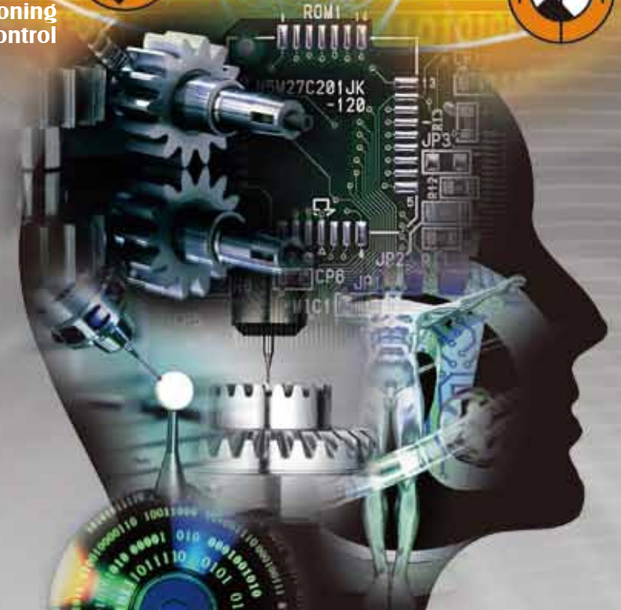


Quarterly 2010 VOLUME 2 ISSUE 8

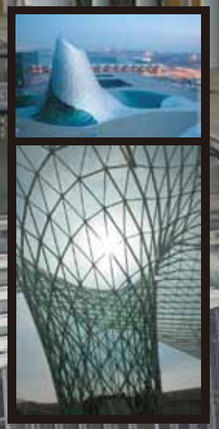
The CHALLENGER

Global quality and service system of metal working industry

Product
Smart machine

Global outlook
Italy

Distribution
Tecnor Macchine



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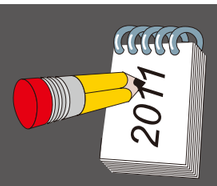
Index

The shoreline of south Italy



Welcome user's submission

of company profile, sharing Challengers' Products experience and pictures of people, products. Please send your story and pictures (images in high-resolution higher than 300 dpi) to your Challenger Factory Outlet or e-mail to m01@mail.buffalo.com.tw
Only English version is acceptable.

From the publisher

First of all, I would like to take the opportunity to thank and welcome our new strong vendors. It's going to be a great benefit while Buffalo machinery is developing many high tech products. So, welcome on board:

Schaeffler Group, Industrial, Germany:

The Schaeffler Group is a renowned supplier to the automotive, industrial and aerospace industries and one of the world's leading manufacturers of rolling bearings and linear products. In Germany, the main brands of the Schaeffler Group – INA, FAG and LuK–are marketed by Schaeffler Technologies GmbH & Co. KG and LuK GmbH & Co. oHG.

INA products have been known for creative application solutions as well as a high level of engineering and manufacturing expertise for many decades. The traditional FAG brand that is over 100 years old has been part of the Schaeffler Group since 2001. For more than 45 years, LuK has been synonymous with strength of innovation, customer focus and quality for numerous products in the automotive drive train.

Korta Group, Spain:

The well-known company specialised in the production of high Precision Ball Screws, and over all these years they have supplied all the major machine tool manufacturers around the world. The Korta brand also plays an important role in other sectors, such as automotion, energy and aeronautics. All its main materials are imported from Germany and with very stable quality.

Moreover, we are pleased to have strong support from Fanuc Ltd, Heidenhain and Siemens, especially in the field of controller for high end products. These are the key to support a very stable growth of the range of our smart machines. It will be fun to see how we admit to the field of high tech machining technology.

A new introduction of smart machine technology can be found in the website http: //www.buffalo.com.tw/ It supports all the high speed machines from Challenger line. Also it will be briefly reported in this issue.

Full production plan had back since May 2010. It looks positive in the following 6-9 months. These are the sweet results through the cooperation from all our wonderful distribution team.

We love you all.

Dr. Paul Chang
September, 2010

Microcut Newsroom

Collaboration with Korta, producer of high precision ball screws

Microcut and Korta will now collaborate and provide highest standard of quality ballscrews. Korta S.A. in Spain, a leading and family company founded 40 years ago by the Korta brothers, specialized in the production of high precision ball screws. Over all these years, the Korta has supplied all the major machine tool manufacturers around the world. The Korta brand also plays an important role in other sectors, such as automotive, energy and aeronautics.

Microcut insists on providing the best quality and wide range of precision ball screws in various sizes and threads (left-handed and right-handed threads) with single or double nuts, made from standard or stainless materials, either ground or rolled. With Kortagroup's clear quality assurance policy certified by the major international standards, it ensures the best machine quality and benefit to Microcut's customers.

Schaeffler Group, Industrial, Germany

LuK INA FAG

SCHAEFFLER GROUP

Microcut also collaborates with the Schaeffler Group, its INA brand has stood for creative application solutions, great engineering and manufacturing expertise and strong customer focus. The traditional FAG brand that is over 100 years old is one of the world's leading brands for applications in machine building, in the automotive industry as well as in aviation and aerospace. For more than 45 years, LuK has been synonymous with strength of innovation, customer focus and quality for numerous products in the automotive drive train.

With INA and FAG, the Schaeffler Group has one of the widest product portfolios in the rolling bearing industry, covering nearly all applications. The joint catalog of standard products includes more than 40,000 products which are supplied to 60 different sectors. INA and FAG also offer a comprehensive range of services for advice, diagnostics, maintenance and mounting rolling bearings and complete systems. In Germany, the brands INA and FAG are marketed by Schaeffler Technologies GmbH & Co. KG, the largest national company in the Schaeffler Group.

The Schaeffler Group has invested significant amounts in research and development, most recently in new R&D centers in Asia and North America. 4,800 of the 65,000 Schaeffler Group employees worldwide (status 2009) work on the development of new products and technologies. Approximately 1,100 inventions are registered as patents every year. With its brands INA, FAG and LuK, the Schaeffler Group is present at 180 locations in 50 countries worldwide, offering wide after-sale service for customers.

Global Outlook

ITALY

Italy's capital, Rome, was for centuries the political centre of Western civilisation, as the capital of the Roman Empire. Italy plays a prominent role in European and global military, cultural and diplomatic affairs.

LOCATION

Italy is located in Southern Europe and comprises the boot-shaped Italian Peninsula and a number of islands including the two largest, Sicily and Sardinia. Although the country occupies the Italian peninsula and most of the southern Alpine basin, some of Italy's territory extends beyond the Alpine basin and some islands are located outside the Eurasian continental shelf.

NATURAL RESOURCES

Italy has few natural resources. With much land unsuited for farming, Italy is a net food importer. There are no substantial deposits of iron, coal, or oil. Proven natural gas reserves, mainly in the Po Valley and offshore in the Adriatic, constitute the country's most important mineral resource. Most raw materials needed for manufacturing and more than 80% of the country's energy sources are imported.

THE ECONOMY

The Italian economy has changed dramatically since the end of World War II. From an agriculturally based economy, it has developed into an industrial state ranked as the world's seventh-largest market economy in 2008. According to International Monetary Fund (IMF) in 2008, its GDP only ranked after USA, Japan, China, Germany, UK and France (GDP nominal per capita: USD$35,435). Italy belongs to the Group of Eight (G-8) industrialized nations; it is the fourth-largest economy in Europe and also a member of the European Union and the Organization for Economic Cooperation and Development (OECD).

According to the World Bank, Italy has high levels of freedom for investments, business and trade. Italy is a developed country, according to The Economist, has the world's 8th highest quality of life. The country enjoys a very high standard of living, and is the world's 18th most developed country, surpassing Germany, the UK and Greece. According to the last Eurostat data, Italian per capita GDP at purchasing power parity remains approximately equal to the EU average.

The FieraMilano is one of the country's and Europe's largest, most innovative and important industrial design expositions.

Italy has the world's 4th largest gold reserve. The country is also well-known for its influential and innovative business economic sector, an industrious and competitive agricultural sector (Italy is the world's largest wine producer), and for its creative and high-quality automobile, industrial, appliance and fashion design.

Despite this, the country's economy suffers from many problems, such as the lack of infrastructure development, market reforms and research investment, and also high public deficit. After a strong GDP growth of +8% from 1964 onwards, the last decade's average annual growth rate lagged with 1.23% in comparison to an average EU annual growth rate of 2.28%. The budget deficits and high public debt account for --2.6% and 105.9% of GDP in 2008, respectively. The Italian Government has found it difficult to bring the budget deficit down to a level that would allow a rapid decrease of that debt. The deficit is expected to grow well above the 3% ceiling in 2009 and 2010.

In addition, Italian living standards have a considerable north-south divide. The average GDP per capita in Northern Italy can far exceed the EU average,whilst some regions and provinces in Southern Italy can be considerably below the EU average.

In the Index of Economic Freedom 2008, the country ranked 64th in the world and 29th in Europe, the lowest rating in the Eurozone. Italy still receives development assistance from the European Union every year. Between 2000 and 2006, Italy received €27.4 billion from the EU.

INDUSTRY AND TRADE

Italy has a smaller number of world-class multinational corporations than other economies of comparable size, but there is a large number of small and medium-sized enterprises, and in the Northern "industrial triangle" (Milan -Turin-Genoa) or the Tuscan industrial triangle (Florence-Prato-Pistoia), where there is an area of intense industrial and machinery production, notably in their several industrial districts, which were for long the backbone of the Italian industry. This has produced a manufacturing sector often focused on the export of niche market and luxury products, capable of facing the competition from China and other emerging Asian economies based on lower labor costs.

The country is the world's 8th largest exporter. In 2007, Italy's total merchandise exports were at US$ 491.507 billion, according to the World Trade Organization. Its major exports and industries are precision machinery, motor vehicles, chemicals, pharmaceuticals, electric goods, and fashion and clothing.

Italy's closest trade ties are with the other countries of the European Union, with whom it conducts about 59% of its total trade. Its largest EU trade partners, in order of market share, are Germany (12.9%), France (11.4%), and Spain (7.4%).

The production of machine tool in 2008-2009 ranked 4th, only ranked after China, Germany and Japan. The export of machine tool ranked 3rd in the world(USD3,316.4million), only ranked after Germany and Japan.

The automobile industry in Italy is a large employer in the country, with a labour force of over 196,000 in 2004, contributing to 8.5% of the Italian GDP. In 2006, Italy was the 5th largest automobile producer in Europe.

EMERGING INDUSTRIES

In the last decade, Italy also became one of the world's largest producers of renewable energy, ranking as the world's fifth largest solar energy producer in 2009 and the sixth largest producer of wind power in 2008. Most of the electricity in Italy comes from the natural gas, petroleum, coal and hydro power.

