Typical drawing abbreviations

Adjust	ADJ
American Wire Gage	AWG
Auxiliary	AUX
Bill of materials	BM or BOM
Center line	CL
Chamfer	CHAM
Counterbore	C'BORE
Countersink	CSK
Diameter	DIA
Dimensions	DIM
Drawing	DWG
Finish all over	FAO
Finish mark	$\sqrt{}^{32}$
Flat head	FH
Harden	HDN
High speed steel	HSS
Inside diameter	ID
Left hand	LH
Material	MATL
Maximum	MAX
Minimum	MIN
National coarse	NC or UNC
National extra fine	NF or UNF
Outside diameter	OD
Pitch diameter	PD
Required	REQD
Right hand	RH
Spotface	SF
Thread per inch	TPI
Tolerance	TOL

RPM and mill feed-rate formulas

RPM

$$RPM = \frac{4CS}{D}$$

where CS is recommended cutting speed for material in surface feet per minute (SFPM), and
D is the diameter of workpiece or cutting tool

Milling Feed-rate, in Inches per Minute (IPM)

IPM = RPM × recommended chip load per tooth × number of teeth on cutter

Symbols and drawing formats for geometric dimensions and tolerances

Geometric Symbols of Position and Location

True position

Concentricity

Symmetry

Geometric Symbols of Form

Perpendicularity (squareness)

Straightness

Flatness

Angularity

Parallelism

Roundness

Cylindricity

Profile of any line

Profile of any surface

Runout (circular or total)

Datum and Basic Dimensions

[A] [B]

[1.375]

Maximum Materials Condition (MMC), Least Material Condition (LMC) and Regardless of Feature Size (RFS)

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Ⓛ

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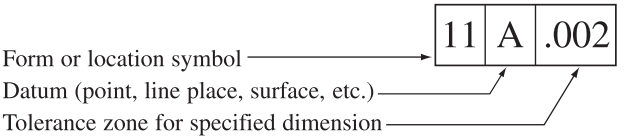
Drawing Format for Geometric Dimensions and Tolerances



Metric Equivalents

Linear Units

25.4 millimeters (mm) = 1 inch
1 millimeter = .03937 inches
1 meter = 3.281 feet
1 meter = 1.094 yards
1 centimeter (cm) = .03281 feet
1 cm = .3937 inches
1 cm = .01 meter (m)
1 cm = 10 millimeters
1 kilometer (km) = 3281 feet
1 km = .6214 miles
1 km = 1094 yards

Area

1 square centimeter (cm^2) = .001076 square ft ($ft.^2$)
1 square centimeter (cm^2) = .1550 square inches ($in.^2$)
1 square meter (m^2) = 10.76 $ft.^2$
1 square meter = 1.196 square yards ($yd.^2$)

Angular

1 radian = 57.30 degrees
1 radian = 3438 minutes
1 degree (angular) = .01745 radians

Weight

1 pound (lb) = 453.59237 grams (g)
1 kilogram (kg) = 2.205 pounds
1 kilogram = .001102 tons

Volume

1 liter (l) = 1000 cubic centimeters (cm^3)
= .03531 cubic feet ($ft.^3$)
= 61.02 cubic inches ($in.^3$)
= .001 cubic meters (m^3)
= .2642 gallons
= 1.057 quarts
1 cubic centimeter (cm^3) = .001 liter (milliliter or ml)
1 cubic foot ($ft.^3$) = 28.32 liters
1 cm^3 = .06102 $in.^3$
1 cubic inch ($in.^3$) = .01639 liters
1 gallon = 3785 cm^3
1 gallon = 3.785 liters

Metric Prefixes and Equivalents

Metric System Prefixes

Tera (T)	1,000,000,000,000 (trillion)
Giga (G)	1,000,000,000 (billion)
Mega (M)	1,000,000 (million)
Kilo (K)	1,000 (thousand)
Hecto (H)	100 (hundred)
Deka (DA)	10 (ten)
Unit	1
Deci (d)	.1 (tenth)
Centi (c)	.01 (hundredth)
Milli (m)	.001 (thousandth)
Micro (mu)	.000001 (millionth)
Nano (n)	.000000001 (billionth)
Pico (p)	.000000000001 (trillionth)

