

Operating Instructions Series 02



For Linde axial piston units in closed loop application.

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Read this operating instruction carefully and entirely, and keep it handy for reference.

This operating instruction refers exclusively to Linde Series 02 hydrostatic units used in closed loop circuits.

- Variable displacement pumps HPV-02
- Variable displacement motors H MV-02
- Regulating motors HMR-02
- Fixed displacement motors HMF-02

This document offers information, hints and instructions with regard to safety, effectiveness and life of the above listed hydrostatic units. These refer to the installation in the drive system, commissioning and use of the Linde units. Furthermore it contains instructions about the necessary maintenance work.

This operation instruction is intended for experts already experienced in handling hydrostatic systems. Due to the vast variety of applications, it is impossible to deal with all executions of hydraulic pumps and motors within the frame of this document. So whenever application requirements, mounting situations and working conditions or simply uncertainties arise, they must be discussed with the manufacturer of the system on the basis of the following documentation. In case contact with Linde sales or service is needed, you are politely requested to take down the serial number from the name plate of the Linde unit. The name plate always reflects technical status of the unit.

Our products are being developed permanently; So, please understand that we have to reserve the right for changes and no claims whatsoever may be derived from the contents of this operating instruction.

By publishing this edition all previous editions become void.

All rights in this instruction are reserved for Linde AG; for internal use however, copies may be produced.

Training centre in Aschaffenburg Nilkheim

In our training sessions we make our clients familiar with knowledge in hydraulics and product related to application. The training subjects have resulted from experience of our service team and will be oriented to specific customer applications if so desired.

Our competent service team with its quick response is available to you worldwide.

Technical support

If you have technical questions concerning our products kindly contact the Linde Organization

For information on your nearest Linde Company Branch, please refer to the contact pages at the end of this document.

 **CAUTION**

All valid safety regulations and accident prevention instructions must be adhered to.

The Series 02 axial piston units referenced in this document are designed for application in the industrial field. As state of the art, they have been designed for safe function and manufactured according to the corresponding practices.

In hydraulic drive systems correct component engineering is crucial; also, a professional approach to system design has a direct influence on the components used with regard to their operational properties and in particular to their life expectancy and working reliability.

It is taken for granted that the basic planning for application, as well as all work related with transport, assembly, installation, commissioning and maintenance are carried out by qualified personnel and supervised by responsible experts.

Special attention is required for:

- Technical data and data about the permissible use (mounting, fitting, surrounding and working conditions) as is contained in product data sheets, installation drawings, spare parts catalogue, order specifications and name plate data.
- General construction and safety procedures
- Rules and requirements specific to the local plant
- Correct use of tools, lifting and material handling accessories.
- Use of personal protection equipment.

Braking arrangement

It is absolutely necessary to install a braking arrangement redundant to the hydrostatic braking system. It must be capable of stopping the vehicle out of its travel motion and/or serve as a parking brake. Or even, in the case of stationary applications bring the machine to a stop.

Loss of frictional connection in the drive train of a hydrostatic system in the neutral position, or during acceleration and deceleration may mean loss of hydrostatic braking altogether.

Legal regulations must be adhered to as well, under all circumstances!

 **CAUTION**

Failure to following the guidelines of this operating instruction may result in the failure of vital functions, machine damage, danger to health and life of personnel, imperilment to environment, as well as loss of warranty rights with Linde Material Handling.

 ENVIRONMENTAL CONCERNS

Protection of the natural fundamentals of life is one of our predominant tasks. We are continuously improving the protection of the environment as far as applications are concerned. We encourage you to contribute your share to comply with this demand. In connection with work to be performed, the environmental regulations of the machine manufacturer must be respected.

In general:

- Greases and oils which cannot be used any more have to be collected. They are normally a threat to water reserves and must be kept away from the environment.
- Adhere to national and local regulations for waste disposal.

Installation of the hydraulic system must be completed according to the circuit and piping diagram and the installation requirements of components as well as the technical data sheets and installation drawings. When designing electro-hydraulic circuits, care must be taken that the electrical requirements are respected, e.g. the prescribed voltage is applied to the equipment. For the hydraulic piping seamless drawn precision steel pipes according to DIN 2391/C or hoses of suitable pressure rating must be chosen. Pipes have to be deburred, washed out and blown through. Pipes which have accumulated scale or rust must be steeped and then neutralized; hose lines when contaminated need brushing out and flushing through.

Cleanliness is an important point. The connection ports of hydraulic equipment are, as a rule, closed by the manufacturer with plastic plugs or tape after thoroughly flushing all passages. Cleanliness must be the supreme concern while assembling a hydraulic system. Never plug finished pipes with rags; use plastic foil, tape or plugs instead. Under no circumstances use cloth.

5.1 General hints for mechanical linkage

The mechanical connection of a Linde Unit to the drive system is made by its housing flange and the shaft end of its primary input or output.

Linde axial piston units are conceived as plug-on units for coaxial connection to a drive system, i.e. for coupling without radial or angular off-set between driving and driven shaft. The corresponding permissible values regarding the transmissible shaft torque and the effective axial forces are found in the technical data sheet, the installation drawing or the catalogue. Axial forces acting directly on the shaft end of Linde axial piston units are to be avoided. If radial forces are unavoidable for certain reasons, do, under all circumstances talk to us in the early design stage. This applies in particular to cantilevered arrangements of tractive components, e.g. drive belts or chains at the shaft end.

5.1.1 Input and output shafts

In Linde axial piston units of series 02, the shaft ends of the primary input or output are released as edge centered splines with involute type splines as per ANSI B92.1. The prescribed counter fit of coupling; pinion or pulley must be strictly adhered to. In principle, both during assembly and disassembly input and output elements must not be treated with knocking or beating forces (e.g. hammer blows) on shaft ends of Linde axial piston units, since this will inevitably lead to damage of the drive assembly, particularly of the shaft bearings.

