



Anton Paar

Instruments for Measurement of Dissolved Carbon Dioxide and Oxygen in Beverages

Lab and At-line

::: Unique Density & Concentration Meters



Wherever You Are:

Measurement of Dissolved CO₂ and O₂ in Beverages

In the production of **alcoholic and non-alcoholic beverages**, it is essential to check and control the CO₂ and O₂ content of the product both during the production process and after bottling.

The CO₂ content strongly influences the taste of beverages and is a considerable cost factor in beverage production. Precise measurement of the carbon dioxide ensures **consistent taste** and **cost-efficient dosing**.

A high level of dissolved O₂ in beverages has a negative impact on the taste and shelf life of the beverage. The continuous monitoring of the oxygen content ensures **product safety** and consistent **beverage quality**.

The best instrument for your application

Whether directly at the production line, in the laboratory or as part of a larger beverage analyzing system, Anton Paar provides the **best instrument for your measurement** application. The range includes instruments for measuring dissolved oxygen and dissolved carbon dioxide without being influenced by other dissolved gases such as air or nitrogen.

Have it all: CO₂ and O₂ combined

Anton Paar's new instrument, **CboxQC**, combines the fast measurement of CO₂ and O₂ in one measuring cycle – available for portable use at-line as well as in a stand-alone version for the laboratory.

For the utmost flexibility, the instruments' new and **robust design** is **small, compact and lightweight**.

At-line

measurement

CO₂
Air Index
N₂ Index
O₂ Index



CarboQC At-line

CO₂
O₂
Air Index
N₂ Index



CboxQC At-line

Laboratory

measurement

System module

integrated in PBA Generation M measuring systems



CarboQC



CarboQC ME



CboxQC



CarboQC ME with Option O₂

The inventor of accurate CO₂ measurement

Anton Paar is the inventor of the Multiple Volume Expansion method, which is the most accurate way of selectively measuring dissolved CO₂ in beverages. This patented method provides the most reliable CO₂ results and avoids the shortcomings of other conventional methods of CO₂ measurement. Maximum precision is ensured with the MVE method.

Measuring dissolved oxygen using a new optical O₂ sensor via luminescence quenching creates a new technological dimension of measurement.

World leader in analytical measuring instruments

Besides years of experience in the field of dissolved CO₂ and O₂ determination, Anton Paar is also the leader in density and concentration measurement, providing complete beverage analysis systems for the laboratory and production process.

Close to you

With a global network of subsidiaries and sales partners, Anton Paar is always close to your site. Local Anton Paar specialists are on call to give quick and competent after-sales support, regular maintenance and service.

At-line Instruments from the Measurement Experts

Direct at-line measurements - whether from process lines, tanks, kegs or casks - provide the assurance that your production process is under control and allow you to verify the CO₂ and O₂ results measured by process equipment.

Fully protected for harsh environments

Anton Paar's at-line series of instruments are built to operate for years under rough conditions. The robust and leakproof housings keep humidity out of the electronics and stop any spills entering the instrument.

Quick to finish: saves you time and money

By measuring CO₂ and O₂ in only 90 seconds, Anton Paar's CboxQC At-line saves you valuable working time and therefore money.

Portable measurement: 10 hours on the go

CarboQC At-line and CboxQC At-line are portable and provide a battery life of up to ten hours. The battery is quickly recharged for continued operation. For the utmost flexibility, the instruments' new design is small, compact and lightweight.

Low-carbonated beverages? No problem!

With a measuring range from 0 to 20 g/L, Anton Paar's CO₂ meters not only measure highly carbonated beverages, but also samples with low CO₂ levels with outstanding accuracy.

Continuous control of CO₂ and O₂? Data Logger!

Using the CO₂ and O₂ Data Logger function you define the interval for continuous measurements from the line or tank. With a memory capacity of 500 measurement results, including timestamp and sample ID, Anton Paar's at-line instruments are prepared for a long working day.





O₂ determination: simple, accurate and ready for measurement anywhere!

The highly accurate determination of dissolved oxygen is based on the optochemical sensor's very fast response time and ideal temperature behavior. This leads to stable and precise results in less than 50 seconds. Durability and minimal maintenance are the prominent features that make the long-lasting optical sensor stand out.

Easy to use, easy to read

The color display makes sure you see your measuring results clearly, even in dark surroundings. Due to the intuitive user interface standard operations can be performed easily. The eight large keys enable operation of the instrument even when wearing protective gloves.

Get started fast with RFID

Equipped with an RFID interface option, the instruments enable you to quickly and conveniently change the method and sample ID automatically, by just reading an RFID tag. Whether using RFID or manual settings, the instruments ensure full traceability.

