Tolerance Stack-Up: Worst Case and RSS

Nominal gap and its variation from up to six dimensions in a chain, by worst case (sum of tolerances) and statistical RSS (root sum of squares).

Method: Worst case Σt_i; statistical RSS √Σt_i² (tolerance analysis practice)

Input parameters

Unit system: SI

Parameter	Value	Unit
Dimension 1: direction (+1 adds, −1 subtracts, 0 unused)	+1: adds to the gap	
Dimension 1: nominal	100.00	mm
Dimension 1: ± tolerance	0.10000	mm
Dimension 2: direction (+1 adds, −1 subtracts, 0 unused)	−1: subtracts from the gap	
Dimension 2: nominal	40.000	mm
Dimension 2: ± tolerance	0.050000	mm
Dimension 3: direction (+1 adds, −1 subtracts, 0 unused)	−1: subtracts from the gap	
Dimension 3: nominal	30.000	mm
Dimension 3: ± tolerance	0.050000	mm
Dimension 4: direction (+1 adds, −1 subtracts, 0 unused)	−1: subtracts from the gap	
Dimension 4: nominal	29.500	mm
Dimension 4: ± tolerance	0.050000	mm
Dimension 5: direction (+1 adds, −1 subtracts, 0 unused)	0: not used	
Dimension 5: nominal	0	mm
Dimension 5: ± tolerance	0	mm
Dimension 6: direction (+1 adds, −1 subtracts, 0 unused)	0: not used	
Dimension 6: nominal	0	mm
Dimension 6: ± tolerance	0	mm

Calculated results

Parameter	Value	Unit
Nominal gap	0.50000	mm
Worst-case variation	0.25000	mm
RSS variation	0.13229	mm
Worst-case minimum gap	0.25000	mm
Worst-case maximum gap	0.75000	mm
Statistical (RSS) minimum gap	0.36771	mm
Statistical (RSS) maximum gap	0.63229	mm

Notes for this case

- RSS assumes independent, centred, normally distributed dimensions; worst case is guaranteed.

Formula and method

$$G = \sum s_i d_i, \quad t_{WC} = \sum t_i, \quad t_{RSS} = \sqrt{\sum t_i^2}, \quad G_{min,max} = G \mp t_{WC}, \quad G_{min,max,RSS} = G \mp t_{RSS}$$

Variables

s_1	Dimension 1: direction (+1 adds, −1 subtracts, 0 unused)	-
d_1	Dimension 1: nominal	m
t_1	Dimension 1: ± tolerance	m
s_2	Dimension 2: direction (+1 adds, −1 subtracts, 0 unused)	-
d_2	Dimension 2: nominal	m
t_2	Dimension 2: ± tolerance	m
s_3	Dimension 3: direction (+1 adds, −1 subtracts, 0 unused)	-
d_3	Dimension 3: nominal	m
t_3	Dimension 3: ± tolerance	m
s_4	Dimension 4: direction (+1 adds, −1 subtracts, 0 unused)	-
d_4	Dimension 4: nominal	m
t_4	Dimension 4: ± tolerance	m
s_5	Dimension 5: direction (+1 adds, −1 subtracts, 0 unused)	-
d_5	Dimension 5: nominal	m
t_5	Dimension 5: ± tolerance	m
s_6	Dimension 6: direction (+1 adds, −1 subtracts, 0 unused)	-
d_6	Dimension 6: nominal	m
t_6	Dimension 6: ± tolerance	m
G	Nominal gap	m
$\pm t_{WC}$	Worst-case variation	m
$\pm t_{RSS}$	RSS variation	m
G_{min}	Worst-case minimum gap	m
G_{max}	Worst-case maximum gap	m
$G_{min,RSS}$	Statistical (RSS) minimum gap	m
$G_{max,RSS}$	Statistical (RSS) maximum gap	m

Method and standards

Linear stack.

Assumptions and limits

- Each direction is chosen as +1, −1 or 0; other values are rejected. A negative minimum gap (interference) is flagged.
- Linear one-dimensional chain.

References

• Worst case Σt_i; statistical RSS √Σt_i² (tolerance analysis practice)

Report details

Report reference	FCC-8ZZN-G8NC (the same inputs always give the same reference)
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Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/mechanical/manufacturing/tolerance-stack-up

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Reopens the calculator with the inputs of this report.