Automotive parts - Blind rivets

1. Scope

This standard describes pullout mandrel blind rivets used for clamping automotive components.

2. Normative references

The following standards, when referred to in this standard, constitute a part of the specifications of this standard. As required, the most recently updated version of the applicable standard (including addenda) shall be applied.

JIS B7721	Tension/compression testing machines -- Verification and calibration of the force-measuring system
JIS D0201	Automobile parts -- General rules of electroplating
JIS G3506	High carbon steel wire rods
JIS G3507-1	Carbon steels for cold heading -- Part 1: Wire rods
JIS G4308	Stainless steel wire rods
JIS H3260	Copper and copper alloy wires
JIS H4000	Aluminium and Aluminium alloy sheets, strips and plates
JIS H4040	Aluminium and Aluminium alloy rods, bars and wires
JIS H4080	Aluminium and Aluminium alloys extruded tubes and cold-drawn tubes

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3. Definitions

The definitions of the main terms used in this standard shall be as follows.

3.1 Blind rivet

Blind rivets, (hereinafter referred to as "rivets") are rivets with a structure that can be clamped from the side of insertion into a hole drilled through parts to be joined. These rivets mainly consist of a rivet body and a mandrel. The names of each part are shown in **Figure 1**.

3.2 Riveting mechanical section

When rivets are clamped, the rivet body is deformed by the mandrel head so that the diameter of rivet tip expands or rivet tip splits. (See **Figure 2**.)

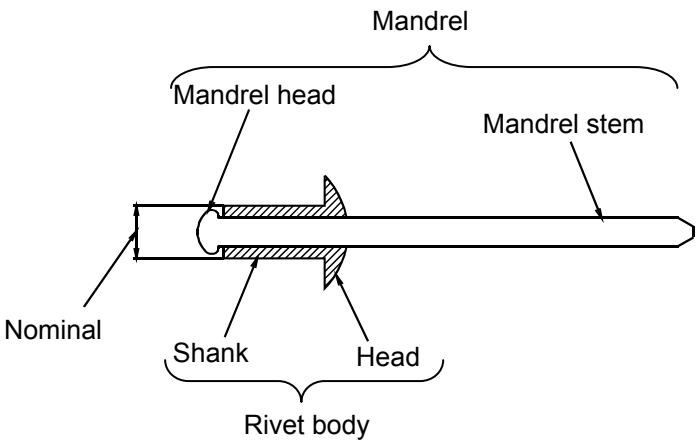

Figure 1 Rivet part names

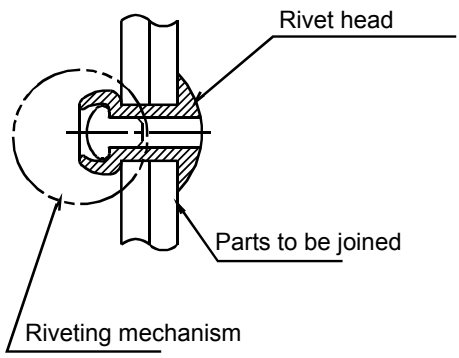

Figure 2 Riveting mechanism

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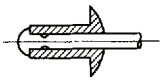
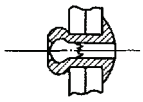
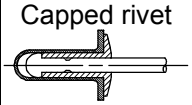
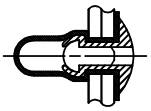
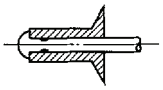
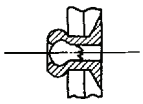
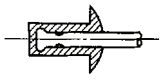
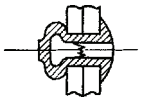
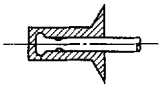
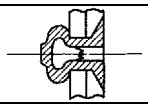
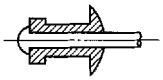
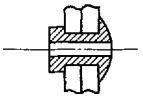
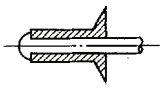
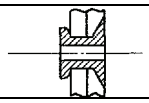
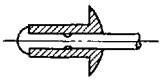
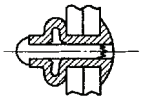
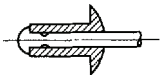
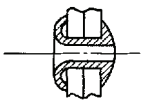
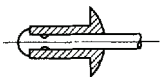
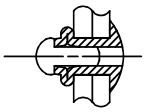
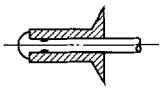
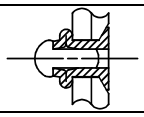
4. Types

Different types of rivets with varying riveting mechanisms or shapes are shown in **Table 1**.

