

Leak Detection of R744 (CO₂) in Production and Service

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Leak Detection of CO₂ – R744

● Overview

- CO₂ - Revolutionary, not an Evolutionary Change
- Technologies are Available
- Challenging to All of Us
 - At Final Assembly
 - At Post Sales Service
- Open and Unanswered Issues
 - Issues That Affect How We Tackle Leak Detection

Leak Detection of CO₂ – R744

- A Revolutionary, not an Evolutionary Change
 - R12 to R134a – *Evolutionary Change*
 - Same or Similar Sensor Technology
 - Similar Chemical Structure
 - Similar Refrigerant Characteristics
 - Similar System Pressures
 - Refrigerants Not Natural Component of Background

Leak Detection of CO₂ – R744

- A Revolutionary, not an Evolutionary Change

- R134a to R744 (CO₂) - *Revolutionary Change*

- New Sensor Technology
- Different Chemical Structure
- Different Gas Characteristics
- Higher System Pressures
- Different Background Considerations
 - CO₂ a natural background component
 - CO₂ background unstable

Leak Testing Today

- Subassemblies/Components

- Helium Leak Detection
- Other (water bath, pressure decay/rise,....)

- Final Assembly

- Leak Detection with Existing Proven Technologies

- Post Sales Service

- Leak Detection with Existing Proven Technologies

Leak Testing Today

- Leak Detection R12 and R134a
 - Leak Detection Technologies
 - Heated Diode
 - Mass Spectrometer
 - Leak Dyes

Leak Testing Today

- Leak Detection R12 and R134a
 - Leak Detection Environment
 - Refrigerants Not Natural Constituent of Background
 - Refrigerant background Problems Self-Imposed
 - Cross Sensitivity Issues Possible
 - Dependent on Sensor Technology

Leak Testing in the Future

● Subassemblies/Components

- No Great Change in Technology
 - Helium Leak Detection over other Methods - sensitivity
 - *Change in Helium Leak Rate Specification?*
 - *Change in Leak Detection Method?*

● Final Assembly

- New Sensor Technology
- Control of the CO₂ Background

● Post Sales Service

- New Sensor Technology
- Control of the CO₂ Background

Leak Detection in the Future

- Leak Detection of CO₂ – R744
 - CO₂ Leak Detection Technologies
 - Metal Oxide Surface Reaction Sensors
 - CO₂ Monitors
 - Slow Reaction
 - Not Implemented into a Leak Detector
 - No Specific Gas Flow to Sensor – Diffusion to Sensor
 - Quadrupole Mass Spectrometer
 - Proven Mass Detectors
 - Implemented as Leak Detectors
 - Fast Response

Leak Detection in the Future

- Leak Detection of CO₂ – R744
 - CO₂ Detection Technologies
 - IR (Infrared) Sensor
 - Proven Detection Method
 - Implemented as Leak Detector
 - Fast Response
 - Other / New Technologies???

Leak Detection in the Future

- Leak Detection of CO₂ – R744
 - Leak Detection Environment
 - CO₂ Is A Natural Constituent of Background Air
 - Background Problems Are Natural
 - CO₂ Backgrounds Unstable - Varies Continuously
 - Big Problem
 - Cross Sensitivity Issues Possible
 - Dependent on Sensor Technology
 - Dependent on Sampling Method

Leak Detection of CO₂ – R744

● Leak Detection Concerns

- CO₂ is present in Atmosphere ≥ 300 ppm
 - 300 ppm is best case minimum concentration
 - Concentration can be much higher in enclosures
 - Depending on ventilation
 - Industrial Environments – 1000 to 2000 ppm common
- 0.1 oz/yr leak is roughly 10 ppm of CO₂ entering LD
 - In 1000 ppm room, looking for a leak $1/_{100}$ the size of background
 - Higher background makes finding small leaks difficult
- CO₂ background much higher than refrigerants or other trace gases

Leak Detection of CO₂ – R744

- Leak Detection Concerns
 - CO₂ Background is Unstable and Varies Greatly
 - Many Sources of CO₂
 - Breath
 - Auto Emissions – Cars Driving Off Production Line
 - Industrial Processes.
 - Variability of Background Creates Difficulties in Detecting Leaks
 - A Stable Background Can Be Handled
- Need to Control the CO₂ Background
 - Need to control CO₂ *Variability*
 - We can work with a stable background

