

MALENOVICE, DATE
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SIX - SPINDLE BAR AUTOMATIC LATHE

MORI - SAY 620 AC

equipped with bar feeder CUCCHI BLT
for automatic loading of bars

Typ MULTI F-6, Model AN / PB20, Version 3,3 M



1. TECHNICAL DESCRIPTION OF THE MACHINE

1.1 TECHNOLOGICAL UTILIZATION AND CHARACTERISTIC OF THE STANDARD BASIC MACHINE

The machines **MORI-SAY 620 AC** are intended for mass and series production of machine parts from bar stock with the maximum length of 4000 mm within the range of diameters from 4 to 20 mm and hexagons from 6 to 17 mm.

The ends of bars must be chamfered at least at 1.5 x 65 degrees (vertex angle - 50 degrees).

Admissible tolerance of both circular and non-circular cross section of a bar clamped in the collet bush is within IT 11 tolerance.

The bars for guiding ZPS material with manual replenishment of bars must be straightened of 1 mm on length of 1000 mm.

Bars for integrated six-channel automatic bar loader must be straightened of 0,5 mm on length of 1000 mm.

After additional installation of the optional equipment, the machine can produce also two different simple parts - it operates as a double three-spindle machine.

The automatic machine is delivered either adjusted for production of a concrete part according to the preliminary mutual agreement or non-adjusted with the optional equipment according to the wish of the customer or non-adjusted without optional equipment.

1.2 MACHINE TECHNICAL DESCRIPTION

The automatic machine **MORI-SAY 620 AC** has the possibility of spindle drum indexing always by one working position. The speed of spindles can be selected continuously using a regulating motor.

The working times (feeds) are derived from an independent regulating drive which enables adjustment of the required working time (feed) in the whole range for the operating mode as well as for setting-up.

It is adapted for the additional mounting of the optional equipment and bar feeding device in the working position III.

The functional movements are performed mechanically, rotary movements by gearings, linear movements by adjustable rocker arm mechanisms with exchangeable disk cams. The bar stop is controlled also mechanically.

The box of drives is mounted on the right-hand side of the machine base, while the headstock box with the spindle drum on its left-hand side. Both boxes are connected through a cross beam in their upper parts.

The machine does not include any hydraulic mechanisms.

2. MAIN TECHNICAL DATA AND DIMENSIONS OF THE MACHINE

MORI-SAY 620 AC

Bar capacity with clamping collets DIN 9012-E:		
- with automatic bar loader Cucchi BLT	mm	22 max.
Dimensions of bar stock ZPS:		
- circular cross section	mm	20
- hexagonal cross section	mm	17
Maximum length of bar	mm	3300
Maximum length of bar feeding	mm	100

Spindles:

- pcs		6
- pitch diameter	mm	180
- speed range	rpm	500-6000

Working time - T_p: s 0,8 - 90

Idle time s 0,7

Longitudinal slides (independent):

- number		6
- range of total strokes		
pos. I, II, IV, V	mm	28 - 80
pos. III and VI	mm	35 - 105
- range of working strokes		
pos. I, II, IV, V	mm	0 - 68
pos. III and VI	mm	0 - 90

Longitudinal slides guiding

- stroke	mm	24 - 50
- resetting	mm	Max. 90

Cross slides:

- number		6
- range of strokes	mm	21 - 42
- range of working strokes	mm	0 - 36
- adjustability	mm	13

Compound slides:

- number (pos. I, II, IV, V)		4
- range of total cross stroke	mm	21 - 42
- adjustability of cross stroke	mm	13
- range of cross working strokes	mm	0 - 36
- range of total longitudinal		
stroke - pos. IV and V	mm	30 - 65
- range of total longitudinal		
stroke - pos. I and II	mm	30 - 60
- range of working longitudinal		
stroke - pos. IV and V	mm	0 - 55
- range of working longitudinal		
stroke - pos. I and II	mm	0 - 51

Supplementary data:**Main electric motor - asynchronous (controlled) SIEMENS:**

- Max. output	kW	10
- Max. speed	rpm	9000

Controlled electric motor of feeds - SIEMENS:

- Max. output	kW	4,1
- Max. speed	rpm	6500
- Torque at maximum speed.....	Nm	6,5

Cooling system electric motor output kW 1,5

Lubricating system electric motor output kW 0.75

Operational power input of electric equipment kW/kVA 19/21

Machine dimensions:

Height of spindle drum axis above floor level	mm	1130
Total machine length		
- with 4 m stock carriage	mm	6098
- with shortened 3 m carriage	mm	5291
- without stock carriage	mm	2950
Machine height	mm	2197
Machine width	mm	1230
Machine weight including standard accessories	kg	5000

3. MACHINE MAIN GROUPS

3.1 Base

The base is open in the direction towards the stock carriage to improve swarf handling and to make machine cleaning easier. The swarf conveyor together with the settling tank with built-up cooling pump are to be inserted into this space.

