

Exact cutting for maximum flight reliability

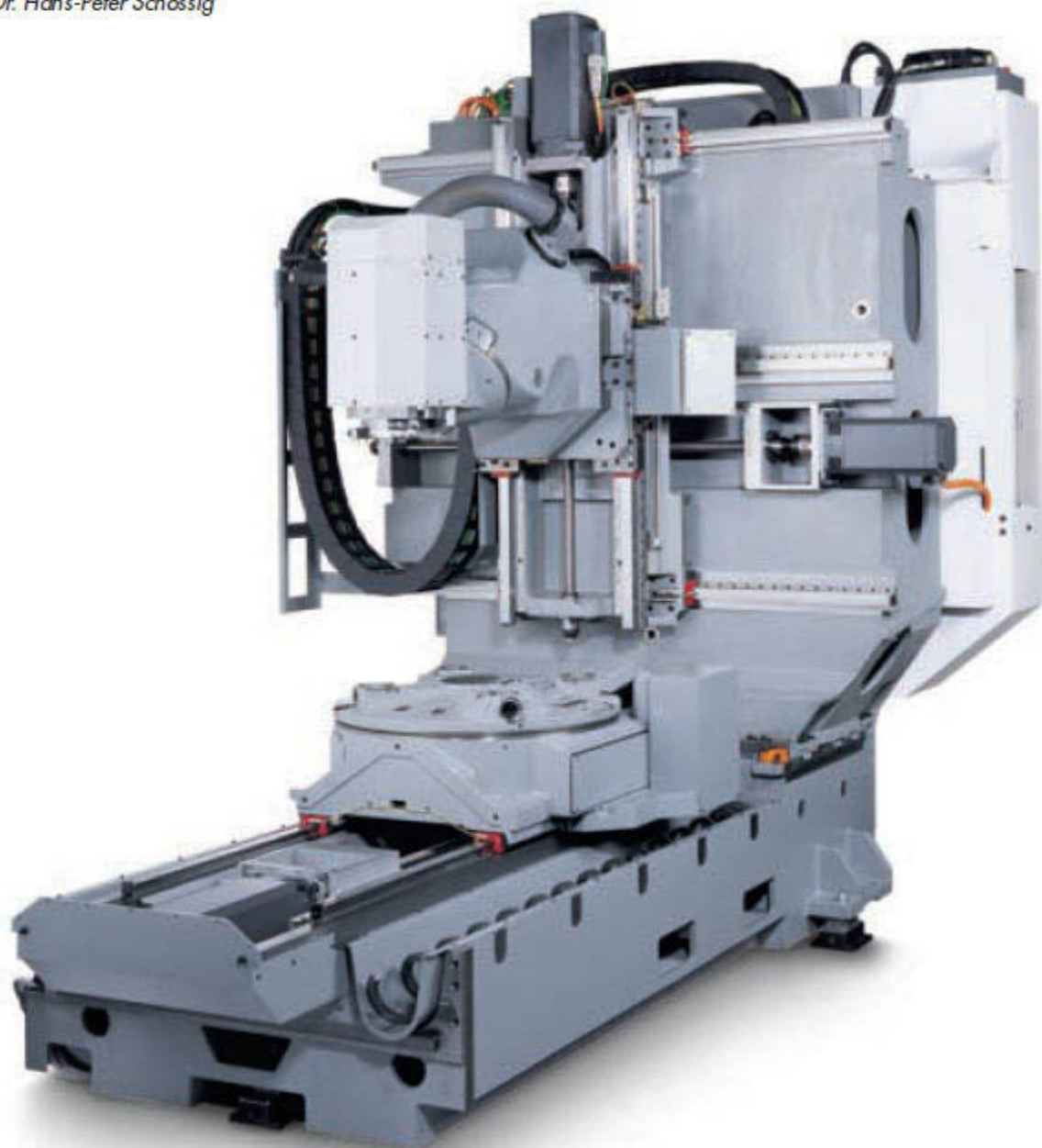
No Airbus takes off without Rust gears

In aerospace, the demand for truly complete machined workpieces is constantly on the rise. This increase applies equally to the complexity of the parts machined by cutting, the diversity of the various small workpiece series, and to the above-average requirements on the workpieces themselves. Without the services of suitable parts suppliers with specific experience gained in particular in this sector of special cutting technologies, end producers like Airbus would be incapable of meeting these growing performance requirements. A growing number of parts suppliers are utilizing complete milling as the cutting technology on production machines with up to five NC axes.

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■ Since 1922 the Oldenburg gear manufacturer and machine builder Kurt Rust GmbH & Co. KG in Wilhelmshaven has been as in metalworking, initially concentrating on tasks commissioned by the gear cutting and machine building industries.

Following the complete destruction of the production building at the end of World War II, production was soon resumed in 1947. Klaus Rust, son of the company founder, acquired copy milling machines as early as the 1960s. At the same time, he created the basis for good business relations with the aerospace industries by grooming his contacts with the aircraft builder operating then under the name of Hamburger Flugzeugbau. These good relations grew constantly under Rust's care.



