Chip breaker and chip conveyor

In the machining steel with high-speed cutting and with normal shape tools , it usually produces a continuous chip that is not only dangerous for the worker and difficult to transport, but during the work can damage the cutting edge.
In addition most of the time these long spirals tangle between the workpiece, tool and tool holder stealing valuable time at the worker that should drop the chips in the collecting tank. This problem becomes dramatic if you must machining in automatic cycle.
The execution of the chip breaker or of a groove that convoys the chips in a regular coil is the more efficient action to take.
The first is a step performed on the face of the cutting tool which has the purpose to force the chip to an abrupt detour and then break it.
You can make different types of chip breaker according to the needs and the type of tool.
It should be noted immediately that the explanations that follow are generic and are intended to better understand the function of the chip breaker, although now the vast majority of tools are mechanically fixed insert in which the chip breaker is performed directly in the process of sintering and even more complex forms of what are shown here.

Parallel chip breaker

It's basically a step parallel to the main cutting edge.
The rake angle is generally equal to the cutting face but can also be different. For example, if you want to simplify the construction of the tool and also its sharpening, you can weld the insert without any inclination angle which is then derived by an appropriate chip breaker.
This system prevents that with the sharpening the cutting edge decreases and then do this damaging if the tool-holder has the same measures of the body of the tool , with impossibility therefore of shimming the tool.
But even in the inserts are usually adopts this system, because the negative inserts have a number of cutting edges twice that positive inserts.
Make the chip breaker with a positive angle, in an insert negative, can make better use of the insert.
The parallel chip breaker, that the figure N°1 shows an example, is mainly used in finishing operations.

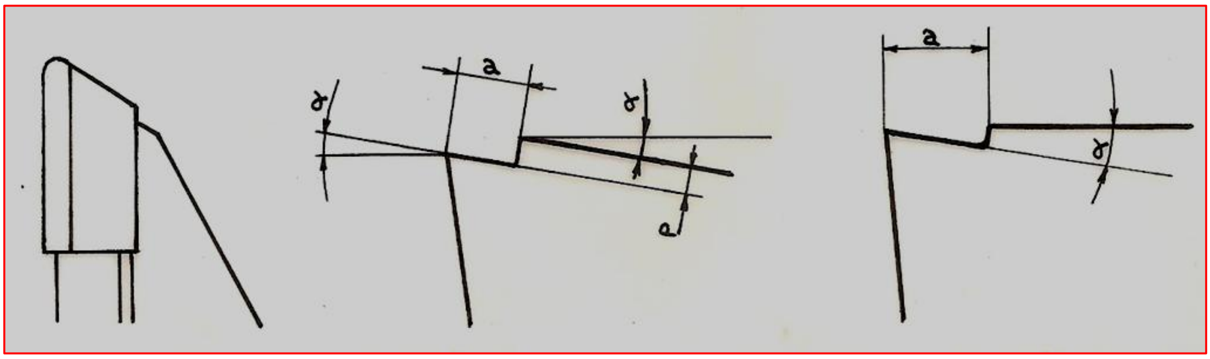

Figure N°1 – *Parallel chip breaker*

Inclined chip breaker

The angular type is suitable for most machining operations and is the most difficult to do.
The chip is flexed towards the area of the workpiece where is broken without damaging the tool.

With reference to figure N°2, the type N°1 is particularly suited for roughing operations and types N°2 and N°3 are more suitable for finish operations.
The shape of the parallel chip breaker can simply be straight with, at the end, without radius or , in the side of the cutting edge, end with a phase **q** having a negative angle of 5 - 10 ° and the other side may be connected with a radius of 1 to 1 , 5 mm.

