

8-1 Dimension of Screw

(1) Dimension of bolt

Table 8-1 Dimension of bolt

Nominal size of bolt	d [mm]	M1	M1.2	M1.4	M1.6	M2	M2.5	M3	M3.5	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27	M30	M33	M36	M39	M42	M45	M48	M52	M56	M60	M64
Pitch	p [mm]	0.25	0.25	0.3	0.35	0.4	0.45	0.5	0.6	0.7	0.8	1	1.25	1.5	1.75	2	2	2.5	2.5	2.5	3	3	3.5	3.5	4	4	4.5	4.5	5	5	5.5	5.5	6
Pitch diameter	dz [mm]	0.838	1.038	1.205	1.373	1.740	2.208	2.675	3.110	3.545	4.480	5.350	7.188	9.026	10.863	12.701	14.701	16.376	18.376	20.376	22.051	25.051	27.727	30.727	33.402	36.402	39.077	42.077	44.752	48.752	52.428	56.428	60.103
Effective area	As [mm ²]	0.460	0.732	0.983	1.27	2.07	3.39	5.03	6.78	8.78	14.2	20.1	36.6	58.0	84.3	115	157	192	245	303	353	459	561	694	817	976	1120	1310	1470	1760	2030	2360	2680
Minor diameter	d1 [mm]	0.729	0.929	1.075	1.221	1.567	2.013	2.459	2.850	3.242	4.134	4.917	6.647	8.376	10.106	11.835	13.835	15.294	17.294	19.294	20.752	23.752	26.211	29.211	31.670	34.670	37.129	40.129	42.587	46.587	50.046	54.046	57.505
Lead angle	tanβ	0.0950	0.0767	0.0792	0.0811	0.0732	0.0649	0.0595	0.0614	0.0629	0.0568	0.0595	0.0554	0.0529	0.0513	0.0501	0.0433	0.0486	0.0433	0.0391	0.0433	0.0381	0.0402	0.0363	0.0381	0.0350	0.0367	0.0340	0.0356	0.0326	0.0334	0.0310	0.0318
3rd class bolt dia.	dh [mm]	1.3	1.5	1.8	2.0	2.6	3.1	3.6	4.2	4.8	5.8	7.0	10.0	12.0	14.5	16.5	18.5	21.0	24.0	26.0	28.0	32.0	35.0	38.0	42.0	45.0	48.0	52.0	56.0	62.0	66.0	70.0	74.0
● Hexagon bolt, nut	s [mm]	—	—	—	3.2	4	5	5.5	6	7	8	10	13	16	18	21	24	27	30	34	36	41	46	50	55	60	65	70	75	80	85	90	95
Part class	e [mm]	—	—	—	3.41	4.32	5.45	6.01	6.58	7.66	8.79	11.05	14.38	17.77	20.03	23.36	26.75	30.14	33.53	37.72	39.98	—	—	—	—	—	—	—	—	—	—	—	—
A (M1.6~M24)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
B (M16~M64)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C (M5~M64)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Style1 Hexagon nut	m [mm]	—	—	—	1.1	1.4	1.7	2	2.4	2.8	3.5	4	5.3	6.4	7.5	8.8	10	11.5	12.5	14	15	17	18.7	21	22.5	25	26	28	30	33	35	38	40
Style2 Hexagon nut	m [mm]	—	—	—	1.3	1.6	2	2.4	2.8	3.2	4.7	5.2	6.8	8.04	10.37	12.1	14.1	15.1	16.9	18.1	20.2	22.5	24.3	27.4	29.4	31.8	32.4	34.4	36.4	40.4	43.4	46.4	49.1
Hexagon Round A	dn1 [mm]	—	—	—	2.75	3.47	4.28	4.79	5.34	6.19	7.20	8.90	11.96	14.59	16.86	19.48	22.10	24.95	28.03	31.22	33.27	37.94	42.16	45.81	50.48	54.70	58.92	63.59	68.26	73.83	78.50	83.17	87.84
Hexagon Round B	dn [mm]	—	—	—	2.14	2.84	3.61	4.10	4.65	5.36	6.36	7.98	10.84	13.36	15.59	18.12	20.56	23.24	26.15	28.95	30.89	—	—	—	—	—	—	—	—	—	—	—	—
Hexagon Round C	dn [mm]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Socket head chamfer	s [mm]	—	—	—	1.5	1.5	2	2.5	—	3	4	5	6	8	10	12	14	—	17	—	19	—	22	—	27	—	32	—	36	—	41	—	46
Socket head chamfer	e [mm]	—	—	—	1.73	1.73	2.3	2.87	—	3.44	4.58	5.72	6.86	9.15	11.43	13.72	16	—	19.44	—	21.73	—	25.15	—	30.85	—	36.57	—	41.13	—	45.83	—	52.53
Socket head chamfer	dk [mm]	—	—	—	3.00	3.00	4.50	5.50	—	7.00	8.50	10.00	13	16	18	21	24	—	30	—	36	—	45	—	54	—	63	—	72	—	84	—	96
Socket head chamfer	k [mm]	—	—	—	1.60	2.00	2.50	3.00	—	4.00	5.00	6.00	8	10	12	14	16	—	20	—	24	—	30	—	36	—	42	—	48	—	56	—	64
Socket head chamfer	dn [mm]	—	—	—	2.533	3.238	3.843	4.616	—	5.968	7.235	8.588	11.57	14.1	16.31	18.84	21.37	—	27.11	—	32.17	—	40.21	—	48.25	—	55.84	—	64.33	—	75.36	—	85.48
Socket head chamfer	dw [mm]	—	—	—	2.72	3.48	4.18	5.07	—	6.53	8.03	9.38	12.33	15.33	17.23	20.17	23.17	—	28.87	—	34.81	—	43.61	—	52.54	—	61.34	—	70.34	—	82.26	—	94.26
Socket head chamfer	dn [mm]	—	—	—	2.378	3.018	3.667	4.377	—	5.709	6.975	8.248	11.21	13.73	15.90	18.40	20.92	—	26.51	—	31.53	—	39.46	—	47.47	—	54.94	—	63.44	—	71.82	—	85.70
Set screw	n [mm]	0.2	0.2	0.25	0.25	0.25	0.4	0.4	0.5	0.6	0.8	1	1.2	1.6	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Set screw	s [mm]	—	—	—	0.7	0.9	1.3	1.5	—	2	2.5	3	4	5	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Set screw	e [mm]	—	—	—	0.803	1.003	1.427	1.73	—	2.3	2.87	3.44	4.58	5.72	6.86	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

