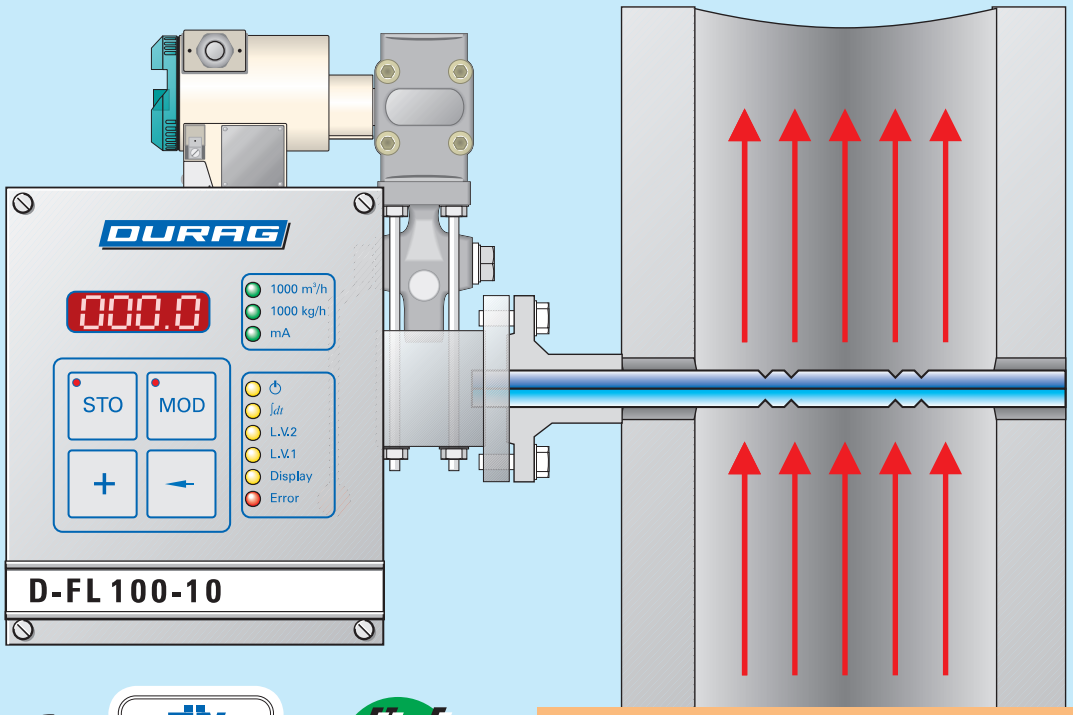
D-FL 100

DURAG



CE

TÜV CERT DIN ISO 9001 zertifiziert

TÜV NORD

Volumenstrom-Meßsystem D-FL 100

- **Durchflußmessung mit einer Sonde nach dem Wirkdruckverfahren (Differenzdruck)**
- **Auswertung mit der Mikroprozessor-Auswerteeinheit D-FL 100-10 (optional)**
- **Einstellbare Parameter**
- **Eingeprägter Strom für Linienschreiber und Anzeigeinstrument**
- **Automatische Rückspüleinrichtung (optional)**

- **Zulassungen**
- Typgeprüft nach den Richtlinien des Bundesministers für Umwelt, Naturschutz und Reaktorsicherheit über die Eignungsprüfung von Meßeinrichtungen für kontinuierliche Emissionsmessungen
- Prüfbericht Nr. 128CU11650 des TÜV Nord, Hamburg
- Aufgeführt in der Liste der geeigneten Meßgeräte zur laufenden Aufzeichnung von Emissionen GMBl Nr. 42 von 1996

D-FL 100 Volume Flow Measuring System

- **Flow rate measurement with a probe by the principle of differential pressure**
- **Evaluation with the D-FL 100-10 Micoprocessor Unit (optional)**
- **Adjustable parameters**
- **Load-independent current for line recorder and indicator instrument**
- **Automatic backflow purging (optional)**

- **Registration**
- Type tested to the guidelines of the Federal Ministry for Environment, Nature Conservation and Reactor Safety on suitability testing of measuring equipment for continuous measuring of emissions
- Test report #128CU11650 of TÜV Nord, Hamburg
- Itemized in the list of suitable measuring instruments for continuous registration of emissions GMBl #42 of 1996

