Nominal Wall Thickness

It is important that this should be correctly designed. A wall section that is too thin can lead to structural failure or poor insulation characteristics.
A wall section that is too thick can result in appearance defects and an overweight or over-engineered part. With the latter point it is also worth remembering that wall thickness governs the moulding cycle time – the thicker the section the longer the cycle time and therefore the more expensive the part becomes. Furthermore, plastics shrink during cooling which in thick sections can result either in the surface of the part forming a sink mark or an internal void.
In most applications a thin, uniform wall with ribs is preferable to a thick wall. There are general guidelines for how thick a part should be, typically 0.75mm – 3mm for filled materials and 0.5mm – 5mm for unfilled. However, this does depend on the design and function of the part concerned.

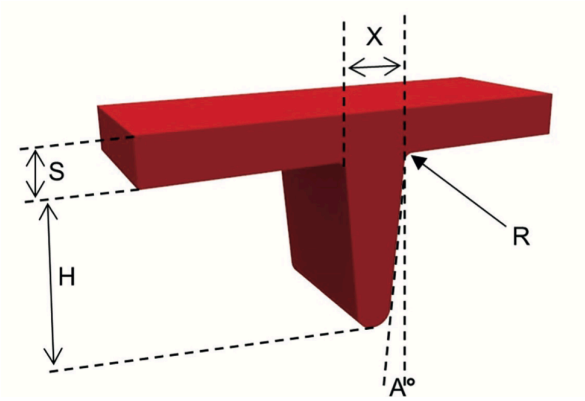
Draft Angles

No single draft angle can be applied to all part designs. Factors like wall thickness, material selection, ejection, shrink rates, finish/texture, wall depth, and manufacturing capabilities all come into play. However, there are some simple rules that can be followed that can help.

When designing a part, apply as much draft angle as possible—a general rule of thumb is 1 degree of draft per 1 inch of cavity depth, but that can change with the aforementioned factors. Try following these general guidelines

Feature	Recommended Draft Angel
VERTICAL FACES	0.5°
MOST SITUATIONS	2°
MINIMUM FOR SHUT OFF	3°
MINIMUM FOR LIGHT TEXTURE	3°
MINIMUM FOR MEDIUM TEXTURE	5°+

Rib Guidelines

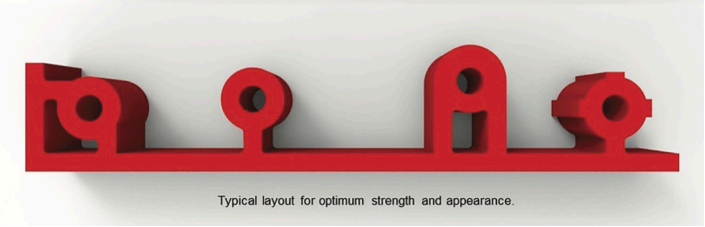


Component section = S
Draft per Rib Side = A = 0.5° - 1.5°
Rib Height = H = < 5 x S (usually 2.5 – 3 x S)
Radius = R = > 0.25 x S – 0.4 x S
Rib thickness = X = 0.4 x S – 0.8 x S
Rib spacing = 2 x S –3 x S

Bosses

These are usually incorporated to facilitate mechanical assembly. They can be designed to accommodate self-tapping screws, push-in or moulded-in inserts or used for ultrasonic welding. Therefore, the boss may have to withstand a variety of forces – tension, torsion, compression, shear and flexing.


All of the above boss layouts will result in sink marks and/or voids.


Typical layout for optimum strength and appearance.

Design suggestions:

- Wall thickness of the boss should be 50% to 70% of the nominal wall. However, this may not be sufficient to withstand the stresses imposed by an insert but a thicker section can cause sink marks. Frequently, a compromise is required.
- Minimum radius of 25% of the wall thickness at the base of the boss is recommended. Further strength may be achieved through the use of support ribs.
- Strength can also be increased by attaching the boss to a nearby wall using a rib.

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Furthermore, plastics shrink during cooling which in thick sections can result either in the surface of the part forming a sink mark or an internal void.
In most applications a thin, uniform wall with ribs is preferable to a thick wall. There are general guidelines for how thick a part should be, typically 0.75mm – 3mm for filled materials and 0.5mm – 5mm for unfilled. However, this does depend on the design and function of the part concerned.

Plastic Injection Moulding Tolerances ISO-20457

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	for dimensions where the deviations are indicated against the dimensions: Series 1	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
		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 / up to	0 / 1	1 / 3	3 / 6	6 / 10	10 / 15	15 / 22	22 / 30	30 / 40	40 / 53	53 / 70	70 / 90	90 / 120	120 / 160	160 / 200	200 / 250	250 / 315	315 / 400	400 / 500	500 / 630	630 / 800	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	±0,68	±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 engineering	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