



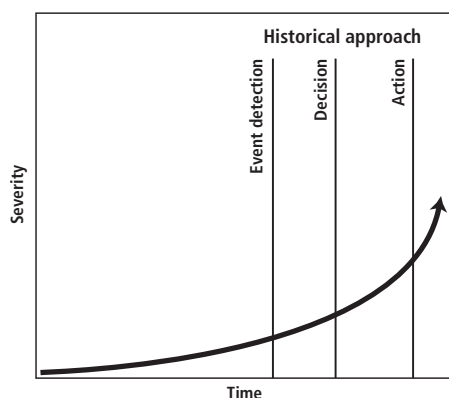
System Monitoring

The New Standard for Steam Trap Management

According to the Alliance to Save Energy, facilities have saved as much as 17% of fuel use when implementing energy-saving processes. Establishing a consistent, long-term steam trap management process is one way to achieve savings.

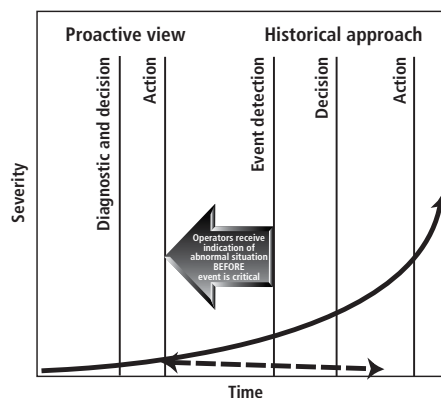
Historical Approach to Steam Trap Program*

Trap inspections are typically performed one time per year. The problem with this approach is that steam traps fail every day. These undetected failures lead to system irregularities, which, when left undetected long enough, can result in severe problems and equate to many dollars lost.



Proactive Approach to Best Practice Steam Trap Management*

Early detection means being able to act on a trap failure before the associated problem becomes severe. Therefore, immediate evaluation of the situation and measurement of the results are critical for continued best practice process improvement, yearly steam loss reductions and sustained monetary savings.



*Schavey, L. and Stout, J., "Achieving Operational Excellence in Gas Plants," Hydrocarbon Processing, January 2005.

Wireless, Labor-free, Instant Notification of Steam Trap Failure!

If you were to describe your vision for steam trap best practice, what would it look like?

Awareness

- The ability to constantly monitor the steam trap population without labor allocation
- Instant notification of steam trap failure

Action

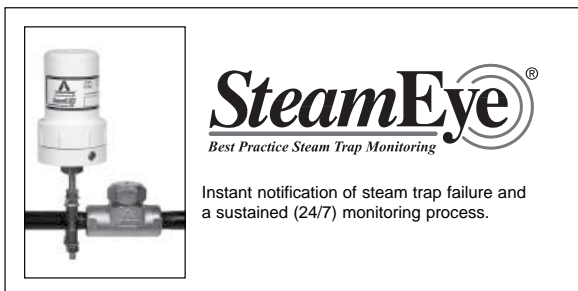
- Quick diagnosis and action on best trap replacement based on return on investment (ROI)

Accountability

- A reporting system that provides tracking, measurement, ROI analysis and easy company-wide communication

SteamEye® and SteamStar® bring steam savings through instant notification of steam trap failure.

SteamEye® is the tool to reduce labor and energy costs by constantly monitoring the steam trap population. SteamStar® is the measurement software that will create company-wide awareness for a whole new level of steam savings. When working together, SteamEye® will feed the moment-to-moment steam trap data into SteamStar®. SteamStar® will instantly report this information through Web-based software that allows easy access for company personnel to make timely, money-saving decisions.



SteamStar® Easy-to-use and Very Affordable Steam Trap Database

SteamStar® is the first Web-based software for recording, monitoring and managing steam trap information.

Improve steam system efficiency.

