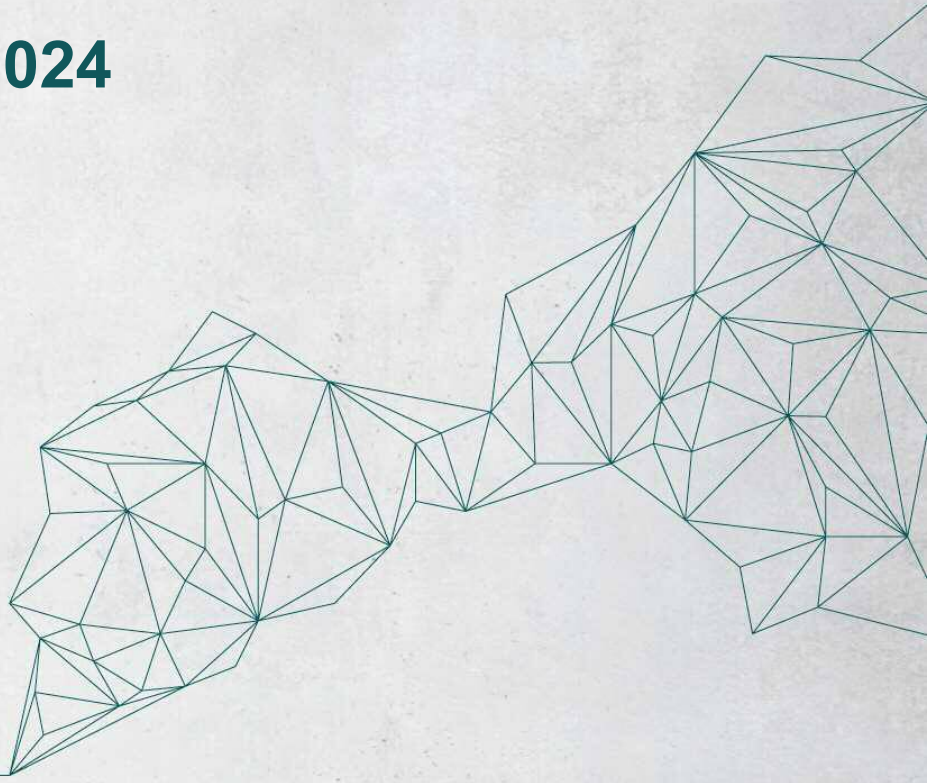
Hall 7A

Chillventa Specialist Forums 2024
Chillventa Fachforen 2024

CONNECTING EXPERTS.



ADVANCED SENSING TECHNOLOGIES

A2L & A3 Gas Sensor Solutions

LEE WASHBOURN – DIRECTOR OF GAS ELECTRONICS

Agenda

- Company Overview
- Refrigerant Market/Regulatory
- Our Roadmap
- Sensor Operating Principle and Specifications
- Sensor Test Data
- Future Developments

Meet SENSIENCE©

COMPANY PROFILE

A global manufacturer of highly engineered sensing, control and sealing components, delivering the technologies, capabilities and creative solutions that give our customers certainty-certainty in safety, certainty in performance, certainty in quality, and certainty in support.

HEADQUARTERS
Columbus, OH

ANNUAL PRODUCTION
900+ Million
Units Manufactured

FOUNDED
1947

EXPERIENCE
75+ YEARS
Trustworthy, stable company with proven reliability

GLOBAL LOCATIONS
10

EMPLOYEES
Nearly **4,000**

CUSTOMERS
1,500+

OWNERSHIP
ONE ROCK
CAPITAL PARTNERS

Multi-site, Multi-region Production for Risk Mitigation

Leading Product Application Experts

Broadest Range of Product Options

Rapid Custom Prototypes

What We Do

CHILLVENTA

SENSING SOLUTIONS

Putting systems in touch with their surroundings to enable new levels of understanding, awareness and response.