In a drive system made of several components it is usually necessary to dampen rotary oscillations from the prime mover or from the driven lot by means of adequate flexible coupling elements. For this case rotary elastic couplings are to be applied which have to be matched to the drive system in their dynamic transmitting properties. In particular it has to be assured that the system stays free of resonance.

5.1.2 Cardan Shaft

The manufacturer's installation instructions must be followed!

In order to avoid rotary oscillations, keep in mind that both input and output parts of the cardan shaft are fitted under the same angle and on the same level. Only balanced cardan shafts may be utilized and the links must be put together correctly!

5.1.3 Additional mechanical power take off (PTO)

All variable pumps of Linde's 02 line are equipped with a mechanical power take off as a through shaft at the rear end. This may be used for powering additional drives.

Care must be taken that the permissible torque is not exceeded at anytime. For tolerable values please refer to the technical data sheet or catalogue.

In the planning stage of a system and subsequent installation utmost care must be taken that the housing of the hydraulic pump and of the hydraulic motor remains completely filled with fluid after initial filling, venting and in every state of operation. They cannot run empty during operation and temporary or long term stand still. If deemed necessary, additional information regarding the mounting position may be inquired before the system is conceived.

6.1 Variable pump HPV-02

If mounting position is horizontal, servo device on top is preferred for better venting.

6.2 Hydraulic motors HMF/V/R-02

Any position is okay, except when the drive shaft points vertically upwards. This requires special measures because of the risk of shaft bearing and shaft seal running dry. A modified version which tolerates this position is available upon inquiry.

7.1 High and low pressure lines, maximum pressures

Be sure that hoses, pipes and fittings are sufficiently strong with regard to bursting. In regards to operational reliability, it is important to keep in mind the maximum permissible pressures at the connection point of working and auxiliary ports of the Linde units.

7.2 Venting port, leakage lines and case pressure

Case drain lines must be installed in such a way that the housings of the hydraulic components are always filled with fluid. The case pressure (build-up) should not rise and stay higher than 2.5 bar (absolute) during operation.

If during the prototype development and while warming up from a cold start, a higher pressure is found short term, this may be accepted as long as it is discussed with Linde

7.2.1 HPV-02 pump with external suction boost pump

The higher one of the two case drain ports on the pump housing has to be connected to tank. If port "T" is used an additional line for "L" or "U" must be installed. The oil not required for boosting is discharged into the pump housing across the boost pressure relief valve, carrying away any air gathered in the pump housing. Ports "L" or "U" of the hydraulic motor must be connected to tank. The leakage line is to be installed below the fluid level in the hydraulic tank.

7.2.2 HPV-02 pump with internal suction gear pump

For venting, use the highest connection point, e.g. "T" (pump control) or the one at the pump housing "L" or "U". The vent line is to be mounted steadily rising towards the tank. This enables any air gathered inside the pump housing to escape into the tank. The highest case drain port "L" or "U" of the hydraulic motor has to be connected to the HPV pump housing e.g. "U".

7.3 Suction line of the ancillary pump external or hybrid

The installation of the suction line must be carried out straight, as short as possible and with few bends. The piping itself has to be rated in such a way and the tank positioned so, that the permissible negative head of (-200mbar) at suction port A/B can be achieved.

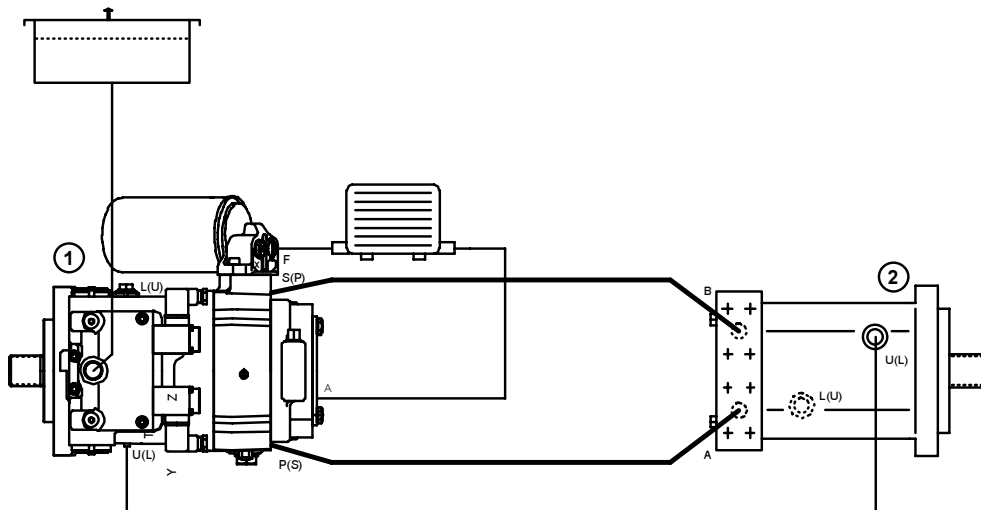
CAUTION

We explicitly emphasize that operation of Linde axial piston units with the housing insufficiently filled with fluid will immediately damage the drive group. Therefore check the installation of the Linde unit in the hydraulic system to assure the case(s) are filled prior to startup.

Circuit Diagram (Example)

- 1 Hydraulic pump HPV-02 size 35-280:
- With electro-hydraulic control E 1
 - drive direction clockwise
 - boost pump with internal suction
 - Oil cooler (by customer) in boost pressure loop

- 2 Hydraulic motor HMF-02 sizes 28-280:
- With purging device.
 - Pressure in at port A: Clockwise rotation.
 - Pressure in at port B: Counter-Clockwise rotation.