Decimal Equivalents of Fractional Inches

Fraction Inch	Decimal Inch	Decimal Millimeters	Fraction Inch	Decimal Inch	Decimal Millimeters
1/64	.015625	0.39688	33/64	.515625	13.09690
1/32	.03125	0.79375	17/32	.53125	13.49378
3/64	.046875	1.19063	35/64	.546875	13.89065
1/16	.0625	1.58750	9/16	.5625	14.28753
5/64	.078125	1.98438	37/64	.578125	14.68440
3/32	.09375	2.38125	19/32	.59375	15.08128
7/64	.109375	2.77813	39/64	.609375	15.47816
1/8	.1250	3.17501	5/8	.6250	15.87503
9/64	.140625	3.57188	41/64	.640625	16.27191
5/32	.15625	3.96876	21/32	.65625	16.66878
11/64	.171875	4.36563	43/64	.671875	17.06566
3/16	.1875	4.76251	11/16	.6875	17.46253
13/64	.203125	5.15939	45/64	.703125	17.85941
7/32	.21875	5.55626	23/32	.71875	18.25629
15/64	.234375	5.95314	47/64	.734375	18.65316
1/4	.2500	6.35001	3/4	.7500	19.05004
17/64	.265625	6.74689	49/64	.765625	19.44691
9/32	.28125	7.14376	25/32	.78125	19.84379
19/64	.296875	7.54064	51/64	.796875	20.24067
5/16	.3125	7.93752	13/16	.8125	20.63754
21/64	.328125	8.33439	53/64	.828125	21.03442
11/32	.34375	8.73127	27/32	.84375	21.43129
23/64	.359375	9.12814	55/64	.859375	21.82817
3/8	.3750	9.52502	7/8	.8750	22.22504
25/64	.390625	9.92189	57/64	.890625	22.62192
13/32	.40625	10.31877	29/32	.90625	23.01880
27/64	.421875	10.71565	59/64	.921875	23.41567
7/16	.4375	11.11252	15/16	.9375	23.81255
29/64	.453125	11.50940	61/64	.953125	24.20942
15/32	.46875	11.90627	31/32	.96875	24.60630
31/64	.484375	12.30315	63/64	.984375	25.00318
1/2	.5000	12.70003	1	1.0000	25.40005

Low Carbon and Alloy Steel Identification

Type of Steel	Number	% of Alloying Elements
Low carbon steels	10xx	Plain carbon, resulfurized,
	11xx	rephosphorized
	12xx	
	15xx	Manganese 1.0–1.6%
Manganese steel	13xxx	Manganese 1.75%
Nickel steels	23x	Nickel 3.5%
	25xx	Nickel 5.0%
Nickel-chromium steels	31xx	Nickel 1.25%–CR .65–.80%
	32xx	1.75%– 1.07%
	33xx	3.5%– 1.5–1.57%
	34xx	3.0% .77%
Molybdenum steels	40xx	Molybdenum .2–.25%
	44xx	.4–.52%
Chromium-molybdenum steels	41xx	CR .5–.95% MO .12–.3%
Nickel-chromium-molybdenum steels	43xx	NI 1.8% CR .5–.8% MO .25%
	47xx	NI 1.03% CR .45% MO .2–.3%
Nickel-molybdenum steels	46xx	NI .85–1.8% MO .2–.3%
	48xx	NI 3.5% MO .25%
Chromium steels	50xx	CR .25–.65%
	51xx	CR .8–1.1%
	50xxx	CR .5% C 1.0%
	51xxx	CR 1.02% C 1.0%
	52xxx	CR 1.45% C 1.0
Chromium-vanadium steel	61xx	CR .5–.9% Vanadium .1–.15%
Tungsten-chromium steel	72xx	Tungsten 1.70% CR .75%
Nickel-chromium-molybdenum steels	81xx	NI .3% CR .4% MO .12%
	86xx	NI .55% CR .5% MO .2%
	87xx	NI .55% CR .5% MO .25%
	88xx	NI .55% CR .5% MO .35%
Silicon-manganese steel	92xx	SI 1.4–2.0% MN .65–.85% CR .60%
Nickel-chromium-molybdenum steels	93xx	NI 3.20% CR 1.2% MO .12%
	94xx	NI .45% CR .4% MO .14%
	97xx	NI .50% CR .2% MO .20%
	98xx	NI 1.0% CR .8% MO .25%