PACKAGED SENSORS	ELECTRO-MECHANICAL	AUTOMATED CONTROLS
• Temperature • Gas Sensing • Pressure	• Bi-metals • Thermal Fuses (TCO)	• Electronic • Heating • Control

HERMETIC SOLUTIONS

Ensuring a robust electrical or signal connection across adverse environmental conditions.

AC/R	INDUSTRIAL	DEFENSE
• Terminals • SH Plates • Power Bolts • Sight Glass	• Sensor/Power Feedthroughs • Battery Seals	• Packages • Feedthroughs • Initiator Assemblies • Laser Lidding

sensience

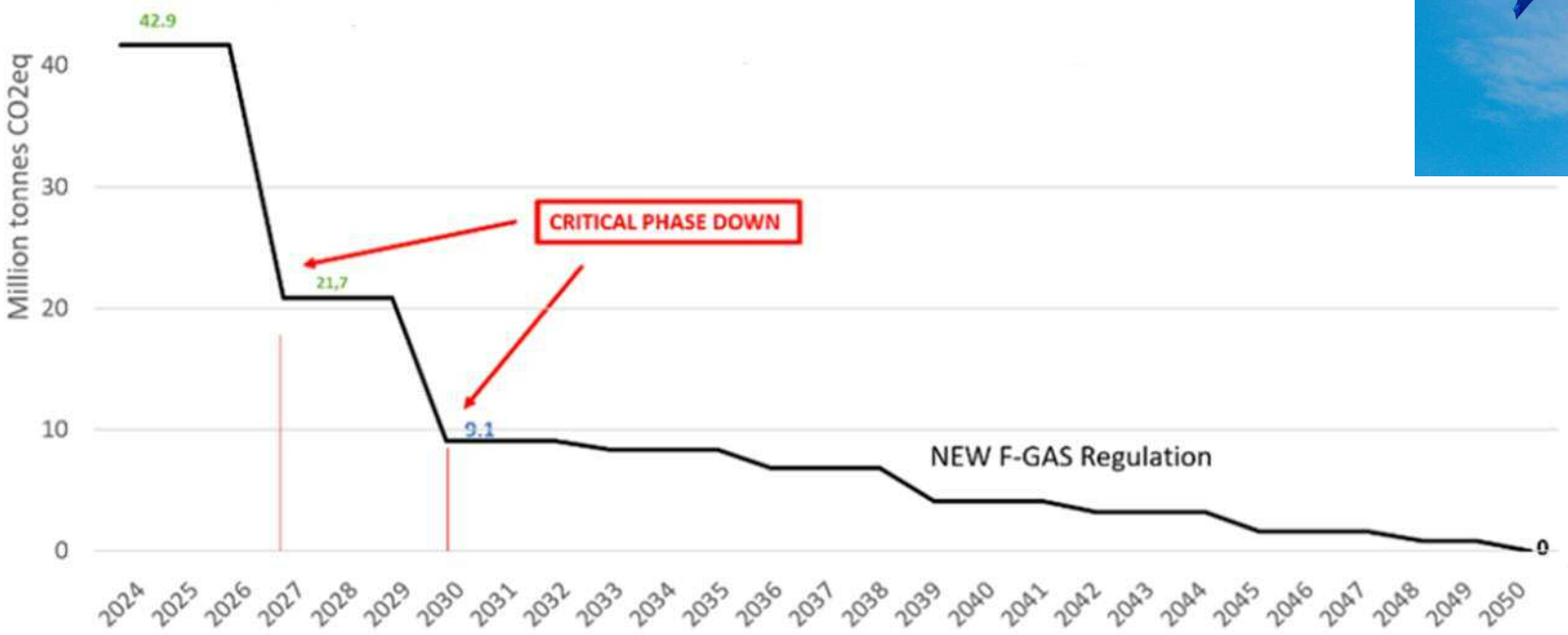
Why Choose Us

Culture of Innovation and New Product Development

- **New Product Development** focused on identifying opportunities aligned with key trends, higher-value products and higher-growth markets;
- Ability to respond rapidly to customer design cycles with unique **Configure to Order (CTO)** process including auto configuration software and 3D printing;
- **Lab and Test Capabilities** at Cincinnati, Hampstead, Tongling, Zhuhai, Juarez, Muskegon, Mansfield and Almelo including Automotive labs, hermetic labs, vibration testing, thermal shock testing, pressure testing, temperature and humidity chambers, gravel impact;
- Implementing **Cloud-based Product Lifecycle Management Platform** to accelerate innovation and maximize reuse of parts;
- Highly qualified engineering team to support technical issues regionally.

