# PREVENTATIVE VS. REACTIVE VALVE MAINTENANCE

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## Introduction

Preventative and reactive valve maintenance plays a key role in the safe and legal operations of natural gas distribution and transmission systems. Despite the requirements by federal regulatory agencies, routine valve maintenance is often an important part of the business that becomes neglected. Reactive valve maintenance can often be defined as the maintenance performed when the reliability or usefulness of system valves have depreciated or failed. On the other hand, preventative valve maintenance suggests that we as pipeline operators take a proactive approach in mitigating valve issues before they occur. Despite the challenges in designing and executing a successful valve maintenance procedure, building a safe and reliable valve network is of the utmost importance. This paper will discuss the importance of a preventative valve maintenance agenda and will study ways to easily alleviate the risks of putting the operators in a vulnerable position due to a valve failure.

## Reactive Valve Maintenance

We've all experienced the difficulties in trying to define what constitutes a "hard to operate" or "inoperable" valve. More times than not, the need to define these terms is due to a period of neglect and a lack of a developed, proactive valve outlook. As much as we hate to admit it, the longer that a valve is neglected, sooner is the likelihood of failure. It's at this point of failure, or inoperability that we often wish we had taken a more proactive approach.

Repairing and replacing problem valves is an incredibly costly undertaking for any gas company. Unfortunately, these happenings often have to be scheduled around critical projects where proper valve operations are required. One such difficulty with reactive valve maintenance is that without routine checks, one cannot accurately predict when a problem will happen. The depreciation of a valves performance over time is a gradual process. The increase in torque or the inability to isolate downstream could quite possibly have been prevented if a proper maintenance agenda had been implemented.

**Preventative Valve Maintenance**

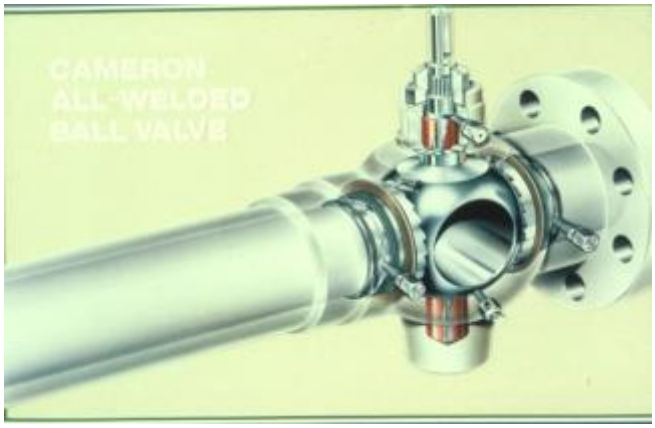
As was mentioned previously, a preventative maintenance plan identifies and proactively mitigates valve problems before they occur. There are many factors to consider in developing a program. For instance, how many valves do we have in our system? How many of those valves could be considered critical to the companies' operations? What types of valves are they? What is the regulatory compliance criteria that must be met? What type of service are these valves in? How much money can we allocate to these assets? How can we allocate our human resources to this effort? How are these valves being handled before, during and after they are in service? Though this may seem like a lot, these examples are just the tip of the iceberg when it comes to evaluating the past, present and future handling of your system valves.

Though creating a proper proactive maintenance program can be strenuous, common mistakes can be avoided through proper training. Some companies have groups whose sole job is to maintain the organizations valves and ensure that they are working properly. Other organizations have increased training and added the maintenance of valves into a groups responsibilities. No matter how it's decided, there are ways to properly make sure the valves are getting the attention they deserve.

As painful as it is to admit, far too often valves are looked at as commodities and liabilities, rather than valuable assets. Just as you look at the motor oil in your vehicle, natural gas system valves should be maintained on a regular basis. To continue this analogy, just as if one were to neglect changing their motor oil for an extended period of time at one point or another their car is going to break down. Doing what you can to prevent the devaluation of your valves will drastically help the longevity of these valuable pipeline assets.

