UDC [678.5/.8].067 : 001.4 : 621.753.1 DEUTSCHE NORM November 1982

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Plastics mouldings

Tolerances and acceptance conditions for linear dimensions

DIN 16 901

Kunststoff-Formteile; Toleranzen und Abnahmebedingungen für Längenmasse

Supersedes July 1973 edition

As it is current practice in standards published by the International Organization for Standardization (ISO), the comma has been used throughout as a decimal marker.

It is not possible to take the tolerances for plastics mouldings from the ISO basic tolerances, since they are correlated with the nominal dimensions on the basis of other principles.

Dimensions in mm

1 General

Deviations from the nominal dimension cannot be avoided in the fabrication of plastics mouldings.

Dimensional deviations occurring in the production process may result from a number of causes:

a) Dispersion in the results of the processing
   This is dependent on
   - uniformity of the moulding material,
   - the machine setting,
   - the mould temperature,
   - deformation of the mould under pressure.

b) Condition of mould
   - manufacturing tolerances for the dimensions of the mould (see DIN 16 749),
   - wear on the mould,
   - variations in the position of movable parts of the mould.

The tolerances in this standard are specified on the basis of the above considerations and a large number of measurements derived from practical applications.

2 Field of application

The tolerances in this standard

are applicable to the dimensions of plastics mouldings produced from thermoplastic and thermosetting moulding materials by compression moulding, transfer moulding, compression injection moulding or injection moulding;

are not applicable to extrusions, blow-moulded or foamed mouldings, deep drawn parts, sintered parts and parts produced by a chip removal machining process.

Table 1 gives the appropriate tolerance groups to be applied to the various moulding materials.

3 Concepts

Moulding shrinkage VS

Moulding shrinkage means the difference between the dimensions of the mould L_W at (23 ± 2) °C and those of the moulding L_F, the latter having been stored for 16 hours after manufacture in standard atmosphere DIN 50 014 – 23/50-2 and then measured immediately after.

$$VS = \left(1 - \frac{L_F}{L_W}\right) \cdot 100\ [\%]$$

Radial moulding shrinkage VSR

The radial moulding shrinkage is the moulding shrinkage in the direction of injection.

Tangential moulding shrinkage VST

The tangential moulding shrinkage is the moulding shrinkage perpendicular to the direction of injection.

Moulding shrinkage difference ΔVS

The moulding shrinkage difference is the difference between the radial and tangential moulding shrinkage

$$\Delta VS = VSR - VST$$

For other concepts:

mouldings, compression mouldings, injection mouldings, moulding materials, see DIN 7708 Part 1

compression moulding, transfer moulding, extrusion, injection moulding, see DIN 16 700

tolerance, deviation, general tolerance, see DIN 7182 Part 1 and DIN 7168 Part 1

tolerances of form and position, see DIN 7184 Part 1 and DIN 7168 Part 2.

For concepts used in the field of high polymer materials, see DIN 7724

Continued on pages 2 to 9

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4 Tolerances

The tolerances shall apply to mouldings at the time of acceptance; see clause 5.

Unless otherwise agreed, a reference must be made on the drawing to the acceptance conditions as specified in clause 5.

4.1 General tolerances[1]

The numbers specified in table 1, column 4, refer to the appropriate tolerance group in table 2.

If the deviations are not specified against the number for the dimension in production documents, order documents, etc. a note must be included referring to this standard, by specifying DIN 16901 and the tolerance group given in table 2.

Example for specifying tolerance group 140:

Tolerances DIN 16901 – 140

4.2 Deviations specified against dimensions[2]

In table 1, columns 5 and 6, two series are given for specifying tolerances against dimensions. The figures in these refer to the appropriate tolerance group in table 2. Series 1 tolerances can be complied with without special measures. Series 2 tolerances require more extensive measures in production.

The series 1 and 2 tolerances shall be divided into upper and lower deviations in accordance with technical requirements.

Example showing division of tolerance 0,8:

$^{+0,8}_{0}$ or $^{0}_{-0,8}$ or $\pm 0,4$ or $^{+0,6}_{-0,2}$ or $^{+0,3}_{-0,5}$ etc.

Note: If it is required that the tolerances be maintained in respect of effects acting on the moulding from the environment or caused by the condition of the moulding during the production process[3], this shall be expressly agreed between the supplier and the customer and specified in drawings, order documents, etc.

