



# **MAX** *Impact Power*

## **Operators Instruction & Parts Manual**

### **MAX K160S**



Version 2023

*Model: MAX K160S*

*Registration number:.....*

*Purchase date:.....*



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## 1 Technical information

### 1.1 MAX K160S

Parameter	Unit	Value
Diameter	[mm]	160
Lenght	[mm]	2110
Weight	[kg]	203
Air consumption, min (recommended)	[m <sup>3</sup> /min]	3,5 (4,5)
Air pressure	[atm]	7

### 1.2 Air hose

Parameter	Unit	Value
Diameter	[mm]	31,5
Lenght	[m]	20
Weight	[kg]	30,5

### 1.3 MAX-Lubricator

Parameter	Unit	Value
Length (including caps)	[mm]	665
Width	[mm]	232
Height	[mm]	180
Weight (without oil)	[kg]	15,8
Tank capacity	[L]	3,1
Air pressure	[atm]	7



## 2 Accessories

With MAX K160S the following accessories can be used:

a) For the alignment of MAX:

- Optical level set

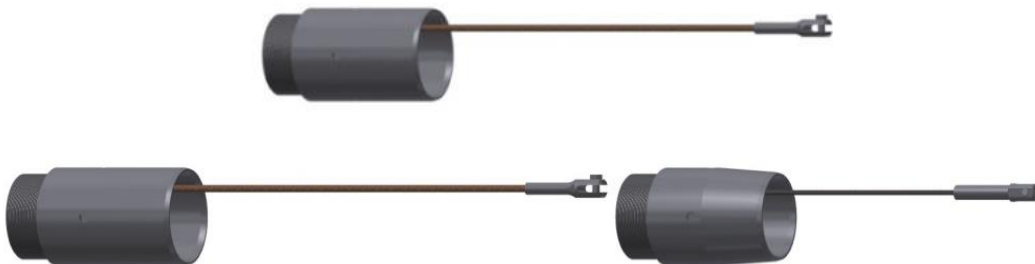


- Starting platform



b) For installing plastic tubes, directly behind the machine:

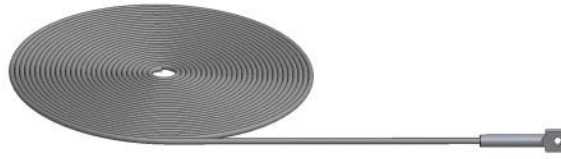
- Tools for pulling PE/PVC pipes diameter  $\phi 125$ ,  $\phi 140$  and  $\phi 160$  (with rope)



- Tensioner with replaceable sleeves

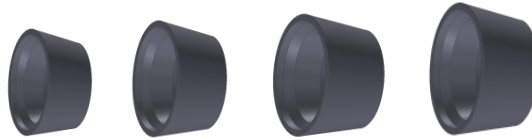


- Steel pulling rope  $\varnothing 8$  mm with interconnector



c) for ramming steel pipes:

- Cones: S356406, S280340, S 230290, S159245,



d) To clean the pipes from debris after ramming the pipes:

- Pipe plugs: PW406, PW355, PW 323, PW 273, PW 219, PW 159,



- Air pressure hose with valve (for the pipe plugs)



- Foam pipeline pig



e) for making drilling holes up to  $\varnothing 219$  and for installing pipes  $\varnothing 180$ ,  $\varnothing 200$  :

- Expanders / Calibrators: PO 200, PO219



- Tip towing for working with calibrators



- Extending rope for towing tool



f) for lubrication we recommend to use EkoMAX Oil. An environmental friendly product that consists of bio-degradable components. The EkoMAX oil lubricant is available in 5 and 20 liter canisters.



### 3 Safety Instructions

Please note specific safety requirements as explained by procedures called out in this manual. Failure to follow these instructions could result in serious personal injury or death. All tools, materials and equipment manufactured and supplied by TERMA, are designed to be used by qualified and trained personnel only. TERMA will not be held liable for any injury or damage to either people or property resulting from the misuse of TERMA equipment.

#### 3.1 Warning signs:



***Danger to people, this symbol is used in conjunction with an inscription that says danger!***



***Danger of heavy swinging loads!***



*Danger of underground utilities!*



*Danger of explosion!*



*Entrapment hazard!*



*High Air pressure!*



*Danger of burning!*

### 3.2 Prohibitory Signs:



*General prohibition signs; this symbol is used in conjunction with a suffix that makes statements about the ban.*



*No unauthorized persons allowed!*

### 3.3 Mandatory Signs:



*Wear ear protection!*



*Wear safety glasses!*





***Wear hands protection!***



***Do not start, operate or service MAX until you have read and understood the operator's manual.***

***Failure to do so may result in serious injury!***

#### **4 Use of MAX K160S**

The MAX K160S is to be used to execute tunneling and for the use of appropriate accessories for drawing PE, PVC pipes and Steel pipes. Using the MAX K160S for other purposes is not permitted. The manufacturer will not be held responsible for any damage sustained through improper use of the MAX K160S.

#### **5 Operation principle**

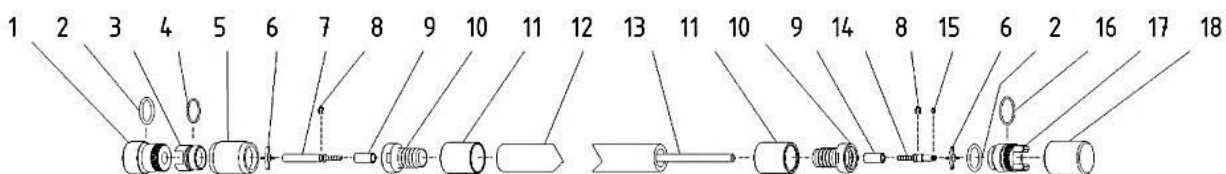
The MAX K160S is a pneumatic earth piercing tool, which is driven through the ground by compressed air. Like any pneumatic tool, MAX requires a compressor with adequate capacity for optimal operation. To ensure the longevity of the MAX, over pressure (max 7 atm) should be avoided at all times.

The compressed air is passed through the MAX-oiler with the compressed air hose attached to the MAX – it is this mechanism that moves the MAX. The exhausted air leaves the MAX via its backside. The MAX lubricator device is equipped with a pneumatic valve to enable a change of direction by simply moving the handle from position F to position R



24.	Control hose connector	PMKWC-S130-00.09	1
25.	Control hose crimping ferrule M130, M160, M180	PMTULZW-W130-00.11-M1	2
26.	Control hose 0,7 m	MTSWG0006	m
27.	Control hose barbed coupling (male)	PMLWCM-W130-00.07	1
28.	Retaining ring (E-clip) M130, M160, M180	MMEMNPZ0002	1
29.	Control hose seal (O-ring 6x2)	MTSORNB0054	1
30.	Control hose cross spacer M130	PMWWC-W130-00.08	1
31.	Outer hose barbed connector	PMKWG-S160-00.10	1
32.	Exhaust flap M160	MTSORIU0021	1
33.	Control stud supporting washer M160	PMPDKS-S160-00.12-P1	1
34.	Outer hose nut connector M180S	PMNKKWG-S180-00.16	1
35.	Outer hose 0,6 m	MTSWG0013	m
36.	Outer hose crimping ferrule M130, M160, M180	PMTULZW-W130-00.10-M1	1
37.	Outer hose barbed coupling female M130	PMLWG-W130-00.04	1
38.	Outer hose quick coupler (male) M130, M160, M180	PMSRB-W130-00.05-M1	1
39.	Coupler seal/Dirt plug seal (O-Ring 36x5)	MTSORNB0036	1
40.	Coupler seal (O-ring 40,2x3)	MTSORNB0039	1
41.	Dirt cap (female)	PMZAZ-W130-00.06-M1	1
...	Control whip hose, complete (Pos. 24, 25 x 2, 26 x 0.7, 27, 28, 29, work)	WAWKC160K	1
...	Outer whip hose, complete (Pos. 35 x 0.8, 36, 37, work)	WAWZ160	1
...	Seal kit M160 basic (Pos. 8 x 3, 9.1., 9.2. x 2, 15, 29)	WAUM160M	1
...	Seal kit M160 complete (Pos. 8 x 3, 9.1., 9.2. x 2, 11.1., 11.2., 12, 15, 16, 17.1., 17.2., 18, 19.1., 19.2., 23, 29, 39, 40)	WAWK160	1

