Rosemount Pressure and Temperature Products Overview
PRESSURE, TEMPERATURE & CORROSION RELATIONSHIP

• Increase in PRESSURE results in increase in corrosion. The reason for this is that the main types of corrosion in oil and gas systems are caused by the presence of CO2 and H2S – most commonly CO2 in the North Sea. CO2 when dissolved in water forms carbonic acid (H2CO2) - increases in pressure therefore also result in increases in the H2CO2 concentration and therefore the corrosion rate.

• There is a rule of thumb that the corrosion rate of metal doubles for every 10 degC increase in TEMPERATURE. This is a bit of generalization and doesn’t necessarily hold true for all types of corrosion but it’s a good way of highlighting the relationship between corrosion and temperature and therefore the value in being able to accurately monitor / trend temperature if you are looking to gauge when the corrosion in your system could be increasing / decreasing.
Pressure Products
Emerson is Your Best Source for Pressure Measurement Instrumentation

• **A history you can rely on**
  • Millions of transmitters installed
  • Largest supplier in the world

• **Most capable product portfolio**
  • Superior Pressure, DP Flow, and DP Level Solutions
  • Innovative technologies
  • Advanced diagnostics & measurement

• **Customer focused**
  • Local Sales, Service, and Field Specialists
  • Global Manufacturing

• **Enabling you to be more competitive**
  • Maximizing productivity
  • Improving Quality
  • Reducing Costs
  • Enhancing Safety
Rosemount Pressure Offering is Designed to Meet All Application Needs

**Standard in Full Portfolio**
- Scaled Variable
- HART, WirelessHART, Foundation Fieldbus
- Inline, Coplanar and Level Connections
- Dual Compartment Housing
- Device Dashboards with EDDL
- SIL2 Safety Certified per IEC 61508

**3051S Series**
- World’s only scalable series
- Best reliability with SuperModule Platform
- Industry leading performance with Ultra & Ultra For Flow Performance
- Innovation to maximize customer value (MultiVariable, Advanced Diagnostics, ERS)

**3051**
- Best selling pressure transmitter in history
- Industry Standard
- Enhanced functionality

**2051**
- Bid Spec Compliant
- Basic Functionality

Accuracy: 0.065%
Rangeability: 100:1
Stability: 5 years

Accuracy: 0.04%
Rangeability: 150:1
Stability: 10 years

Accuracy: 0.025%
Rangeability: 200:1
Stability: 15 years
Rosemount 3051S: The Only Transmitter You’ll Ever Need

**Performance**

- Reference Accuracy: 0.025 %
- Total Installed Performance: 0.1%
- Stability: 15 Years
- Warranty: 15 Years
- Rangeability: 200:1
- Safety Certified Diagnostics: SIL 2/3

**Capabilities**

- Pressure Ranges: 0.1 in.H20 to 10,000 psi (0,25 mbar to 689 bar)
- Process Temperatures: -102 °F to +698 °F (-75 °C to +370 °C)
- Variables™: DP, P, Temperature, Level, Volume, Mass & Energy Flow
- Protocols: HART®, WirelessHART®, Foundation™ Fieldbus
- Diagnostics: Complete coverage from your process to the host
Full Diagnostics: From The Process To The Control Room

Detect Electrical Loop Issues that Cause On-Scale Failures

Comprehensive Transmitter and Safety Certified Diagnostics
- Enhanced SIS Coverage
- Diagnostic and Event Status Logs
- Customizable Service Alerts

Spot and Diagnose Process Problems Before They Impact Production
- Plugged Impulse Lines
- Process Changes
- Process Transients
Enhancements

Improved Performance
• 0.04 % Reference Accuracy
• 150:1 Rangedown
• Low Temp (-60°C )

Functionality
• Scaled Variable
• Selectable HART 5/7
• Low Flow Cutoff
• Process alerts

Capabilities
• Power Advisory Diagnostics
• Local Operator Interface
• WirelessHART
• Safety Certification
• External Button Options
• Ultra Low Copper Housing Option

Industry’s Broadest Offering of Pressure, Level and Flow Solutions
New Capabilities Simplify Commissioning and Maintenance

Local Operator Interface (LOI)
The LOI features straightforward menus and built-in configuration buttons so you can commission without complicated training or tools.

External Buttons
External Buttons are sealed from transmitter electronics allowing for Configuration in Hazardous Areas.

