

Technical article

# Construction Machines: Increased Availability and Energy Efficiency Thanks to Innovative Safety Valves

## Bucher Hydraulics offers a wide range of products with high functionality

The construction-machine industry is one of the most important user areas for Bucher Hydraulics safety valves. The company provides highly competitive components for the safety of earth-moving and construction plant. Based on decades of experience in the design, development and manufacture of safety valves, and on the company's special innovative spirit and close cooperation with its customers, Bucher Hydraulics offers an extensive product portfolio with advanced and forward-looking solutions. The spectrum ranges from application-proven standard safety valves up to the safety valve that features the additional built-in benefit of energy regeneration.

High levels of safety and functionality coupled with compact design are some of the most important requirements in mobile applications. Whether mobile crane or excavator, safety valves are a major factor in global competitiveness, where the focus is on high-performance machines with high levels of availability. With its extensive range of safety valves, Bucher Hydraulics is not only handling the differing requirements in mobile applications in a systematic manner, but is also optimising the overall system in partnership with the user. Customer support extends from joint project development via implementation and customisation of the safety valves right through to commissioning. In connection with more stringent exhaust-emission regulations, for example, this led to the strategy of integrating energy regeneration into the safety valves.



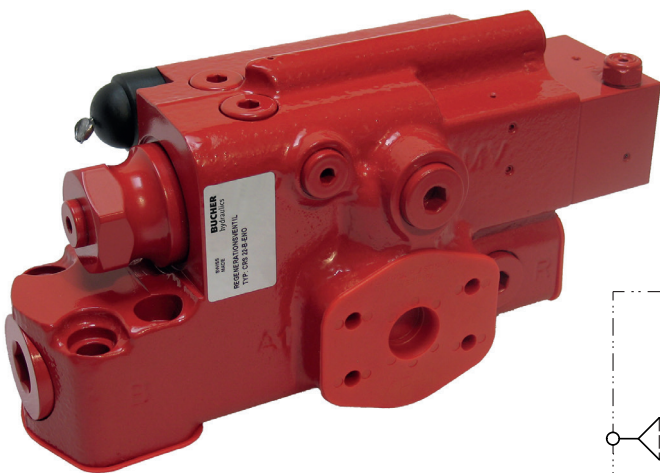
Safety across the board: With safety valves from Bucher Hydraulics, even extreme loads can be moved safely but also with delicate, finger-tip control.

## Energy savings included

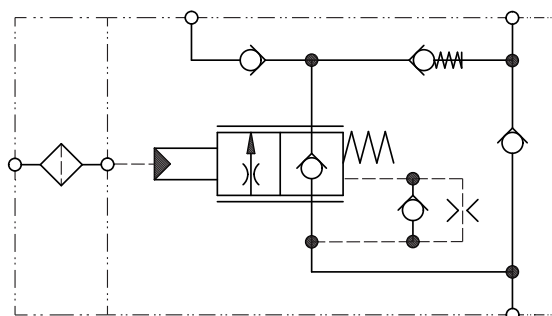
The CINDY-REG series is the result of this development work. „REG“ stands for regeneration. The valve systematically focusses on energy efficiency in the safety circuit and delivers energy savings of up to 25 percent. In its application, the functionality of the valve extends far beyond that of the conventional excavator pipe-rupture valve. The valve controls the load over the entire speed range.

In addition, the innovative solution differs from previous designs in that no additional energy source is required to retract the cylinder. Instead of a conventional counterbalance valve or excavator pipe-rupture function to control the lowering operation on mobile vehicles, a counterbalance valve with additional functionality is now used. Its intelligent regeneration concept allows the direct infeed of part of the oil flow into the opposite side of the cylinder. When this volume is filled, the surplus oil flow is routed to tank with no significant back-pressure. The system thus significantly reduces the demand for pump flow, which – depending on the system – can then be available for other functions.

It is also possible to incorporate a preload that can be used to stabilise the system in the event of oscillations. In addition to features such as a zero-leakage control assembly and a fast-acting, directly operated pressure relief function, the safety valve includes an integral balance valve for tandem applications. This advanced combination of safety functions and energy saving is finding ever-wider use in the material-handling field, in applications such as ship un-loading or long-reach excavators. Wherever shorter cycle times, greater energy efficiency, low maintenance and comprehensive safety are in demand, the CINDY-REG thus ensures a competitive total cost of ownership (TCO).



