

TOYOTA ENGINEERING STANDARD

NO. : TSB1503G

TITLE : PROJECTION WELD NUTS

CLASS : C2

Established/Revised : Rev.8(Jul.2005)

This standard has been revised in consequence of the following changes:
(1) disused parts in Appendix have been deleted; and
(2) a Remark regarding TSZ0001G has been added to the Scope.

Engineering Information
Planning Dept.
Engineering Administration Div.
TOYOTA MOTOR CORPORATION

TOYOTA ENGINEERING STANDARD	TSB1503G	CLASS
		C2

PROJECTION WELD NUTS

1. Scope

This standard covers the shape, dimensions and quality of projection weld nuts (hereinafter referred to as "nuts") for automobiles.

Remark:

This part shall conform to the sub-paragraph "Substance Prohibition and Restriction" in TSZ0001G.

2. Classification

The classification of the nuts shall conform to Table 1.

Table 1

Classification	Type indication number	Property class	Thread size	Shape and dimensions
Square projection weld nut	94223	8	M4, M5, M6, M8, M10, M12	See Attached Table 1.

3. Material

The nuts shall be made of carbon steel containing 0.28 % or less carbon (equivalent to S25 in TSG3200G) such that the products satisfy the mechanical properties specified in Section 4.

4. Mechanical Properties

The mechanical properties of the nuts shall conform to the property class 8 specified in TSB1002G.

Prepared and Written by:	Engineering Administration Div.
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Engineering Administration Div.	

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5. Weld Strength

The weld strength of the nuts shall meet Table 2 when tested in accordance with Section 11.2. The nuts shall be acceptable when the values of breakaway load and torque are greater than the values shown in Table 2 even if the weld is deformed in the forced and torque breakaway tests.

Table 2

Thread size	M4	M5	M6	M8	M10	M12
Forced breakaway load (N)	3040 min.			3430 min.	5685 min.	
Breakaway torque (N·m)	24.5 min.	29.4 min.	39.2 min.	63.7 min.	98.1 min.	166.7 min.

Remark:

Values given in Table 2 are for evaluation of the performance of the nuts themselves and are applicable to test pieces welded under the welding conditions and using test steel sheets given in Table 5. The standard weld strength of the nuts welded to products for practical use is given in Table 3 for reference.

Table 3 Weld Strength of Nut Welded to Product (Reference)

Thread size	M4	M5	M6	M8	M10	M12
Breakaway torque (N·m)	19.6 min.	22.6 min.	29.4 min.	39.2 min.	58.8 min.	78.5 min.

6. Shapes and Dimensions

The shapes and dimensions of the nuts shall conform to Attached Table 1.

7. Threads

7.1 Threads of Nuts

The threads of the nuts shall conform to TSB0200G, and their types, pitches and tolerance zone class shall be in accordance with Table 4.

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Table 4 Threads of Nuts (Unit: mm)

Type	Thread size	Pitch	Tolerance zone class
Coarse pitch thread	M4	0.7	6H
	M5	0.8	
	M6	1	
	M8	1.25	
Fine pitch thread	M10		
	M12		

The nuts shall have the thread accuracy specified in Section 7.1 even after welded under the welding conditions given in Table 5.

Remark:

The thread accuracy specified herein is applicable to the test pieces prepared by using test steel sheets and welded under the welding conditions given in Table 5, and is not intended to control the thread accuracy after the nuts are welded to actual products.

8. Appearance

The appearance of the nuts shall conform to the requirements of Section 9 with respect to surface roughness, and shall be free of cracks, burrs, flaws, rust, that are detrimental in the use.

9. Surface Roughness

The surface roughness of the top and projection bottom faces of the nuts shall be 6.3a specified in TSZ2301G, and the threaded portion shall be finished smooth.

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The nuts shall not be subjected to surface treatments. The nuts, however, may be coated with rust-preventive oil for the purpose of temporary rust prevention during the period from manufacture to delivery. Degree of coating shall be determined through consultation among the divisions concerned.

11. Test Methods**11.1 Mechanical Property Test**

The test methods of mechanical properties (proof load test and hardness test) shall conform to TSB1002G. The application method of the proof load shall conform to Fig. 1.

