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News

PIETROCARNAGHI

Pietro Carnaghi Unimill 100 kW of milling power

EMO Hannover
16-21·9·2013
HALL 13 STAND C76

www.pietrocarnaghi.it

PIETROCARNAGHI

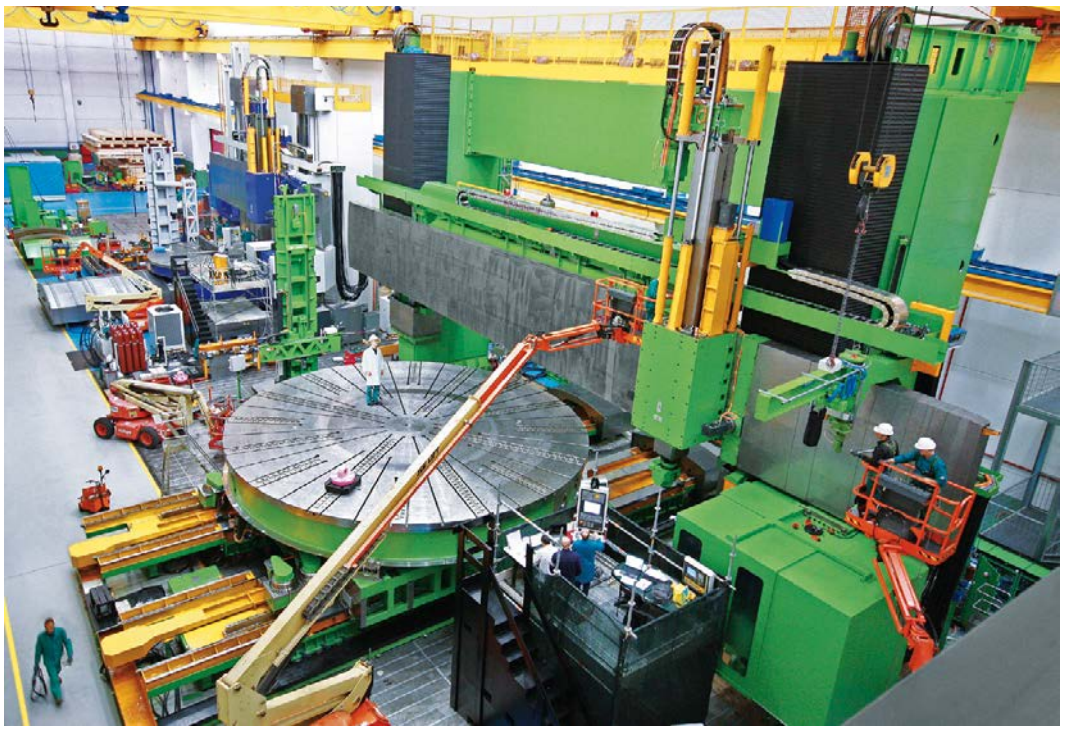
The company focus

Pietro Carnaghi company was founded in 1922 and it is today an important reference point in the international scenario of the machine tool manufacturers, supported by more than 9 decades of experience.

Pietro Carnaghi specializes in machine tools with high demanding performances, is today active on the market in the production of:
- Vertical lathes
- Movable portals milling machines (GANTRY type)
- FMS (Flexible Manufacturing Systems), cells.

Pietro Carnaghi is world leader in the production of reliable and high quality machines and provides in addition to the machines, the advanced process technology and effective aid to the customer's production needs.
Main application fields of **Pietro Carnaghi** customers are:
Energy: machining of Gas, Steam and Hydro electrical turbines; nuclear energy; wind energy
Aeronautics, Jet engines
Shipyards
Aerospace
Mining equipment and earthmoving
Bearings
General Mechanics

Pietro Carnaghi established its main plant complex in Villa Cortese (nearby Milan, Italy). After been dislocated in the near town of Busto Arsizio (VA), in year 2000 the investments in the infrastructures in the new site have been continuous and consistent. Year after year **Pietro Carnaghi** enlarged its buildings, offices, assembly equipment and machining capacity in a very relevant way.
Several steps of heavy investments upgraded the Company site from an original 8,000 sqm to 50,000 sqm (540,000 sq.ft) of covered area. The vision of the families Carnaghi and Radice (holding together 100% of the property of the Company) made possible impressive interventions on **Pietro Carnaghi** assets and capacity. The relevance of the resources and the timing of the investments made possible for the Company to develop brand new buildings having the experience of the recent past realizations.



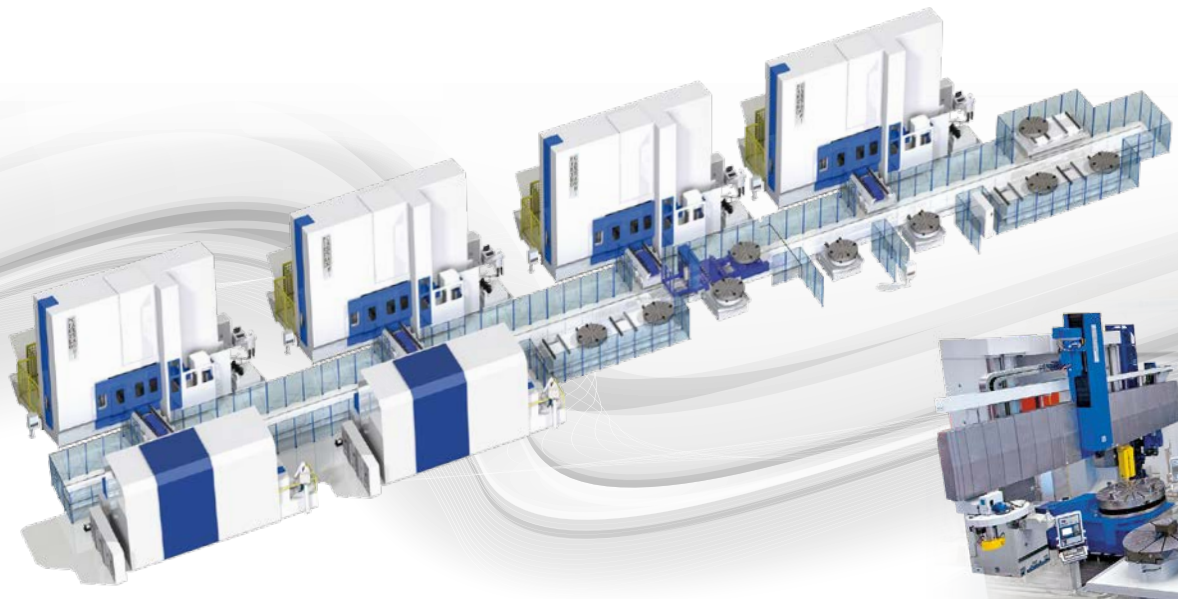
Pietro Carnaghi today is proud to show the best equipped environment to build machine tools.
The different assembling areas (studied for machines with maximum size of 21 mt height and over 18 meter max. turning diameter) are equipped with:

- reinforced concrete foundations and cast iron floors: to simulate the final machining condition and to be able to demonstrate the tightest accuracy reachable in production, for any machine size in the product range
- air conditioning system with filtration system, no circulating air and zone selection
- possibility to keep constant temperature in every area of the buildings
- cranes up to 150 ton capacity
- aerial platforms for machine assembling
- automatic trolleys to move huge components (up to 100 ton)
- light control standards
- dedicated and optimized areas for painting, deburring, packing and shipping
- machining departments under temperature/ humidity control to grant the maximum performance for machining
- possibility and capacity to fully machine internally all the components of the machine tools in the production range (10 meter tables and huge columns).

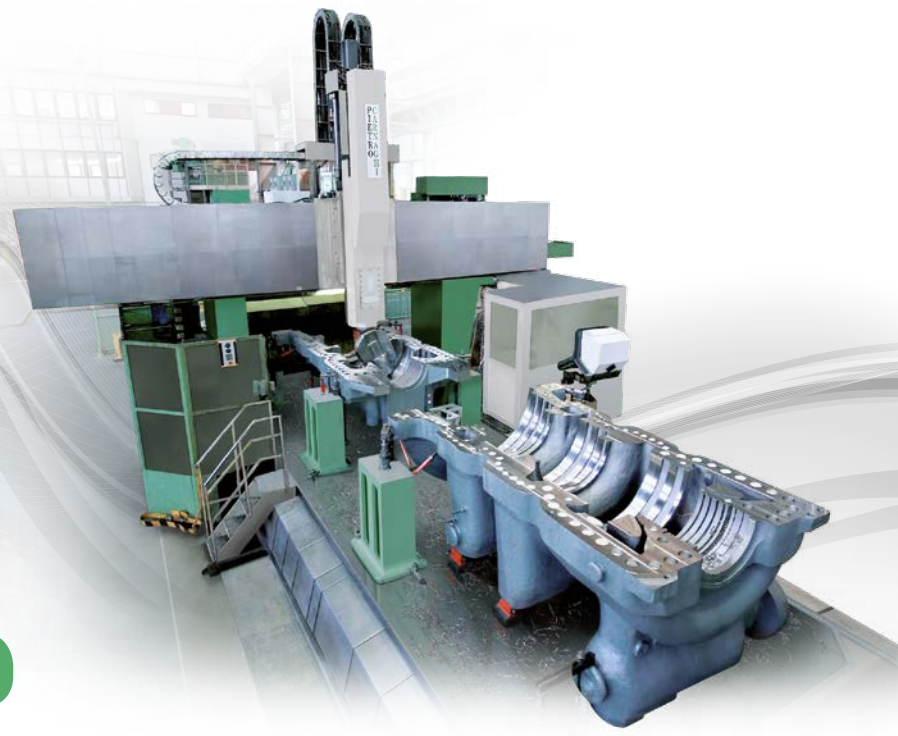
Pietro Carnaghi Product Range

Vertical Lathes and Machining Centers

Big dimension Vertical Lathes and Machining Centers (AP Series)



Flexible Manufacturing Systems



Movable Portal Gantry Milling Machines

Machining Department

Pietro Carnaghi believes in the importance of having the proper machining capacity in order to cover all production dimensions and to fully control the whole process of production.
With this firm belief the Company invested in a brand new machining environment, “The Workshop of the Future”.
Today the machining capacity is completely in temperature control environments, with an impressive ratio of 97% of pure air.
All machines are fully enclosures, and equipped with sophisticated air filtration systems.

The machining capacity consists of:
- **PIETRO CARNAGHI GANTRY UNIMILL 35**
(movable portal gantry milling machine with 3500 mm between columns, 8000 mm length)
- **PIETRO CARNAGHI MOVABLE table milling machines**
(2000 and 3500 mm between columns)
- **PIETRO CARNAGHI GANTRY UNIMILL 100**
(movable portal gantry milling machine with 10.000 mm (32.8 ft) between columns; machining height: 6.000 mm (19.6 ft); Turning table of 8.000 mm (26.2 ft) diameter; 20.000 mm length)
- **3 PIETRO CARNAGHI Vertical lathes**
with max. turning diameter of mm 1.600, 3.500, 5.200 (ft 5.2 – 11.5 – 17).
- **1 Machining center**
mm 1.200 x 1.200 with automatic pallet
- **1 Horizontal boring machine**
mm 3.000 x 3.000 x 1.500 with pallet
- **1 Horizontal boring machine**
mm 12.000 x 3.500 x 2.500
- **4 Movable Table Grinding machines**

AC28 TMY 2500

Machine model	**AC28 TMY**
Maximum turning diameter	**2800 mm**
table diameter	**2500 mm**
Max. turning height	**2400 mm**

- Y axis movable table for off-center machining
- Machine fully hydrostatic
- Universal head with continuous B axis

- Application: energy

Geolocator: China

Gantry Turning and Milling Centre

UNIMILL

Unimill multitasking centres meet the needs of an extremely competitive market, where large workpieces have to be machined with quality, precision and high productivity. Pietro Carnaghi has responded with high tech, state of the art solutions.

Pietro Carnaghi is known for the quality of its machines: over the years, the company has developed a number of models, from vertical portal milling machines through to vertical lathes and the latest gantry machines. In recent years, the company has precisely focused its attention on the milling machines, renewing the Unimill line.
Unimill are large Gantry movable portal milling machines, with a clearance between columns from 4 metres (Unimill 40) up to the 13 metres of the Unimill 130. The models UNIMILL deliver machining capabilities ideal for all the industries (including energy, aerospace, construction of earth moving machines, etc.)

Unique characteristics
Building machines of this size requires special capabilities and know-how: **Pietro Carnaghi** has to its credit numbers of installations (more than 950), and producing the Unimill series has been an even more impressive feature.
The technical solutions used in building these machines are extremely innovative:

To overcome this kind of effects, the design engineers have developed special mechanical compensation systems that nullify the consequences of variations in temperature, through automatic mechanical features integrated in the machine's structural parts.
This hydro-mechanical system repositions the structures correctly in relation to the perfect geometry. Measurements reveal that with this system, the machine delivers positioning precision (as per standard VDI 3441) to within 8 microns every two meters of stroke. UNIMILL can proudly claim twice the accuracy level set by the international regulations.