Teams up with process instrumentation

The at-line instruments are the ideal complement to Anton Paar's process instrumentation, such as the Carbo 510 online CO₂ analyzer and Cobrix 5 inline beverage analysis system for °Brix, Diet and CO₂ monitoring.

Your Longstanding Partner for Laboratory Measurements

Using Anton Paar's laboratory solutions for dissolved gas measurement allows you to perform reliable QC on finished packages and run measurements for product development with the highest accuracy.

High accuracy, more benefit

The patented CO₂ measuring method is not influenced by other dissolved gases such as oxygen and nitrogen, is rapid, and needs only minimum sample volume. Together with a new reliable optochemical oxygen sensor the results achieve the highest level of repeatability:

→ CO₂ repeatability s.d.: up to 0.005 vol.

→ O₂ repeatability s.d.: ±2 ppb

Low sample amount? No problem!

The very low sample volume of around 100 mL provides reliable CO₂ and O₂ results, even out of very small packages.

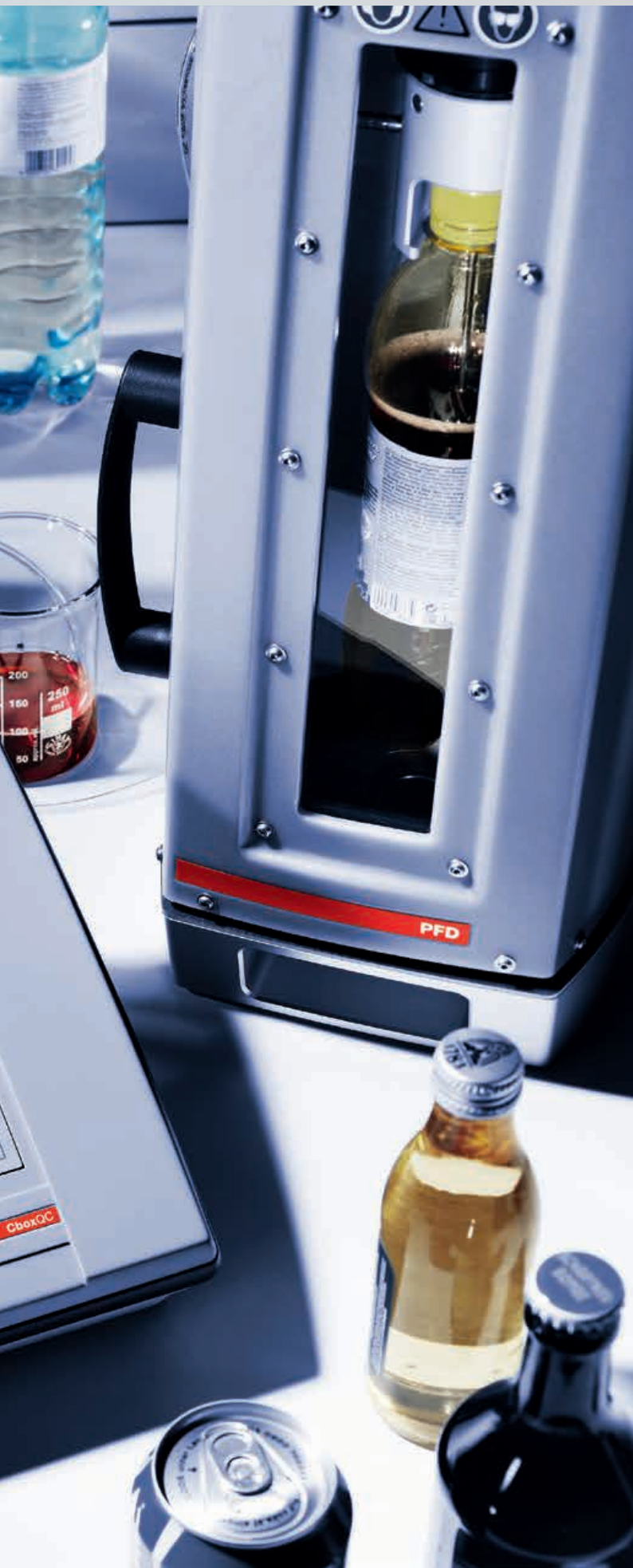
PFD filling device - the perfect complement

Using Anton Paar's CO₂ and O₂ instruments in combination with a piercing and filling device means easy handling. Just press 'Start' and the sample is transferred to the measuring chamber without any loss of CO₂ and O₂. Reliable results can therefore be guaranteed.

TPO quick check? For sure!

Quality control of the Total Package Oxygen is in great demand. By measuring dissolved oxygen the TPO value can be calculated via Anton Paar's free software AP-SoftPrint or by connecting to a DMA Generation M system.





Fast and wireless

For fast and simple documentation, Anton Paar's dissolved gas meters print your measuring results or stored data on the optional Bluetooth printer.

