

INVENIO

Smart Sensor Network for CUI Condition Monitoring

INVENIO is a comprehensive hardware and software solution designed to monitor, analyze and predict the potential for Corrosion Under Insulation (CUI). It is based on the installation of a wireless sensor network (with no need to remove insulation) that enables data driven CUI management based on real-time humidity measurements. The combination of analysed and processed data (i.e. machine learning algorithms), real-time data (typically 1 measurement per hour), and long battery lifetime (+10 years) make INVENIO a unique solution for long term and high scale deployment in industrial plants.

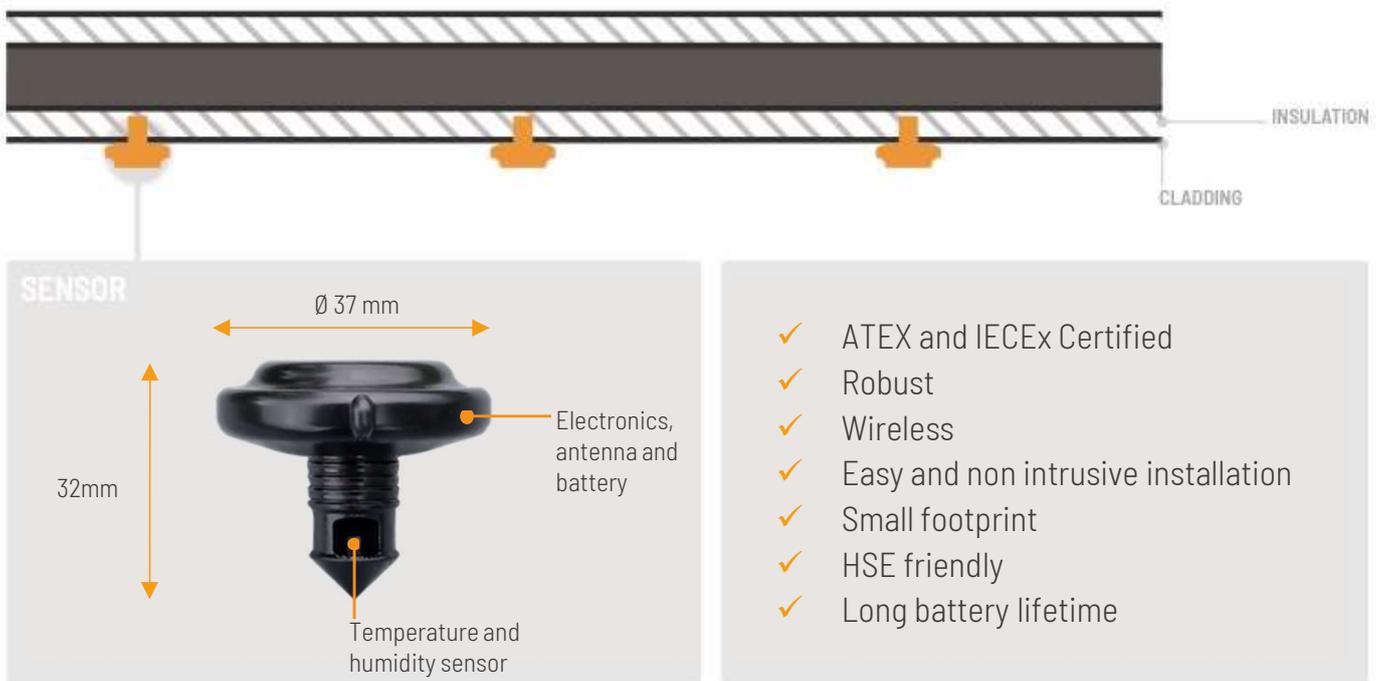


For more information and development of customized solutions, please contact us:

INVENIO RH-1B

The INVENIO RH-1B is designed for retrofit installation in insulated pipes for monitoring CUI (Corrosion Under Insulation).

The INVENIO RH-1B sensors measure relative humidity and temperature and sends these data wirelessly to the nearest INVENIO GW-1 Gateway. The INVENIO Gateway then relays the measurements to INVENIO Cloud and Site Monitoring SW.



