



[calculatoratoz.com](http://calculatoratoz.com)



[unitsconverters.com](http://unitsconverters.com)

# Distortion in Weldments Formulas

Calculators!

Examples!

Conversions!

Bookmark [calculatoratoz.com](http://calculatoratoz.com), [unitsconverters.com](http://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 25 Distortion in Weldments Formulas

## Distortion in Weldments

### Angular Distortion

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

$$\text{fx } \varphi = \frac{\delta_{\max}}{0.25 \cdot L}$$

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2\_img.jpg\)](#)

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

#### 2) Angular Distortion at x of Fillet Welds

$$\text{fx } \delta = L \cdot \left( 0.25 \cdot \varphi - \varphi \cdot \left( \frac{x}{L} - 0.5 \right)^2 \right)$$

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa\_img.jpg\)](#)

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

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

$$\text{fx } L = \frac{\delta_{\max}}{0.25 \cdot \varphi}$$

[Open Calculator !\[\]\(f1c5da15572e3e09d343161be98f508d\_img.jpg\)](#)

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



#### 4) Maximum Angular Distortion of Fillet Welds

$$fx \quad \delta_{\max} = 0.25 \cdot \varphi \cdot L$$

[Open Calculator !\[\]\(cbe80b694ebd74fcfe136a095b608235\_img.jpg\)](#)

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

#### 5) Rigidity of Fillet Welds

$$fx \quad R = \frac{E \cdot p_{tb}^3}{12 + (1 - \nu^2)}$$

[Open Calculator !\[\]\(3e2231b1ad3ca8da8658228c00dd08e0\_img.jpg\)](#)

$$ex \quad 0.601313\text{Nm/rad} = \frac{15\text{N/m} \cdot (802.87\text{mm})^3}{12 + (1 - (0.3)^2)}$$

### Transverse Shrinkage in Joints

#### Butt Joints


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

$$fx \quad A_w = \frac{p_{tb} \cdot (S_b - 1.27 \cdot d)}{5.08}$$

[Open Calculator !\[\]\(7d1d6890825e83a6a4a51febe2dcc7f3\_img.jpg\)](#)

$$ex \quad 5.499976\text{mm}^2 = \frac{802.87\text{mm} \cdot (0.365\text{mm} - 1.27 \cdot 0.26\text{mm})}{5.08}$$



7) Degree of Restraint (Butt joints) 

$$\text{fx } k_s = \left( \frac{1000}{86} \cdot \left( \frac{S}{s} - 1 \right) \right)^{\frac{1}{0.87}}$$

Open Calculator 

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

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

$$\text{fx } t_1 = \frac{0.62 \cdot t_2 + 0.12 \cdot t_3}{0.38}$$

Open Calculator 

$$\text{ex } 6.294737\text{mm} = \frac{0.62 \cdot 2.6\text{mm} + 0.12 \cdot 6.5\text{mm}}{0.38}$$

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

$$\text{fx } t_2 = \frac{0.38 \cdot t_1 - 0.12 \cdot t_3}{0.62}$$

Open Calculator 

$$\text{ex } 2.597097\text{mm} = \frac{0.38 \cdot 6.29\text{mm} - 0.12 \cdot 6.5\text{mm}}{0.62}$$

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

$$\text{fx } t_3 = \frac{0.38 \cdot t_1 - 0.62 \cdot t_2}{0.12}$$

Open Calculator 

$$\text{ex } 6.485\text{mm} = \frac{0.38 \cdot 6.29\text{mm} - 0.62 \cdot 2.6\text{mm}}{0.12}$$



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

$$\text{fx } w_0 = \frac{W}{10 \frac{S_t - S_0}{b}}$$

[Open Calculator !\[\]\(e2376d476d06eb31946dc01a69a4403a\_img.jpg\)](#)

$$\text{ex } 4.99\text{g} = \frac{5.14064\text{g}}{10 \frac{5.30\text{mm} - 2.20\text{mm}}{0.24}}$$

## 12) Plate Thickness for given Transverse Shrinkage in Butt Joints

$$\text{fx } p_{tb} = \frac{5.08 \cdot A_w}{S_b - (1.27 \cdot d)}$$

[Open Calculator !\[\]\(0b5e7e25e8775f7e7e80906ada4f0021\_img.jpg\)](#)

$$\text{ex } 802.8736\text{mm} = \frac{5.08 \cdot 5.5\text{mm}^2}{0.365\text{mm} - (1.27 \cdot 0.26\text{mm})}$$

## 13) Root Opening given Transverse Shrinkage

$$\text{fx } d = \frac{S_b - 5.08 \cdot \left( \frac{A_w}{p_{tb}} \right)}{1.27}$$

[Open Calculator !\[\]\(bd3b31712ad9bab5a241210fa6925cdd\_img.jpg\)](#)

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



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

$$fx \quad S = s \cdot (1 + 0.086 \cdot k_s^{0.87})$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0\_img.jpg\)](#)

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

## 15) Total Metal Deposited in Weld given Total Transverse Shrinkage

$$fx \quad w = w_0 \cdot \left(10^{\frac{S_t - S_0}{b}}\right)$$

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5\_img.jpg\)](#)

$$ex \quad 5.14064\text{g} = 4.99\text{g} \cdot \left(10^{\frac{5.30\text{mm} - 2.20\text{mm}}{0.24}}\right)$$

