Fatigue Life by Basquin and Damage by Miner's Rule

Cycles to failure at a stress amplitude by Basquin's law with your constants, and the Miner's rule damage and remaining life for up to three stress blocks.

Method: Basquin (1910) σ_a = σ_f'(2N_f)^b; Palmgren–Miner linear damage D = Σ n_i/N_i

Input parameters

Unit system: SI

Parameter	Value	Unit
Fatigue strength coefficient From fatigue data for the material and surface.	900.00	MPa
Fatigue strength exponent	-0.090000	
Block 1: stress amplitude	300.00	MPa
Block 1: cycles applied	20,000	
Block 2: stress amplitude	250.00	MPa
Block 2: cycles applied	100,000	
Block 3: stress amplitude	200.00	MPa
Block 3: cycles applied	500,000	

Calculated results

Parameter	Value	Unit
Block 1: cycles to failure	100,073	
Block 2: cycles to failure	758,768	
Block 3: cycles to failure	9,054,966	
Miner damage sum	0.38686	
Repeats of the block sequence left (1/D − 1)	1.5849	

Notes for this case

- Miner's rule ignores sequence effects; failures occur between about D = 0.3 and 3.

Formula and method

$$N_f = \frac{1}{2}\left(\frac{\sigma_a}{\sigma_f'}\right)^{1/b}, \quad D = \sum \frac{n_i}{N_{f,i}}$$

Variables

σ_f'	Fatigue strength coefficient	Pa
b	Fatigue strength exponent	-
σ_{a1}	Block 1: stress amplitude	Pa
n_1	Block 1: cycles applied	-
σ_{a2}	Block 2: stress amplitude	Pa
n_2	Block 2: cycles applied	-
σ_{a3}	Block 3: stress amplitude	Pa
n_3	Block 3: cycles applied	-
N_{f1}	Block 1: cycles to failure	-
N_{f2}	Block 2: cycles to failure	-
N_{f3}	Block 3: cycles to failure	-

D	Miner damage sum	-
R	Repeats of the block sequence left (1/D − 1)	-

Method and standards

Basquin and Miner.

Assumptions and limits

- High-cycle, fully reversed.
- No endurance limit: every amplitude above zero adds damage, which is conservative for amplitudes below the endurance limit. A block of zero amplitude adds none and its cycles to failure are not shown.
- No mean-stress correction: correct the amplitudes first.

References

• Basquin (1910) σ_a = σ_f'(2N_f)^b; Palmgren–Miner linear damage D = Σ n_i/N_i

Report details

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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/materials/properties/basquin-miner-fatigue

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.