ASHCROFT®
Trust the shield.®

Avoid Pressure Equipment Failure

Your process pressure instruments play a critical role in your applications. They accurately and reliably measure and monitor pressure to determine if process systems are working effectively and efficiently, or if you need to make system alterations or adjustments. This helps ensure the safety of your personnel, the efficiency of your processes and the quality of your products.

BUT WHAT HAPPENS WHEN YOUR PRESSURE INSTRUMENTS BREAK DOWN?

There are many causes of instrument failure, and these “instrument killers” can cause all types of problems, throwing a wrench in your project. Luckily, most of these issues can be prevented if you know the warning signs.

This guide will outline the most common instrument killers that endanger your pressure equipment. Although the focus of this guide is on pressure gauges, when the word “instrument” is used, it is referring to a gauge, pressure switch or transducer.

This guide will also teach you how to see these instrument killers coming ahead of time and how to solve them so you can keep your processes running smoothly, safely and accurately.

Pressure Instrument
Problem Warning Signs

Instrument maintenance is one of the keys to achieving and maintaining personnel safety, process efficiency and product quality. A comprehensive maintenance plan makes it easier for you to identify instrument issues and execute appropriate solutions before they become more significant or widespread problems. This helps save you time and money by preventing costly service work, unplanned downtime and equipment or process-based employee injuries.

Early warning signs of gauge issues include:

Pointer Flutter

The gauge pointer continually moves back and forth, making it difficult to read the measurement indicated.

Unresponsiveness

The pointer component does not move in response to changes in the operating pressure for which it is designed.

Component Damage

Various components of the gauge may have damage. For example, the pointer may be dented, a sign the gauge has been severely under or overpressured. In a liquid-filled gauge case, yellowed fill usually indicates elevated ambient temperature at the gauge. Also, the dial may be discolored, which is another sign of elevated temperature.

A melted or deformed gauge window, usually acrylic, is also a sign of extreme elevated temperature. The gauge window and dial are coated in a black powder making gauge readability an issue. This is typically the result of excessive pulsation and/or vibration that causes fretting or wear of the gauge movement teeth.

Among others, these signs serve as indicators of underlying gauge issues. If you can recognize them and understand their causes, you will be better prepared to diagnose and resolve problems that may occur in your own process instruments.

COMMON PRESSURE INSTRUMENT PROBLEMS AND SOLUTIONS

The key to overcoming problems with your instruments is recognizing their signs and understanding their problems. This information makes it much easier to determine and execute the right solution.

Below are some of the most common pressure instrument problems, including why they occur, what effects they have on the instrument and the overall operation or process, and how to resolve them.

EXCESSIVE PULSATION/VIBRATION

Problem

In processing equipment, surges in process pressure can cause pulsation of the gauge pointer. Similar to pulsation, vibration can lead to pointer flutter and component damage in gauges. They can be classified into two categories: high-frequency/low-amplitude and low-frequency/high-amplitude.

The former causes pointer flutter and centralized gauge movement gear teeth damage on the segment, while the latter causes widespread gear teeth damage across the segment and increased stress on the Bourdon tube.

As a rule of thumb, if pulsations or vibrations trigger pointer movement of 5% or more of the full-scale range, you should take steps to reduce their generation or their effect on the instrument.

Solution

There are three common solutions for instrument problems stemming from excessive pulsations or vibrations:

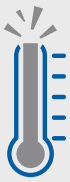
- **Dampening the movement/tube**
  You can dampen the effect of pulsations/vibrations on the gauge by filling the case with silicone, glycerin or halocarbon that includes an integrated throttle screw. Also consider a dry gauge with a dampened movement, like Duragauge ***PLUS!™*** Performance - a dry gauge that works like a liquid-filled gauge dampening the effects of pulsation and vibration without the headaches associated with liquid filled gauges.

- **Installing the instrument assembly away from the source**
  You can use capillary to mount the instrument further away from the source of the pulsation and vibration. Capillary is available in lengths from 1 foot to 100 feet.

- **Restricting the flow of the process material**
  You can reduce pulsation to the instrument by integrating a pulsation dampener, throttle screw, steel needle valve or a diaphragm seal to dampen the flow of process material. These accessories dissipate pulsation before it reaches the instrument.

LOW/HIGH TEMPERATURES

Problem



Instruments are rated for use in a specific temperature range. Using them in temperatures outside of this range can lead to significant damage, depending on their design and construction. For example:

- Dry gauges are typically rated for use in ambient temperatures below 200 °F (93 °C). Above this temperature, they may experience dial discoloration, window discoloration (if acrylic) or gasket hardening. Process temperatures for dry gauges are typically rated for between -20 °F (-20 °C) to 250 °F (121 °C).

