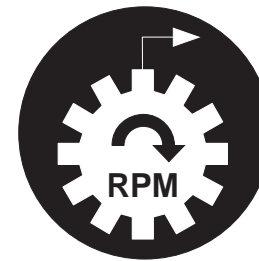
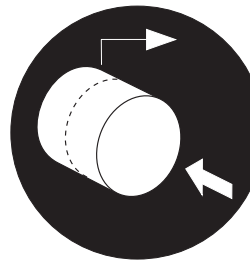
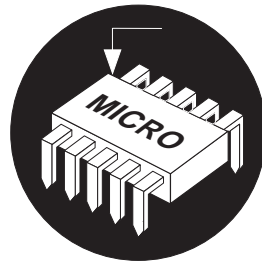
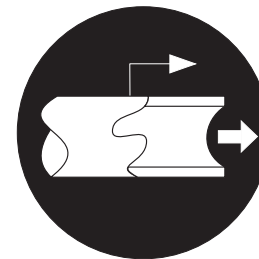
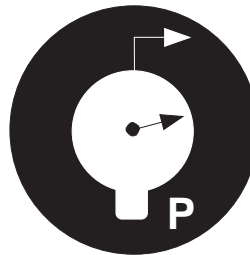
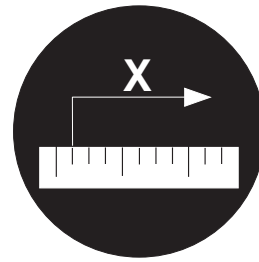


# Your Guide to the Electronic Control of Fluid Power



The members of the National Fluid Power Association (NFPA) have prepared this application as an introduction to the electronic control of fluid power. The application and components described here are representative — electrohydraulics and electropneumatics can be effectively utilized in countless processes, and components are available in many different sizes and configurations.

NFPA's manufacturers invite you to contact them for additional information.

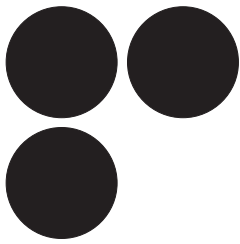
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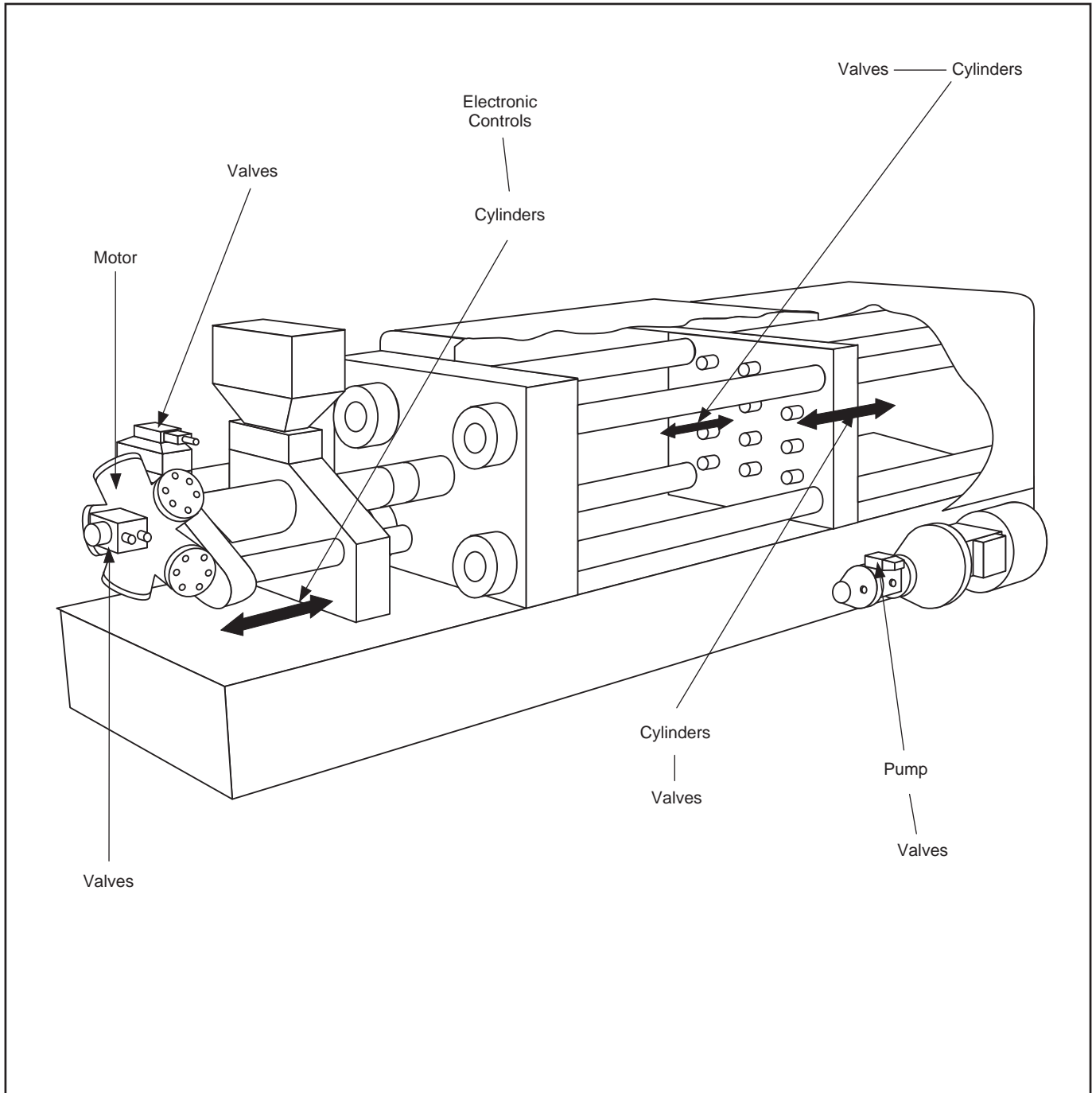
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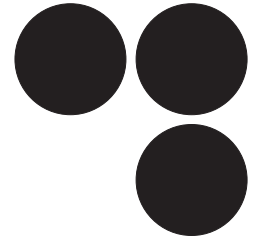
# Electrohydraulics at Work