EXPLANATIONS	
1 Hydraulic Pump HPV-02	
P, S	High pressure port
B	Suction port boost pump
A	Pressure port boost pump
F	Control and boost pressure supply
T	Tank and vent port
X	Boost pressure qage port
Y, Z	Control pressure qage port
MY, MZ	Proportional solenoid 24V
Ms, Mp	High pressure qage port
L	Oil filling, tank and vent port
U	Drain, flushing return from hydr. Motor
2 Hydraulic Motor HMF-02	
A, B	High pressure ports
L, U	Oil leakage ports
Connection enabling case to be filled with oil.	

Acceptable fluids

- Mineral oil HLP according to DIN 51524
- Biodegradable oils upon inquiry
- Other hydraulic fluids upon inquiry

Technical data

Working Viscosity Range	[mm ² /s] = [cSt]	10 to 80
Optimum Working Viscosity	[mm ² /s] = [cSt]	15 to 30
Max. Viscosity (short time start up)	[mm ² /s] = [cSt]	1000

Viscosity Recommendations

Working temperature [°C]	Viscosity class [mm ² /s] = [cSt] at 40 °C
30 to 40	22
60 to 80	46 or 68

Linde recommends exclusive use of hydraulic fluids for which the manufacturer confirms their suitability for high pressure hydraulic systems. Knowledge of operating temperature in the circuit is a precondition for the right choice of fluid. The choice of hydraulic fluid should be made in such a way that operational viscosity at operational temperature stays in the optimum range (see table above). Note: leakage oil temperature is influenced by pressure and rotating speed and is always above circuit temperature. The temperature should not be above 90°C at any point in the system. If it is not possible to adhere to the above conditions for any reason, you are requested to contact us.

CAUTION

Mixing different mineral hydraulic fluids is only possible after consulting us for release. Mixing mineral oils with bio-type oils is always forbidden.

Filtration

In order to ensure functionality of the hydraulic components and their high efficiency, cleanliness of the working fluid should at least correspond to class 18/13 as per ISO 4406 at all time. With today's filtration technology, however, far better values can be achieved, which contributes essentially to prolonging the working life of hydraulic pumps and motors and the whole system.

The main connection ports of the hydraulic pump are connected to the main connection ports of the hydraulic motor by means of hydraulic hoses, pipes or tubes. The circulation of fluid always goes from the hydraulic pump to the hydraulic motor and from there directly back to the hydraulic pump. Leakage is replaced by an auxiliary pump (boost pump). Since leakage is extremely small in such systems, it is necessary to continuously exchange the oil by means of a purging system on the hydraulic motor to provide cooling. So the boost pump also works as a purging pump and as a pressure source for the servo control.

The direction and speed of flow and therefore rpm and direction of rotation at the output shaft of the hydraulic motor depends on:

- The pump direction of rotation
- The over centre direction of the swash plate

Pump rotation is always defined by looking at the drive shaft and noted on the name plate.

Changing of drive rotation requires conversion of both HPV pump and auxiliary pump. System pressure is determined by the load on the motor shaft. Different kinds of control for hydraulic pumps and motors may be found on the respective data sheets.

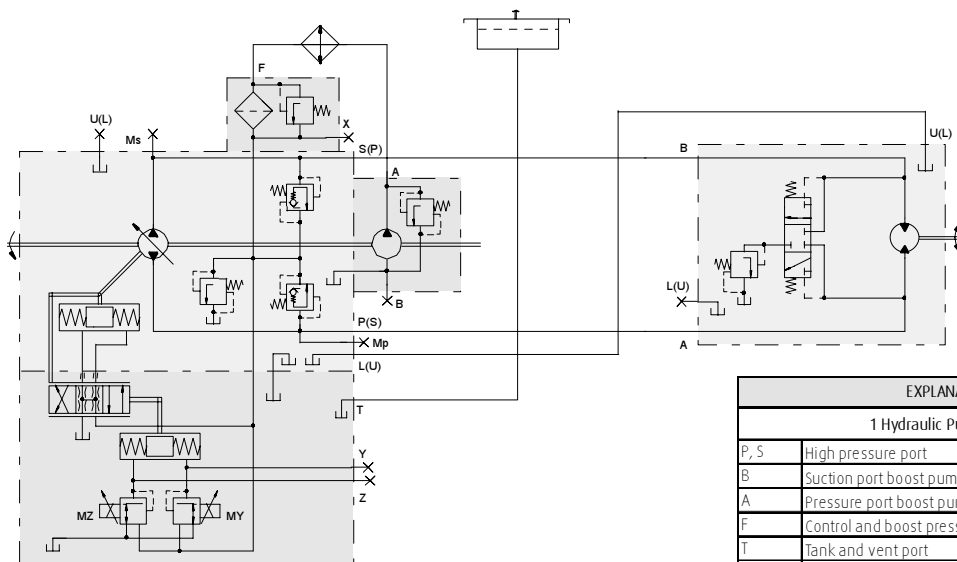
Circuit diagram (example)

1 Hydraulic pump HPV-02 size 35-135

- With electro-hydraulic control E 1
- Drive direction clockwise
- Boost pump with internal suction
- Oil cooler (by customer) in boost pressure loop

2 Hydraulic motor HMF-02 sizes 28-280:

- with purging device*
- pressure in at A: clockwise rotation
- pressure in at B: counter clockwise rotation



EXPLANATIONS	
1 Hydraulic Pump HPV-02	
P, S	High pressure port
B	Suction port boost pump
A	Pressure port boost pump
F	Control and boost pressure supply
T	Tank and vent port
X	Boost pressure gage port
Y, Z	Control pressure gage port
MY, MZ	Proportional solenoid 24V
Ms, Mp	High pressure gage port
L	Oil filling, tank and vent port
U	Drain, flushing return from hydr. Motor
2 Hydraulic Motor HMF-02	
A, B	High pressure ports
L, U	Oil leakage ports
Connection enabling case to be filled with oil.	

*Purging arrangement, see functional description of hydraulic motors.

Read operational instruction carefully and completely before you begin with start up.

Professional and careful start up is the prerequisite for trouble-free operation and optimum life expectancy!