Tourism is one of the fastest growing and profitable sectors of the national economy: with 43.7 million international tourist arrivals and total receipts estimated at $42.7 billion, Italy is the fourth highest tourism earner and the fifth most visited country in the world. Despite a slump in the late-1980s and during the Gulf War, Italy has, since the mid-1990s, rebuilt a strong tourism industry.

The new Ferrari 458 Italia. Italy is the world's 7th largest exporter of goods.

The water taxi provides public transport on the river

Distribution

Tecnor Macchine
Tecnologia e Flessibilità al servizio del cliente

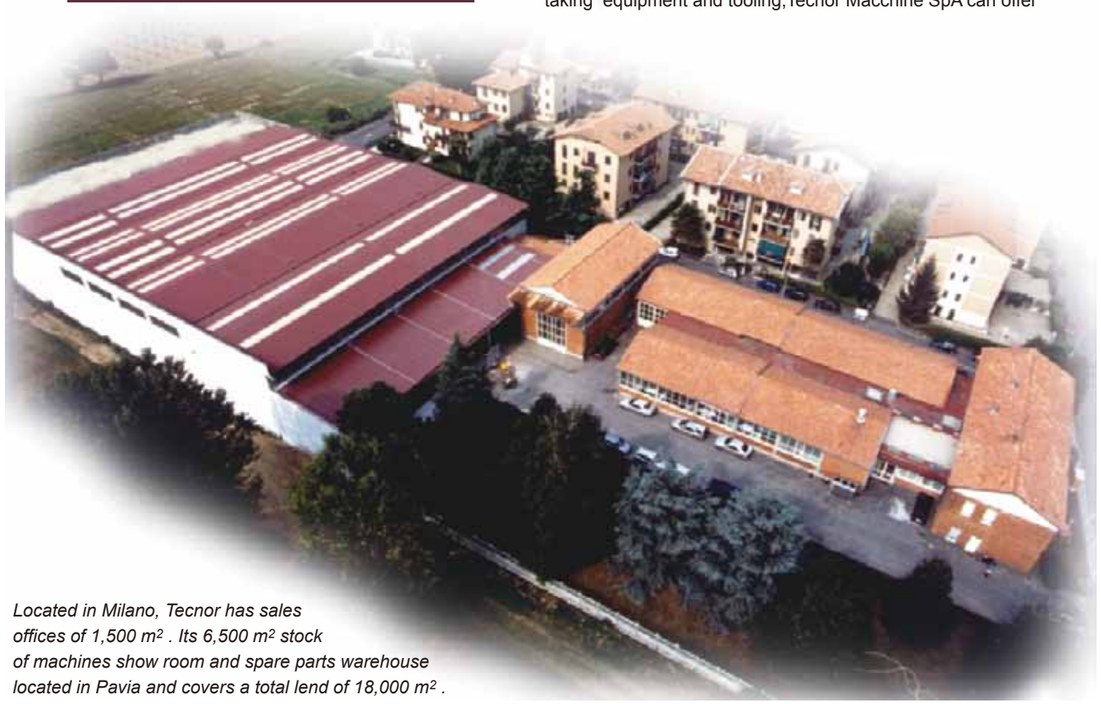
Established in 1966, Tecnor Machine is one of the most important machine tool distributors in the Italian territory. With a wide range of high tech machine tools, Tecnor satisfies the needs of customers in the Italian market. 18 agencies in different regions of Italy covers the whole Italian territory provide efficient sales and after sale service net, offering customers prompt and high quality technical service. Located in Milano, Tecnor has sales offices of 1,500 m^2 . Its 6,500 m^2 stock of machines show room and spare parts warehouse located in Pavia and covers a total land of 18,000 m^2 . 57 staff of Tecnor includes 36 service personnel and 6 sales managers who direct 58 salesmen in different regions. Tecnor can study and realize tailored work cycles, tools and equipment for the most complicated parts. A team of technicians situated throughout the national territory are available to offer competent and timely solutions.

Mr. Paolo Barani, deputy Managing director, Mr Carlo Barani, Managing director and Mrs Simona Barani

In early 2009, in order to expand the range of vertical machining center and CNC horizontal borer to the market, Tecnor Machine SpA sells exclusive brand MICROCUT machines.
The collaboration with Microcut machinery will expand the product range by entering the Italian market among the new CNC horizontal borer , vertical machining centers, and the travel column machining center.

Besides, MCG-5X Gantry type 5 axes machining center is available for high speed machining, simultaneous and multi-task machining with a single setup.

In collaboration with companies that are specialised in the design and execution of CAD-CAM software and special part-taking equipment and tooling,Tecnor Macchine SpA can offer complete operating solutions, suitable for any problem presented by a customer.



Located in Milano, Tecnor has sales offices of 1,500 m^2 . Its 6,500 m^2 stock of machines show room and spare parts warehouse located in Pavia and covers a total lend of 18,000 m^2 .

At its Service Centre in headquarters Pavia, Tecnor can carry out personalised operating tests on both service three – axis machine tools and high–speed five–axis machine tools for their customers. Also, Tecnor's mechanical and electronic technicians and programmers can carry out the mechanical and electronic examinations and repairs on the machine tools sold. A team of technicians throughout the national territory are available to offer competent and timely solutions.

SPECIAL SERVICE FOR CUSTOMER-TRADE-IN ON SECOND HAND MACHINES

Tecnor facilitates customers' investment by offering a trade-in on their used machine. These second hand machines are then entirely refurbished with original spare parts and resold with a guarantee. In its Service Centre in Pavia, a department dedicates completely to the retrofitting of these traded-in machines.

TURNKEY SOLUTIONS

Tecnor Macchine is able to study and realize tailored work cycles, tools and equipment for the most complicated parts. Also, it offers optimal solutions for multiple part-taking equipment to obtain the highest efficiency from the system, both manually and automatically. Its strict collaboration, consolidated over time with their partners with regards to robot integration, tooling and part-taking equipment, allows Tecnor Macchine SpA to supply automated plants with highly technological gantry and anthropomorphic robots integrating them with new or existing working cells. This way, companies that work with three shifts 365 days a year can increase their production and at the same time reduce costs.

This partnership allows Tecnor Macchine to continually grow under the technological and innovative aspect creating a body of knowledge necessary to face the most challenging problems.

"Challenger 2010 seminars " in Milano Italy.

Microcut Machine displayed in BIMU 2010

Tecnor Macchine SpA, in collaboration with Microcut, exhibits the new product range on the BIMU trade fair during 5~9th, October,2010. In the 2010 BIMU exhibition, the advanced new products will be presented including HBM-5T with Fanuc 31i, MCG-5X-800 with Heidenhain i TNC530, Dual-500 with Fanuc 18i, V-26 with Heidenhain i TNC530. The wide range of product options is available to meet a variety of advanced machining requirement for both potential customers and their existing customers.

Distribution

Quick, flexible and good value processing with modern turning lathes

To be able to manufacture products in a flexible and quick way in the required quality – this ability can make medium-sized businesses successful. Prerequisite for this are high performance machine tools and an efficient production flow.

Dr.-Ing. Roland Römer, managing director of company Roemer Foerdertechnik GmbH in Wetter-Ruhr states: "When it comes to the purchase of new turning lathes availability and reliability had as much priority as a favorable price."

To organize the production flow of products efficiently is one of the daily tasks of Dr.-Ing. Roland Roemer. He and his staff are supposed to manufacture the products as economically priced as possible, in the shortest time and of course with the required high quality. Parts of the product portfolio of the medium-sized business are for example hydraulic bumper, drum and disc brakes, clutches, crane wheels, strand casting extraction devices and special machines. The company is also exclusive producer of extension devices (such as the 'F-load arm' and the 'DS-load arm') for rack feeders of a local company, formally known as Demag / Dematic.

Availability and reliability of the machines have equal priority as a favourable price.

"Only if we are able to offer our products and service quicker, more flexible and more economical price than our competitors, we get the order", Mr.Roemer defines the requirements of the market."My goal is to produce our products in a more economic way than anybody else can do" states the head of the company categorically. As some older, conventional lathes were not able to meet these requirements in performance, he modernized his machinery and restructured his production.

The choice of the supplier for the new lathes was fairly easy for Mr. Roemer. Because some CNC machine tools of the Volz machine trading company (Volz GmbH & Co. KG) were already operating in production to his entire satisfaction, he also requested the respective quotations regarding two cycle lathes and two CNC-lathes again from the machine trading company in Witten.

"Regarding the supply availability and reliability had as much of a high priority as a favourable price" Roemer states. The Witten-based company Volz won the bidding. "Based upon the good price-performance ratio and their promixity, I decided to cooperate with company Volz", Mr. Roemer substantiates his puchase decision.

Prompt Service is guaranteed

The Roemer company ordered two cycle lathes-- Microturn Challenger BNC with turning lengths of 2000 and 4000 mm respectively, as well as two CNC lathes--Microturn Challenger HTL 76 with turning lenghts of 1250 mm."These turning lathes meet exactly the requirements of our customers", Volz sales expert Manfred Strunk emphasizes.

Meanwhile the lathes are in operation in the company's production without any deficits and criticism. When there was once a minor error at the machine, the service-technician of company Volz was on site quickly and solved the problem immediately. Mr. Roemer is content with the cooperation with company Volz. When it comes to the equipment of the cycle lathes with self centering rests of the brand Schunk "Together we solved this task in the shortest time possible." he stated.

Processing times reduced drastically

With the investment in new machines, Mr. Roemer gets closer to his aim, to produce competitively than anybody else, as he points out with an example: "Whereas a gas cylinder in earlier days was processed in 4 clamping steps within 60 minutes, it is now possible to be done this within 10 minutes, in only one clamping." This clear improvement in productivity can not only be related to the new lathes though, but also to a change in construction of the gas cylinders.