Easy checks – reliable results

Anton Paar's CO₂ and O₂ meters are supplied factory-adjusted and can be used right from the start. The periodical recommended system check implemented in the instruments' quick access area guides you through the CO₂, O₂ and tightness check carried out with deionized water and nitrogen.

Correct filling for correct results

Correct results strongly depend on the right filling under pressure: the new series' integrated FillingCheck™ feature automatically detects filling errors.

Talks the same language

The user interface is clearly arranged and you intuitively find your way through the menu. Preprogrammed methods and measuring units, automatic service reminders and numerous wizard features help you in your everyday work.

Works through power outages

Voltage fluctuations or power outages are no threat for the new series of instruments. They automatically switch to battery-operated mode for up to 10 hours. You can continue your measurements as planned without losing any data, time or money.

Modular options for the future

With the stand-alone instruments you have the option to connect an Anton Paar DMA Generation M density meter in the future and therefore build your own measuring system for complete beverage analysis such as PBA-B, PBA-S/SI and PBA-SD.

Built to Work in a Team

Which beverage parameters do you need to determine? Combine a CarboQC ME module with a wide range of Anton Paar instruments to get the beverage analysis you need in one measuring cycle, with minimum sample preparation required. This teamwork brings quick and efficient results and saves space in the lab.

Accuracy that speaks for itself

The CarboQC ME provides fast and accurate information on the selective amount of CO₂ dissolved in a beverage sample using Anton Paar's patented Multiple Volume Expansion method.

O₂ measurement completes the team

Option O₂ with CarboQC ME allows the simultaneous determination of the dissolved O₂ and dissolved CO₂ contents in beverages within one measuring cycle. The Option O₂ is the perfect complement for Anton Paar's beverage analysis systems such as PBA-S/SI/SD and PBA-B Generation M.

A strong partner

Parameters such as density are influenced by dissolved CO₂. Knowledge of the true CO₂ content can be used to fully compensate the influence. This means that the density of a carbonated beverage can be fully CO₂-corrected. No more degassing required!

Stability for years

As the measuring module is permanently connected to the density meter and does not have to be disconnected or moved, it has a high level of system stability. This gives you reliable results over a long working life.

