

Gas Detection at the Speed of Sound

GASSONIC



GASSONIC OBSERVER-*i*

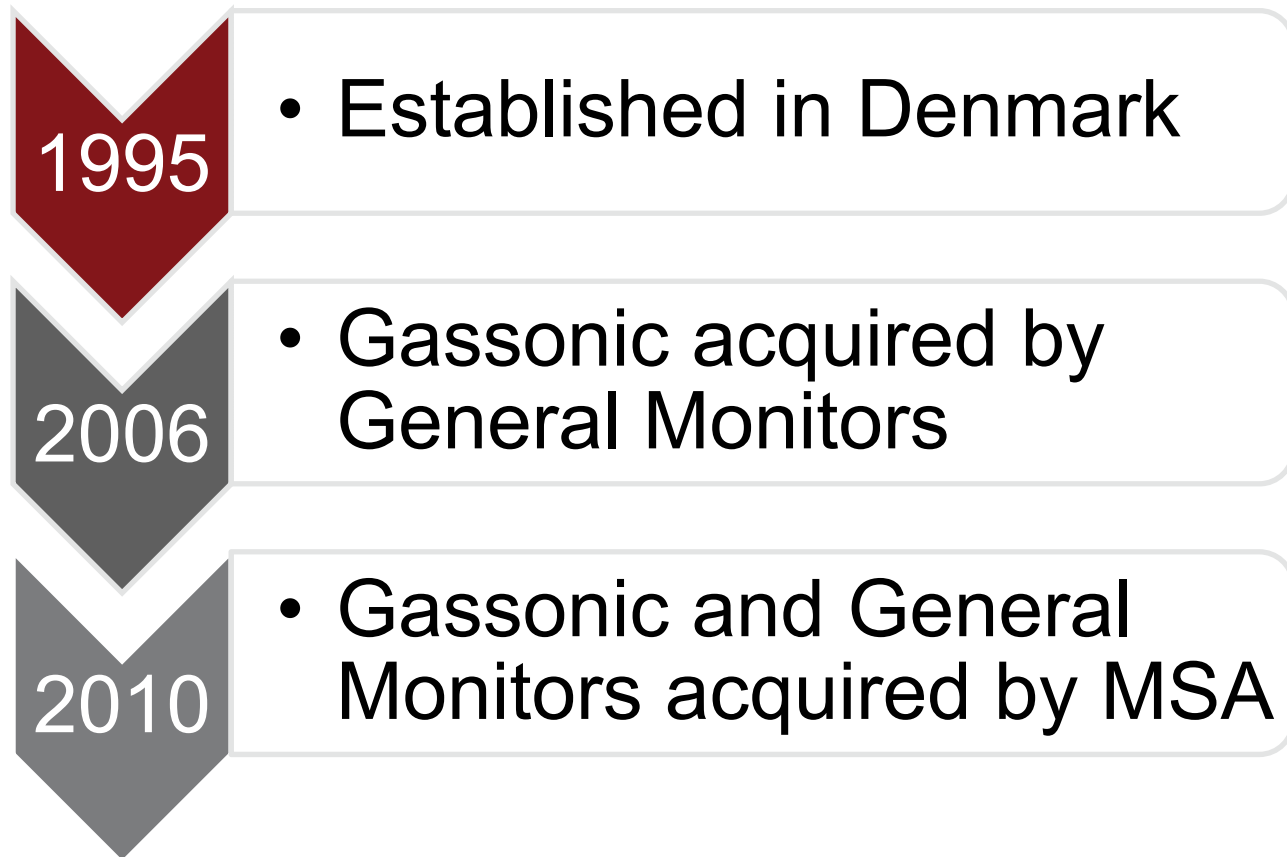
How fast does your gas detection system detect leaks?

Ultrasonic Gas Leak Detection

GASSONIC

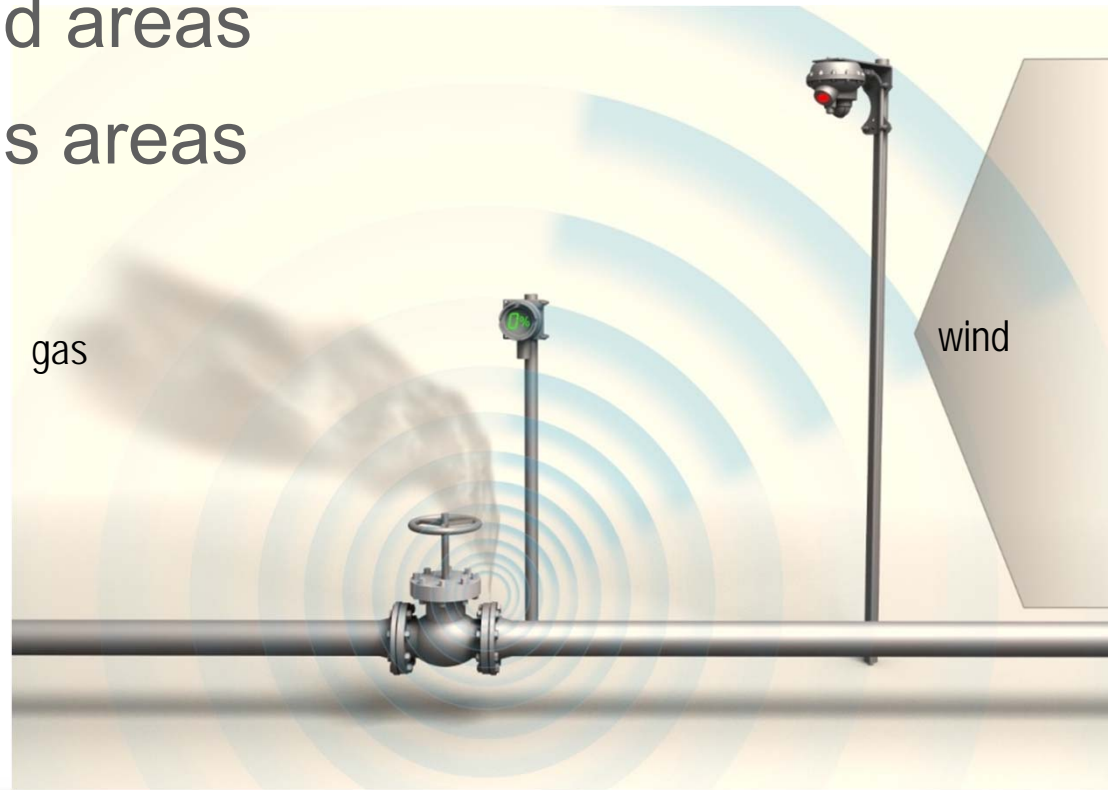


Increase detection reliability and reduce risk as ultrasonic gas leak detection provides instant and verifiable detection of gas leaks. The GASSONIC ultrasonic technology detects pressurized gas leaks instantly regardless of gas dilution and ever changing weather conditions found on most on- and offshore installations in the petrochemical industry.



Over 4000 detectors installed in the field

- Instant detection of flammable gas leaks
- Pressurized gas installations
- Outdoor or ventilated areas
- Explosion hazardous areas
- Fixed installations



Lower Explosive Level (% LEL):

A concentration measurement in a pre-defined point that may create a true picture of the nature of the gas leak.

Leak rate (kg/s):

Detection related to the leak rate, makes it possible to introduce a performance standard for the gas leak detection system.

Example: Gas leaks with a leak rate of 0.1 kg/s (0.22 pounds/sec) or more must be detected.

- Why traditional technologies can be problematic
 - Changing wind directions
 - Gas dilution
 - Direction of the leak
- Acoustic technology limitations
 - Low pressure (normal application of 10 bar (150 psi) and higher)
 - Not suited for liquids