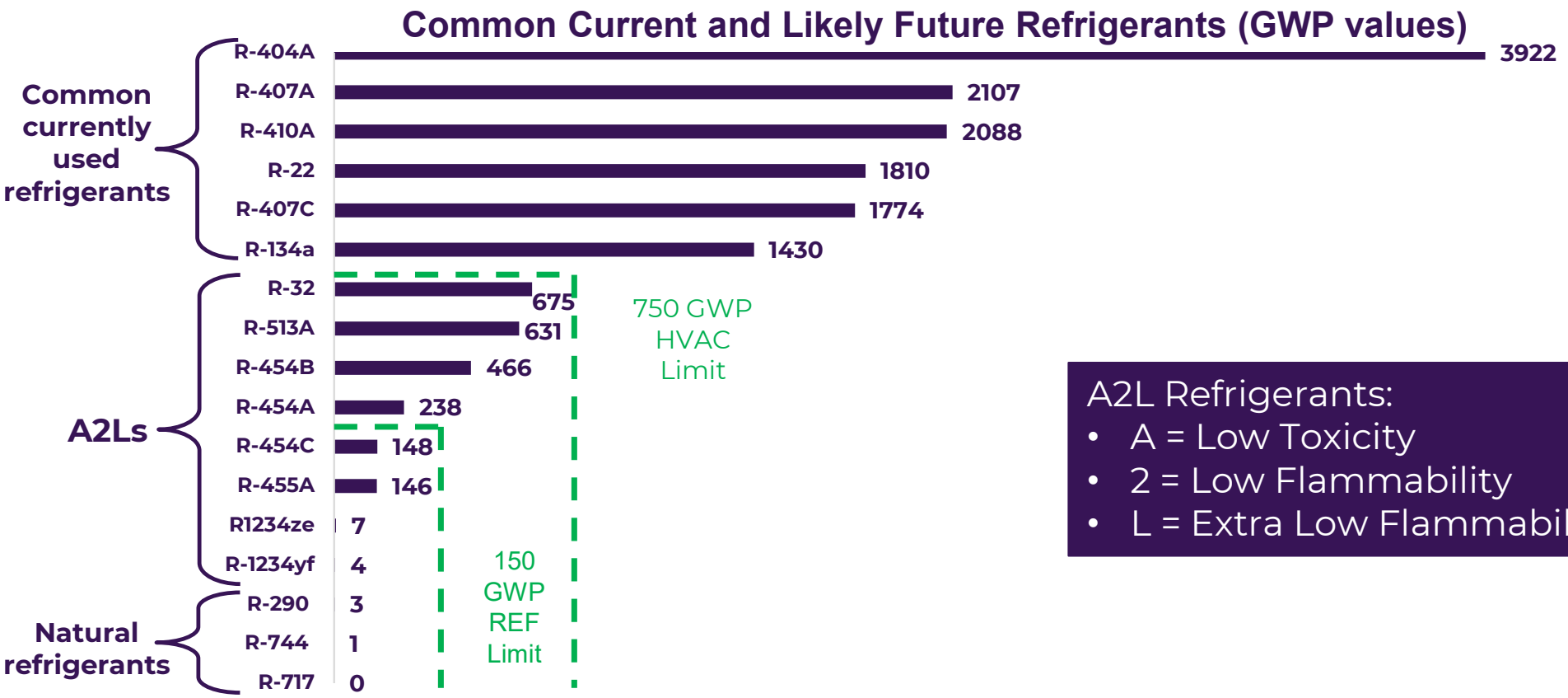
Regulations Focused on Sustainability Drive HFC Reduction

