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Tube sheet diameter
2500 mm (100”)

Tube sheet max thickness
700 mm (27.5”)

tubes diameter
9,5 ÷ 51 mm (3/8”÷ 2”)

Photograph
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AU-50 MAUS ITALIA

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MA

MA-3501

MA-2501

Single or double axis cnc working centre with movable machine for rolling, facing and grooving of the tube bundle tubes.

The ***MA-2501*** is the most innovative and effective solution ever proposed by Maus Italia as for automating the process cycles of assembling of the medium-sized and large heat exchangers.

● *High technology*

The ***exclusive FOCS3 centring system*** together with the cnc, ***without the traditional mechanic contact accessories,*** which has been widely tested in our 30-year experience in the automation field, guarantee an extremely high geometry precision in the operations **with a deviation of only 0,05 mm** *(0.002")*.

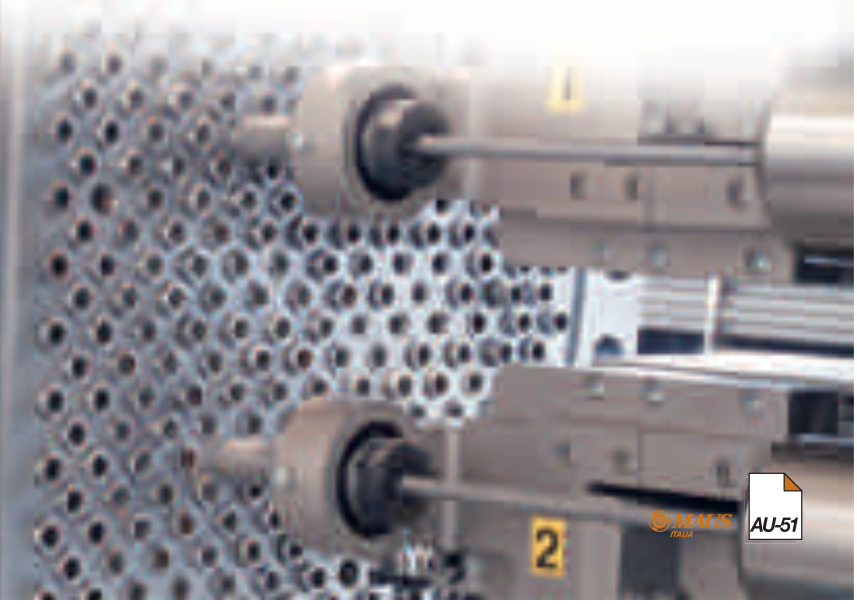
The setting of all the working and positioning parameters is operated by **Windows XP®** operating system with cutting edge graphical and multitasking features.

● *Maximum productivity*

The ***MA-2501*** cnc working centre enables the **single or double axis expansion, TIG orbital welding, and facing** of the tube sheet tubes as well as the *optional* **grooving** of the tube sheet holes: entirely automated and cost efficient processes and a remarkably reduced production time.

● *Maximum manoeuvrability*

Thanks to the **servo hydraulic machine base** *(optional)* and the 8 pivoting wheels provided, the ***MA-2501*** enables the **correct alignment** of the machine to the tube sheet which is fundamental as for quality.



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Column

The vertical dimensions are halved for transport thanks to the hinged column folding at its base on the horizontal crane.

Centring feeler

Optional self-learning laser centring system which is able to work both in synchrony with the cnc and autonomously.

Tool holder head

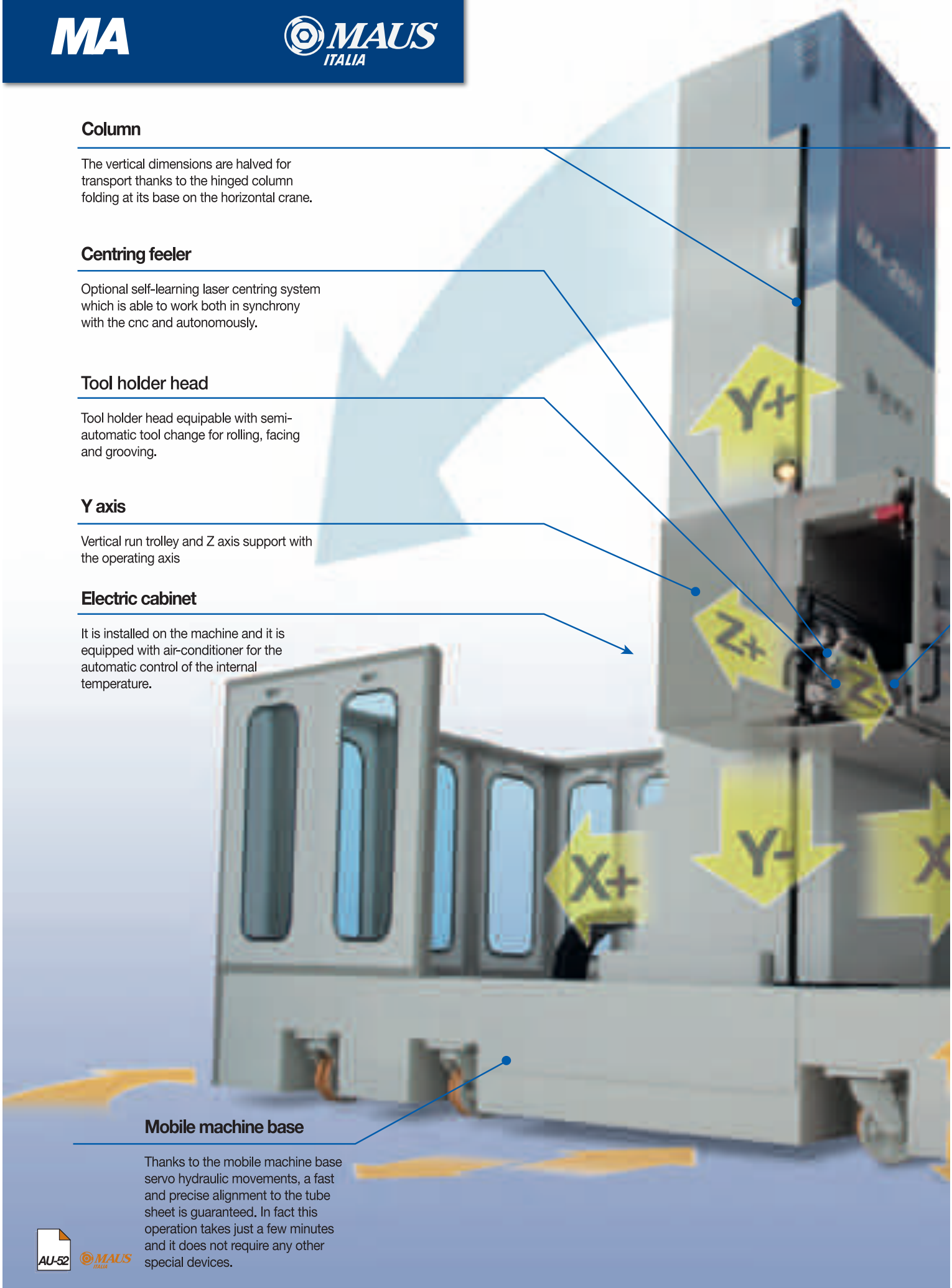
Tool holder head equipable with semi-automatic tool change for rolling, facing and grooving.

Y axis

Vertical run trolley and Z axis support with the operating axis

Electric cabinet

It is installed on the machine and it is equipped with air-conditioner for the automatic control of the internal temperature.



Mobile machine base

Thanks to the mobile machine base servo hydraulic movements, a fast and precise alignment to the tube sheet is guaranteed. In fact this operation takes just a few minutes and it does not require any other special devices.

