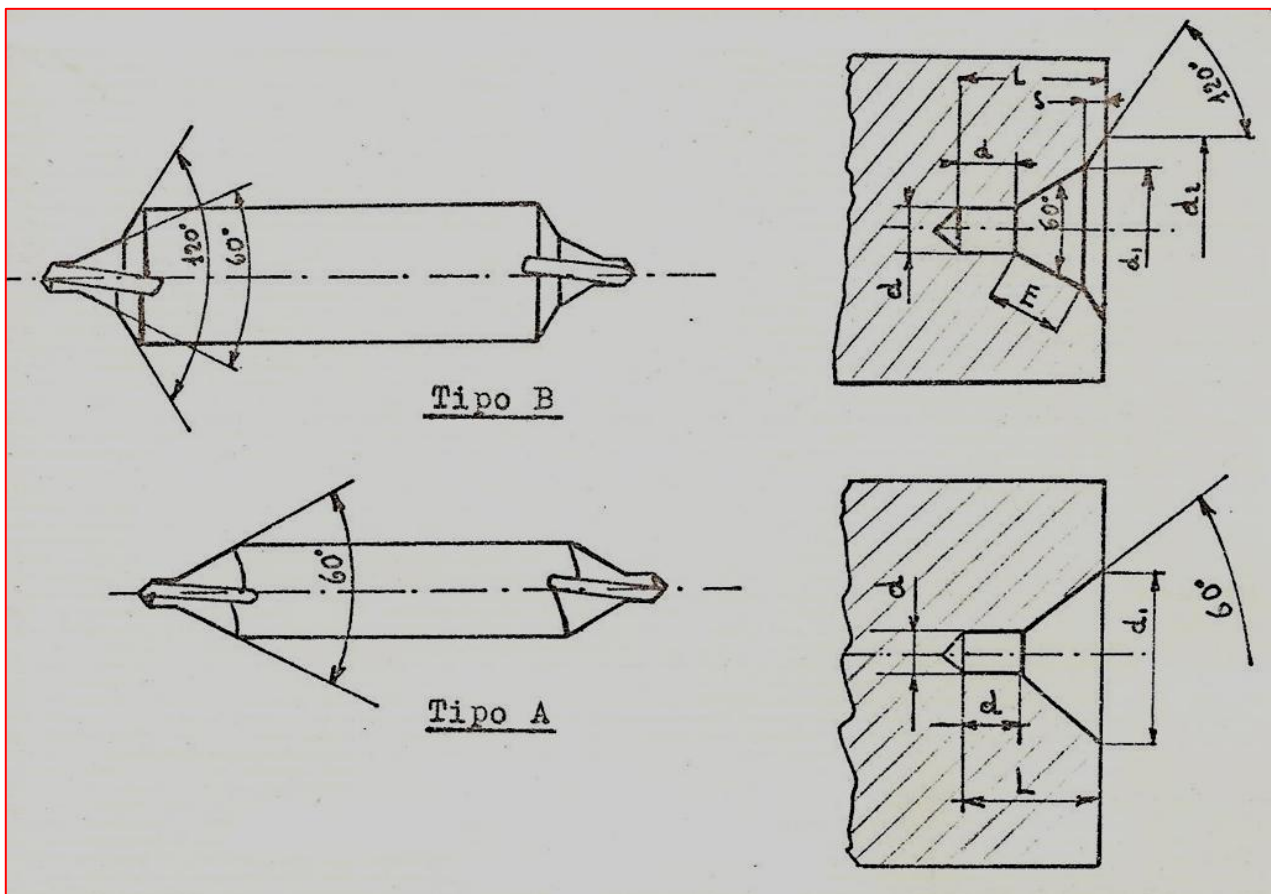# Center drills

A special case of drill bits are the drill bits for centers. They can be divided into two groups:

1) *Normal Center Drills* with straight cutting edges
2) *Drills for centers with curved profile*

The first type can execute the center with the protection chamfer or without protection chamfer.
With reference to figure N°1 we can observe that the tract E that mates with the tailstock, is protected by the chamfer of protection that prevents any deformation on the edge which can cause an inaccurate centering of tailstock.

