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JAPANESE INDUSTRIAL STANDARD

**General Tolerancing Rules
for Plastics Dimensions**

JIS K 7109—1986

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General Tolerancing Rules
for Plastics Dimensions

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1. Scope

This Japanese Industrial Standard specifies the general items of rational tolerancing rules for plastics dimensions.

2. Definitions and Symbols

For the purposes of this standard main definitions and symbols shall be as follows:

- (1) plastics The solid formed artificially to be useful by using high polymer as the main raw material. However, fibers, rubbers, paints, adhesives, etc. are excluded.
- (2) reference value (m) The reference dimensions of plastics shown in drawing by the assembler.
- (3) tolerance (Δ) The difference of reference value and the specified limit value.
- (4) producer The person manufacturing plastics.
- (5) assembler The person to manufacture products made of plastics.
- (6) user The person using products of assembler.
- (7) permissible limit value (Δ_0) In the case where the dimension of plastics is different from the reference value, and therefore in the stage of user or assembler malformation is caused, the difference between the limit value and the reference value to be toleranced on the dimension.
- (8) average loss (A_0) Average of losses generated when the dimension has exceeded the tolerable limit value.
- (9) loss on producer side (A) The price when the assembler purchases from the producer (estimate value of purchase cost price).
- (10) proportional constant (k) The constant expressing economic loss. The value of average loss A_0 divided by the value of square of permissible limit value Δ_0 .

$$k = \frac{A_0}{\Delta_0^2}$$

- (11) selected permissible limit value⁽¹⁾ (Δ_0) The permissible limit value of larger k out of proportional constants k of the user and the assembler.

Note (1) The symbol of selected permissible limit value is same as the symbol of permissible limit value, but these are divided by using method.

- (12) selected average loss⁽²⁾(A_0) Out of the proportional constant k of the user and the assembler, the average loss of larger k .

Note (2) The symbol of selected average loss is same as the symbol of average loss, but these are divided by using method.

3. Obtaining Method of Tolerances

3.1 Obtaining Methods of Selected Permissible Limit Value d_0 and Selected Average Loss A_0 These shall be obtained according to the following procedures:

- (1) The permissible limit value d_0 and the average loss A_0 in the stage of user are estimated.
- (2) The permissible limit value d_0 and the average loss A_0 in the stage of assembler are estimated.
- (3) The proportional constant k of (1) and (2) is obtained.
- (4) The values of two k 's are compared, and the permissible limit value d_0 and the average loss A_0 of larger value of k are selected.

Remarks 1. The permissible limit value d_0 and the average loss A_0 may be approximate value in many cases.

2. In the case where the permissible limit value d_0 and the average loss A_0 are different in plus side and minus side of dimension these shall be obtained separately on both sides. In this case, by using only larger k , the loss may be obtained similarly on plus side and minus side.

Example: The example of plastics parts used for acoustic products

- (1) It is assumed that when the difference of dimension of a part from the reference value exceeds 0.15 mm, because of sound strain half number of users repair the product and the permissible limit value d_0 in the user stage is estimated to be 0.15 mm.

If the repairing cost of this product is 3000 yen, and the period of time for the user to carry-in and -out for repair is 1 h and the loss is hour in the user stage (this value is calculated corresponding to respective cases) is 3000 yen, the average loss A_0 in the user stage is estimated as follows:

$$A_0 = 3000 + 3000 = 6000 \text{ (yen)}$$

- (2) If it is taken that when the difference of the dimension of plastics part from the reference value exceeds 0.07 mm, it is impossible to assemble, or to obtain the performance as the product, the permissible limit value d_0 in the assembler stage is estimated to be 0.07 mm.

In case where in the stage of assembler defective unit is found after assembly, if the part cost is 200 yen (purchase price), the period of time is 5 min and the time loss is 3000 yen per hour (this value is calculated corresponding to respective cases), the average loss A_0 in the stage of assembler is estimated as follows:

$$A_0 = 200 + 3000 \times \frac{5}{60} = 450 \text{ (yen)}$$

- (3) Proportional constants k in the stages of user and assembler are obtained.

user:

$$k(1) = \frac{6000}{0.15^2} = 266667$$

assembler:

$$k(2) = \frac{450}{0.07^2} = 91837$$

- (4) The values of proportional constants k are compared.

$$k(1) > k(2)$$

Therefore, as the selected permissible limit value and the selected average loss, the permissible limit value d_0 and average loss A_0 in the stage of user shall be selected:

$$d_0 = 0.15 \text{ (mm)}$$

$$A_0 = 6000 \text{ (yen)}$$

3.2 Estimation of Loss A on Producer Side The estimation of purchase price cost for assembler to purchase from the producer shall be carried out.

