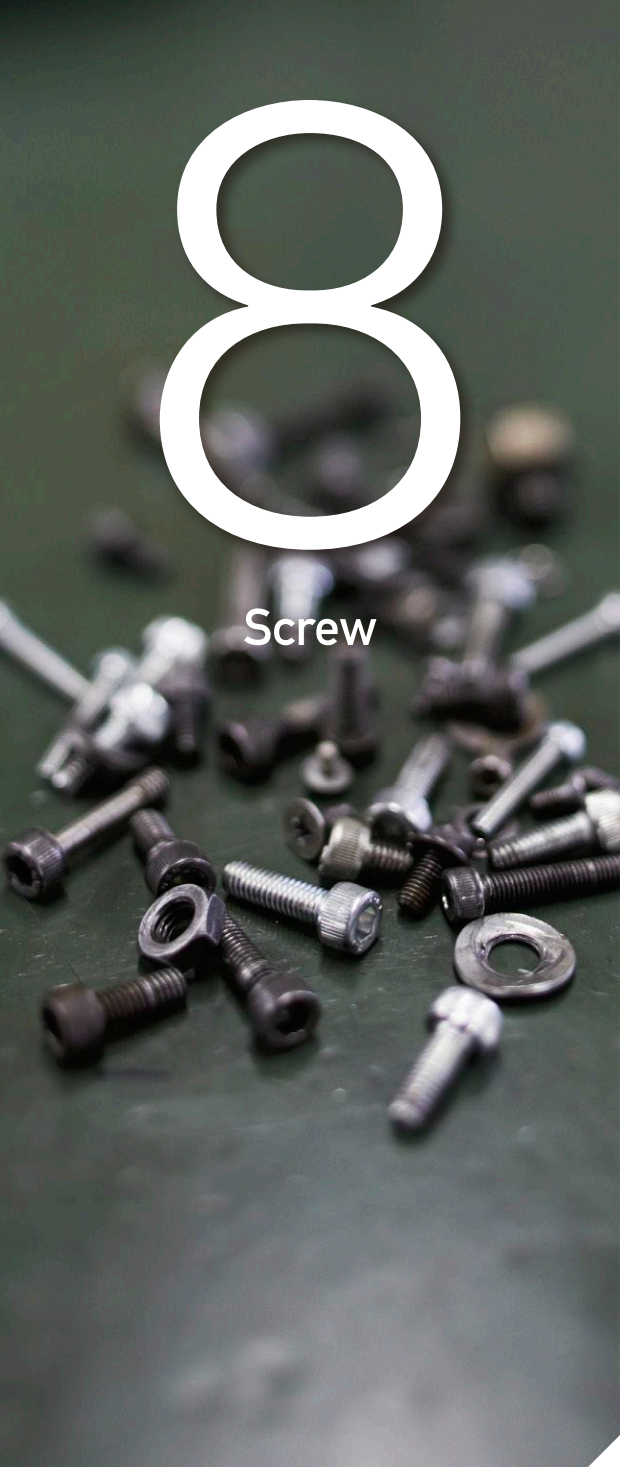
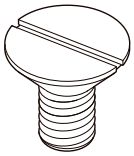


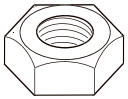
8 Screw

Names of Screws

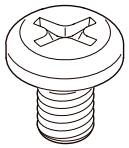
Small screws with slits



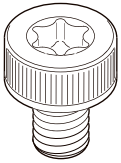
Nuts



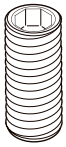
Cross-recessed pan screws



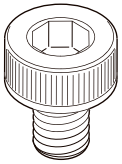
Hexalobular screws



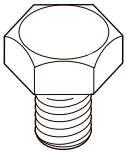
Hexagon set screws



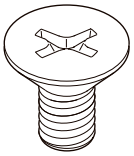
Hexagon socket head bolts



Hexagon bolts



Cross-recessed countersunk screws



8 Screw

8-1 Dimensions of Screws

(1) Bolts

Nominal size of bolt

	d	[mm]	M1	M1.2	M1.4	M1.6	M2	M2.5	M3	M3.5	M4	M5	M6	M8	M10
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
Pitch diameter	d_2	[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
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
Minor diameter	d_1	[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
Lead angle	$\tan\beta$		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
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