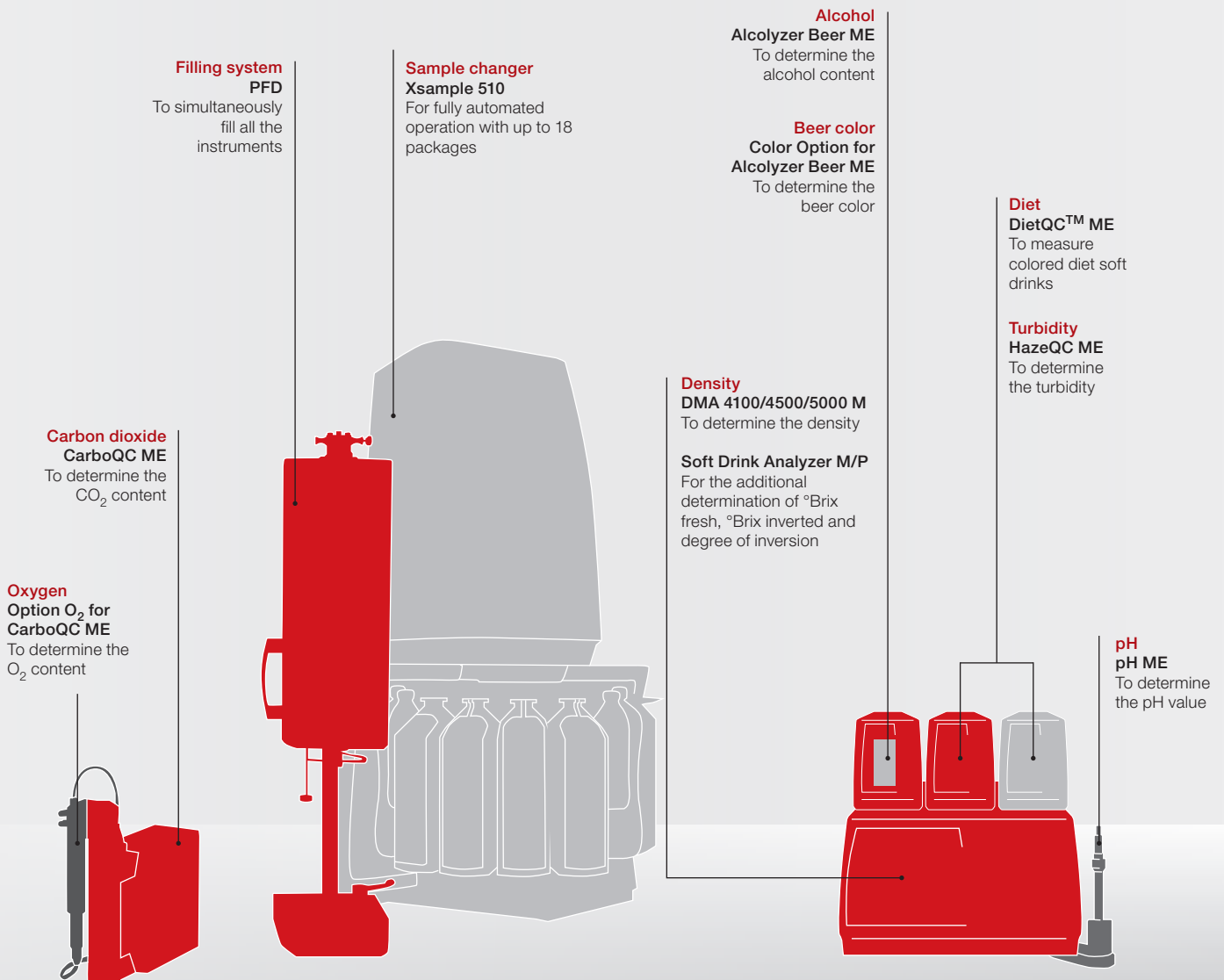
Fit for the future

Combining a CarboQC ME module with a DMA Generation M density meter and PFD is a secure investment which allows you to add further modules in the future. Whether you require an Alcoalyzer, the Option O₂, automatic sample changer or other modules at a later date, Anton Paar's modular concept allows you to create a measuring system to exactly suit your requirements.

	PBA-B	PBA-S	PBA-SI	PBA-SD
Standard configuration				
Master instrument	DMA M	DMA M	SDA M/P	DMA M/ SDA M/P
CarboQC ME	•	•	•	•
Alcoalyzer Beer ME	•	○	○	○
DietQC™ ME	○	○	○	•
PFD	•	•	•	•
Options				
pH ME	•	•	•	•
Option O ₂	•	•	•	•
Options for the corresponding system				
Color Option for Alcoalyzer Beer ME	•	○	○	○
HazeQC ME	•	○	○	○
Xsample 510 instead of PFD	•	•	•	○

All results at a glance

The combined system provides the utmost convenience: The CO₂ and O₂ values are automatically transferred to the master instrument. Measured data are displayed on the DMA M density meter screen along with all other measured parameters. Just press a button to print these results as one report.

