MAUS ITALIA

Matex

High-tech low voltage electrical portable equipment
and mobile station for semi-automatic tube expansion

Production

Tube expansion

REV / ENG
01/24

A winning story since 1961

The Beginning

At the end of the 1950s, Domenico Franco Agostino became the Italian representative of Albert Otto, a German manufacturer of tube expanders. In 1961 Franco Agostino's Albert Otto Italiana was founded and in 1972, after purchasing an area of 10,000 square metres in the municipality of Bagnolo Cremasco, Maus Italia Sas was established.

The Growth

In 1976 his son Stefano, a mechanical engineer, joined the company. Together with his father, he studied products, introduced new machinery onto the market and filed the first patents by Maus Italia. Above all, Stefano was firmly convinced that people are the very heart of a company's success. Therefore, he invested in human capital by valuing people and roles, and he surrounded himself with skilled operators as well as technical, commercial and administrative collaborators. The result was a winning, competent and proactive team.
His daughter Anna - also a mechanical engineer - has been working in the company since 2016, giving new impetus and energy to the business her father and grandfather had built.
Father and daughter work together side by side every day to guarantee the excellence of Maus Italia and support all customers worldwide with competence and passion: the company's distinctive traits.

Stefano Agostino
CEO - Mechanical Engineer

Anna Agostino
COO - Mechanical and Management Engineer

In-house production of each component
Workshop 4.0 and 24/7 production control

The production of Maus Italia branded items is entirely carried out in Bagnolo Cremasco, in the heart of an Italian industrial area 30 km southeast of Milan.
The company boasts a 4.0 workshop equipped with state-of-the-art machinery, an in-house heat treatment room and a final inspection department that allow Maus Italia to independently manage every phase of the manufacturing process of its wide range of products whilst maintaining high quality standards.

Quality first.
Design and development

One of Maus Italia's strengths is its willingness to understand its customers' needs.

Our technical department is always ready to find operational solutions to the most complex applications, even via feasibility studies. We develop accurate work processes, draw with FEM analyses to verify our mechanical-structural performance and optimise the manufacturing process of each component.

Ready To Deliver

A well-stocked and complete warehouse of finished products enables Maus Italia ship quickly to customers all over the world according to a ready-to-deliver logic.
The warehouse is fully located within our premises in Bagnolo Cremasco at controlled temperatures and conditions to guarantee the maximum safety and quality of Maus Italia products for all our customers.

Quality, environment and safety policy

Research, quality and safety are the watchwords of Maus Italia Spa.

Maus Italia has several projects underway aimed at increasingly sustainable development and integrates environmental concerns into its business model. The company's actions, behaviour and development choices are focused not only on the short run but rather mainly on a medium and long-term horizon.

MANAGEMENT SYSTEM CERTIFICATION
DNV
ISO 9001 - ISO 14001
ISO 45001

Every day in over 80 country worldwide

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Matex

Hi-tech portable equipment and electric mobile stations for semi-automatic controlled expansion of tubes

1/4" to 3" (6,35 to 76,20 mm)

The **process of tube expansion** in tube sheet bundles using the traditional tube expander must meet **quality, productivity and repeatability requirements** which are essential to successfully pass the strict **pressure, tightness tests at which the tube bundles** are subjected in the final testing stage to meet the strict construction standards.

To start and **control the operation of the tube expander**, Maus Italia offers a **range of motorised control systems and accessories**, divided in three main families: portable, semi-automatic and automatic.

Our experience has selected the **control of the torque measured on the expander axis** as the most appropriate reference technology.

Unlike pure dimensional control, torque control **is able to compensate parameter variability** (e.g. tolerances on sheet hole diameter and tube thickness), ensuring **reliability, repeatability and productivity** for heat exchanger manufacturers.

Thanks to its fifty-year experience in the industry, Maus Italia, a company always focused on research, has designed and manufactured the ***Matex***, the new **hi-tech** electric mobile stations for semi-automatic expansion of tubes, **top of range in the "semi-automatic" product**, whose innovative solutions allow tube expansion on an industrial scale.

These extraordinary results are achieved thanks to the latest generation electronic components selected by the engineers of Maus Italia thanks to experience gained in the manufacturing of the ***MA-2501*** working centres.

Overview of the features of the Matex Series

Flex Matex

Workstation with flexible shaft

Matex flex is the **most practical solution** proposed by Maus Italia for the expansion of **tube bundle heat-exchangers tubes (use of 5X torque multiplier) with OD 6,35 ÷ 19,05 mm (1/4" ÷ 3/4")**.

It consists of:

Matextsx-blu

Continuos cycle digital **control unit** with microprocessor and touch screen interface

Matex R F6000

Low voltage brushless **electric rolling motor** featuring a high number of revolutions with arrangement for the use with flexible shaft

FSD 12/2000

Flexible shaft for motor-tube expander mechanic drive with optional torque multiplier (5X)

PE/901

Digital input remote control **pedal set**

TPB-2

Balancer to support the flexible shaft

Porter flag

Support/handling **trolley** for the controller with rolling motor support

Packaging dim.	*mm (inches)*	1400 x 820 x 1210 (4.6 x 2.7 x 4.0)
Net weight	*Kg (Lb)*	190 (419)
Gross weight	*Kg (Lb)*	300 (662)

Port Matex

Workstation with portable electric tube expander

Port Matex is the "portable" solution proposed by Maus Italia for the expansion of tubes of tube bundle heat-exchangers tubes with OD **6,35 ÷ 31,75 mm (1/4" ÷ 1.1/4")**.