Product

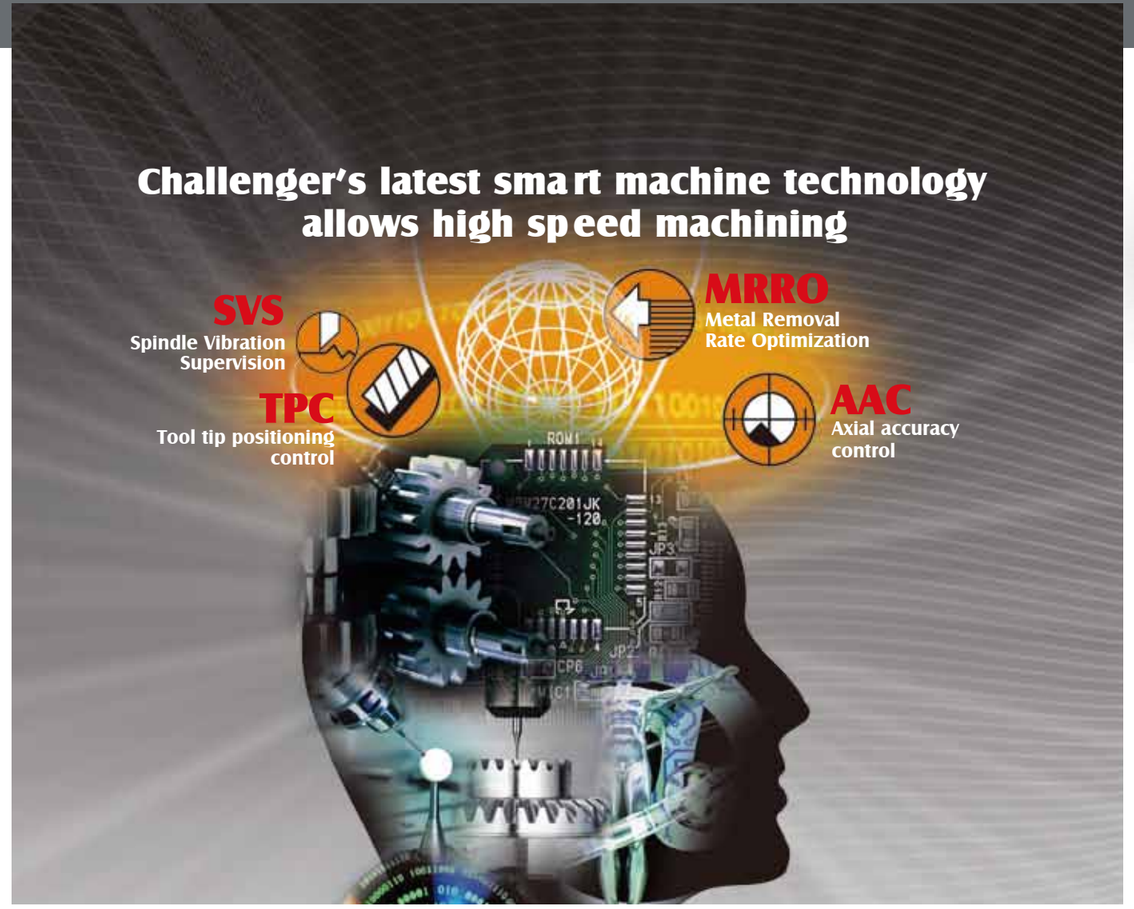
High speed machining (HSM) technology is the trend of production. The combination of spindle power, spindle speed, and machine-axis feed rates produces a greater metal removal rate than conventional metal cutting technology. It offers benefits to wide range of applications for dies and moulds, aerospace, electronics, medical,automobile and defense industries.

HSM can save the production cost via higher productivity and higher machining accuracy. The higher productivity and machining speed can save your time and increase your turnover. And the high machining accuracy can achieve the excellent requirement of finish.

While the characteristics of HSM are high speed and high removable rate, those will also cause thermal deformation and vibration on the spindle and machine body. To strengthen the HSM machine ability, Challenger developes smart machine functions to overcome the thermal and vibration problems induced from HSM.

A high degree of thermal stability ensures successful production. The machine can achieve the required accuracy in each axis over the whole traverse range even with strongly varying speeds and machining forces.

Abnormal vibrations can also reduce the surface finish quality and the machining quality. Depending on its background of theory and experience, the Challenger's smart machine functions not only solve these problems but also optimize the cutting condition and the metal removal rate.



The smart machine functions will be available first on Buffalo's HSM vertical machining center (VMC)-V series, then on MVCG-5X, TT-40. And the spindle Vibration Supervision will be applied on HBM-4.
Now, let see how Challenger's smart machine function make HSM better!

Tool-tip Positioning Control

TPC

- High accuracy
- Real time compensation
- Better surface finish

TPC directly compensates the spindle thermal growth by an electrical type sensor, reducing tolerance to 5~6 times.

Accuracy improved **5~6** times!

Spindle Vibration Supervision

SVS

- High finish quality
- Longer life time
- Information recorder

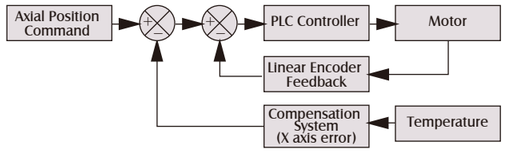
SVS extends spindle bearing and tool life and prevent negative effect on surface quality and accuracy by monitoring the spindle vibration status. Also SVS provides useful information for further maintenance.

Axial Accuracy Control

AAC

- Axial thermo monitoring
- High precision

AAC Integrates temperature sensors and thermal error model to compensate the thermal induced positioning error.
The spindle speed and axial feed rate are reduced once the temperature increase is detected by the sensor. The thermal error can be reduced from 20μm to 3μm by this thermal compensation system.



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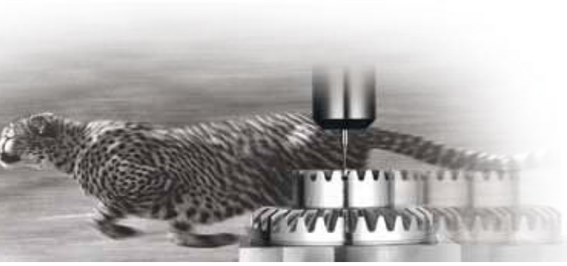
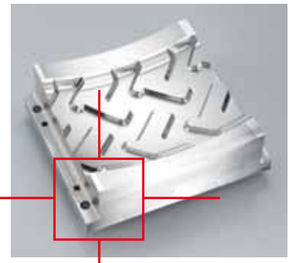


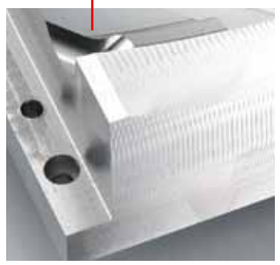
Metal Removal Rate Optimization

MRRO

- Optimization of productivity
- Extremely fast processing time
- High tool durability and perfect surface

MRRO can derive the optimal cutting condition by considering the limitation of machine (e.g. machinability, characteristics of tool and workpiece and chattering problem). This function provides an intelligent function to determine the optimal cutting condition. Loading of the spindle and feed drives are monitored online and automatically controlled. The metal removal rate can be largely increased and cycle time can be reduced as well.





Without compensation

With compensation

R&D ZONE

Analysis of the harmonic losses and bearing load for motorized high speed spindle Part I: Modeling

Paul Chang and Aaron Juan

Abstract—Angular contact bearings is the most popular type of bearings used in the motorized high speed spindle. An initial preload and operating-induced load control is managed to ensure its rigidity, but the centrifugal force and temperature will rise with the rapid increase of spindle speed. Although the centrifugal force and thermo induced bearings load are applied on the spindle assembly. This paper aims to study innovative structure solution of spindle and develop a new type of super precision bearings which will ensure the lifetime and high performance of spindle. Section II proposed an improved inverter output filter, for pulsewidth modulated (PWM) drive system. The proposed filter is shown to effectively reduce the power losses in the spindle. This usage of the filter can improve lifetime of bearings and gain a higher output power of the spindle. The simulations show a 20 KW, 400 Hz PWM drive system with total loss reduced by 13.36%, and a 20KW, 800HZ PWM drive system with total loss reduced by 15.77%. Therefore, the filter configuration is an excellent contribution for PWM drive system.

Keywords: centrifugal force, thermo induced bearings load, inverter output filter

I. INTRODUCTION

In recent years, due to the requirement of high speed machining applications, high speed spindles have became one of the most important components in machine centers. Better productivity and quality of the high speed high power machining are always desired. It is well-known that the major mechanical limitation on the spindle performance is the characteristics of the high speed bearings [1-2]. Also, the stiffness and rated capacities of the spindles are limited by the performance of the bearings.Therefore, lots of researches and studies are made to analyze and improve the bearing performance [3-5].

A newly-developed innovative techniques for evaluating oxide nonmetallic inclusions and an updated steel making procedure can contribute to a much longer life of bearings. It also provides a 20% higher revolution capacity [1-2]. High material fatigue life and wear resistance can be achieved by using a specific heat treatment. The material cronidur 30 is the key issue. Its unique properties as to fatigue strength and corrosion resistance contribute to long working life of bearing significantly. The new bearing will be able to take higher admissible contact pressure, higher admissible speed and enhance lubrication. A contribution of steel ring and ceramic balls are applied in broad range of application to spindle parts in machining aluminum alloy, titanic alloy, ferrous metals and nonmetallic materials.

For the drive systems of the spindle, due to the development of power electronics and pulsewidth modulation technique, the PWM inverters are widely applied to the variable frequency and variable voltage drive of AC machines in various applications. In high speed machining applications, a typical topology of the spindle drive is composed of a three phase rectifier and a PWM inverter [6-8]. It is also well-known that the pulsewidth modulated output voltage consists of the fundamental component and various high frequency harmonic [9]. Unfortunately, these high frequency voltage harmonic will cause additional power losses in the spindle and hence additional temperature raise [10-14]. Therefore, due to the thermal capacity of the spindle and the capacity of the coolant system, the output power and torque of the spindle are usually degraded to prevent damaging the spindle. A filter composed of a LC trap and a RLC type filter [7] is mainly proposed to eliminate the switching frequency component. However, it may not be suitable for the high speed machining applications because the frequency of the first high frequency component is not a constant and will vary with the operation speed of the spindle with a wide range.

In this paper, an output filtered PWM inverter [6] is used to reduce harmonic distortion of the inverter output voltages as well as the additional power losses caused by the voltage harmonic. However, in the high speed spindle drive, the frequency of the first high frequency harmonic may be only about ten times the fundamental electrical frequency at the stator winding. Hence, the filter design can then only be the compromise between remaining the fundamental component and reducing the high frequency harmonic. From the simulation results, the power losses in the spindle may be reduced by about 13% and 15% as the spindle is operated at 12000rpm and 24000rpm respectively.

II. HIGH PERFORMANCE BEARINGS WITH NEW MATERIAL

2.1 Bearing configuration and load analysis

In high speed machining applications, angular contact ball bearings are widely used in the high speed spindles. Fig. 2.1 shows two typical configurations of the spindle bearings with a spring preload and constant offset preload respectively. For the spring preload, most of the load induced by the thermal expansion and centrifugal force during high speed operations can be absorbed by the springs. However, due to the limitation of the stiffness, this kind of bearing configuration is only suitable for high speed light duty cutting applications. As to the other configuration with constant offset preload, due to the benefit of high rigidity, it is more suitable for heavy duty cutting operations.