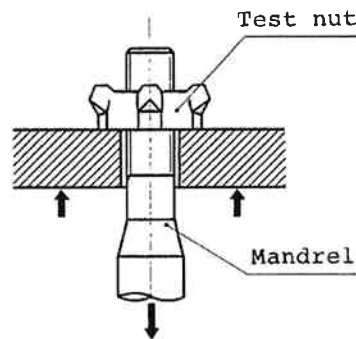


Fig. 1 How to Apply Proof Load

11.2 Weld Strength Test**11.2.1 Forced Breakaway Test**

Drill a hole as shown in Fig. 2 on a test steel sheet shown in Table 5, and weld the nut to the test steel sheet under the welding conditions given in Table 5. Place the test piece thus prepared on a spacer as shown in Fig. 2, screw a bolt into the welded nut, and then gradually apply a compressive load to the head of the bolt in such a manner that the direction of load application aligns with the center axis of the screw threads. Measure the load required to cause the nut to break away from the steel sheet.

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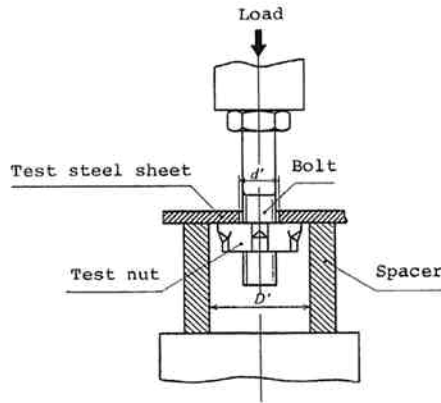


Fig. 2 Forced Breakaway Test

Thread size	Property class	$\phi d'$		$\phi D'$
		Basic dimension	Tolerance	
M4	8	5	+0.3	16
M5		6	0	17
M6		7		23
M8		9		
M10		11		26
M12		13		30

Remark 1:

"d'" and "D'" shall conform to the above table.

Remark 2:

Use the bolt of property class 8.8 specified in TSB1302G or the bolt of part Grade A, tolerance zone class 6g, and property class 8.8 or higher as specified in JIS B 1180.

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Table 5 Test Steel Sheet and Welding Conditions

Thread size	Property class	Test steel sheet		Welding conditions		
		Material	Sheet thickness (mm)	Current (A)	Weld time (Hz)	Welding force (N)
M4	8	SPC270C (pickled) of TSG3100G	1.0	8500	6	2210
M5				9500		2700
M6						
M8						
M10			1.6	11500	8	3190
M12			2.3	13500	10	3920

Remark 1:
The test steel sheet shall be 40×40 mm or larger.
Remark 2:
The material in the table is specified in TSG3100G.

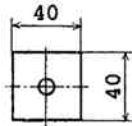


Fig. 3 (Unit: mm)

Remark:
The ammeter to be used in the measurement of current shall be the type for the exclusive use for single-phase AC power source. Table 6 lists the basic ratings of the welding current meter.

Table 6 Basic Ratings of the Welding Current Meter

Item	Description
Operating environment	Temperature: 0 to 40 °C, relative humidity: 90 % or less (non condensation)
Power requirements	AC 100 V or built-in battery
Current sensor	Toroidal coil (2-part type)
Variables measured and range	Welding current: 5 to 20 kA (no range selection), weld time: 0 to 99 cycles
Measurement accuracy	Welding current: ±2 % or less (full-scale), weld time: ±0 cycles

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The welding current of the single-phase AC spot welding machine shall be defined as follows.

The welding current shall be the RMS value which is the arithmetic mean of all cycles except the first three after the machine has been energized.

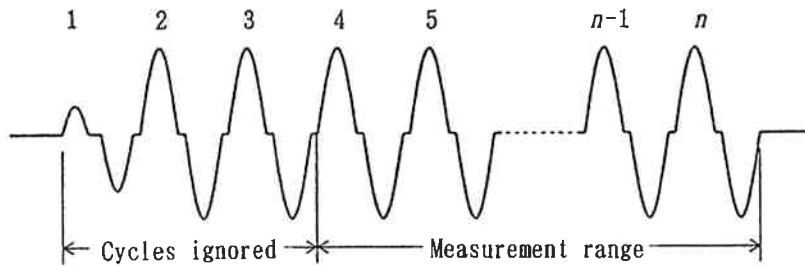


Fig. 4 Welding Current Waveform and Welding Current Value I of Single-Phase AC Spot Welding Machine

Remark:

$$\text{Current } I = \frac{\sum_{i=4}^n I_i}{n - 3}$$

where,

I_i : RMS current of each cycle

n : weld cycle

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11.2.2 Torque Breakaway Test

Weld the nut to the test steel sheet in the same way as Section 11.2.1. Fix the steel sheet as shown in Fig. 5, and apply torque to the nut on a plane at right angles to the center axis of the screw threads. Measure the torque required to cause the welded part of the nut to break away from the test steel sheet.

