



Operating Instructions

Linde Hydraulics

Linde

Linde Valve Components

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Read this operating instruction carefully and entirely, and keep it handy for reference. This operating instruction refers exclusively to Linde valve components used in open loop circuits.

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 valve components 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.

Our products are being developed constantly; 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 Hydraulics GmbH; for internal use however, copies may be produced.

Technical support

If you have technical questions concerning our products kindly contact the Linde Hydraulics Organisation.

CAUTION

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

The valve components 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.

During planning, a safe state must be defined by the user, as it may depend on added components.

The maximum temperature to be expected must also be taken into account. The maximum permissible differential temperature of oil and valve must be defined.

Regarding the surface temperature of hydraulic components, the standards EN 563 and EN 982 must be observed.

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.

CAUTION

Failure to follow 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 Hydraulics.

 **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.

The 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 EN 10305-1/6 (ISO 3304) or hoses according to ISO/TR 17165-2 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. Do not use cloth under any circumstances.

DANGER

Any amendments, attachments and modifications of hydraulic components possibly with negative effect on safety **must not** be applied without consulting us.

5.1 High and Low Pressure Lines, Maximum Pressures

Ensure that hoses, pipes and fittings are of sufficient strength 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. Observe the instructions in the installation drawings, also regarding possible pressure protection.

5.2 Venting Port, Leakage Lines and Case Pressure

As a rule drain lines have to be kept separate from the main return line. The drain line has to enter the hydraulic tank below the oil level. All leakage and bleed lines must not be reduced in cross section and must be enlarged accordingly when connecting. The dimension must be ample enough that even at low temperatures the return flow pressure of the leak oil will be near zero.

The case pressure (build-up) should not rise and stay higher than 2.5 bar (absolute) during operation.

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

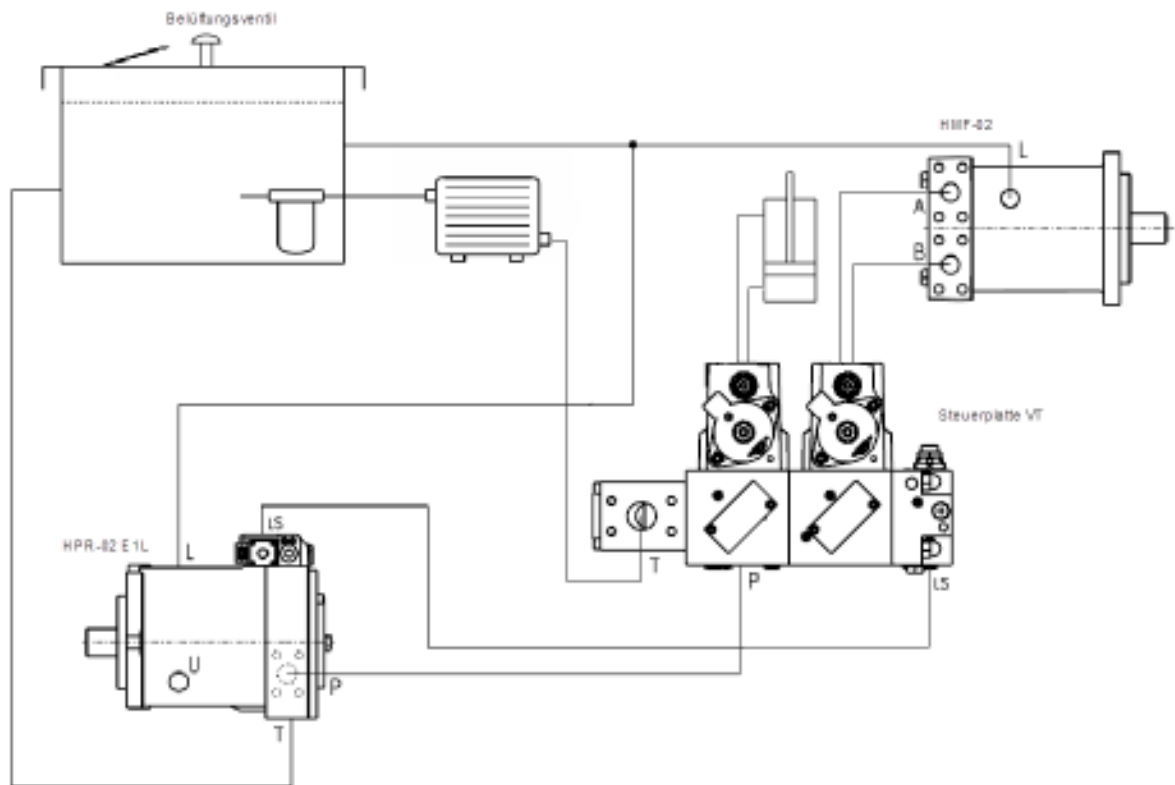
CAUTION

The operation of Linde valve components which are not sufficiently vented leads to impairments in the control and functional behaviour. Therefore check the installation of the Linde unit in the hydraulic system to ensure the case(s) are filled prior to startup. In particular, the control pressure caps of the individual valve functions must be checked for proper venting.

