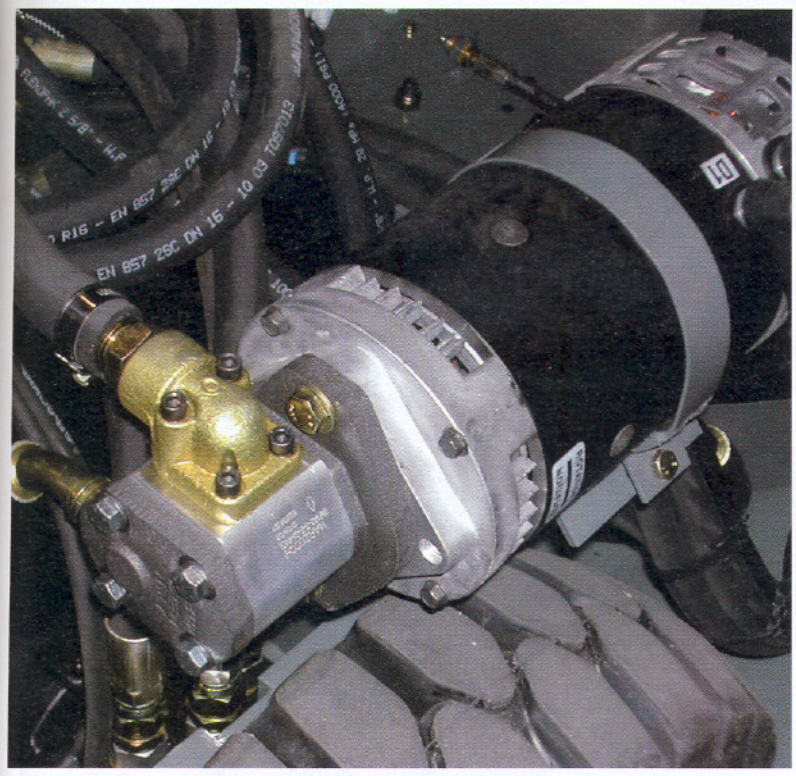
DANILO PERSICI

CO-OPERATIVE SOCIETY

Following extensive testing, JLG Industries has found that its partnership with a certain pump manufacturer has allowed it to meet all of its performance and productivity requirements



Power unit of JLG Industries' Toucan with GHP1A2 Marzocchi pump

Marzocchi Pompe was established in 1961 by Guglielmo and Stefano Marzocchi, in Casalecchio di Reno, on the outskirts of Bologna, Italy. Today the company is the head of an industrial group that employs more than 400 people. This group – owned and lead by Adriano and Paolo Marzocchi – operates in the fields of hydraulic pumps and motors, and suspension systems for motorbikes and mountain bikes.

Over the years, Marzocchi Pompe has expanded the company business and increased its product range to reach its present position as one of the most important Italian manufacturers of external gear pumps and motors.

As a result of the trust and respect accumulated over a long period of time, the company 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.

Classification

The current Marzocchi range varies between 0.19-200.3cm^3/rev (0.0104-12.223in^3/rev) and is divided into eight groups according to gear size (0.25, 0.5, 1P, 1, 2, 3, 3.5, 4). Within each group, the different displacements are obtained by changing the gear width. 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; special versions are available for temperatures between -40°C and +120°C (-40°F/+248°F).

Monodirectional and bi-directional motors are divided into three families (1,2,3) covering a range of displacements between 2.8 and 87cm^3/rev (0.17/53.1in^3/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 expertise gained over time allows Marzocchi to co-operate effectively with its customer in order to guarantee the best performance.

Application

The application presented here has been developed in co-operation with JLG Industries, one of the world's leading producers of access equipment (aerial work platforms and telehandlers) and highway-speed telescopic hydraulic excavators and several other machines. The company's diverse product portfolio encompasses leading brands such as JLG aerial work platforms and an array of complementary accessories that increase the versatility and efficiency of these products for end users.

JLG's Toucan aerial platforms offer durability, reliability, and the convenience of quick set-up and operation; they are easy to manoeuvre and available with working heights up to 13m and load capability up to 250kg. The very small width of those platforms, starting from 78cm, allows the platform to easily pass through a narrow access door.

Its products and services are marketed through a multichannel approach that includes a highly trained sales force and utilises a broad range of marketing techniques, integrated supply programs and a network of distributors in the industrial, commercial, institutional and construction markets.

JLG Industries is one of the first customers to use the Marzocchi Pompe GHP1A2 pump, which was supplied in two different displacements – 3.5cc and 5.2cc – for the Toucan range of aerial platforms.