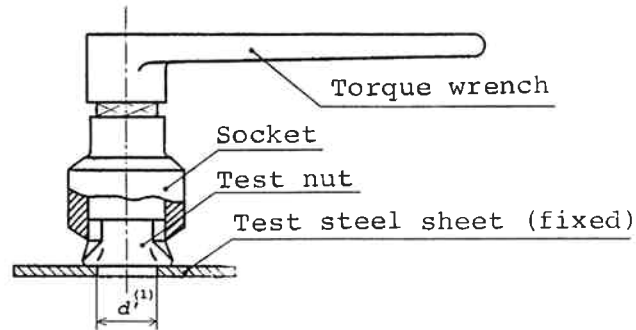


Fig. 5 Torque Breakaway Test

Note:(1)

Welding shall be conducted in the same way as in the test of Fig. 2. However, the drilling of the steel sheet may be omitted.

12. Part Number and Mass

The part number and mass of the nuts shall conform to Attached Table 1. The mass tolerance shall conform to TSZ2900G.

13. Product Identification

Identification of nut products shall conform to Section 7 of TSB1002G.

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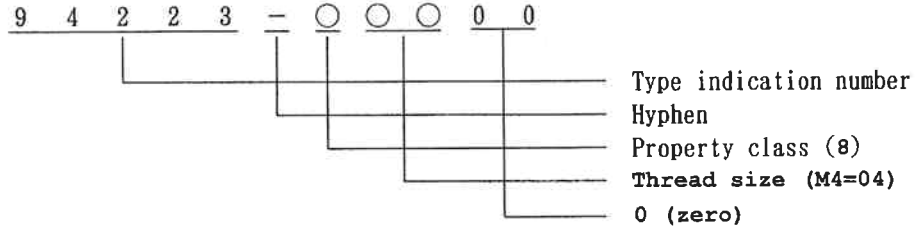
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14. Part Number

The formation of the part number of the nuts shall be as follows:



15. Part Name

The part name of the nuts shall be "NUT, WELD".

Applicable Standards

TSB0200G	Metric Screw Threads
TSB1002G	Mechanical Properties of Nuts
TSB1302G	Hexagon Bolts with Flange
TSG3100G	Cold Rolled Steel Sheets
TSG3200G	Carbon Steels for Machine Structural Use
TSZ0001G	Control Method for Substances of Environmental Concern
TSZ2301G	Definitions and Evaluation Methods for Surface Texture Parameters
TSZ2900G	General Mass Tolerances
JIS B 1180	Hexagon Head Bolts and Hexagon Head Screws

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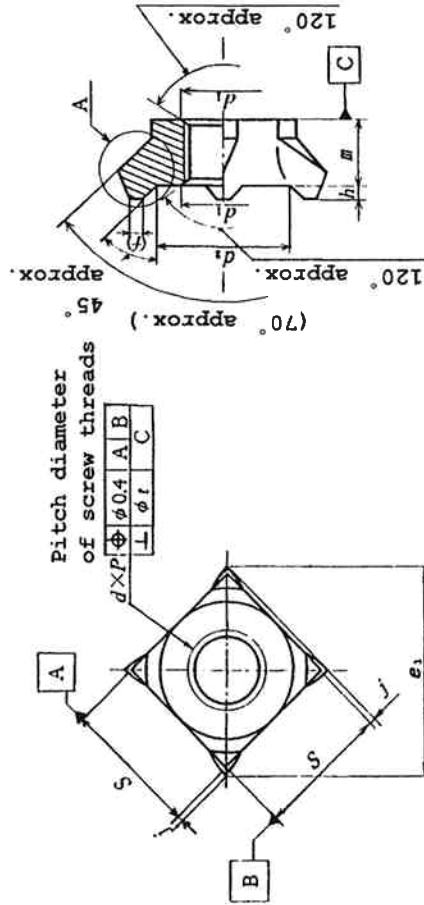
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Attached Table 1 Square Projection Weld Nut



(Unit: mm)

