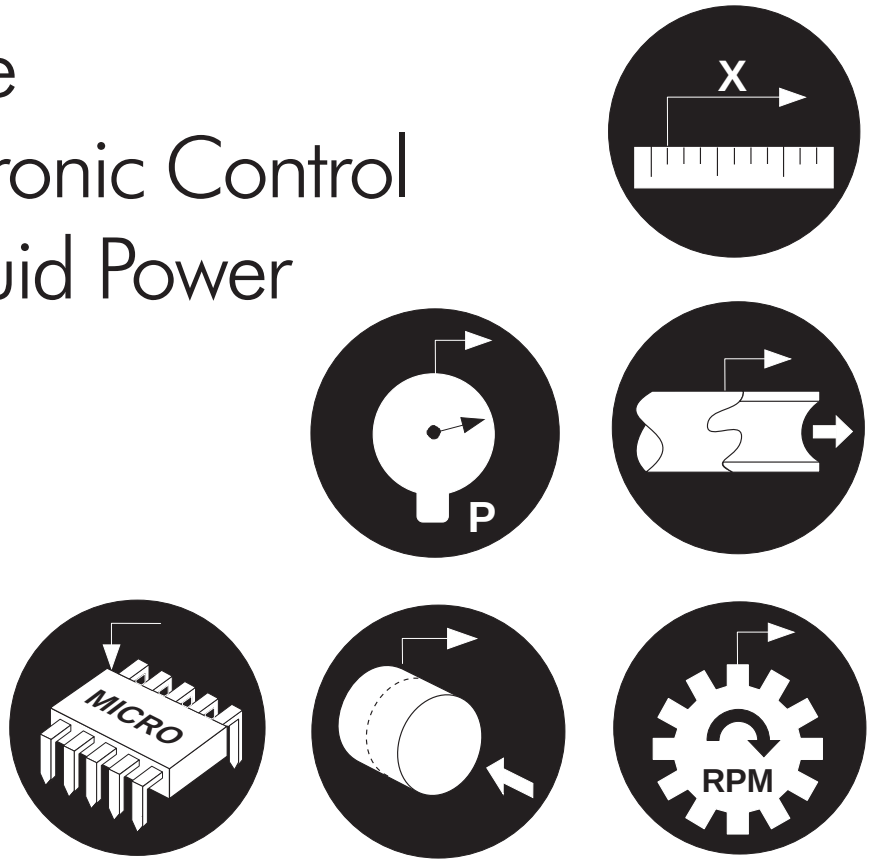
Your Guide to the Electronic Control of Fluid Power



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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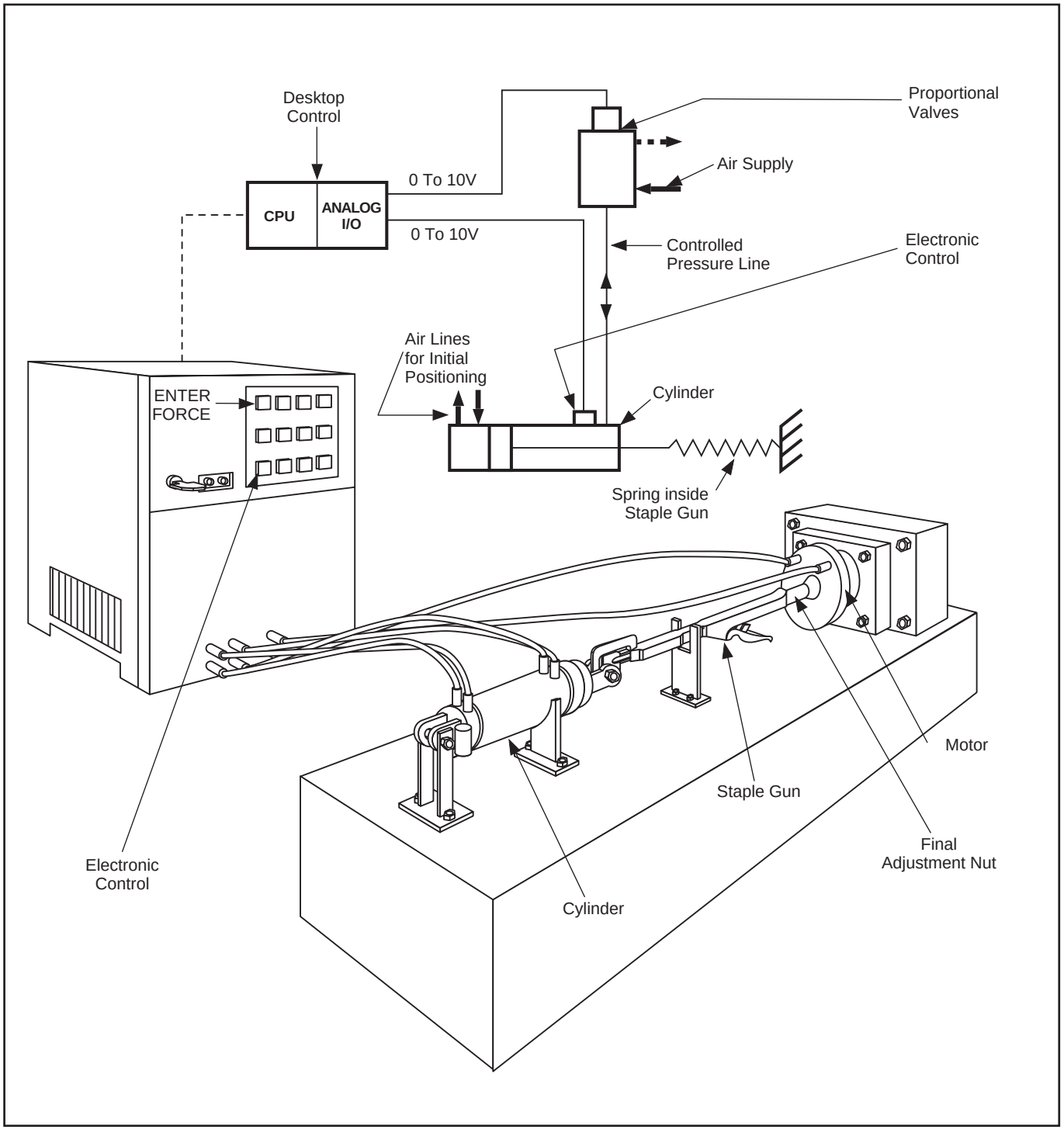
Electropneumatics at Work

