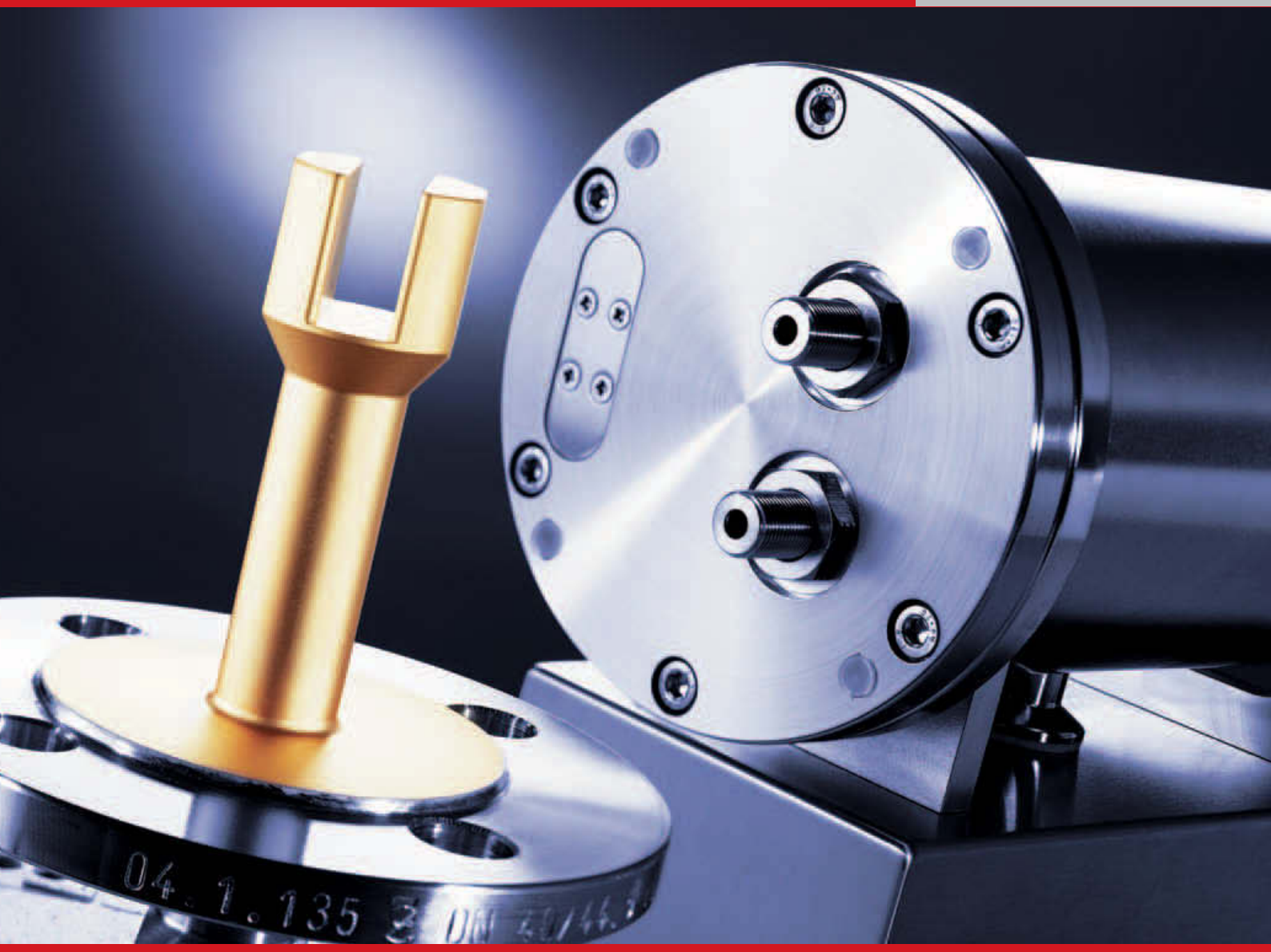
Anton Paar

Process Measurement Solutions

::: Unique Density & Concentration Meters



Long-standing History of Innovation

Anton Paar GmbH, founded in 1922, is a family-owned, highly innovative company with more than 1300 employees worldwide. Using the latest technologies, Anton Paar GmbH is a renowned producer of a variety of high-quality, high-performance instruments and a contract manufacturer of high-precision parts and system components.