Tailor-made solutions
In addition to the three linear axes and the accessories equipped with 2 axis heads, the Unimill features an integrated rotary table that provides the **Pietro Carnaghi** top level turning capacity, on a milling machine.

starting from the structure, correctly sized with the aid of FEM calculations and thermo-symmetrical concept designs. The critical structures are able to compensate any deformation due to thermal expansion. The design of the kinematics of the X (moving portal) and Y (crossrail) axes, both hydrostatically supported with drive systems comprising two motors with rack and pinion transmission and electronic backlash recovery system. For long time **Pietro Carnaghi** engineers worked hard on the problems caused by thermal expansion. The first UNIMILL 100 built is in operation in the Company's own workshops at Villa Cortese (Milan), where the effects of expansion on large structures have been studied and verified in depth. Since every variation in temperature triggers a difference of 10 micron for every degree of thermal difference on every meter of length of the structure, the machine has been designed to guarantee the greatest possible immunity to changes in temperature.

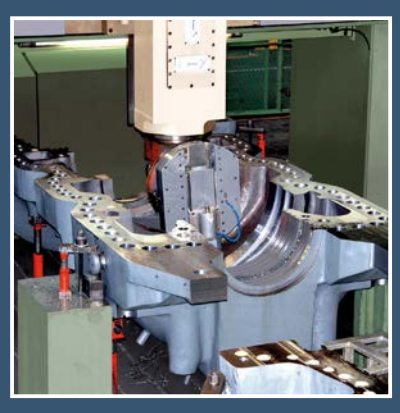
Table operates in indexing mode or in interpolation with the other axes and, a vital factor when workpieces are very large and handling has to be minimized, it is also able to perform very heavy-duty turning operations thanks to its power upto 300 kW.
In the largest version, the table is capable to support up to 500 tons: in spite of this weight, the hydrostatic bearing that sustains it guarantees high precision, reliability and easy maintenance.
The multiple decades of experience of **Pietro Carnaghi** in turning are carrying to the UNIMILL a unique feature of most complete machine. The big plus it is that turning operation is not an “added feature” to a milling machine. It is a main characteristic guaranteed by the machine structure rigidity and design.
Since extremely complex workpieces may have to be machined, the carriage ram is capable to operate with a stroke of up to 4 meters: a stroke of such a length has required a suitable sizing, resulting in a cross-section of 600x600 mm. Milling spindle provides power up to 113 kW (and with available torque of over 10,000 Nm).
The ram can be fitted with a series of accessories and heads by means of large-sized Hirth couplings: this ensures mounting precision at all times, combined with the maximum resistance to the forces the machine is able to generate.
The flexibility of the available configurations and motors guarantee to reach 4000 rpm.
The X axis stroke can be set to the user’s requirements. Normally, the total length of the X axis is calculated with alternate machining areas.

Accessories and options

Unimill can be configured exactly to the User’s specifications: the options available include automatic head changing systems, for horizontal, vertical or indexing heads.

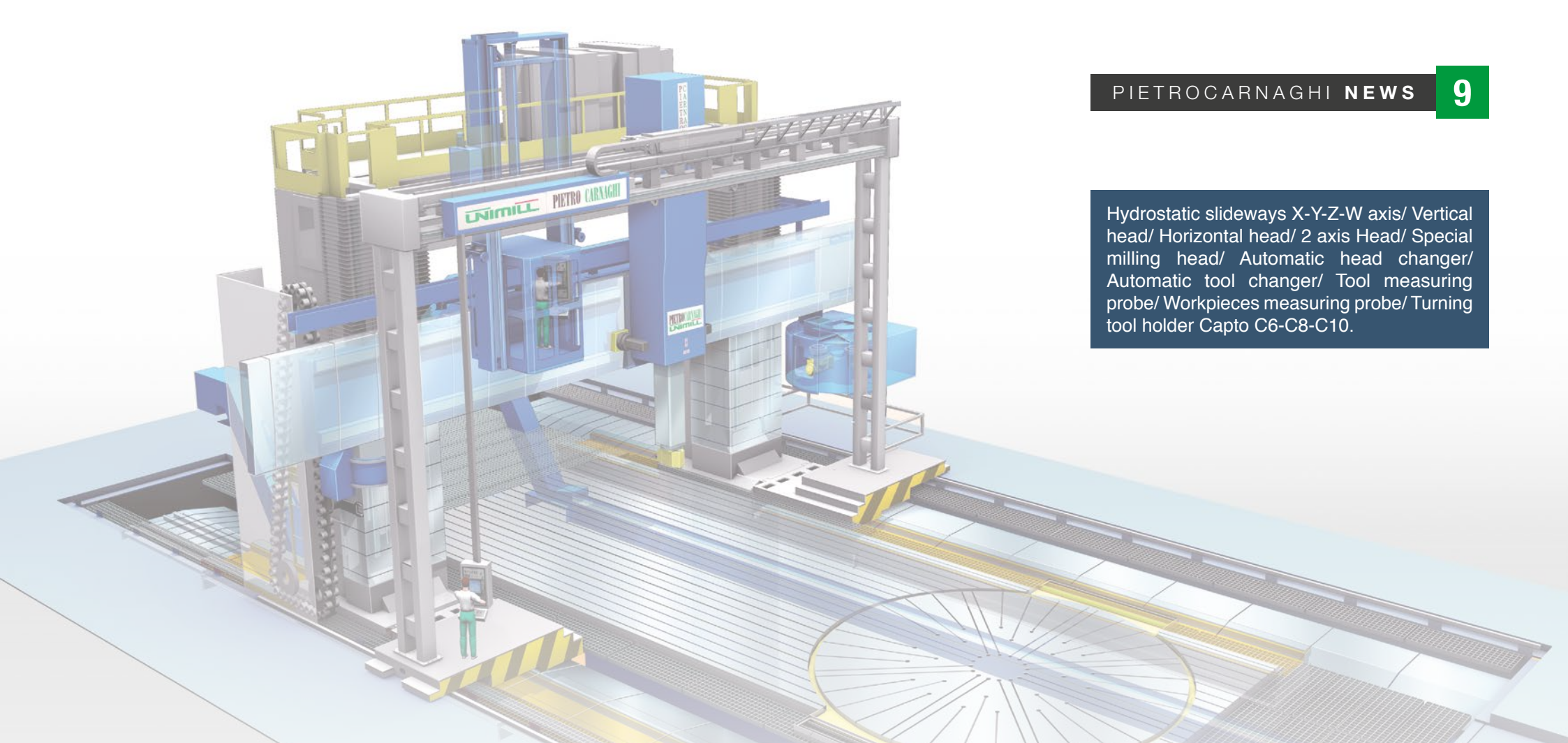
A complete range of milling accessories are designed to perform the best machining results.

From long extension heads studied for energy applications, disk cutters accessories to multiple-axis heads for continuous machining processes.



With any type of tool, ISO50 (Big Plus spindles available), ISO60 or HKS100 and HSK135 spindles.
Accessory and tool change is automatic, with multiple possibility of configurations: tool chain systems, disc magazines, or movable pick-ups for the heaviest accessories.
Tool storage capacity is unlimited and robot movable pick up solutions are available.

Operator cabinet with enhanced full motion on all machining area is a very interesting feature, giving the operator the most high level of freedom in the movements.
Multi-cameras package are available to optimize operator views.



Hydrostatic slideways X-Y-Z-W axis/ Vertical head/ Horizontal head/ 2 axis Head/ Special milling head/ Automatic head changer/ Automatic tool changer/ Tool measuring probe/ Workpieces measuring probe/ Turning tool holder Capto C6-C8-C10.

TYPE OF MACHINE / MACCHINA TIPO		UNIMILL 40	UNIMILL 50	UNIMILL 60	UNIMILL 70	UNIMILL 80	UNIMILL 90	UNIMILL 100	UNIMILL 110	UNIMILL 120	UNIMILL 130
Distance between the columns	mm	4000	5000	6000	7000	8000	9000	10000	11000	12000	13000
Table width	mm	3000	4000	5000	6000	7000	8000		9000	10000	11000
Milling height - fixed cross rail	mm	1500 - 2000 - 2500									
Milling height - movable cross rail	mm	3000 - 3500 - 4000		3000 - 4000 - 5000 - 6000		4000 - 5000 - 6000 - 7000			4000 - 5000 - 6000 - 7000 - 8000		
Ram stroke - Z axis	mm	1500		2000 - 2500 - 3000 - 3500 - 4000							
Ram section	mm	480 x 480		600 x 600							
Milling power	kW	37 / 50		60 / 75 / 113							
Milling torque	Nm	1900 / 2600		6122 / 6250 / 10100							
RPM, max	rpm	4000		4000 / 2500							
Tool taper		ISO 50 - HSK 100		ISO 50 or HSK 100 / ISO 60 or HSK 160							
Rapid feed X, Y, Z	mm/min	20000		15000			10000				
Turning table diameter	mm	3000	4000	5000	6000		8000			10000	

Machine model AS 160 TM-10000

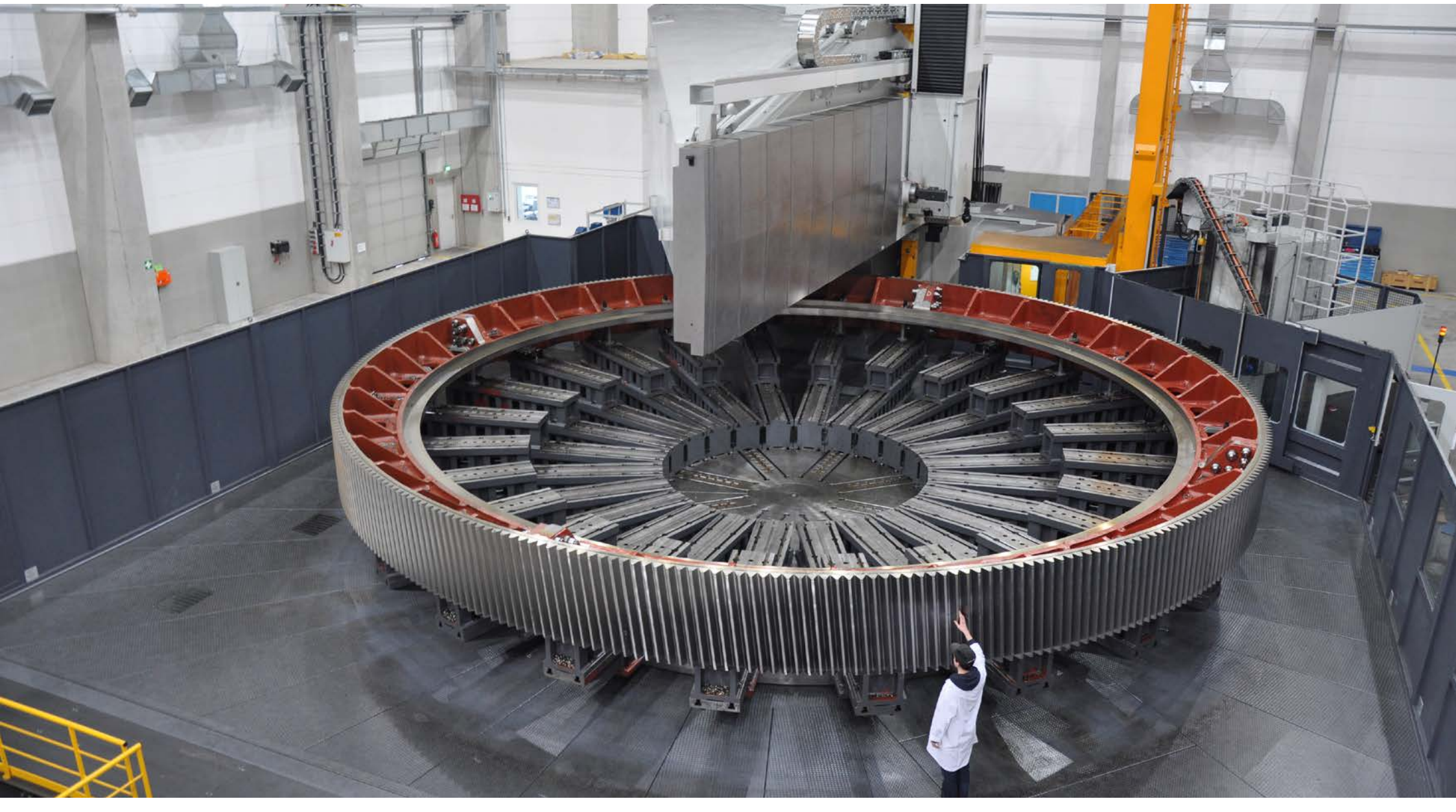
Gear Cutting, Turning, Boring and Milling
of Components Used in Heavy Industry

Main Motor Power	**650 kW**
Turning Diameter (max.)	**16.000 mm**
Diameter of the Table	**10.000 mm**
Table Speed (max.)	**20 rpm**
X-Travel	**9.500 mm**
X-Axis Feed (max.)	**10.000 mm/min**
Z-Travel	**3.500 mm**
Z-Axis Feed (max.)	**10.000 mm/min**
W-Travel	**4.000 mm**

Geolocator: Germany

Single Column Vertical Lathe model AS 160 TM 10000

16 metres diameter of boring, cutting and milling for big gear machining

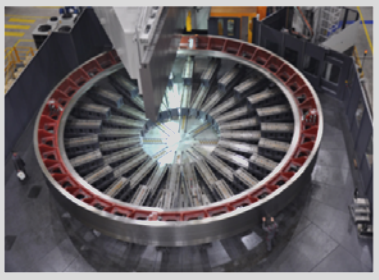


Ferry Capitain, leading supplier of grinding mill components to mining industry invested to machine components for their gear driven solutions.

