Gauge Your Best Practices

WIKI - Part of your business
Importance of Mechanical Gauges

Why Maintain Them?

• Provide a local pressure and temperature indication

• Detect signs of degradation in process performance not otherwise tracked through DCS equipment

• Identify potential loss of process or loss of containment

• Predict how long a piece of equipment can be safely and economically run

• Diagnose causes of system and production disruptions
Local Indication: Sole Source of Data

- Discharge pressure
- Suction pressure
- Mechanical seal flush pressure
- Filter differential pressure
- Utility pressure (steam, nitrogen, plant air)
- Exchanger temperature
- Vessel temperature
Rethinking Instrumentation

What Do Pressure Gauges Have to Do With Reliability & Profitability?
Pressure and Temperature Instruments

Myth
- Mechanical pressure gauges do not help me increase productivity or reliability

Reality
- Pressure and temperature gauges are cost-effective tools that tell you what’s happening with your process and critical equipment

Impact
- The right gauge will ensure you have the data you need to ensure the reliability and safety of your operations
5 Ways Gauges Help Troubleshoot Critical Equipment and Reduce Costly Repairs

Problem: Poor Pump Performance
Is the Pump Damaged? Process Off-Spec?

1. DISCHARGE PRESSURE
   Is pressure reading at design?
   NO

2. SUCTION PRESSURE
   Is suction pressure reading at design?
   NO
   YES

3. SUPPLY PRESSURE
   Strainer clogged, or other upstream process issues.

4. PRIMARY FLUSH PRESSURE
   15-30 psig higher than suction pressure?
   NO

5. SECONDARY FLUSH PRESSURE
   30 psig higher than primary flush pressure?
   NO

Problem: Mechanical Seal Failure
Is the Seal Receiving Adequate Cooling? Lubrication?

Pressure not adequate to maintain cool, clean seal chamber – grit & heat accelerate wear.

Barrier contamination & accelerated seal face wear possible from low set pressure.
Gauge Maintenance Is Not Easy

■ Present State of Gauge Population
  “No analysis has been performed in a long time … if ever.”

■ Knowledge Gap
  “I inherited a mixed bag. The plant was constructed before I was born.”

■ Lack of Ownership
  “Operations replaces gauges. Maintenance stores them. That is the extent of our procedures.”

■ Like and Kind Replacement
  “Our P&IDs have gauge locations marked but no specifications are indicated.”

■ Lack of Resources
  “I don’t have time to identify, analyze, correct and document the 1000+ gauges in our plant.”
The Pressure Gauge:  
**Current State**

40% of pressure gauges reviewed have failed or are in danger of failing.

*Based on more than 250 Instrument Audits*
Why Gauges Fail
Gauge Failure

The most common gauge failures based on data analysis of more than 250 Instrument Audits.

Pressure Spikes

Overpressure/High Pressure

Pulsation

Vibration

Corrosion

Temperature

Clogging

Mishandling and Improper Use
Pressure Spikes
Pressure Spikes

Main Causes
- Opening and closing valves while the system is running
- Pressure surges or impulses

Symptoms
- Pointer is bent (Fishtail) from spike in pressure

Consequences
- Spikes in pressure can cause the Bourdon tube to rupture
- May cause movement gears to disengage in gauges that do not have underload/overload stops which can cause permanent movement damage
Pressure Spikes

Bourdon Tube Warped & Split
Pressure Spike: Best Solution

Overpressure Protector

- At a predetermined pressure, the overpressure protector "shuts-off" pressure to the gauge, preventing damage to the sensing element and protecting the calibration.
- The set-point is externally adjustable.
- WIKA overpressure protectors also feature a piston valve that is designed to dampen system pulsation.
- Overpressure safe up to 14,500 psi (1,000 bar).
- Vacuum safe.
Gauge Failure – Overpressure/High Pressure

Overpressure/High Pressure
Overpressure/High Pressure

**Main Cause**
- Caused by system running at full rate of capacity of the pressure gauge

**Symptoms**
- Pressure gauge is operating at either full scale or past full scale value
- Pointer pegged against stop pin

**Consequences**
- Can cause the Bourdon tube to rupture, which could lead to a media leak
- Causing increased wear on movement and internal components, which can cause permanent movement damage
High Overpressure Safety

- Gauge with a safety case design and a high overpressure safety range – 2X the standard flow pressure
Pulsation
Pulsation

Main Causes
■ Caused by the pump rapidly cycling or large pressure swings

Symptoms
■ Difficult to read pressure measurement due to pointer flutter
■ Broken or loose pointer