Steam system efficiency can be directly linked to how well the system is managed. SteamStar® provides diagnostic reporting at various levels of organizational responsibility. The reports permit the evaluation of current conditions and provide the knowledge necessary to make money-saving decisions.

Achieve best practice energy management goals.

History has shown that companies maximize sustainable cost savings when energy goals are measured, monitored, and managed on a consistent basis. SteamStar® is the Web-based tool that will bring data together by site, by region and by company to help achieve best practice energy management goals.

Save valuable time.

Typically steam trap data are presented from multiple sites in different software formats and with different qualifying terminology. These variables make managing steam system information difficult and time-consuming. SteamStar® offers a platform for company-wide steam data to be viewed and analyzed without wasted time.

Eliminate costs associated with software

licensing agreements. Licensing agreements can cost tens of thousands of dollars for initial software purchase. For the software to facilitate multiple users, additional capital outlay is required. The Web-based platform of SteamStar® eliminates licensing fees and dramatically reduces the required investment. A one month return on investment!

Improve company-wide communication.

Users at the plant level can perform evaluations to determine root causes of steam system issues. Using the same platform, the global energy manager has the ability to analyze data for sites around the world. This level of communication promotes understanding of steam system efficiency.

| Location Name | Location | Installed | In Service | Detected | Last Audit | Last Audit | General Notes |
|------------------------|--------------------|-----------|------------|----------|------------|------------|---------------|
| Anderson Petrochemical | | | | | | | |
| Asia | | | | | | | |
| Davis Bay | Sumpting, Province | 246 | 218 | 23 | 11/26/04 | 6/6/05 | |
| Klong, Malaysia | Klong | 49 | 49 | 32 | 10/17/04 | 8/27/05 | |
| Europe | | | | | | | |
| Anderson Croatia | Zagreb | 997 | 997 | 131 | 4/12/04 | 10/18/05 | |
| Anderson France | Nantes | 1,087 | 1,087 | 100 | 6/15/04 | 10/18/05 | |
| Anderson Germany | Hamburg | 815 | 815 | 336 | 3/15/05 | 10/18/05 | |
| Anderson Slovakia | Bratislava | 652 | 652 | 60 | 8/13/04 | 6/30/05 | |
| Anderson UK | Southampton | 25 | 25 | 3 | 10/13/04 | 10/13/05 | |
| United States | | | | | | | |
| Central Region | | | | | | | |
| Bentley, TX | Bentley, TX | 1,430 | 1,430 | 410 | 10/2/04 | 6/14/05 | |
| Jules, IL | Jules, IL | 3,380 | 3,380 | 816 | 10/13/04 | 6/30/05 | |
| Phillipsburg, KS | Phillipsburg, KS | 543 | 543 | 116 | 9/13/04 | 6/6/05 | |
| Three Rivers, NC | | 24 | 24 | 2 | 9/24/05 | 11/26/05 | |
| East Coast Region | | | | | | | |
| Bradford, PA | Bradford, PA | 403 | 403 | 79 | 8/22/04 | 6/6/05 | |
| Paulsboro, NJ | Paulsboro, NJ | 838 | 838 | 336 | 8/2/04 | 6/6/05 | |
| Gulf Coast Region | | | | | | | |
| Biloxi, MS | Biloxi, MS | 53 | 46 | 15 | 10/1/04 | 11/18/05 | |
| Corpus Christi, TX | Corpus Christi, TX | 47 | 47 | 21 | 6/15/04 | 10/11/05 | |
| Hercules, LA | Hercules, LA | 47 | 47 | 11 | 5/13/04 | 6/6/05 | |
| West Coast Region | | | | | | | |
| Los Angeles, CA | Los Angeles, CA | 815 | 815 | 336 | 1/5/05 | 6/6/05 | |

Screen shot of SteamStar® home page.

SteamStar® Easy-to-use and Very Affordable Steam Trap Database

SteamStar® Web-based software will evaluate steam system data.