*d₂: JIS B0205, p: JIS B0205, β: tanβ = p/πd₂ (see P25)

(2) Small bolt, nut not based on ISO

Table 8-2 Small bolt, nut not based on ISO

Small hexagon bolt, nut	d [mm]	M8	M10	M12	(M14)	M16	(M18)	M20	(M22)	M24	(M27)	M30	(M33)	M36	(M39)
s [mm]	12	14	17	19	22	24	27	30	32	36	41	46	50	55	
e [mm]	13.9	16.2	19.6	21.9	25.4	27.7	31.2	34.6	37	41.3	47.3	53.1	57.7	63.5	
k [mm]	5.5	7	8	9	10	12	13	14	15	17	19	21	23	25	
m [mm]	6.5	8	10	11	13	15	16	18	19	22	24	26	29	31	
dn1 [mm]	5	6	7	8	10	11	12	13	14	16	18	20	21	23	
Hexagon Round	dn [mm]	10.68	12.76	15.61	17.66	20.3	22.3	25.0	27.6	29.6	33.3	37.5	41.7	45.4	49.6
Round	dn [mm]	10.03	12.01	14.82	16.55	19.07	21.1	23.6	26.1	28.1	31.1	35.2	39.2	42.7	46.8

* (see P25)

(3) Dimension of very small screw

Table 8-3 Dimension of very small screw

Small screw with slit	d	M1	(M1.1)	M1.2	(M1.4)	M1.6	M1.8
d ₂	0.838	0.938	1.038	1.205	1.373	1.573	
p	0.25	0.25	0.25	0.3	0.35	0.35	
tanβ	0.0950	0.0848	0.0767	0.0792	0.0811	0.0708	
d _{min}	0.622	0.722	0.822	0.954	1.063	1.263	
A _{1min} [mm ²]	0.3039	0.4094	0.5307	0.7148	0.8875	1.253	
a	0.32	—	0.32	0.32	0.4	—	
A	0.2	—	0.2	0.25	0.25	—	
B	—	—	—	(1.3)	(1.5)	—	
C	—	—	—	(0.7)	(0.7)	—	

d_{min}: Root diameter, A_{1min}: Area of section of root diameter

unit: [mm]