All the measures needed to assure quality were available following early work with British and French standards adopted by the BDU, the Federal Association of German Aerospace Technology and Equipment Industries. At present Rust is able to fulfil thirty-three sets of standards – comprising 282 standards and quality specifications – in aviation and other industries!

Rust produces exclusively at its North German home. We will get back to its company depth and its other important virtues later on. The overall high motivation of the 100 people currently employed, also affects their business partners. The specialized, above average knowledge that its employees acquire, is one of the main reasons for their loyalty in spite of the fact that the surrounding aerospace companies are constantly on the look-out for very qualified people. Machined quality and delivery reliability are appreciated by big OEM's, such as Airbus, EADS, Eurocopter in Aerospace and Rheinmetall, Bran & Luebbe and Fock in General Machining, to name but a few of Rust's customers. Clearly, Rust's core customers are in the aerospace industry and not just because this industry is going through boom times.

In line with the general trend, milling is proving to be a technology of growing significance. Plant manager Karl-Heinz Mueller says: „Machining of precision parts within aerospace invariably involves milling every radius of a complex, weight reducing and often thin-walled workpiece geometry.“ For reasons of strength, to name but one, these precision workpieces known as structural or integral parts must be milled out of solid blocks or billets of raw material, and in some cases over 90% of the material has to be removed.“ The managing partner Rudolf Witte summarizes the customer requirements as follows “Punctual delivery of maximum quality at competitive prices!“, continuing: “Of course, the aerospace industry exerts massive time and cost pressure on their parts suppliers. And it becomes all the more important that Rust constantly invests considerable sums in technical equipment, especially where chips are generated. Sometimes aircraft parts must be delivered in aviation quality forty-eight hours following receipt of the order data. This demands, in addition to the high-quality standards of delivered products, extremely efficient operation cycles. So high flexibility is what we want.“



Engineering and Plant Manager Karl-Heinz Müller of Rust (middle) exchanging ideas with sales engineer Sven Stolle (left) of DMG Bielefeld and Sales Engineer Volker Baldauf (right) of DECKEL MAHO.

At 100% capacity per order, light – and very soon ten – Index, Gildemeister and Montfort's CNC – machines, four of which are Index G300 mill-turn centres, are presently machining ultra-complex, rotating parts in the turning department. Often milling and gear cutting is followed in one clamping. Obviously, Rust is utilizing the advantages of complete-machining in their turning department as well.

In the milling department, 16 CNC – machines are operating under demanding conditions and soon there will be 18 machines. The strong growth in this segment of the company is a reflection in particular of the technical and organizational development of

this medium-sized company relative to the use of advanced machining technology.

This encouraging experience gained early with the then ultra-modern Deckel CNC machines like the DC 40, FP4 NC, FP 5NC, and FP4 CCT, in 1996 led to intensifying contacts with DMG Bielefeld. The cutting experts of Wilhelmshaven had already recognized at this early time that applications, particularly out of the aviation sector, would require, a migration from four-axes milling to five-side machining in the one-clamping.

Even at that time, DECKEL MAHO GmbH Pfronten of the Gildemeister Group could provide machines fitted

Manufactured by Rust: Aerospace workpieces meeting the highest demands.



for this purpose with a horizontal-vertical swivelling milling head. On the DMC 60 U universal machining centre (x / y / z travels = 600 / 700 / 600 mm) this universal head delivered as much as 28 kW, at a max 12,000 rpm. The larger DMC 80 U (x / y / z travels = 800 / 700 / 600 mm), with standard motor gear box, could mill at up to 8,000 rpm, delivering max 475 Nm.

Both machines were fitted with (1) a universal SK 40 tool changer for sixty tools, (2) a production package with internal high-pressure coolant supply and (3) a pallet changer for 500 x 630 or 800 x 630 mm (DMC 80 U). The machines could mill five sides at reduced set-up times and presented the opportunity to get a feel for the pioneering features of the MillPlus CNC. Sure enough, in 1999, one each of these machining centres were acquired and installed – paving the way for the next corporate trend – 5-axes simultaneous milling.

Even the next universal machining centres, the DMC 60 U hi-dyn and DMC 80 U hi-dyn bought in early 2001, featured as the fifth or B axis a swivelling milling head for simultaneous five-axes milling in the otherwise well-proven analogous specification. Because aviation parts were starting to exhibit ever more complex geometries in spite of the short delivery times and the shrinking batch sizes, (many of which did not exceed twenty-four identical parts), this five-axes technology came at just the right time. In addition to a DMU 80 T in a monoBLOCK® design, likewise commissioned as a five-axes configuration in early 2002, Rust bought another five-axes universal machining centre a year later – the DMC 80 U hi-dyn with B axis.

“Structural or integral safety class I parts” as indispensable modules for Airbus & Co., machined in accordance with BDU QSFA quality standards along five axes simultaneously on a DECKEL MAHO DMC 100 U duoBLOCK® universal milling centre.

