GUIDE

Valves in mining enrichment

– how to ensure operation
(and avoid unplanned downtime).

Ramén Valves
We know the flow

The valves are a small part of an enrichment plant, but a very important part nonetheless. You need knowledge to prevent the risk of them causing downtime, production errors and occupational injuries. You need to know how to choose and order the right valve solutions, and how to install and maintain them.

That is exactly what this guide will teach you.

It is aimed at people in jobs that involve the processing side of mining operations. You might develop valve solutions, supply valves to the mining industry, or stand responsible for purchasing, operation, or maintenance at a mining company.

The guide is divided into four sections:

Product selection: How to choose the right ball sector valves for enrichment plant processes

Ordering: How to order the right valves

Maintenance: How your staff should maintain the valves to avoid accidents and downtime

Work environment: How to make the work environment safer

How to choose the right ball sector valves for enrichment plant processes

The enrichment of metals and minerals mined in a mine places special demands on the equipment. This applies not least to the valves that regulate and isolate media in the plant. Using the wrong valves increases the risk of costly downtime, accidents and environmentally harmful emissions. Not to mention shorter product service life and expensive maintenance.

So how do you come up with a good solution?

The right valves are essential for efficient and safe mining

Mineral processing is hard on the equipment used in mining processing. But choosing quality products is not enough, they must be the **right products for the purpose.** Not least regulating valves come in lots of variants and sizes, and one size does not fit all.

Avoid the trap of resorting to **old input data** used for previous installations – it may well be out of date. Nor is it a good idea to blindly rely on the **supplier** identifying the problems.

If you perform technical investigations and help companies in the mining industry to optimise their processes, you would be well advised to **ensure for yourself** that the supplier has the right data. Find out which **process characteristics** are to be achieved and specify them in the documentation. Always ensure with the client that the input data is correct and up-to-date. Old input data can cause major problems in retrospect when components such as valves are dimensioned incorrectly by the supplier.

Choose a product based on use

When choosing valves, the most important thing is to work on the basis of the relevant **media and applications**, i.e. what the valve is to control and what is to be achieved in the process, such as a certain flow, pressure, level, temperature or other aspect.

Common **media** include:

- Slurry, a mixture of sand, minerals and other materials that are processed in various stages to produce end products such as gold, silver, iron or zinc
- Water, e.g. process water or flushing water
- Chemicals added to purify or extract minerals
- Gas, such as natural gas, oxygen, nitrogen, hydrogen or other industrial gases

In an **enrichment plant** for iron ore, the ore is finely crushed, impurities are removed and the iron content is increased. To access and remove impurities, the ore is ground to a fine concentrate and mixed with water to form a **slurry**.

Some common **applications** in the mining industry are the control of lime water, grinding water and make-up water. Other applications include managing water flow to and from separators, water recycling, dewatering or sand pumping. Each application makes its own specific demands on the valves.

A regulating valve must be sized and optimised for the job it is supposed to do, i.e. for the media it is supposed to regulate. Any processes it is subjected to during start-up, cleaning or shutdown must be taken into account. Valves can regulate different media, but they can also be used to dose chemicals or water, for example, in order to achieve optimal process characteristics. It is important in this case to ensure it is adapted to the media and volume to be dosed.

Having **too few chemicals** may **impair process performance** and cause **failure of the product** made by the plant.

Having **too many chemicals** is bad for the environment and **wears out the equipment**, resulting in shorter service intervals. The fact that chemicals are often expensive also increases the **cost of production.**

The **materials** in the valves also impact on sustainability. Some materials are **corroded** by the chemicals – the valve simply rusts away. **Corrosive, acidic and explosive chemicals** have specific material requirements. **The particles** wear down the valves, causing **erosion** in valves coated with certain coatings such as ceramic. **Rubber-lined** products are available that are designed to cope with the slurry by repelling the particles from the surface.

Installation and maintenance are also part of the use of the product. How difficult is it to maintain and replace the products?

Correctly sized valves of the right quality dramatically increase service intervals. It is a major advantage if they are also easy to service and do not require complicated interventions such as hose changes.