4.3 Dimensions related to the mould (see figure 1)

Dimensions in table 2 related to the mould are in each case dimensions in the same part of the mould.

4.4 Dimensions not related to the mould (see figure 2)

Dimensions in table 2 not related to the mould are dimensions determined by the interaction of movable elements of the mould, e.g. wall thickness dimensions and bottom thickness dimensions or dimensions determined by the shims or mould slides.

Note: The tolerances on these dimensions are greater than those on the mould-related dimensions because the movable parts of the mould do not always reach the same final position when the mould is closed.

When the permissible deviations are entered against the dimension, take care to ensure that the dimensions lying in the closing direction of the mould all vary in the same direction, i.e. that the bottom thickness for example increases when the overall height of the moulding increases.

For non-mould-related dimensions in the direction of closing of the mould, the values specified in table 2 can be increased if necessary in the case of compression moulding. In such a case the dimensions shall be marked with these increased tolerances.

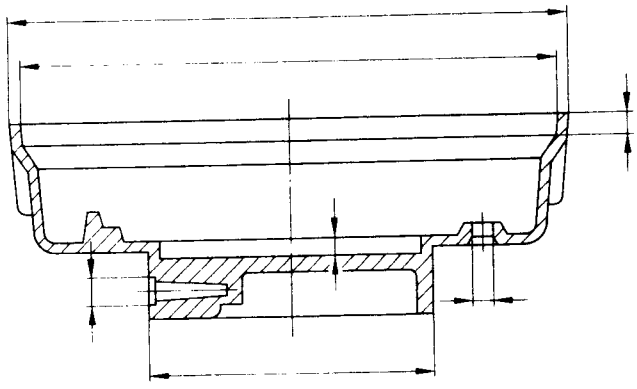

Figure 1. Mould-related dimensions

4.5 Reduction of tolerances

For particular dimensions tolerances narrower than those specified in table 2 may be obtainable by special measures.

For precision engineering at the present time the last two lines in table 2 apply.

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1) Formerly designated as: "Dimensions without specified tolerance"

2) Formerly designated as: "Dimensions with specified tolerance"

3) These could be for example, temperature, atmospheric humidity, gases and vapours, liquids

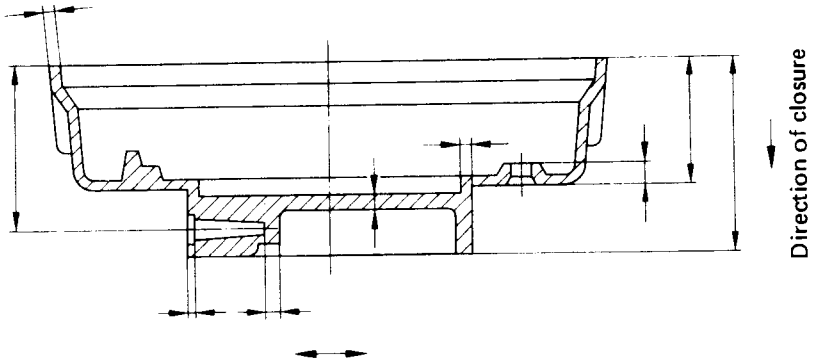

Figure 2. Non-mould-related dimensions

4.6 Drafts

Since all deviations apply to the nominal dimensions entered on the drawing, the drawing must clearly show the point on the draft taper to which the nominal dimension applies.

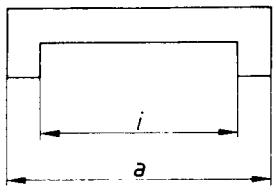

Figure 3. Basic shape of moulding

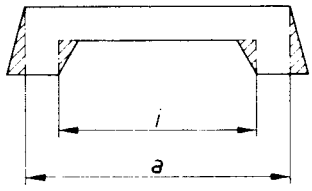

Figure 4. Plus variation for draft
Extra material compared with the basic shape of the moulding

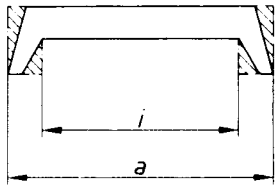

Figure 5. Minus variation for draft
Loss of material compared with the basic shape of the moulding

i = inside dimension

a = outside dimension

The size of the required draft tapers must be specified in the drawing.

4.7 Tolerances of form and position

Deviations of form and position occurring after removal from the mould are dependent on the shape of the mould among other things.

