



Distortion in Weldments Formulas

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List of 25 Distortion in Weldments Formulas

Distortion in Weldments

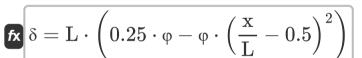
Angular Distortion

1) Angular Change when there is Maximum Distortion of Fillet Welds

$$\phi = rac{\delta_{
m max}}{0.25 \cdot L}$$

 $\boxed{1.2\mathrm{rad} = \frac{1.5\mathrm{mm}}{0.25 \cdot 5\mathrm{mm}}}$

2) Angular Distortion at x of Fillet Welds



Open Calculator 🗗

Open Calculator

Open Calculator

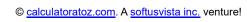
$$\boxed{ 0.54 \mathrm{mm} = 5 \mathrm{mm} \cdot \left(0.25 \cdot 1.2 \mathrm{rad} - 1.2 \mathrm{rad} \cdot \left(\frac{0.5 \mathrm{mm}}{5 \mathrm{mm}} - 0.5 \right)^2 \right) }$$

3) Length of Span for Maximum Angular Distortion of Fillet Welds

$$ext{L} = rac{\delta_{ ext{max}}}{0.25 \cdot \phi}$$

 $\texttt{ex} \ \texttt{5mm} = \frac{1.5 \text{mm}}{0.25 \cdot 1.2 \text{rad}}$







4) Maximum Angular Distortion of Fillet Welds

fx $\delta_{
m max} = 0.25 \cdot \phi \cdot {
m L}$

Open Calculator 🚰

- $ex 1.5mm = 0.25 \cdot 1.2rad \cdot 5mm$
- 5) Rigidity of Fillet Welds
- $m R = rac{E \cdot p_{tb}^3}{12 + \left(1 oldsymbol{
 u}^2
 ight)}$

Open Calculator

Butt Joints 🚰

6) Cross-sectional area of weld for given transverse shrinkage in butt joints

 $\mathbf{K} \mathbf{A}_{\mathrm{w}} = rac{\mathbf{p}_{\mathrm{tb}} \cdot (\mathbf{S}_{\mathrm{b}} - 1.27 \cdot \mathbf{d})}{5.08}$

Open Calculator

 $= \frac{802.87 \text{mm} \cdot (0.365 \text{mm} - 1.27 \cdot 0.26 \text{mm})}{5.08}$



7) Degree of Restraint (Butt joints)

 $\mathbf{k}_{\mathrm{s}} = \left(rac{1000}{86} \cdot \left(rac{\mathrm{S}}{\mathrm{s}} - 1
ight)
ight)^{rac{1}{0.87}}$

Open Calculator 🗗

 $\boxed{ 647.3872 = \left(\frac{1000}{86} \cdot \left(\frac{100 \mathrm{mm}}{4 \mathrm{mm}} - 1 \right) \right)^{\frac{1}{0.87}} }$

8) Depth of First V-groove for Minimum Distortion of Butt Joint

fx $egin{aligned} \mathbf{f_1} = rac{0.62 \cdot \mathbf{t_2} + 0.12 \cdot \mathbf{t_3}}{0.38} \end{aligned}$

Open Calculator

9) Depth of Last V-groove for Minimum Distortion of Butt Joint

fx $t_2=rac{0.38\cdot ext{t}_1-0.12\cdot ext{t}_3}{0.62}$

Open Calculator 🗗

 $\mathbf{ex} \left[2.597097 \mathrm{mm} = rac{0.38 \cdot 6.29 \mathrm{mm} - 0.12 \cdot 6.5 \mathrm{mm}}{0.62}
ight]$

10) Depth of Root Face for Minimum Distortion of Butt Joint

 $\mathbf{t}_3 = rac{0.38 \cdot \mathrm{t}_1 - 0.62 \cdot \mathrm{t}_2}{0.12}$

Open Calculator 🗗

 $= \frac{0.38 \cdot 6.29 \text{mm} - 0.62 \cdot 2.6 \text{mm}}{0.12}$





11) Metal Deposited in First Pass of Welding given Transverse Shrinkage

fx
$$\left[\mathrm{w}_0 = rac{\mathrm{w}}{10^{rac{\mathrm{S_t} - \mathrm{S_0}}{\mathrm{b}}}}
ight]$$