(4) Dimension of head of small screw

Table 8-4 Dimension of head of small screw

		M2	(M2.2)	M2.5	M3	(M3.5)	M4	M5	M6	M8	M10
⊕#	⊕	0	0	1	1	2	2	2	3	4	4
⊖ Slit width	⊖=a	0.4	0.5	0.6	0.8	1	1.2	1.2	1.6	2	2.5
Pan screw	D	3.2	4.0	5.0	5.6	7.00	8.00	9.5	12.0	16.00	20.00
Pan screw	H	1.30	1.60	2.10	2.4	2.60	3.10	3.70	4.6	6.0	7.5
Countersunk screw	D	3.0	3.8	4.7	5.5	7.30	8.40	9.30	11.30	15.80	18.30
Countersunk screw	H	1	1.2	1.5	1.65	2.35	2.7	2.7	3.3	4.65	5

unit: [mm]

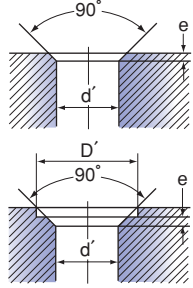
(5) Dimension of head of small screw not based on ISO.

Table 8-5 Dimension of head of small screw

		M2	(M2.2)	M2.5	M3	(M3.5)	M4	(M4.5)	M5	M6	M8
⊕#	⊕	1(0)	1	1	2(1)	2	2	2	2	3	3
⊖ Slit width	⊖=a	0.6	0.6	0.8	0.8	1	1	1	1.		

8-2 Dimension of Screws

Figure 8-1 Bolt hole diameter, facing diameter, screw prepared hole



(1) Screw prepared hole, facing diameter

Table 8-7 Bolt hole diameter, facing diameter

Nominal size of screw	Bolt hole diameter d'				Molding e	Facing diameter D'
	1st class	2nd class	3rd class	4th class (1)		
M1	1.1	1.2	1.3	—	0.2	3
M1.2	1.3	1.4	1.5	—	0.2	4
M1.4	1.5	1.6	1.8	—	0.2	4
M1.6	1.7	1.8	2	—	0.2	5
*M1.7	1.8	2	2.1	—	0.2	5
M1.8	2.0	2.1	2.2	—	0.2	5
M2	2.2	2.4	2.6	—	0.3	7
M2.2	2.4	2.6	2.8	—	0.3	8
*M2.3	2.5	2.7	2.9	—	0.3	8
M2.5	2.7	2.9	3.1	—	0.3	8
*M2.6	2.8	3	3.2	—	0.3	8
M3	3.2	3.4	3.6	—	0.3	9
M3.5	3.7	3.9	4.2	—	0.3	10
M4	4.3	4.5	4.8	5.5	0.4	11
M4.5	4.8	5	5.3	6	0.4	13
M5	5.3	5.5	5.8	6.5	0.4	13
M6	6.4	6.6	7	7.8	0.4	15
M7	7.4	7.6	8	—	0.4	18
M8	8.4	9	10	10	0.6	20
M10	10.5	11	12	13	0.6	24
M12	13	13.5	14.5	15	1.1	28
M14	15	15.5	16.5	17	1.1	32
M16	17	17.5	18.5	20	1.1	35
M18	19	20	21	22	1.1	39
M20	21	22	24	25	1.2	43
M22	23	24	26	27	1.2	46
M24	25	26	28	29	1.2	50
M27	28	30	32	33	1.7	55
M30	31	33	35	36	1.7	62
M33	34	36	38	40	1.7	66
M36	37	39	42	43	1.7	72
M39	40	42	45	46	1.7	76
M42	43	45	48	—	1.8	82
M45	46	48	52	—	1.8	87
M48	50	52	56	—	2.3	93
M52	54	56	62	—	2.3	100
M56	58	62	66	—	3.5	110
M60	62	66	70	—	3.5	115
M64	66	70	74	—	3.5	122
M68	70	74	78	—	3.5	127

Note: (1) 4th class will be used mainly for cast extracting hole.

