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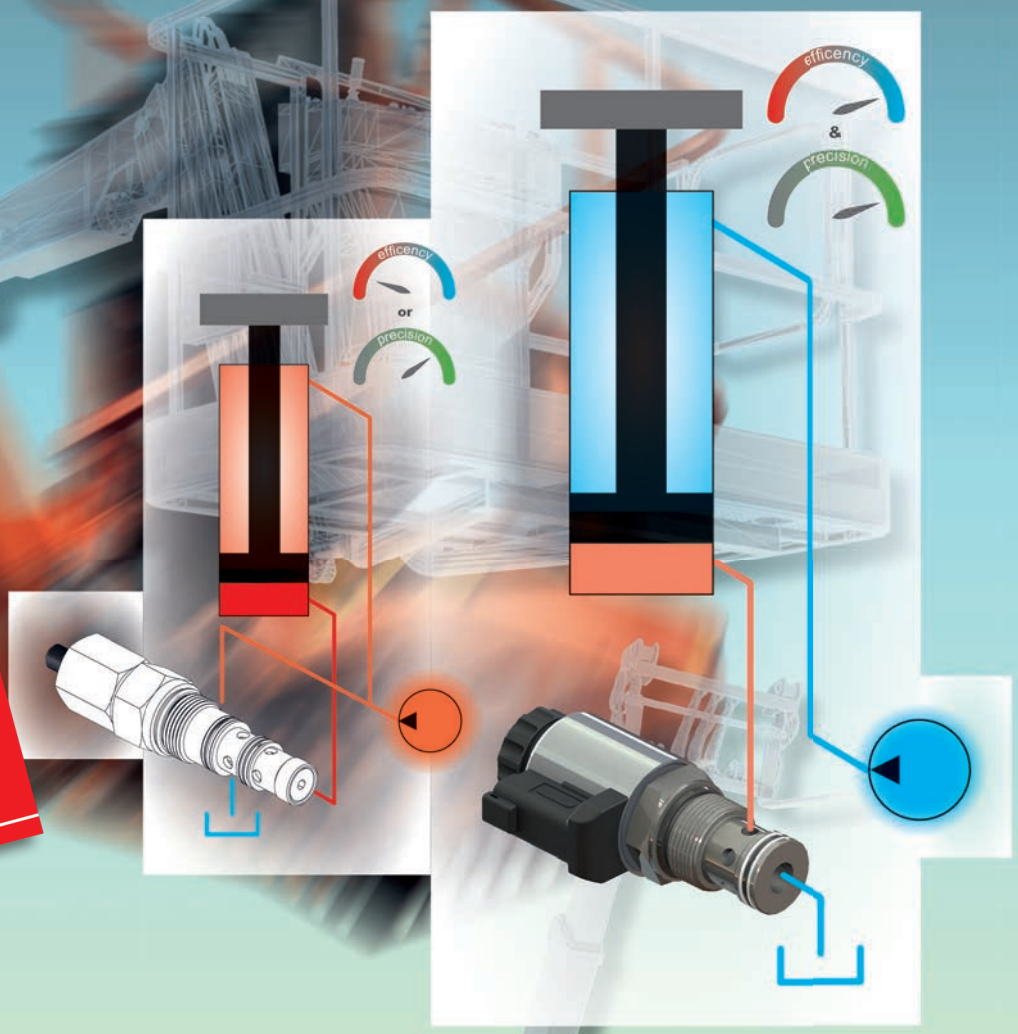
Organ des Forschungsfonds
Fluidtechnik im VDMA

