Anton Paar

Patented technology exclusively by Anton Paar (Patent AT 516420 B1)

Pulsed Excitation Method

DENSITY REDEFINED

Digital density measurement redefined

After more than 50 years of incremental improvements, Anton Paar redefines digital density measurement and shapes the future of the technique once again.

1960s

Digital density measurement invented by Prof. Otto Kratky

1967

First digital density meter built and presented by Anton Paar

1988

Viscosity compensation of density results

1997

Concept of a "reference oscillator" introduced in DMA 4500 Classic

2008

Debut for the first automatic air bubble detection – FillingCheck™ – in the DMA M series

2015

"Task Force Density"

In 2015, an Advanced Technologies Research Group was established at Anton Paar's high-tech Center for Analytical Instrumentation (CAI) in Graz, Austria. This multidisciplinary team was composed of outstanding scientists and researchers from fields such as physics, micro-electronics and advanced simulation technologies, and experienced Anton Paar market experts.

In less than three years, Anton Paar has once again redefined density measurement with the groundbreaking invention of a new measuring principle: the Pulsed Excitation Method (PEM).

2018

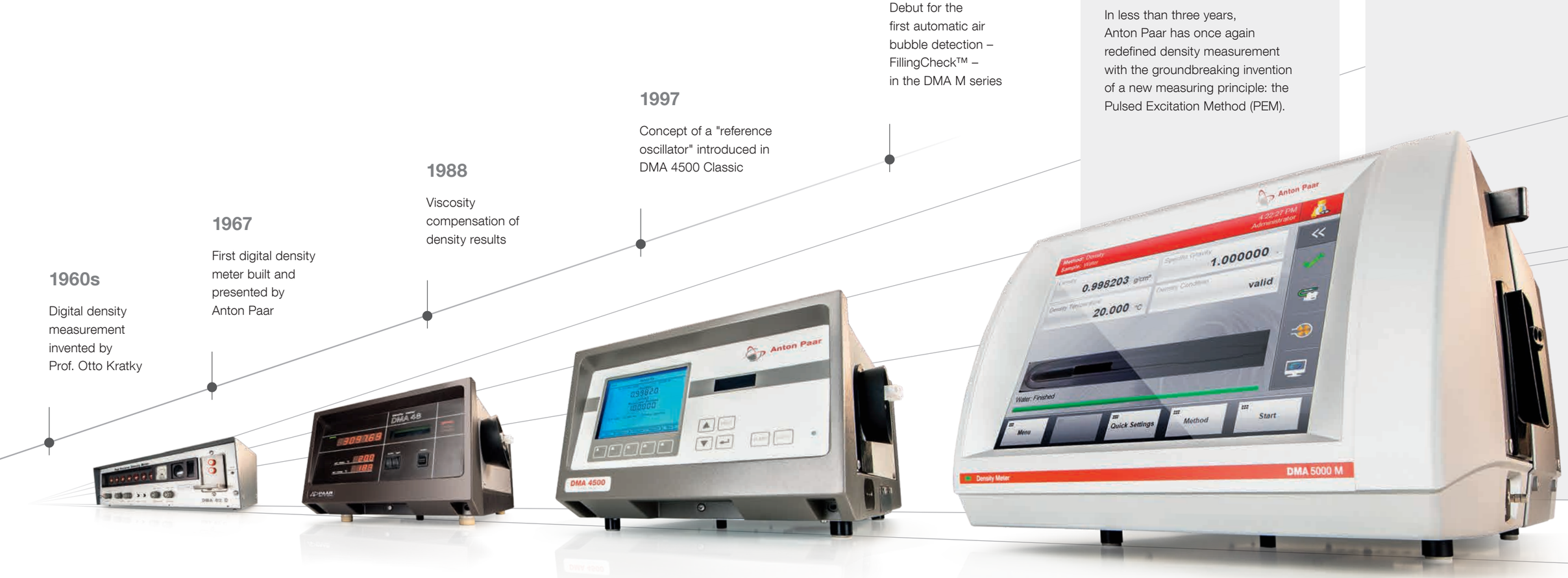
2 x better viscosity correction

8 new patents

16 new features

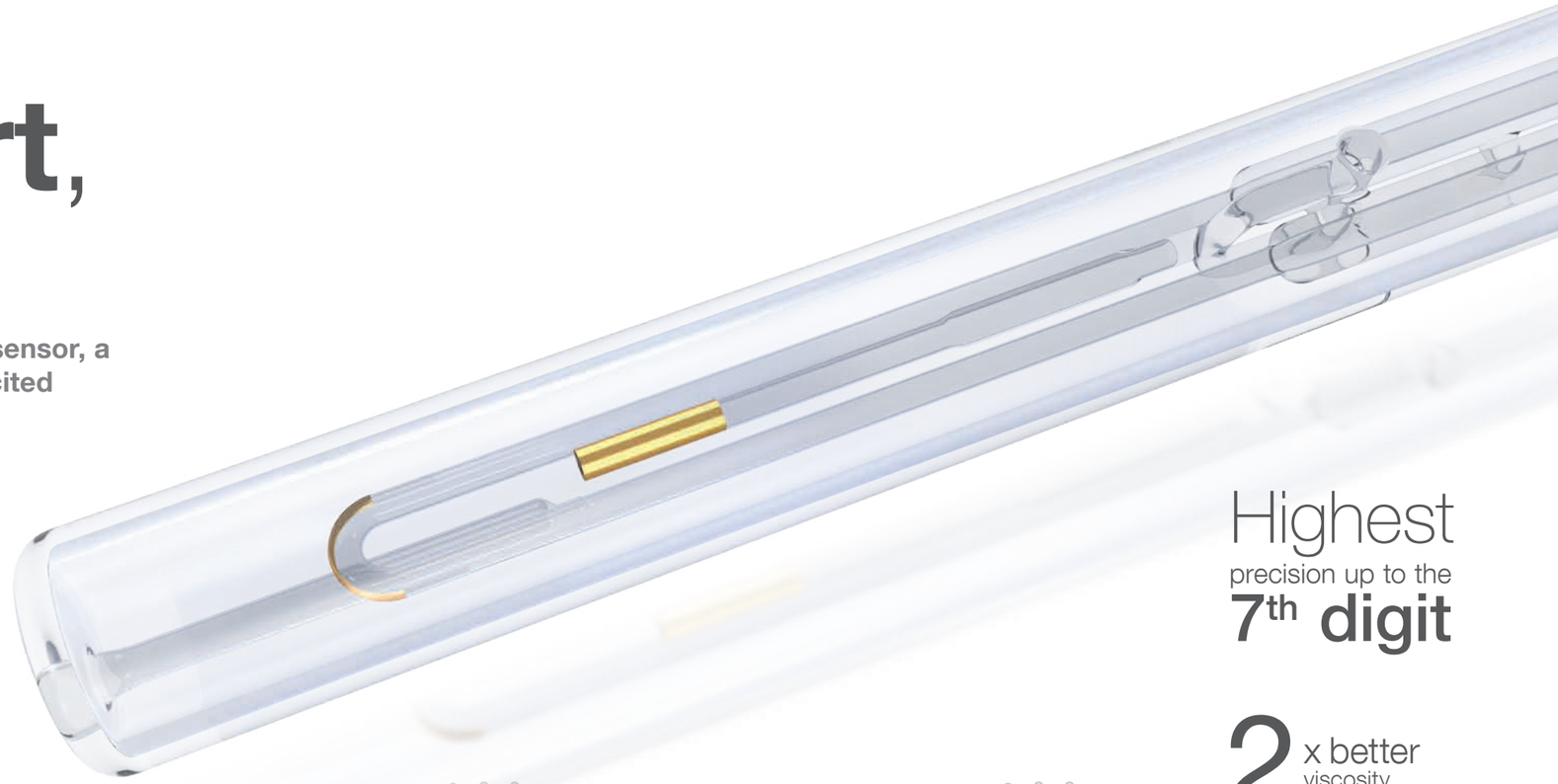
Viscosity measurement included

Best Filling Check™ ever



A new **heart**, a new **start**