Marzocchi pumps equip 80% of the Toucan range (Toucan 800, 861, 870, 1010, 1210, 1310). The pump is housed in the main hydraulic circuit and, together with the main 24V 4.8kW electrical motor, generates the hydraulic power required to operate the hydraulic motors and the cylinders. This unit gives the hydraulic power for drive motors that allows the Toucan to move, and the slewing motor that allows the platform to rotate while the main (mast) cylinder driven by the

JLG Industries' Toucan 1010

JLG Industries is a world leader in access equipment

The Toucan 800 – Marzocchi equips 80% of the Toucan range with its pumps

Marzocchi pump takes care of the extension of the platform. And finally, the jib cylinder looks after the orientation of the platform.

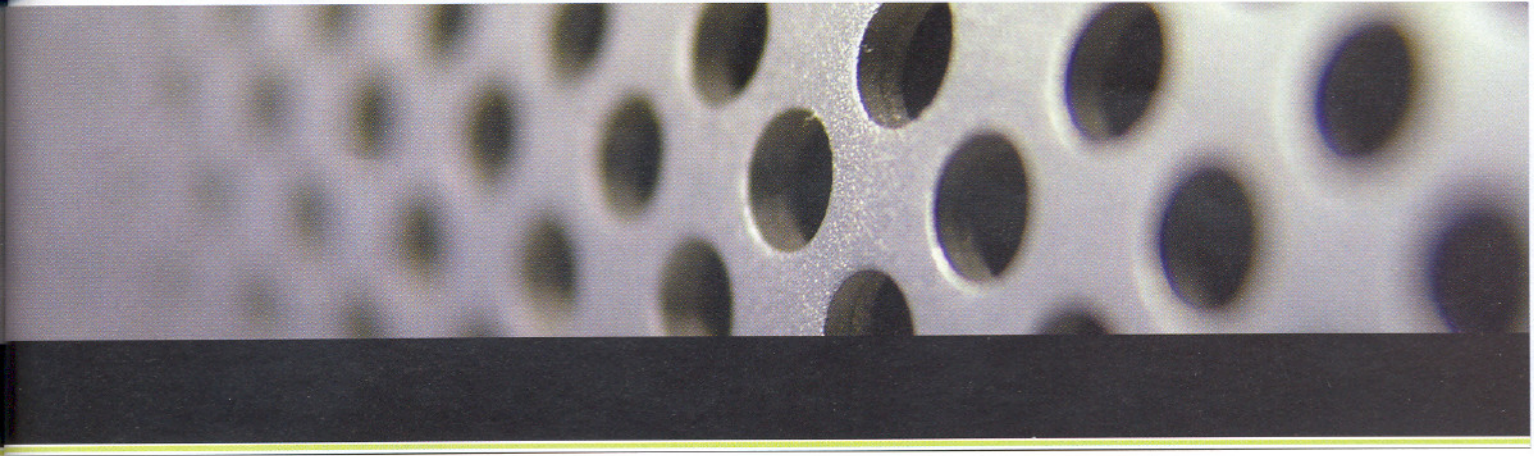
Most of the units are fitted with an electronic controller that enables the fine control of movement speeds via a joystick (drive) or a potentiometer (mast, jib, slew). In addition to this, the powerplus option on the Toucan 1210 includes a second power unit for even more improved drive speed and gradeability.

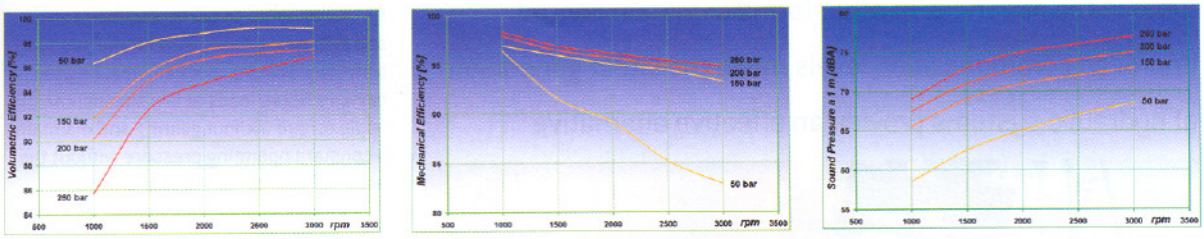
Pump type GHP1A2 with cast iron flange and body

The Marzocchi pumps were chosen as they offered the correct displacement to obtain optimum performances for the electrical motors used. Moreover, tests carried out by JLG also highlighted the good behaviour of Marzocchi pumps with low rotation speed and the optimal capability of holding the pressure very well. The GHP1A2 pump belongs to the group 1 family and is equipped with the connecting flange of group 2 and a cylindrical shaft with a generous key.