Angular tolerances, tolerances of form and position shall be specified in accordance with DIN 7184 Part 1 directly against the dimension or (where applicable) as general tolerances in accordance with DIN 7168 Part 1 and Part 2.

Example showing method of specifying general tolerance:

Angular tolerances, tolerances of form and position DIN 7168 – mT

4.8 Tolerances for parts produced by chip removal machining processes

For parts produced by chip removal machining processes, DIN 7160, DIN 7161 and DIN 7172 Part 1 apply.

4.9 Tolerances for threads

The following shall be used as a guideline: tolerance class "coarse" for metric threads in accordance with DIN 13 Part 14 and tolerance class "B" for pipe threads in accordance with DIN ISO 228 Part 1.

5 Acceptance conditions

Acceptance shall not take place earlier than 16 hours after manufacture of the plastics moulding or after any required post-moulding treatment.

The atmosphere used for acceptance shall be standard atmosphere DIN 50014 – 23/50-2. For other temperatures and relative humidities, the measured values must be corrected by taking into account the appropriate coefficients of linear expansion.

Post-moulding treatment (conditioning or heat treatment) shall be agreed between the supplier and the customer.

For plastics parts made of moulding materials for which the change in dimension – e.g. through moisture absorption or re-crystallization – has to be taken into account in making the measurements for acceptance, the type of post-moulding treatment must be specified by agreement between the supplier and the customer. It is advisable also to agree that the specified treatment condition shall apply also to the measurement.

Table 1. **Correlation of tolerance groups with moulding materials**

1	2			3	4	5	6
Symbol for basic material	Mouldings made from			Moulding materials in accordance with DIN	Tolerance groups for general tolerances	for dimensions where the deviations are indicated against the dimensions Series 1	Series 2
EP	Epoxy resin moulding materials				130	120	110
EVA	Ethylene vinyl acetate copolymer moulding materials			16 778 Part 1	140	130	120
PF	Phenolic plastic moulding materials	with inorganic fillers	Type 11.5, 12, 13 13.5, 13.9, 15, 16	7708 Part 2	130	120	110
		with organic fillers	Type 30.5, 31, 31.5, 31.9, 32, 51, 51.5, 51.9, 52 52.9, 71, 74, 75, 83, 84		140	130	120
UF MF	Aminoplastic moulding materials and aminoplastic/ phenolic plastic moulding materials	with organic fillers	Type 131, 131.5, 150 152, 152.7, 153, 154, 180, 181, 181.5	7708 Part 3	140	130	120
		with inorganic fillers	Type 155, 156, 158		130	120	110
		with organic and inorganic fillers	Type 157, 182, 183		140	130	120
UP	Polyester resin moulding materials		Type 801, 802, 803, 804	16 911	130	120	110
UP	Polyester resin mats		Type 830, 830.5, 831 831.5, 832, 832.5, 833, 833.5	16 913 Part 3	140	130	120
	Compounds for cold moulding		Type 212, 214	7708 Part 4	140	130	120
ASA	Moulding materials based on acrylonitrile-styrene acrylester copolymers				130	120	110
ABS	Moulding materials based on acrylonitrile-butadiene-styrene copolymers (with and without fillers)			16 772 Part 1	130	120	110
CA	Cellulose acetate moulding materials			7742 Part 1	140	130	120
CAB	Cellulose acetate butyrate moulding materials			7742 Part 1	140	130	120
CAP	Cellulose acetate propionate moulding materials				140	130	120
CP	Cellulose propionate moulding materials				140	130	120
PA	Polyamide moulding materials (amorphous, with or without fillers)				130	120	110
PA 6	Polyamide 6 moulding material [1] (without filler)				140	130	120
PA 66	Polyamide 66 moulding materials [1] (without filler)				140	130	120
PA 610	Polyamide 610 moulding materials [1] (without filler)				140	130	120
PA 11	Polyamide 11 moulding materials [1] (without filler)				140	130	120
PA 12	Polyamide 12 moulding materials [1] (without filler)				140	130	120
	Glass fibre reinforced polyamide 6, 66, 610, 11 and 12 moulding materials				130	120	110
PB	Polybutylene moulding materials				160	150	140
PBTP	Polybutylene terephthalate moulding materials		(without filler)		140	130	120
			(with filler)		130	120	110
PC	Polycarbonate moulding materials (without filler, with filler)			7744 Part 1	130	120	110

1) In the case of unreinforced, partly crystalline, non-hardening moulding materials (thermoplastics) the next highest tolerance group shall apply for wall thicknesses over 4 mm.

