

Process Improvement by LiquiSonic® –  
Oil Circulation Ratio in Refrigerant Units In liquids, we set the measure.

# SensoTech



Our aim: The best technology for your measuring task

- Headquarter in Magdeburg – Barleben (Germany)
- Subsidiaries in USA and China
- Global network and worldwide customer relationships
- Nearly 35 years experience in inline analytical technology
- Quality management with certification of DIN EN ISO 9001
- Application driven support and trainings



# LiquiSonic®

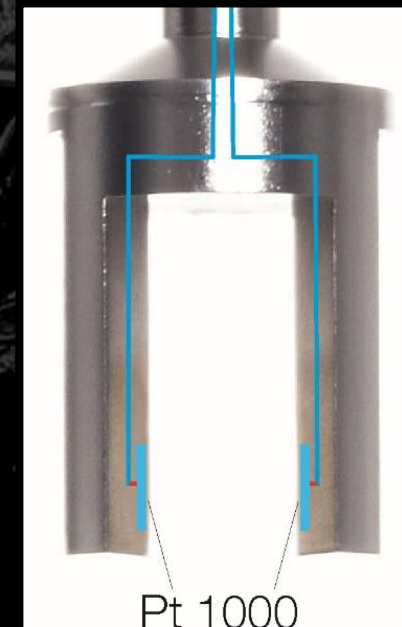
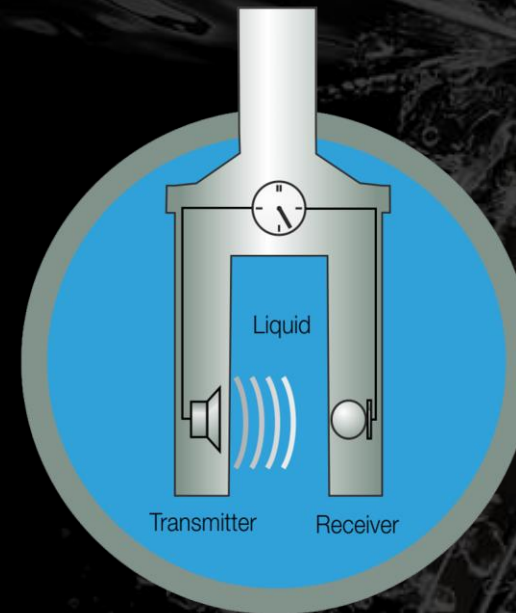
## Measuring method – sonic velocity

- measurement of the propagation velocity of ultrasonic waves in a liquid:

$$v = \frac{s}{t}$$

v: sonic velocity  
s: distance  
t: travel time

- temperature compensation
- accuracies of the devices:
  - sonic velocity:  $\pm 0.05$  m/s
  - temperature:  $\pm 0.025$  °C



# Main Challenges of OCR Monitoring

Inline Monitoring to peak efficiency



determine the optimal  
oil concentration



Offline analysis is inaccurate  
and cumbersome



Results are time-delayed

- ▶ No rapid reactions to process changes
- ▶ Compressor malfunctions and damages

