

The Society of the Plastics Industry's
Machinery Component Manufacturers Division

Recommended Dimensional Guidelines for Single Screws

The following recommendations for single screws of injection molding machines and extruders have been prepared as a guide to manufacturers and processors. These guidelines have been developed to provide working tolerances that produce effective performance with economy of manufacture. Manufacturers are encouraged to meet or exceed these guidelines and processors are entitled to expect screws that they purchase to be in conformance with the guidelines.

Lengths

The following tolerances apply to most linear dimensions of a screw including, but not limited to the **overall length** of the screw, the **flighted surface** and the **drive**. The tolerances increase with the linear dimension involved.

<u>English Measurement</u>		<u>Metric Measurement</u>	
<u>Linear Dimension</u>	<u>Tolerance</u>	<u>Linear Dimension</u>	<u>Tolerance</u>
To 12"	± .010"	To 300mm	± .25 mm
12-60"	± .030"	300-1500mm	± .75 mm
60-120"	± .045"	1500-3000mm	±1.00 mm
120-200"	± .060"	3000-5000mm	±1.50 mm
over 200"	± .090"	over 5000mm	±2.25 mm

Flight Width

The tolerances set forth below relate to the **screw flight width** at any point in the length of the flighted surface. The tolerances increase with the size of the screw and, therefore, the width of the flight.

<u>English Measurement</u>		<u>Metric Measurement</u>	
<u>Specified Flight Width</u>	<u>Tolerance</u>	<u>Specified Flight Width</u>	<u>Tolerance</u>
To .500"	± .015"	To 12mm	± .38 mm
.500-1.000"	± .020"	12-25mm	± .50 mm
over 1.000"	± .030"	over 25mm	± .75 mm

Channel Depths

The tolerance guidelines set forth below are for the **channel depths** of the **feed** and **meter sections** of a screw. As the channel depth increases, the tolerance also increases.

<u>English Measurement</u>		<u>Metric Measurement</u>	
<u>Channel Depth</u>	<u>Tolerance</u>	<u>Channel Depth</u>	<u>Tolerance</u>
To .100"	± .003"	To 2.5mm	± .08 mm
.100-.500"	± .007"	2.5-13.0mm	± .18 mm
over .500"	± .012"	over 13.0mm	± .30 mm

Barrier Flight Undercut

The barrier flight (or secondary flight) in a barrier screw is undercut (or a reduced diameter) from that of the primary flight, permitting the flow of melted polymer over it. The undercut is expressed as the difference in radius of the barrier flight from the primary flight. This **barrier flight undercut** has a greater tolerance in screws with larger diameters, as follows.

<u>English Measurement</u>		<u>Metric Measurement</u>	
<u>Screw Diameter</u>	<u>Tolerance</u>	<u>Screw Diameter</u>	<u>Tolerance</u>
To 6.0"	± .002"	To 152 mm	± .05mm
Over 6.0"	± .003"	Over 152 mm	± .075mm

Screw Section Lengths

Screw section lengths (also referred to as **zones**) such as the feed, transition or meter sections, are defined by their length and also toleranced by a fraction of a turn (or diameter).

The tolerance for screw sections for all sizes of screws, expressed in turns (or diameters) is **± 1/8 of a turn.**

Keyways & Splines

Keyways and splines are two methods used to drive or rotate the screw with the quill of the machine. The keyway is a rectangular groove extending forward from the rear end of the screw drive. A spline is a series of grooves (usually straight-sided) located similar to the keyway and performing the same function.

Keyway tolerances for all sizes of screws are recommended as follows:

<u>English Measurement</u>	<u>Metric Measurement</u>
Specified Depth + .005"	Specified Depth + .13mm
Specified Width + .002" - .000"	Specified Width + .05 mm - .00mm

Spline tolerances are recommended as set forth in the following table, using metric measurements (see illustration on next page):

d (mm)	Designation	Teeth	D (mm)	B (mm)
11	6x11x14	6	14	3
13	6x13x16	6	16	3,5
16	6x16x20	6	20	4
18	6x18x22	6	22	5
21	6x21x25	6	25	5
23	6x23x28	6	28	6
26	6x26x32	6	32	6
28	6x28x34	6	34	7
32	8x32x38	8	38	6
36	8x36x42	8	42	7
42	8x42x48	8	48	8
46	8x46x54	8	54	9
52	8x52x60	8	60	10

d (mm)	Designation	Teeth	D (mm)	B (mm)
56	8x56x65	8	65	10
62	8x62x72	8	72	12
72	10x72x82	10	82	12
82	10x82x92	10	92	12
92	10x92x102	10	102	14
102	10x102x112	10	112	16