Innovatively combined: as an additional feature, the CINDY-REG safety valve from Bucher Hydraulics offers energy recovery directly at the cylinder, which saves up to 25 percent of the energy.



**All-inclusive concept**

This technically sophisticated solution is based on decades of application and product know-how within Bucher Hydraulics. The company's product portfolio includes five different types of safety valves and ensures machine safety from start to finish:

- basic pipe-rupture valves
- excavator pipe-rupture valves
- leak-free load-control valves (CINDY)
- spring-loaded counterbalance valves
- travel brake valves

All Bucher Hydraulics safety valves are suitable for installation in safety systems that conform to the DIN EN ISO 13849-2 standard. Bucher Hydraulics supports users in all aspects of machine safety, whether industrial or mobile applications. The hydraulic specialist places particular emphasis on first-rate stability, responsiveness, absence of leakage and the economical use of energy.

Basic pipe-rupture valves close automatically when their set flow rating is exceeded. Excavator pipe-rupture valves are used when manufacturers have to comply with the requirements of ISO 8643 and EN 474 for excavators equipped with a lifting device. For example, as soon as a load hook is attached to the bucket, then the boom, arm and adjusting cylinders must be safeguarded against a possible pipe burst so that, in the event of an actual pipe burst, uncontrolled lowering or excessive acceleration of the load will be prevented. In addition, the valve holds the actuator in its position when the main valve is centred.

Users can fit this pipe-rupture valve to excavators without having to make any changes to the basic hydraulic system, which may or may not include a material-handling function, because the behaviour of the machine remains the same in both cases. Even the operator will not notice any difference resulting from the use of the safety valve. This is made possible by the virtually load-independent, two-stage follower principle that features permanently low opening pressures, and which even under different loads retains its fine controllability right up to the maximum pressure. At the same time, in closed loop systems the pilot system has a beneficial effect on energy consumption.

### From excavators into crane winches

In addition to its metallic hardened seats, the sophisticated system used in the excavator pipe-rupture valves has a number of other impressive technical advantages. Firstly, the absence of dynamic seals in the main control axis has a positive effect that is seen in the low hysteresis and stable, unchanging settings. Secondly, the load pressure, which acts in the closing direction, ensures that the valve closes completely, even with a broken spring. Excavator pipe-rupture valves from Bucher Hydraulics thus make a significant contribution to increasing safety, a claim that has also been confirmed in tests. The standards stipulate that, for an initial speed of 200 millimetres per second, the speed of the load on the hook must not increase to more than double that level when a pipe rupture occurs. During customer acceptance procedures, however, the Bucher specialists test at 300, sometimes 400, millimetres per second and verify that even then the lowering speed remains within the controlled range.

Leak-free load-control valves are yet another type of safety valve. These combine the load-holding and pipe-rupture functions. They prevent hydraulic actuators from running ahead of the available oil supply and can be used in the high-pressure range up to 420 bar rated pressure with a safety factor of at least 3. Thanks to the particular design of the main control axis, the load-control valves offer extremely low leakage rates.

Again, the load pressure acts in the closing direction, and safe operation is ensured over the whole pressure and flow range. In keeping with the trend toward higher flow rates, these safety valves are available in larger sizes with flow ratings up to 1,000 litres per minute. The well-known principle of the Bucher Hydraulics leak-free load-control valves is particularly suitable for this purpose. To mention just one of the advantages, the function is independent of flow forces.

As a result of many years of intensive cooperation with customers, Bucher Hydraulics engineers have developed additional application-oriented solutions from the original principle. They integrated the load-control valve into the crane winch, which – as one of the main functions – is situated in the superstructure and requires the highest levels of safety. The load-control valves, used in winches with hydraulic motors, score highly here thanks to their very reliable closing. In addition, the high opening ratio of the Bucher Hydraulics load-control valves makes it possible to use very low motor inlet pressures under all load conditions. This is consistent with the pronounced trend towards increased energy efficiency.