# Main Challenges of OCR Monitoring

Inline monitoring to peak efficiency



Long duration of sampling and data evaluation



Avoidable and unnecessary adjustments of the oil ratio



Unsteady conditions or high effort to maintain consistent process parameters



Inaccurate or uncontrollable dosing of oil

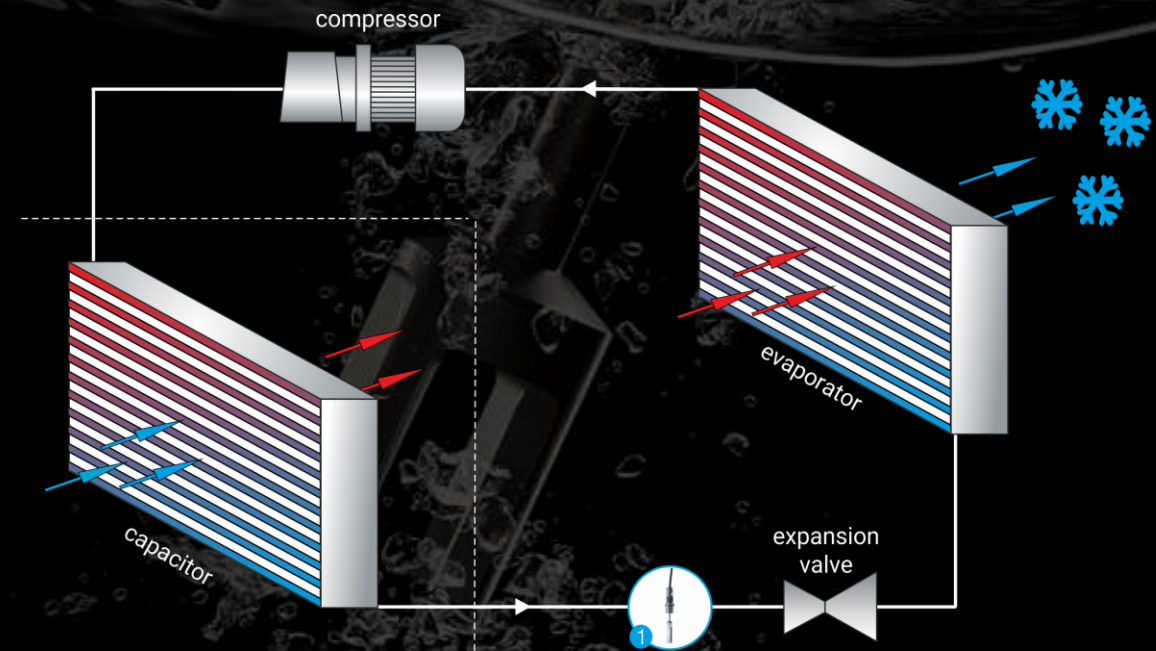
# Oil Circulation Ratio in Refrigeration Systems

LiquiSonic® Target

**Enables you to find the optimal ratio between oil and refrigerant 24/7.**

Inline monitoring allows

- ▶ Fast reactions to process changes
- ▶ Maximizing cooling efficiency
- ▶ Maximizing compressor pump lifetime



# Oil Circulation Ratio in Refrigeration Systems

LiquiSonic® - your powerful inline analyzer

## Selection of already measured refrigerants

- R22
- R143

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- R32
- R125
- R134a
- R245fa
- R404A
- R407A
- R407c
- R410A
- R454-B
- R454-C
- R1234yf
- R1234ze
- R1233zd (E)

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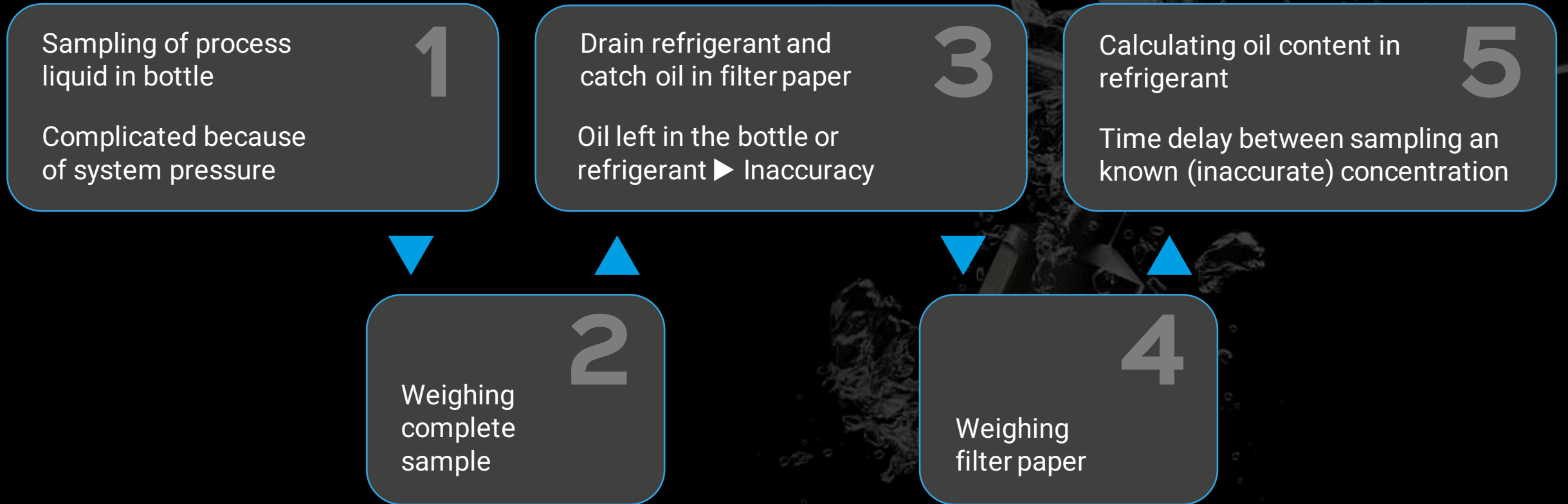
- R290 (Propane)
- R744 (Carbondioxide)
- R717 (Ammonia)

