Chapter 12: Drawing files

Manufacture drawing files

Provide all information to allow the manufacture of an object

Accurate and clear information
→ Manufacturer and inspector of the part

Required information:

- Geometry: shape of the part
- Dimension: size and location of features
- Tolerance: required accuracy of dimensions

Chapter 12: Drawing files

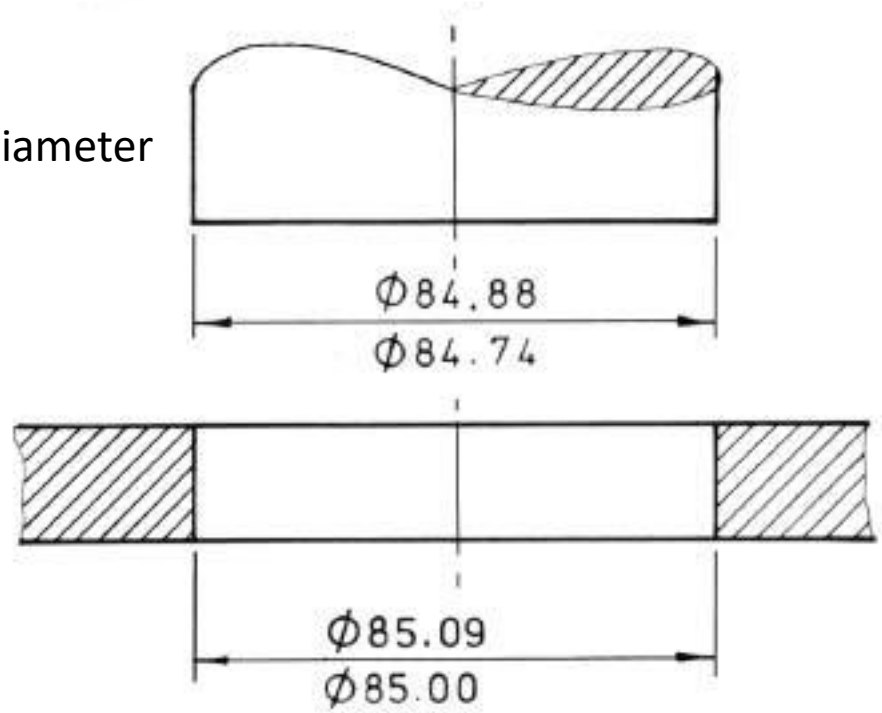
Tolerance

Functions:

- Indicate the required accuracy of dimensions or locations
- Allows clearance or interference in assembly

Shaft of 85 mm diameter

Hole of 85 mm diameter



Tolerance

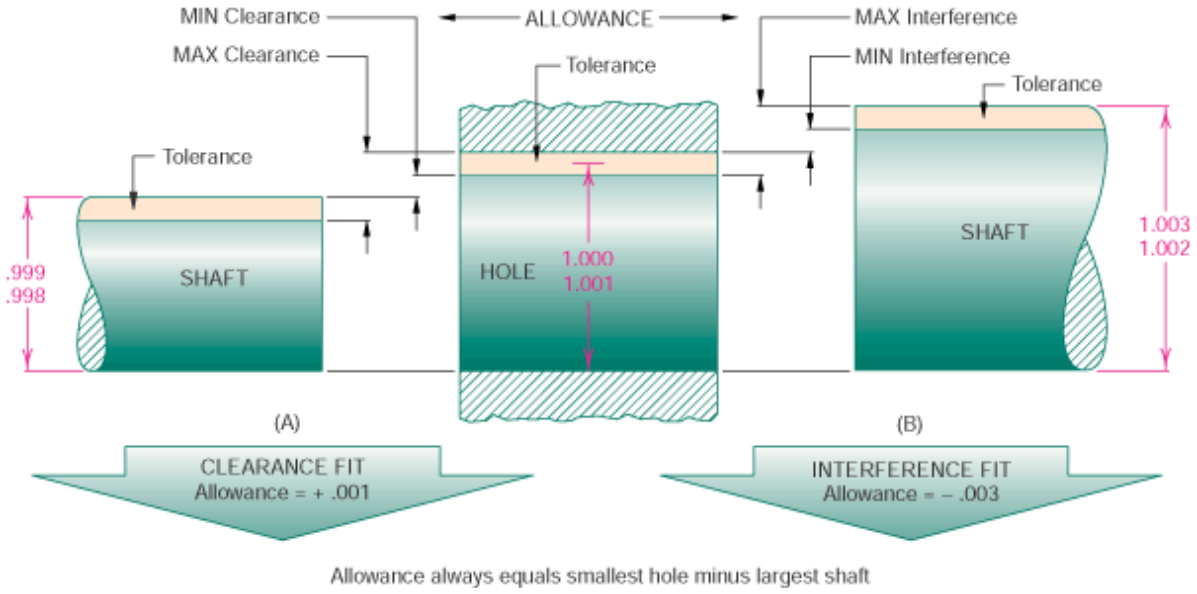
Functions:

- Indicate the required accuracy of dimensions or locations
- Allows clearance or interference in assembly

Clearance fits: rotate or slide freely

Transition fits: accurate and steady fit, but still removable

Interference fits: securely fit with force



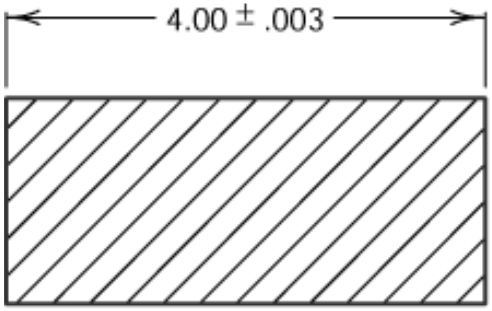
Allowance always equals smallest hole minus largest shaft

Chapter 12: Drawing files

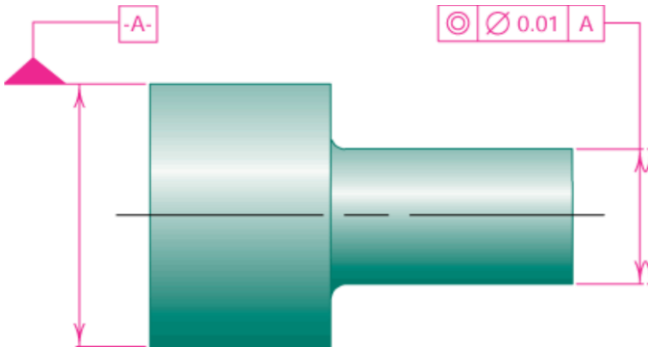
Tolerance

Tolerances of parts or features

- Dimensions



- Geometry

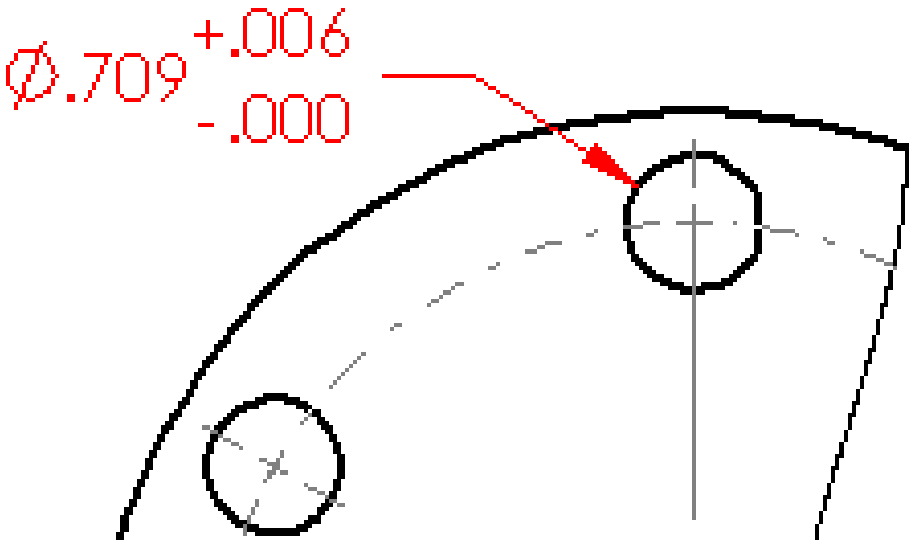


Chapter 12: Drawing files

Tolerance

Tolerance of dimensions

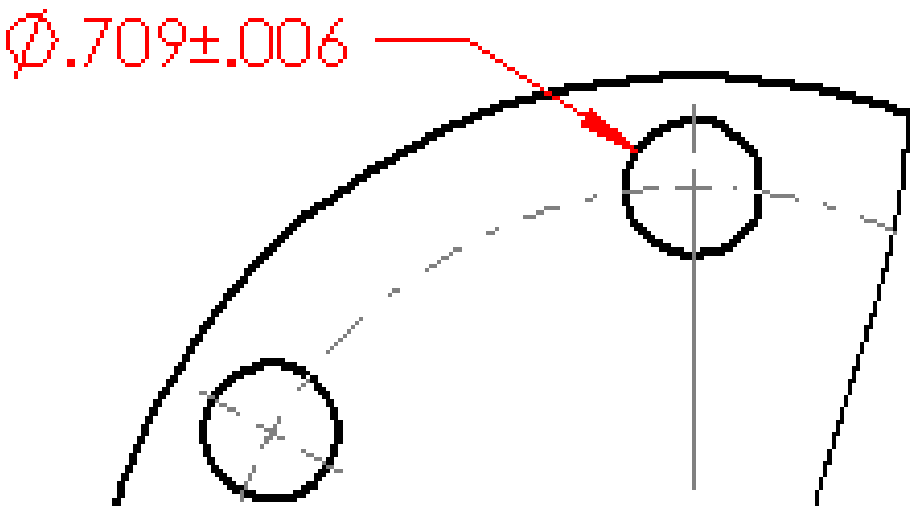
Bilateral tolerance



Tolerance

Tolerance of dimensions

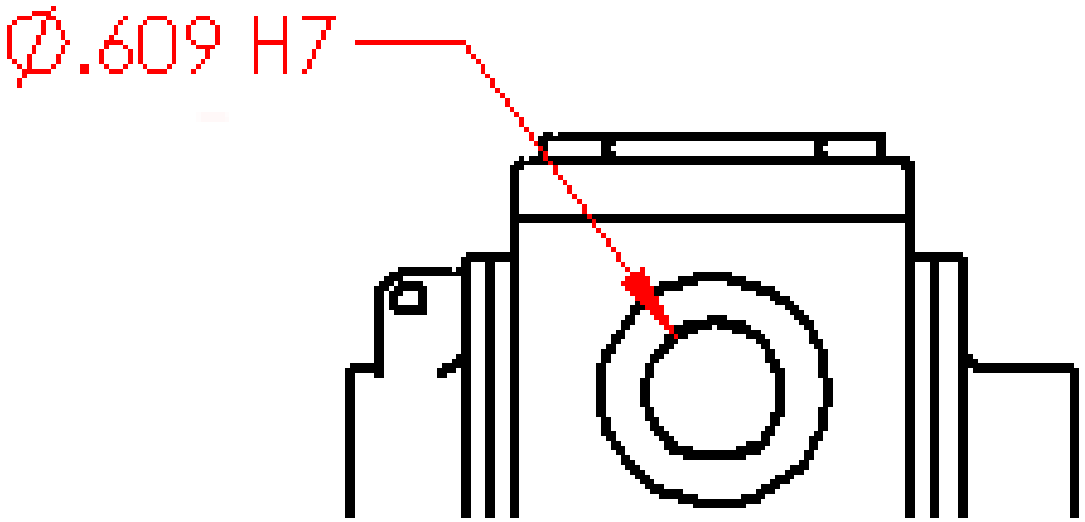
Symmetric tolerance



Tolerance

Tolerance of dimensions

ISO fit tolerance



Tolerance

Tolerance of dimensions

ISO fit tolerance

BASIC SIZE		LOOSE RUNNING			FREE RUNNING			CLOSE RUNNING			SLIDING			LOCATIONAL CLEARANCE		
		Hole H11	Shaft c11	Fit	Hole H9	Shaft d9	Fit	Hole H8	Shaft f7	Fit	Hole H7	Shaft g6	Fit	Hole H7	Shaft h6	Fit
40	MAX	40.160	39.880	0.440	40.062	39.920	0.204	40.039	39.975	0.029	40.025	39.991	0.050	40.025	40.000	0.041
	MIN	40.000	39.720	0.120	40.000	39.858	0.060	40.000	39.950	0.025	40.000	39.975	0.009	40.000	39.984	0.000
50	MAX	50.160	49.870	0.450	50.062	49.920	0.204	50.039	49.975	0.089	50.025	49.991	0.050	50.025	50.000	0.041
	MIN	50.000	49.710	0.130	50.000	49.858	0.080	50.000	49.950	0.025	50.000	49.975	0.009	50.000	49.984	0.000
60	MAX	60.190	59.860	0.520	60.074	59.900	0.248	60.046	59.970	0.106	60.030	59.990	0.059	60.030	60.000	0.049
	MIN	60.000	59.670	0.140	60.000	59.826	0.100	60.000	59.940	0.030	60.000	59.971	0.010	60.000	59.981	0.000
