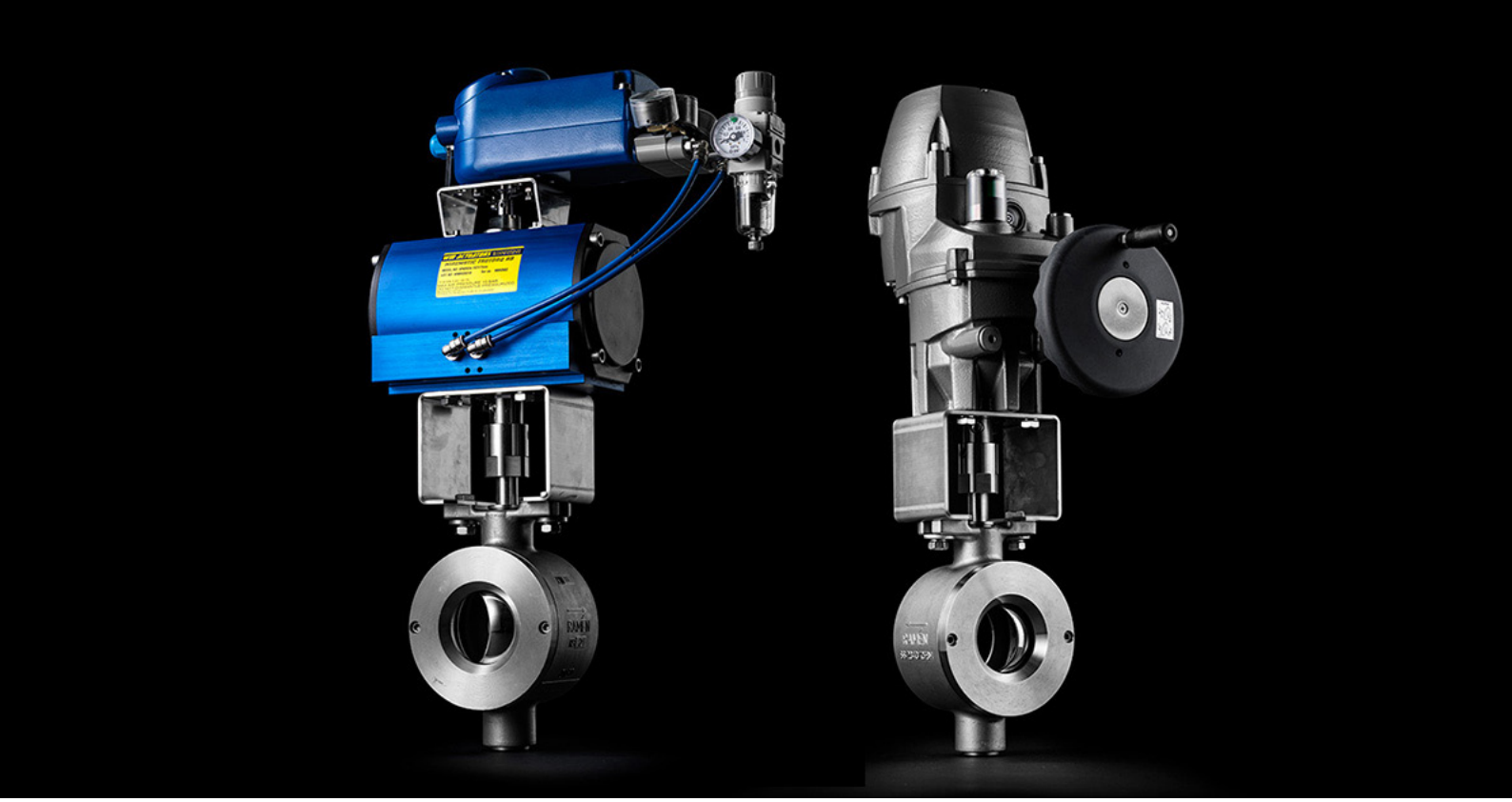