50 JAHRE DURAG 50 YEARS Hegwein

Solutions for Emission and Combustion

DURAG Group

Anwendung

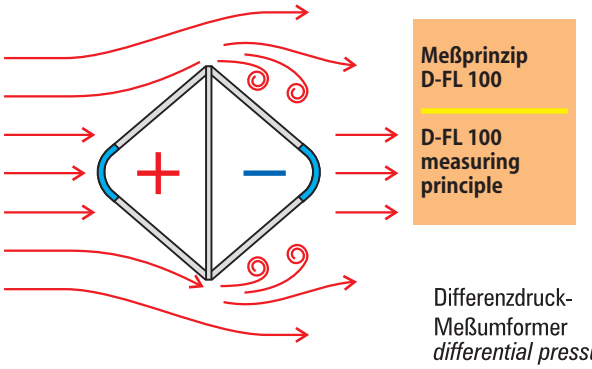
Nach TA Luft sind die Schadstoffemissionen einer Anlage zu überwachen. Zur Ermittlung der Schadstoffmasse ist u.a. die Durchflußmenge des Abgases mit einer Meßeinrichtung zu messen.

Das DURAG Meßsystem D-FL 100 ermittelt die Geschwindigkeit bzw. die Durchflußmenge eines Abgases kontinuierlich. Wählbare Grenzwertüberschreitungen werden trägheitslos gemeldet, wodurch notwendige Eingriffe in die Regelung der Anlage ermöglicht werden, um vorgeschriebene Emissionsgrenzwerte einzuhalten.

Meßverfahren

Das Meßsystem D-FL 100 arbeitet nach dem mechanischen Wirkprinzip. Die Sonde besitzt zwei voneinander getrennte Kammern, zwischen denen sich durch die Strömung eine Druckdifferenz aufbaut. Der entstehende Differenzdruck ist dabei proportional zum Quadrat der Gasgeschwindigkeit. Durch die spezielle Form der Sonde wird zum einen ein möglichst großer Differenzdruck erzeugt und zum anderen wird die Linearität des Meßsignals bezüglich des Durchflusses gewährleistet.

Unter Berücksichtigung der anderen Durchflußparameter wie z. B. Absolutdruck und Temperatur läßt sich mit Hilfe der Mikroprozessor-Auswerteeinheit D-FL 100-10 daraus der Volumenstrom von Betriebs- auf Normbedingungen umrechnen. Hierfür sind zwei weitere Stromeingänge (0-20 mA) an der Auswerteeinheit für die Temperatur und den Druck vorgesehen. Auf die Auswerteeinheit kann verzichtet werden, wenn ein Emissionsauswerterechner vorhanden ist, der die Temperatur- und die Druckabhängigkeit der Gase kompensieren kann und den aktuellen, korrigierten Wert des Volumenstromes berechnet.



Meßprinzip D-FL 100

D-FL 100 measuring principle

Lieferumfang

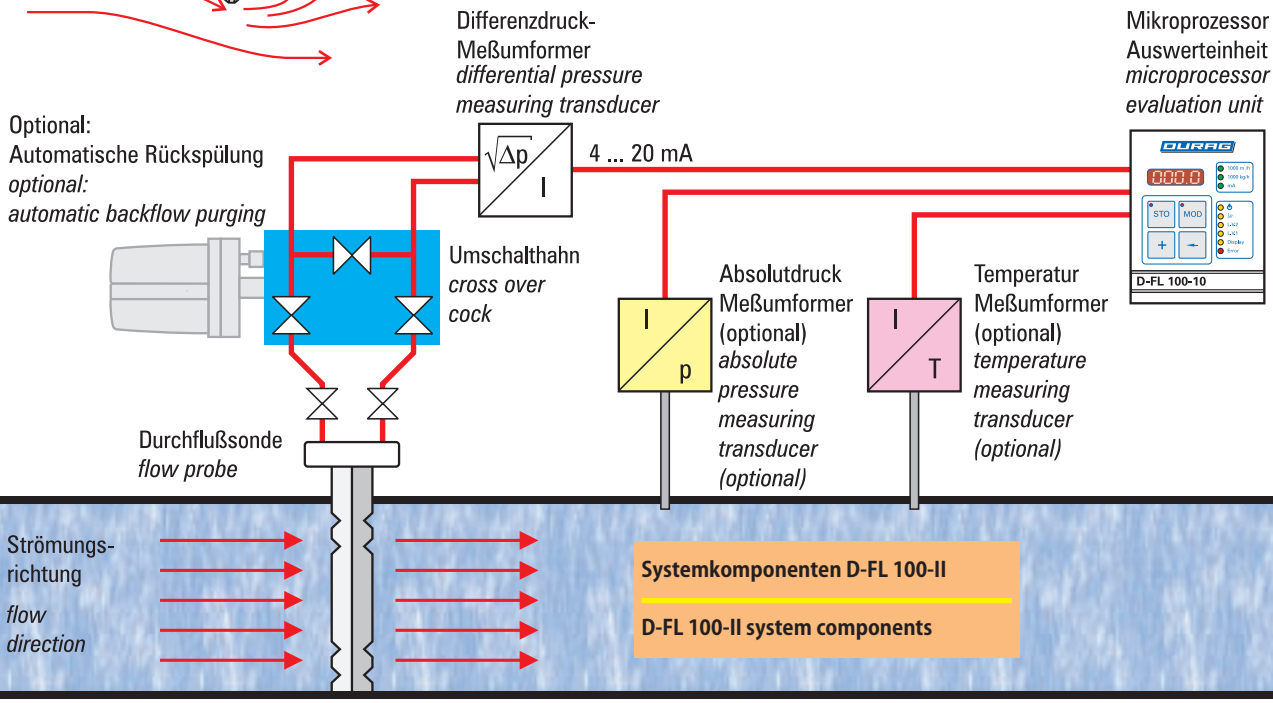
- **D-FL 100-I**
  Durchflußmessung ohne Temperatur- und Druckkorrektur
  - 2 Montageflansche
  - Durchflußsonde (Material: 1.4571)
    Bauart 1: für Kamindurchmesser 0,4-2,0 m
    Bauart 2: für Kamindurchmesser 2,0-4,0 m
    Bauart 3: für Kamindurchmesser > 4,0 m
  - Gegenlager
  - Differenzdruck-Meßumformer
  - Umschalthahn
  - Adapter für Schlauchanschluß
- **D-FL 100-II**
  Durchflußmessung mit Temperatur- und Druckkorrektur
  - Mikroprozessor-Auswerteeinheit D-FL 100-10
  - Absolutdruck-Meßumformer
  - Temperatur-Meßumformer
- **Zubehör optional**
  - Adapter für Umschalthahn
    (Differenzdruck Meßumformer direkt an der Sonde)
  - Wetterschutzhauben bei Außenmontage
  - automatisch gesteuerte Rückspüleinrichtung für die Sonde
    (Pressluft erforderlich)

