

MIRACLE SIGMA TECHNOLOGY

THE EXCLUSIVE ADVANTAGE FOR DIFFICULT-TO-CUT MATERIALS



01-02 | 2015

NCF FERTIGUNG

Werkzeugmaschinen | Werkzeuge | Fertigungsprozesse

**BESTENS
BEDIENT**
Spindelarmaturen
Hersteller setzt
erfolgreich auf
Mazak-Maschinen

**STARKE
KOMBINATION**
Punktlieferung durch
im Auftrag der DZ
schleunigt auf 19
TNC-gesteuerten
Horn-Stationen

**VORTEIL IM
SUBSTRAT**
Im NCF-Check
Schwer-Strapazier-
bereich Materialien
erkauft NCF das
sensitivste TP15.

**Special
Tooling**
GRÖßER SONDERTEIL
AB SEITE 111

ph HORN ph

SUBSTANTIAL ADVANTAGE

by **Harald Klieber** It is well known that not even the tool experts at Mitsubishi Materials in Meerbusch near Düsseldorf know the exact secret composition of the substrate. „Our TF15 carbide grade is sensational, we use it as a material for numerous solid carbide tools in our product portfolio. It delivers optimal performance especially in steel, cast iron and aluminium as well as HRSA and titanium alloys“. The high cutting performance achieved in tests at renowned metal cutting companies, is described by Enrique Lopez-Eñers and Petra Reinhold.

Miracle Sigma is a range of technologies from Mitsubishi Materials that offers innovative solutions for efficiency, process reliability and optimisation. All important requirements of the modern cutting tool are covered, with properties such as sharpness, hardness, the latest advanced coatings as well as modern cooling and lubrication.

The polished Zero- μ surface noticeably reduces cutting resistance and the formation of built-up edges. Mitsubishi Materials also produces the new MMS drills with Tri-Coolant holes which, compared to round cooling holes, delivers double the coolant volume directly to the cutting edge.

The features of the Miracle Sigma concept; Zero- μ surface of an ALTiCrN coating, the balanced TF15 carbide substrate and optimised geometries are combined in various ways with outstanding carbide tools.

„The PVD based Miracle Sigma coatings are our high-end coating concept. As with most modern coatings, Mitsubishi Materials also developed a special smoothing process using slightly abrasive fluids,“ says Petra Reinhold, the Technical Service Manager. „The extremely smooth Zero- μ surface is immediately visible when placed next to a conventional ALTiN coated tool.“ Using this technology, Mitsubishi Materials has developed a wide range of tools for a diverse range of applications, in particular for Inconel, titanium and other difficult-to-cut materials. The VQ end mill is one such tool series and includes square, ball nose and corner radius end mills from 0.2 mm to 25 mm. The smallest end mill with four flutes has a diameter of just 0.4 mm, and has been shown to increase productivity drastically, particularly in the manufacture of Torx screws.

With Zero- μ coating, up to 20% less cutting resistance

„Outstanding cutting performance is due to the Zero- μ surface as well as the innovative geometry; comprising irregular tooth spacing's with a variable rake angle, that prevents vibrations, extends tool life and increases productivity,“ explains Petra Reinhold.

Machining expert Enrique Lopez-Eñers describes the effect of Zero- μ treatment based on the example of a 4-flute $\varnothing 6$ end mill. The VQ-MHV end mill has a much lower friction when milling a 1xD slot in stainless steel (DIN 1.4301). „This shows that the cutting resistance with Zero- μ treatment is around 20% lower. Added to this is a substantially reduced built-up edge formation. Reduction of built-up edge means less wear and therefore a higher tool performance can be expected, says Enrique Lopez-Eñers. The effects in normal practice are demonstrated in the slot milling of turbine blades in Inconel 718: On a 5-axis DMU 85 FD mono-block, a VQ-MHV end mill completed three required blade slots at a speed of 30 m/min and fz 0.047 mm per tooth (ap and ae 12 mm) – without noticeable wear when compared to the conventional end mills tested.

Many of these VQ end mill types are also available as a screw-in version in the iMX exchangeable head end mill series. This innovative series, where both the head and shank are made from solid carbide, promise high productivity and excellent surface finishes even on long overhang applications.



Ideal for difficult-to-cut materials: the new VQ end mills with anti-vibration control and Zero- μ coating. Available from \varnothing 0.2 to 25 mm.

Images: NCF, Mitsubishi Materials

„From the raw material to the finished insert design, everything is in-house work“.

Tooling experts Petra Reinhold and Enrique Lopez-Eßers value the creativity of MMC development engineers

„Instead of conventional drilling and reaming, we also recommend circular interpolation plunge milling.“

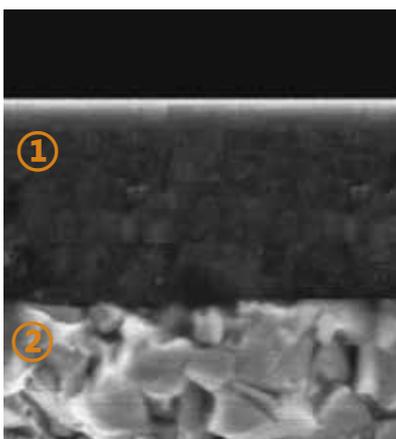
Petra Reinhold



Change of strategy to helical interpolation

Mitsubishi Materials also uses tools employing Miracle Sigma technology for drilling and reaming. However, for difficult-to-cut materials, a different strategy is recommended. „Instead of conventional drilling and reaming, we also recommend circular interpolation plunge milling.“ Petra Reinhold gives three reasons for this: primarily lower tool costs due to the use of standard end mills, avoidance of wrap around during pure plunge milling and less work hardening due to short contact times.