5.3 Function diagram (example)

Hydraulic components in the open loop circuit:

- Hydraulic pump HPR-02 E1L
- Hydraulic motor HMF-02
- Control valve block VT with LSC directional control valves



EXPLANATION	
Hydraulic pump HPR-02 E1L	
P	High pressure port
T	Suction port
LS	Load sensing port
L, U	Filling, vent and leakage ports. Pump housing must be always filled with oil.
Hydraulic motor HMF-02	
A, B	High pressure ports
L, U	Filling, vent and leakage ports. Pump housing must be always filled with oil.
Control valve block VT	
P	High pressure port for hydraulic pump
T	Tank pressure port
LS	Load sensing port

Acceptable fluids

- Mineral oil HLP according to DIN 51524-2
- Biodegradable oils according to ISO 15380 upon request
- Other hydraulic fluids upon request

Viscosity range recommendation

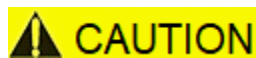
Pressure fluid temperature range	[°C]	-20 to +90
Working viscosity range	[mm ² /s] = [cSt]	10 to 80
Optimum working viscosity	[mm ² /s] = [cSt]	15 to 30
Max. viscosity (short time start-up)	[mm ² /s] = [cSt]	1000

Viscosity recommendation

Working temperature [°C]	Viscosity class [mm ² /s] = [cSt] at 40 °C
30 to 40	22
40 to 60	32
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).

The Linde hydraulic system must not be operated in viscosity range < 10 mm²/s! 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 of the system. If it is not possible to adhere to the above conditions for any reason, you are requested to contact us.



Mixing mineral oils with bio-type oils is always forbidden!

Filtration

In order to ensure functionality of the hydraulic components and their high efficiency, it is necessary to select the viscosity class of the working fluid according to ISO 4406:

- Minimum requirements: 20/18/15
- For reliable proper function: 18/16/13 or better
- We recommend for proportional directional control valves: 16/14/11

A high degree of oil purity clearly contributes to prolonging the life expectancy of the hydraulic system. If it is not possible to adhere to the above conditions for any reason, you are requested to contact us.

The open loop hydraulic circuit

The hydraulic pump used in open loop circuit has two main port connections: One suction port and one high pressure port. The suction port is connected to the hydraulic tank while the high pressure port is connected to the multiple directional control valve block.

When the pump being used is driven, it takes oil from the hydraulic tank. The fluid circulation is always from the hydraulic pump to the directional control valve block. From there through the pipes and hoses the fluid is sent to the implements e.g. hydraulic cylinder and/or hydraulic motor.

The flow direction and speed of the fluid determines the direction of motion and velocity of the hydraulic cylinder as well as the direction of motion and speed of the hydraulic motor.

Return oil from the cylinder/motor returns to the directional control valve block and as a rule from there through the oil cooler, filter and back to the tank. Hydraulic pumps and motors always have filling, venting and drain ports in addition to the main ports.