Example: The purchase price cost of plastics part used in acoustic product is estimated to be 200 yen herein.

$$A = 200 \text{ (yen)}$$

3.3 Discussion of Working Capacity and Instrumentation Capacity In the estimation of loss A on producer side, discuss whether working is possible in what degree of precision for the part to be set with the tolerance or whether there exists a sufficient instrumentation capacity to judge it or not based on Appendixes 1 and 2. In the results, where the capacity is insufficient, carry out the improvement.

3.4 Calculation of Tolerance d The tolerance d shall be calculated according to the following formula:

$$d = \sqrt{\frac{A}{A_0}} \times d_0$$

Example: In the case where $A_0 = 0.15$ (mm),

$A_0 = 6000$ (yen), and $A = 200$ (yen):

$$d = \sqrt{\frac{200}{6000}} \times 0.15 = 0.027 \text{ (mm)}$$

3.5 Discussion on Tolerance d If considered that there exists unreasonableness in discussion of results of 3.2, 3.3 and 3.4, the value of A is changed and the recalculation of d shall be carried out.

- (1) In the case where the working capacity is sufficient and the fraction defective is adequate, for values of A and d carry out the recalculation.

Example: $d = 0.027$ (mm) shall be decided.

- (2) In case where the working capacity is insufficient and the fraction defective (p) is excessively large, correct the value of loss A on the producer side and recalculate the value of d :

$$\frac{A}{1-p}$$

Example: In the case where $A = 200$ (yen), $p = 0.3$:

$$\frac{200}{1-0.3} = \frac{200}{0.7} = 285.7 \text{ (yen)}$$

$$d = \sqrt{\frac{285.7}{6000}} \times 0.15 = 0.033 \text{ (mm)}$$

- (3) In case where even the above-mentioned discussions are carried out, the improvement of working capacity is impossible and the tolerance is not satisfied, carry out the 100 % inspection.

3.6 Decision of Tolerance The tolerance shall be decided with based on the discussion of 3.5.

Reference: The relations of reference dimension of each part, average loss A_0 in the stage of user, loss A on the producer side, permissible limit value A_0 in the stage of user and tolerance d obtained according to this standard, concerning the case where the proportional constant k of user side is large are shown in Reference Table.

Reference Table

No.	Function	Reference value m (mm)	Tolerance decided by assembler side (mm)	Loss on producer side A (Yen)	Permissible limit value user stage d_0 (mm)	Average loss on user stage A_0 (Yen)	Permissible value obtained according to this standard d (mm)
1	Outer dia.	3.95	0.040	30	0.11	5,000	0.009
2		5.40	0.020	6	0.04	100	0.018
3		6.00	0.100	300	0.18	10,000	0.028
4		6.00	0.050	10	0.10	1,500	0.008
5		6.11	0.015	30	0.08	5,000	0.006
6		6.30	0.050	55	0.15	10,000	0.011
7		30.00	0.040	5	0.15	1,500	0.009
8		30.00	0.200	500	0.30	2,000	0.150
9		38.50	0.120	400	1.00	15,000	0.163
10		39.15	0.100	600	0.13	2,000	0.071
11		41.30	0.035	250	0.15	6,000	0.031
12		60.00	0.025	30	0.08	5,000	0.006
13		120.00	0.150	25	0.23	20,000	0.026
14	Inner dia.	2.00	0.015	100	0.08	1,500	0.021
15		2.00	0.015	60	0.05	2,000	0.009
16		3.00	0.010	150	0.05	5,000	0.009
17		3.00	0.040	30	0.30	5,000	0.023
18		4.00	0.025	200	0.05	1,500	0.016
19		4.00	0.015	15	0.05	5,000	0.003
20		4.90	0.010	500	0.03	2,000	0.015
21		6.00	0.015	100	0.05	3,500	0.009
22		6.05	0.030	50	0.13	9,000	0.010
23		7.90	0.050	100	0.08	1,000	0.025
24		9.00	0.030	76	0.06	1,000	0.017
25		10.00	0.018	50	0.03	6,000	0.003
26		18.00	0.015	4,000	0.08	5,500	0.068
27		31.75	0.150	40	0.30	2,000	0.042
28		46.00	0.013	1,500	0.05	6,000	0.023
29		56.80	0.025	120	0.09	5,000	0.014
30		65.00	0.150	300	0.50	8,000	0.097
31	Width	39.00	0.05	40	0.26	3,000	0.030
32		302.00	0.50	100	0.08	1,000	0.025
33	Length	8.80	0.025	2,000	0.20	5,000	0.126
34		100.00	0.05	10	0.10	500	0.014
35	Pitch	23.00	0.02	25	0.04	1,000	0.024
36		45.00	0.05	160	0.15	1,600	0.047
37		69.80	0.01	300	0.30	10,000	0.050
38	Run out	0.00	0.05	100	0.10	3,000	0.018
39		0.00	0.10	300	0.15	3,000	0.047