Leak Detection of CO₂ – R744

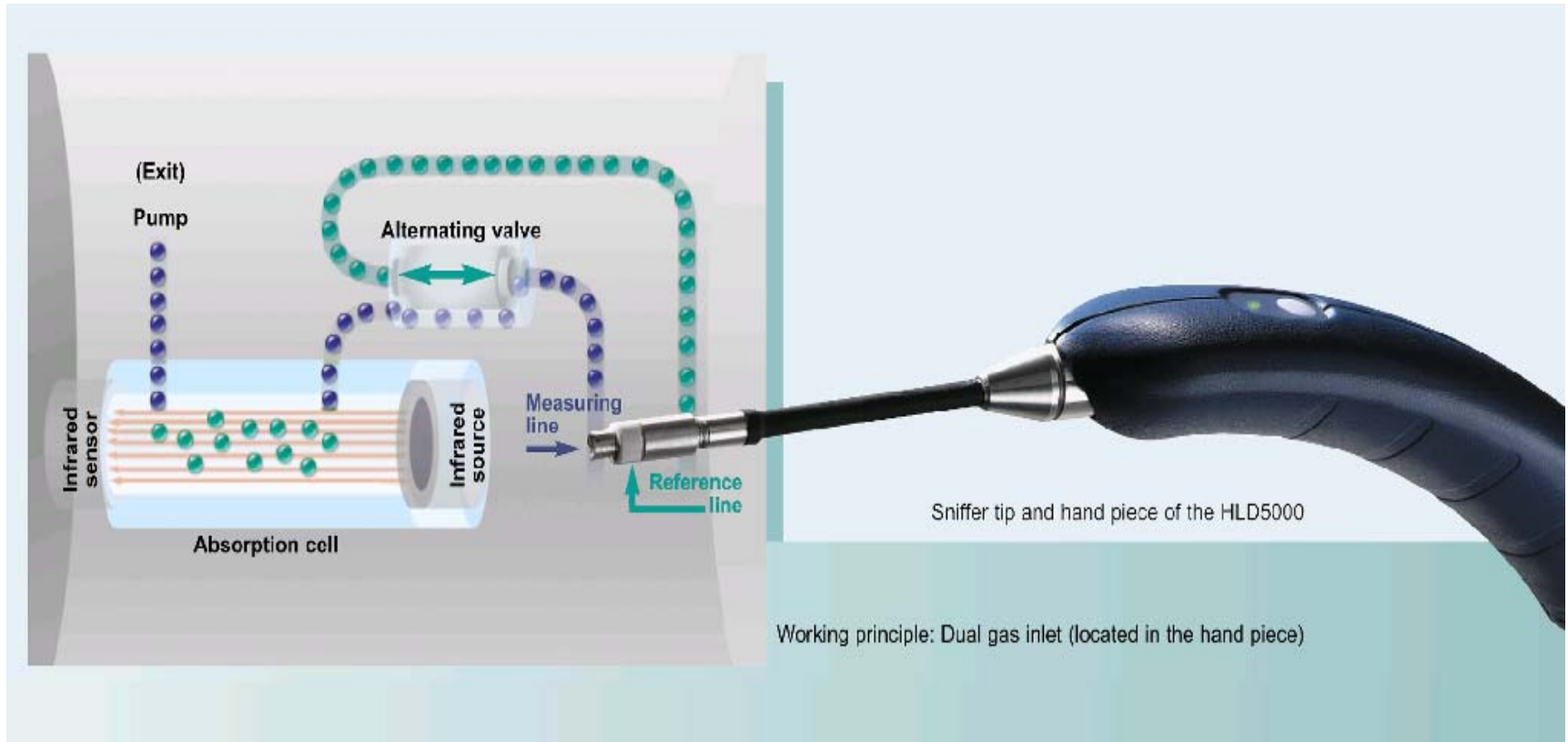
- Control of the CO₂ Background
 - Possible Solutions
 - Testing Booths
 - Operator Masks
 - Gas Shields on Sniffer Tip
 - Background Compensation On The Detector
 - Example to Follow
 - Other Methods or Technologies???

Background Compensation

Gas is drawn from two inlets, alternating 3 times each second.

Refrigerant in either of the two gas streams is absorbed by infrared light, as it fills the cell.

The signal from ambient is subtracted from the signal from the leak.



The Future Of Leak Testing

Questions and Concerns

- System Charge?
- Operating Pressure?
- Expected Life Cycle of AC System Charge?
- Permissible amount of loss over period of time?
- Service Concept?
 - Recharges – How Frequent?
 - Where? Filling Stations, Garages, Certified Garages Dealership?
- How Will These Factors And Others Affect the Maximum Permissible Leak Rate?

The Future Of Leak Testing

Questions and Concerns

- Post Sale Service Leak Detection
 - Same Story
 - New Sensors
 - Control of the CO₂ Environment
 - Control the CO₂ *Variation*
 - Likely more difficult than Production Environment

The Future Of Leak Testing

- We Need To Work Together To Solve The Leak Detection Challenge
 - We \Rightarrow Leak Detector/Sensor Manufactures and The Climate Control Specialist (All of You)
 - Setting Leak Rate Standard
 - Developing Applicable Sensors and Leak Detectors
 - Developing Leak Testing Methods
 - Developing Application Specific Solutions
 - Developing Controls for the Environment

The Future Of Leak Testing

- INFICON Offers Our Leak Detection Expertise To The Mobile Air Conditioning Community
 - We want to work with you as we embrace new refrigerants and new leak detection technologies, methods and challenges.
 - Please contact INFICON with your Leak Detection Issues and Concerns

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