



machine tools for
shipbuilding industry



RAFAMET

>>> RAFAMET S.A.

Comprehensive solutions, advanced technologies and cost efficient productivity now much more than ever before are obvious requirements that the right equipment supplier is expected to meet in order to help various industries to be successful, to stay competitive in this global manufacturing market.

- For more than a century, RAFAMET has served to meet the diverse needs of the metal-working industry. Today RAFAMET SA is one of the world's leading builders of innovative and productive machine tools.

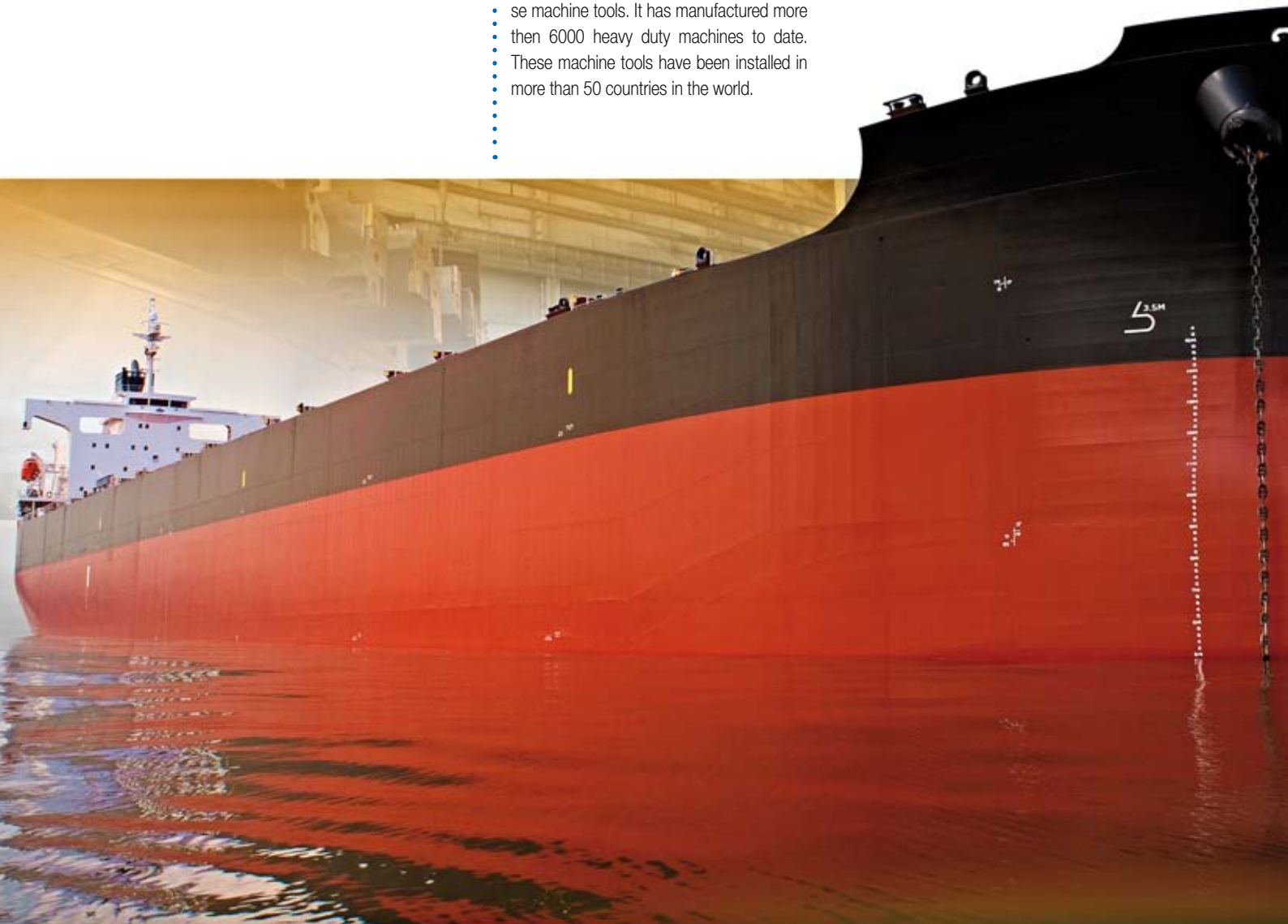
- At the beginning of the twentieth century the foundry shops then existing began producing wheel lathes for machining railway wheel sets. This type of production continues up to the present day.

