

Analysis of Riveted Joints — I

A riveted joint may fail by shearing through the rivets (single or double shear), crushing the rivets, tearing the plate between the rivets, crushing the plate or by a combination of two or more of the foregoing causes. Rivets placed too close to the edge of the plate may tear or shear the plate out to the edge but this type of failure is avoided by placing the center of the rivet 1.5 times the rivet diameter away from the edge.

The efficiency of a riveted joint is equal to the strength of the joint divided by the strength of the unriveted plate, expressed as a percentage.

In the following formulas, let,

d = diameter of rivets;

D = diameter of holes;

t = thickness of plate;

t_c = thickness of cover plates;

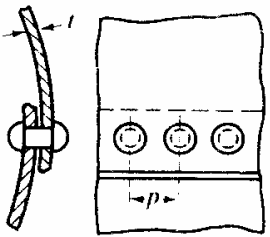
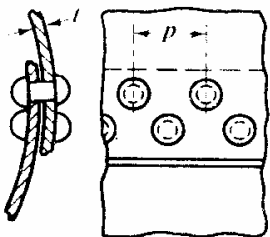
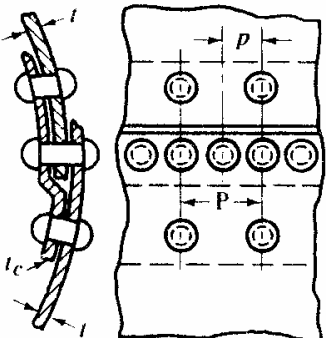
p = pitch of inner row of rivets;

P = pitch of outer row of rivets;

S_s = shear stress for rivets;

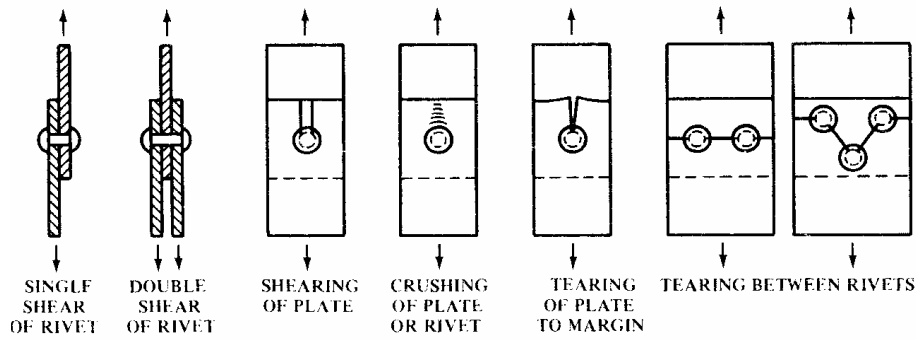
S_t = tensile stress for plates;

S_c = compressive or bearing stress for rivets or plates.

	For Single-riveted Lap-joint (1) Resistance to shearing one rivet = $\frac{\pi d^2}{4} S_s$ (2) Resistance to tearing plate between rivets = $(p - D)tS_t$ (3) Resistance to crushing rivet or plate = dtS_c
	Double-riveted Lap-joint (1) Resistance to shearing two rivets = $\frac{2\pi d^2}{4} S_s$ (2) Resistance to tearing between two rivets = $(p - D)tS_t$ (3) Resistance to crushing in front of two rivets = $2dtS_c$
	Single-riveted Lap-joint with Inside Cover Plate (1) Resistance to tearing between outer row of rivets = $(P - D)tS_t$ (2) Resistance to tearing between inner row of rivets, and shearing outer row of rivets = $(P - 2D)tS_t + \frac{\pi d^2}{4} S_s$ (3) Resistance to shearing three rivets = $\frac{3\pi d^2}{4} S_s$ (4) Resistance to crushing in front of three rivets = $3tdS_c$ (5) Resistance to tearing at inner row of rivets, and crushing in front of one rivet in outer row = $(P - 2D)tS_t + tdS_c$