It consists of:

Matextsx-blu

Continuos cycle digital **control unit** with microprocessor and touch screen interface

Matex R P####

Low voltage brushless **electric rolling motor** featuring a high number of revolutions in 4 versions

PE/901

Digital input remote control **pedal set**

TPB-2

Balancer to support the portable rolling motor

Porter flag

Support/handling **trolley** for the controller with rolling motor support

Packaging dim.	*mm (inches)*	1400 x 820 x 1210 (4.6 x 2.7 x 4.0)
Net weight	*Kg (Lb)*	180 (397)
Gross weight	*Kg (Lb)*	290 (640)

Quadrol Matex

Workstation with telescopic shaft

Quadrol Matex is the **most complete solution** proposed by Maus Italia for the expansion of **tube bundle heat-exchangers tubes** with **OD 9,52 ÷ 76,20 mm (3/8"÷ 3").**

It consists of:

Matextsx-blu

Continuos cycle digital **control unit** with microprocessor and touch screen interface

Matex R V4 - Matex R L4

Low voltage brushless **electric rolling motors** with 4-speed gear

F/308 HS

Telescopic shaft for motor-tube expander mechanic drive

F/314 HS - F/317 HS

Adapters with female-female double quick couplings specific for high speeds

PE/901

Digital input remote control **pedal set**

Porter plus
Porter executive

Trolleys for controller support/handing and rolling motor support with manual or **continuos servo-assisted handling on axis Y.**

Packaging dim.	*mm (inches)*	1570 x 820 x 1210 (5.2 x 2.7 x 4.0)
Net weight	*Kg (Lb)*	250 (552)
Gross weight	*Kg (Lb)*	360 (794)

Flex Matex

Hi-tech tube rolling system with flexible shaft for tubes with outside diameter of 6,35 to 19,05 mm (1/4" up to 3/4")

In the ***Flex Matex*** system, to the digital control unit with microprocessor ***Matextsx-blu*** (torque-based speed continuous variation) as been added an extraordinary innovation of **flexible shaft *FSD 12/2000*** mounted on ***Porter flag*** trolley for quick handling in the workshop.

The ***Flex Matex*** system, dedicated to demanding users, is recommended for **serial production of small heat-exchangers** where tool lightness and manoeuvrability sensibly reduces the production times.

Compared with the traditional rolling equipment with fixed speed motor, ***Flex Matex*** excels in terms of high productivity, high quality of the expanded product and significant reduction of tool wear.

Direct without 5x multiplier

Max. speed
6000 rev/min (RpM)

De outside dia. tubes
6,35 ÷ 9,52 mm (1/4"÷ 3/8")

Max. torque
3,5 Nm (2.6 Ft Lb)

With 5x multiplier

Max. speed
1500 rev/min (RpM)

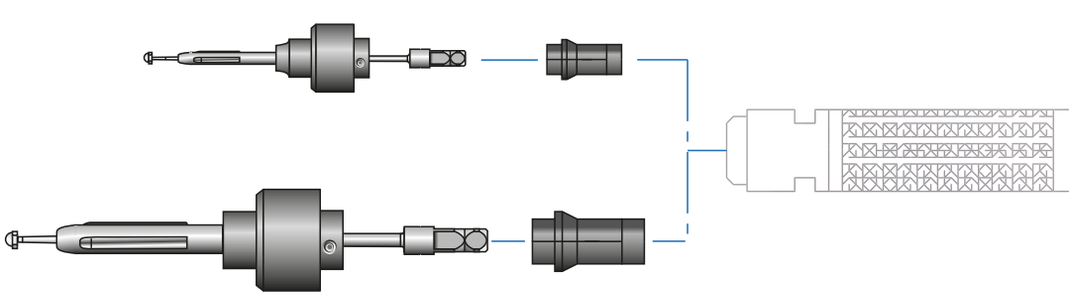
De outside dia. tubes
6,35 ÷ 19,05 mm (1/4"÷ 3/4")

Max. torque
13,5 Nm (9.9 Ft Lb)

Built-in joint

The flexible shaft FSD 12/2000 includes in the handle a cylindrical clamp adapter that fits perfectly the standard Maus Italia mandrel.

In the standard supply of the flex Matex there are two cylindrical clamp adapters for ø8 and ø12 mm.



Port Matex

Portable hi-tech tube rolling system for tubes with outside diameter of 6,35 to 31,75 mm (1/4" up to 1.1/4")

In the ***Port Matex*** system, the digital control unit with microprocessor ***Matextsx-blu*** (torque-based speed continuous variation) is associated with a small powerful portable brushless motor available in 4 versions:

Matex R P6000 **Matex R P1500**
Matex R P1000 **Matex R P600**

The ***Port Matex*** system, dedicated to demanding users, is recommended for the production of small exchangers where tool lightness and manoeuvrability sensibly reduces production times.

The ***Porter flag*** trolley and the balancer ***TPB-2*** are options available to ease the use of the portable equipment.

Compared with the traditional expansion system with fixed speed motor, ***Port Matex*** excels in terms of high productivity, high quality of the expanded product and significant reduction of tool wear.

Matex R P6000

Max. speed
6000 rev/min (RpM)

De outside dia. tubes
6,35 ÷ 9,52 mm (1/4"÷ 3/8")

Max. torque
3,5 Nm (2.6 Ft Lb)

Matex R P1500

Max. speed
1500 rev/min (RpM)

De outside dia. tubes
6,35 ÷ 19,05 mm (1/4"÷ 3/4")

Max. torque
13,5 Nm (9.9 Ft Lb)

Matex R P1000

Max. speed
1000 rev/min (RpM)

De outside dia. tubes
6,35 ÷ 25,40 mm (1/4"÷ 1")

Max. torque
3,5 Nm (15.1 Ft Lb)

Matex R P600

Max. speed
600 rev/min (RpM)

De outside dia. tubes
6,35 ÷ 31,75 mm (1/4"÷ 1.1/4")

Max. torque
35 Nm (25.8 Ft Lb)

Quadrol Matex

Hi-tech expansion system with telescopic shaft for tubes with outside diameter from 9,52 to 76,20 mm (3/8" up to 3")

Maus Italia introduces the ***Quadrol Matex*** system with the digital control unit with microprocessor ***Matextsx-blu*** (torque-based speed continuous variation) in conjunction with suspended electric rolling motor ***(Matex R V4 or Matex R L4)***.
The telescopic shaft ***F/308 HS*** is used for the mechanical driving of the tube expander.