Fig. N°1- *Center Drills with straight cutting edges*

Drills for centers can be constructed in high speed steel but also in carbide.
They are subject to various normalizations such as the UNI 3223 or DIN 333, it includes:
➢ *DIN 333-A - Drills for center with an angle of 60°*
➢ *DIN 333-R - Drills for center with a radius centered on 60°*
➢ *DIN 333-B - Drills for center with angles of 60° and 120° (with protection chamfer)*

The characteristics of the centers according to UNI 3223 are shown in table N°1, and the size of some of the drills according to standard DIN are shown in tables N°2 - 3 - 4.
For more details please refer to the original tables UNI and DIN.

Table N°1 - Standard size of the centers with and without chamfer protection (UNI 3223)

d (mm)	Type A		Type B			
	d_1	L_{min}	d_1	d_2	L_{min}	S
0,5	1,25	1,2	--	--	--	--
0,75	1,9	1,8	-	--	--	--
1,0	2,5	2,3	2,5	3,9	2,7	0,4
1,5	3,8	3,5	3,8	5,9	4,1	0,6
2,0	5,0	4,6	5,0	7,8	5,4	08
3,0	7,5	6,9	7,5	11	7,9	1,0
4,0	10	9,2	10	14,2	10,4	1,2
5,0	12,5	11,5	12,5	17,7	13	1,5
6,0	15	13,8	15	21,2	15,6	1,8
8,0	20	18,4	20	27	20,4	2,0
12,0	30	27,6	30	38	30	2,4

Table N°2- Sizing of some center drills Standard DIN 333-A (ref. Fig No.3)

d (mm)	D (Body diameter) mm	L_1 (mm)	L_2 (mm)
1	3,15	31,5	1,3
1,6	4	35,5	2
2	5	40	2,5
2,5	6,3	45	3,1
3,15	8	50	3,9
4	10	56	5
5	12,5	63	6,3
6,3	16	71	8

Table N°3- Sizing of some center drills Standard DIN 333-B (ref. Fig No.3)

d (mm)	D (Body diameter) mm	L_1 (mm)	L_2 (mm)
1	4	35,5	1,6
1,6	6,3	45	2,4
2	8	50	2,9
2,5	10	56	3,6
3,15	11,2	60	4,4
4	14	67	5,6
5	18	75	6,9
6,3	20	80	8,6

Table N°4- Sizing of some center drills Standard DIN 333-R (ref. Fig No.3)

d (mm)	D (Body diameter) mm	L_1 (mm)	L_3 (mm)	Radius (mm)
1	3,15	31,5	3	3,15
1,6	4	35,5	4,25	5
2	5	40	5,3	6,3
2,5	6,3	45	6,7	8
3,15	8	50	8,5	10
4	10	56	10,6	12,5
5	12,5	63	13,2	16
6,3	16	71	17	20

