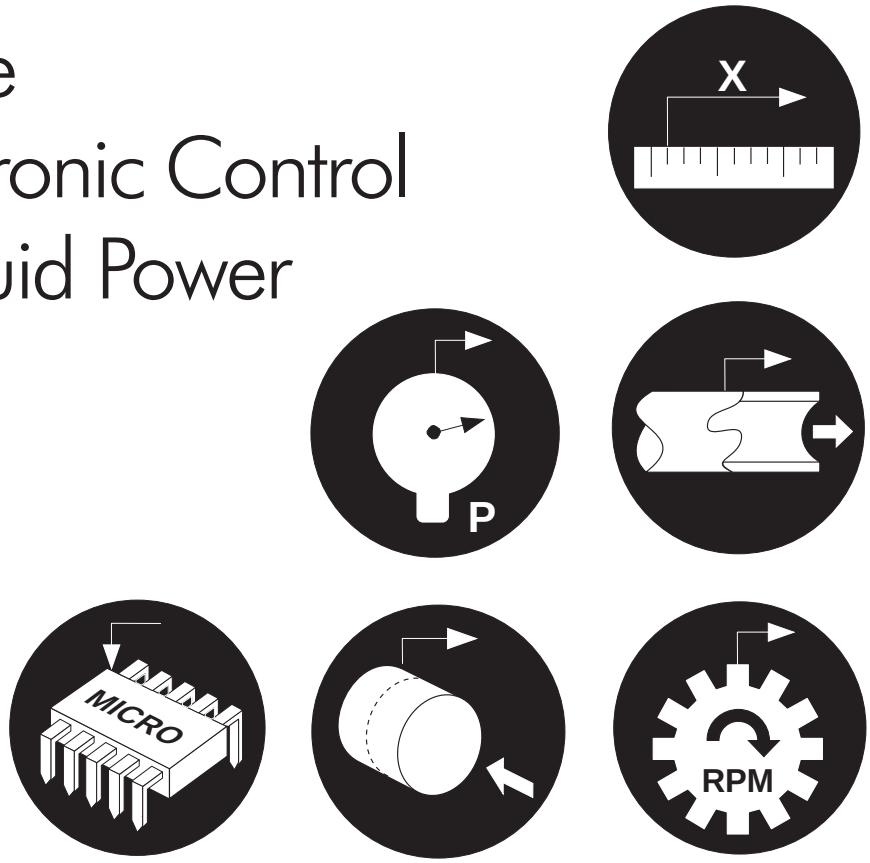
# Your Guide to the Electronic Control of Fluid Power




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.



National FLUID POWER Association®



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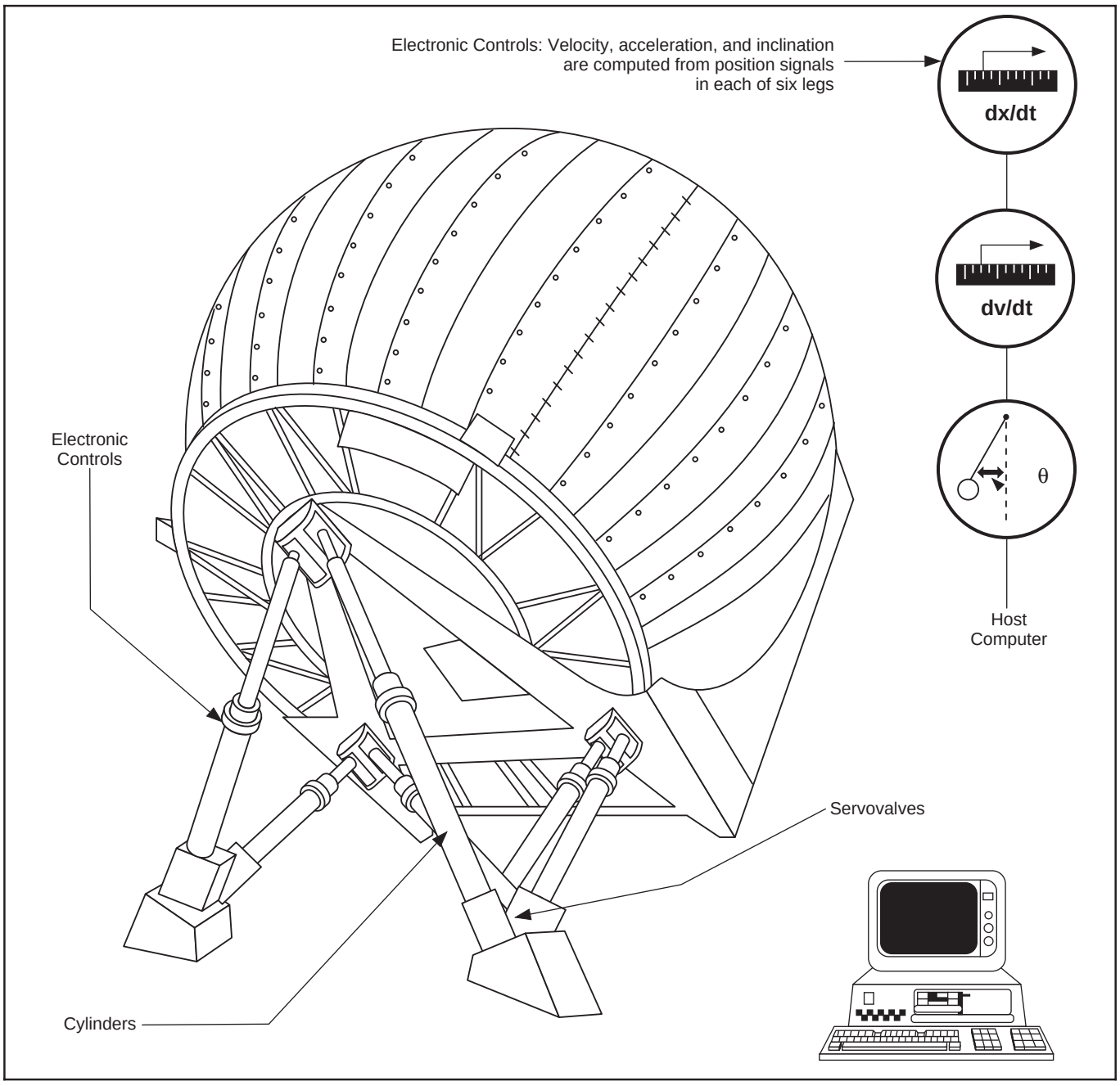
# Electrohydraulics at Work

