



# Independent Verification of Compressor Performance: BCAS, NEL and the role of ISO 1217

Measurement Focus Group

Birmingham, 2026-04-23

BCAS: **Tim Preece (presenter)**, Ashley Quarterman, Steve Downham

TÜV SÜD: **Sandy Black (presenter)**, David Braybrook, Calum McLaughlin, Lynda Rutherford

**Add value.  
Inspire trust.**

# Overview



## British Compressed Air Society [BCAS] - Tim Preece

- Introduction to BCAS
- Objective of the Performance Verification Programme

## TUV SUD National Engineering Laboratory [NEL] - Sandy Black

- Third party test facility description
- ISO 1217 considerations



# British Compressed Air Society (BCAS) Data Sheet and Performance Verification Programme

Tim Preece, BCAS Technical Officer

# Who are BCAS? In the beginning...



- Formed in 1930.
- At Government suggestion.
- Consolidate market – one common voice.
- One point of contact – for government.
- Only manufacturer members.



# Who are BCAS? Today...



- We are the only UK Technical Trade Association open to manufacturers, distributors and end users of compressors, vacuum pumps, pneumatic tools and allied products.
- BCAS & its membership is the co-ordinated voice of our business when speaking to UK and European legislators, Governmental agencies, regulators and the media.
- We are a not for profit, independent organisation with mutual status working to improve standards and best practice in our industry.
- We are the sum of our membership and our strength lies in their participation & inclusion.

# BCAS PVP Objective



Our objective is simple - **To mirror the existing CAGI PVP scheme**  
*giving consistency of performance data across the 50Hz & 60Hz markets*

- BCAS members create standardised format datasheets for the **50Hz** market
  - Rotary (Screw and Vane) Compressors:
    - Fixed speed           Lubricated & Oil-Free
    - Variable speed       Lubricated & Oil-Free
    - From 4kW to 160 kW (covering majority of market)
  - Programme launched May 2025, first tests July 2025 for 7.5kW Fixed Speed
  - Possible future expansion for Refrigerated Dryers (to be reviewed once compressor scheme running)
  - Metrics to include:
    - Flow (if variable speed unit, up to 5/6 points throughout the speed range)
    - Pressure
    - Total package power
    - Specific Energy Requirement (SER – ie: KW/m<sup>3</sup>/min)
    - Isentropic efficiency (tbc)
- Dedicated BCAS [website](#) launched to host Participant Data Sheets...

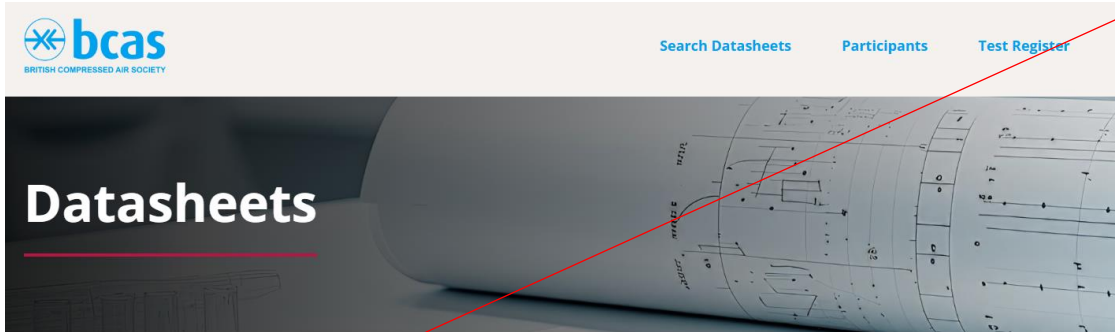
# BCAS Participants (11x Brands)



# BCAS Performance Verification Programme



https://performance.bcas.org.uk/datasheets/



Home » Datasheets

Choose a kW category to filter the datasheets.

- 46kW to 55kW
- 4kW to 11kW**
- 12kW to 22kW
- 91kW to 160kW
- 56kW to 90kW

4kW to 11kW

- Atlas Copco : G7 FS : 10barg : fixed speed
- Atlas Copco : GA11VSDs : 10barg : variable speed
- Atlas Copco : GA11VSDs : 7barg : variable speed
- Atlas Copco : GA7 : 7barg : fixed speed
- Atlas Copco : GA7 FS : 10barg : fixed speed
- Atlas Copco : GA7VSDs : 7barg : variable speed
- BOGE : C 10 L : 7barg : fixed speed
- BOGE : C 10 L : 9barg : fixed speed
- BOGE : C 12-2 LF : 10barg : variable speed
- BOGE : C 12-2 LF : 13barg : variable speed
- BOGE : C 12-2 LF : 7.5barg : variable speed
- BOGE : C 9 : 12barg : fixed speed