Sizing and product selection – this is where things have to be right

Sizing a regulating valve correctly is crucial for a process to run efficiently and without failures. The supplier makes calculations to ensure a c**ost-effective, reliable and sustainable valve solution**. These are based on your input, which means that complete and accurate tender documentation is crucial.

The most important factors for correct sizing are:

- Media
- Flow – min, normal, max
- Temperature of media
- Inlet pressure
- Outlet pressure or backpressure, i.e. pressure

Other parameters to consider:

- Pressure drop when valve is closed
- Density, viscosity, concentration, and the presence of abrasive particles
- Pipe size and material
- Suitable materials for parts in contact with media
- Any requests for actuators, positioners, or accessories such as solenoid valves, limit switches or air filter regulators

The physical dimensions of the solution, how much space the valve requires in the installation, are also important. A compact small valve solution makes installation and maintenance easier than a solution requiring a lot of space.

The material does of course need to match the medium and the application. If the valve is to withstand a **high mechanical load**, such as being opened and closed many times, this needs to be taken into account when sizing the solution. Also check that it is **CE-marked according to the Pressure Equipment Directive**.

Choosing products wisely is very much about finding the **right quality level**. For example, using stainless steel or unnecessarily large valves when they are not needed is an unnecessarily major investment. On the other hand, technology that is too simple or choosing cheap materials often leads to demanding maintenance work, and expensive production failures in a worst-case scenario. Regardless of the technical level, the supplier must have test-pressurised the products and issued an **Inspection & Test Plan, ITP**, or functional certificate. While you are asking for this, you can also ask to see the **calculation data** as well, which shows what input data was used and what choices the supplier made.

If the valves are to be connected to a digital **communication system** such as Profibus, they need to support the **industry protocol** applicable to the plant in order to work.

Look at the life cycle cost

Cheap products can turn out expensive. Going for the **lowest unit price** is a risky strategy as it is often synonymous with inferior materials and construction. Products break or wear out more quickly.
A malfunctioning or leaking valve **compromises safety and production and increases maintenance costs**. The purchase price is just the tip of the iceberg. To be able to propose economically sustainable solutions for the mining industry, you need to take into account the total cost over time, known as the *Total Cost of Ownership, TCO.*