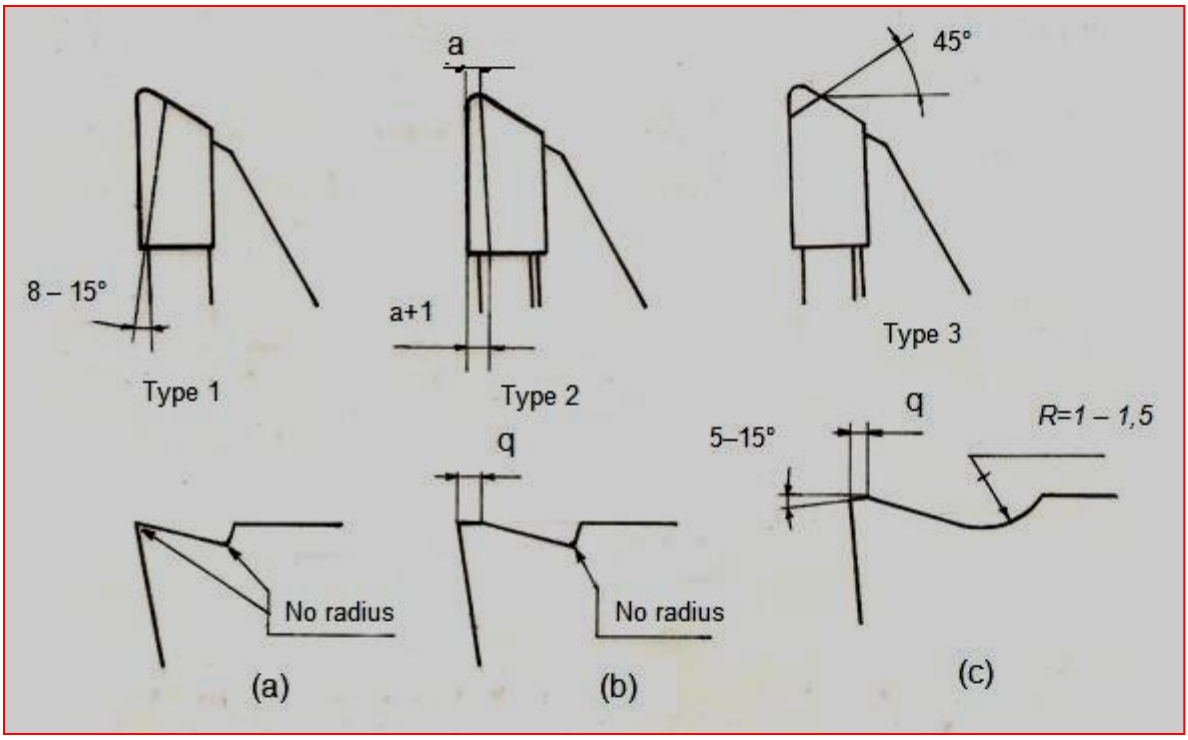

Figure N°2 – *Inclined chip breaker*

The first type without radius at the end, or with a very small radius (about 0.2 mm) is used for finishing operations and it is the real chip breaker because it has precisely the scope to break the chip ; the second type must be considered a conveyor chips because of the large radius usually facilitates to generate a regular coil but not to break the chips .
The depth p of the chip breaker depends not only on the material, but even on the feed and the depth of cut.
Its value can range from 0.4 mm for finishing operations to 1 mm for the heavy operations.
The phase may be a minimum of 0.2 mm, this value can be increased up to a value of the feed per revolution.
The phase is designed to increase the impact resistance of the cutting edge and to prevent them deteriorating because of the chips coming out at high speed.
In the entries also plays a key role to the effects of the breaking strength of the cutting edge in that it directs the cutting effort to the body and turning the flexion stress in compression stress.
The width and depth of the chip breaker depend, as already mentioned, from the cutting depth , from the feed and from material being processed.
Can be taken as a basis the values obtained through the diagram in figure N°3 together with table N°1. Based on the working parameters you can determine the number of the zone on the diagram, and with this number and according to the strength of the material to be machined it's possible to find, in the table, the depth and width of the of the chip breaker.

