Riveted Joint Strength and Efficiency

Tearing, shearing and crushing strengths of a riveted lap or butt joint over one pitch, and the joint efficiency against the solid plate, by textbook strength of materials.

Method: Strength of riveted joints per pitch length (textbook strength of materials)

Input parameters

Unit system: SI

Parameter	Value	Unit
Plate thickness	12.000	mm
Rivet hole diameter	21.000	mm
Pitch of the rivets	70.000	mm
Rivets per pitch length 1 for single riveted, 2 for double riveted, and so on.	2.0000	
Rivets in	Single shear (lap joint)	
Double-shear factor 2 in theory; some codes and textbooks use 1.875.	2.0000	
Allowable tensile stress of the plate	80.000	MPa
Allowable shear stress of the rivets	60.000	MPa
Allowable crushing stress	120.00	MPa

Calculated results

Parameter	Value	Unit
Tearing strength of the plate between holes (p − d) t σ_t	47.040	kN
Shearing strength of the rivets	41.563	kN
Crushing strength n d t σ_c	60.480	kN
Strength of the solid plate p t σ_t	67.200	kN
Strength of the joint (least of the three)	41.563	kN
Joint efficiency	61.850	%

Notes for this case

- The joint fails first by shearing of the rivets.
- Textbook strength-of-materials check over one pitch; it is not a design to any boiler code.

Formula and method

$$P_t = (p-d)\,t\,\sigma_t, \quad P_s = n\,k_s\,\frac{\pi d^2}{4}\,\tau \ (k_s = 1 \text{ single shear},\ k_s = k \text{ double shear}), \quad P_c = n\,d\,t\,\sigma_c$$

$$\eta = \frac{\min(P_t, P_s, P_c)}{p\,t\,\sigma_t}$$

Variables

t	Plate thickness	m
d	Rivet hole diameter	m
p	Pitch of the rivets	m
n	Rivets per pitch length	-
shear	Rivets in	-
k	Double-shear factor	-

σ_t	Allowable tensile stress of the plate	Pa
$\mathcal{T}$	Allowable shear stress of the rivets	Pa
σ_c	Allowable crushing stress	Pa
P_t	Tearing strength of the plate between holes (p − d) t σ_t	N
P_s	Shearing strength of the rivets	N
P_c	Crushing strength n d t σ_c	N
P	Strength of the solid plate p t σ_t	N
P_{min}	Strength of the joint (least of the three)	N
η	Joint efficiency	-

Method and standards

Strength of one pitch length of the joint in each failure mode, compared with the strength of the unpierced plate.

Assumptions and limits

- Static strength; no allowance for corrosion or fatigue.
- Not a code design.
- For a butt joint with cover plates, tearing and crushing use the main plate thickness; the cover plates (each usually thinner than the plate, two together thicker) are assumed not to govern.

References

- Strength of riveted joints per pitch length (textbook strength of materials)

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

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