The tank for lubricating oil is formed on the right-hand side of the base under the box of drives. The lubricating oil level can be checked using the level indicators.

The pump for pumping leaked cooling medium from the bottom of the base back into the settling tank is installed in the internal space of the base under the space for removal of parts.

Finished parts are taken away from the machine through the internal space of the base into the holes in the side of the base.

There are holes in the longitudinal sides for installation of bars for machine transport. The levelling screws for machine levelling are placed in four pockets in the base bottom part.

3.2 Box of Drives

It is attached to the machine base on the right-hand side from the operator's post.

Two vertical cam shafts and control mechanisms with rocker arms for six independent longitudinal slides, four compound slides, independent drive of hexagon and mechanical control of PICK-UP feed are installed in the front and side spaces.

There are constant gear transmissions for driving worms in the central part. Drives of thread cutting attachment for cutting with screwing tap and threading die can also be installed here as an optional equipment.

The electric motor of the regulating drive of feeds is mounted on the right-hand side of the box of drives. The torque is transferred from the electric motor through a flexible coupling and gear transmissions to individual mechanisms.

The main electric motor for driving the spindles is installed on the upper side of the box of drives from the rear operator's side.

Drives of optional equipment are to be installed in the box of drives from the right-hand side. The gear ratios of the individual gears can be changed using pick-off gears.

It is possible to turn the machine over using a hand crank. The hole for installation of the crank is on the box of drives in the right-hand bottom part from the operator's post.

The box of is provided with two output shafts. The central shaft serves for driving the spindles while the lower one for drives of feeds in the headstock box.

3.2.1 Brake

A brake is used to stop the machine feeds immediately in the event of a power cut. The brake is a part of the regulating drive of feeds.

3.2.2 Overload Release Clutch

It is located on both worm wheels of the vertical shafts. It transmits torques needed to overcome the operating resistances of mechanisms whose motions are derived from these shafts.

The torque of the clutch has been set up in the factory.

3.2.3 Drive of Longitudinal Slides

The movements (feeds) of all the longitudinal and compound slides, hexagon and PICK-UP feed are controlled by exchangeable disk cams installed on two vertical shafts along both sides of the box of drives. The fast exchangeable control cams are mounted with nuts through flexible washers to the carrying disks with gearing.

3.2.4 Drives of Optional Equipment

The box of drives is adapted to mounting gears for driving the equipment for thread cutting with screwing tap or threading die, chaser, for reaming, high-speed drilling and the equipment with the same speed as the speed of machine spindles or another piece of optional equipment.

The space for installation of drives and pick-off gears is accessible after turning the electrical box in the longitudinal axis of the machine and opening the cover of the box of drives.

3.2.5 Auxiliary Machine Turning-Over

It is possible to turn the machine over by means of the motor of the regulating drive of feeds to enable manual machine control at adjusting.

In emergency cases, it is possible to turn the machine over using a hand crank. The hole for crank insertion is located on the box of drives, in the right bottom part from the operator's post. Before crank inserting, it is necessary to reset the plate which blocks insertion and simultaneously closes the terminal switch which registers hand crank insertion and blocks the automatic feeds.

3.3 Headstock Box

It is attached to the machine base in the left from the operator's post.

The spindle drum is mounted inside of the box. Around the spindle drum, in the front wall, the locking mechanism of the spindle drum in its working position is installed.

Brackets of six cross slides are screwed to the front wall. The drives of all the cross slides are mounted along the spindle drum.

On the front wall behind the cut-off slide, a mechanical control of the bar stop is installed.

The bracket with the spindle drum indexing mechanism is screwed to the rear wall. The guiding bars of the clamping and feeding mechanism are also mounted on the rear wall.