The heart of a modern digital density meter is the measuring sensor, a U-shaped tube made from borosilicate glass or metal. It is excited to oscillate at its characteristic frequency, which is directly related to the density of the sample. After Anton Paar's re-invention of digital density measurement, there are now two excitation methods on the market: conventional and new.



Highest
precision up to the
7th digit

2 x better
viscosity
correction

launched in the
1960s

Reached
its limits

Used in conventional density meters

Forced Oscillation Method

launched in
2018

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Pulsed Excitation Method

Since the launch of this method by Anton Paar in the 1960s, a constant oscillation of the U-tube has been the state of the art. In this method, the U-tube is forced to oscillate continuously at its characteristic frequency. Over the years, continuous improvements like viscosity correction of the measured results and filling error detection were implemented.
However, this technology has reached its limits. In order to advance, Anton Paar's dedicated research team has rethought this technology from scratch.

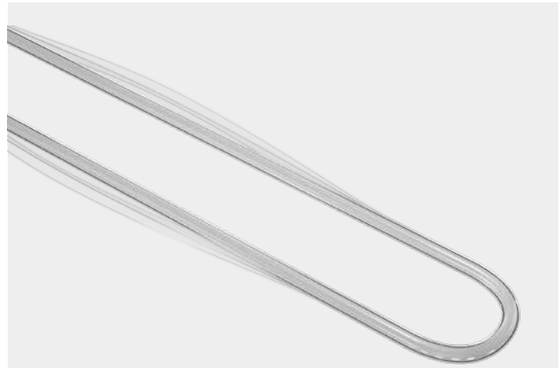
The new patented **Pulsed Excitation Method (PEM)** redefines digital density measurement. After reaching a stable oscillation, the excitation is switched off and the oscillation fades out freely. This sequence of excitation and fade-out is repeated continuously, creating a pulsing oscillation pattern. By allowing the natural oscillation of the U-tube and evaluating this oscillation pattern, the instrument gains three times more information than with the conventional Forced Oscillation Method.