Cleanliness

Oil reservoir and installation have to be checked again for cleanliness before the hydraulic medium is added. This act has to be performed immediately before pouring in. It may even be expedient to rinse the entire installation! Make sure that only absolutely clean and filtered hydraulic fluid is filled in.

Drive rotation

Before starting the engine make sure that the HPV-02 pump will be driven with the correct direction of rotation. With electric motors, it must be checked that the electrical connections are correct. The electric symbol is normally found in the cover of the connector box.

⚠ CAUTION

Under no circumstances start the engine to check the rotation! If the HPV-02 pump is driven against its specified rotation, the boost pump (auxiliary pump) is unable to build up base pressure. For lack of lubrication the drive group will instantly be damaged (initial damage) which may result in total break down.

Initial filling of the hydrostatic transmission

Before starting the prime mover, it must be assured that the housings of the hydraulic components are filled with oil. Before the hydraulic components may be loaded, the entire circuit must be filled up and vented.

Test instruments

During commissioning it is necessary to monitor the base pressure (boost pressure of the auxiliary pump). Remove the plug from gauge port "X" in the filter flange and connect a gauge 0-40 bar.

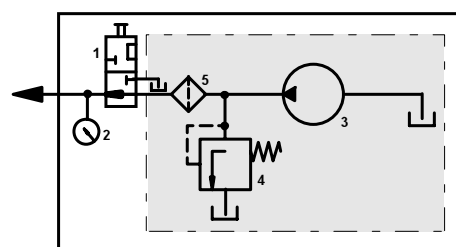
Filling device

We recommend performing the initial filling by means of a filling device. The filling device consists of a gear pump with a capacity of about 5 l/min and a pressure relief valve at 23 bar (pressure setting of boost pressure relief valve e.g. 19 bar +4 bar), plus a fine mesh filter of 10µm or better.

Filling device consisting of:

- | | |
|--------------------------|-----------------|
| 1. Shut off valve | |
| 2. Low pressure gauge | 0-40 bar |
| 3. Gear pump | Q=5 l/min |
| 4. Pressure relief valve | p=23 bar |
| 5. Fine strainer | 10 µm or better |

Filling device

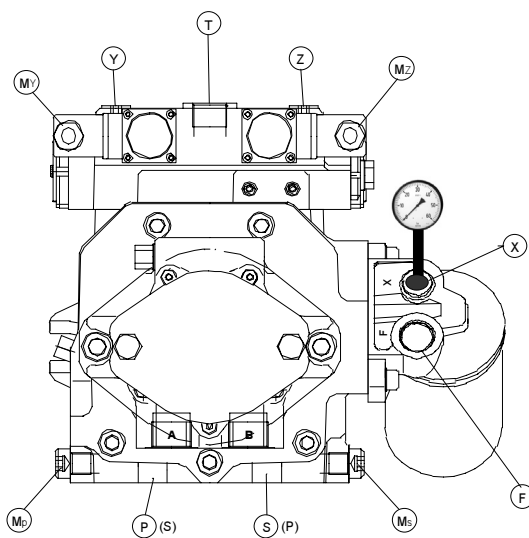


10.1 Initial filling of the HST with a filling device.

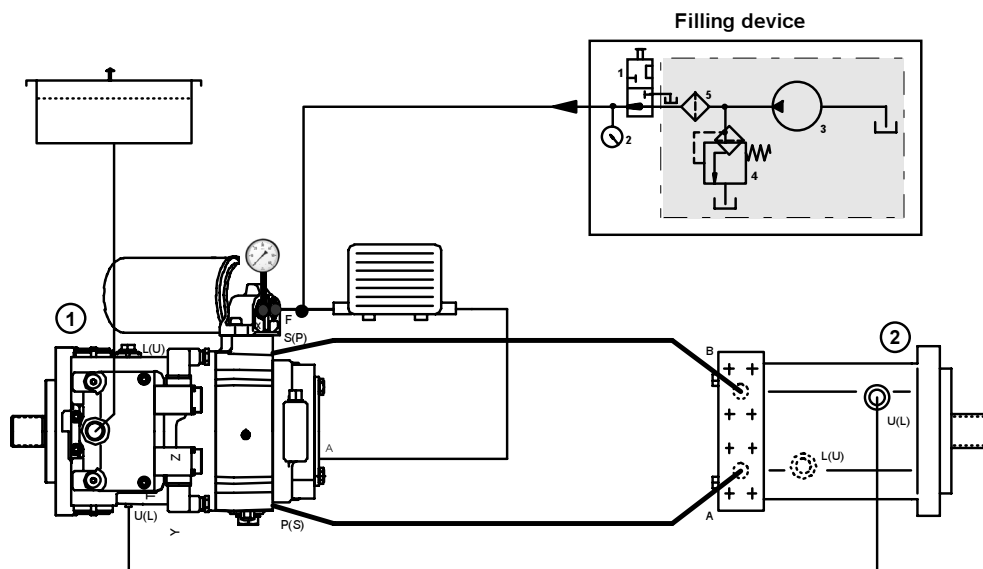
Preparation

- Connect gauge to port "X"
- Connect filling device to port "F" (boosting).
- Loosen vent plug on cooler.
- Loosen fittings on gauge ports "Ms" and "MP" of the HPV pump and remove them. Connect two small lines for venting and lead both into a bucket.
- Loosen plug on port "L" or "U" (the one which is not occupied).

If the housing of the hydraulic motor is not easily accessible, it must be filled with clean oil beforehand.



EXPLANATIONS	
Hydraulic Pump HPV-02 E1	
P, S	High pressure port
B	Suction port boost pump
A	Pressure port boost pump
F	Control and boost pressure supply
T	Tank and vent port
X	Boost pressure gage port
Y, Z	Control pressure gage port
MY, MZ	Proportional solenoid 24V
Ms, Mp	High pressure gage port
L	Oil filling, tank and vent port
U	Drain, flushing return from hydr. motor



Filling and Venting of the entire system

When using the filling device, depending on the installation, the entire system is filled with hydraulic fluid.