Consequences
■ Increased wear on Bourdon tube and components
■ Gauge will not indicate within published accuracy
■ Overpressure will not be indicated due to compromised gauge accuracy
Pulsation: Good Solution

Socket Restrictor

- Socket Restrictor – keeps a constant pressure across the orifice and dampens the effects of pulsation, which helps prevent internal damage to the Bourdon tube and movement, extending the life of the gauge

- Economical – low-cost solution

- Available in brass, stainless steel or Monel®, the socket restrictor reduces the size of the internal bore
Pulsation: Good Solution

Liquid Filled Case

- **Benefits:**
  - Adds lubrication to movement
  - Glycerin fill is inexpensive
  - Will help dampen the system
  - **Will not stop pulsation by itself**

- **Fill fluids include:**
  - Glycerin
  - Silicone
  - Halocarbon®
  - Fluorolube®
Needle Valve

- Needle valves isolate a pressure instrument from the application
- Soft seat versions are ideal for gaseous media where a bubble tight seal is required

Adjustable Snubber

- Adjustable needle valve design
- Stainless steel & brass construction

Porous Metal Pressure Snubber

- Uses a porous metal disc to provide restriction
- Low cost
- Effective on clean service

Needle Valve

Adjustable Snubber

Porous Metal Pressure Snubber
Pulsation: Best Solution

All-Welded System - AWS

- Eliminates potential leak paths
- Tamper-resistant design to prevent separation of individual components
- Extends gauge life
- Meets fugitive emission demands
- Complies with the EPA’s dual-containment requirements
- Appropriate for high temperature and thermal cycling applications
- Prevents media leakage, even when surges and pressure spikes are present
- Available from inventory for immediate delivery

M93X.D1
Vibration
Vibration

MAIN CAUSES
■ Vibrating equipment near the gauge, usually from pumps or similar type equipment

SYMPTOMS
■ Increases wear on movement and components
■ Damage occurring to internal components may be difficult to determine
■ As movement wears, the Bourdon tube can vibrate or even crack

CONSEQUENCES
■ Difficult to read pressure and failed gauges
■ Loss of containment (LOC)
■ Fugitive emissions
Pointer has fallen off due to severe vibration

Dust on inside of window from wear of internal components
■ Failing gauges don’t always show symptoms externally, but they are not giving you proper readings

■ Cracks in tubes lead to the worst scenarios, including potential loss of containment
Liquid Fill

- Liquid-filled cases dampen vibration and reduce wear on internal components
Field-fillable Case Design

- Designed to be liquid filled
- Easy to fill case
- Dampens tube and movement
- Fill acts as lubricant/coolant
- Fill fluids includes:
  - Glycerin
  - Silicone
  - Halocarbon®
  - Fluorolube®
Gauge Failure – Corrosion

Corrosion
Corrosion

Main Causes

- Pressure gauge materials are not compatible with the media they are measuring or the surrounding environment
- Media attacking the wetted parts of the pressure gauge

Symptoms

- Case, pointer, lens, connection, or dial erosion or discoloration

Consequences

- Loss of containment
- Fugitive emissions
Corrosion

Case, pointer, dial & lens completely eroded from media corrosion
Corrosion from atmospheric conditions
Let WIKA gauge experts develop a custom seal depending on your system’s media

- WIKA offers a variety of custom materials, such as Teflon, precious alloys (e.g., gold and silver), or carbon steel

- WIKA’s Metal Bonded Diaphragms work for processes requiring Hastelloy®, Monel® and Tantalum flush diaphragms
Temperature
Main Causes
- Ambient & media temperatures that exceed instruments allowable temperature limits

Symptoms
- Pressure system joints either sweat or loosen
- Pressure system alloy cracks
- The dial turns grey, brown, or discolored
- In liquid filled gauges, the case fill can turn brown or black in color

Consequences
- Can cause other components to break down or erode
- Loss of containment
- Fugitive emissions
Temperature

Melting dial and discolored fill fluid from excessive process media temperatures
Ambient temperatures are just as important to consider as process media temperatures.
Temperature: Best Solution

Cooling Element

- Ensure that the media temperatures are within allowable temperature limits
- Excessive process temperature applications may require the use of diaphragm seal solutions
  - Diaphragm Seal (300°F)
  - Diaphragm Seal + Cooling Element (500°F)
  - Diaphragm Seal + Cooling Tower or Capillary (750°F)
Clogging
Clogging

Main Causes
- Measurement instruments are not compatible with the process media
- Not using the proper accessories to protect against clogs

Symptoms
- Inoperable gauge
- Shows no pressure when the system is operating

Consequences
- No way to measure pressure in the system to avoid overpressure issues
- Pressure system to gauge becomes clogged from solids in the process media
- Pressure system can be clogged from highly viscous and crystallizing media
Clogging