The proposed F-gas quota phase down from 2024



Source: EPTA Refrigeration

Industry Shifting to Flammable Refrigerants and Detection Systems



A2L Refrigerants:

- A = Low Toxicity
- 2 = Low Flammability
- L = Extra Low Flammability

Refrigerant Regulations & Standards

New F-Gas Regulation (February 2024)

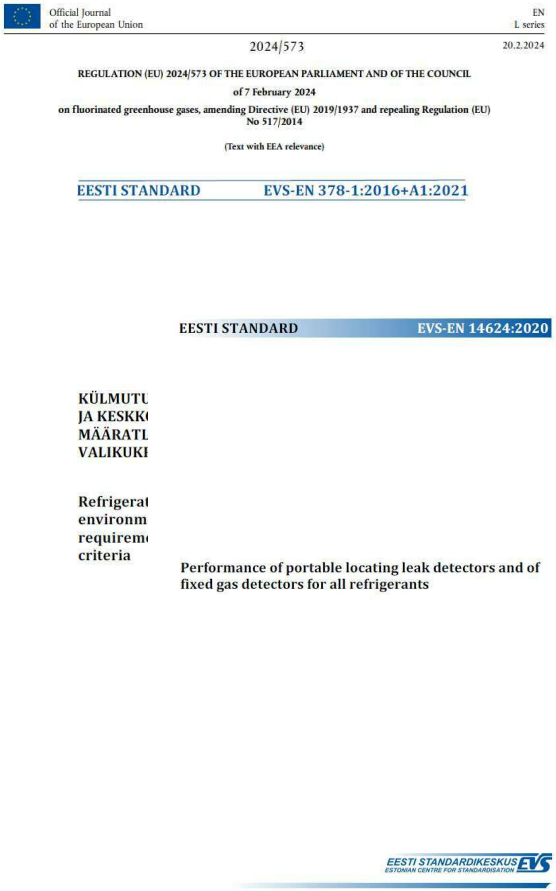
- complete phase out of F-gasses across the EU by 2050;
- significantly reduced quota from 2025;
- the amount of equipment bans and increased level of detail;
- service bans.

P-FAS (still in the evaluation process)

- Entry into force projected to be within the timeframe of 2027 to 2028;
- Potential significant impact on HVACR;
- Additional bans could come into force.

- **EN 378:2016 – Refrigeration standard**

- **EN 14624:2020 - Refrigerant detector performance standard**



Official Journal of the European Union

EN
L series

2024/573

20.2.2024

REGULATION (EU) 2024/573 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 7 February 2024

on fluorinated greenhouse gases, amending Directive (EU) 2019/1937 and repealing Regulation (EU) No 517/2014

(Text with EEA relevance)

EESTI STANDARD EVS-EN 378-1:2016+A1:2021

EESTI STANDARD EVS-EN 14624:2020

KÜLMUTU
JA KESKK
MÄÄRATL
VALIKUKI

Refrigerat
environm
requirem
criteria

Performance of portable locating leak detectors and of fixed gas detectors for all refrigerants