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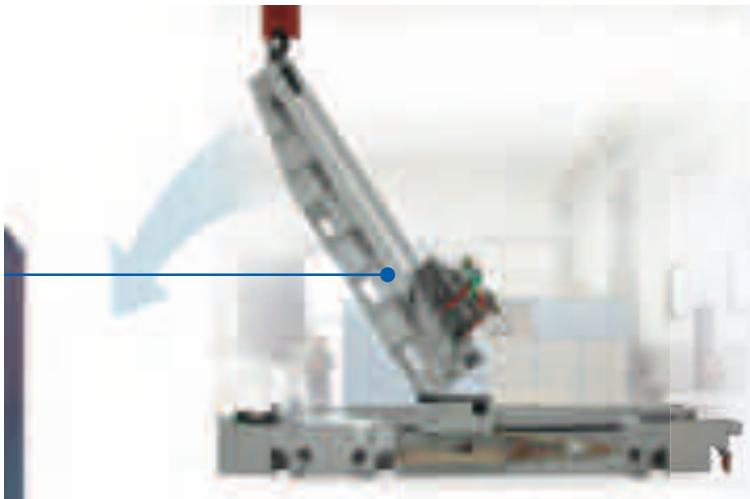
Single or double axis cnc working centre with movable machine for rolling, facing and grooving of the tube bundle tubes.



Machine status signalling

A complete range of signals and alarms about the machine status helps the operator both in the operative stages and while setting a new work.

Z axis

Transverse run trolley sheet approach for both first and second axis (optional)

Third axis: TIG orbital welding

Welding generator holder compartment

Installed on the machine and isolated from the other electronic components to prevent issues due to the high-frequency starting.

Control console

The control console is located in such a way that maximum visibility of the working area is guaranteed.
The cnc display guarantees the maximum working easiness.

X axis

Column support trolley for horizontal positioning.

Remote control

It enables the operator to handle the main positioning in manual mode, remaining near the working area in total safety.

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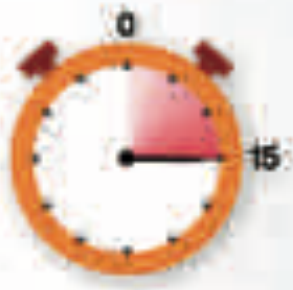
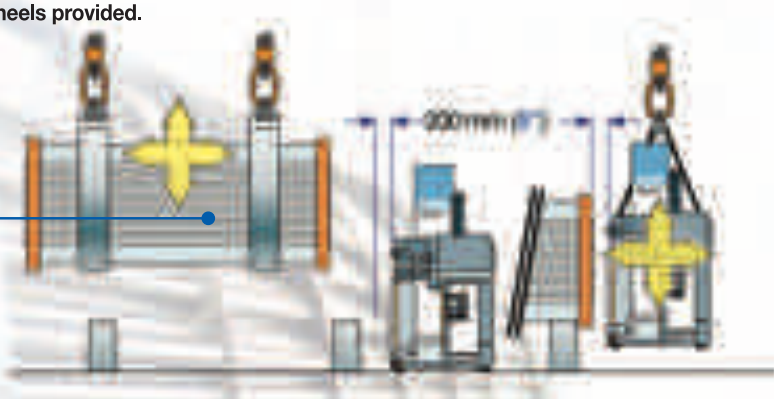
Required time 15 min.



As for **quality**, a **precise alignment of the machine to the tube sheet** is essential. Having to deal with large heat exchange instruments, the thing that mainly concerns the technician is **how to manage such a tricky operation in a correct and safe way.**

Thanks to the **optional servo hydraulic machine** — optionally proposed for ***MA-2501*** — the **zero setting concept, typical of the traditional machine tools**, is completely revolutionized leading the **machine to line up with the tube sheet.**

Thanks to the **servo hydraulic system installed**, it is possible to move the machine in the **three dimensions** in a **few minutes** and, in combination with the ***FOCS-3*** feeler, to perform the **correct alignment of the sheet zero to the cnc program.**
Moreover, it provides a **total flexibility**: if the tube sheet dimensions exceed the available run of the machine, it is possible to **break up the program in parts or quadrants** — not necessarily equal — and proceed to **the exchanger rotation or to the displacement of the machine to the different sectors to be worked.** This operation is made easier by the **8 pivoting wheels provided.**

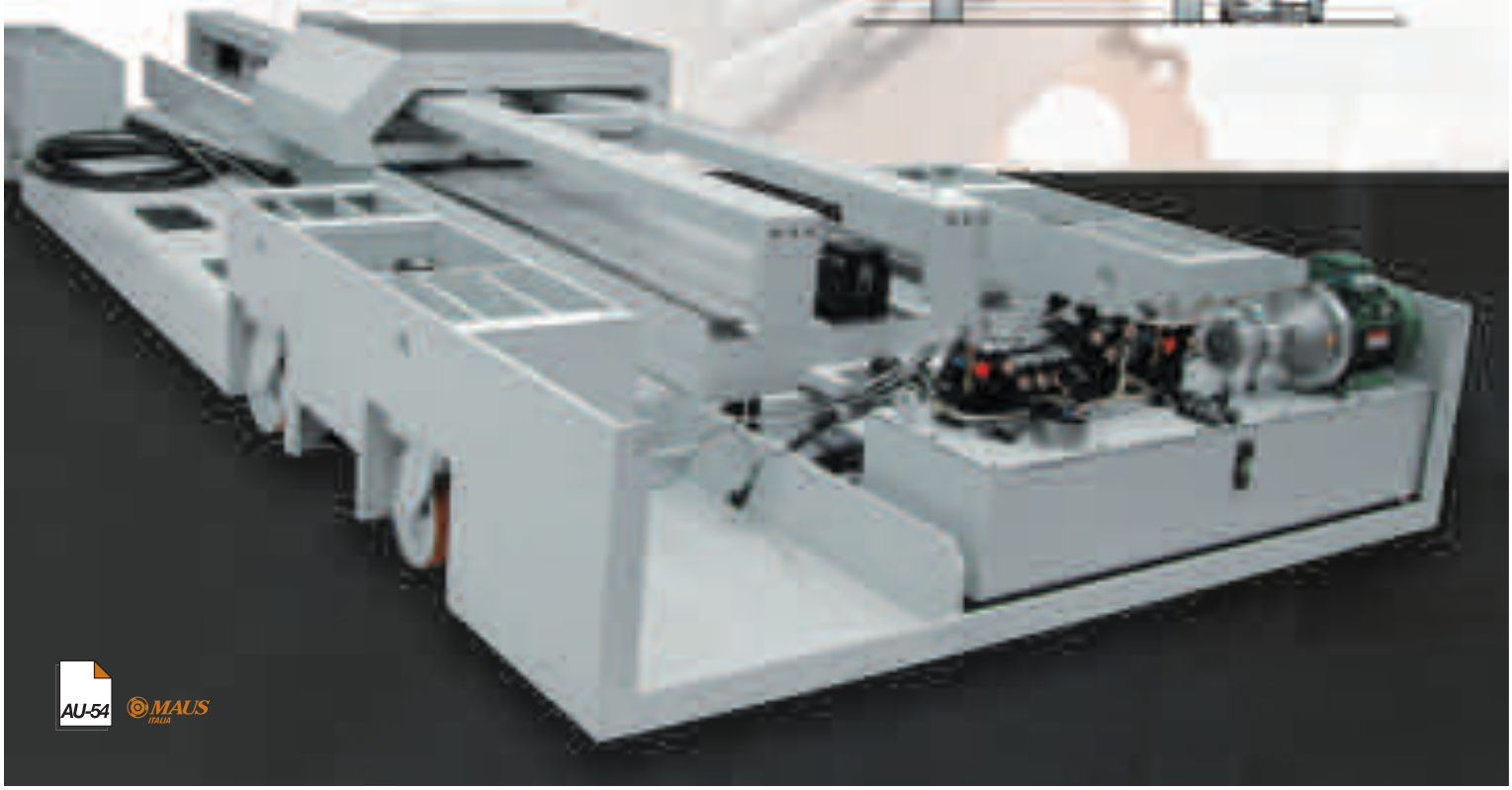


1 Approximate positioning

Using the regular hoisting devices available in the workshop **(gantry crane),** the operator **positions the tube bundle at a safety distance** of approx 200 mm (*8"*) **in a non definitive manner.**

2 Precision positioning

Using the **"Translation"** command, max run 150 mm (*6"*), the operator **moves the machine near to the tube sheet positioning it at the desired working distance.**
Whenever necessary, **this command may be repeated** to cover longer distances.