**Types of Valves**

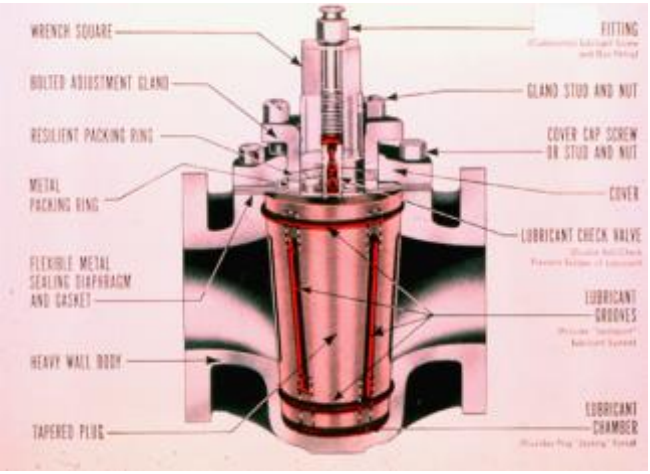
Being that this paper is primarily directed at local distribution and transmission companies, we can limit the remainder of this content to primarily focusing on the most common valves, ball valves and plug valves. These valves can each be used for a variety of applications and are generally the most popular. Though they are different design styles and should be cared for differently, they both are generally the same in function. They both are considered quarter-turn or 90 degree valves, meaning the bore goes from open to close as the valve rotates 90 degrees. Although these valves are similar in function, they should be selected based on technical applications and services.




Ball valves offer a unique set of features that aren't available in the majority of plug valves. Ball valves which use a hallow, pivoting ball to control flow offer advantages in situation where you may require a tight shutoff or a full port is required. After gaining popularity in the 1970's ball valves were often used where companies need reliable leak protection and a low pressure drop. A ball valve is typically designed to be operated in the fully open or the fully closed position. A ball valve is designed to seal on its own without the use of any external media.

Plug valves which are also quarter-turn valves are typically cylindrical in shape and use a cone to control the flow of gas. Most plug valves are two

ported, meaning they are either in the open or the closed position. The majority of plug valves are lubricated plug valves, meaning they need a viscous lubricant injected under pressure in order to stop the flow of gas. Typically these valves are used as isolation valves, bypass valves or blow down valves. Generally, maintenance on plug valves are greater than that of ball valves.




**Regulations**

The DOT and public utility commissions each have recommended and required regulations for maintaining system valves. These may differ from transmission to distribution companies or state by state, but these are general guidelines that they require gas companies to follow.

Typical DOT guidelines require companies to maintain "critical valves," on a yearly basis. The definition for critical valves is somewhat vague and can be open for interpretation. This interpretation usually includes isolation valves, block valves, and all valves that are located or work closely in relation to high consequence areas. Confusion often arises while defining the roles of certain valves. Why would a valve be in place if it wasn't critical to the systems operation?

Typical maintenance recommendations provided by the regulatory agencies typically require each valve labeled "critical" to be cycled at least 25%. Sometimes they include the recommendation of adding lubricants or sealants to the valves, but more often than not, that is left to the discretion of the user.

Many companies that already have structured preventative maintenance plans have them scheduled around their own interpretations of the rules and guidelines provided by the DOT and PUC. These organization will give the gas company a pretty accurate starting block on how to structure your preventative maintenance plan.

**Storage**

Upon receipt of the valves from the manufacturer there are things you can do to prepare the valve to work properly in the future. The first thing you should do is a visual inspection of the valve. This visual inspection should include verification of the name badge, and that all test results are attached. Users should also be sure to check for shipping and handling damages, and coating imperfections. If there are any damages to the valve upon receipt, the manufacturer should be notified immediately.

In addition to visual inspections of the exterior of the valve, it is important to verify that the valve was shipped and will be stored in the fully open position. Once this is verified, it is important to make sure the end covers are intact and secure. This will ensure that the seats and the bore remain clean from any dirt or debris. If possible, it is recommended by manufacturers to store the valves in a clean, dry and safe environment.

**Installation and Commissioning**

Once the valve has made its way out to the field to be prepped for installation, there are more factors that should be considered in preserving the life of the valve. First of all it is critically important to verify that the valve is still in the full open position and the valve is clear from dirt and debris. Next, it should be confirmed that the seat and stem sealant systems, as well as the manual gear box or actuator are in proper working condition. This means running a small amount of valve FLUSH or lubricant through the seat seals to ensure action. For weld end valves it is also critically important to prep the valve for welding. For this, the technician should coat the internals of the ball or the plug with a grease to prevent weld material from damaging the valve.

Upon installation to the pipeline, the inspectors should ensure that contractors are familiar with the valve manufacturers' installation, operations and maintenance manuals. Valve manufacturers list specific prep, welding and heating instructions for welded body valves, as well torque specifications for bolted body designs. After successful installation, before the valve is operated, it is recommended to once again FLUSH and lubricate the valve in order to empty the seat pockets from any debris.