Except the design of the preload, there are also two main issues which will contribute to the bearings load. One is the thermal induced load which is resulted from the heat generated by the friction. The other main issue is the centrifugal force induced load. The centrifugal force induced load will increase rapidly during high speed operations. To reduce these two effects on the bearings load, a high performance bearing made with new material would be very useful for high speed spindles [15-21]. The new type bearings can provide better wear resistance and the thermal expansion can also be reduced by using the ceramic balls.

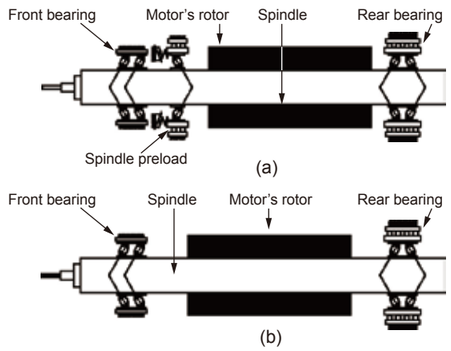


Fig.2.1 (a)Bearing design with preload spring (b)Bearing design with constant offset preload

2.2 High performance bearing with new material

Recently, high speed machining technology has attracted a lot of attention and the high speed spindles become one of the most important components in the machine center. It is well-known that the characteristics of the bearing are always the key point in the design of high speed spindles. To improve the performance of the bearing, several metallurgical technologies are developed and applied for manufacturing. In this paper, a new material called cronidur 30 is introduced which can provide better performance than the traditional M50 steel. Fig. 2.2 shows a seizure testing module made with four balls in which one rotating ball is placed on the other three fixed balls. Fig. 2.3 and Fig. 2.4 show the testing results of dry seizure and oil bath seizure tests respectively. From these two figures, it is obvious that the seizure capacity of the cronidure 30 is much better than that of M50. Fig. 2.5 shows the wear resistance test result. From the surface originated flaking test of the bearings shown in Fig. 2.6, it can be seen that the lifetime of the bearing made with cronidur 30 is about two times longer than that of the bearing made with M50.

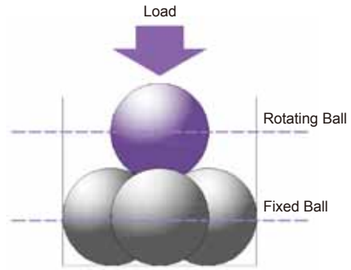


Fig. 2.2 4 Balls seizure test [1]

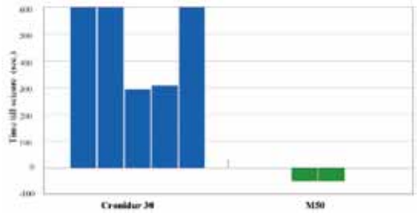


Fig. 2.3 Dry seizure test [1]

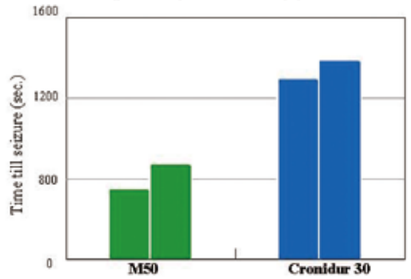


Fig. 2.4 Oil bath seizure test [1]

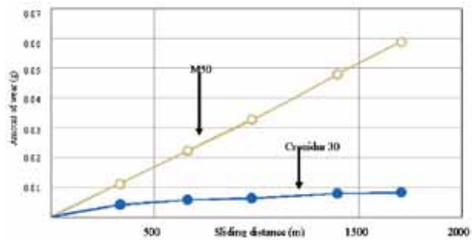


Fig. 2.5 Wear Resistance test report

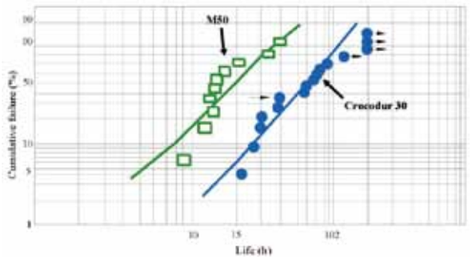


Fig. 2.6 Surface originated flaking test

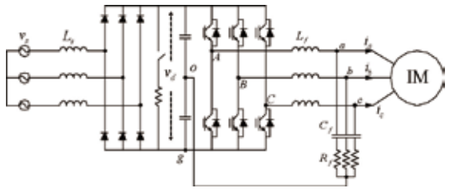


Fig. 3.1 Circuit diagramof the filtered PWM inverter.

Consequently, from the above performance study reports, it is no doubt that the angular contact ball bearings made by the new material, cronidur 30, can provide better performances such as longer lifetime and better wear resistance. Therefore, if the new bearings are applied to the high speed spindle, the lifetime and reliability of the spindle can also be improved.

III. OUTPUT FILTERED DRIVE FOR HIGH SPEED SPINDLE

PWM inverters are widely adopted for variable voltage variable frequency motor control applications. However, there will be additional harmonic components in the voltages and currents because of the PWM operation. These harmonic will cause additional power losses in the machine. For a high speed spindle, the output torque is usually limited by the thermal capacity. To increase the output torque, one of the most effective solutions is to reduce the power losses in the spindle. In this paper, a filtered PWM inverter shown in Fig.3.1 is adopted to reduce the voltage harmonic as well as the induced power losses.

In the following subsections, the analysis of the harmonic components due to the PWM inverter is first described. Next, the design of the LCR filter is illustrated for the spindle application. At the last subsection, analytic calculations of the harmonic losses are expressed.

A. Analysis of the harmonic components

Fig. 3.2 shows the relative waveforms of an inverter with sine PWM control. The triangular voltage Vin with switching frequency f_s is compared with the three phase balance sinusoidal control signals, VconA, VconB, and VconC. The switching points of the IGBTs are determined by the intersections of the control signals and the triangular carrier signal. The ratios of control signals to the carrier signals are defined as the modulation indices, Ma, Mb and Mc. From the voltage waveforms, VAg and VBg, it is seen that there are dc components involved in the output voltages. The dc components will be cancelled in the line to line voltage, VAB. One can see that the line voltage contains serious harmonic distortion which will cause additional power losses and thermal in the spindle. To realize the harmonic components, the line voltage is analyzed with Fourier analysis and the resulted spectrum is shown in Fig. 3.3

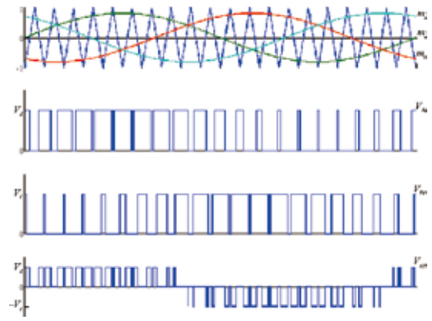


Fig. 3.2 Basic waveforms of the SPWM-controlled inverter.

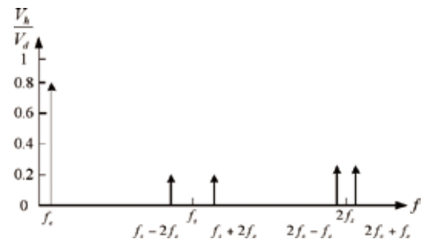


Fig. 3.3 The spectrum of the line voltage.

As shown in Fig. 3.3, it is obvious that the first harmonic component of the line voltage is with frequency (fs-2fe). These harmonics do not contribute to the output torque of the spindle, but cause additional stray losses. Reducing the harmonic from the inverter will obviously reduce the harmonic power losses and the temperature raise.

B. Analytic calculations of the harmonic losses

As mentioned above, the high frequency harmonic in the inverter output voltages will cause additional losses in the spindle which will result in additional temperature raise. It turns out that the output torque is necessary to be reduced due to the limited thermal capacity. The harmonic losses are commonly known as a composition of winding copper losses, hysteresis losses and eddy current losses.

$$P_{loss} = P_{copper} + P_h + P_c \quad \text{----------(4)}$$

According to research results in [13], the major iron losses are induced by the eddy current. Therefore, the effects of the hysteresis losses are neglected in this approach. Basically, the copper losses are expressed as

$$P_{copper} = \sum_n (3I_{sn}^2 R_s + 3I_{rn}^2 R_r) \quad \text{----------(5)}$$

Where I_{sn} and I_{rn} are the n-th harmonic currents of stator and rotor, R_s and R_r are the stator and rotor resistances. The classical eddy-current losses are given by

$$P_c = \sum_n k_c B_n^2 (n\omega_e)^2 V \quad \text{----------(6)}$$

where K_c is the coefficient of eddy current effect, B_n is the n-th harmonic flux density, ω_e is the electrical angular frequency and V is the effective volume of the core. For easy to analyze the harmonic losses, the material is assumed linear, i.e. the flux density is always proportional to the voltage amplitude. Therefore, the harmonic eddy current losses can be calculated with analyzed voltage harmonic. If the effects of the resistance and leakage inductance are neglected, one can get the following expression.

$$NA\frac{dB(t)}{dt} \approx v(t) \quad \text{----------(7)}$$

Where $v(t)$ is the terminal voltage, N is the number of turns and A is the effective area of the cross section. Then the harmonic flux density can be obtained

$$B_h(t) = \sum_n B_n \cos(n\omega_e t + \phi_n) \quad \text{----------(8)}$$

$$B_n = \frac{V_n}{NAn\omega_e} \quad \text{----------(9)}$$

where B_n and V_n are the flux density and voltage amplitude of the n-th harmonic. From the above equations, the harmonic eddy-current losses can be derived as

$$P_{ch} = \frac{k_c}{N^2 A^2} \sum_n V_n^2 \quad \text{----------(10)}$$

It is obvious that reducing the currents and voltages harmonic will result in the power losses reduction in the spindle. It also turns out that the output torque can be increased under the same limited thermal capacity.

C. Design of the LCR filter

To reduce the influence of the PWM harmonic, a three phase LCR filter is adopted and connected between the inverter and the spindle. The transfer function of the filter is given as

$$H(s) = \frac{sR_f C_f + 1}{s^2 L_f C_f + sR_f C_f + 1} \quad \text{----------(1)}$$

To keep the filter over-damped, the resistor R_f is determined by

$$R_f \geq \sqrt{\frac{4L_f}{C_f}} \quad \text{----------(2)}$$

The cut-off frequency of the filter is

$$f_c = \frac{1}{2\pi\sqrt{L_f C_f}} \quad \text{----------(3)}$$

To filter out the high frequency harmonics, the cut-off frequency should be chosen between the fundamental frequency and the first harmonic frequency.

In the recent high speed milling machines, the maximum speed of the spindle is usually up to 24000 rpm, and the corresponding electrical fundamental frequency is 800 Hz. As an example, if the switching frequency is set to 10 kHz, then the first harmonic frequency will be 8.4 kHz. Therefore, the filter cut-off frequency can be chosen as five times of the fundamental frequency.