Table 1 Rivet types

Type	Code	Head shape	Riveting mechanism		(Reference diagram) Shape before riveting	(Reference diagram) Shape after riveting	Table number of Annex A
1	1 D	Round	Pullout break mandrel type[a]	Open-end expanding tip type[c]			**Table A.1** **Table A.2**
					Capped rivet 		**Table A.3**
	1 C	Counter sunk					**Table A.4** **Table A.5**
2	2 D	Round		Closed-end expanding tip type[d]			**Table A.6**
	2 C	Counter sunk					**Table A.7**
3	3 D	Round	Pull through mandrel type[b]	Open-end expanding tip type			**Table A.8**
	3 C	Counter sunk					**Table A.9**
4	4 D	Round	Pullout break mandrel type	Open-end split type[e]			**Table A.10**
							**Table A.11**
5	5 D	Round	Pullout break mandrel type	Open-end non-split type[f]			**Table A.12**
	5 C	Counter sunk					**Table A.13**

Note: [a]
When the rivet is clamped, the mandrel breaks along the line of reduced diameter and is pulled out.
Note: [b]
When the rivet is clamped, the mandrel and its head are pulled out without breaking.
Note: [c]
The tip of the rivet is open and the riveting mechanism causes the tip to bulge when clamping.
Note: [d]
The tip of the rivet is closed and the riveting mechanism causes the tip to bulge when clamping.
Note: [e]
The tip of the rivet is open and the riveting mechanism causes the tip to split (into three or four sections) when clamping.
Note: [f]
The tip of the rivet is open and the riveting mechanism causes the tip to bulge without splitting when clamping.

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5. Requirements

5.1 Rivet body and mandrel combinations

The rivet body and mandrel combinations are shown by material in Table 2.

Table 2 Rivet body and mandrel combinations

Combination number	Rivet body	Mandrel	Applicable types								
			1 D	1C	2 D	2 C	3 D	3 C	4 D	5D	5C
10	Aluminum alloy 1 100	Aluminum alloy 7 000 series or 2 000 series	○	○	○						
15	Aluminum alloy 5 052		○	○						○	
18	Aluminum alloy 5 052 or 5 056	Aluminum alloy 5 000 series							○		
11	Aluminum alloy 5 052	Carbon steel	○	○			○				
12	Aluminum alloy 5 056		○	○	○	○	○	○			
13	Aluminum alloy 5 154		○	○			○	○	○		
14	Aluminum alloy 2 117						○	○			
19	Aluminum alloy 5 251		○	○							
16	Aluminum alloy 5 154	Stainless steel	○	○	○						
17	Aluminum alloy 5 052		○								
20	Low-carbon steel	Carbon steel	○	○			○	○		○	○
31	Austenitic stainless steel		○	○			○			○	
30	Austenitic stainless steel	Stainless steel	○	○	○					○	
50	Copper alloy	Carbon steel	○		○		○				

Note: (1)
The chemical compositions of materials are shown in **5.5 Table 4**.
Note: (2)
Combination numbers 11 and 17 can be used for capped rivets.
Note: (3)
The "series" number for aluminum alloys represents a range of alloy numbers. For example, the 2 000 series alloy number represents alloy numbers between 2000 and 2999.

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5.2 Performance

5.2.1 Strength

After undergoing the tests outlined in **6.1**, rivet strength must satisfy the requirements shown in **Table 3**.

Table 3 Rivet clamping strength (minimum value)