Another factor during the installation and commissioning of the valves that plays a huge role in the long term success of the valves is the hydrotest and pressure testing. During a hydrotest it is important to keep the valve in the full open position when the pipeline is being filled. This will allow debris to flow through the valve and downstream to the end of the line. Once this is completed, operators should close the valve halfway to allow for the pressure differential to be equal in all parts of the valve. As pressure increases, visual inspections of the valves should be done to make sure there isn't any leakage. After the hydrotest has been completed, the valve should be returned to the full open position and the seats should be flushed or lubricated to prevent rusting of the hydrotest fluid. Be sure to drain the valve body to confirm that no liquids remain in the bottom of the valve during normal open operation.

After the hydrotest it is common to follow with a high pressure gas or air test. This test is often done with high pressure air or nitrogen. To do this test it is important to cycle the valve to the half-closed position to fully pressurize the valve. At this point, the valve can be operated to fully open or fully closed position depending on the design of the valve At this point the valve can be inspected for seat leakage and verification that they are in proper working condition. Valves have a tremendous risk of being damaged during installation. It is critically important to make sure to follow the manufacturer's recommendations and instructions during this period.

**Reasons for Failure**

As a valve goes through its service life, if you get to a point where a valve becomes hard to operate or inoperable, there are a few things that you can look for to try to troubleshoot your valve. There are both internal and external causes of hard to turn, inoperable or leaking valves. When you have an issue with a valve, you should always start by inspecting what you can visually see. There are

definite areas you should check before assuming that your valve is leaking.

You can start out by visually inspecting external causes. On certain models you can verify if you are getting complete rotation of the bore by checking the stops on the valve. This can be done on certain designs of ball valves. In addition to verifying rotation of the seats through the inspection ports, you can verify rotation through locating and slowly opening the body blow down fitting on certain types of ball valves. If the body of the valve blows down you can verify that the seats are holding. If the body continues to leak, you know that pressure is leaking by the seats. It may also be necessary to check and see if the gearbox or actuator stops are set correctly. If the stops are set too early on the actuator, you may not be getting full rotation of the ball or plug.

If an external evaluation checks out, you can start to assess internal causes for your valves issues. These internal causes can be many. To begin with, seizure to the seat could be a reason for inoperability. Over time, grit, dirt, debris and other pipeline garbage can collect in the valve creating a hard to turn, or leaking valve. In order to correct this, it is recommended to inject a valve flush into the valve in order to dislodge any of the debris that is causing this issue. It may take a couple of tries, but the repetition should dislodge any unwanted material. Another possibility is the seizure of the plug or the ball due to settling. This situation requires additional force to shift the ball or the plug back into its proper position. These valves often have heavy components that settle during periods of inactivity. High pressures and weight associated with these components with increase the torque and cause sticking. Routinely injecting a flush or lubricant material can keep these components from setting in the valves.

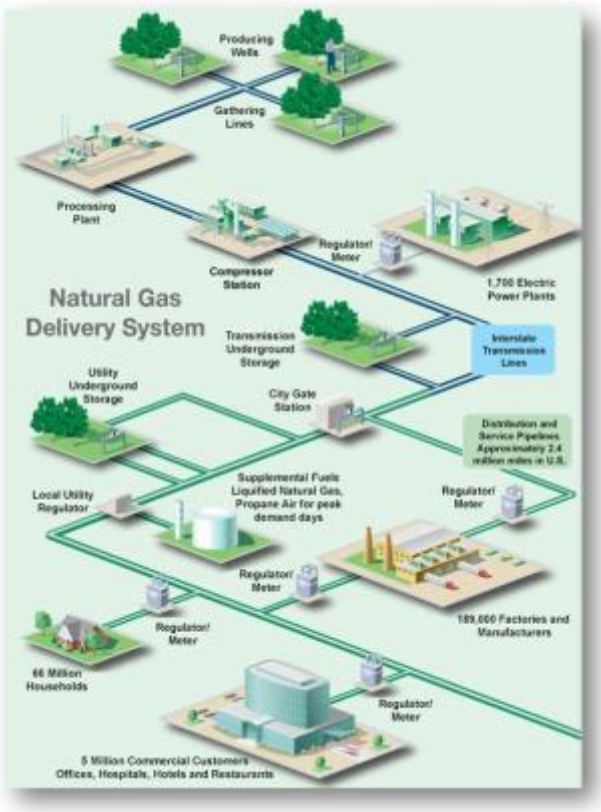
The examples listed above are just a few of the many reasons why you may experience valve failure. Proactive maintenance to keep the valves clean will go a long way in preventing these situations from occurring. Corrective action plans, also known as reactive valve maintenance can go a long way in keeping your valves running properly, but mitigating these situations before they occur will allow for generally smoother operations.