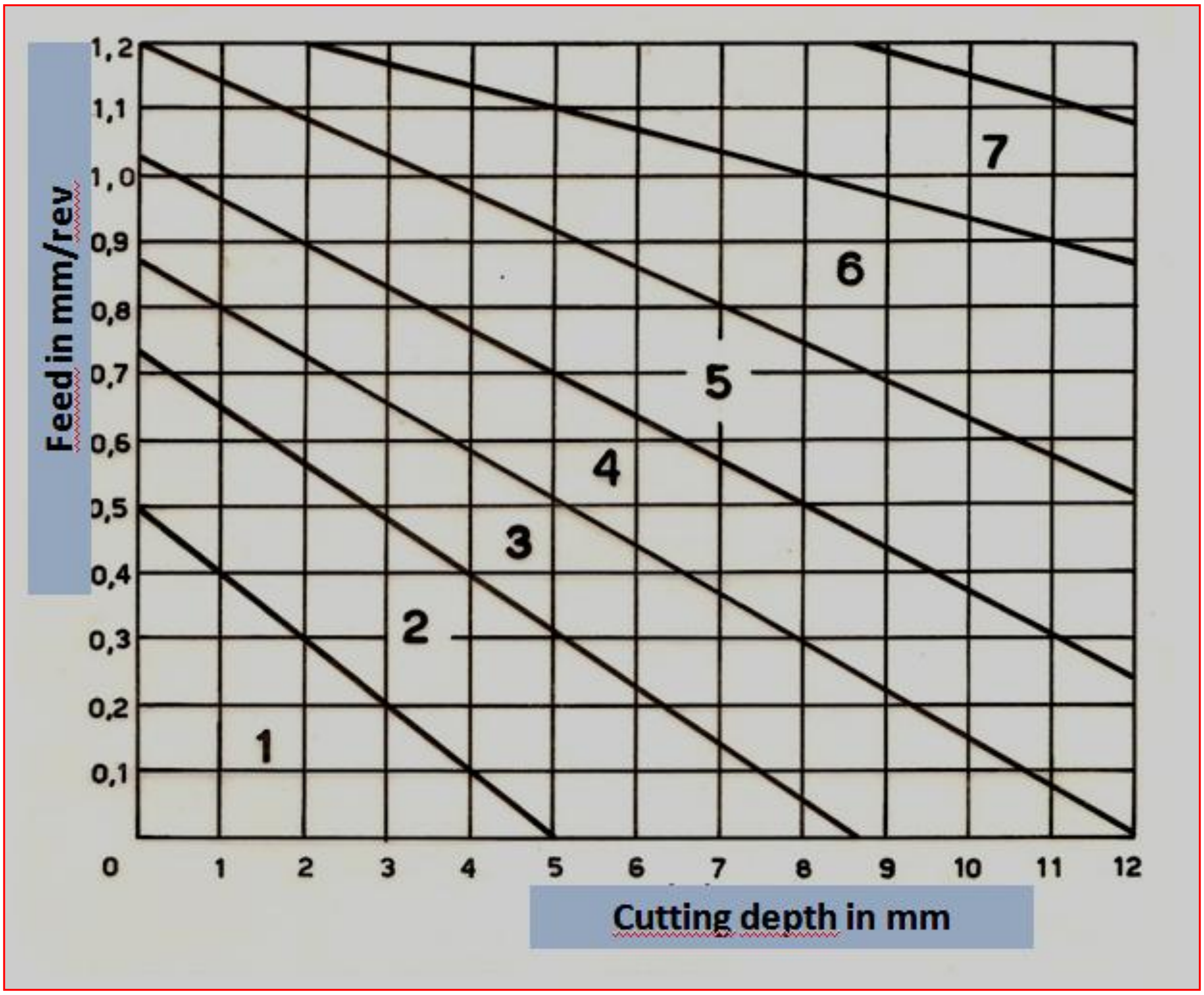

Figure N°3

Table N°1- Width and depth of the chip breaker in mm

Material		Number of the area						
		1	2	3	4	5	6	7
R up to 700 N/mm^2	a	1,0 - 1,5	1,5 – 2,2	2,2 - 2,8	2,8 – 3,5	3,5 – 4,5	4,5 – 5,5	5,5 - 6,0
	p	0,4 – 0,5	0,5 – 0,6	0,6	0,6 – 0,7	0,7 – 0,8	0,8 – 0,9	0,9 – 1,0
R more of 700 N/mm^2	a	0,9 – 1,4	1,4 – 2,0	2,0 – 2,5	2,5 – 3,2	3,2 – 4,0	4,0 – 5,0	5,0 – 5,4
	p	0,3 – 0,4	0,4 – 0,5	0,5	0,5 – 0,6	0,6 – 0,7	0,7 – 0,8	0,8

The operation to make the chip breaker is very delicate because determines the more or less high-performance tool. Are used a diamond wheel with resinoid or vitrified bond . After executing the chip breaker with the small phase flat or inclined , it is useful to perform two operations subsidiaries.