O+P FLUIDTECHNIK

INDUSTRIEHYDRAULIK – MOBILHYDRAULIK – PNEUMATIK



MIT 14 SEITEN

Mobile Maschinen

TITEL

ENERGIEEFFIZIENZ UND STABILITÄT

Ventiltechnik bei elektro-hydraulischen Lasthaltefunktionen

HYDAC SPECIAL-EDITION

VEREINIGTE FACHVERLAGE
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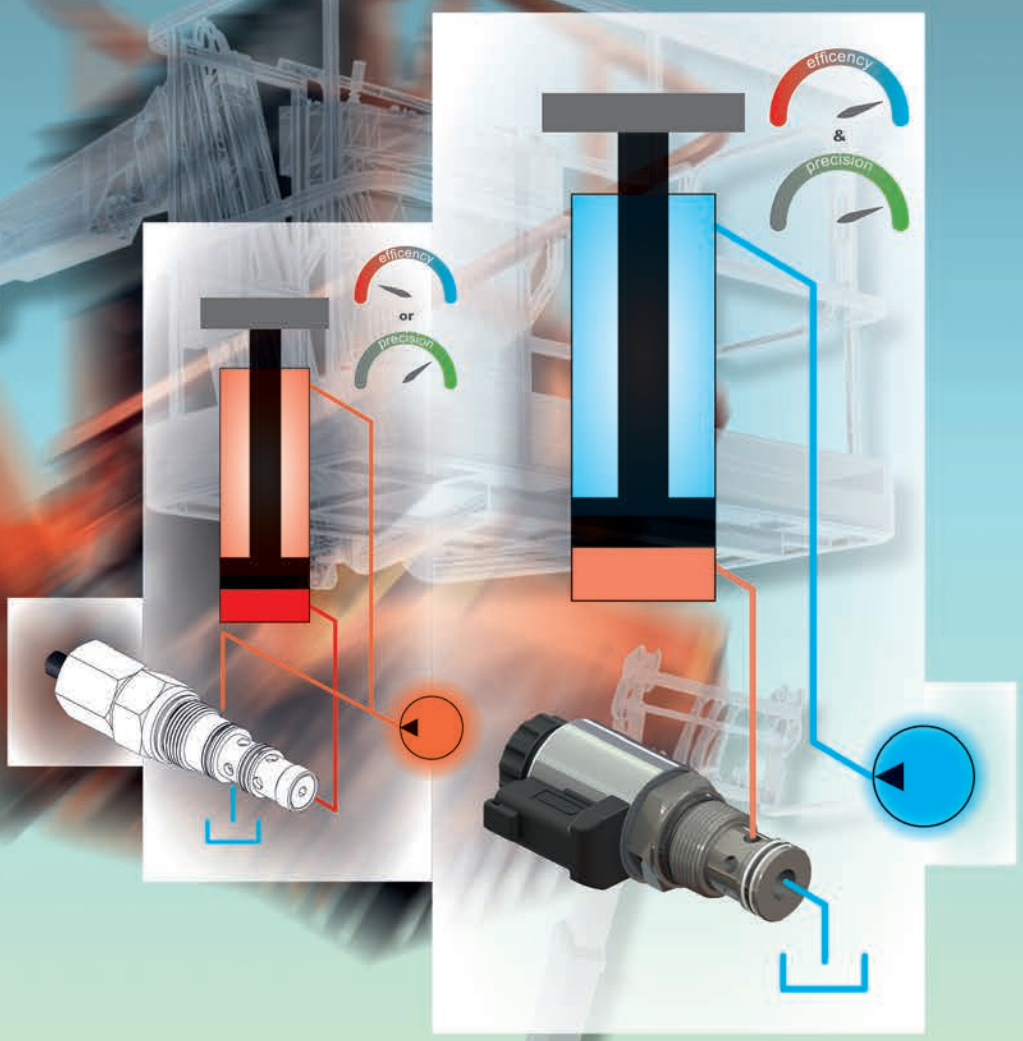
VALVE TECHNOLOGY
FOR ELECTRO-HYDRAULIC LOAD HOLDING FUNCTIONS



Authors: *Peter Bruck, Alexander Streit and Dr. Nora Nägele, Hydac*

The precise lowering of loads is not an easy task, especially when wheel loaders and tractors are in the forward holding position. When using counterbalance valves, it is very difficult to combine energy efficiency and stability. Electro-hydraulic load holding functions can be advantageous in this respect.

MAIN POINTS

- ELECTRO-HYDRAULIC LOAD HOLDING OFFERS FULL CONTROL
- SOFTWARE CAN KEEP THE INLET PRESSURE AT THE MINIMUM LEVEL
- ESPECIALLY EFFECTIVE WITH HIGHLY CHANGEABLE LOAD CONDITIONS
- SPECIAL VALVES ARE REQUIRED FOR THIS

With today's solutions for precise lowering of leading loads with counterbalance valves, machine manufacturers have to choose between energy efficiency and stability:

While energy efficiency requires a high pilot ratio (ϕ), experience has shown that stable load lowering benefits from a lower ϕ. Valves with a low ϕ (for increased stability) need a high inlet pressure on the pump side when lowering loads. This requires a large amount of energy. This ultimately leads to the oil warming up, which must then be compensated for with an increase in the cooling capacity.

Although valves with a high ϕ are more energy efficient in comparison, they lead to instable lowering of loads, especially in systems susceptible to vibration, due to the reactive behaviour.

As a result, machine manufacturers face the dilemma of finding a compromise between energy efficiency and stability.