EESTI STANDARDIKESKUS EVS
ESTONIAN CENTRE FOR STANDARDISATION

Our Gas Sensing Journey

CHILLVENTA

1 ✓
JOINT DEVELOPMENT AGREEMENT
Sensience-NevadaNano
AUGUST 20, 2021

SENSIENCE
ADVANCED SENSING TECHNOLOGIES
NevadaNano

2 ✓
PHASE 1 DEVELOPMENT

3 ✓
PHASE 2 DEVELOPMENT
R32, R454B MODBUS

START: APRIL 2022

4
UL CERTIFICATION
UL 60335-2-40 Ed 4.0
R32 MODBUS
✓
SEPTEMBER 27, 2023

5
UL CERTIFICATION
UL 60335-2-40 Ed 4.0
R454B MODBUS
Dual R32/R454B
✓

6 ✓
LAUNCH
MASS PRODUCTION READY
DELICIAS, MX

7
DEVELOPMENT
- R454C/A
- **A3 GAS**
- ANALOG/SERIAL OUTPUT
- **A2L DETECTION +MITIGATION**

Sensience 30G A2L Refrigerant Sensor

Reliable, Real-World Applicability Compliant With UL 60335-2-40, Annex LL

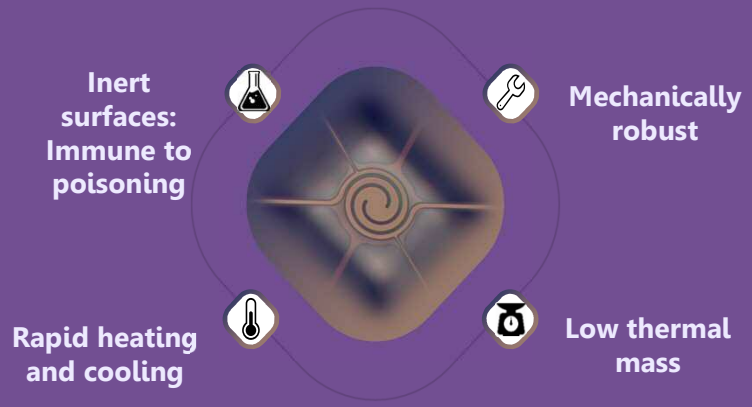
The **Sensience** 30G A2L refrigerant sensor, enabled by proprietary technology, is a reliable sensing solution for refrigerant detection systems to help the OEM comply with UL 60335-2-40.

OPERATING PRINCIPLE

The **Molecular Property Spectrometer (MPS)** gas sensor's transducer is a micro-machined membrane with a precision nano-calorimeter. The transducer continually samples the air to determine if a gas is present that matches the molecular properties of the refrigerant of interest. Sensor data are processed by patented algorithms to accurately report concentration, across a wide environmental range from -40°C to +80°C and 0 to 100%RH condensing conditions.

TECHNICAL SPECIFICATIONS	Sensors are calibrated for specific refrigerant
Refrigerant	R-32
	R-454 blends
Communication interface	RS-485 Modbus® RTU
	Digital serial UART (5V) – in development
	5 Vdc PWM – in development
Supply voltage/current	5V ± 10%; 80mA max
Agency Compliance	UL 60335-2-40 Annex LL
Operating Temperature	-40 TO 80°C
Storage Temperature	-40 TO 85°C (unpowered)
Operating Humidity Ranges	0 TO 100% RH condensing
Operating Pressure Ranges	65 TO 110 kPa
Measurement Range	0-100% LFL
Resolution	0.1% LFL
Response Time	<30 seconds to 25% LFL step change
Lifetime	15+ years with no calibration required

Sensor Technical Overview



Operating Principle

- Transducer is a micro-machined membrane with an embedded Joule heater and resistance thermometer.
- The MEMS transducer is mounted on a PCB within a rugged enclosure open to ambient air.
- Measurements of the thermodynamic properties of the air/gas mixture.
- Sensor data are processed by patented algorithms to report accurate concentration and classify the flammable gas.

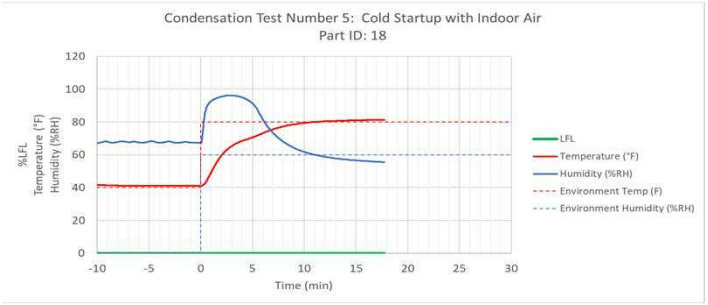
How does the sensor detect gas?

1. Gas rapidly defuses through the sensor's mesh screen and into the sensor chamber, entering the MEMS sensor module.
2. The joule heater rapidly heats the gas sample.
3. Real-time environmental conditions (temperature, pressure, and humidity) are measured by the integrated environmental sensor.
4. The energy required to heat the sample is precisely measured using a resistance thermometer.
5. The gas level, corrected for gas category and environmental conditions, is calculated and output to the system control.