IV. PERFORMANCE EVALUATION

To evaluate the performance of the new type bearings and the output filtered inverter, corresponding simulations are carried out with ANSYS and PSIM and some results are also given in this section.

First, a model of the high speed spindle with angular contact ball bearings is constructed in ANSYS. Simulation results of traditional and new type bearings are shown in Fig. 4.1 and Fig. 4.2 respectively. Figure 4.1 shows an ANSYS thermal analysis of a spindle equipped with traditional angular contact ball bearing. In 600 sec. temperature of the front bearing will be 55˚C and the rear bearing is 53.613˚C. In Figure. 4.2, another simulation shows the same spindle is equipped with new type of bearing. And its temperature raises only to 45˚C at the front bearing and 44.142˚C at the rear bearing. It's clear that the temperatures can be reduced about 10˚C. It's a great improvement in the spindle lifetime and thermal growth. The cutting tolerance will be greatly improved as well.

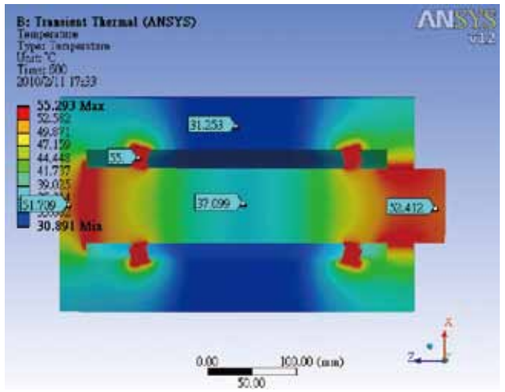


Fig. 4.1Thermal Analysis of bearing with mate M50

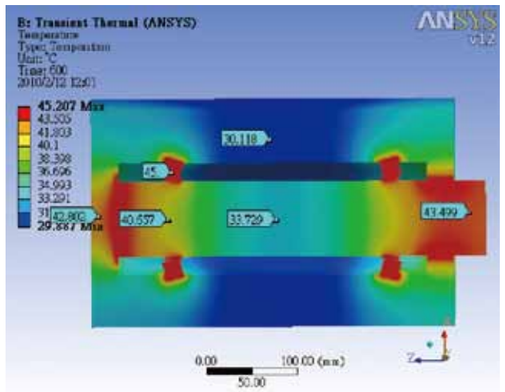


Fig. 4.2 Thermal Analysis of bearing with Mate Crocodur 30

For the spindle drive system, an output filtered inverter was constructed with PSIM to simulate the high speed operations. The relative parameters in the simulation are listed as following.

\ DC bus voltage = 565V
Switching frequency = 5 kHz
Stator inductance=317.5 uH
Filter inductance=300 uH
Filter capacitance=9.9 uF
Maximum spindle speed= 24000rpm

Fig 4.3 shows the waveforms of the inverter output voltage without filter and with filter respectively at 24000rpm spindle speed. To evaluate the reduction of the harmonic voltage, one can use FFT to analyze the harmonic components. Fig. 4.4 shows the FFT results of the voltages shown in Fig. 4.3.

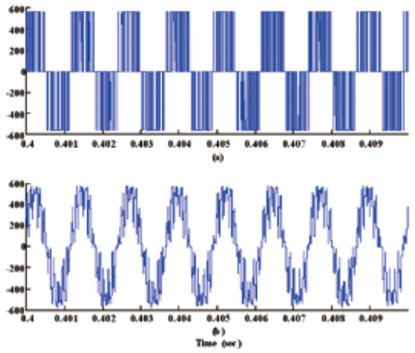


Fig .4.3 Waveforms of the inverter output voltage (a) without filter and (b) with filter.

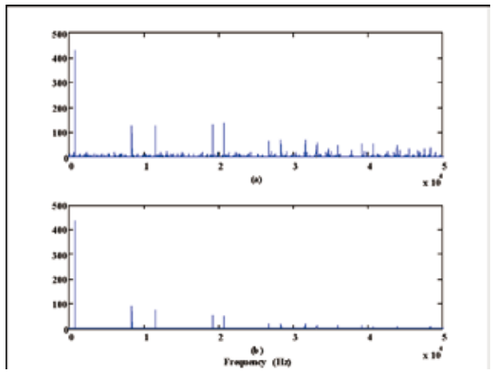


Fig. 4.4 FFT results of the output voltages (a) without filter and (b) with filter.

REFERENCES

[1] NSK LTD, "Metallurgical Technologies to Extend Bearing Life", Feb. 2009.
[2] SCHAEFFLER GROUP, "FAG Super Precision Bearings," Issue AC4/130/7 EA, Apr. 2008.
[3] J. S. Chen and K. W. Chen, "Bearing load analysis and control of a motorized high speed spindle," International Journal of Machine Tools & Manufacture, vol. 45, 2005, pp.1487-1493.
[4] S. M. Kim, K. J. Lee, and S. K. Lee, "Effect of bearing support structure on the high-speed spindle bearing compliance," International Journal of Machine Tools & Manufacture, vol. 42, 2002, pp. 365-373.
[5] F. Aggogeri, A. Merlo and M. Mazzola, "Multifunctional structure solutions for Ultra High Precision (UHP) machine tools," International Journal of Machine Tools & Manufacture, on-line Nov. 2009
[6] Y. Sozer, D. A. Torrey and S. Reva, "New inverter output filter topology for PWM motor drives", IEEE Transactions on Power Electronics, vol.15, no. 6, Nov. 2000, pp. 1007-1017.
[7] J. Huppunen and J. Pyrhönen, "Filtered PWM-inverter drive for high-speed solid-rotor induction motors", IEEE Proceeding of Industry Applications Conference, vol. 3, 2000, pp. 1942-1949.
[8] N. Mohan, T. M. Undeland and W. P. Robbins, Power Electronics: Converters, Applications, and Design (2nd edition). John Wiley, 1995.
[9] R. Liu, C. C. Mi and D. W. Gao, "Modeling of eddy-current loss of electrical machines and transformers operated by pulsewidth-modulated inverters", IEEE Transactions on Magnetics, vol. 44, no. 8, Aug. 2008, pp. 2021-2028.
[10] J. J. Lee, Y. K. Kim, H. Nam, K. H. Ha, J. P. Hong and D. H. Hwang, "Loss distribution of three-phase induction motor fed by pulsewidth-modulated inverter", IEEE Transactions on Magnetics, vol. 40, no. 2, Mar. 2004, pp. 762-765.
[11] A. Boglietti, A. Cavagnino, T. L. Mthombeni and P. Pillay, "Comparison of lamination iron losses supplied by PWM voltages: US and European Experiences", IEEE International Conference on Electric Machines and Drives, May 2005, pp. 1431-1436.
[12] M. Amar and R. Kaczmarek, "A general formula for prediction of iron loses under nonsinusoidal voltage waveform", IEEE Transactions on Magnetics, vol. 31, no. 5, Sept. 1995, pp. 2504-2509.
[13] R. J. Wang and M. J. Kamper, "Calculation of eddy current loss in axial field permanent-magnet machine with coreless stator", IEEE Transactions on Energy Conversion, vol. 19. no.3, Sept. 2004, pp. 532-538.
[14] H. Li and Y. C. Shin, "Analysis of bearing configuration effects on high speed spindles using an integrated dynamic thermo-mechanical spindle model," International Journal of Machine Tools and Manufacture, vol. 44, issue 4, March 2004, pp. 347-364.
[15] C. W. Lin, J. f. Tu and J. Kamman, "An integrated thermo-mechanical-dynamic model to characterize motorized machine tool spindles during very high speed rotation," International Journal of Machine Tools and Manufacture, vol. 43, issue 10, Aug. 2003, pp. 1035-1050.
[16] S. Casotto, F. Pascon, A. M. Habraken and S. Bruschi, "Thermo-mechanical-metallurgical model to predict geometrical distortions of rings during cooling phase after ring rolling operations," International Journal of Machine Tools and Manufacture, vol. 45, issue 6, May 2005, pp.657-664.
[17] I. Mane, V. Gagnol, B. C. Bouzgarrou, and P. Ray, "Stability-based spindle speed control during flexible workpiece high-speed milling," International Journal of Machine Tools and Manufacture, vol. 48, issue 2, Feb. 2008, pp.184-194.
[18] S. M. Kim, K. J. Lee, and S.K. Lee, "Effect of bearing support structure on the high-speed spindle bearing compliance," International Journal of Machine Tools and Manufacture, vol. 42, issue 3, Feb. 2002, page 365-373.
[19] D. A. Krulewich, "Temperature integration model and measurement point selection for thermally induced machine tool errors," Mechatronics, vol. 8, issue 4, June 1998, pp. 395-412.
[20] J. Yuan and J. Ni, "The real-time error compensation technique for CNC machining systems," Mechatronics, vol. 8, issue 4, June 1998, pp.359-380.
[21] D. A. Rendusara and P. N. Enjeti, "An improved inverter output filter configuration reduces common and differential modes dv/dt at the motor terminals in PWM drive Systems", IEEE Transactions on Power Electronics, vol. 13, no. 6, Nov. 1998, pp. 1135-1143.

Now Even User-Friendlier: The New Improvements to the MANUALplus 620

For years, MANUALplus controls have been known for their convenience of operation. An additional step in the direction of user friendliness was made with smart.Turn programming, which made it possible to expand the control's range of applications to single-spindle CNC lathes. HEIDENHAIN also used this opportunity to greatly expand the functions of the MANUALplus 620 once again. The new software supports machining with the Y axis, recognizes multipoint tools, monitors tool life and much more.

The MANUALplus 620—a model of user-friendly operation

Facing a part on a lathe using a driven tool

New functions for drilling and milling in the C and Y axes

The new software substantially adds to the control's capabilities in drilling and milling operations: machining with the Y axis, for example, makes it possible to machine slots or pockets with even floor surfaces and vertical groove edges.

The user can choose between various infeed strategies for milling: direct infeed, infeed in a pilot hole or a 3-D approach arc, and helical (spiral) or reciprocating plunge. Appropriate predrilling cycles with calculation of the predrilling position supplement these new strategies.

Other new cycles are for deburring with the C and Y axes as well as for inscriptions by engraving on a face or lateral surface (XY or YZ plane). For all of these cycles you only need a few parameters to get the job done.

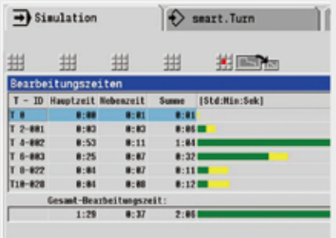
Speaking of getting your job done: the graphical interactive ICP contour editor supports work with the C and Y axes in smart.Turn programs. For standard figure such as slots, circles or polygons you only need a few parameters. Holes and figures to be milled can be arranged in linear or circular patterns, and even hierarchical arrangements such as figures within other figures are no problem for the MANUALplus 620. One example: the user defines a pocket and, within the pocket, a slot, and then holes within the slot. And all of that without any long-winded computations, because ICP finds the positions of these figures and holes automatically.