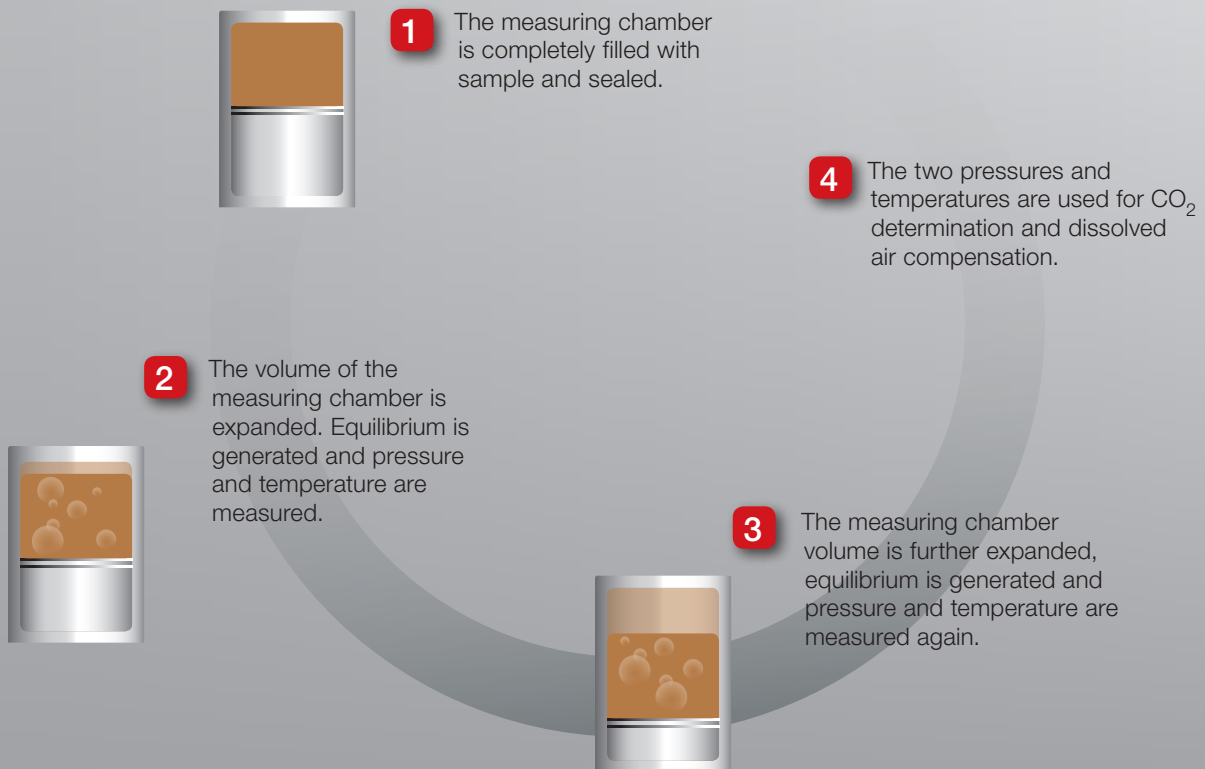


Unique: Multiple Volume Expansion Method

The Multiple Volume Expansion (MVE) method was invented and patented by Anton Paar (AT 409673, GB 237 3584, US 6,874,351). It determines the true dissolved CO₂ content in beverages.

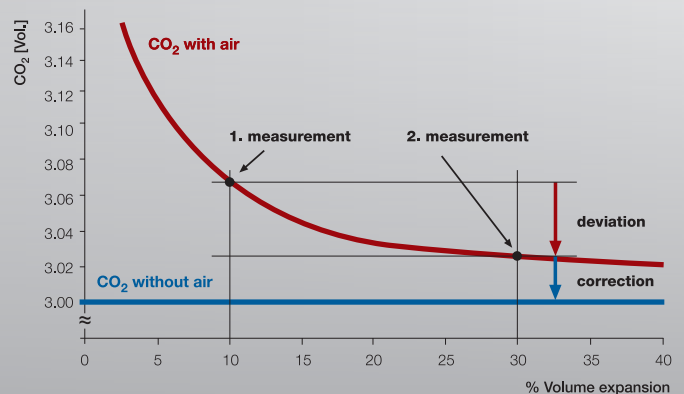
How does it work?

The short answer is: MVE is a selective method. By expanding the measuring chamber twice, only the CO₂ content is determined and the effect of other gases - such as nitrogen and oxygen - is eliminated. In more detail the method works as follows:



Why does it work?

The patented Multiple Volume Expansion method makes use of the fact that the solubility of air in beverages is much lower than that of CO₂. Due to the difference in solubility, when expanding the volume of the measuring chamber, the partial pressure of air decreases much more than that of CO₂. The difference between the equilibrium pressure and temperature results measured at the first and second volume expansions of the measuring chamber is used to determine the amount of dissolved air and mathematically calculate and compensate for this amount. The result is the true CO₂ concentration in the beverage.



Why do CO₂ results differ depending on the measuring method used?

The answer lies in the way the measurement is influenced by the following factors:



- ▶ External environmental influences
 - Altitude & weather
- ▶ Method-dependent influences
 - Sniffing
 - Compensation tables
 - Incomplete equilibration
- ▶ Sample-dependent influences
 - Dissolved air in the sample
 - Package size

Altitude & weather

Environmental factors affect CO₂ measuring instruments. Anton Paar's CO₂ meters have an integrated absolute pressure sensor for accurate correction.

Sniffing

Sniffing is generally performed with traditional pressure/temperature (p/T) methods for compensating dissolved air when measuring CO₂ in bottles or cans. Sniffing means briefly opening and closing the package in order to release the overpressure in the headspace to the ambient pressure. During sniffing, some carbon dioxide is also lost from the beverage which leads to falsified results. To eliminate the influence of sniffing, Anton Paar's CO₂ meters use the Multiple Volume Expansion method, which delivers CO₂ results which are not affected by the air or nitrogen content.

Compensation tables

Tables are used to compensate the effects of sniffing. However, as sniffing is affected by many external factors, it is impossible to know whether the tables are compensating too much, not enough or correctly for the sniffing effects.

Incomplete equilibration

Incomplete equilibration causes the CO₂ measurement to deliver results which are different than the actual CO₂ content.

Dissolved air in the sample

Traditional pressure/temperature (p/T) methods do not differentiate between the partial pressure of air and the partial pressure of CO₂ measured in the beverage. Pressure measurement is assumed to be a one-to-one measure of carbon dioxide alone, which is incorrect. This effect is also seen when using instruments which apply single expansion of the measuring chamber.

