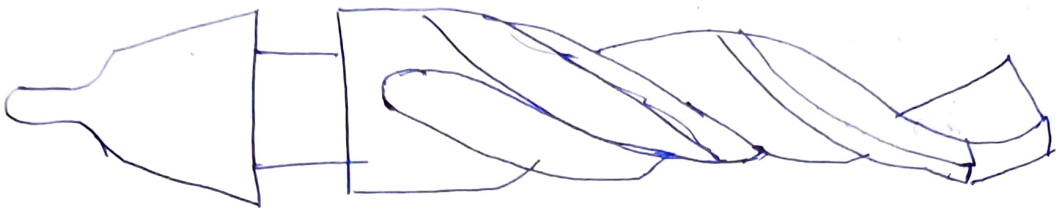
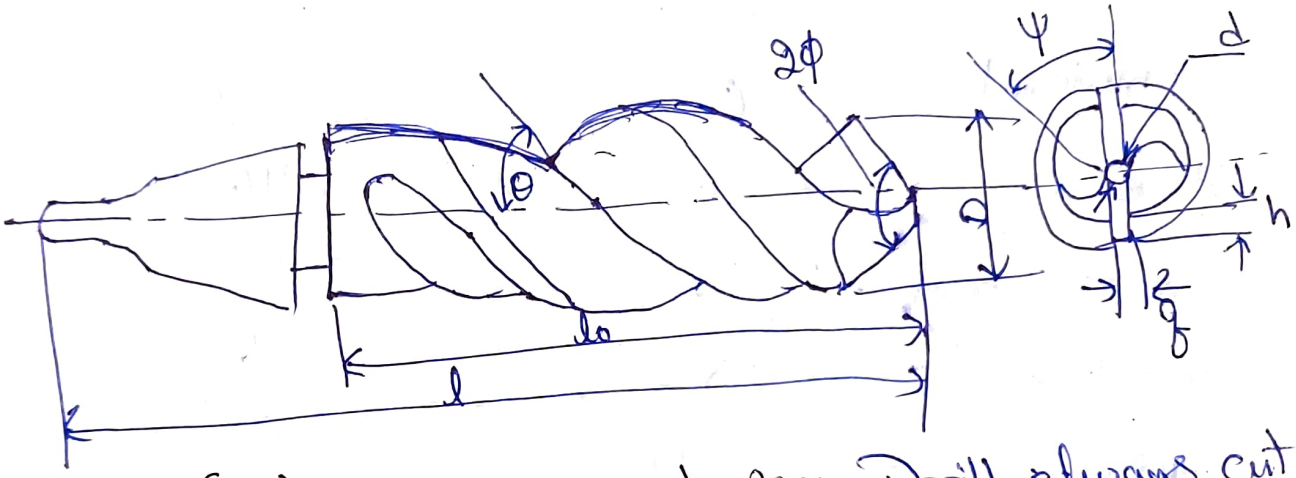
Design Of Drill (Twist Drill)





i) Drill dia.(D) and reverse taper. Drill always cut oversize. Thus, the size of the drill should always be slightly smaller than the dia. of the hole to be drilled. To reduce friction b/w the drill and the work, the dia. of the drill over the margins at the body of the drill is slightly tapered back towards the shank.

Drill Dia. D (mm)	1-10	10-18	>18
Reverse tapper (mm/100mm)	0.03-0.08	0.04-0.10	0.05-0.12

ii) Core dia (do) It is essential to insure the strength and stiffness of drill.

Drill Dia. D (mm)	0.25-1.25	1.5-12	13+
Core dia d_o (mm)	$0.24 D^{0.8}$	(0.15-0.19)D	(0.125-0.145)D

iii) Flute Helix Angle (θ) Its depends on the metal being cut. and dia. of the drill.

Drill dia mm	0.25-0.45	0.5-0.95	1-2.9	3-4	4.5 8.4	8.5-9.9	10-80
θ	18-19°	20-21°	22-23°	24°-25°	26-27°	28°	30°

iii) Point Angle (2ϕ) / Lip Angle

Work material	θ	2ϕ
Stee	30°	116-118°
Stainless Steel	25°	120°
Cast Iron	25-30°	116-120°
Copper	35-45°	125°
Bronze	8-20°	125-130°
Aluminum Alloy	35°-45°	130-140°
Plastics	8-15°	60-100°

iv) Thickness of cutting blade (b) / Land width.
It is affects the strength and width of the flute.

D mm	3-8	8-20	over 20
b mm	0.62D	0.6D	0.58D

v) Auxiliary flank height & width (hf) / Margin
It's purpose is to guide the drill and reduce friction during operation.

$h = (0.02-0.03)D$ — hight

$f = (0.06-0.07)D$ — width.

vi) Length of drill cutting portion (l_o) and total length (l)

Drill with cylindrical shank., range from 0.25-20 mm dia.

1.) Short drill

Dia. D = 1-20 mm

l_o = 6-65 mm

2) Medium drill

D = 0.25-20

l_o = 3-140 mm

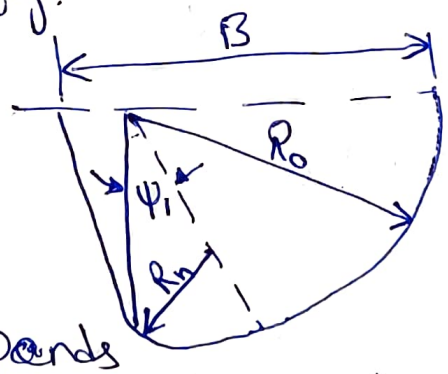
3) long drills

D = 1.95-20

l_o = 55-165 mm

vii) Shape of Flute profile. The cutting edge or the lip of a twist drill which is formed by the intersection of the face and the relief surface of the cutting edge is normally a straight line. The profile of the cross-section of flute in fig.

$R_0 = C_1 C_2 C_3 D$



Profile of the Flute Cross-section

Coefficient C_1 depends on lip angle 2ϕ and helix angle θ

$$C_1 = \frac{0.026 \times 2\phi \times \sqrt[3]{2\phi}}{\theta}$$

Coefficient C_2 depends on core dia: d_o and drill dia. D

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$$C_2 = \left[\frac{0.14\,D}{d_o}\right]^{0.044}$$

D Coefficient C_3 takes into account the dia of the flute milling cutter D_c ~~and is~~

$$C_3 = \left[\frac{13\sqrt{D}}{D_c}\right]^{0.9/\theta}$$

D_c = dia. of the fluting cutter.

ii

Nose radius of the cutter ~~wheel~~ teeth R_o

$$R_o = C_n D$$

$$C_n = 0.015\theta^{0.75}$$

Cutter Width B

$$B = R_o + \frac{R_n}{\cos\psi_1}$$

$\psi = 10^\circ$ [if $\psi \approx 1$]

$$B = R_o + R_n$$