Sonderanfertigung

Die Durchflußsonde ist auch in anderen Materialien lieferbar für Anwendungen mit besonders aggressiven Abgasen:

- Hastelloy (2.4819)
  Empfohlen für Heizkraftwerke, chemische Industrien sowie in der Papierherstellung
- Inconel (2.4816)
  Empfohlen für Betriebstemperaturen über 600 °C

Ebenso ist der Differenzdruck-Meßumformer mit einer Trennmembran aus Hastelloy lieferbar.



Systemkomponenten D-FL 100-II

D-FL 100-II system components

Application

According to TA-Luft pollutant emissions of industrial plants must be monitored. For mass determination of the pollutants, also the exhaust gas flow must be measured with the help of a measuring device.

The DURAG D-FL 100 Measuring System continuously determines the flow velocity and the flow rate of the exhaust gas. Preselectable limit value surpassings are indicated inertia-free, so permitting necessary interventions in the plant control system so as to comply with prescribed emission limit values.

Measuring Method

The D-FL 100 Measuring System works according to the principle of mechanical effect. The probe has two separate chambers, between which a pressure difference, caused by the flow in the duct, builds up. The differential pressure resulting at the probe is proportional to the square of the gas speed. Due to the probe's special shape, a highest possible differential pressure is produced, whereby the linearity of the measuring signal is guaranteed.

On this basis, and taking the other flow parameters into account, the volume flow can be converted from operational to standard conditions by the D-FL 100-10 Microprocessor Evaluation Unit. For this purpose, two additional current inputs (0-20 mA) for a temperature probe and a pressure probe have been provided for at the evaluation unit. If an emission evaluation computer is available, which can compensate the pressure and temperature-dependence of the gases and that calculates the actual corrected value of the volume flow, the evaluation unit is not needed.