PERFORMANCE VERIFICATION PROGRAMME DATA SHEET

ROTARY COMPRESSOR: FIXED SPEED

MODEL DATA - FOR COMPRESSED AIR

1	Manufacturer:	Champion
2	Model No:	2907
3	Date:	01.08.2024
4	Model No:	X
5	Air Cooled:	
6	Water Cooled:	
7	Other:	
8	Phase State:	
9	# of Stages:	1
10	Rated Capacity at Full Load Operating Pressure**	0.90 m³/min**
11	Full Load Operating Pressure*	9.50 barg*
12	Maximum Full Flow Operating Pressure*	10.00 barg*
13	Drive Motor Nominal Rating	7.00 kW
14	Drive Motor Nominal Efficiency	90.50 % (per motor)
15	Fan Motor Nominal Rating (if applicable)	N/A kW
16	Fan Motor Nominal Efficiency	% (per motor)
17	Total Package Input Power at Rated Capacity and Full Load Operating Pressure*	2.60 kW**
18	Total Package Input Power at Rated Capacity and Full Load Operating Pressure**	9.50 kW**
19	Package Specific Power at Rated Capacity and Full Load Operating Pressure*	9.75 kWh/100m³**
20	Isentropic Efficiency	97.50 % (per motor)

VERIFIED BY BCAS

# Third party test facility



# Third party test facility



**Test facility designed to assess the performance of industrial air compressors in a repeatable and controlled condition to ISO 1217:2009**