- Since then RAFAMET has developed its products to include special purpose wheel lathes for railways and multi-purpose heavy duty single and double column vertical turning and boring mills.

- Over the years the Company has become one of the largest suppliers of special purpose machine tools. It has manufactured more than 6000 heavy duty machines to date. These machine tools have been installed in more than 50 countries in the world.

Whilst maintaining its traditional production, RAFAMET continues to develop new product lines, using the Company's own, engineering task force. Such a development, in recent years, has helped RAFAMET to be able to enter new manufacturing fields, i.e. bridge type milling machines, horizontal lathes, special machines, modular machining centres etc.

Simultaneously RAFAMET has developed the customer service and support program. It's total commitment to customer satisfaction has become a daily routine for the entire RAFAMET's staff. Moreover RAFAMET has been working in the ISO 9001 Quality Assurance/Management Standard environment since 1996.



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ISO 9001

BUREAU VERITAS
Certification

N° 199857



Our work is based on the ISO 9001 quality system, which is continuously being improved and our principal goal is the complete satisfaction of our Customers.

FS 550 CNC

Special Milling Machine

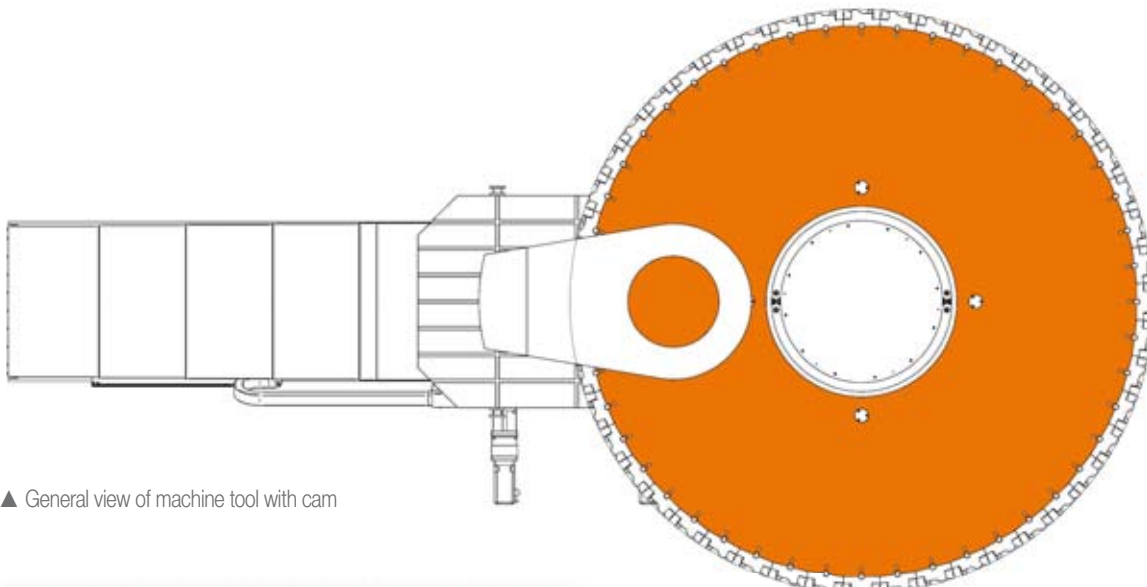
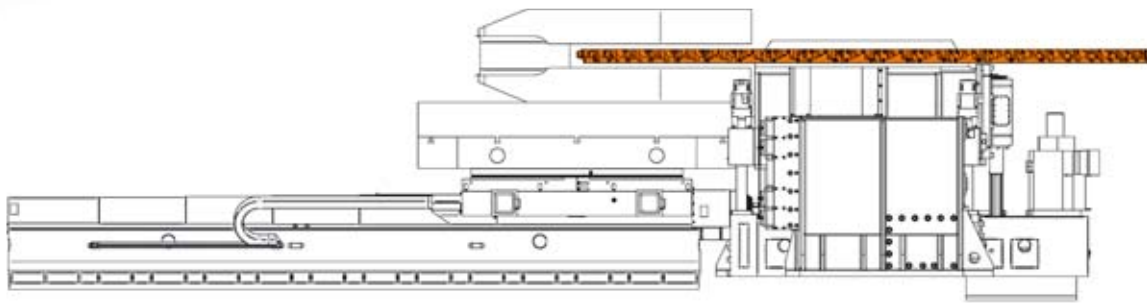
The machine tool is specifically designed to perform heavy-duty milling covering the following operations:

- Roughing and finishing of crankshaft cam webs
- Roughing and finishing of crank-pins

The cutting process is fully controlled by a latest Siemens SINUMERIK 840D CNC system to provide an automated and productive machining of the cams in a selected process range.

FS 550 CNC Milling Machine basic members are a milling unit and a rotary and movable table on which the cams are clamped. The machine tool is provided with a chip evacuation system consisting of two belt-type conveyors.





▲ General view of machine tool with cam

Technical specification FS 550 CNC

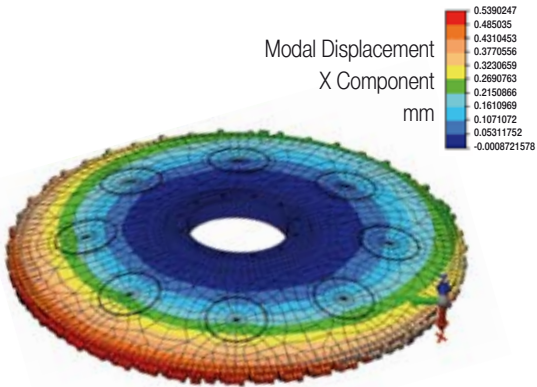
Milling unit:	
Diameter of milling cutter	5500 mm
Max. milling depth, approx.	2000 mm
Width of milling cutter	130 mm
Rotation rates of milling cutter	0.5 - 10 rpm
Vertical travel of milling cutter	400 mm
Power of milling cutter rotation drive	150 kW
Rotary table:	
Table surface	2000 x 3000 mm
Travel of table slide base along bed	3000 mm
Speed of table slide base travel	1 - 4000 mm/min
Table rotation rates for milling	0.5 - 1 rpm
Max. load of table	20 Mg

The milling unit drives a milling cutter installed on a main spindle. The main spindle supported in radial and thrust anti-friction bearings is powered by means of the motors of total power of 150 kW. The main spindle along with the cutter travels in vertical direction. It is positioned depending on a distance between the cam webs and a required cutting depth. The milling cutter rotation rates are adjustable. The table is mounted in a carriage travelling radially in relation to the milling cutter.

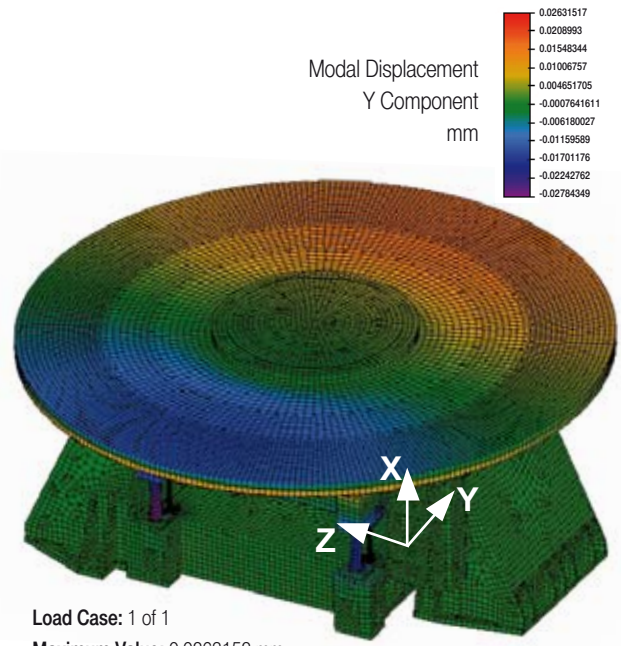
► FS 550 CNC installation at Customer's site