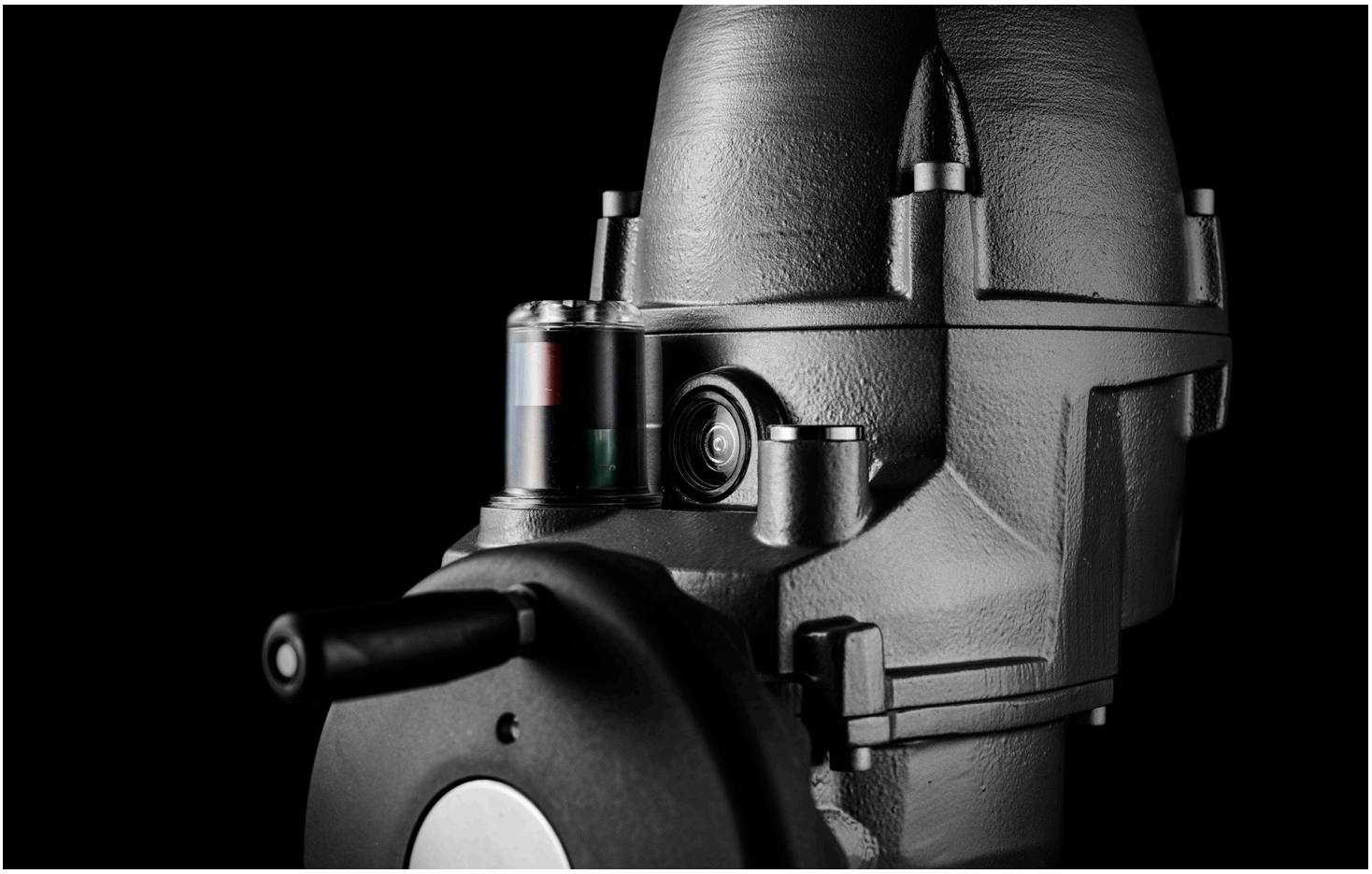


