

THE LAST DETAIL

ONLY THE MOST RELIABLE COMPONENTS WILL DO FOR LIEBHERR'S WHEELED LOADERS – THAT'S WHY EACH AND EVERY GEAR PUMP AND MOTOR THEY USE GOES THROUGH AN EXHAUSTIVE TESTING AND RUNNING-IN PROCEDURE BEFORE BEING ACCEPTED

Over the years, Marzocchi Pompe has expanded, increasing its product range to reach its current position as one of the leading Italian manufacturers of external gear pumps and motors. As a result of the trust and the respect gained over a long period of time, the company is widely considered a very reliable partner, one that provides customers with specific know-how, high-quality products, and excellent service for all hydraulic applications.

Marzocchi has recently developed an application in collaboration with Liebherr Group. Today Liebherr is not only one of the world's leading construction machinery OEMs, but is also an acknowledged supplier of technically innovative user-oriented products and services in numerous other fields. Employing approximately 33,000 staff in more than 120 facilities on all continents, the company produces an extensive range of hydraulic excavators, hydraulic rope excavators, crawler tractors and loaders, wheeled loaders and dumper trucks for the earthmoving machinery sector. The high quality requirements with which Liebherr products have to comply are ensured by in-house production of major sub-assemblies in much of the programme.



Distinguished features

As a result of their high efficiency and reliability, Marzocchi gear pumps and motors are used in the construction of Liebherr wheeled loaders. The smaller models (L 506 - L 514, the so-called stereoloaders), distinguish themselves by virtue of their manoeuvrability, compact design and smooth travel characteristics, enabled by oscillating frame articulation and the oscillating rear axle, as well as centre-pivot and rear-wheel steering.

The main benefits of the larger wheeled loaders lie in their cost effectiveness and environmental friendliness – under the same operating conditions they consume up to 25% less fuel than comparable machines from other manufacturers.

Liebherr is able to offer a wide selection of wheeled loaders which, due to the many versatile equipment options available, are able to be tailored specifically to any particular operating conditions. A grand total of 17 models with standard bucket contents of 0.8-5.5m³ are particularly impressive in their individual size classes, predominantly as a result of their very high standards of economy, reliability, performance capacity, and ease and convenience of operation.



The running-in department of the Marzocchi Pompe factory

The L 506 - L 514 stereoloaders feature standard bucket contents of between 0.8-1.5m³. These models feature excellent manoeuvrability, in combination with exceptionally high levels of stability and security against tip-overs.

In a departure from conventional centre-pivot wheeled loader design, the maximum articulation angle is only 30°. By offering a perceptible increase in security against tip-overs, it allows heavier loads to be carried with a comparatively low operational weight. The reduction in the articulation angle is achieved due to the stereo steering system, a combination of pivot steering and steered rear axle.

As well as the security against tipping, this also considerably increases the wheeled loader's manoeuvrability. The turning



circles of the stereo loaders is 20% smaller than that of comparable models in this size class – a particular advantage in confined spaces and a guarantee of even greater efficiency in operation. Another benefit of these stereoloaders is the combination of oscillating rear axle and oscillating centre pivot.

Liebherr's all-round class of wheeled loaders (L 524 - L 542) consists of four units, with a standard bucket content capacity of between 2.0-2.7m³. The large unit range includes six machines, from the L 550 (3.2m³) up to the L 586 (5.5m³), which is still the world's largest hydrostatically driven wheeled loader. The vehicles in these size classes are particularly impressive in terms of their economy of operation.

As a result of the hydrostatic drive concept, the drive components can be installed with a much greater degree of freedom in the unit. Liebherr uses the components' own weight as a natural counterweight in the rear, which means that additional ballast can be done away with. This provides greater degrees of efficiency with low operating weight – and that, in turn, means potential fuel consumption reductions of up to 25%.

Service brakes are practically free of any wear due to the hydraulic braking

effect of the drive. The stepless traction force regulation also means that tyre wear can be reduced by up to 25%.

For industrial operations, the all-round wheeled loader models can be optionally equipped with a parallel lifting frame, and the large (L 550 - L 556) units with the newly developed industrial lift arms. Both varieties of lifting gear provide particularly high retention forces in the upper lifting range, which is ideal for large and heavy equipment units such as wood grapples or high tipping and light materials buckets. The parallel guide system is also extremely well-suited for the use of load forks.

To ensure safe and rapid changes between the different equipment units, these two lifting gear variants are also fitted as standard with a quick-coupling device. The Marzocchi GHP3AD-66-S1 gear pumps form part of the main hydraulic circuit of the wheeled loaders; the ALM2BK1-D-12 gear motor, with electroproportional valve and gauge port, is used in the cooling system of the vehicles. Gear pumps and motors are volumetric machines widely used in hydraulic system design, and feature a simple construction in a compact size; they are reliable, and offer an excellent cost/performance quality ratio.

