Oswald Mutter, Head of Engineering and Product Management Wandfluh Hydraulics + Electronics

INNOVATIVE SOLUTIONS FOR TILTROTATORS

Wandfluh components and subsystems make a decisive contribution to increasing the functionality and reliability of tiltrotators.

A swivelling rotary drive, also known as a tiltrotator, ensures extremely flexible use of buckets, tongs, and other attachments on excavators. The tiltrotator is mounted between the end of the excavator's articulated main arm and the selected implement and gives the excavator extended, wrist-like capabilities, such as multiple 360° rotation and swivelling by around 45 %.

This allows for safe human operation and offers huge productivity benefits. The boom becomes an extension of the operator's arm. When working, the tiltrotator uses a quick coupler mounted on the underside that simply picks up the implement, such as the bucket, and automatically locks it in place, improving safety.

The added manoeuvrability of a tiltrotator attachment makes it much more efficient to work on slopes at right angles, for example, or to use a grapple to transport and sort logs in the correct position. The tiltrotator is mechanically attached to the main arm of the excavator and connected to the excavator's existing hydraulic system. A hydraulic block integrated into the tiltrotator attachment controls the hydraulic tiltrotator functions.

Depending on the tiltrotator manufacturer and the specific equipment requirements, the hydraulic control blocks are equipped with screw-in cartridges and NG4 or NG6 Cetop valves in on-off or proportional function. However, proportional LS directional control valves in a load-compensated design are also being used more frequently. In close collaboration with various manufacturers, Wandfluh has equipped an exceptionally high number of tiltrotators with a wide variety of valves, which have proven their value in challenging applications.

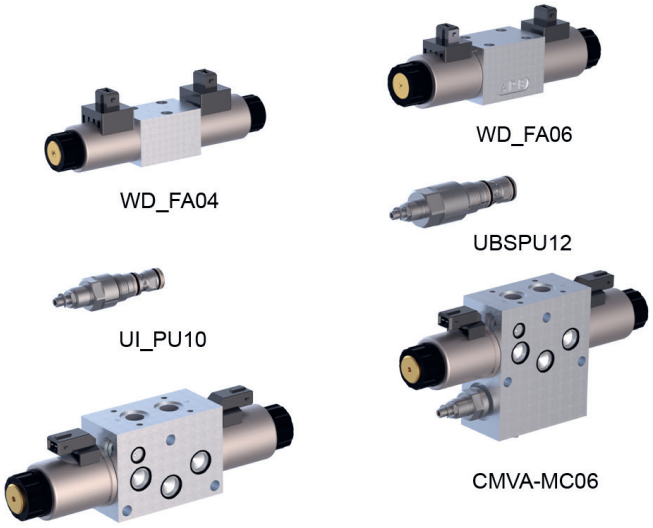
At the component level, we offer a range of solutions that include space-saving NG4 Cetop directional control valves, flow-optimised NG6 Cetop on-off valves, and NG6 prop valves with application-specific meter-in and meter-out functions. Our product line also comprises screw-in valves, which can be used as stable inline and bypass pressure compensators. In addition, we provide solenoid poppet valves, as well as pressure valves in diverse designs. The component programme is rounded off by the LS-capable CMV(A)-06 series in load or flow-compensated design.

The simple rotary and swivelling concepts are based on on-off valves, with the focus being on fast 360° rotation. Such on-off concepts can result in movements that are too jerky for certain applications, which is why the on-off valves can be replaced by electric proportional valves in these cases.

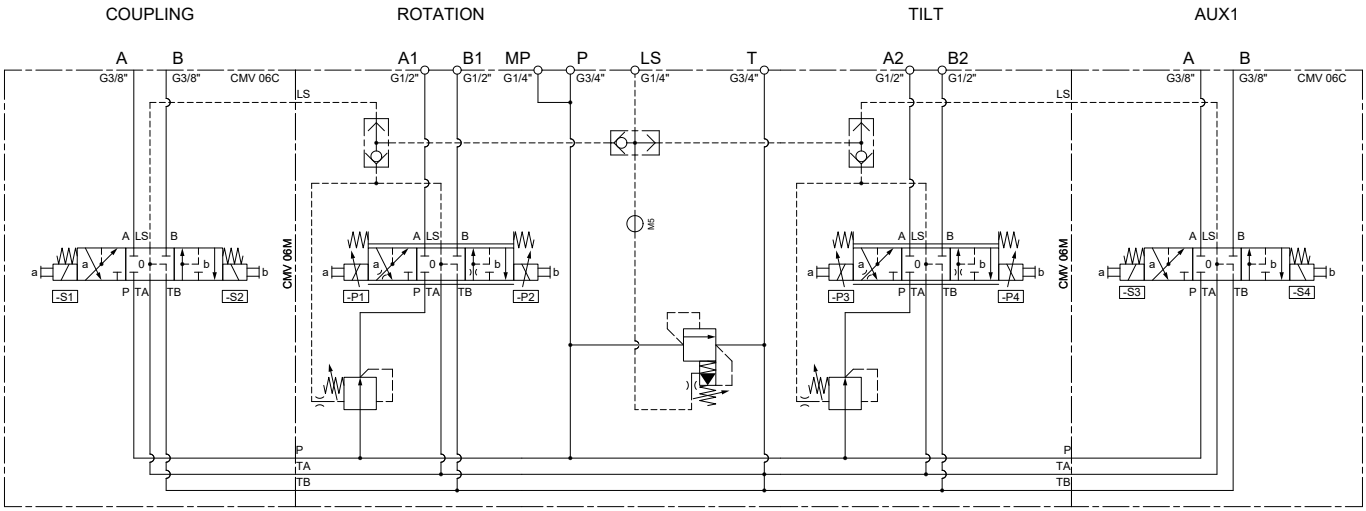
There is potential for improvement in the interplay between the rotary and swivelling function when using load-compensated proportional technology. Like any fluid, the hydraulic medium also seeks the path of least resistance. This means that if the load on the swivelling and rotary drives differs, the driver that must cope with the higher load stops. Instead, the hydraulic medium takes the path to the drive with the lower load.