	Double-riveted Lap-joint with Inside Cover Plate (1) Resistance to tearing at outer row of rivets $= (P - D) t S_t$ (2) Resistance to shearing four rivets $= \frac{4\pi d^2}{4} S_s$ (3) Resistance to tearing at inner row and shearing outer row of rivets $= (P - 1\frac{1}{2}D) t S_t + \frac{\pi d^2}{4} S_s$ (4) Resistance to crushing in front of four rivets $= 4 t d S_c$ (5) Resistance to tearing at inner row of rivets, and crushing in front of one rivet $= (P - 1\frac{1}{2}D) t S_t + t d S_c$
	Double-riveted Butt-joint (1) Resistance to tearing at outer row of rivets $= (P - D) t S_t$ (2) Resistance to shearing two rivets in double shear and one in single shear $= \frac{5\pi d^2}{4} S_s$ (3) Resistance to tearing at inner row of rivets and shearing one rivet of the outer row $= (P - 2D) t S_t + \frac{\pi d^2}{4} S_s$ (4) Resistance to crushing in front of three rivets $= 3 t d S_c$ (5) Resistance to tearing at inner row of rivets, and crushing in front of one rivet in outer row $= (P - 2D) t S_t + t d S_c$
	Triple-riveted Butt-joint (1) Resistance to tearing at outer row of rivets $= (P - D) t S_t$ (2) Resistance to shearing four rivets in double shear and one in single shear $= \frac{9\pi d^2}{4} S_s$ (3) Resistance to tearing at middle row of rivets and shearing one rivet $= (P - 2D) t S_t + \frac{\pi d^2}{4} S_s$ (4) Resistance to crushing in front of four rivets and shearing one rivet $= 4 t d S_c + \frac{\pi d^2}{4} S_s$ (5) Resistance to crushing in front of five rivets $= 4 t d S_c + t d S_c$

Dimensions are usually specified in inches and stresses in pounds per square inch. See page 1383 for a discussion of allowable stresses which may be used in calculating the strengths given by the formulas. The design stresses are usually set by codes, practices, or specifications.