Continuous Steam Trap Monitoring captures real time steam trap operation from SteamEye®. SteamEye® is the automated steam trap monitoring tool that provides accurate and constant information from each steam trap. This information is translated by SteamStar® into actionable reports. All of the reports available in SteamStar® are designed for best practice measurement.

- Executive Summary
- Steam and Monetary Loss
- Defective Trap Report
- Manufacturer Summary
- Trap Evaluation by Application

Company Benchmarking

This premium report establishes a comparison to sister sites and industry peer best practices. The user has a choice of which sites to benchmark and which factors to compare. Steam losses and monetary losses can be compared by site, by type of application, by type of trap, and more. This report will offer management a wide analysis of which sites are working to reduce steam losses and which lag behind. It will also highlight any areas of concern in terms of high steam trap failure rate compared to total monetary losses. This report is a valuable tool for facility managers and global energy managers alike.

Prioritized Work Orders

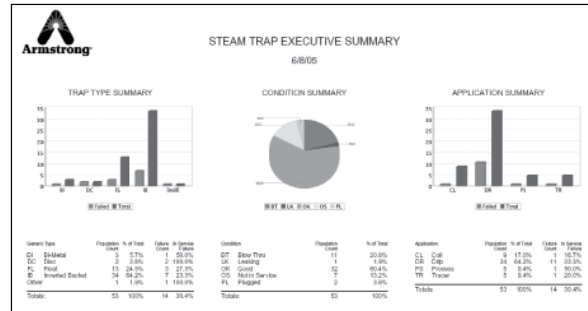
The work order report is a premium report that was designed for optimum facility payback on labor and material while keeping energy losses to a minimum. This report is available at the site or unit level and will create a work order for steam trap repairs based on payback.

Trend History

The premium trend analysis report will assist a manager with the comparison of multiple years of data. The data available for comparison are steam loss, monetary loss, fuel consumed, and emissions created. Like the other premium reports, the trend analysis report can be compared by site and/or region. It will also track emissions—CO₂, SO_x, NO_x—and highlight the progress made toward steam system efficiency and dollars saved.

Emissions Summary

The premium emissions report is valuable for its ability to focus on the quantifiable emissions of CO₂, SO_x, and NO_x in one summarized view. Steam system efficiency is not only viewed as important in terms of energy losses but also in terms of environmental impact. The emissions report is especially beneficial to users that are penalized by world governments for high emission factors.



Screen shot of executive summary.



| Tag Number | Condition | Annual Cost (\$USD) | Location | Manufacturer | Model | Recommendations | Comments |
|------------|-----------|---------------------|---|--------------|---------|-----------------------------------|----------|
| 114 | Blow Thru | 11374 | 030M by Absorber above pumps | Namco | 50 | | |
| 108 | Blow Thru | 5343 | Penthouse, Domestic hot water heaters supply | Armstrong | 3003 | | |
| 104 | Leaking | 1912 | 070M PWC station | Watson | W0001 | Replace with Armstrong model 2015 | |
| 122 | Leaking | 1580 | 220M MP drip | MEPCO | 44-215A | | |
| 100 | Leaking | 1484 | 120M | Spirax-Sarco | UT02SL | | |
| 110 | Leaking | 877 | 030M PWC by Absorber | Spirax-Sarco | UT02SL | | |
| 105 | Flooded | | Penthouse, Domestic hot water heater 27-0000 | MEPCO | 44-215A | | |
| 112 | Plugged | | 070M Flash tank by condensate pump | Spirax-Sarco | 51H | | |
| 113 | Plugged | | 030M Heat to Absorber | | | | |
| 110 | Flooded | | Penthouse, Domestic hot water heater 27-0000A | MEPCO | 44-215A | | |

Screen shot of prioritized work order.

Bringing
Intelligence
to Wireless
Monitoring

ARMSTRONG INTELLIGENT MONITORING
AIM



Cut The Cord

Is your plant monitoring system held back by outdated technology or devices that can't think for themselves? It's time to cut the cord and enter the world of intelligent wireless monitoring from Armstrong International.