Real Gas Leak Test with Ultrasonic Detectors

GASSONIC

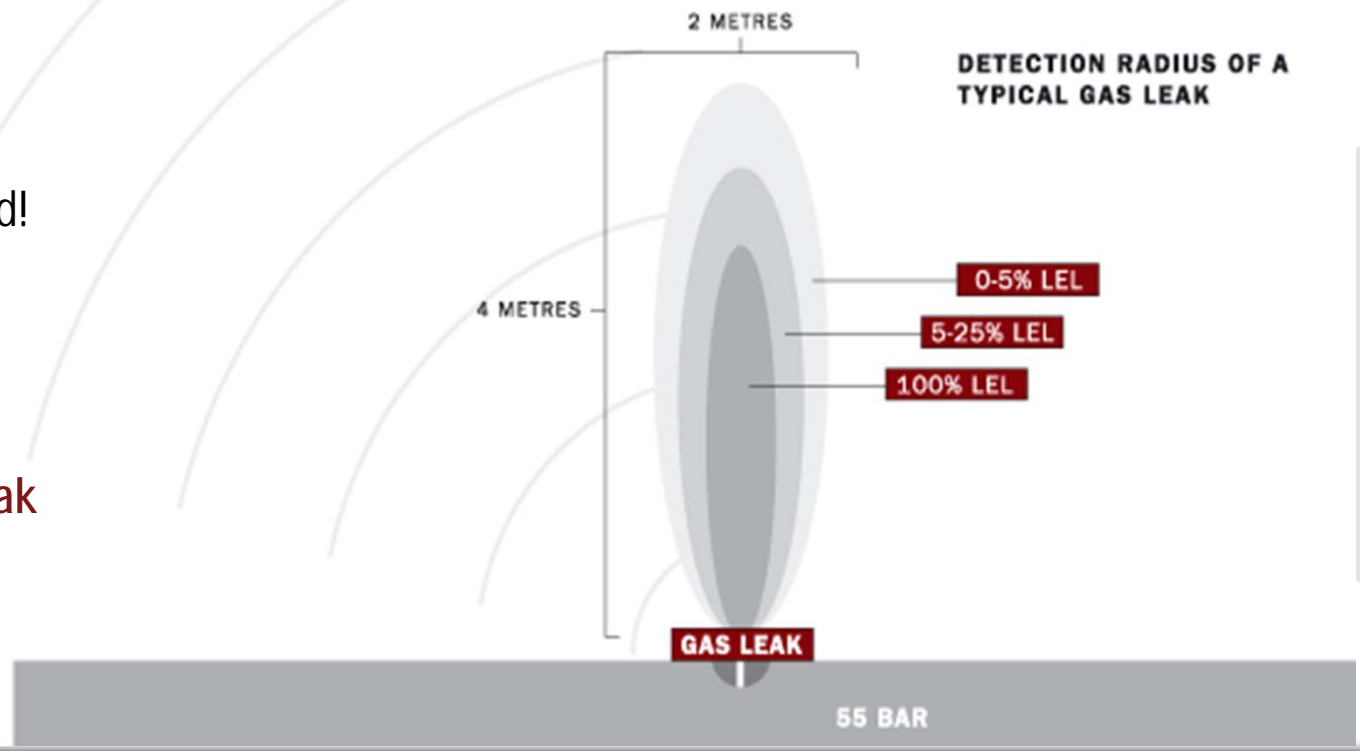
Live gas leak test on a North Sea off-shore installation:

Within 4-5 meters the gas concentration around the leak was below 5% LEL!

None of the existing gas detection systems alarmed!

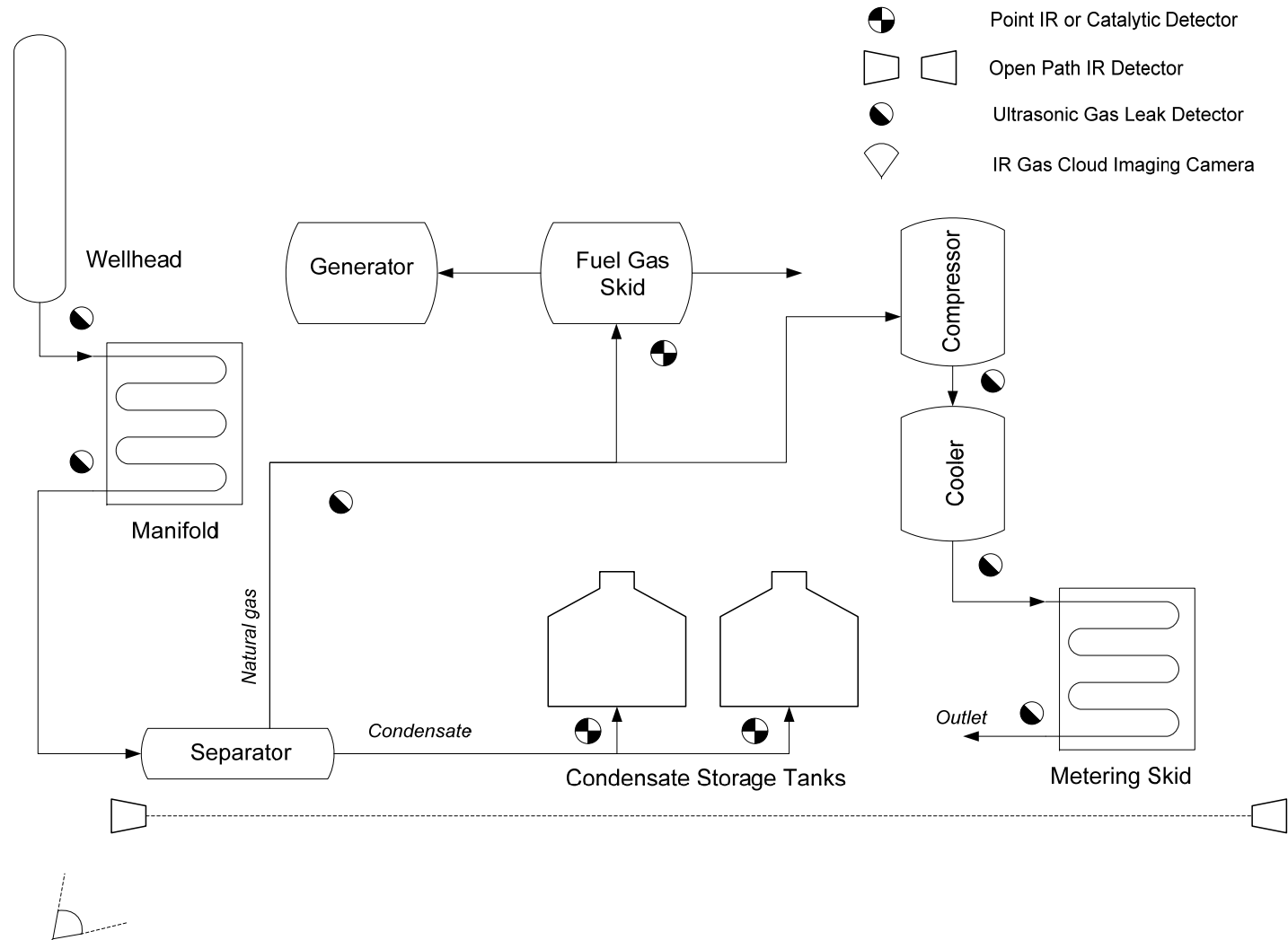
The ultrasonic gas leak detector detected the leak up to 19 meters away!