80	MAX	80.190	79.550	0.530	80.074	79.900	0.248	80.046	79.970	0.106	80.030	79.990	0.059	80.030	80.000	0.049
	MIN	80.000	79.660	0.150	80.000	79.826	0.100	80.000	79.940	0.030	80.000	79.971	0.010	80.000	79.981	0.000
100	MAX	100.220	99.830	0.610	100.087	99.880	0.294	100.054	99.964	0.125	100.035	99.988	0.069	100.035	100.000	0.057
	MIN	100.000	99.610	0.170	100.000	99.793	0.120	100.000	99.929	0.036	100.000	99.966	0.012	100.000	99.978	0.000
120	MAX	120.220	119.820	0.620	120.087	119.880	0.294	120.054	119.964	0.125	120.035	119.988	0.069	120.035	120.000	0.057
	MIN	120.000	119.600	0.180	120.000	119.793	0.120	120.000	119.929	0.036	120.000	119.966	0.012	120.000	119.978	0.000
160	MAX	160.250	159.790	0.710	160.100	159.855	0.345	160.063	159.957	0.146	160.040	159.986	0.078	160.040	160.000	0.065
	MIN	160.000	159.540	0.210	160.000	159.755	0.145	160.000	159.917	0.043	160.000	159.961	0.014	160.000	159.975	0.000
200	MAX	200.290	199.760	0.820	200.115	199.830	0.400	200.072	199.950	0.168	200.046	199.985	0.040	200.046	200.000	0.075
	MIN	200.000	199.470	0.240	200.000	199.715	0.170	200.000	199.904	0.050	200.000	199.956	0.015	200.000	199.971	0.000
250	MAX	250.290	249.720	0.860	250.115	249.830	0.400	250.072	249.950	0.168	250.046	249.985	0.090	250.046	250.000	0.075
	MIN	250.000	249.430	0.280	250.000	249.715	0.170	250.000	249.904	0.050	250.000	249.956	0.015	250.000	249.971	0.000
300	MAX	300.320	299.670	0.970	300.130	299.810	0.450	300.081	299.944	0.189	300.052	299.983	0.101	300.052	300.000	0.084
	MIN	300.000	299.350	0.330	300.000	299.680	0.190	300.000	299.892	0.056	300.000	299.951	0.017	300.000	299.968	0.000
400	MAX	400.360	399.600	1.120	400.140	399.790	0.490	400.089	399.938	0.208	400.057	399.982	0.111	400.057	400.000	0.093