The dedicated ***Porter*** trolley is proposed in two versions: **plus** with manual continuous handling on axis Y or **executive with continuous servo-assisted handling on axis Y.**

The ***Quadrol Matex*** system, dedicated to demanding users, is recommended for the **production of medium-big heat-exchangers** where **tool power and manoeuvrability** sensibly reduces production times.

Compared with the traditional expansion system with fixed speed motor, ***Quadrol Matex*** excels in terms of high productivity, high quality of the expanded product and significant reduction of tool wear.

With Matex R V4

Max. speed
800 rev/min (RpM)

De outside dia. tubes
9,52 ÷ 44,45 mm (1/4"÷ 1.3/4")

Max. torque
125 Nm (92.2 Ft Lb)

With Matex R L4

Max. speed
450 rev/min (RpM)

De outside dia. tubes
9,52 ÷ 76,20 mm (3/8"÷ 3")

Max. torque
180 Nm (132,8 Ft Lb)

Matextsx-blu

Continuous cycle electronic digital control unit with touch screen interface

The digital **control unit *Matextsx-blu*** is the brain of the system. Easy to use and equipped with 8" LCD **touch screen**, it has user friendly interface with dedicated software and it is protected by a sturdy metal case with a high degree of protection IP 55.

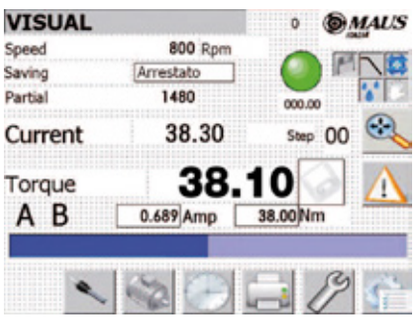
The ***Matextsx-blu*** allows the compensation of the tolerances for both the diameter of the holes in the tube sheets and of the thickness of the tubes with consequent **reaching of uniform sealing** of all the tubes at the operating pressure of the heat-exchange equipment, also estimating **tube rolling times.**

Designed to match the rolling motors of the ***R***-series,

Indipendent of the voltage variation ±10%

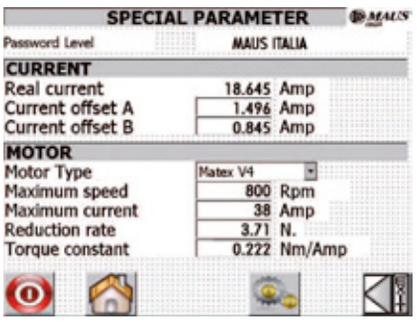
Viewing

During the tube rolling process, this screen is the home page for the operator who needs to control all parameters involved. Acess to all “Setup” screens is controlled by the icon menu on the bottom.



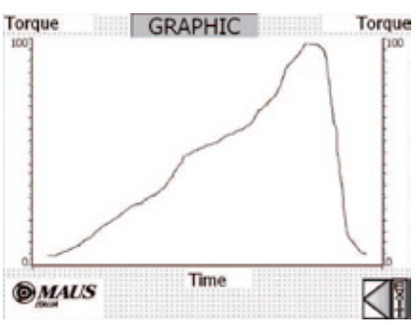
Special parameters

Setup/Verification screen (with password protection) of the configuration of the rolling motors connected to the control unit. Command centre for the automatic setting of the rolling motor offset and for general configuration.



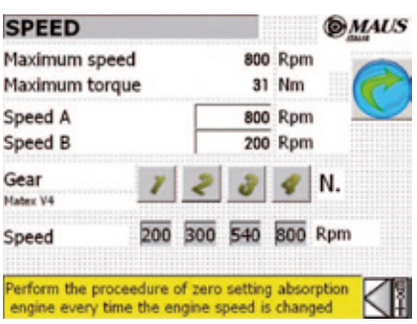
Graph

Displays in real time the graph of the torque delivered by the expander in Nm of the last 30”. The displayed “range” is from zero Nm to the value reached by the machine.



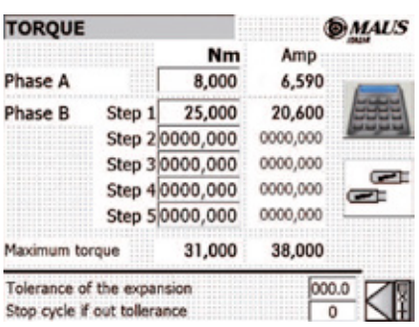
Speed

Adapts to the rollling motors of the ***R*** series connected to the rolling unit and selected in the “Setup”. The speed of the two main stages of the tube rolling can be defined; the **approach** (Phase A) and the **crushing** (Phase B) and if provided the rev/min for each stage.



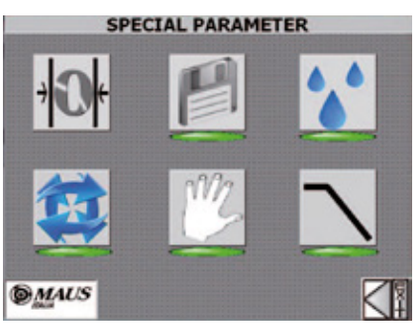
Torques

It is possible to set the torque values of the rolling motors for two main stages of the tube rolling; **approach** (Step A) and **crushing** (Step B).
Setting the torque value in Nm, the motor draw value Ampere is displayed next to the above value.



Main menu

Screen for quick acces to:
- Motor offset
- Tube rolling report activation
- Activation of lubrificant during cycle
- Operation in automatic cycle
- Operation in manual cycle
- Activation of “decreasing speed”



Matex R

Low-voltage electric rolling motors with brushless motor

Several models of **electric rolling motors** are available to meet the main technical requirements from the market, according to the tube size and to the required expansion characteristics.

Strong and **low-noise**, the ***R*** series rolling motors feature a **low-voltage variable speed brushless motor** (48 V) and integrated suspension and are **specially designed to provide**:

- Great increase in sensitiveness;
- Continuous speed variations;
- Flexibility of use.

