( \frac{\mathbf{D}_{\mathrm{b}}}{\mathbf{d}_{\mathrm{s}}} - \mathbf{C}_{\mathrm{f}} \right)$$

Open Calculator 🕑

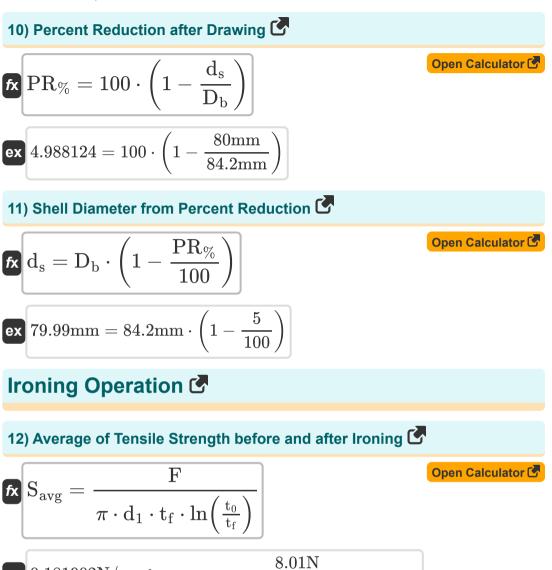
$$0.004498 {
m N/mm^2} = \pi \cdot 80 {
m mm} \cdot 1.13 {
m mm} \cdot 35 {
m N/mm^2} \cdot \left(rac{84.2 {
m mm}}{80 {
m mm}} - 0.6
ight)$$



ex

e)

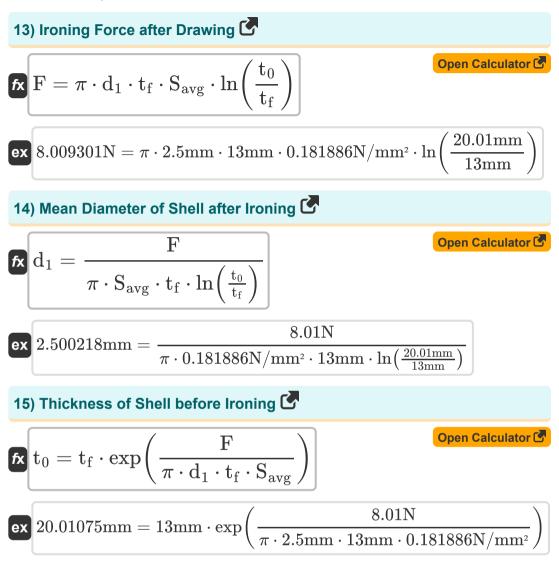




ex 
$$0.181902 \text{N/mm}^2 = \frac{8.01 \text{N}}{\pi \cdot 2.5 \text{mm} \cdot 13 \text{mm} \cdot \ln(\frac{20.01 \text{mm}}{13 \text{mm}})}$$