Table 1. (continued)

1	2	3	4	5	6
Symbol for basic material	Mouldings made from	Moulding materials in accordance with DIN	Tolerance groups for general tolerances	Tolerance groups for dimensions where the deviations are indicated against the dimensions Series 1	Tolerance groups for dimensions where the deviations are indicated against the dimensions Series 2
PDAP	Polydiallyl phthalate moulding materials (with inorganic filler)		130	120	110
PE	Polyethylene moulding materials [1] (without filler)	16 776 Part 1	150	140	130
PESU	Polyether sulphone moulding materials (without filler)		130	120	110
PSU	Polysulphone moulding materials (with filler, without filler)		130	120	110
PETP	Polyethylene terephthalate moulding materials (amorphous)		130	120	110
	Polyethylene terephthalate moulding materials (crystalline)		140	130	120
	Polyethylene terephthalate moulding materials (with filler)		130	120	110
PMMA	Polymethyl methacrylate moulding materials	7745 Part 1	130	120	110
POM	Polyoxymethylene (polyacetal) moulding materials [1] (without filler), length of mouldings: <150 mm		140	130	120
	Polyoxymethylene (polyacetal) moulding materials [1] (without filler), length of mouldings: ≥ 150 mm		150	140	130
	Polyoxymethylene (polyacetal) moulding materials [1] (with filler)		130	120	110
PP	Polypropylene moulding materials [1] (without filler)	16 774 Part 1	150	140	130
	Polypropylene moulding materials [1] (glass fibre reinforced, reinforced with talcum or asbestos fibre)		140	130	120
PP/EPDM	Mixture of polypropylene and rubber (without filler)		140	130	120
PPO	Polyphenylene oxide moulding materials		130	120	110
PPS	Polyphenylene sulphide moulding materials (with filler)		130	120	110
PS	Polystyrene moulding materials	7741 Part 1	130	120	110
PVC-U	Unplasticized polyvinyl chloride moulding materials	7748 Part 1	130	120	110
PVC-P	Plasticized polyvinyl chloride moulding materials	7749 Part 1	No data available at present		
SAN	Styrene acrylonitrile moulding materials (with filler, without filler)	16 775 Part 1	130	120	110
SB	Styrene butadiene moulding materials	16 771 Part 1	130	120	110
	Mixtures of polyphenylene oxide and polystyrene (with filler and without filler)		130	120	110
	Fluorinated polyethylene-polypropylene moulding materials		150	140	130
	Thermoplastic polyurethane — Products with 70 to 90 Shore A [2]		150	140	130
	Thermoplastic polyurethane — Products with over 50 Shore D [2]		140	130	120

1) See page 4
2) For Shore hardness tests A and D see DIN 53505

Table 2. **General tolerances and tolerances on dimensions with deviations entered against the dimension**