With the **low-voltage** rolling motors, the strict **safety** requirements set out for portable equipment in **work sites characterised by the presence of great metal masses are satisfied.**

Designed for exclusive use with the control unit ***Matextsx-blu***, they are paired as follows:

Matex R L4	***F***	***P***	***V4***	***L4***
Flex Matex	●			
Port Matex		●		
Quadrol Matex			●	●

Matex R F

Flexible shaft

Matex R F6000

		F6000 Direct WITHOUT 5X multiplier	F6000 WITH 5X multiplier
Max. speed	rev/min (R.P.M)	6000	1200
Max. torque	Nm (Ft Lb)	3,50 (2.6)	17,50 (12.9)
O.D tubes Max.	mm (inches)	*9,52* (3/8")	*19,05* (3/4") *

* ***Non ferrous***

Matex R P

Portable

Matex R P####

		P6000	P1500	P1000	P600
Max. speed	rev/min (R.P.M)	6000	1500	1000	600
Max. torque	Nm (Ft Lb)	3,50 (2.6)	13,50 (9.9)	20,50 (15.1)	35,00 (25.8)
O.D tubes Max.	mm (inches)	*9,52* (3/8")	*19,05* (3/4")	*25,40* (1")	*31,75* (1.1/4")

Matex R L4

Telescopic shaft

Matex R L4

Mechanical gearbox		I	II	III	IV
Max. speed	rev/min (R.P.M)	110	170	300	450
Max. torque	Nm (Ft Lb)	180 (132.8)	150 (110.6)	84 (61.9)	57 (42.0)
O.D tubes Max.	mm (inches)	*76,20* (3")	*63,50* (2.1/2")	*50,80* (2")	*38,10* (1.1/2")

Matex R V4

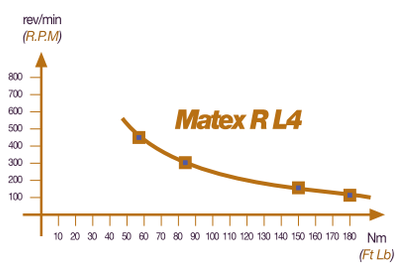
Telescopic shaft

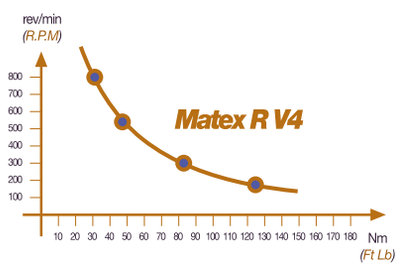
Matex R V4

Mechanical gearbox		I	II	III	IV
Max. speed	rev/min (R.P.M)	200	300	540	800
Max. torque	Nm (Ft Lb)	125 (92.2)	83 (61.2)	47 (34.7)	31 (22.9)
O.D tubes Max.	mm (inches)	44,45 (1.3/4")	38,10 (1.1/2")	31,75 (1.1/4")	25,40 (1")

Flexibility of use

Due to the **4 speed gearbox**, the **rolling motors** ***Matex R L4*** and ***Matex R V4*** are able to **optimize the "range" of speed on the base of the operating parameters, as described in the below tables and graphs.**





F/308 HS

Articulated telescopic shaft for mechanical drive from R L4 and R V4 motors to the tube expanders manufactured by Maus Italia

It is the technological evolution of the previous ***F/308***, with innovative design solutions making it reliable, particularly easy to handle as well as accurate and stable at high speeds.

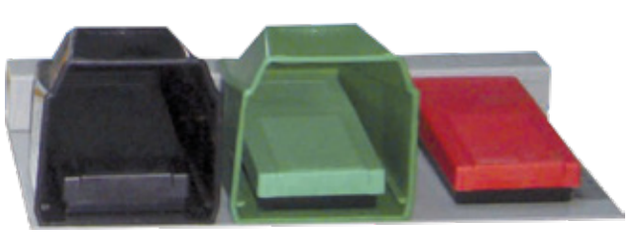
It increases the operating range along the X and Y axis and it completes motion along the Z axis; It allows to quickly connect the tube expander by means of the ***F/317 HS*** joint.

F/314 HS - F/317 HS

Joints with double female-female quick coupling specific for high speeds

The joints with double quick coupling ***F/314 HS*** and ***F/317 HS***, besides allowing to **replace the tube expander in very short time**, with an **accurate and patented design**, ensure that the shaft ***F/308 HS*** is **perfectly coaxial** with the tube expander mandrel, reducing any vibration and allowing the operator to more easily insert of the tube expander, even if rotating, into the tube.

PE/901



Digital input remote control pedal set

Working cycle

It is hereinafter analysed the evolution of the rotation speed of the **rolling motors *Matex R*** in the phases of tube rolling, as indicated in the diagram alongside:

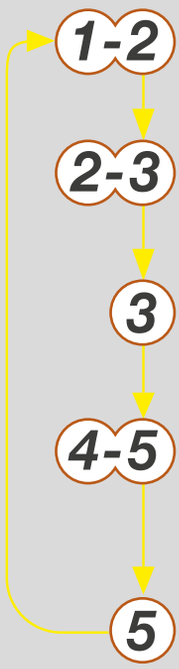
approach of the tube to the wall of the tube sheet hole with **high speed rotation** of the tube expander;

