VI. ACTUATOR DESIGNS

Selecting the right Actuator is another important step in choosing the right design for your valve application. The Actuator choice is important because the Actuator directly links the valve's Operator (either a person or a control system) and the valve's Seat (which directly controls the flow media). In fact, the Seat and Actuator are usually the two most important considerations in selecting a valve.

Just as valves are available with two basic Packing designs (Packed and Packless), two basic valve Actuation options exists. These are the Manual and Automatic options. Advantages and disadvantages apply to both the Manual and Automatic options.

A) Manual Actuation

Multi-Turn Handles are commonly used in flow regulation and shut-off applications. Round and T- Bar handles may be used interchangeably, except with soft-seat tapered stems such as a Kel-F® seat. The reason is higher torques are possible with T-Bar handles, which may result in crushing the thermoplastic soft-seat material. Vernier handles are found almost exclusively on Metering valves, where they may provide the operator with a visual indication of how far open a valve is.

Quarter-Turn Handles are used in shut-off applications; are associated exclusively with Ball, Plug and Quarter-Turn Diaphragm valves; and, usually provide directional indication. In addition, some Quarter-turn product lines feature a Lock-Out device for securing the handle in either the open or closed position.

Lever Handles are also known as "toggle" handles, and feature rapid shut-off control. They are usually quite valuable in simple "on/off" applications.

For most instrument valves, plastic handles provide the best choice and options, and are designed to deliver the required loads for proper shut-off torques. With quarter-turn ball valves, the tendency is to shape the plastic handle to include a point, indicating the valve position. Color coding of handles is common and an important feature for instrumentation valves. The matching of color for fluid or line purposes has advantages, especially when a large number of valves are clustered closely together. Instrumentation piping and tubing are harder to mark or color than larger piping, so that the colored handle is often the best way to identify the lines.

B) Remote Actuation

Selecting a Remote Actuator demands close attention to the details regarding your application. There are many aspects to consider. These considerations include, but are not limited to, safety, reliability, system performance, cost and inaccessibility of the valve and actuator. Of course, the relative importance of these aspects are different for each valve application, and thus prudence is demanded in selecting any Remote Actuator. However, all Remote Actuators must reliably perform the following functions:

1) Move the valve seating element (ball, plug or tapered stem) to the desired position.
2) Hold the valve seating element in the desired position against the flow stream's forces.
3) Seat the valve seating element by applying enough force or torque.
4) Provide the required rotational travel to move the valve seat from the open to closed positions.
5) Provide the required operating speed for proper actuation frequency.

Pneumatic and Electric Actuators

Pneumatic Actuators are the work horses of the instrumentation industry. Their long history of reliable, robust and safe service has earned them a reputation for excellent performance. Pneumatic Actuators are powered by compressed air, which is not only commonly available in most instrumentation environments, but also contributes to the non-explosive characteristics of Pneumatic Actuators. Pneumatic Actuators are available in fail-open (normally open), fail-closed (normally closed) and fail-as-is (double acting) configurations.

Pneumatic Actuators are superior to Electric Actuators for applications requiring high actuation frequencies. This is because Pneumatic Actuators have no duty cycle, whereas Electric Actuators usually have a duty cycle rating. This means that Pneumatic Actuators can cycle continuously. Electric Actuators, on the other hand, with a duty cycle of 25 percent, mean they should be at rest 75 percent of the time.

Stalling is an area where Pneumatic Actuators are superior to Electric Actuators. Stalling occurs when the actuator still has power applied to it (either air pressure or electric current), but it has reached the rotation limit for its current actuation cycle. Stalling in electric actuators is often caused by a mis-application, where the actuator is sized below a required torque. Electric Actuators tend to overheat when the motor stalls. Overheating due to stalling can seriously decrease an Electric Actuator's life expectancy, and even worse, potentially contribute to fire or explosion. Pneumatic Actuators are safer than Electric Actuators, with respect to stalling, because Pneumatic Actuators never overheat in a stalled condition.

Electric Actuators are commonly used where it is impractical to locate and properly maintain the requisite air supply required by Pneumatic Actuators. Moreover, Pneumatic Actuators are sometimes susceptible to clogged air lines in low temperature applications (caused by frozen condensate). Electric Actuators have their special niche applications, and the increasing dominance of computer-based process control systems insures the use of Electric Actuators will grow considerably.

Pneumatic Actuators are often more cost-effective than Electric Actuators because of their rugged design based on the safety of air-operation. Pneumatic Actuators are inherently explosion proof because no sparks or high temperatures are generated. Furthermore, they are not sensitive to wet environments. Electric Actuators in harsh environments may require NEMA enclosures.

Double-Acting Rotary Pneumatic Actuators require pressurization to either close or open the valve. The piston is coupled to the actuator shaft via a rack and pinion gear drive, which produces the desired rotary valve stem motion. Spring-Return Rotary Pneumatic Actuators require pressurization of only one actuator port to either close or open the valve. The spring-return module automatically reverses the valve stem position when the actuation pressure is removed.

Piston Pneumatic Actuators produce linear motion, as opposed to the rotating motion produced by the Rotary Pneumatic Actuator. The Piston design requires pressurization to open or close the valve, depending upon the desired mode. The valve's internal spring forces the valve to a desired position when the actuator pressure is removed, in normally-open or normally-closed designs.

Cleaning Requirements & Options

VII. CLEANING REQUIREMENTS AND OPTIONS

Many valve applications require special cleaning with respect to either media compatibility or particle generation. These are frequently found in applications such as life support systems and pharmaceutical and semiconductor manufacturing. Parker Hannifin IVD has always strived to provide instrumentation valves for these crucial applications. This effort is reflected in the Parker Hannifin IVD C3 and C4 cleaning specifications, which are based upon cleaning processes ES8003 and ES8004, respectively.

