

# the difference between

## THE DIFFERENCE BETWEEN:

# Directional Seated Valves and Directional Spool Valves as Control Components

The widespread use of tried-and-tested technologies such as directional spool valves often results in engineers ignoring potential alternatives. Directional seated valves, often overlooked, can perform many of the same functions at a lower product cost, along with decreased energy needs and a smaller footprint.

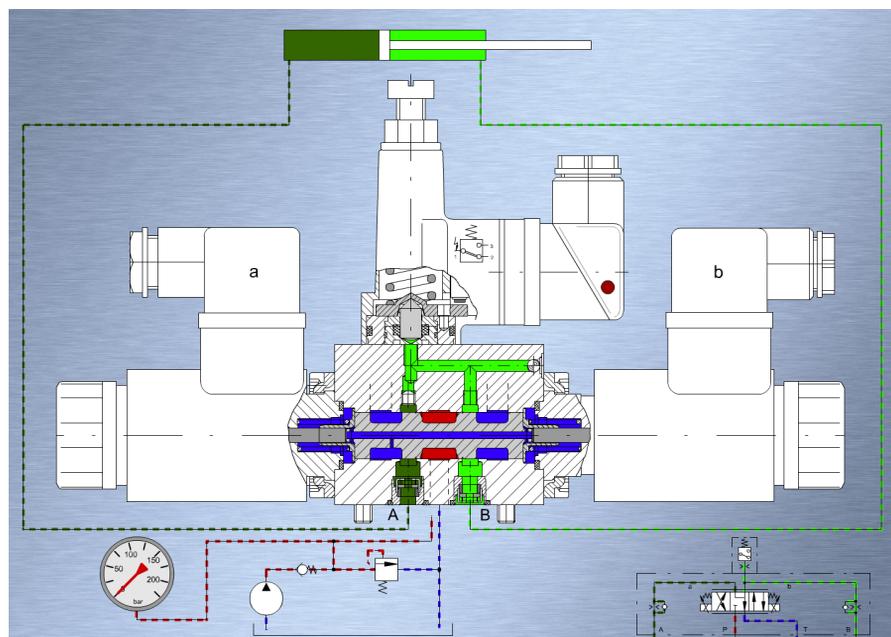
**HYDRAULIC SYSTEMS CAN** only function through the use of valves. Understanding the basic operation of the different valve types enables engineers to select and implement the correct one that best serves the intended purpose. Because budgets are always a factor, proper selection is critical. This article compares directional spool valves with directional seated valves to help explain some common misunderstandings between the two.

### Directional Spool Valves

Directional spool valves operate using a moving spool situated inside the valve housing where an actuating force moves the spool in such a way that the channels inside the housing are connected or separated (*Fig. 1*). Pressure oil channels flow into the housing radially and the valve spool moves through a central, axial bore. As a result, there is an inherent, continuous leakage from the pressure side to the tank side. Moreover, the

working lines are also not sealed tightly unless upstream check valves are used. The leakage becomes greater with wear, meaning the losses in the hydraulic system increase the

longer the valve is in use. Leakage is determined using a combination of the gap size between the spool and housing, the viscosity of the hydraulic fluid and the system pressure.



1. Basic design of a directional spool valve.

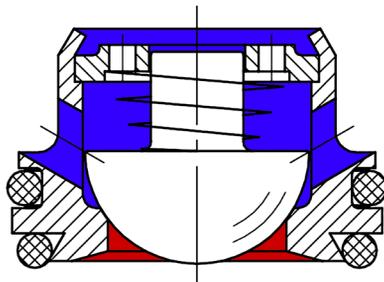
In addition, contamination may lead to clogging of the gap between the spool and the housing if the same switching position is maintained for a long period of time. This can cause malfunctions and binding.

Directional spool valves provide a wide variety of control functions, as well as high switching power and low actuation forces. The valves may be direct- or pilot-operated and may be controlled electrically, mechanically, hydraulically or pneumatically. When operating at particularly higher pressures, greater leakage losses around the spool and housing are a given and should always be taken into consideration when costing out a design, as engineers must be continually aware of energy costs into the future.