# Third party test facility



Pressures up to 15 bar(g) and flow rates up to 2,048 Sm<sup>3</sup>/h

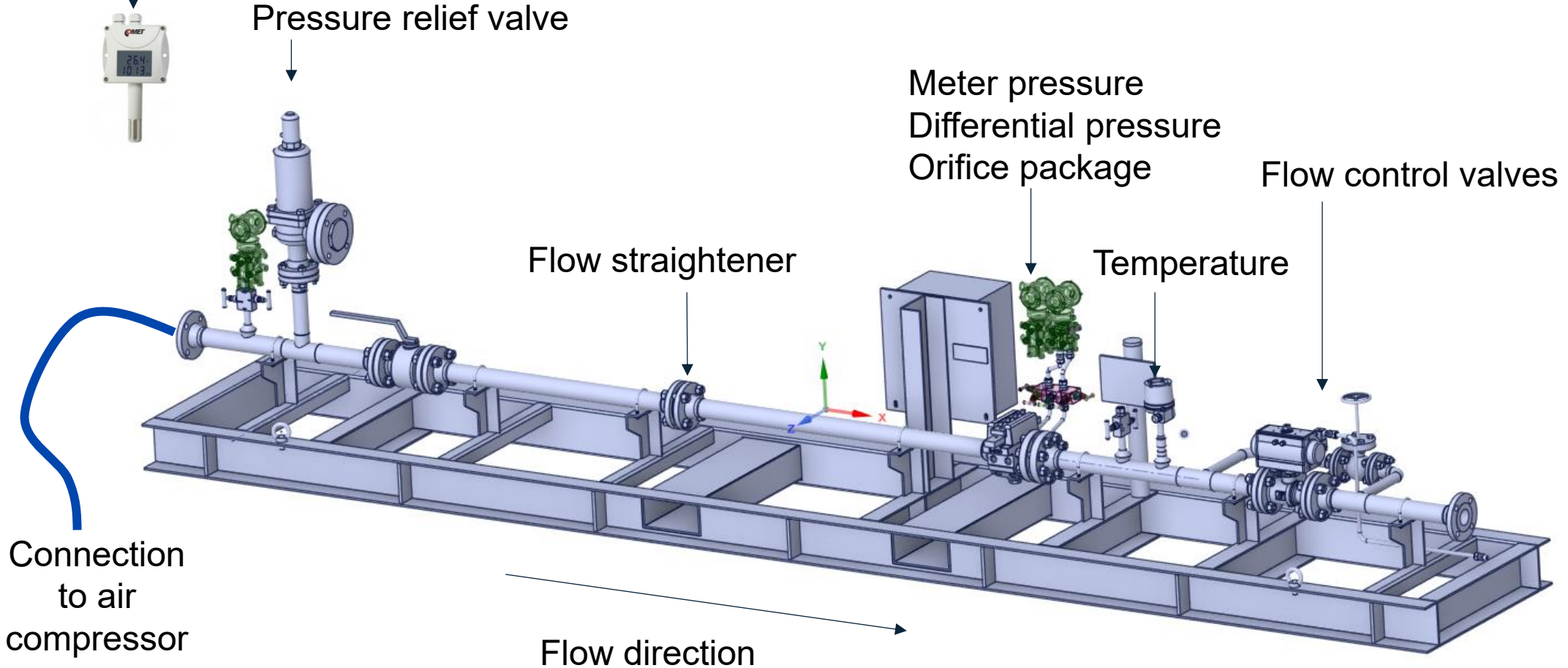
Power consumption between 5 – 160 kW

Flow measurement on the discharge : 2 inch ISO 5167 orifice

# Third party test facility



Atmospheric pressure, temperature and humidity



# Compressors

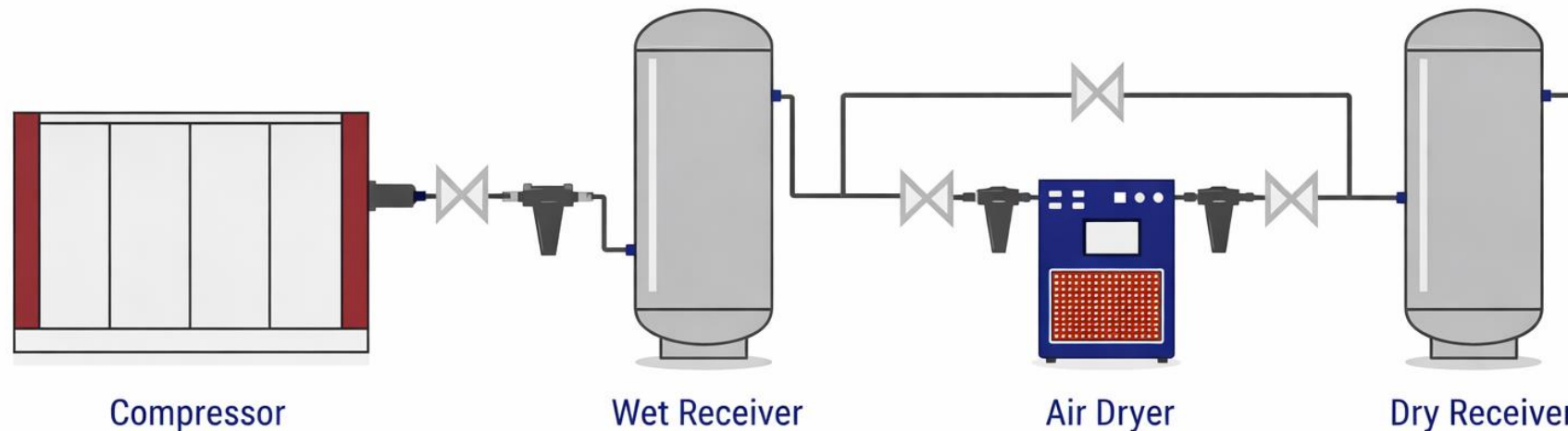
**Compressed air is widely used as a power source in industry**  
(e.g. power tools, actuate valves, manufacturing, filtration, aeration)

Compressed air often manufactured on site using a compressor.

Cost of production is often unclear.

Compressor ramps up and down, leaks in the system, **unverified manufacture information.**

**Typical layout:**

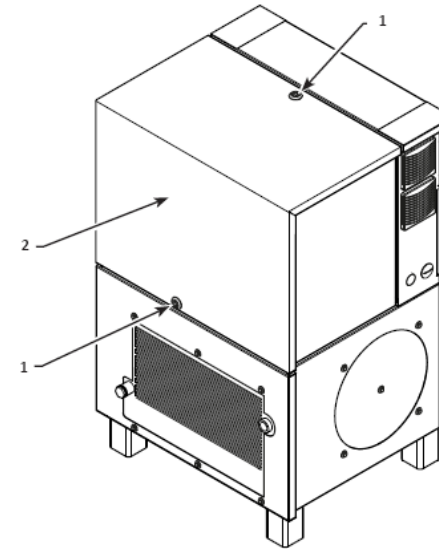


# Compressors

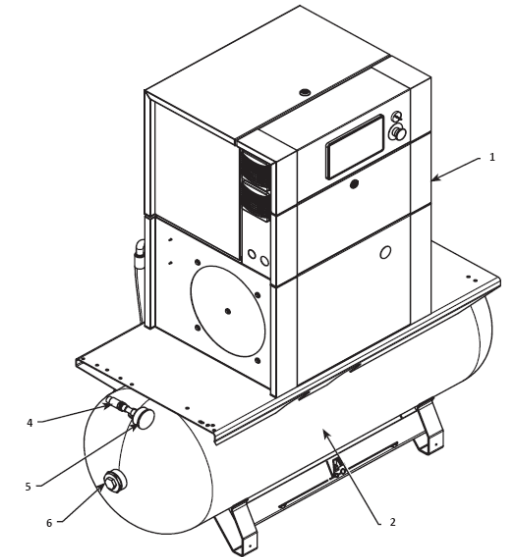


## Typical datasheet:

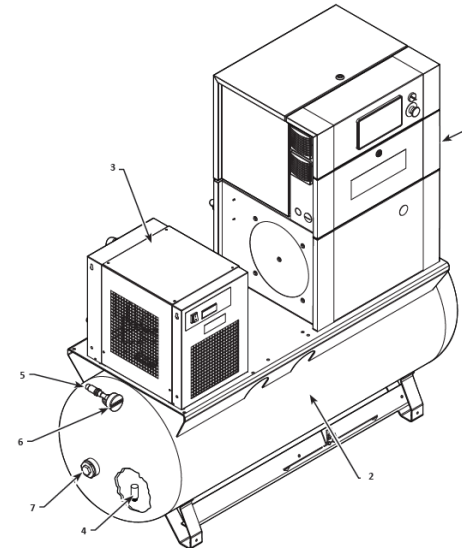
kW		7,5				11			
Maximum operating pressure	bar	7	8	10	13	7	8	10	13
Minimum operating pressure	bar	5,0							
Ambient temperature	°C	+ 1 / + 46							
Flow	m³/min	1,14	0,99	0,97	0,80	1,59	1,58	1,39	1,14
After-cooler outlet temperature above ambient temp.	°C	13	13	13	13	14	13	12	14
Sound pressure level (to ISO 2151)	dB(A)	70				70			
Nominal motor rating	kW	7,5				11			
Full-load current max. (400V)	A	17				24,2			
Full-load current max. (230V)	A	31				44,5			
Motor protection type		IP55, IE3							
Nominal speed	rmp	2950							
Nominal fan motor power	kW	no separate fan motor							
Recommended fuse size 400V / 230V	A	20 / 35				35 / 50			
Cooling air flow through ventilator	m³/min	25				32			
Cooling air outlet temperature above ambient temp.	°C	18				20			
Max. allowable pressure drop in duct at ambient 35°C / 45°C	Pa	110 / 90				130 / 70			
Total oil volume	l	4							
Residual oil capacity	mg/m³	≤ 3							
Compressed air delivery connections		EN 10226 Rp 3/4" (DIN 2999 - Rp 3/4)							
Weight	kg	205				219			