Open Calculator 🚰

 $ext{ex} 4.99 ext{g} = rac{5.14064 ext{g}}{10^{rac{5.30 ext{mm} - 2.20 ext{mm}}{0.24}}}$

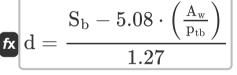
12) Plate Thickness for given Transverse Shrinkage in Butt Joints

 $p_{
m tb} = rac{5.08 \cdot {
m A_w}}{{
m S_b} - (1.27 \cdot {
m d})}$

Open Calculator

 $\mathbf{ex} \left[802.8736 \mathrm{mm} = rac{5.08 \cdot 5.5 \mathrm{mm}^2}{0.365 \mathrm{mm} - (1.27 \cdot 0.26 \mathrm{mm})}
ight]$

13) Root Opening given Transverse Shrinkage



Open Calculator

 $extbf{ex} 0.26 ext{mm} = rac{0.365 ext{mm} - 5.08 \cdot \left(rac{5.5 ext{mm}^2}{802.87 ext{mm}}
ight)}{1.27}$



14) Shrinkage of Unrestrained Joint from given Shrinkage of Restrained Butt Joint

 $extbf{K} = ext{S} \cdot (1 + 0.086 \cdot ext{k}_{ ext{s}}^{0.87})$

Open Calculator 🚰

ex $100 \text{mm} = 4 \text{mm} \cdot \left(1 + 0.086 \cdot (647.3872)^{0.87}\right)$

15) Total Metal Deposited in Weld given Total Transverse Shrinkage

 $\mathbf{w} = \mathbf{w}_0 \cdot \left(10^{rac{\mathrm{S_t} - \mathrm{S_0}}{\mathrm{b}}}
ight)$

Open Calculator

 $extbf{ex} \left[5.14064 ext{g} = 4.99 ext{g} \cdot \left(10^{rac{5.30 ext{mm} - 2.20 ext{mm}}{0.24}}
ight)
ight]$

16) Total Transverse Shrinkage during Multi-Pass Welding of Butt Joint

 $\mathbf{x} \left[\mathrm{S_t} = \mathrm{S_0} + \mathrm{b} \cdot \left(\log 10 \! \left(rac{\mathrm{w}}{\mathrm{w_0}}
ight)
ight)
ight]$

Open Calculator 🗗

 $= 2.20 \text{mm} + 0.24 \cdot \left(\log 10 \left(\frac{5.14064 \text{g}}{4.99 \text{g}} \right) \right)$

17) Transverse Shrinkage in Butt Joints 🗗



Open Calculator

$$0.365 \mathrm{mm} = \left(5.08 \cdot \left(\frac{5.5 \mathrm{mm}^2}{802.87 \mathrm{mm}}\right)\right) + (1.27 \cdot 0.26 \mathrm{mm})$$





18) Transverse Shrinkage in First Pass given Total Shrinkage

 $\mathbf{E} \left[\mathbf{S}_0 = \mathbf{S}_{\mathrm{t}} - \mathbf{b} \cdot \left(\log 10 \left(rac{\mathbf{w}}{\mathbf{w}_0}
ight)
ight)
ight]$

Open Calculator 🗗

19) Transverse Shrinkage of Restrained Joint

fx $\mathrm{s} = rac{\mathrm{S}}{1 + 0.086 \cdot \mathrm{k_s^{0.87}}}$

Open Calculator

 $ext{ex} = rac{100 ext{mm}}{1 + 0.086 \cdot (647.3872)^{0.87}}$

Lap Joint with Fillets 🗗

20) Length of Fillet Leg in Lap Joints from Shrinkage

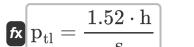
 $ag{h} = rac{ ext{s} \cdot ext{p}_{ ext{tl}}}{1.52}$