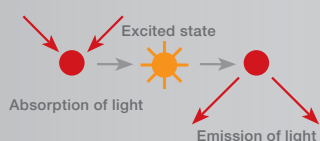
Package size

Traditional p/T methods determine the CO₂ content indirectly by measuring temperature and pressure right out of the gas phase in the headspace. Depending on the type of package, the headspace sizes vary, which affects the amount of CO₂ measured. Anton Paar's CO₂ meters directly determine the CO₂ content out of the liquid phase.

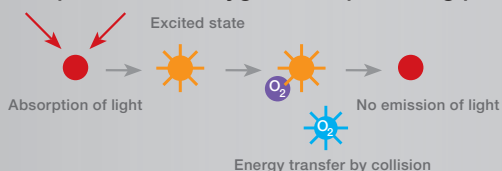
Precise: O₂ Measuring Method

The continuous monitoring of the oxygen content with an instrument that remains unaffected by other dissolved gases is indispensable for beverage analysis. Anton Paar presents a new dimension of measuring dissolved oxygen in beverages.

Luminescence process in the absence of oxygen



In the presence of oxygen: the quenching process



How does it work?

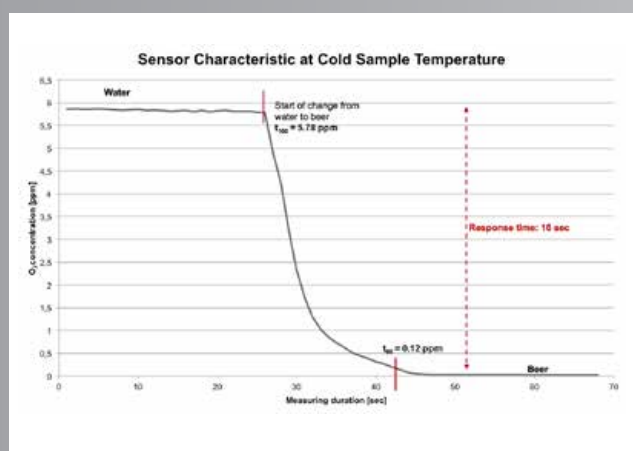
Anton Paar's oxygen meter uses an optochemical sensor for fast and highly accurate determination of dissolved oxygen. The principle of measurement is based on the effect of dynamic luminescence quenching by molecular oxygen. The new way of measurement in this sensor allows measuring while liquids are flowing through the cell. It is not a stationary measurement.

Measuring principle of dissolved oxygen

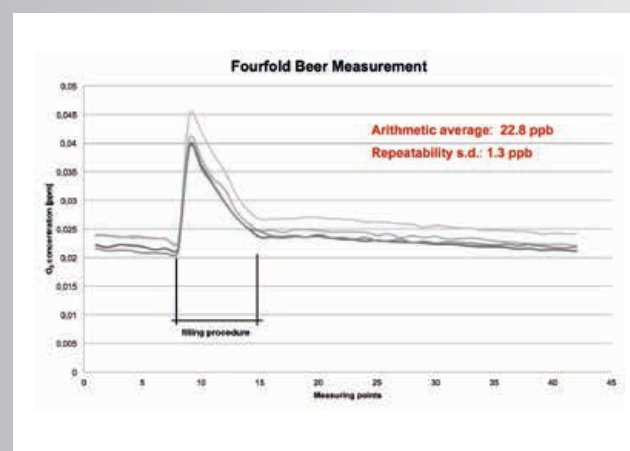
What makes Anton Paar's measurement of oxygen unique?

The pressure-resistant, high-resolution optical oxygen sensor correctly measures all kinds of beverages. The fast response time and ideal temperature behavior of the sensor allow excellent measurement stability within a few seconds, even when measuring cold samples.

This means the measuring principle guarantees results based on the repeatability of ± 2 ppb and reproducibility of ± 4 ppb as well as multiple measurements even out of small sample packages. The sensor has a long working life and requires minimal maintenance.



The sensor characteristic shows a response time of less than 20 seconds when changing from water to beer at 4 °C to 7 °C.



Measurement conditions:

Sample package: 0.5 L beer can
Temperature: 6 °C to 11 °C
Rinsing volume before starting measurement: 240 mL
Rinsing volume between each measurement: 50 mL

Oxygen determination – simple, accurate and ready for measurement anywhere!

Automatic Filling of up to 18 Samples

Filling CarboQC and CboxQC in the laboratory

PFD Piercing and Filling Device

Fill samples reliably and safely directly out of PET bottles, glass bottles or cans into the measuring chamber using the PFD. No sample preparation, such as degassing or filtering, is needed. PFD pierces the bottle closure or the base of the can and transfers sample from the package using a compressed gas. No dissolved CO₂ or O₂ is lost.