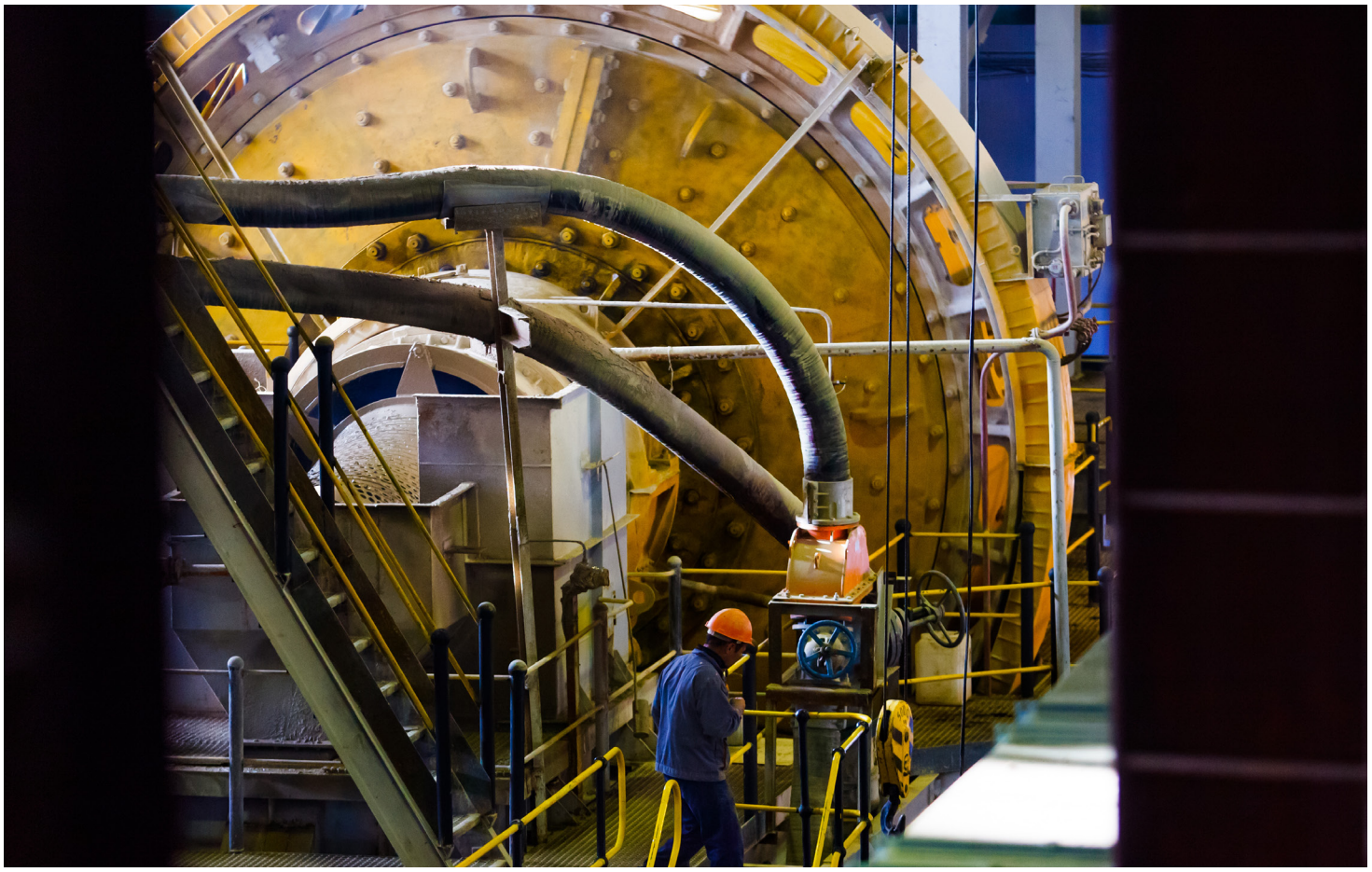
Some factors to consider that contribute to the overall cost include:

- Service life
- Maintenance intervals
- Spare parts requirements
- Need for cleaning
- Fault rate
- Wear and tear
- Harm to the environment, people and equipment
- Production losses and delays
- Energy consumption
- Consumption of oil and other lubricants

The valves are a small part of the enrichment of minerals and metals, but a very important part nonetheless.

We hope you now have a better understanding of what to consider when designing solutions for a mining plant involving valves.

If you have any questions about which valve solution would be suitable for a particular plant, please contact us.



Checklist for ordering the right valves for an enrichment plant

Ordering valves is not difficult.

But ordering the **right** valves can be a challenge. Not least in the mining industry, where using the wrong product in an enrichment plant can have major consequences.

If your job is to supply the mining industry with robust and affordable components, you probably have a wide range of items to keep track of. Keeping track of every single product category can present a challenge.

So how can you make sure the order is correct without delaying it? By keeping track of:

- What you need to pay attention to in tender documentation
- What to ask of the technical consultant and supplier

Do not rely on old assumptions

A common mistake when receiving an enquiry and ordering products for a valve solution is to **rely on old assumptions**. What has worked in the past or been chosen for other customers will not necessarily work for the contract you are currently focusing on. There is an imminent risk of something being wrong somewhere.

More haste, less speed

It is not uncommon to largely pass on specifications that suppliers receive. Time is money, but it pays to do your homework before ordering. Tender documentation is not always correct. Important information is missing at times. Especially if the supplier was not involved at an early stage or is relying on information from a less knowledgeable source.

If things do not add up in the request for a quotation, things can easily be passed from pillar to post, making the ordering process take *longer*.

Include everything in the procurement documentation

The range of valves and automation is enormous, especially if we are talking about regulating valves, and one supplier can have hundreds of variants. There is a reason for that: every medium, application and facility has its own unique requirements for the valves to ensure that things work and perform as they should. To be sure that you are ordering the right products, it is important to ensure there are no gaps or inaccuracies in the tender documentation.