## Selection of already measured compressor oils

- ND8
- ND11
- ND12
- ND14
- PAG 100
- PAO EXP-5401
- POE 68
- POE EXP-3846
- POE Fuchs
- Reniso C85E
- RB68
- RB-68EZ-XL
- RFL-100x
- RL-32-3MAF
- SP-A2
- ZE-GLES RB74
- DH-PS
- FW56EA
- Mobil DTE 746
- And many more...

# Oil Circulation Ratio in Refrigeration Systems

Challenges of classical OCR-monitoring – Bottle fill method



# The Solution for Consistent Quality

Ensure a safe and economical process



Oil influences the efficiency of the climatization.

BUT: Accurate sampling is impossible, not reliable and time consuming!

Goal is to find the optimal ratio between oil and refrigerant as quick as possible.

# The Solution for Consistent Quality

Ensure a safe and economical process

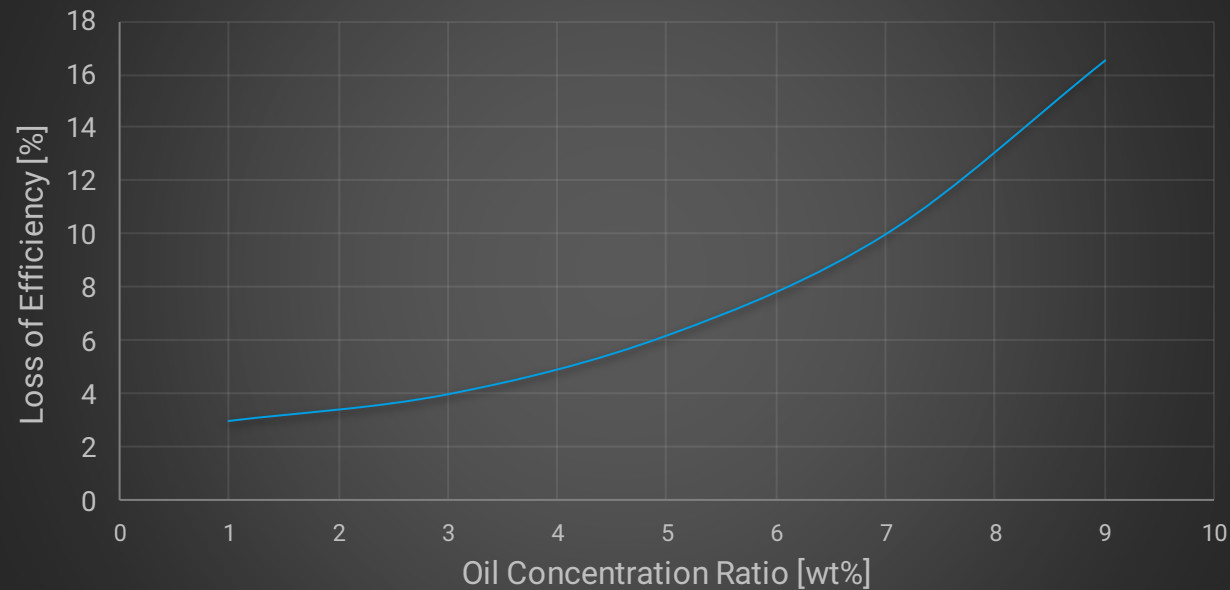
Factors of process quality

Oil Concentration

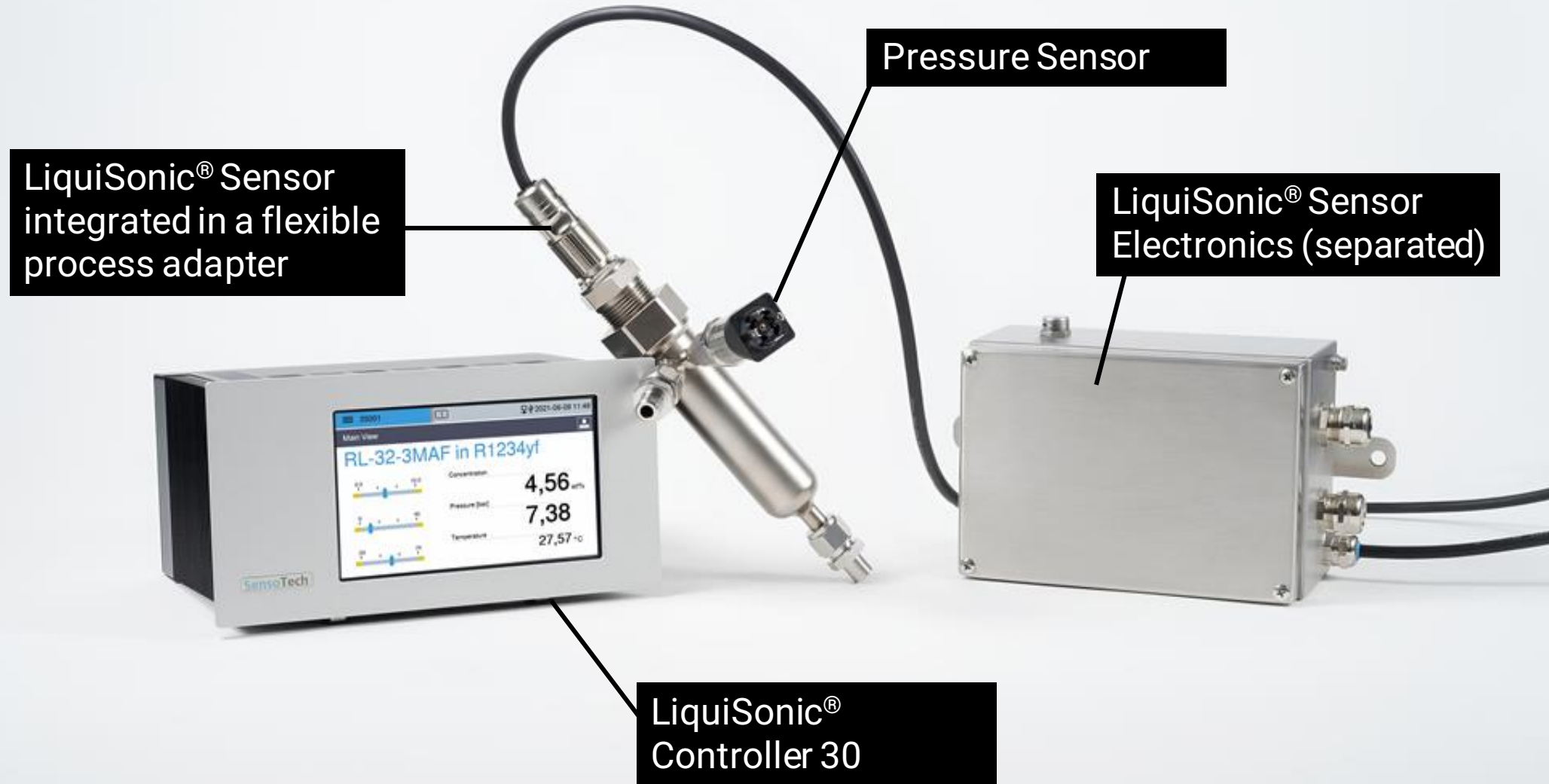


Cooling efficiency

Influence of OCR to Efficiency

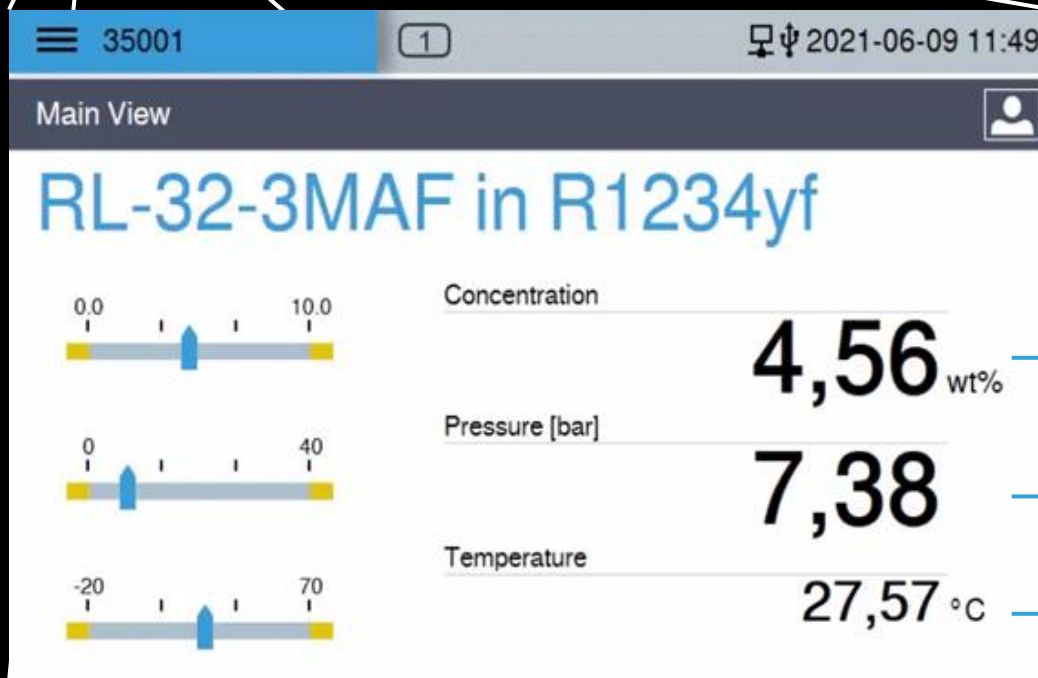


## One Plug & Play Package



# The Solution for Consistent Quality

Real Time monitoring with LiquiSonic®



**Highly precise and reliable determination of**

- Sonic velocity and
- Temperature and
- Pressure

**The Controller displays in real time:**

- Oil concentration  $\pm 0,1$  wt%
- ▶ up to 99 combinations of oil and refrigerant
- Pressure compensation included
- Temperature compensation included