	MIN	400.000	399.240	0.400	400.000	399.650	0.210	400.000	399.881	0.062	400.000	399.946	0.018	400.000	399.964	0.000
500	MAX	500.400	499.520	1.280	500.155	499.770	0.540	500.097	499.932	0.228	500.063	499.980	0.123	500.063	500.000	0.103
	MIN	500.000	499.120	0.480	500.000	499.615	0.230	500.000	499.869	0.068	500.000	499.940	0.020	500.000	499.960	0.000

Tolerance

Tolerance of dimensions

ISO fit tolerance

	ISO Symbol		Description
	Hole Basis	Shaft Basis	
Clearance fits	H11/c11	C11/h11	Loose running fit for wide commercial tolerances or allowances on external members
	H9/d9	D9/h9	Free running fit not for use where accuracy is essential, but good for large temperature variations, high running speeds, or heavy journal pressures
	H8/f7	F8/h7	Close running fit for running on accurate machines and for accurate location at moderate speeds and journal pressures
	H7/g6	G7/h6	Sliding fit not intended to run freely but to move and turn freely and locate accurately
Transition fits	H7/h6	H7/h6	Locational clearance fit provides snug fit for locating stationary parts but can be freely assembled and disassembled
	H7/k6	K7/h6	Locational transition fit for accurate location; a compromise between clearance and interference
	H7/n6	N7/h6	Locational transition fit for more accurate location where greater interference is permissible
Interference fits	H7/p6*	P7/h6	Locational interference fit for parts requiring rigidity and alignment with prime accuracy of location but without special bore pressure requirements
	H7/s6	S7/h6	Medium drive fit for ordinary steel parts or shrink fits on light sections; the tightest fit usable with cast iron
	H7/u6	U7/h6	Force fit suitable for parts that can be highly stressed or for shrink fits where the heavy pressing forces required are impractical