(a) Compressor



(b) Compressor + air receiver



(c) Compressor + drier + air receiver

What does this refer to?

How do I compare other models?

Volume flow ... in / out / standard / actual?

# ISO 1217



## *ISO 1217:2009 Displacement Compressors – Acceptance tests*

This standard specifies methods for acceptance tests regarding volume rate of flow and power requirements.

Fixed speed compressors covered in **Annex C** and Variable speed compressors covered in **Annex E**.



# ISO 1217 – Flow rate considerations!



## 6.4 Computation of test results

*b) The mass flow rate shall be determined according to 5.6*

*c) When the gas being compressed is not dry, the influence of moisture shall be taken into account by correcting the absorbed power*

*d) The actual volume flow rates at the inlet is obtained by converting the gas flow measured through the measured device from the condition there to the condition at the **standard inlet point**, due consideration being paid to any separated moisture according to 6.5.4 and 6.6.*

## 5.6 Measurement of flowrate

*The actual delivered flow rate of the compressor shall be measured by performing a test as indicated in ISO 5167-1 or ISO 9300*

*.....Measurement of the aspirated volume flow rate may be used.....when measurement of delivered volume flow rate is not practical.*

*.....Where aspirated air is measured....the measurement device should not restrict the measurement.*

ISO 5167-1:2003 Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part1: General principles and requirements

# ISO 1217 – Acceptance criteria



## Acceptance Tests

*In general, the tolerances are reported below when compared to the manufactures datasheet*

*Volume Flow rate is within 4 - 7 %*

*Power is within 5 – 8%*

Volume flow rate at specified conditions $(\text{m}^3/\text{s}) \times 10^{-3}$	Volume flow rate %	Specific energy requirement %	Power requirement (at zero volume flow rate or at pressure ratio of 1) <sup>a</sup> %
$0 < q_V \leq 8,3$	$\pm 7$	$\pm 8$	$\pm 10$
$8,3 < q_V \leq 25$	$\pm 6$	$\pm 7$	$\pm 10$
$25 < q_V \leq 250$	$\pm 5$	$\pm 6$	$\pm 10$
$q_V > 250$	$\pm 4$	$\pm 5$	$\pm 10$

NOTE The tolerance values in this table cover and include manufacturing tolerances of the compressor and tolerances relating to the measurements taken during the test.

<sup>a</sup> Where specified, the manufacturer shall state the method used.

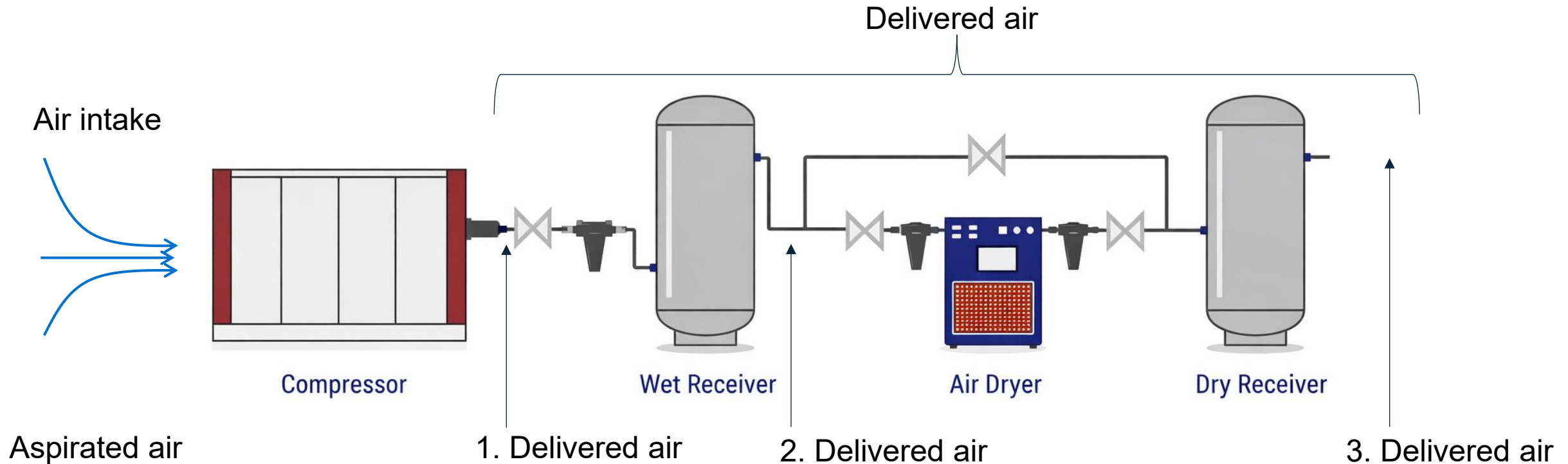
# ISO 1217 – Flow rate considerations!