## Flight Simulator




### The Problem

Modern aircraft are much too complex and expensive to first test the controls in the air, even by skilled test pilots. On-ground training in realistic simulators is, of course, the answer.

### Its Solution

There are simulator systems for almost every type of aircraft flying today, and many can pitch, roll and yaw like a real plane as the pilot inside operates the controls. The latest version is a high-performance motion platform for simulating new tilt-wing aircraft that take off vertically. The platform—an enclosed cockpit—is supported by six electrohydraulic actuator legs, arranged in three bi-pod pairs that are orchestrated rapidly to create the motions. Linear position sensors on each actuator leg contuously and accurately monitor the leg extension, and the

signals are interpreted by the host computer as height and tilt. Also, velocity and acceleration are readily computed from the rapidly changing position sensor readings, so every rate of platform motion can be generated.

Supplying the system is a hydraulic power unit (reservoir, pump and controls) that can deliver up to 200 gpm at 2000 psig. Overall power capacity is 200 hp, but brief overloads are allowed. Integral electrohydraulic servovalves on the actuators respond to computer signals and tell the actuators to rapidly perform the work of moving the platform.

The electrohydraulic servo system has a response time that is three times faster than most older designs, resulting in more realistic motions and therefore quicker and better honing of the pilots' skills. Pilot readjustment time from simulator to actual aircraft is expected to be greatly reduced.

Electronic control is handled manually from a panel on the main cabinet during initial startup. After the functional checks are completed, the control is turned over to a host computer which has software programs designed to react with the pilot-in-training to create the desired simulated responses. Fault detection, self-diagnostics and machine logic are the tasks of a programmable logic controller. Approximately 130 points in the system are monitored and, when a fault is detected, its type is indicated by a light, and a description is displayed on a CRT.

Serious faults call for shutdown. If the emergency controls are still functioning, there is a gentle settling of the platform. If emergency control is lost, then the abort mode takes place and the platform settles abruptly.

Actual operation is impressive. Maximum actuator extension is 66 inches, and at this point the top of the 25-foot-diameter cockpit dome is three stories high. Maximum payload is 34,000 pounds. The platform design is state-of-the-art. It is required to have a mean time between failures of at least 2200 hours, with down time restricted to 20 minutes on average and 90 minutes maximum most of the time. In addition, the system has to be modular enough to allow fast setup at the customer's site.*

*Design and manufacture was accomplished in a cooperative effort at two sites by experts in three disciplines: mechanical design, computer simulation and control, and electrohydraulics. It's expected that most of the testing will be done at the manufacturing and assembly plant, before the platform is dismantled and re-assembled at the customer's location. An alternative is to ship the modularized parts directly to the customer, and do the final assembly and testing there.

## Related Applications

Six-legged platforms or tables, driven by electrohydraulic actuators with electronic position sensing and high-speed servovalves, all controlled by a host computer, can serve ably in any application where quick, complex motion of a mounted component or system is required. Possible applications include testbeds for shipboard equipment and aircraft electronic gear, and for other equipment that moves abruptly with the wind and waves.

## How Electronics Improved This Application

- Speed
- Accuracy
- Automation
- Adjustable sequence and timing
- Monitoring and diagnostics
- Standard components
- Upgradability

### Components Used in Industrial Hydraulic Systems*

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

***Click here to access the NFPA Fluid Power Product Locator, which includes information about and links to NFPA member companies.**

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