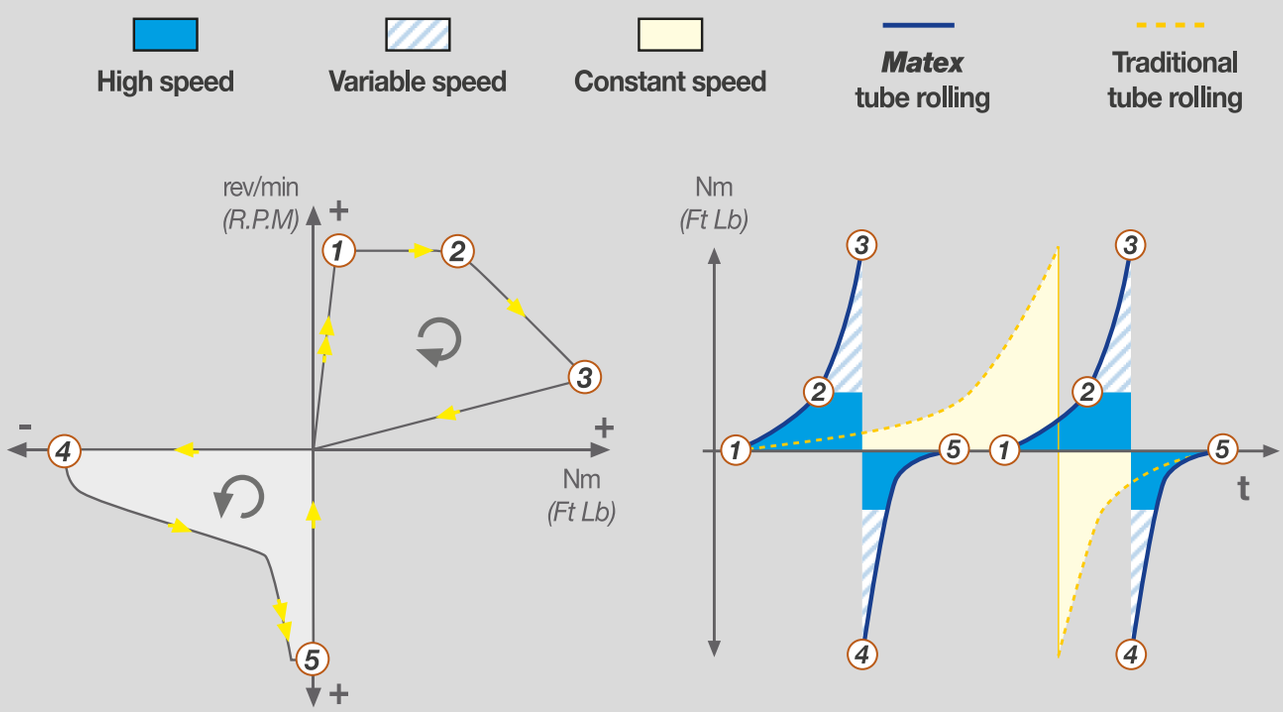
crushing of the tube thickness with torque-based speed decreasing **continuous variation**

reaching the set torque value, with **stop** of the rotation of the tube expander;

unlocking of the tube expander with initial slow rotation speed and fast rotation up to the complete extraction of the tube expander;

instantaneous **stop** of the rotation to permit the reinsertion of the tube expander in the next tube during the **scheduled pause** before the **automatic restart** of the **continuous cycle** from the point ①

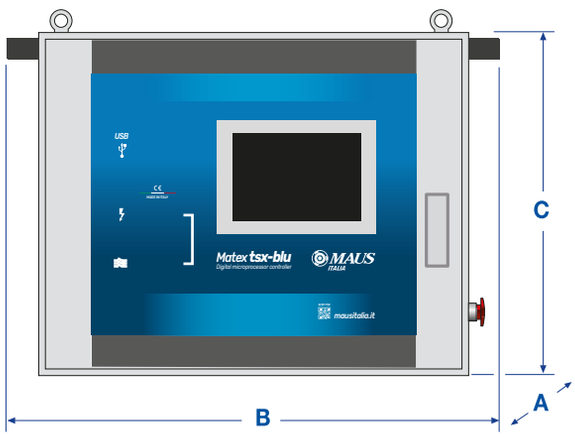




Matextsx-blu

Supply		
Voltage	Volt - Ph	400 - 3
Frequency	Hz	50/60
Installed power	Kw	2,5
Motor voltage	V	48
Pedal set voltage	V	24

Dimensions			
Lenght (depth)	A	mm (Ft)	475 (1.56)
Width	B	mm (Ft)	600 (1.97)
Height	C	mm (Ft)	475 (1.56)
Weight		Kg (Lb)	75 (166)
Degree of protection		IP	55
Colours		RAL	7030 - 7035



On request, the ***Matextsx-blu*** control unit is available as well in the 220 Vac single phase version.

Matex R

Supply			Matex R P####				Matex RF6000	Matex R V4	Matex R L4
Motor voltage		V	48				48	48	48
Motor power		Kw/A	0,80/38				0,80/38	2,24/38	2,24/38
Working capacity			**P6000**	**P1500**	**P1000**	**P600**		**Mechanical gearbox I II III IV**	
Max. speed		rev/min (R.P.M)	6000	1500	1000	600	6000	200-300-540-800	110-170-300-450
Max. torque		Nm (Ft Lb)	3,50 (2.6)	13,50 (9.9)	20,50 (15.1)	35,00 (25.8)	3,5 (2.6)	125 (92.2)	180 (132.8)
Max. tube Ø		mm (inches)	*9,52* (3/8")	*19,05* (3/4")	*25,40* (1")	*31,75* (1.1/4")	*9,52* (3/8")	*44,45* (1.3/4")	*76,20* (3")
Telescopic shaft		Cod.	/				FSD 12/2000	F-308 HS/3	F-308 HS/3
Joints		Cod.	F/314 HS				/	F/317 HS	F/317 HS
Advised shank			M				Cylindrical jaw	3	3
Dimensions									
Lenght	A	mm (inches)	*340* (13.4")				*270* (13.4")	*609* (10.7")	*609* (10.7")
Width	B	mm (inches)	*75* (3")				*70* (2.8")	*180* (7")	*180* (7")
Height	C	mm (inches)	*250* (9.8")				*250* (9.8")	*280* (11")	*280* (11")
Weight		Kg (Lb)	6 (13.3)				6 (13.3)	24 (53)	24 (53)
Degree of protection		IP	55				55	55	55
Colours		RAL	9005 - 7035				9005 - 7035	9005-7030-7035	9005-7030-7035

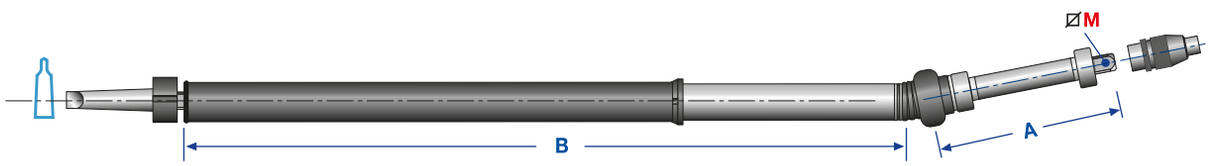
* ***Direct WITHOUT 5X multiplier***

Lubricator LCQ1

To increase the life of the tools, it's possible to add the **lubrificator *LCQ1*** and the related **tank with minimum adjustment** of the lubrificant.
This lubrificator can be used with specific tube expanders.