*The actual delivered flow rate of the compressor shall be measured by performing a test as indicated in ISO 5167-1 or ISO 9300*

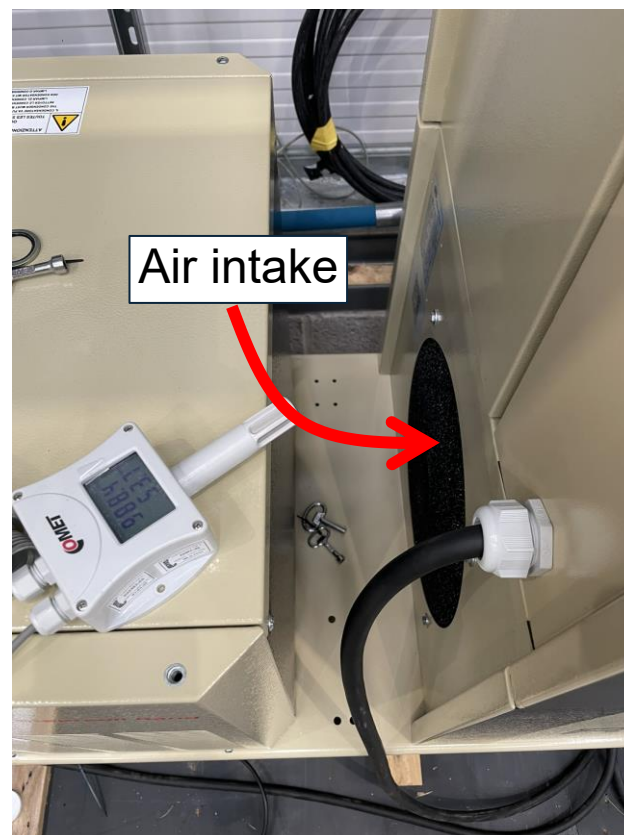
*.....Measurement of the **aspirated volume flow rate** may be used.....when measurement of delivered volume flow rate is not practical.*

*.....Where aspirated air is measured.....the measurement device should not restrict the measurement.*



# Flow rate challenges: ISO 1217

Measure aspirated air?



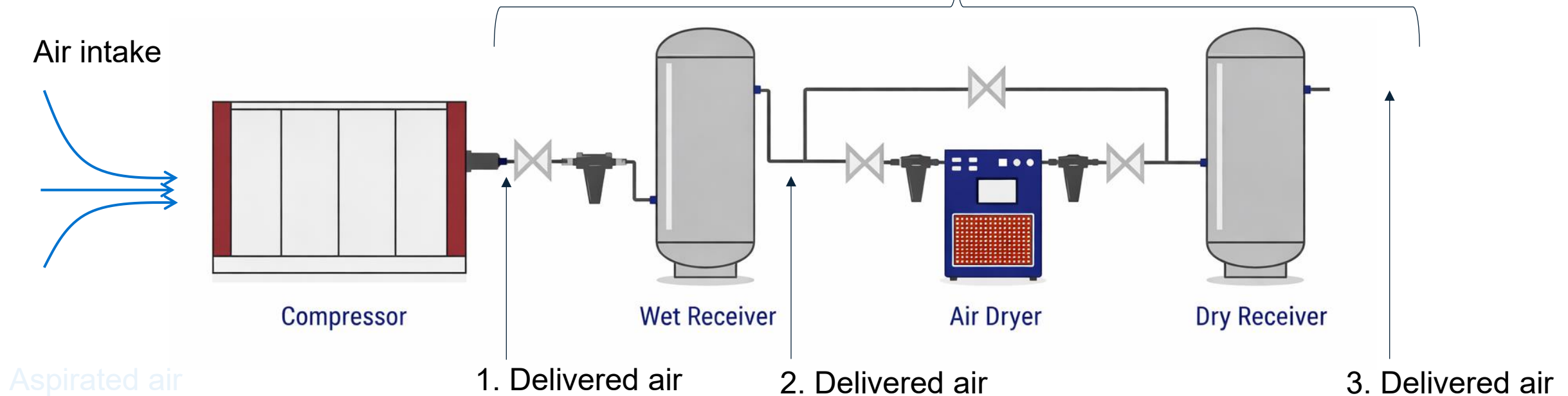
*Aspirated air may not be feasible in all scenarios without restricting the flow...!*

# ISO 1217 – Flow rate considerations!

## Measure actual delivered air

ISO 5167 or ISO 9300 requires the gas to be **single-phase**.

So measure actual delivered air, but where?