Hexagon bolts, nuts

		d	[mm]	M1	M1.2	M1.4	M1.6	M2	M2.5	M3	M3.5	M4	M5	M6	M8	M10
		s	[mm]	—	—	—	3.2	4	5	5.5	6	7	8	10	13	16
Part class	A (M1.6～M24)	e	[mm]	—	—	—	3.41	4.32	5.45	6.01	6.58	7.66	8.79	11.05	14.38	17.77
	B (M1.6～M64)			—	—	—	3.28	4.18	5.31	5.88	6.44	7.50	8.63	10.89	14.20	17.59
	C (M5～M64)			—	—	—	—	—	—	—	—	—	8.63	10.89	14.20	17.59
		k	[mm]	—	—	—	1.1	1.4	1.7	2	2.4	2.8	3.5	4	5.3	6.4
Style 1 (Hexagon nut)		$m_{(MAX)}$	[mm]	—	—	—	1.3	1.6	2	2.4	2.8	3.2	4.7	5.2	6.8	8.4
		$m_{(Min)}$		—	—	—	1.05	1.35	1.75	2.15	2.55	2.9	4.4	4.9	6.44	8.04
Style 2 (Hexagon nut)		$m_{(MAX)}$	[mm]	—	—	—	—	—	—	—	—	—	5.1	5.7	7.5	9.3
		$m_{(Min)}$		—	—	—	—	—	—	—	—	—	4.8	5.4	7.14	8.94
Pitch diameter of bearing surface	Hexagon	dn_1		—	—	—	2.75	3.47	4.28	4.79	5.34	6.19	7.20	8.90	11.96	14.59
	Round A	dn		—	—	—	2.14	2.84	3.61	4.10	4.65	5.36	6.36	7.98	10.84	13.36
	Round B			—	—	—	2.15	2.78	3.54	4.04	4.59	5.28	6.28	7.40	10.75	13.27
	Round C			—	—	—	—	—	—	—	—	—	6.282	7.902	10.75	13.27

Hexagon socket head bolts

	d	[mm]	M1	M1.2	M1.4	M1.6	M2	M2.5	M3	M3.5	M4	M5	M6	M8	M10
	s	[mm]	—	—	—	1.5	1.5	2	2.5	—	3	4	5	6	8
	e	[mm]	—	—	—	1.73	1.73	2.3	2.87	—	3.44	4.58	5.72	6.86	9.15
	k	[mm]	—	—	—	1.60	2.00	2.50	3.00	—	4.00	5.00	6.00	8	10
	dw		—	—	—	2.72	3.48	4.18	5.07	—	6.53	8.03	9.38	12.33	15.33
Pitch diameter of bearing surface	dn		—	—	—	2.533	3.238	3.843	4.616	—	5.968	7.235	8.588	11.57	14.1
	dk	[mm]	—	—	—	3.00	3.80	4.50	5.50	—	7.00	8.50	10.00	13	16
Pitch diameter of bearing surface	dn'		—	—	—	2.378	3.061	3.667	4.377	—	5.709	6.975	8.248	11.21	13.73

Set screws

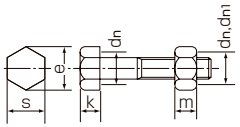
	d	[mm]	M1	M1.2	M1.4	M1.6	M2	M2.5	M3	M3.5	M4	M5	M6	M8	M10
	n	[mm]	0.2	0.2	0.25	0.25	0.25	0.4	0.4	0.5	0.6	0.8	1	1.2	1.6
	s	[mm]	—	—	—	0.7	0.9	1.3	1.5	—	2	2.5	3	4	5
	e	[mm]	—	—	—	0.809	1.011	1.454	1.73	—	2.3	2.87	3.44	4.58	5.72

Hexalobular screws

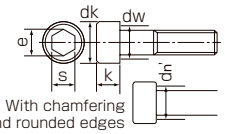
	b	M2	M2.5	M3	M4	M5	M6	M8	M10	M12	(M14)	M16	(M18)	M20
	Hole number	6.00	8.00	10.00	20.00	25.00	30.00	45.00	50.00	55.00	60.00	70.00	80.00	90.00
	k	2.00	2.50	3.00	4.00	5.00	6.00	8.00	10.00	12.00	14.00	16.00	18.00	20.00
	dw	3.48	4.18	5.07	6.53	8.03	9.38	12.33	15.33	17.23	20.17	23.17	25.87	28.87
no knurling	dk	3.80	4.50	5.50	7.00	8.50	10.00	13.00	16.00	18.00	21.00	24.00	27.00	30.00
knurling		3.98	4.68	5.68	7.22	8.72	10.22	13.27	16.27	18.27	21.33	24.33	27.33	30.33
Pitch diameter of bearing surface	dn	3.061	3.667	4.377	5.709	6.975	8.248	11.21	13.73	15.90	18.40	20.92	23.52	26.51