Insist that the documentation you receive is **as complete as possible**, but do **not blindly rely on it** either.

Particularly important aspects to include in the tender documentation to the supplier are:

- Media
- Flow (min, normal, max)
- Temperature of media
- Inlet pressure
- Outlet pressure, also known as backpressure, pressure drop across the valve

Some key questions to ask the developer of a technical solution are:

- What is the application of the valve – what should its function be?
- In which environment will the valve be used, and what demands does the environment place on the valve?
- If the medium is liquid, what is its density, viscosity and concentration?
- Are any particles present that will cause wear?
- What materials are suitable for parts in contact with media?
- What spare parts are available, and how are broken parts replaced?
- Are there any requirements for certification and labelling of the products, and if so which ones?

Maintain the right technical level

Keep the possibility that you might be **overreaching in the back of your mind**. Choosing oversized valves or materials that can withstand stresses to which they will never be subjected costs money, for no benefit. Ask yourself question: what will the solution **cost**, and what will it **achieve**?

At the same time, **overly simple products** can mean an unnecessarily **high maintenance budget** and may end up with an end customer facing unplanned **downtime** at the enrichment plant. A real example of the wrong technical level – in both directions at the same time – is the plant where stainless steel valves were installed instead of cast iron, but without rubber linings. They ended up having to replace the expensive valves once a fortnight.

There have also been cases where valves have been supplied with advanced control equipment with Profibus interfaces without having any other equipment to talk to. One lesson that can be learned from this is to **adapt the products to the technical level of the plant**.

Maintain personal contact with the supplier

Get into the habit of always **checking with the supplier** before ordering. There may be a **cheaper or better solution** you are unaware of.

As we all know, a good relationship makes communication easier: quick answers, quick orders, more business. A **good cooperation with the supplier** can avoid misunderstandings and inadequate information and avoid delays, product failures and dissatisfied customers.

The supplier must also be able to **keep you informed** and give you ”quick training” in control engineering, product selection and other aspects. At Ramén Valves, we are happy to help you.

Correct maintenance – how to look after valves to avoid stoppages and accidents in the mine

Incorrect management of the valves in an enrichment plant can result in high maintenance costs, production failures and, in a worst-case scenario, personal injuries. Staff need to have the right knowledge if they are to take care of them properly. Especially when it comes to regulating valves.

"Do we have anyone here who knows anything about ball sector valves?"

You need to know what you are doing if you are going to **replace the ball in a ball sector valve**. There is a lot to keep track of, from avoiding **pinch hazards** and fitting the valve in the **right direction** and at the right angle to tightening the bolts to the **right torque**. Plenty of scope for the "human factor", in other words.

No wonder many companies **replace the whole valve** instead of just the broken part so as to avoid risks. But keeping only complete valves in stock to replace existing ones during planned downtime is an **expensive** maintenance strategy.

If you are a project manager or maintenance manager for a plant and recognise this, there are two things you can do. One the one hand, you can make sure your technical staff receive **training** on how to take care of the valves. On the other, you can choose valves with a **long service life** and that are **easier to replace** and maintain.

The right procedures from delivery to replacement

Looking at ball sector valves, what do you specifically need to think about?

It all starts when the valves are **delivered**. Check that they match the order and were not damaged in transit.

The label shows the characteristics of the product and must include the correct pressure class, size, type, material code, material and any CE marking.

Valves are marked with individual serial numbers so that they can be identified and traced. Ask the supplier to **mark the valve** with its unique position number in the plant, what is known as the **TAG number**. The TAG number is then also indicated in the PID drawing of the plant that describes the components and where it is located. This will make the product traceable, which can help to avoid misunderstandings and mistakes.

There must also be a **material certificate according to standard EN 10204**, known as a 3.1 or 3.2 certificate. This shows what the valve is made of and allows it to be traced back to the supplier.

Store valves in **open position** where they are not at risk of corrosion or soiling, and keep the cover on. If they have rubber linings, it is important for them to be stored in the **dark**, as rubber ages more quickly when exposed to UV radiation in sunlight.