Stapler Test



The Problem

For some time now, many surgical incisions have been closed by surgical staples made from special metals such as steel or titanium rather than by traditional suturing methods. Because the tissues being joined vary in depth and density, the staple guns that dispense these specialized fasteners are designed to have an adjustable

clamping force. The force is controlled by varying the tension on the spring contained within the gun.

Miscalculation of the required spring tension can result either in poor closure of the curled points of the staples, or in actual penetration through the adjacent tissue. So, the staple guns are carefully calibrated at the factory to provide a consistent output force from one instrument to the next. This allows the surgeon to develop a judgment base for determining closure depth (by spring tension) over a variety of surgical situations.

Its Solution

To increase the speed and accuracy of this calibration process, one surgical stapler manufacturer created a special fixture using a pneumatic cylinder with electronic control of pressure. It maintains a finely adjusted, constant force on the staple gun's spring during calibration.

The key to the success of this application lies in a series of special mathematical algorithms which are run on a standard programmable controller. The desired spring force is entered in pounds. When the operator starts the calibration cycle, the controller computes the appropriate corresponding analog voltage used by an electronic proportional pressure control valve. It pressurizes a special air cylinder whose non-rotating rod is hooked to the triggering spring of the stapler gun.

The air cylinder rod pulls on the spring, extending it until the spring force balances the rod force. After 100-millisecond settling time, actual pressure is sensed by a pressure transducer mounted in the cylinder's input port, and the signal is sent to the controller. The signal is interpreted as spring force.

If spring force deviates from the desired set point, the algorithm computes the correcting compensating signals to the electronic proportional pressure control valve. This compensating process repeats until the actual force matches the required force.

An air motor, actuated via a pressure switch, tightens a retaining nut on the stapler to lock in the correct spring tension. A three-way valve, which is used to pre-position the cylinder rod into locked position against the stapler, is released; the stapler gun is replaced with another, and the cycle is started again.

To maintain a sterile environment, no oil is used in the air to lubricate the cylinder or valving; it is prelubricated at the factory. In addition, a submicron filter removes all particles from the air circuit.

Related Applications

Somewhat similar to the stapler application is the grinding of industrial diamonds with a free-floating abrasive wheel. The wheel is attached to an air cylinder rod in a supported-slide configuration; pre-set cylinder pressure limits the movement of the grinding wheel against the diamond surface. Another *floating* application might be a remotely controlled air spring.

How Electronics Improved This Application

- Automation
- Improved monitoring
- Standard components

Components Used in Pneumatic Systems*

Actuators
After Coolers
Air Compressors
Air Dryers
Air Line Lubricators
Controls (electronic) and Software
Cylinders
Filters
Filter/Regulators
FRLs
Fittings
Gauges
Grippers
Hose
Manifolds
Motors
Mufflers
Regulators
Rotary Actuators
Seals
Shock Absorbers
Slides
Switches
Tubing
Vacuum Products
Valves

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