F/308 HS

F/308 HS		Handle A		Telescopic range B		Extensibility		Max. torque		Weight		M
Model	N	mm	inches	mm	inches	mm	inches	Nm	Lb Ft	Kg	Lb	mm
F/308 HS-3	3	225	8.9	650÷1060	25.6÷41.7	410	16.1	180	132	7,9	17.41	18
* F/308 HS-3L	3	225	8.9	850÷1460	33.5÷57.5	610	24.0	180	132	8,9	19.62	18 *



F/314 HS

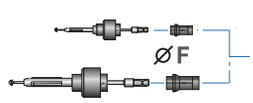
F/317 HS	F	Weight	
Model	inches	Kg	Lb
F/314 HS-1/4"	1/4"	0,18	0.40
F/314 HS-3/8"	3/8"	0,21	0.46

FSD 12/2000

FSD 12/2000	Lenght		Max. torque		Weight		F
Model	mm	inches	Nm	Lb Ft	Kg	Lb	mm
FSD 12/2000	2000	78.7	3,5	2.6	5,8	12.8	8-12

F/317 HS

F/317 HS	F	Weight	
Model	inches	Kg	Lb
F/317 HS-3/8"	3/8"	0,29	0.64
F/317 HS-1/2"	1/2"	0,31	0.68
F/317 HS-3/4"	3/4"	0,38	0.84



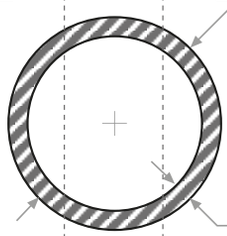
Porter

Work axes		Porter Flag	Porter Plus	Porter executive
X axis	motion	/	manual sliding	manual sliding
Y axis	motion	manual sliding	servo manual	motor-driven
Working capacity				
Supported torque	Nm (Ft Lb)	100 (73)	250 (184)	250 (184)
Supported weight	Kg (Lb)	150 (330)	150 (330)	150 (330)
Horizontal stroke	mm (inches)	/	1000 (39)	1000 (39)
Vertical stroke	mm (inches)	/	650 (25)	650 (25)
Dimensions				
Lenght (depth)	mm (Ft)	1200 (4.0)	1400 (4.6)	1400 (4.6)
Width	mm (Ft)	700 (2.3)	700 (2.3)	700 (2.3)
Height	mm (Ft)	2070 (6.8)	2030 (6.7)	2030 (6.7)
Weight	Kg (Lb)	70 (155)	81 (179)	113 (250)
Colours		Anodised aluminium	Anodised aluminium	Anodised aluminium

* ***Version with extra extensibility for use with tube expanders whose lenght exceeds 500 mm (19,7")***

BWG Table

OD	00 BWG		0 BWG		1 BWG		2 BWG		3 BWG		4 BWG		5 BWG		6 BWG		7 BWG		8 BWG		9 BWG		10 BWG		11 BWG	
“ mm	“	mm	“	mm	“	mm	“	mm	“	mm	“	mm	“	mm	“	mm	“	mm	“	mm	“	mm	“	mm	“	mm
sp →	0.380	9,65	0.340	8,64	0.300	7,62	0.284	7,21	0.259	6,58	0.238	6,05	0.220	5,59	0.203	5,16	0.180	4,57	0.165	4,19	0.148	3,76	0.134	3,40	0.120	3,05
1/4” (6,3)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/8” (9,5)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1/2” (12,7)	-	-	-							-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5/8” (15,9)	-	-	-							-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3/4” (19,0)	-	-	-							-	-	-	-	-	-	-	-	-	-	-	-	-	0.482	12,2	0.510	12,9
7/8” (22,2)	-	-	-	-					-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.607	15,4	0.635	16,1
1” (25,4)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.670	17,0	0.704	17,9	0.732	18,6	0.760	19,3
1.1/4” (31,8)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.890	22,6	0.920	23,4	0.954	24,3	0.982	25,0	1.010	25,7
1.1/2” (38,1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.140	28,9	1.170	29,7	1.204	30,6	1.232	31,3	1.260	32,0
1.3/4” (44,4)	-	-	-	-	-	-	-	-	-	-	-	-	1.310	33,2	1.344	34,1	1.390	35,2	1.420	36,0	1.454	36,9	1.482	37,6	1.510	38,3
2” (50,8)	-	-	-	-	-	-	-	-	-	-	1.524	38,7	1.560	39,6	1.594	40,5	1.640	41,6	1.670	42,4	1.704	43,3	1.732	44,0	1.760	44,7
2.1/4” (57,1)	1.490	37,8	1.570	39,8	1.650	41,8	1.682	42,7	1.732	43,9	1.774	45,0	1.810	45,9	1.844	46,8	1.890	47,9	1.920	48,7	1.954	49,6	1.982	50,3	2.010	51,0
2.1/2” (63,5)	1.740	44,2	1.820	46,2	1.900	48,2	1.932	49,1	1.982	50,3	2.024	51,4	2.060	52,3	2.094	53,2	2.140	54,3	2.170	55,1	2.204	56,0	2.232	56,7	2.260	57,4
2.3/4” (69,8)	1.990	50,5	2.070	52,5	2.150	54,5	2.182	55,3	2.232	56,6	2.274	57,7	2.310	58,6	2.344	59,5	2.390	60,6	2.420	61,4	2.454	62,3	2.482	63,0	2.510	63,7
3” (76,2)	2.240	56,9	2.320	58,9	2.400	60,9	2.432	61,8	2.482	63,0	2.524	64,1	2.560	65,0	2.594	65,9	2.640	67,0	2.670	67,8	2.704	68,7	2.732	69,4	2.760	70,1
3.1/4” (82,6)	2.490	63,3	2.570	65,3	2.650	67,3	2.682	68,2	2.732	69,4	2.774	70,5	2.810	71,4	2.844	72,3	2.890	73,4	2.920	74,2	2.954	75,1	2.982	75,8	3.010	76,5
3.1/2” (88,9)	2.740	69,6	2.820	71,6	2.900	73,6	2.932	74,5	2.982	75,7	3.024	76,8	3.060	77,7	3.094	78,6	3.140	79,7	3.170	80,5	3.204	81,4	3.232	82,1	3.260	82,8
3.3/4” (95,2)	2.990	75,9	3.070	77,9	3.150	79,9	3.182	80,8	3.232	82,0	3.274	83,1	3.310	84,0	3.344	84,9	3.390	86,0	3.420	86,8	3.454	87,7	3.482	88,4	3.510	89,1
4” (101,6)	3.240	82,3	3.320	84,3	3.400	86,3	3.432	87,2	3.482	88,4	3.524	89,5	3.560	90,4	3.594	91,3	3.640	92,4	3.670	93,2	3.704	94,1	3.732	94,8	3.760	95,5
4.1/4” (108,0)	3.490	88,7	3.570	90,7	3.650	92,7	3.682	93,6	3.732	94,8	3.774	95,9	3.810	96,8	3.844	97,7	3.890	98,8	3.920	99,6	3.954	100,5	3.982	101,2	4.010	101,9
4.1/2” (114,3)	3.740	95,0	3.820	97,0	3.900	99,0	3.932	99,9	3.982	101,1	4.024	102,2	4.060	103,1	4.094	104,0	4.140	105,1	4.170	105,9	4.204	106,8	4.232	107,5	4.260	108,2