(2) Figures in red are not prescribed on ISO273.

Nominal size of * screw is not included ISO meter. Screw on ISO R 261.

(2) Screw starting hole diameter

Table 8-8 Screw starting hole diameter (Metric coarse thread dimension)

Nominal size of screw	Screw			Facing hole diameter(2)					Ref. Female screw inner diameter (3)			
	Outside diameter d	Pitch	(1) Standard thread overlap	System					Minimum permissible dimension	Max permissible Dimension		
				90	85	80	75	70		4H (below M1.4) 5H (above M1.6) 1st class	5H (below M1.4) 6H (above M1.6) 2nd class	7H 3rd class
M1	1.0	0.25	0.135	0.76	0.77	0.78	0.80	0.81	0.729	0.774	0.785	—
M1.1	1.1	0.25	0.135	0.86	0.87	0.88	0.90	0.91	0.829	0.874	0.885	—
M1.2	1.2	0.25	0.135	0.96	0.97	0.98	1.00	1.01	0.929	0.974	0.985	—
M1.4	1.4	0.3	0.162	1.11	1.12	1.14	1.16	1.17	1.075	1.128	1.142	—
M1.6	1.6	0.35	0.189	1.26	1.28	1.30	1.32	1.33	1.221	1.301	1.321	—
M1.8	1.8	0.35	0.189	1.46	1.48	1.50	1.52	1.53	1.421	1.501	1.521	—
M2	2.0	0.4	0.217	1.61	1.63	1.65	1.68	1.70	1.567	1.657	1.697	—
M2.2	2.2	0.45	0.244	1.76	1.79	1.81	1.83	1.86	1.719	1.813	1.838	—
M2.5	2.5	0.45	0.244	2.06	2.09	2.11	2.13	2.16	2.013	2.113	2.138	—
M3	3.0	0.5	0.271	2.51	2.54	2.57	2.59	2.62	2.459	2.571	2.599	2.639
M3.5	3.5	0.6	0.325	2.92	2.95	2.98	3.01	3.05	2.850	2.975	3.010	3.050
M4	4.0	0.7	0.379	3.32	3.36	3.39	3.43	3.47	3.242	3.382	3.422	3.466
M4.5	4.5	0.75	0.406	3.77	3.81	3.85	3.89	3.93	3.688	3.838	3.878	3.924
M5	5.0	0.8	0.433	4.22	4.26	4.31	4.35	4.39	4.134	4.294	4.334	4.384
M6	6.0	1	0.541	5.03	5.08	5.13	5.19	5.24	5.017	5.157	5.197	5.217
M7	7.0	1	0.541	6.03	6.08	6.13	6.19	6.24	5.917	6.107	6.153	6.217
M8	8.0	1.25	0.677	6.78	6.85	6.92	6.99	7.05	6.647	6.859	6.912	6.982
M9	9.0	1.25	0.677	7.78	7.85	7.92	7.99	8.05	7.647	7.859	7.912	7.982
M10	10.0	1.5	0.812	8.54	8.62	8.70	8.78	8.86	8.376	8.612	8.676	8.751
M11	11.0	1.5	0.812	9.54	9.62	9.70	9.78	9.86	9.376	9.612	9.676	9.751
M12	12.0	1.75	0.947	10.3	10.4	10.5	10.6	10.7	10.106	10.371	10.441	10.531
M14	14.0	2	1.083	12.1	12.2	12.3	12.4	12.5	11.835	12.135	12.210	12.310
M16	16.0	2	1.083	14.1	14.2	14.3	14.4	14.5	13.835	14.135	14.210	14.310
M18	18.0	2.5	1.353	15.6	15.7	15.8	16.0	16.1	15.294	15.649	15.774	15.854
M20	20.0	2.5	1.353	17.6	17.7	17.8	18.0	18.1	17.294	17.649	17.744	17.854
M22	22.0	2.5	1.353	19.6	19.7	19.8	20.0	20.1	19.294	19.649	19.744	19.854
M24	24.0	3	1.624	21.1	21.2	21.4	21.6	21.7	20.752	21.152	21.252	21.382
M27	27.0	3	1.624	24.1	24.2	24.4	24.6	24.7	23.752	24.152	24.252	24.382
M30	30.0	3.5	1.894	26.6	26.8	27.0	27.2	27.3	26.211	26.661	26.771	26.921
M33	33.0	3.5	1.894	29.6	29.8	30.0	30.2	30.3	29.211	29.661	29.771	29.921
M36	36.0	4	2.165	32.1	32.3	32.5	32.8	33.0	31.670	32.145	32.270	32.420
M39	39.0	4	2.165	35.1	35.3	35.5	35.8	36.0	34.670	35.145	35.270	35.420
M42	42.0	4.5	2.436	37.6	37.9	38.1	38.3	38.6	37.129	37.659	37.799	37.979
M45	45.0	4.5	2.436	40.6	40.9	41.1	41.3	41.6	40.129	40.659	40.799	40.979
M48	48.0	5	2.706	43.1	43.4	43.7	43.9	44.2	42.587	43.147	43.297	43.487
M52	52.0	5	2.706	47.1	47.4	47.7	47.9	48.2	46.587	47.147	47.297	47.487
M56	56.0	5.5	2.977	50.6	50.9	51.2	51.5	51.8	50.046	50.646	50.796	50.996
M60	60.0	5.5	2.977	54.6	54.9	55.2	55.5	55.8	54.046	54.646	54.796	54.996
M64	64.0	6	3.248	58.2	58.5	58.8	59.1	59.5	57.505	58.135	58.305	58.505
M68	68.0	6	3.248	62.2	62.5	62.8	63.1	63.5	61.505	62.135	62.305	62.505