Tools such as CNC machining, SMD electronics, orbital welding and laser technologies are used at Anton Paar according to strict ISO 9001 guidelines.

Worldwide partnerships and a reliable distribution network in over 110 countries with well-trained sales and service engineers provide fast and efficient support to all Anton Paar customers.

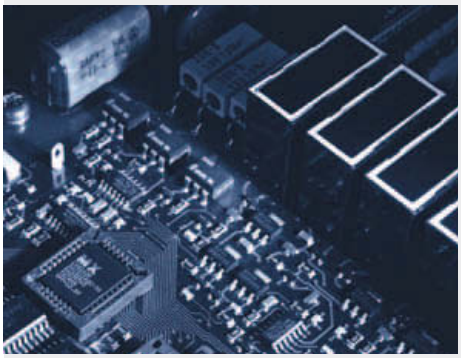
Anton Paar and the oscillating U-tube principle

It all started in 1967: Anton Paar launched the first digital density meter with an oscillating U-tube sensor, marking a turning point for density measurement by replacing old-fashioned hydrometers and pycnometers. Hans Stabinger and Hans Leopold, two renowned Austrian scientists, invented the principle and developed the prototypes, and Ulrich Santner, then head of Anton Paar, took over production: The first density meter was born.

Anton Paar's instruments for process applications

Anton Paar has supplied process instruments to industry for over 30 years. We offer a wide range of instruments and accessories to meet the requirements of customers in a variety of industrial branches.

These products have gained a great reputation for their quality, reliability and accuracy. They are used throughout the world in highly demanding applications and even in hazardous areas.



Applications

Anton Paar's process instrumentation ensures the continuous control of product quality and product specifications within tight tolerance limits.

A variety of wetted parts, materials and process connections are available to suit each application. A team of application specialists offers expert advice based on long experience, and assists in solving new application tasks.

Density measurement

Precise density and concentration measurement of …

- food
- beverages (extract, alcohol, °Brix, etc.)
- sugar
- oleum
- hydrochloric acid
- phosphoric acid
- nitric acid
- boric acid
- sodium hydroxide
- ammonia
- sulfuric acid up to 90 %
- hydrogen peroxide
- glucose
- ethanol
- starch solutions
- hydrocarbons
- fuels
- lubricants
- liquefied petroleum gas

Sound velocity measurement

Precise sound velocity and concentration measurement of …

- food
- beverages (extract, alcohol, °Brix, etc.)
- sugar
- alkalis
- solvents
- emulsions
- reaction monitoring
- sulfuric acid above 90 %
- oleum
- acetic acid
- sodium hydroxide
- potassium hydroxide solution
- oil in refrigerants
- acids in particular measuring ranges
- phase separation
- interphase detection

Combined density and sound velocity measurement

Precise concentration measurement of …

- food
- beverages (extract, alcohol, °Brix, etc.)
- sucrose/inverted sugar/water
- formaldehyde/methanol/water
- sodium chloride/sodium hydroxide/water
- sulfuric acid/oleum concentrations
- emulsions
- reaction monitoring

Complete Solutions

Anton Paar's process instruments can be used in various combinations. We have optimal standard solutions configured for many applications, flexible and adaptable to suit individual requirements.
A complete monitor combines the sensor with an mPDS evaluation unit and an application-specific software program.

Typical applications

The following are standard systems consisting of a combination of the units listed in this booklet.

Sulfuric Acid Monitor

- Measures sulfuric acid concentration from 0 to 100 %
- Fully resistant tantalum or gold-plated sensor

Oleum Monitor

- Measures oleum concentration from 0 to 65 % free SO_3
- Fully resistant gold-plated sensor

API Petroleum Monitor

- Specific gravity, API gravity and density at 15 °C/60 °F

Rolling Oil Monitor

- Measures oil concentration continuously
- Optional pressure compensation

Phase Change Monitor

- Detection of phase changes and liquid/liquid interfaces

Formaldehyde Monitor

- Measures formaldehyde and methanol concentration

Cobrix 5 Beverage Analyzer

- Continuous measurement of °Brix, % Diet, CO_2, alcohol, sugar inversion, original extract and additional parameters
- Inline or bypass version available
- For all soft drinks, beer types, wine, juices and FABs (alcopops)
- Flexible positioning of the evaluation unit up to 250 m away from the sensor