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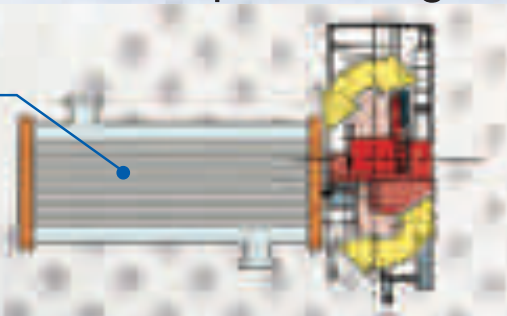
Optional

Servo hydraulic machine base: fast positioning

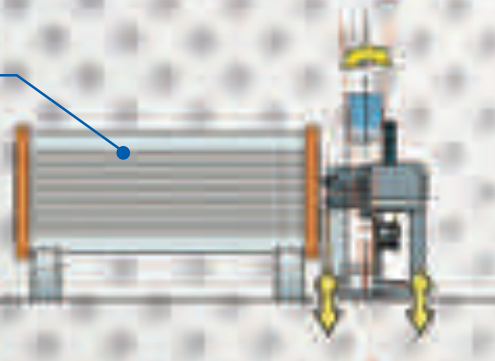
3 Horizontal alignment

Using the **"Rotation"** command, it is possible to rotate by +/- 8° the **X axis horizontal runway.** The ***FOCS-3*** feeler displays in real time the distance rate of the tube sheet with a precision of +/- 0,05 mm *(0.002")*.



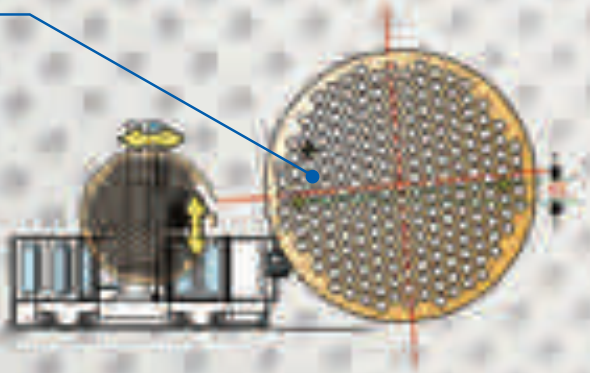
4 Vertical alignment

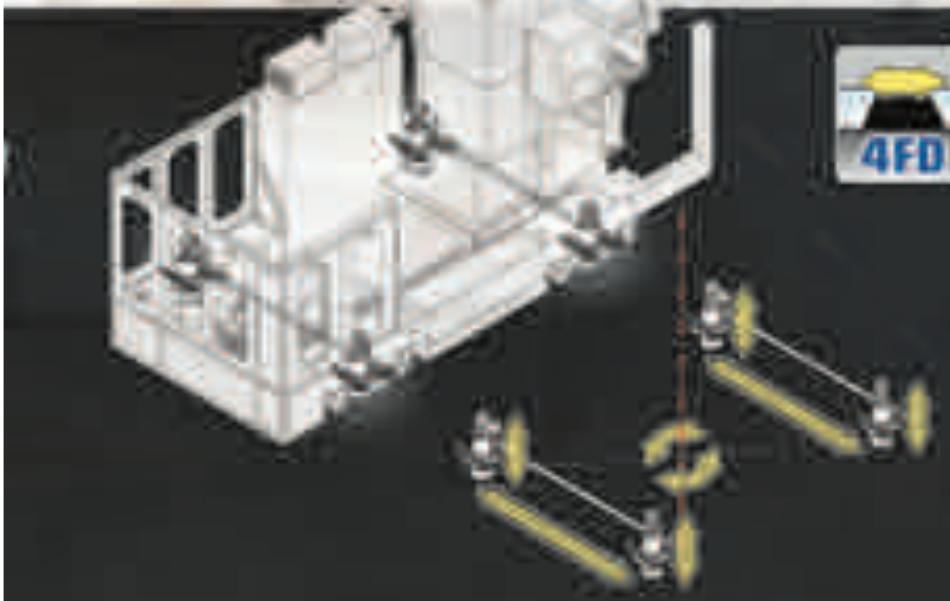
Thanks to the **4 independent servo hydraulic legs**, the operator can easily **verify and correct the vertical rod (Y axis) alignment to the tube sheet.**



5 Zero setting

Collimation of the tubesheet hole centre **matrix of the cnc program to the machine zero setting.** A semi-automatic procedure combined to the ***FOCS-3*** laser self-learning centring feeler enables to **calculate and store both the position and the actual rotation of the tube sheet** with regard to the machine.





4FD

4FD
Four Feet Drive

The new ***MA-2501*** and ***MA-3501*** servo hydraulic machine base guarantees toughness and precision.

In particular, the **4 positioning legs** contribute to compensate the horizontal thrusts.

The transmission system on each leg guarantees continuity and precision in translation.

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Up to 850 expansions/hr
1200 faces/hr
800 grooves/hr

MA-3501

MA-2501

Second axis: rolling, facing and grooving

Optional

Proposed as an optional, it enables to **significantly increment productivity** in rolling, facing, and grooving.

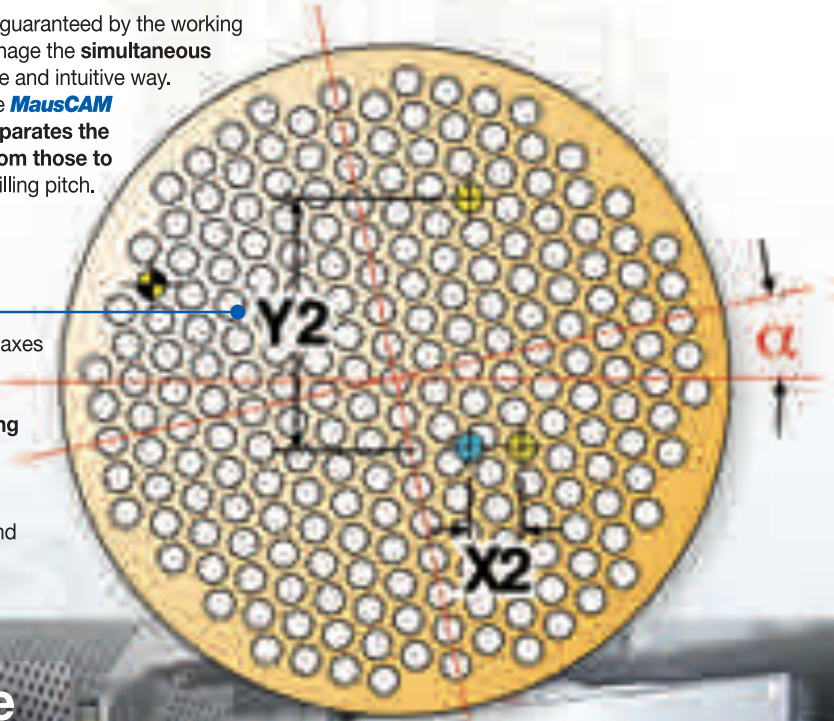
The system enables to **work simultaneously on two tubes or tubesheet holes in a completely autonomous and independent way.**

High productivity

The **second working axis** is the result of a project designed for a specific purpose: **productivity and quality.**
The complete independence of the two axes is guaranteed by the working channels **cnc technology** and it enables to manage the **simultaneous operation of the two installed tools** in a simple and intuitive way.
Thanks to the **cnc** programming assisted by the ***MausCAM*** software provided, ***MA-2501*, automatically separates the sheet areas to be worked by a double tool from those to be worked** by a single tool, according to the drilling pitch.