Scope of Delivery

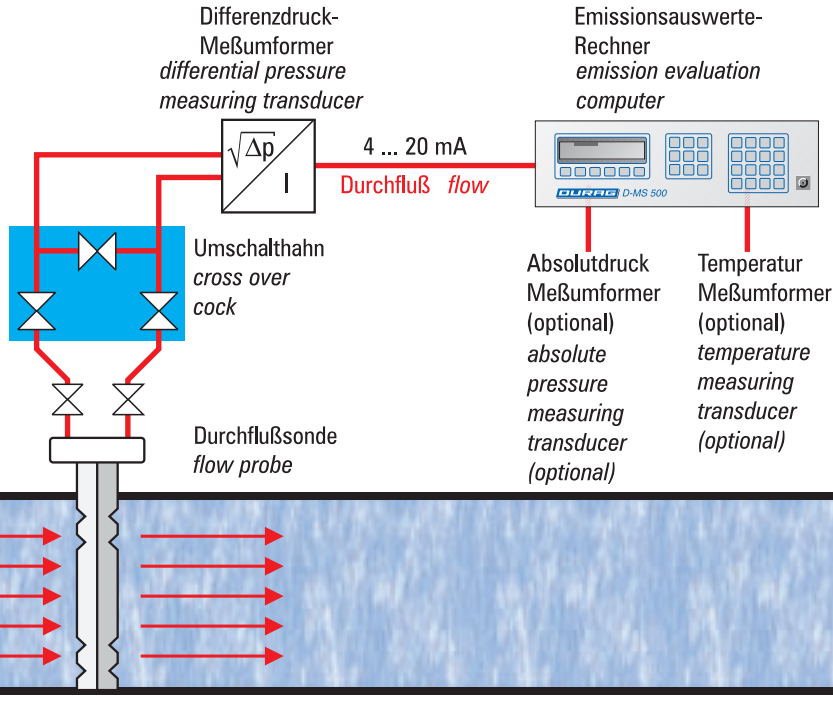
- **D-FL 100-I**
  Flow measuring <u>without</u> temperature and pressure compensation
  - 2 mounting flanges
  - Flow probe (material: 1.4571)
    Design 1: for stack diameters 0.4-2.0 m
    Design 2: for stack diameters 2.0-4.0 m
    Design 3: for stack diameters > 4.0 m
  - Counter support
  - Differential pressure transducer
  - cross over cock
  - adaptor for flexible tube connection
- **D-FL 100-II**
  Flow measuring <u>with</u> temperature and pressure compensation
  - D-FL 100-10 Microprocessor Evaluation Unit
  - Absolute pressure measuring transducer
  - Temperature measuring transducer
- **Optional accessories**
  - Adaptor for cross-over cock
    (differential pressure transducer mounted to the probe)
  - Weather protection hoods when mounted in an outside area
  - Automatic back flow purging for the probe
    (pressurized air required)

Special Designs

The flow probe is also available in special materials for application with particularly aggressive exhaust gases:

- **Hastelloy (2.4819)**
  recommended for heating power plants, chemical plants and in paper manufacturing
- **Inconel (2.4816)**
  recommended for operation temperatures of over 600 °C

The d.p. transducer is also available with a separating membrane made of Hastelloy.



Anwendung D-FL 100-I mit Emissionsauswerte-Rechner (z.B. DURAG D-MS 500)

Application with D-FL 100-I with Emission Evaluation Computer (e.g. DURAG D-MS 500)

Volumenstrom-Meßsystem D-FL 100

Technische Daten D-FL 100

Länge der Meßstrecke

Sonde I ..... 400 - 2000 mm
Sonde II ..... 2000 - 4000 mm
Sonde III ..... > 4000 mm

Profilquerschnitte

Sonde I ..... 22 x 23,9 mm
Sonde II ..... 50 x 53,4 mm
Sonde III ..... 90 x 100 mm
Mindestgeschwindigkeit ..... 3 m/s
Abgastemperatur über
dem Abgastaupunkt ..... bis +320°C
Sondenmaterial: ..... 1.4571 (standard)
(andere Sonderwerkstoffe auf Anfrage verfügbar, z.B.: 2.4819, 2.4816

Elektrische Daten

Auswerteeinheit D-FL 100-10

Netzspannung ..... 115/230 V ±10%
Frequenz ..... 50/60 Hz
(Andere Spannungen und Frequenzen auf Anfrage)
Leistung ..... ca. 10 VA
Garantiefehlergrenze ..... ±2%
Grenzwerte ..... zwei unabhängig einstellbare Grenzwerte L.V.1 und L.V.2
Ausgangssignal ..... analoger Strom 4 - 20 mA, Live Zero 4 mA
max. Bürde ..... 500 Ohm
Relaisausgänge ..... 2 x Grenzwert, 1 x Status „Messung“, alle Kontakte potentialfrei
Integrationszeit des Meßwertes ... 1 - 180 s frei einstellbar
max. zulässiger
Umgebungstemperaturbereich .. -20° +50°C

Differenzdruck-Meßumformer (radiziert)

Meßspanne ..... einstellbar 1 - 20 mbar
Hilfsenergie ..... DC 11-30 V
Schutzart ..... IP 65

Technical Data of D-FL 100

Length of measuring range

Probe I ..... 400 - 2000 mm
Probe II ..... > 2000 - 4000 mm
Probe III ..... > 4000 mm