Brix Monitor

- High-precision °Brix measurement of soft drinks, syrups and fruit juices

Beer Monitor

- High-precision measurement of alcohol, real and original extract
- Optional CO_2 measurement for maximum system accuracy

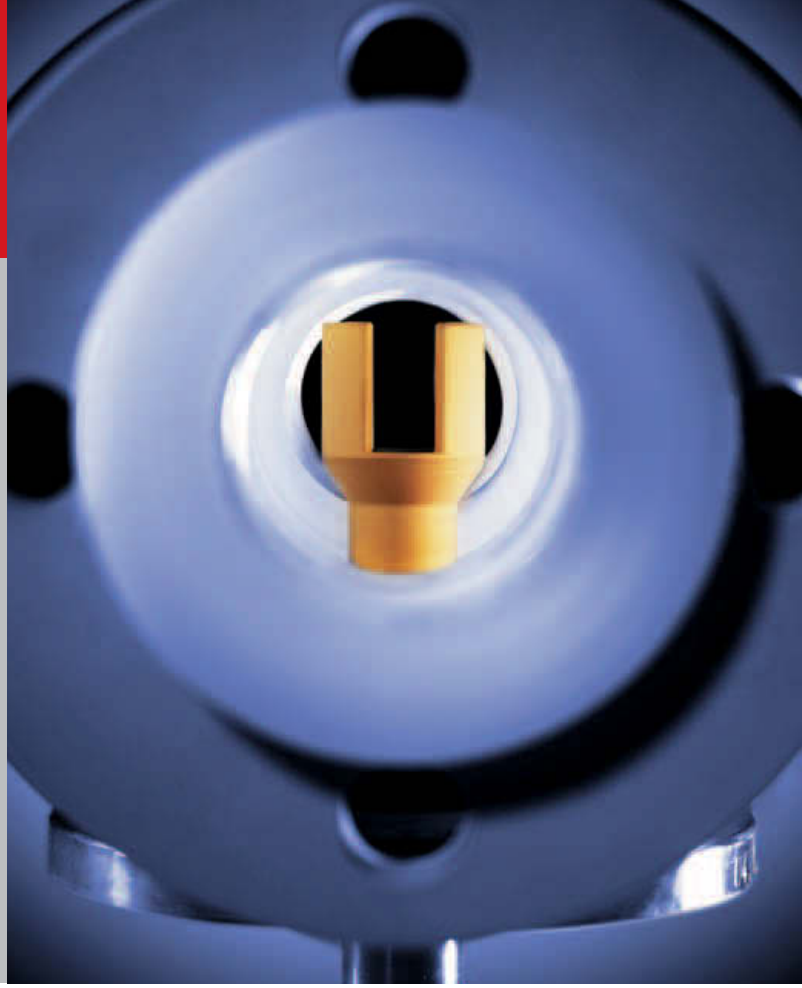
Alcohol Monitor

- High-precision measurement of alcohol in ethanol-water mixtures
- PTB type approval (optional)

Density Monitor

- Density at measuring temperature and temperature-compensated density

Sound Velocity Measurement



For many liquid mixtures, the speed of sound is directly proportional to the concentration of the components. Therefore, sound velocity measurement can often be used for concentration measurement of 2-component mixtures. The sound velocity is also a characteristic property of a liquid and can be used for material characterization.

Features and benefits

- High resolution and repeatability
- Fast response to changes in concentration or temperature provides accurate drift-free measurement
- Robust design
- Automatic conversion into concentration readings by mPDS 1100/mPDS 5 Evaluation Unit
- ATEX certificate (optional)

SPRn sound velocity sensors – Measuring principle

The sample flows perpendicular to a sound signal. The speed of sound is measured between a transmitter and a receiver and temperature compensation is achieved using an integrated Pt 1000 temperature sensor.