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

$$fx \quad S_t = S_0 + b \cdot \left(\log 10 \left(\frac{w}{w_0}\right)\right)$$

[Open Calculator !\[\]\(ab4e2b3fc7e7887b7a72f548aa6f5e60\_img.jpg\)](#)

$$ex \quad 5.299995\text{mm} = 2.20\text{mm} + 0.24 \cdot \left(\log 10 \left(\frac{5.14064\text{g}}{4.99\text{g}}\right)\right)$$

## 17) Transverse Shrinkage in Butt Joints

$$fx \quad S_b = \left(5.08 \cdot \left(\frac{A_w}{P_{tb}}\right)\right) + (1.27 \cdot d)$$

[Open Calculator !\[\]\(5abce1a84a655b073239ab33e1199487\_img.jpg\)](#)

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



## 18) Transverse Shrinkage in First Pass given Total Shrinkage

$$fx \quad S_0 = S_t - b \cdot \left( \log_{10} \left( \frac{w}{w_0} \right) \right)$$

[Open Calculator !\[\]\(9dfdaff1d86ba3c1f8353b4d1b61b8c5\_img.jpg\)](#)

$$ex \quad 2.200005\text{mm} = 5.30\text{mm} - 0.24 \cdot \left( \log_{10} \left( \frac{5.14064\text{g}}{4.99\text{g}} \right) \right)$$

## 19) Transverse Shrinkage of Restrained Joint

$$fx \quad s = \frac{S}{1 + 0.086 \cdot k_s^{0.87}}$$

[Open Calculator !\[\]\(2b376d1a92330ab09dad2665d2f89bf5\_img.jpg\)](#)

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

## Lap Joint with Fillets

## 20) Length of Fillet Leg in Lap Joints from Shrinkage

$$fx \quad h = \frac{s \cdot p_{tl}}{1.52}$$

[Open Calculator !\[\]\(0d7ca0919e6c47bbd874bfa0189fe22e\_img.jpg\)](#)

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



## 21) Thickness of Plates in Lap Joints

$$fx \quad p_{tl} = \frac{1.52 \cdot h}{s}$$

[Open Calculator !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107\_img.jpg\)](#)

$$ex \quad 908.2mm = \frac{1.52 \cdot 2.39mm}{4mm}$$

## 22) Transverse Shrinkage in Lap Joint with Fillets

$$fx \quad s = \frac{1.52 \cdot h}{p_{tl}}$$

[Open Calculator !\[\]\(e8fb589d58dad1692debababa5e928b6\_img.jpg\)](#)

$$ex \quad 4.540035mm = \frac{1.52 \cdot 2.39mm}{800.17mm}$$

## T-Joint with Two Fillets

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

$$fx \quad h_t = \frac{s \cdot t_b}{1.02}$$

[Open Calculator !\[\]\(e9474ce1d70442456f8fe9c393ea149c\_img.jpg\)](#)

$$ex \quad 0.011765mm = \frac{4mm \cdot 3mm}{1.02}$$

## 24) Thickness of Bottom Plate in T-Joints

$$fx \quad t_b = \frac{1.02 \cdot h_t}{s}$$

[Open Calculator !\[\]\(9db214d549b9aeebe72aa11d3a5c4b1a\_img.jpg\)](#)

$$ex \quad 2.55mm = \frac{1.02 \cdot .01mm}{4mm}$$





## 25) Transverse Shrinkage in T-Joint with Two Fillets

[Open Calculator !\[\]\(666e09182d4cd268646ea700ea60dcdf\_img.jpg\)](#)

$$\text{fx } s = \frac{1.02 \cdot h_t}{t_b}$$

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



## 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*)
- **$p_{tb}$**  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*)
- **$S_0$**  Transverse Shrinkage in First Pass (*Millimeter*)
- **$S_b$**  Transverse Shrinkage of Butt Joint (*Millimeter*)
- **$S_t$**  Total Transverse Shrinkage (*Millimeter*)
- **$t_1$**  Depth of The First V Groove (*Millimeter*)
- **$t_2$**  Depth of The Last V Groove (*Millimeter*)
- **$t_3$**  Depth of Root Face (*Millimeter*)
- **$t_b$**  Thickness of Bottom Plate (*Millimeter*)
- **$w$**  Total Weight of Weld Metal Deposited (*Gram*)
- **$w_0$**  Weld Metal Deposited in First Pass (*Gram*)



- $x$  Distance from the Center Line of the Frame (Millimeter)
- $\delta$  Distortion at Some Distance (Millimeter)
- $\delta_{\max}$  Maximum Distortion (Millimeter)
- $\phi$  Angular Change in Restrained Joints (Radian)
- $\nu$  Poisson's Ratio



## Constants, Functions, Measurements used

- **Function:** **log10**,  $\log_{10}(\text{Number})$   
*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 ( $\text{mm}^2$ )  
*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* 



## Check other formula lists

- [Distortion in Weldments Formulas](#) 
- [Heat Input in Welding Formulas](#) 
- [Heat Flow in Welded Joints Formulas](#) 

Feel free to SHARE this document with your friends!

## PDF Available in

[English](#) [Spanish](#) [French](#) [German](#) [Russian](#) [Italian](#) [Portuguese](#) [Polish](#) [Dutch](#)

6/19/2024 | 8:43:42 AM UTC

[Please leave your feedback here...](#)