Clogged gauge connection
Let WIKA gauge experts help you determine the best solution to prevent clogging for your system

- **Good solution:** All-Welded System

- **Best solution:** High Pressure Seals reduce the number of connections within the process, thus providing a built-in anti-clogging feature by eliminating internal cavities
Gauge Failure – Maintenance/Improper Use

Maintenance or Improper Use
Maintenance/Improper Use

Main Causes
- Gauge is placed on an application it is not designed to handle
- Lack of knowledge, improper training
- Workers accidentally dropping the gauge

Symptoms
- Cracked case
- Broken window lens
- Crooked/bent gauge

Consequences
- Loss of containment
- Fugitive emissions
Maintenance/Improper Use

- **Cracked Case**
- **Broken Window**
WIKAI’s *Instrument Safety Training* helps you improve plant safety

- Use the proper installation methods
  - Do not tighten by grabbing the case & turning
  - Always use the wrench flats to install the gauge properly

- Install the correct gauge every time
Improving Costs, Reliability of Your Instrumentation
Let us be your gauge experts

- Gauges, if used properly, can help you identify an issue before costly problems develop

- Our Full Audit Service Team (FAST) will take care of your gauges to help
  - Lower inventory costs
  - Improve reliability
  - Reduce gauge maintenance costs

- And best of all, FAST is the only solution you need—a total care services program at no additional cost to you

WIKAI’s FAST engineers helped a large chemical plant address 50 years of gauge proliferation. Read the case study to learn more.
FAST Expertise

Over 250 Instrument Audits

Over 150K Instruments Reviewed
A **Full Suite of Services at Zero Cost**

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<td><strong>WIKA's Instrument Audit</strong> provides expert analysis and solutions from our FAST engineers who help you put the right gauges in place for your applications to improve reliability and lower costs.</td>
<td>Our team performs an Instrument Audit, standardizes the instruments you need and sends the products to you when you need them... before your turnaround begins so you can avoid delays.</td>
<td>Send us your failed gauge, and our engineers will conduct a root cause analysis. By understanding the mode of failure, our FAST engineers can recommend a reliable solution.</td>
<td>Our FAST engineers train your team to look for signs of instrument failure when completing a scheduled evaluation of your instrumentation.</td>
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FAST Instrument Audit

Establishes a Sustainable Gauge Maintenance Program

- Visual inspection of pressure, temperature gauges to build a comprehensive record of gauge installations and rate problematic conditions
- Data analysis to provide engineering-based recommendations that improve, standardize and consolidate your population
- Implementation support, including ERP imports, MOC documentation, and Easy Order Guides (See a sample)
- Improves reliability, and decreases inventory and maintenance costs year after year
Average FAST Audit Savings

$51,171\dagger$ in first year savings,
Ongoing annual savings of $21,073\ddagger$

- Decrease Maintenance Costs*
- Correct gauges for processing conditions: 20%
- Increase in Reliability*: 25%
- Standardize on full scale ranges, options for gauges: 30%
- Reduction in Inventory*: 10%

First year savings only includes engineering resources for physical audit, storeroom review, data compilation, and implementation support. Based on average audit of 1,000 installations, requiring two instrumentation engineers for one week.

\dagger Ongoing annual savings. Inventory savings based on industry averages for overhead, inventory management, shrinkage, obsolescence, inventory tax, and cost of capital.

\ddagger Based on results from more than 250 WIKA instrument audits.
Ensure the Right Instrumentation for Start-up

- Our team performs a full Instrumentation Audit and standardizes what instruments you need...before your turnaround actually begins.

- With this advanced preparation, we ensure that the right instruments are at your plant at the exact time you need them – eliminating the risk of delay.

- Action plan with part number, IOM and data sheet for each installation.
Getting to the Root of the Problem

- If you have gauges that are continually failing, then send them to us
- Our FAST engineers will perform a root cause analysis
- Can alert you to problems with more expensive equipment
- Reduces likelihood of downtime and decreases maintenance costs

WIKA’s FAST engineers assessed a recurring gauge failure and identified a larger issue before costly repairs were required. Learn how.
FAST FACT
U.S. process plants lose more than $10 billion per year from abnormal situations caused by human error.

Source: Abnormal Situation Management Consortium

- Education and training are best tools to maintain operational efficiency and employee safety in your plant
- Our Instrument Safety Training will teach your team to look for warning signs
- Held at your site or ours, the training helps reduce maintenance costs and wrench time
How much could you save with FAST Audit?

Contact us for a Cost Savings Estimate or to Learn More about WIKA’s FAST Services.

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