SPRn 4115/SPRn 4215 Sound Velocity Sensor

- Typical applications: original extract of beer, purity of liquids, interface detection, concentration of bulk chemicals, etc.
- Inline installation, fork-type sensor
- Material (wetted parts): Stainless Steel 316 Ti, gold coated, Hastelloy C276 or Monel 400
- L version (long shaft 100 mm) for installation in tanks
- Gold coating for sulfuric acid applications
- 2T sensors: stable measurement values at production stop, high gas bubble tolerance

SPRn 4214 Sound Velocity Sensor

- Typical applications: concentration determination of wort chemicals, refrigerants
- Bypass installation, tube-type sensor
- Material (wetted parts): Hastelloy C276
- LS version for samples with low sound velocity, e.g. freons

<< SPRn 4115 2T Sound Velocity Sensor

<< SPRn 4115 L Sound Velocity Sensor

<< SPRn 4214 Sound Velocity Sensor

Density Measurement

The Anton Paar oscillating U-tube method

A U-shaped metal or glass tube is forced into harmonic oscillation. The period of oscillation is dependent on the density of the sample in the tube. Therefore, by measuring the period of oscillation, the density or density-related values can be calculated to a high level of accuracy.

Density sensors - Measuring principle

Sample flows continuously through the vibrating U-tube sensor. The characteristic frequency of vibration is measured and the separate evaluation unit instantly translates the signal into a density or concentration value. Temperature compensation is achieved using an integrated temperature sensor.

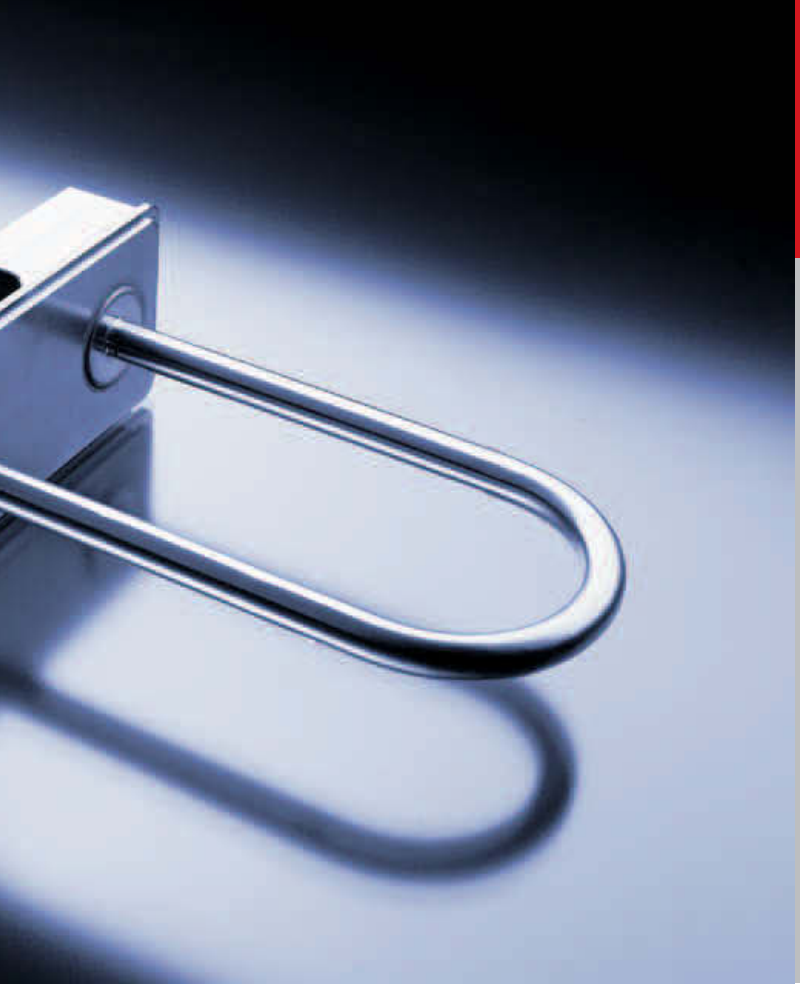
L-Dens 427

- Typical applications: storage, transport and delivery of petroleum and ethanol products
- Compact design
- Frequency output, Modbus, HART, 4 - 20 mA analog signal, mPDS output
- Inner diameter: 6.6 mm
- ATEX and FM approval

<< DPRn 427
Density Sensor

<< DPRn 427 (S)
Density Sensor

<< L-Dens 427



Features and benefits

- The most accurate measurement on the market
- The high linearity provides exceptional accuracy over a wide density range
- Rapid response to changes in concentration or temperature provides real-time results and drift-free measurement
- Extremely high resolution and repeatability
- Robust design for continuous operation
- Selection of wetted parts materials to suit most applications
- Automatic conversion into specific gravity, °Brix, % alcohol, % H_2SO_4, API gravity and many other concentration readings by mPDS 1100/mPDS 5 Evaluation Unit
- ATEX certified sensors available