Automatic compensation

The operating wheelbase between the two tool axes is not a mere direct function of the tube sheet drilling pitch, but it shall **also take into account the actual tube sheet positioning with regard to the machine.**
Thanks to a complete and revolutionary handling device of the second axis — numerically controlled both **horizontally** and **vertically** — it is possible to automatically compensate the **X2** and **Y2** wheelbase.



In-depth process in the presence of tube sheet with box

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Applied technologies

Total quality

TL
Free tubes

Rolling on a tube simply inserted into the tube sheet — without being blocked and consequently free to move longitudinally — has been one of the **first issues successfully solved** by the Maus Italia ***MA*** series machines.

Whether a forced rolling or a pre-welding approach has to be performed, the proposed working centres — duly equipped — are able **to block and expand** a free tube at the desired protrusion, in a c**ompletely autonomous and automatic** manner.

RP
Parallel roller

The **RP** technology — better known as parallel roller — was introduced on the ***MA*** series working centres in 1991 by Maus Italia.

It enables to **minimize the tube elongations and its relative residual tensions after rolling in order to reach a uniform tube-to-tubesheet contact all along the expansion.**
It provides for the use of **tube expanders with the roll housing site axis parallel to the cage axis.**

The main a**dvantages** are:

- **tube cylindricity** after rolling;
- **reduced tube elongation**;
- **mandrel rotation speed independent from the rolling speed *(reduced tool wear)***;
- **reduction of the residual internal tensions** between tube and tube sheet.

CPZ
Automatic compensation of the expansion limit depth

Z axis zero setting automatic system:

the external **edge of the tube sheet** becomes the **reference mark** for each single tube, regardless of the **tubesheet deformation** or the machine alignment to the tube sheet.

CDAS
Mandrel forward movement digital control

The pin forward movement digital control enables **to verify the real-time actual tube expansion dimension.**
This technology enables **to record the value of any performed expansion.**

CVSC
Speed continuous variation

The latest innovation in rolling.
The tube expander mandrel **rotation speed varies continuously** according to the **instantaneous torque**

Advantages:

- **Optimized expansion cycle** according to the toughness of the expanding tube material
- **Reduced tool wear**
- Higher **processing speed**

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Optional

Third optional axis: **TIG** *orbital* welding

The option of the third **TIG** *orbital* welding axis completes the working centre.
By a single machine positioning and a single "part program", the operator is able to perform rolling and milling operations as well as to weld the tubes to the tube sheet.

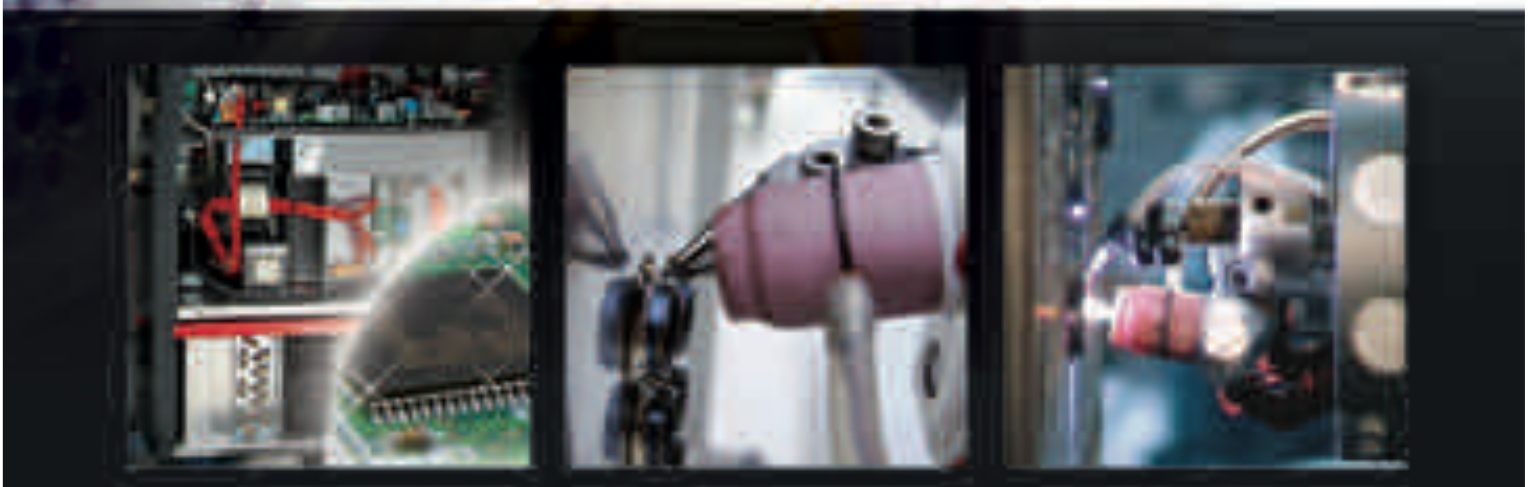
Welding torch lock

The cnc positioning of the welding head combined to the ***FOCS-3*** feeler control and correction guarantees the proper centring of the welding orbit to the tube, leading to quality and uniformity of the welded joint.

Total integration

The excellent result achieved is due to the perfect combination and integration of all the components of the system which have been designed, manufactured, and tested to work in an automation environment.

For further details refer to ***MaTIG-500*** AU-62



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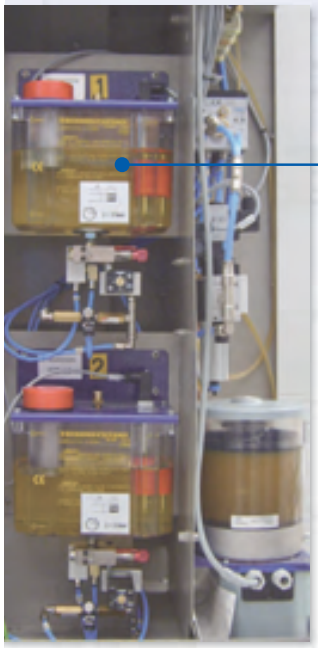
Long-lasting reliability



Tool lubrication

An internal tool lubrication automatic system, equipped with a properly set minimum level control, automatically manages the appropriate lubrication of the mandrel.

Guide lubrication

Grease lubrication gearcase for recirculating ball screws activated according to the number of meters covered by each machine axis.
The linear guides are instead equipped with a device directly applied to the runners which enables more than 10000 km *(approx 6200 mi)* covered without any maintenance intervention.

Climate-controlled electric cabinet

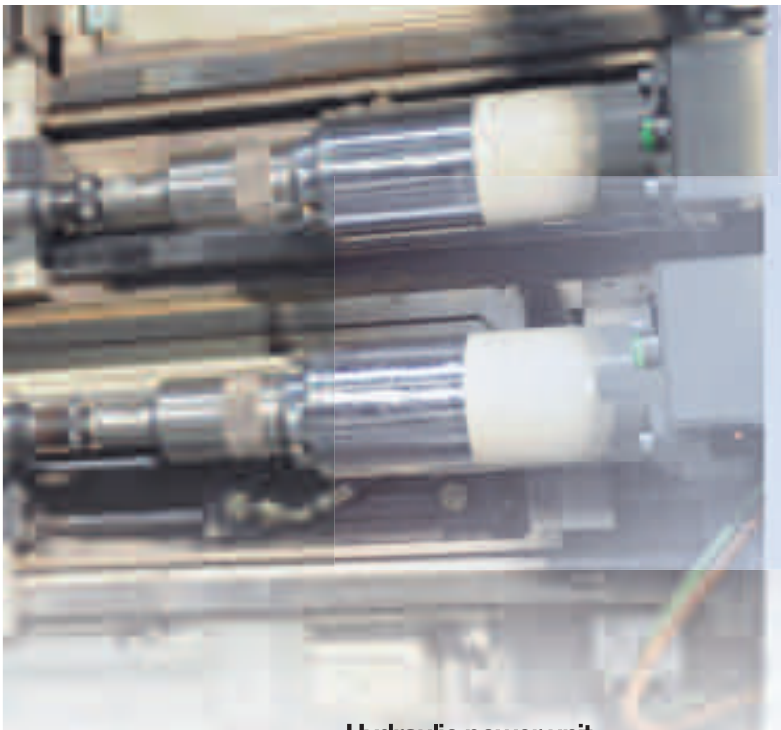
A double air-conditioner controls and automatically manages the temperature in order to protect the electronic equipment on the machine.