External Buttons configurations:
- LOI Operation (M4)
  Used for LOI navigation
- Digital Zero (DZ)
  Compensate for mounting position effects
- Traditional Analog Zero & Span (D4)
  Re-range transmitter with applied pressure

LOI Menu
Intuitive, easy to use LOI menu enables one minute commissioning

Internal Buttons
When external button options are used for other functions, the internal buttons are always available to operate LOI.

Security
Multiple levels of security have been implemented so you can confidently control device configuration changes.
Safety Goes Beyond Certification – Rosemount 3051 Has Comprehensive Diagnostics

Sensor & Electronics Diagnostics
Real time internal component monitoring ensures measurement data reliability

Process Alerts
Proactive notification of process excursions allowing you to take preventive action

Power Advisory
Power Advisory monitors the integrity of electrical loop notifying you of on-scale failures. Available with safety certification.

Safety Certification
Easily meet safety requirements with SIL2/3 Certification (IEC 61508)
Rosemount 2051
Rosemount 2051 Capabilities and Enhancements

**Enhancements**

**Improved Performance**
- 0.065 % Reference Accuracy
- P8: 0.05% Ref. Acc.
- 100:1 rangedown
- Low Temp (-60 °C)

**Functionality**
- Scaled Variable
- Selectable HART 5/7
- Low Flow Cutoff
- Process alerts

**Capabilities**
- Local Operator Interface
- WirelessHART
- Safety Certification
- External Button Options

**Offering of Pressure, Level and Flow Solutions**
Rosemount Wireless for Pressure
Rosemount Wireless Pressure Offering

All Products Provide
- 10-year power module life
- Scaled variable functionality
- Integrated flow, level and pressure solutions

Rosemount 3051S Wireless
- 0.025% span
- 15-year stability
- 15-year limited warranty
- Aluminum / SST housings
- Expanded wetted materials
- External antenna options
- Process alerts

Rosemount 3051 Wireless
- 0.04% span
- 10-year stability
- Polymer housing
- Internal antenna
- Process alerts

Rosemount 2051 Wireless
- 0.065% span
- 5-year stability
- Polymer housing
- Internal antenna
- Process alerts

Rosemount 3051S Wireless
- 0.025% span
- Ultra / Ultra for Flow
- 15-year stability
- 15-year limited warranty
- Aluminum / SST housings
- Expanded wetted materials
- External antenna options
- Process alerts
New to Market Capabilities Deliver Increased Reliability, Personnel Safety and Product Longevity

- Designed to ASME B40.1 Specifications
- Analog Display – 4.5” (115 mm)
- Scales – Single / Dual
- WirelessHART® Protocol
- Local Status Indication
- Industry Proven Pressure Sensor Technology
- Accuracy – Grade 2 (0.5% of Span)
- Standard Process Connections
Robust Product Design and Decreased Number of Mechanical Components Extend Product Longevity

Robust Design + Piezoresistive Pressure Sensor

Reduced Mechanical Components - Standard
- Designed to maintain structural integrity across various process pressure fluctuations
- No case filling required
- Components:

- Solid State Sensor
- Piezoresistive Pressure Sensor
- Bourdon Tube

Bourdon Tube

Mechanical Components + Linkages
- Vibration and Pulsation wear components

Components
- Tube
- Linkages
- Pins
- Gears

Potential Risks:
- Violent Shaking
- Cracked Glass or Casing
- Disconnected Dial
- Loose Dial

10-year installed life
The Rosemount Wireless Pressure Gauge Helps You…

Reduce maintenance challenges with industry-proven sensor technology

- Multiple Isolation Barriers
- High Overpressure Resistance: Up to 150x of Scale Range
- Burst Pressure Limits: Up to 11,000 psi (758 bar)
- Reduced Mechanical Components

Improve personnel safety with enhanced gauge quality and reliability

- Robust Product Design
- Brand Status Indication
- Battery Life: 10-year installed life

Verify pressure readings without leaving the control room

- Personnel Safety
- Data Reporting
- Data Availability
- Access Remote Locations
- Process Insight
Temperature Products
Rosemount Single Point Temperature Transmitter Offering

- **Rosemount 248**
  - DIN B and Railmount
  - HART & WirelessHART

- **Rosemount 148**
  - Head mount
  - PC Programmable

- **Rosemount 644**
  - DIN A and Railmount
  - HART, FF & Profibus
  - Transmitter-Sensor Matching
  - LCD & LOI
  - SIL 2 certified
  - Single & dual sensor input
  - Hot Backup
  - T/C Degradation
  - Min/Max Tracking
  - Sensor Drift Alert