DPRn 417/DPRn 427/DPRn 427 (S) Density Sensor

- Typical applications: beverages, soft drinks, chemicals, oil, etc.
- Recommended for applications requiring the highest precision
- Materials (wetted parts): Hastelloy C276, Stainless Steel 316 Ti or Incoloy 825
- Inner diameter: 6.6 mm
- PTB type approval for fiscal measurement (optional)
- Measurement at high temperatures up to 150 °C (optional)
- Stainless steel housing (optional)

DPRn 407/ DPRn 427 Ta Density Sensor

- Typical applications: aggressive or high-purity liquids, sulfuric acid, HCl, other acids, etc.
- Material (wetted parts): borosilicate glass, PVDF, tantalum
- Inner diameter: 7 mm

DPRn 4122 Density Sensor

- Typical applications: high flow rates or less homogeneous samples
- Material (wetted parts): Stainless Steel 316Ti
- Large inner diameter: 22 mm
- Various flanges and clamps available

DPRn 422 Density Sensor

- Typical applications: high pressure up to 200 bar and/ or low flow rates
- Material (wetted parts): Hastelloy C276
- Inner diameter: 2.8 mm

Accessories

- **Online Fitting:** for easy installation of DPRn 417/427, DSRn 427, DTR 427.
- **Inline Pump 5:** quick and easy inline installation in lines where stop conditions occur. For DPRn 427 (S) and DSRn 427 (S).
- **Inline Adapter:** quick and easy inline installation in lines with sufficient and continuous flow. For DPRn 427 (S) and DSRn 427 (S).

STABINGER MESSTECHNIK **Developed in cooperation with Labor für Messtechnik Dr. H. Stabinger GmbH, Graz**

Combined Density and Sound Velocity Measurement

To determine three concentrations in a 3-component mixture density and sound velocity are determined simultaneously. The data are then processed using polynomial formulas. Examples: Beer (alcohol/extract/water), formaldehyde/methanol/water. The density/sound velocity concept is also applied for product characterization and purity control.

Features and benefits

- High resolution and repeatability, rapid response and accurate measuring results
- Designed to withstand the rough conditions of the industrial environment
- Requires mPDS 5 Evaluation Unit
- ATEX certified sensors available

Density & sound velocity sensors – Measuring principle

The sample flows continuously through a single combined sensor measuring the speed of sound and the density simultaneously. Temperature compensation is achieved using a Pt 1000 temperature sensor.

DSRn 427 Density/Sound Velocity Sensor

- Typical applications: concentration of bulk chemicals such as formaldehyde/methanol/water; fresh °Brix and degree of inversion of soft drinks; alcohol, real and original extract of beer
- Material (wetted parts): Hastelloy C276 or Incoloy 825

DSRn 427 (S) Density/Sound Velocity Sensor with stainless steel housing

- Typical applications: fresh °Brix and degree of inversion of soft drinks (Brix Monitor), alcohol, real and original extract of beer (Beer Monitor)
- Material (wetted parts): Hastelloy C276
- Stainless steel housing
- Inline Pump 5 or Inline Adapter for inline installation without additional bypass components (optional)

<< DSRn 427 (S) Density/Sound Velocity Sensor with Inline Pump 5

<< DSRn 427 Density/Sound Velocity Sensor

mPDS Evaluation Units and Software

The mPDS evaluation units process measuring signals from DPRn density sensors, SPRn sound velocity sensors and DSRn density/sound sensors. Concentration conversions are carried out by the powerful software. The flexible hardware provides analog and digital inputs, analog outputs, alarm capabilities, large displays, etc.

The optionally available PC software DAVIS is a custom-tailored tool for data acquisition and control.

mPDS 1100 Evaluation Unit

- Connects to a DPRn density or SPRn sound velocity sensor
- Concentration conversions for common applications such as °Brix, °Plato, % alcohol, API gravity, specific gravity, etc.
- Determines the density and concentration of 2-component liquids
- Option: intrinsically safe DPRn/SPRn input
- Option: Profibus DP