Tolerances on shaft (see Table Below):

Illustration of Spline:

B = d10

D = a11

d = f7

Tolerance Zones for External (Shaft) Dimensions

Basic Size		B (d10)	D (a11)	d (f7)
From	To			
0	3	-.020 to -.060	-.270 to -.330	-.006 to -.016
3	6	-.030 to -.078	-.270 to -.345	-.010 to -.022
6	10	-.040 to -.098	-.280 to -.370	-.013 to -.028
10	14	-.050 to -.120	-.290 to -.400	-.016 to -.034
14	18	-.050 to -.120	-.290 to -.400	-.016 to -.034
18	24	-.065 to -.149	-.300 to -.430	-.020 to -.041
24	30	-.065 to -.149	-.300 to -.430	-.020 to -.041
30	40	-.080 to -.180	-.310 to -.470	-.025 to -.050
40	50	-.080 to -.180	-.320 to -.480	-.025 to -.050
50	65	-.100 to -.220	-.340 to -.530	-.030 to -.060
65	80	-.100 to -.220	-.360 to -.550	-.030 to -.060
80	100	-.120 to -.260	-.380 to -.600	-.036 to -.071
100	120	-.120 to -.260	-.410 to -.630	-.036 to -.071
120	140	-.145 to -.305	-.460 to -.710	-.043 to -.083
140	160	-.145 to -.305	-.520 to -.770	-.043 to -.083
160	180	-.145 to -.305	-.580 to -.830	-.043 to -.083
180	200	-.170 to -.355	-.660 to -.950	-.050 to -.096
200	225	-.170 to -.355	-.740 to -1.030	-.050 to -.096
225	250	-.170 to -.355	-.820 to -1.030	-.050 to -.096
250	280	-.190 to -.400	-.920 to -1.240	-.056 to -.108
280	315	-.190 to -.400	-1.050 to -1.370	-.156 to -.108
315	355	-.210 to -.440	-1.200 to -1.560	-.062 to -.119
355	400	-.210 to -.440	-1.350 to -1.710	-.062 to -.119
400	450	-.230 to -.480	-1.500 to -1.900	-.068 to -.131

Hollowbores

In some cases, a screw is cored for cooling by boring a hole from the drive end of the screw well into the flighted section of the screw. The tolerance for the cored length (or hollowbore) is the same for all sizes of screws.

English Measurement

Specified length $\pm .030$ "

Metric Measurement

Specified length $\pm .76$ mm

Nose Thread Pilots

A nose thread pilot is an internal cylindrical surface at the meter end of a screw used to accurately locate a non-return valve or other attachment connected to the end of the screw. The tolerance for the length of the pilot is especially important on an injection screw which will be fitted with a valve. The tolerance is the same for all sizes of screws.

English Measurement

Injection Specified length $\pm .005$ "
Extrusion Specified length $\pm .015$ "

Metric Measurement

Specified length $\pm .13$ mm
Specified length $\pm .40$ mm

Flight & Bearing Diameters

The diameters of the flighted section and the bearing surface of the screw are vital to the performance of the screw. The flight diameter is the outside diameter of the screw flights. The bearing diameter (or Hub) is the diameter of the screw immediately behind the flighted length which prevents the escape of material and provides a seal between the screw and the barrel. The tolerances for these two diameters is stated below:

<u>Screw Diameter</u>	<u>English Measurement</u>	<u>Metric Measurement</u>
To 6.0"	+ .000 - .002"	+ .00 - .05mm
Over 6.0"	+ .000 - .004"	+ .00 - .10mm

Shank Diameter

The shank is the non-flighted section of the screw, also referred to as the drive end. The tolerance for the diameter of the shank is the same for all sizes of screws.