The box is closed from both sides with covers which enable access to the internal mechanisms.

3.3.1 Drives of Cross Slides

The movements (feeds) of cross slides in all working stations are controlled by exchangeable disk cams mounted on four longitudinal shafts seated along both sides of the spindle drum.

The cam for driving the stock bar stop, the cam for driving the PICK-UP tool slide and the cam for spindle drum locking are also installed here.

The overload release clutch protecting the mechanisms in the headstock box against overloading is installed on both worm wheels.

3.3.2 Spindle Drum Indexing

The intermittent motion for the spindle drum indexing is derived from a Geneva mechanism. It is mounted on the external wall of the headstock box. It is possible to index by only one working position.

The mechanism is protected against overloading with three shear pins. The spindle drum indexing mechanism can be set out of operation using a gear-shift bar.

3.3.3 Spindle Drum Locking

The locking mechanism sets the spindle drum into the working position and holds it in this position during the working time.

The accurate adjustment into the working position is ensured by three rims with spur gearings.

The thrust for locking is induced by preloaded springs. Spindle drum unlocking - disengaging the locking rim from mesh is executed mechanically.

3.3.4 Spindle Drum Locking Control

It is executed by means of a mechanism controlled by the cam installed on the longitudinal shaft.

Four locking stations are installed evenly on the periphery of the locking rim.

3.3.5 Spindle Drum

Machine working spindles and bar stock clumper and feeder are mounted in the spindle drum. Attached to it are also the toothed rims for locking and indexing. The flanges for securing the bearings of spindles are screwed to the spindle drum front face.

The internal locking rim with spur gearing is fastened on the drum shoulder behind the flanges.

3.3.6 Spindle SAY620 AC

Six spindles are installed in the spindle drum. A clamping and feeding collet is in the front part of each spindle. The bearings for clamping and feeding device are on the ends of spindles.

The spindle of the machine SAY620 AC is adapted for use of GILDEMEISTER clamping collets. The design of the spindle enables to use fast exchangeable collets of HAINBUCH. The spindle is dynamically balanced.

3.3.8 Clamping and Feeding Device

The clamping and feeding device is arranged in the space between the headstock box and rear bracket. It is operated mechanically by a clamping drum cam and a feeding drum cam. The cams control clamping and feeding slide which move on two guiding bars installed in headstock box wall and in the machine rear bracket.

Their movement is transferred on the clumper and feeder on the machine spindles. The clamping force is kept on the value necessary for bar stock clamping within the tolerance IT11 with a bundle of preloaded Belleville springs.

3.4 Cross Beam

It joins the box of drives with the headstock box. The mutual position of these main groups of the machine is secured by pins after setting.

The cables of electric installation pass through the beam. The cooling distributions are mounted on the external side.

3.5 Working Slides

One cross and one independent longitudinal slides are assigned to each of the six working positions. The movements of these slides are controlled with independent exchangeable cams applicable to control of all the slides. The total strokes of all the slides are changeable by resetting the draw rod in the rocker arm of the control mechanism.

The cross slides in the positions I, II, IV and V are fitted with compound slides.

3.5.1 Cross Slides

They are intended for cross turning, recessing, facing and cutting off. When using optional equipment, also for thread cutting and rolling, profile turning or for other working operations.

All the sliding surfaces of the guideways are hardened, protected against penetration of soil and lubricated with automatic doses of oil.

The cross slides of working positions I through V are in the working run from 0° to 150° , the cross slide of the working position VI (cutting off one) from 0° to 60° , in case of cutting off a part in the position III (cutting off one), from 0° to 60° .

The maximum total working stroke in all working positions is 42 mm. The resetting of cross slides is 13 mm.

3.5.2 Compound Slides

They enable surfacing, straight cylindrical turning and when tilting by $+3^{\circ}$, straight turning of cones. When using optional equipment, they can be used also for thread cutting and rolling or for other operations.

The compound slides are parts of the basic configuration of the machine.

The compound slides are hardened and lubricated with oil through a pressure dosing system. The compound slides are in the working run from 0° to 150° .

3.5.3 Longitudinal Slides

They are utilized for clamping optional equipment for tools at straight turning of cylindrical surfaces, drilling, boring, reaming, thread cutting and rolling, recessing or to induce the auxiliary feed of handling means.

All sliding surfaces are hardened. They are lubricated with automatic doses of oil.