**Scheduling Maintenance**

If a valve has been put in place and is working properly with no problems concerning sealing ability. In order to maintain the valve properly, the operator will need to implement a scheduled routine of sealant system top-ups with synthetic lubricant. Typically, a new valve will require top-up more often than a valve that has been in operation for one year or more. It is this first critical year of operation that the valve seals sit tightest against the ball or plug, and lubricant is required to reduce the breakout torque during operation

Scheduling when to do maintenance can often be one of the most difficult decisions made with valve operations. Though as mentioned previously, regulations sometimes help with deciding on a schedule. Often, these decisions are left to the operators. The most important factor in this is deciding which valves are to be labeled as critical valves. Operators' cannot continue to only maintain their valves on a worst case scenario basis.

Defining critical valves may be dependent on the customers that are downstream of that valve. For instance, if a given valve has a combination of hospitals and schools downstream, that valve would probably be considered critical. In areas where critical customers are limited, it may be best to define valves by their application. As previously discussed, this could be decided to focus strictly on block valves or isolation valves. This decision needs to also be defined based on resources available.




After valves are defined based off their levels of criticality, it is imperative to define the timeframe in which these valves will be serviced and maintained. It is recommended by regulation agencies and manufactures for critical valves to be maintained on a yearly basis. This yearly valve maintenance schedule will consist of a basic visual inspection, valve operation and injection of lubricant. Checklists with specific instructions are recommended for field visits. Maintenance of pipeline valves is not a strenuous or demanding process. Generally, it only takes a few minutes to keep these valves in proper working condition.

Valves not labeled as critical can be visited on a less frequent basis. This may also be defined by the regulatory agencies, but it is recommended to not exceed more than a few years. The percentage of valves that fall in this category can be put on a rotational schedule. Valves in this category can be defined by age, location, application, etc, and can be grouped as families. Each year certain families should be maintained and visited in accordance to your schedule. Maintenance for these valves can be done on a rotational basis.

Creating a proper schedule and defining valve families may be the most intensive part of the valve maintenance process. Once these schedules are developed, the routine maintenance will become just another task operators tackle on their daily rounds. Each and every system is different, but creating a maintenance plan in order to prevent valve operators from becoming vulnerable due to inoperable assets will allow for safer and more reliable pipeline infrastructure.

**Training**

The entirety of the implementation of a preventative maintenance procedure will be easier to unfold once the operations people are

comfortable and competent working with the different valves throughout the system. Training is a key factor in how the maintenance plan is viewed. The operators need to be comfortable with all aspects of the valves. They need to be competent with all of the valves in the system, their functionality and all parts and components associated with those valves. Included in this are gear boxes and actuators. These operators also need to be comfortable with the valve maintenance operations as well. This would include operating the maintenance tools (grease guns), properly operating the valves, and knowing how different valves require slightly different maintenance techniques.

Once these skills are mastered, the operators will have the confidence required to properly carry out the maintenance schedule that will best suit the system. Qualified operators should have a competency in all facets of the valve installation, operations and maintenance.

It is important to keep in mind that valve manufacturers are always more than happy to assist in the training of their product. As was mentioned previously, each valve model has a slightly different design. Though many of them are similar in function, there are small intricacies that require the valves to be treated in a unique way. Knowledge of these intricacies are required for operators to be fully prepared for all the possible situations.

## Conclusion

Though much of the information presented in this paper is already known by many pipeline operators, thousands of valves every year continue to be labeled, “hard to turn,” “inoperable,” “leaking,” or “failed.” Creating a preventative valve maintenance procedure and being proactive rather than reactive will in the end save millions of dollars in valve replacements or lost production. This small, procedural change to a gas system can drastically affect the safety and productivity of an organization.

Starting with a preventative valve maintenance agenda, you will soon find that the valves throughout your system are performing much more reliably. Consistently operating, lubricating and making sure the valves are clean of debris will allow the operators to work on safer equipment. No longer will the operators be put in the vulnerable situation of valve failures. Reacting to problem valves will become a forgotten issue once a preventative valve maintenance agenda is adopted.

## References

Be sure to utilize the resources provided by the valve manufacturers. Installation, operations and maintenance manuals for various valves list step by step instructions for proper procedures.