Measuring compressed air quality according to ISO 8573

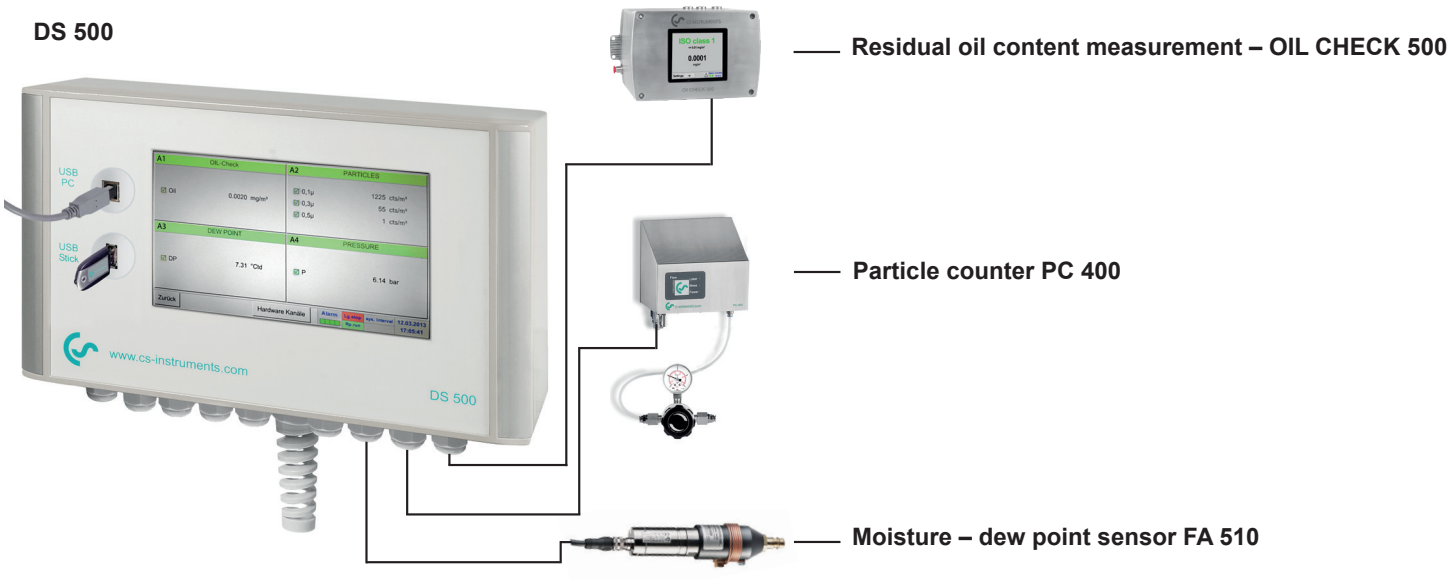
Compressed air is an expensive, but also indispensable medium in industrial, automated production. It is therefore all the more important for users to always keep an eye on the quality of their compressed air system.

ISO 8573 is an internationally recognised standard that defines the most important impurities in compressed air. The implementation of this standard supports the precise testing of the most important impurities in compressed air particles, water, gas, microbiological and oil contamination.

However, some of these methods require samples to be analyzed in a laboratory. This is always associated with time delays and only provides the customer with an average snapshot over the measured period and is not always practical.

So how do we measure these impurities under everyday, real operating conditions?

CS INSTRUMENTS offers this customized solutions for stationary and mobile monitoring. An alarm can be used to signal that maintenance work is required on the compressed air treatment system (dryer and filter) so that oil, water and particles do not enter the compressed air network. This reduced prevents the risk of contamination of end products and increases the process reliability and life span of pneumatic components.



ISO 8573 consists of the following parts, under the general title Compressed air:

Anwendungen von Druckluft:

- Part 1: Contaminants and purity classes
- Part 2: Test methods for oil aerosol content
- Part 3: Test methods for measurement of humidity
- Part 4: Test methods for solid particle content
- Part 5: Test methods for oil vapour and organic solvent content
- Part 6: Test methods for gaseous contaminant content
- Part 7: Test method for viable microbiological contaminant content
- Part 8: Test methods for solid particle content by mass concentration
- Part 9: Test methods for liquid water content

ISO 8573-1:2010 Class	Solid particles			Humidity	Oil
	Number of particles per m³			Pressure dew point	Total share of oil (liquid aerosol and vapour)
	0.1 - 0.5 µm	0.5 - 1 µm	1 - 5 µm		mg/ m³
0	In accordance with specification by the device user, stricter requirements than class 1				
1	≤ 20,000	≤ 400	≤ 10	≤ -70 °C	≤ 0.01
2	≤ 400,000	≤ 6,000	≤ 100	≤ -40 °C	≤ 0.1
3	--	≤ 90,000	≤ 1,000	≤ -20 °C	≤ 1
4	--	--	≤ 10,000	≤ +3 °C	≤ 5
5	--	--	≤ 100,000	≤ +7 °C	--
6	--	--	--	≤ +10 °C	--
7	--	--	--	--	--
8	--	--	--	--	--
9	--	--	--	--	--
x	--	--	--	--	--

In this editorial we will focus on the inline methods to detect oil aerosols, humidity and particles (including microbiological contaminants) on a continuous basis.