# The SensoTech Solution



LiquiSonic® sensor & pressure sensor

+



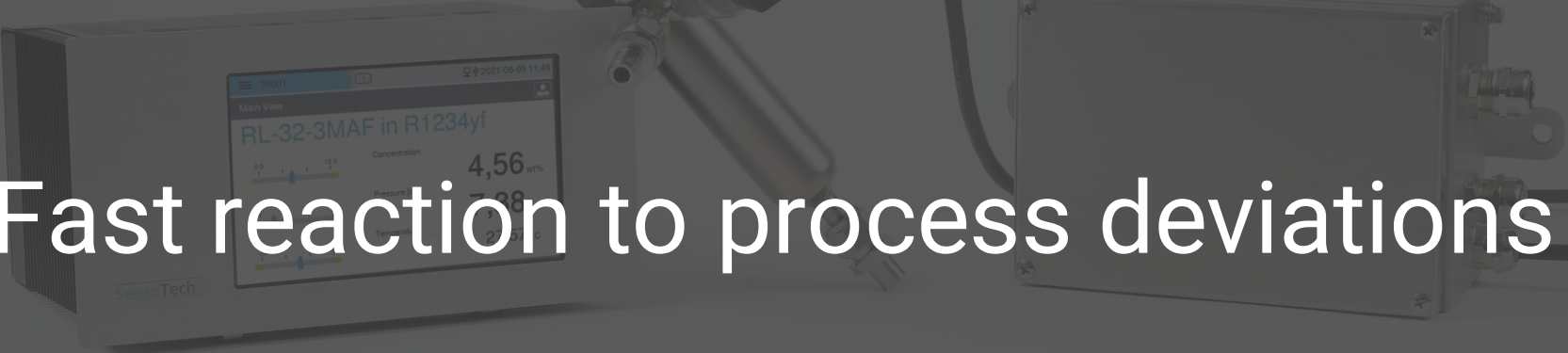
Customized process adapter

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Your complete plug & play solution

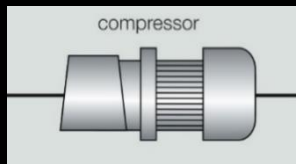
# The SensoTech Solution

- ✓ Reliable real-time values
  - ✓ Accurate dosing and monitoring of oil content
  - ✓ Fast reaction to process deviations
  - ✓ Automated redosing possible
- 
- A photograph of the SensoTech RL-32-3MAF monitoring unit. The device is a rectangular box with a color touchscreen display. The screen shows a 'Main View' with the text 'RL-32-3MAF in R1234yf' and 'Concentration 4,56 wt%'. Below this, there are two horizontal bars representing 'Present' (7.88) and 'Target' (2.25) values. The device is connected to a stainless steel dosing pump assembly via a black cable. To the right of the main unit is a separate, smaller rectangular control box with various ports and connectors.

# The Solution for Consistent Quality

LiquiSonic® – your way for improvement

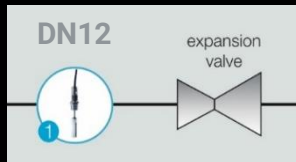
## Installation of measuring device



After the  
compressor



In liquid  
phase



In front of  
expansion  
valve



Temperature:  
-20 to 60 °C

## Measurement

- Many refrigerants already measured by SensoTech
- Combination with every oil type possible

## Support

Calculation model developing for your individual oil-refrigerant combination.