Lamp

Perfect visibility of the working area thanks to the low voltage spot halogen lamp located directly over the working area.

Ergonomic console and remote control

Hinged to the protection structure, the console enables to control the whole working area especially during the setting stages.
As a further complement, a remote control allows to perform the main manual movements and it enables the operator to verify the alignment on the machine in total safety.



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MA-2501

Main components

Hydraulic power unit

Integrated in the hydraulic machine base, the power unit operates the hydraulic actuators in order to perform the auxiliary handlings on board.

Sinumerilk 840 D

The ***MA-2501*** cnc group adopts the **"Totally Integrated Automation"** SIEMENS® solution that implies a uniform system of products in which every component is designed to work in synergy with the others.

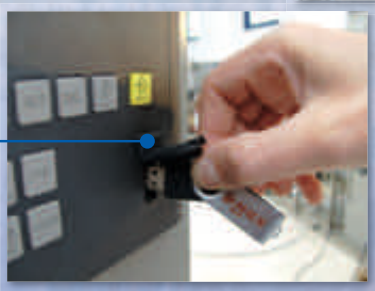
Alarm signalling lamp

Immediate signalling of the machine status

- Green light: automatic cycle in progress
- Red light: alarm status
- Light off: machine in standby

Safety systems

A fixed safety structure bounds the machine preventing the access to the axes operating areas.
This system is integrated with a set of fixed as well as mobile safety photoelectric barriers.
The sliding cover with electromechanical interlock completes the protection of the mandrel rotation area.



USB communication port

For a fast and reliable exchange of information between machine and office.

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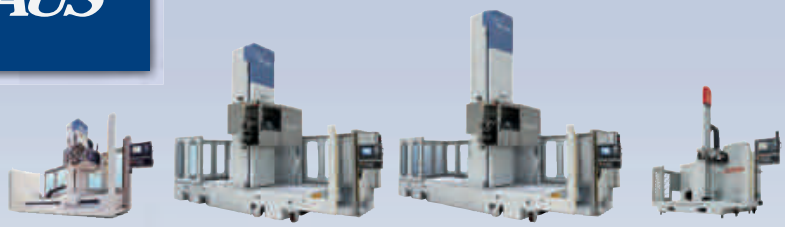

Supply		MA-500	MA-2501	MA-3501	MaTIG-500
Voltage	Volt - Ph	400 - 3	400 - 3	400 - 3	400 - 3
Frequency	Hz	50	50	50	50
Installed power	Kw	17	50	50	16
Dimensions		**MA-500**	**MA-2501**	**MA-3501**	**MaTIG-500**
Length A	mm (Ft)	4200 (13.78)	6500 (21.32)	7600 (24.93)	2700 (8.86)
Width B	mm (Ft)	1700 (5.58)	2350 (7.71)	2350 (7.71)	1425 (4.67)
Height C	mm (Ft)	2160 (7.10)	4950 (16.24)	5155 (16.91)	3050 (10.01)
Heigh for transport	mm (Ft)	1850 (6.10)	2730 (8.10)	2730 (8.10)	2850 (9.40)
Weight	Kg (Lb)	7500 (16540)	13500 (29770)	16000 (35300)	850 (1880)
Colours	RAL	7030 - 7035	7030 - 7035	7030 - 7035	7030 - 7035
Additional packing		- - -	1	1	- - -
Additional packing dim.	(Ft) Kg	- - -	1800x1400x1200 (6.00x4.60x4.00)	1800x1400x1200 (6.00x4.60x4.00)	- - -
Additional weight	Kg (Lb)	- - -	280 (620)	310 (690)	- - -
Dimensional capacities		**MA-500**	**MA-2501**	**MA-3501**	**MaTIG-500**
Stroke X	mm (inches)	✱ 1700 (66.929)	2500 (98.425)	3500 (137.795)	1500 (59.055)
Stroke Y	mm (inches)	✱ 600 (23.622)	2500 (98.425)	3500 (137.795)	1800 (70.866)
Stroke Z	mm (inches)	400 (15.748)	800 (31.496)	800 (31.496)	300 (11.811)
Minimum height T	mm (inches)	780 (30.709)	920 (36.220)	950 (33.465)	500 (19.685)
Fast forward movement		**MA-500**	**MA-2501**	**MA-3501**	**MaTIG-500**
X axis	m/min (Ft/min)	20 (98.4)	20 (65.6)	20 (32,8)	20 (65.6)
Y axis	m/min (Ft/min)	20 (98.4)	20 (65.6)	20 (32,8)	20 (65.6)
Z axis	m/min (Ft/min)	25 (98.4)	25 (82.0)	25 (82.0)	20 (65.6)
U axis	m/min (Ft/min)	15 (49.2)	15 (49.2)	15 (49.2)	- - - - - -
Working capacity		**MA-500**	**MA-2501**	**MA-3501**	**MaTIG-500**
Tube sheet diameter	mm (inches)	1000 (39") max.	2500 (100")	3500 (140")	1500 (3/8"÷5/8")
Tube sheet max thickness	mm (inches)	200 (8")	700 (27.5")	700 (27.5")	- - - - - -
Tube max diameter	mm (inches)	✱ 6÷16 (1/4"÷5/8")	9,5÷51 (3/8"÷2")	9,5÷51 (3/8"÷2")	4÷51 (5/32"÷2")
Tube expander torque	Nm (Ft Lb)	4 (2.950)	100 (73.756)	100 (73.756)	- - -
Tube expander max speed	rounds/min (R.P.M)	3000	1500	1500	- - -
Tube expander motor max power	Kw	1,25	5	5	- - -
Max tube pulling force	KN (Lb)	3,4 (2.508)	6,0 (4.425)	6,0 (4.425)	- - - - - -
Max tube thrust force	KN (Lb)	3,0 (2.213)	5,0 (3.688)	5,0 (3.688)	- - - - - -
Min wheelbase two tube expanders	mm (inches)	- - - - - -	160 (6.299)	165 (6.496)	- - - - - -
Max wheelbase two tube expanders	mm (inches)	- - - - - -	305 (12.008)	305 (12.008)	- - - - - -
Tool lubrication	Lt (GalUS)	3 (0.793)	3 x2 (0.793 x2)	3 x2 (0.793 x2)	- - - - - -
Welding		**MA-500**	**MA-2501**	**MA-3501**	**MaTIG-500**
Max welding current	Amp	- - -	6÷200	6÷200	6÷200
No-load voltage	Volt	- - -	81	81	81
Orbital speed	giri/min (R.P.M)	- - - - - -	0÷6	0÷6	0÷6
Welding wire speed	giri/min (R.P.M)	- - - - - -	0÷150	0÷150	0÷150
Welding wire spool	Kg/Ømm (Lb/Øinches)	- - - - - -	1-100 (2.2/3,937)	1-100 (2.2/3,937)	1-100 (2.2/3,937)
Cooling unit	Lt (GalUS)	- - - - - -	6 (1,585)	6 (1,585)	6 (1,585)
Cooling capacity	Kw	- - -	2	2	2
Electrode diameter	mm (inches)	- - - - - -	1÷3,2 (0,039÷0,126)	1÷3,2 (0,039÷0,126)	1÷3,2 (0,039÷0,126)
Welding wire diameter	mm (inches)	- - - - - -	0,8÷1,2 (0,031÷0,047)	0,8÷1,2 (0,031÷0,047)	0,8÷1,2 (0,031÷0,047)