1) - Round off the sharp edge with a diamond file. This rounding may widen towards the bottom of the cutting edge in the chip evacuation area, the sharp of the cutting edge and the area of chip evacuation are so widely and rationally protected. And this it's a very delicate operation, difficult, especially in the connection between cutting edge and radius, whose success depends entirely on the operator and where precise control is almost impossible.
2) Make a chamfer on the edge of the front inner edge chip breaker. To do this ever. This chamfer greatly protects a very vulnerable point of tool and prevents the tool from breakage that the chips can cause very easily. (see figure N°4).

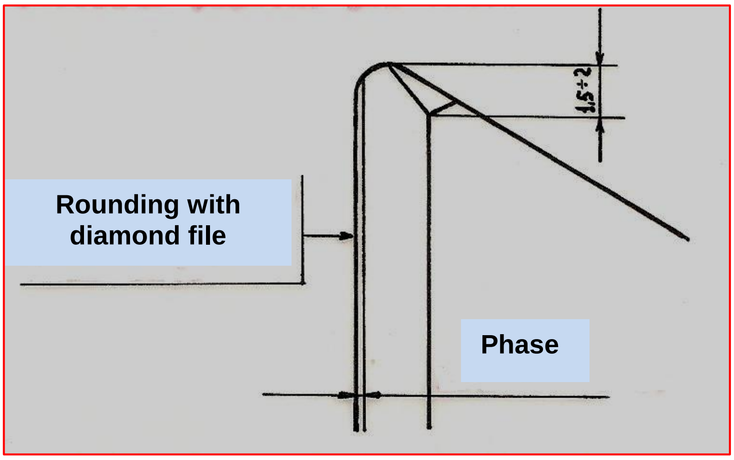

Figure N°4

On the body must be a relief in order to avoid that the diamond wheel going to touch the steel.

Chip conveyor

Widely used in high speed steel tools (less than carbide) has a circular shape.
It is obtained by a disc grinding wheel , the radius of the shape and width depends on the depth and rake angle.
With reference to figure N°5 you can calculate the depth by:

$$p = R - \sqrt{R^2 - \left(\frac{a}{2}\right)^2}$$

With the angle **α** which is given by: $\sin\alpha = \frac{a}{2 \cdot R}$

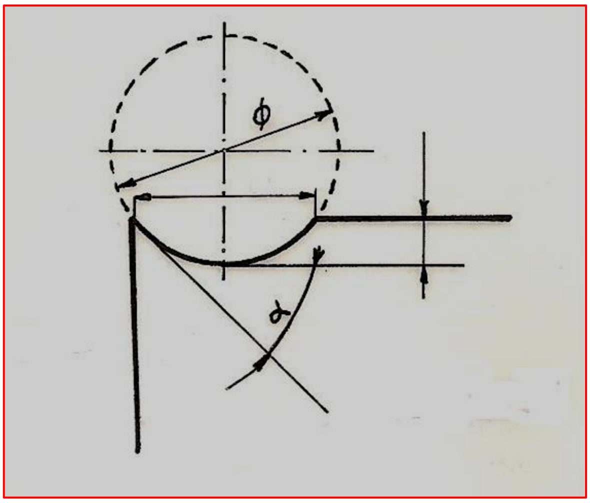

Figure N°5

This kind of chip conveyor is used in the machining of soft materials such as soft steel and aluminum alloys where it is necessary to obtain a well-finished surface. The diagram in figure N° 6 relates the width , depth and angle α.