AIM™ brings intelligence to wireless technology by applying smart thinking devices to monitor critical plant applications in real time.



Three Challenges - One System Solution

Three constant challenges that plant managers and maintenance personnel face in the operation of any system include:

- Identifying a failure - ability to immediately pinpoint what has failed, when it failed and where it failed.
- Evaluating the scope - comprehending the magnitude of the failure especially in terms of energy lost and emissions discharged to the atmosphere.
- Measuring the impact - accurately calculate the costs including wasted energy, process disruptions and plant shut downs, safety hazards and fines levied.

AIM™ enables your team to tackle all three challenges with one system solution that combines a mix of methods including acoustic and temperature monitoring with integrated software through a smart wireless gateway to deliver:

- Immediate failure notification of devices such as steam traps
- Immediate notification of release to flare for emissions mitigation
- Pinpoint accuracy of failure location for fast resource deployment
- Detection of "sizzling" relief valves for proactive maintenance scheduling
- Preemptive warning of hazardous vapor release to improve worker safety

Ready, AIM™, Fire



Problem

- Identifying condition of critical steam traps that are difficult to access.
- Condensate backing up into turbine caused by plugged steam trap.
- Significant energy loss due to failed steam traps on high pressure steam lines.
- Reboiler not draining properly due to plugged steam trap.

Solution



ST5700
Steam Trap Monitoring

Result

- A safe and reliable methodology for testing inaccessible steam traps for immediate failure notification.
- Significant cost avoidance from potential turbine blade damage.
- Significant energy savings due to reduced consumption.
- Immediate identification of root cause problem to reduce potential production loss.

Problem

- Excessive use of flare due to safety relief valve lift.
- Leaking isolation and bypass valves for critical process.
- Gas pressure regulator failure.

Solution



AD5000
Acoustic Monitoring

Result

- Reduced hydrocarbon emissions to the environment and significant cost avoidance from potential environmental fines.
- Material loss reduction due to immediate location identification.
- Reduced process loss due to immediate identification and location of the root cause; Reduced safety issues.

Problem

- High viscosity in bulk storage tanks causing potential pumping issues due to inadequate temperature.
- Potential solidification in sulfur/asphalt transfer lines due to inadequate temperature.
- Pump trap failure (Flooded).
- Electric pump cavitation/seal failure.

