

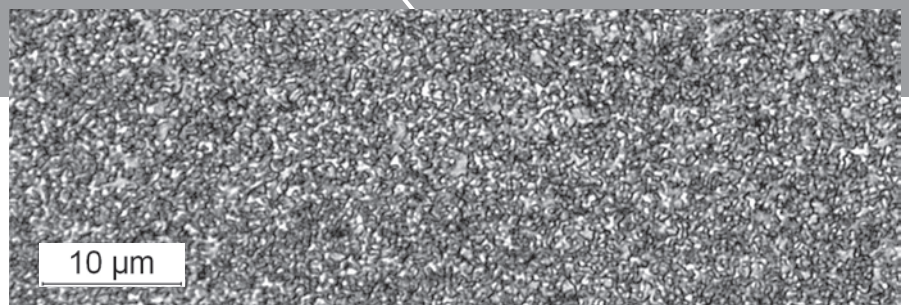
# Selection of the most suitable carbide grade – Recommendation of applications

> **Ultra-fine grain carbides** are characterized by a very high hardness and wear resistance. They are used for milling tools and drills for processing abrasive, soft and tough materials, in nozzles and in wear protection parts.

> WC grain size | **ultra-fine, 0.5 – 0.7  $\mu\text{m}$**

Grade	Cobalt content %w/w	Properties and recommendations
RX3UF	3.0	The cemented carbide grade RX3UF with ultrafine grain and only 3% cobalt is our hardest and most wear resistant grade. However the transverse rupture strength and the fracture toughness are very low. This grade is furthermore sensitive to thermal stress and thermal strain. The main application for this grade is the field of wear protection, therefore in nozzles for plating of abrasive material in air or water, in guides, transport equipment, linings as well as in tools for drilling and milling of graphite.
RX8UF	8.0	This very hard grade is used particularly for manufacturing vibration-free rotating tools for processing aluminium, copper, silver, gold, graphite and glass-fiber-reinforced plastics (GFP).
RX12UF	12.0	Due to its higher cobalt content, this grade is suitable for machining high- and low-alloyed steels, cast iron, titanium and many other materials at a higher feed rate. Also ideal for high-speed milling. Especially suitable for the mould construction.

> RX12UF



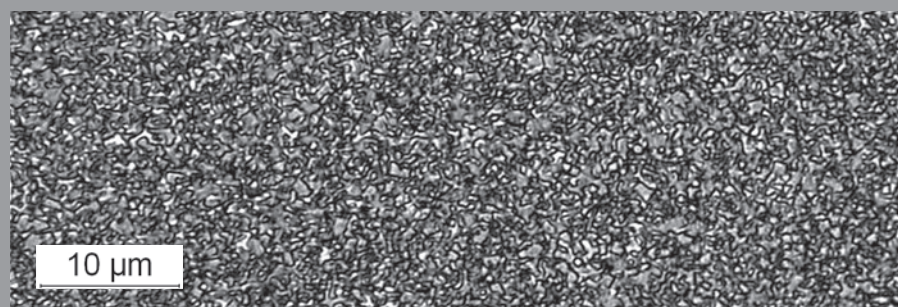
# Selection of the most suitable carbide grade – Recommendation of applications

> **Submicron grain cemented carbides** are our most frequently used grain size class. The very homogeneous, fine microstructure of this grade allows for high hardness and cutting abilities and is excellently suited for machining and milling tools, drills, guides, cutting tools, pressing dies, in wear protection and even for fine punching tools.

> WC grain size | **submicron, 0.7 – 0.9  $\mu\text{m}$**

Grade	Cobalt content %w/w	Properties and recommendations
RX3	3.3	Our so far hardest carbide grade is relatively break and impact sensitive due to its low cobalt content, and is not suitable for machining tools. In contrast, this type is used for sand blasting nozzles, spray nozzles and similar applications, drawing dies for soft metals, or in wear protection for linings against abrasive wear.
RX6	6.0	Very hard, easy cutting grade for machining, milling, drilling and lathing of aluminium, copper, silver, gold, graphite and glass-fiber-reinforced plastics (GFP). Also used in wear protection.
RX7	7.5	Very hard, well cutting grade for machining aluminium, copper, silver, certain types of steel, graphite and glass-fiber-reinforced plastics (GFP) with increased breaking resistance and edge stability. Can also be used for wood processing.
RX10	10.0	This most important submicron grade offers a balanced ratio between high hardness and good breaking resistance and is therefore suitable for all types of machining, milling, drilling and lathing tools for processing high and low alloyed steels, cast iron, titanium and non-iron metals; in pressing dies, drawing dies, in wear protection and in tools for fine punching thin sheets. Standard grade for T-slot cutters. Manufacture of guides for the sheet processing industry.
RX15	15.0	The high cobalt content of this submicron grade brings an increased level of toughness of the material. RX15-NG is suitable for machining at an interrupted cut, for paper cutting blades and for fine punching of thin sheets of medium to high toughness.