The center drills of R-type the contact with the tailstock is at only one point with a certain self-centering action of the piece.
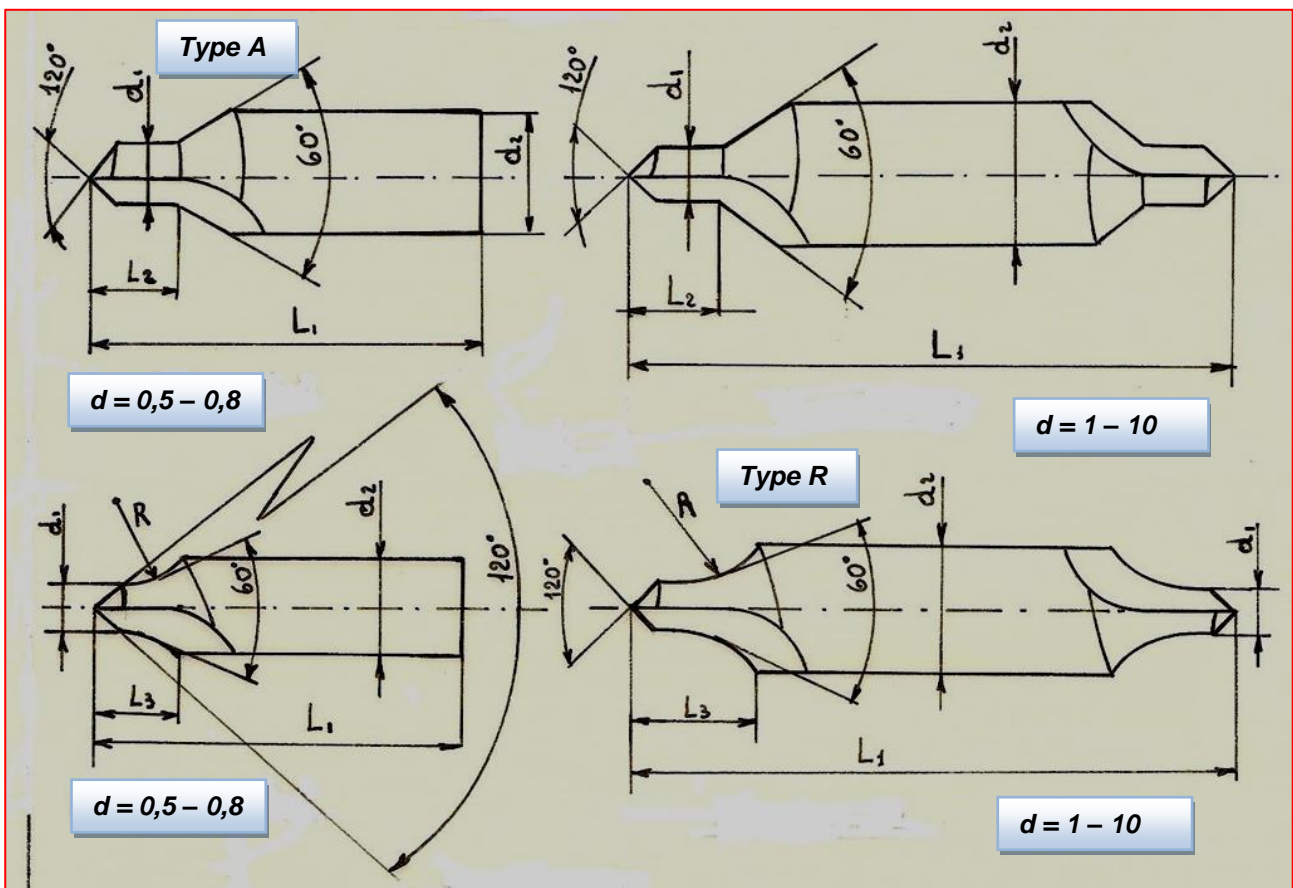
The position of the center of the radius R can be determined as follows, with reference to figure N°2:

$$\overline{AB} = \frac{D}{2} - \frac{d}{2} \quad ; \quad \overline{BC} = L_3 - \frac{d}{2} \cdot \tan 30° \quad ; \quad \overline{AC} = \sqrt{\overline{AB}^2 + \overline{BC}^2} \quad ;$$

$$\tan \alpha = \frac{\overline{BC}}{\overline{AB}} \quad ; \quad \cos \beta = \frac{\overline{AC}}{2R} \quad ; \quad \overline{EO} = R \cdot \sin(\alpha - \beta) \quad ; \overline{AE} = R \cdot \cos(\alpha - \beta)$$
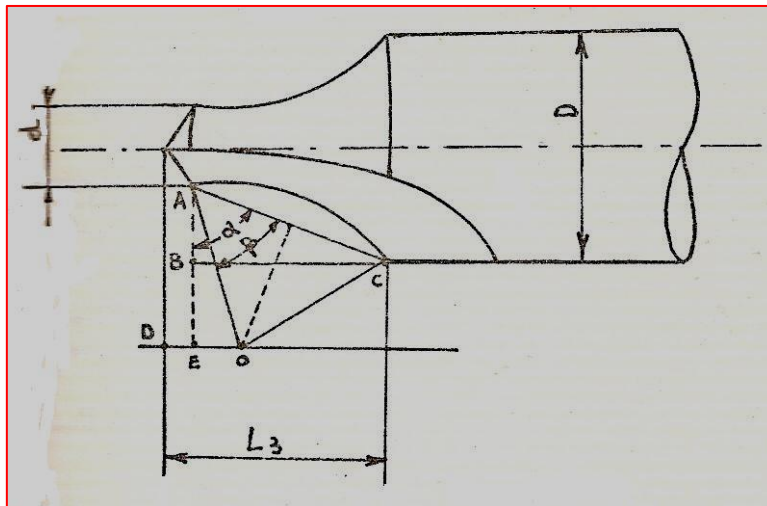