# ISO 1217 – Flow rate considerations!



*ISO 5167-1 or ISO 9300 is valid for single phase. But what happens when you compress air?*

Air is a mixture of **dry air** ( $N_2$ ,  $O_2$ ,  $Ar$ ,  $CO_2$ ...) and **water vapour** ( $H_2O$  gas)

**Relative humidity:** ratio of the actual water-vapour content (or partial pressure) to the maximum possible at the same temperature, expressed as a percentage

**E.g. 50 % RH ~ 8.6 g water per  $m^3$  of air at 20C**

**100 % RH ~ 17.3g water per  $m^3$  of air at 20 C**

**Pressure dew point:** indicates the temperature at which water vapour begins to condense at a given pressure.

A compressor raises the pressure and temperature of air; downstream cooling and expansion reduce the temperature (and may reduce pressure depending on system losses).

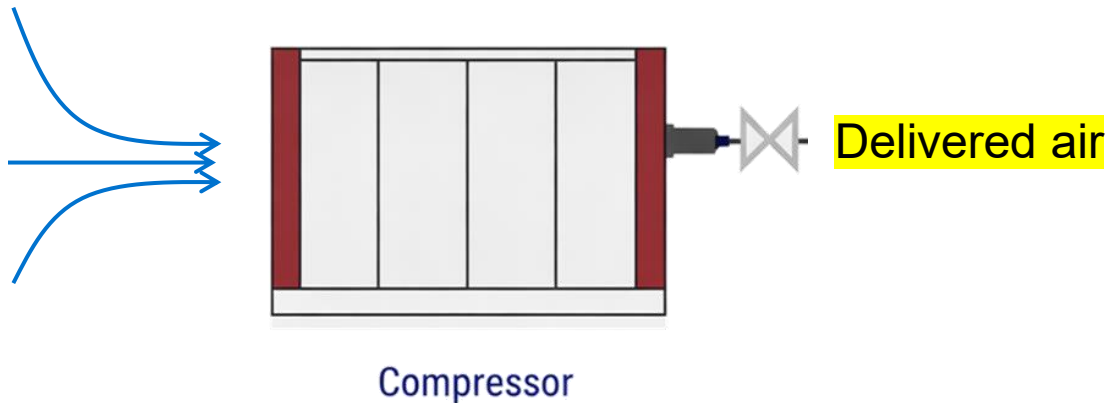
Therefore, liquid water may form at or downstream of the compressor outlet as the air cools and reaches its pressure dew point.

# Flow rate challenges: ISO 1217

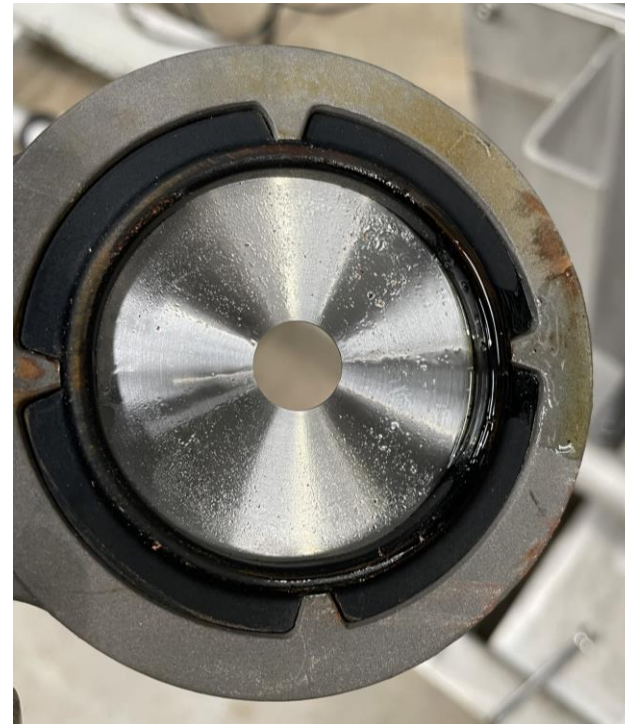
## Location 1: measure directly from the compressor

- ✓ Direct flow rate from compressor
- ✓ Power directly measured from compressor (no additional dryer or any other equipment contribution)
- X Potentially wet gas – wet orifice plate, higher DP and over-reading of flow rate – ISO 5167 not applicable