Experienced SensoTech in-house Technical Center

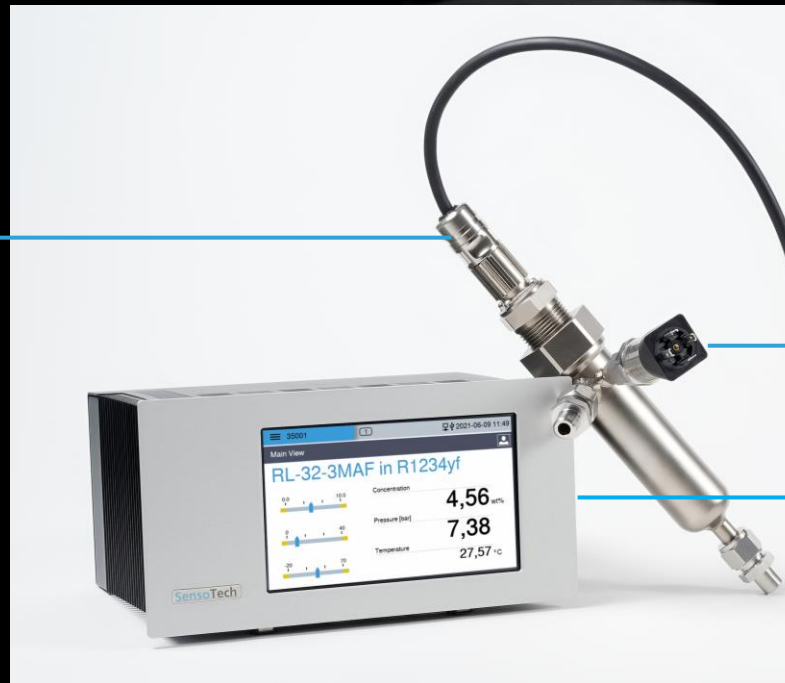


# LiquiSonic® OCR – Your Powerful Monitoring Unit

Solves multiple problems at once

## LiquiSonic® Sensor

- T-adapter
- DN12 Swagelok connection
- highly accurate measurements
- fast response time
- robust sensor design
- maintenance-free



## Pressure Sensor

- Inline monitoring of pressure for ideal pressure compensation

## LiquiSonic® Controller

- displays oil concentration **AND** pressure
- Trend view
- Powerful diagnostic capabilities
- Easy connection to PCS
- Multiple fieldbus interface and data transfer
- maintenance-free