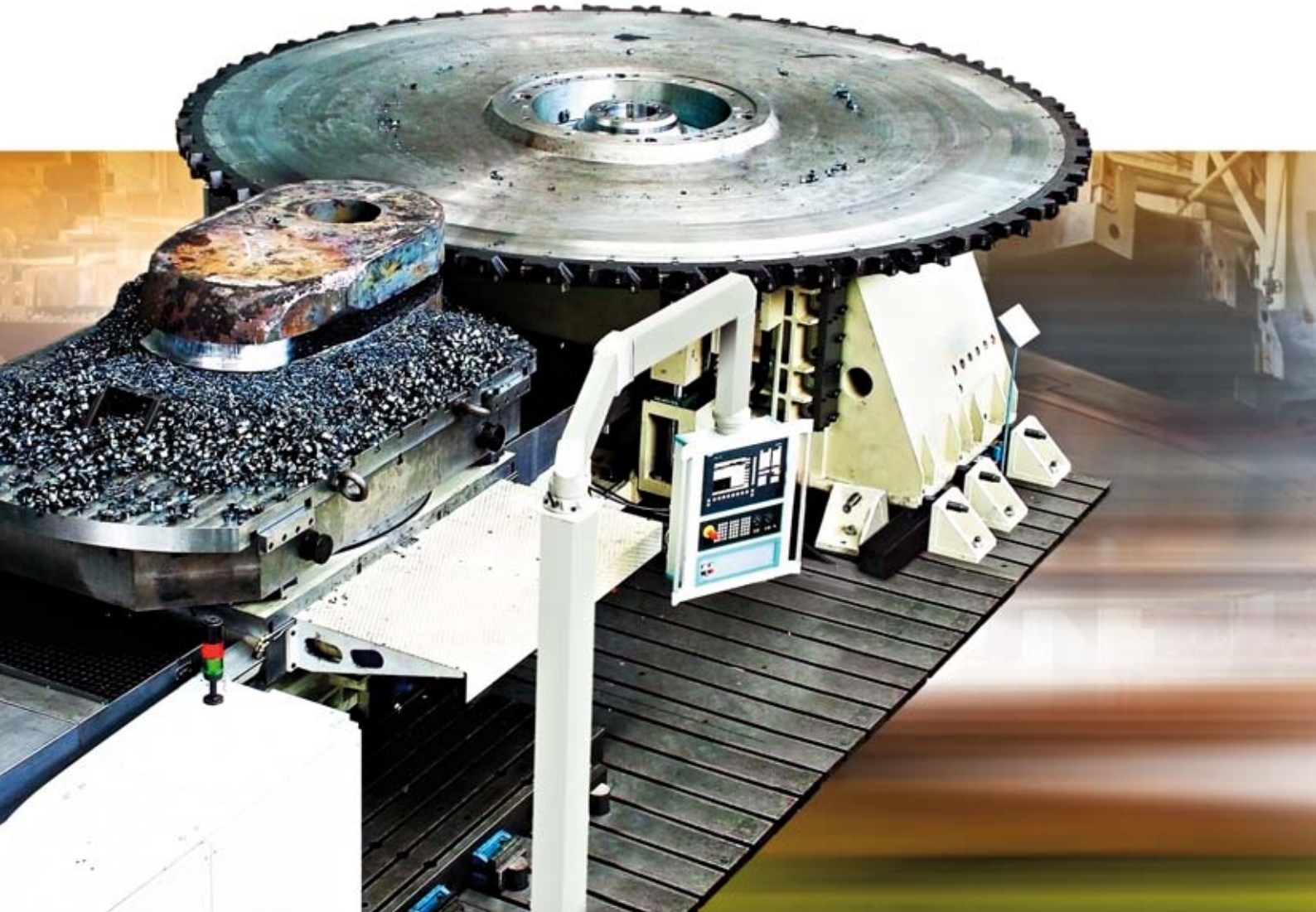
>>> Finite Element Analysis Modeling of FS-550 CNC