Another advantage, as proved in the JLG application, is that the available SAE splined shaft is able to transmit the very respectable torque of 145Nm. The GHP1A2 is therefore a very compact unit but is still very robust due to the spheroid cast iron flange and cover construction that allows the pump to easily handle peak pressure up to 290 bar and rotational velocity up to 6,000rpm while covering displacements from 1.4cc/rev up to 13.8cc/rev. This pump belongs to the new series of products expressly developed for the mobile market to give the end user the ability to comply with constrain requirements typical of mobile applications. The graphs show the GHP1A2 performances in terms of volumetric and mechanical efficiency.

The optimised design of the pump allows the user to have outstanding volumetric and mechanical efficiency in





Graphs show the volumetric efficiency (left), mechanical efficiency (centre) and noise level (right) of the GHP1A2AS7

most working conditions, with maximum values that reach 98%. Those high values of efficiency, increasing the battery life, allow the user to have improved autonomy and economy of the platform.

Another appreciable characteristic of the pump is the low noise emission which makes the platform suitable for use in situations where noise is a key issue or must be kept below a given level, such as commercial centres. The graph shows the level of noise emission from a pump as a result of the pressure and the velocity at 1m distance; it is clear that the noise emission stays just above 75dB(A) – even in the most stressed working conditions.

All the new pumps developed by Marzocchi are designed using state-of-the-art FEM and CFD numerical simulation software that give the flexibility – starting from the initial pump specifications – to have most of the design and verification work done on a 3D numerical model. This saves time by eliminating unnecessary testing, and means the best solution can be hammered out before a real prototype is actually produced.

This kind of approach reduces some costs and time typically associated with the development of new products, and gives the possibility of offering top-class solution at very competitive prices.

In addition to this, all the innovations for cost-effective assembly, testing and run-in are constantly improved in the R&D department, and the know-how is regularly transferred to the production line in terms of new processes, tools and test benches for a continuous improvement of the product's quality.

Run-in

After assembly, all Marzocchi gear pumps undergo run-in and testing on a dedicated test bench. The run-in is the last stage of the manufacturing process and it is one of the most important operations because it permits optimisation and checking of the 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 tolerances among the parts – a process 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 therefore the particle dimensions. These particles must be small enough not to interfere with the running of the product under testing and its future performance. Each pump in 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, the product's efficiencies are measured at fixed parameters.

The depth of the milling depends on many factors, including elastic and plastic deformation of the parts constituting the pump, and tolerances and dynamical effects. But most important factor for correct milling is the pressure that bends the gears, pushing them against the inner surface of the body and giving an increased depth in the centre of the milling.

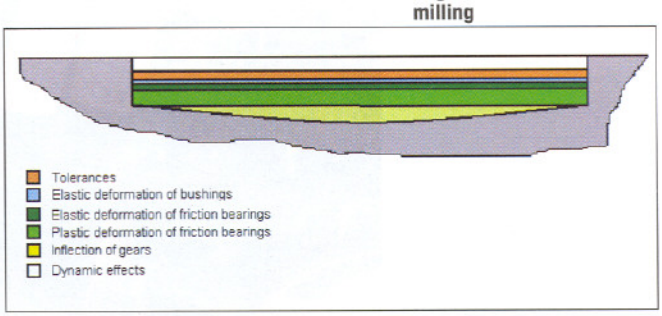
Given these considerations – and because of the huge importance of the pressure ramp, which mainly determines the milling velocity and therefore the results of a correct milling process – the run-in process is computer controlled.

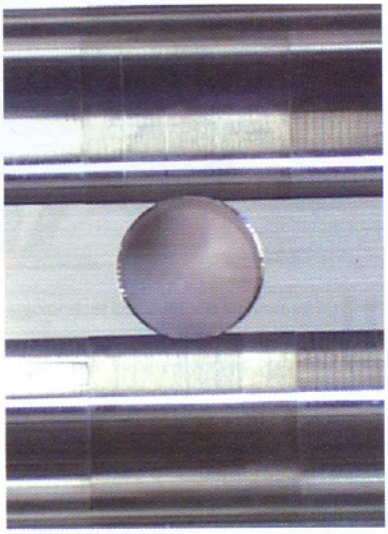
At the end of the run-in process the testing phase takes place and efficiencies, performances, flow, temperature, torque and absorbed power are measured. If the measured values do not comply with the limits of acceptance set in the testing machine, the pump is discarded and sent to maintenance for revision. Testing data is automatically acquired and recorded in order to have updated statistics on product performances; this data can be supplied on customer request.

Marzocchi is delighted and proud that JLG has chosen to use its pumps in the Toucan series. It is a recognition of the quality and effort that Marzocchi Pumps put in its everyday production. ***IVT***

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

BELOW: **Causes of generation of milling**





Inner surface of body pump with 'milling' of gears

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