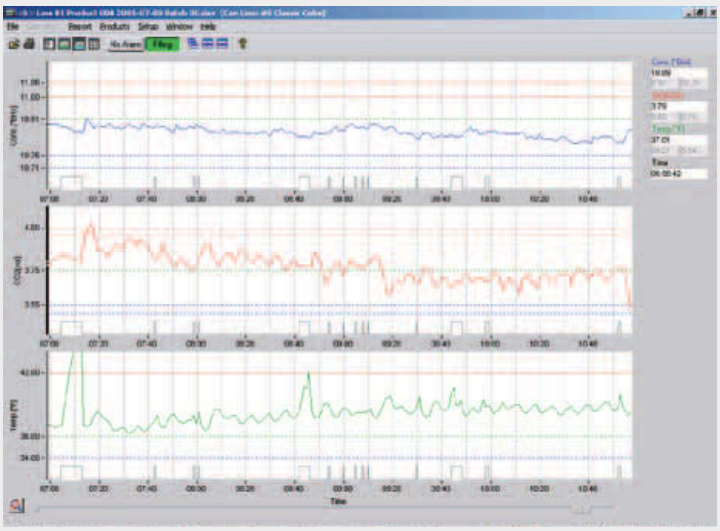
mPDS 5 Evaluation Unit

- Connects to a DPRn, SPRn or DSRn sensor
- Additional connection for an Anton Paar Carbo 510 CO_2 Analyzer
- Large 8.4" color touchscreen, 640 x 480 pixel
- Multiple line monitoring (2 lines)
- Choice of several screen layouts:
  - small and large numeric output fields
  - graphical output fields
- 999 different products with alphanumeric names
- Easy adjustment with reference values
- Different user levels
- Different bus systems

DAVIS Data Visualization Software

The DAVIS software is an interactive Windows™-based software for data acquisition and control.

- DAVIS for mPDS 1100
- DAVIS 5 for mPDS 5
- Graphical real-time trend indication
- Storage of all data and alarms
- Statistical analysis
- Network capability
- Protocol reporting and printing
- Remote maintenance and operation



Viscosity Measurement

L-Vis 510 is an inline viscometer from Anton Paar which can be immersed directly in the production liquid. It continuously displays the viscosity at the process temperature and reference temperature, allowing 24-hour monitoring of suspensions, lubricants, starch adhesives and many more process liquids. L-Vis 510 can be used to achieve consistent product quality and reduce reject product. Data exported to a controller can be used to keep the production process in a defined viscosity range.

Features and benefits

- Temperature and viscosity measured inline
- New measuring principle, only available from Anton Paar
- Stable results, even under adverse flow conditions
- For suspensions, lubricants, starch adhesives and many more process liquids

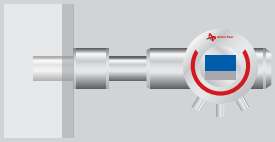
In position for production monitoring

L-Vis 510 is installed directly in the pipe or stirring tank. No bypass is required. It is simple to retrofit the inline viscometer into existing plants. The process liquid flows through the sensor, the viscosity and temperature are measured simultaneously and both are displayed on the screen.

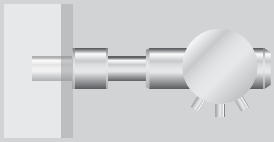
Maintenance intervals greatly depend on the production liquid: L-Vis 510 is maintenance-free when measuring lubricants and oils; measurement of suspensions requires regular maintenance. Due to Anton Paar's worldwide network of subsidiaries and sales partners, a certified Anton Paar service engineer is on call wherever you are.

Installation and operating terminal position

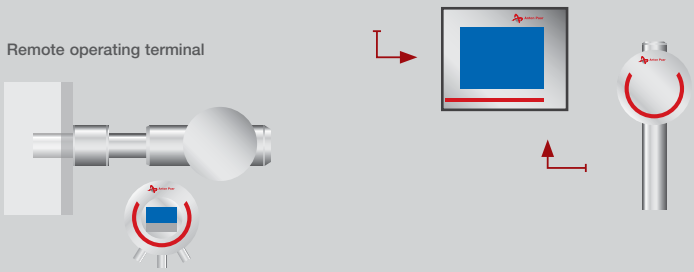
Integrated operating terminal



Smart Sensor



Remote operating terminal



Measured values

- Dynamic viscosity
- Process temperature

Calculated values

- Dynamic viscosity at reference temperature (Arrhenius function)
- Kinematic viscosity at process temperature
- Kinematic viscosity at reference temperature

