



Digital Displacement® fluid power technology replaces the port plates and wash plates in conventional hydraulic machines with computer controlled high speed solenoid valves. Digital Displacement® technology is to hydraulics what switched mode was to electronics.

Digital Displacement® technology has the following key benefits:

- Very high efficiency at full and part-load
- Multiple independent variable displacement services from one compact package
- Fine output control and very fast response
- Low noise emissions



A wide variety of current and potential applications can benefit from Digital Displacement® technology's key strengths of controllability, performance and efficiency. Artemis and its technology licensees are using Digital Displacement® to improve well-established hydraulic products as well as bring hydraulics into new industries and applications.

Operating principle

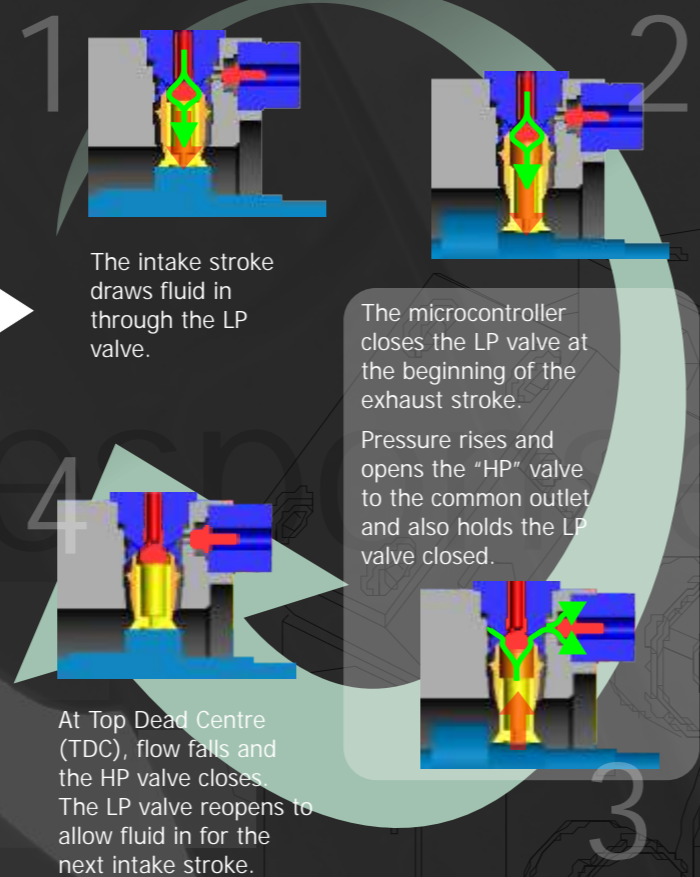
Digital Displacement® machines are typically multi-cylinder pumps and/or motors. Each cylinder has two poppet valves, one connecting it to low pressure fluid (the LP valve) and one to a high pressure output (the HP valve). A microcontroller reads a shaft position sensor and controls at least the LP valve.

The microcontroller is able to choose to operate one or more valves, or not operate them, each revolution to determine how much flow is generated. The adjacent diagram explains how this works in the pumping mode of operation.

Hydraulic motors are achieved with the addition of a controlled high pressure (HP) valve. Motors are also pump/motors - operation as a pump is inherent.

Unused cylinders consume very little energy because fluid enters and leaves them without ever being pressurised. On the other hand, any used valves are typically used in their entirety, so they operate at full efficiency by transferring the maximum amount of power.