Oil aerosol content:
Looking at ISO 8573-2, there are different test methods authorized to measure oil aerosol content.

The following table is taken from the ISO 8573-2 standard document. The measurement methods correspond to a temporal sample. The results can therefore be used for validation.

Parameter	Method A - Full flow	Method B - Full flow	Method B2 - Partial flow
Contamination range	1 mg/m³ to 40 mg/m³	0,001 mg/m³ to 10 mg/m³	0,001 mg/m³ to 10 mg/m³
Max. velocity in filter	See 7.1.2.10	1 m/s	1 m/s
Sensitivity	0,25 mg/m³	0,001 mg/m³	0,001 mg/m³
Accuracy	± 10% of actual value	± 10% of actual value	± 10% of actual value
Max. temperature	100 C°	40 C°	40 C°
Testing time (typical)	50 h to 200 h	2 min to 10 h	2 min to 10 h
Filter construction	Coalescing line filter	Three-layer membrane	Treee-layer membrane

For online measurements that provide the user with a continuous display and also an indication of peak contamination, modern measuring systems such as PID sensor technologies are used. These sensors provide a permanent, highly accurate oil vapour measurement by using the Photo Ionization Detector (PID) method.

The sensors can be easily connected to the compressed air system via a ball valve or quick coupling and continuously analyze the air. The measured values can be recorded and alarms can be triggered if limit values are exceeded. These are the main advantages over temporary measurement methods.

Residual oil measurement - OIL CHECK 500
The OIL CHECK 500 enables permanent, highly accurate measurement of the vaporous residual oil content from 0.001 mg/m³ to 4 mg/m³. The minimum measured value of the OIL CHECK 500 of 0.001 mg/m³ means that compressed air quality class 1 (ISO 8573) and therefore the entire measuring range can be monitored. Long-term stability is achieved using the patented Force-Pressure-Variation method. This involves measuring at different pressures to ensure that there is no oil vapor contamination in order to perform a zero adjustment.

Measurement of humidity:

ISO 8573-3 looks at test methods for the measurement of humidity.
This next table has been taken out of the ISO 8573-3 standard document:

Table 1 - Test methods for measuring humidity

Method in order of uncertainty		Uncertainty ±°C	Range for humidity level expressed as pressure dew point° , °C	Remarks
Method	**Table**		-80 -60 -40 -20 0 +20 +40 +60	
Spectroscopic	**2**	**a**		Detection limit for water vapour is about 0,1 x 10^{-6} to 1 x 10^{-6} b
Condensation	**3 and 4**	**0,2 to 1,0**		
Chemical	**5**	**1,0 to 2,0**		
Electrical	**6, 7 and 8**	**2,0 to 5,,0**		
Psychrometer	**9**	**2,0 to 5,0**		
a The uncertainty is not yet available in °C. **b Volume fraction.** **c Pressure dew point is defined in ISO 7183.**				

The spectroscopic and condensation methods are very accurate but also very expensive to use as continuous measuring solutions. The chemical and psychrometers are spot checks which can't be used for continuous measurements. The most commonly used method to measure humidity levels and dew point temperatures are the electrical method. The most commonly used sensors in this category are sensors based on capacitance.

This is due to the fact that these sensors offer the greatest measuring range with very good accuracies and repeatabilities.

These sensors can also easily be installed through a ball valve or a quick coupler and give continuous measurements which can be recorded and/ or used to trigger alarms if limit values are breached.

Moisture – dew point sensor FA 510

FA 510 measures the pressure dew point down to -80 °Ctd. Also in this case the continuous measurement takes care that alert is triggered immediately if the compressed air dryer breaks down. The sensor enables permanent monitoring of the compressed air dryer.