The Ferry Capitain high level manufacturing technology selected PIETRO CARNAGHI AS 160, single column machine with 10 meters table, and 16 meters maximum diameter. The table is shared with an integrated machine for gears cutting.

From customer's website www.ferrycapitain.fr:

Published 10/06/2013



The Perfect Machine

The VBCM16 is equipped with the latest machining and gear-cutting technology. Capable of handling parts up to Ø16m(52')...

Our latest investment is the **VBCM16** machining centre is in operation since the beginning of 2013.

Installed in a dedicated 2000m² temperature-controlled building in our Hattingen (Germany) FCMD facility, **the VBCM16** is equipped with the latest machining and gear-cutting technology. Capable of handling parts up to Ø16m(52'), it can hold up to 450 metric tons on its table for turning operations (350t for gear cutting), accommodate part heights up to 6000 mm, and cut high-hardness gears of tooth size up to module 50 with face widths up to 1500 mm.

SIEMENS

www.siemens.com/sinumerik

On the road to Industrie 4.0 in CNC technology with Sinumerik from Siemens

Industrial corporations are facing deep-rooted changes in the world of manufacturing. This change is taking place alongside increasing integration of product development and production processes with the benefit of innovative software systems and high-performance software – a decisive step on the road towards a new industrial age.

With the Sinumerik product family, Siemens is championing the development of this change through comprehensive integration:

- Enhancement of CNC machining productivity and flexibility by a further developed Sinumerik portfolio
- Constantly improving integrated solutions in the construction of machine tools
- Sinumerik and Integrated Drive Systems (IDS) for optimum added value through consistent integration across the entire life cycle

Answers for industry.

Machine model AP 90 TM T 8000

PIETRO CARNAGHI Vertical lathe mod. AP 90 TM T with two carriages.
For turning, drilling, milling and grinding operations.

Main Motor	**8000 mm table with 300 kW power**
Turning diameter	**9000 mm**
Turning height	**7000 mm**

- Hydrostatic crossrail vertical movement
- The carriage with a section of RAM 600 x 600 mm has a stroke of 3500 mm, giving 71 kW of milling power
- The movements of the carriages, table, RAM and crossrail are with hydrostatic system.
- Automatic balancing-systems assures the high precision of the machine structure.
- An operator platform is integrated on the carriage, to let operators reach inside machining areas.

Geolocator: China

PIETROCARNAGHI
Machine Tools

Pietro Carnaghi provides Flexible Manufacturing Systems for intensive production needs.

The case of Axle Transmission Components for Construction & Mining Equipment Manufacturer

A leading manufacturer of construction and mining equipment selected **Pietro Carnaghi** to supply Flexible Manufacturing Systems for a variety of parts. These systems produce critical parts for the axle assemblies for large construction and mining vehicles.

The system consists of multiple live spindle vertical lathes, and other types of machine tools performing secondary operations. Parts are delivered to the machines by a pallet transporter system controlled by **Pietro Carnaghi** cell controller.

Machine Models
The machines used for this project are sized 1400 and 1800 mm table diameter.
The heavy duty machine structure, forged alloy steel ram, and hydrostatic linear ways provide the rigidity and accuracy required to produce these precision parts. The Hirth coupling interface between the ram and ram attachments insures maximum repeatability when changing the various turning, milling, and special ram attachments required for the processes. Each machine is equipped with a large tool magazine proving sufficient cutting tools to produce each part in the family of production mix.

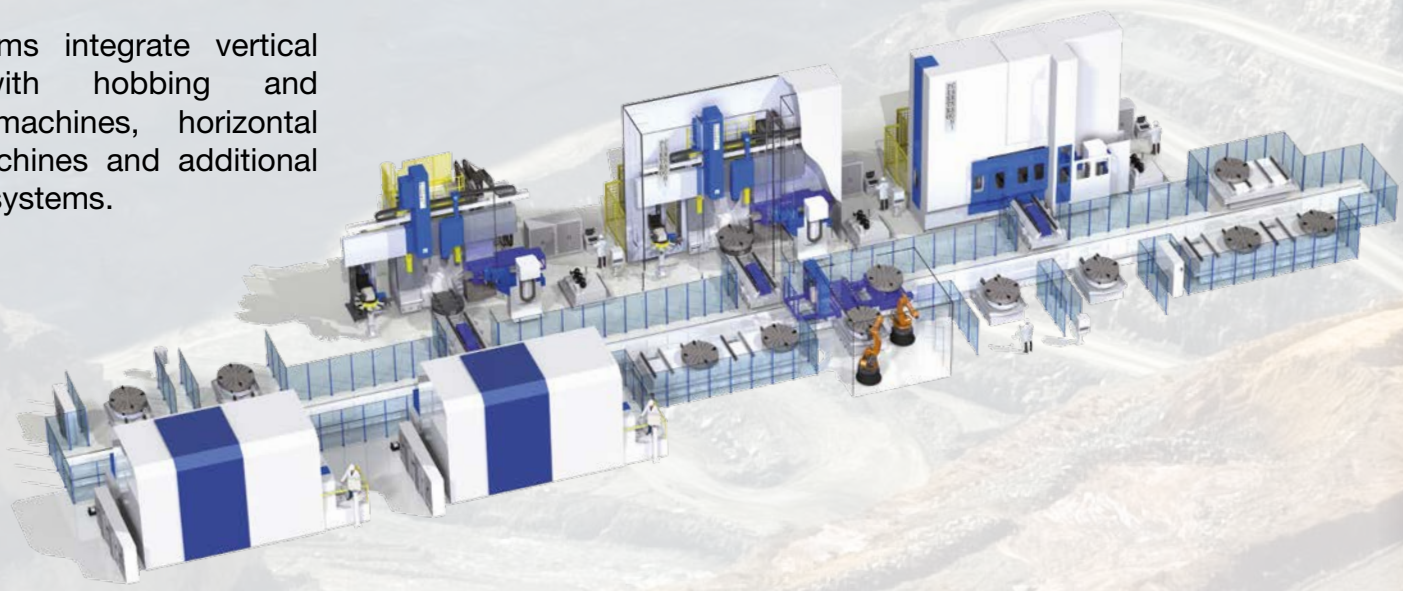
The inherent machine accuracy along with the interchangeable turning and milling heads has eliminated the need for multiple set-ups on various types of machine tools. The critical part features are produced in fewer setups on the vertical lathes insuring consistent part quality.

In addition to the Flexible Manufacturing Systems, **Pietro Carnaghi** provided complete turnkeys on the parts consisting of part processing, part programs, tooling, and workholding systems.

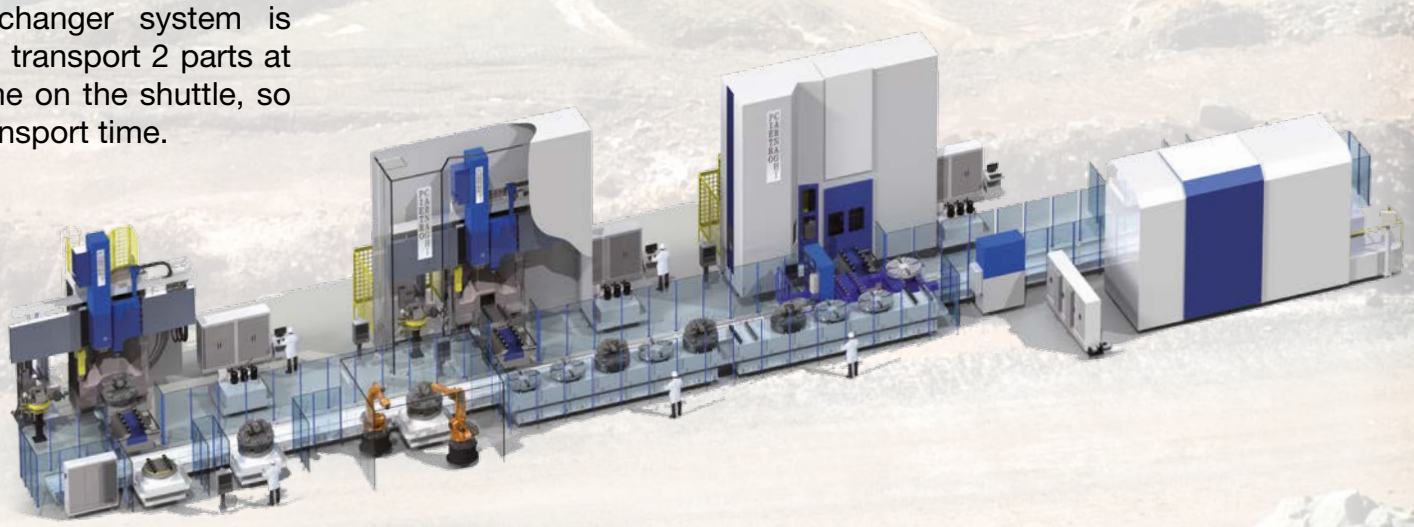
Cell Management Software

Pietro Carnaghi FMS are equipped with a production software that is studied to optimize the scheduling of part programs, tool management, part probing, calibrations and feeding in the workpieces.
The whole software is conceived to have several levels of customization, starting form a basic level of FIFO (First in-First out) up to a fully automatic production scheduler system with input data forms to setup the production needs for every day/week. Any event can be managed by the system, having stations dedicated to store pallets with tool breakage parts, missing tools in the process, etc.
The **Pietro Carnaghi** Software is also connectable to Customer Plant Management Systems.

The systems integrate vertical lathes with hobbing and shaping machines, horizontal boring machines and additional operation systems.



The pallet changer system is conceived to transport 2 parts at the same time on the shuttle, so to reduce transport time.



Horizontal carriage with tailstock ensure the best machining capability for the most challenging components in height

A multiple set of Parking Stations (SPS) is designed to support production needs in terms of idle time for machine feeding.

HEIDENHAIN

Manufacturing More Efficiently with HEIDENHAIN

TNC 640 – the TNC counturing control for machining centres and milling/turning machines
The new TNC 640: for the first time, milling and turning are combined in one TNC. Now users can switch as desired between milling and turning—within one and the same NC program.

TNC 640: the new high-end control for milling and turning operations

With "Dynamic Efficiency," HEIDENHAIN combines important functions of TNC controls for heavy machining. They make the machine operator's work easier, but also make the manufacturing process itself faster, more stable and more predictable—in short, more efficient. It combines effective control functions with intelligent machining strategies in order to increase the metal removal rate and reduce machining time.

dynamic + efficiency

comprises these three TNC functions:

- **Adaptive Feed Control** – **AFC** optimizes the feed rate depending on the machining situation
- **Active Chatter Control** – **ACC** reduces chatter tendencies and permits higher feed rates and greater infeeds
- **Trochoidal milling** – accelerates roughing of slots and pockets

As is usual with HEIDENHAIN controls, the functions are particularly easy and convenient for the user. The combination of these TNC features, in particular, exploits the potential of the machine and tool and at the same time limits the mechanical load. The effort is worth it. Increases of 20 % to 25 % to metal removal rates are possible—which results in dramatically more economical heavy machining.

HEIDENHAIN absolute encoders
With its absolute encoders for machine tools, HEIDENHAIN has set new standards in terms of time and functionality. And you produce accuracy from the very first part.
New: LC 281 with measuring length up to 28040 mm

Our DIADUR symbol shows you that encoders from HEIDENHAIN in your machine tool ensure continually high accuracy:
www.heidenhain.it/accuracy

Linear and angle encoders from HEIDENHAIN make it possible: accuracy from the first part.

HEIDENHAIN 3-D touch probes
HEIDENHAIN 3-D touch probes can do more than just enable you to align and measure your workpieces exactly. You can also measure between working steps. And you can measure tools. Functional readiness is indicated on the new 3-D touch probes by a blinking LED.