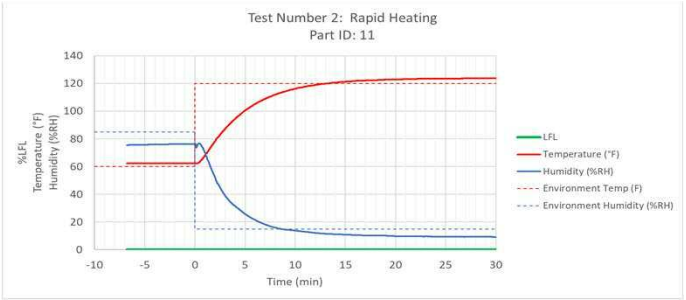
Software Enables MPS Versatility to Accurately Target Specific Applications

Proven Real World Environmental Performance

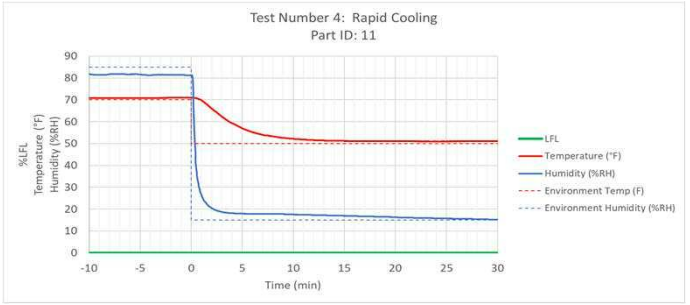
RESISTANT TO RAPID EXCURSIONS OF TEMPERATURE AND RELATIVE HUMIDITY



Condensing Environment

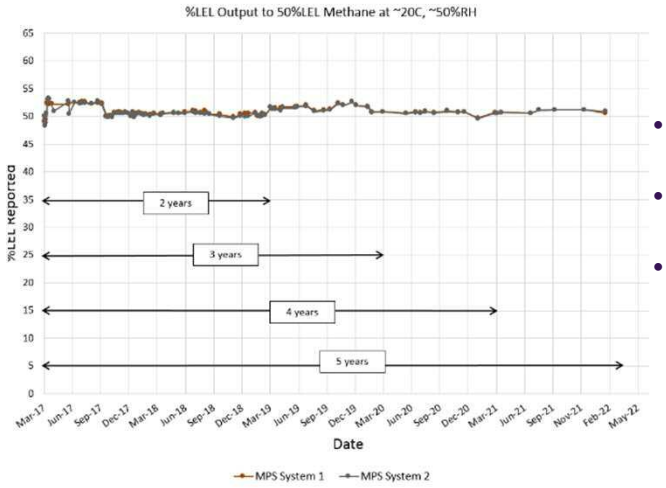


Rapid Heating



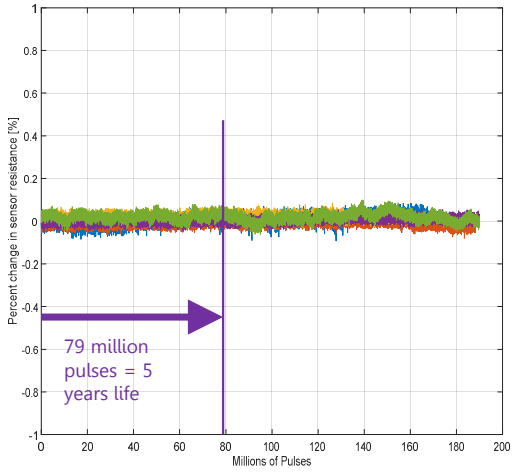
Rapid Cooling

EXTENDED OPERATION DRIFT TEST



- Continuous operation for over 5 years
- Tens of millions of measurement cycles
- **No drift in sensor accuracy**