## 6.2 Air pressure hose

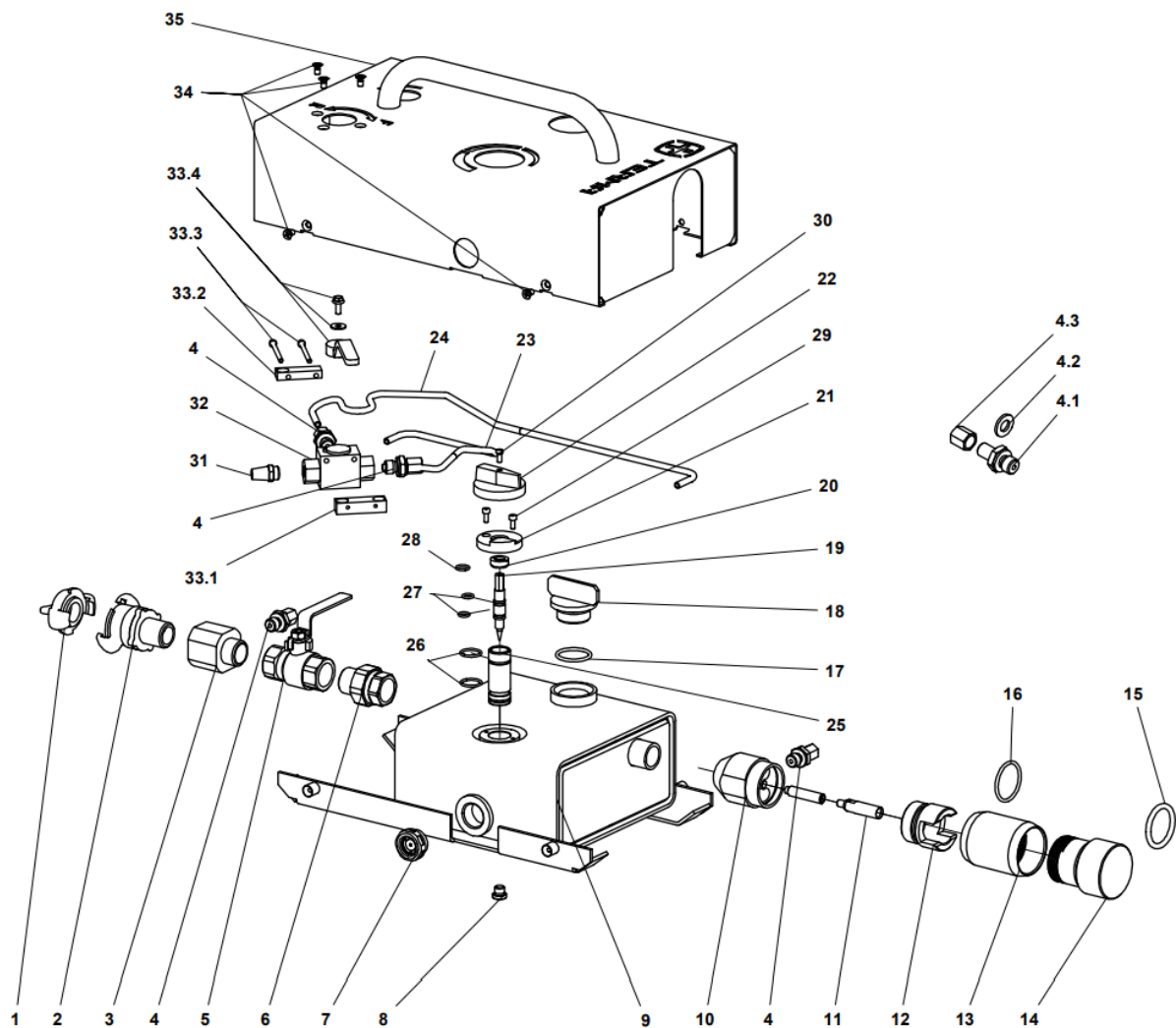


Drawing 6.2.1

Nr.	Name	Art.	Q-ty
1.	Dirt plug (male)	PMZAW-W130-00.01-M1	1
2.	Coupler seal/Dirt plug seal (O-Ring 36x5)	MTSORNB0036	2
3.	Outer hose quick coupler (female)	PMLWZ-W130-00.03	1
4.	Coupler seal (O-Ring 36x3)	MTSORNB0035	1
5.	Coupler nut	PMNAW-W130-00.02	1
6.	Control hose cross spacer M130	PMWWC-W130-00.08	2
7.	Control hose barbed coupling (female)	PMLWCZ-W130-00.09	1
8.	Retaining ring (E-clip) M130, M160, M180	MMEMNPZ0002	2
9.	Control hose crimping ferrule M130, M160, M180	PMTULZW-W130-00.11-M1	2
10.	Outer hose barbed coupling female M130	PMLWG-W130-00.04	2
11.	Outer hose crimping ferrule M130, M160, M180	PMTULZW-W130-00.10-M1	2

12.	Outer hose 20 m	MTSWG0013	m
13.	Control hose 20 m	MTSWG0006	m
14.	Control hose barbed coupling (male)	PMLWCM-W130-00.07	1
15.	Control hose seal (O-ring 6x2)	MTSORNB0054	1
16.	Coupler seal (O-ring 40,2x3)	MTSORNB0039	1
17.	Outer hose quick coupler (male) M130, M160, M180	PMSRB-W130-00.05-M1	1
18.	Dirt cap (female)	PMZAZ-W130-00.06-M1	1
...	Control hose 20m, complete M130, M160, M180 (Pos. 7, 9 x 2, 13 x 20, 14, 15, work)	WAWWC130W	1
...	Air supply/control hose 20 m, complete M130, M160, M180	WAWZ13020	1

### 6.3 MAX-Lubricator with Reversing Mechanism



Drawing 6.3.1

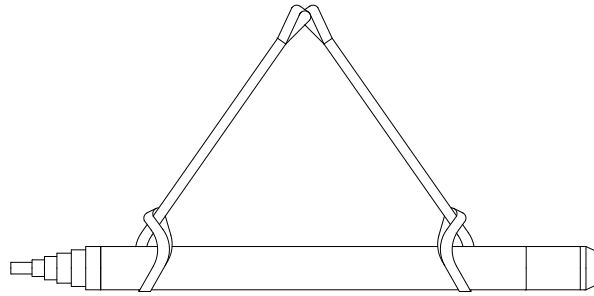
Nr.	Name	Art.	Q-ty
1	GEKA dust cap with chain 42 mm	MMEHYZS0002	1
2	GEKA GZ-Coupling 42 mm 3/4"	MMEHYZL0002	1

3	Splitter II	PMRZG2-OL130-00.01	1
4.1.	XGE 6LR fitting from 1/4" straight connector	MMEHYZL0006	4
4.2.	DPR 6L/S compression ring from 1/4" straight connector	MMEMNIN0004	4
4.3.	Nut M12x1.5 M 6L from the straight connector 1/4"	MMEMNNA0006	4
5	Ball valve 3/4"	MMEHYZA0004	1
6	Threaded plug GN 749 1/8"	MMEMNKR0002	1
7	Union fitting 3/4"	MMEHYSR0001	1
8	Oil level sight glass 3/4"	MMEMNIN0008	1
9	Tank container	PMZZM-OL130-01.00-M1	1
10	Splitter I (set)	PMRZG1-OL130-03.00-M1	1
11	Straight standpipe hose tail 130	PMKWO-OL130-00.06	1
12	Outer hose connector (female) M130	PMLWZ-W130-00.03	1
13	Air hose nut M130	PMNAW-W130-00.02	1
14	End cap M130, M160, M180 (male)	PMZAW-W130-00.01-M1	1
15	O-ring 70NBR PN-90/M-73092	MTSORNB0036	1
16	O-ring 36x3 70NBR PN-90/M-73092	MTSORNB0035	1
17	O-ring 30,2x3 of oil cap, 70NBR	MTSORNB0032	1
18	Oil cap	PMKWO-OL130-04.00	1
19	Needle valve	PMIGL-OL130-02.00	1
20	Gland (stuffing box)	PMDŁ-OL130-02.03	1
21	Clamping plate	PMJAR-OL130-00.04-M2	1
22	Flow control knob	PMPOL-OL130-00.05-M2	1
23	Hydraulic pipe fi6x1	MMERUHY0001	0,39 m
24	Hydraulic pipe fi6x1	MMERUHY0001	0,57 m
25	Needle seat	PMGNIG-OL130-02.01	1
26	Needle seal (O-ring 18x2)	MTSORNB0011	2
27	Needle seal (O-ring 8x2)	MTSORNB0056	2
28	Gland seal (O-ring 10x2)	MTSORNB0001	1
29	Clamping plate screw M4x10 DIN 912	MMEMNSR0058	2
30	Flow control knob screw M4x10 DIN 933	MMEMNSR0059	1
31	Sintered bronze silencer 2931-1/4" Camozzi	MMEHYTL0001	1
32	Three way ball valve with holes 1/4" BSP 500 BAR	MMEHYZAOTW0005	1
33.1.	Valve mounting block 1	PMKMZ-OL130-07.01	1
33.2.	Valve mounting block 2	PMKMZ-OL130-07.02	1
33.3.	Allen screw M4x50 ISO4762 OC 5,8	MMEMNSR0658	2
33.4.	Handle for three-way ball valve 1/4" WKH and WKH3 (R12)	MMEHYZA00065	1
34	Screw M5x10 Z (WSM)	MMEMNWK0026	7
35	Oiler body	PMOOM-OL130-05.00Z	1

## 7 Transportation

Due to the heavy weight of the machine, the MAX K160S should be handled with extra care and only be transported and lifted with leads. When moving the MAX by hand, ensure that you always lift the body of the MAX.

**MAX should never be moved, carried, pulled or dragged by the hose!  
This is a precaution to avoid any damage to the hose, MAX and yourself!**



Drawing 7.1



***The machine should be securely moved and lifted by straps at the front and back of the cylinder, in such a manner that sliding out is avoided (Drawing 7.1.).***



***Make sure there are no persons under a lifted device! Persons under the load are in a danger zone for themselves and others.***

***Always check the quality and condition of the lifting straps before use!***

## 8 Preparations before use

### 8.1 General Instructions

Before starting the MAX, you need to check for the existence and exact position of the buried pipe and cables by contacting the respective utilities or owners of networks. The exact location and existence of the buried cables and pipes should be determined by using trial pits or cable and pipe detection equipment.



***The area where work is carried should be marked and locked to avoid unauthorized entry to the site!***



***Should you accidentally hit an electrical cable, leave the site immediately. Ensure no-one else enters the site and contact the electrical company to turn off the electrical supply!***



***Should you accidentally hit a gas pipe, leave the site immediately, ensure no one else enters the site and contact the gas company to turn off the gas supply!***

### 8.2 Starting pit

The minimum depth specification for operation of the MAX is ten times the tool diameter. (10 x 160 mm = 1600 mm). Minimum cover = 10 x Diameter of the MAX.

If the minimum depth is not observed, there is a risk of surface damage from soil displacement.

The length of the starting pit depends on the type of hole and the use of accessories (Solo-Boring or pipe pulling).

The starting pit needs to have enough space for the MAX accessories and pipes. The air pressure hose must be fully rolled out (avoid kinking).

The starter pit width should allow free access to the MAX, and its accessories precise alignment.