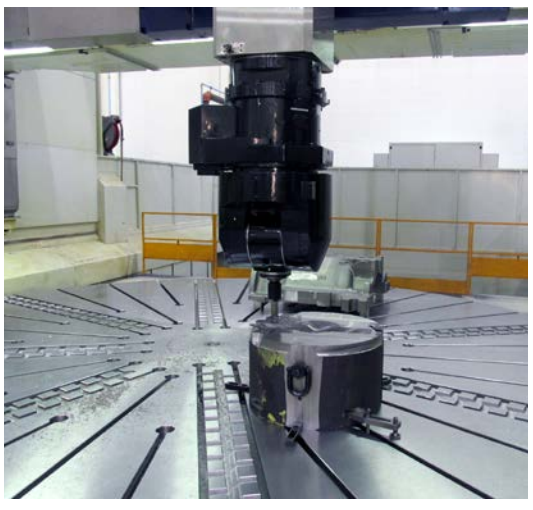
3-D touch probes from HEIDENHAIN stand for fast, time-saving workpiece alignment and tool measurement.

HEIDENHAIN ITALIANA S.r.l., Via Asiago, 14, 20128 Milano, Italy, ☏ +39 02270751, www.heidenhain.it

Metalex
High-Tech Manufacturing Company

Pietro Carnaghi for Metalex Manufacturing – USA

Advanced Milling Feautes plus Turning Capacity

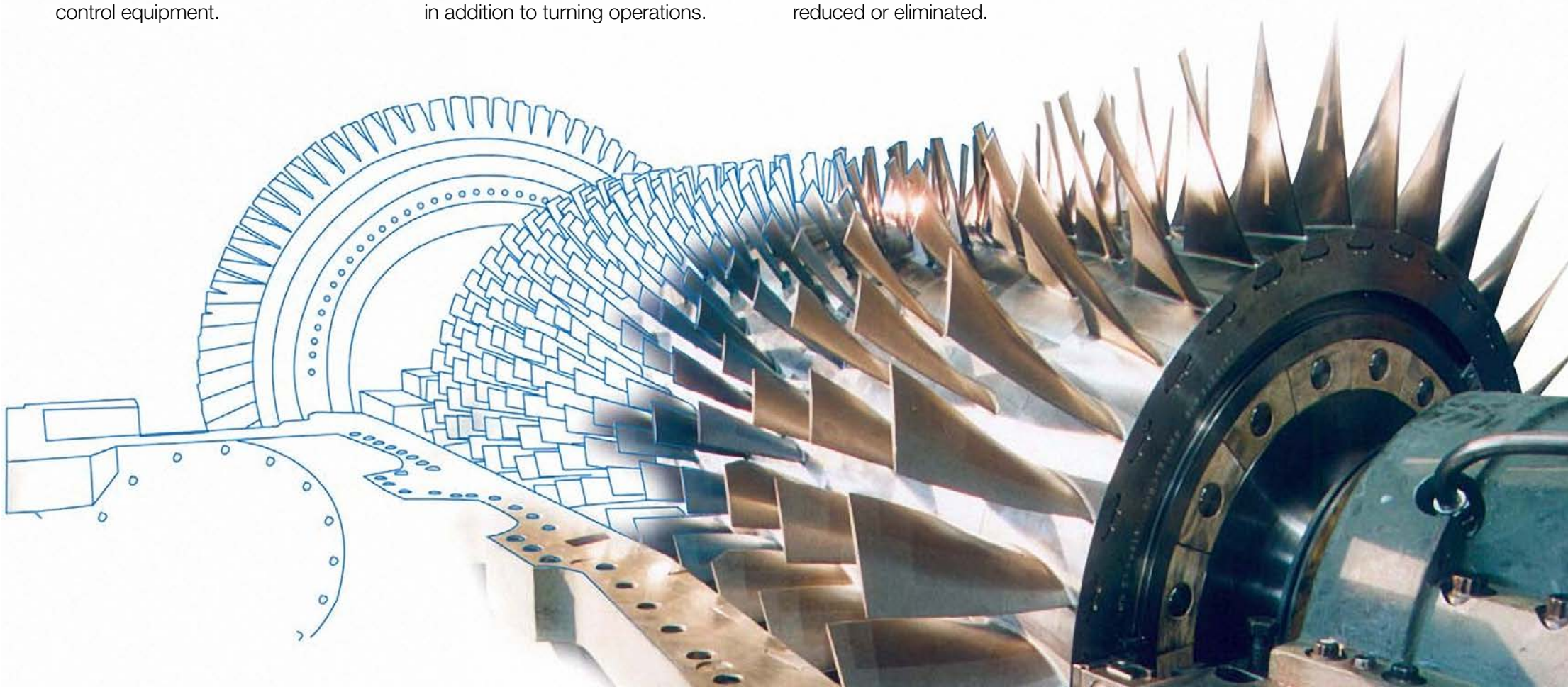


Metalex Manufacturing is a high quality, advanced technology contract machining company located in Cincinnati, Ohio. Founded in 1971, Metalex is known for producing close tolerance, complex, and challenging parts. The Metalex campus consists of three state-of-the-art environmentally controlled buildings housing milling, turning, grinding, and EDM machines, in addition to quality control equipment.

The largest machines at Metalex is a Vertical Turning and Milling Vertical Lathe built by Pietro Carnaghi. The model AP72TMY has a maximum turning diameter of 7.2 meters with a maximum turning height of 7 meters on a 6.5 meter diameter table with a load capacity of 200 tons. The table is mounted on an hydrostatic Y linear axis that moves between the columns proving 5-sided machining capability in addition to turning operations.

The machine is used to produce critical parts for the power generation, military, aerospace, energy, and defense industries. Many of these large, complex parts typically require multiple set-ups on various types of machine tools. Using the Carnaghi AP72TMY with the Y-axis table, and a variety of interchangeable turning and milling heads, the need for multiple set-ups on various machine tools is reduced or eliminated.

To complete the machining capacity the Pietro Carnaghi AP72 is equipped with a 2 continuous axis universal head, adding the feature of 5 axis interpolation.
The universal head is C and B axis interpolating with table C axis and Y axis movement (in addition to the X and Z axis), giving the possibility to perform the most complex contouring, with an high torque availability.



PIETROCARNAGHI

Volley Female Team
thanks all the supporters for
10 years
of passion and success!

Mediolanum Forum, **Milan**
Pietro Carnaghi Villa Cortese vs Foppapedretti Bergamo
Italian Championship Final - **Attendance: 7730**

2010

Rimini - Season 09/10
Italian Cup Winner

2011

Catania - Season 10/11
Italian Cup Winner

"Extract from an interview with: Chen Yu Ming - Former Chief Engineer - Senior Engineer - Shanghai Turbine Co., Ltd. of Shanghai Electric Group"

Shanghai Turbine Plant (STP in brief) of Shanghai Electric Group, built in 1953, is the first manufacturer of steam turbine in China. At the beginning of 80's, STP imported the manufacturing technology of steam turbine from WESTERNHOUSE company in USA, cooperated with SIEMENS to become a China-Germany joint venture in 1996, imported technology of SIEMENS 1000MW supercritical turbine and heavy-duty steam turbine. STP now has over 3200 employees, among which over 40% are engineering technicians, over 20% are senior engineers. STP devotes itself to design, manufacturing thermal power turbine, nuclear turbine and heavy-duty gas turbine. STP has more than 35% market share in domestic market and its turbine units are exported to India, Iran, Vietnam, Brazil, Turkey and Philippines, etc. STP's output is bigger than other suppliers and has become the biggest turbine maker in the world.

As we all know, steam turbine is mainly used to drive the generator for power supply. Steam turbine is mainly composed of rotor, blades, cylinder, isolation plate and valves, etc.. Manufacturing technology of steam turbine is complicated and it has the high machining requirements and tight tolerance control. In addition, It is more difficult to make gas turbine with higher accuracies. This needs perfect technology and quality insurance, and higher accuracies and more advanced CNC machines plus advanced tools. Otherwise, impossible to make qualified turbines.

From 2005, STP started consecutive investment, to purchase a lot of important CNC machines from abroad to meet the requirement of manufacture. I was the Project Manager for purchasing important machines, was responsible for first 10m VTL for Shanghai Electric Lingang Manufacturing Base and 8m VTL for STP project, I had to follow the complete procedure: Project Application – Introduction of Suppliers' Proposals - Tender documents Preparation – Tendering - Bidding Evaluation - Contract Signature (technical contract) - Design Review – Pre-acceptance – Final Acceptance – putting into Production.

We would make comparison between the machines from at least 3 suppliers before purchasing a CNC machine from outside of China. First, to check whether or not the CNC machine could reach our technological requests; Second, to understand its unique advantages for improving the accuracy and productivity, reliability, "hardware" and compact construction. Third, to check their reference lists. Through the investigation to their users, to understand their QC system and accuracies check standard, to investigate the machine operation status and major problems, and whether or not the problem was solved already. To know about suppliers' "commitment" and service response (including after sales service), whether or not to do what they said; Fourth, delivery time. The delivery should be on schedule so that there was no influence to our production schedule; Finally, price.

Both machines are used for manufacturing the cylinders of nuclear power and large turbine. The cylinders of 1000MW turbine are very big. The size of up-part of low-pressure external cylinder: 7,100 mm in length, 10,800 mm in width, 3,440 mm in height, weight is more than 40 tons. Only the machines which are able to machine big sizes and heavy workpieces with high quality and excellent performance can meet the needs in this field. The machine in Lingang was requested to machine diameter up to 10 m, height up to 7.3 m, with table load of 250 tons, to be equipped with advanced attachment heads and tool storage, Capto tools, Renishaw workpiece probe and tool probe, in order to improve machining efficiency and ensure machining quality. RAM travel was requested as 4 m, its section was ≥600 mm2. We made tight requests for machine its own accuracies, for roundness and roughness of machined workpieces. Generally, machining results for cylinders reached 3 "HIGH": HIGH stiffness, HIGH dynamic accuracies, HIGH reliability, to ensure long term production.

Machine model AP 100 TM-8000

10 Meters of turning capacity for steam turbines

Turning diameter	**10000 mm**
Table diameter	**8000 mm**
Turning height	**7500 mm**
Slide vertical travel	**4000 mm**
Main table motor	**170 Kw**
Table with hydrostatic bearing	**350 T loading**
Milling/drilling carriage	**71 Kw**
Ram size	**600x600 mm**

- Double disk pick up magazine for 6 accessories and 18 tools
- Camera on carriage
- Operator elevator with motorized platform

Geolocator: Shanghai

Shanghai Electric selects Pietro Carnaghi

上海电气
SHANGHAI ELECTRIC

Pietro Carnaghi is the leading maker worldwide for middle-size and large-size vertical lathes. Its market share reaches 40% in the world in this field. Its machines are high quality products, and each type of machines is integrated with the most advanced technologies and experiences in decades, in order to meet the requirements in the market. “Seeing is the believing”! When I visited Pietro Carnaghi in 2006, I saw that many high quality and new machines were in producing; I saw its 5S management and QC system, its new assembly workshops, its new machine development including large gantry milling machines. That really gave me deep impression! At that time, I also visited Siemens workshop in Germany, and saw the real machining by Pietro Carnaghi vertical turning & milling centers there. That was good enough to convince us to believe that Pietro Carnaghi had capability and experience to make CNC vertical turning & milling centers for turbine manufacturing, and to meet the requirements of our turbine industry completely.

Now, Pietro Carnaghi AP100TM8000 in Lingang Works and AP80TM6500 in our Turbine Workshop are machining large cylinders, and playing the important role for our qualified products on schedule. This also explains the above points.

I felt that Pietro Carnaghi could use new technologies in its machines to improve the machine progressiveness and reliability, and could listen to the customers with open mind to improve its jobs, because of follows:

(1) The convenience of operator’s handling and operation is considered in the design of its machines. There is specific Pietro Carnaghi MMI with graphics and data integrated into Siemens CNC 840D. For example, the pressure and the gap of hydrostatic pockets of table, the balance between both ends of crossrail and other important data are displayed and can be easily adjusted.

(2) For machine installation, Pietro Carnaghi practically considered the influence from local environment (including temperature, humidity, voltage, dust and so on), especially for safety, they took effective measurements for personnel safety. For example, the 380V/400V transformers were installed for both machines, voltage stabilizer for servo control, UPS for retroversion of 2 axes from workpiece and lubrication pumps when power failure, proper protection class of Siemens motors for hot and wet installation site, special protection painting for electrical cabinet and units from condensation, etc.. All efforts played good roles to improve the machine safety and reliability, and to reduce the machine failure.

(3) They developed specific and practical “Troubleshooting” system. The operator can follow the displayed information of error area and detailed drawing to find the problem easily and to solve the problem. This saves us a lot of repairing time and improves our productivity.

(4) They modified machine floor plan in according to the actual requests from the customer. For example, we made several times of internal discussion for the installation of our AP80TM6500, when considering machine foundation, large installation area, height of crane and transportation channel, and we felt difficult. Then, we discussed with Pietro Carnaghi, and Pietro Carnaghi provided 4 solutions for us and re-modified the foundation drawings. Finally, we got very good result.