12 BWG		13 BWG		14 BWG		15 BWG		16 BWG		17 BWG		18 BWG		19 BWG		20 BWG		21 BWG		22 BWG		23 BWG		24 BWG		OD
“	mm	“	mm	“	mm	“	mm	“	mm	“	mm	“	mm	“	mm	“	mm	“	mm	“	mm	“	mm	“	mm	mm
0.109	2,77	0.095	2,41	0.083	2,11	0.072	1,83	0.065	1,65	0.058	1,47	0.049	1,24	0.042	1,07	0.035	0,89	0.032	0,81	0.028	0,71	0.025	0,64	0.022	0,56	← sp
-	-	-	-	-	-	-	-	-	-	-	-	0.152	3,8	0.166	4,1	0.180	4,5	0.186	4,7	0.194	4,9	0.200	5,0	0.206	5,2	1/4” (6,3)
-	-	-	-	0.209	5,3	0.231	5,8	0.245	6,2	0.259	6,5	0.277	7,0	0.291	7,3	0.305	7,7	0.311	7,9	0.319	8,1	0.325	8,2	0.331	8,4	3/8” (9,5)
-	-	0.310	7,9	0.334	8,5	0.356	9,0	0.370	9,4	0.384	9,7	0.402	10,2	0.416	10,5	0.430	10,9	0.436	11,1	0.444	11,3	0.450	11,4	0.456	11,6	1/2” (12,7)
0.407	10,3	0.435	11,1	0.459	11,7	0.481	12,2	0.495	12,6	0.509	12,9	0.527	13,4	0.541	13,7	0.555	14,1	0.561	14,3	0.569	14,5	0.575	14,6	0.581	14,8	5/8” (15,9)
0.532	13,4	0.560	14,2	0.584	14,8	0.606	15,3	0.620	15,7	0.634	16,0	0.652	16,5	0.666	16,8	0.680	17,2	0.686	17,4	0.694	17,6	0.700	17,7	0.706	17,9	3/4” (19,0)
0.657	16,6	0.685	17,4	0.709	18,0	0.731	18,5	0.745	18,9	0.759	19,2	0.777	19,7	0.791	20,0	0.805	20,4	0.811	20,6	0.819	20,8	0.825	20,9	0.831	21,1	7/8” (22,2)
0.782	19,8	0.810	20,6	0.834	21,2	0.856	21,7	0.870	22,1	0.884	22,4	0.902	22,9	0.916	23,2	0.930	23,6	0.936	23,8	0.944	24,0	0.950	24,1	0.956	24,3	1” (25,4)
1.032	26,2	1.060	27,0	1.084	27,6	1.106	28,1	1.120	28,5	1.134	28,8	1.152	29,3	1.166	29,6	1.180	30,0	1.186	30,2	1.194	30,4	1.200	30,5	1.206	30,7	1.1/4” (31,8)
1.282	32,5	1.310	33,3	1.334	33,9	1.356	34,4	1.370	34,8	1.384	35,1	1.402	35,6	1.416	35,9	1.430	36,3	1.436	36,5	1.444	36,7	1.450	36,8	1.456	37,0	1.1/2” (38,1)
1.532	38,8	1.560	39,6	1.584	40,2	1.606	40,7	1.620	41,1	1.634	41,4	1.652	41,9	1.666	42,2	1.680	42,6	1.686	42,8	1.694	43,0	1.700	43,1	1.706	43,3	1.3/4” (44,4)
1.782	45,2	1.810	46,0	1.834	46,6	1.856	47,1	1.870	47,5	1.884	47,8	1.902	48,3	1.916	48,6	1.930	49,0	1.936	49,2	1.944	49,4	1.950	49,5	1.956	49,7	2” (50,8)
2.032	51,5	2.060	52,3	2.084	52,9	2.106	53,4	2.120	53,8	2.134	54,1	2.152	54,6	-	-	-	-	-	-	-	-	-	-	-	-	2.1/4” (57,1)
2.282	57,9	2.310	58,7	2.334	59,3	2.356	59,8	2.370	60,2	2.384	60,5	2.402	61,0	-	-	-	-	-	-	-	-	-	-	-	-	2.1/2” (63,5)
2.532	64,2	2.560	65,0	2.584	65,6	2.606	66,1	2.620	66,5	2.634	66,8	2.652	67,3	-	-	-	-	-	-	-	-	-	-	-	-	2.3/4” (69,8)
2.782	70,6	2.810	71,4	2.834	72,0	2.856	72,5	2.870	72,9	2.884	73,2	2.902	73,7	-	-	-	-	-	-	-	-	-	-	-	-	3” (76,2)
3.032	77,0	3.060	77,8	3.084	78,4	3.106	78,9	3.120	79,3	3.134	79,6	3.152	80,1	-	-	-	-	-	-	-	-	-	-	-	-	3.1/4” (82,6)
3.282	83,3	3.310	84,1	3.334	84,7	3.356	85,2	3.370	85,6	3.384	85,9	3.402	86,4	-	-	-	-	-	-	-	-	-	-	-	-	3.1/2” (88,9)
3.532	89,6	3.560	90,4	3.584	91,0	3.606	91,5	3.620	91,9	3.634	92,2	3.652	92,7	-	-	-	-	-	-	-	-	-	-	-	-	3.3/4” (95,2)
3.782	96,0	3.810	96,8	3.834	97,4	3.856	97,9	3.870	98,3	3.884	98,6	3.902	99,1	-	-	-	-	-	-	-	-	-	-	-	-	4” (101,6)
4.032	102,4	4.060	103,2	4.084	103,8	4.106	104,3	4.120	104,7	4.134	105,0	4.152	105,5	-	-	-	-	-	-	-	-	-	-	-	-	4.1/4” (108,0)
4.282	108,7	4.310	109,5	4.334	110,1	4.356	110,6	4.370	111,0	4.384	111,3	4.402	111,8	-	-	-	-	-	-	-	-	-	-	-	-	4.1/2” (114,3)