Leak size: 3 mm
Gas pressure: 55 bar (808 psi)
Leak rate: 0.06 kg/s



Technology Diversification

GASSONIC



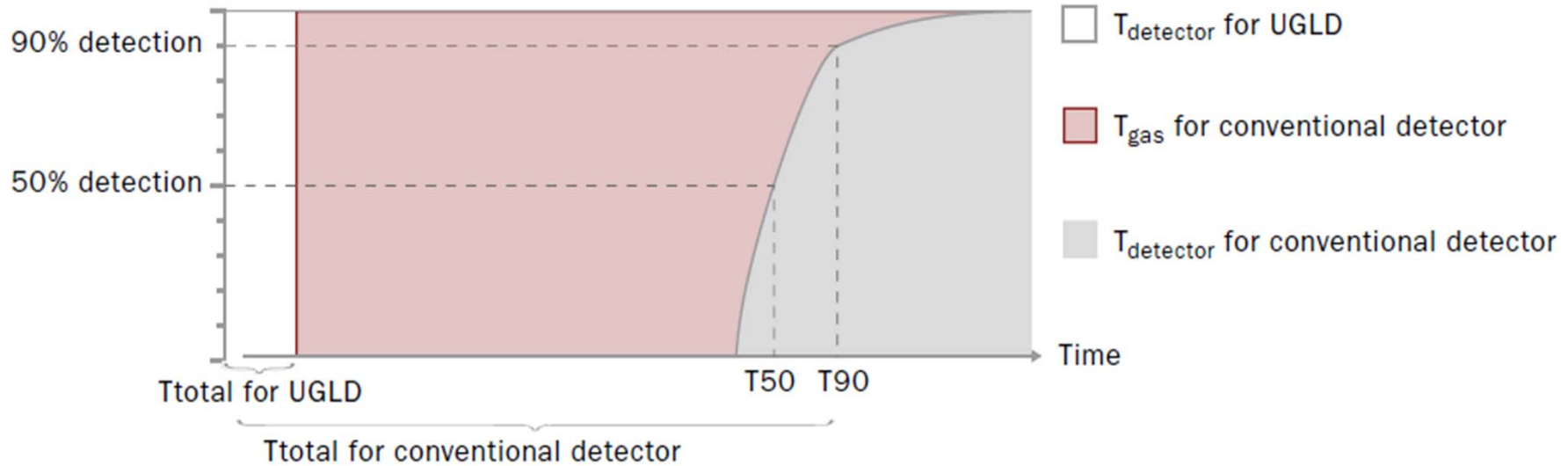
Total Speed Of Response

GASSONIC

Ultrasonic leak noise vs. gas accumulation

TOTAL SPEED OF RESPONSE [CONVENTIONAL]: $T_{total} = T_{detector} + T_{gas}$

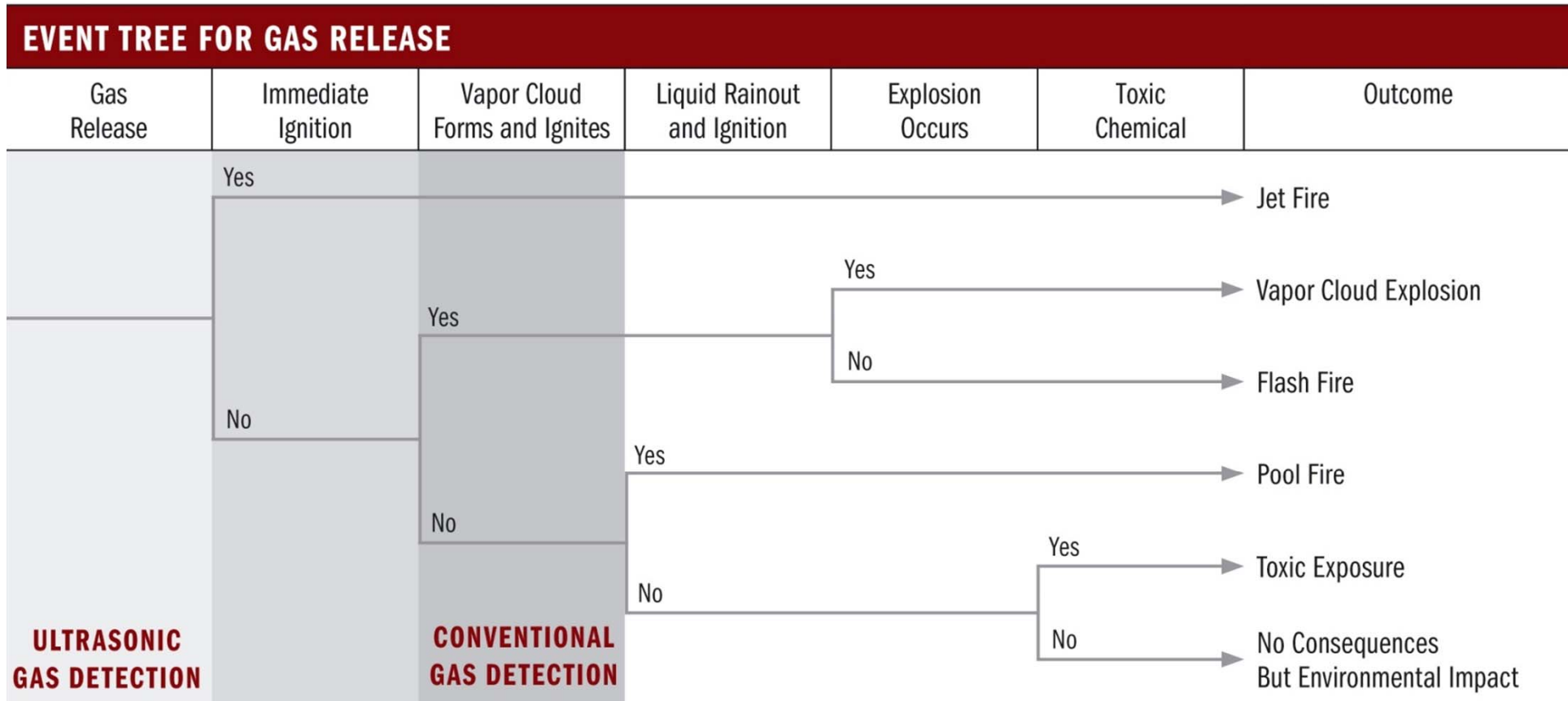
TOTAL SPEED OF RESPONSE [UGLD]: $T_{total} = T_{detector} + T_{ultrasound}$



Gas Release Event Tree



Deployment of early response to improve hazard management



What is a Leak

GASSONIC

Performance standard is 0.1 kg/sec? (0.22 pounds/sec)

Leak rate (mass flow rate) categories for methane based gas leaks (Ref: HSE from UK):

Minor gas leak:	0 – 0.1 kg/s
Significant gas leak:	0.1 – 1 kg/s
Major gas leak:	1 kg/s or larger

A 0.1kg/sec Methane leak:

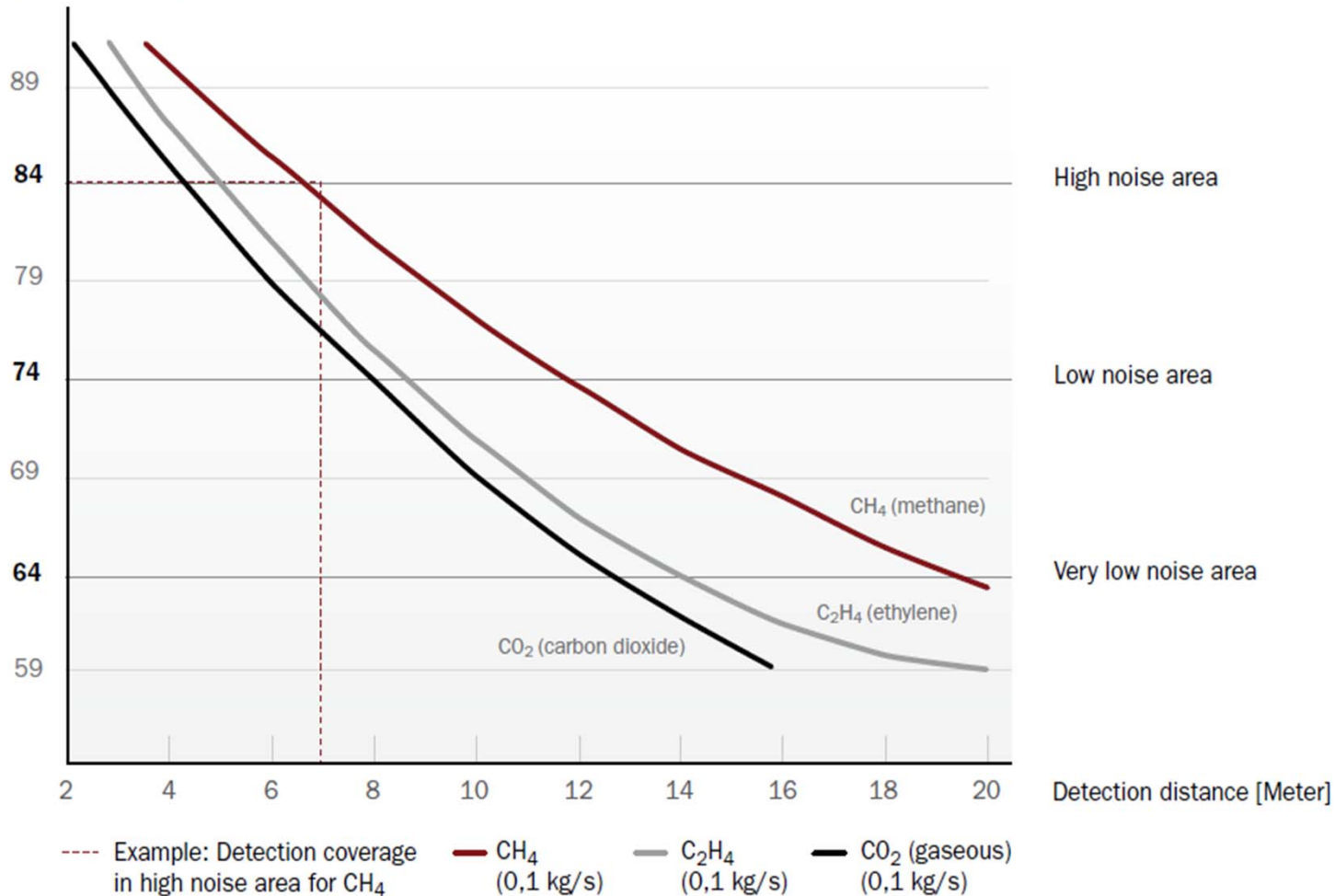
4 mm (0.16 in) hole size at 45 Bar (653 psi) gas pressure

Leak Detection Coverage

GASSONIC

Trigger level
[dB (ultrasound)]

