

TEAM EFFORT

FOLLOWING EXTENSIVE TESTING, LIEBHERR INDUSTRIES HAS FOUND ITS PARTNERSHIP WITH A MANUFACTURER OF PUMPS HAS ENABLED IT TO MEET ALL ITS REQUIREMENTS FOR PERFORMANCE AND PRODUCTIVITY

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. Thanks to the trust and the respect gained over a long period of time, Marzocchi Pompe is considered a very reliable partner on the market, able to provide 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 manufacturers of construction machinery, but is also an acknowledged supplier of technically innovative user-oriented products and services in numerous other fields. With approximately 33,000 employees in more than 120 companies on all continents, Liebherr produces an extensive range of hydraulic excavators, hydraulic rope excavators, crawler tractors and loaders, wheel 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.

Distinguishing features

Marzocchi gear pumps and motors, thanks to their efficiency and reliability, are used in the production of Liebherr wheeled loaders. The smaller wheel loader models L 506 – L 514, the so-called stereoloaders, distinguish themselves with their manoeuvrability, compact design and smooth travel characteristics, as well as centre-pivot and rear-wheel steering, and oscillating frame articulation and oscillating rear axle.

The main features of the larger wheel loaders are cost effectiveness and environmental friendliness. They consume up to 25% less fuel than comparable machines from other manufacturers under the same operating conditions.

Liebherr is able to offer a wide selection of units which, thanks to the many versatile equipment options available, can be tailored specifically to any particular operational conditions. A



FIGURE 3: Marzocchi Pompe factory, the running-in department

total of 17 wheel loader types with standard bucket contents of 0.8 – 5.5m³ are particularly impressive in their individual size class thanks to their extremely high standards of economy, reliability, performance capacity, ease and convenience of operation.

The L 506 – L 514 range of stereo loaders feature standard bucket contents of between 0.8 and 1.5m³. These stereo loaders feature excellent manoeuvrability combined with exceptionally high levels of stability and security against tipping.

In a departure from conventional centre pivot wheel loader design, the maximum articulation angle is only 30°. This offers a perceptible increase in security against tipping, and allows

heavier loads with comparatively low operational weight to be carried. The reduction in the articulation angle is achieved thanks 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 manoeuvrability of the wheel loader. 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 more efficiency in operation.

Another feature of these stereo loaders is the combination of oscillating rear axle and oscillating centre pivot. The all-round class of wheeled loaders (L 524 – L 542) consists of four units, with standard bucket content capacity of between 2.0 and 2.7m³. The large unit range includes six machines, from the L 550 (3.2m³) to the L 586 (5.5m³), which is still the largest hydrostatically driven wheel loader in the world. The wheel loaders in these size classes are particularly impressive in their economy of operation.

Thanks to the hydrostatic drive concept, the drive components can be installed at will 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 means greater degrees of efficiency with low operating weight, and that, in turn, means fuel consumption reductions of up to 25%.

Service brakes are practically free of any wear thanks to the hydraulic braking effect of the drive. The stepless traction force regulation also means that tyre wear is reduced by up to 25%. For industrial operations, the all-round wheel loaders 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 lifting gear varieties provide particularly high retention forces in the upper lifting range, 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 change 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 are part of the main hydraulic circuit of the wheel loaders;

the ALM2BK1-D-12 gear motor, with electro proportional valve and gauge port, is used in the cooling system of the vehicle. Gear pumps and motors are volumetric machines widely used in hydraulic system design. They have simple construction, compact size; they are reliable, and offer an excellent cost/performance quality ratio.

Expanding product range

In recent years, Marzocchi Pompe has extended its product range with the creation of two new lines: 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, dedicated to the 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. R&D has applied the latest virtual simulation techniques, which, together with the new tools for the experimental



The Liebherr wheel loader family





FIGURE 1: Liebherr application of Marzocchi GHP3AD-66-S1 gear pump



FIGURE 2: Liebherr application of Marzocchi ALM2BK1-D-12 gear motor with electro proportional valve and gauge port

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 department has been equipped with new experimental test benches for mechanical, hydraulic, acoustic and vibration performance analysis; and durability test benches 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 and 200.3cm³/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 customer 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 and special versions are available for temperatures between -40°C and +120°C (-40°F/+248°F). Mono-directional and bi-directional motors are divided into three families (1,2,3) covering a range of displacements between 2.8 and 87cm³/rev (0.17/53.1in³/rev). The maximum working pressures for the 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 – the run-in is the final stage of the manufacturing process and it 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, thus creating the best-possible tolerances among the parts. This process is performed under computer control; the definition of the gradual increase of the pressure is particularly important because it establishes the machining speed of the material by the gears and thus 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 so that no contaminating material remains in the circuit and 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, another 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 discharge pressure exists at the outlet, compensation seals and rotating parts are subjected to the maximum stress according to resisting torque.

Under counter pressure, 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 are 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.

Final tests

On the Marzocchi motor test bench, the final control is divided in three phases. Firstly, the braking phase: at an established rotation speed, a resisting torque is applied to the motor shaft. The application of this torque creates a variation in the fluid's inlet speed and pressure; the test-bench control system stabilises the motor in fixed conditions in which running parameters are acquired, such as volumetric and mechanical performances and draining flow rate. Secondly, the counter-pressure phase: 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 thirdly, the start-up phase: without

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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, the three phases are performed for both rotations. After this test, the motor is delivered to the customer perfectly run-in, boasting extreme reliability that makes it suitable for use even in extreme conditions.

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