- ▶ gas spring for safety shield ensures operator safety
- ▶ easy cleaning due to removable safety shield
- ▶ stability guaranteed by clever design and high-quality materials



SFD Sparkling Wine Filling Device

For transferring wine and sparkling wine samples, the SFD filling device is available. SFD pierces the cork of the wine bottle and inserts a sample tube. The sample is transferred under pressure without loss of CO₂. The SFD Filling Device can be used with both plastic and traditional corks.

- ▶ full operator protection
- ▶ for all sizes, from small bottles to magnum bottles
- ▶ sample transfer directly from the bottle

Filling CarboQC ME and CarboQC ME + Option O₂ in a modular system

To fill a modular system including a CarboQC ME (e.g. Anton Paar's PBA systems), you can connect a PFD or SFD for single samples or use an Xsample 510 package sampler.

Xsample 510 Package Sampler

The Xsample 510 fills samples from up to 18 different types of bottles or cans fully automatically and cleans the measuring cells between measurements.

- ▶ high sample throughput – optional bar code reader
- ▶ fully automatic filling and cleaning
- ▶ easy handling - high safety standard - robust design



Specifications

		At-line		
		CarboQC At-line	CboxQC™ At-line	
Measuring range	CO ₂	0 g/L to 12 g/L (0 vol. to 6 vol.) at 30 °C (86 °F) 0 g/L to 20 g/L (0 vol. to 10 vol.) < 15 °C (59 °F)		
	O ₂	--	0 ppm to 4 ppm	
	Temperature			
	Pressure	0 bar to 10 bar absolute (0 psi to 145 psi)		
Repeatability s.d.	CO ₂	0.04 g/L (0.02 vol.)		
	O ₂	--	± 2 ppb ¹	
	Pressure	0.01 bar		
Reproducibility s.d.	CO ₂	0.1 g/L (0.05 vol.)		
	O ₂	--	± 4 ppb ² , ± 10 ppb ³ , ± 20 ppb ⁴	
	Pressure	0.08 bar		
Resolution	CO ₂	0.01 g/L		
	O ₂	--	0.1 ppb < 100 ppb	
O ₂ response time t ₉₈ %		--	less than 20 seconds at 25 °C, from air to nitrogen	
Measuring units		CO ₂ : g/L, vol., kg/m ³ Temperature: °C, °F, K Air/O ₂ /N ₂ Index: ppm, mg/L Package pressure: bar, psi, mbar, kPa	CO ₂ : g/L, vol., kg/m ³ O ₂ : mg/L, ppm, ppb, % sat., µg/L Temperature: °C, °F, K Air/N ₂ Index: ppm, mg/L Package pressure: bar, psi, mbar, kPa	CO ₂ Temp Air/O ₂ /N ₂ Package pres
Sample volume		150 mL	150 mL	
Measuring time per sample		55 seconds	90 seconds	
Power supply		AC 100-240 V, 50/60 Hz, 1.5 A; DC 12 V, 3.0 A		
Rechargeable battery type		Li-Ion 11.1 V, 2.25 Ah (optional: Li-Ion 11.25 V, 2.25 Ah)		
Maximum at-line operation		up to 10 hours		
Interfaces		1 x USB for PC, 1x RS-232 for printer/AP-SoftPrint optional: 1 x RFID, 1 x Bluetooth		1 x USB
Data memory		500 measured results		
Options		High-performance battery, RFID/Bluetooth option		High-performance battery
Available accessories		Portable thermal printer with Bluetooth interface, RFID tags, carrying strap		Portable thermal printer
Protection class		IP67		
Dimensions (L x W x H)		262 mm x 209 mm x 176 mm (10.3 in x 8.2 in x 6.9 in)		
Weight		2.1 kg (4.6 lbs)	2.7 kg (6 lbs)	2.7 kg (6 lbs)

¹ Valid for measuring range < 200 ppb

² Valid for measuring range < 1000 ppb

³ Valid for measuring range < 1000 to 2000 ppb

⁴ Valid for measuring range < 2000 to 4000 ppb

Sample filling

	PFD piercing and filling device	SFD piercing and filling device for sparkling wine and wine bottles
Filling mode	Pressurized filling from closed packages	Pressurized filling from closed and open packages
Compressed gas supply	6 ± 0.5 bar (87 ± 7 psi) relative	7.5 bar relative ± 0.5 bar (109 psi ± 7 psi) for sparkling wine 3 bar relative ± 0.5 bar (44 ± 7 psi) for wine
Package types and maximum allowed volume of packages to be measured	Glass bottles: 1 L Cans: 0.5 L PET bottles: 3 L	Glass bottles: 0.2 L to 1.5 L
Maximum height with piercing head in highest position	1020 mm (40.2 in)	690 mm (27.2 in)
Ambient temperature for operation	0 °C to +40 °C (+32 °F to +104 °F)	0 °C to +40 °C (+32 °F to +104 °F)
Dimensions (L x W x H)	190 mm x 270 mm x 670 mm (7.5 in x 10.6 in x 26.4 in)	320 mm x 370 mm x 550 mm (12.6 in x 14.6 in x 21.7 in)
Weight	10.1 kg (22.3 lbs)	12.3 kg (27.1 lbs)
Power supply	--	--
Interfaces	--	--