Types of Rivet and Plate Failure

Rivet Lengths for Forming Round and Countersunk Heads*

To Form Round Head								To Form Countersunk Head							
Diameter of Rivet in Inches								Diameter of Rivet in Inches							
Grip in Inches	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	Grip in Inches	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4
Length of Rivet in Inches								Length of Rivet in Inches							
1/2	1 5/8	1 7/8	1 7/8	2	2 1/8	2 1/4	...	1/2	1	1 1/8	1 1/4	1 1/4	1 3/8	1 3/8	...
5/8	1 3/4	2	2	2 1/8	2 1/4	...	...	5/8	1 1/8	1 1/4	1 1/4	1 3/8	1 3/8	...	...
3/4	1 7/8	2 1/8	2 1/8	2 1/4	2 3/8	...	...	3/4	1 3/8	1 3/8	1 3/8	1 1/2	1 1/2	...	...
7/8	2	2 1/4	2 1/4	2 3/8	2 1/2	...	...	7/8	1 1/2	1 1/2	1 1/2	1 3/8	1 3/8	...	...
1	2 1/4	2 3/8	2 3/8	2 1/2	2 3/8	2 3/4	2 7/8	1	1 3/8	1 3/8	1 3/8	1 3/4	1 3/4	1 7/8	1 7/8
1 1/8	2 3/8	2 1/2	2 1/2	2 3/8	2 3/4	2 7/8	3	1 1/8	1 3/4	1 3/4	1 7/8	1 7/8	2	2	...
1 1/4	2 1/2	2 5/8	2 5/8	2 3/4	2 7/8	3	3 1/8	1 1/4	2	2	2	2	2	2 1/8	2 1/8
1 3/8	2 5/8	2 3/4	2 3/4	2 7/8	3	3 1/8	3 1/4	1 3/8	2 1/8	2 1/8	2 1/8	2 1/4	2 1/4	2 3/8	2 3/8
1 1/2	2 7/8	3	3	3 1/8	3 1/4	3 1/8	3 1/2	1 1/2	2 1/4	2 1/4	2 1/4	2 3/8	2 3/8	2 1/2	2 1/2
1 5/8	3	3 1/8	3 1/8	3 1/4	3 3/8	3 1/2	3 1/2	1 5/8	2 3/8	2 3/8	2 3/8	2 1/2	2 1/2	2 5/8	2 5/8
1 3/4	3 1/8	3 1/4	3 1/4	3 1/2	3 3/8	3 3/4	3 3/4	1 3/4	2 5/8	2 5/8	2 5/8	2 5/8	2 5/8	2 3/4	2 3/4
1 7/8	3 3/4	3 3/8	3 3/8	3 3/8	3 3/4	3 7/8	3 7/8	1 7/8	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 7/8	2 7/8
2	3 1/2	3 1/2	3 3/8	3 3/4	3 7/8	4	4	2	2 7/8	2 7/8	2 7/8	2 7/8	2 7/8	3	3
2 1/8	3 3/8	3 3/8	3 3/4	3 7/8	4	4 1/8	4 1/8	2 1/8	3 1/8	3	3	3	3 1/8	3 1/8	3 1/8
2 1/4	3 3/4	3 7/8	3 7/8	4	4 1/8	4 1/4	4 1/4	2 1/4	3 1/4	3 1/8	3 1/8	3 1/8	3 1/4	3 1/4	3 1/4
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2 3/8	4 1/8	4 1/8	4 1/8	4 1/4	4 3/8	4 1/2	4 1/2	2 3/8	3 1/2	3 1/2	3 1/2	3 1/2	3 1/2	3 3/8	3 3/8
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2 7/8	4 3/8	4 3/8	4 3/8	4 3/4	4 7/8	5	5	2 7/8	3 7/8	3 3/4	3 3/4	3 3/4	3 3/4	3 7/8	3 7/8
3	4 5/8	4 5/8	4 5/8	4 3/4	4 7/8	5	5 1/8	3	4	3 7/8	3 7/8	3 7/8	3 7/8	4	4
3 1/8	...	4 3/4	4 3/4	4 7/8	5	5	5 1/4	3 1/8	...	4 1/8	4 1/8	4 1/8	4 1/8	4 1/8	4 1/8
3 1/4	...	4 7/8	4 7/8	5	5 1/8	5 1/4	5 1/4	3 1/4	...	4 1/4	4 1/4	4 1/4	4 1/4	4 1/4	4 1/4
3 3/8	...	5	5	5 1/8	5 1/4	5 3/8	5 3/8	3 3/8	...	4 3/8	4 3/8	4 3/8	4 3/8	4 3/8	4 3/8
3 1/2	...	5 1/8	5 1/8	5 1/4	5 3/8	5 1/2	5 1/2	3 1/2	...	4 1/2	4 1/2	4 1/2	4 1/2	4 1/2	4 1/2
3 3/4	...	5 3/8	5 3/8	5 3/8	5 3/2	5 3/8	5 3/8	3 3/4	...	4 3/8	4 3/8	4 3/8	4 3/8	4 3/8	4 3/8
3 7/8	...	5 1/2	5 1/2	5 1/2	5 3/8	5 3/4	5 3/4	3 7/8	...	4 3/4	4 3/4	4 3/4	4 3/4	4 3/4	4 3/4
4	...	5 3/8	5 3/8	5 3/4	5 3/4	5 7/8	5 7/8	4	...	5	5	5	5	5	5
4 1/8	...	5 3/4	5 3/4	5 3/4	5 7/8	6	6	4 1/8	...	5 1/8	5 1/8	5 1/8	5 1/8	5 1/8	5 1/8
4 1/4	...	5 7/8	5 7/8	6	6 1/8	6 1/4	6 1/4	4 1/4	...	5 1/4	5 1/4	5 1/4	5 1/4	5 1/4	5 1/4
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5	...	...	...	7	7	7 1/8	7 1/8	5	...	6	6	6	6	6	6
5 1/8	...	...	...	7 1/8	7 1/4	7 1/4	7 1/4	5 1/8	...	6 1/8	6 1/8	6 1/8	6 1/8	6 1/8	6 1/8
5 1/4	...	...	...	7 1/4	7 1/4	7 3/8	7 3/8	5 1/4	...	6 1/4	6 1/4	6 1/4	6 1/4	6 1/4	6 1/4
5 3/8	...	...	...	7 3/8	7 3/8	7 1/2	7 1/2	5 3/8	...	6 3/8	6 3/8	6 3/8	6 3/8	6 3/8	6 3/8
5 1/2	...	...	...	7 3/4	7 3/4	7 7/8	7 7/8	5 1/2	...	6 1/2	6 1/2	6 1/2	6 1/2	6 1/2	6 1/2
5 5/8	...	...	...	7 7/8	7 7/8	8	8	5 5/8	...	6 3/4	6 3/4	6 3/4	6 3/4	6 3/4	6 3/4
5 3/4	...	...	...	8	8	8 1/8	8 1/8	5 3/4	...	6 7/8	6 7/8	6 7/8	6 7/8	6 7/8	6 7/8
5 7/8	...	...	...	8 1/8	8 1/8	8 1/4	8 1/4	5 7/8	...	7	7	7	7	7	7

* As given by the American Institute of Steel Construction. Values may vary from standard practice of individual fabricators and should be checked against fabricator's standard.