Information

The pressure of the filling device opens the boost pressure relief valve in the pump; as a result, the pump housing, hydraulic tank, cooler and hydraulic motor housing are filled. Make up valves for the closed loop open and both main lines are filled. Take care that the relief valve of the filling device is set at least 4 bar higher than the corresponding boost pressure setting. While filling, monitor the reservoir for over filling.

Filling procedure

- Switch the filling device on.
- Keep an eye on the venting plugs on hydraulic motor and cooler and close as soon as no more bubbles show in the hydraulic fluid.
- The hydraulic tank is to be filled as high as to the middle of the upper level indicator. Monitor for leak!
- Next disconnect the micro hoses on the high pressure gauge connections "Mp" and "Ms" and plug the connection ports.
- Remove filling device.
- Collect any hydraulic fluid that may have come out and wipe clean



ENVIRONMENTAL CONCERNS

Attention

Dump the collected waste fluid according to the prevailing regulations, do not use it again!
Now the hydraulic system is nearly full of hydraulic fluid and vented.



DANGER

Before starting the engine, remember the following points!

- A. Make sure the pilot lines for the pump's control are disconnected! In the starting phase the HPV-02 pump must not be actuated!
- B. Disengage the vehicle and secure it against rolling away or jack it up. Safeguard machines according to their nature. Safeguard surroundings of the vehicle. Uninvolved personnel are to be kept at a safe distance at the moment of starting.

Start drive engine for the first time and leave it running for a few seconds

- Engine is running at low idle. The HPV-02 pump runs at no load.
- Electric motors: switch on and after 5 seconds switch off.
- After initial oscillation boost pressure rises immediately to set pressure of the safety valve. This can be read on the gauge (port "X").
- Switch engine off and check fluid level in the tank. Top off if necessary.
- If the pressure setting could not be reached in the starting phase switch engine off at once. Find the reason before you start again.
- Wait for approx. 5 minutes before you start once more and search the installation for possible leakage! Attach micro-hose lines to the high pressure gauge ports "MP" and "MS" and lead them both into a bucket. If micro-hose are not available then bleed main lines by cracking open the fittings on "MP" & "MS" for a couple of turns.
- Connect/activate control of the HPV-02 pump

Starting the engine again

- Engine is running at low idle.
- HPV-02 pump runs at no load. Boost pressure is stable and shows the required value.
- Set engine speed at approx. 1500 rpm and switch off after 5-10 seconds.
- Disconnect the micro hoses from the high pressure gauge ports "MP" and "MS"; install plugs and secure with the corresponding torque.
- Check oil level in the hydraulic tank and top off as required.

Start drive engine again

- Drive engine runs at low idle.
- HPV-02 pump runs at no load. Boost pressure is stable and shows the required value.
- Operate engine at working speed.
- Have HPV-02 pump gradually actuate in both directions up to max angle (for some 30 seconds in each direction). Full load should not be reached.
- By now the purging device of the motor is also activated. With a pressure differential A-B of some 20 bar a measured quantity of hydraulic fluid is discharged and thereby taking the remaining air with it.
- Switch engine off. Remove gauge from port "X". Install plug and tighten. Check the system again for leaks and tighten if necessary.
- Check fluid level again and top off if required.

Hint

Leave the vehicle for about 30 min. Residual air can escape to the hydraulic tank only when the drive engine is at stand still.

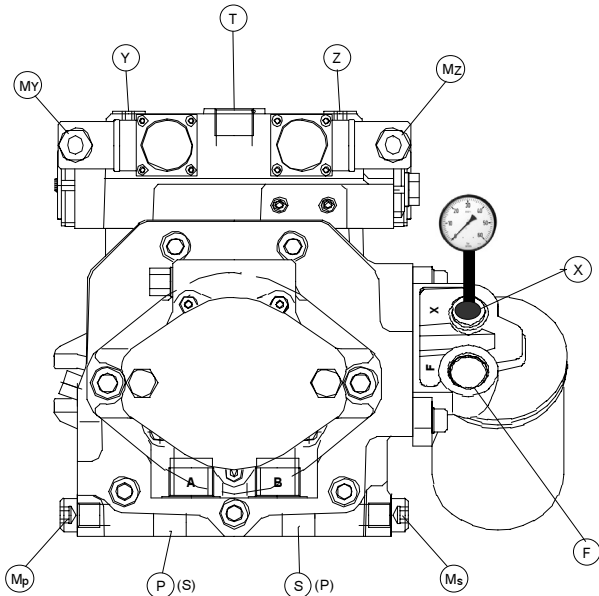
THE HYDROSTATIC TRANSMISSION IS NOW READY TO USE!

10.2 Initial filling of the HST without a filling device

Preparation

- Before you ignite the engine make sure that the housings of the hydraulic units are filled with hydraulic fluid.
- Fill hydraulic reservoir with hydraulic fluid.
- Vent the HPV housing at port "T" or "L (U)" and the motor housing at port "L (U)".
- Connect a pressure gauge at port "X".
- Loosen cooler vent plug.
- Loosen the fittings at gauge ports "MS" and "MP" of the HPV pump and take them away. Connect micro hoses as vent lines and lead them both into a bucket.

