

Commissioning Hydraulic Installations

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1 Preparations for commissioning

1.1 Checking the fluid tank

Oil tanks in hydraulic installations are checked for cleanliness before they leave the factory and all apertures are tightly sealed.

Due to unfavourable circumstances during transportation from the factory to the place of installation and any intermediate storage that might become necessary, it is possible for oil tanks to become contaminated with water, dust, etc. before it is time to commission the installation. If extended intermediate storage (i.e. for more than six months) is expected from the outset, proper corrosion protection may make it necessary to seal the return lines and suction lines inside the oil tank in order to prevent drainage.

During the process of installation on site it often happens that the connecting points for return lines remain open for long periods of time.

For all these reasons, therefore, it is essential for the fluid tank of an installation to be inspected and cleaned if necessary before it is filled with fluid (do not use linting cleaning cloths).

1.2 Checking the pipework between hydraulic installation and actuators

If the commissioning is not carried out by the same people who install the pipework between hydraulic installation, control gear and actuators, it is essential for the pipework to be inspected first, either a full or random inspection. Satisfactory operation of the system and long service life for the components are very closely related to the internal cleanliness of the pipework.

The correct connection of the individual actuators to the hydraulic installation according to the circuit diagram should also be checked because any mistakes mean wasted fluid and unnecessary "messaging about" afterwards.

1.3 Aligning the pump and electric motor

The alignment between the pump and electric motor can sometimes become disturbed during transport and the fitting of other components, etc.

Some types of pump cannot tolerate either radial or axial loads and, in addition, flexible elements in couplings will only permit a small amount of parallel or angular offset.

This point should never be forgotten, even when everyone is urging the commissioning to be started immediately.

1.4 Gas charging of any accumulators

Only nitrogen should ever be used for charging hydraulic accumulators.

The accumulators should be charged to the value of charging pressure indicated on the circuit diagram (the fluid side of the system must be depressurized when this is done). So that the nitrogen volume of the gas bottles can be properly utilized, there are so-called "charging units" which enable the nitrogen bottle pressure to be suitably "pumped up".

In the case of piston-type accumulators connected to gas bottles it is sometimes possible to use the hydraulic system to "pump up" the nitrogen pressure.

Remember, however, that this procedure is very dangerous with bladder-type accumulators because of the risk of over-straining the bladder.

1.5 Filling with fluid

Regardless of the type of container in which the fluid is delivered it will not be clean enough for immediate use so must be passed through a filter before entering the system. The absolute filtration rating of the filling filter must be at least identical to that of the filters in the system.

1.6 The commissioning team

For reasons of safety, only persons directly involved with the commissioning should be allowed on site while the commissioning is taking place.

It is easy to make this statement but in reality there are probably several other companies seeking to complete their work urgently at the same time.

Remember, nevertheless, that after a serious accident it will be no good saying "They should have known better".

2 Commissioning

2.1 Pressure settings

Release the pressure settings of all pressure relief valves, pressure reducing valves and pump pressure regulators except those valves which have a fixed TÜV (safety approval society) setting.

2.2 Servo systems

In the case of servo systems remove the servo valves and replace them with flushing plates or, even better, by directional control valves of the same size. Actuators must be short-circuited. Fluid temperatures attained throughout the hydraulic system during flushing should be at least equal to the normal service temperature attained during subsequent operation. Filter elements must be changed as necessary.

The flushing time can be calculated from the following formula

$$t = \frac{V}{Q} \times 5 \quad [\text{h}]$$

V = Tank capacity in L

Q = Delivery rate of high pressure pump in L/min

2.3 Commissioning of pumps

Some types of pump need to be filled with fluid before being started up for the first time in order to prevent bearings and other mechanisms from running dry.

Start and stop the pump drive motor briefly in order to check the direction of rotation. If it is correct, the pump can be run continuously and the system checked for leaks and correct flow.

Provided no defects are discovered, the setting of the pressure relief valve can be slowly increased to the value given on the circuit diagram and locked.

Filling pumps and boost pumps can be commissioned in the same way. At the same time, the system must also be bled.

The next step is to commission any pilot fluid pumps. If no defects are discovered in this circuit, the control fluid pressure can be set to the prescribed value and locked. The pilot circuit must also be bled.

The next step is to commission the main pumps one by one.

Once again:

Bleed both the inlet side and the system side and check the direction of rotation on the first brief start. While the various pumps are being set to work a close watch must be kept on the level of fluid in the tank. It must be topped up if necessary until the whole system is full.