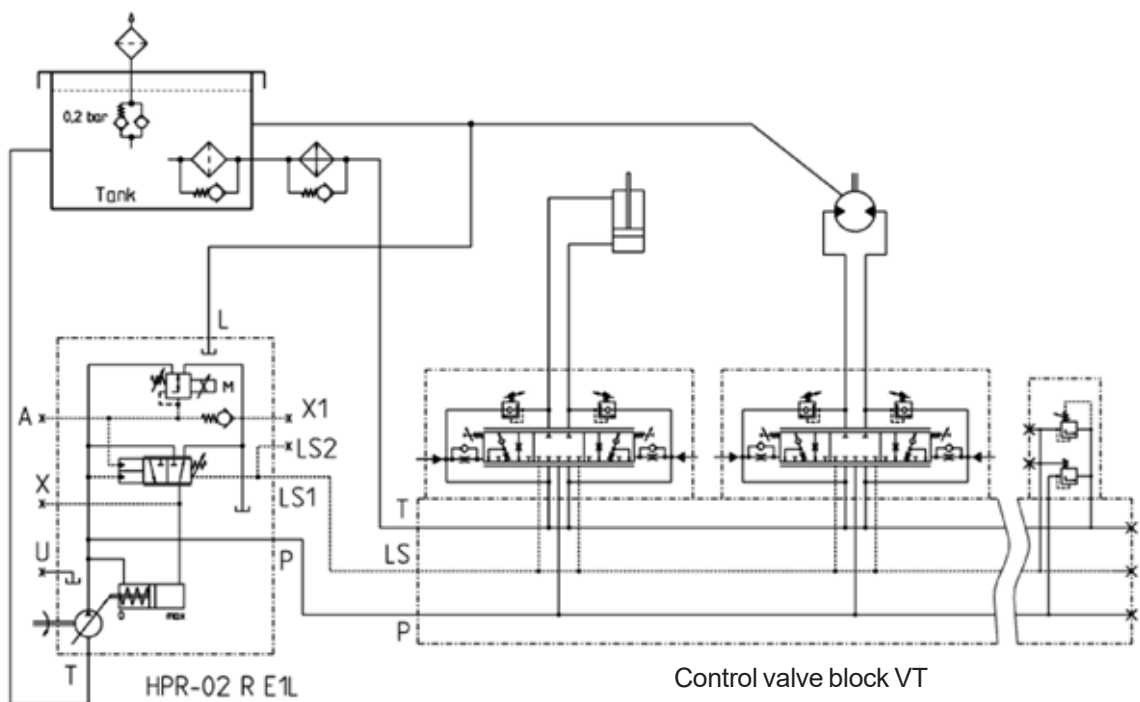
The leakage oil of the components is sent separately back to tank.

If the hydraulic tank is not pressurized, to avoid contamination out of the air, a breathing filter must be installed to avoid contamination from the air.

Circuit diagram (example)

Hydraulic components in the open loop circuit:

- Hydraulic pump HPR-02 E1L
- Hydraulic motor HMF-02
- Control valve block VT with LSC directional control valves



Read operational instructions carefully and thoroughly before you begin with start up. Professional and careful start up is the prerequisite for trouble-free operation and optimum life expectancy!

We recommend the following preparatory work before using our components as standard:

- Acceptance measurement of the installed valves by our customer service.
- Preparation of an FMEA on the hydraulic system.
- A complete functional test of the valve as part of recurring maintenance.
- Sufficient testing of the entire hydraulic system, e.g. endurance run of the machine, field test.

Additionally we recommend adhering to the following standards:

- ISO 4413 "Fluid engineering – design guidelines hydraulics"

Cleanliness

Oil reservoir and installation have to be checked again for cleanliness before the hydraulic medium is added. This procedure has to be performed immediately before pouring takes place. It may even be expedient to flush the entire installation! Make sure that the pressure fluid corresponds to the required grade of cleanliness.

Drive rotation

Before starting the engine make sure that the pump being used 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 pump being used is driven against its specified rotation, the drive group will instantly be damaged (initial damage) due to the lack of lubrication. This may result in total break down. At the same time, cavitation phenomena in the valve components can damage seals.

Defective seals then inevitably lead to a functional failure of the valve component.

Initial filling of the hydrostatic transmission

Before starting the prime mover, it must be ensured that the housings of the hydraulic components are filled with oil. Before the hydraulic components may be loaded, the entire circuit must be filled and vented. The suction port and the casing of the pump being used are not related to each other!

Before the hydraulic components may be exposed to load, the entire circuit must be filled and vented. Required gauges and instruments for monitoring the system need to be fitted.

Filling of the hydraulic system with a filling device

Even new oil fresh from a barrel or a bulk tank, normally corresponds only to purity grade 23/21/18. Therefore we recommend the initial filling to be done with the help of filling device. This unit has to be equipped with a filter of at least the same filter mesh as the main filter element in the hydraulic system.

Filling the hydraulic system without the filling device directly from the barrel or bulk tank may only be performed through the main filter element of the hydraulic system. This filter element must not be removed from its container in the hydraulic tank for quicker filling!

8.1 Initial Filling and Venting of the Entire System

Take care during the filling procedure not to overfill the hydraulic tank.

Fill the hydraulic tank up to the middle of the oil level indicator. During the filling procedure loosen the fittings of the leakage lines on the pump and motors.

Depending of the hydraulic installation the system fills up automatically. If this is not the case the hydraulic tank can be slightly pressurized < 0.2 bar to support the air venting process.