DETECTION COVERAGE FOR 0.1 KG/S LEAKS

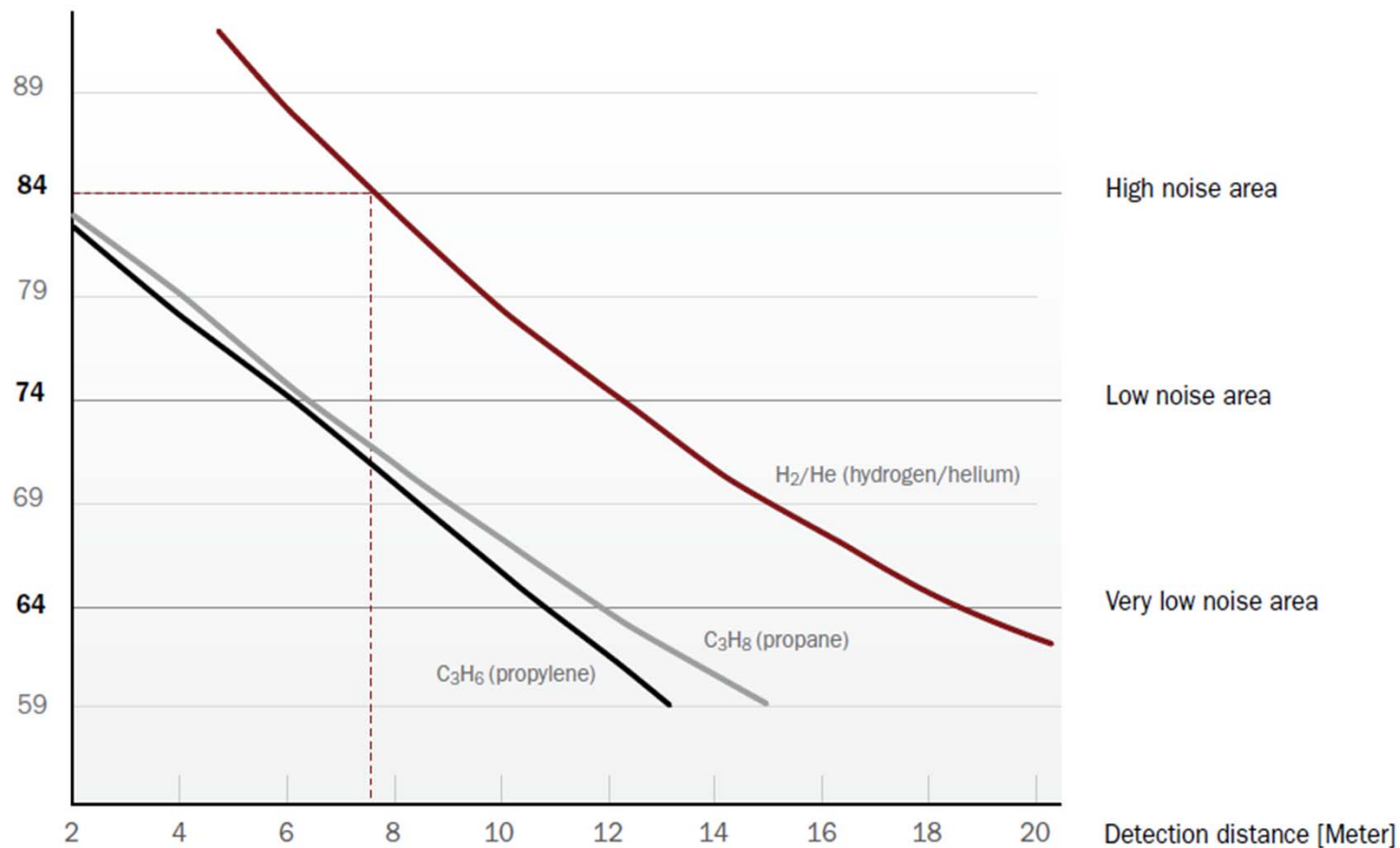


Leak Detection Coverage

GASSONIC

Trigger level
[dB (ultrasound)]

DETECTION COVERAGE FOR 0.01 KG/S LEAKS



--- Example: Detection coverage
in high noise area for H₂

— H₂/He
(0,01 kg/s)

— C₃H₈
(0,018 kg/s)

— C₃H₆
(0,016 kg/s)

First Generation

- Simple analog high pass filters
- Suppress low frequency acoustic noise
- Trigger Levels depending on background noise
- In very noisy areas the detection range is reduced

Second Generation

- Single pattern recognition
- Each detector is trained after installation
- Suppress only the specific acoustic background noise
- Trigger Levels still needed
- If the background noise signature change, false alarms can occur
- New training is required

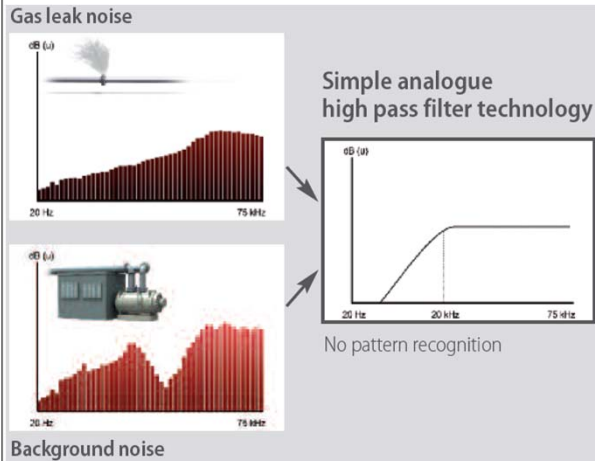
Third Generation

- Utilize Advanced Neural Network (**ANN**) technology
- ANN algorithms are pre-trained with real gas leak noise and background noise signatures
- No Trigger Levels needed
- Maximum coverage in all areas
- Plug and play and no need for re-training