(5) They provided systematic training for our operators and maintenance personnel during machine installation & commissioning. Before the end of machine warranty period, Pietro Carnaghi re-checked the machine and its accuracies. Their specialist came to our workshop on time when requested by us.

The company, who always considers the customers’ requests when doing machine design, machine floor plan, machine installation, machining and operation, maintenance, who provides machines with good performance and accuracies, who provides good service, is welcome for us! And that is trustable supplier.

We sincerely hope that Pietro Carnaghi would continue its efforts to provide the first class and the most efficient machines for the customers worldwide.

Pietro Carnaghi product line has established itself on the market thanks to characteristics of high precision, quality and productivity with great stock removal capacity and technical solutions in the motion of the fully hydrostatic axes. All the available solutions give the best technological machine according to the sizes of the pieces to be machined and to the precision and quality requirements of machining processes.
The application sectors: energy (nuclear, gas and steam turbines, wind mills, hydroelectric generators), jet engines (Low Pressure Turbines, Combusting chambers, Discs, Casing, Compressors), earth moving equipment, shipyard industry, aerospace, machinery for the petrochemical sector, for paper and printing industry, big forged components and high-precision bearings.
Pietro Carnaghi grants an high level of customer orientation thanks to its flexible and dynamic machine configurations (based on an experience of more than 950 installations). Each implementation is the fruit of a synergistic work among the company's departments. Thanks to the competence and experience gained in 90 years, **Pietro Carnaghi** supplies machines, processes, equipment, tools and programmes for a safe start up of complete and reliable turn-key projects.

GREAT MACHINES FOR BIG TASKS

PIETRO CARNAGHI machines match rigidity, precision and productivity

AP SERIES MACHINES FOR LARGE COMPONENTS

AC16 TM 1400

Max. Turning diameter on pallet	**1600 mm (63 in.)**
Pallet diameter	**1400 mm (55.1 in.)**
Max. turning height	**1250 mm (53.2 in.)**
Max. permitted load on pallet	**10000 kg (22046 lb)**

- Automatic tool change capability 280 tools (Capto C8, C10 and ISO50)
- Automatic setting boring bars on Capto C10

Geolocator: USA

Inveio™
Uni-directional crystal orientation

SANDVIK Coromant

New GC4325 for steel turning

Performance beyond what the eye can see

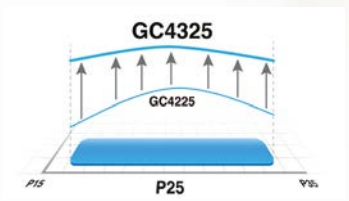
The first insert grade featuring **Inveio**™

An innovation at the atomic level has changed the face of metal cutting. The finely controlled structure of its coating guarantees that GC4325 shows longer tool life and more reliable wear in the widest range of steel turning applications.

It redefines the performance possibilities of ISO P25 and is everything you ever needed in one single insert.

Outstanding predictability
We even use x-ray to ensure optimum quality standards

Superior endurance
Keeps your machine running at the maximum



Redefining 'ISO P25'
The widest steel turning application

See the whole story at:
www.sandvik.coromant.com/gc4325

ORIGINALLY PUBLISHED IN METALWORKING WORLD 2.2011 - SANDVIK COROMANT

TEXT: HENRIK EK, GEOFF MORTIMORE | PHOTO: MARTIN ADOLFSSON

SUPER SIZE ME

Milwaukee, Wisconsin, US. It looks like a cross between a tank, a tractor and a crane. When demand for this enormous electric mining shovel more than doubled in two years, size became an issue for maker Bucyrus (now Caterpillar Global Mining).

■■■ In Lewis Carroll's *Alice in Wonderland,* the heroine drinks from a bottle that shrinks her to a tiny size. You get the same feeling standing in front of the electric mining shovel unit at US manufacturer Bucyrus' (now Caterpillar Global Mining) main shop south of Milwaukee, Wisconsin.

Let's put things in perspective. The assembled unit weighs nearly 1,400 tonnes – as much as five double-decker Airbus 380 planes. The bucket reaches a height of 18 metres when it stretches out to scoop rocks.

It's as tall as a seven-storey building, and its 120-tonne payload capacity is as big as that of two fully loaded trailer trucks.

Big is beautiful here. Since its founding in 1880 in Ohio, Bucyrus (now Caterpillar Global Mining) has been large-scale by every possible definition. Almost all the parts for the company's different mining machines, including shafts, gears, sheaves, pulleys and frame components, are produced at the main shop.

A walk around the facilities in the complex reveals an array of giant steel parts, not always easy for the untrained eye to identify. One of the biggest is a swing rack, a giant gear wheel that sits horizontally under the shovel's body and makes the unit turn. "It's our biggest part and one of three main parts we had to craft more efficiently," says John Matysiak, manufacturing engineer at Bucyrus (now Caterpillar Global Mining).

When it comes to the company's electric mining shovel, we are really talking about massive scales. A single part for such a piece of equipment could measure up to 5.5 metres in diameter.

The electric mining shovel is powered by an electric motor, one of the few parts that are not made in-house. It works as well for open-pit gold and copper mining in the Australian heat as for oil sand operations in the northern Canadian cold.

But the gigantic scale of the machines can present a challenge when it comes to mobility.

"Some of these parts weigh around 110,000 kilos," Matysiak says. "It means we can't possibly ship our whole units to the customer assembled. We do some sub-assembly right here, but sometimes the mines are at very remote locations. We have to ship everything in parts."

Just creating the three biggest parts included several steps at different locations around the complex. "We had to move the parts so many times when machining them," Matysiak says. "We had to do turning at one place and then use a crane to put the part on one of our internal railway carts to get it to another facility for gear cutting. Sometimes a part travelled several miles before [it was] finished."

This logistical problem was highlighted by a study that pointed to a future capacity squeeze. In 2005, when Bucyrus (now Caterpillar Global Mining) announced the first phase of its multimillion-dollar expansion of its South Milwaukee manufacturing facility, the company believed that demand for electric →

AT A GLANCE

FOUNDED: 1880 in Bucyrus, Ohio
OWNERSHIP: Entered into merger agreement with Caterpillar in 2010
LINE OF BUSINESS: Maker of surface and underground mining equipment
MAIN PRODUCTS: Draglines, electric mining shovels, blast hole drills
NUMBER OF EMPLOYEES: 10,000
TURNOVER (2009): 2.65 billion US dollars.

Single parts can be 5.5 metres in diameter and weigh well over 100,000 kilograms.

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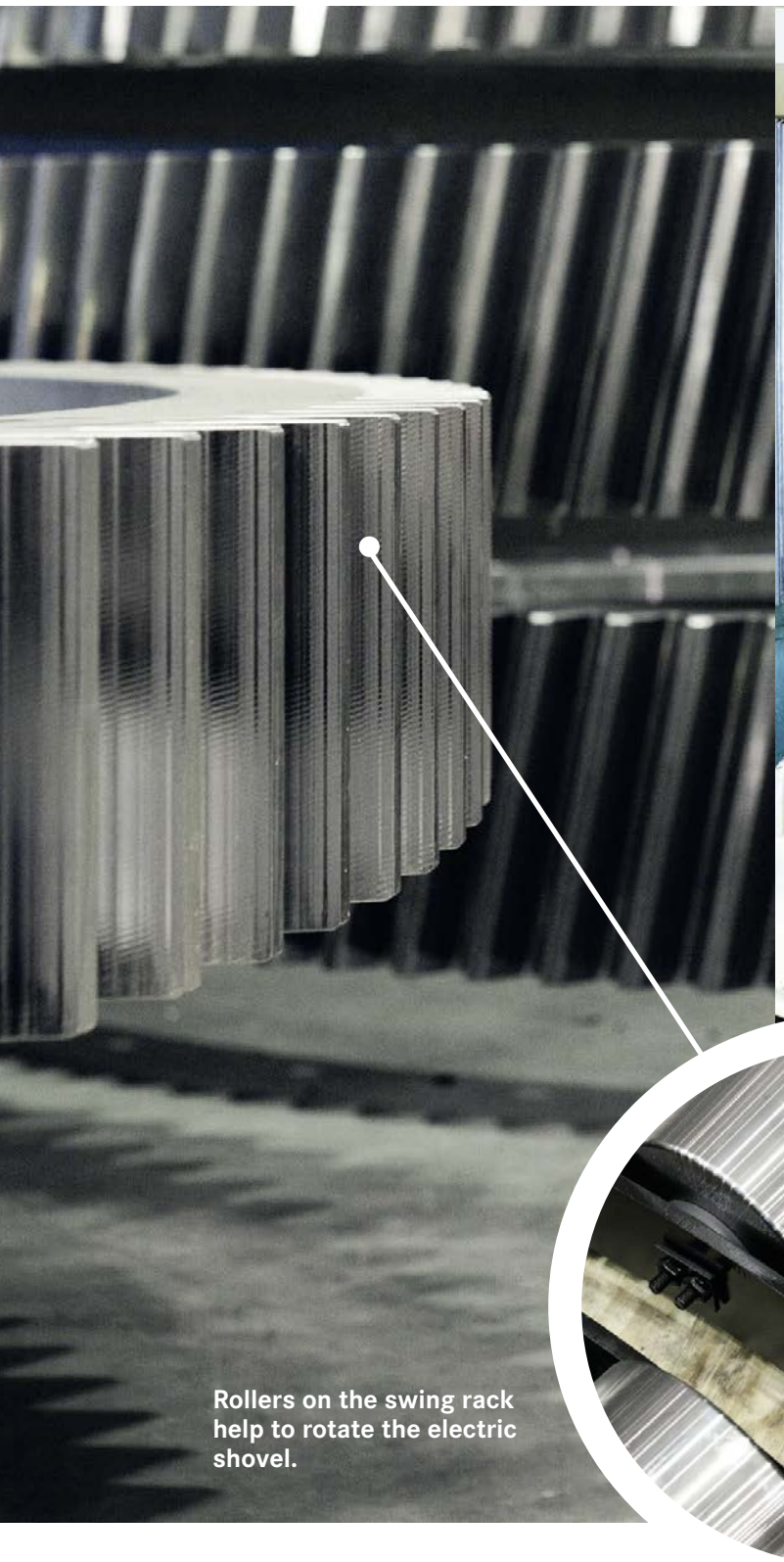

Rollers on the swing rack help to rotate the electric shovel.

The five-metre table PietroCarnaghi machine can turn, drill, bore, tap and mill in one setup.

THE CHALLENGE IN BRIEF

THE CHALLENGE:

To meet rising demand for the electric mining shovels, forecast to increase significantly, as well as capacity constraints in three key components.

THE SOLUTION:

Sandvik Coromant had to find the most efficient tooling solution for the machine, which could handle turning, milling, drilling, boring and tapping of these components. It did so in a twin-column, live-tooled five-metre table 200 HP VTC from Pietro Carnaghi.

THE RESULT:

The new machine reduced the number of setups on all parts, leading to considerable cost savings and 19 percent in lead time, equal to several days. ■

> “ Previously we made eight to 10 units a year. We were told that over a two-year period that number would go up to 24. ”
>
> **JOHN MATYSIAK, MANUFACTURING ENGINEER AT BUCYRUS (NOW CATERPILLAR GLOBAL MINING).**

→ mining shovels would increase significantly in the coming years because of growing global demand for coal, copper, iron ore, oil sands and other commodities.

“Previously we made eight to 10 units a year,” Matysiak says. “We were told that over a two-year period that number would go up to 24.” The current capacity for electric mining shovels is just over 30.

Bucyrus (now Caterpillar Global Mining) also manufactures blasthole drills, used to drill holes and plant explosives in harder types of rocks. Occasionally it also receives an order for a dragline, a huge crane-like shovel. As orders increased, it became clear that the existing process wasn’t fast enough to meet the demand.

The company took a close look at the capacity constraints on three key components – the swing rack, hoist drum and hoist drum gear - all very large and manufactured in the same time-consuming process that required shipment to various departments for completion.

Bucyrus (now Caterpillar Global Mining) found what it was looking for in a twin-column, live-tooled five-metre table 200 HP VTC from Italian manufacturer Pietro Carnaghi, which can turn, drill, bore, tap and mill in one setup. This instantly reduced the number of setups on any given part, saving significant time and money.

Sandvik Coromant was chosen to find the most efficient tooling solution for the machine, involving both the Italian and American Sandvik Coromant organizations (see sidebar).

Bucyrus (now Caterpillar Global Mining) also reduced lead time, according to Matysiak. Additional savings came through reduced queue time and transport costs as well as improved quality of the components.

For Sandvik Coromant, not only is it the first time it has been involved in a start-up project with Bucyrus (now Caterpillar Global Mining), but it also marks a success for its “Right from the Start” campaign on an international level, involving many different levels of Sandvik Coromant in two countries. ■

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TECHNICAL INSIGHT

Big business

With demand ramping up fast, Bucyrus (now Caterpillar Global Mining) had only one option: to get a new and efficient machine centre.