HPV 02 E1



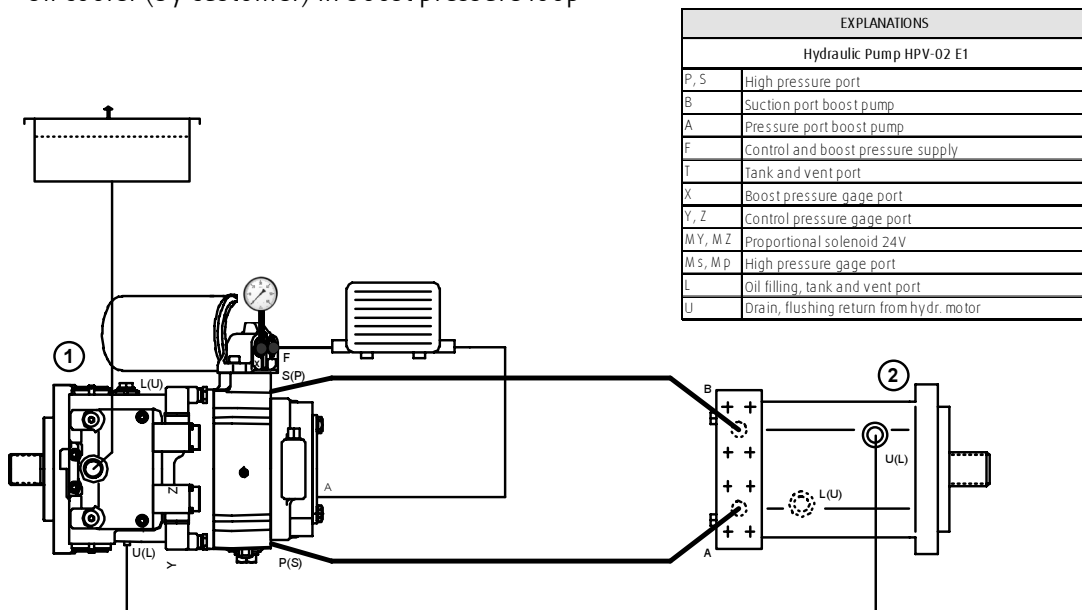
EXPLANATIONS	
Hydraulic Pump HPV-02 E1	
P, S	High pressure port
B	Suction port boost pump
A	Pressure port boost pump
F	Control and boost pressure supply
T	Tank and vent port
X	Boost pressure gage port
Y, Z	Control pressure gage port
MY, MZ	Proportional solenoid 24V
Ms, Mp	High pressure gage port
L	Oil filling, tank and vent port
U	Drain, flushing return from hydr. motor

Circuit diagram (example)

1. Hydraulic pump HPV-02 size 35-280:
 - With electro-hydraulic control E 1
 - Drive direction clockwise
 - Boost pump with internal suction
 - Oil cooler (by customer) in boost pressure loop

2. Hydraulic motor HMF-02 size 28-280:
 - With purging device

Pressure in at A: clockwise rotation
 pressure in at B: counter clockwise rotation



 DANGER

Before starting the drive engine the following points need your attention!

- A. Make sure the input signal for the HPV servo is disconnected! The HPV pump must be off stroke in the starting phase!
- B. Disengage the vehicle and secure against rolling away or prop up. Secure the machines according to their nature. Also secure the surroundings of the vehicle. During the starting phase uninvolved persons must keep sufficiently safe distance.

Actuate the prime mover for the first time

- Have the operator rotate the engine twice for 5-10 seconds.
- Electric motors: switch on and off.
- After initial oscillations the boost pressure rises and can be read on the gauge (port "X").
- Check fluid level in the hydraulic tank and top off if required.
- Should boost pressure not rise during starting refrain from activating the drive engine and find out the reason.
- Before actuating again wait for some 5 minutes and check the installation for possible leaks.
- Ask the operator to run the engine again for 5-10 seconds twice.
- Boost pressure should rise immediately and can be read on the gauge (port "X").
- Check fluid level in the hydraulic tank and fill up if necessary.

Start the prime mover for a first time and have it run for several seconds.

- The drive engine runs at low idle speed. The HPV-02 pump runs with no load.
- Electric motors: switch on and after 5 seconds switch off.
- Boost pressure rises immediately and can be read on the gauge (port "X").
- Set engine speed at about 1500 rpm and after approx 5-10 seconds switch off.
- Disconnect micro hoses from the high pressure gauge ports "MP" and "MS"; apply plugs and tighten them.
- Check fluid level in the hydraulic tank and top off if necessary.
- Before starting again wait for about 5 minutes and check the installation for leakages!
- Connect /activate servo of the HPV-02 pump.

Start the prime mover once more

- The prime mover runs at low idle speed.
- The HPV-02 pump runs with no load. Boost pressure is stable and shows the required value, e.g. 19 bar.
- Have engine run at working speed.
- Swing HPV pump slowly in both directions up to max tilting angle (in each direction for about 30 seconds). Pump should not reach maximum load pressure.
- Now the discharge arrangement of the hydraulic motor is also activated. At a pressure difference (A-B) of approx. 10 bar, a flow of oil is discharged into the motor's case carrying the trapped air with it.
- Stop drive engine. Remove gauge from port "X". Fit the plug screw and tighten it. Check for leakage again and tighten the fittings if needed.
- Loosen plug screws at the high pressure gauge ports "MP" and "MS" and vent, subsequently tighten with the appropriate torque.
- Repeat checking the fluid level and fill up if required.

Hint

Leave the vehicle alone for about 30 min. The residual air in the system can escape to the hydraulic tank only when the engine is off!

**ENVIRONMENTAL CONCERNS****Attention**

Waste fluid must be collected and dumped as prescribed. **Do not re-use!**
Now the hydraulic system is nearly filled with hydraulic fluid and vented.

THE HYDROSTATIC TRANSMISSION IS READY TO USE!

Maintenance of the hydrostatic transmission is confined to exchanging the filter of the HPV-02 pump and exchanging the hydraulic fluid

11.1 Checking and maintenance points

CAUTION

Access to all checking and maintenance points should be considered at the design stage. Difficult access to and poor visibility of maintenance points generally make them hard to clean. That residual dirt may get into systems and assemblies when they are opened for any reason. Moreover, there is the risk of injury and mishandling.