Tolerance group from table 1	Code letter [1]	Nominal dimension range																				
		over	0	1	3	6	10	15	22	30	40	53	70	90	120	160	200	250	315	400	500	630	800
		up to	1	3	6	10	15	22	30	40	53	70	90	120	160	200	250	315	400	500	630	800	1000
General tolerances																							
160	A		±0,28	±0,30	±0,33	±0,37	±0,42	±0,49	±0,57	±0,66	±0,78	±0,94	±1,15	±1,40	±1,80	±2,20	±2,70	±3,30	±4,10	±5,10	±6,30	±7,90	±10,00
	B		±0,18	±0,20	±0,23	±0,27	±0,32	±0,39	±0,47	±0,56	±0,63	±0,84	±1,05	±1,30	±1,70	±2,10	±2,60	±3,20	±4,00	±5,00	±6,20	±7,80	± 9,90
150	A		±0,23	±0,25	±0,27	±0,30	±0,34	±0,38	±0,43	±0,49	±0,57	±0,68	±0,81	±0,97	±1,20	±1,50	±1,80	±2,20	±2,80	±3,40	±4,30	±5,30	± 6,60
	B		±0,13	±0,15	±0,17	±0,20	±0,24	±0,28	±0,33	±0,39	±0,47	±0,58	±0,71	±0,87	±1,10	±1,40	±1,70	±2,10	±2,70	±3,30	±4,20	±5,20	± 6,50
140	A		±0,20	±0,21	±0,22	±0,24	±0,27	±0,30	±0,34	±0,38	±0,43	±0,50	±0,60	±0,70	±0,85	±1,05	±1,25	±1,55	±1,90	±2,30	±2,90	±3,60	± 4,50
	B		±0,10	±0,11	±0,12	±0,14	±0,17	±0,20	±0,24	±0,28	±0,33	±0,40	±0,50	±0,60	±0,75	±0,95	±1,15	±1,45	±1,80	±2,20	±2,80	±3,50	± 4,40
130	A		±0,18	±0,19	±0,20	±0,21	±0,23	±0,25	±0,27	±0,30	±0,34	±0,38	±0,44	±0,51	±0,60	±0,70	±0,90	±1,10	±1,30	±1,60	±2,00	±2,50	± 3,00
	B		±0,08	±0,09	±0,10	±0,11	±0,13	±0,15	±0,17	±0,20	±0,24	±0,28	±0,34	±0,41	±0,50	±0,60	±0,80	±1,00	±1,20	±1,50	±1,90	±2,40	± 2,90
Tolerances on dimensions with deviations entered against the dimension																							
160	A		0,56	0,60	0,66	0,74	0,84	0,98	1,14	1,32	1,56	1,88	2,30	2,80	3,60	4,40	5,40	6,60	8,20	10,20	12,50	15,80	20,00
	B		0,36	0,40	0,46	0,54	0,64	0,78	0,94	1,12	1,36	1,68	2,10	2,60	3,40	4,20	5,20	6,40	8,00	10,00	12,30	15,60	19,80
150	A		0,46	0,50	0,54	0,60	0,68	0,76	0,86	0,98	1,14	1,36	1,62	1,94	2,40	3,00	3,60	4,40	5,60	6,80	8,60	10,60	13,20
	B		0,26	0,30	0,34	0,40	0,48	0,56	0,66	0,78	0,94	1,16	1,42	1,74	2,20	2,80	3,40	4,20	5,40	6,60	8,40	10,40	13,00
140	A		0,40	0,42	0,44	0,48	0,54	0,60	0,68	0,76	0,86	1,00	1,20	1,40	1,70	2,10	2,50	3,10	3,80	4,60	5,80	7,20	9,00
	B		0,20	0,22	0,24	0,28	0,34	0,40	0,48	0,56	0,66	0,80	1,00	1,20	1,50	1,90	2,30	2,90	3,60	4,40	5,60	7,00	8,80
130	A		0,36	0,38	0,40	0,42	0,46	0,50	0,54	0,60	0,68	0,76	0,88	1,02	1,20	1,50	1,80	2,20	2,60	3,20	3,90	4,90	6,00
	B		0,16	0,18	0,20	0,22	0,26	0,30	0,34	0,40	0,48	0,56	0,68	0,82	1,00	1,30	1,60	2,00	2,40	3,00	3,70	4,70	5,80
120	A		0,32	0,34	0,36	0,38	0,40	0,42	0,46	0,50	0,54	0,60	0,68	0,78	0,90	1,06	1,24	1,50	1,80	2,20	2,60	3,20	4,00
	B		0,12	0,14	0,16	0,18	0,20	0,22	0,26	0,30	0,34	0,40	0,48	0,58	0,70	0,86	1,04	1,30	1,60	2,00	2,40	3,00	3,80
110	A		0,18	0,20	0,22	0,24	0,26	0,28	0,30	0,32	0,36	0,40	0,44	0,50	0,58	0,68	0,80	0,96	1,16	1,40	1,70	2,10	2,60
	B		0,08	0,10	0,12	0,14	0,16	0,18	0,20	0,22	0,26	0,30	0,34	0,40	0,48	0,58	0,70	0,86	1,06	1,30	1,60	2,00	2,50
Precision engi-neering	A		0,10	0,12	0,14	0,16	0,20	0,22	0,24	0,26	0,28	0,31	0,35	0,40	0,50								
	B		0,05	0,06	0,07	0,08	0,10	0,12	0,14	0,16	0,18	0,21	0,25	0,30	0,40								