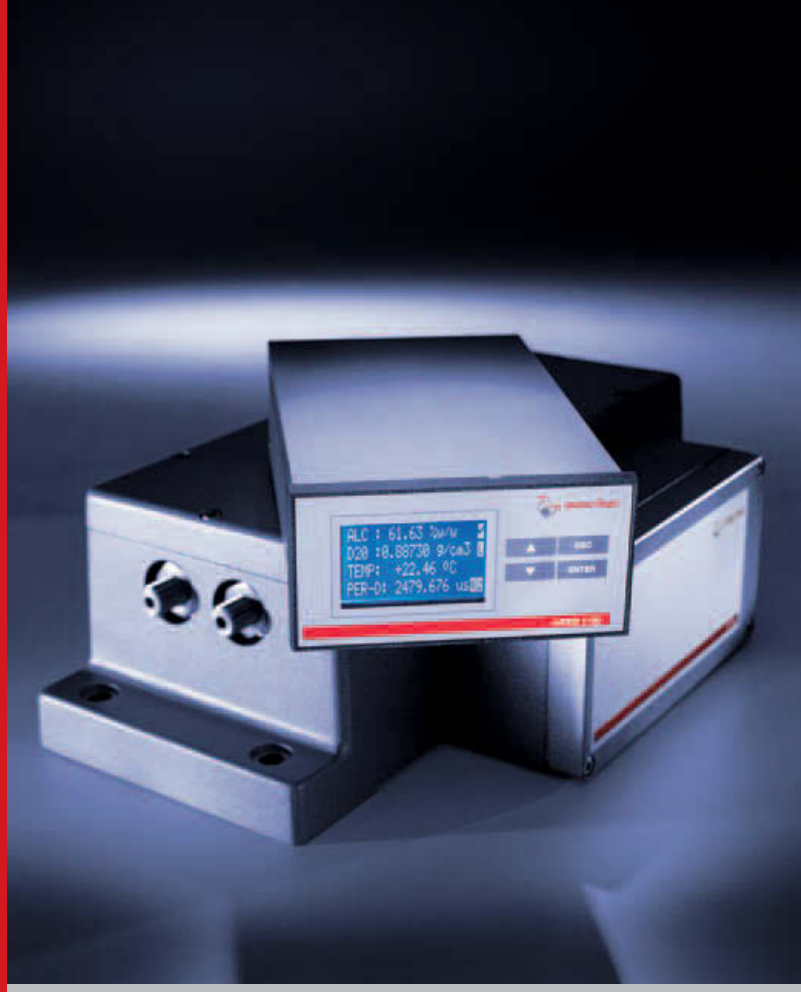
Typical applications

- Suspensions (ceramics, wall paints, plasterboards, roof tiles, waterbased paints, drilling fluids, battery paste, etc.)
- Oils and lubricants
- Starch Adhesives (corrugated box boards, paper bags, paper boxes, carton sealing, paper tube winding, laminated paper board, gummed tape coating, gummed paper coating, textile coating)
- Viscose