***For narrow Start and End pits (especially those with a depth of 1 meter or more) we recommend that the Start and End pit walls are supported, this is to avoid undue strain, and potentially, their collapse!***



***Always ensure that work is carried out in areas marked clearly with signage stating that work is in progress. No entry to any unauthorized persons!***

### **8.3 Target pit**

The width and depth of the End pit should be able to take the MAX out of the pit without obstruction - even if the drilling direction has been adjusted.

If for any reason this is not possible, the MAX should be reversed to the Starting pit and removed from there.

## **9 Instructions**

### **9.1 Safety Information**

MAX jacking machine should be used at ambient temperatures not lower than + 5 °C. Working in smaller temperatures may cause stop the machine during operation.



***Operation of MAX K180S only to be carried out by suitably trained, qualified, and certified personnel only. New operators or operators in training should only work under the constant supervision of a fully qualified person.***



***Operating crew should always wear the appropriate safety equipment: ear protection, safety shoes/boots, hard hat, safety glasses, gloves etc.***



***Faulty or damaged items should be replaced immediately by a trained, qualified and certified person only.***



***Any changes or alterations to the MAX or to the accessories will invalidate the guarantee.***

***The MAX should only be operated when all parts (lubricator, hoses, accessories) have been secured and checked.***

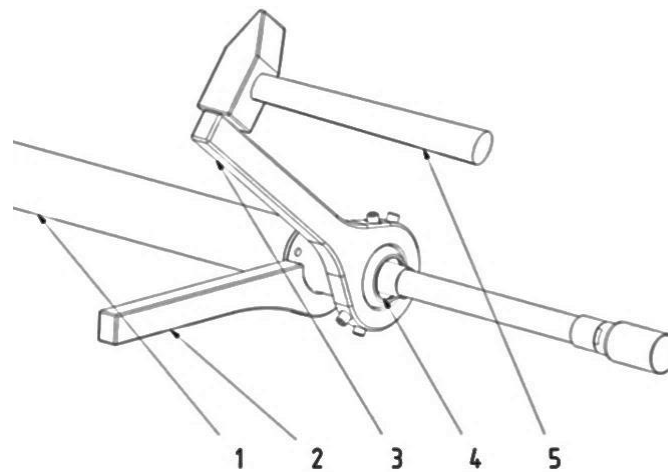
### **9.2 Convert the MAX K160S**

After each action (Solo-Boring or Pipe pulling) the MAX can be upgraded via (Screwing or unscrewing the accessories):

Type of work	End screw	Sleeve with rope connection	Towing tool
Solo-Bore	+	-	+
Direct pipe installing	-	+	-
Expanding using Calibrator	+	-	+
Installing pipe with Calibrator	-	-	+
Pipe jacking	+	+	+

+ correct use

- incorrect use



Drawing 9.2.1.

To change the rear part (Drawing 9.2.1.) follow these proceedings:

- a) Disconnect the air compressor.
- b) MAX **(1)** and Spanner **(2)** place on a solid and stable surface. The pin of the spanner must be placed into the indentations.
- c) The second spanner **(3)** is on the part which needs to be unscrewed - **(4)** hammer on the spanner. The pin of the spanner must be placed into one of the indentations.
- d) Check the position of the spanner and the part to remove **(4)** loosen with the hammer **(5)** and take it off.
- e) When loose, unscrew by hand.



***It is strictly forbidden to use the MAX without the Tailpiece!***



***The operation of the Machine in such situation will result in a sudden ejection of emissions from the cylinder.***

- f) Teflon tape residues and other dirt on the thread of the component should be cleaned with a wire brush.
- g) The threads of the part to be fitted need to be wrapped the opposite way to the screwing direction with Teflon tape. (End screw nipple). We recommended LOCTITE 55, at last two three threads.
- h) Place the taped part on the MAX, then screw it tight with the spanner until you have some resistance.



i) Tightening with spanner and hammer.

### 9.3 Connecting the Air Hose



**Before connecting, blow air through the air hose to remove dirt or any other debris or contamination.**

To connect the air hose (Drawing 9.3.1.) proceed as follows:

a) Place the compressor in a safe and stable location; take into consideration the distance from the MAX to the starting pit and the length of the drill to be carried out.



**Secure the compressor against unexpected movements!**

b) Hose **(1)** ensure the hose is securely interlocked and the safety rings are tightened before the MAX is started.



**Whilst blowing air through the hose, do not blow compressed air from the hose at people. The air and dirt can cause injury.**

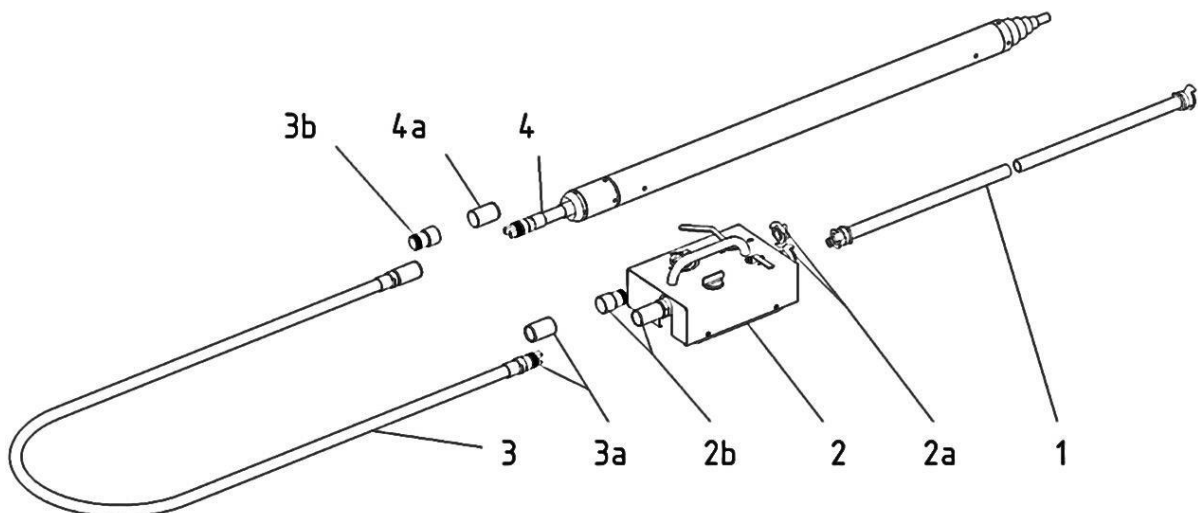
c) Remove the cap from the lubricator **(2a)** Lubricator **(2)** connect the hose from the compressor **(1)** ( $\frac{3}{4}$ " GEKA-connection 42 mm) connect.



**Please note that the GEKA coupling must be secured with a nut to prevent inadvertent decoupling.**

d) Cap from the Lubricator **(2b)** and from that to the coupling plug of the compressed air hose **(3a)** unscrew - the hose can be connected to the MAX Lubricator. Screw firmly together until resistance is felt.

e) Protective cover **(3b)** from the air hose can now be disconnected. Clean the hose by blowing some air through it. Note: that the interior of the air pressure hose can also be blown through by operating the control valve.



Drawing 9.3.1.

f) Position MAX in the Start Pit and remove the cap from **(4a)** the hose at the MAX. **(4)** Connect the air hose coming from the lubricator to the small hose at the MAX.

#### 9.4 Functions of the Lubricator

The lubricator ensures that the necessary lubricant is mixed with air and supplied to MAX. The compressed air from the compressor blows through the lubricator where it mixes with the lubricant - this results in a spray effect of oil and air. In this form, it passes through the air hose to the inside of the MAX device and ensures optimum lubrication for all moving parts. As a lubricant, we recommend MAX EKO Oil, which is safe to use and bio-degradable.

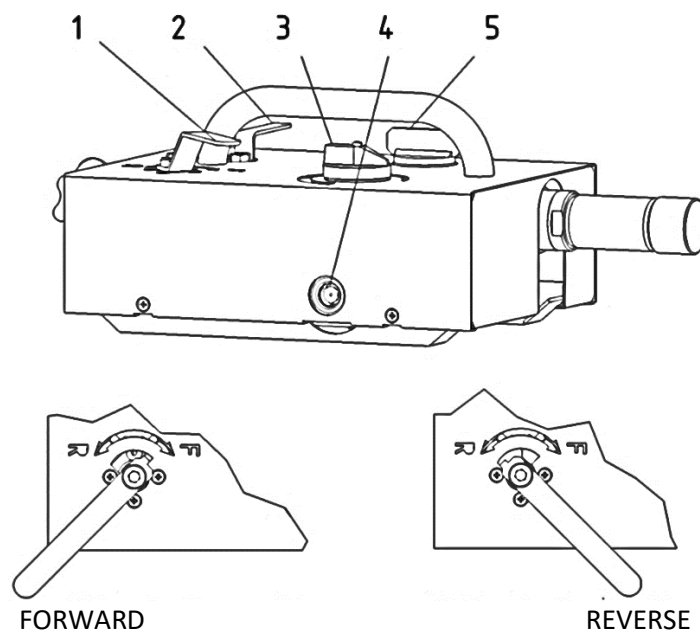
Located at the lubricator is a valve which is used to change the direction, by turning this handle the MAX will change from a forward to a backward (reverse) motion and vice versa.