The objectives were clear. A study showed that Bucyrus' (now Caterpillar Global Mining) weakest point was in the big turning facility. The company needed a new machine centre, but it also wanted:

- A more cost-efficient cutting process
- A machine that would help reduce handling and transport of large parts
- A machine that would fit in the large turning facility.

"Not many manufacturers could meet those demands," says John Matysiak, manufacturing engineer at Bucyrus (now Caterpillar Global Mining).

Italian machine tool builder Pietro Carnaghi could. At the same time, Bucyrus (now Caterpillar Global Mining) faced tooling options, and Sandvik Coromant was involved from the start to find the most efficient solution.

"We hadn't worked with Sandvik Coromant before, but we knew they were capable when it came to turning," Matysiak says.

Lyle Schmaus, sales engineer at Sandvik Coromant.

The order to Pietro Carnaghi included turn keys for the three main parts: the swing rack, which enables pivoting for the shovel body; the hoist drum, which hoists the cable for the shovel; and the hoist gear, which turns the drum.

The machine was to be fitted with Coromant Capto C8 clamping units from Sandvik Coromant for all the OD and ID tool blocks. Sandvik Coromant Italy prepared process layouts, time studies and tool lists. Bucyrus (now Caterpillar Global Mining) received this information from Pietro Carnaghi and contacted Sandvik Coromant US for input. To deal with process and tool selection issues, Sandvik Coromant US worked as a mediator between Pietro Carnaghi, Sandvik Coromant Italy and Bucyrus (now Caterpillar Global Mining). The Sandvik Coromant US group out of Pontiac, Michigan, was also involved.

The finalized list of required tools, including Coromant Capto C8 clamping units, CoroDrill 880 drills, Duobore and CoroBore boring tools and a variety of milling cutters, was approved by the customer and by Pietro Carnaghi. When the machine was shipped, Sandvik Coromant US provided daily support to Pietro Carnaghi and Bucyrus (now Caterpillar Global Mining) through all the required run-off parts.
Numerous changes had to be made to tool type, insert grade and geometry and processes in "real" time in order to achieve the aggressive run-off schedule.

"The people at Pietro Carnaghi had only seen two-dimensional drawings of the parts. Sometimes you have to see a part in real life to fully understand how to craft it," says Lyle Schmaus, sales engineer at Sandvik Coromant.

"Lyle and Sandvik Coromant were with us from the start and gave us real-time support in the early stages," says Matysiak. "Lyle spent about five weeks here."

The Pietro Carnaghi machine was installed in 2009 and became fully operational in mid-2010.

"It's even on over-capacity," says programmer Neil Cramer. "It's working so well that all the engineers have started putting everything in here, not only the three original main parts." According to the numbers, Bucyrus (now Caterpillar Global Mining) has made all the right choices.

Says Matysiak: "We were aiming for a 25 percent cost reduction. On average we're at 44 percent, which is very exciting. In transportation we're down 66 percent and in lead time19 percent. That equals many, many days." ■

Originally published in *Metalworking World* 2.2011 - *Sandvik Coromant*

PIETROCARNAGHI
Machine Tools

High rigidity for small diameter machining

Pietro Carnaghi developed machines with high rigidity, precision and productivity for table size of 800, 1000, 1200 mm

Pietro Carnaghi product line has consolidated to offer the advantages of massive and huge machines…even on the smaller applications.
The new design lines for 800 -1000-1200 mm table, only Turning or Vertical Multitask Turning & Milling Centres, are focused for production of components in the fields of jet engines (Low Pressure Turbines, Combusting chambers, Discs, Casing, Compressors), gearboxes, aerospace, high-precision bearings.

AC16 TM 1400

Max. Turning diameter on pallet	**1600 mm (63 in.)**
Pallet diameter	**1400 mm (55.1 in.)**
Max. turning height	**1250 mm (53.2 in.)**
Max. permitted load on pallet	**10000 kg (22046 lb)**

- Automatic tool change capability 280 tools (Capto C8, C10 and ISO50)
- Automatic setting boring bars on Capto C10

Geolocator: USA

The experience of **Pietro Carnaghi** grants the best approach to the even more challenging exotic materials (Inconel, titanium, special alloys)
The main characteristics of these machines have been developed on the experience in a wide range of critical machining conditions.

- Special bearing solutions to ensure minimum deformation in X and Y direction
- New concept for heating control
- New line of spindles, with enhanced control of axis positioning
- Minimal maintenance
- Machine accuracy constancy
- Faster rapid movements (up to 40 meters)
- Innovative tool & accessory change solutions
- Compact layout, optimized on Customer's floorspace

Pietro Carnaghi supplies machines, processes, equipment, tools and programmes for a safe start up of complete and reliable turn-key projects.

These machine are the perfect solution for the most challenging production needs, and can be integrated in **Pietro Carnaghi** FMS systems with the most advanced Production Control Software developed on Customer's needs (see page 15).

AC16 TM T P 1250

Max. turning diameter	**1600 mm**
Table diameter	**1250 mm (1400 mm)**
Max. turning height	**1400 mm**

- Available different configurations with fixed or movable crossrail, basic machining capability can be only for turning (version T) or with live spindle solution for milling/drilling (TM) with 37 kW.
- All machining axis are hydrostatic type and there's fully automatic tool and accessory change and storage systems (rack type, robot arena, or disks + chains).
- There is optional rotational pallet system with no. 2 table pallets.
- A twin carriage configuration is available for more effecting material removal or for thin profile machining
- Application: jet engines

Geolocator: Germany

AC24 TMY 2000

Workable diameter on the pallet	**2400 mm**
Pallet diameter	**2000 mm**
Max. turning height	**1000 mm**

- Y axis movable table for off-center machining
- Machine fully hydrostatic
- Universal head with continuous B axis
- Application: jet engines

Geolocator: Spain

ATF12 TM 1000

Max. turning diameter	**1200 mm**
Table diameter	**1000 mm, or 800 mm**
Max. turning height	**1200 mm**

- A Y axis head may be added to complete the machining capacity
- Vertical lathe Pietro Carnaghi model ATF 12 TM has turning, milling and drilling capabilityThe design is single-column frame, with a very compact design, without reducing the machine rigidity, that permits to obtain consistency in the performances in years and years of the most challenging machining.
- The basic machining capability can be only for turning (version T) or with 37 kW live spindle solution for milling/drilling (version TM).
- All machining axis are hydrostatic type and there's full automatic tool and accessories loading/unloading with toolchain and accessory storage magazine (rack type, robot arena, or disks).
- There is optional rotational pallet system with no. 2 table pallets. With this solution the workpiece setup time can be done in masked time, when the vertical lathe is machining. High pressure coolant package available to reach up to 350 bar at the tool.
- Pietro Carnaghi has a wide range of different accessories, for turning, drilling, milling, boring, grinding operations.

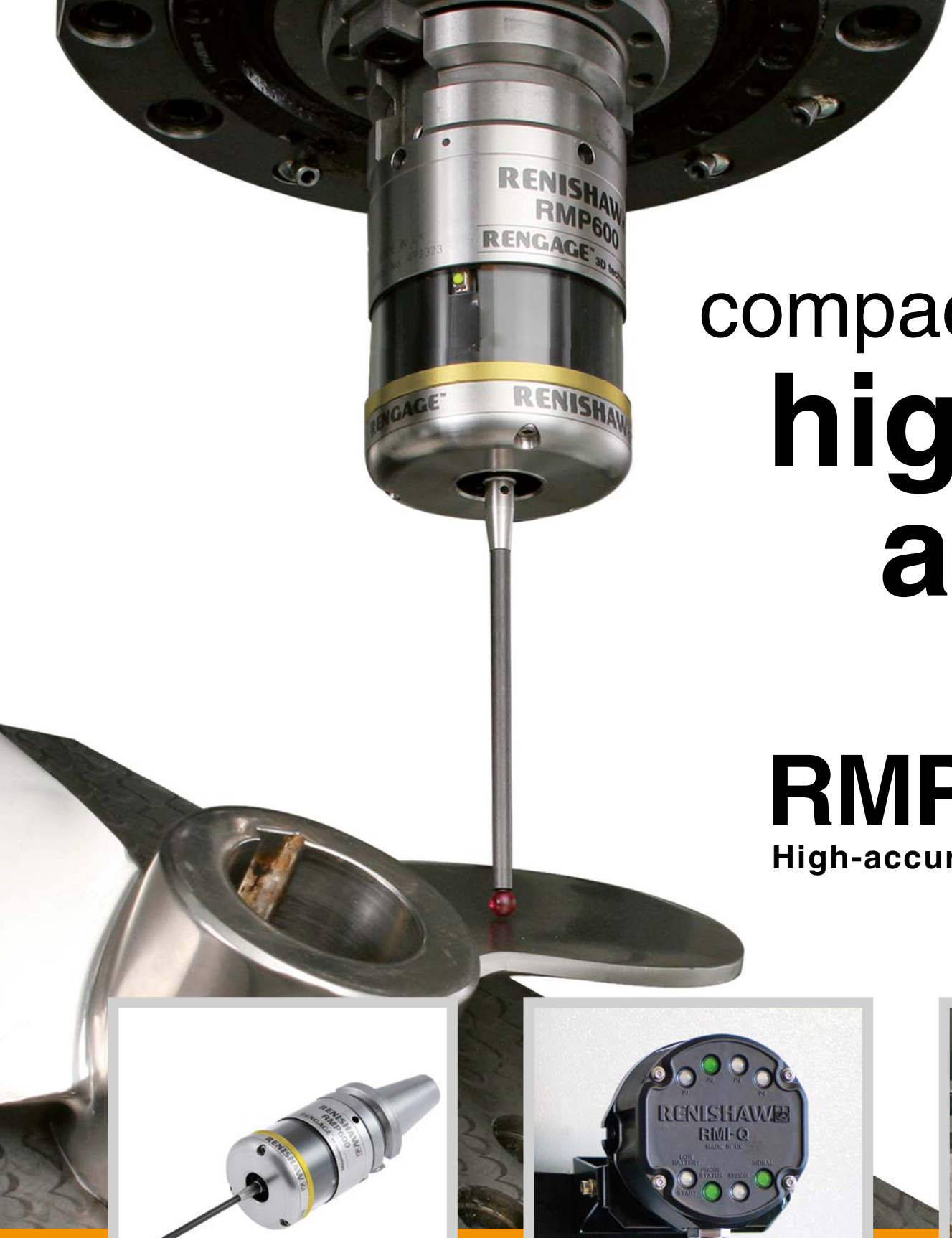
Geolocator: Sweden

ATL 12 T

Max. Turning diameter on pallet	**1200 mm**
Max. turning height	**1000 mm**
Table diameter	**1000 mm, or 800 mm**

- Compact design, no foundation required
- All machining axis are hydrostatic type and there's full automatic tool and accessories loading/unloading with tool and accessory storage magazine (rack type, robot arena, or disks).
- Rotational integrated pallet system with no. 2 table pallets.
- Application: jet engines, turbine disks

Geolocator: Spain



RENISHAW
apply innovation™

compact in size
high in
accuracy

RMP600

High-accuracy radio inspection probe

The excellent 3D performance of RMP600 is ideal for high precision, 5-axis and mould and die applications where probing of contoured surfaces to a high accuracy is required.

The Renishaw RMP600 is a compact, high accuracy touch probe with radio signal transmission, offering all the benefits of automated job set-up, plus the ability to measure complex 3D part geometries on all sizes of machining centres.

Simple set up

Once installed, reliable communications are assured within the industrial environment.

Compact and robust

The RMP600 is ideal for machines of all sizes and can access surfaces cut with short tools. Its robust stainless steel body makes it suited to the harshest machine environments.

Ideal for retrofit

The RMI (a combined antenna and interface) can be positioned anywhere near the machine, resulting in a fast installation. The RMP600 system is ideal for retrofitting to machines with no previous probing or as an upgrade.