Bleed all the hydraulic components and catch and wipe up the escaped fluid. Tighten up the leakage lines. Almost all of the hydraulic system is now filled and vented.



ENVIRONMENTAL CONCERNS

Dump the collected waste fluid according to the prevailing regulations, do not use it again!



DANGER

Before starting the engine, remember the following points!

- A. If there is an on/off valve in the suction line, make sure it is completely open.
- 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.
- C. If there is a safety lever, keep it in the lock position.

Initial start-up

Start drive engine for the first time and leave it running for a few seconds, take care of unusual noises.

- Engine is running at low idle. The pump being used runs at no load.
- Electric motors: switch on and after 5 seconds switch off.
- In case of trouble investigate the reason.
- Switch engine off and check fluid level in the tank. Top off if necessary.
- Bleed the hydraulic components and catch and wipe up the escaped fluid.
- Before restarting the engine, check the installation for tightness!

Start drive engine again, adjust speed at about 1500 rpm

- Carry out the functional movements unloaded. Continually monitor pressure fluid level in the hydraulic tank and top off if required.
- Shut off the drive engine
- Before restarting the engine, check the installation for tightness!

Start drive engine again and run it at maximum speed

- Carry out the functional movements unloaded. Continually monitor pressure fluid level in the hydraulic tank and top off as required.
- Shut off the drive engine
- Before restarting the engine, check all connections are tight and no signs of leaks!

Start drive engine again and run it with the maximum speed

- Carry out the functional movements unloaded as long as the functions of the implements are smooth in motion without erratic movement.
- Having reached the working temperatures load the system and check all functions again.
- Monitor the hydraulic system temperature.
- After the successful initial start up shut off the drive engine.

Leave the vehicle switched off for about 30 min

The residual air in the system can escape to the hydraulic tank only when the engine is off!

If after repeated starts of the drive engine and actuation of the implements foam is generated in the hydraulic tank, the cause of aeration must be investigated.

For example: Connections from pipe to hose on the suction line of the hydraulic pump.

We recommend again checking all fittings and tightening screws of SAE flanges, even when they are not leaking. Tighten them again to the required torque.

 **CAUTION**

Both the checking and tightening of the fittings and screws must be done while the system pressure is released and implements unloaded!

Start up at low temperatures

This kind of start up is performed in the same steps as described above. Additionally all the hints regarding lower temperature limit and lower viscosity limit must be strictly observed (see chapter regarding pressure fluid, temperature and filtration). All the additional requirements of the machine manufacturer must be met accordingly.

THE HYDROSTATIC SYSTEM IS NOW READY FOR USE!

9 Maintenance

CAUTION

Access to all checking and maintenance points must be considered at the design stage. Difficult access to and poor visibility of maintenance points generally make them hard to clean. Residual dirt may get into systems and assemblies when they are opened up for any reason. Moreover, there is the risk of injury and mishandling. Simplified service and maintenance save you time and money!

9.1 Checking and Maintenance Points

- High pressure (HP)
 - xP
 - xLS
- Low pressure (LP)
 - xT
 - xT₀

9.2 Test Points

- Oil level
- Dip sticks

9.3 Maintenance Points

- Filters
- Drain plugs
- Magnetic plugs

9.4 Service Interval: Hydraulic Oil Return Line Filter

We recommend exchanging the hydraulic oil return flow filter directly after the initial start up. **Further replacements after every 1000 up to 2000 working hours.** Follow the machine manufacturers recommendations. While replacing the filter care must be taken that no dirt can enter the system. Use only recommended original filters!

9.5 Service interval: Hydraulic Oil

Attention! Use proper handling and storage procedures and material.

High working temperatures in combination with frequent phases of cooling down at lower ambient temperatures result in water condensation and shorten the change intervals of hydraulic fluid.

The hydraulic fluid applied determines the safety and reliability of the machine operation. We recommend having an oil analysis taken at given time for oil change.

Comply with the guidelines of the machine manufacturer. Depending on the application, **the hydraulic fluid is to be exchanged after every 1000 to 3000 working hours.**

Proper oil exchange is done by draining all the oil from tank, pump and motor housing.

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

Training Centre in Aschaffenburg-Nilkheim

In courses on our hydraulic and electronic products we train our customers in the complex hydraulic systems of open and closed loop applications.

The up to date training contents result from the experience of our service team and will be oriented to specific customer applications if so desired.

Our competent service team provides quick support to you, worldwide.

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