THE INCREASING IMPORTANCE OF ENERGY EFFICIENCY

For mobile machines as well as other machines, the aspect of energy efficiency is becoming more and more of a priority due to the growing importance of electrification. This is the particular focus of attention here as it is directly related to the electrified machine's battery design. This in turn represents a significant cost driver on the part of the machine manufacturer.

It is for this reason that the dilemma of finding a compromise between energy efficiency and stability for load holding is becoming more and more of a priority. Current approaches to solutions from machine manufacturers are increasingly concentrating on electro-hydraulic load holding.

ELECTRO-HYDRAULIC LOAD HOLDING AND LOAD LOWERING FUNCTIONS

Even with electro-hydraulic systems, the basic function of conventional load lowering, in which the speed of the actuator is regulated by the inlet flow rate, is retained. Here, however, it is possible to use software to constantly regulate the inlet pressure to the minimum pressure level required in the situation. This means that cavitation is avoided and the full control of the lowering movement is maintained.

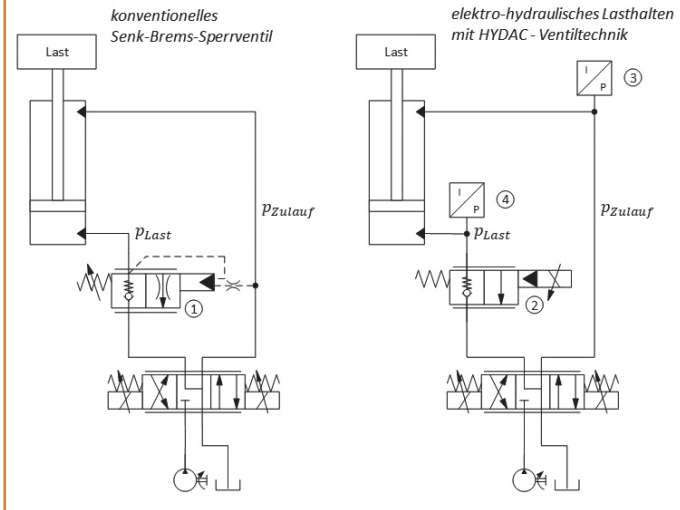
The hydraulic part of the control loop (Figure 01: Comparison of conventional vs. electro-hydraulic load holding) is implemented by replaceing the conventional downstream counterbalance valve (1) with a pilot-operated, proportional, poppet-type flow control valve (PWS) (2). The system states can be detected via the sensors, for example (3) - (4).

REDUCED INLET PRESSURE

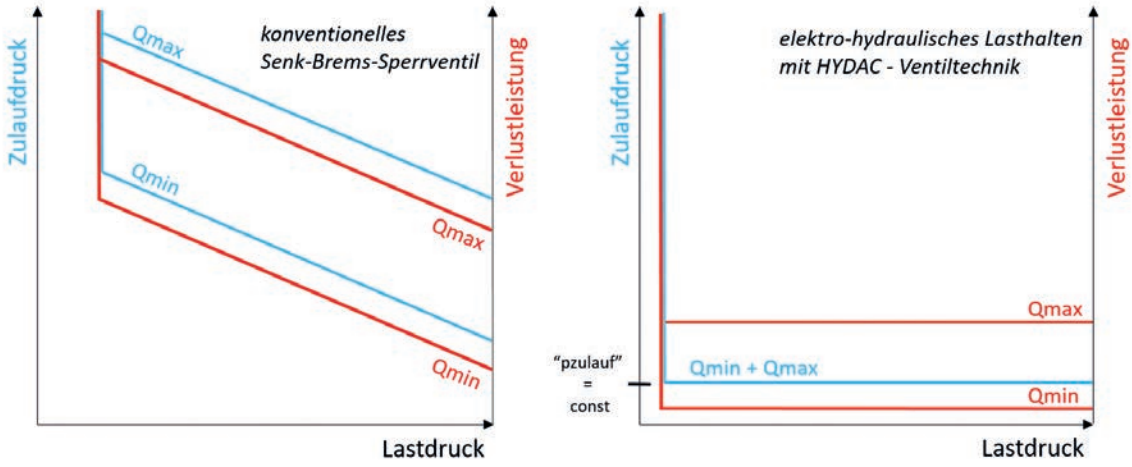
Figure 02 clearly displays the energy saving potential of the electro-hydraulic load holding function in comparison to conventional solutions. If large volume flows are required with low leading loads, the power loss is greatest in conventional systems as the required control pressure is highest here. With electro-hydraulic load holding, on the other hand, the power loss can be kept at a low level by keeping the inlet pressure as low as possible.