English Measurement

+ .000 - .002"

Metric Measurement

+ .000 - .50mm

Hollowbore Diameter

The tolerance for the length of the hollowbore is stated in a previous paragraph. The tolerances for the diameter of a hollowbore are dependent upon the size of the screw, as shown below.

<u>Screw Diameter</u>	<u>English Measurement</u>	<u>Metric Measurement</u>
To 3"	± .020"	± .5mm
3" to 6"	± .040"	± 1.0mm
Over 6"	± .060"	± 1.5mm

Nose Thread Pilot Diameter

The depth of the nose thread pilot is stated in a previous paragraph. The tolerances for the diameter are the same for all sizes but differ between injection and extrusion screws.

	<u>English Measurement</u>	<u>Metric Measurement</u>
Injection	+ .001" - .000"	+ .025 - .000mm
Extrusion	+ .002" - .000"	+ .050 - .000mm

The tolerance for injection screws is particularly important because they will be fitted with valves.

Concentricity of Outside Diameters

Concentricity of cylindrical surfaces of a screw exists when all of the cylindrical shapes share the same axis (and the axis is the true center of the screw). The deviation in the concentricity of one surface to another is measured as the maximum reading on a dial indicator, also referred to as Total Indicator Reading (TIR). The tolerance in concentricity deviation (also known as runout) varies with the length of the screw, as follows:

<u>English Measurement</u>		<u>Metric Measurement</u>	
<u>Screw Length</u>	<u>TIR</u>	<u>Screw Length</u>	<u>TIR</u>
To 100"	.004"	To 2500 mm	.100mm
100-200"	.006"	2500-5000mm	.150mm
200-300"	.010"	5000-7600mm	.250mm
Over 300"	.015"	Over 7600mm	.400mm

These tolerances apply to the concentricity of the **outside diameter** of the screw, the **bearing surface** and all portions of the **screw drive**. The concentricity of diameters in flighted sections cannot be accurately measured due to the interrupting effect of the flight. Flight depth variations taken from a true OD are used as a measure of concentricity in this area.

Concentricity of Inside Diameters

The tolerances for inside diameters are the same for all sizes of screws. However, there is a different tolerance for the register of the screw as compared with the other inside diameters.

Nose Thread Pilots, Nose Threads and Hollowbores

English Measurement (TIR)

.001"

Metric Measurement (TIR)

.025mm

Screw Register

English Measurement (TIR)

.0005"

Metric Measurement (TIR)

.013mm

Flight Radii

Unless otherwise specified, the flight radii connecting the flight with the root of the screw should not be less than ½ of the flight depth, up to a 1" or 25mm radius. The tolerances should be as follows:

English Measurement

Specified ± .030"

Metric Measurement

Specified ± .75mm

Perpendicularity & Parallelism

All **flights**, unless otherwise specified, should be perpendicular to the screw axis from the root radius to the OD on both sides. Other surfaces perpendicular to the screw axis can be tested by use of a surface plate and an adjustable height table indicator or a precision square. Other perpendicular surfaces would include the **register face** and the **rear drive face**. The tolerances for these surfaces are the same for all sizes of screws and may be measured in distance or degrees, as follows:

English Measurement

± .001 in./in.
.006 degrees

Metric Measurement

± .0025mm/mm
.006 degrees

Parallel surfaces can be determined by TIR or by using a surface plate and an adjustable height gauge. All dimensions meeting the concentricity and/or flight depth guidelines are considered acceptable.

Screw Threads

The variation in threads used in the manufacture of screws is too broad to be addressed by these recommendations. It is suggested that whenever thread selection is made, either ANSI or ISO standards are observed for ease of measurement and compatibility.

Surface Finish

Surface finish tolerances are different for plated vs. unplated surfaces, as indicated below:

	<u>English Measurement</u>	<u>Metric Measurement</u>
Chrome-plated surfaces:		
Channel	16 microinches	.40 micrometers
OD	32 microinches	.80 micrometers
Bearing/shank	32 microinches	.80 micrometers
Unplated surfaces	32 microinches	.80 micrometers

Hard Surfacing

All hard surfacing materials should be specified as to alloy, width or weld, and depth of weld.

Measurement Temperature

All measurements should be taken at room temperature of 72 degrees F (\pm 20 degrees F) or 22 degrees C (\pm 11 degrees).