The lubricator (drawing 9.4.1.) comes with:

- Valve to adjust the air supply **(2)**. Transverse position of the valve lever closes the supply of compressed air. Lever in the longitudinal direction means full opening of the valve.
- Valve for reversing **(1)**. The possible positions of the control valve lever and the corresponding directions of the MAX (forward-backward) shows the drawing 9.4.1 - Oil adjustment knob **(3)** to adjust the amount of oil with the air. (min-max)
- Oil level glass **(4)**
- Oil filler cap **(5)**



*The oil filler cap (5) should never be unscrewed whilst the MAX is in operation!*



Drawing 9.4.1

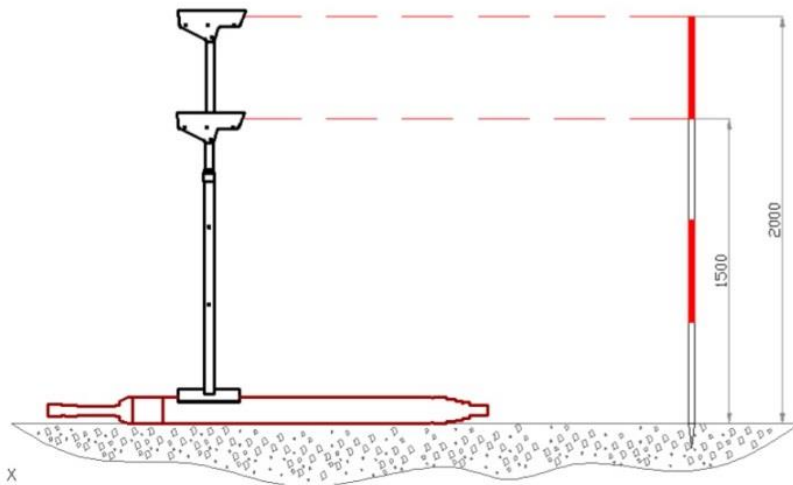
#### 9.5 Alignment of the MAX K160S

For accurate aiming of the MAX in the starting pit, we recommend using the Optical Level Set.

To aim the machine precisely follow these steps:

- a) Position a surveying stake in the End pit in the place where the end of the borehole should be located.
- b) Place the MAX machine into the Start pit and pre-align it to the End pit, then place the TERMA telescopic sight onto the machine.

- c) With a help of TERMA telescopic sight you have to align the MAX machine to the surveying stake by changing horizontal and vertical position of the machine.



## 9.6 Solo-Boring

For this action the machine should have the End Screw



***To perform Solo-Boring the MAX must be equipped with the air hose pulling eye.***

***Before using the device, it should be inspected. This is especially important if it has not been in use for a substantial period of time.***

To perform a Solo-Boring the following procedures should be adhered to:

- Connect the Air hose (see 9.3 Connecting the Air Hose).
- Position MAX into the starting pit and align precisely to the planned target (see 9.5. Alignment of the MAX K160S).
- Direction handle in Forward position (F) .
- Valve of the air supply (2) at the lubricator with a quick movement open to the maximum position, to start-up the MAX at full power.



***Ear protection should be worn when performing Solo-Boring at all times.***



***It is prohibited for anyone to stay in between the MAX and the pit wall in front of the MAX. There is a danger of Entrapment!***

- When the MAX starts to operate, the air supply has to be reduced. This is necessary because the MAX has not been run into the soil. When the air supply valve is fully open at the lubricator (2), the MAX will be unstable and will not be able to move forward and backwards. Slowly opening the valve ensures that the MAX will slowly navigate its way into the soil while remaining stable i.e. not moving from forward to backward.

- f) Whilst the MAX slowly finds its way into the soil, the MAX will stop a few times while finding its target. The direction should be checked for accuracy, to avoid the MAX going out of line.
- g) After the MAX has drilled into the soil for 1/2 up to 2/3 of its length (this depends on ground conditions), you can open the valve and the MAX can be used at full speed.
- h) The disappearance of the MAX into the pit wall contents can result in soil being thrown outside abruptly, which may lead to eye damage.



***During operation of the MAX, soil and other debris in combination with the exhausted air could be thrown from the back of the MAX. Stay in a safe place and use Eye protection!***

- i) During drilling, monitor the air hose at all times and the noises emitted from the MAX. If the hose is shaking rapidly, (cycling back and forth in the starting pit) the MAX could be swimming in the bore. Reduce the air supply to the MAX to allow the soil to grip the sides of the casing and allow forward progress to continue.
- j) At all times, a good flow of lubricator is required.
- k) When MAX enters the End pit, reduce the air flow.

### 9.7 Reversing MAX K160S



***When the MAX encounters a rock or insurmountable obstacle, the tool is pushed off course. The reciprocating action of MAX, however, will break a rock up and allow the tool to pass. In addition, if the tool should encounter an unbreakable rock, MAX can be easily reversed and retrieved to re-start the bore.***

MAX can easily reverse (move backward) to the starting pit if there is not enough space to lift the MAX out of the End pit.

To reverse MAX, we should:

- a) Position the handle of the control valve in reverse (R) on the lubricator. Reversing MAX from forward to backward is done under pressure (do not close the air supply).
- b) When reversing, the operator should firmly hold the hose and ensure that the tool does not back-up over it.



***Do not attempt to reverse the mole when the sleeve for inserting PE/PVC pipes is attached and there is no pipe inside.***



***Do not attempt to working at reverse the mole with air supply valve at maximum position. The air supply valve during the reversing has to be adjusted maximum at ¾ opened.***



***When reversing the MAX, soil and other debris in combination with the exhausted air could be thrown from the back of the MAX. Stay in a safe place and use Eye protection!***

### 9.8 Manual pulling of plastic pipes

For installing PE, PVC pipes (manually) the Insert nipple (1) could be used (Figure 9.8.1.). This method can be used for pipes of diameter  $\varnothing 25 \div \varnothing 55$  mm.

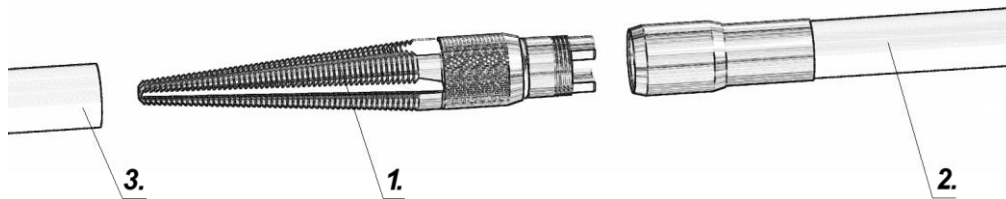


Figure 9.8.1

To insert pipes manually proceed to the following steps:

- When the MAX has completely cleared the borehole, disconnect the Air Hose from the machine (2) than disconnect the Air Hose from the Lubricator (The air hose stays in the borehole)
- Screw and tight the Insert nipple (1) into the plastic pipe (3).
- Attach the Insert nipple (1) to the Air hose (2)
- Beginning from the Starting pit pull the air hose carefully through the bore hole.

### 9.9 Direct installing PE/PVC Pipes

This method is used for the installation of a one piece plastic pipes (Figure 9.9.1). The MAX should be equipped with the (1) Pipe Tool for inserting PE/PVC pipe and by pulling rope (10) and the clamping plate with tensioner (7). Prepare the pipe to be pulled by making a cut at its end, which will be introduced into the pulling tailpiece, according to the drawing below:

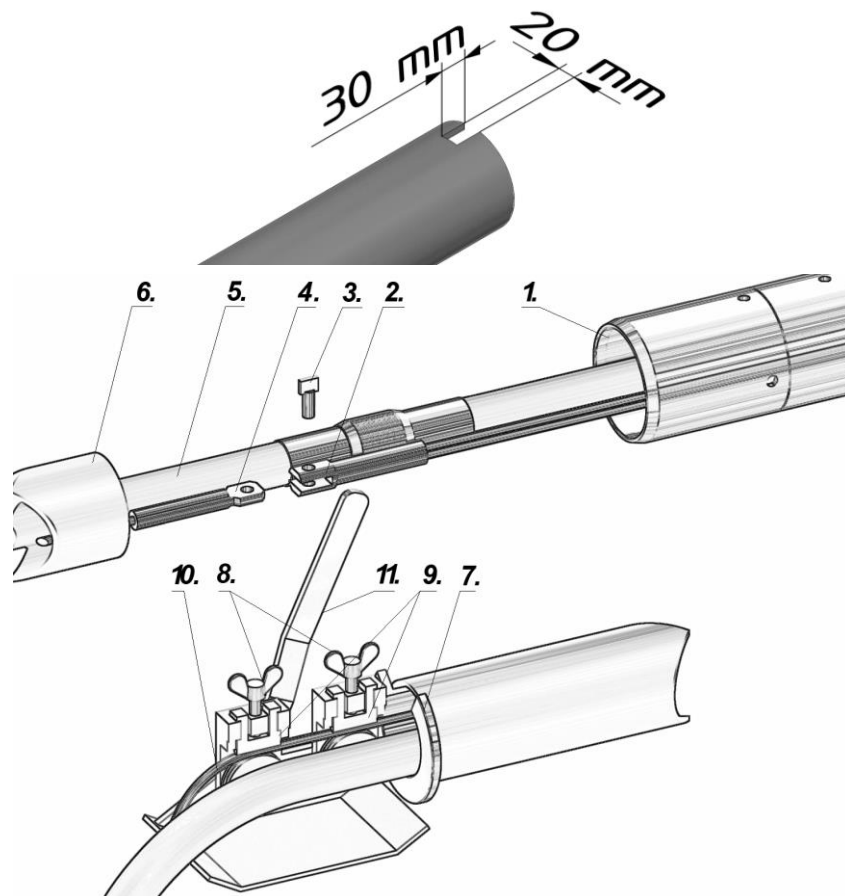


Figure 9.9.1

For the immediate retraction of PE, PVC pipes please proceed as follows:

- a) Follow the procedures as with Solo Bore, repeat step a to f.
- b) MAX needs to stop when it is for  $\frac{3}{4}$  of the length into the soil
- c) Disconnect the air hose **(5)** from the small connection hose at the MAX
- d) Air hose and pulling rope **(10)** to be placed in the pipe **(6)** insert
- e) Then forward the tied hose after pulling the rope, separate from each other again.
- f) Extensions of the connection cable **(2)** and the pulling rope **(4)** have to be link up with the screw **(3)**.
- g) The PE pipe **(6)** can now be inserted into the sleeve **(1)**
- h) Introduce the insertion piece **(7)** into one of the PE pipe's end.
- i) After the pulling rope **(10)** put the clamps **(9)** on the tensioner.
- j) The jaws of the tensioner's clamps should be clutched with the screws **(8)**
- k) Pull the whole rope-tensioner-sleeve construction to the machine with the handle **(11)**.
- l) After reaching a sufficient pressure on the coupled parts we can Start the mole. During operation the consumed air will be discharged through the end part of the pipe. The soil or debris acquired during the process of connecting the pipe to the MAX can suddenly be thrown out of the pipe.