Solution

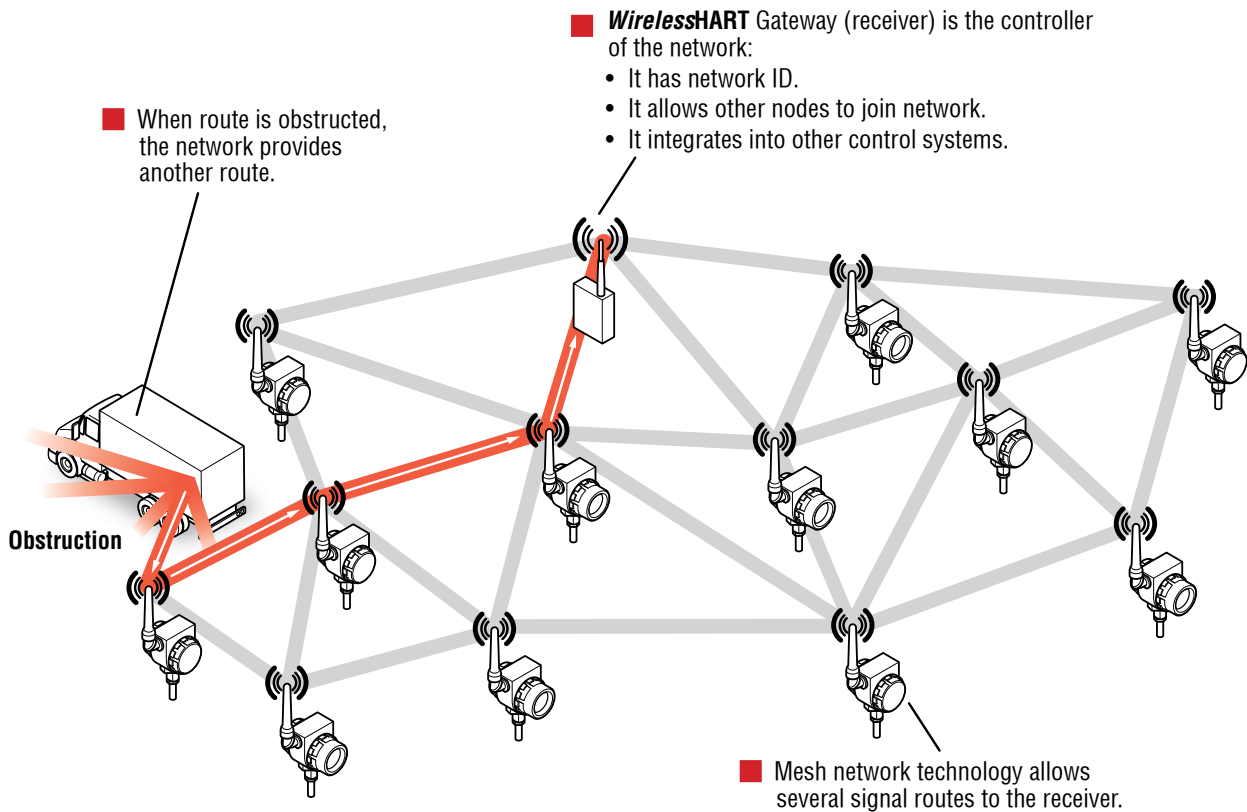


TD5100
Temperature Monitoring

Result

- Immediate low temperature indication and location on the storage tank to prevent transfer/tank loading problems due to high viscous material.
- Immediate low temperature indication and location on sulfur line to prevent material solidification.
- Early detection of reduced inlet condensate temperature to pump trap.
- Early detection of high temperature condensate into electric pump receiver.

Smart Mesh Technology



Self Organizing.

- Devices automatically establish routes for efficient and reliable communication.
- Expansion is simple... additional devices seamlessly integrate into existing networks.
- Mesh topology allows for easy network reconfiguration.

Self Healing.

- If obstructions are introduced within an existing network, the system will automatically adjust communication paths for continuous and reliable data flow.

Industry Standard IEEE 802.15.4.

- 2.4 GHz 16 band.
- Continuously hops across 16 channels to reduce potential interference.

No Blind Spots.

- Utilizing industry standard *WirelessHART™*, an open mesh networking design, AIM™ communicates through and around stacks, silos, cranes and other obstructions.

Harsh Environments? No Worries.

- AIM™ is designed to withstand extreme ambient temperature conditions (-40°F - 194°F) (-40°C - 90°C).

No Plant Disruptions.

- Installing AIM™ won't disrupt plant processes. There's no shutdown required to perform an installation and AIM is non-intrusive to valves, pipes and system equipment.

WirelessHART



The HART Communication Protocol has served as the world's leading process communication technology for smart instruments since 1989. Today, more than 30 million HART devices are installed and in service worldwide.

Industry suppliers are manufacturing and shipping HART products in record numbers—75% of the smart devices installed are HART-enabled.

More HART products are installed in more plants around the world than any other. No other communication protocol comes close.

Wireless technology allows users to access the vast amount of unused information stranded in these installed HART smart devices— 85% of the installed HART devices. It also provides a cost-effective, simple and reliable way to deploy new points of measurement and control without the wiring costs.