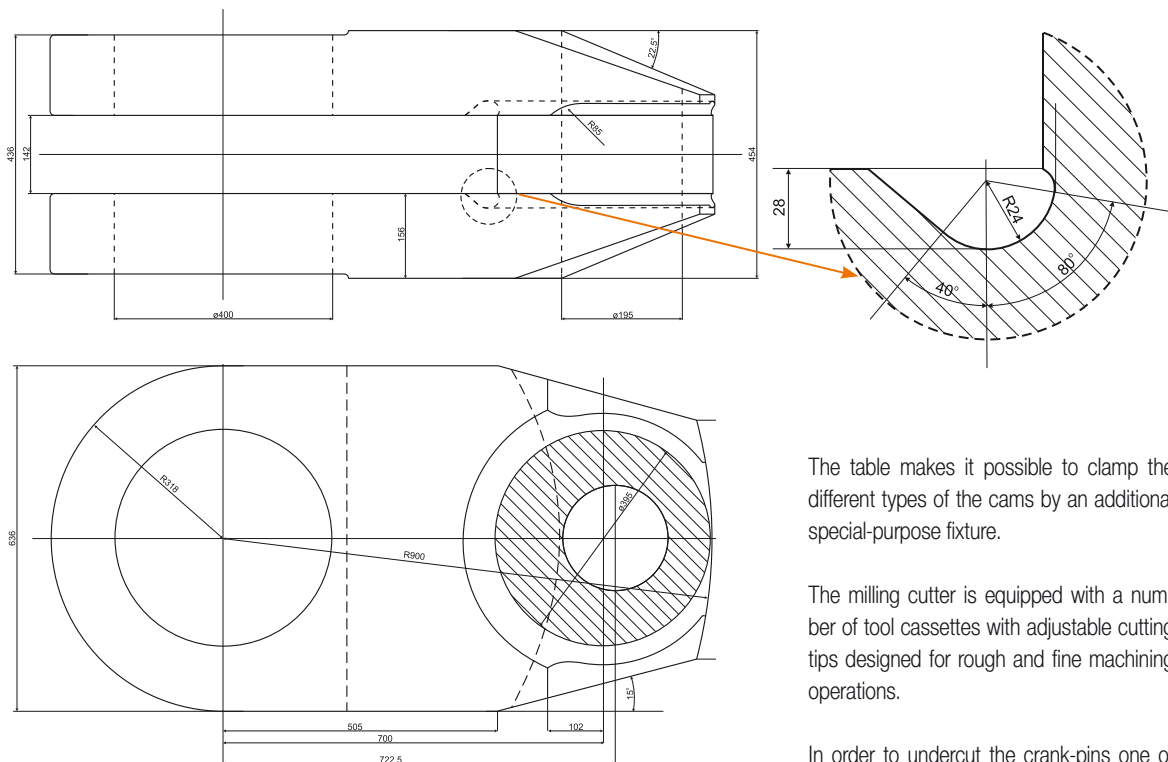


Mode: 1 of 10
 Frequency: 30.7058 cycles/s
 Maximum Value: 0.539025 mm
 Minimum Value: -0.000872158 mm



Load Case: 1 of 1
 Maximum Value: 0.0263152 mm
 Minimum Value: -0.0278435 mm





▲ Sample crankshaft cam

The table makes it possible to clamp the different types of the cams by an additional special-purpose fixture.

The milling cutter is equipped with a number of tool cassettes with adjustable cutting tips designed for rough and fine machining operations.

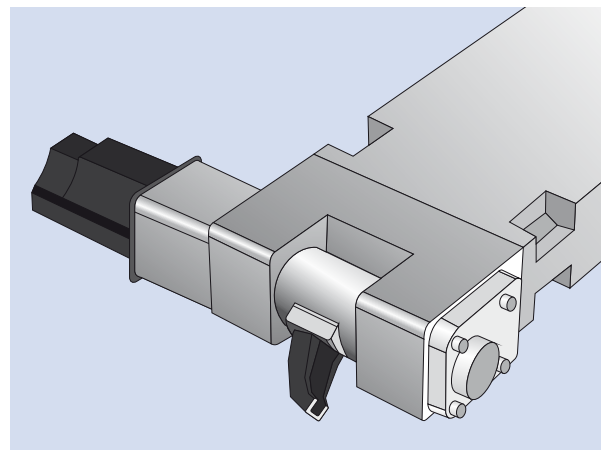
In order to undercut the crank-pins one of the cassettes can be replaced with a special device with a movable tool.