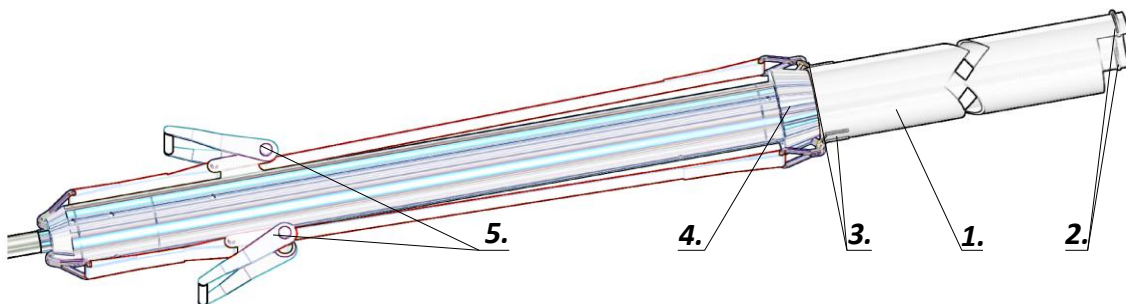


***During pipe installing there is always the possibility that soil and other debris in combination with the exhausted air could be thrown from the end of the pipes. Stay in a safe place and use Eye protection!***

- m) After the MAX has arrived in the End pit, the air supply needs to be reduced.
- n) In the End pit, enough space should be available in order to disconnect the pipes and the Air hose.
- o) Slowly close the air supply and allow the MAX to stop.
- p) Disconnect all parts, pulling rope, clamps and tensioner.

### 9.10 Installing steel pipes (ramming-jacking)

For steel pipe jacking the MAX could be equipped with the Sleeve with rope connections or with the End screw. Depending on the diameter of the pipe the correct cone and straps need to be used.



Drawing 9.10.1

Steel Pipe Ramming as indicated by the following steps (Drawing 9.10.1):

- a) At the beginning of the steel pipe **(2)** the two rings need to be welded; First the 2 rings are welded on the outside, then another in the inside of the tube to facilitate the removal of debris after completion. At the end of the tube **(3)** the connections are welded two ears to attach the straps (to connect the machine to the steel pipe).

- b) The steel pipe in the starting pit, placed in the direction of the planned installation.
- c) Cone **(4)** to be placed in the steel pipe.
- d) Prepare the ground that machine and pipe are on same level of height.
- e) MAX with the head forwards to be positioned in the cone **(4)** with help of the straps **(5)** establish connection with the pipe. The straps on one side hold the welded ears on the tube and the sleeve on the other side in contact with the MAX.
- f) Compressed air hose to be connected according to 9.3
- g) Handle on the Lubricator to be positioned in to F (forward)
- h) Start the machine



***It is prohibited for anyone to stay in between the MAX and the pit wall in front of the MAX. There is a danger of Entrapment!***



***Danger of explosion!***



***Operating crew should always wear the appropriate safety equipment: ear protection, safety shoes/boots, hard hat, safety glasses, gloves etc.***



***During pipe jacking operation the MAX K130S should not be reversed to return. This would result in losing the connection, could result in damaging the cone, tube or straps.***

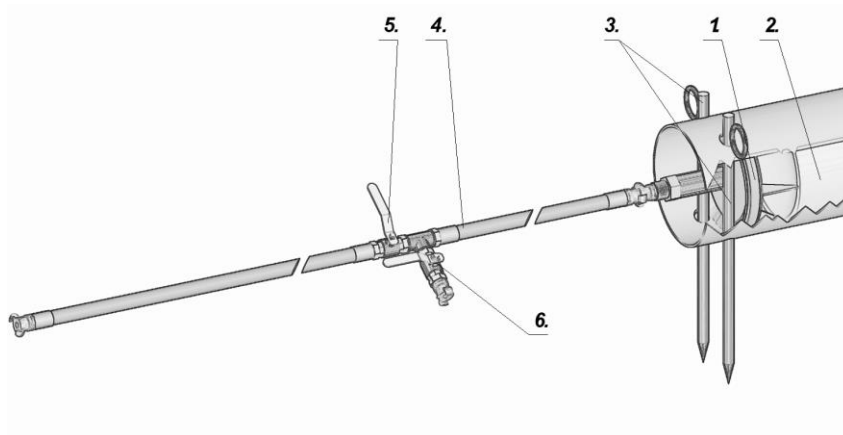


***During a long lasting pipe jacking operation the cone, head, pipe and other parts of the machine can get hot, Risk of Burns!***

- i) If the pre-exaggerated tube has reached its target, stop the machine.
- j) Remove the straps.
- k) Change the course of direction of the MAX (R) to reverse.
- l) Start the MAX and to enable to release the machine from the cone
- m) Finally remove/release the cone from the steel pipe.

### **9.11 Cleaning of steel pipes after ramming**

To remove debris from the rammed pipe, prepare as follows: pipe plug **(1)** of diameter corresponding to the rammed pipe diameter, foam pipeline pig **(2)**, locking rods **(3)** to secure the pipe plug, Air hose **(4)** with valves (5, 6) (Figure 9.11.1), and a welding machine.



Drawing 9.11.1

To remove soil and debris from a rammed pipe, follow these steps:

- a) clean the inside of the pipe from the ground to a depth of approximately  $3\div 4 \times D$  (D - pipe's diameter).
- b) make four through holes in the pipe for the locking rods (3) according to the figure 9.11.2.



Drawing 9.11.2

- c) Wait for the pipe to cool and remove the slag from the weld to prevent damage to the pipe plug.
- d) Insert the foam pipeline pig (2) into the prepared pipe.
- e) Put the pipe plug (1) inside the pipe and secure it with the locking rods (3).
- f) Tighten the pipe plug seal with a wrench (60 mm).
- g) Connect the short end of the air hose with valves (4) to the pipe plug.
- h) Connect the other end of the air hose to the compressor.
- i) Make sure that the valves (5) and (6) on the air hose are closed and all connections are well secured and tightened.
- j) Start the compressor.
- k) Open the valve on the compressor (keep the valves on the hose closed) and wait for the hose to fill with compressed air.
- l) To start cleaning the pipe, open the valve (5) on the air hose.



***During operation of Pipe Ramming, soil and other debris in combination with the exhausted air could be thrown from the back of the machine. This can lead to serious injuries or endanger life.***

***Stay in a safe place! Never stand in line with the machine or with the pipes and always use Eye protection!***





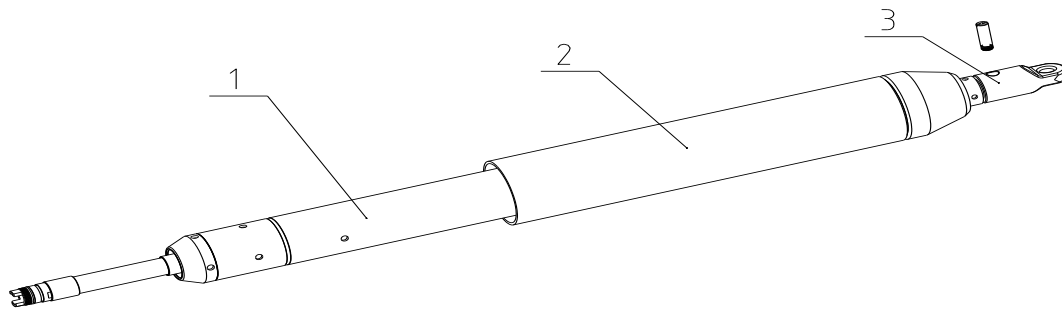
**The area where work is carried should be marked and locked to avoid unauthorized entry to the site!**



- m) If the removing does not start after 2 minutes the compressor needs to be switched off.
- n) The operator should slowly release air pressure by gently opening the valve (6).
- o) Remove the pipe plug and the foam pipeline pig.
- p) Reinstall the pipe plug without the pipeline pig, pour some water into the air hose (4) though the valve (6), and start the compressor.
- q) Water under pressure penetrates into the voids of the soft clay soil and makes it more flexible, in addition, it reduces the friction between the inner surface of the pipe and the clay. The volume of water required depends on the actual situation. Usually it is no more than 100 liters.
- r) Disconnect compressor and relieve air pressure again. Remove the pipe plug, reinstall the foam pipeline pig and pipe plug and start the removal process from the beginning. When the removal process begins, reduce the compressed air supply to limit the ejection rate.

### 9.12 Expanding drill hole with widening accessories.

To achieve wider drilling holes with expander tools (Drawing 9.12.1) Proceed to the following: The machine **(1)** with the threaded sleeve, Calibrator **(2)**, Tip towing **(3)** and in addition a winch and rope to be used.



Drawing 9.12.1



***It is not recommended to use a winch with a pulling force over 1.6 Tons !***

To perform a Solo-Boring the following procedures should be adhered to:

- a) A sole Boring with the machine without expansion (see **9.6. Solo-Boring**)

Minimum cover: 10 times the diameter, with a diameter  $\varnothing 219$  mm – **Minimum cover = 2100 mm**

- b) after achieving Target pit by mole, mount the Winch in Target pit in the same axle like mole.

- c) Connect the rope about the machine head by means of the Tip Towing **(3)**. Then pulling back the rope to the Start Pit using the mole working on Reverse direction.

- d) in the Start Pit remove the Tip Towing **(3)** form mole and put the Calibrator **(2)** on the mole.

- e) reinstall Tip Towing **(3)** on the mole and place the mole in a pre-made hole.  
 f) using Winch to towing make a hole using Calibrator.



***It is important to keep a permanent tension on the rope!***

- g) After the machine has reached the target pit it is required to remove all accessories and return the machine by using the reverse handle on the lubricator.