Simple

- Reduced installation and wiring costs
- Always on security
- Adjusts as new instruments are added and to changes in plant infrastructure

Reliable

- “Hops” across channels
- Co-existence with other wireless networks
- Optimizes bandwidth and radio time
- Mesh network and multiple access points

Secure

- Protects valuable information with multi-layered security
- Robust multi-tiered always on security
- Protects wireless network with channel hopping
- Reports message integrity failures and authentication failures

| Item | Description |
|--------------------------------------|---|
| Based on Industrial Standards | HART - IEC 61158 WirelessHART - IEC/PAS 62591Ed.1 EDDL - IEC 61804-3 Radio & MAC - IEEE 802.15.4(TM)-2006 IEC/PA |
| Radio Standard | IEEE 802.15.4-2006 @ 250kbps |
| Frequency Band | 2.4GHz |
| Frequency Management | Channel hopping on a per packet basis |
| Distance | Up to 250 m (820 ft) line-of-sight between devices |
| Power | Battery |
| Topologies | WirelessHART Mesh |

Transmitted Information • The following information is sent from the nodes.

| Information | Device ID | HART Tag | Primary Variable (PV) | Secondary Variable (SV) | Tertiary Variable (TV) | Quaternary Variable (QV) |
|---------------------------------|-------------------------------------|-------------------------------------|---|---|---------------------------|-------------------------------|
| Acoustic Model AD5000 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Counts (0-255) | Current temperature reading (°F or °C) | Alarm Setting (default 0) | Estimated Battery Life (Days) |
| Steam Trap Model ST5700 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Trap Condition <ul style="list-style-type: none"> • 1 – OK = no alarm; steam trap is functioning properly. • 2 – CD = alarm; steam trap plugged/locked or steam supply valve off. • 3 – BT = alarm; steam trap failed open, experiencing steam loss. | Current temperature reading (°F or °C) | Temperature Setting* | Estimated Battery Life (Days) |
| Temperature Model TD5100 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | Temperature (°F or °C) | Status Bit <ul style="list-style-type: none"> • 1 – Temp. above setting • 2 – Temp. below setting | Temperature Setting | Estimated Battery Life (Days) |

Work Smarter - Not Harder

AIM™ helps you work smarter by anticipating your needs and taking the guess work out of system troubleshooting enabling you to address problems before they spiral out of control. Here's how.

Smart Thinking is in the Box

AIM™ works through a centrally located wireless gateway that enables real time, 24/7 monitoring.



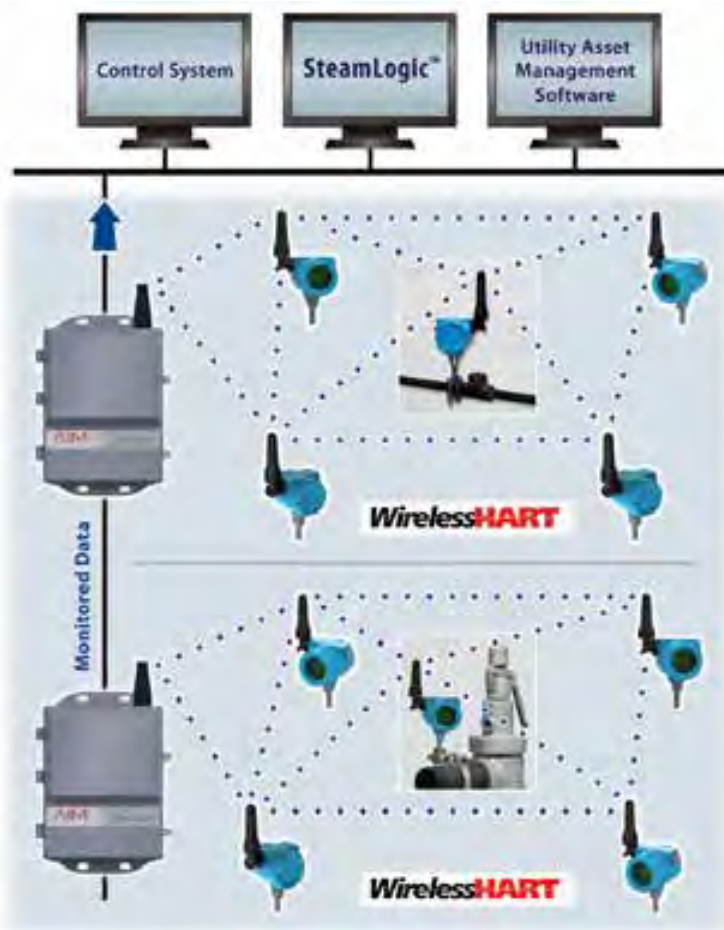
The AIM™ Wireless Gateway easily connects and organizes WirelessHART devices to your host system while providing industry-leading security, scalability, and data