Each valve has a **maximum and minimum permissible temperature** and a **maximum and minimum permissible working pressure** depending on its design and the temperature to which it is exposed.

Before installing a valve, check that its data matches the process media, pressure and temperature. Pipes must be cleaned and free of contaminants or other debris that could damage the valve during commissioning.

Always fit the valve according to the supplier's instructions. It is extremely important to consult the supplier's documentation on how to install the valve so as to achieve the best and safest operation.

Different valves may have different restrictions on how they can be mounted – horizontally or vertically, for example. Failure to follow these instructions increases the risk of leakage causing personal injury or damage to the equipment. For example, a flammable medium may cause a fire if it comes into contact with electrical components or hot objects.

If the valve has an actuator, test it before commissioning. Check that it closes and opens properly and that the ball sector works between the desired max and min positions.

Avoid changing mechanical stops in the valve without consulting the manufacturer. The valve may be damaged if the **angle of rotation** is **exceeded** during operation, installation or assembly.

Compressed air, electrical connections and control signals must be disconnected before **disassembling** the valve from the pipeline. Actuators with a built-in spring for what is known as the **failsafe or spring return position** must be set in the position in which the spring is **not tensioned**. The spring may cause serious personal injury if it releases its force during servicing. Here, too, follow the **suppliers' instructions** – and in reverse order during **installation**.

Keep the maintenance schedule up to date

The maintenance team needs to be aware of when it is **time to inspect** the production line and what it should look like. The maintenance schedule needs to be **updated** so that the drawings show the latest installations and changes. Otherwise, it is easy to miss small discrepancies that can lead to major problems. Also require the supplier to clearly **mark all equipment** so that it is visible even if the operating environment is dirty and dark. Otherwise, it can be difficult to be sure of what you are looking at.

Train staff – and define requirements for the supplier

It is easy to underestimate the demands on the technicians who will be performing the tasks. **New staff** who lack experience and skills can easily make mistakes, which is not surprising.

Training is absolutely essential when it comes to ensuring correct assembly, maintenance and disassembly. Ask whether your **supplier** offers training on this.

But even if you put your technicians through a **training programme**, this is no substitute for a **good relationship** with a manufacturer who can provide the necessary specialist expertise. **Make demands of your suppliers** and choose one that gives you what you need and helps you build your own expertise.

How to make your work environment safer – focus on valves

Valves may not be the first thing you think of when it comes to a safe work environment in the mining industry. But the fact is that the wrong valves, incorrect installation and incorrect maintenance pose a risk to personnel, the environment and operational safety.

What happens in the pipes should stay in the pipes. And there are a number of laws and regulations to keep track of and comply with.

This is what you need to bear in mind.

Risks in mining production

The employer holds **primary responsibility for the work environment** and is obliged to carry out systematic work environment management, i.e. to examine the work environment regularly to see what risks are present and to remedy any risks detected.

The work environment in the mining industry is hazardous, with everything from darkness and the risk of collapse to dust and radon gas. It is easy to focus on the work environment in the mine. We would like to strike a blow here for the work environment at the enrichment plant, and an important part of the production equipment: **the valves**.

Poor knowledge of valves increases risks

An **unplanned release** is not just dirty and unpleasant. A medium leaking from a pipe, valve or pump can destroy other equipment. It can be expensive to restore it, not to mention the cost of downtime. The medium is hazardous to the health of the personnel who have to deal with it if it contains chemicals, gas or any other toxic or corrosive component.

A **leak** may cause **slippery floors** or, if things go very wrong, give staff a very unhealthy **shower.**

A valve with the **wrong pressure class** might even **explode**.

Chemicals, superheated steam and dust in the same space as people quite simply equate to health risks.

Assembly and disassembly of valves is a **critical step**. Uncorrect handling may harm personnel or equipment while work is being carried out; and it can turn the equipment into a ticking time bomb. This is why it is so important for technicians to learn all about the suppliers' instructions.