> RX10



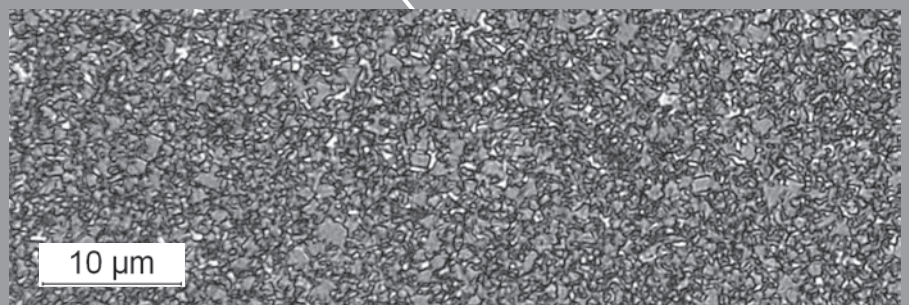
# Selection of the most suitable carbide grade – Recommendation of applications

> **Fine grain cemented carbides** are the standard in general wear protection. They are used for guides, bushings, nozzles, slide rings, cutting rings, linear blades, circular blades, lathe tips, reshaping, rolling, drawing and pressing tools.

> WC grain size | **fine, 1.0 – 1.5 µm**

Grade	Cobalt content %w/w	Properties and recommendations
RF13	6.5	This grade is used for manufacturing cemented carbide slitting and milling disks and circular saw blades, for cutting inserts, nozzles, guides, bushings and linear blades, with low impact, and is also suitable for woodworking tools. For lathing, milling, drilling, reaming and countersinking of hardened steels, hard and grey cast iron, light metals, aluminium, Si-, Cu-, Mn-alloys, plastics, glass, ceramics and graphite.
RF24	12.0	This fine grade of medium cobalt content is used for the manufacturing of cutting rings, slide rings, blades, guides, bushings, lathe tips, dies, drawing and pressing tools.
RF40	20.0	This hard metal grade contains a high percentage of cobalt binder and is therefore suitable for tools subject to high impact stresses such as hammer jaws, reshaping tools, stamping tools.
RF54	27.0	This grade contains the maximum possible cobalt binder content and is characterized by a very high fracture toughness and transverse rupture strength and is therefore highly impact-resistant. It is used in tools for hot and cold forming, for manufacturing steel springs, in hammer jaws and in shredders.

> RF13



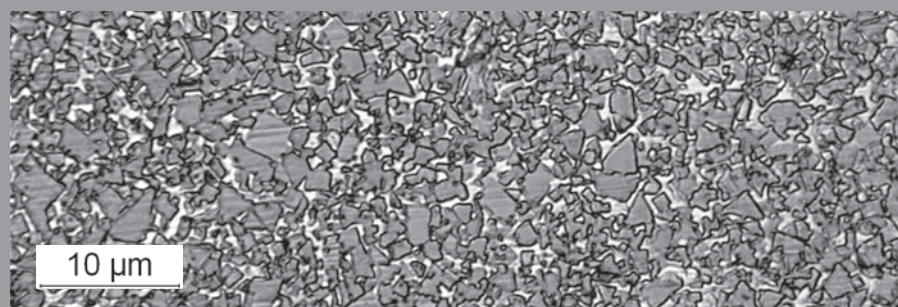
# Selection of the most suitable carbide grade – Recommendation of applications

> These cemented carbide grades **with medium grain size** combine good hardness and wear resistance with high transverse rupture strength, fracture toughness and thermal shock resistance. Application in general wear protection, for guides, bushings, slide rings, cutting rings, blades, lathe tips, reshaping, rolling, drawing and pressing tools.