„We have carried out several tests with a well-known supplier of products for the aerospace industry. With conventional drilling and reaming (Ø11 mm), tool life was finished after 5 to 6 holes. The breakthrough came with a strategy change: by using circular interpolation plunging with our 4-flute VQ-MHV end mill, Ø8 mm at 40 m/min and fz 0.14 mm. This enabled us to machine the required 72 holes with a single tool and demonstrated the success of our TF15 carbide substrate. When machining difficult-to-cut materials, coatings are often contentious because they can lead to adhesion depending on the material and application. Our Smart Miracle coating prevents adhesion and optimises the machining process in that it extends the tool life,“ explains Petra Reinhold. She also adds “using tools with these coatings when machining nickel-based alloys is basically an advantage.”



① New Al-rich [Al, Ti]N PVD coating with 20% more aluminium oxide

② Special carbide substrate

„The secret lies in the multi-layer PVD coating of Tough-Σ .“

Enrique Lopez-Eßers

Intelligent grades with Al-rich coating technology

According to Enrique Lopez-Eßers, the new MP9005 and MP9015 grades with AlTiN Miracle Sigma coating, promise excellent performance and are a must when turning difficult-to-cut materials, in particular heat-resistant alloys, titanium and Inconel. „We call this coating Al-rich because the aluminium content has been increased to over 60%. Substantially increasing the aluminium content ensures extremely good heat protection and simultaneously provides the benefit of a highly stable coating structure. Tests on Inconel 718 speak for themselves,“ The MP9005 grade used at a cutting speed of Vc 60 m/min and fz 0.22 mm/rev with an in-process time of 60 minutes, showed a minimal flank wear of below 0.15 mm. „Conventional PVD and CVD indexable inserts had 0.26 and 0.2 mm, of wear and the cutting times were only a maximum of 16 minutes (PVD) and 52 minutes (CVD). Our MP9005 did not only last longer but also managed to machine considerably more parts.“

Mitsubishi Materials also promises a similar level of efficiency in the machining of difficult-to-cut materials with the new grades that employ innovative, multi-layer Tough-Σ Miracle Sigma coating technology. This does not only allow considerably higher productivity due to a low cutting resistance, but realises unusually high cutting parameters at the same time. For example, for difficult to cut milling applications, the new MP9130 grade was developed which, when used for inserts that fit VFX cutter bodies, it achieved extremely high metal removal rates when rough machining titanium alloys. „The key factor is the improved heat and wear resistance. The secret lies in the multi-layer PVD coatings of Tough-Σ that prevents wear penetrating to the substrate,“ says Lopez-Eßers.



Mitsubishi Materials promises the highest efficiency when machining titanium alloys with the development of the VFX shell mills.

Tri-Coolant technology for efficient drilling

Technology expert Petra Reinhold assures that it pays to use tools from the Miracle Sigma family for difficult-to-cut materials applications and emphasises this with a drilling example. This example is based on the MMS drill series which, with an optimised cutting edge geometry for reducing built up edges and small flute margins for reducing friction, promises maximum precision, smooth chip removal and excellent drilling results. According to Petra, "the special triangular shaped coolant holes in 6 to 20mm MMS drills increases their performance considerably. In addition, an 8.5 drill is able to deliver 11 litres of coolant per minute instead of 5.5 for conventional coolant holes." The face and chamfer geometry was also optimised. "All these improvements together ultimately increase productivity in drilling operations by up to 50% and often much more," adds Petra.

'Difficult-to-cut' remains in the foreground

It is not just about carbide at Mitsubishi Materials. The Japanese subsidiary of the Mitsubishi Group has six business segments and 23,000 employees in more than 77 countries. "The strength of Mitsubishi Materials in the Advanced Materials & Tools segment lies above all in the fact that the three Japanese production facilities cover the entire manufacturing process chain from the raw material through to the finished tools," emphasises Enrique Lopez-Eßers. "The CBN segment is also remarkable, Mitsubishi Materials is among the first five manufacturers to introduce CBN to the market since 1978. For us, the optimal machining of difficult-to-cut materials continues to be a very important topic with high development potential and will remain in the foreground in our company for years to come."

www.mitsubishicarbide.com



Enrique Lopez-Eßers
Manager Industrial Marketing
MMC Hartmetall GmbH,
Meerbusch, Germany

Difficult-to-cut remains in the foreground

"The optimal machining of difficult-to-cut materials is of much greater significance for Mitsubishi Materials in recent years. New, benchmark manufacturing technologies and intelligent tool solutions have increasingly underlined the enormous development potential in that they have been geared to applications across the industry. Based on the resulting individual and, at the same time, diverse customer needs, we have developed special tools, coatings and technologies, including the VQ solid-carbide end mill series and Miracle Sigma technology; these are constantly developed directly with customers in order to meet their specific needs."

www.mmc-hardmetal.com