## Directional Seated Valves

The most basic design of a seated valve is the check valve. Inside the valve, a ball, cone or small plate is pressed directly onto a circular through-bore by fluid pressure, or by a spring (Fig. 2). This means fluid flow is interrupted without any intervention by an external force. And as long as the pressure is maintained, the ball, cone or plate remains securely in its seat. The same, basic principle is incorporated in designing directional seated valves; all that is added is the directional function, and it is possible to depict all circuit symbols from 2-position/2-way to the 3-position/4-way function. Using extremely precise manufacturing techniques for the valve seat and the sealing elements, these valves provide guaranteed leakage-free operation in the closed position over a period of hours, or even days.

Because of their operation and design, the lifetime and reliability of directional seated



2. Basic design of a check valve

valves are many times greater than those of directional spool valves. Even floating dirt or small particles of contamination do not reduce their switching reliability. Finally, as with spool valves, these valves can also be controlled electrically, mechanically, hydraulically or pneumatically.

Understanding the functional principles of directional seated valves, engineers are able to reconsider existing solutions to realize a variety of different types of savings.

One of the major concerns of incorporating directional seated valves is initial cost. While it is true these products have a higher purchase cost upfront, a closer look may indicate otherwise. For example, during the design process, it is important to consider the full life cycle of the product. Because these valves are leakage-free, their level of

energy savings is very high. In many applications, the use of a seated valve for directional control eliminates the need for an additional check valve, used to maintain a position. In particular, with the design of the hydraulic system in standby mode, up to 80% of energy costs can be saved, greatly reducing the payback period.

Another common misconception about directional seated valves is they are only available in a few circuit symbols and therefore only suitable for special applications. This is not true when working with companies such as HAWE Hydraulik, which has a range of directional seated valves. These include a considerable diversity of different circuit symbols and actuation variants—usable in an extremely wide variety of applications.

Nearly all conceivable switching functions of 2-way, 3-way and 4 directional valves are available and, in some cases, additional functions are possible. For example, a 3-position/4-way valve can be made into a 4-position/4-way valve by energizing both coils simultaneously to enable the 4th switching position. And with built-in switching position monitoring, the company's NBVP valve type also supports the manufacturer in satisfying the requirements for functional safety (ISO 13849).

For customers concerned about standard connection patterns, HAWE Hydraulik products encompass directional seated valves with a nominal size 6 (CETOP 3) pattern (Fig. 3). These include the NBVP and the NG valves, where both series enable pressure ranges of up to 500 bar. If electromagnetic actuation is used, it functions with DC AC voltage and some series are also available with energy-saving, 8-watt technology.

The standardized CETOP 3



3. Type NBVP directional seated valves in nominal size 6 with switching position monitoring.



**4. The EMP type proportional directional seated valve is available for raising and lowering loads.**

connection pattern makes changing over from spool valves to seated valves particularly easy, as the seated valve is simply structured on the existing connection pattern, eliminating the expense of replacing the sub-plates (or manifolds) in the process.

### **Applications that Rely on Seated Valve Technology**

A primary operation using directional seated valves is the use of hydraulic power packs for tooling machines. Benefits include long life, imperviousness to contamination and extremely high MTTFd values. The leak-free design provides users with an energy-efficient standby mode, in which the power pack only runs when the hydraulic accumulator needs to be recharged. When the hydraulic accumulator is charged, the power pack switches off.

Directional seated valves, however, are not only used in stationary systems. When raising and lowering loads with lifting gear, the zero-leakage, tightly-sealed switching position can be used to hold the heavy load safely. If a 2/2-way directional seated valve from HAWE Hydraulik's EM series is used with a proportional solenoid, it can simultaneously control the speed of movement as well (Fig. 4).

Due to the tapered seat, this valve type is leakage-free in the closed switching position, while in the open position the flow rate is restricted in line with demand. Alternatively, this valve type is also available in a "soft shift" version with attenuated operation, which increases the switching time with on/off control; this prevents short-term pressure peaks and thereby avoids damaging other components.

The HAWE Hydraulik range of products also includes a variety of other models and actuation types for directional seated valves. The common thread when purchasing these valves is the large number of diverse possibilities available for increasing the energy efficiency of machines, or meeting safety requirements. In some cases, fault exclusion according to ISO 13849 is even possible, and valves for special applications—such as hydraulic lubrication systems or use in explosive environments—are also available.

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