This is the case when a log is picked up at one end and then both rotated and swivelled. Since a high torque is required to lift the overhanging lateral load, but less force is required to rotate it, the end of the log remains down.

Performing both movements simultaneously and smoothly is possible with Wandfluh solutions based on the innovative CMV(A)-06 programme, which allows both a sectional and a monoblock design. To ensure the independent operation of the controlled rotary and swivelling drives, individual pressure compensators are provided for both functions. The two pressure compensators connected in line distribute the volume flow as required and independently of the load. This implies that both the rotary and swivelling drives can be operated simultaneously, sensitively, and safely from zero to maximum speed.



Examples of our components for tiltrotators



Typical hydraulic circuit diagram of a modern tiltrotator

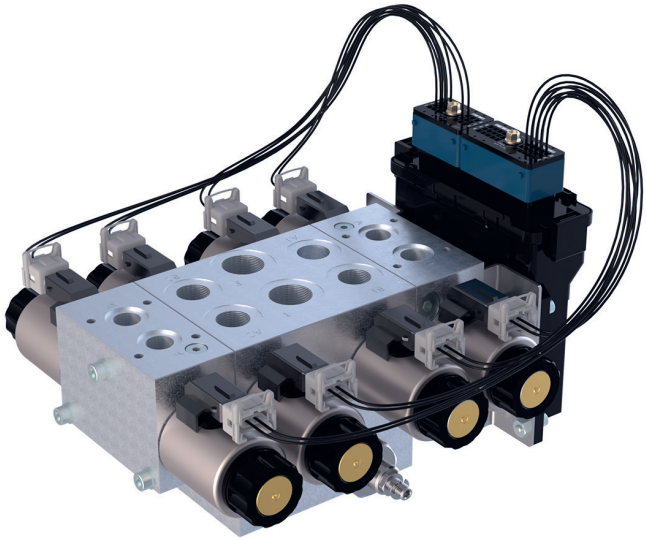
The operating pressure can be set to the maximum pressure via the pressure relief valve; the pressure will only rise to the required load pressure plus the control pressure differential thanks to the built-in load signalling line. When idling, i.e. when no function is called up, the oil circulation is depressurised, which of course also helps to further improve energy efficiency.

Due to the restricted space available for the installation of the hydraulic control block in conventional tiltrotators, the requirements for the solution design are very demanding. The design advantages in terms of flexibility of the Wandfluh CMV(A)-06 LS programme come into effect here. Sectional elements conforming to standard designs, combinations of individual monoblocks incorporating standard sections, as well as customised monoblocks are available for solution design. At the same time, we can even equip the solutions with integrated CAN bus capable electronics, resulting in plug & play solutions for the electronics as well.

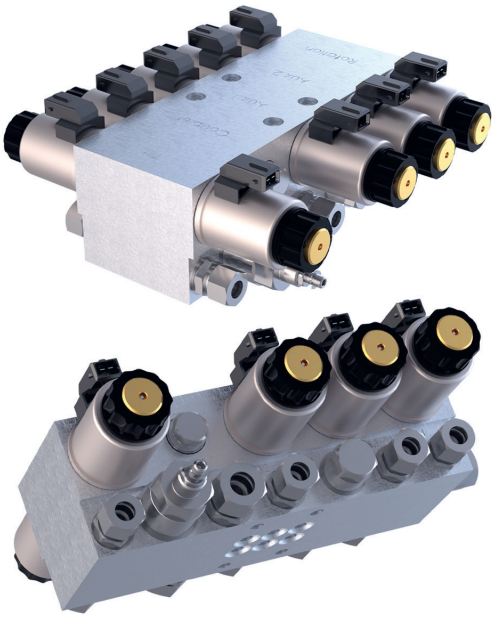
The control blocks are made of aluminium, which makes them exceptionally light. Steel blocks are also available on request. The maximum working pressure in aluminium is 250 bar. The supply flow that can be discharged via the bypass pressure compensator is approx. 120 l/min. The individual 6/3 LS valve can manage a flow rate of up to approx. 60 l/min. The operating temperature may be between -25 and +70 °C. The operating voltage of the solenoid valves is designed for 12 or 24 VDC power supply.