3.6 Bar Stock Stop

The bar stop limits the length of bar feeding into the working space of the machine. The functional movement is derived mechanically by means of a disk cam. The proper stock stop is installed on a common bracket with the cutting off slide. The stop control device can be installed also behind the cross slide of the position III as a part of optional equipment.

3.7 Control of Functions

Electric functions are controlled with a rotary sensor on the vertical shaft of the drive of longitudinal slides or with sensors of the appropriate mechanisms.

3.8 Machine Lubrication

The lubricating pump delivers lubricating oil through a cleaner into the control block where it is distributed in two separate circuits - circulation system and lost oil dosing lubrication system.

The lubricating oil cooler can be ordered as a part of optional equipment. An electric motor and a thermostat belong to the cooler.

3.9 Cooling System

CAUTION: 1. It is prohibited to use on the machine such cutting liquids which cause corrosion of steel, copper, brass and bronze parts of the machine and destroy sealing elements of the machine. The cooling system may not be started if the spindles are idle. It is absolutely necessary to observe this instruction especially when using cutting liquids on a water base.

(Reason: Spindle sealing is not in operation if the spindles are idle.)

The hydraulic pump is mounted on the cover of the settling tank and is freely accessible.

3.10 Exhaustion of Products

The machine is adapted to connection to a separate exhaustion system or to a central exhaustion system.

3.11 Lighting and Guards

The working space of the machine is illuminated with two lighting fittings installed along both sides of the cross beam on the box of drives. The feeding voltage of the lighting system is 220V AC.

When setting up the machine, it is possible to use a portable lamp 220V AC. The lamp is to be connected into the plug on the electric box from the rear operator's side.

The individual handling holes of the machine are guarded with screwed covers or doors with hinges. The stock carriage is provided with guards with tiltable sides. The working space of the machine is closed from both sides with sliding guards with glassed viewing part which are secured against getting out of the guideways. They are provided with an electromagnetic locking system which prevents in door opening if the spindles are running.

3.12 Stock Carriage

The guiding tubes with internal flexible guiding are seated and locked in flanges. The front flange is supported on the rear machine bracket while the front one on the carriage stand. The complete stock carriage is guarded.

3.13 Swarf Removal

The way of swarf removal out of the working space is selected according to the shape of chips arising at machining of bar stock. The chips can be carried out by means of a worm or slat conveyor with a settling tank or it is possible to select another way according to the list of optional equipment.

Caution:

If the way of swarf removal has not been specified in the order, the worm conveyor with a settling tank is a standard part of the machine. It is suitable for most ways of swarf removal.

4. ELECAL EQUIPMENT OF THE MACHINE

- Nominal voltage of feeder supply mains 3/PEN AC 400/230V (+/-5%), 50Hz
- All electrical equipment by Siemens
- Main controlled electric motor Siemens - spindle drive SINAMICS S120, 1PH8107-1DF00-2HD1
- Controlled electric motor Siemens - feed drive (for working time) SINAMICS S120, booksize 1FT7084-5AH70-1BB1
- Motor Siemens - machine lubrication - capacity 0.55 kW
- Motor Siemens - cooling system - capacity 0.75 kW
- Programmable PLC Automat Siemens, SIMATIC S7 1500 - CPU1515F-2 PN
- Display for programmig and diagnostics functions
- Angle measuring instrument for working cycle and machine control
- Digital indication of machine condition
- Rotary control panel with Siemens Simatic Touch Panel screen
- Lighting to working area Waldmann

When placing your order, kindly give following data:

Operation voltage: (Standard: 400 V)
Control voltage: (Standard: 24 V)
Lighting system voltage: (Standard: 20 V)
Supply mains frequency: (Standard: 50Hz)

Other versions and voltage adjustment available upon extra charge.