Cross section of the probe

Probe I ..... 22 x 23.9 mm
Probe II ..... 50 x 53.4 mm
Probe III ..... 90 x 100 mm
Minimum velocity ..... 3 m/s
Exhaust gas temperature over
the exhaust gas dew point ..... up to +320°C
Material of the probe: ..... 1.4571 (standard)
(other materials available on request, e.g.: 2.4819, 2.4816

Electrical data

D-FL 100-10 Microprocessor Evaluation Unit

Mains voltage ..... 115/230 V ±10%
Mains frequency ..... 50/60 Hz
(Other voltages and frequencies on request)
Power consumption ..... approx. 10 VA
Conventional error limit ..... ±2%
Limit values ..... 2 limit values L.V.1 and L.V.2 independently adjustable
Output signal ..... analog current 4 - 20 mA, Live Zero 4 mA
Maximum load ..... 500 Ohms
Relay outputs ..... 2 x limit value, 1 x “measurement”-status, all contacts zero voltage
Measuring value
integration time ..... 1 - 180 s freely adjustable
Max. permissible ambient
temperature range ..... -20° +50°C

Differential Pressure Measuring Transducer (root extractor)

Measuring range ..... adjustable 1 - 20 mbar
Feeder voltage ..... DC 11-30 V
Protection class ..... IP 65

Solutions for Emission and Combustion

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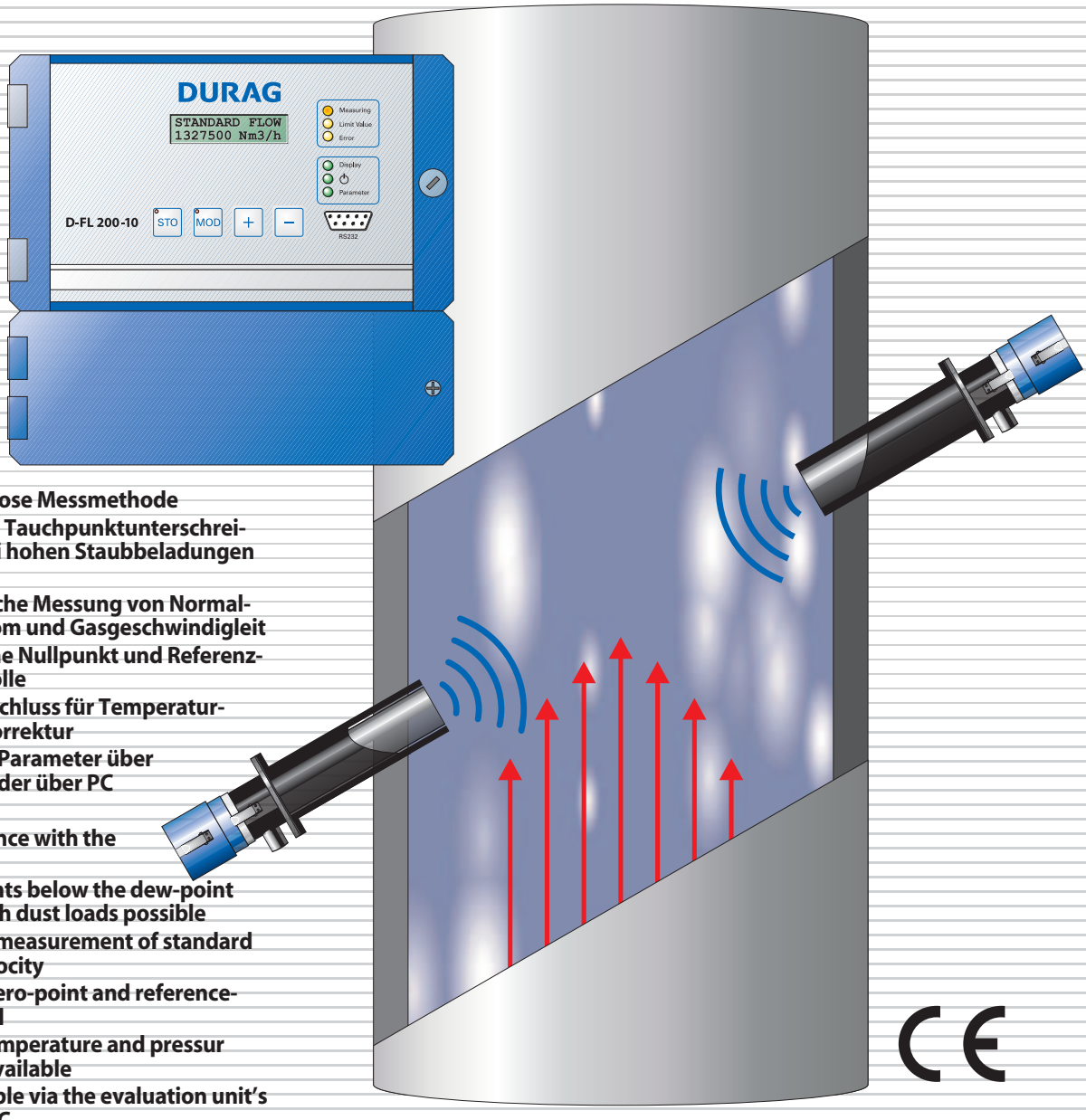