> WC grain size | **medium, 2.2 – 2.8  $\mu\text{m}$**

Grade	Cobalt content %w/w	Properties and recommendations
RM13	6.5	This grade has been developed for the manufacturing of guides, bushings, valve fittings, balls, blades, rotary burrs, subject to relatively low impact stresses, and is also suitable for woodworking tools. Can be used for somewhat higher toughness requirements and for interrupted cuts instead of our grade RF13.
RM17	8.5	This hard metal grade is used for guides, bushings, cutting rings, cutting wheels, blades, lathe tips, grinding balls, valve fittings, plungers, slide rings, mandrels, mixers, impact bodies, deburrers, peeling tools and rotary burrs.
RM22	11.0	This grade with medium binder content ideally combines hardness and breaking resistance and is often used for initial equipping. In particular, it is used to manufacture dies, punches, valve fittings, cutting rings, slide rings, shaft sleeves, grinding mandrels, guides, bushings, sensor capsules, lathe tips, drawing and pressing tools.
RM30	15.0	The somewhat higher cobalt content of this grade in comparison to RM22 improves the breaking resistance and the fracture toughness. It is therefore used in more sensitive tools and applications, such as dies, bending and reshaping tools, drawing tools, embossing stamps, tracers and shredders.
RM40	20.0	The grade RM40 with medium grain and 20% cobalt is very tough and break resistant but also sufficient dimensionally stable. It is used for forming tools, stamps and punches, matrices, and moulds for punching load like cold-form matrices, hammering tools or tools for the production of valves and plungers.
RM50	25.0	The grade RM50 with medium grain and 25% cobalt is even tougher and more crack resistant as RM40. Thanks to its very high transverse rupture strength it is the standard grade in metal forming. It is used for all applications where punching and strongly deforming tools are used in, like matrices, pressing tools and moulds, bending tools, punches and shredders, especially in the steel production and automotive industry.

> RM30



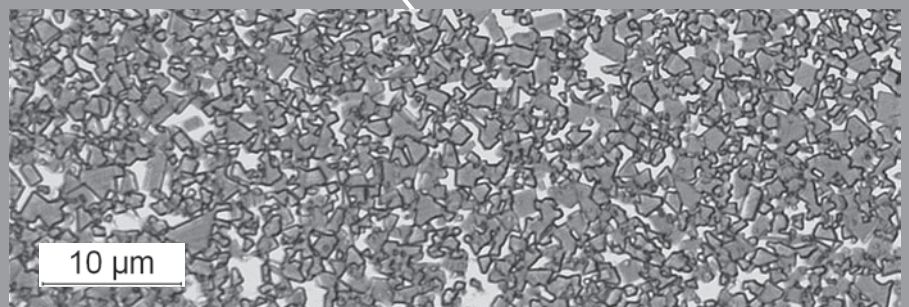
# Selection of the most suitable carbide grade – Recommendation of applications

> Our three **EDM grades** were especially developed for processing with electro-erosion (wire and sink erosion). They contain a corrosion inhibitor which protects them from pitting corrosion in the erosion bath. These grades ideally combine hardness and fracture toughness. They are optimized with regards to reducing the risk of tension cracks during the EDM process.

> WC grain size | **medium, 2.5 – 3.5 µm**

Grade	Cobalt content %w/w	Properties and recommendations
RCR17	8.5	Our hardest EDM grade is applied in punches and dies. It is used for punching thin foils and sheets of low toughness and for processing abrasive or soft materials.
RCR24	12.0	The grade RCR24 with 12% cobalt shows a somewhat higher toughness than RCR17. It is the standard cemented carbide grade used in electro-erosion. Its application range corresponds approximately to the one of RM22. Somewhat thicker and tougher foils and sheets can also be punched.
RCR30	15.0	For very large EDM blocks and plates, we have developed a special electro-erosion grade that contains a bit more cobalt and also has a slightly higher initial grain size of 3.5 µm. The corrosion inhibitor has also been adjusted. This grade is characterized by a higher fracture toughness and reduces the risk of tension cracks significantly, even with asymmetrical erosion. The area of application is similar to that of RM30, whereby even thick, tough materials can be punched using RCR30.

