KROHNE

Product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature meters
- Pressure meters
- Analysis products
- Products and systems for oil & gas industry
- Measuring systems for the marine industry

PipePatrol

Leak detection and localisation system

- The most sensitive internal leak detection system available
- Outstanding reliability due to “Leak Pattern Recognition”
- Highly accurate leak information
- Continuous and robust monitoring in all pipeline operating conditions

www.krohne.com
Achieve more with KROHNE

Welcome to KROHNE. As a world-leading manufacturer and supplier of industrial process instrumentation solutions, we serve a wide range of industries across the globe.

Ever since our foundation in 1921, the name KROHNE has stood for innovative, reliable measurement solutions covering every aspect of process instrumentation. Today, our products and services cover the entire range of measurement and analysis processes, from individual measuring points to complete plant solutions. Adding valuable support to our product portfolio are our extensive customer care and consulting services.

Developed in conjunction with leading experts from one of Germany’s technical universities, our PipePatrol leak detection and localization system was initially designed for the most demanding pipelines in German industry. After extensive testing and TÜV approval, the product was subsequently released onto the global market.

Over the last decade, PipePatrol has been successfully implemented on more than 100 gas and liquid pipelines throughout the world, easily meeting or exceeding all applicable quality and performance regulations, such as the German TRRL and the American API 1104.

PipePatrol gives you the edge

PipePatrol’s outstanding performance and quality increase safety as well as delivering tangible cost-saving benefits.

A 1% leak in a 20-inch line can rapidly translate into a loss of 450,000 barrels a year. At the same time, if left undetected, it could contaminate 10 square kilometres of lake within 24 hours. Thanks to its ultra-fast leak detection and precise localization, KROHNE’s PipePatrol allows you to react quickly and reliably.

During the TÜV acceptance process, a series of leak tests were performed on an installed PipePatrol system on a 10-inch, 31 km pipeline in Northern Germany. Several leaks were simulated 22.4 km from the inlet by releasing Naphtha from the pipelines into a tanker truck at flowrates between 210 and 265 m³/h.

Within just 30 seconds, PipePatrol succeeded in detecting all leaks, to an accuracy of 1.3% of the nominal flow. This meant that only 95 litres of product escaped before the leak was detected.

PipePatrol not only detected all leaks but also precisely located them.

On this 10-inch diameter 31 km pipeline, average location accuracy was ± 0.4 %. To ensure the fastest possible response time, PipePatrol displays an arrow on a map, indicating the precise location of the leak.
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PipePatrol’s technology makes it the most sensitive and accurate internal leak detection system on the market

**Extended Real-Time Transient Module (E-RTM)**

E-RTM takes RTM technology to the next level. PipePatrol’s unique Leak Pattern Recognition is the only proven technology that compares what is actually happening in a pipeline with what should be happening – all without generating false alarms.

Unlike other systems, it does not simply compare outlet flow with inlet flow. Instead, it uses the measured conditions at inlet and outlet to calculate the hydraulic profiles of the pipeline. One of these, the calculated flow profile, is compared to the measured flow for both inlet and outlet.

PipePatrol’s Signature Analysis module uses Leak Pattern Recognition to analyze this data continually and determine the leak status of the pipeline. Because E-RTM uses relative values, it continues to work effectively under transient pipeline conditions, without any significant effect on its sensitivity. E-RTM is arguably the only technology that allows fast and sensitive leak detection in any kind of pipeline operation.
Principle of Extended Real-Time Transient Model (E-RTTM)

- Flowmeter
- Pressure and temperature meters
- Temperature and pressure measured
- Flowrate measured
- Flowrate calculated, leak-free
- Comparing measured values to calculated values
  - Filtered decision values
  - Leak signature analysis using pattern recognition
    - Leak signature database
    - Leak alert, leak rate, leak position
PipePatrol has the power to precisely identify the location of a leak.

To identify the source of the leak accurately, PipePatrol combines the advantages of three localization methods.

**Gradient Intersection Method**

Under zero leak conditions, pressure drops uniformly along the pipeline. When a leak occurs, more liquid or gas flows through the pipeline before the leak than after it.

The pressure gradient along the pipeline therefore changes at the leak. The leak location can thus be identified at the point where the gradient changes.

**Extended Wave Propagation Method – using intermediate pressure measurements and time of flight**

Using the same physical principle as the wave propagation method, PipePatrol’s extended wave propagation method takes into account intermediate station measurements.

Using the information from intermediate stations and E-RTIM’s knowledge about the velocity of sound profile in the pipeline, jitter error introduced by slow sensor scan rates can be eliminated. This unique method provides outstanding leak location identification in any kind of operation.

**Wave Propagation Method – using times of flight**

A sudden leak will cause a negative pressure wave in the pipeline, simply because gas or liquid is leaking out. This pressure wave will travel through the pipeline at the sound velocity of the gas or liquid.

Depending on the location of the leak, the pressure wave will arrive at one end of the pipeline before it arrives at the other. The leak position can be calculated from the difference in the arrival times at inlet and outlet.
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PipePatrol can be effortlessly integrated into your operation

Designed for both uncompromising accuracy and total ease of use, PipePatrol is as easy to retrofit into existing plant as it is to include in new systems.

