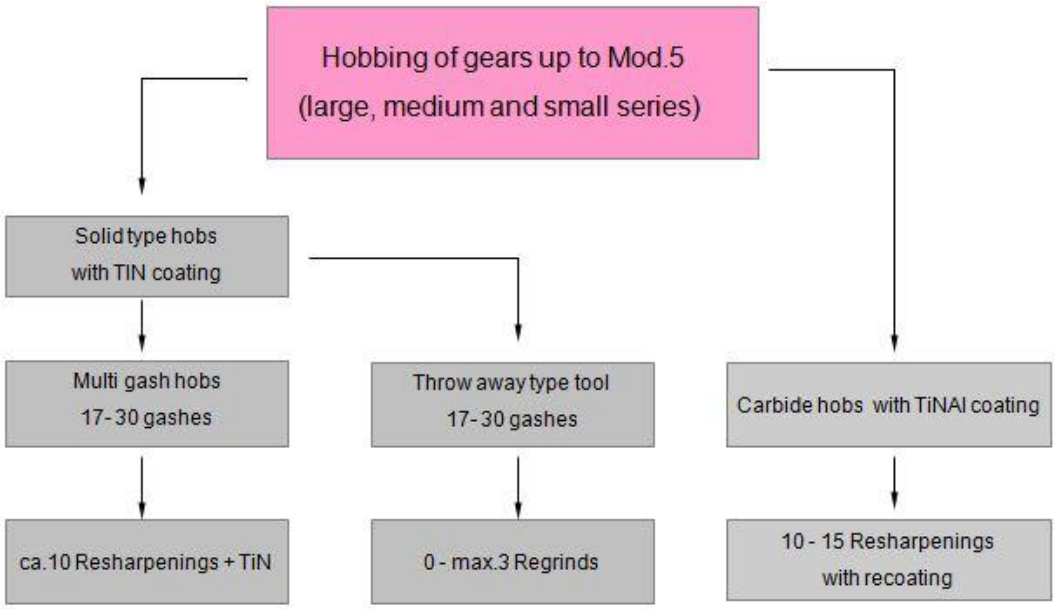
Dry hobbing – more information (1)

The basic question is: *Dry or wet, HSS or Carbide?*
In order to find an answer we must examine the following points:

- *Characteristics of substrates*
- *Wear distribution of carbide hobs*
- *Wear distribution of HSS hobs*
- *Influence on tool life due to*
  - *Pressure angle*
  - *Cutting edge preparation*
  - *Carbide grade*
  - *Chip thickness*
  - *Cutting speed*
- *Influence of conventional and climb cutting on the cutting force*
- *Influence of the spindle revolution on the cutting force*
- *Achievable qualities*
- *Shift strategies for high speed steel and carbide*
- *Comparison of production costs dry and wet, HSS and Carbide*

Nowadays the most common types of hobs are:



Carbide hobs or HSS hobs ? We examine now the characteristic of carbide in comparison with HSS. There are different type of carbide, divided in three basic groups.
For each group there are many sub-groups which differ in composition and structure.
Each group is suitable to process various materials, like shown in the following table.

Grade	Composition	Working range
P	WC TIC, TaC, NbC Co	Steel and cast iron
M	WC, TIC, TaC, Co	Steel with high austenite content
K	WC CO	Cast iron and non ferrous material

To make hobs are used only two quality: P - Grade and K - Grade . Each one have some advantages and some disadvantages.

Advantages of K-Grade : *good tool life with coating - less tool changes*
Disadvantages of K-Grade: *only usable if coated - edge build up if used uncoated*
Advantage of P-Grade : *possible applications without coated cutting edge*
Disadvantages of P-Grade : *larger grain size, in case of breakage greater wear*

In the figure N°1 is shown the different characteristic of standard carbide and the new type of micro-grained carbide.