11.1.1 Test points

- High pressure (HP)
- Low pressure (LP)

11.1.2 Checking points

- Oil level.
- Measuring sticks.

11.1.3 Maintenance points

- Filters
- Filler and drain plugs
- Magnetic plugs

11.2 Exchange of filters

The filter supplied with the HPV pump has to be replaced 100 hours after final commissioning. Further exchanges must be made after every 500 working hours. Only original Linde filters may be utilized.

11.3 Exchange of hydraulic fluid

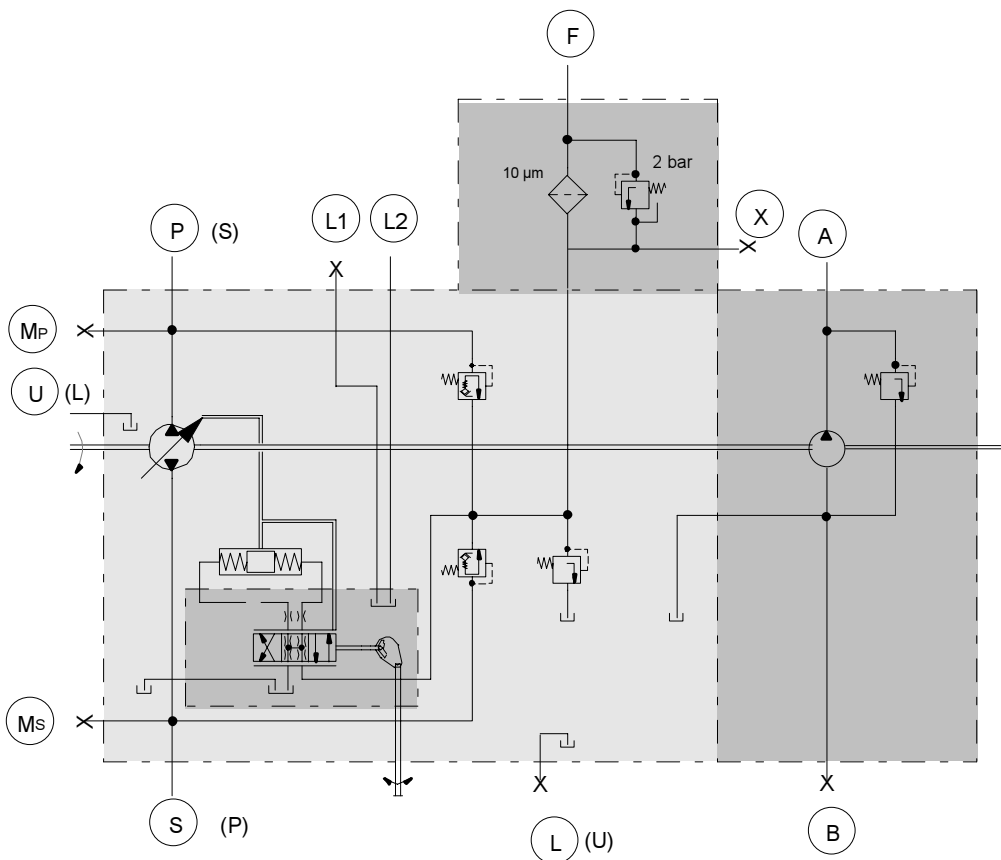
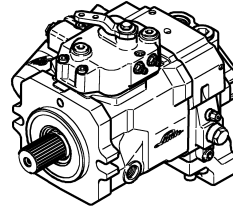
Attention ! Use proper handling and storage procedures and material.

Depending on the application, the hydraulic fluid is to be exchanged after every 1000 to 2000 working hours. High working temperatures in combination with frequent phases of cooling down at lower temperatures result in water condensation and shorten the exchange intervals of hydraulic fluid. Proper oil exchange is done by draining all the oil from tank, cooler, pump and motor housing. The quantity of oil remaining in the high pressure circuit need not be replaced (do not bother to open the high pressure lines).

Procedures stated for initial filling are similarly applicable to the exchange of hydraulic fluid.

12.1 Hydraulic pump HPV-02

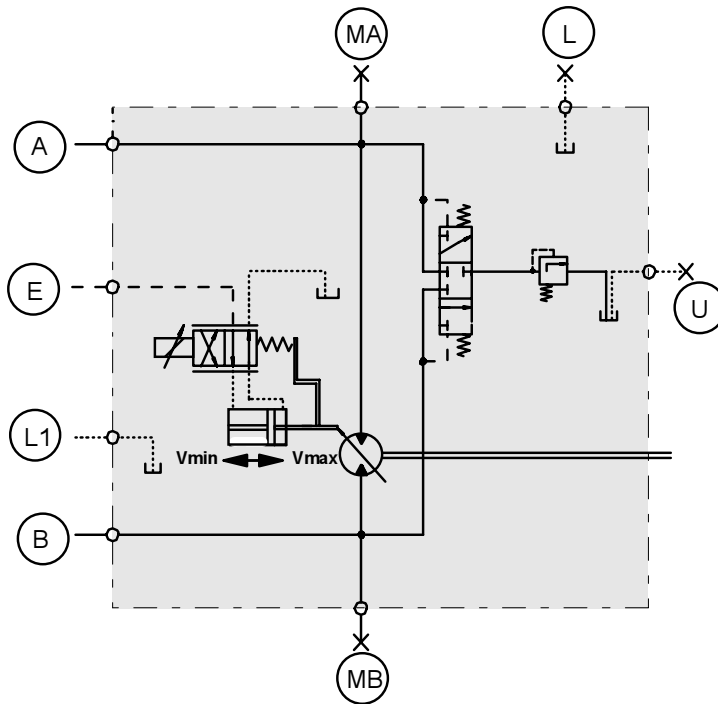
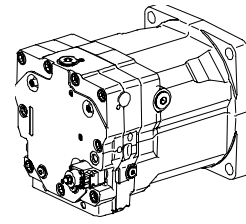
- Mechanic-hydraulic control M1
- Drive direction CW
- Boost pump with internal suction



EXPLANATIONS	
P, S	High pressure port
A	Pressure port boost pump
B	Suction port boost pump
F	Control pressure supply, Boost
X	Control pressure gage port
Ms, Mp	High pressure gage port
L, U	Drain (filling, vent) ports and flushing return from hydr. motor
L1, L2	Vent ports

12.2 HYDRAULIC MOTOR HMV-02

- Electric control E1
- With purging device

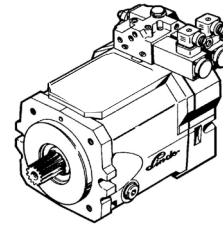


Pressure in at A: CCW rotation
 Pressure in at B: CW rotation.

