

CONNECT FOUR

It takes a lot of skill, care and forward thinking to connect two or more pumps in parallel. But new connection systems for multiple modular pumps make it a pleasure



New series of micro-fuse joints



Marzocchi pumps has recently introduced, as a new series, a novel and highly robust connecting system for multiple modular pumps. This type of pump perfectly suits any application requiring several pumps to be connected in parallel to the single driving shaft of an endothermic engine or electrical motor. They may have multiple inlets or a common inlet for simpler and more cost-effective solutions.

In all models of the new series, with the exception of group 0.5, all the connections to the driving shaft and those between front, intermediate and rear modules use splined shaft ends. Unlike the traditional tang drive ends or Oldham connections, splined shaft ends exhibit higher robustness and, due to the higher number of working teeth, produce an extra 35% torque from the same size of shaft.

Furthermore, the careful design of the clearances in the connection enables a good compensation for the unavoidable misalignment that occurs between the shafts of different modules, while preserving the possibility of transmitting high torques and power.

State-of-the-art FE modelling software and numerical simulations have been

intensively used for the design, reducing the high costs and time-consuming demands common with prototyping.

An optimum solution was identified, maximising the ratio between the maximum transmittable torque and overall dimensions of the connection. The adopted design results in the whole connection working better, with the high number of teeth providing a much better spreading of the load and a uniform stress distribution over the whole connection.

The high number of teeth also helps to reduce wear, caused by the misalignments that result in a continuous sliding of the connection relative to the shaft. Because of the low torques, only the group 0.5 connections have tang drive ends.

The splined shaft ends are made from steel and obtained via a cold rolling process that plastically deforms the material, giving high resistance to fatigue and increasing the robustness by up to 90%. The inner splined profiles of the connection are also made from steel. The micro-fusion process from which they are obtained enables the production of complete, finished parts without any machining work being required

afterwards, with all the additional costs and time that entails.

Apart from the smaller sizes it makes possible, the micro-fusion technique avoids most of the common problems related to the machining process, where all the features required for a correct tooling may produce dangerous concentrations of stress that then become a source of cracks. Multiple pumps are provided with suitable centring rings and polyurethane gaskets for a simple mounting process that guarantees a perfect alignment and sealing between elements.

This innovation increases the opportunities for using multiple modular pumps, providing the installer with a much more safe and reliable solution wherever high torques are required in heavy applications.

An equation can be used to calculate the torque M_t required for a correct functioning of pumps subjected to a difference of pressure between inlet and outlet:

$$M_t = [V \cdot \Delta P] / [62.8 \cdot h_{hm}] \text{ [Nm]}$$

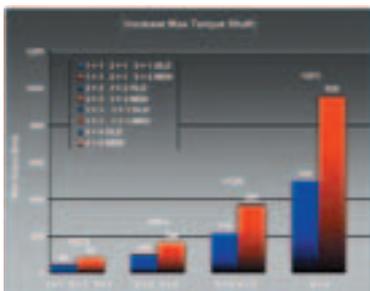
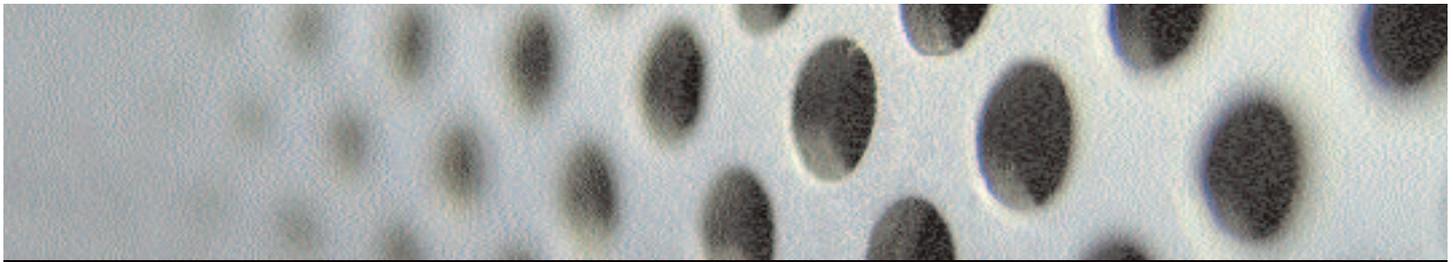
where:

V = displacement [cm³/rev];

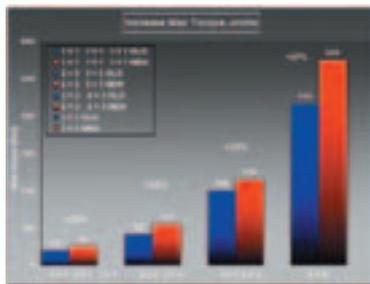
ΔP = pressure differential [bar];

h_{hm} = hydromechanical efficiency; (indicative value = 0.85).

TOP TO BOTTOM:
New GHP12 series
pump; new ALPP1
series pump; and
a 2 + 0.5 joint



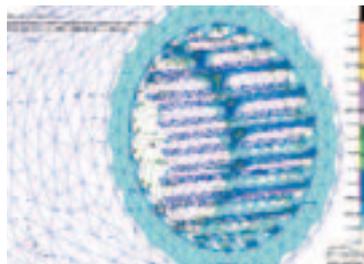
Increase of max torque of new shafts



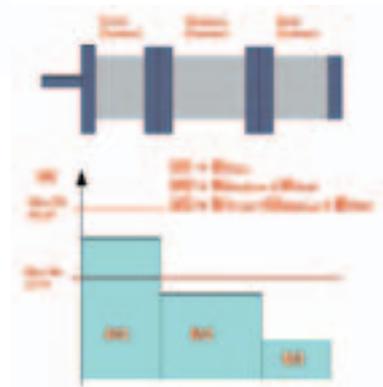
Increase of max torque of new joints



3 + 1 type joint



FEA analysis of new joint



Distribution of torque in a multiple pump

In the case of multiple pumps, the driving shaft, as well as the shaft of the front pump, has to deliver the sum of the torques required by all the pumps (M3 in Figure 1). The connection between the front and intermediate pumps is the most critical because it must withstand the torque required by the intermediate and rear pumps (M2 in Figure 1).

When choosing a multiple modular pump, care must be taken in checking the operating conditions to ensure that all the shafts and connections can safely bear the torque. Marzocchi's multiple modular pumps are available in five different groups with either cast iron (GHP) or aluminum (ALP) intermediate flanges.

The company's technical office is available to help customers decide on the correct dimensioning of multiple modular pumps. However, there are some simple tips to make the choice easier:

- The group of an element must be equal to or larger than the group of the following element, while the displacement of an element must be equal to or larger than the displacement of the following element;
- The direction of rotation must be the same for the front and rear elements. All

the intermediate elements do not have their own direction of rotation, as this is determined by the mounting.

The current Marzocchi range covers displacements from 0.19cc³/rev up to 200.3cc³/rev (0.0104in³/rev to 12.223in³/rev) and flow rates from 0.29 l/min to 480 l/min (0.0638 gal/min to 105.59 gal/min). The range is split into eight groups of different size (0.25, 0.5, 1P, 2, 3, 3.5, 4) and within each group, the displacement is varied, changing the width of the gears.

Several configurations are available for flanges, shafts and connections, while custom solutions can also be produced to customer requirements. Cast iron versions are available for groups 1, 2 and 3.

Maximum operating pressures depend on the displacement and type of pumps – these are typically 230 bar (3,300psi) for aluminum versions and 280 bar (4,100 psi) for cast iron versions. **ivt**

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New polyurethane gaskets and centring rings

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