Refer to JIS B1136

Hexagon bolts, nuts

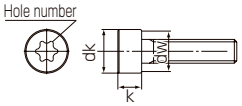


Hexagon socket head bolts



Set screws

Hexalobular screws



Various dimensions of bolts

M12	M14	M16	M18	M20	M22	M24	M27	M30	M33	M36	M39	M42	M45	M48	M52	M56
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
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
84.3	115	157	192	245	303	353	459	561	694	817	976	1120	1310	1470	1760	2030
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
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
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

Refer to B0205, B1082, B1001

M12	M14	M16	M18	M20	M22	M24	M27	M30	M33	M36	M39	M42	M45	M48	M52	M56
18	21	24	27	30	34	36	41	46	50	55	60	65	70	75	80	85
20.03	23.36	26.75	30.14	33.53	37.72	39.98	—	—	—	—	—	—	—	—	—	—
19.85	22.78	26.17	29.56	32.95	37.29	39.55	45.2	50.85	55.37	60.79	66.44	71.3	76.95	82.6	88.25	93.56
19.85	22.78	26.17	29.56	32.95	37.29	39.55	45.2	50.85	55.37	60.79	66.44	71.3	76.95	82.6	88.25	93.56
7.5	8.8	10	11.5	12.5	14	15	17	18.7	21	22.5	25	26	28	30	33	35
10.8	12.8	14.8	15.8	18	19.4	21.5	23.8	25.6	28.7	31	33.4	34	36	38	42	45
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
12	14.1	16.4	17.6	20.3	21.8	23.9	26.7	28.6	32.5	34.7	—	—	—	—	—	—
11.57	13.4	15.7	16.9	19	20.5	22.6	25.4	27.3	30.9	33.1	—	—	—	—	—	—
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
15.59	18.12	20.56	23.24	26.15	28.95	30.89	—	—	—	—	—	—	—	—	—	—
15.51	17.86	20.30	22.98	25.89	28.76	30.70	35.09	39.00	42.42	46.70	50.62	54.20	58.58	62.97	68.28	72.51
15.51	17.86	20.30	22.98	25.89	28.76	30.70	35.09	39.00	42.42	46.70	50.62	54.20	58.58	62.97	68.28	72.51

Refer to JIS B1180, B1181

M12	M14	M16	M18	M20	M22	M24	M27	M30	M33	M36	M39	M42	M45	M48	M52	M56
10	12	14	—	17	—	19	—	22	—	27	—	32	—	36	—	41
11.43	13.72	16	—	19.44	—	21.73	—	25.15	—	30.85	—	36.57	—	41.13	—	45.83
12	14	16	—	20	—	24	—	30	—	36	—	42	—	48	—	56
17.23	20.17	23.17	—	28.87	—	34.81	—	43.61	—	52.54	—	61.34	—	70.34	—	82.26
16.31	18.84	21.37	—	27.11	—	32.17	—	40.21	—	48.25	—	55.84	—	64.33	—	75.36
18	21	24	—	30	—	36	—	45	—	54	—	63	—	72	—	84
15.90	18.40	20.92	—	26.51	—	31.53	—	39.46	—	47.47	—	54.94	—	63.44	—	74.43

Refer to JIS B1176

M12	M14	M16	M18	M20	M22	M24	M27	M30	M33	M36	M39	M42	M45	M48	M52	M56
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	8	—	10	—	12	—	—	—	—	—	—	—	—	—	—
6.86	—	9.15	—	11.43	—	13.72	—	—	—	—	—	—	—	—	—	—

Refer to JIS B1117, B1177

※d_2: JIS B 0205, p: JIS B 0205, β : $\tan\beta = p/\pi d^2$ See P.35 for more details