Work Environment Act

The Swedish Work Environment Authority's (AV's) regulations for mining and quarrying (AFS 2010:1) address risks and measures to prevent ill-health and accidents, such as appropriate working methods, equipment, ventilation and evacuation. By their very nature, they are based primarily on mining rather than the work at an enrichment plant.

However, AV also has **special regulations** for **pressure vessels, vacuum vessels, pipelines and tanks**, for example – more about that soon.

SIL - reducing the risk of injury caused by technical equipment

Safety Integrity Level, SIL is part of the standard **IEC 61508** and is a safety rating indicating the risks of being near technical equipment. SIL is designed primarily for **digital security systems**. IEC 61508 specifies **4 safety integrity levels**, 4 being the highest level. When building an **SIL-rated safety syste**m for a plant, you first identify the **safety functions**, perform a **risk analysis** and specify the **safety requirements**. Based on this, the SIL system is **designed** and **verified** to ensure that the right level of integrity has been achieved. Only then is it built. For example, if the system includes a "pressurised device", the owner is obliged to have a competent organisation check the safety system.

A SIL rating increases production safety and uptime and reduces the risk of downtime.

ATEX classification plan minimises explosion risks

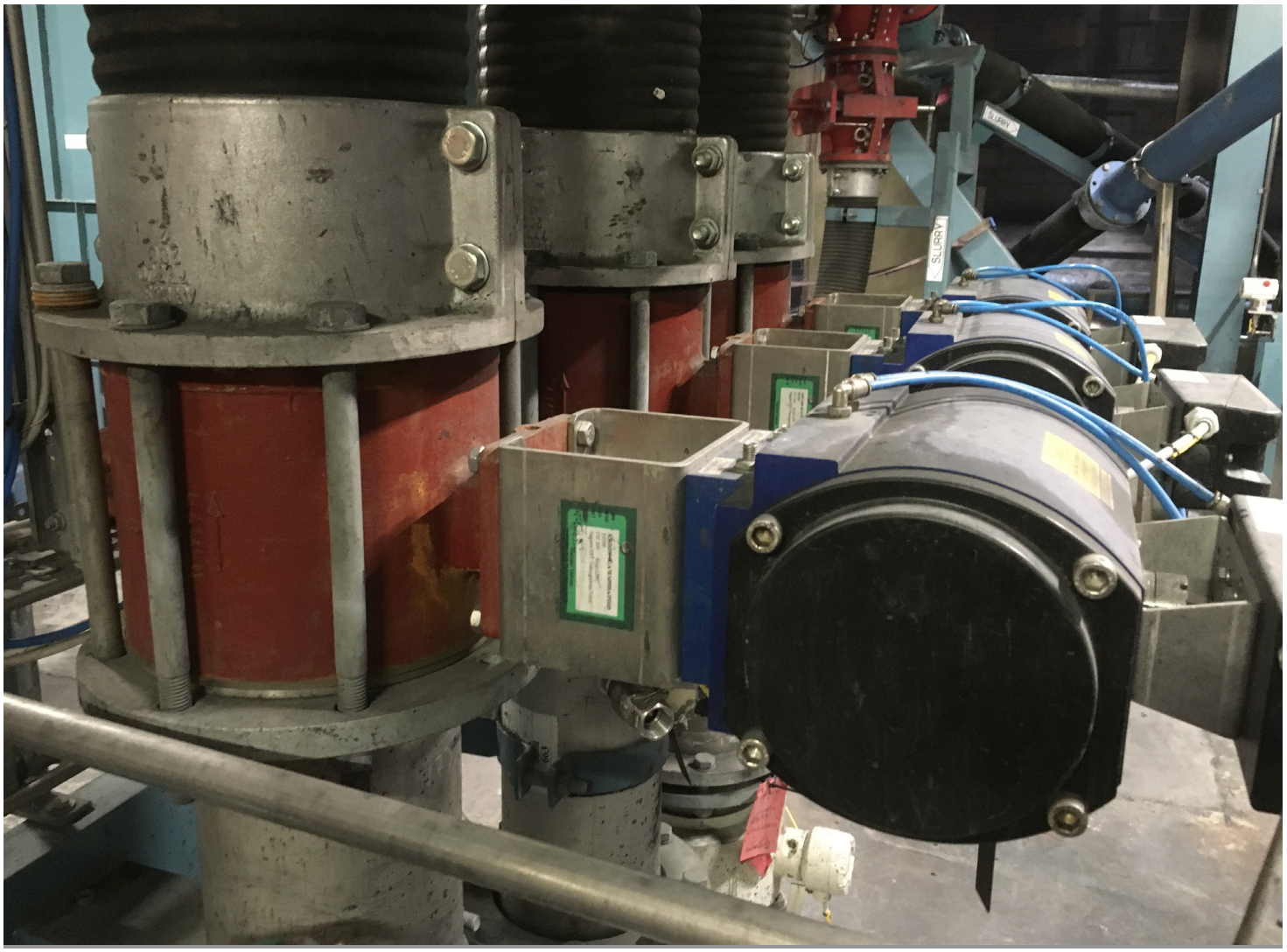
ATEX requirements/level: perform a risk analysis. Classification plan.