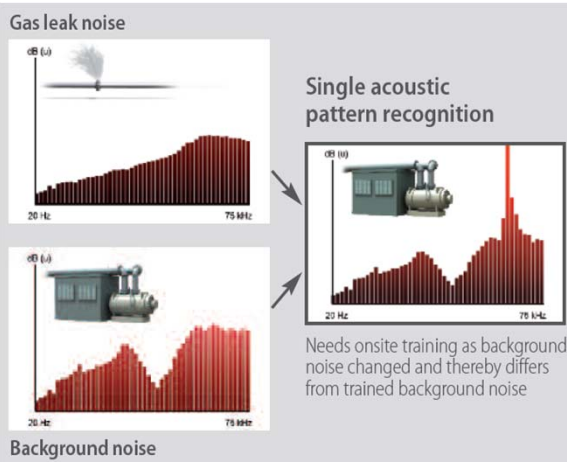
The Generations of UGLD

GASSONIC

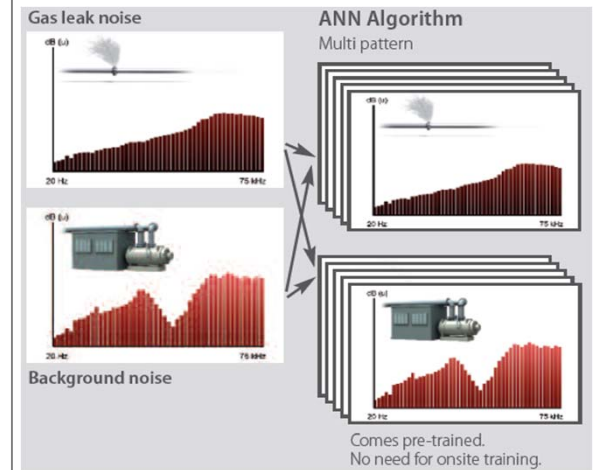
First Generation



Second Generation



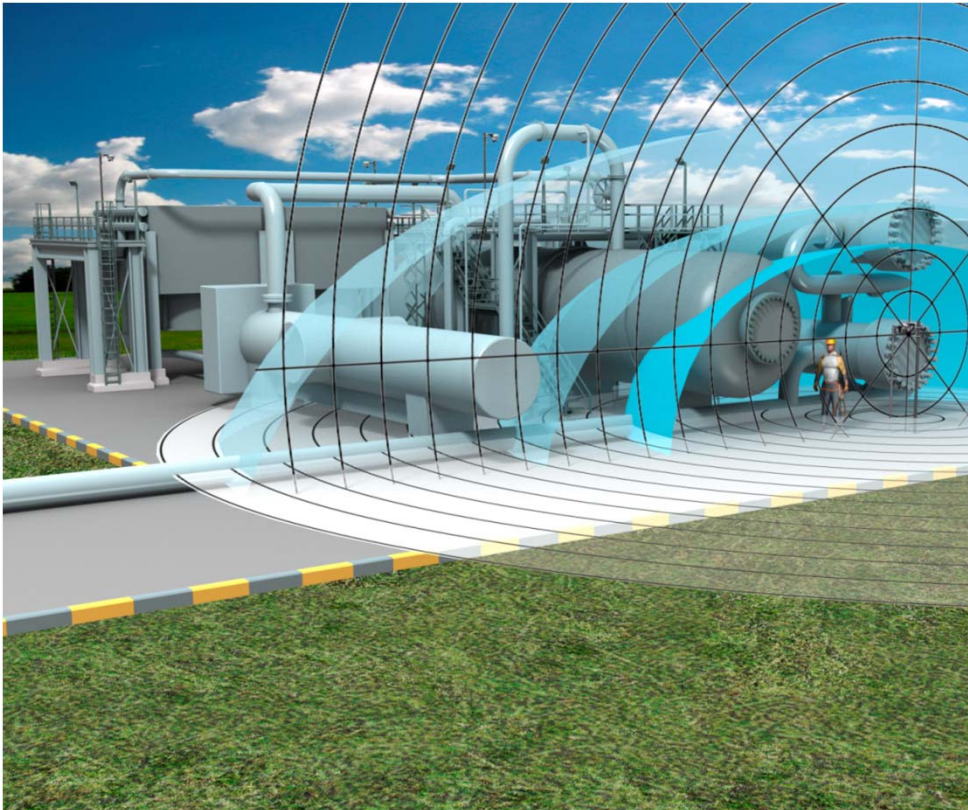
Third Generation



Detection Coverage for UGLD

GASSONIC

First & Second Generation UGLD



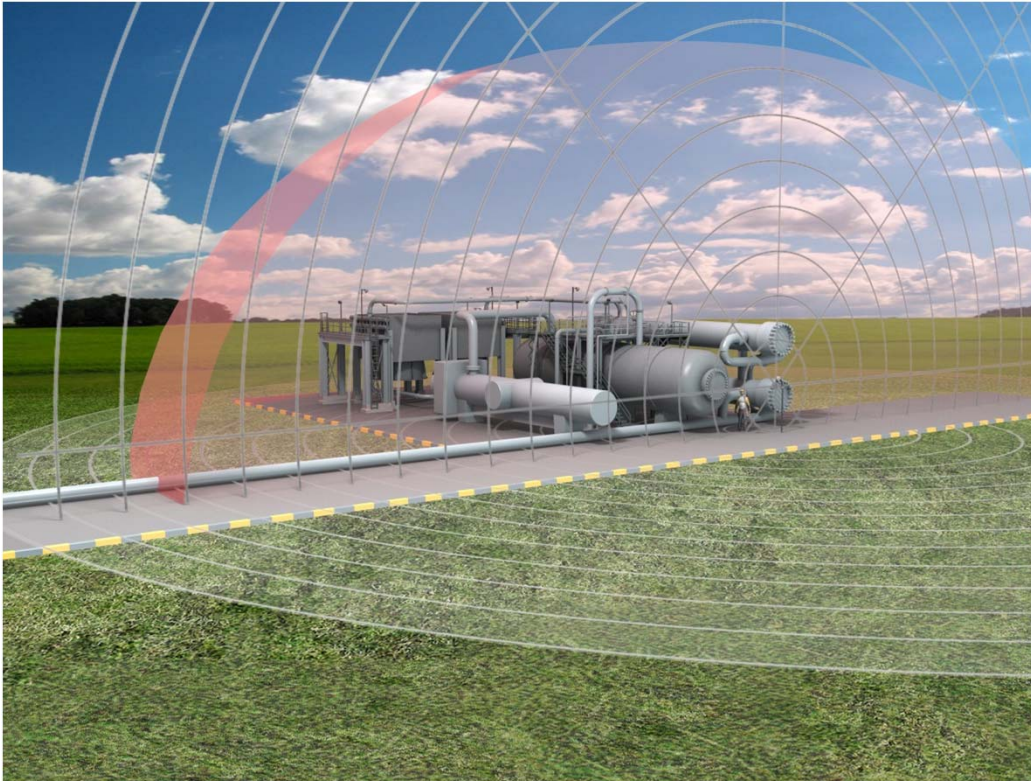
High-noise areas: Background noise <78dB
5 - 8 m (16 – 26 ft) coverage (84dB)
Ex: Turbo compressor area or complete open offshore weather deck

Low-noise areas: Background noise <68dB
9 - 12 m (30 – 39 ft) coverage (74dB)
Ex: Areas with no machinery or low-frequency machine made noise

Very low-noise areas: Background noise <58dB
13 - 20 m (43 – 66 ft) coverage (64dB)
Ex: Salt dome gas storage or onshore wellhead area in calm environment

The coverage of a 0.1kg/sec leak is based on the trigger level setting and can be as small as 8 meter.

Third Generation UGLD



Detection is based on ANN algorithms and no trigger levels in Enhanced Mode.

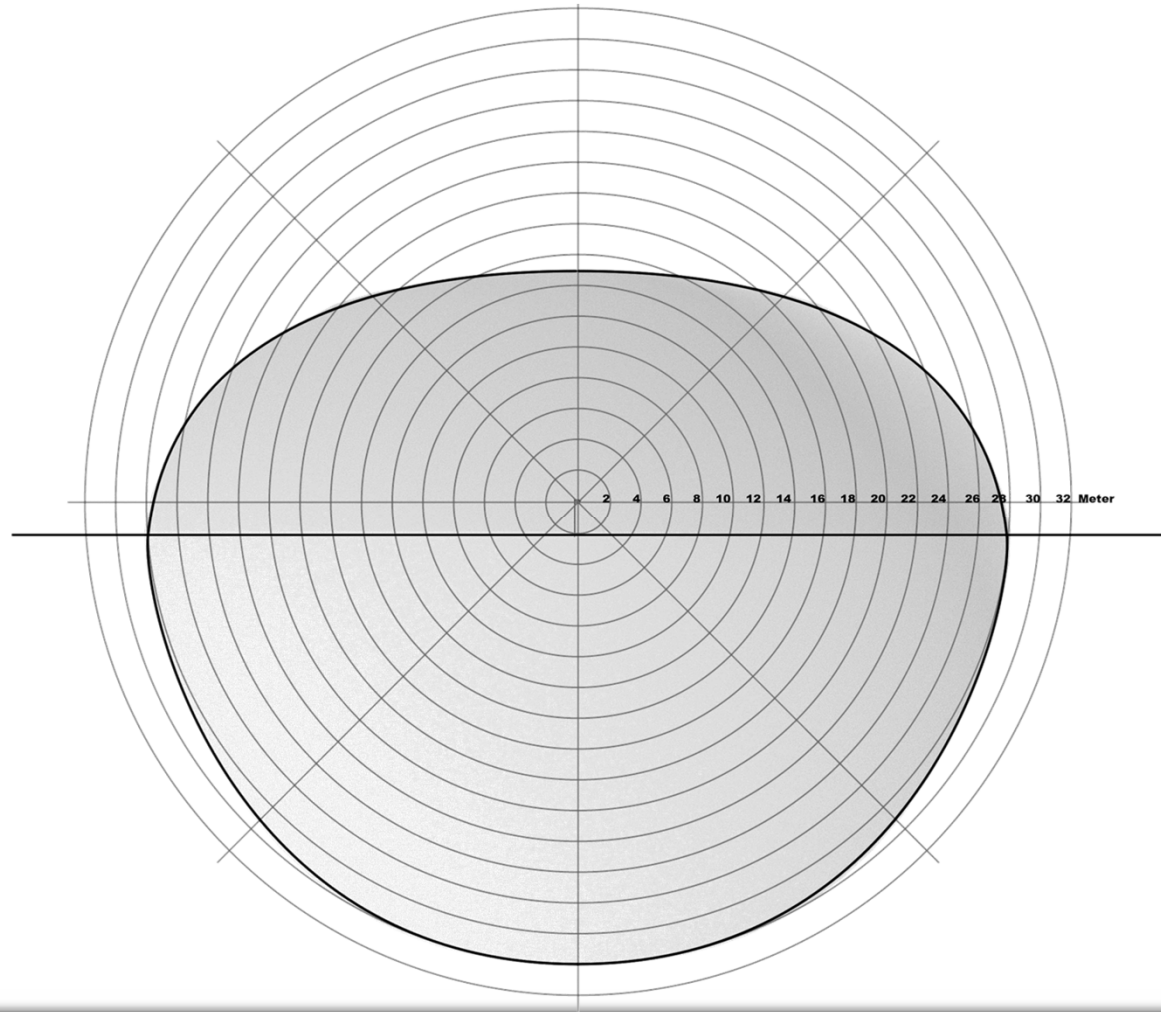
Maximum coverage of 30 meters can be achieved in all background noise levels.