ACCELERATED OPERATION DRIFT TEST



- 6 MPS sensors pulsed as in normal operation
- Cycled 14 times per second
  - Normal operation: once every 2 seconds
- Sensors tested for 118 - 190 million cycles
  - 7.4 - 12 years of equivalent operation
- Result:
  - **No sensor failures.**
  - **No sensor drift.**
    - <0.1% variation in sensor baseline resistance

Chemicals DV TEST

Substance Exposure Testing Beyond 60335-2-40 Annex LL

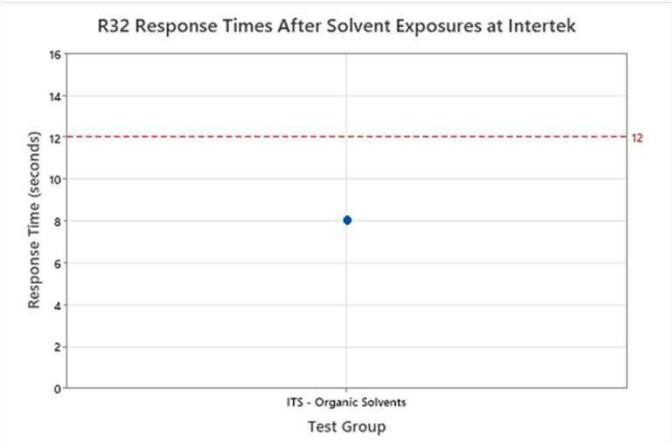
Chemical under the test	Test condition and Pass Criteria	①Concentration Allowed for Workplaces (ppm)
Methanol	Refer to Annex LL. 5DV However: Concentration and exposure time shall follow ① ppm / 2 hours Power on (N=3) ・No exceeding 7%LFL during the test. ・After the test low ratio and high ratio test gas test will be conducted. ・Response time shall be within 12 seconds in 25%LFL.	200
Ethanol		1000
Propanol		400
Butanol		100
Acetaldehyde		200
Acetone		1000
methyl ethyl ketone		200
Acetic Acid		10
Ethyl Acetate		400
Butyl Acetate		150
Toluene		200
Xylene		100
Hexane		500
Heptane		500

Chemicals	Factor	Concentration (ppm)	Duration (Hours)
Dichloromethane	OSHA limit	50	180
	4x	200	45
Chloroform	OSHA limit	50	180
	4x	200	45
Tetrachloroethylene	OSHA limit	100	180
	4x	400	45

SOLVENT EXPOSURE TESTS

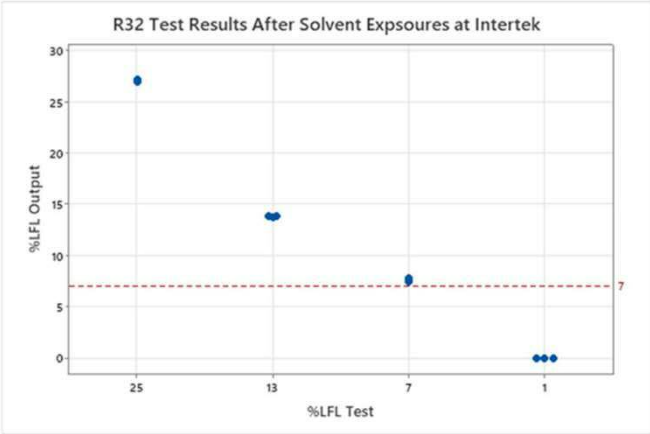
Zero false positives reported during exposure

POST EXPOSURE RESPONSE TIME



Maintains response time after exposure

POST EXPOSURE ACCURACY



Maintains measurement accuracy after exposure

What's Next

✓ R290 Sensor compliant with EN 60079-29

- Samples December 2024;
- Production 2026.

✓ Sensor with Integrated Mitigation functions

- Samples early 2025;
- Production mid 2025.

QUESTIONS?

THANK YOU

sensience

Find us at booth #4-130 (hall 4)

Hall 7A

CHILLVENTA

Chillventa Specialist Forums 2024
Chillventa Fachforen 2024

CONNECTING EXPERTS.