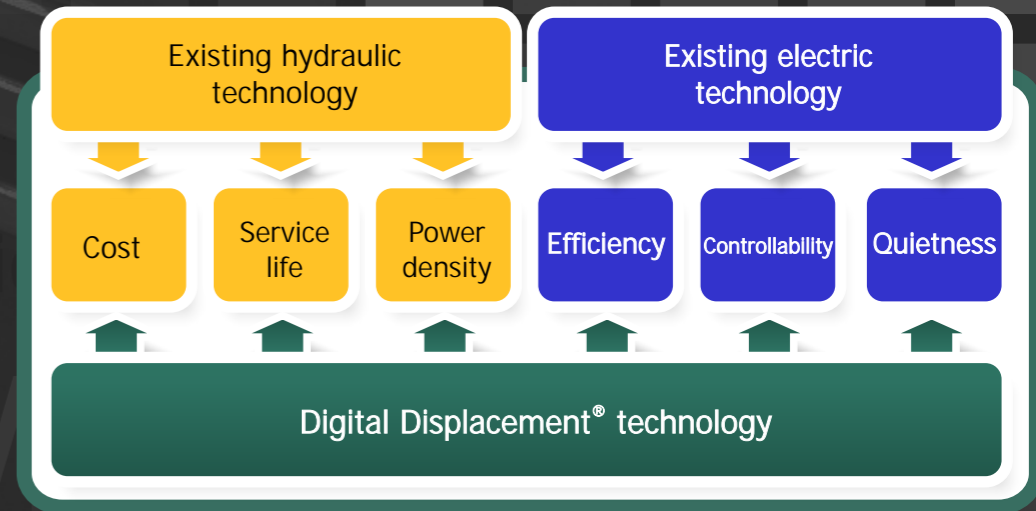
In contrast to conventional pump/motors, Digital Displacement® pump/motors achieve full four-quadrant control from only one high pressure line. There is no need for both inlet and outlet to be pressure rated, simplifying the system design and lowering the system cost.



Benefits

Digital Displacement® technology gives hydraulic machines the three benefits that electric motors are known for, while retaining the traditional hydraulic advantages of power density, cost and robustness.

The reasons behind the three new benefits are explained below.

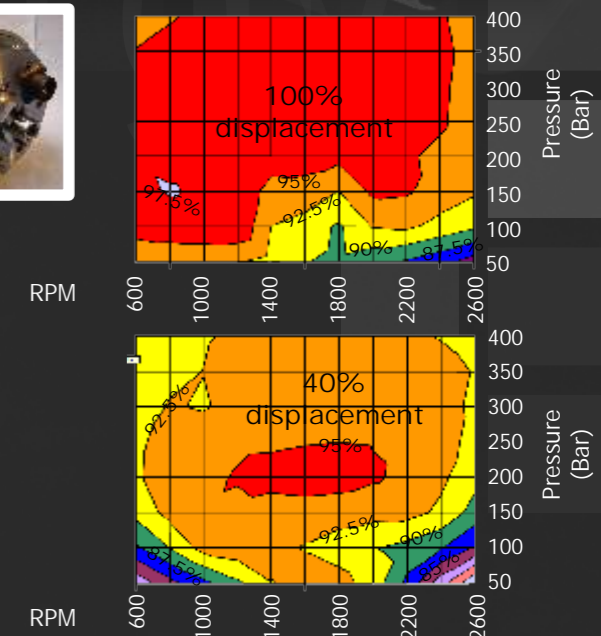
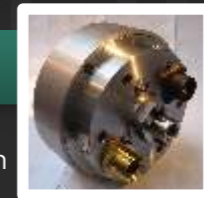


Unparalleled Efficiency

Digital Displacement® machines are more efficient than any other known hydraulic technology at partial flow.

Normal hydraulic machines lose efficiency dramatically at partial displacement because leakage and shear losses remain high at partial loads. However, Digital Displacement® pumps and motors completely isolate idling cylinders from the load, eliminating losses due to leakage and shear and delivering unparalleled efficiency across the whole operating range. For example, Digital Displacement® machines have idling losses as low as 1% of the rated output power.

Independent tests by the established hydraulics industry leaders have shown time and again that Digital Displacement® machines are the most efficient variable displacement machines ever built. These graphs show the efficiency results (shaft power in to fluid power out) from one such controlled, calibrated, independent test on a 30kW machine.



Unbeatable Controllability

Digital Displacement® machines control flow, pressure, position or velocity directly without proportional valves, and can switch their control characteristics on the fly.

The direct digital electronic control allows much simpler application integration and eliminates the servo-hydraulic control required in traditional analogue systems. A Digital Displacement® machine's high speed valve technology allows its output to change from 0-100% and back again in just one shaft revolution, while direct digital control at the cylinder level delivers exactly zero hysteresis and perfect linearity.

Separate commutating valves for each cylinder means one machine can simultaneously provide several independent services with different pressures and flows.

Outstanding Quietness

Digital Displacement® machines eliminate the 'whine' traditionally associated with hydraulic pumps and motors.

Whereas cylinder commutation in most traditional machines happens at a predetermined shaft angle, the direct-acting poppet valves in Digital Displacement® machines commutate cylinders when the pressure is equalised. As well as improving efficiency, the harsh sound normally coming from the throttling of cylinder decompression flow is completely eliminated.