FOUR CYLINDER SET – SPEED CALCS

## Example of the difference in speeds of one to four cylinders being fed with one pump.

$$Area = \frac{\pi \times D^2}{4} \qquad = \frac{3{,}142 \times 200^2}{4}$$

$$\boldsymbol{Area\ of\ one\ cylinder = 31420\ mm^2}$$

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1.

$$\boldsymbol{V = \frac{Q}{A}}$$

Speed of **one** cylinder with 50 litre per min pump $= \frac{50 \times 10^6}{31420\ mm^2}$

$$\boldsymbol{= 1591{,}34\ mm\ per\ min}$$

$$minutes = \frac{Distance\ in\ \ mm}{mm\ per\ min}$$

$$= \frac{2000\ mm - stroke}{1591{,}34\ mm\ per\ min}$$

$$\boldsymbol{= 1{,}257\ minutes\ to\ complete\ the\ 2000\ mm\ stroke}$$

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2. Total Area of **two** cylinders 31420 x 2 = 62840 mm$^2$

$$Speed\ of\ \boldsymbol{two}\ cylinders\ together\ with\ 50\ litre\ per\ \min\ pump = \frac{50 \times 10^6}{62840\ mm^2}$$

$$= \boldsymbol{795{,}67 mm\ per\ min}$$

$$minutes = \frac{Distance\ in\ \ mm}{mm\ per\ min}$$

$$= \frac{2000\ mm - stroke}{795{,}67 mm\ per\ min}$$

$$\boldsymbol{= 2{,}512\ \ mininutes\ to\ complete\ the\ 2000\ mm\ stroke}$$

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3. Total Area of four cylinders 31420 x 4 = 125680 mm$^2$

$$Speed\ of\ \boldsymbol{four}\ cylinders\ together\ \ with\ 50\ litre\ per\ \min\ pump = \frac{50 \times 10^6}{125680\ mm^2}$$

$$\boldsymbol{= 397{,}84\ mm\ per\ min}$$

$$minutes = \frac{Distance\ in\ \ mm}{mm\ per\ min}$$

$$= \frac{2000\ mm - stroke}{397{,}84\ mm\ per\ min}$$

$$\boldsymbol{= 5{,}03\ minutes\ to\ complete\ the\ 2000\ mm\ stroke}$$

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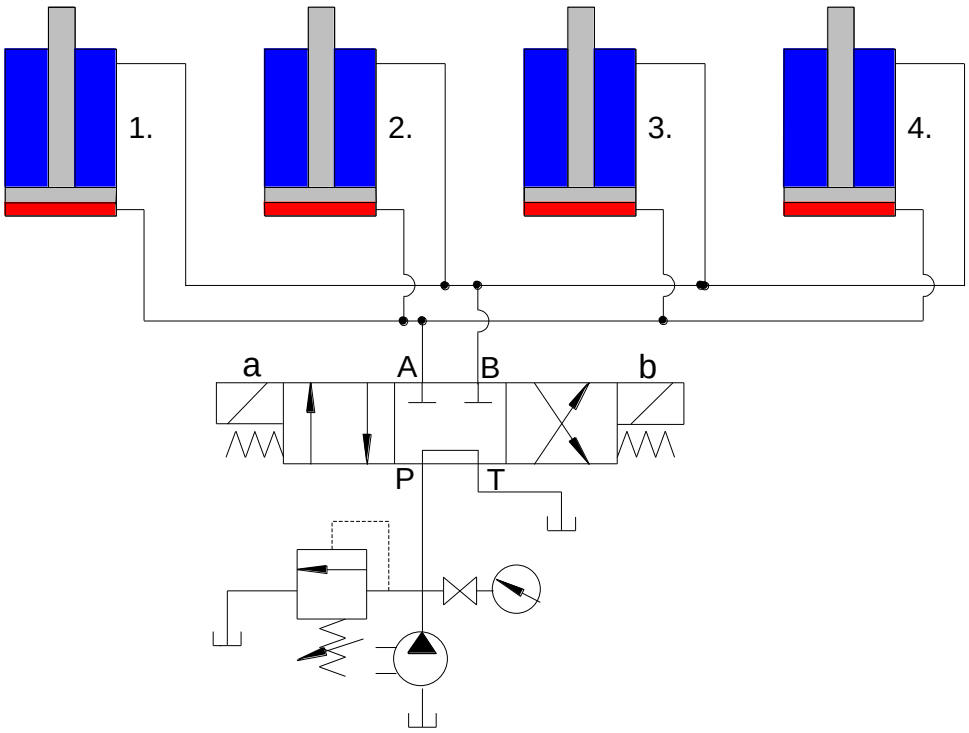


The circuit must be read in conjunction with the calculations above, indicating the time it takes for the cylinders to extend.

As may be observed, the cylinders are being supplied with oil from one pump, which means the pump flow rate is divided between the four cylinders. One must bear in mind, the cylinders are unlikely to extend together, and even if there is no load on them, each cylinder seal will possibly have a different frictional resistance. By fitting flow controls to the cylinders to have them move together will be an exercise in futility, as it will be almost impossible to synchronise the cylinders. A slight change in the viscosity of the oil due to temperature variation will cause the cylinders to extend or retract at different speeds. If a series of cylinders as shown above are to be used for say a clamping application, only once the last cylinder has reached the load will the system come under pressure. Flow control valves will only slow the system down.

A method to allow the cylinders to move together, would be to use rotary flow dividers. Unfortunately, flow dividers would have to have a series of relief valves and check valves so the cylinders may be synchronised at the end of each stroke, as a slight by-pass of oil past a piston seals, would in a very short time cause the cylinders to be out of phase.

If it was necessary for the cylinders to extend or retract together very accurately, then one would have to make use a servo system, which would electronically control the cylinders.

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