# LiquiSonic® OCR – Your Powerful Monitoring Unit

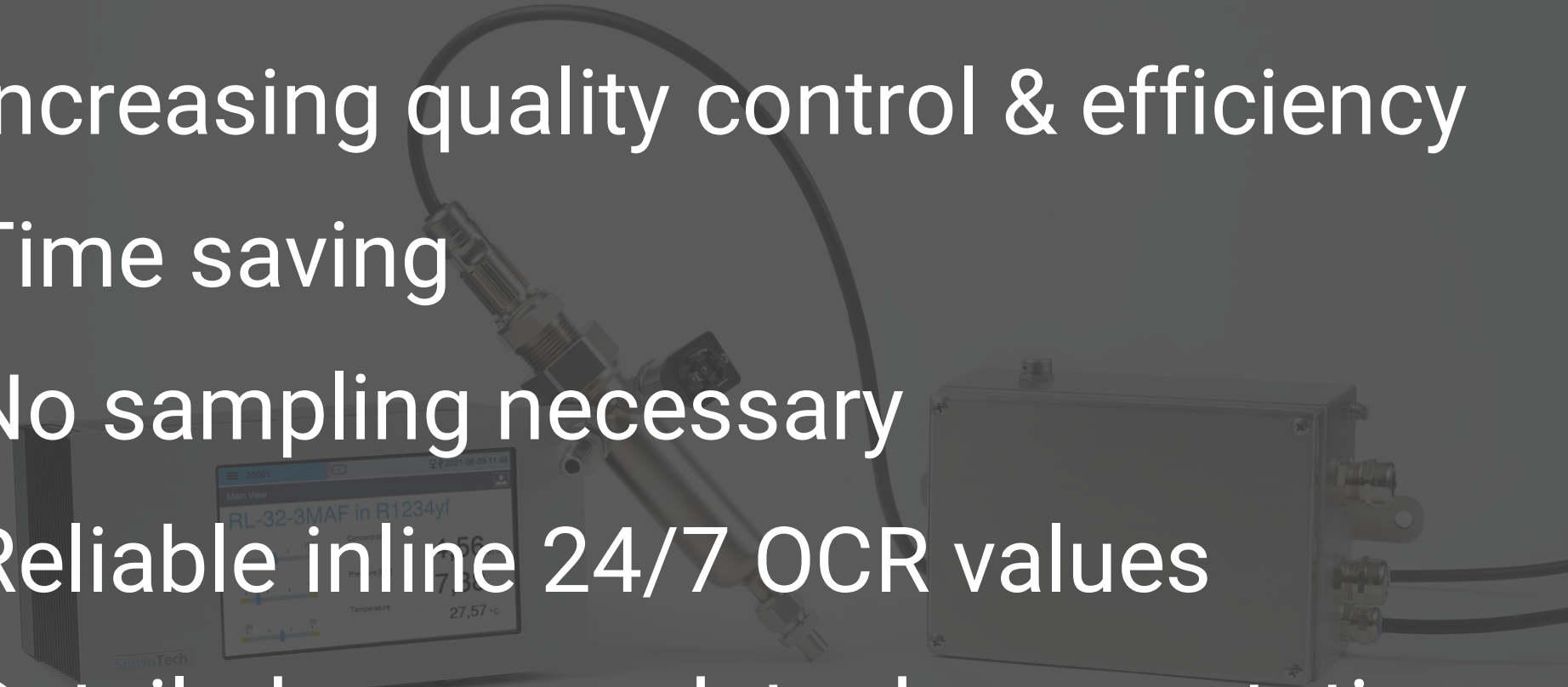
Solves multiple problems at once

## LiquiSonic® Ex Sensor

- ATEX and IECEx explosion proof
- DN12 Swagelok connection
- Ideal for propane and flammable refrigerants



# The SensoTech Solution

- ✓ Increasing quality control & efficiency
  - ✓ Time saving
  - ✓ No sampling necessary
  - ✓ Reliable inline 24/7 OCR values
  - ✓ Detailed process data documentation
  - ✓ Comfortable CAN Bus interface
- 
- The background image shows a SensoTech RL-32-3MAF in R1234yf sensor and its control unit. The sensor is a cylindrical metal component with a black cable attached. The control unit is a rectangular metal box with several connectors on its side. A small screen displays real-time data: 'RL-32-3MAF in R1234yf', 'Temperature 27,57 °C', and '27,57 °C'. The SensoTech logo is visible on the control unit.

# LiquiSonic® OCR – Accessories



BUS cable ▲  
up to 1000m



Certificates,  
protocols and service



Plastic Controller  
housing IP56 &  
Rack mounting  
version ▶



freely selectable  
power supply, e.g.  
24 V DC

Swagelok connected  
T-adapters for  
easy installation ▶



# LiquiSonic® OCR – Your Powerful Monitoring Unit

## Process Automation



- Direct installation in vehicles
- Detailed process insights
- Fast process changes to optimize development time

### Connection to PCS process control system

- Ethernet
- Profinet
- Profibus DP
- Modbus RTU
- Modbus TCP
- CAN Bus
- Analog outputs 4 – 20 mA
- Digital outputs: 6 electronic relays
- Analog and digital inputs