- **Rosemount 648**
  - WirelessHART
  - IS Power Module
  - Configurable Alerts
  - LCD

- **Rosemount 3144P**
  - Single or Dual Sensors Input
  - HART & FF
  - Hot Backup
  - T/C Degradation
  - Min/Max Tracking
  - Sensor Drift Alert
  - Transmitter-Sensor Matching
  - Dual Compartment
  - SIL 2 certified
  - LCD

**Features:**
- Quality
- Reliability
- Performance
- Complete Point Solutions
Transmitters: Improve Reliability

3144P

Field Hardened Dual Compartment Housing
- Fully Potted Electronics
- Completely Isolated Cavities
- Self Draining Conduit Entries
- Superior EMI/RFI Resistance

Safety Certified
- SIL 2

5 Year Stability

Dual Sensor Capable

Diagnostics Suite
- Hot Backup
- Sensor Drift
- Thermocouple Degradation
- Min/Max Logging
- Statistical Process Monitoring

Transmitter Sensor Matching (Callendar Van Dusen)

Integral Transient Protection

The premier transmitter for safety, control, and reliability
Rosemount 644 Provides Added Functionality

Expanded Functionality

• Dual sensor inputs
• SIL 2 Safety Certified to IEC 61508
• Advanced diagnostic offering
• Enhanced accuracy and stability
• Advanced LCD display with Local Operator Interface
• Integral transient protection
• Large, 3-conduit junction box
• Selectable HART Revision (5 and 7)
High Density Measurement

**Rosemount 848T Family**
*The First Choice Solution for High Density Applications*

- Heat Exchangers
- Bearing Temperatures
- Distillation Column and Reactor Profiles
- Boilers
- Tanks

**Rosemount 848T Foundation Fieldbus**

**Rosemount 848T Wireless**

- Quality
- Reliability
- Performance
- Complete Point Solutions
Temperature Innovation

Source: Emerson Process
Emerson’s Approaches to Improving Safety and Reliability for Thermowells

1) Prevent
Utilize known process parameters, product designs, best practices & calculations

2) Suppress
Suppress effects on the thermowell induced by process conditions

3) Eliminate
Eliminate thermowells altogether and reduce the risk of process leaks and thermowell failure to zero

Levels Of Protection
Thermowells: A Critical Part of Temperature Measurement

- Thermowells are the KEY barrier between the process and the sensor and instrumentation
- Thermowells can fail
  - Vibration fatigue
  - Bending stress
  - Process pressure
  - Corrosion and erosion
  - Other mechanical and chemical stresses
Rosemount Twisted Square Thermowell

- Revolutionary patented design that improves reliability and reduces risk
  - Eliminates over 90% of dynamic stress (primary source of thermowell fatigue failures)
- Great solution for thermowells that do not pass ASME PTC 19.3 TW evaluations
- Simplifies design effort by reducing iterative calculations
- Available in a wide variety of mounting styles, materials and process connections
Twisted Square™ Eliminates Over 90% of Flow Induced Vibration

- Traditional thermowell
  - Ribbons of vortices to synchronize and shed along entire span
  - Alternating low pressure cells apply destructive forces on thermowell
- Twisted Square
  - Twisted separation point prevents vortex synchronization
  - Balanced side-to-side forces due to disruption of alternating pattern
Rosemount Twisted Square Thermowell Benefits

- Reduces design effort for thermowell calculations
  - Fewer required inputs than PTC 19.3 TW-2016
  - Use worst case scenario for robust design
- Perfect solution for applications with changing process conditions
- Design thermowell to allow for future expansion
- Pain-free retrofit option
  - Avoids complicated and expensive field modifications to pipe
- Allows for longer thermowells at higher velocities
- Design one robust thermowell to be used in different applications
- Reduces inventory
  - Use the same thermowell size for more of your temperature points
- Available with the full offering of Rosemount Sensors and Transmitters factory assembled
Emerson’s Approaches to Improving Safety and Reliability for Thermowells

1) Prevent
Utilize known process parameters, product designs, best practices & calculations

2) Suppress
Suppress effects on the thermowell induced by process conditions

3) Eliminate
Eliminate thermowells altogether and reduce the risk of process leaks and thermowell failure to zero
Non-Intrusive design eliminates the need for WFC’s