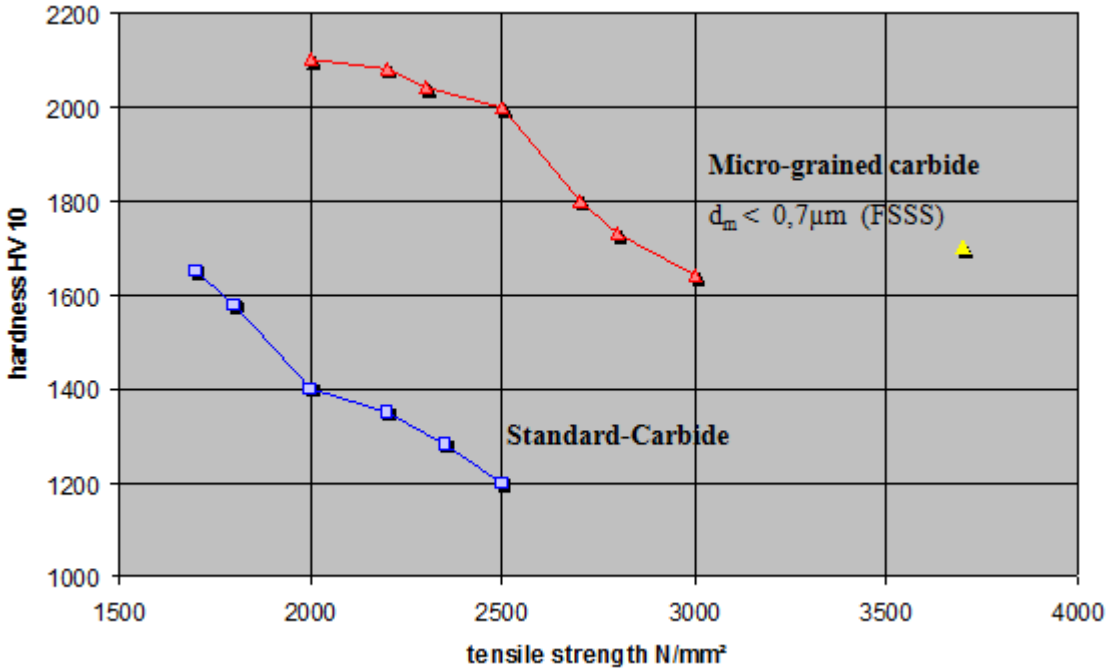


Figure N°1

Then distribution of the carbide components and the difference of the carbide grain dimension is shown in the pictures N°2 and N°3.

