Damage-Equivalent Load from Load Cycles (Miner's Rule)

Damage-equivalent load range of a fatigue load spectrum from up to five load ranges and their cycle counts, for a given S-N slope and equivalent number of cycles.

Method: Damage-equivalent load with Miner's rule

Input parameters

Unit system: SI

Parameter	Value	Unit
Load range 1	400.00	kN
Cycles at range 1	1,000,000	
Load range 2	800.00	kN
Cycles at range 2	100,000	
Load range 3	1,500.0	kN
Cycles at range 3	10,000	
Load range 4	0	kN
Cycles at range 4	0	
Load range 5	0	kN
Cycles at range 5	0	
S-N curve slope (steel welds 3–5, composites about 10)	4.0000	
Equivalent number of cycles	1.0000e+07	

Calculated results

Parameter	Value	Unit
Damage-equivalent load range	329.02	kN
Total cycles	1,110,000	
Share of damage from the worst bin	43.201	%

Notes for this case

- DEL = (Σ $n_i S_i^m$ / N_eq)^(1/m) from Miner's linear damage sum on an S-N curve of slope m. Load ranges come from rainflow counting of time series; the result depends strongly on m.

Formula and method

$$DEL = \left(\frac{\sum_i n_i S_i^m}{N_{eq}} \right)^{1/m}$$

Variables

S_1	Load range 1	N
n_1	Cycles at range 1	-
S_2	Load range 2	N
n_2	Cycles at range 2	-
S_3	Load range 3	N
n_3	Cycles at range 3	-
S_4	Load range 4	N
n_4	Cycles at range 4	-

S_5	Load range 5	N
n_5	Cycles at range 5	-
m	S-N curve slope (steel welds 3–5, composites about 10)	-
N_{eq}	Equivalent number of cycles	-
DEL	Damage-equivalent load range	N
$\sum n_i$	Total cycles	-
$\max(n_i S_i^m)/\sum$	Share of damage from the worst bin	-

Method and standards

Equivalent fatigue load.

Assumptions and limits

- Linear damage accumulation; no mean-stress correction.

References

Damage-equivalent load with Miner's rule

Report details

Report reference	FCC-K3P3-YFAJ (the same inputs always give the same reference)
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Release checks	3 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/environmental/wind-power/damage-equivalent-load

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.