More clearance — More interference

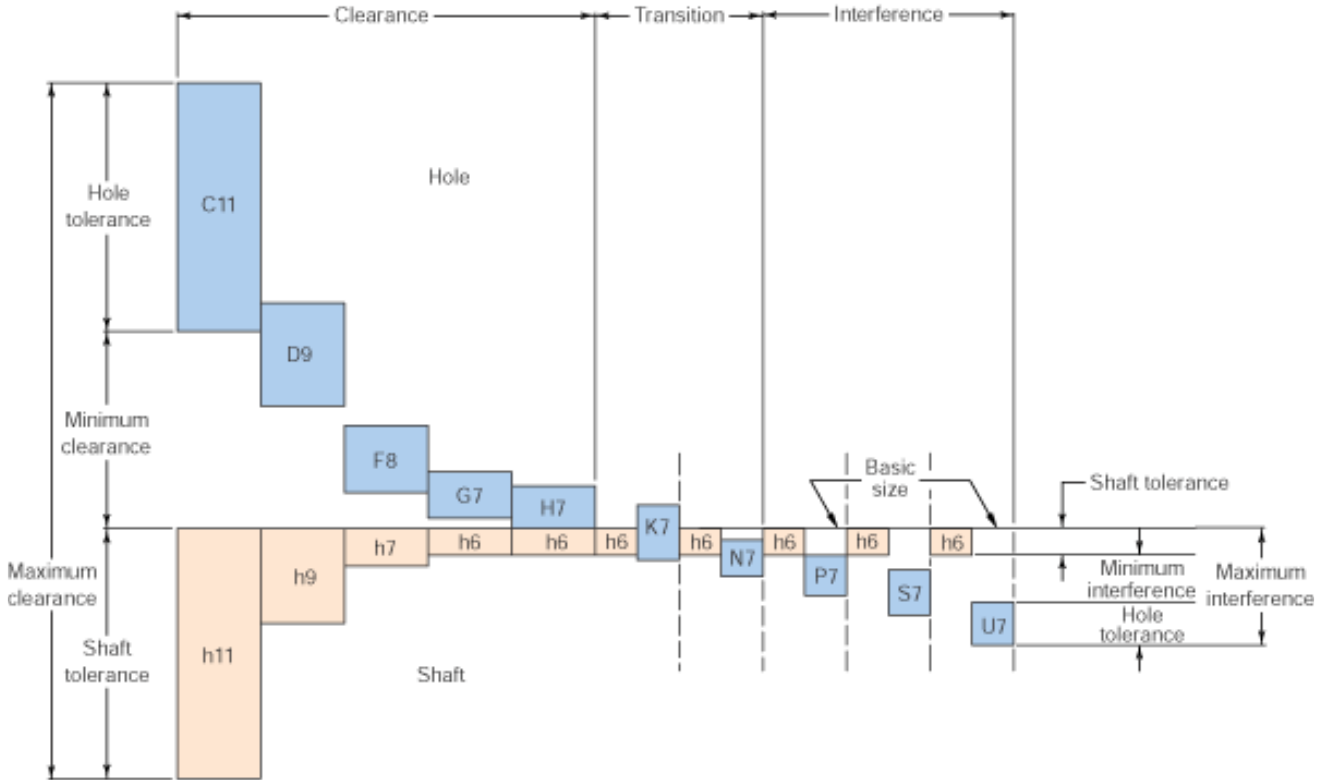
*Transition fit for basic sizes in range from 0 through 3 mm