GASSONIC OBSERVER-*i*

Detection Coverage for UGLD

GASSONIC

GASSONIC OBSERVER-*i* coverage in Enhanced Mode, based on 0.1kg/sec methane leak



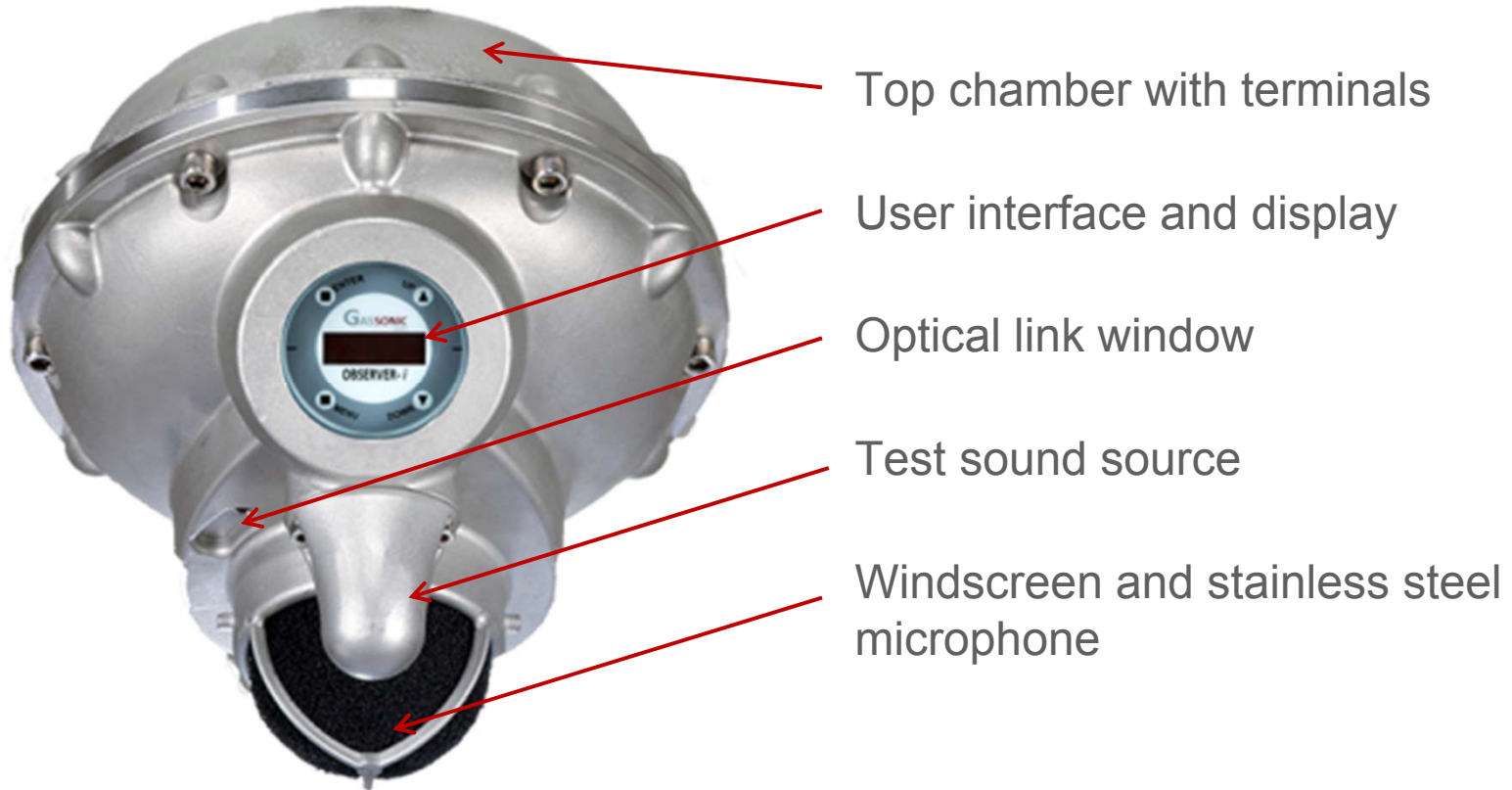
Detector Type Comparison

GASSONIC

	Surveyor	Observer-H	OBSERVER-i
Area Classification	Intrinsically Safe	Explosion proof	Explosion proof
Dynamic range	44 to 104 dB	58 to 104 dB	40 to 120 dB
Operation Mode	Classic (dB trigger levels)	Classic (dB trigger levels)	Classic / Enhanced
Coverage (0.1kg/s)	5 to 20 meters	5 to 20 meters	30 meters
Self Test	No	Yes	Yes
Sensor	S.S. Microphone	S.S. Microphone	S.S. Microphone
Safety Integrity Level	SIL 2	SIL 2	SIL 3
Test and Calibration	1701/SB100	1701/SB100	1701/SB100

Detector Type

GASSONIC



GASSONIC OBSERVER-*i*

- Main Features:
 - **Artificial Neural Network (ANN)**
 - **Senssonic™** integrated acoustic self-test
 - **Backwards compatible** with Observer-H
 - **Standard 4-20 mA analog**
 - **HART**
 - **Dual Modbus** serial digital interface
 - **Alarm Relay** and **Error Relay** outputs
 - **Explosion proof housing (Eexd)**
 - **316L stainless steel**
 - Minimal calibration and **low maintenance**
 - **FM, CSA, ATEX, IECEx** certification
 - **SIL 3** Suitable (FM certified to IEC 61508)



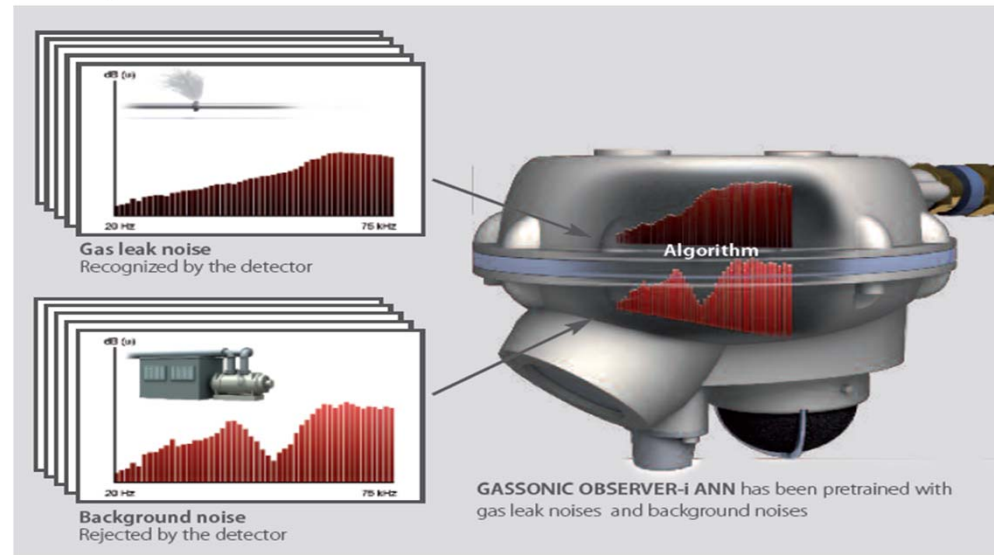
Artificial Neural Network (ANN)

GASSONIC

- True ANN, not “single fingerprint” learning
- ANN is similar to face recognition, but with noise sources
- Programmed to ignore background noise and only respond to leaks
- No complicated setup and special software
- No need for background noise mapping before installation
- No need for re-training when plant conditions change



Training of the Neural Network



Operation Modes

GASSONIC

Earlier generations of UGLDs only “listened” for the gas leak noise in the ultrasonic frequency range from 25 kHz and higher. Utilizing ANN, the OBSERVER-i frequency range can be lowered down to 12 kHz without interference from unwanted background noise. The lower frequency range significantly increases the detection radius.

Acoustic frequency range of the GASSONIC OBSERVER-I
Third Generation Ultrasonic Gas Leak Detector
Due to the extended frequency range, a longer
leak detection range can be obtained.

Acoustic frequency range
of First and Second Generation
Ultrasonic Gas Leak Detectors

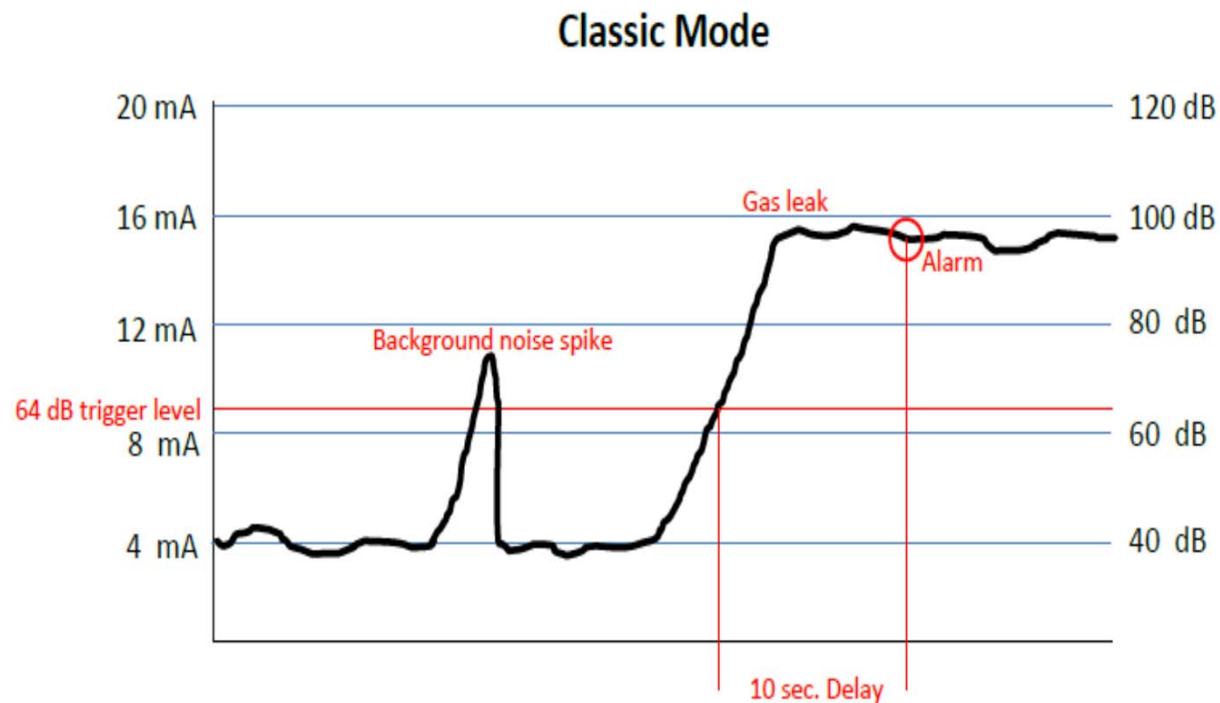


Acoustic sound within the human hearing range.
Most background noise in plants and other industrial facilities,
including turbines, motors, and compressors, falls within this frequency range.

Acoustic sound beyond the human hearing range.
Very few background noise will occur in this area.
Leaking gas produces acoustical sound within this range.