> RCR30



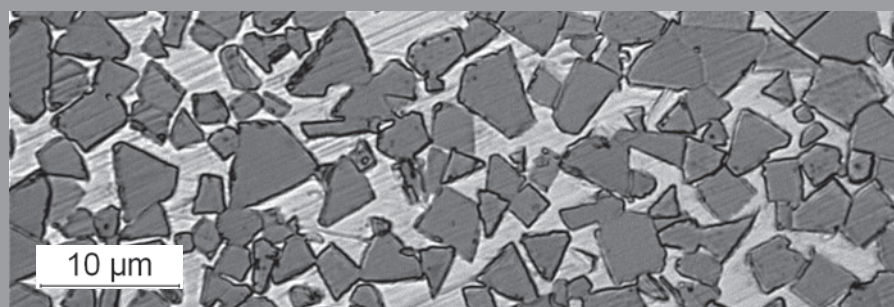
# Selection of the most suitable carbide grade – Recommendation of applications

> The **coarse grain grades** from Hartmetall-Estech AG have higher fracture toughness and thermal shock resistance in comparison to the finer grades with the same cobalt content. They are therefore well suited against impact stress. A primary area of application is in mining/road construction.

> WC grain size | **coarse, 5.5 – 6.5 µm**

Grade	Cobalt content %w/w	Properties and recommendations
-	7.0	Application of this coarse grain grade for milling tools, deburrers, rollers, chisels and choppers in mining, road construction, concrete processing, ore mining and processing, crude oil production, recycling and steel manufacturing.
RB20	10.0	Application of this coarse grain grade for milling tools, deburrers, rollers, chisels and choppers in mining, stone processing, road construction, concrete processing, ore mining and processing, crude oil production, recycling and steel manufacturing. Alternative to RB14 if higher breaking resistance and impact resistance are required. Also used in punching tools for metal sheets of very high toughness.
RB30	15.0	Fracture-resistant, impact-resistant coarse grain grade for shredders, hammer jaws, hammer tools, drawing tools for highly tough materials, hot wire rollers, chisels, pressing dies. Used in mining, road construction, waste processing and recycling, ore mining and processing, steel manufacturing, reshaping/forming technology. Also used in punching tools for metal sheets of very high toughness.
RB44	22.0	This carbide grade combines a high cobalt content with coarse WC grains. It is extremely break-resistant and impact-resistant. Used in cold and hot forming tools, in pressing dies and drawing tools, in the fabrication of rods, valves and springs made of highly tough steels, in hammer jaws and in shredders for scrap processing and recycling.
RB50	25.0	RB50 contains also 25% cobalt and is a coarse grain grade. Because of the coarse grain and the high cobalt content, this grade combines the highest fracture toughness and resistance to thermal shock and is applied when high temperature stress or thermal shocks occur. So it is used also for hot forming matrices. Further application fields are similar to RB44 and RM40.

> RB20-H



# Selection of the most suitable carbide grade – Recommendation of applications

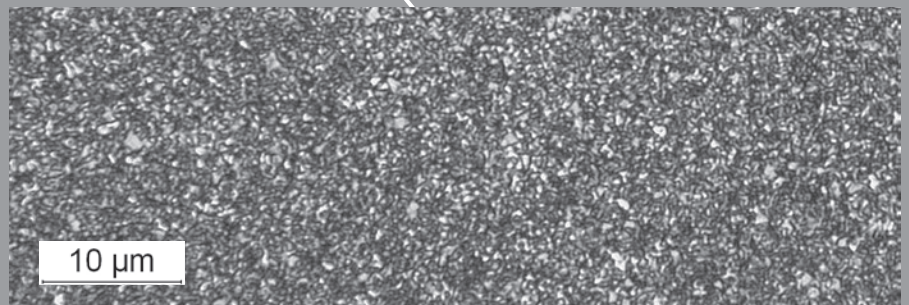
> Our cemented carbide grades with **nickel binder** and chrome additive are extremely corrosion-resistant and are generally not attacked by acids, bases, waste water or organic solutions. They are therefore suitable for all applications in wear protection in the chemical industry, as spray nozzles in plastic manufacturing and for applications in the food processing industry where Hartmetall Estech AG, as one of the only two companies worldwide, has a certificate from the US-FDA which confirms the safety of these nickel grades in the food industry.

Upon request, most of our nickel hard metals can also be delivered completely non-magnetisable, e.g. for pressing tools in the manufacturing of magnets.