This offers the greatest potential for energy savings in applications with heavily changing load conditions as the energy requirement is no longer dependent on the set pressure of a conventional counterbalance valve. To implement these types of systems efficiently, PWS valves are required. These work without

01 **Comparison of conventional vs. electro-hydraulic load holding**



02 **Inlet pressure in relation to load pressure**



compensation (e.g. via pressure compensators). In gravity lowering applications, these valves have already proven themselves with and without a pressure compensator.

BASIS FOR PRECISION AND DYNAMIC PERFORMANCE

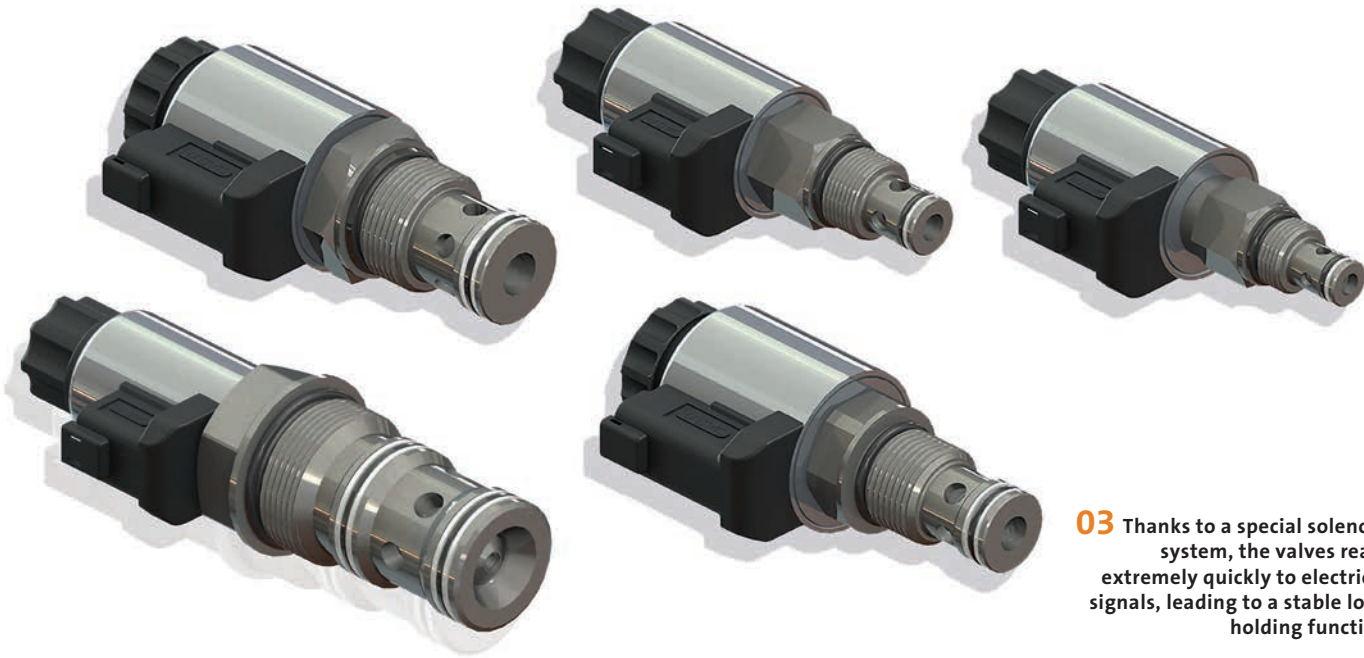
With the Hydac PWS range, these types of systems can easily be implemented and the conflict between energy efficiency and stability is reduced. With their precise controllability - even at high differential pressures - the valves offer the ideal prerequisite for implementing these types of control systems.

Hydac's own solenoid system acts as a basis for precision and dynamic performance. An effective fine control geometry and therefore precision is made possible by a large solenoid stroke. A high solenoid force which enables a valve design with large pilot cross-sections also leads to highly dynamic valves. For this reason, Hydac valves react extremely quickly to electrical signals and lead to a stable load holding function.

The Hydac product range includes a large variety of valves with various nominal sizes and characteristics and is therefore ideally suited to a large number of applications. Critical applications can also be realised in an energy-efficient manner by using Hydac PWS valves in electro-hydraulic control loops for load holding.

Images: *Hydac*

www.hydac.com



03 **Thanks to a special solenoid system, the valves react extremely quickly to electrical signals, leading to a stable load holding function**