- The GASSONIC OBSERVER-i has two output modes
 - Classic Mode
 - Backwards compatible with the Observer and Observer-H
 - Enhanced Mode (ANN)

- Need Trigger Level *and* Delay Time
- Trigger Level determines the coverage (Sensitivity)
- 40 to 120 dB = 4 to 20 mA (Better than Observer-H)



- **NO Trigger Level needed**, only Delay Time
- Three output modes, Discrete SPL (EAO1), Discrete (EAO2), SPL Only (EAO3)
 - EAO1 and EAO2 has discrete AO similar to MSIR Flame Detector (16 mA Warning, 20 mA Alarm)
 - EAO1 40 to 120 dB = 4 to 12 mA, 16 mA Warning, 20 mA Alarm
 - EAO2 40 to 120 dB = 4 mA Normal, 16 mA Warning, 20 mA Alarm

OBSERVER-i Classic Mode and OBSERVER-H analog output comparison

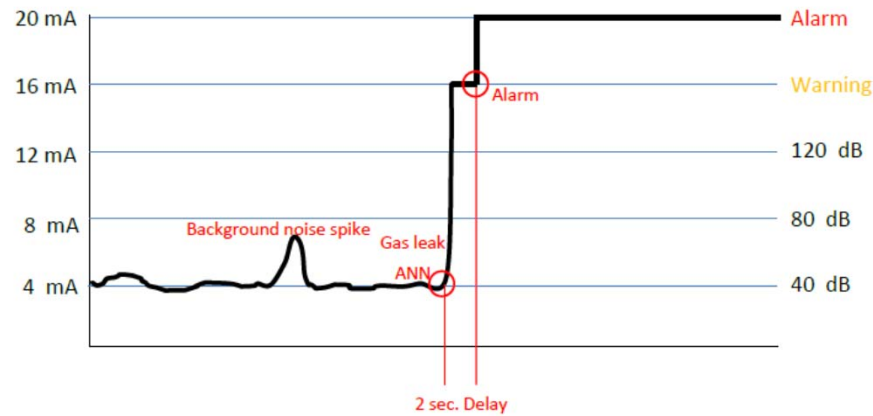
	Observer-i	Observer-H
SPL	mA	mA
40	4.0	
44	4.8	
49	5.8	
54	6.8	
58	7.6	4.0
59	7.8	4.3
64	8.8	6.1
69	9.8	7.8
74	10.8	9.6
79	11.8	11.3
84	12.8	13.0
89	13.8	14.8
94	14.8	16.5
99	15.8	18.3
104	16.8	20.0
109	17.8	
114	18.8	
120	20.0	

- Alarm Function in Enhanced Mode
 - It is an “AND” function
 - Sound level has to pass ANN Sensitivity Level “AND” a real gas leak identified
 - ANN Sensitivity Level default at 59 dB can be set as low as 49 dB (recommended)

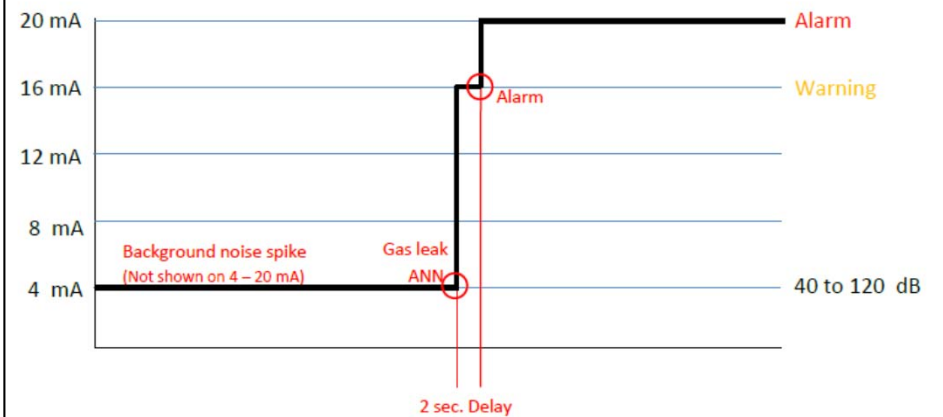
Enhanced Modes

GASSONIC

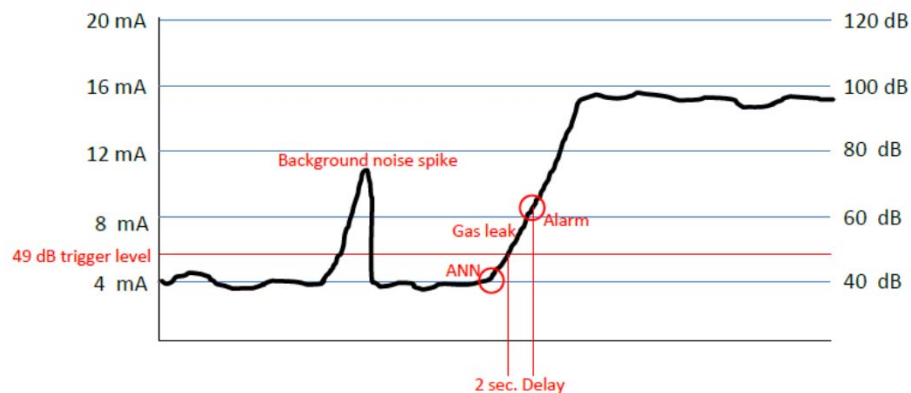
Enhanced Mode (EAO1)



Enhanced Mode (EAO2)



Enhanced Mode (EAO3)



- Senssonic™ built-in acoustic integrity test
 - External loop configuration
 - Controlled functionality and integrity test every 15 minutes
 - No un-revealed failures between inspections
 - Fault indicated on 4-20 mA, Error Relay, Display, Modbus, and HART



Test transducer



1701 Portable Test & Calibration Unit

- Intrinsically Safe (ATEX, C-UL)
- Verify the operation and if necessary, calibrate the Gassonic UGLD.
- Requires no electrical connection to the UGLD
- Traceable and calibrated to international standards
- Tests full dynamic range as well as delay function
- No need to open up detector or remove parts in the field



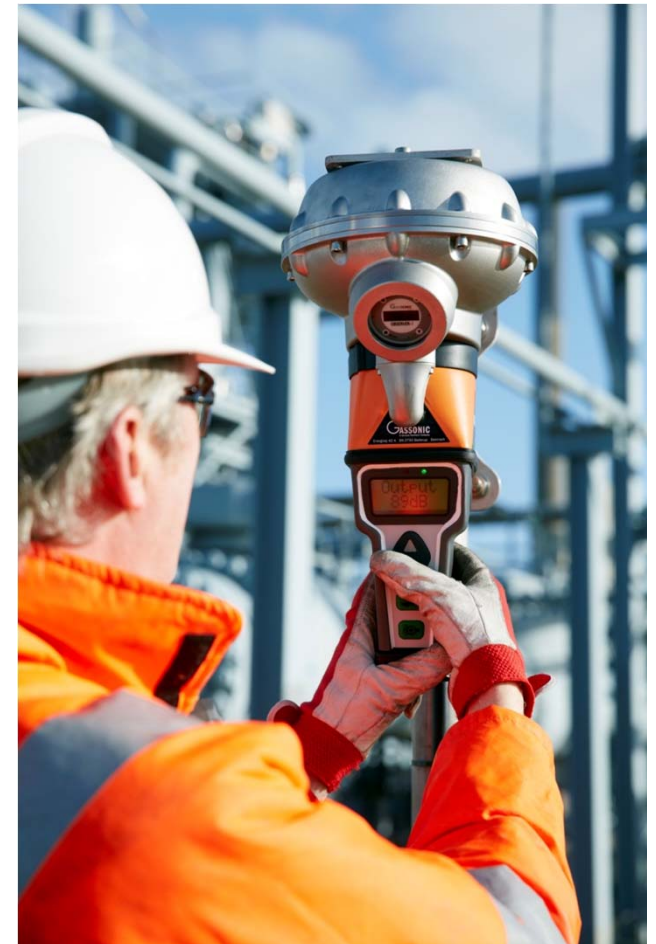
SB100 Bump Tester

- Intrinsically Safe (CSA, FM, ATEX, IECEx)
- For bump test of GASSONIC UGLDs
- Not a calibrated device
- Remote testing up to 18m (59ft) away
- Does not replace gas leak simulation
- GASSONIC OBSERVER-*i* recognizes the SB100 sound signature

Testing - 1701 Portable Test & Calibration Unit

GASSONIC

- Prior to testing
 - Clean Windscreen and optical link window
- Testing/Calibration
 - Traceable to international standards
 - Gain Test (functionality/tolerance)
 - Delay Test (Loop to F&G System)
 - Calibration if required by plant procedures
- Maintenance
 - Factory calibration needed every 2 years



Testing - SB100 Bump Tester

GASSONIC

■ Remote Bump Testing

- Cannot be used for calibration
- Testing up to 18m (59ft)
- The table below does not correspond to real gas leaks (Gas leak simulation is recommended)

Test Range Distance	Average Sound Level Reading* +/-5 dB
4 m (13 ft)	88
6 m (20 ft)	82
8 m (26 ft)	78
10 m (33 ft)	74
12 m (39 ft)	70
14 m (46 ft)	68
16 m (52 ft)	64
18 m (59 ft)	60