Open Calculator 🗗

 $= 2.105711 \text{mm} = \frac{4 \text{mm} \cdot 800.17 \text{mm}}{1.52}$



21) Thickness of Plates in Lap Joints 🔓

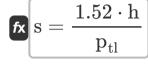


Open Calculator 🗗

= $\frac{1.52 \cdot 2.39 \mathrm{mm}}{4 \mathrm{mm}}$

22) Transverse Shrinkage in Lap Joint with Fillets

 $1.52 \cdot 2.39 \text{mm}$

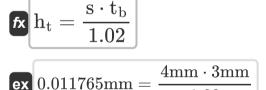


Open Calculator 🖸

 $4.540035 \text{mm} = \frac{1.52 - 2.55 \text{mm}}{800.17 \text{mm}}$

T-Joint with Two Fillets

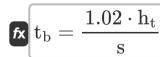
23) Length of Fillet Leg from Transverse Shrinkage in T-Joints



Open Calculator

1.02

24) Thickness of Bottom Plate in T-Joints



Open Calculator

 $\mathbf{ex} \left[2.55 \mathrm{mm} = rac{1.02 \cdot .01 \mathrm{mm}}{4 \mathrm{mm}}
ight]$



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25) Transverse Shrinkage in T-Joint with Two Fillets



Open Calculator

$$extbf{x} = rac{1.02 \cdot ext{h}_{ ext{t}}}{ ext{t}_{ ext{b}}}$$

$$\boxed{3.4\text{mm} = \frac{1.02 \cdot .01\text{mm}}{3\text{mm}}}$$



Variables Used

- A_w Cross Sectional Area of Weld (Square Millimeter)
- b Constant For Multi Pass Shrinkage
- **d** Root Opening (Millimeter)
- E Young's Modulus (Newton per Meter)
- **h** Length of Fillet Leg (Millimeter)
- **h**_t Length of Fillet Leg in T Joint (Millimeter)
- k_s Degree of Restraint
- L Length of Span of The Fillet Welds (Millimeter)
- **p**_{th} Plate Thickness in Butt Joint (Millimeter)
- **p**_{tl} Plate Thickness in Lap Joint (Millimeter)
- R Rigidity of Fillet Weld (Newton Meter per Radian)
- **S** Transverse Shrinkage (Millimeter)
- S Transverse Shrinkage of Unrestrained Joint (Millimeter)
- Sn Transverse Shrinkage in First Pass (Millimeter)
- S_h Transverse Shrinkage of Butt Joint (Millimeter)
- S_t Total Transverse Shrinkage (Millimeter)
- t₁ Depth of The First V Groove (Millimeter)
- t₂ Depth of The Last V Groove (Millimeter)
- **t**₃ Depth of Root Face (Millimeter)
- t_h Thickness of Bottom Plate (Millimeter)
- w Total Weight of Weld Metal Deposited (Gram)
- W₀ Weld Metal Deposited in First Pass (Gram)





- **X** Distance from the Center Line of the Frame (Millimeter)
- δ Distortion at Some Distance (Millimeter)
- δ_{max} Maximum Distortion (Millimeter)
- **Φ** Angular Change in Restrained Joints (Radian)
- ν Poisson's Ratio





Constants, Functions, Measurements used

- Function: log10, log10(Number)

 The common logarithm, also known as the base-10 logarithm or the decimal logarithm, is a mathematical function that is the inverse of the exponential function.
- Measurement: Length in Millimeter (mm)
 Length Unit Conversion
- Measurement: Weight in Gram (g)
 Weight Unit Conversion
- Measurement: Area in Square Millimeter (mm²)
 Area Unit Conversion
- Measurement: Angle in Radian (rad)
 Angle Unit Conversion
- Measurement: Torsion Constant in Newton Meter per Radian (Nm/rad)
 Torsion Constant Unit Conversion
- Measurement: Stiffness Constant in Newton per Meter (N/m)
 Stiffness Constant Unit Conversion





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- Distortion in Weldments
 Formulas
- Heat Flow in Welded Joints
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- Heat Input in Welding Formulas

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