- Liquid-filled gauges are typically rated for use in ambient temperatures up to 150 °F (66 °C). Above this temperature on a liquid-filled gauge they may experience leaching of the gasket and O-ring material and discoloring of the fill liquid. Both extremely low and extremely high temperatures can also trigger accuracy issues in instruments. A standard dry gauge can experience slowed point response time in low temperatures.

  Gauge accuracy is affected when ambient gauge temperature exceeds the temperature at which it was calibrated. As a guide, if a gauge is calibrated at 68 °F (20 °C), accuracy will be affected by approximately 0.4% per 25 °F/13.9 °C.

Solution

There are several common solutions for instrument problems stemming from excessively high or excessively low temperatures:

- **Mounting the instrument remotely**
  You can install the instrument away from the process with capillary to protect it from high or low temperatures. A gauge pipe mounting bracket is a convenient available option when remotely mounting the gauge. Ashcroft capillary is rated for temperatures of -300 ° to 750 °F (-184 °C to 399 °C). A simple 5-foot length of capillary between the instrument and the process is very effective at increasing low temperature and decreasing high temperatures.

- **Mounting the instrument directly**
  The Ashcroft MicroTube™ or finned siphon are rigid devices mounted directly to the instrument and then to the process so there is no need to consider how to mount the instrument if it were remotely mounted. The MicroTube™ siphon has been engineered for process pressures to 5000 psi and process temperatures to 800 °F (427 °C). The finned siphon is rated for pressures to 3000 psi and process temperatures to 700 °F (371 °C). Both devices are good temperature dissipaters.

- **Incorporating a coil or pigtail siphon for steam applications**
  These siphons when attached to the instrument can curtail temperature in steam applications. A pigtail siphon is used for vertical mounting whereas a coil siphon is used for horizontal mounting. Prior to installation, the siphon loop needs to be filled with water. The water acts as a barrier to protect the instrument from the elevated temperature and the harmful effects of water hammer, which is typical with steam applications.

PRESSURE SPIKES

Problem

Pressure spikes have many causes, including water hammer, overly rapid valve actuation, equipment malfunction or process fluid freezing. Gauges subjected to these conditions often show signs of damage like a dented pointer, a ruptured or deformed tube, or a broken segment gear. This damage can lead to unresponsiveness to changes in process conditions or complete instrument failure, both of which can result in poor operation or performance in your process. Pressure spikes or surges beyond the full-scale range of a gauge or overpressure can result in accuracy degradation, gauge failure or worst-case rupture of the bourdon tube.

Solution

There are many solutions if you experience instrument problems stemming from pressure spikes, including:

- **Integrating an internal stop**
  You can integrate an internal stop/overload stop to increase gauge proof pressure. This device typically increases gauge proof pressure by an additional 20%.

- **Installing a pressure limiting valve (PLV) or a gauge with high overpressure capability**
  This accessory device can be set to shut off at the full-scale range of the gauge. When process pressure falls below the full-scale gauge range pressure, the PLV will reset and allow process pressure to flow through the instrument. Another option to consider is a gauge with high overpressure capability like the Ashcroft T6500 with the XRA option. This gauge allows for overpressure up to 400% of the gauge range.

- **Selecting a new, properly rated gauge**
  You should choose a new gauge that accommodates the maximum operating pressure. For optimal readability, the gauge pointer should normally operate at 12:00 on the dial face. If the normal operating pressure of the gauge is 50 psi, choose a full-scale range twice the operating range or 0/100 psi.

INSTRUMENT CLOGGING

Problem

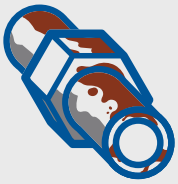
Instruments installed in equipment for “dirty” processes—i.e., processes involving particulates, slurries and sludge—are highly susceptible to clogging. Process material can become stuck on the instrument’s inner surfaces as it flows through the system, which can hinder the operation of the instrument and the efficiency of the process.

Solution

If the instrument’s process connection is susceptible to process media buildup or blockage, you can prevent clogging by isolating the instrument from the process media. A diaphragm seal or isolation ring are good choices. When clogging of the diaphragm seal is a concern, consider an available flushing connection. It is designed to flush process media buildup in the seal. Attaching a valve to the flushing port is ideal to control process flow. For heavy slurries or sludge, consider an isolation ring. This 360-degree design for process flow makes clogging virtually impossible.

INSTRUMENT CORROSION

Problem



The wetted parts of an instrument must be compatible with the process material. Otherwise, the instrument may corrode during use, which can affect product and process quality. Under severe process conditions, process media that is not compatible with the wetted parts of the instrument will result in eventual failure of the instrument causing the media to escape into the environment. This becomes a safety issue where operators can be injured or, in extremes, lose their lives.