Air intake



*(but should there be a reference to ISO/TR 11583:2012 in ISO 1217?)*

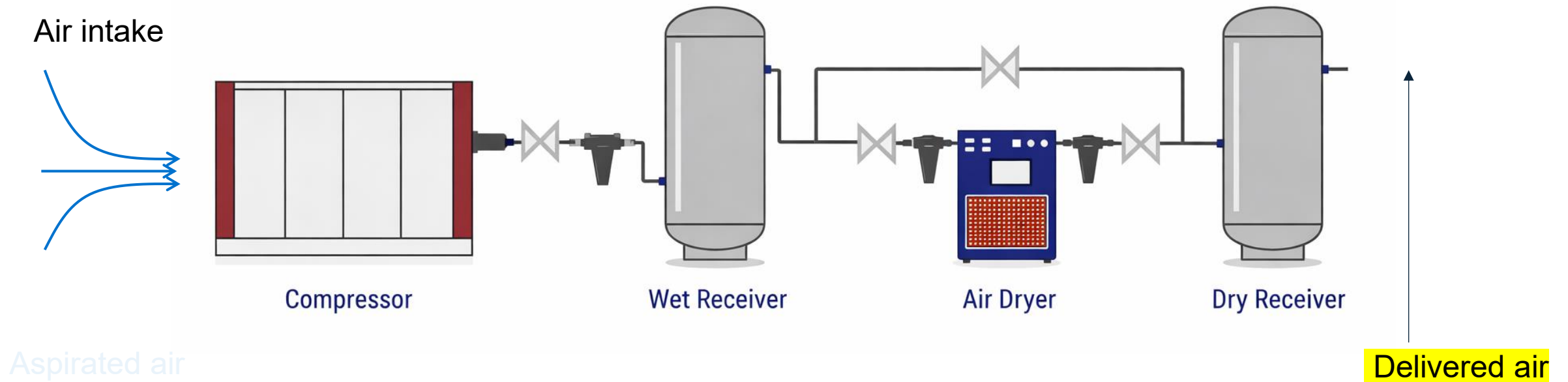


# Flow rate challenges: ISO 1217



## Location 3: measure at the end of the process

- ✓ Single phase gas likely – a dry orifice plate (hopefully!)
- ✗ Potential unknown pressure losses as more attached equipment
- ✗ Dryer power requirement may need subtracted – only interested in compressor output.

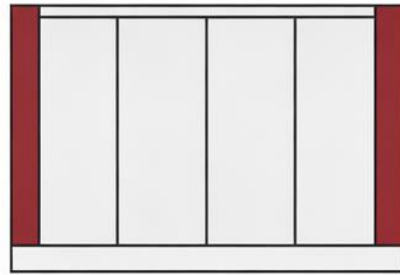
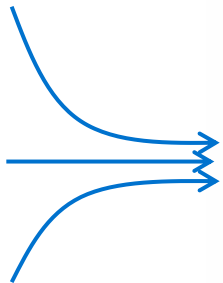


# Flow rate challenges: ISO 1217

## Location 2: After a wet receiver

- ✓ Higher likelihood for single phase air at the metering location
- ✓ Only measure compressor power

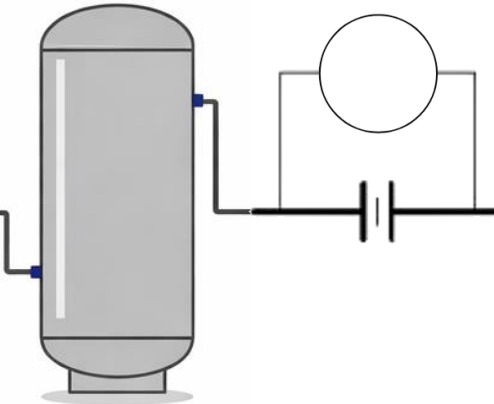
Air intake



Compressor



Wet Receiver



Aspirated air

## 6.4 Computation of test results

b) The mass flow rate shall be determined according to 5.6

$$q_m = \frac{C}{\sqrt{1 - \beta^4}} \varepsilon \frac{\pi}{4} d^2 \sqrt{2\Delta p \rho_1}$$

What is the density of air?

Discharge coefficient is a function of Reynolds number

# Flow rate challenges: ISO 1217

We are **not** measuring the composition of the air

Regardless of equation of state selected you need to measure or make assumptions on:

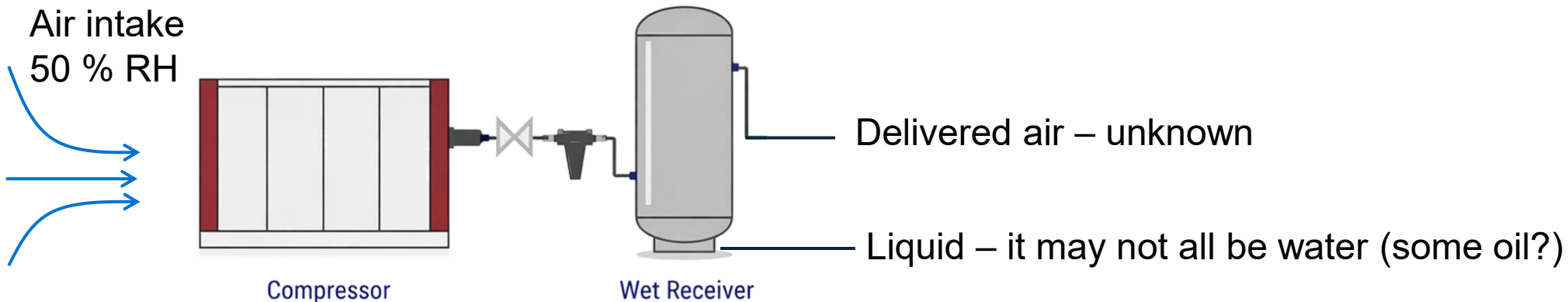
- Air composition

We measure:

- Pressure (before and after the compressor)
- Temperature (before and after the compressor)
- Humidity (only at the inlet)

What's the density of my air at point of measurement?