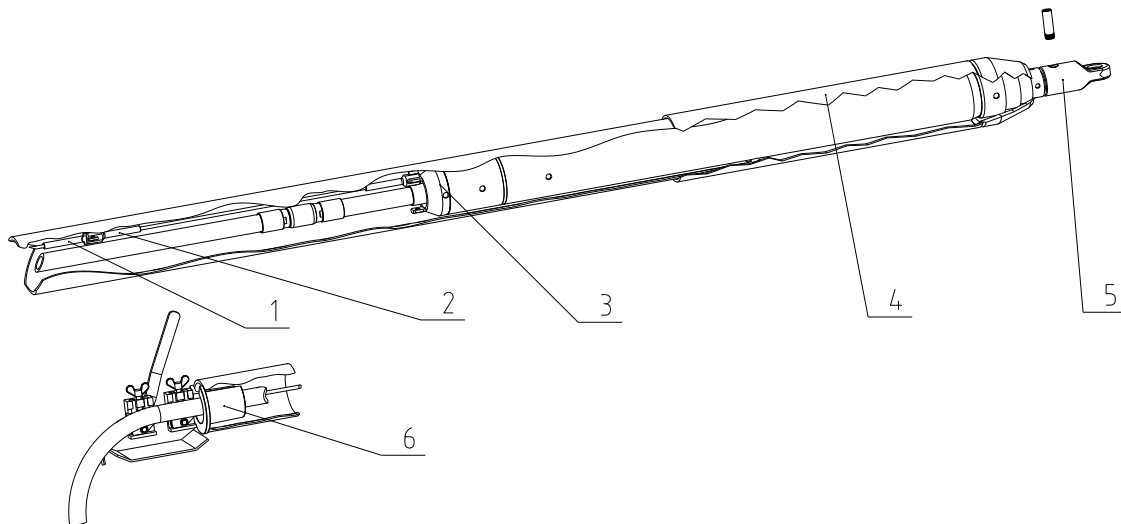


***It is not allowed to reverse the machine with the expansion accessories still connected to the machine!***

- h) Repeating steps from point c) until the required diameter is achieved.

### 9.13 Installing of pipes mm with expanders

For installing pipes (Drawing 9.13.1) the following equipment is required: Calibrator **(4)**, Tip Towing **(5)**, Winch, Pulling Rope **(1)**, MAX machine with Towing Tool **(3)**, Connection Cable **(2)** Tensioner **(6)** with a sleeve depending on the pipe to be installing.



Drawing 9.13.1

In order to pull the tube  $\varnothing 180$  we must proceed to the following:

- To perform operations such as mentioned in point 9.12 from step a) to step e).
- Place in the Start Pit the machine ready for startup, put on her Calibrator **(4)** and put the Tip Towing **(5)** winch with rope on the head of the machine.
- Place the machine now into the previously made hole for about 3/4 length with the enlarger and then stop it.
- Disconnect the power supply and control hose from the machine, put this hose with the Pulling Cable into the inserting tube
- connect the Pulling Cable **(1)** to the Towing Tool **(3)** using Connection Cable **(2)**
- Connect the Power Supply and Control hose to the machine
- Insert the pulling tube to the Calibrator
- use the Tensioner **(6)** to secure the inserted tube in the Calibrator
- pull the tube using mole and winch. Always keep the rope tensioned. Loosening the mole from the expander can damage the Calibrator.
- When you reach the target pit, remove the tip towing tool from the machine, remove the Calibrator and remove the mole. The pipe can now be adjusted to the required position.

### 9.14 After care

Each time that the hose is disconnected, the security cap should be placed, to avoid any debris entering the hoses. Do the same when disconnecting the connectors on the MAX. It is especially important to place the security cap on the short connecting hose for the MAX, as debris inside this hose cannot be blown out by air. If any dirt from the hose gets inside the MAX, damaged parts or a damaged MAX can result.



***Before disconnecting Air hoses, make sure the air supply has been switched off.***

- When lifting or carrying the MAX, follow the instructions in section **7. Transport**
- After the MAX has finished the boring in the Start or End pit, it is recommended to remove any soil or debris from the MAX. To carry out this procedure the air hose needs to be connected and the MAX needs to be turned on for 30 seconds.
- It is important that MAX and accessories are kept clean to ensure their proper functioning.
- The Air hose needs to be cleaned and rolled up - avoid nicking the hose.

## 10 Maintenance



***It is prohibited to repair, perform internal inspections or carry out any maintenance on MAX. Maintenance only can be performed by a qualified technician who has been trained to perform these jobs, or, alternatively at a manufacturer service center.***

***Technical changes to MAX, repairs and maintenance carried out, outside of a manufacturers service center, will invalidate MAX's warranty and guarantee claims.***



***It is prohibited to use MAX or its accessories when they are in sub-standard, technically poor condition.***

### 10.1 Daily inspection

The scope of daily service/inspection includes:

- External visual inspection of the machine, lubricator and hoses.
- Check the screw connections of the head, cylinder, tail piece and make sure there is no gap anywhere between any of the elements.
- Check the connections and fittings of the hoses as well as on the lubricator.
- Check the air hoses for damages.
- Check the condition of the seals of the pneumatic hoses
- Control the oil level In the lubricator.
- Check for any oil leaks in the lubricator and its valves.

Maintenance after completion of work includes :

#### **a) Normal dry working conditions**

- place the machine on a dry surface.
- Turn the machine on for 20 seconds with maximum lubrication (Drawing 10.1.1)

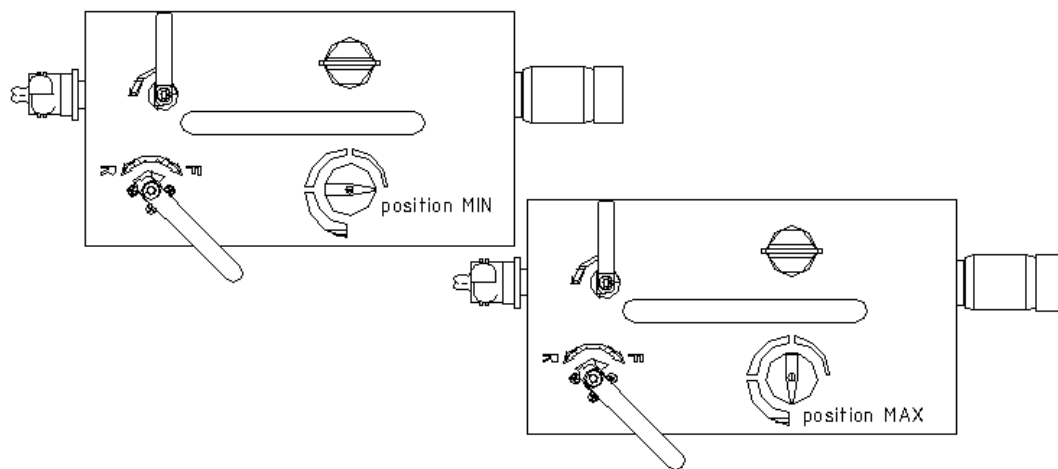
#### **b) Wet working conditions (wet ground, rain, snow)**

- place the machine on a dry surface.

- Turn the machine on for 30 seconds with minimum lubrication,
- Pour 150ml anti-corrosion oil **KorMAX** into the short hose connected to the machine, as well in the big and the small hose.
- Turn on the machine for 3-5 seconds to distribute the oil gradually through the inside of the machine.

**c) Possibility of debris inside the machine, like mud and Clay.**

- place the machine on a dry surface.
- Pour 200ml diesel oil into the short hose connected to the machine, as well in the big and the small hose.
- Turn on the machine for 30 seconds to distribute the oil gradually through the inside of the machine and dissolve all contaminants, then turn of the machine.
- Pour 150ml anti-corrosion oil **KorMAX** into the short hose connected to the machine, as well in the big and the small hose.
- Turn on the machine for 3-5 seconds to distribute the oil gradually through the inside of the machine.



Drawing 10.1.1

**10.2 When MAX has not been in use for a while**

If the machine will not be in use for more than 7 days, it should be properly preserved. This is best to be done in our workshop or in one of the workshops of our authorized dealers. If you do not have this possibility, you can do the following:

- By compressed air clean the hose from sand, oil and water with the lubricating valve in closed position ((Drawing 10.1.1).
- Connect and start the machine with the lubricating valve in closed position.
- During these operations you need to change the direction valve several times R>F .
- The action described in point c, should be repeated until no more water and oil comes from the machine.
- Stop the machine and disconnect the air hose and add 150 cm<sup>3</sup> of anti-corrosion oil **KorMAX** in the small air hose connected to the machine (in the inside as well as in the outside hose).



***Before decoupling the air hose, check that it is not under pressure!***

- Connect the hoses and restart the machine.

- g) During these operations you need to change the direction valve several times R>F .
- h) Stop the machine, disconnect the hoses and place caps on the machine and hoses.

### 10.3 Technical Inspections

Inspections should only be done by qualified and trained personnel:

- I Inspection:** before the end of the 6th Month by standard operation
- II Inspection:** before the end of the 12th Month by standard operation
- III Inspection:** before the end of the 18th Month by standard operation

Inspection of MAX:

- a) Disassemble all parts of MAX
- b) Clean all parts
- c) Inspect all components, checking for wear and tear:
  - Piston
  - Front and backside of the piston, for air leaks
  - Control connection
  - Cylinder slide
  - Pistons seal and rings
  - Injection hose sleeves
  - all connections in reverse mechanism

Inspection of the Air hose:

- a) Check injection sleeves.
- b) Check all couplings for wear and tear, possibly, renew the seals.

Inspection of the lubricator:

- a) Check the valves for leaks and smooth operation.
- b) Check the couplings for wear and possibly replace seals.
- c) Check the needle and all around it, possibly replace seals.
- d) Check the pipes for blockages and clean or replace them if necessary.