For the sensitive control of large tiltrotators, higher volume flows are required to enable the rotation at high speed with small loads. For this purpose, Wandfluh offers a pilot-controlled option called PMV (Proportional Mobile Valve). The volume flow of the PMV main spool is regulated proportionally to the desired amount by means of small, space-saving and energy-efficient pressure control valves. The maximum flow rate for size NG16 is a high 180LPM per section. The PMV variant also uses an individual pressure compensator for load-independent operation. The modular elements enable an optimal system design in terms of low pressure drop and high individual flow rates with optimised space utilisation.

The following plug connections are available for the electrical connection of the solenoid coils: DIN EN 175301-803, Deutsch DT04-2P and Junior Timer plug (axial or radial arrangement). The size and position of the threaded connections and the mounting options are highly customisable. They can also be combined with flange options on existing rotary feedthroughs.



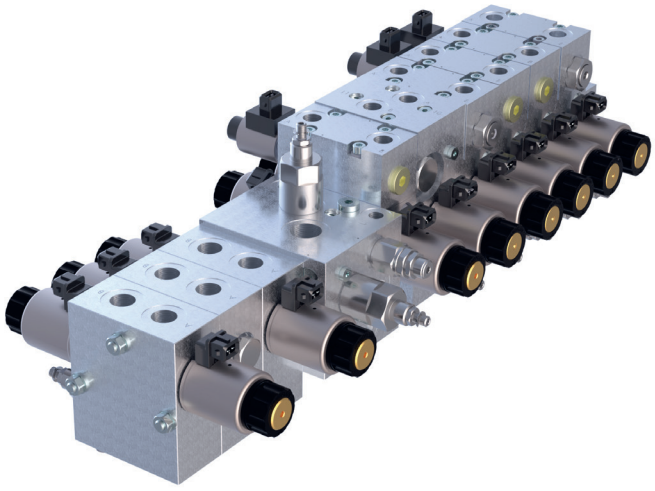
Tiltrotator solution consisting of the hydraulic control block with CAN bus capable electronics, based on a CMVA monoblock, complemented with two sectional CMVA-06 LS modules and our MD2 CAN controller.



Customised tiltrotator solution consisting of a CMVA monoblock, flanged onto an existing rotary union.

To turn the excavator boom into an extension of the operator's arm, the operator has joysticks in the cab with which he can select the functions to be operated and control the movements very sensitively and continuously. This enables both quick rough positioning and readjustment at close range. This saves time and shortens the familiarisation phase for the operator. Proportional control of the valves is performed either by the internal or external electronics, operated via conventional joystick controls.

Wandfluh offers both small, robust proportional amplifiers that can control a pressure valve or a directional control valve in a functionally optimized manner. Alternatively, Wandfluh also offers mobile controllers that can control several valves proportionally. The integrated solenoid current control of the Wandfluh electronics minimises the influence of temperature on the solenoids. The adjustable dither function prevents a stick-slick effect, thus optimising the response behaviour and hysteresis of the valve. As described, the command value for the electronics comes from the joystick, but also from a higher-level controller via a standardised CANopen protocol. This interface provides integrated monitoring and diagnostic functions in addition to pure control.



Customised CMVA-06 solution for a road paver

Based on the extensive functionalities of the PMV, the CMV(A)-06, the existing portfolio of NG4 and NG6 on-off and proportional valves and the comprehensive range of screw-in valves, the hydraulics and electronics experts at Wandfluh have the expertise and willingness to respond to the highly individual requirements and wishes of tiltrotator manufacturers. Together, they develop clever, innovative solutions that make hydraulic equipment highly individual. They also optimise weight and space and increase energy efficiency and functionality. All this is based on proven Wandfluh-specific reliability and quality.

Since 1946, Wandfluh Hydraulics + Electronics AG, has been characterised by innovative thinking and passion. Today we are the leading supplier of electro-hydraulic valve and system solutions in the electro-hydraulics sector. As a global family business, now in its third generation, we inspire our customers worldwide with high-quality products. By focusing on specific application requirements and electro-hydraulic functions, we develop new innovative solutions - from standard components to custom components and customised systems - that make a significant contribution to our customers' market success.

In addition to innovative solutions for tiltrotators, we have the application knowledge and product portfolio to work in close partnership with our customers to develop tailor-made, user-friendly and future-proof solutions for other specific applications such as road pavers, road rollers, aerial platforms, mobile cranes, and excavators.