Property class	Thread size (d)	Pitch (P)	S Tolerance	j	m		h Tolerance	e1 Min.	d1 Tolerance	d2 Tolerance	phi t	f	g	Mass tolerance	Part number
					Basic size	Tolerance									
8	M4	0.7	8	0.3	3.2	0	0	11.2	5	8	0.06	0.3	1.1		94223-80400
	M5	0.8	9	to 0.5	5	-0.3	1	12.6	5	9	0.09	to 0.3	2.2		94223-80500
								16.2	7	12	to 4.1				
	M6	1	12	to 0.5	7.5	0	-0.36	17.1	9	12	0.15	1.5	5.5	MB	94223-80600
								19.8	11	14	0.2	to 1.5	9.7		
	M10	1.25	14	to 1	10	0	-0.43	23.6	13	17	0.25	to 2	16.9		94223-81000
	M12							23.6	13	17	0.25	to 2	16.9		94223-81200

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Remark 1:
Variation in (m+h) in one nut shall not exceed 0.1 mm.

Remark 2:
The dimensions in the drawing shown in () are reference dimensions.

Remark 3:
Unless otherwise specified, the dimensions shall be at the discretion of the nut manufacturer. The A section may be of the shape as shown in Fig. 6. In any case, the shape shall not have adverse effects on the weldability.



Fig. 6

Remark 4:
When selecting nuts, it is recommended to refer to the application guidance in the following table.

Remark 5:
Application guidance for square projection weld nut is shown for reference.

Mating steel sheet	Mating bolt property class
	4.8, 6.8, 8.8
Common steel sheet: Thin (Thickness; up to 1.6 mm)	M4 to M12 Property class 8 nut
Common steel sheet: Thin (Thickness; 1.6 mm and over)	
High tensile steel sheet: (Tensile strength; 393 MPa and over)	

Remark 6:
The classification of the sheet thickness and tensile strength is indicated as an aim. The flatness of the welding surface of mating steel sheet also has a large effect. For application to a place of poor flatness such as drawn surface, it is recommended to consult the production engineering departments.

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APPENDIX UNUSABLE PROJECTION WELD NUTS

1. Scope

The use of projection weld nuts specified in this Appendix (hereinafter referred to as "nuts") are to be discontinued, for the purpose of reduction in the parts variety, and these nuts, therefore, shall not be additionally adopted in designs.

Remark:

This part shall conform to the sub-paragraph "Substance Prohibition and Restriction" in TSZ0001G.

2. Classification

The classification of nuts shall conform to Appendix Table 1.

Appendix Table 1

Classification	Pilot	Type indication number	Nominal diameter	Property class	Appendix Attached Table
Square projection weld nut, Type 2	None	94220	6, 8, 10	6N	1
		94225	12		
Hexagon projection weld nut, Type 1		94221	8		2
		94226	12		
Square projection weld nut, Type 1		94223	4, 5, 6, 8, 10, 12		3

3. Material

The material of nuts shall conform to Section 3 of the Text.

4. Mechanical Properties

The mechanical properties of nuts shall be 6N as specified in TSB1002G.

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5. Weld Strength

The weld strength of nuts shall conform to Section 5 of the Text. However, even if its weld portion is deformed in the forced and torque breakaway tests, the nuts are acceptable when the values of breakaway torque are greater than the values shown in Appendix Table 2.

Appendix Table 2 (Unit: N·m)

Thread size	Breakaway torque		
	Square projection weld nut, Type 2	Hexagon projection weld nut, Type 1, Type 2	Square projection weld nut, Type 1
M4	24.5 min.		24.5 min.
M5			29.4 min.
M6	39.2 min.	34.3 min.	39.2 min.
M8		44.1 min.	63.7 min.
M10	58.8 min.		98.1 min.
M12	78.5 min.		166.7 min.

6. Shapes and Dimensions

The shapes and dimensions of nuts shall conform to Appendix Attached Tables 1 to 3.

7. Threads

The threads of nuts shall conform to Section 7 of the Text.

8. Appearance

The appearance of nuts shall conform to Section 8 of the Text.

9. Surface Roughness

The surface roughness of nuts shall conform to Section 9 of the Text.

10. Surface Treatment

The surface treatment of nuts shall conform to Section 10 of the Text.

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11. Test Methods

The test methods for nuts shall conform to Section 11 of the Text. However, the test conditions for hexagon projection weld nuts shall be changed as shown below.