reliability. The Gateway interface is easily viewed in a web browser.

Wireless Gateway Specifications

- Burst rate: User Selectable 4, 8, 16, 32 second or 1 to 60 minutes
- Network Size: Up to 100 devices
- Output: Ethernet, Modbus (485 or TCP), OPC, HART IP
- Approvals: FM, CSA, ATEX, IECEx

Wireless Architecture



AIM™ Wireless Gateway Web Browser Interface



SteamLogic™ Program Interface



Other Interfaces:

- Data historian connectivity for trending and analysis (Note: Data historian not included with AIM™ Wireless Gateway).

Ready, AIM™, Fire



Adjustable



Extreme Weather

Factory Mutual (FM) Approval



| | |
|-------------------------------|---|
| <i>United States</i> | Intrinsic Safe for Class I/II/III, Division 1, Groups A, B, C, D, E, F, and G Zone Rating: Zone 0, AEx ia IIC Temperature Code: T3 Ambient Temperature Range: T_{amb} -40°C to 90°C (-40°F to 194°F) For use with TADIRAN model TLH-5920 lithium ion battery only Standards used for Certification: FM3600, FM3610, FM3810, ANSI/ISA 60079-0, ANSI/ISA 60079-11 |
| <i>Canada</i> | Intrinsic Safe for Class I/II/III, Division 1, Groups A, B, C, D, E, F, and G Zone Rating: Zone 0, Ex ia IIC Temperature Code: T3 Ambient Temperature Range: T_{amb} -40°C to 90°C (-40°F to 194°F) For use with TADIRAN model TLH-5920 lithium ion battery only Standards used for Certification: CSA 1010.1, CSAC22.2No.157, CSAC22.2No.25,CAN/CSAE60079-0, CAN/CSA60079-11 |
| <i>European Certification</i> | ATEX Intrinsic Safety Ex ia IIC T3 Ambient Temperature Range: T_{amb} -40°C to 90°C (-40°F to 194°F) For use with TADIRAN model TLH-5920 lithium ion battery only Standards used for Certification: EN60079-0,EN60079-11, EN 60079-26 |
| <i>IECEX Certification</i> | Equipment Protection Level: Ga Gas/Vapour: EX ia IIC T3 Ambient Temperature Range: T_{amb} -40°C to 90°C (-40°F to 194°F) For use with TADIRAN model TLH-5920 lithium ion battery only Standards used for Certification: IEC 60079-0, IEC 60079-11, IEC 60079-26 |

| | |
|--|---|
| Output | WirelessHART 2.4 GHz |
| Local Display (if applicable) | Liquid Crystal Display Viewing Area: 1.34" x 0.55" (34 mm x 14 mm) |
| Temperature Operating Range | With display: -30°C to 80°C (-22°F to 176°F) Without display: -40°C to 90°C (-40°F to 194°F) |
| Materials of Construction | Housing – Aluminum Paint – Powder Coat O-ring – Nitrile Stem – 304 SS Antenna – Nylon 6,6 Nampelate – 304 SS |
| Battery Type | Tadiran Lithium Ion Model – TLH-5920 |
| Weight | 2.2 lbs (1 Kg) |
| ST5700 Note: For proper operation, node must be installed on a steam trap operating at no less than 15 psig (1 bar). | |



Steam System Survey



History

Industries use approximately 42% of the total energy consumed annually in the United States. Of this, about half (or 21% of total U.S. energy consumption) is used to generate steam in more than 54,000 large industrial-sized boilers.