8-1 Screw
Dimensions of Screws

(2) Small Bolts/Nuts, non ISO standards

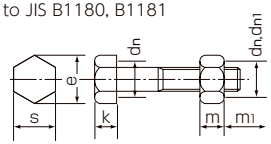
Small hexagon nuts, bolts

Table 8-2. Dimensions of small bolts and nuts

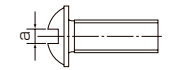
	d	[mm]	M8	M10	M12	(M14)	M16	(M18)	M20	(M22)	M24	(M27)	M30	(M33)	M36
	s	[mm]	12	14	17	19	22	24	27	30	32	36	41	46	50
	e	[mm]	13.9	16.2	19.6	21.9	25.4	27.7	31.2	34.6	37	41.6	47.3	53.1	57.7
	k	[mm]	5.5	7	8	9	10	12	13	14	15	17	19	21	23
	m	[mm]	6.5	8	10	11	13	15	16	18	19	22	24	26	29
	m_1		5	6	7	8	10	11	12	13	14	16	18	20	21
Hexagon	dn_1		10.70	12.79	15.64	17.70	20.3	22.40	25.0	27.6	29.7	33.3	37.6	41.8	45.5
Round	dn		10.03	12.06	14.82	16.55	19.07	21.1	23.6	26.1	28.1	31.1	35.2	39.2	42.7

Refer to JIS B1180, B1181

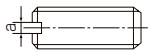
※ (See P.35 for more details of hexagon and round bearing surface)



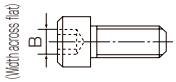
(3) Fine Screws



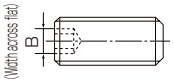
Small screws with slits



Set screws with slits



Hexagon socket head bolts



Hexagon set screws

Table 8-3. Dimensions of fine screws

	d	M1	(M1.1)	M1.2	(M1.4)	M1.6	M1.8
Small screws with slits	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_1	0.729	0.829	0.929	1.075	1.221	1.421
	As	0.460	0.588	0.732	0.983	1.27	1.70
	a	0.32	—	0.32	0.32	0.4	—
Set screws with slits	a	0.2	—	0.2	0.25	0.25	—
Socket head bolts	B	—	—	—	(1.3)	(1.5)	—
Set screws	B	—	—	—	(0.7)	(0.7)	—

※ d1min: Root diameter, A1min: Area of section of root diameter Unit: [mm]

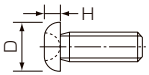
(4) Small Screws

Table 8-4. Dimensions of small screws

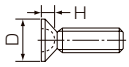
		M1.6	M2	M2.5	M3	(M3.5)	M4	M5	M6	M8	M10
⊕#	⊕	0	0	1	1	2	2	2	3	4	4
⊖ Slit width	⊖= a	0.4	0.5	0.6	0.8	1	1.2	1.2	1.6	2	2.5
Pan screws	D	3.2	4.0	5.0	5.6	7.00	8.00	9.50	12.00	16.00	20.00
	H	1.30	1.60	2.10	2.40	2.60	3.10	3.70	4.6	6.0	7.5
Countersunk screws	D	3.0	3.8	4.7	5.5	7.30	8.40	9.30	11.30	15.80	18.30
	H	1	1.2	1.5	1.65	2.35	2.7	2.7	3.3	4.65	5

Refer to JIS B1111

Unit: [mm]



Pan screws



Countersunk screws

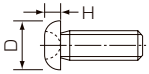
(5) Small Screws, non ISO standards

Table 8-5. Dimensions of small screws ⊕⊖

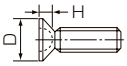
		M2	(M2.2)	M2.5	M3	(M3.5)	M4	(M4.5)	M5	M6	M8
⊕#	⊕	1 (0)	1	1	2 (1)	2	2	2	2	3	3
		( ) Supports ISO			( ) Truss head						
⊖ Slit width	⊖= a	0.6	0.6	0.8	0.8	1	1	1	1.2	1.2	1.6
Pan screws	D	3.5	4	4.5	5.5	6	7	8	9	10.5	14
	H	1.3	1.5	1.7	2	2.3	2.6	2.9	3.3	3.9	5.2
Countersunk screws (Spherical countersunk screws)	D	4	4.4	5	6	7	8	9	10	12	16
	H	1.2	1.3	1.45	1.75	2	2.3	2.55	2.8	3.4	4.4
Truss screws	D	4.5	5	5.7	6.9	8.1	9.4	10.6	11.8	14	17.8
	H	1.2	1.3	1.5	1.9	2.2	2.5	2.8	3.1	3.7	4.8
Bind screws	D	4.3	4.7	5.3	6.3	7.3	8.3	9.3	10.3	12.4	16.4
	H	1.2	1.3	1.5	1.9	2.2	2.5	2.8	3.1	3.7	4.8
Spherical screws	D	3.5	4	4.5	5.5	6	7	8	9	10.5	14
	H	1.3	1.5	1.7	2	2.3	2.6	3	3.4	4	5.4