This results in density meters with:
The highest precision: PEM results in a viscosity correction of results for high viscosity samples which is two times better, and therefore gives unparalleled repeatability and reproducibility.
Viscosity insight: For Newtonian fluids, PEM delivers the viscosity in addition to the density value.
Accuracy: 5 % in the range from 10 mPa·s to 3,000 mPa·s.
More confidence: PEM has a more reliable bubble and particle detection in the filled sample and monitors the condition of the measuring cell.
FillingCheck™ for metal oscillators: Due to PEM, filling error detection is now also available for instruments with metal oscillators for measurements up to 150 °C.

Clearly
the better way

Benchtop density meters make use of U-tube technology with two different types of oscillation directions, X and Y, named after their physical movement. Over time, the X-oscillator proved to have technological limitations.

X-oscillator		Y-oscillator
Straight parts moving towards each other	***Oscillation direction***	Bend of the U-tube moving up and down
Limited accuracy for viscous samples	***Viscosity influence***	No limitations over the full range
High error rate with inhomogeneous samples or in case of particles and bubbles	***Sample condition***	Particles and bubbles are detected reliably
Accuracy limited to 0.001 g/cm³	***Measurement performance***	Accuracy up to 0.000007 g/cm³



As the technology leader, we always go for the better way. This makes the decision obvious: For the highest precision, only Y-oscillators are used in Anton Paar benchtop density meters.

