

# The LatchTool *PowerCylinder*<sup>TM</sup>

Microhydraulics for mechatronic systems . . .

. . . combining the power of hydraulics with fluidic control<sup>TM</sup>

The *PowerCylinder*<sup>TM</sup> is a resistance regulated automatic transmission with three-hydraulic circuits integrated together in a **closed** assembly. A stand-alone mechanical force amplifier that weighs ounces yet leverages pounds into tons.

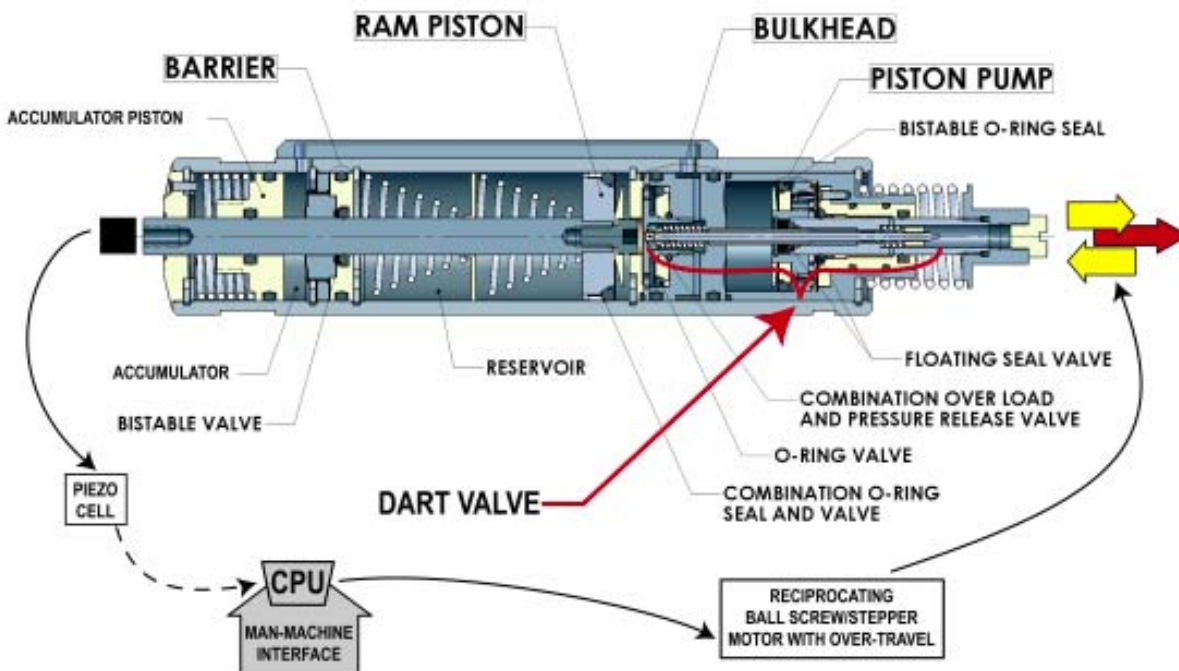
**FastFlow**<sup>TM</sup> valves are a new class of floating seal valves that substitute for simple check valves, poppet valves and pressure regulated bi-stable valves. They are o-ring seals that double as valves. Their cross-sectional flow paths are annuli rather than constricted orifices, substantially reducing pressure drops and frictional losses. **FastFlow**<sup>TM</sup> valves automatically respond to system pressures, enabling fluidic integration of hydraulic circuits. They eliminate the need for spool-valves, manifolds and facilitate miniaturization.

The **Dart Valve** assembly is the basis for mechatronic integration. This multipurpose mechanism prevents a *PowerCylinder*<sup>TM</sup> from

being over-pressurized and adjusts the maximum force a *PowerCylinder*<sup>TM</sup> will deliver. It also resets the unit and is the basis for the *PowerCylinder*'s modulated control. Modulation is achieved by the over retraction of the pump piston which lifts the dart valve from its seat. Other embodiments offset the pump from the actuator-dart valve assembly. Closed-loop stepper motor/ball screw combinations drive each modular unit.

Networks of small mechatronically linked *microhydraulic* components or "bricks", can replace elaborate hydraulic systems. Gone are the complexity and weight of hydraulic fluids, their umbilical connections, hydraulic pumps, accumulators and reservoirs. Gone too are the possibilities of an environmental or catastrophic disaster from a leaking or a severed hydraulic line. *Plug-and-play* maintenance offers compelling efficiencies.

## Modulating *PowerCylinder*<sup>TM</sup>



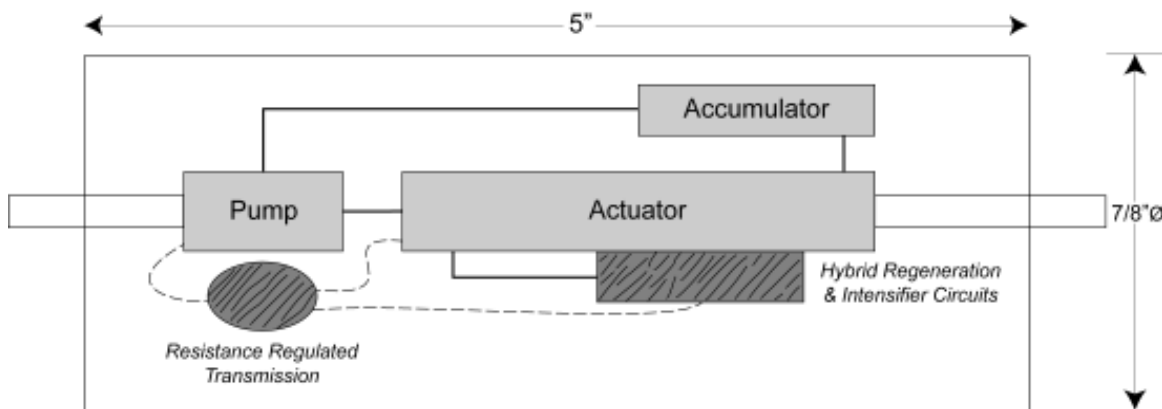
# PowerCylinder™

## A LatchTool Technology

The LatchTool *PowerCylinder™* is a **NEW** standalone OEM component that simply and easily delivers exceptional force and rapid displacement economically.