Unit: N

Type	Combination number	Test item	Rivet nominal diameter						
			2.4	3.0	3.2	4.0	4.8	6.0	6.4
1	10	Shear strength	—	245	—	—	—	—	—
		Tensile strength	—	330	—	—	—	—	—
	11, 15, 17 and 19	Shear strength	310	—	530	850	1 160	—	2 050
		Tensile strength	360	—	670	1 020	1 420	—	2 490
	12, 13 and 16	Shear strength	400	580	760	1 160	1 690	—	3 110
		Tensile strength	530	760	980	1 560	2 220	—	4 090
	20	Shear strength	580	—	1 160	1 650	2 400	—	4 450
		Tensile strength	760	—	1 380	2 090	3 020	—	5 520
	30 and 31	Shear strength	1 020	—	1 870	2 890	4 230	—	7 560
		Tensile strength	1 250	—	2 360	3 650	5 340	—	9 340
	50	Shear strength	—	—	830	1 270	—	—	—
		Tensile strength	—	—	1 030	1 620	—	—	—
2	10	Shear strength	—	—	440	580	930	—	—
		Tensile strength	—	—	490	710	1 110	—	—
	12	Shear strength	—	—	1 070	1 560	2 220	—	4 000
		Tensile strength	—	—	1 240	2 130	3 070	—	4 890
	16	Shear strength	—	—	980	1 410	1 960	—	—
		Tensile strength	—	—	1 220	2 090	2 750	—	—
	30	Shear strength	—	—	1 870	2 890	4 230	—	—
		Tensile strength	—	—	2 360	3 650	5 340	—	—
	50	Shear strength	—	—	980	—	—	—	—
		Tensile strength	—	—	1 330	—	—	—	—
3	11	Shear strength	—	—	380	640	930	—	—
		Tensile strength	—	—	680	850	1 330	—	—
	12	Shear strength	—	—	690	1 020	1 380	1 530	—
		Tensile strength	—	—	1 200	1 600	2 490	2 990	—
	13 and 14	Shear strength	—	—	620	980	1 470	—	2 670
		Tensile strength	—	—	980	1 560	2 230	—	4 270
	20	Shear strength	—	—	1 020	1 510	2 050	2 340	—
		Tensile strength	—	—	1 670	2 530	3 360	3 830	—
	31	Shear strength	—	—	1 640	2 220	3 220	—	—
		Tensile strength	—	—	1 950	3 220	4 600	—	—
	50	Shear strength	560	—	1 000	1 690	2 110	—	—
		Tensile strength	800	—	1 710	2 510	3 270	—	—
4	13	Shear strength	—	—	780	1 260	1 860	—	—
		Tensile strength	—	—	740	1 080	1 640	—	—
	18	Shear strength	—	—	—	490	590	—	—
		Tensile strength	—	—	—	690	780	—	—

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Table 3 Rivet clamping strength (minimum value) (continued...)

Unit: N

Type	Combination number	Test item	Rivet nominal diameter						
			2.4	3.0	3.2	4.0	4.8	6.0	6.4
5	15	Shear strength	—	—	500	700	1 000	—	—
		Tensile strength	—	—	700	780	1 400	—	—
	20	Shear strength	—	—	950	1 300	1 850	—	3 350
		Tensile strength	—	—	1 200	2 000	2 750	—	4 600
	30 and 31	Shear strength	—	—	1 400	2 000	2 850	—	—
		Tensile strength	—	—	1 800	3 000	3 650	—	—

Note:
The requirements in **Table 3** do not apply to capped rivets. Capped rivet strength requirements shall be agreed on by both the supplier and receiving parties.

5.2.2 Water-tightness

Capped rivets are determined to be water-tight if there is no water leakage after undergoing the tests outlined in **6.2**.

5.3 Shape and Dimensions

The rivet shape and dimensions are shown in **Annex A**.

5.4 External appearance

The rivet body and mandrel surfaces shall have no defects such as burrs, flaking, or cracks or scratches that interfere with operation.

5.5 Materials

5.5.1 Rivet body and mandrel

The usual rivet body and mandrel materials are shown in **Table 4**.

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Table 4 Rivet body and mandrel materials

	Material	Chemical composition (%)
Rivet body	Aluminum alloy 1 100 2 117 5 052 5 056	**JIS H4040 5.2** (Chemical composition)
	Aluminum alloy 5 154	According to **JIS H4000 5.2** (Chemical composition)
	Aluminum alloy 5 251	According to **JIS H4080 5.2** (Chemical composition)
	Low-carbon steel	According to **JIS G3507-1** Section **5** (Chemical composition)
	Austenitic stainless steel	According to **JIS G4308** Section **4** (Chemical composition)
	Copper alloy	According to **JIS H3260 4.2** (Chemical composition)
Mandrel	Aluminum alloy 2 000 series 5 000 series 7 000 series	According to **JIS H4040 5.2** (Chemical composition), or **JIS H4000 5.2** (Chemical composition)
	Carbon steel	According to **JIS G3506** Section **4** (Chemical composition)
	Stainless steel	According to **JIS G4308** Section **4** (Chemical composition)

Note: (1)
Materials that have no accompanying type number or alloy number may vary between rivet manufacturers. In this case, the material certification must be provided upon agreement between the supplier and receiving parties.
Note: (2)
The "series" number for aluminum alloys represents a range of alloy numbers. For example, the 2 000 series alloy number represents alloy numbers between 2000 and 2999.