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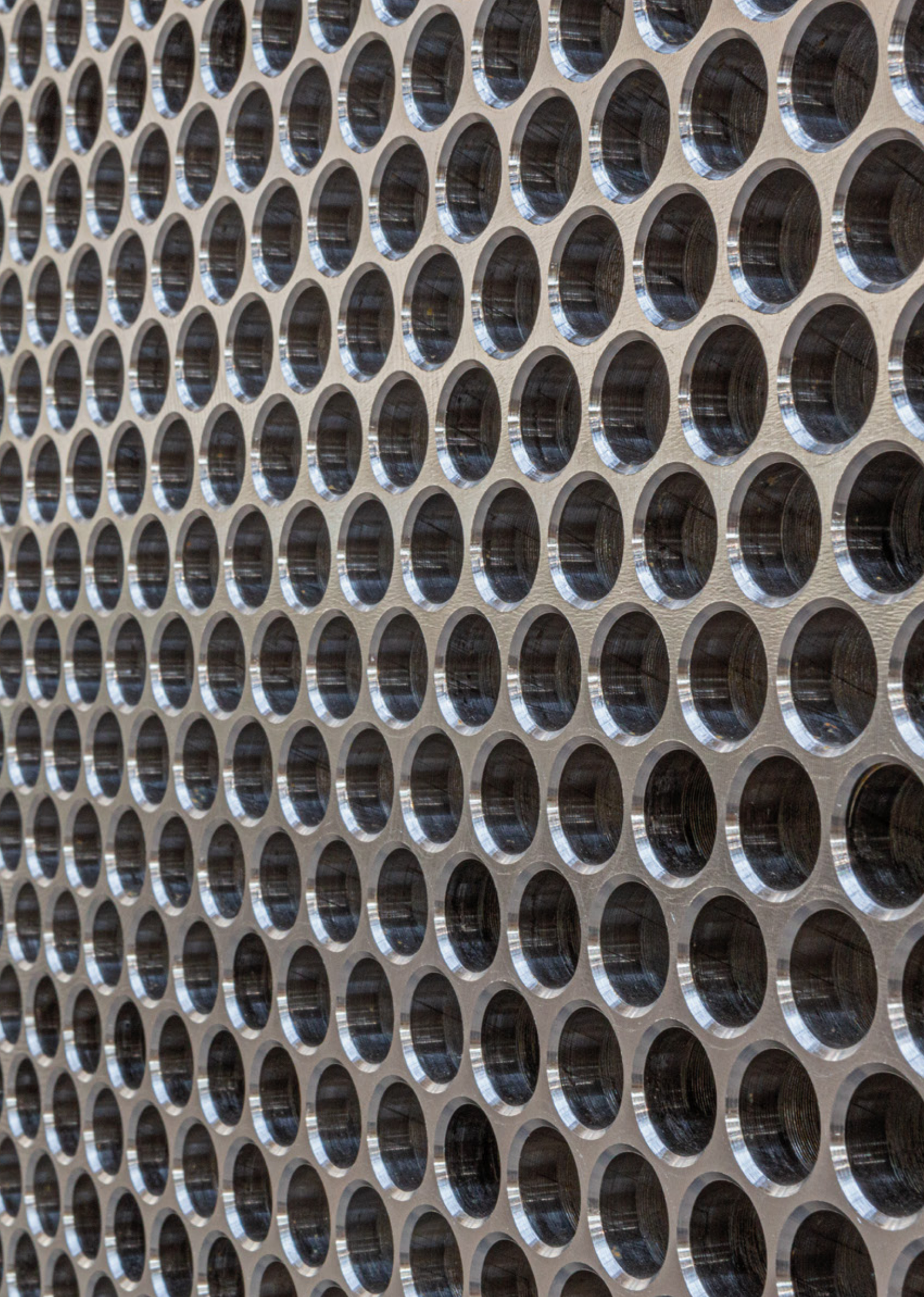
Maus Italia S.p.A.

SP 415 KM 30 (nuova strada di arrocco)
26010 Bagnolo Cremasco (CR) Italy
PIVA: 00141010199

Telefono: +39 0373 2370

expo@mausitalia.it
www.mausitalia.it



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