In the meantime the A380 had been approved, and Rust delivered the first components for the world’s largest passenger aircraft in September 2002. Rudolf Witte, Karl-Heinz Müller and his representative Andree Eck recollect – “In the run-up phase to the actual A380 production it was clear that there would be no production drawings for the components, in contrast to the Airbus aircraft manufactured until then. The parts suppliers were provided with so-called volume models designed in Catia V4. We had to invest in a new programming system, modify the CNC machine post-processors and buy new measuring machines, if our tender for

the A380 parts contract was to have any chance of success.”

“Furthermore, the components were larger than any we had manufactured until then. So we started to search for milling centres that could reliably handle simultaneous five-axes milling in the next larger dimension for greater productivity and without sacrificing flexibility. We confronted the milling machine sector with our seemingly conflicting array of requirements and after a number of comparative investigations, finally looked at the duoBLOCK® concept of the newest universal machining centres from DECKEL MAHO Pfronten. Specifically the highly compact model DMC 100 U with the machining chamber X/Y/Z = 1,000 x 1,000 x 1,000 mm seemed to us to be the best candidate. Its additionally enhanced dynamic response with 60 m/min rapid traverse along all linear axes with 0.7 g acceleration and also

the particularly powerful SK 50 motor spindle delivering 44 kW at 10,000 rpm in the swivelling milling head as the fifth axis solved the difficulties presented by our specifications for maximum productivity and flexibility. After all, the batch sizes for these complex milling processes range from only one to a maximum twenty-four pieces.”

Karl-Heinz Müller adds: “As early as the test machining stages we were already impressed by the further enhanced machine’s attributes even at the early machining test runs, compared with the machining centres we had been using until then, such as the ratio of the machining chamber to the machine’s footprint, the optimized chip flow off the smoothly-surfaced machining chamber and the flawless chip discharge on both sides of the machine bed.

Andree Eck expanded on this: “The further developments undergone by the



Pfronten machines also affected the MillPlus IT CNC unit that we know so well. The wealth of basic equipment was to our requirements. Even the standard version of this machine could handle our demanding cutting tasks, as indeed the machining centres we had previously bought from Pfronten had done at the time.

The only specific options available on the order for two DMC 100 U duoBLOCK® milling centres were a special pallet drilling jig, a dual-pressure coolant supply, and the facility for a vacuum fixture. From February 2005 these two machines, both also exhibiting the same rigidity, were delivered to Wilhelmshaven, with just six months between and were immediately commissioned there. Shortly after commissioning the first universal machining centre, the DMC 100 U duoBLOCK® was already machining with efficiency, and the

second milling centre followed suit after a remarkably short commissioning period in the late autumn of 2005. Both large numbers of structural components for multilayer parts families and flap track parts leave the DMC 100 U duoBLOCK® machines with the accustomed first class quality. All necessary part fixtures for this, as for all other machines, are designed and built completely by Rust.

DMG Bielefeld and Deckel Maho Pfronten already received a new order from Rust – two additional DMC 100 U duoBLOCK® units in the established five-axes configuration are expected to be delivered in June 2006. Soon the milling department will be harnessing a total of four of these workhorses. In Wilhelmshaven City, where the company has been based since its founding, work has already commenced on an additional with about 500 m² of production area. This is to provide the

space needed for the new additions to the milling centres.

Also worth mentioning is the direct online data route that starts at the customers' CAD division. The various, constantly changing CAD input data must first undergo (in the programming stages) a processing strategy before they are converted to NC data for the most diverse CNC machines. This requires a lot of experience, in particular for simultaneous five-axes milling on DECKEL MAHO machines, but above all on the DMC 100 U duoBLOCK® milling centres. After many years of work this is the brainchild of Thorsten Iken, who often worked many hours overtime.

His assessment: "Our current 3D CAM system Cimatron facilitates efficient CAM over a wide machine range and, therefore, covers five-axes milling as well. In addition, software provided by the company Vericut provides us with special evaluations on the screens of our programming division so that no collisions can occur on the five-axes machines during the final stage of simultaneous milling. For this to happen, the software must depict true to scale on the screens both the respective machine type with the corresponding tools and the fixture with the workpieces." What Thorsten Iken is too modest to mention is the many hours of work he and his programming colleagues have invested in these practical software applications. Everybody at Rust is well motivated for their everyday activities. This is par for the course.

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Complex structural parts, here in the tool changer of a DECKEL MAHO universal milling centre, have been milled out of solid blanks without time taken for tool positioning over years.

Job preparation à la Rust: ultra-complex workpieces for five-axes simultaneous machining are programmed by Thorsten Iken (left), afterwards there are collision evaluations. On the right in the picture Sven Stolle of DMG Bielefeld, in the middle Karl-Heinz Müller of Rust.

The production of integral parts must ensure 100% quality assurance for a partnership with Airbus.