GUIDE

How to choose automation for industrial valves

- Key factors to consider when choosing automation
- Advantages and disadvantages of different control methods
- Different types of mechanical couplings
- Different types of actuator technologies and their features

RaménValves
We know the flow



Key factors to consider when choosing automation

By choosing the right automation, you can enhance process efficiency and optimize overall operations.

Valve automation means that the valve is equipped with a control element (actuator), a mechanical device that changes the position of the valve.

Automation is often pneumatically or electrically driven, but can also be hydraulic. In addition, electronics are needed to manage the input signal and the actuator, as well as the feedback of the valve position and status.

Here are some key factors to consider when choosing automation for your valve:

- The function of the valve
- The control method
- The mechanical aspects

Function

The control element in valves can often be set to optimise the process.

The function of the valve is a good starting point. Should it just close and open, or should it regulate a flow? What do we want to achieve in the process – a specific flow, a specific pressure, a specific level or a specific temperature?

Opting for cheaper products may compromise process parameters such as maintaining the correct temperature or achieving a stable flow rate.

It is also necessary to consider the technical requirements of the plant. There is no point in choosing valves with advanced control equipment **interfacing to digital communication systems** such as Profibus, Foundation Fieldbus, Ethernet or HART if there will be no other equipment to talk to.

However, if the valve is to be connected to one of these systems, make sure they support the **industry protocol** that applies to the plant.

Control method

Valves can be controlled using various methods and technologies, depending on the specific application, industry, and desired level of control.

Here are different ways of controlling valves:

• **Electrically** – Electric actuators use an electric motor to drive the valve's movement. They can be easily integrated into automated systems and controlled remotely. Electric control offers precise positioning and feedback options.

• **Pneumatic** – Pneumatic control involves using compressed air to operate the valve. Pneumatic actuators can be used to open and close the valve based on changes in air pressure, making them suitable for quick and precise control.

• **Hydraulic** –Hydraulic control uses fluid pressure to operate the valve. Hydraulic actuators provide smooth and powerful control, making them suitable for heavy-duty applications and situations where high tourqe is required.

A common mistake is to oversize or undersize the solution. If you oversize it, you will incur unnecessary costs. On the other hand, if you undersize it, you risk it failing or breaking down.

Advantages and disadvantages of different control methods

Electrically actuated

Although these valves come with a higher price tag, they eliminate the need for a compressor, an advantage that pneumatic systems do not offer. Electrically actuated valves provide excellent positional accuracy and can also offer modulating control.

Pros:
• Does not require a compressor, reducing associated costs and maintenance.
• High positional accuracy.
• Capable of modulating control.

Cons:
• Higher initial cost compared to pneumatic systems.
• Typically slower than pneumatics.

Pneumatically-controlled

Often chosen for their cost-effectiveness, pneumatically-controlled valves are a popular choice. However, these systems rely heavily on a compressor that can supply stable and clean instrument air, a factor that can significantly escalate the overall expense.

The investment may be justified if the plant houses numerous valves, but otherwise, an electrical solution might be a superior alternative, both technically and financially.

Pros:
• Low initial cost of valves.
• Quick response times and high speed.
• Simple design and easy maintenance.

Cons:
• Requires a compressor which can increase costs.
• Air supply must be clean and dry to prevent damage.

Hydraulic solutions

Hydraulic actuation is less common and typically employed for large, high-torque valves that operate infrequently. In such cases, the hydraulic system is often a mobile unit. While hydraulic systems can generate high forces and maintain them without additional energy supply, they require careful maintenance to prevent leakage.

Pros:
• Capable of generating and maintaining high forces.
• Suited for large, high-torque valves that operate infrequently.

Cons:
• Risk of leakage requiring diligent maintenance.
• Less common, potentially leading to availability or support issues.

Ramén Valves selects specific solutions that are of the right quality and provide long and safe operation. In principle, it should be plug and play – just connect the control signal and air or electricity.

Ramén KSC Electric Ball Sector Valve

Ramén KSC Pneumatic Ball Sector Valve

Mechanical aspects

An important factor when choosing automation is what is needed to mount the valve mechanically. **ISO 5211, VDI/VDE** or **Namur** are standards for the mechanical coupling (interface) between valve and actuator. They also specify the standard for the coupling between actuator and positioner (or limit switch). The product type and manufacturer determine which standard applies.

It is important to know who takes responsibility for the functioning of the valve when different parts are assembled by different parties.