A) Cleaning for Oxygen Service

Oxygen systems require careful design and cleanliness considerations. Meticulous cleaning is one basic essential in preventing or contributing to oxygen fires. Accordingly, Parker Hannifin IVD has established strict procedures to ensure proper cleanliness levels for valves to be placed in oxygen service. Valves for oxygen service are processed under Parker Hannifin IVD ES8003 and are identified by a "C3" in the valve's product nomenclature.

Users and designers of oxygen systems should refer to the guide materials available from organizations such as the *Compressed Gas Association* (CGA), the American Society for Testing and Materials (ASTM), the *American National Standards Institute* (ANSI), the *American Welding Society* (AWS) and the *National Fire Protection Association* (NFPA).

Valve selection and use also requires careful consideration. Guidelines emphasize that valves must be opened slowly. Accordingly, both the valve selection and operating procedures must be thoroughly investigated. By the nature of their design, full flow, quarter-turn valves such as Ball or Plug valves are quick to open and can induce high velocities. These high velocities can, in turn produce adiabatic compression and a resulting source of momentary heat ignition energy. This heat can ignite organic contaminants, plastics and small metallic particles in the form of burrs or loose chips.

Parker IVD's cleaning process ES8003 has been developed to remove or prevent contaminates such as burrs and metal filings, machining oils, human oils, lint, dust and hydrocarbons from entering oxygen systems from valves. In addition, valves requiring lubrication for function are lubricated only with those compatible for oxygen service.

Copies of ES8003 are available upon request from IVD, and all product lines can be ordered cleaned to this specification. The user should evaluate the procedure and determine if it meets the needs for the application.

B) High Purity Cleaning

Semiconductor process technology has demanded ultra high levels of cleanliness. Microscopic particle contamination can wreck havoc in a semiconductor manufacturing process. Furthermore, these processes are demanding cleaner systems as the size of microchip circuitry decreases each year. In fact, the entire clean room industry has developed in response to meeting the ever demanding needs of these industrial processes.

All Packless valves are supplied with a special cleaning process which is similar to the C3 oxygen service cleaning specification. For more demanding applications, these valves are available with a High Purity cleaning level. Valves cleaned to the High Purity standard are processed under Parker Hannifin IVD ES8004, and are identified by a "C4" in the valve's product nomenclature. Details of the ES8004 cleaning process are available upon request.

With this cleaning, all operations are conducted in a Class 100 Clean Room as defined in Federal Standard 209. In simple terms, the room environment cannot exceed 100 particles of any contaminant greater than 0.5 microns in size, in any given cubic foot of room air. The human eye cannot see particles of this size. Cleaning technology here involves the use of high pressure 18 megohm deionized water equipment to shear away any contaminants on the wetted surfaces of components. Laser-based particle counting is used to measure the cleanliness prior to shipment, and a special double-bagged packaging (consisting of a nitrogen-purged inner nylon bag with an outer protective polyethylene bag) is used to preserve the cleanliness of the component until it is opened at the user's facility.

Codes & Standards

VII. CODES AND STANDARDS

Instrumentation valve selection requires valves meet standards established to protect the valve user from products which are made from inferior materials or designed to less than acceptable criteria. Until 1987, there were no definitive industry standards specifically devoted to instrumentation valves. ANSI B31.1, entitled "Power Piping", referenced instrumentation in paragraph 122.3. Unfortunately, the document was of little value beyond recommended guidelines for materials and wall thickness determinations.

In the 1980's, the *Manufacturers Standardization Society of the Valve and Fittings Industry* (MSS) created a committee in which Parker IVD participated, to develop the first standard for instrumentation valves. Entitled *MSS SP-99,* this document was the first of its kind to specifically address the instrumentation market.

Unlike larger process valves which have numerous ANSI design specifications such as ANSI B16, the purchaser of instrumentation valves was left to reply on the manufacturer for sound design engineering and appropriate test qualification. This still remains the case, but *MSS SP-99* forms the basis for common practice among the responsible parties involved.

MSS SP-99 applies to small valves and manifolds developed for and primarily used in instrument, control and sampling piping systems. It addresses steel and alloy valves of one inch nominal pipe size and smaller. In its current form, the Standard Practice does not deal with brass valves. The document requires all pressure boundary components to be manufactured from materials identified in it. In addition, material certifications, identifying chemical analyses and mechanical properties, must be obtained for all pressure boundary parts.

The design requirements in *MSS SP-99* deal principally with end connections. Familiar ANSI standards for pipe threads, pipe socket welds and pipe buttwelds are incorporated by reference. Requirements for tubing remain the responsibility of the manufacturer. That is, mechanical tube fittings, tube socket welds and tube buttwelds are to be designed in accordance with the manufacturer's standard. *MSS SP-99* adopted ASME qualification requirements for end connections welded to the valve body. All welds must be performed in accordance with the *ASME Boiler and Pressure Vessel Code, Section IX.*

The most noteworthy item within *MSS SP-99* is the new *Cold Working Pressure* rating system (abbreviated CWP). Valves manufactured in accordance with this practice shall have Cold Working Pressure ratings established by hydrostatic burst qualification tests. The CWP rating of a valve is determined based upon 1/4 of the lowest burst pressure recorded for three production test valves, factored by the ratio of specified to actual tensile strengths of the pressure boundary materials.

The formula for calculating CWP is:

$$\text{CWP} = (0.25) \times (\text{Lowest Burst Pressure in three tests}) \times \frac{\text{Material Tensile Strength (specified)}}{\text{Material Tensile Strength (actual)}} \quad \text{(EQ. 1)}$$