Easy retrofit using existing field instrumentation
PipePatrol will interface seamlessly with your existing systems, placing minimal demands on your instrumentation and personnel. PipePatrol will use existing instrumentation:

- Pressure meters at the inlet and outlet
- Temperature meters at the inlet and outlet
- Flowmeters at the inlet and outlet
- Ambient temperature meters
- Any additional instrumentation will be used to boost performance

As a result, installation – including retrofitting – is always simple and straightforward.

Effective interfacing with any SCADA system
PipePatrol uses a flexible Plug-In Driver Interface to communicate. The system supports a variety of protocols, including OPC, Modbus TCP/IP, Modbus Serial, HART™ and PROFIBUS®:

- Support for proprietary SCADA Hardware
- Ethernet or Serial communication
- Provides a standard interface to share information with SCADA

Simple and intuitive operation
For maximum security and effectiveness, PipePatrol’s operator interface has been designed for instant clarity of information, displaying only what the operator actually needs to see.

For this reason, it is possible to train new operators effectively in a matter of just a few hours.

Detail view of a pipeline segment. Here, all relevant information of the leak monitoring are shown. In case of an alarm, time, leak rate and leak location are clearly displayed and visualised graphically on the pipeline.
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PipePatrol remains reliable at all times

A top-quality leak detection system will always give an unambiguous alarm. Because it is correct 100% of the time, it will never waste valuable maintenance staff time on chasing phantom leaks.

Sudden leaks typically occur during start-up, shut-down and operational changes. This is logical, since under these conditions the pressure in the pipeline changes. Unfortunately, those pressure changes cause transients, inlet and outlet flow will vary drastically. The best leak detection systems should be able to cope reliably with such transients while retaining the ability to detect small leaks very quickly.

- PipePatrol records all pipeline data under working conditions, 24 hours a day, 365 days a year. This data enables the system to adapt constantly, achieving maximum sensitivity regardless of the exact pipeline properties. Parameters are tuned to guarantee continuous maximum performance throughout the operating life of a PipePatrol installation.

Typical applications:
- Long crude oil pipelines from oil fields to refineries
- Multiproduct pipelines from refineries to tank farms
- Subsea pipelines from FPSO units and platforms
- Non-continuously operated pipelines transporting for example jet fuel
- Long water pipelines from desalination plants to cities
- Very long natural gas pipelines from gas fields to refineries
- Refined product pipelines for products used in chemical plants
- Supply of process gases
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PipePatrol can be easily scaled to meet changing needs

In addition to leak detection, PipePatrol offers additional modules to improve the efficiency and safety of pipeline operation.

Efficiency analysis
Monitors the pipeline with regard to deposition and helps the user to operate the pipeline in a manner that is both energy efficient and cost-effective.

Inventory calculation
Delivers the exact turnaround and interprets this value.

Operator training
The implemented training function allows for efficient staff training, focusing on safe and efficient system handling.

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Thief detection
PipePatrol’s ultra-high sensitivity makes it possible to reliably detect theft, even of tiny amounts.

Hydraulic profiles
Hydraulic profiles guarantee safe operation of the pipeline, either under maximum steam pressure or under monitoring.

Batch management
The products described above can be expanded to form a management system by means of a planning tool. This monitors the tank levels, calculates start and arrival times, and ensures safe operation as well as optimum capacity use of the pipelines.

Batch tracking
The calculation of a product's position and the mixing zone of the pipeline enables accurate statement preparation regarding arrival times and amounts of the absolute product. In addition, it is easier to separate the blend from the product.
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## Specifications

**Functions**
- Leak detection and localisation during pumping, ramp-up, ramp-down, shut-in and standstill conditions
- Continuous monitoring during all operating conditions
- Supporting functions: batch tracking and instrument error analysis
- Stand-alone operation without human interaction

**Standards and Regulations**
- American API 1130 ("Computational Pipeline Monitoring for Liquid Pipelines")
- German TRP ("Technical Rules for Pipelines")
- Numerous local standards in countries such as Russia, Canada, Brazil and Malaysia

**Areas of Application**
- Liquid and gas pipelines, from simple single lines to complex networks where appropriate instrumentation is available
- Liquid applications cover single and multi-product operation, with or without IRA

**On-Site Instrumentation**
- Existing standard flow, pressure and temperature instrumentation at inlet and outlet
- Intermediate station instrumentation improves performance

**Connectivity**
- Any SCADA system
- Standard interfaces: Modbus / Modbus TCP and OPC
- Sensitivity: $\leq 0.5\%$ nominal flow

## Technical data

<table>
<thead>
<tr>
<th>Specific performance criteria</th>
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</tr>
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<tr>
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<tr>
<td>Incorrect leak declarations not to exceed 2 per year*</td>
<td>Overall</td>
<td></td>
</tr>
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**Objective**

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*This figure can be achieved only if the instrumentation system has the same or better reliability.

**Objective**

- **Typical performance according to API 1130 for a 200 km crude oil pipeline**

Based on experience, KROHNE expects PipePatrol E-RITM to meet the performance criteria set out above. It is assumed that typical data refresh rates and instrumentation is used. Intermediate stations with pressure measurements are assumed every 50 km. These performance figures are provided as a reference only. Actual system performance will be provided after an LDS Sensitivity Study following the investigation of the complete instrumentation system, based on actual pipeline data.
Specifications

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Sensitivity
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** Leak detection functionality will be available even if pressure and temperature meters are not working.

Typical performance according to API 1130 for a 300 km crude oil pipeline.

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