We always know how the interface between different parts are dimensioned. For example, larger valves have much greater forces to handle than smaller ones and should be able to do so for a long time. By sizing the valves correctly, we ensure that the mechanical interfaces are correct, and can therefore guarantee long trouble-free operation regardless of external conditions.

At Ramén Valves, all our valves are fitted with standard mouting kits as per ISO 5211, with special anti-backlash coupling to avoid any hysteresis that would compromise the controllability and accuracy of our solution.

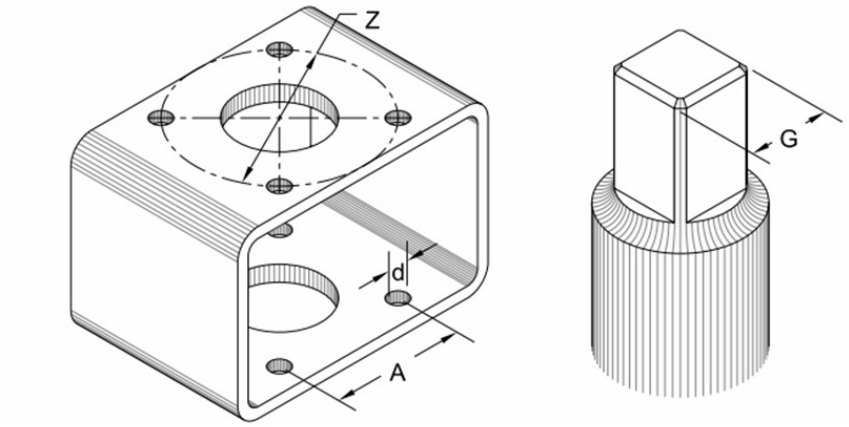
What is ISO 5211?

ISO 5211 is an international standard that specifies a standardized interface for mounting actuators (such as electric, pneumatic, or hydraulic actuators) on industrial valves. This standard defines the dimensions and requirements for the mounting flange and drive connection to ensure compatibility and interchangeability between valves and actuators from different manufacturers.

ISO 5211 simplifies the design, installation, and maintenance of automated valve systems in various industrial applications.

Extract from ISO 5211 Standards

ISO 5211 defines the actuator mounting dimensions and drive square size.



MM INCH	A	Ød	ØZ	Number of Bolts	Bolt Ø	G
F03	25.4 1.00	5.5 7/32	36 1.417	4	M5 10 - 24	9 .354
F04	29.7 1.17	5.5 7/32	42 1.654	4	M5 10 - 24	11 .433
F05	35.4 1.39	6.5 5/16	50 1.969	4	M6 1/4 - 20	14 .551
F07	49.5 1.95	8.5 3/8	70 2.756	4	M8 5/16 - 18	17 .669
F10	72.1 2.84	10.5 7/16	102 4.016	4	M10 3/8 - 16	22 .866
F12	88.4 3.48	12.5 9/16	125 4.921	4	M12 1/2 - 13	27 1.063
F14	99 3.90	17 3/4	140 5.512	4	M16 5/8 - 11	36 1.417
F16	116.7 4.59	21 7/8	165 6.496	4	M20 3/4 - 10	46 1.811

Dimensions in mm and in.

Different types of mechanical couplings

Mechanical couplings are used to connect valves to other components. There are several types of couplings, each with its own advantages and applications. Here are some of the different types:

Backlash free couplings – why are they needed and when does it not matter?

Backlash-free couplings, also known as zero-backlash couplings or torsionally rigid couplings, are essential in various mechanical systems where precise motion control and synchronization between two connected components are critical. The term ”backlash” refers to the degree of angular play or rotation between the input and output shafts of a coupling.

Backlash-free couplings are necessary in applications where precision, accuracy, and synchronization are paramount. They eliminate angular play between connected components and ensure consistent and reliable performance.

However, in less demanding applications where cost, shock absorption, or speed is the primary concern, standard couplings with some degree of backlash tolerance may suffice.

Why is bracket and coupling between valve and actuator always preferred vs direct mount?