Expanding product range

The ALM2BK1-D-12 gear motor and GHP3AD-66-S1 gear pump are from two new lines with which Marzocchi Pompe has recently extended its product range. The first, called ALP and ALM, includes pumps and motors with aluminium flanges and covers, and is the natural evolution of the previous production range; the second, called GHP and GHM, is a new line of products with cast iron flanges and covers, and is dedicated to high-pressure applications and to the mobile market.

Within the company, this change has involved the whole production cycle. The project design department, with its 40 years' experience in this sector, has completely revised the design of the products and their production process. The R&D department has applied the latest virtual simulation techniques, which, together with new tools for the experimental mechanics, have produced specific product optimisation aimed at satisfying the current market demands for top efficiency, reliability and reduced noise levels.

Great efforts have been made on research into the internal mechanical and hydraulic conditions of the pumps and motors. For this purpose, the R&D



Liebherr application of Marzocchi GHP3AD-66-S1 gear pump



Liebherr application of Marzocchi ALM2BK1-D-12 gear motor with electroproportional valve and gauge port

department has been equipped with new experimental test benches for analysis of the mechanical, hydraulic, acoustic and vibration performance; as well as durability test benches that are able to simulate the toughest working conditions. These innovations were transferred to the production department using a widescale renewal of the run-in and test benches.

Range specifications

The current Marzocchi production range varies between 0.19-200.3cc/rev (0.0104-12.223in³/rev), and is divided into eight groups according to gear size. A wide range of flange, shaft and coupling configurations is available; these components can also be manufactured according to the customer's specifications. The cast iron versions exist in groups 1, 2 and 3. Maximum operating pressure depends on pump displacement and type: it varies on average between 230 bar (3,300psi) on aluminium models and 280 bar (4,100psi) for cast iron versions.

All products can also be supplied with Viton seals, while special versions are also available for temperatures between -40° to +120°C (-40° to +248°F). Mono-directional and bi-directional motors are divided into three families (1,2,3), and cover a range of displacements between 2.8-87cc/rev (0.17-53.1in³/rev). The maximum working pressures for these motors are similar to those established for the pumps, and they can deliver torque up to 250Nm and power up to 60kW.

The quality of each component is only the starting point, however – as the final stage of the manufacturing process, the run-in is one of the most important operations as it checks the optimisation of product efficiencies. During run-in tests, increasingly higher pressure levels are created; the gears, inflected by the hydraulic load, act as tools machining

the pump body, thereby creating the best-possible tolerances among the parts.

This crucial process is performed under computer control; with the definition of the gradual increase of the pressure being of particular importance because it establishes the machining speed of the material by the gears and therefore the particle dimensions. These particles must be small enough not to interfere with the running of the product.

Each motor from each group has a personalised pressure ramp to ensure that no contaminating material remains in the circuit and that the pump is able to attain maximum performance levels immediately. Reversible motors and pumps are subject to the run-in procedure on both rotations.

After this process, product efficiencies are measured at fixed parameters. Test data is automatically acquired and recorded in order to have updated statistics on product performances; this data can be supplied on customer request. As far as motors are concerned, after the run-in, a further specific test is carried out on a dedicated test bench, where the relative operating conditions must be reproduced: under braking, when the energy of the fluid is transferred to the shaft to overcome the resisting torque; and under counter pressure, when the fluid passes through the motor with the shaft free to turn without load.

Under braking conditions, the stress distribution is similar to that which exists on the pumps: if maximum pressure exists at the inlet, and there is discharge pressure at the outlet, then compensation seals and rotating parts are subjected to the maximum stress according to resisting torque.

Under counter pressure, both inlet and outlet are subject to the same conditions: at maximum pressure the stress on the rotating parts is zero, while the flanges, body and external seals are subjected to

the maximum stress. A typical motor's working conditions will fall somewhere between these two situations: part of the energy is transferred to the shaft and part is used, for example, by another motor connected in series.

The final step

On the Marzocchi motor test bench, the final control is divided into three phases. Firstly, the braking phase: at an established rotation speed, a resisting torque is applied to the motor shaft, which creates a variation in the fluid's inlet speed and pressure, then the test-bench control system stabilises the motor in fixed conditions in which running parameters are acquired, such as draining flow rate and volumetric and mechanical performances.

Then there is the counter-pressure phase: here, a fixed amount of oil passes through the motor without any resisting torque applied to the shaft; the outlet line is kept closed and therefore a bilateral pressure is established. The drain flow rate is measured at these conditions.

And finally, there is the start-up phase: without any resisting torque applied on the shaft, the start-up torque is determined by measuring the minimum inlet pressure at which the motor starts running.

In the case of bi-directional motors, these three phases are performed for both rotations. Only after successful completion of this test is the motor delivered to the customer – perfectly run-in and boasting extreme reliability that makes it suitable for use even in extreme conditions. **IVT**

Ing. Danilo Persici leads FEA and CFD analysis in Marzocchi's R&D department in co-operation with Bologna University



CONTACT

www.marzochigroup.com
pompel@marzochigroup.com