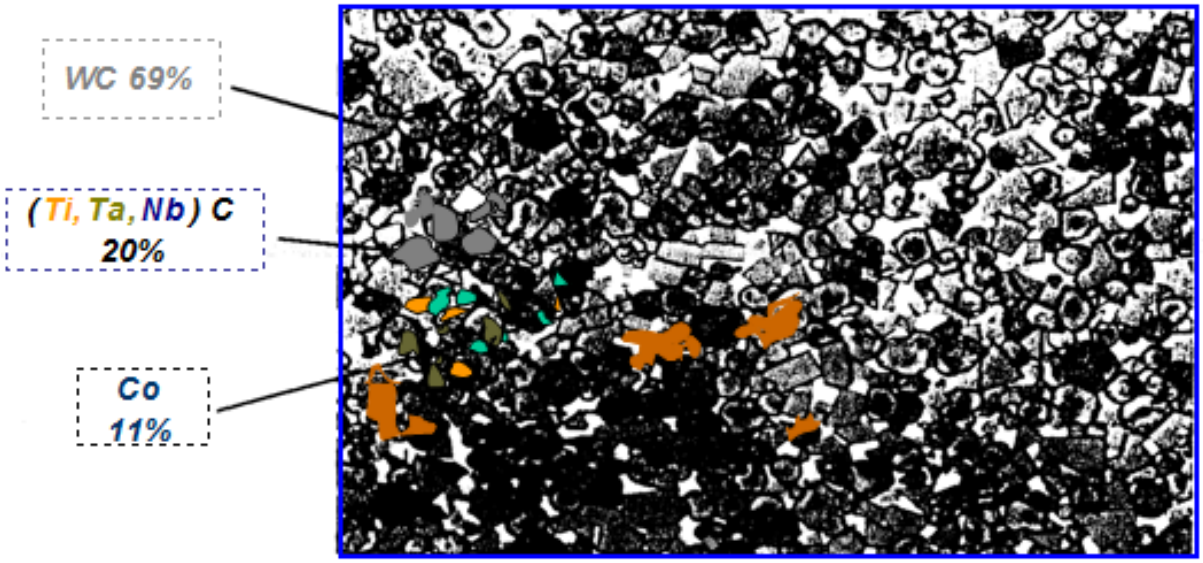


Figure N°2- *Structure of a P 30-40 grade*

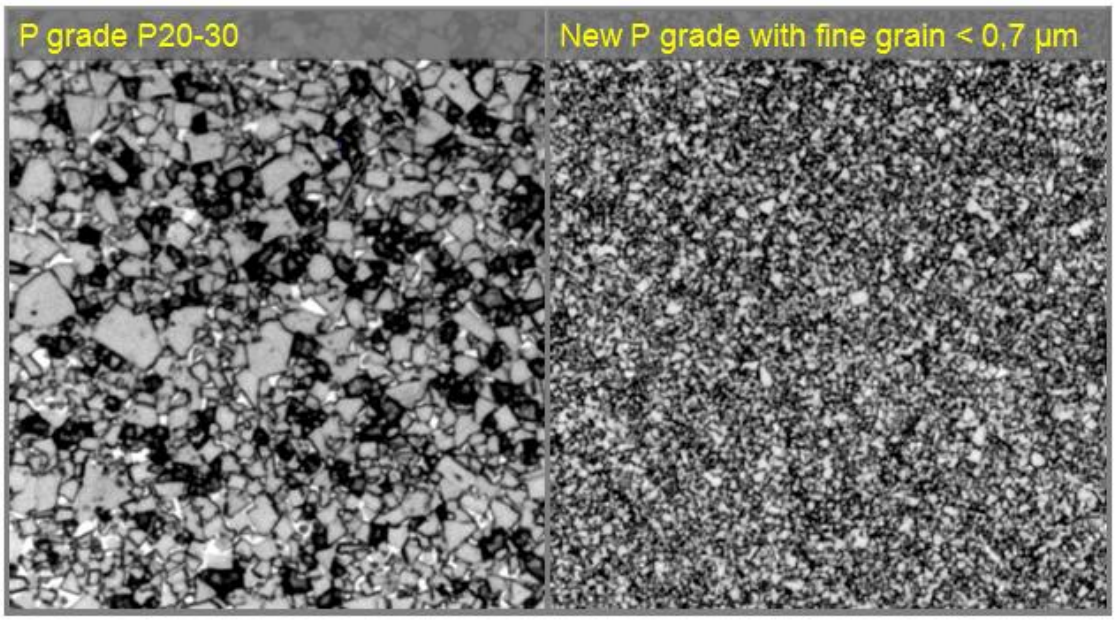


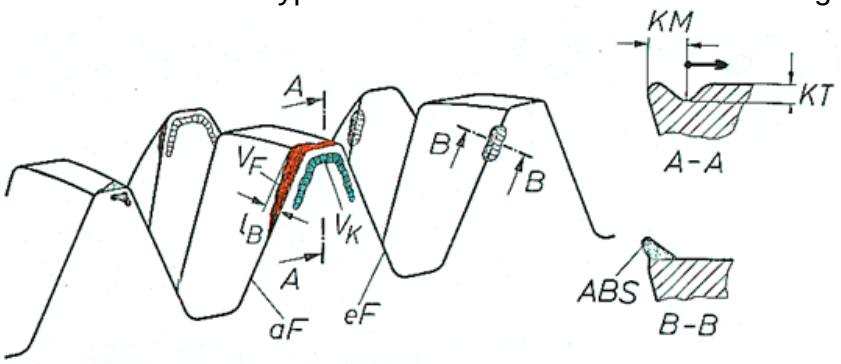
Figure N°3 - *Comparison of the new and old carbide structures*

In the table N°1 there are the comparison of the technical characteristic between HSS steel and carbide.

Table N°1

Characteristics		HSS	Carbide
Hardness	HV10	800 - 900	1200 - 1900
Tensile strenght	N/mm²	5000	1000 - 2500
Density	g/cm³	8 - 8,3	11 - 15
Elasticity coefficient	10³ N/mm²	217	480 - 660
Thermal distortion	µm/(m*°C)	10 - 13	5 - 7
Thermal conductivity (bis 20°C)	W/(m*°C)	19	30 - 100
Working temperature	°C	ca. 500	ca. 1000

There are two types of wear that occur on hob teeth.
The first is known as crater-type wear and it forms on the cutting face, that is on the surface that is resharpened. The second type is abrasive-type wear and this forms immediately behind the cutting edge.
The characteristic of different wear types in a steel hob are shown in the figure N°4.