Gaining new perspectives: simulation the program run

The numerous graphical simulations for material removal, the proportioning of cuts, and the finished contour have always provided valuable support for program verification. Now, with the new software, the control has been expanded with new views and a convenient, well arranged multi-window depiction of the simulation. Besides the "turning view," for operations with the C axis it offers the face and lateral surface views, and for working with the Y axis the XY and YZ views. The user simply selects a window combination with up to four views that give him an optimal perspective for checking the program code and the machining operation.

During simulation of an NC program, the control calculates the unit times for the programmed operation. A table clearly shows the machining time and idle time of each working step. That not only helps in calculations, for example to make a quotation for a customer, it also provides a great perspective for finding opportunities for optimization.

Straightforward simulation of the machining times of an NC program



Clear-cut simulation: the new multi-window view

Short setup times, long production times

The new "tool measurement by touch probe" function saves setup time. Finding tool dimensions has become surprisingly easy with the HEIDENHAIN touch probe and the new preprogrammed measuring cycles: simply pre-position the tool, select the measuring direction and start the measuring cycle. From the positions measured, the MANUALplus calculates the tool lengths and loads the dimensions in the tool database.

Another new feature is the tool life monitoring with replacement tools. The permissible tool life in terms of time or number of finished workpieces can be individually defined. If the "interchange chain" is also defined, the MANUALplus has all the information it needs to automatically switch to a "sister tool" when an older tool is worn out. The MANUALplus does not stop production until all of the tools in a "chain" have been exhausted.

Do you use tools with more than one cutting edge? No problem. The cutting edges can be individually dimensioned and assigned to a tool. If such a multipoint tool is placed in the turret, the MANUALplus knows every cutting edge and regards them individually—even for the tool-life monitoring. +

Valuing the proven is essential

Of course, the new software on the MANUALplus 620 has kept all the features that for years have made it so valuable in its daily work on cycle and CNC lathes.

- *Powerful **teach-in function**: machine your first part interactively while saving your cycle program for the rest of the batch.*
- ***smart.Turn** programming mode: you can use "intelligent" updating and DIN PLUS for special tasks.*
- ***ICP** interactive graphic **contour editor***
- ***Tool and technology database**: simplifies the definition of tool parameters and proposes the appropriate feed rate for each machining step (in a three-dimensional table with workpiece materials, cutting materials, and operating modes).*

New User Functions for the iTNC 530

With its new software 340 49x-06, HEIDENHAIN is introducing the type of improvements that make a user's heart beat faster!

New NC software 340 49x-06!

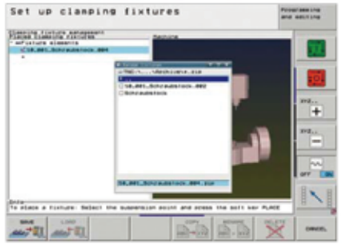
Improvement

Dynamic Collision Monitoring (DCM—software option)

Save **entire clamping situations** and restore them at a later time. This possibility is a great advantage for integrated fixture systems, since the measurement process otherwise necessary when the fixture system is placed on the machine again can be omitted entirely.

Another new feature is **ToolholderWizard**, which enables you to enter parameters for tool carriers, e.g. angle heads simply and with conversational guidance.

This protects the housings of the various touch probes from collision with fixtures and permanent machine components: simply assign the appropriate file to the touch probe in the tool table.



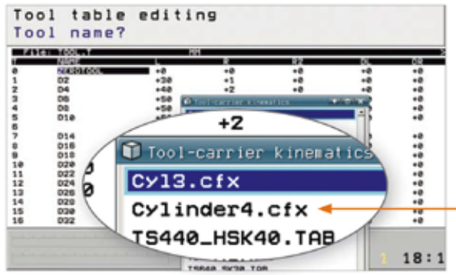
Improvement

KinematicOpt: inspecting and compensating machine error (software option)

Now also measure the **misalignment of an angle axis** (head or table). For head axes the rotary axes are measured twice, each time with a stylus of a different length. In addition, the new **calibration cycle 460** is available because the styli must be changed between the two measuring cycles. With the new calibration cycle 460 you calibrate using the HEIDENHAIN calibration sphere already in place.

Support for the **measurement of Hirth-coupled spindle heads** has also been improved. Positioning of the spindle head can now be performed via an NC macro that the machine manufacturer can integrate in the calibration cycle.

Possible backlash in a rotary axis can now be ascertained more precisely. By entering an angular value in the new **Q432 parameter of Cycle 451,** the TNC moves the rotary axis at each measurement point in a manner that its backlash can be ascertained.

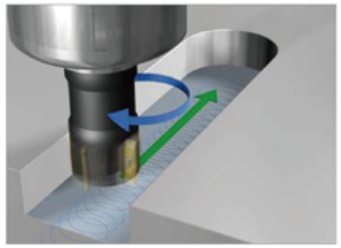


For the touch probes, HEIDENHAIN provides appropriate parameter files.

NEW

New Cycle 275, TROCHOIDAL SLOT

This new cycles enables you to manufacture closed and open slots and any desired contour slots quickly and efficiently. The cycle begins with a roughing operation that is also know by the term **trochoidal milling**. In the subsequent operation the side walls are finished in order to remove the "saw teeth" produced during roughing.

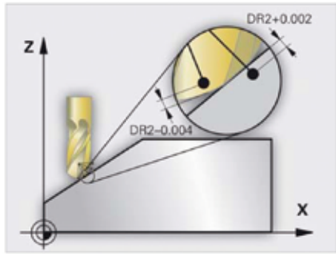


How does trochoidal milling work? The roughing process consists of trochoidal motions (Greek "trochos" = wheel). This means that the TNC calculates the milling path by superimposing a linear forward motion over a circular motion of the cutter. With trochoidal milling, large cutting depths and high cutting speeds are possible because the equally distributed cutting conditions prevent wear-increasing influences on the tool. Quite the opposite: when tool inserts are used the entire cutting length is exploited to increase the attainable chip volume per tooth. Not only that, but it's easier on the machine mechanically. Enormous amounts of time can also be saved by combining this milling method with the integrated adaptive feed control (AFC) software option.

NEW

New 3-D radius compensation with 3D-ToolComp (software option)

Make a compensation-value table defining angle-dependent delta values that describe the tool deviation from the ideal circular shape. **3D-ToolComp** then corrects the radius value defined for the workpiece's current point of contact with the tool. In order to determine the point of contact exactly, the NC program must be created with surface-normal blocks (LN blocks) by a CAM system. The surface-normal blocks specify the theoretical center point of the radius cutter, and in some cases also the tool orientation relative to the workpiece surface.



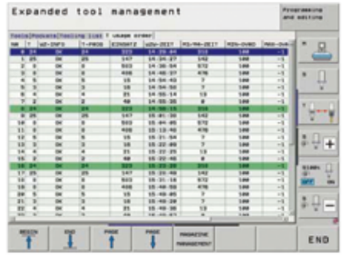
Deviation of the tool from its ideal circular form

The best method is to define the compensation-value table fully automatically by way of a special cycle that uses a Blum laser system to measure the form of the tool so that the iTNC can then use this table directly.

Improvement

Enhanced tool management (software option, machine-specific function)

Enjoy a much better perspective of your tools and magazines. Many new features are offered: You can use your mouse to load and unload tools through drag-and-drop. The tool usage list informs you how long each tool has been cutting workpieces. Another new feature is clearly structured tables that use color coding to indicate various tool statuses.



Well organized and easy to read: The tool usage list

With the new features in the 340 49x-06 software it's full speed ahead.

+++ Even more improvements +++

Program selection

And now, when you call a program using PGM CALL, you can select the desired program in a pop-up window. The TNC automatically enters the path name.

3-D line graphics

The 3-D line graphics can now also be displayed in full-screen mode to improve clarity of detail.

PLANE function

When tilting to position using the TURN function, enter an MB retraction path (move back), which if desired can extend to just before the limit switch (MB MAX).

Manual alignment

In the manual probing cycles you can compensate measured workpiece misalignment by a movement of the rotary table.

Q parameter programming

Now you can define jump addresses through QS string parameters, e.g. IF = 0 GOTO LBL QS99.

You'll find more information in the interactive Klartext e-magazine

www.heidenhain.de/klartext

Key Component

Wireless, fast and secure – Blum Radio Touch Probe TC60

The touch probe TC60 was especially developed for situations where the distance between the probe and the receiver is very long or where a continuous visual contact during the measuring process cannot be guaranteed. This is for machines with large machining areas, 5-axes processing, 5 face milling or when the probe has to be immersed within the workpiece. The signal transmission is carried out through the innovative BRC technology, a method that sets new standards in respect of speed, reliability and user-friendliness.

In contrast to conventional touch probes, it does not use the three point contact measuring principle or high sensitive switching elements. Therefore the touch probe Blum TC60 guarantees highest accuracy and superior measuring speeds in all approach directions.

The new high speed touch probe TC60 wins hands down when it comes to speed, reliability and user-friendliness.

Features

- Multidirectional probe: Ø 63 mm
- Max. probing speed: 3 m/min
- Repeatability: 1 µm 2σ
- Very high acceleration and measuring speeds
- Reliable BRC transmission technology - Extremely fast signal transmission absorbing the influence of inconstant measuring speeds
- Touch proof even under extreme coolant and pollution conditions
- Up to 100,000 measurements due to low power consumption
- No-wear measuring mechanism with long-term stability
- Robust design
- Self centering stylus eliminates realignment after stylus change
- Protection class IP68
- Easy operation by intelligent pairing procedure between probe and receiver
- Enables much higher measuring speeds and accuracy than with conventional probes
- Handling up to 6 probes with one interface IF59-A2 using identifier.
- Different probes on nearby machines won't influence each other.
- The TC60 can be applied on the **Microcut HBM** borer series.

The optional front kit allows direct integration of the RC66 into the machine panel. Chip accumulations at the receiver and cumbersome cables in the workspace have thus become a thing of the past.

Blum Measuring Software FormControl V4

Form Control V4 is developed for comprehensive production control in machining centers. The software enables the operator to perform contour measurements in the machine as well as fast workpiece control due to measurement and analysis of geometrical standard elements.

The application of the software allows a fast detection of machining errors directly in the machining center, eliminating the need for time-consuming resetting of the workpiece on a separate measuring machine. Re-work is done within the initial set-up, thereby not only saving further time-consuming alignment of the workpiece, but also increasing essential accuracy.