Device for crank-pin undercutting ▶

Crank-pin relief ◀

Sample assembled crankshaft ▼





TV 240 CNC Horizontal Lathes

In basic execution, the horizontal lathe, TV series is the a multi-purpose CNC machine tool. Together with optional equipment, the lathe can be supplied as a Horizontal Machining Center with manual tool exchange, automatically operated tool and workpiece probes of Renishaw make as well as turning, drilling, and milling capacities.

The lathe basic units:

- Step bed
- Headstock
- Tailstock
- Turning carriage and milling & drilling carriage (optional equipment)
- Complete control cabinet and control panel

The lathe bed is provided with four guide ways. On left-hand side of the bed, a headstock is located and fixed. Both turning and milling & drilling carriages as well as tailstock and steady rest are set on the bedways. A workpiece is clamped in the centers of headstock and tailstock. Main control panel is fixed on the turning carriage. Auxiliary control panel is fixed on the tailstock.

Machine Tool Application:

The lathe is designed to machine the large-size carbon and alloy steel heat treated shafts in range of turning, milling and drill-



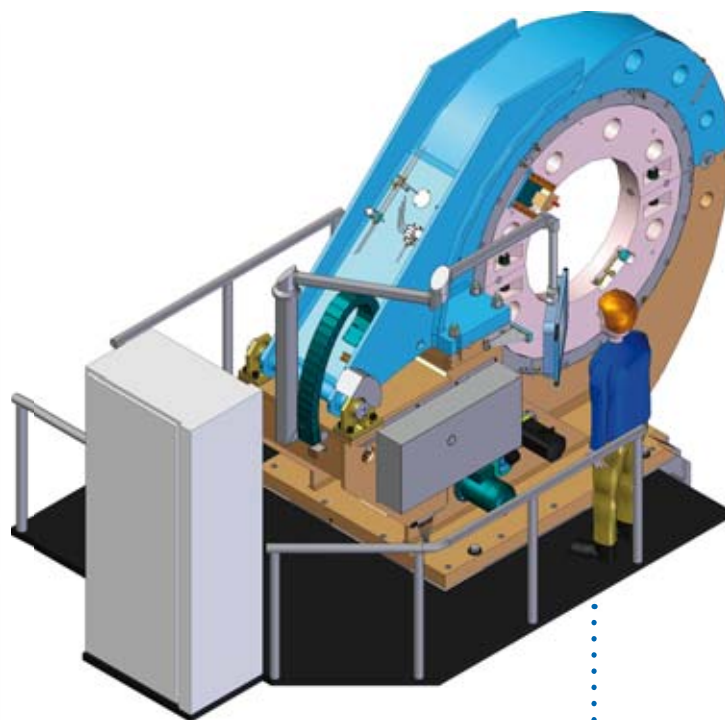
- ▲ Headstock and turning slide.
- ◀ Drilling of holes in a shaft flange

ing. The use of CNC system enables to automatic operation according to technological program.



TV 240 CNC Technical specification

Max. turning diameter	Ø 2400 mm
Max. workpiece length	30500 mm
Standard distance between centers	4000 mm
Distance between centers	30500 mm
Max. chucking diameter	Ø 2200 mm
Max. weight of workpiece clamped in centers and supported by steady rests	120 Mg
Outer diameter of four jaws chuck.	Ø 2400 mm
Range of main drive spindle rotation rates	0.5 - 120 rpm
Max. power of spindle drive	120 kW
Max. stroke of tailstock quill	350 mm
Tailstock quill cross-section	480 x 480 mm
Infinitely variable range of carriage feed	0.1 - 1000 mm/min
Infinitely variable range of cross slide feed	0.1 - 2000 mm/min
Rapid feed of carriage and cross slide	6000 mm/min
Accuracy of carriage positioning	± 0.008 mm/1m
Accuracy of cross slide positioning	± 0.005 mm/1m
Accuracy of spindle positioning	10 arc sec
Repeatability of carriage positioning	0.005 mm/1m
Repeatability of cross slide positioning	0.003 mm/1m
Repeatability of spindle positioning	7 arc sec
Weight of basic machine tool	290 Mg
Overall dimensions of machine tool:	
Length	41000 mm
Width	5200 mm
Height	4150 mm