> WC grain size | **submicron, 0.7 – 0.9 µm**

Grade	Nickel content %w/w	Properties and recommendations
RCS12	6.0	Our hardest nickel binder cemented carbide grade is very wear resistant; however not suitable for applications where there is a risk of breakage. Use in guides, mixing rods, slide rings, spray nozzles, cutting blades and other wear parts in laboratories, chemical industry, pump construction, grinding and mixing systems and in plastics processing (GFP).
RCS17	8.5	Similar area of application as RCS12; however, the nickel hard metal grade RCS17 is slightly more break resistant. Use in guides, mixing rods, slide rings, spray nozzles, cutting blades and other wear parts in laboratories, chemical industry, pump construction, grinding and mixing systems, in plastics processing and in the food industry.
RCS24	12.0	This newly developed grade of nickel binder cemented carbide has a significantly higher binder content than the two previously mentioned grades. Thus, it is especially suitable for applications with a risk of breakage. Primary applications include slide rings, shaft sleeves and sealing elements in the chemical industry, in the pump construction and in the food processing industry. It is also used for mixing and grinding systems of materials with highly inhomogeneous composition.

> RCS17



# Selection of the most suitable carbide grade – Recommendation of applications

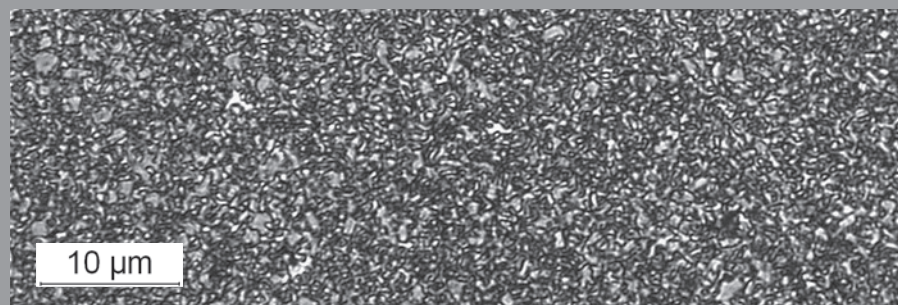
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> WC grain size | **fein, 1.0 – 1.5 µm** | **medium, 2.0 – 2.8 µm**

Grade	Nickel content %w/w	Properties and recommendations
RCF16	8.0	Standard nickel grade with fine grain, good temperature resistance, good solderability. Similar uses as RCS17. Additionally suited for guides in welding technology
RCF24	12.0	The nickel grade RCF24 with 12% nickel and fine grain combines a higher fracture toughness and break resistance with better thermal resistance as RCS24 with a similar application field. This grade is used in the food industry, when higher impact resistance is needed, but also in the chemical industry, in corrosive or extraction or mixing and grinding systems, as well as guides and construction of pumps.
RCFN22	11.0 (Nickel/Chrom)	This nickel binder cemented carbide has a high chrome content. It is the most corrosion-resistant of all our hard metal grades and is fully non-magnetisable. Use in slide rings and sealing elements in the pump construction and in the chemical industry for highly corrosive liquids. An additional application is pressing tools in the magnet industry.
RCM30	15.0	Due to its increased nickel content and the medium grain size, we use RCM30 in particular as a highly breaking resistant, relatively impact- and fracture-resistant, temperature-resistant and easily solderable nickel binder cemented carbide grade. Application especially in large slide rings, sealing elements and dies. The corrosion resistance of this grade is sufficient for most applications in the chemical industry and pump construction.

> RCN





# Selection of the most suitable carbide grade – Recommendation of applications

> In the framework of its innovation program, Hartmetall Estech AG has also developed two new hard metal grades with **alternative binding agents**, namely on the basis of **iron/nickel/cobalt alloys**. In a martensitic structure, these show a particularly high fracture toughness when used up to a maximum of 500°C.

> WC grain size | **submicron, 0.7 – 0.9 µm**

Grade	Fe/Ni/Co-content %w/w	Properties and recommendations
RXE20	10.0	RXE20 consists of a very homogeneous submicron tungsten carbide grain and 10% iron/nickel/cobalt binder agent. We thus combined a high hardness and wear resistance with excellent fracture toughness. This grade of cemented carbide can be processed using wire and sink EDM. Excellent for use in wear protection, in fine punching of tough foils and metal sheets, and as blades, milling tools and drills in the plastic, wood and paper processing industries at temperatures <500°C. Hartmetall Estech AG possesses a stock program of long round rods in RXE20.
RXE40	20.0	RXE40 has a similar structure as RXE20, but with the double percentage of the binding agent. We thus increase the breaking resistance and the fracture toughness. Use in punching stamps, dies and pressing tools, for processing highly tough materials, and in the wood and paper industry, at application temperatures of up to 500°C maximum. Hartmetall Estech AG has stocks of long round rods as sintered or h6 and square rods in this hard metal grade.

> RXE40