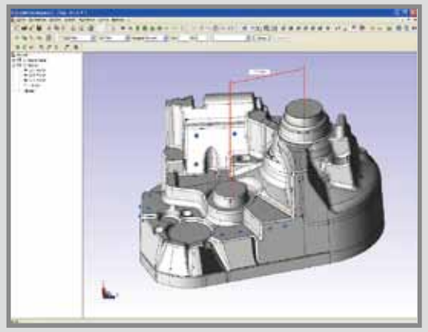
If a workpiece should be measured, the operator simply indentifies the measuring points with the mouse on the 3D model. Also the real measuring sequence is executed with a single mouse command. The Data transfer between NC and PC takes place via ADIF (Automatic data interface).

Features

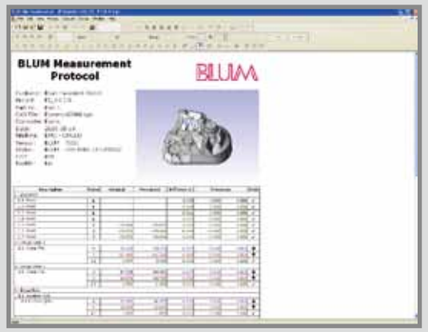
- Contour measurement in the machining center
- Measurement and analysis of geometrical standard elements
- Fast detection of machining errors
- Immediate rework in initial setup
- Collision control
- Easy to use with logically structured and self-explaining user interface
- Increase of in-process reliability
- Application with any probe system desired
- Options: 5-axes measurement and Best-Fit-Function
- Easy generation of printable measuring protocol

FormControl V4 now enables measurement of geometrical elements as e.g. bores, pins, cones, spheres, bars and grooves (correlated or relative to a machine axis).

Even complex contours will already be measured in original setting with the software FormControl V4.



The new features of FormControl V4 enable to detect e.g. dimensions, position and axis angle of geometrical elements. The measuring points are easily set by mouse click.



The measuring result can be analyzed directly on the PC or output as printed measuring protocol.

FAQ Trouble shooting

Q: We have just replaced the headstock of our BNC lathe after crash. Could you advise the necessary inspections after installing the headstock?

A: You have to check geometrical accuracy on three parts: spindle, tailstock quill and turret. The procedure of inspection is as following:

1. Inspecting the spindle accuracy:

1) Use a 300mm test bar for spindle alignment (see A in Fig. 1) and loosen all the fixing screws (for example, see B in Fig. 1) of the headstock.

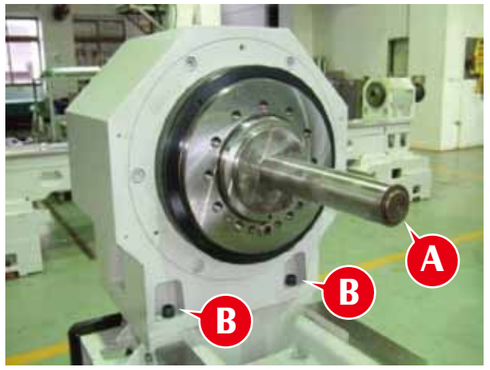


Fig.1

2) Apply the stylus of the indicator to the horizontal plane of the test bar. Move the carriage along Z-axis and measure the maximal difference. (see Fig. 2).

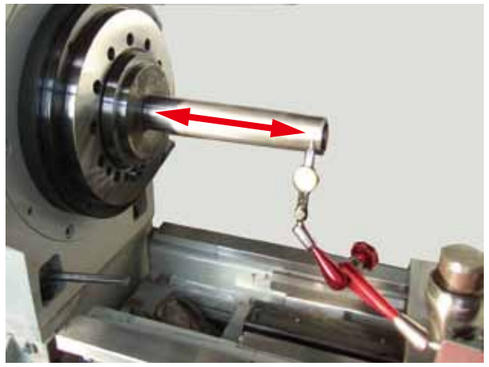


Fig.2

3) Ensure the accuracy in the horizontal plane to be within 0~±0.01mm. The front end of the test bar must incline to the turret to sustain the turret well. Refer to Table 1 for tolerance for different turret mounted position.

Table 1: The accuracy in the horizontal plane for different turret position

	Front mounted turret	Rear mounted turret
Tolerance	0~+0.01mm (see Fig.3)	0~-0.01mm (see Fig.4)

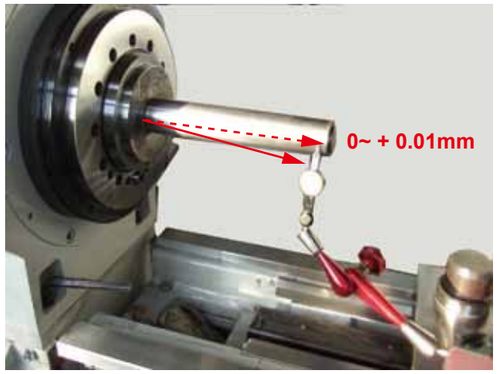


Fig.3

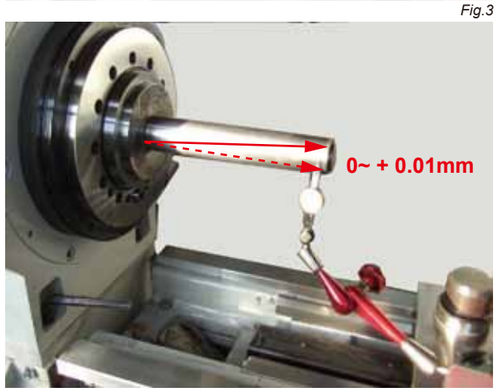


Fig.4

4) Apply the stylus of the indicator to the vertical plane of the test bar. Move the carriage along Z-axis and measure the maximal difference. (see Fig. 5)

5) The accuracy in the vertical plane should be within 0~ +0.01mm for tail of test bar.

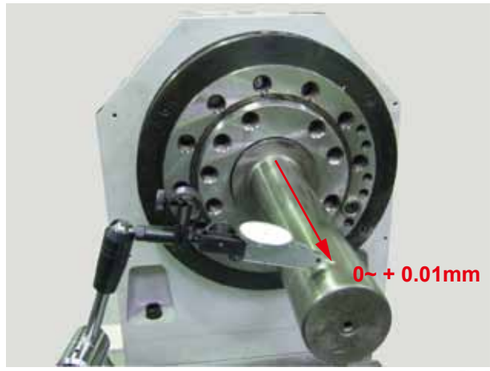


Fig.5

6) Insert a transfer sleeve (A in Fig. 6) and a center (B in Fig. 6) into the spindle bore.

7) Apply the stylus of the indicator to the center taper (see Fig. 6) and rotate the spindle in manual way. Measure the run-out accuracy and ensure the accuracy to be within 0.015mm.

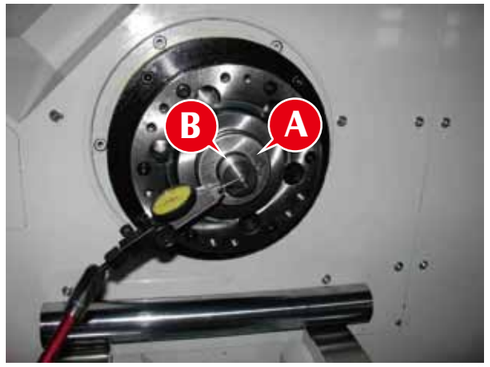


Fig.6

8) Tighten all the fixing screws (see B in Fig. 1) of the headstock.

2. The alignment of tailstock v.s spindle:

1) Use a test bar with 300mm in length between the spindle and tailstock (see Fig. 7).

2) Apply the stylus of the indicator to the horizontal plane of the test bar. Move the carriage along Z-axis through the full longitudinal travel and measure its maximal difference (see Fig. 7).

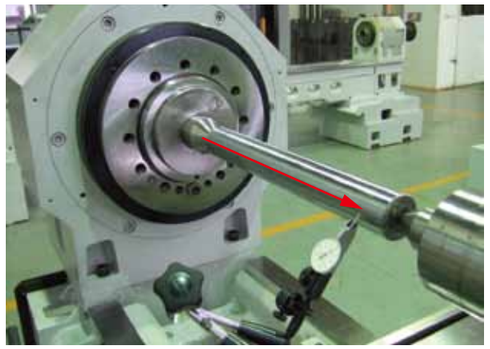


Fig.7

3) Ensure the accuracy in the horizontal plane to be within 0~±0.01mm. The front end of the test bar must incline to the turret to sustain the turret well. Refer to Table 2 for accuracy of different turret mounted position.

Table 2: The accuracy in the horizontal plane of different turret position

	Front mounted turret	Rear mounted turret
Tolerance	0~+0.01mm	0~-0.01mm

4) If the accuracy in the horizontal plane is out of tolerance, adjust the gib of tailstock (see A in Fig. 8,).

Fig.8

5) Apply the stylus of the indicator to the vertical plane of the test bar. Move the carriage along Z-axis through the full longitudinal travel and measure its maximal difference.

6) Ensure the accuracy in the vertical plane to be within 0~+0.02mm (see Fig.9).

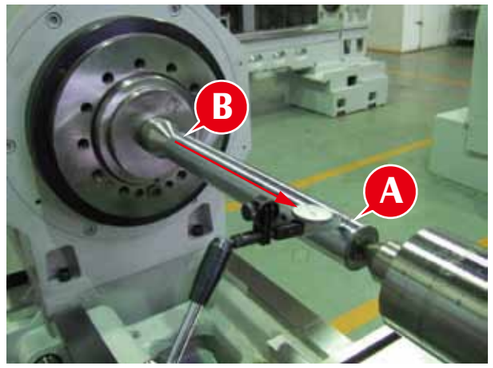


Fig.9

7) If point A is higher than point B (see A and B in Fig. 9), grind the base of tailstock (see Fig. 10, marked in red).

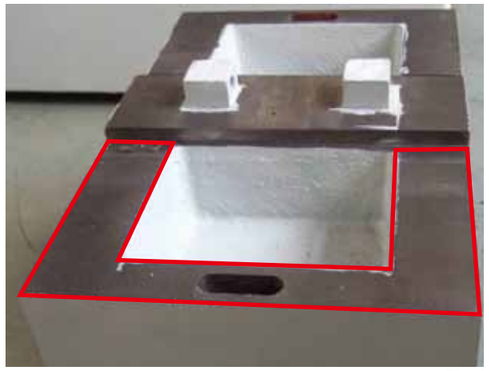


Fig.10

8) If point B is higher than point A (see A and B in Fig. 9), take off the head stock and grind the bed (see Fig. 11, marked in red) to adjust vertical position.