Chapter 12: Drawing files

Tolerance

Tolerance of dimensions

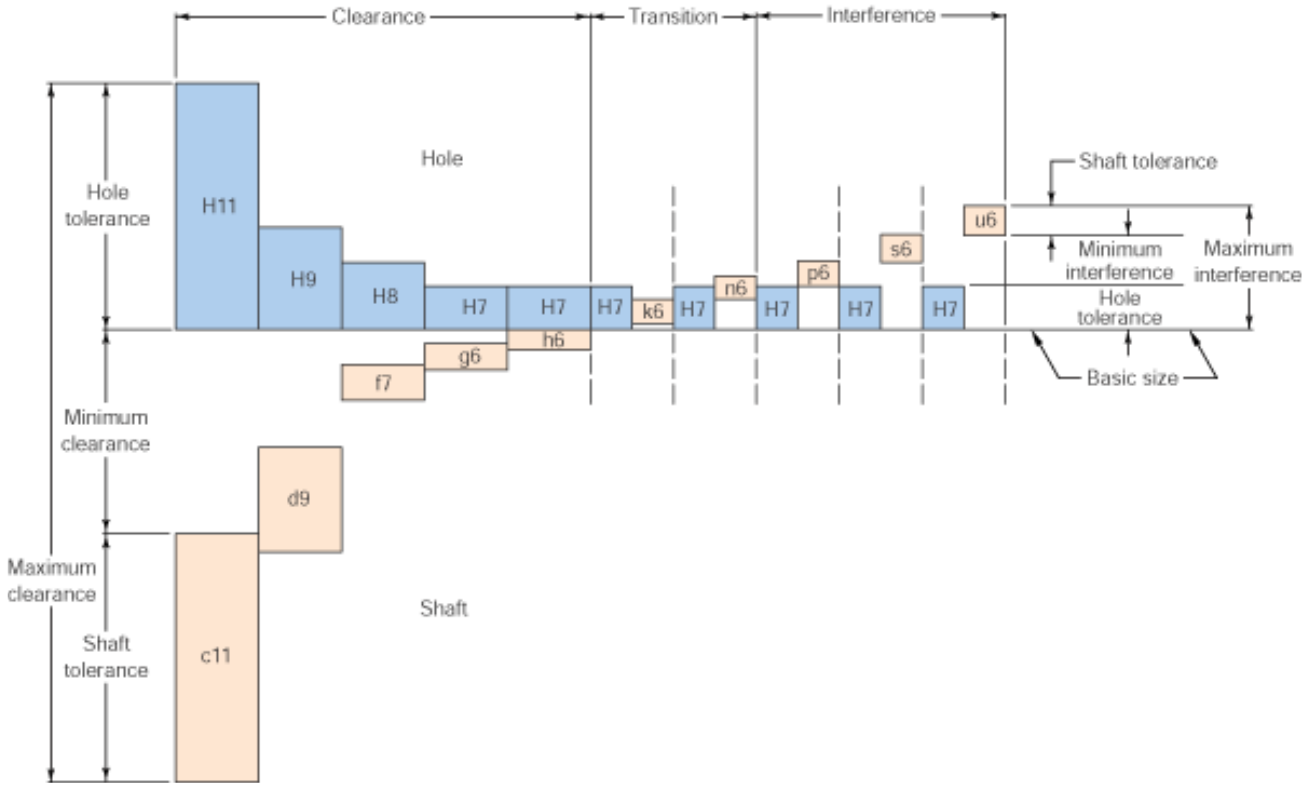
ISO fit tolerance for shaft



Tolerance

Tolerance of dimensions

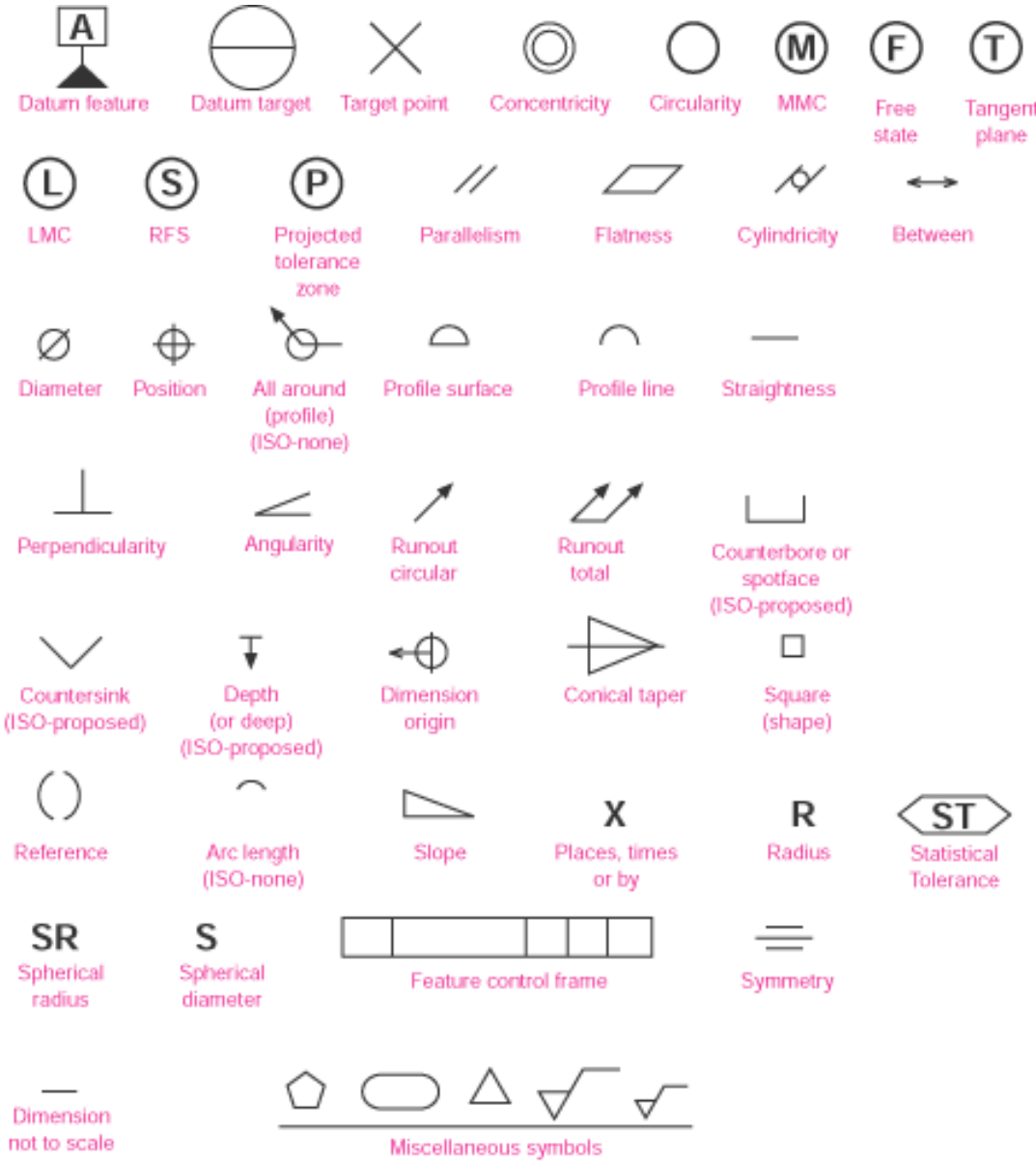
ISO fit tolerance for hole



Chapter 12: Drawing files

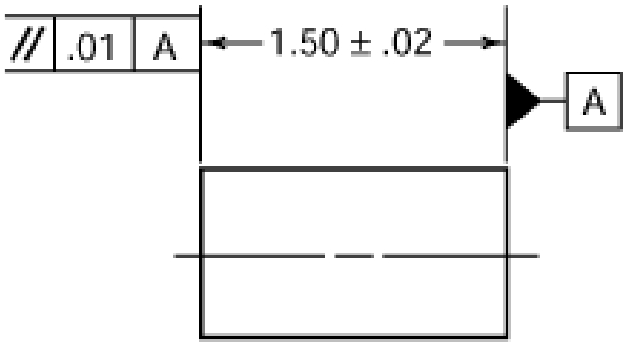