▲ CAD rendering of CAM 900 Reeling Mill

>>> CAM 900 Reeling Mill

CAM 900 Reeling Mill is specifically designed to machine the crank-pins of the crankshafts used in the vessels engines. The swivel shackle is mounted in the slotted lever. Both units are divisible. Opening and closing of the slotted lever along with the swivel shackle is powered by a hydraulic cylinder. There is a tool holder slide with a replaceable tool installed inside the swivel shackle. Thanks to the division of the units it is possible to load the journal to be machined and, after the swivel shackle is closed, to perform rough and finish machining. The swivel shackle rotation is powered by a drive system adjusting cutting speed. A separate drive unit makes it possible to control radial motion of a tool during the swivel shackle rotation. The reeling mill can cooperate with a horizontal lathe on which an assembled crankshaft is clamped. Its design as a portable unit allows to install it on the different lathes. It is provided with its own control and drive systems as well as power hydraulics.

CAM 900 Technical specification

Active length of cutting edge	330 mm
Range of crank-pins diameters	Ø 660-910 mm
Rotation rates of reeling mill	0.25-15 rpm
Radial travel of tool slide	30 mm
Feed of tool slide (mechanical)	0.05-25 mm/min





FB & GMC Series Bridge-type Milling Machines

These modern CNC machine tools that may be manufactured as both a Planer Mill or a Gantry-type Milling Machine, are specifically designed to perform the following operations:

- Milling
- Reaming
- Drilling
- Boring
- Threading

Together with a wide variety of special equipment the machines can be supplied as a milling centers with automatic tool exchange and automatic tool and workpiece measurement systems.

Application of CNC system enables automatic and efficient machining according to a technological program.

Machine Tools Basic Units (FB / GMC)

- Bed with table / plate
- Fixed bridge / Gantry
- Fixed or movable cross-rail
- Vertical milling head

The vertical milling head located on the cross-rail travels in an axis lateral to the bed (Y axis). The vertical milling head is provided with a ram travelling vertically (Z axis). The ram is equipped with a spindle driven by AC motor of infinitely variable speed. The spindle is adapted to clamp automatically ISO-50 milling and drilling tools. The machine basic bodies as columns, cross-rail, bed, and table are made of high grade cast iron what ensures high geometrical stability of the machine and efficient vibration damping. This is important particularly to the columns and cross-rail being at risk of thermal dilatations influencing directly geometrical accuracy of the machine.



▲ GMC 320 cnc at work

Technical specification FB&GMC

Working envelope:

X axes	up to 23000 mm
Y axes	up to 4500 mm
Z+W axes	up to 4000 mm
Vertical ram cross-section	up to 500x500 mm
Power of main drive motor	up to 90 kW
Spindle rotation rate	up to 3000 rpm



>>> RAFAMET S.A.

RAFAMET is one of the worldwide leading companies designing and manufacturing medium- and large-size heavy-duty machine tools.

Engineering & programming

From concept through design & analysis to final implementation, RAFAMET strong engineering & programming task force equipped with 33 Workstations with Solid Edge, AutoCAD, and Prelude CAD Software has the expertise in developing engineering solutions and software programs tailored to meet specific needs of wide variety of metalworking industries.

Own foundry

To ensure required productivity rate and top quality of machined surfaces in the same time, major members of our machine tools are made as heavily-ribbed box-type iron castings providing excellent rigidity and vibration damping of main structures even when machining at high cutting parameters.

Grey iron: 0.1-40 ton piece
 Ductile iron: 0.1-15 ton piece
 Overall dimensions: 10000×4000×3000 mm

Pattern making, moulding, heat treatment, laboratory

Contract machining

As a machine tool builder having great metalworking experience, RAFAMET offers customers a contract machining capability. Our stock of machine tools can handle cast iron, forged and fabricated workpieces weighting up to 60 tons within working envelope of 14000×3600×3600 mm.

Service & technical support

At RAFAMET, we not only build quality machines, we also provide training, service, and support to keep them in peak operating condition.



During installation, operators and maintenance staff receive a specific training on how to use and maintain the machine in order to ensure its best performance and a fault-free operation.

The English / German / Russian speaking servicemen having great skills in CNC machine tools are ready to assist our customers in case of any need.

RAFAMET machine tools users have at their disposal dedicated ISDN-based remote diagnostics facility able to communicate with the machines' control systems for immediate fault recognition and reporting.



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