A compact hydraulic system is a standalone motorized pump, reservoir, and controller combination that can power and modulate an actuator. The PowerCylinder is all of that and an actuator too, but with unparalleled economies in both real estate and weight.

The LatchTool *PowerCylinder™* is a resistance-regulated, fast-closing, high-force hydraulic actuator equipped with its own internal pump. The LatchTool technology provides an alternative method of plumbing hydraulic circuits with a proprietary class of floating-seal valves that reduces or eliminates the need for external reservoirs, accumulators, and valve manifolds. This seal technology offers significant economies in weight and space. The PowerCylinder is designed as an off-the-shelf force amplifier to be installed as a component in larger



The PowerCylinder can be hand driven. Presently, a pistol type handle is available with a 6:1 leverage. Within seconds the ram of this 32 ounce system has been extend 1½" and is delivering 3,000 pounds at the business end.

Coupled with a ball screw actuator, the PowerCylinder quietly accelerates and multiplies thrust.

LatchTool *PowerCylinders™* are small self-contained *fluid power packages* featuring plug-and-play simplicity with force-to-weight ratios unthinkable for their size. Their breakthrough proprietary valve technology enables compact integrated hydraulic systems sealed in a tiny cylinder to have output ratings from a few pounds to multiple tons. The PowerCylinder automatically shifts between three circuits in response to the encountered load. This feature minimizes the work expended as shown on a force/deflection curve. [See Figure 1]

assemblies for either mechanical or electromechanical actuation.

The PowerCylinder circuitry has been designed to rapidly extend its ram while ramping up in stages to a factory preset maximum force. The transition between stages is regulated in a manner analogous to the sympathetic nervous system's response to local stimuli. This arrangement is ideal for crimping, holding, and cutting. LatchTool Group has demonstrated that the PowerCylinder can be further integrated with an electronic controller and interface to provide modulation. This feature will enable real-time interplay for example between a driver and rapidly changing braking requirements.

Its unit construction enables plug-and-play simplicity in both product assembly and field maintenance replacing whole hydraulic subassemblies with self-contained cartridges. Gone is the need to flush and purge hydraulic circuits and to contend with accidental fluid spills. Gone too are the catastrophic implications of a ruptured or severed hydraulic line; as well as ancillary fluid

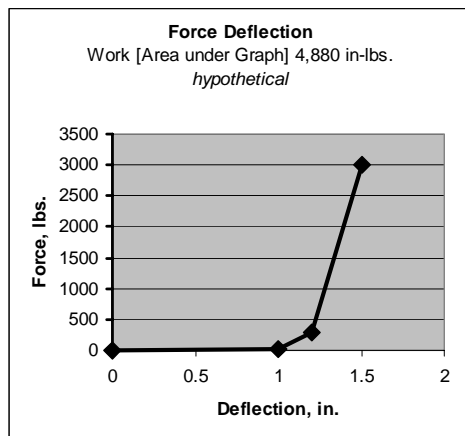


Figure 1

handling, control, and distribution systems and their complicated umbilical connections.

The present LatchTool *PowerCylinder™* is deliverable as a sealed unit to your specifications . . . from pre-set force amplification to the stroke of the ram. And it is scalable, beginning with an OD of less than an inch. The LatchTool *PowerCylinder™* brings the features of hydraulic power and positioning to a range of smaller applications.

The LatchTool *PowerCylinder™* is designed for mass-customized manufacture and assembly. Preliminary costing places a 1/2"Øx3" PowerCylinder, produced in substantial quantities, in the \$8 to \$10 range. A larger 7/8"Øx5" PowerCylinder is presently being offered for sale as an evaluation unit. A leveraged 50# input extends the ram up to 1 1/2" while delivering 3,000# at the business end. This unit is offered at the one-off price of \$5,995 and includes certain sundries to assist the evaluation. Published prices may vary without notice and are for indication purposes only. Modulation packages are custom assembled. Production run pricing is volume and specification sensitive and will be worked up on a case-by-case basis.

LatchTool plans to introduce stock PowerCylinders for sale on an open-source basis. The company is also entertaining select application specific end-use licenses, joint development agreements, and strategic alliances and will entertain standstill agreements to prevent preemption during the evaluation and business development phase.

## A Remotely Controlled - 7/8"Øx5" LatchTool PowerCylinder

The demonstration unit adopts off-the-shelf components coupled to a man-machine interface to control the PowerCylinder.

Modes of operation include "clamp and hold" and "modulate". Potential applications for "clamp and hold" include shears, vises, and workholding fixtures. Applications requiring modulation include actuators and brakes. Individual applications will drive the detailed design of the controller/amplifier, the drive train, the human interface and substantially reduce component real estate.