Solution

If you want to avoid instrument problems stemming from corrosion, you should ensure the material for the instrument’s wetted parts is suitable for the process material’s composition, concentration and temperature. If it is not possible to choose a compatible instrument wetted parts material, you can integrate a diaphragm seal/instrument isolator or isolation ring constructed from an appropriate material for the process. Refer to the Ashcroft corrosion guide for process compatibility guidance.

INSTRUMENT ABUSE

Problem

Instruments are delicate pieces of equipment. While integrating the right design elements and accessories can help protect them from damage during severe service applications, it cannot protect them against abuse, i.e., incorrect installation or usage. Installing or using instruments incorrectly can cause significant damage, which can lead to measurement error or component failure.

Solution

If you want to avoid instrument problems stemming from instrument abuse, you should install, use and maintain your instruments properly. Installing NPT instruments requires the use of an open-ended wrench. Do not attempt to install and tighten the instrument using the instrument case! This often causes irreparable damage to the instrument.

Do not use the instrument as a step ladder after it is installed as this presents safety issues. Not only can the instrument be damaged, but someone can get hurt.

Inspect the instruments routinely for damage and performance.

You are now equipped with the knowledge you need to keep your people, processes and profits safe and secure. If you know what problems to look out for and how to solve them, you won't have to fear "instrument killers."

At Ashcroft, we are committed to helping customers select and source the right instruments for their needs. Whether you need assistance choosing instruments for a new process or operation, or resolving instrument issues with an existing equipment setup, we've got you covered.

ASHCROFT SOLUTIONS IN ACTION

Ashcroft Critical Application Solution Experts® (CASE®) help existing and prospective customers identify process challenges and recommend appropriate products and product configurations to resolve or prevent them. The following CASE study shows how our recommended solutions can improve the safety and protection of pressure instrumentation used in critical process applications.

CASE STUDY: ADDED PROTECTION FOR REFINERY'S HF ALKY UNIT

The customer: A refinery with a hydrofluoric acid (HF) alkylation unit—also referred to as an "HF Alky" unit. These units are used in petroleum refining operations to convert isobutane and alkenes (primarily propylene or butylene) into alkylate, which is used to make gasoline.

The problem: Hydrofluoric acid is hazardous and corrosive and, if accidentally released, can form a vapor cloud that causes severe reactions and possible fatalities.

The CASE diagnosis: After visiting the plant, reviewing the application, and performing on-site analysis of the gauge in use, Ashcroft recommended a gauge assembly with additional safety features for improved protection.

The CASE solution: The gauge assembly we recommended to the customer featured the ALD (Acid Leak Detection) system. Its key benefits include:

- Tamper proof design with the gauge welded to the seal
- Visual indication of leaking process media
- Dual containment for safety

ASHCROFT SOLUTIONS IN ACTION

CASE STUDY: MINIMIZED EXTREME EFFECTS FOR GAUGES IN PETROCHEMICAL APPLICATION

The customer: A refinery using pressure gauges for a variety of applications.

The problem: The gauge pointer indicated 42 psi with no applied pressure.

The CASE diagnosis: After providing an on-site pressure instrument audit where each gauge and process was documented and logged over a two-day period, Ashcroft noted signs of extreme service, such as elevated temperature, vibration, pressure pulsation, or damage. We diagnosed that 17% of all gauges exhibited signs of damage, including discolored fill, overpressure, liquid fill leaks, water ingress, broken windows, and/or loss of pressure containment.

The CASE solution: After determining the cause of the problem, we provided the customer with our recommendations on how to prevent the issues we found in the audited gauges. Recommendations included:

- Replacing the current gauges with ***PLUS!™*** Performance technology for most gauges at the facility. The technology would allow for a 50% reduction in gauge inventory, elimination of liquid fill leaks and fill discoloration issues, and dampening of the effects of pulsation and vibration for a longer-lasting gauge.
- Adding a pressure limiting valve (PLV) for when overpressure exceeds gauge proof pressure.
- Glycerin-filled case gauges were also recommended for the small percentage of severe vibration applications.
- An optional IP65 weatherproof gauge case to prevent water/moisture ingress and featured an acrylic gauge window to reduce the risk of the window breaking in the future.

Don’t let unreliable pressure and temperature measurements disrupt your business.

Process, **industrial/OEM** (original equipment manufacturer) and manufacturing companies need quality pressure and temperature measurements to keep their critical equipment and processes running. Understanding that your business can’t stop, Ashcroft designs and manufactures reliable instrumentation to meet the most challenging applications worldwide so you can confidently run your business.

Contact Us Now

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