EOS	Minimum inputs
Ideal gas	$T, p, \text{humidity}$
CIPM-2007	$T, p, \text{humidity}, \text{CO}_2$
ASHRAE RP-1485	$T, p, \text{humidity}$
IAPWS G8-10	$T, \rho, \text{dry-air mass fraction}$
GERG multi-fluid	$T, p/\rho, \text{full composition}$
Peng–Robinson	$T, p, \text{critical props, composition}$



# Flow rate challenges: ISO 1217



## Does it matter?

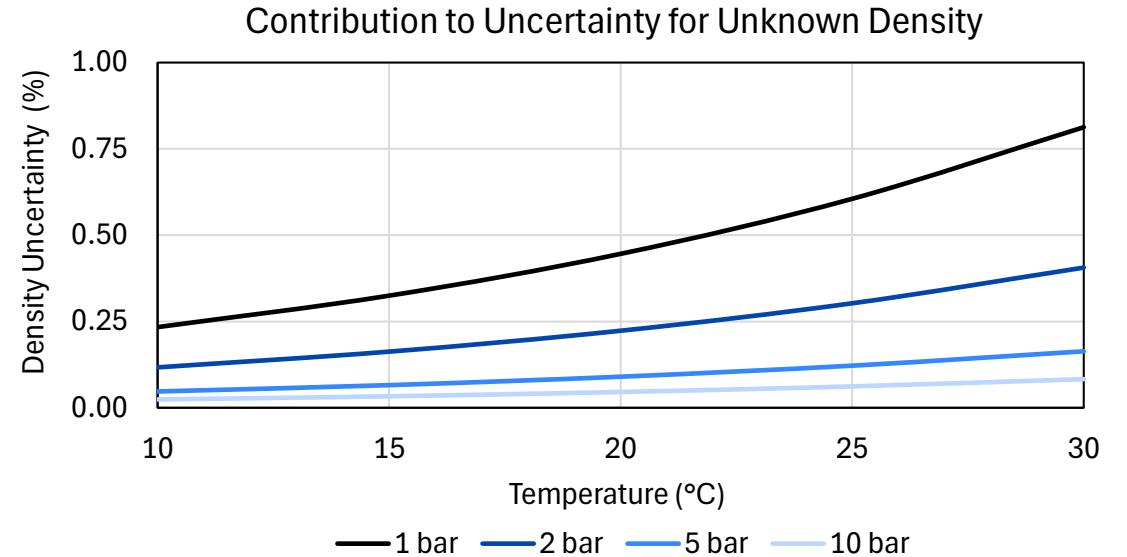
Consider at meter pressure and temperature

- Dry air,  $\rho_{\text{dry}}$
- Air at 50 % relative humidity,  $\rho_{50\%}$
- Fully saturated air,  $\rho_{\text{sat}}$

- Maximum uncertainty of density is

$$\rho = \rho_{50\%} \pm \left( \frac{\rho_{\text{dry}} - \rho_{\text{sat}}}{2} \right)$$

- Uncertainty of density at 20 °C is < 0.5 % at 1 bar
- So < 0.25% for mass flow rate
- Significantly lower uncertainty at elevated pressures
- Acceptance tolerance is between 4-7 %

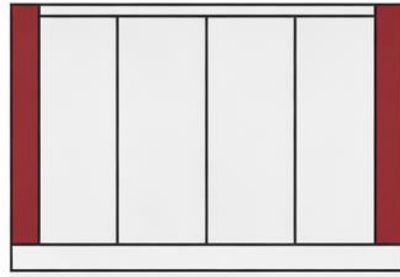
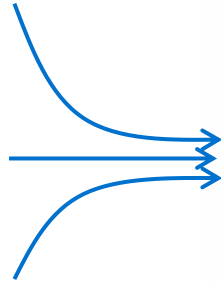


Volume Flow Rate at specified conditions	Volume Flow Rate	Specific Energy Consumption	No Load / Zero Flow Power
m <sup>3</sup> /min	%	%	%
Below 0.5	+/- 7	+/- 8	+/- 10
0.5 to 1.5	+/- 6	+/- 7	
1.5 to 15	+/- 5	+/- 6	
Above 15	+/- 4	+/- 5	

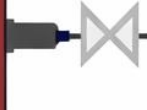
# Flow rate challenges: ISO 1217



**Air intake**  
Pressure  
Temperature  
Humidity



Compressor



Wet Receiver

**Delivered air**  
Pressure  
Temperature



**Delivered flow rate**

But... flow rates are reported to the **INLET CONDITIONS**

And corrected to account for condensate

## 6.4 Computation of test results

*d) The actual volume flow rates at the inlet is obtained by converting the gas flow measured through the measured device from the condition there to the condition at the standard inlet point, due consideration being paid to any separated moisture according to 6.5.4 and 6.6.*

*\* There is a consideration for condensed water in the wet receiver*

# Conclusion



- Compressing ISO 1217 into 20 minutes is never straightforward—much like the standard itself - but hopefully today’s overview has helped demystify it
- The UK’s first, independent performance verification programme for 50 Hz rotary compressors in the European market is in operation.
- BCAS and TUV SUD have worked together to develop a simple scalable solution to adhere as closely as possible to ISO-1217

Round	Description	Compressors tested	Compressors remaining	Start date
1	7 kW Fixed Speed Compressors	13	1	2025
2	11 kW Variable Speed Compressors	3	5	2026

- Further rounds on 22 kW+ in discussion and planned for 2026 onwards.



# Thank you



## Contact Details

**Dr. Sandy Black**  
Head of Consultancy

Email: [sandy.black@tuvsud.com](mailto:sandy.black@tuvsud.com)  
Phone: +44 7513 723884

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