**Rosemount Wireless Temperature Transmitters**

- **Easy** to communicate temperatures from the field
- **Fast** installation and commissioning within minutes
- **No wires**
- Available “Extended Range” antenna

**Rosemount Pipeclamp Sensors**

- **Easy** to add new temperature measurements
- **Fast** installation within minutes
- **No process intrusions**
Current Temperature Measurement: Traditional Surface Sensor Assembly

- Surface temperature
- No leak point
- No wake frequency calculations
- Easy install

- No pipe penetration required
- Simplified design considerations: no wake frequency calculations
- Applicable for small pipe applications
- Applicable for viscous processes
- Reduced maintenance/no process shutdown

- HOWEVER…surface temperature does NOT give an accurate or repeatable representation of how the process is behaving
Introducing Rosemount X-well Technology!
A New Way To Measure Temperature

Accurate process temperature
No leak point
No wake frequency calculations
Easy install

- Complete point solution for measuring process temperature without the requirement of a thermowell or process penetration

- Process temperature calculated via Rosemount X-well thermal conductivity algorithm which takes into account thermal conductive properties of the temperature assembly and process pipe
How Rosemount X-well Technology Works

• By measuring ambient (T1) temperature and pipe surface temperature (T2)

And combining that with…

• An understanding of the temperature measurement assembly’s thermal conductivity properties.…

• User supplied information on their process piping…
  - Pipe material
  - Pipe schedule

• Rosemount X-well Technology can calculate and extrapolate the process temperature inside the pipe (T3)
**Total System Accuracy Comparison #1**

**Process Near Ambient Temperature**

<table>
<thead>
<tr>
<th>Condition</th>
<th>648+Thermowell+RTD</th>
<th>648+X-Well</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>30°C</strong></td>
<td>Worst Case Error</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DA+ ATE+SE</td>
<td>DA+ ATE+PTE+SA</td>
</tr>
<tr>
<td></td>
<td>0.225°C + 0.045°C + 0.19°C</td>
<td>0.29°C + 0.058°C + 0.10°C + 0.19°C</td>
</tr>
<tr>
<td></td>
<td>±0.46°C</td>
<td>±0.64°C</td>
</tr>
<tr>
<td><strong>Total Probable Error</strong></td>
<td>(\sqrt{DA^2 + ATE^2 + SE^2})</td>
<td>(\sqrt{DA^2 + ATE^2 + PTE^2 + SA^2})</td>
</tr>
<tr>
<td></td>
<td>(\sqrt{0.225^2 + 0.045^2 + 0.19^2})</td>
<td>(\sqrt{0.29^2 + 0.058^2 + 0.10^2 + 0.19^2})</td>
</tr>
<tr>
<td></td>
<td>±0.30°C</td>
<td>±0.37°C</td>
</tr>
</tbody>
</table>

When process and ambient temperature are similar, Rosemount X-well accuracy ~ traditional thermowell accuracy.
Total System Accuracy Comparison #2
Process Differs From Ambient Temperature

When process and ambient temperature differ

**Rosemount X-well accuracy becomes slightly less than traditional thermowell accuracy**

**TPE less than 1% of process temperature**
Total System Accuracy Comparison #3
Rosemount X-well  Worst Case Scenario

When process and ambient temperatures are at opposite ends of X-Well sensor limits, Rosemount X-well will be at its most inaccurate TPE less than 1.2% of process temperature

Accuracy Calculator available
Rosemount X-well Performance Under Various Conditions

**Changing Ambient**
- Water loop
- Carbon steel pipe
- Process temp 60 °C
- Ambient temp changes from +40 to -40 sharply
- Error w/out correction up to 5 °C
- **Error w/ X-well < 0.2 °C**

**Large Ambient and Process Delta**
- Process temp 111 °C
- Ambient temp -40 °C
- Error w/out correction up to 10 °C
- **Error w/ X-well < 0.5 °C**
Changing Process

- Process temp 110-230 °C
- Ambient temperature 23 °C
- Error w/out correction up to 10 °C
- **Error w/ X-well < 0.5 °C**

Unstable Process- Large Ambient and Process Delta

- Process temp smoothly increases from 140 to 165 °C
- Ambient temperature 23 °C
- Error w/out correction is about 8 °C,
  - **Error w/ X-well < 3 °C** (non stable process)
Questions