Fig. N°2- *Position of the center of the radius R of the drills with curved cutting edge*

Fig. N°3- *Center drills type A and type R – construction details*

The center drills with curved edges do not present corners on the profile therefore they are less susceptible to breakage compared to the drills with straight cutting edges.
In some cases, however, where the piece should be subject to further heavy processing , the center performed with this drill cannot guarantee perfect stability on the tailstock.
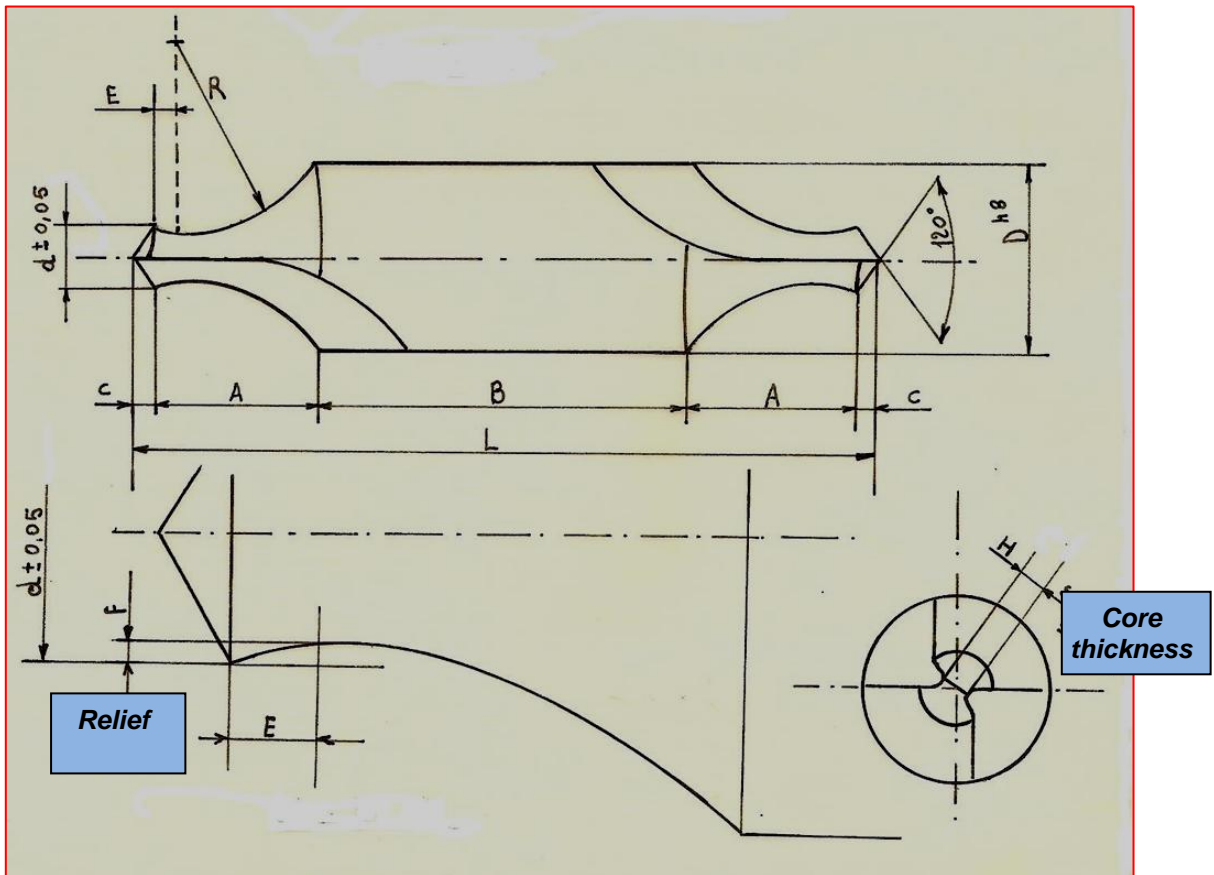
Fig. N°4- *Center drills type R – Detail of the relief on the initial part*

It should be noted that the center of the radius is moved to the inside of the quantity **E** in order to generate on the peripheral cutting edge a certain relief **f** on the outer diameter.
The clearance angle **γ**, for a certain radius **R** and a certain shift **E** is given by:

$$\sin \gamma = \frac{E}{R}$$