- Remote control via web browser
- Online monitoring with real-time data logging
- Increasing security
- Saving resources

# SensoTech LiquiSonic – OCR

Oil Concentration Measurement at China Automotive Technology Research Centre (CATARC)



The sensor for the LiquiSonic® OCR system is mounted on an automotive test stand and ensures real-time highly accurate measurement results.



„Using the LiquiSonic® OCR online system has allowed us to get a complete picture of how the refrigerant oil is circulating through the system during compressor operation. This allows the amount of refrigerant oil in the compressor to match the normal operation of the compressor (reducing blockage time) without affecting the cooling capacity of the air conditioning system. The device has been working with high accuracy and efficiency for six months, saving us a lot of testing time.“

Mr. Wang  
Factory director

# SensoTech LiquiSonic – OCR

## Oil Concentration Measurement at DENSO Eching



„We have decided in favour of LiquiSonic® because of the simple installation, the flexibility to switch between various oil-refrigerant combinations and no maintenance. An advantage has been also the air conditioning circulation station, developed by SensoTech and DENSO AUTOMOTIVE in SensoTech’s in-house laboratory, to measure different oil refrigerant combinations.“

Jan-Martin von Pozniak  
Senior Technical Manager

# SensoTech LiquiSonic – OCR

Companies already trusting in LiquiSonic®



上汽大众





In liquids, we set the measure.

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