5. BASIC OUTFIT DELIVERED TOGETHER WITH THE MACHINE

- Counter of daily and overall amounts of workpieces, display on screen
- Automatic centralised machine lubrication with pump
- Tool cooling equipment, set with pump and distribution lines
- Hardened and precise ground ways
- Precise spindle drum locating using Hirth coupling
- Independent movement of central block
- 1 central longitudinal guide slide rest
- 6 independent longitudinal slides incl. independent longitudinal drives
- 2 independent cross slides in position 3+6 incl. independent cross drives
- 4 compound slides in position 1+2+4+5 incl. independent cross and longitudinal drives
- Overload clutches in all the longitudinal and cross drives
- General spindle stop (for spindle stopper only)
- 1 set of 12 pcs. of additional standard cams for the longitudinal and cross slides
- 1 set of standard accessories

6. STANDARD ACCESSORIES

- Set of special tools for machine operation and maintenance
- Short-time wear parts
- Table of cams and strokes
- Foundation bolts
- Accompanying engineering documentation:

Machine installation, operation and maintenance manual

Record on machine accuracy testing

Report on initial inspection of electrical equipment

List of standard accessories



7. OPTIONAL ACCESSORIES

Optional accessories are available for delivery with the machine upon special order and to specified prices. Type and number of pieces will depend on parts, which shall be manufactured on the machine (conditioned by customer's requirements and needs), and on technology methods required.

8. COLOUR PAINT COATING

Machine outside paint:	RAL 9003 (white signal)
Electrical box outside paint:	RAL 9003 (white signal)
Base and sliding doors:	RAL 7016 (gray anthracite)
Removable sedimentation tank:	RAL 7016 (gray anthracite)
Stock reel and stand or automatic bar loader:	RAL 7016 (gray anthracite)

9. OFFER

Item no.	Designation	BROUP Item	Quantity
			Pcs
		BASIC MACHINE	
01.	MORI-SAY 620 AC 	Six - spindle bar automatic lathe machine in metric standard configuration. Power 3 x 400 V/50 Hz with PLC-Siemens. Adapted for Gildemeister collets, including basic outfit and standard accessories. Documentation in the czech language.	1
		COLLET OPENING / CLAMPING and FEEDING DEVICES	
02.	R115AR11P2.12	Clamping device in position 6.	1
03.	R115AR12P2.12	Feeding device in position 6.	1
		BAR LOADER AND BAR FEEDER	
04.	R102AV18P1	Pneumatic control of material stop device for MULTI F-6 automatic loader	1
05.	CUCCHI BLT 	Automatic bar feeder 6 channel version model AN Compact MULTI LS-6 PB25, (bar Ø8-22mm), Type 3,3 m. Simultaneously providing functions of loading, bar feeding in pos. 6., and also remnant recovery management. Including the accessories for bars Ø13h9x3000mm, Ø6h9x3000mm, Ø9h9x3000mm	1
06.	" "	Installation of the automatic bar loader, commissioning and loader handover performed at customer's premises through CUCCHI BLT service engineers (place within EU countries only)	1

		CHIPS CONVEYORS	
07.	CHI-DE-601-A	Removable tank with paddle-type conveyor	1
		COUNTERSPINDLE (PICK-UP) / CENTRAL BLOCK ATTACHMENTS	
08.	PIK-DE-601-A	Synchro pick-up spindle AUTOR at station 6, with hydraulic control for clamping collet and collet cleaning device	1
09.	976AV22P5	Hydraulic assembly (pump and tank) for pick-up spindle	1
10.	R909AV14P1	Pick-up brake (counterspindle speed deceleration) via threaded couplings	1
11.	PIK-AT-608-A	Special collet for pick-up spindle	2
12.	PIK-CA-804-Z	Special cam for pick-up spindle	1
		ROTATING TAILSTOCKS and ROLLER BEARINGS	
13.	R999AV84P3.01	Spring loaded slide at stations 2+3	2
14.	R011AV60P2	Toolholder on central block Ø 40 mm, L= 90, at stations 2+3	2
15.	R011AV42P2	Drill holder Ø 40 / MORSE 2 at stations 2+3	2
16.	4123330050	Support pin MORSE 2, at stations 2+3	2
17.	TRB-DE-003-A	Rotating Tailstock at stations 2+3	4
		THREADING	
18.	THR-DE-601-A	Universal threading attachment complete with spindle, 2 sets of gears, clutches, backing device, drill holder) at station 5	1
19.	THR-CA-611-Z	Standard threading cam	1
		RECESSING SLIDES FOR LONGITUDINAL SLIDES	
20.	RSL-DE-601-A	8° ram-type recessing slide IMG at stations 3+5	2
		DRILL HOLDERS FOR CENTRAL BLOCK	
21.	R011AV60P1	Toolholder on central block Ø40H6, L=60	2
22.	G 39.05	Basic drill holder ZÜRN (150105) for head WE 39.03 with internal cooling, A=22mm	2
23.	WE 39.03	Interchangeable drill holder – head ZÜRN (298105) with internal cooling, A=22 for collet ER25	4
		TOOLHOLDERS FOR CROSS SLIDES	
24.	AD 43019.01	Adaptor plate Göltenbodt for slides at stations 1+4+5	3
25.	AD 43019.02	Adaptor plate Göltenbodt for slides at station 3	1
26.	AD 43022.01	Adaptor plate Göltenbodt for slides at station 6	1
27.	CK 43002.11	Pre-settable turret Göltenbodt at stations 1+2+3+4+5+6	5
28.	BA 09003	Exchangeable flat form toolholder 12x12 Göltenbodt at stations 1+3+4+5+6	10
		COLLETS Hainbuch model GILDEMEISTER GM20	
29.	SG 9012 BZ	Set of 7 base body for clamping collets	1
30.	SK 9012 BZ	Set of 7 clamping collets, round Ø 13 mm (for parts „Hülse“ no. 10072806)	1