EXPLANATIONS	
A, B	High pressure port
E	Control pressure PE 20-40 bar
MA, MB	Gage port high pressure
U, L	Oil filling, drain, tank and vent port, purge oil
L1	Oil filling, drain, tank and vent port

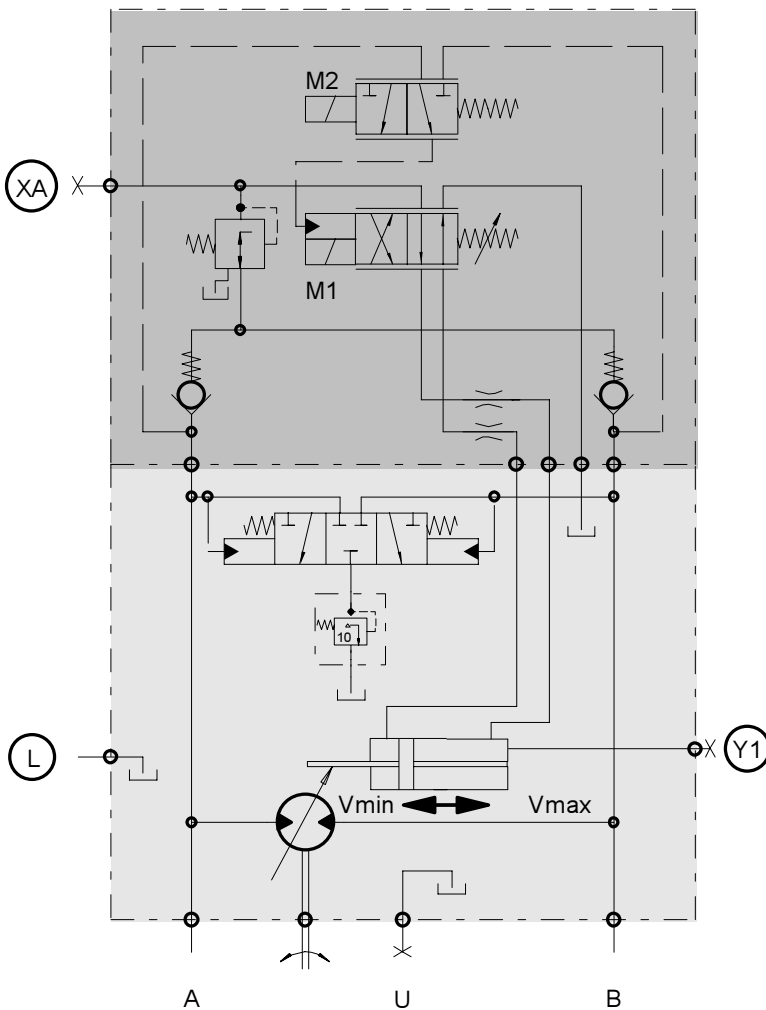
12.3 HYDRAULIC MOTOR HMR-02

- With electric maximum displacement override
- Electric brake pressure shut-off
- Purging system



Pressure in at A: CCW rotation

Pressure in at B: CW rotation.



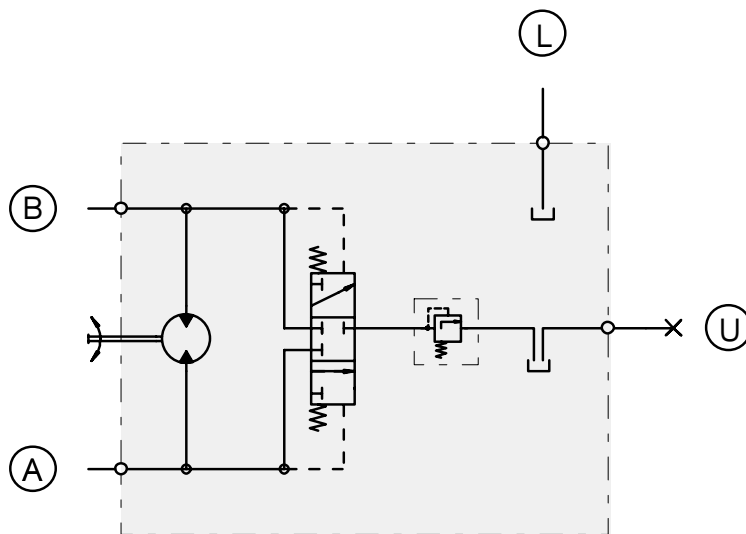
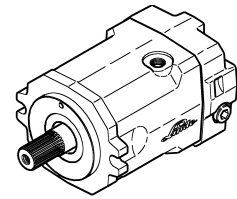
EXPLANATIONS	
A, B	Main pressure ports
Y1	Gage port actuating pressure
XA	Gage port, actuating pressure supply
L, U	Drain, filling, vent ports. Port enabling case to be filled with oil.

12.4 HYDRAULIC MOTOR HMF-02

- Purging system

Pressure in at A: CW rotation

Pressure in at B: CCW rotation.



EXPLANATIONS	
A, B	Main pressure ports
L, U	Drain, filling, vent ports. Port enabling case to be filled with oil.

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