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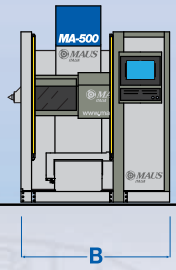
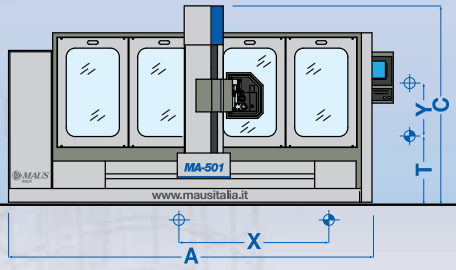
Optional

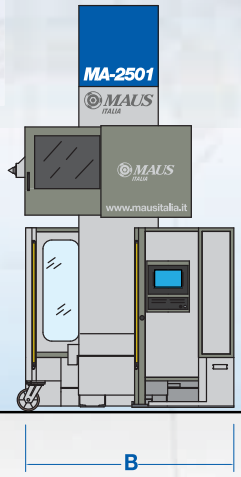
MA-500 ✱ Extensible stroke upon request: **X** up to 2500 mm (98,425"); **Y** up to 1200 mm (59,055").
MA-500 ✱ "Heavy" tube expanders line upon request: workable tube max diameter: 9,5÷51 mm (3/8"÷2")

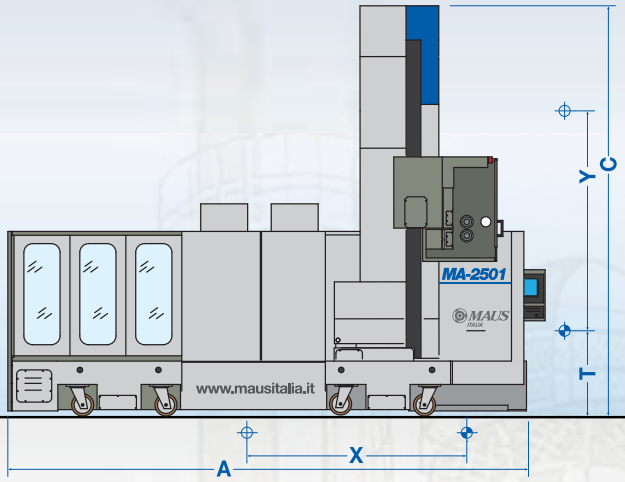
MA-500



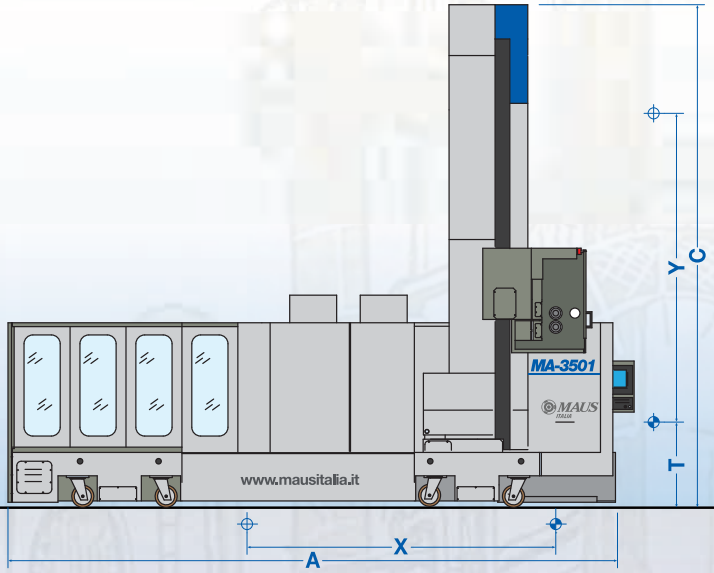


MA-2501

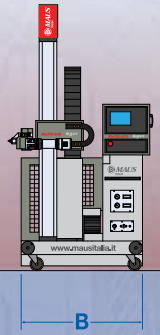


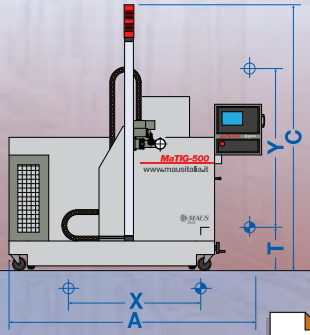


MA-3501



MaTIG-500





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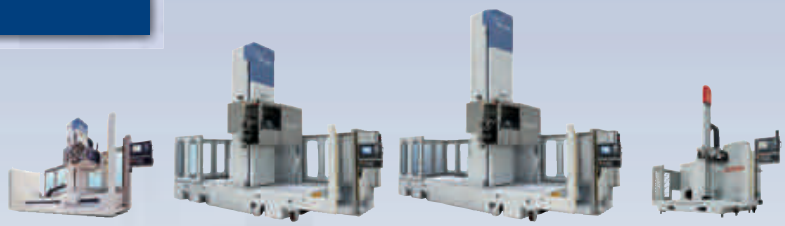
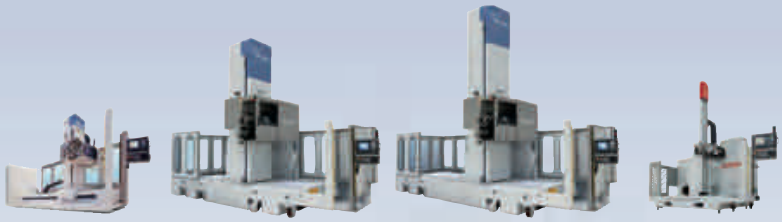


Processes	MA-500	MA-2501	MA-3501	MaTIG-500
Rolling	●	●	●	–
Welding	–	⊕	⊕	●
Facing	⊕	⊕	⊕	–
Grooving	⊕	⊕	⊕	–
Servo assisted positioning	**MA-500**	**MA-2501**	**MA-3501**	**MaTIG-500**
Servo hydraulic machine base	–	⊕	⊕	–
Z working axis	**MA-500**	**MA-2501**	**MA-3501**	**MaTIG-500**
Z1	●	●	●	●
Z2	⊕	⊕	⊕	–
Z3 *(Welding)*	–	⊕	⊕	–
Centring and distance	**MA-500**	**MA-2501**	**MA-3501**	**MaTIG-500**
FOCS-2 *(centring only)*	⊕	–	–	⊕
FOCS-3 *(centring + tube sheet distance)*	–	⊕	⊕	–
High quality	**MA-500**	**MA-2501**	**MA-3501**	**MaTIG-500**
Real time report *(Rolling)*	●	●	●	–
AVC *(Welding)*	–	⊕	⊕	●
Software	**MA-500**	**MA-2501**	**MA-3501**	**MaTIG-500**
MausCAM	⊕	⊕	⊕	⊕
Data exchange	**MA-500**	**MA-2501**	**MA-3501**	**MaTIG-500**
USB	●	●	●	●
RS232	●	●	●	●
Ethernet	●	●	●	●

Provided ● *Optional* ⊕ *Not available* –



Main components	MA-500	MA-2501	MA-3501	MaTIG-500
Sinumerik	● 840 D	● 840 D	● 840 D	● 810 D
Quick tube expander change	●	●	●	–
Automatic tool lubrication	●	●	●	–
Guide lubrication	●	●	●	●
Air conditioned electric cabinet	●	●	●	●
Lamp	●	●	●	–
Ergonomic console	●	●	●	●
Hydraulic power unit	+	+	+	–
Alarm signalling lamp	●	●	●	●
Safety	**MA-500**	**MA-2501**	**MA-3501**	**MaTIG-500**
Fixed mechanical protection	●	●	●	●
Fixed photoelectric barrier	●	●	●	●
Mobile photoelectric barriers	●	●	●	+
Cover with interlock	●	●	●	–
Applied technologies	**MA-500**	**MA-2501**	**MA-3501**	**MaTIG-500**
TL *Free tubes (with hydraulic head)*	+	+	+	–
RP *Parallel (and inclinated) rolls*	●	●	●	–
CPZ *Z automatic compensation*	+	+	+	–
CDAS *Mandrel forward movement digital control*	●	●	●	–
CVSC *Speed continuous variation*	●	●	●	–
Accessories	**MA-500**	**MA-2501**	**MA-3501**	**MaTIG-500**
Remote control	+	●	●	–

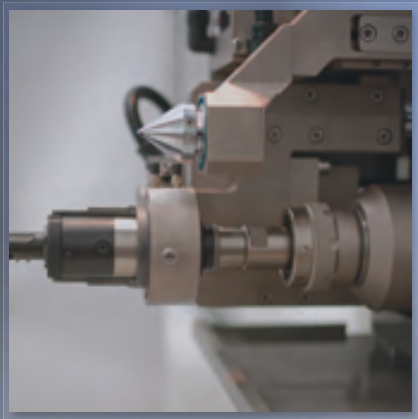
Provided ● *Optional* + *Not available* –

3 Accessories and tools for the MA series cnc working centres

Maus Italia here presents a brief overview of the tools and the accessories designed for the ***MA-500***, ***MA-2501***, and ***MA-3501*** working centres.

