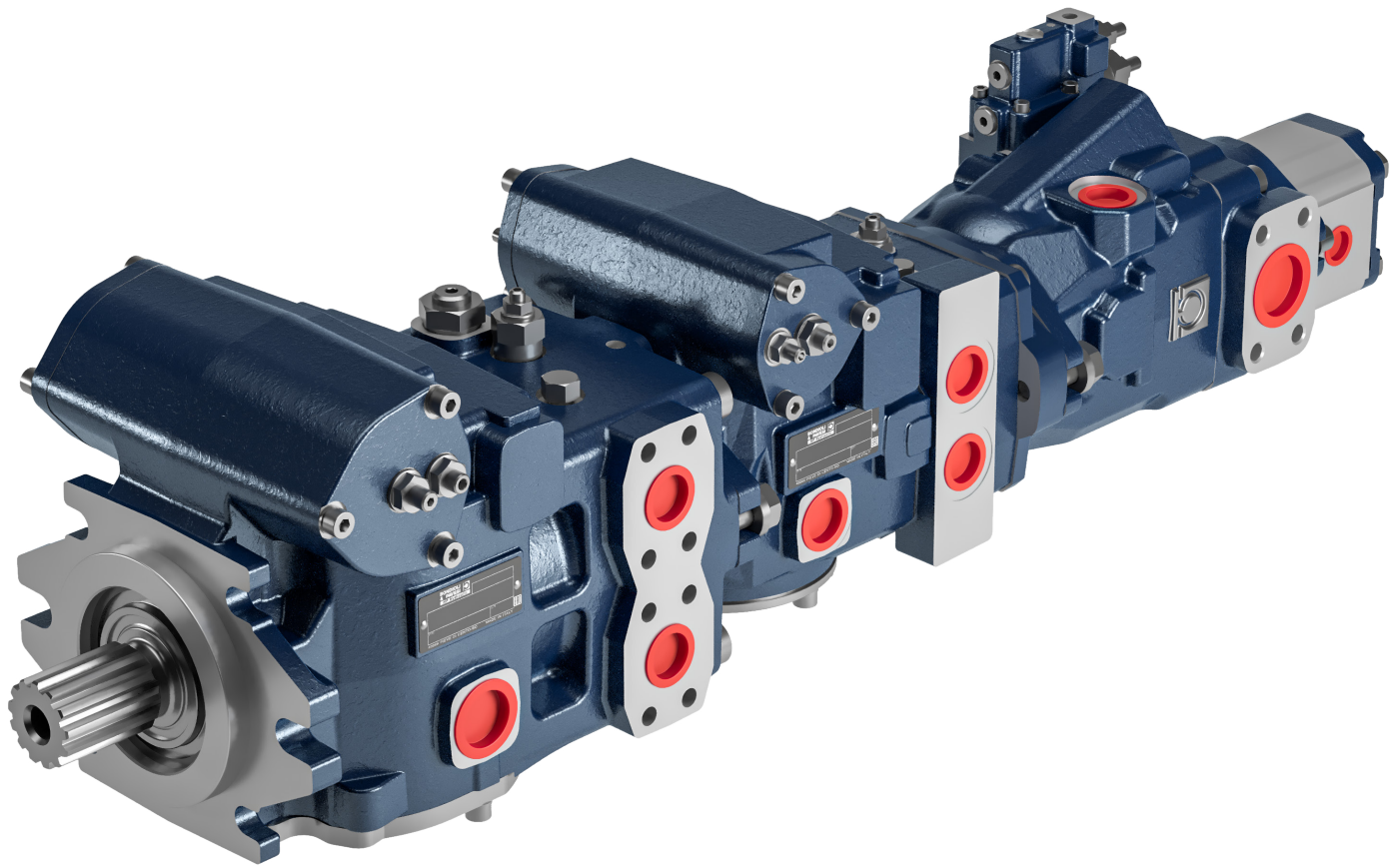
Multiple pumps



Introduction

HP multiple pumps have been designed to achieve maximum performance in the smallest possible spaces. In order to achieve significant transmissible torque values, for multiple pumps formed by stages of the same series (for example HPP2A + HPP2A), ad hoc drive systems with special splines have been designed. On the other hand, when multiple pumps of different series are made (for example HPP8 + HPA4C), the stages are assembled using the SAE standard.
The relative catalogues contain, both for the shafts and for the fittings, all the information that the technician must keep in mind when calculating the total transmissible torque of the multiple pump, as well as the transmissible torques for each stage that composes it. Multiple pumps must be cascaded from the largest to the smallest series.