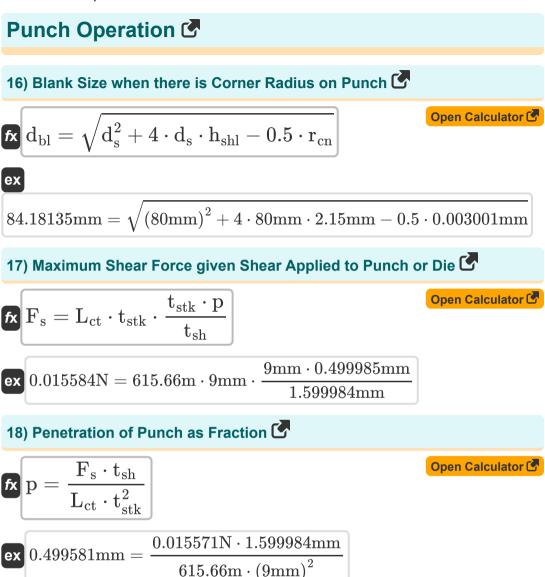




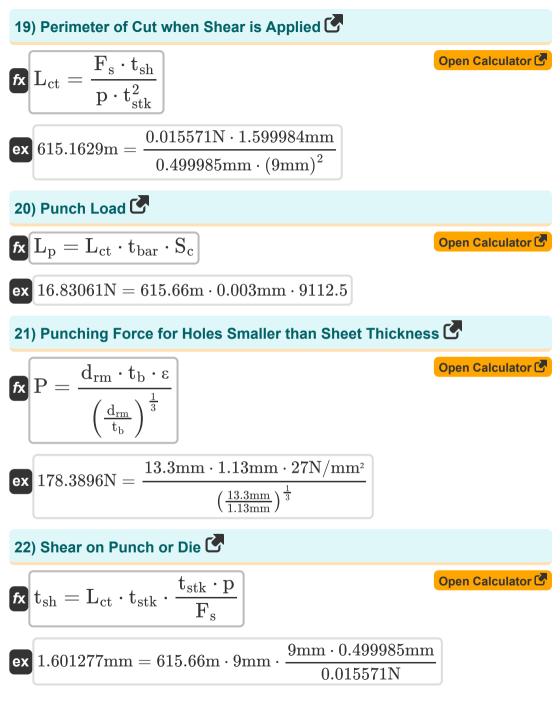








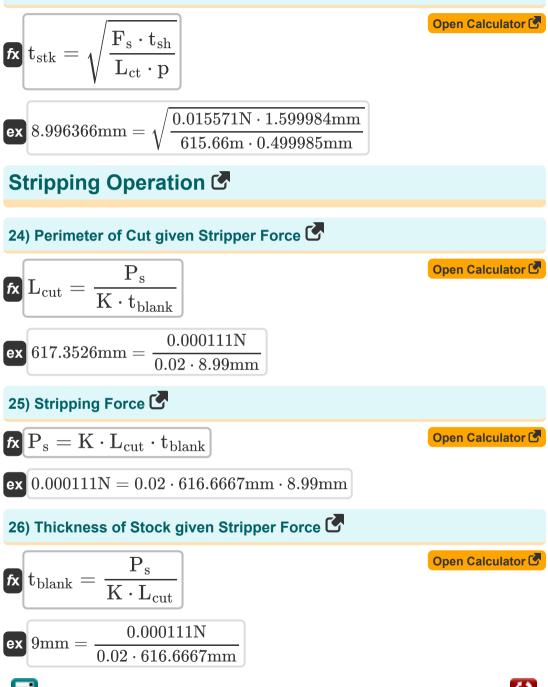








23) Stock Thickness when Shear used on Punch 🕑



## Variables Used

- **B**al Bend Allowance (*Millimeter*)
- Cf Cover Friction Constant
- C<sub>s</sub> Clearance between Two Shears (Millimeter)
- **d<sub>1</sub>** Mean Shell Diameter after Ironing (*Millimeter*)
- D<sub>b</sub> Sheet Diameter (Millimeter)
- d<sub>bl</sub> Blank Diameter (Millimeter)
- **d**<sub>rm</sub> Punch or Ram Diameter (Millimeter)
- **d**<sub>s</sub> Outer Diameter of Shell (Millimeter)
- **F** Ironing Force (Newton)
- **F**<sub>B</sub> Bending Force (Newton)
- **F**<sub>s</sub> Maximum Shear Force (*Newton*)
- hshl Shell Height (Millimeter)
- K Stripping Constant
- Kbd Bending Die Constant
- L<sub>b</sub> Bent Part Length (Millimeter)
- Lct Cutting Perimeter (Meter)
- Lcut Perimeter of Cut (Millimeter)
- L<sub>p</sub> Punch Load (Newton)
- **p** Punch Penetration (*Millimeter*)
- P Punching Force or Load (Newton)
- **P**<sub>d</sub> Drawing Force (Newton per Square Millimeter)

- **P**<sub>S</sub> Stripper Force (Newton)
- PR<sub>%</sub> Percent Reduction after Drawing
- r<sub>c</sub> Radius (Millimeter)
- rcn Corner Radius on Punch (Millimeter)
- S<sub>avg</sub> Average Tensile Strength Before & After Ironing (Newton per Square Millimeter)
- Sc Strength Coefficient
- to Shell Thickness before Ironing (Millimeter)
- tb Sheet Thickness (Millimeter)
- t<sub>bar</sub> Bar Thickness (Millimeter)
- tblank Blank Thickness (Millimeter)
- t<sub>f</sub> Shell Thickness after Ironing (Millimeter)
- t<sub>sh</sub> Shear on Punch (Millimeter)
- tstk Thickness of Stock (Millimeter)
- W Width between Contact Points (Millimeter)
- E Tensile Strength (Newton per Square Millimeter)
- **0** Subtended Angle in Radians (*Radian*)
- λ Stretch Factor
- σ<sub>ut</sub> Ultimate Tensile Strength (Newton per Square Millimeter)
- σ<sub>v</sub> Yield Strength (Newton per Square Millimeter)
- **T** Shear Strength of Material (Newton per Square Millimeter)

### **Constants, Functions, Measurements used**

- Constant: pi, 3.14159265358979323846264338327950288 Archimedes' constant
- Function: exp, exp(Number) n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.
- Function: In, In(Number) The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.
- 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 Millimeter (mm), Meter (m) Length Unit Conversion
- Measurement: **Pressure** in Newton per Square Millimeter (N/mm<sup>2</sup>) *Pressure Unit Conversion*
- Measurement: Force in Newton (N) Force Unit Conversion
- Measurement: Angle in Radian (rad) Angle Unit Conversion



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