Specifications

Sensor		DPRn 417 DPRn 427 (S)	DPRn 427 ta	DPRn 407	DPRn 4122	DPRn 422	DSRn 427 (S)	SPRn 4115 A 2T	SPRn 4115 2T Varivent	SPRn 4115 L 2T	SPRn 4214 (LS)
Wetted parts (other materials on request)		1.4571, 316 Ti Hastelloy C276 Incoloy 825	Tantalum	Borosilicate glass	1.4571, 316Ti	Hastelloy C276	Hastelloy C276	1.4571, 316Ti	1.4571, 316Ti	1.4571, 316Ti, Hastelloy C276, Monel 400, gold coated	Hastelloy C276
Tube inner diameter/ Sound distance	mm	6.6	7	7	22	2.8	6.6	13			14/6.5-LS 2.5
Process connection		Threads (parallel) G3/8" ISO 228		Hose connectors OD 10 mm PVDF	Tube end 1", Tri-Clamp DIN/ISO, DIN 11851, DIN 2633, ANSI	Fittings 1/8"	Threads (parallel) G3/8" ISO 228	DIN 11851 NW 65	Varivent	DIN 2527, DIN 2633, ANSI	Threads (parallel) G3/4" ISO 228
Measuring range	g/cm^3 m/s	0 to 3 g/cm^3					0 to 3 g/cm^3 800 to 3000 m/s	800 to 3000 m/s			800 to 3000 m/s LS: 200 to 1600 m/s
Measurement repeatability	g/cm^3 m/s	1 x 10^{-5} Hast: 5 x 10^{-6}	1 x 10^{-5}				5 x 10^{-6} 0.01 m/s	0.01 m/s			
Accuracy in the adjusted range	g/cm^3 m/s	1 x 10^{-4} Hast: 5 x 10^{-5}	1 x 10^{-4}				5 x 10^{-5} 0.1 m/s	0.1 m/s			
Temperature range (sample)	°C, °F	-25 to 125 °C, -13 to 257 °F									
Pressure range	bar, psi	max. 50, max. 725		max. 10, max. 145	max. 50, max. 725 (depending on the flange)	max. 200, max. 2900	max. 50, max. 725	max. 15, max. 217	max. 14, max. 203	max. 100, max. 1450 (depending on the flange)	max. 50, max. 725
Flow rate (water)	l/h, gal/h	100 to 500, 25 to 125 (1000 max., 250 max.)			350 to 6000, 100 to 1600 (10 000 max., 2500 max.)	20 to 50, 5 to 12.5 (100 max., 25 max.)	100 to 500, 25 to 125 (1000 max., 250 max.)	N/A			200 to 1500, 50 to 375 (2500 max., 625 max.)
Dimensions	mm	470 x 274 x 139		555 x 274 x 139	560 x 330 x 105	280 x 258 x 101	470 x 274 x 139	120 x 118 x 80			220 x 120 x 80
Weight	kg	28		18.5	17	6	28	4	3	4	3
ATEX certificate		EEx ia IIC T6					EEx ia IIB T6				

Transmitter		DTR 407	DTR 4122	DTR 427	DTR 427 ta	DTR 422	STR 4115 A	STR 4115 Varivent	STR 4115 L	STR 4214 (LS)
Wetted parts (other materials on request)		Borosilicate glass	1.4571, 316Ti	Hastelloy C276 Incoloy 825	Tantalum	Hastelloy C276	1.4571, 316Ti	1.4571, 316Ti	1.4571, 316Ti, Hastelloy C276, Monel 400, gold coated	Hastelloy C276
Tube inner diameter/ Sound distance	mm	7	22	6.6	7	2.8	13			14/6.5
Process connection		Hose connectors OD 10 mm PVDF	Tube end 1", Tri-Clamp DIN/ISO, DIN 11851, DIN 2633, ANSI	Threads (parallel) G3/8" ISO 228		Fittings 1/8"	DIN 11851 NW 65	Varivent	DIN 2527, DIN 2633, ANSI	Threads (parallel) G3/4" ISO 228
Measuring range	g/cm^3 m/s	0 to 3 g/cm^3					800 to 3000 m/s			800 to 3000 m/s LS: 200 to 1600 m/s
Measurement repeatability	g/cm^3 m/s	5 x 10^{-5}					0.1 m/s			
Accuracy in the adjusted range	g/cm^3 m/s	2 x 10^{-4}					0.2 m/s			
Temperature range (sample)	°C, °F	0 to 100 °C, 32 to 212 °F								
Pressure range	bar, psi	max. 10, max. 145	max. 50, max. 725 (depending on the flange)	max. 50, max. 725		max. 200, max. 2900	max. 15, max. 217	max. 14, max. 203	max. 100, max. 1450 (depending on the flange)	max. 50, max. 725
Flow rate (water)	l/h, gal/h	100 to 500, 25 to 125 (1000 max., 250 max.)	350 to 6000, 100 to 1600 (10 000 max., 2500 max.)	100 to 500, 25 to 125 (1000 max., 250 max.)		20 to 50, 5 to 12.5 (100 max., 25 max.)	N/A			200 to 1500, 50 to 375 (2500 max., 625 max.)
Dimensions	mm	555 x 274 x 139	560 x 330 x 105	470 x 274 x 139	470 x 274 x 139	280 x 258 x 101	220 x 120 x 80			
Weight	kg	18.5	17	28	28	6	3	3	4	3
ATEX certificate		EEx ia IIB T5								



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Instruments for:

Density & concentration measurement

Rheometry

Viscometry

Sample Preparation

Microwave synthesis

Colloid science

X-ray structure analysis

Refractometry

Polarimetry

High-precision temperature measurement

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