[1] A for non-mould-related dimensions
B for mould-related dimensions

Standards referred to

DIN 13 Part 14	ISO metric screw thread; bases of the tolerance system for screw threads 1 mm diameter and larger
DIN 7160	ISO deviations for external dimensions (shafts) for nominal dimensions from 1 to 500 mm
DIN 7161	ISO deviations for internal dimensions (holes) for nominal dimensions from 1 to 500 mm
DIN 7168 Part 1	General tolerances; linear and angular dimensions
DIN 7168 Part 2	General tolerances; form and position
DIN 7172 Part 1	ISO tolerances and ISO deviations for linear dimensions over 500 up to 3150 mm; basic tolerances
DIN 7182 Part 1	Tolerances and fits; fundamental concepts
DIN 7184 Part 1	Tolerances of form and position; concepts, indications on drawings
DIN 7708 Part 1	Types of plastic moulding materials; plastics products; concepts
DIN 7708 Part 2	Types of plastic moulding materials; phenolic moulding materials
DIN 7708 Part 3	Types of plastic moulding materials; aminoplastic moulding materials; aminoplastic/phenolic moulding materials
DIN 7708 Part 4	Types of plastic moulding materials; materials for cold extrusion
DIN 7724	Grouping of high polymer materials on the basis of the temperature dependence of their mechanical properties; principles, grouping, concepts
DIN 7741 Part 1	Plastic moulding materials; polystyrene (PS) moulding materials, classification and designation
DIN 7742 Part 1	Plastic moulding materials; cellulose ester moulding materials; classification and designation
DIN 7744 Part 1	Plastic moulding materials; polycarbonate (PC) moulding materials, classification and designation
DIN 7745 Part 1	Plastic moulding materials; polymethyl methacrylate (PMMA) moulding materials, classification and designation
DIN 7748 Part 1	Plastic moulding materials; unplasticized polyvinyl chloride (PVC-U) moulding materials, classification and designation
DIN 7749 Part 1	Plastic moulding materials; plasticized polyvinyl chloride (PVC-P) moulding materials, classification and designation
DIN 16700	Plastics; moulding techniques for moulding materials; production processes and production equipment, concepts
DIN 16749	Moulds for plastic mouldings; tolerances and permissible deviations for compression moulds and injection moulds
DIN 16771 Part 1	Plastic moulding materials; styrene butadiene (SB) moulding materials, classification and designation
DIN 16772 Part 1	Plastic moulding materials; acrylonitrile butadiene styrene (ABS) moulding materials, classification and designation
DIN 16774 Part 1	Plastic moulding materials; polypropylene (PP) moulding materials, classification and designation
DIN 16775 Part 1	Plastic moulding materials; styrene acrylonitrile (SAN) moulding materials, classification and designation
DIN 16776 Part 1	Plastic moulding materials; polyethylene (PE) moulding materials, classification and designation
DIN 16778 Part 1	Plastic moulding materials; ethylene vinyl acetate copolymers (EVA) moulding materials, classification and designation
DIN 16911	Plastic moulding materials; polyester resin moulding materials, types, requirements, testing
DIN 16913 Part 3	Plastic moulding materials; reinforced reaction resin moulding materials; prepreg, in web form, capable of flowing; polyester resin mats; types, requirements
DIN 50014	Atmospheres and their technical application; standard atmospheres
DIN 53505	Testing of elastomers; Shore A and D hardness testing
DIN ISO 228 Part 1	Pipe threads where pressure tight joints are not made on the threads; designation, dimensions and tolerances

Further standards and other documents

DIN 7728 Part 1	Plastics; symbols for homopolymers, copolymers and mixtures of polymers
DIN 16940	Extruded hoses made of plasticized PVC (plasticized polyvinyl chloride); permissible deviations for dimensions for which tolerances are not indicated
DIN 16941	(at present at the stage of draft) Extruded sections made of thermoplastics; general tolerances on dimensions, tolerances of form and position
DIN 53598 Part 1	Statistical evaluation of samples, with examples taken from the testing of elastomers and plastics
DIN 55302 Part 1	Statistical evaluation methods; frequency distribution, mean and dispersion, basic concepts and general procedure for calculation
DIN 55302 Part 2	Statistical evaluation methods; frequency distribution, mean and dispersion, method of calculation in special cases

DIN ISO 1101 Part 1 (at present at the stage of draft) Technical drawings; geometrical tolerancing tolerances of form, orientation, location, run-out; generalities, definitions, symbols, indications on drawings

DIN ISO 1302 Technical drawings; methods of indicating surface texture on drawings

DIN ISO 1629 Rubber and latices; nomenclature

VDI 2001 VDI code of practice. Thermosetting plastics mouldings

VDI 2006 VDI code of practice. Design of injection moulded components made of thermoplastic materials

ASQ printed form for statistical evaluation; order No. AWF 172, obtainable from AWF, 1000 Berlin 33 and Beuth Verlag GmbH, 1000 Berlin 30.