Tolerance

Tolerance of geometry



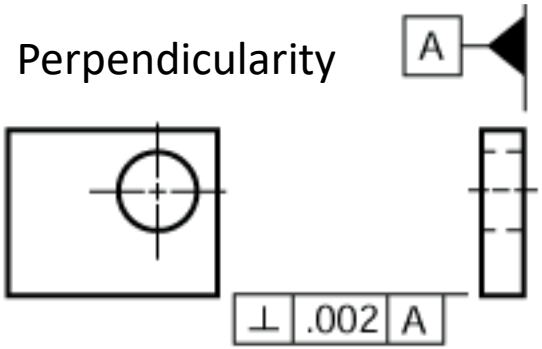
Tolerance

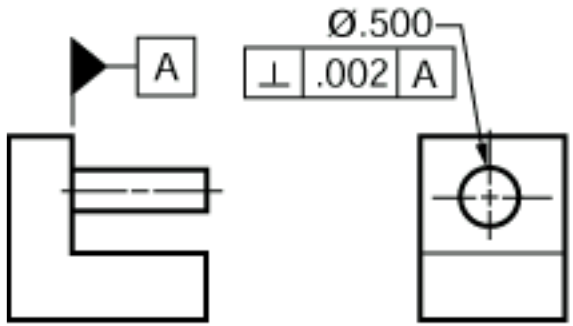
Tolerance of geometry



Parallelism

Perpendicularity



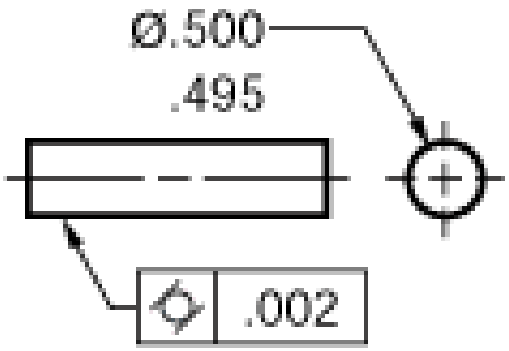


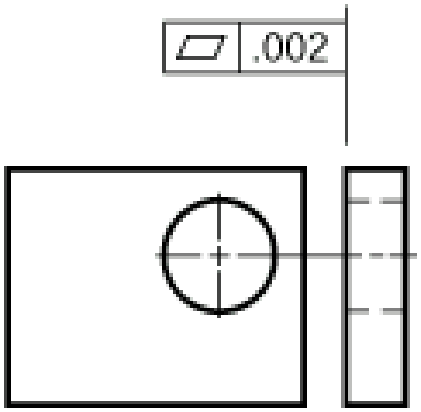