⁵ Depending on the diameter of the package

Laboratory		System	
CarboQC	CboxQC™	CarboQC ME	CarboQC ME + Option O2
0 g/L to 12 g/L (0 vol. to 6 vol.) at 30 °C (86 °F) 0 g/L to 20 g/L (0 vol. to 10 vol.) < 15 °C (59 °F)		0 g/L to 12 g/L (0 vol. to 6 vol.) at 30 °C (86 °F) 0 g/L to 20 g/L (0 vol. to 10 vol.) < 15 °C (59 °F)	
--	0 ppm to 4 ppm	--	0 ppm to 10 ppm
-3 °C to 30 °C (27 °F to 86 °F), acc. ± 0.2 °C		0 bar to 6 bar relative (0 psi to 87 psi)	
0.01 g/L (0.005 vol.)		0.01 g/L (0.005 vol.)	
--	± 2 ppb ¹	--	5 ppb ¹
0.005 bar		--	--
0.05 g/L (0.025 vol.)		0.05 g/L (0.025 vol.)	
--	± 4 ppb ² , ± 10 ppb ³ , ± 20 ppb ⁴	--	20 ppb ²
0.04 bar		--	--
0.001 g/L		--	--
--	0.1 ppb < 100 ppb	--	--
--	less than 20 seconds at 25 °C, from air to nitrogen	--	less than 20 seconds at 25 °C, from air to nitrogen
CO ₂ : g/L, vol., kg/m ³ Temperature: °C, °F, K O ₂ Index: ppm, mg/L Air/N ₂ Index: ppm, mg/L Package pressure: bar, psi, mbar, kPa	CO ₂ : g/L, vol., kg/m ³ O ₂ : mg/L, ppm, ppb, % sat., µg/L Temperature: °C, °F, K Air/N ₂ Index: ppm, mg/L Package pressure: bar, psi, mbar, kPa	CO ₂ : g/L, vol., kg/m ³ Temperature: °C, °F, K Air/O ₂ /N ₂ Index: ppm, mg/L Package pressure: bar, psi, mbar, kPa	CO ₂ : g/L, vol., kg/m ³ O ₂ : mg/L, ppm, ppb, % sat., µg/L Temperature: °C, °F, K Air/N ₂ Index: ppm, mg/L Package pressure: bar, psi, mbar, kPa
100 mL	100 mL	approx. 150 mL	min. 150 mL (when filling similar samples)
55 seconds	90 seconds	approx. 90 seconds	approx. 2 minutes
0 A		--	--
1.6 Ah)		--	--
		--	--
USB for PC, 1 x RS-232 for printer/AP-SoftPrint/DMA Generation M optional: 1 x RFID, 1 x Bluetooth		2 x CAN	2 x CAN
		1000 measured results	
high-performance battery, PFD, SFD, Xsample 510, RFID/Bluetooth option		Module with DMA M or Soft Drink Analyzer M/P as a master instrument; pH ME, DietQC ME, HazeQC ME, Alcozyzer Beer ME + Color Option, PFD, Xsample 510	
thermal printer with Bluetooth interface, RFID tags, carrying strap, rubber protection		--	--
		--	--
258 mm x 201 mm x 170 mm (10.2 in x 7.9 in x 6.7 in)		305 mm x 85 mm x 275 mm (12.0 in x 3.3 in x 10.8 in)	320 mm x 120 mm x 330 mm (12.6 in x 4.7 in x 13.0 in)
0 kg (4.4 lbs)	2.6 kg (5.7 lbs)	approx. 3.0 kg (6.6 lbs)	approx. 3.7 kg (8.2 lbs)

Xsample 510 automatic package sampler	
Automatic pressurized filling from up to 18 ⁵ closed packages	
6 bar (87 psi) relative	
Glass bottles: 0.33 L, 0.5 L Cans: 0.25 L, 0.33 L, 0.5 L PET bottles: 0.5 L, 1 L, 1.5 L, 2 L, 3 L	
--	
0 °C to +35 °C (+32 °F to +95 °F)	
900 mm x 750 mm x 1200 mm (35.4 in x 29.5 in x 47.2 in)	
75 kg (165.3 lbs)	
AC 100-240 V, 50/60 Hz	
1 x RS-232, 1 x S-BUS, 1 x CANopen in, 1 x CANopen out	



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Instruments for:

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measurement



Photos: Croce & Wir

Specifications
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