For applications with lower flow rates, the spring-loaded counterbalance valves come to mind. They are available with various opening ratios as a cost-effective option. Thanks to their special design with a damped actuating piston, these counterbalance valves from Bucher Hydraulics offer first-class stability and good controllability.

Even in hydraulic travel-drives we find Bucher Hydraulics safety valves being used. The travel brake valves prevent the drive motors from over-running when travelling downhill and enable controlled braking. This prevents cavitation and critical travel situations. With all these safety aspects, however, ride comfort must still be safeguarded. To ensure this, we need a well thought-out balance between damping and fast valve response.

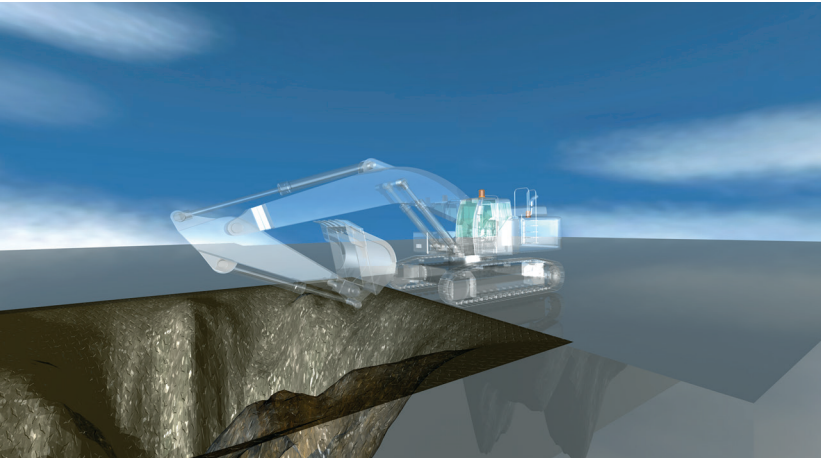
Depending on the application and installation space, the safety valves can be supplied as plate-type, cartridge and SAE flange designs as well as in line-mounting configurations. To meet the often harsh environmental conditions, from now on the valve surfaces will be coated with a high quality zinc-nickel finish.



**Inspected and tested for reliability**

To control large loads delicately and position them with millimetre accuracy calls for a high degree of reliability in every respect. Consequently, no safety valve leaves the factory without testing. Hydraulic testing is carried out before shipment, and the valve characteristics are saved, so that valves cannot be released until the tests have been passed successfully. Furthermore, the development phase includes both pulsation testing in endurance trials as well as burst tests. The objective here is to put into effect the company's own high standards – standards to which Bucher Hydraulics has totally committed itself.

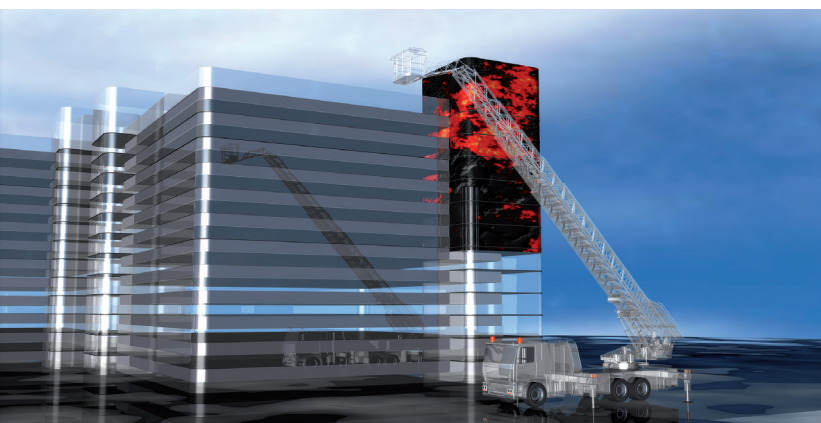
To support this ongoing development of the safety valves and expansion of the product portfolio, Bucher Hydraulics uses its extensive expertise, identifies pioneering technologies and attaches great importance to achieving high safety standards, which are a 'must' in many applications. In this way, users can select particular safety valves to suit their various requirements. The sophisticated technology creates competitive advantages through increased efficiency, based on increased machine availability and energy savings.



Application excavator



Application material handler



Application fire fighter truck

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