The choice between a bracket and coupling (indirect mount) or a direct mount configuration between a valve and actuator depends on factors such as the type of valve, actuator, application requirements, and industry standards. Indirect mounting allows for greater flexibility in alignment adjustment, making it ideal for valves and actuators that may not be perfectly aligned due to manufacturing tolerances or field conditions.

It also provides easier access to the valve and actuator components, making maintenance and replacement tasks more straightforward.

Direct mount configurations can transmit excessive forces, vibrations, and torque directly to the valve, increasing the risk of damage.

A bracket and coupling can serve as a buffer, isolating the valve from such forces and protecting it from damage. It is also compatible with different actuators, making it easier to switch between actuators without modifying the valve or its mounting.

It is considered standard practice in industries like process control and can compensate for thermal expansion in applications where temperature variations can cause pipeline contraction.

What is the square in the datasheet of the valve and the actuator (star coupling)?

Square: The term ”square” in a valve datasheet refer to the dimensions of the valve shaft, typically expressed in inches or millimeters. For example, a valve shaft with a ”square” of 14 mm would have a nominal size of 14mm. This dimension is important for selecting the appropriate valve or actuator size for a specific application.

Star Coupling: A ”star coupling” typically refers to a type of coupling mechanism used to connect the output shaft of an actuator to the valve stem or the driven component. Star couplings are designed to transmit torque between two shafts while allowing for slight misalignment and angular displacement.

The term ”star coupling” may be used to describe the coupling mechanism itself, but it doesn’t typically refer to a specific measurement or specification in a datasheet.

What is the F unit?

The F unit defines the location of the holes on the mounting kit that will allow to assemble the actuator on the valve mounting kit or flange.

Different types of actuator technologies and their features

Diaphragm vs piston actuators

Diaphragm actuators are devices that use a diaphragm (usually made of a flexible, elastomeric material) to convert pneumatic pressure into linear or rotary motion. The diaphragm is housed in a chamber, and as air pressure is applied, it expands or contracts, causing movement that can be used to control valves or other mechanical devices.

Characteristics:

• Leak-Proof: The diaphragm provides a tight seal, minimizing leakage of the control medium.
• Low Friction: Minimal moving parts result in less friction and wear.
• Limited Force and Stroke: May not provide sufficient force for larger valves or high-pressure applications and have limited movement (stroke) due to the diaphragm's flexibility.

Piston actuators utilize a piston within a cylindrical housing to convert energy (often pneumatic or hydraulic pressure) into linear motion. The pressure applied to the piston generates force that is transferred to the object being controlled, such as a valve stem.

Characteristics:

• High Force: Capable of exerting significant force, suitable for larger valves and high-pressure applications.
• Durability: Often more durable in harsh conditions and can handle higher pressures and temperatures.
• Precision: Can provide precise control over the position of the actuated object.
• Size and Weight: More compact especially on rotary valves.

When pneumatic actuators are needed, our Ball Sector Valves are consistently equipped with piston actuators, ensuring a compact design while maintaining superior controllability.

Scotch yoke vs rack and pinion type actuator

A Scotch yoke type actuator is a mechanical device used to convert rotary motion into linear motion. It is named after the scotch yoke mechanism it employs.

A rack and pinion actuator is a mechanical device used to convert energy, often in the form of fluid pressure (e.g., hydraulic or pneumatic pressure), into linear motion.

The choice between scotch yoke and rack and pinion actuators depends on several factors, including the valve's characteristics, control requirements, environmental conditions, and application-specific needs.

Let's compare these two types of actuators:

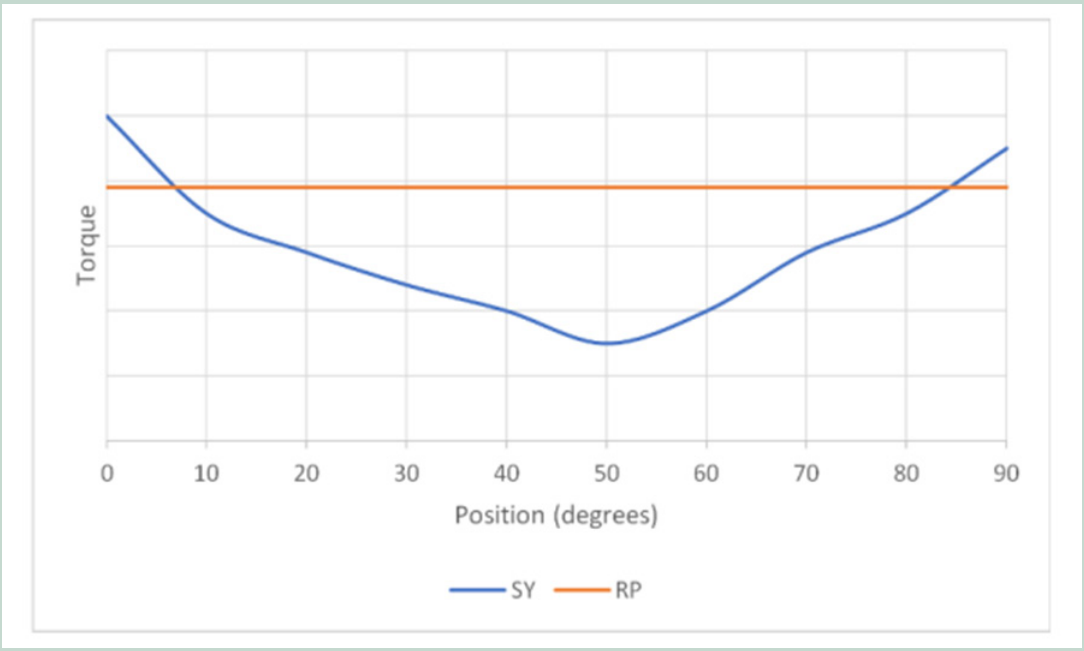
Scotch yoke actuators:

• **Mechanism**: A scotch yoke actuator uses a scotch yoke mechanism to convert rotary motion into linear motion. It consists of a rotating crank connected to a sliding yoke, which moves the valve stem or actuating rod linearly.
• **Control Flexibility**: Scotch yoke actuators are typically used for on/off control applications. They are well-suited for valves that require simple open/close operations.
• **Torque**: Scotch yoke actuators provide greater torque in the open and close positions, which can be beneficial for overcoming high sealing forces in some valves. However, they may have limitations in terms of precise control and modulation.
• **Size and Weight**: They are generally larger and heavier than rack and pinion actuators, which can be a consideration in applications with space constraints.

Rack and pinion type actuators:

• **Mechanism**: Rack and pinion actuators use a piston and cylinder arrangement to provide linear motion to the valve stem. Compressed air or hydraulic fluid is used to move the piston inside the cylinder.
• **Control Flexibility**: Rack and pinion actuators are suitable for both on/off control and precise modulation. They offer better control over the valve's positioning and flow rates, making them ideal for applications requiring fine control.
• **Force and Thrust**: These actuators provide a more uniform torque output throughout the rotation which is beneficial in control application.
• **Size and Weight**: Rack and pinion actuators tend to be compact and lightweight, making them suitable for applications where space and weight constraints are important.

At Ramén Valves, we always use rack and pinion actuators, since our Ball Sector Valves have low torque requirements, and the rack and pinion actuators will provide better accuracy and controllability with a more compact design.



Comparison of torque output between scotch yoke and rack and pinion

Spring-return vs double-acting actuators

Choosing between spring-return and double-acting actuators for industrial valves depends on the specific requirements of your application. Each type of actuator has its advantages and disadvantages, and the decision should be based on factors such as control needs, safety considerations, and the valve's function.

Here's a comparison of spring-return and double-acting actuators:

Double-Acting Actuators:
Double-acting actuators, provide force in both the opening and closing directions of the valve. They are known for bidirectional control and precise positioning.