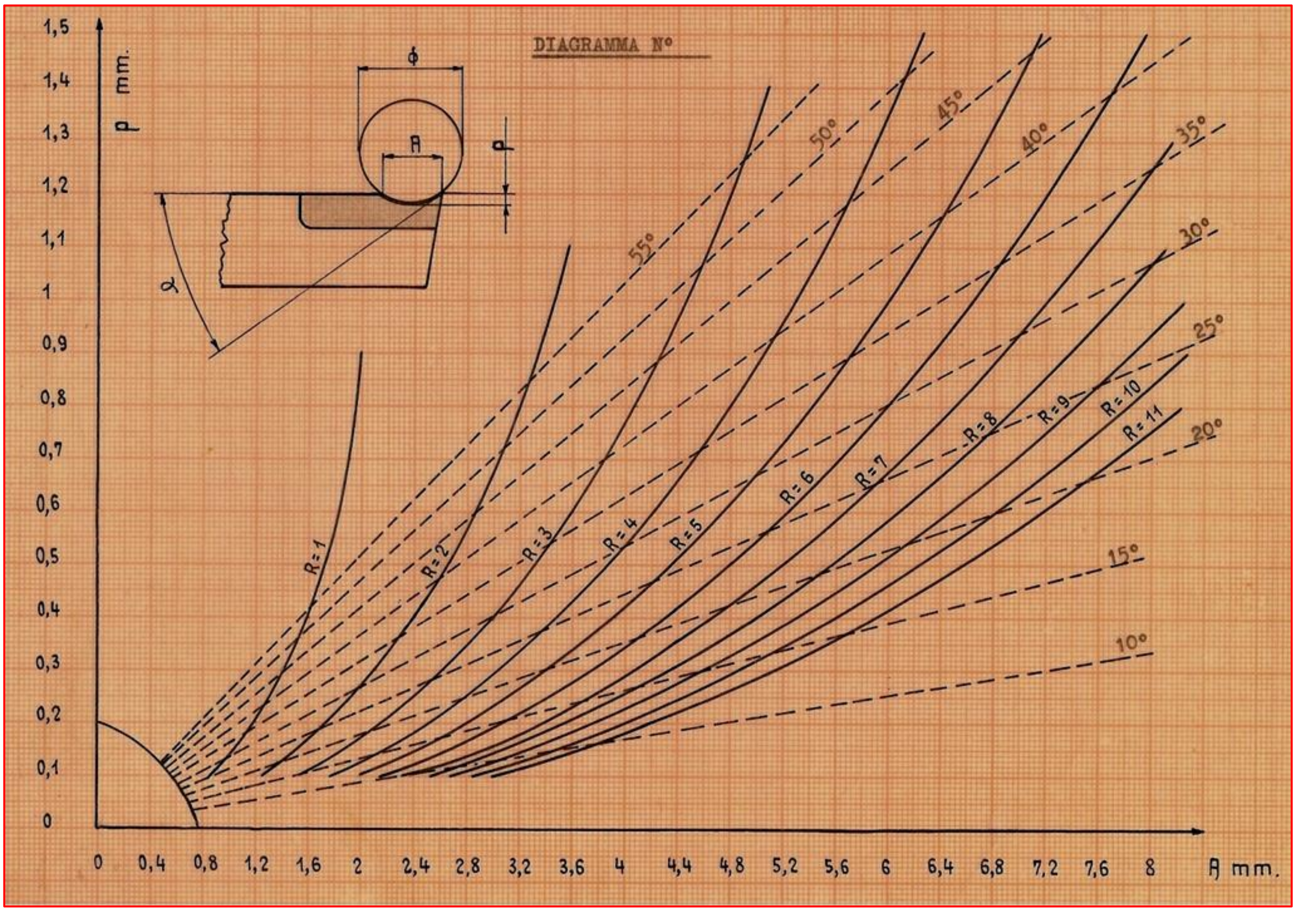

DIAGRAMMA N°
ρ mm.
A mm.
φ
A
ρ
α
R=1
R=2
R=3
R=4
R=5
R=6
R=7
R=8
R=9
R=10
R=11
55°
50°
45°
40°
35°
30°
25°
20°
15°
10°
1,5
1,4
1,3
1,2
1,1
1
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
0 0,4 0,8 1,2 1,6 2 2,4 2,8 3,2 3,6 4 4,4 4,8 5,2 5,6 6 6,4 6,8 7,2 7,6 8

Figure N°6