Each pump should be kept under constant watch until it is pumping smoothly and continuously. A pump which is sucking in the occasional air bubble or fluid containing large numbers of bubbles will give off loud knocking noises or a very loud continuous noise. Since very high rates of pressure rise are achieved in positive displacement pumps, the compression of the air bubbles causes severe localized overheating of the fluid and therefore damage.

Unless a pump starts drawing bubble-free fluid after a few minutes of running, it should be shut down quickly in order to ascertain the cause.

2.4 Commissioning control gear and actuators

Control gear and actuators should be put into service at low rates of flow and low pressure in order to avoid any damage due to incorrect circuitry, either electrical or hydraulic.

Once it has been established that the circuitry is correct, the actuators correctly controlled and the limit switches correctly positioned, the pressures and flow rates can be increased to the prescribed values.

Throughout the whole time a close watch must be kept on:

- tank fluid level
- tank fluid temperature
- all components for external leaks
- sources of noise
- pump and motor body temperatures
- clogging of filters.

2.5 Other settings

Set pressure relief valves to the prescribed value and lock.

Set pump pressure regulators and lock.

Set pressure reducing valves, pressure sequence valves and pressure unloading valves.

Adjust tank level monitor.

Set pressure switches and differential pressure switches.

Set temperature controllers.

Set switching points of temperature monitoring devices.

2.6 Other checks

Is the pipework properly secured to withstand fluctuations in pressure?

Are the fixing points positioned correctly?

Are hoses fitted so that they do not chafe when pressurized?

2.7 Commissioning of systems with proportional valves

This type of system should be commissioned as described previously.

The functions can be exercised by “emergency manual control”. In order to avoid damage, proportional valves should first be operated using a portable electronic service unit. This type of auxiliary electronic equipment is available from equipment manufacturers as a service pack. Its use is not confined to commissioning, but is useful later as a service aid for checking over the proportional valves and their amplifier boards.

2.8 Commissioning systems with servo valves

The servo valves must be removed before starting commissioning. They should be replaced either by flushing plates or, if the system allows, by directional control valves of the same size. When flushing is complete, the servo valves can be replaced but the greatest cleanliness must be exercised. Once again the whole hydraulic control system should be operated manually first.

Battery-powered or mains-powered portable control units are also available for use with servo valves. Again, these are extremely convenient both for commissioning and for subsequent fault-finding.

2.9 Commissioning high-speed systems

Typical high-speed systems are those found on presses, plastics injection moulding machines, special-purpose machine tools, rolling mills, crane control systems, etc. and it is often impossible to commission them and optimize their operation with conventional tools and instruments such as pressure gauges, thermometers, etc.

For commissioning and optimizing these more complex systems it is necessary to have an appropriate amount of sophisticated instrumentation suitable for the particular application that is capable of multi-channel, simultaneous recording of a range of parameters, such as pressures, electrical signals, strokes, speeds, flow rates, etc., in order to determine such factors as dead times, peak pressures, pressure dips, motion overlaps, etc. so that the safety aspect can be clearly analyzed and documented for the eventual end-user.

3 The most common errors in commissioning

Apart from maintenance, commissioning is possibly the single most important process affecting the service life and correct function of a hydraulic installation.

Obviously, therefore, it is essential to eliminate as many errors as possible from the commissioning process.

The most common errors are:

- forgetting to check the tank fluid level
- forgetting to filter the fluid put into the system
- forgetting to check over the installation before starting commissioning (involving subsequent modifications and waste of fluid)
- forgetting to bleed parts of the system
- setting pressure relief valves too close to the working pressure
- setting pump pressure regulators higher than or the same as the pressure relief valve
- not flushing servo systems for the correct length of time
- not taking any notice of abnormal pump noises (cavitation, suction line leaks, excessive air in the fluid)
- neglecting lateral strain on cylinder rods (i.e. installation errors)
- not bleeding cylinders (leading to seal damage)
- setting limit switches too finely
- setting pressure switches without allowance for switching hysteresis
- not filling hydraulic pump and motor bodies with fluid before the first start
- failing to keep a record of settings
- not locking or sealing setting devices
- allowing too many people around the installation during commissioning.

4 Summary

Depending on the size and complexity of an installation, the commissioning can be carried out either by those who will be responsible for its subsequent operation (provided they have sufficient hydraulic knowledge or have been properly trained) or by manufacturers' personnel using the appropriate instrumentation and tools.

Past experience has shown quite clearly that customers often save nothing in the long run when attempting to cut costs by not employing a commissioning specialist from the manufacturer.