Top results – in any situation

The Pulsed Excitation Method provides unmatched sensitivity regarding bubbles, particles, or homogeneity of the sample. The whole design of the measuring cell guarantees stable results unaffected by any external influences such as frequently changing users with different filling styles.
The instrument monitors the condition of the measuring cell itself and issues a warning in case of potential measuring errors. The latest generation even warns users when environmental conditions, such as humidity and temperature, are not optimal and gives recommendations on how to ensure the maximum lifetime of your instrument.

We take credible specifications seriously

We derive the terminology and definitions of relevant metrological specifications from the ISO 5725 standard. This is not common practice in the density meter business – Anton Paar is the only density meter supplier whose specifications leave no room for doubt. The trueness of our instrument specifications is verified with national standards, traceable to measurements with the hydrostatic balance.

Smart glass-drift compensation

The aim to provide a 4-digit density meter at an unbeatable price made us search for drift compensation without a costly reference oscillator. The result: one-point water adjustment, a unique feature on the density meter market. The measured oscillation period of water is compared to that of the last adjustment. Using this data, a potential drift is corrected automatically. You are ready for measurement in half the time compared to any other benchtop density meter available.

Full-range factory adjustment – now also for metal oscillators

Density meters with a metal oscillator based on the Pulsed Excitation Method receive a wide-range density adjustment before shipping. This Temperfect™ adjustment is permanently stored along with the density temperature coefficients in the device so that you can simply choose a measuring temperature between 0 °C and 150 °C. You don't need to make any manual adjustments – just measure density right away.

1 **point** water adjustment

Ready to measure from 0 °C to 150 °C

Instrument **self** diagnosis

ISO 5725

More than **50 years** of experience in your hand

Highest robustness and accuracy

Improving a glass oscillator's robustness while increasing the accuracy of the measured result is a masterpiece of development work. One µm too much in wall thickness could result in an unacceptable loss of sensitivity. The new measuring cell of our portable density meter series is more rugged and at the same time delivers more accurate results. How is that? The influence of viscosity on the density result is compensated via an intelligent phase transition in excitation of the oscillator. This makes accurate measurements possible in a sample's viscosity range three times wider than in the past – up to 300 mPa·s.

Operated by movement of the instrument

Via an integrated motion sensor the portable density meter is able to allocate its own spatial position. By a simple move of the instrument you automatically identify sample names in just a second via an RFID (Radio Frequency Identification) interface, start a measurement, and abort it, if necessary. Your second hand stays free to hold you steady when measuring hard to reach samples.

Intrinsically safe

It takes only one piece of paper to prove it – but it needs the whole instrument's intelligent design and manufacturing to assure it: safety for density measurements in explosive atmospheres. Our intrinsically safe handheld density meters for the chemical and petroleum industry are the only certified option for use in hazardous atmospheres.

Replaceable measuring cell

In field environments, sometimes robustness is not enough. Accidents may happen at any time. To counter this, we made the measuring cell for our portable instrument replaceable by applying a patented design. Each measuring cell keeps its individual adjustment data safe on a small electronic board, waiting for the moment to be connected to the operating panel. By offering a DIY repair to our customers we can ensure your density meter is ready for use 24/7.

10x faster

Ready in one second

Maximum life time

The Only intrinsically safe device

3x wider viscosity range

Today’s world requires combined solutions and standardization across departments, plants, and subsidiaries. Anton Paar meets this demand with the broadest portfolio of density meters available: from the only intrinsically safe handheld density meter on the market to the most accurate benchtop density meter.

But the portfolio does not end there: Numerous sample changers allow you to process up to 96 samples in a row fully automatically, including a heated sample changer for measurements at up to 90 °C.

For the ultimate fusion of your laboratory and production plant, Anton Paar inline sensors measure density, Brix, concentration, API gravity, and other parameters and communicate with the benchtop DMA density meters via our matchmaking features. This connection guarantees correct density results in the lab and at the production line at all times.

Anton Paar density meters are ready wherever high-end density and concentration measurement are needed – across all industries and applications.

The **broadest portfolio** for laboratories and production sites

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www.anton-paar.com/densityredefined