(1) The welding conditions shall conform to Appendix Table 3.

Appendix Table 3

Thread size	Test steel sheet		Welding conditions			Weld machine	
	Material	Sheet thickness (mm)	Current (A)	Weld time (Hz)	Welding force (N)		
M4	SPC270C (pickled) of TSG3100G	1.0	13500	to	9	1960	P2-type Tap 2
M5			13700				
M6			14000	to	10	2160	
			14200				
M8		15000	to	11	2355	P2-type Tap 1	
		15200					
M10	1.6	15300	to	9	3430	P2-type Tap 3	
M12		15500					

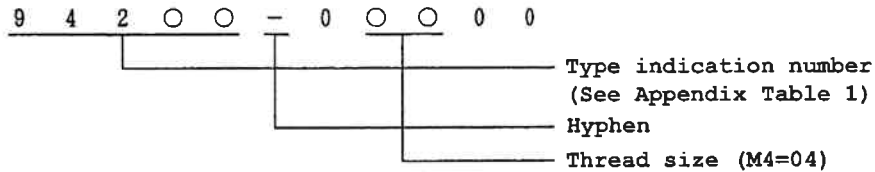
(2) The dimension *d'* of Fig. 5 in the Text shall be determined according to the diameter of a hole in the mating test sheet shown in Appendix Attached Tables 2 and 3. Drilling is always required for the nuts provided with a pilot, although it may be omitted for the nuts without a pilot.

12. Mass and Mass Tolerance of Nuts

The mass of nuts shall conform to Appendix Attached Tables 1 to 3. The mass tolerance shall conform to TSZ2900G.

13. Part Number

The part number of nuts shall be as follows.



14. Part Name

The part name of nuts shall be "NUT, WELD".

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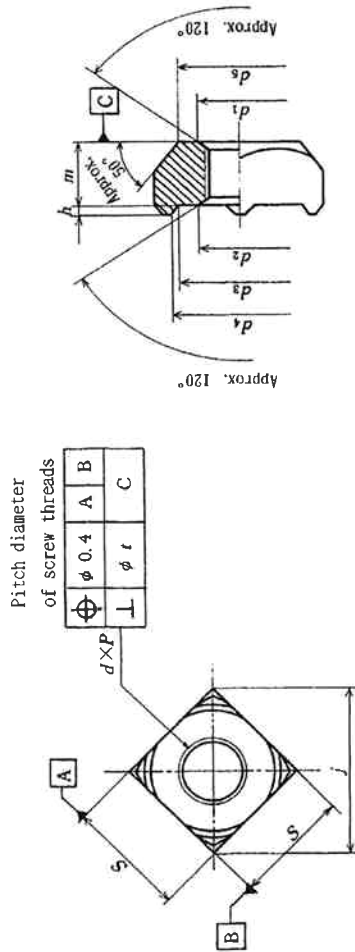
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Appendix Attached Table 1 Square Projection Weld Nut, Type 2



(Unit: mm)

Property class	Thread size (d)	Pitch (P)	S	e ₁	m		h	Tolerance	Basic size	Tolerance	Basic size	Tolerance	Basic mass (g)	φt	Mass tolerance	Part number
					Tolerance	Basic size										
GN	M5	0.8	10	12.8	4.0	±0.15	0.8	±0.1	0.8	6	7	11	2.0	0.07	2.0	94225-00500
	M6	1.0	12	16.2	5.0				7	8	13	4.0	0.09	4.0	94220-00600	
	M8	1.25	15	20.2	6.5	±0.2	1.2		9	10	16	7.0	0.12	7.0	94220-00800	
	M10		17	22.7	7.0			11	12	17	14	13.5	0.15	13.5	94220-01000	
	M12	17	22.7	10.0				13	14	18	19	13.5	0.20	13.5	94225-01200	

Remark 1:
Variation of projection height at 4 points with respect to the top surface of the nut shall not exceed 0.07 mm.

Remark 2:
The ends of the projections shall be provided with a flat sface which can be visually confirmed.

Remark 3:
Dimensions not specified shall be agreed upon by the partiers concerned and shall meet the requirements of the specification of Section 5 in Appendix.