Call +39 0119661052 or visit www.renishaw.it

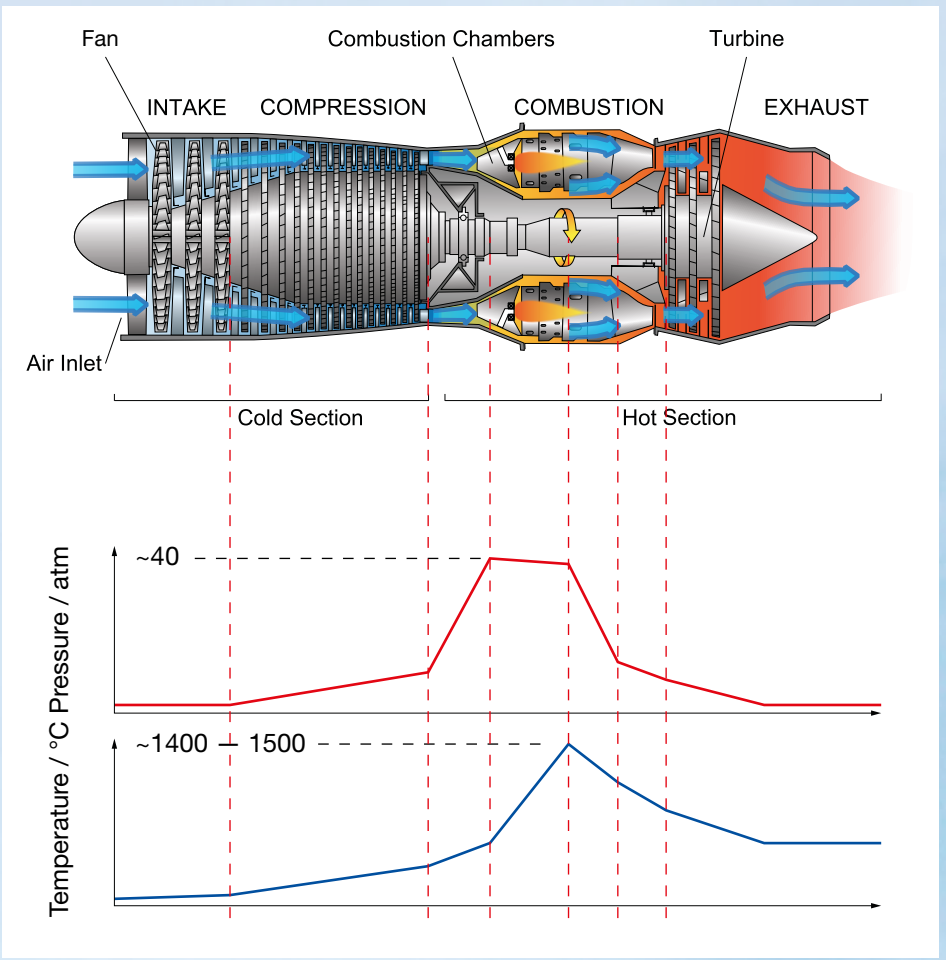
Renishaw SpA, Via Prati 5, 10044 Pianezza (TO)
T 0119661052 **F** 0119664083 **E** italy@renishaw.com

Jet engines machining by Pietro Carnaghi

HOW IT WORKS?

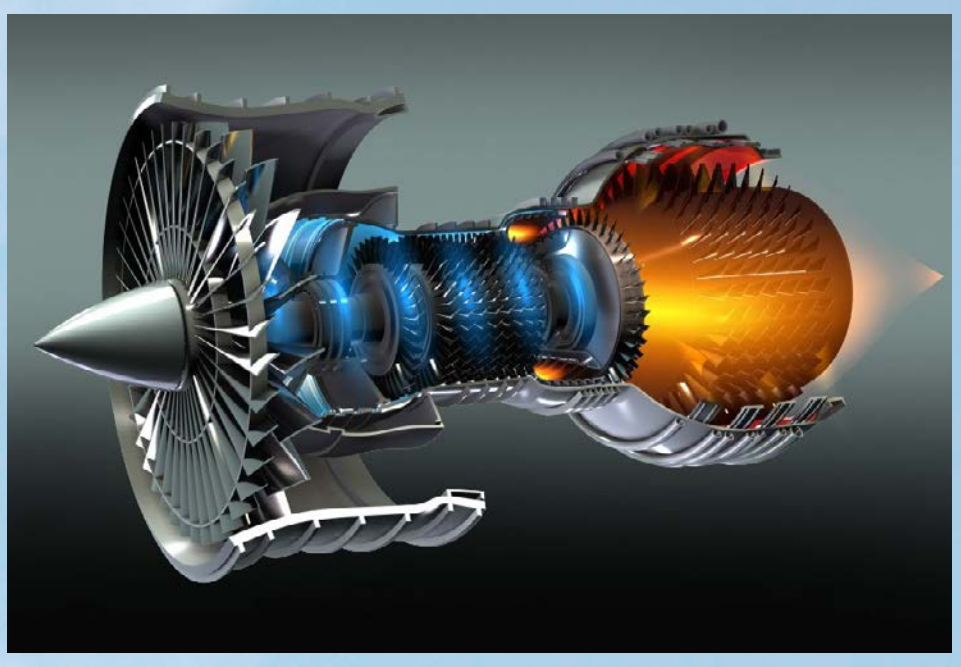
The jet engine can be divided into three main section, all connected through a long shaft:
- Compressor
- Combusting chamber
- Turbine

Each section prepares the air to to gain the needed energy to provide the airplane the thrust necessary to move forward or, in other words, to fly.



This high pressure gas is then injected by fuel, inside of the combusting chamber. An electrical sparkle ignites the mixture, resulting in a controlled combustion. At this stage the high pressure, high temperature produce a very fast flow of burning gas, with a huge amount of thermal and kinetic energy. Passing the turbine, through a sequence of stationary and rotary disks with blades, the flow is released through the shroud, to generate the needed thrust to move forward the airplane.

A part of the energy generated inside the combusting chamber is used by the turbine to generate the needed power to rotate the shaft, leaving anyway a net thrust that can reach 400kN (40 tons, or, in other words, the weight of 40 small utility cars). The rotation of the shaft generated by the turbine, produce a positive amount of work used by the compressor, that inflate new, fresh air into the combusting chamber, in a self-sustaining process.



WHICH PARTS PIETRO CARNAGHI VERTICAL LATHES MACHINE?

Of course different section of the jet engine requests different material, that has to fulfill all the engineering needs, like thermal stability, thermal expansion, fatigue resistance, high temperature creep resistance and so on. Engineers has developed new type of material, able to fulfill all these demands, leaving the whole system as light as possible, to reach the maximum ratio power/weight. The so called “cold” section of the engine (the compressor side, together with the fan), is normally made out of titanium alloy, such as the world famous 64 (Ti6Al4V) or the newest Ti-5553 (Ti5Al5Mo5V3Cr). Strong and light weight material, turning and milling operation on this composite is a really demanding operation for both the tool and the machine tool. The well know strength of the **Pietro Carnaghi** machines (Vertical turning center, or Multitasking center) fulfill all the demands of torque needed in milling operations, with a full range of accessory heads with a superior stiffness able to achieve heavy cut with disk cutter and long edge shoulder mills. Typical component machined are fan cases, compressor disks and stator disks, impeller, mount ring and inner ring.
Combusting chamber is the connection point between the so called “cold” engine area and “hot” side: from this point on, the demands in terms of material are different, looking at the thermal stability and thermal expansion. This is the domain of the heat resistance super alloys, or Ncikel base super alloys (like Inconel 718, Renè 41, Waspalloy …), where the key point in terms of machining approach is the temperature. Because of their very low thermal conductivity factor, these material need a special approach to turning and milling operations: while in turning the high pressure coolant, together with new insert’s material (like CBN and Ceramic) is the real advantage to increase productivity and reach a stable and consistent process, in milling high torque at low rpm is needed, together with a superior stiffness and rigidity in either the structure of the machine and the attachment heads.
Pietro Carnaghi, thanks to its decades experience in high pressure coolant, has a relevant applications experience, with different customer machining disks, combusting chambers, shroud and turbine vanes. With **Pietro Carnaghi** Vertical Lathes, having the Y axis feature available, each customer can ensure the complete machining process on a single stable machine, saving set up times, fixtures and machine operator time.

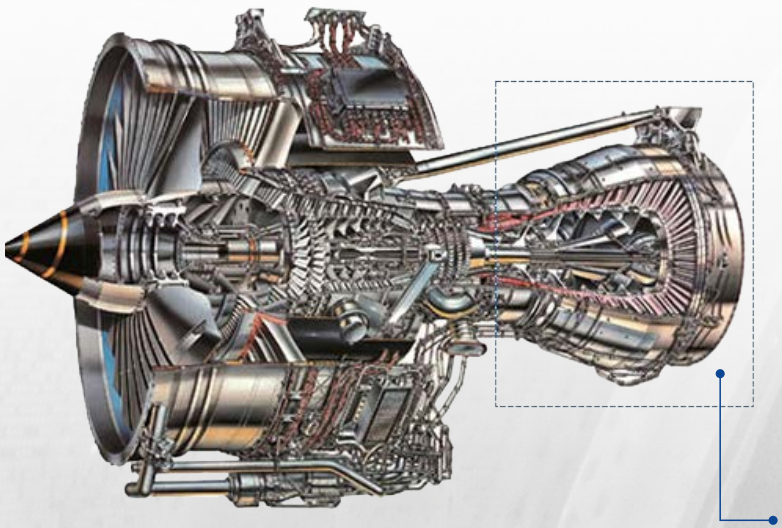
PIETROCARNAGHI Machine Tools

the power of talent

Pietro Carnaghi machines for jet engines components installed in ITP Group, Bilbao (Spain)

The ITP group, made up of SENER (53.125%) and Rolls-Royce (46.875%), includes among its activities such areas as Design, Research & Development, Manufacture and Casting, as well as the Assembly and Testing of aeronautical engines and gas turbines. It is also the official maintenance service provider for the majority of the world's currently active engine manufacturers. The ITP Group has 18 production centres in Spain, Great Britain, Malta, the USA, India and Mexico, and a staff of 2,950 workers.

ITP Main Production

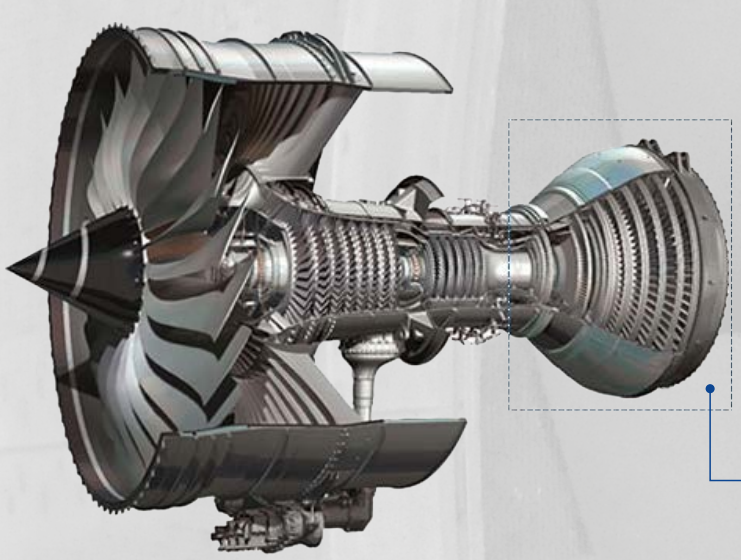


TRENT 900	
Airframe	Airbus A380 - A380F
Thrust	70,000 lb - 80,000 lb
Fan Diameter	116 in

ITP responsibility
Low pressure turbine (design, manufacturing and assembly): NGV1-5, Discs 1-5, casing, seals, TBH and RBS.

TRENT 1000	
Airframe	Boeing 787 "Dreamliner".
Thrust	53,000 lb - 75,000 lb
Fan Diameter	112 in

ITP responsibility
Low pressure turbine (design, manufacturing and assembly): NGV1-6, Discs 1-6, casing, seals, TBH and RBS.



XWB	
Airframe	Airbus A350 XWB -800, -900 & -1000
Thrust	74,000 lb - 92,000 lb.
Fan Diameter	118 in

ITP responsibility
Low pressure turbine (design, manufacturing and assembly): NGV1-6, Discs 1-6, casings, seals, TBH and RBS.