31.	SK 9012 BZ	Set of 7 clamping collets, round Ø 6 mm (for parts „Buchse“ no. 10349009)	1
32.	SK 9012 BZ	Set of 7 clamping collets, round Ø 9 mm (for parts „Rundbuchse“ no. 10066448)	1
33.	9258E/RS	Set of 7 outer sleeves for feeding collets RS20	1
34.	RS20	Set of 7 inner feeding collets, round Ø 13 mm (for parts „Hülse“ no. 10072806)	1
35.	RS20	Set of 7 inner feeding collets, round Ø 6 mm (for parts „Buchse“ no. 10349009)	1
36.	RS20	Set of 7 inner feeding collets, round Ø 9 mm (for parts „Rundbuchse“ no10066448)	1
37.	MQQ08	Fixture for Manual changing of the clamping collets SK 9012 BZ	1
38.	EKV9012BZ	Assembly aid for clamping base body SG 9012 BZ	1
39.	S20	Wrench for internal feeding collets RS20	1
40.		Set of 6 bushes round Ø 13,5 mm for feeding collets (for parts „Hülse“ no. 10072806)	1
41.		Set of 6 bushes round Ø 6,5 mm for feeding collets (for parts „Buchse“ no. 10349009)	1
42.		Set of 6 bushes round Ø 9,5 mm for feeding collets (for parts „Rundbuchse“ no10066448)	1
		CAMS	
43.	TOO-CA-660-Z	Additional standard cam	12
44.	TOO-CA-660-Z	Additional standard cam	4
45.	TOO-CA-661-Z	Customized cam	4
		REMOVAL OF THE WORKPIECE ON THE PIN	
46.	R011AV60P1	Toolholder on central block Ø40H6, L=60, at stations 4+6	2
47.	PIK-CA-012-Z	Cam for moving the removal pin at stations 4+6	2
48.	PAUT	Removal pin with pulling fork at stations 4+6	2
		SPECIAL ATTACHMENTS	
49.	R919AV15Pxx	Pneumatic parts-catching attachment connected to PLC (slip way of the finished parts) with ends of the bars incl. pneumat. cylinder at station 6	1
50.	R919AV15Pxx	Pneumatic parts-catching attachment connected to PLC (slip way of the finished parts) incl. pneumat. cylinder at station 4	1
51.	R919AV21P7.01	External workpiece belt conveyor L = 737, S = 80 ULMER including electric wiring	2
		OTHER ATTACHMENTS	
52.	R925AV3P21	Oil exhauster Filtermist S800 + elektrostatische modul Bristol B 1000 EFN incl. modification of the machine and interface on the machine (electric)	1
53.	BATEC	Fire safety and extinguishing system CO2 according to DIN14497 with ø150 mm oil mist exhaustion flap	1
54.	TOO-DE-071-A	MIDDEX sensor for check of the tool breakage	2

		LUBRICATING and COOLING SYSTEMS	
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55.	KNOLL	High pressure device 40 bar-55 l/min for cooling oil incl. screw pump KTS32 and filter unit FKA/160 with automatic backwash filter TURBO (filter mesh size 150 µm) including 12,6 kW cutting oil cooling system (air-cooled flow-through chiller alpha 13-O)	1
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