For **further technical** information, refer to the relevant catalogue.

The **technical staff** of the Maus Italia "Automation and Welding Division" is at customers' complete disposal to suggest the ideal solution to any kind of application.



MAUS ITALIA

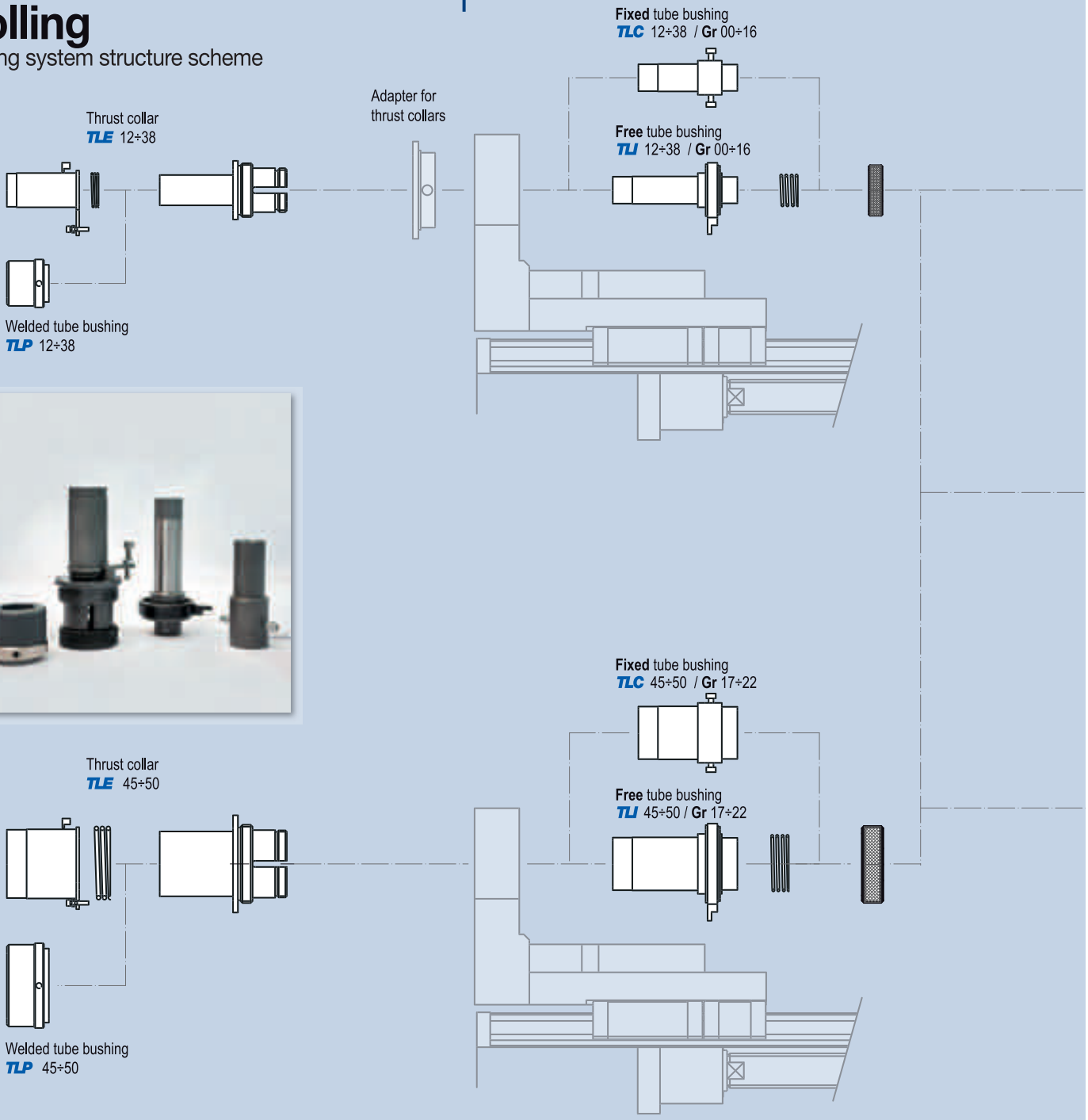
MA-3501

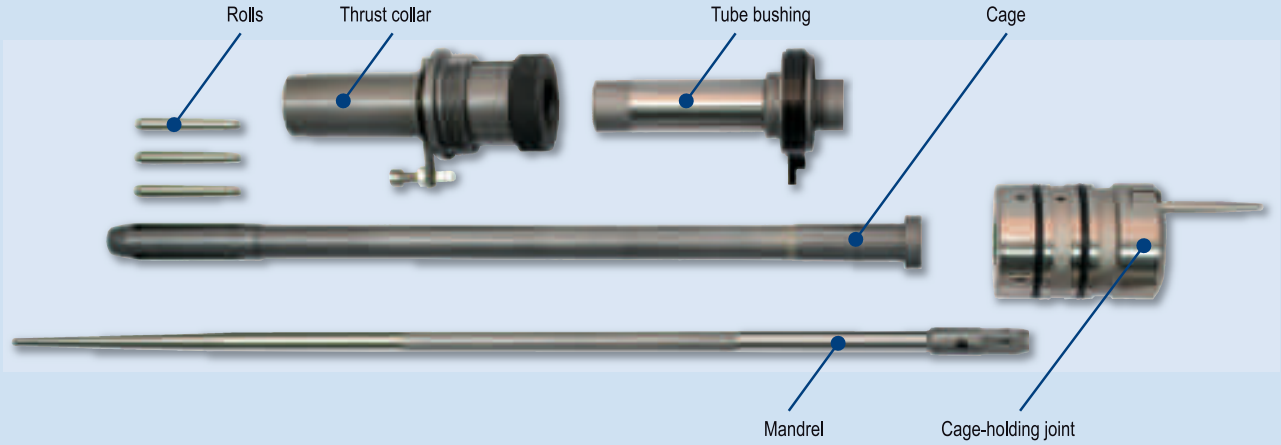
MA-2501

Accessories and tools for tube expansion

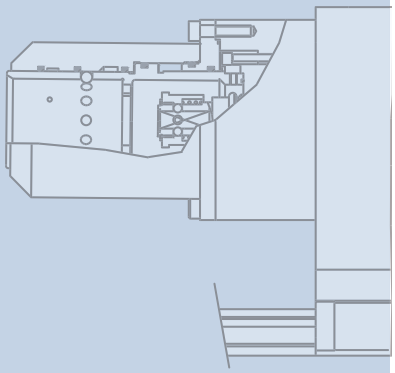
Rolling

Tooling system structure scheme





MA-2501
MA-3501



Series **V** rolls
Lu 50 mm *(1.968")*
Gr 1÷8

Series **T** rolls
Lu 30 mm *(1.181")*
Gr 00÷8

MA-2500 mandrels
Gr 00÷8

Quick connect
cage holder joint complete with
rotating distributor for lubrication
Gr 00÷8