Refer to JIS B1111

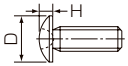
Unit: [mm]



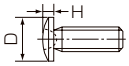
Pan screws



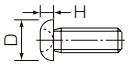
Countersunk screws
(Spherical countersunk screws)



Truss screws



Bind screws



Spherical screws

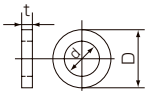
(6) Washers

Table 8-6. Dimensions of washers

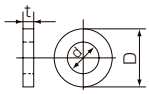
			M2	(M2.2)	M2.5	M3	(M3.5)	M4	(M4.5)	M5	M6	(M7)	M8	M10	M12	(M14)	M16	(M18)	M20	(M22)	M24
Plain washers, small, round	d		2.2	2.4	2.7	3.2	3.7	4.3	4.8	5.3	6.4	—	8.4	10.5	13	15	17	19	21	23	25
	D		4.5	4.5	5	6	7	8	9	9	11	—	15	18	20	24	28	30	34	37	39
	t		0.3	0.3	0.5	0.5	0.5	0.5	0.8	1	1.6	—	1.6	1.6	2	2.5	2.5	3	3	3	4
Plain washers, polished, round	d		2.2	2.4	2.7	3.2	3.7	4.3	4.8	5.3	6.4	—	8.4	10.5	13	15	17	19	21	23	25
	D		5	6	6	7	8	9	10	10	12	—	16	20	24	28	30	34	37	39	44
	t		0.3	0.5	0.5	0.5	0.5	0.8	0.8	1	1.6	—	1.6	2	2.5	2.5	3	3	3	3	4
Spring washers	d		2.1	—	2.6	3.1	3.6	4.1	4.6	5.1	6.1	7.1	8.2	10.2	12.2	14.2	16.2	18.2	20.2	22.5	24.5
	2号	t	0.5	—	0.6	0.7	0.8	1	1.2	1.3	1.5	1.6	2	2.5	3	3.5	4	4.6	5.1	5.6	5.9
		D	4.4	—	5.2	5.9	6.6	7.6	8.3	9.2	12.2	13.4	15.4	18.4	21.5	24.5	28	31	33.8	37.7	40.3
	3号	t	—	—	—	—	—	—	—	—	1.9	2.0	2.5	3.0	3.6	4.2	4.8	5.4	6.0	6.8	7.2
		D	—	—	—	—	—	—	—	—	12.2	13.4	15.6	18.8	21.9	24.7	28.2	31.4	34.4	38.3	41.3

※ d: Plain washer inner dia. Refer to JIS B1251, B1256

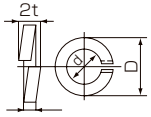
Unit: [mm]



Plain washers, small, round



Plain washers, polished, round



Spring washers

8 Screw

8-2 Screw Relevant Information

(1) Screw Threaded Hole and Countersink Hole

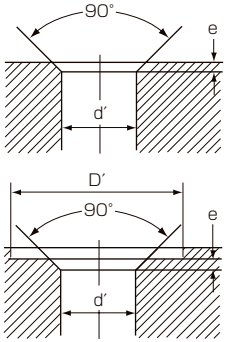


Table 8-7. Diameters

Nominal size of screw	Bolt hole diameter d'				Chamfering 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 is appropriate mainly for cast extracting holes.
2. Figures in bold are not prescribed in ISO 273.
3. The nominal sizes of ※ screws are not included in ISO meter screws of ISO 261.