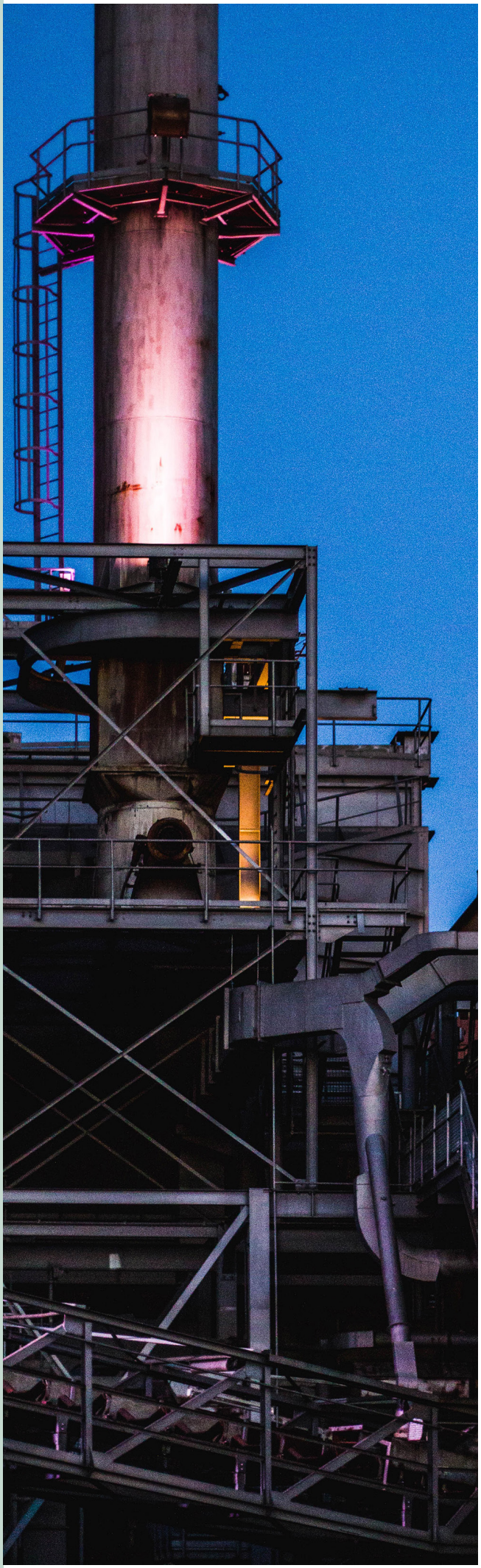
Spring-Return Actuators:
Spring-return actuators use a spring mechanism to return the valve to a specific position when the actuating force is removed. They are often used in fail-safe or emergency shutdown applications.

A spring-return actuator is often referred to as "fail-safe" because of its inherent safety feature that ensures a specific response in the event of a power or pressure failure.

These actuators have a spring-loaded mechanism that stores potential energy when in its default position. In normal operation, the actuator is powered to move in one direction, opposing the spring's force. If a power or pressure failure occurs, the actuator's power source is cut off, releasing the spring's stored energy, and pushing it back to its default position.

The safe position is chosen based on specific application safety requirements. The automatic return to the safe position provides additional safety and reliability in critical applications.

At Ramén Valves, we use double acting actuators as standard since it provides more precise control in both direction (opening and closing). However, spring return actuator can be beneficial if a fail-safe position (open or close) is beneficial for the process upon loss of air or electrical supply.



Choosing Between Analog and Digital Positioners

Positioners are devices used in industrial valve automation systems to precisely control the position of a valve's actuator, ensuring accurate control of process variables such as flow, pressure, and temperature. The choice between analog and digital positioners depends on the specific requirements of your application.

Analog positioners are suitable for basic control tasks where accuracy and advanced features are not critical, and cost-effectiveness is a priority.

Digital positioners are preferred when precise control, advanced diagnostics, and integration with modern control systems are essential. They are especially beneficial in industries where safety, compliance, and process optimization are top priorities.

In many modern industrial applications, digital positioners have become the preferred choice due to their advanced capabilities and compatibility with today's sophisticated control systems.

However, analog positioners still have their place in simpler applications or when budget constraints are a concern.

If you develop and sell production equipment to factories, it is a competitive advantage to have a flexible offering that can be easily adapted to the customer's wishes and needs.

If you would like to know more about which automation is best for your solution, please contact us.

Ramén Valves has been a valued partner to the process industry for 40 years. Our customers supply everything from residue burners in mines and steel mills to sterilisation through steam and clean air systems in the food industry.

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