Creep Life Fraction by Robinson's Rule

Consumed and remaining creep life of a tube or header from hours and rupture life at up to four conditions (Robinson's life-fraction rule).

Method: Robinson's linear life-fraction rule D = Σ t_i/t_r; i; rupture lives from the user's material data (e.g. via the Larson–Miller parameter)

Input parameters

Unit system: SI

Parameter	Value	Unit
Hours at condition 1	60,000	h
Rupture life at condition 1 From the material's stress-rupture or Larson–Miller data at that temperature and stress.	400,000	h
Hours at condition 2	20,000	h
Rupture life at condition 2 From the material's stress-rupture or Larson–Miller data at that temperature and stress.	120,000	h
Hours at condition 3	0	h
Rupture life at condition 3 From the material's stress-rupture or Larson–Miller data at that temperature and stress.	1,000,000	h
Hours at condition 4	0	h
Rupture life at condition 4 From the material's stress-rupture or Larson–Miller data at that temperature and stress.	1,000,000	h

Calculated results

Parameter	Value	Unit
Life fraction used Σ t/t_r	31.667	%
Life fraction remaining	68.333	%
Remaining hours at condition 1	273,333	h

Notes for this case

- Robinson's rule is an engineering estimate; scatter in rupture data is large, so apply a design margin.

Formula and method

$$D = \sum_i \frac{t_i}{t_{r,i}}, \quad t_{rem} = \max(0,\ 1 - D)\, t_{r,1}$$

Variables

t_1	Hours at condition 1	s
$t_{r,1}$	Rupture life at condition 1	s
t_2	Hours at condition 2	s
$t_{r,2}$	Rupture life at condition 2	s
t_3	Hours at condition 3	s
$t_{r,3}$	Rupture life at condition 3	s
t_4	Hours at condition 4	s
$t_{r,4}$	Rupture life at condition 4	s
D	Life fraction used Σ t/t_r	-

$1-D$	Life fraction remaining	-
t_{rem}	Remaining hours at condition 1	s

Method and standards

Robinson's linear life-fraction rule (E. L. Robinson, Trans. ASME 74, 1952): creep damage is the sum of the time at each condition over the rupture life at that condition, and failure is predicted when the sum reaches 1. The remaining hours are at condition 1 and are shown as zero once the sum reaches 1; the remaining fraction is then negative.

Assumptions and limits

- Linear damage summation.
- Remaining hours assume future operation at condition 1; if the tube will run at another condition, put that condition first.

References

• Robinson's linear life-fraction rule D = Σ t_i/t_r
• i; rupture lives from the user's material data (e.g. via the Larson–Miller parameter)

Report details

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

This calculator online

https://calc.firecad.com/boilers-power-plant/boiler-pressure-parts/robinson-creep-life-fraction

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Reopens the calculator with the inputs of this report.