## Plastic Injection Molding



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# Force, Position and Velocity Control



## The Problem

To increase the productivity and, at the same time, improve quality while producing evermore complex products with more sophisticated materials, it is necessary to precisely control the many aspects of an injection molding machine from temperature and clamping tonnage, to plastic injection speed and plastic pressures in the mold.

## Its Solution

Achieving these requirements while providing controls to reduce shock and noise with precise repeatable performance is accomplished by electrohydraulic controls. Injection molding machines utilize a range of electrohydraulic controls for various functions such as:

**Clamping:** Direct-acting cylinders or mechanical advantage devices such as toggle mechanisms typically provide the force. Proportional directional control valves provide velocity, acceleration and deceleration control. The speed and large mass of clamping create high inertia loads that demand precise control to avoid mold damage on closing.

**Injection:** Position, velocity, and pressure of injection into the mold cavities are controlled. The control is transferred from velocity to pressure during the injection cycle and is a critical factor in component quality. This transfer is called: PQ (Pressure/Quantity) flow, or mode transfer, and is accomplished with proportional directional control or servovalves. The cylinder has both position and pressure sensors.

**Plasticizing:** To ensure a fluid, homogeneous plastic for injection, a specially designed screw feeds plastic granules from the hopper into the heated injection barrel. This screw is driven by a variable speed, high torque hydraulic motor controlled for two speeds by on-off valves or, for variable speed, by proportional directional control valves. As plastic is forced into the barrel, the injection cylinder retracts under controlled loading, ready for the next injection.

**Ejection/Core Pulling:** Once a component process is completed, the cores (if used) are withdrawn and the component is automatically ejected. Again, these use on-off valves or simple proportional directional control valves, depending on the complexity of the process or component.

## Related Applications

Precision control of powerful hydraulic force is the trademark of injection molding. Other examples include presses, metal die casting, forming of steel sheet, and extrusion of aluminum ingots.

## How Electronics Improved This Application

- Increased speed, without shock
- Flexible process control
- Repeatability
- Remote parameter control
- Ease of setup
- Standard components

### Components Used in Industrial Hydraulic Systems\*

Accumulators	Motors
Controls (electronic) and Software	Power Units
Cylinders	Pumps
Filters	Pump Drives
Fittings	Reservoirs
Flanges	Rotary Actuators
Fluids	Seals
Gauges	Shaft Coupling
Heat Exchangers	Shock Absorbers
Hose	Switches
Hydrostatic Drives	Tubing
Manifolds	Valves

\*[Click here to access the NFPA Fluid Power Product Locator, which includes information about and links to NFPA member companies.](#)