5.5.2 Rivet caps

As there is a wide selection of resin materials that can be used for the cap depending on the application, this should be agreed on by both the supplier and receiving parties.

5.6 Surface treatment

Surface treatment is covered by the following requirements.

a) Rivet body

Rivet body surface treatment is shown in Table 5.

Table 5

Material	Surface treatment	Applicable standards
Aluminum alloy	Surface treatment is not performed	—
Stainless steel		
Copper alloy		
Low-carbon steel	Ep-Fe/Zn 5B [MFZn 5B: Outdated standard] Ep-Fe/Zn 5C [MFZn 5C: Outdated standard] Hexavalent chromium-free treatment equivalent to the above.	**JIS D0201**

Note:
Surface treatments not included in this table should only be performed upon agreement between the supplier and receiving parties.

b) Mandrel

Mandrel surface treatment is shown in Table 6.

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Table 6

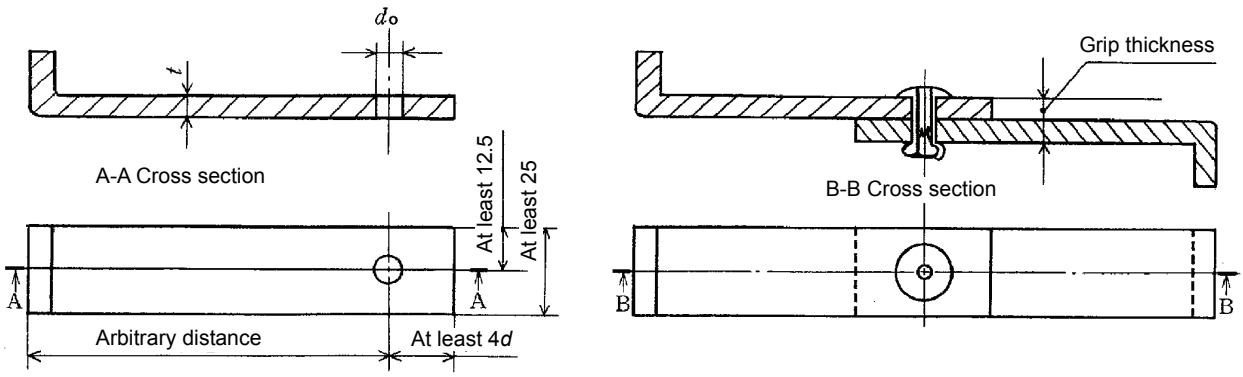
Material	Surface treatment
Aluminum alloy	Surface treatment is not performed
Stainless steel	
Carbon steel	Anti-corrosion treatment [(a)]
Note: [(a)] Phosphate coating treatment or electrogalvanizing (hexavalent chromium-free), or anti-corrosion treatment can be carried out. However, the thickness is not specified.	

6. Test procedure

6.1 Strength test

6.1.1 Steel plates for strength tests

The steel plates used for testing rivet shear and tensile strength are shown in **Figures 3, 4, and Table 7**.



Note:

d represents the diameter of the rivet body.