The formula for calculating the torque to be used is:

$$M = \frac{\Delta p \cdot c}{62{,}83 \cdot \eta_m} \qquad [Nm]$$

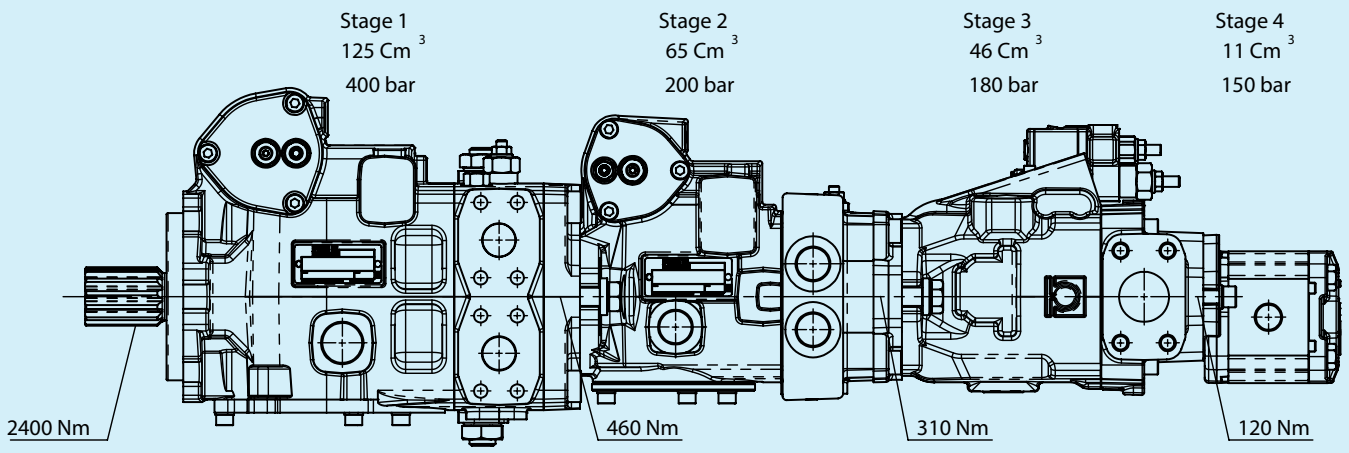
where:

M = Torque (Nm)
Δp = Pressure (bar)
c = Pump displacement (cm^3)
62.83 = Conversion factor
ηm = Mechanical efficiency = 0.9

Verification of the transmissible torque of a 4-Stage multiple pump

Below is a useful example that allows you to verify the correct sizing of the transmissible torques of a multiple pump according to the displacements chosen and the operating pressures of each stage.
The example considered that all the stages that make up the multiple pump can go under pressure at the same time.
This obviously stresses the pump more; It is therefore essential to verify both the transmissible torque of each stage and the overall one.
The calculation is made from the last stage of the pump up to the primary shaft. In all stages, the result of the calculated torque must be less than or equal to the maximum permissible torque for each drive joint, including the shaft profile of the pump.

HPP8 + HPP4 + HPA4C + HPLP2



Stage 4:

Group 2, displacement 11 cm^3.
Maximum operating pressure 150 bar.
Absorbed torque M4 = 29.2 Nm.
The joint condition 4 is met (maximum limit 120 Nm).

Stage 3:

HPA4C pump, displacement 46 cm^3.
Maximum operating pressure 180 bar.
Absorbed torque M3 = 146.5 Nm.
Added to joint 4, we have: 29.2+146.5 = 175.7 Nm.
The condition of joint 3 is met (maximum limit 310 Nm).

Stage 2:

HPP4 pump, displacement 65 cm^3.
Maximum operating pressure 280 bar.
Absorbed torque M2 = 322 Nm.
Added to joint 3, we have: 175.7+322 = 497.7 Nm.
The condition of joint 2 is NOT met (maximum limit 460 Nm). The operating pressure or the displacement must be lowered. Supposing we reduce the operating pressure of 240 bar, we will have an absorbed torque M2 = 276 Nm. M2 + M3 + M4 = 451.7 Nm. In this case, the condition of joint 2 is met (maximum 460 Nm).

Stage 1:

HPP8 pump, displacement 125 cm^3.
Maximum operating pressure 400 bar.
Absorbed torque M1 = 884.4 Nm.
Added to joint 2, we have: 451.7+884.4 = 1336.3 Nm.
The condition of the splined shaft is met (maximum limit 2400 Nm).
The pump turns out to be correctly sized.

For any special cases, conditions and specific needs, please contact the Bondioli & Pavesi customer service.

Maximum speed

The maximum speed of a multiple pump is limited to the lowest maximum speeds of the individual stages.

The order code of a multiple pump is obtained by summing, as shown in the example, the codes of the individual pumps (stages) obtained by following the order instructions page of the sheets of the individual pumps.

Stage 1		Stage 2		Stage 3		Stage 4
HPP8 125 R E 9 G K P 8 0 000	**+**	**HPP4 065 R B 1 G K I 3 0 000**	**+**	**HPA4C 46 R B 9 S L A 5 0 000**	**+**	**HPL PA2 11 D SV G4 G4 B ST**

Depending on the available versions, different combinations of multiple pumps can be configured. For more information, contact our technical sales department.