Particle content:

ISO 8573-4 looks at test methods for solid particle content.
This next table has been taken out of the ISO 8573-4 standard document:

Method	Applicable concentration range particles/m^3	Applicable solid particle diameter µm
		< 0,10 0,5 1 <5
Laser particle counter	**0 to 10^5**	
Condensation nucleus counter	**10^2 to 10^8**	
Differential mobility analyser	**Not applicable**	
Scanning mobility particle sizer	**10^2 to 10^8**	
Sampling on membrane surface in conjunction with a microscope	**0 to 10^3**	

The most commonly used test method for measurement of solid particle content by counting is by using laser particle counters. The sensors can easily get connected to the compressed air system through a ball valve or quick coupler and analyse the air on a continuous base. Accuracy is influenced by the size of the laser diode and optics in use as well as the flow rate through the instrument. The greater the air volume that can be analysed at a particular time the higher the achieved accuracy.

Some laser particle counters only measure down to a particle size of 0.3µm (microns). This is not adequate for the food industry as particle sizes down to 0.1µm need to be detected in order to be able to determine the ISO 8573 classes.

Particle counter PC 400

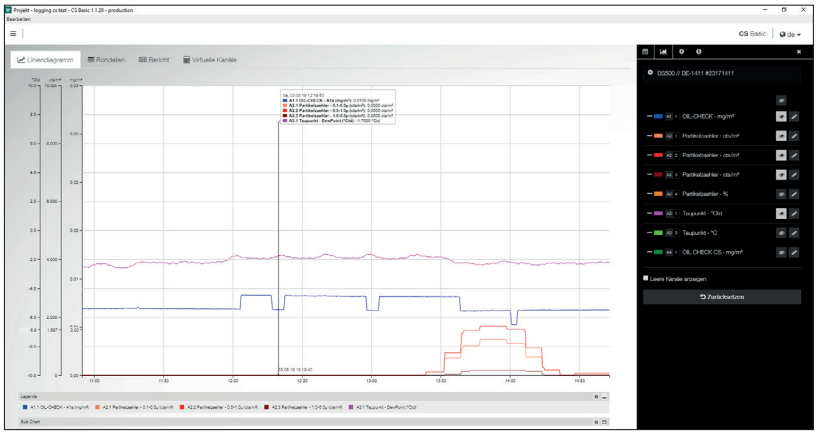
The highly precise, optical particle counter PC 400 measures particles from a size of 0.1 µm and is therefore suitable for monitoring the compressed air quality class 1 (ISO 8573).

DS 500 - the intelligent chart recorder of the next generation

The centerpiece of comressed air quality measurement is the chart recorder DS 500. It measures and documents the measured data of the sensors for residual oil content, particles and moisture. The measured values are indicated on a 7” colour screen. The curve progressions from the beginning of the measurement can be viewed by an easy slide of the finger.

The integrated data logger stores the measured values safely and reliably. The threshold value can be freely entered for each measured parameter. 4 alarm relays are available for automatic alarm in case of threshold value exceedance.

Optionally DS 500 can be upgraded with up to 12 sensor inputs. For connection to a PLC DS 500 has an Ethernet interface as well as a RS 485 interface. The communication is done via the Modbus protocol.



Graphical and tabular evaluation of the measured data via PC software

Channel	Average	Minimum	Date of minimum	Maximum	Date of maximum
A1.1 OIL-CHECK - A1a (mg/m³)	0.0171 mg/m³	0 mg/m³	02.08.19 08:42:54	0.0501 mg/m³	05.08.19 08:12:34
A2.1 Partikelzaehler - 0.1-0.5µ (cts/m³)	1245.3243 cts/m³	0 cts/m³	05.08.19 08:15:00	22460.1504 cts/m³	02.08.19 09:07:44
A2.2 Partikelzaehler - 0.5-1.0µ (cts/m³)	2150.4244 cts/m³	0 cts/m³	05.08.19 08:15:00	36727.2891 cts/m³	02.08.19 09:07:44
A2.3 Partikelzaehler - 1.0-5.0µ (cts/m³)	506.1915 cts/m³	0 cts/m³	05.08.19 08:15:00	11477.2783 cts/m³	02.08.19 09:07:44
A2.4 Partikelzaehler - LaserPwr (%)	100 %	100 %	02.08.19 08:37:31	100 %	02.08.19 08:37:31
A3.1 Taupunkt - DewPoint (°Ctd)	-1.851 °Ctd	-2.7353 °Ctd	03.08.19 09:50:56	-0.1837 °Ctd	02.08.19 09:17:54
A3.3 Taupunkt - Temperatur (°C)	28.8685 °C	22.7486 °C	03.08.19 10:35:29	32.4303 °C	04.08.19 18:27:52
A4.1 OIL CHECK CS - A4a (mg/m³)	0.0133 mg/m³	0 mg/m³	02.08.19 08:42:54	0.0463 mg/m³	02.08.19 09:05:52