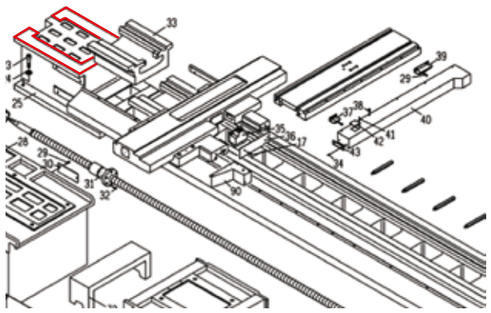


Fig.11

3. Alignment of turret:

1) Measure the thickness of the front and rear spacer and ensure the thicknesses are the same (see Fig.12 and 13). The tolerance is 0.01mm.

Fig.12

Fig.13

2) Place the raiser block on the cross slide and apply the stylus of the indicator to the block surface.
3) Move the saddle along Z-axis (see Fig. 14) and measure the maximal difference. Ensure the accuracy to be within 0.01mm.

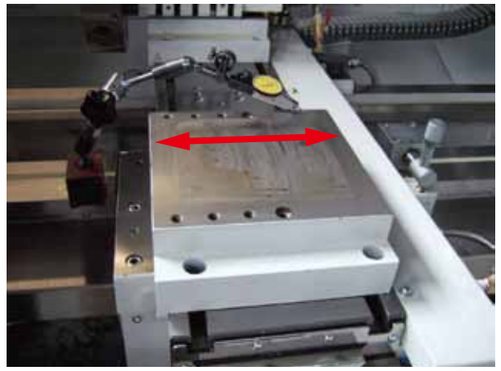


Fig.14

4) Move the cross slide along X-axis (see Fig. 15) and measure the maximal difference. Ensure the accuracy to be within 0.01mm.

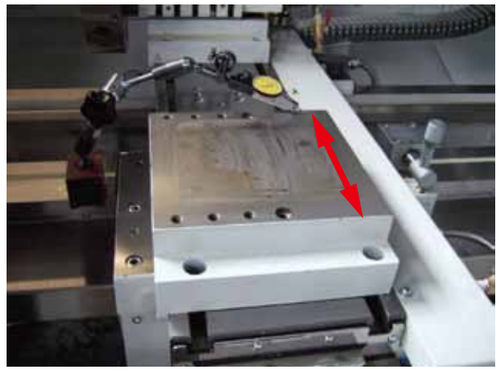


Fig.15

5) Mount the turret on the raiser block and apply the stylus of the indicator to the turret surface.
6) Move the turret along X-axis(see Fig.16) and measure the maximal difference. Ensure the accuracy to be within 0.03mm.

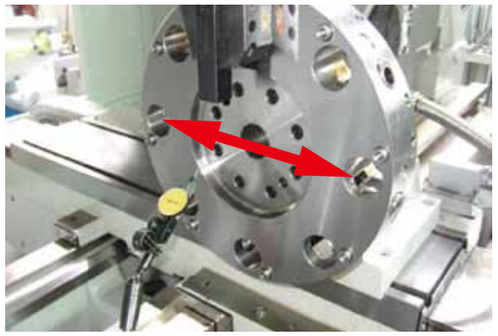


Fig.16

7) Install the tool holder to the 1st tool mounted bore and apply the stylus of the indicator to the horizontal surface of tool holder.
8) Move the turret along X-axis (see Fig. 17) and measure the maximal difference. Only test bore no. 1 and ensure the accuracy to be within 0~+0.03mm.

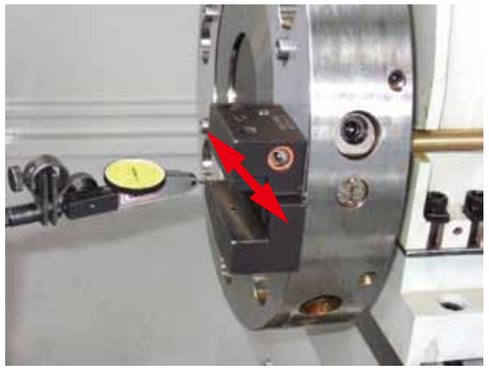


Fig.17

9) Use a test bar with length of 160mm and diameter of 40mm for VDI40 in the 1st tool mounted bore (see Fig. 18). Apply the stylus of the indicator to the test bar in the horizontal and vertical plane respectively.
10) Move the turret along Z-axis (see Fig. 18) and measure the maximal difference. Test bore no. 1 and ensure the accuracy to be within 0~+0.03mm.

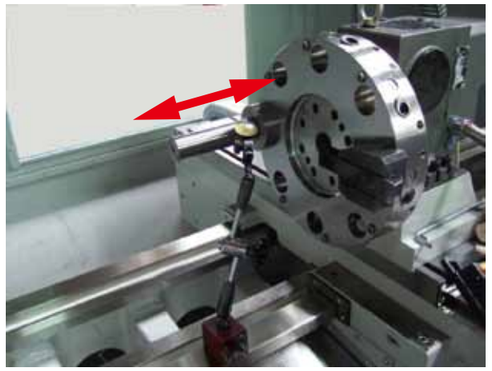


Fig.18

11) Insert a test bar with length of 160mm and diameter of 40mm in the 1st tool mounted bore and clamp the coaxial indicator on the spindle chuck (see Fig. 19).
12) Move the turret along the X-axis and center the test bar by using the coaxial indicator (see Fig. 19).

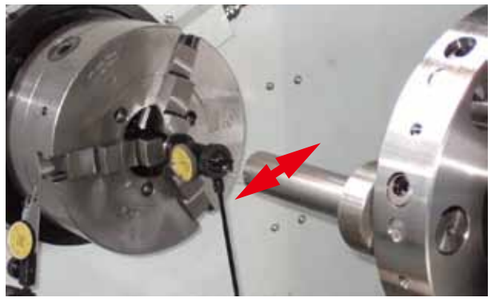


Fig.19

13) Using the coaxial indicator to measure the offset of test bar in the vertical plane (see Fig. 20). Check the height difference between spindle nose center and test bar center. The tolerance should be 0.00mm~+0.03mm for **TB. & Hyd. turret & E4** toolpost. The tolerance should be 0.00mm~+0.01mm for **power turret + C axis.**

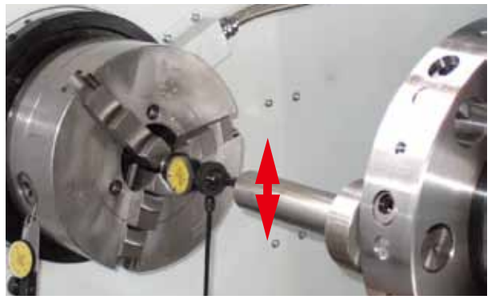


Fig.20

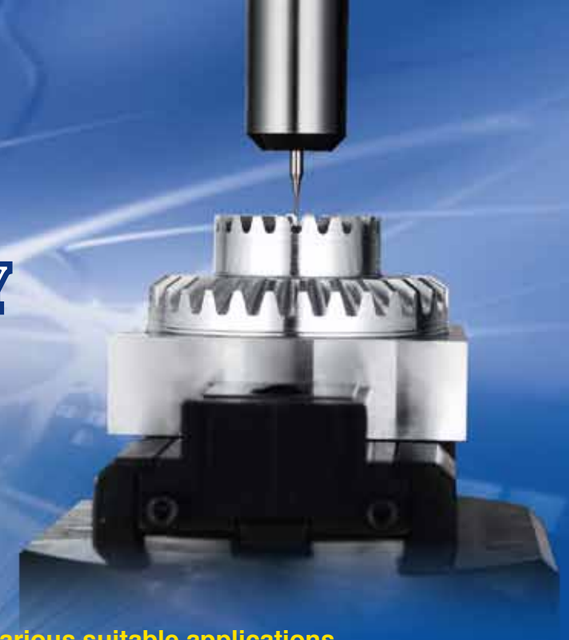
14) If the accuracy in the vertical plane is out of tolerance, take off the turret from the raiser block and mill the front and rear spacer (see A in Fig. 21 and Fig. 13) to adjust its vertical accuracy.

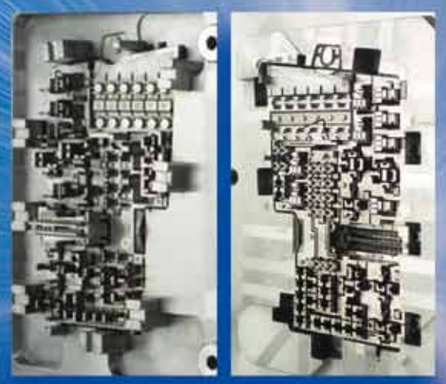
Fig.21

NOTE:

All the tolerance value in this case would vary from different swing diameter and turning length of the machine; please refer to the standard ISO 1708:1989 for detailed tolerance classification.

CHALLENGER HIGH ACCURACY MACHINING





Various suitable applications

- Die and mold market
- Automobile industry
- Medical industry
- General workshop

High Productivity

- High speed processing time with Heidenhain iTNC 530
- Direct driven spindle 15,000 rpm (optional built-in spindle up to 24.000 rpm)
- 48 M/min rapid traverse (V-26, V-30 models)
- Refrigerated ballscrews for higher accuracy
- Fast tool to tool changes time (2 seconds)

High Reliability

- 45mm roller type linear guide way for V-26/30
- 35mm (Z axis), 30mm (X & Y axis) roller type linear guide way for V-20 and V-22
- 720mm Y axis guide ways distance for V-26/30, & 480mm for V-20 and V-22
- Precision ground class C3 ballscrew double nuts with oil cooler
- Rigid basement stress relieved for better performances
- Direct measuring in all axes

V SERIES HIGH SPEED VERTICAL MACHINING CENTERS

Exhibitions

2010 Q4 2011 Q1	Period	Title of Exhibition / Country	Distribution company
October	Sep.28-Oct.1	St.Petersburg show / Russia	BPK
	5-8	Moscow show / Russia	BPK
	5-9	BIMU / Italy	Tecnor
	6-9	Bucarest / Romania	NCT
	12-17	TATEF 2010 / Istanbul	Celik
	13-15	Eurotool / Poland	IGO
	14-16	Open House / France	Didelon
	19-22	Tekniska Mässan / Sweden	VISLANDA Maskin AB
November	8-10	OPEN HOUSE 2010 / Germany	Volz
	9-12	Metavak 2010 / Netherland	Dijkink
	10-13	EMAF 2010 / Portugal	MATER
	16-20	Swiss MT exhibition / Switzerland	RIMA
	17-19	OPEN HOUSE 2010 / Germany	Volz
	24-27	Metalex 2010 / Thailand	S.M.T Asia
	24-27	OPEN HOUSE 2010 / Mexico	FAMA
January	20-26	IMTEX 2011 / India	M/s Techtronics
March	1-6	TIMTOS 2011 / Taiwan	Buffalo Machinery