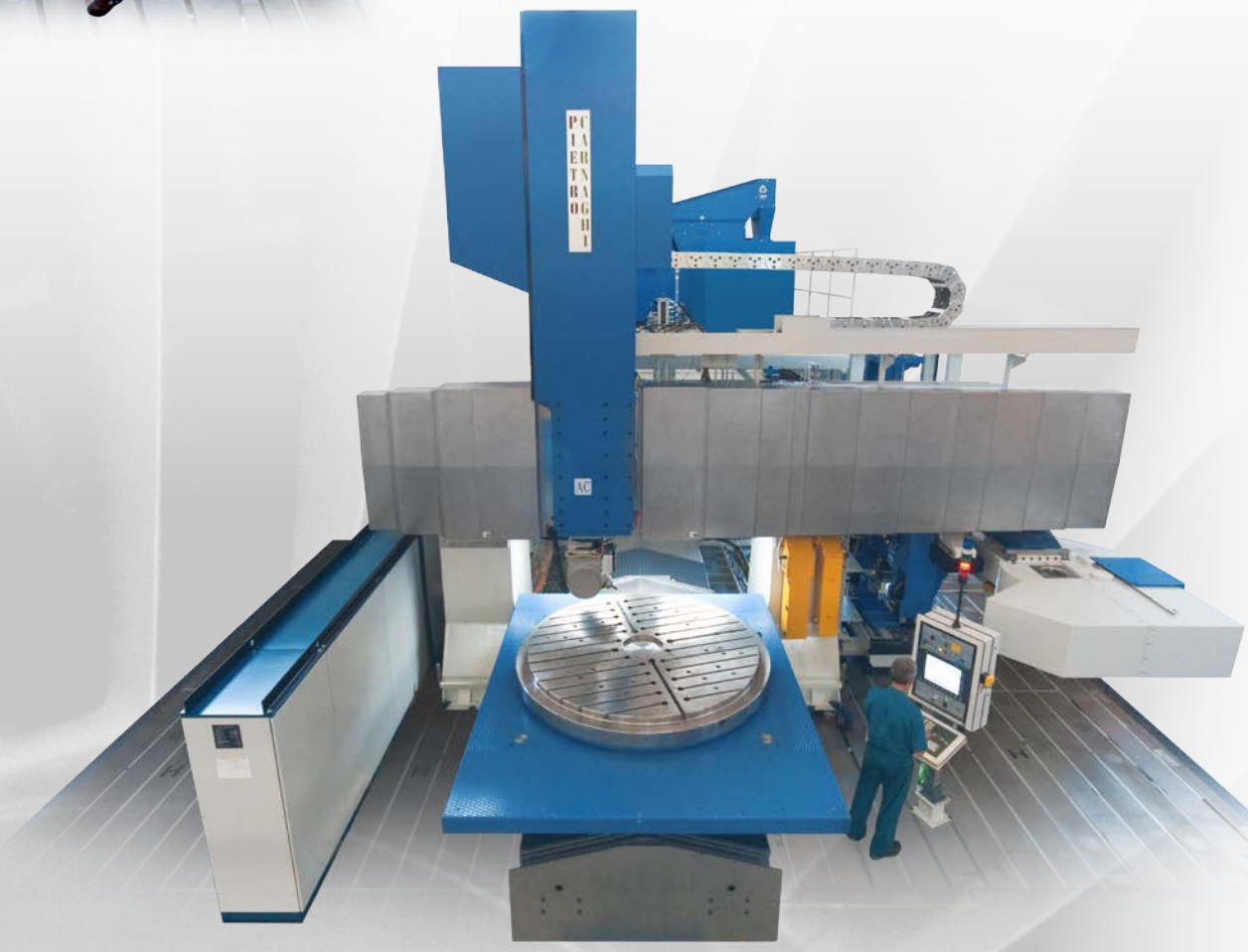
Pietro Carnaghi for ITP production

Rotating pallet system

ITP selected Pietro Carnaghi technology and confirms investments in vertical lathes for the next year.
Pietro Carnaghi supply to ITP several machines, with turning diameter from 800-1000 to 2400 mm.

Y axis moving table and multiple axis universal head

Machining features include turning operation, milling and drilling and Y axis interpolation (moving table feature). Numbers of machines are equipped with rotating pallets, to minimize the time dedicated to loading/unloading operations. Multiple axis universal heads ensure to cover all operations to be done on the components. A series of special accessories have been developed by Pietro Carnaghi, in order to meet ITP machining needs and guarantee the best performance achievable.



Tool magasize rack type

High capacity tools storage have been guaranteed by means of different types of solutions: chains, multi-level rack systems.

PIETROCARNAGHI
Machine Tools

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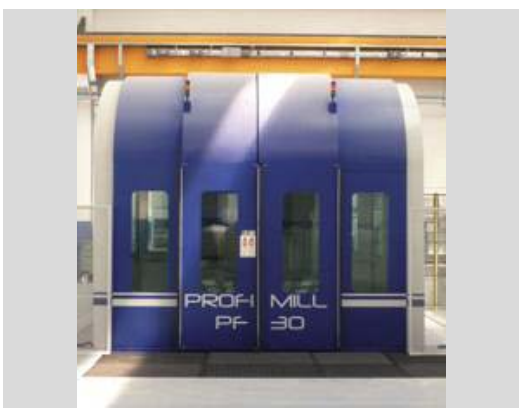
The new generation of finish machining



FLY is a highly technological reality, specialized in the mechanical finishing, welding, coating and assembly of components in light alloys, metallic alloys and super alloys for critical structural use in the most advanced industrial sectors. FLY is a modern and young company born in 2008 from an idea of Forgital Group, an internationally-know leader in the production of seamless hot forged rings. The main purpose has been to create a highly technological machining center that could verticalize a particular production process, the finish machining, integrating it in an already well-established Supply Chain. In the Group this offer is called “Compact Supply Chain™”, a system that can provide complete solutions to improve and simplify the production process through the deep integration of technologies and services, from the forging piece to the finished product.

The main markets for FLY products are:
- Gas and steam turbines
- Nuclear power
- Aeronautics (both Aero engines and Aero structures)
- Aerospace (Space launchers)
- Chemical reactors (Using corrosion resistant Alloys)
- Deep water equipment (Using duplex and super duplex).

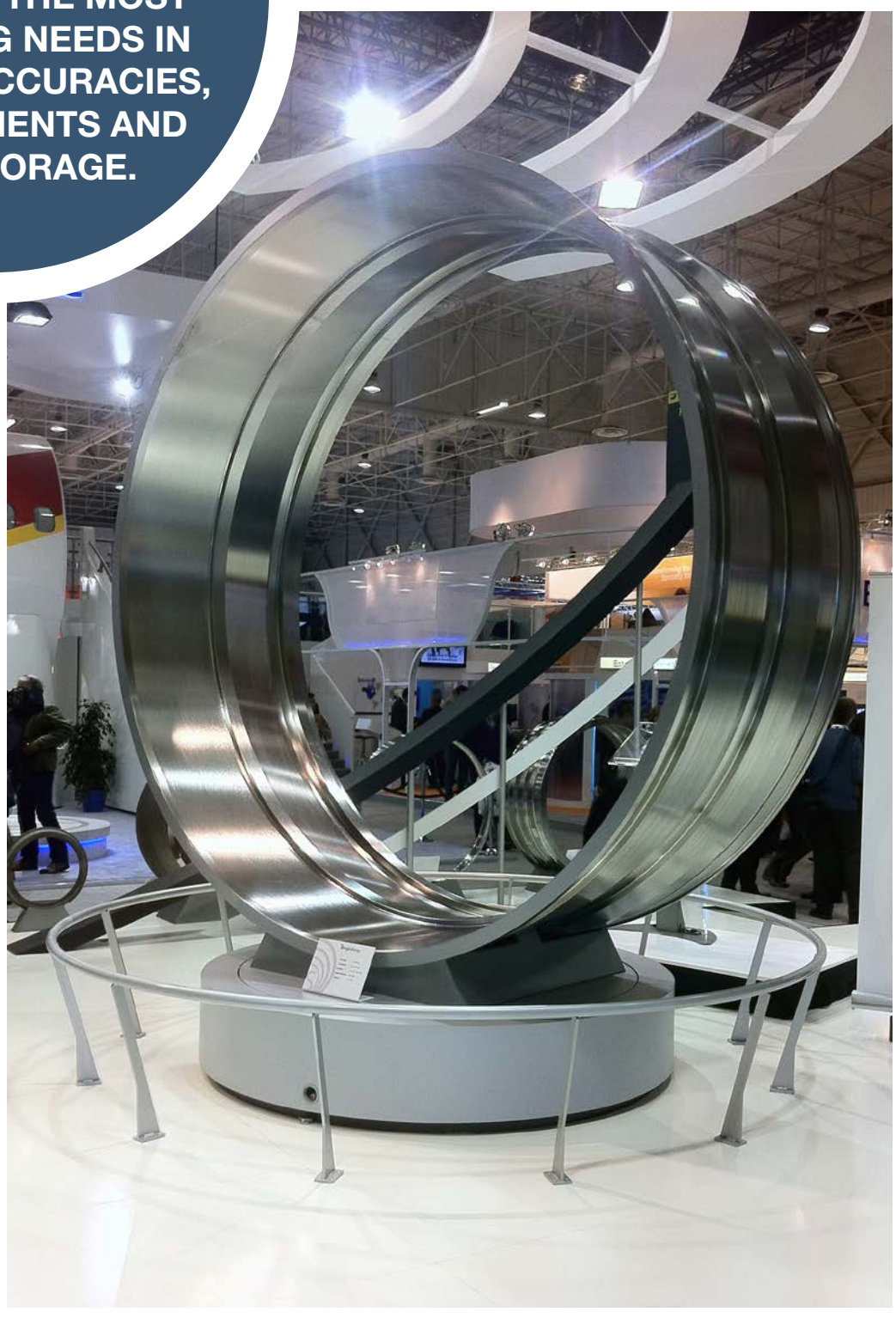
FLY can provide products and services to OEMs (ORIGINAL EQUIPMENT MANUFACTURERs) for complete, finished parts, as well as to Subcontractors.

The machining shop can work medium and large-sized components (diameters from 400 to 4000 mm).

FLY project has been designed since the beginning to be a top level machining site:
- N° 8 Pietro Carnaghi VTL up to 3.6 meters 3 & 5 Axis, Milling and Dril ling
- N° 1 Pietro Carnaghi FMS with pallet Excenger
- N° 2 Milling Center
- N° 1 Profile Mill up to 3.5 meters
- N° 1 CMM DEA Mesuring machine up to 5 meters
- N° 1 Welding Cell
- N° 1 X-ray Bunker for inspection
- N° 1 FPI Station
- N° 1 Sand blasting & Coating station
- N° 1 Assembling area

In FLY, all the efforts are deeply focused to meet customer’s needs through excellence. The way to reach this ambitious goal is the perfect integration of Fly in the Forgital Group Compact Supply Chain (CSC™), with the specific role of “Integrated Solutions Lab”, acting as a laboratory and transferring competences and skills to the CSC TM. To reach excellence, also collaboration with high technological partners is a Key factor. That’s why Fly since its beginnings is working in deep cooperation with Pietro Carnaghi, to define and study the best machines tools suitable for the important projects Fly is involved in.

PIETRO CARNAGHI SUPPLY MACHINES FOR JET ENGINES COMPONENTS, AND COVER ALL THE MOST DEMANDING NEEDS IN TERMS OF ACCURACIES, MEASUREMENTS AND TOOL STORAGE.



PIETROCARNAGHI Machine Tools

Cool down and watch productivity rise

The combustor chamber of an aeroplane engine is made of exotic materials such as titanium and nickel base alloys. Because of its size - up to 2 metres in length and 1 metre in height - manufacturers must use long overhangs.
Italian machine tool builder **Pietro Carnaghi** has created a solution for its vertical lathes that uses high-precision coolant that is sprayed on with a pressure of up to 500 bars to create better results when manufacturing such components. The result: productivity improvements of 30 to 50 percent. “This achievement is a result of several factors in addition to pressure,” explains Mario Ottolenghi, area manager for **Pietro Carnaghi**. “The most important is that the coolant is sprayed on the exact spot where the insert hits the material.” He points out that the correct use of coolants can improve the cutting data for many difficult-to-manufacture components within the aerospace industry.
“The high static rigidity combined with the high damping capacity of the hydrostatic guide means that we can shorten the cutting time, even in situations where the ram has a high overhang.”

Exctract from “Metalworking World” by Sandvik Coromant

SHUTON, Technological excellence in development and manufacture of High Precision Ballscrews

SHUTON COMPLEX BALLSCREWS

- High rigidity with low preload torque
- Higher dynamic and static load capacity
- Long durability, preload conservation
- Low temperature, minimized friction
- Smooth rotation
- High efficiency and performance

HIGH DYNAMICS SHUTON COMPLEX

- DN >200000
- Minimum temperature
- Higher preload conservation in extreme conditions
- Feed Speed up to 100m/min
- Acceleration up to 15m/s2
- Higher control parameters Kv and Kp

SHUTON COMPLEX SPECIAL SERIES

- Special diameters
- Length up to 15m in single piece
- Peak load ballscrew
- Thermal expansion control ballscrews
- Special antirust treatment balllcrews
- Nut rotation system
- Technological solutions for deflection reduction

NEW SHUTON HDL

- Solutions with higher dynamic & static load capacity
- Machine tool, Injection molding and press applications
- Reduced noise level
- Higher Speeds
- Higher Durability

NEW SHUTON i +

- Extended range for optimised performance:
  - Increased circuit quantity: benefits in load capacity, rigidity, life and maximum force
  - Reduced nominal diameter: benefits in temperature, noise and energy consumption

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PIETRO CARNAGHI

Machine Tools

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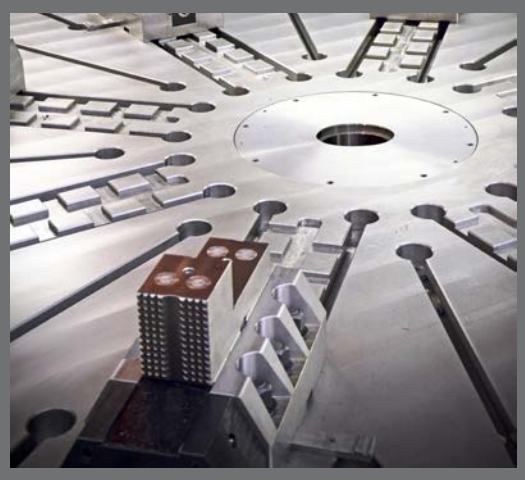

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