- Berührungslose Messmethode
- Messung bei Tauchpunktunterschreitung und bei hohen Staubbeladungen möglich
- Kontinuierliche Messung von Normalvolumenstrom und Gasgeschwindigleit
- Automatische Nullpunkt und Referenzpunktkontrolle
- Direkter Anschluss für Temperatur- und Druckkorrektur
- Einstellbare Parameter über Tastenfeld oder über PC

- No interference with the medium
- Measurements below the dew-point and with high dust loads possible
- Continuous measurement of standard flow and velocity
- Automatic zero-point and reference-point control
- Inputs for temperature and pressur correction available
- Programmable via the evaluation unit's keys or via PC

CE

Volumenstrommessgerät D-FL 200

Volume Flow Meter

D-FL 200

TÜV CERT DIN ISO 9001 zertifiziert

Solutions for Emission and Combustion

DURAG GROUP

Anwendung

Nach TA Luft sind die Schadstoffemissionen einer Anlage zu überwachen. Zur Ermittlung des Schadstoffmassenstroms ist u.a. die Durchflussmenge des Abgases mit einer Messeinrichtung zu messen. Das DURAG Messsystem D-FL 200 ermittelt die Geschwindigkeit bzw. die Durchflussmenge eines Abgases kontinuierlich. Wählbare Grenzwertüberschreitungen werden sofort gemeldet, wodurch notwendige Eingriffe in der Regelung der Anlage ermöglicht werden, um vorgeschriebene Emissionsgrenzen einzuhalten. Das Messsystem eignet sich insbesondere für Abgasmessungen unter dem Taupunkt und bei aggressiven Medien, da die Sensoren durch die Spülluft vollständig vom Abgas entkoppelt sind.

Messverfahren

Das Messsystem D-FL 200 arbeitet nach dem akustischen Laufzeitdifferenzprinzip. Die beiden verwendeten Ultraschallsensoren arbeiten als Schallsender und als Schallempfänger. Die Messköpfe mit den Sensoren werden so in einen Kamin eingebaut, dass eine vektorielle Komponente der Gasströmung mit der Schallausbreitungsrichtung zusammenfällt. Wechselseitig senden und empfangen die Ultraschallwandler kurze Impulse. Die Gasströmung beeinflusst die Laufzeiten der Schallimpulse derart, dass diese mit der Strömung verkürzt und entgegengesetzt der Strömung verlängert werden. Die beiden mathematischen Gleichungen für diese Laufzeiten beinhalten nur die beiden Unbekannten „Gasgeschwindigkeit" und „Schallgeschwindigkeit". Das Gleichungssystem lässt sich nach diesen beiden Variablen auflösen. Die Geschwindigkeit multipliziert mit dem Querschnitt ergibt die Volumenströmung. Temperatur und Absolutdruck sind nur für die Berechnung des Normvolumenstroms notwendig

Installation

Das Messsystem wird mit einer ausführlichen Beschreibung und Montageanleitung ausgeliefert. Zur Ausrichtung der Einschweißflansche kann eine optische Justiereinrichtung zur Verfügung gestellt werden. Auf Anfrage stehen Ihnen unsere Techniker zur Vor-Ort-Inbetriebnahme und zur Systemschulung zur Verfügung.