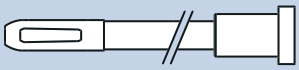
Cage
Gr 00÷8
di 9,6÷23,0 mm *(0.378"÷0.906")*
RE 0÷400 mm *(0.000"÷15.748")*

Series **V** rolls
Lu 50 mm *(1.968")*
Gr 9÷14

Series **T** rolls
Lu 30 mm *(1.181")*
Gr 9÷14

MA-2500 mandrels
Gr 9÷14

Quick connect
cage holder joint complete with
rotating distributor for lubrication
Gr 9÷14

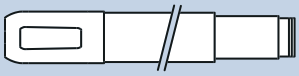


Cage
Gr 9÷14
di 21,0÷32,0 mm *(0.827"÷1.260")*
RE 0÷400 mm *(0.000"÷15.748")*

Series **T** rolls
Lu 30 mm *(1.181")*
Gr 15÷22

MA-2500 mandrels
Gr 15÷22

Quick connect
cage holder joint complete with
rotating distributor for lubrication
Gr 15÷22



Cage
Gr 15÷22
di 30,0÷49,0 mm *(1.181"÷1.929")*
RE 0÷400 mm *(0.000"÷15.748")*

Gr size
de tube outside diameter
di tube inside diameter
Lu roll usefull length
RE expansion depth

MA

MAUS ITALIA

MA-3501

MA-2501

Accessories and tools for tube facing

Facing

Tooling system structure scheme

Thrust collar
TI 12÷38

Thrust collar
TI 45÷50

Tube pilot holding pin
MAGP10

Tube pilot
MAGB10 7,0÷10,5 mm
(0.276"÷0.413")

F751 Tube pilot
MAG751 10,4÷13,4 mm
(0.409"÷0.528")

F751 cutter
F751 Gr 2

Tube pilot holding pin
MAGP13

Tube pilot
MAGB13 7,0÷15,0 mm
(0.276"÷0.591")

Widia bits
MACU 5/8"

F751 Tube pilot
MAG751 12,3÷23,7 mm
(0.484"÷0.933")

F751 cutter
F751 Gr 3÷5

Tube pilot holding pin
MAGP19

Tube pilot
MAGB19 12,0÷24,5 mm
(0.472"÷0.965")

Widia bits
MACU 3/4"÷1"

F751 Tube pilot
MAG751 23,4÷48,0 mm
(0.921"÷1.890")

F751 cutter
F751 Gr 6÷7

Tube pilot holding pin
MAGP32

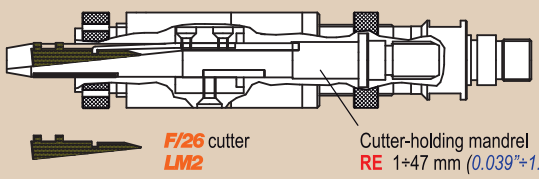
Tube pilot
MAGB32 24,0÷49,0 mm
(0.945"÷1.929")

Widia bits
MACU 1.1/4"÷2"

Grooving

Tooling system structure scheme

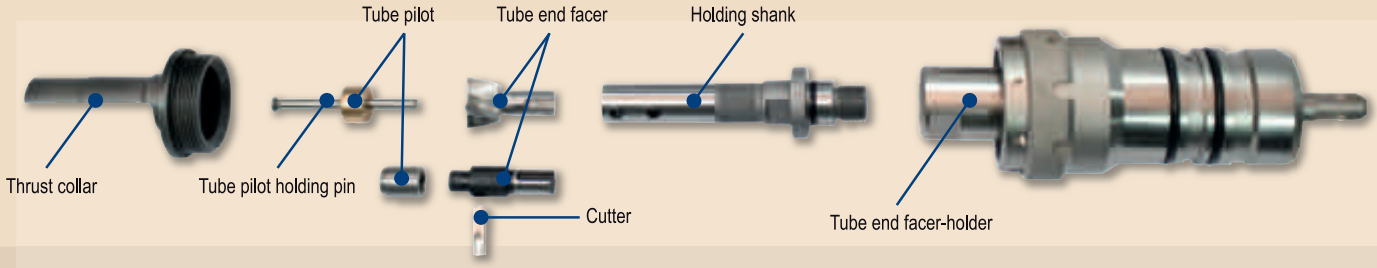
Thrust collar
TFC 2÷4



F/26 cutter
LM2

Cutter-holding mandrel
RE 1÷47 mm *(0.039"÷1.850")*

AU-80 MAUS ITALIA



HSS tube end facer
MAFHSS10 11÷15

Bevelling
tool 60°- 90°
MAS13 10÷15

Holding shank
MAC-10 de 3/8"÷1/2"

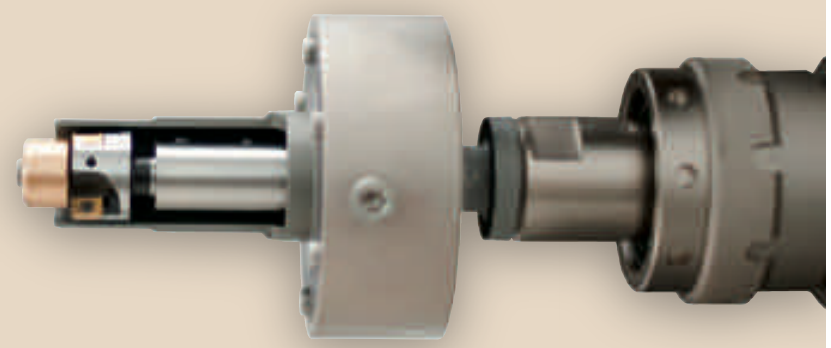
F751 tube end facer
MAF751 5/8"

Insert tube end facer
MAFAST13 5/8"

HSS tube end facer
MAFHSS13 15÷18

Bevelling
tool 60°- 90°
MAS13 10÷18

Holding shank
MAC-13 de 1/2"÷5/8"



F751 tube end facer
MAF751 3/4"÷1"

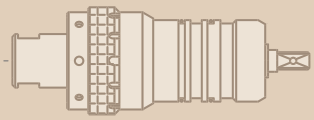
Insert tube end facer
MAFAST19 3/4"÷1"

HSS tube end facer
MAFHSS-9 22÷28

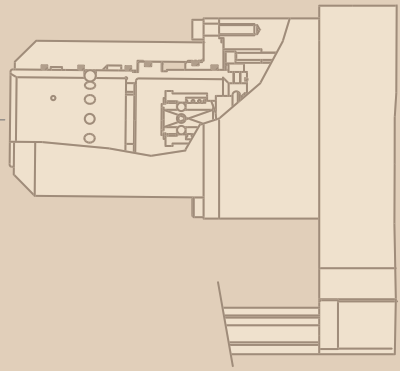
Bevelling
tool 60°- 90°
MAS19 22÷28

Holding shank
MAC-19 de 3/4"÷1"

Quick connect tube end facer-holder complete with rotating distributor for lubrication
MA-2501 - MA-3501



MA-2501
MA-3501



F751 tube end facer
MAF751 1.1/4"÷2"

Insert tube end facer
MAFAST32 1.1/4"÷ 2"

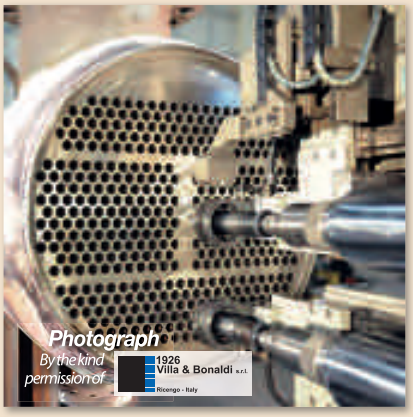
HSS tube end facer
MAFHSS32 34÷53

Bevelling
tool 60°- 90°
MAS32 34÷50

Holding shank
MAC-32 de 1.1/4"÷2"

F/26 grooving tool
de 5/8"÷1.1/4"

Gr size
de tube outside diameter
di tube inside diameter
Lu roll usefull length
RE expansion depth



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