Figure 3 Steel plates used for shear tests

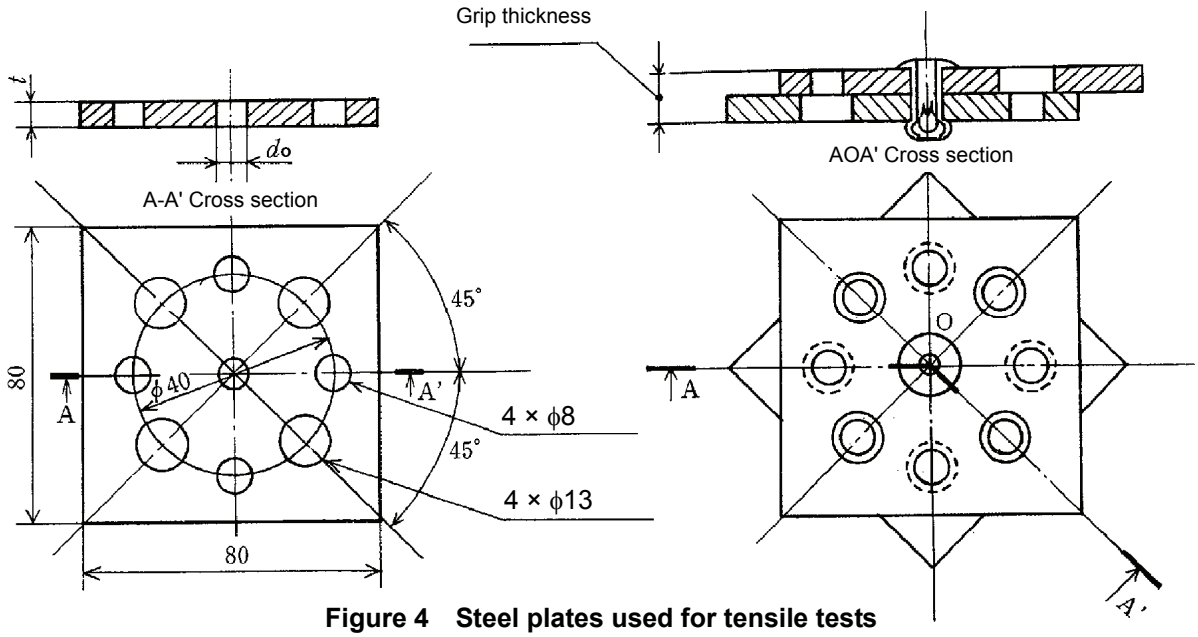


Figure 4 Steel plates used for tensile tests

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Table 7 Hole diameters and thickness of steel plates used for strength tests

Unit: mm

Type	Rivet nominal diameter	Hole diameter d_o		Steel test plate thickness t
		Standard dimension	Tolerance	
1 2 3	2.4	2.5	+0.1 -0	Set to 40-50% of the largest value in the recommended grip range shown in **Annex A**. (Grip thickness $2t$ shall be 80-100% of the recommended grip range.)
	3.0	3.1		
	3.2	3.3		
	4.0	4.1		
	4.8	4.9		
	6.0	6.1		
	6.4	6.5		
4	3.2	3.4	+0.1 -0	
	4.0	4.2		
	4.8	5.0		
5	3.2	3.4	±0.1	
	4.0	4.2		
	4.8	5.0		
	6.4	6.6		

Note: (1)
Steel test plates shall not be surface treated and have a hardness of 46-50 HRC.
Note: (2)
If countersunk rivets are used, a counter bore of 120° shall be made at the clamping position of the rivet head.

6.1.2 Strength test procedure

6.1.2.1 Shear test

The procedure for conducting shear tests is as follows.

a) Use the fastening tool specified by the manufacturer for the particular type of rivet to clamp the rivet to the steel test plates.

b) Set the rivet clamped in step **a)** into a tensile testing machine as specified in **JIS B7721**.

c) In the same manner as shown in **Figure 5**, apply a load to the rivet at a speed of 10-15 mm per minute until it fails.

d) The rivet shear strength is taken as the maximum load applied to the rivet at the time, or just before it fails.

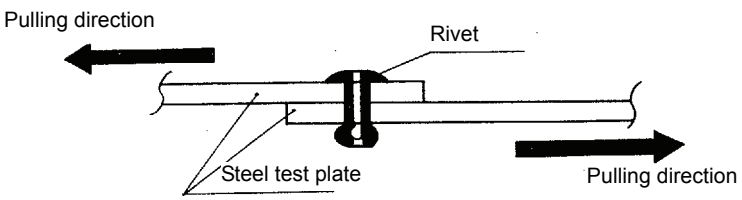

Figure 5 Shear test

6.1.2.2 Tensile test

Tensile tests are conducted as follows.

a) Use the fastening tool specified by the manufacturer for the particular type of rivet to clamp the rivet to the steel test plates.

b) Use the test jig shown in **Figure 6** and set the rivet clamped in step **a)** into a tensile testing machine as specified in **JIS B7721**.

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c) In the same manner as shown in **Figure 7**, apply a load to the rivet at a speed of 10-15 mm per minute until it fails.

d) The rivet tensile strength is taken as the maximum load applied to the rivet at the time, or just before it fails.