Perpendicularity

Tolerance

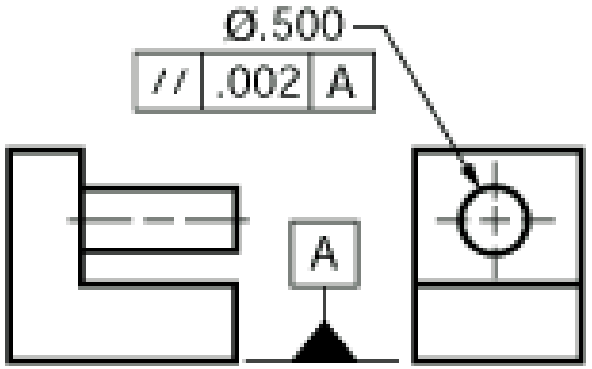
Tolerance of geometry

Cylindricity





Parallelism

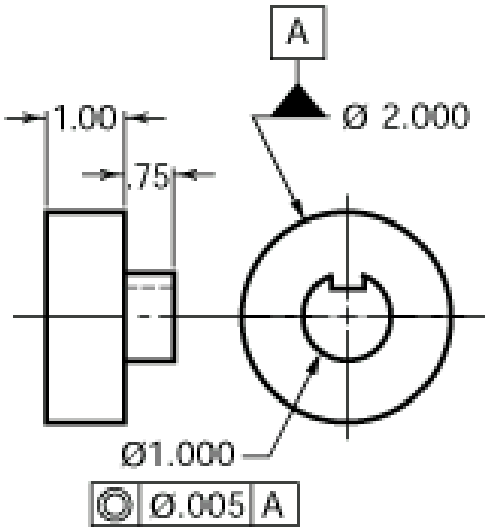


Parallelism

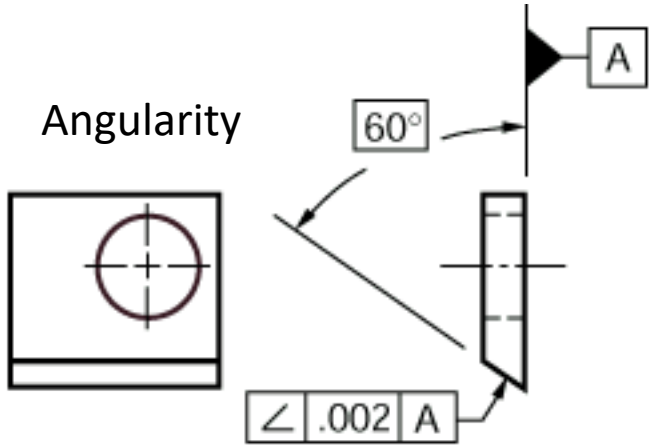
Tolerance

Tolerance of geometry

Concentricity



Angularity



Angularity