## 11 Troubleshooting

Faults	Reason	Solution
Starting problems	Air supply valve at the lubricator is opened too slowly	Air intake valve to the lubricator needs to be opened quickly
	Piston is located in the center position	Change the control valve on the lubricator quickly from F to R to F
	Low pressure of the incoming air	Adjust the compressor to 7 atm.
	Damage to the seals of the Piston	Replace the seals
	Air flow is reduced -the hose is nicked or is not fully laid out	Clean pneumatic hoses
	Insufficient lubrication	Put Some oil (50 ml) into the air hose
The performance of MAX is less than usual	Low air pressure	Adjust the compressor to 7 atm.
	Damage to the seals of the Piston or Controller	Replace the seals
	Insufficient lubrication	Increase oil flow by turning the handle on the lubricator. To achieve immediate results, you can pour oil directly into the compressed air hose
	Piston clamping due to dirt on the seals.	Assemble MAX and clean all seals
	Piston clamping due to impact on the piston seal rings. Piston-cylinder friction	Replace percussion piston seal rings. Investigate the cylinder slide. Polish visible parts.
	Pressure loss through leaking couplings or hose	Replace seals and or/hose
MAX cannot change direction	Piston is clamping due to dirt on control parts	Remove control parts, clean and replace.
	Defective seals in controller	Replace seals
	Defective control hose (seals inside the air hose)	Replace seals in the control hose
MAX moves forward and backward whilst entering the pit wall.	MAX does not have enough resistance from the soil (friction). Lack of resistance may occur in Wet ground	Reduce the air supply by the valve at MAX lubricator.
MAX works very slowly	There is not enough pressure from the compressor to increase the MAX's functioning speed.	Check the air pressure coming from the compressor and adjust to 7 atm
	Air escapes through damaged seals or leaks in hoses	Replace seals on/or hoses
Machine change the trajectory	Allignment was incorrect	Adjust the position with the use of the optical instruments
	MAX defers from its set direction due to wet ground conditions	Reduce the air supply through the valve on the lubricator
	The head is worn	Replace the head



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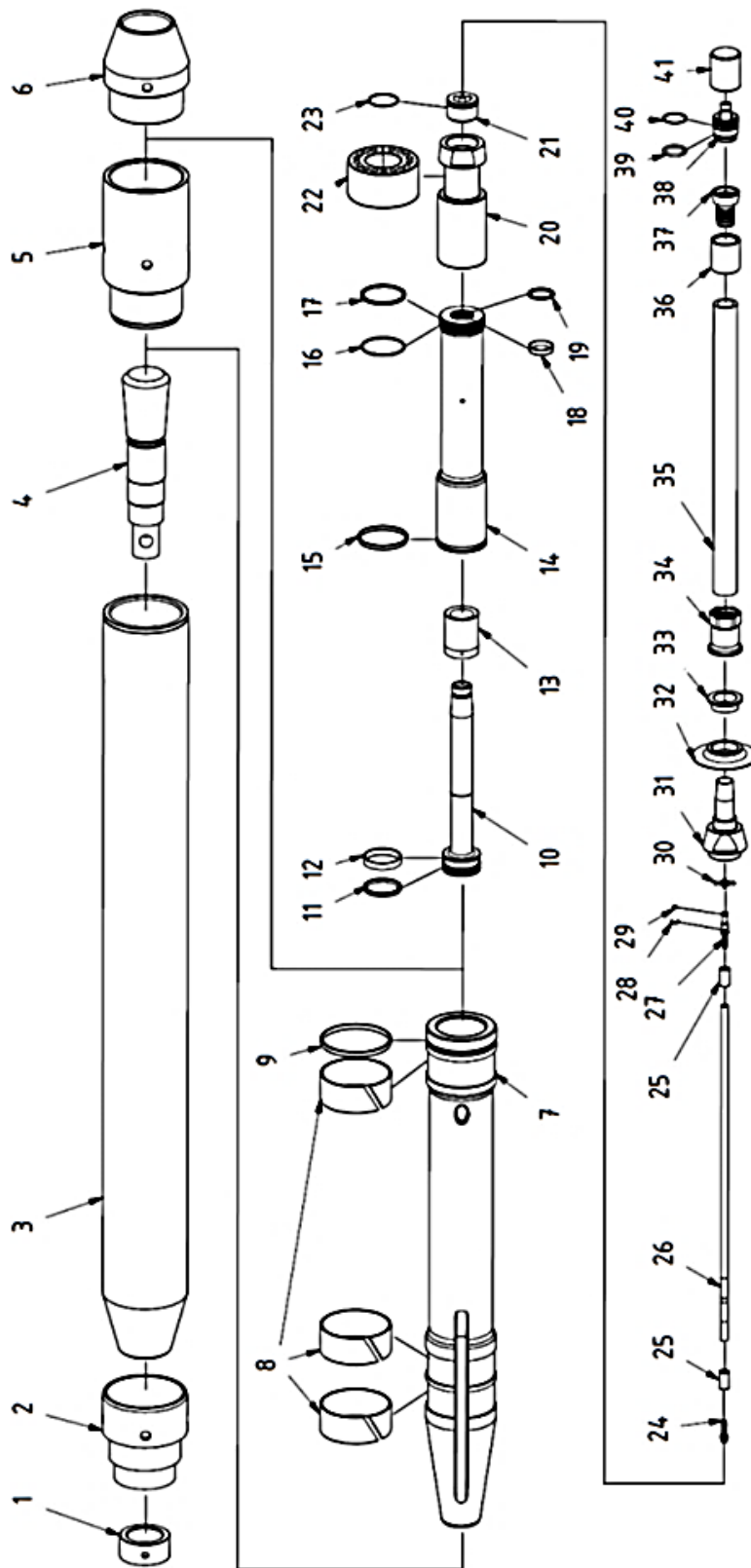
**MAX** *Impact Power*

Your Local Dealer:

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12 Spare parts

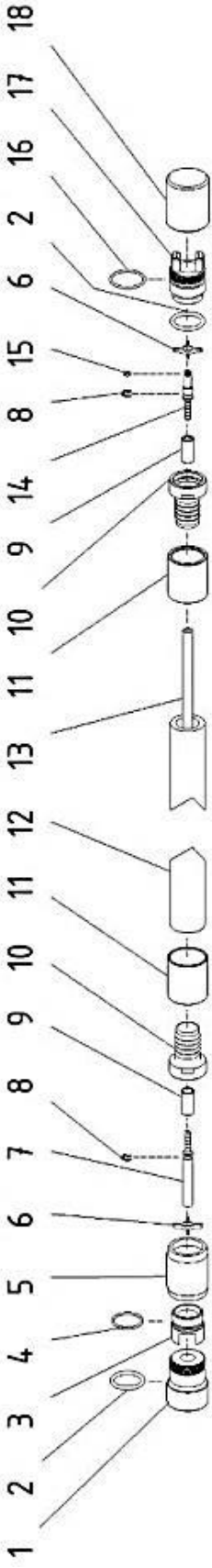
12.1 MAX K130S – mole spare parts list





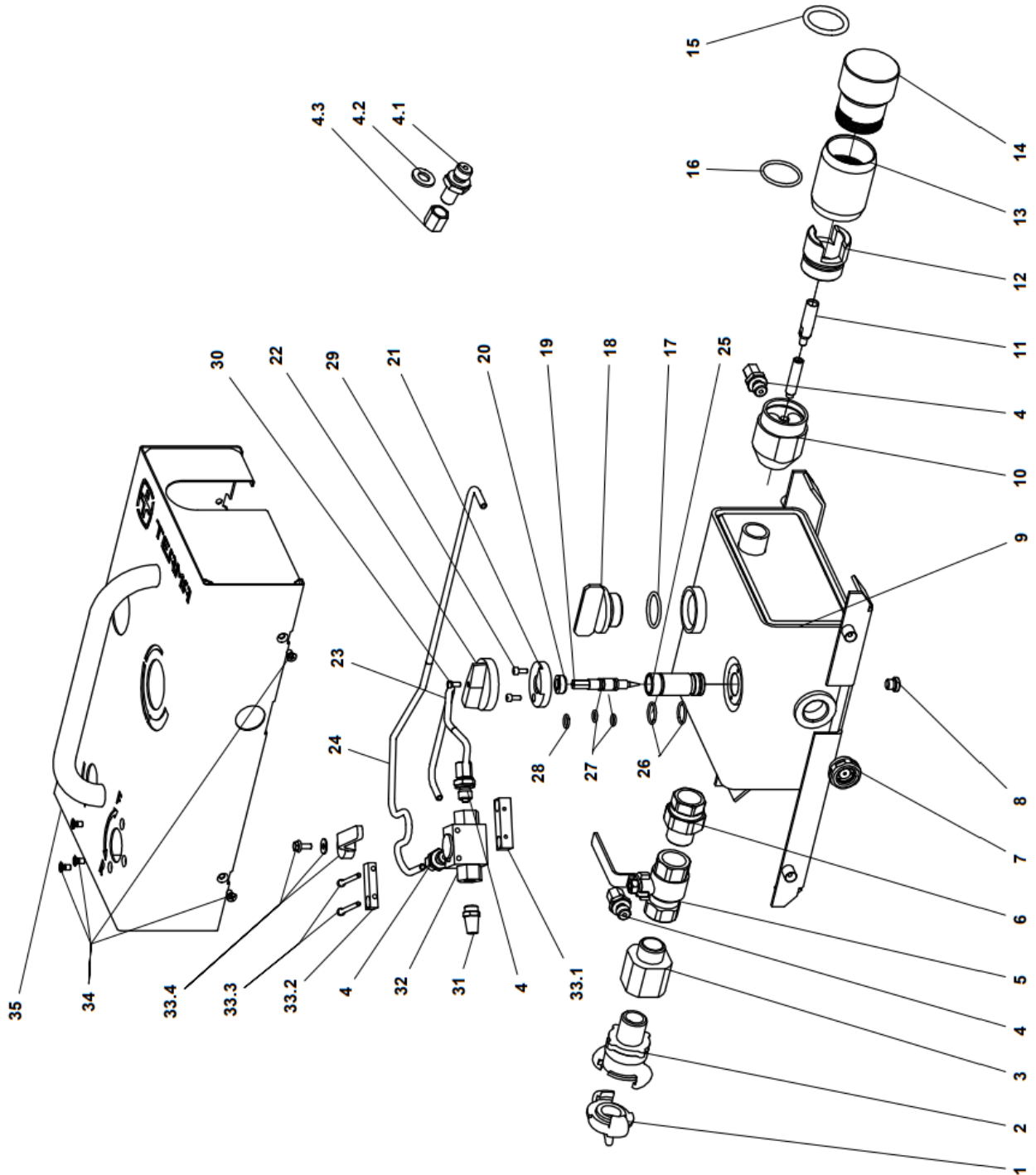
No.	Name	Item number	QTY
1.	Stepped head nut	PMNAK-M160-00.09	1
2.	Stepped head	PMNAS-M160-00.01	1
3.	Cylinder	PMCYL-M160-00.02	1
4.	Chisel	PMPRZ-M160-00.08	1
5.	Control stud housing	PMTSR-M160-00.03	1
6.	Reverse cone with pulling eyes	WAHW160	1
7.	Impact piston	PMBIJ-M160-00.05	1
8.	Piston teflon sliding tapes	PMPRB-M160-00.06	3
9.1.	Piston seal (Teflon)	PMUSB-M160-00.07	1
9.2.	Piston seal (O-ring 121x3,5 SI)	MTSORSI0029	2
10.	Control rod	PMRUS-S160-00.06	1
11.1.	Control rod teflon seal	PMUS1-S160-00.04	1
11.2.	Control rod seal (O-ring 58x5 70NBR)	MTSORN0083	1
12.	Control rod sliding tape I	PMPT1-S160-00.13	1
13.	Elastic damper	PMAMOR-S160-00.14	1
14.	Control piston	PMTLS-S160-00.01	1
15.	Control piston teflon seal	PMUTS-S160-00.02	1
16.	Seal (O-ring 77x3,5 SI)	MTSORSI0032	1
17.1.	Control piston teflon seal II	PMUS2-S160-00.03	1
17.2.	Control piston seal II (O-ring 74x3,5 SI)	MTSORSI0031	1
18.	Control rod sliding tape II	PMPT2-S160-00.05	1
19.1.	Control piston teflon seal III	PMUS3-S160-00.15	1
19.2.	Control piston seal III (O-ring 44,7x3 SI)	MTSORSI0034	1
20.	Control cylinder	PMCYLSTR-S160-00.07	1
21.	Splitter	PMROS-S160-00.09	1
22.	Elastic block	PMLSR-S160-00.08	1
23.	Splitter seal (O-ring 52x3 SI)	MTSORSI0030	1
24.	Control hose connector	PMKWC-S130-00.09	1
25.	Control hose crimping ferrule M130, M160, M180	PMTULZW-W130-00.11-M1	2
26.	Control hose 0,7 m	MTSWG0006	m
27.	Control hose barbed coupling (male)	PMLWCM-W130-00.07	1
28.	Retaining ring (E-clip) M130, M160, M180	MMEMNPZ0002	1
29.	Control hose seal (O-ring 6x2)	MTSORN0054	1
30.	Control hose cross spacer M130	PMWWC-W130-00.08	1
31.	Outer hose barbed connector	PMKWG-S160-00.10	1
32.	Exhaust flap M160	MTSORIU0021	1
33.	Control stud supporting washer M160	PMPDKS-S160-00.12-P1	1
34.	Outer hose nut connector M180S	PMNKKWG-S180-00.16	1
35.	Outer hose 0,6 m	MTSWG0013	m
36.	Outer hose crimping ferrule M130, M160, M180	PMTULZW-W130-00.10-M1	1
37.	Outer hose barbed coupling female M130	PMLWG-W130-00.04	1
38.	Outer hose quick coupler (male) M130, M160, M180	PMSRB-W130-00.05-M1	1
39.	Coupler seal/Dirt plug seal (O-Ring 36x5)	MTSORN0036	1
40.	Coupler seal (O-ring 40,2x3)	MTSORN0039	1
41.	Dirt cap (female)	PMZAZ-W130-00.06-M1	1
...	Control whip hose, complete (Pos. 24, 25 x 2, 26 x 0.7, 27, 28, 29, work)	WAWKC160K	1
...	Outer whip hose, complete (Pos. 35 x 0.8, 36, 37, work)	WAWZ160	1
...	Seal kit M160 basic (Pos. 8 x 3, 9.1., 9.2. x 2, 15, 29)	WAUM160M	1
...	Seal kit M160 complete (Pos. 8 x 3, 9.1., 9.2. x 2, 11.1., 11.2., 12, 15, 16, 17.1., 17.2., 18, 19.1., 19.2., 23, 29, 39, 40)	WAUK160	1

12.2 Pneumatic Air hose 20 m spare parts list



<b>Nr.</b>	<b>Name</b>	<b>Art.</b>	<b>Q-ty</b>
1.	Dirt plug (male)	PMZAW-W130-00.01-M1	1
2.	Coupler seal/Dirt plug seal (O-Ring 36x5)	MTSORNB0036	2
3.	Outer hose quick coupler (female)	PMLWZ-W130-00.03	1
4.	Coupler seal (O-Ring 36x3)	MTSORNB0035	1
5.	Coupler nut	PMNAW-W130-00.02	1
6.	Control hose cross spacer M130	PMWWC-W130-00.08	2
7.	Control hose barbed coupling (female)	PMLWCZ-W130-00.09	1
8.	Retaining ring (E-clip) M130, M160, M180	MMEMNPZ0002	2
9.	Control hose crimping ferrule M130, M160, M180	PMTULZW-W130-00.11-M1	2
10.	Outer hose barbed coupling female M130	PMLWG-W130-00.04	2
11.	Outer hose crimping ferrule M130, M160, M180	PMTULZW-W130-00.10-M1	2
12.	Outer hose 20 m	MTSWG0013	m
13.	Control hose 20 m	MTSWG0006	m
14.	Control hose barbed coupling (male)	PMLWCM-W130-00.07	1
15.	Control hose seal (O-ring 6x2)	MTSORNB0054	1
16.	Coupler seal (O-ring 40,2x3)	MTSORNB0039	1
17.	Outer hose quick coupler (male) M130, M160, M180	PMSRB-W130-00.05-M1	1
18.	Dirt cap (female)	PMZAZ-W130-00.06-M1	1
...	Control hose 20m, complete M130, M160, M180 (Pos. 7, 9 x 2, 13 x 20, 14, 15, work)	WAWWC130W	1
...	Air supply/control hose 20 m, complete M130, M160, M180	WAWZ13020	1

### 12.3 Lubricator with reversing mechanism



Nr.	Name	Art.	Q-ty
1	GEKA dust cap with chain 42 mm	MMEHYZS0002	1
2	GEKA GZ-Coupling 42 mm 3/4"	MMEHYZL0002	1
3	Splitter II	PMRZG2-OL130-00.01	1
4.1.	XGE 6LR fitting from 1/4" straight connector	MMEHYZL0006	4
4.2.	DPR 6L/S compression ring from 1/4" straight connector	MMEMNIN0004	4
4.3.	Nut M12x1.5 M 6L from the straight connector 1/4"	MMEMNNA0006	4
5	Ball valve 3/4"	MMEHYZA0004	1
6	Threaded plug GN 749 1/8"	MMEMNKR0002	1
7	Union fitting 3/4"	MMEHYSR0001	1
8	Oil level sight glass 3/4"	MMEMNIN0008	1
9	Tank container	PMZZM-OL130-01.00-M1	1
10	Splitter I (set)	PMRZG1-OL130-03.00-M1	1
11	Straight standpipe hose tail 130	PMKWO-OL130-00.06	1
12	Outer hose connector (female) M130	PMLWZ-W130-00.03	1
13	Air hose nut M130	PMNAW-W130-00.02	1
14	End cap M130, M160, M180 (male)	PMZAW-W130-00.01-M1	1
15	O-ring 70NBR PN-90/M-73092	MTSORNB0036	1
16	O-ring 36x3 70NBR PN-90/M-73092	MTSORNB0035	1
17	O-ring 30,2x3 of oil cap, 70NBR	MTSORNB0032	1
18	Oil cap	PMKWO-OL130-04.00	1
19	Needle valve	PMIGL-OL130-02.00	1
20	Gland (stuffing box)	PMDŁ-OL130-02.03	1
21	Clamping plate	PMJAR-OL130-00.04-M2	1
22	Flow control knob	PMPOL-OL130-00.05-M2	1
23	Hydraulic pipe fi6x1	MMERUHY0001	0,39 m
24	Hydraulic pipe fi6x1	MMERUHY0001	0,57 m
25	Needle seat	PMGNIG-OL130-02.01	1
26	Needle seal (O-ring 18x2)	MTSORNB0011	2
27	Needle seal (O-ring 8x2)	MTSORNB0056	2
28	Gland seal (O-ring 10x2)	MTSORNB0001	1
29	Clamping plate screw M4x10 DIN 912	MMEMNSR0058	2
30	Flow control knob screw M4x10 DIN 933	MMEMNSR0059	1
31	Sintered bronze silencer 2931-1/4" Camozzi	MMEHYTL0001	1
32	Three way ball valve with holes 1/4" BSP 500 BAR	MMEHYZAOTW0005	1
33.1.	Valve mounting block 1	PMKMZ-OL130-07.01	1
33.2.	Valve mounting block 2	PMKMZ-OL130-07.02	1
33.3.	Allen screw M4x50 ISO4762 OC 5,8	MMEMNSR0658	2
33.4.	Handle for three-way ball valve 1/4" WKH and WKH3 (R12)	MMEHYZA00065	1
34	Screw M5x10 Z (WSM)	MMEMNWK0026	7
35	Oiler body	PMOOM-OL130-05.00Z	1