INVENIO RH-1B Specifications

Minimum temperature	-20°C	Typical temperature accuracy	±0.2°C
Maximum temperature	100°C	Lifetime	Min. 10 years @ 1-hour interval (non-extreme climatic conditions)
Communication interface	RF - 915 MHz	Power	Battery cell
Radio cryptography	AES-128	Weight	17 g
Radio protocol	Proprietary	Ex certification	ATEX/IECEx intrinsically safe, zone 0, gas group IIC, temp class T4
Typical RH measurement accuracy	±2%		

INVENIO GW-1

The GW-1 is equipped with a new compact and light weight EX-d enclosure, simplifying installation, as well as additional options for connecting to the INVENIO Cloud. Both Wi-fi and cabled connection (ethernet or serial) are supported in the absence of 4G coverage. For increased robustness, the GW-1 has an optional internal rechargeable backup battery combined with increased buffering capabilities, allowing sensor data to be safely buffered during a potential power outage.

Minimum temperature	-40°C
Maximum temperature	60°C
Material	Aluminum (optional AISI 316)
Weight	2.9 kg (5.3 kg AISI 316)
Radio frequency	915 MHz
Cryptography towards sensors	AES-128
Protocol towards sensors	Proprietary
Cryptography towards server	TLS/SSL
Protocol towards server	MQTT v3.1
Upstream Interface	Cellular (4G with 2G fallback)
Configurations	Wi-Fi, Ethernet, RS-485
Power	85 VAC to 264 VAC 24 VDC PoE Backup battery in case of power outage (optional)
Antenna Barriers	ATEX/IECEX flameproof/molded encapsulation with intrinsically safe antenna connection, zone 1/0, gas group IIC, temp class T6
Ex certification	ATEX/IECEX flameproof encapsulation, zone 1, gas group IIC, temp class T5

INVENIO GW-1 Specifications



INVENIO Site Monitoring SW

Pre-analyzed data: The solution includes advanced streaming analysis of the data, which enables a higher-level visualization of the current and historical water wetting state. This means that the user has an overview of the state of the entire asset, with the possibility to highlight best/worst case areas, and to drill down into these areas to see which parts of the respective areas are affected, and for how long. The user can focus more on the risk domain, and less about interpreting raw data from the sensors.

Responsive aggregations: Aggregations over time provides a responsive user-interface (UI) which enables the user to quickly review vast periods of time, with built-in statistical analysis to describe the data in view.

Real-time data: Data is available for visualization in the matter of seconds after being transmitted from the sensor.

**Screen dumps below are intended for illustration purposes. Provided SW can deviate.*

The screenshots illustrate the INVENIO Site Monitoring SW interface. The top-left dashboard shows a summary of points and their states:

Total no of points			Probability of Failure (PoF)		
453	3 458	2 394	123	397	5 785
Wet	Damp	Dry	Very high	High	Medium or lower

The middle-left dashboard displays a table of all systems with the highest detected state:

Group	Current state	Total no of wet days	Points in group that are wet	CUI risk given measurements
Group 1	Wet	328 d	98%	Very high
Group 2	Wet	298 d	79%	Very high
Group 8	Wet	178 d	57%	High
Group 4	Damp	22 d	2%	High
Group 7	Damp	18 d	3%	Medium
Group 3	Damp	12 d	1%	Medium
Group 9	Damp	8 d	2%	High
Group 11	Damp	5 d	1%	Medium
Group 10	Damp	2 d	1%	Medium
Group 5	Damp	2 d	1%	Low

The top-right dashboard shows a 3-day rolling average chart of points in each wetness category (Wet, Damp, Dry) from Feb 2020 to Dec 2020.

The bottom-right dashboard shows a weekly cumulative total bar chart of days in state (Wet, Damp, Dry) for the week of 2020-06-10.

The bottom-left screenshot shows an aerial view of the site with sensor locations marked by numbered circles (5, 37, 65, 79, 88, 22) and a 50m scale bar.