**As tested on the GASSONIC OBSERVER-i, OBSERVER, GASSONIC Surveyor, MSA EX-5, and MSA IS-5.*



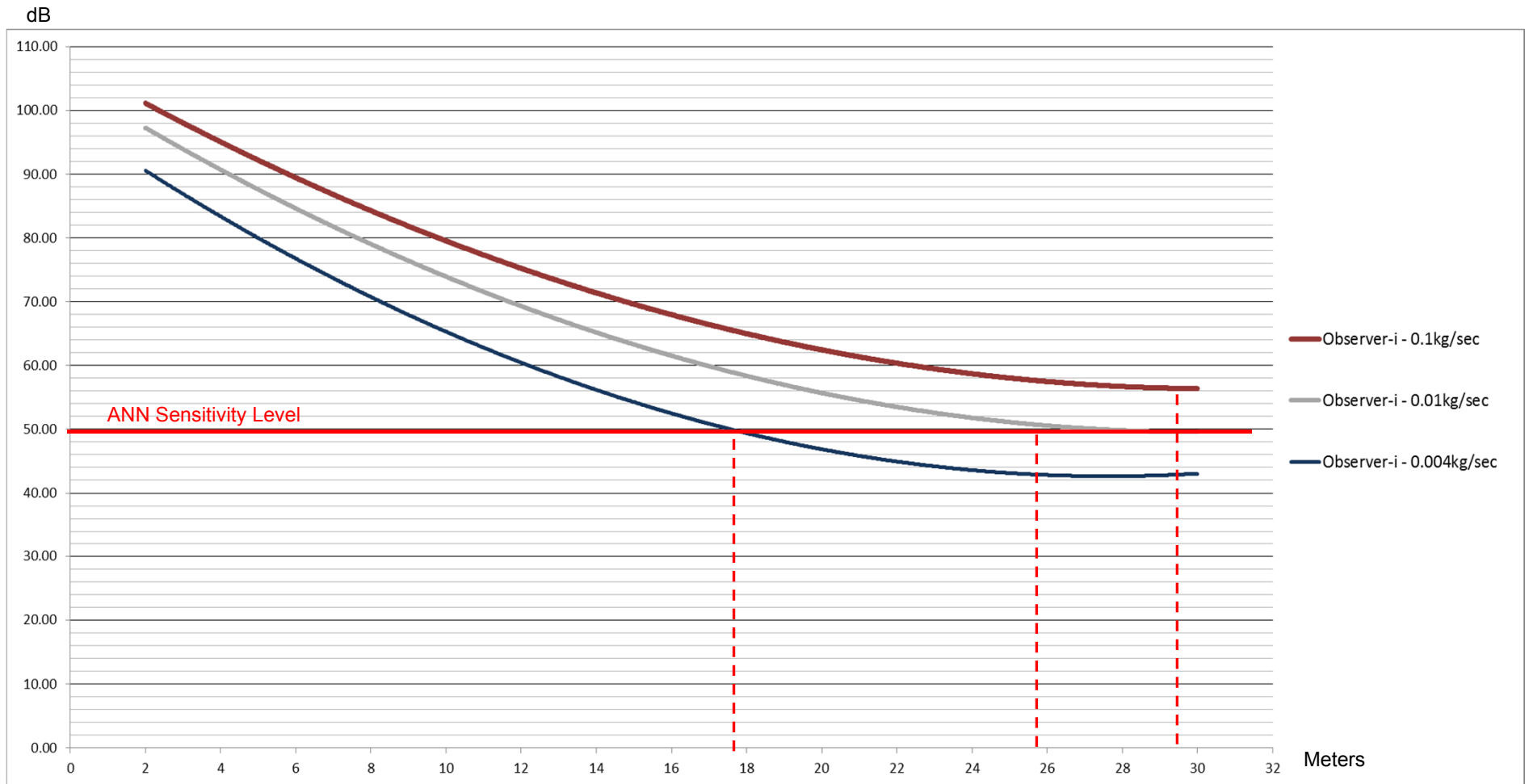
Testing – Gas Leak Simulation

GASSONIC

- Recommended gas leak equipment
 - 4 meter long high pressure hose with regulator, valve and nozzle
 - 2 or 4 mm nozzle
- Testing procedure
 - Maximum 0.1 kg/sec (0.22 pound/sec) leak rate from a standard 50 Liter nitrogen cylinder
 - Leak testing performed at coverage perimeters



GASSONIC OBSERVER-i coverage with N₂ leak simulation



- Most of the major end-users within the oil and gas industry are implementing UGLD technology for projects worldwide
 - Europe, Africa, Middle East, Far East/Central Asia, Australasia
 - North Sea: England, Norway (Sleipner, Gullfaks)
 - Caspian Sea Region: Azerbaijan (Shah Deniz), Russia (Sakhalin II), Kazakhstan (Kashagan)
 - Middle East: Oman (Saih Rawl, Saih Nihyada, Al-Kawther, Harweel)
 - Far East/Central Asia: China (Bohai Bay), Malaysia (Shell Bintulu), Pakistan (Rehmat), Indonesia (Tanggung)
 - Africa: Equatorial Guinea (Marathon ALBA), Algeria (Hassi Berkine)

- More than 4000 Gassonic UGLDs installed worldwide
 - The Americas:
 - USA - Dow Chemical, Chevron Global Gas, Caledonia Energy, Shell Offshore, Chevron Pipeline, EnCana, Seneca Resources
 - Canada - Dow Chemical, Nexen, EnCana, SBM
 - Trinidad & Tobago – BP, BG, NGC
 - Chile – Chile LNG
 - Argentina – Total
 - Mexico – Pemex

Existing Installations – Onshore Wellheads

GASSONIC

Ultrasonic detectors installed on wellheads in Europe and Africa



Major gas supplier in Europe using only ultrasonic detectors on its outdoor gas plants

Existing Installations – Offshore Platform

GASSONIC

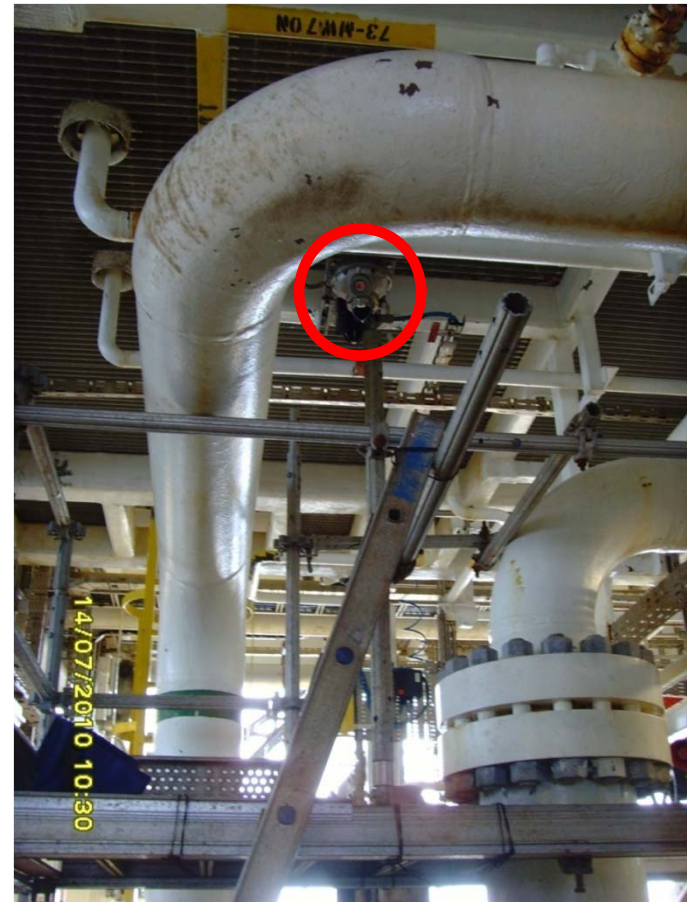
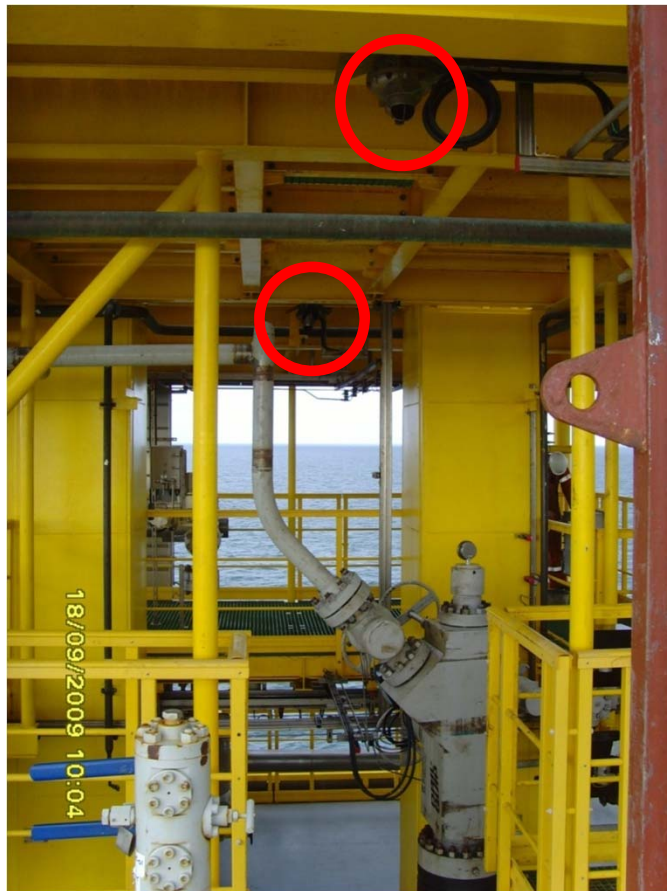


7 out of 9 Ultrasonic detectors installed on a Hess weather deck in the North Sea.

Existing Installations – Offshore Platform

GASSONIC

Observers offshore



- Why GASSONIC OBSERVER-i UGLD?
 - Artificial Neural Network
 - Improved detection range (30 m)
 - Plug and play – no training required in field
 - No trigger levels
 - Reduce risk
 - Instant and reliable detection
 - Unaffected by changing weather conditions
 - No undetected failures because of built-in self test function
 - Cost effective – reduced total cost of ownership