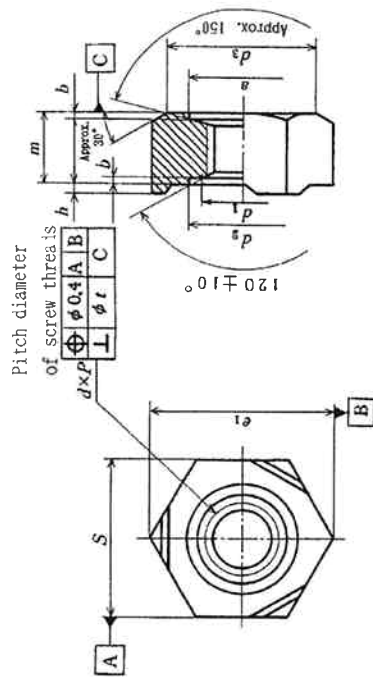
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Appendix Attached Table 2 Hexagon Projection Weld Nut, Type 1



(Unit: mm)

Property class	Thread size (d)	Pitch (P)	S		e ₁	m	h		d ₂	Tolerance	d ₃	a	b	φt	Diameter of hole on mating sheet (reference)	Basic mass (g)	Mass tolerance	Part number
			Tolerance	Min.			Max.	Min.										
6N	M8	1.25	15	16.6	21.1	7.5	0.6	0.8	11	+0.2 0	14.2	11	0.5	0.15	9	7.1	MB	94221-00800
	M12		19	21.1			0.8	1.0										15

Remark 1: The shape and dimensions of projections shall be agreed upon by the parties concerned and shall meet the requirements of Section 5 in Appendix.

Remark 2: "d₁" shall be (nominal diameter of screw thread +1) mm.

Remark 3: Variation of the projection height at 3 points with respect to the top surface of the nuts shall not exceed 0.15 mm.

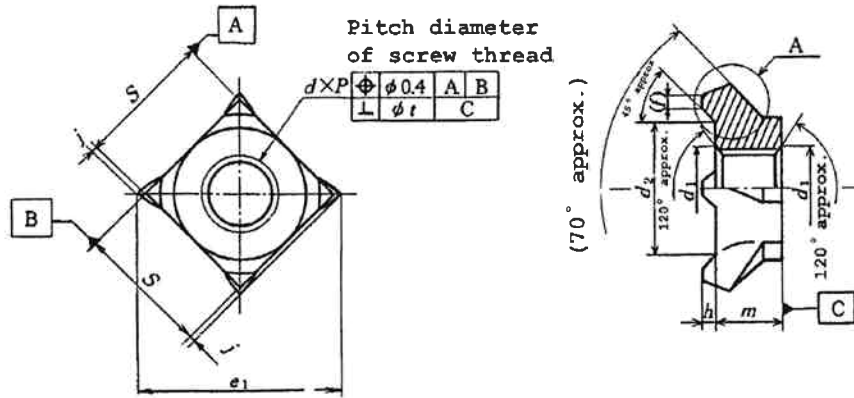
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TOYOTA ENGINEERING STANDARD

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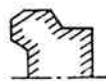
Appendix Attached Table 3 Square Projection Weld Nut, Type 1



(Unit: mm)

Property class	Thread size (d)	Pitch (P)	S		j	m		h	e ₁	d ₁	d ₂	φ t	f (Reference)	Basic mass (g)	Mass tolerance	Part number				
			Tolerance			Basic size	Tolerance										Tolerance		Tolerance	
6N	M5	0.8	9	0 to -0.25	0.3 to 0.5	4	0	1	12.6	6	9	0.07	0.3 to 1.5	1.8	MB	94223-60500				
	M6	1.0	10	0 to -0.30	5	0	13.9									7	10	0.09	2.7	94223-60600
	M8	1.25	12	0 to -0.36	6.5	0	17.1									9	12	0.12	4.8	94223-60800
			14	8	0	19.8	11									14	0.15	7.7	94223-61000	
	M12	17	1.0	10	-0.36	1.2	23.8									13	17	0.20	0.5 to 2	13.6

- Remark 1:
Variation in (m+h) in one nut shall not exceed 0.1 mm.
- Remark 2:
The dimensions in the drawing shown in () are reference dimensions.
- Remark 3:
Unless otherwise specified, the dimensions shall be at the discretion of the nut manufacturer. The A section may be of the shape as shown in Appendix Fig. 1. In any case, the shape shall not have adverse effects on the weldability.



Appendix Fig. 1

- Remark 4:
The 6N nut of M4 is commonly usable for 8N nut of M4.

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