Lieferumfang D-FL 200 Standardsystem

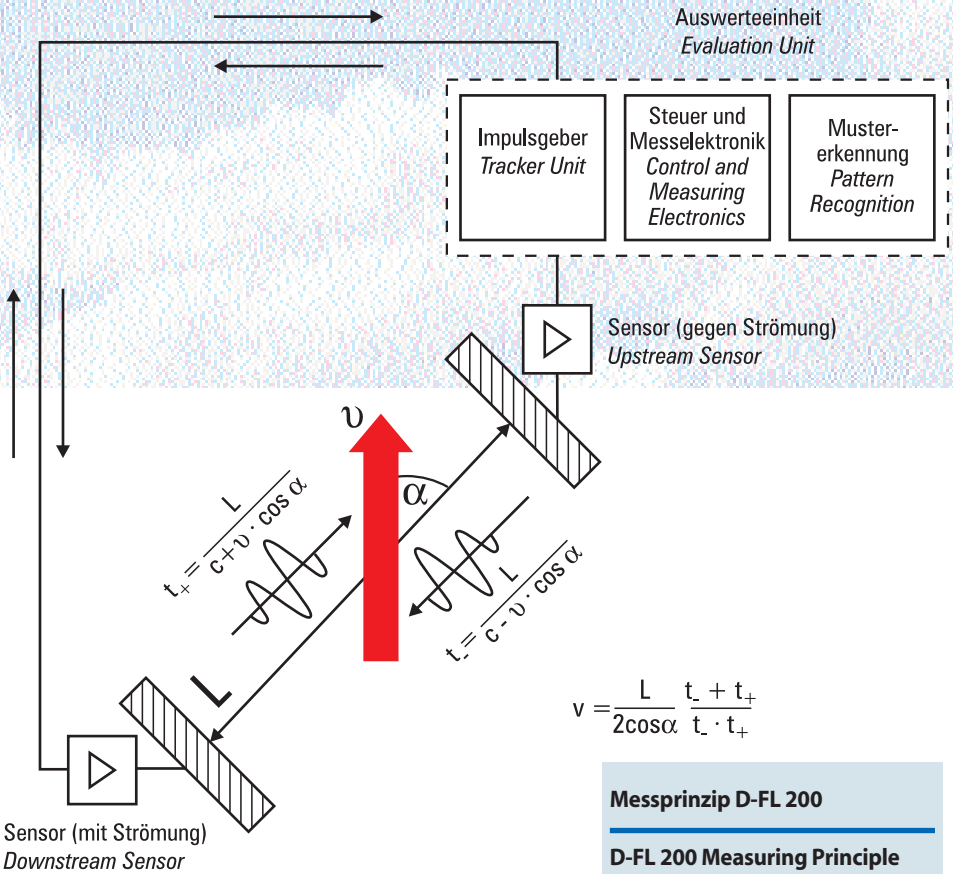
- **2 Montageflansche (Mat. 1.4571)**
- **2 Messköpfe**
- **1 Auswerteeinheit D-FL 200-10 mit Gehäuse IP 65**
- **1 Spülluftseinheit zur Sauberhaltung und Kühlung der Sensoren**

Zubehör optional

- **Relais-Eingangs/Ausgangskarte für Null-/Referenzpunkt**
- **Fieldbuskarte**
- **Temperatur-Messumformer**
- **Absolutdruck Messumformer**
- **Wetterschutzhaube für die Auswerteeinheit**
- **Wetterschutzhauben für die Messköpfe**
- **Wetterschutzhaube für die Gebläseeinrichtung**
  Die Wetterschutzhauben sind nicht erforderlich, wenn die Geräte in geschützten Räumen montiert werden.
- **Spülluftsensor mit potentialfreiem Fehlerkontakt**

Zulassungen

- Eignungsgeprüft nach den Richtlinien des Bundesministers für Umwelt, Naturschutz und Reaktorsicherheit über die Eignungsprüfung von Messeinrichtungen für kontinuierliche Emissionsmessungen.
- Rundschreiben d. BMU vom 11.10.2000 - IG I 3 - 51134/2
- Prüfbericht vom TÜV Nord, Nr. 99 CU 019 vom 12.8.2000



Messprinzip D-FL 200

D-FL 200 Measuring Principle

Application

According to TA-Luft pollutant emissions of industrial plants must be monitored. For mass determination of the pollutants, also the exhaust gas flow must be measured with the help of a measuring device. The DURAG D-FL 200 measuring system continuously determines the flow velocity and the flow rate of the exhaust gas. Prescaleable limit value surpassings are indicated at once, so permitting necessary interventions in the plant control system in order to comply with prescribed emission values.

The measurement system is especially designed for flow monitoring below the dew-point and for aggressive gases. The sensors are completely decoupled from the gas by means of purge air.

Measuring Method

The ultrasonic flowmeter D-FL 200 works on the acoustic pulse differential method. The used ultrasonic transducers can work either in transmit-mode or in receive-mode. The measuring heads with the sensors are mounted on the duct in a way that a vectorial component of the gas-flow coincides with the direction of the sound. The transducers continuously transmit and receive impulses. The gas flow affects on the transit-time. The time upstream is reduced and the time downstream is prolonged. The mathematical description of these two transit-times includes two unknown variables: „gas velocity" and „speed of the ultrasound". These two unknown variables can be resolved out of the system of equations. The resulting velocity can be multiplied by the cross-section of the duct to obtain the volume flow. Temperature and pressure are only needed for the calculation of the standard flow.