Note:

(1) H₁=0.541266P

(2) Screw prepared hole =d-2XH₁; (Catching rate)

(3) Permissible limit dimension of inner diameter of female screw is prescribed in JIS B 0209. (Permissible limit dimension and tolerance of meter coarse screw thread)

Remarks: Thick letter of left side from --- line, - - - line, — line prescribed in each JIS B 0209.

4H (below M1.4), 5H (above M1.6) or first class, 5H (below M1.4), 6H (above M1.6),

or second-class and 7H or third class show within permissible dimension of female inner diameter.

8-3 Bolt Looseness

(1) Classification and causes of looseness

Table 8-9 Classification and causes of looseness

Looseness generated by bolt return without turning	Classification		Causes
	1	2	
Looseness generated by bolt return with turning	1 Initial looseness	2 Subsidence	Contact part is flatted from unevenness
	3 Looseness by jogging movement	4 Looseness by permanent deformation of sealant	Plastic deformation of bearing surface
	5 Looseness by over-tightening	6 Looseness resulted from heat	Friction by lateral displacement of contact part
	7 Looseness by vibration force axis angle (Parallel, around axis of thread)	8 Looseness by axis vibration external force	Permanent set in fatigue like gasket
	9 Looseness by impact external force in axis right angle	10 Looseness by impact external force in axis	Proceeding of bolt plastic deformation
	1	2	Internal stress change over recrystallizing temperature or different thermal expansion in jointed parts
	3	4	Relative displacement of bearing surface and threaded parts
	5	6	Dissipation and lowering of threaded and bearing surface parts by restitution and shock wave in impact
	7	8	
	9	10	

(2) Preventing loose joint

Table 8-10 Preventing loose joint

Method of using elastic washer			
Belleville spring washer	Spring washer	Claw spring washer	Toothed washer
Method to use check nut		First tighten the lower nut to about 80% of the specified torque. Then, tighten the upper nut to 100% of the specified torque. This generates a reactive force between the two nuts and prevents them from becoming loose. If the load capacity of the nuts is likely to cause a problem, use the thicker one on top as shown in figure (b)	
(a)	(b)		
Method to use small screw		Method to use claw or wire	
			Caulking
Method to bend or calk part of washer			
Claw washer (special JES B-493)		Tongued washer (special JES B-493)	
			Key channel
Method to apply part of material to side of nut		Method to use split cotter	
Method to use power applying to bearing surface			
Method to deform			
Method to fill nylon		Method to use force loosening check nut	
			Expansion channel (4~6 places)