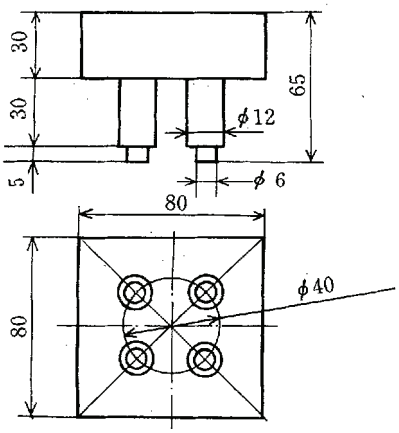

Figure 6 Test jig

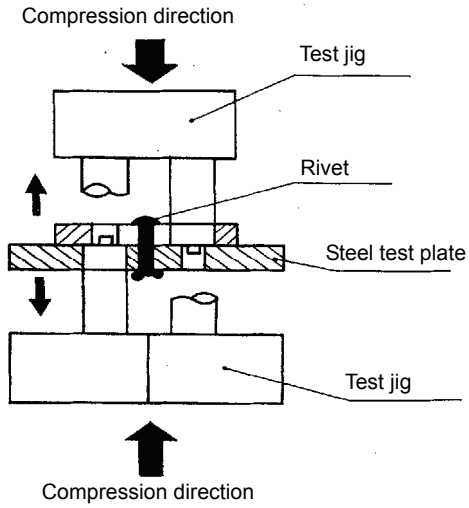

Figure 7 Tensile test

6.2 Water-tightness test procedure

Water-tightness tests for capped rivets are conducted as follows.

a) Use the fastening tool specified by the manufacturer for the particular type of rivet to clamp the rivet to the steel test plates under the conditions specified in **Table 8**.

b) Place the rivet clamped in step **a)** into a tank filled with colored water as shown in **Figure 8**.

c) Perform tests with the rivet orientated as shown in **Figure 8**, as well as with it orientated so that the rivet head is facing the water tank.

d) Increase the air pressure by adjusting the pressure reducing valve in increments of 50 kPa until the pressure reaches 500 kPa. After each pressure increment, leave it for five minutes and visually check for any water leakage between the steel test plates and the rivet.

Table 8 Hole diameters and thickness of steel plates used for water-tightness tests

Unit: mm

Rivet nominal diameter	Hole diameter		Steel test plate thickness *t*
	Standard dimension	Tolerance	
3.2	4.3	+0.1 -0	Set to 50-60% of the smallest value in the recommended grip range shown in **Table 11**. (Grip thickness *2t* is set between the smallest and largest value of the recommended grip range + 20%.)
4.0	5.2		
4.8	6.2		

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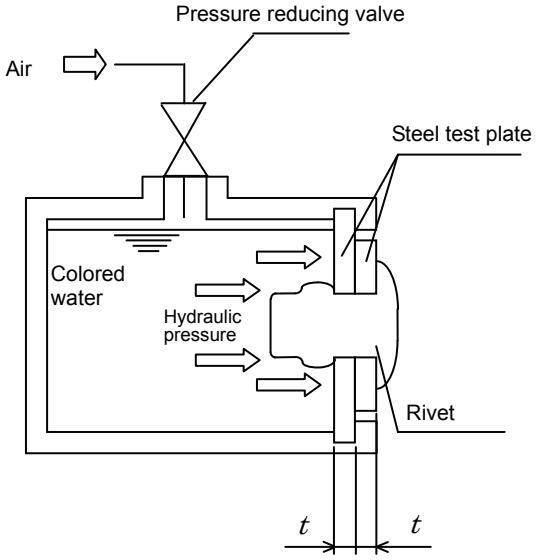

Figure 8 Water-tightness test

7. Inspection

Inspections shall be carried out according to **7.1** to **7.3**. However, the sampling method for lot inspection should be agreed on by both the supplier and receiving parties.

7.1 Performance inspection

7.1.1 Strength test

The rivet must meet the requirements in **Table 3** after carrying out the tests in **6.1**. However, this does not apply to capped rivets. Capped rivet strength requirements shall be agreed on by both the supplier and receiving parties.

7.1.2 Water-tightness test

Capped rivets are determined to be water-tight if there is no water leakage after undergoing the tests outlined in **6.2**.

7.2 Shape and dimensions inspection

Shape and dimensions are measured using calipers or a dial meter inspection and must comply with the requirements in **Annex A**.