Unfortunately, much of that steam is lost through leaks in the distribution system, including piping, valves and steam traps. Lost steam must be replaced, which can only be done in a boiler that consumes fuel.

The cost of replacing wasted steam can be enormous in terms of system efficiency, lost production, fuel consumption, makeup water treatment cost, and maintenance. These additional costs must be factored into the bottom line of every organization.

Environmental Considerations

Inadequate trapping on steam mains not only results in economic losses, it also creates environmental concerns as additional fuel is burned to replace lost steam. For example, assume the steam-main pressure is 150 psig and the leak size is 5/64"—about the thickness of a penny. In this instance, approximately 27 lb of steam will be wasted per hour—escaping from the system or blowing through a trap and into the return line.

Twenty-seven pounds per hour may not sound significant, but over one year (8,400 hours), that small leak will waste the following equivalent amounts for fuel:

- 1.9 tons of bituminous coal at a value of \$679 (coal cost \$57/ton)
- 2,385 gal of residual oil at a value of \$978 (oil cost \$0.41/gal)
- 3,141 ccf of natural gas at a value of \$1,272 (gas cost \$4.05/mcf)

Pulverized bituminous coal in a dry bottom-firing boiler will generate the following pollutants per year:

- 727 lb of particulate matter
- 465 lb of sulfur oxides
- 250 lb of nitrogen oxides
- 7.2 lb of carbon monoxide
- 9.7 tons of total carbon

These figures represent a case in which just one trap has blown through—typical failure mode of many steam traps. Compound the figures by the number of potential failed traps and you can begin to understand the value of trap maintenance, both in terms of energy and the extra load placed on your environmental cleanup systems.

Evaluation = Efficiency = Dividend

Reliable evaluation of steam trap operation is necessary for traps to work at peak efficiency. Trap testing is a key element in a complete energy management program, and an essential skill for protecting your investment.

Accurately evaluating steam trap operation can pay dividends in energy conservation, save countless maintenance hours, and reduce unscheduled downtime caused by trap failure.

Steam-Trap Survey

To ensure that your steam traps are maximizing the return on your product investment, your first steps should be to conduct a steam-trap audit or trap survey, then implement a comprehensive trap-maintenance program. Proper trap maintenance requires someone who knows how each type of trap functions and can determine if each trap is operating as required.

Armstrong has the ability and trained personnel to conduct steam system energy audits for any facilities in the world. Our factory-trained technicians have decades of experience and have tested tens of millions of steam traps worldwide.

Test and Replace Just the Failed Traps

The sooner a trap is identified as an energy waster, the sooner it can be replaced. Since newer testing methods require minimal labor, traps can be tested more frequently and failed traps can quickly be identified. In addition, perfectly good traps that may be misdiagnosed as failed by less reliable testing techniques will no longer be routinely replaced, thus saving the expense of a new trap and related labor costs.

Armstrong continues to lead the industry with innovative testing and tracking tools such as SteamStar®, SteamEye® and TrapAlert™.

By using SteamEye® technology, you can better spend your maintenance time repairing only defective traps and not evaluating traps that have been misdiagnosed as failed. In conjunction with SteamStar®, the system becomes the premier steam trap management package for maintaining a healthy steam system.

Maintaining the Boiler Plant

Boiler plant reliability and efficiency depend on the stability and success of each component of the steam generation, distribution and condensate return system. Maintaining a boiler plant means paying close attention to components including flanges, elbows, valves, unions and steam traps, since each component has the potential to waste steam.

We can help with proper system evaluations, as well as piping recommendations, replacement-trap sizing and troubleshooting.