Previous editions

DIN 7710 Part 1: 05.59, 04.65, 01.74

DIN 7710 Part 2: 05.59, 12.66, 01.74

DIN 16901: 07.73

Amendments

The standard has been completely revised in comparison with the July 1973 edition; the number of moulding materials in table 1 has been increased and table 2 has been rearranged. The "Concepts" clause has been adopted for the first time.

Explanations

This standard has been prepared by FNK Subcommittee 501.1 *Toleranzen für Pressteile und Spritzgussteile.*

It was not possible to give any correlation of moulding materials with the tolerance group given in table 2 for precision engineering. Before these tolerances are used for precision engineering applications, the supplier and customer must clarify whether the nature of the proposed moulding material is such that the tolerances can be complied with.

The actual deviations on a dimension measured on a larger number of mouldings are generally normally distributed so that a statistical evaluation of the results of measurement in accordance with DIN 55302 is possible using a ASQ printed form, order No. AWF 172.

As previously, the numerical values in table 2 are only production tolerances and not overall tolerances (see figure 6).

This limitation must be adhered to because there is no method of assessment for taking into account post-shrinkage and swelling that can be applied to all cases occurring in practice.

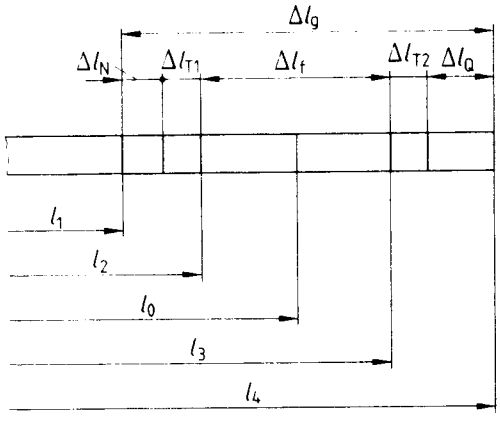

Figure 6. Nominal dimension with possible deviations

In the diagram

l_0 is the nominal dimension
l_1 is the least possible dimension
l_2 is the minimum dimension from the drawing
l_3 is the maximum dimension from the drawing
l_4 is the largest possible dimension
Δl_g is the total tolerance
Δl_f is the manufacturing tolerance
Δl_N is the post-shrinkage
Δl_{T1} is the change in dimension with a fall in temperature
Δl_{T2} is the change in dimension with a temperature rise
Δl_Q is the swelling

Tolerance and efficiency

Small tolerances require various measures that increase costs. Economic manufacture of mouldings therefore requires that the tolerances specified shall not be smaller than is technically necessary for the purpose.

Behaviour of moulding compounds

In general mouldings made of moulding materials with organic fillers have a larger post-shrinkage or swelling than those of moulding materials with inorganic fillers.

Mouldings made of aminoplastic moulding materials have greater post-shrinkage than those of phenolic plastic moulding materials with similar filler.

Mouldings made of partly crystalline non-thermosetting moulding materials (thermoplastics) have greater post-shrinkage than those made of amorphous non-thermosetting materials (thermoplastics).

Mouldings made of reinforced non-thermosetting moulding materials (thermoplastics) have a lower moulding shrinkage and post-shrinkage than mouldings made of non-reinforced moulding materials.

With some moulding materials in some circumstances there may be changes in the dimensions of the mouldings as a result of loss of material (post-shrinkage) to the environment or absorption of material from the environment (swelling) which may be non-uniform in the moulding and hence could result in sag, twisting or distortion.

It is necessary to take account of possible temperature-dependent changes in dimensions when specifying tolerances and permissible deviations where mouldings are used together with other components, the materials of which have differing coefficients of linear expansion.

Temperature rises resulting from the nature of the application may result in accelerated post-shrinkage. This post-shrinkage can to some extent be avoided by heat treatment.

Post-shrinkage of mouldings is dependent on the shape and in some circumstances can be non-uniform. The processing conditions can also influence post-shrinkage.

Mouldings made of non-thermosetting partly crystalline moulding materials and produced with little moulding shrinkage, generally have greater post-shrinkage as the restraint on the shrinkage has been greater.

International Patent Classification

B 29 C
B 29 G