The Products Directive and **the Work Directive** are two important laws that regulate what equipment is allowed in areas where there is a risk of gas or dust explosion. Metal dust or other flammable dust may suffice.

These are usually referred to as **ATEX**, after the French ATmosphere EXplosible. If a plant handles flammable gases and liquids, the person carrying out the activity must **assess the risk** of gas or vapour being formed in the air in **sufficient concentration** to ignite, known as an **explosive atmosphere**. The risk of ignition must also be assessed. The person responsible for the plant is also obliged to ensure that a **classification plan** is drawn up for the area, which then determines the requirements for the equipment.

All equipment in a classified area must meet the requirements. For example, it can be **intrinsically safe** (EX ia) or **explosion-proof** (Ex d). **Intrinsically safe** means that the equipment cannot produce a spark or enough energy to ignite an atmosphere. **Explosion-proof** means that the equipment is enclosed so that any spark or energy cannot ignite the atmosphere outside the enclosure.

Always check the ATEX classification of the valve and its components to avoid unnecessary risks.



Check the CE marking

A CE mark on a product means that the manufacturer certifies that the products comply with EU health and safety requirements. All valves must be CE-marked, and your supplier must be able to explain what the CE marking stands for. A CE-marked product must be accompanied by a ”**declaration of conformity**”, a document in which the manufacturer declares that the product is compliant with EU safety requirements. This means:

- that the manufacturer declares at its own risk that the EU’s essential health and safety requirements are met.
- that there is documentation in Swedish in the form of installation and maintenance instructions
- that all necessary signs, markings and instructions for use and maintenance are present.

Instructions for use in Swedish must always accompany the CE-marked product.

Pressurised plants

Pressurised equipment is work equipment that entails specific risks, not least leakage and external damage. The regulations state that work must be planned, organised and carried out in such a way that dangerous situations do not arise. Safety work must be ongoing and include:

- Risk assessments
- Inspection, maintenance and control of the devices
- Information to staff so that they are aware of the risks
- Correct location and temperature
- Measures for filling and emptying, such as securely attached hoses

Protection to prevent damage to components – or worse, injuries that might be caused by overpressure or underpressure – is a legal requirement in many cases.

In a mining environment, there are many types of installations that handle **media with overpressure**. Examples include compressed air, instrument air, high-pressure washing for flushing and steam for cleaning. **Pressure Equipment Directive** Pressure equipment (AFS 2016:1) is defined as installations at pressures of **0.5 bar or higher**. Installations and plants must be protected so that they do not fail, or – in a worst-case scenario – cause an explosion or implode in the event of negative pressure. **Use and inspection of pressure equipment** (AFS 2017:3) regulates **safety valves** and their regular inspection.

There are no laws for negative pressure and vacuum, but well recommended industry standards and practices are in place. **Check with your supplier** on how best to protect parts that may be exposed to negative and positive pressure.

If you would like to know more about how to ensure the reliability of your mining production, please contact us.

Ramén Valves has been a valued partner to the mining industry for 40 years. We supply valve solutions for applications commonly involving abrasive media.

Sources:

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