V_F	Side wear	l_B	amount of wear
V_K	cratering	e_F	entering flank
KT	depth of cratering	a_F	leaving flank
KM	med. depth cratering	ABS	edge build up

Figure N°4- *Wear distribution in a HSS Hob*

A carbide hob has different wear, because very often the wear start when there are a micro breakage in the cutting edge, as shown in figure N°5.

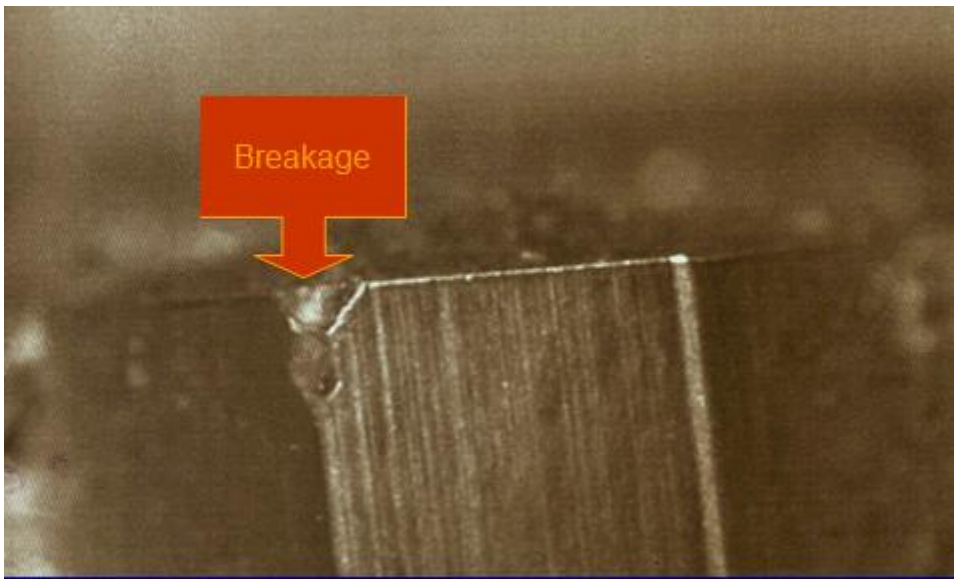


Figure N°5- *In the carbide hob the wear start where there are a edge breakage*

If we cut with a carbide hob (grade K), very often there are the phenomenon of edge build up on the hob tooth during dry cutting.
This is very dangerous because the increase the speed of production of wear. The coating film reduce a lot the because this film, which is deposited onto the tool surface and which is normally about 3 microns thick, is extremely hard and is able to retain its hardness properties at high temperatures without chemically reacting with the work piece steel. The formation of material build up behind the cutting edge does therefore not occur.

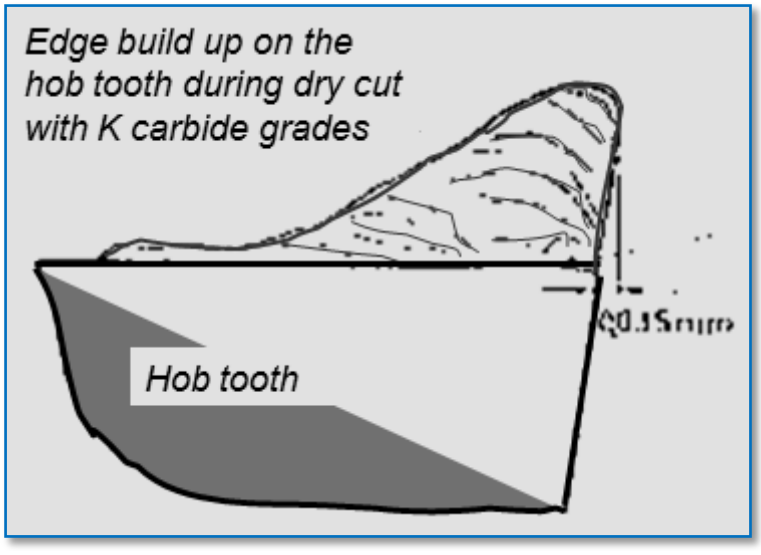


Figure N°6

Related writings : Dry hobbing – more information (2)
Dry hobbing and carbide hobs
Hob wear