Unit: [mm]

(2) Screw Threaded Hole Depth

Table 8-8. Diameters

Screw				Facing hole diameter (2)					Ref.: Female screw inner diameter (3)			
				System						Max. permissible dimension		
Nominal size of screw	Outside diameter d	Pitch P	(1) Standard catching height H1	90	85	80	75	70	Minimum permissible dimension	4H (Below M1.4) 5H (Over M1.6) 1st class	5H (Below M1.4) 6H (Over 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	1.679	—
M2.2	2.2	0.45	0.244	**1.76**	**1.79**	**1.81**	**1.83**	1.86	1.713	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	4.917	5.107	5.153	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

Remarks: Figures in bold on the left side of the – –line, ·····line, and —line are 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 they are within the permissible dimension of the female inner diameter. Unit: [mm]

Note: (1) $H_1 = 0.541266P$ (2) Screw prepared hole = d - 2 x H1 (Catching rate/100)

8-3 Bolt Looseness

(1) Classification and causes of looseness

In bolt looseness, there are the following two causes:

①Looseness generated by bolt return without turning, and

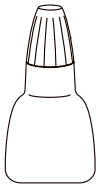
②Looseness generated by bolt return with turning.

Depending on the cause of the looseness, it will be necessary to select appropriate looseness prevention measures.

Table 8-9. Classification and causes of looseness

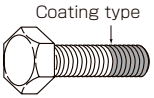
	Classification	Causes
Looseness generated by bolt return without turning	1. Initial looseness	Contact part becoming flattened from being uneven
	2. Subsidence	Plastic deformation of bearing surface
	3. Looseness by fretting corrosion	Friction by lateral displacement of contact part
	4. Looseness by permanent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

(2) Chemical loosening prevention



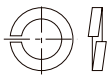
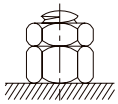
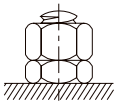
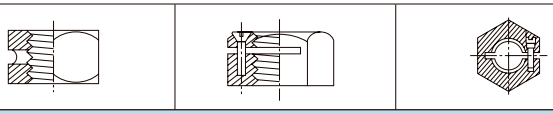
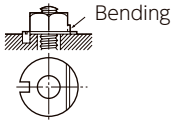
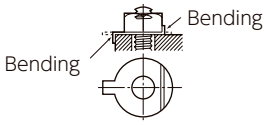
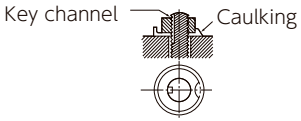
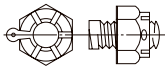
Liquid adhesive for screws

Stick adhesive for screws



(3) Mechanical loosening prevention

Table 8-10. Preventing loose joints

<table>
<tr><th colspan="4">Methods of using elastic washers</th></tr>
<tr><td>Belleville spring washer</td><td>Spring washer</td><td>Claw spring washer</td><td>Toothed washer</td></tr>
<tr><td>  </td><td>  </td><td>  </td><td>  </td></tr>
<tr><td colspan="2">Method of using check nut</td><td colspan="2" rowspan="2">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).</td></tr>
<tr><td>(a)  </td><td>(b)  </td></tr>
<tr><td colspan="3">Method of using small screw</td><td>Method of using a claw or wire</td></tr>
<tr><td colspan="3">  </td><td>  </td></tr>
<tr><th colspan="4">Methods to bend or calk part of the washer Calking</th></tr>
<tr><td>Claw washer</td><td colspan="3">Tongued washer</td></tr>
<tr><td>  </td><td colspan="2">  </td><td>  </td></tr>
<tr><td colspan="2">Method to apply part of the material to the side of the nut</td><td colspan="2">Method of using split cotter</td></tr>
<tr><td colspan="2">  </td><td colspan="2">  </td></tr>
<tr><td colspan="4">Method to use power applied to the bearing surface</td></tr>
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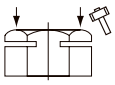
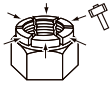
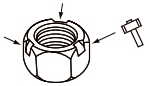
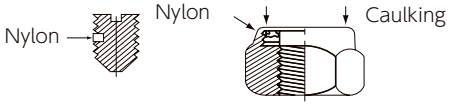
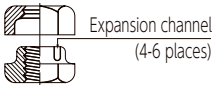
<tr><td colspan="4">Method of deforming</td></tr>
<tr><td>  </td><td>  </td><td>  </td><td>  </td></tr>
<tr><td colspan="2">Method of filling nylon</td><td colspan="2">Method to use force-loosening check nut</td></tr>
<tr><td colspan="2">  </td><td colspan="2">  </td></tr>
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