7.3 External appearance inspection

The external appearance inspection is carried out visually to check compliance with the requirements in **5.4**.

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8. Product code

Rivet product codes are made up of the applicable standard number, type number, combination number, rivet nominal designation, and a special code (E, LF, ELF, or EC).

Example: JASO F 206-2012 1D 11-32048 E

- JASO F 206-2012: Standard number
- 1D: Type number
- 11: Combination number
- 32048: Rivet nominal designation
- E: Special code

Note:

Special code definitions

E: Expanded grip range, LF: Large flange, ELF: Expanded grip range with large flange, EC: Expanded grip range with a cap.

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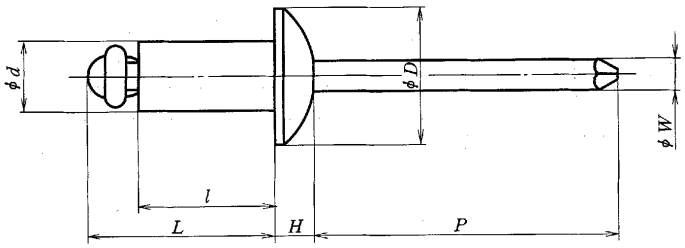
Annex A
(Normative)

Rivet shape and dimensions

Table A.1 - 1D shape (including some with the LF special code)



Unit: mm

Rivet nominal designation	Rivet nominal diameter	Recom-mended grip range	Rivet body							Mandrel		(Reference)
			Length		Diameter *d*		Head diameter *D*		Head height *H* (Max)	Protrusion length *P* (Min)	Diameter *W* (Reference)	Rivet hole diameter
			l (Min)	*L* (Max)	Standard dimension	Tolerance	Standard dimension	Tolerance				
24016	2.4	1.0-1.6	3.5	7.5	2.4	+0.07 -0.11	4.8	±0.3	0.9	26	1.45	2.5
24032		1.6-3.2	5.1	9.1								
24048		3.2-4.8	6.7	10.7								
24064		4.8-6.4	8.3	12.3								
24080		6.4-8.0	10.4	14.4								
24096		8.0-9.6	12.0	16.0								
30032	3.0	1.6-3.2	5.7	10.7	3.0		6.0		1.3		1.83	3.1
30048		3.2-4.8	7.4	12.4								
30064		4.8-6.4	9.2	14.2								
32016	3.2	1.0-1.6	4.0	9.2	3.2		6.4				1.93	3.3
32032		1.6-3.2	5.6	10.8								
32048		3.2-4.8	7.2	12.4								
32064		4.8-6.4	8.8	14.2								
32080		6.4-8.0	10.3	16.0								
32096		8.0-9.6	11.9	17.8								
32128		9.6-12.8	15.1	21.4								
32160		12.8-16.0	18.9	25.2								
32192		16.0-19.2	22.4	28.7								
40032	4.0	1.6-3.2	6.1	11.4	4.0		8.0 (11.9)	±0.4 (±0.5)	1.6	27	2.42	4.1
40048		3.2-4.8	7.7	13.0								
40064		4.8-6.4	9.3	14.8								
40080		6.4-8.0	10.9	16.6								
40096		8.0-9.6	12.5	18.4								
40128		9.6-12.8	15.7	22.0								
48032	4.8	1.6-3.2	6.7	13.0	4.8		9.6 (15.9)	±0.5 (±0.6)	1.8 (2.3)		2.90	4.9
48048		3.2-4.8	8.3	14.7								
48064		4.8-6.4	9.9	16.5								
48080		6.4-8.0	11.4	18.3								
48096		8.0-9.6	13.0	20.1								
48128		9.6-12.8	16.2	23.6								
48160		12.8-16.0	19.4	27.0								
64032	6.4	1.6-3.2	7.8	15.9	6.4		12.8	±0.6	2.1	32	3.84	6.5
64064		3.2-6.4	11.0	17.8								
64096		6.4-9.6	14.2	21.5								
64128		9.6-12.8	17.4	25.0								
64160		12.8-16.0	20.6	28.4								
64192		16.0-19.2	23.8	31.8								

Note:
The standard rivet head diameter is two times the rivet body diameter. However, for rivet types that have an additional variation with a head diameter that is three times the body diameter (large flange LF), the additional dimensions for the head diameter and height are shown in parenthesis. Large flange nominal designations have an additional "LF" added to the end.

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