Installation

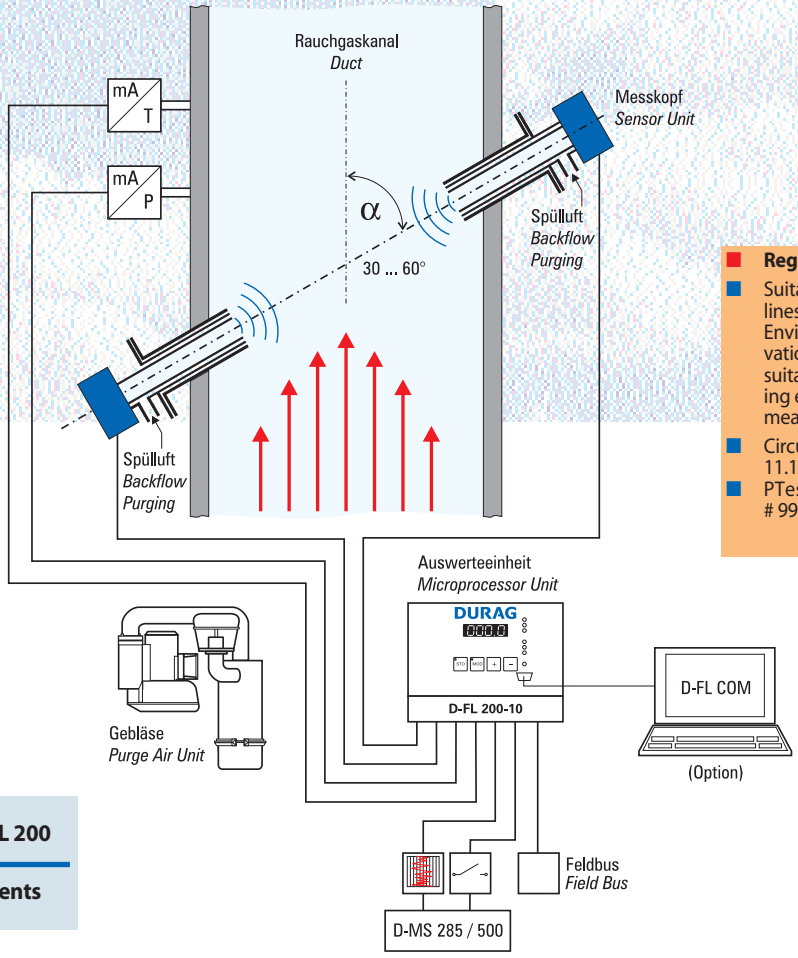
Equipment delivered includes extensive documentation on mounting and installation. For alignment of the welding pipes we offer an optical sighting device. On request, you can hire our technicians for instrument initiation, who, at the same time , can instruct your personnel on the functioning and maintenance of the unit

Scope of delivery of the D-FL 200 Standard System

- **2 mounting flanges (Mat. 1.4571)**
- **2 measuring heads**
- **1 evaluation unit D-FL 200-10 with IP 65 housing**
- **1 purge air fan for keeping the sensors clean and for cooling**

Optional accessories

- **Relais in/output card for zero/reference point**
- **Fieldbus card**
- **Temperature measuring transmitter**
- **Absolute pressure transmitter**
- **Weather protective hood for the evaluation unit**
- **Weather protective hoods for the sensor units**
- **Weather protective hood for the purge air fan**
  The weather protective hoods are not necessary when the instrument is mounted in a protected area.
- **Purge air sensor with potential-free error contact**



Registration

- Suitability tested to the guidelines of the Federal Ministry for Environment, Nature Conservation and Reactor Safety on suitability testing of measuring equipment for continuous measuring of emissions.
- Circular letter of the BMU from 11.10.2000 - IG I 3 - 51134/2
- PTest report by TÜV Nord, # 99 CU 019 vom 12.8.2000

Systemkomponenten D-FL 200

D-FL 200 System Components

DURAG

Technische Daten D-FL 200

Messköpfe

Länge der Messstrecke:	bis 11 m
Einbauwinkel:	30°-60°
Messbereich:	0-5.000.000 m³/h entsprechend 0-40 m/s
Abgastemperatur:	200°C max. 400°C max. (Option)
Schutzart:	IP65
Messkopfanschluss:	15 m 50 m max. (Option)
Gewicht:	15 kg pro Sensor

Auswerteeinheit D-FL 200-10

Netzspannung:	115/230 V, ±10%, 50/60 Hz (Andere Spannungen auf Anfrage)
Leistung:	ca. 50 VA
Garantiefehlergrenze:	±2% vom Messbereichsendwert
Ausgangssignale:	Normalvolumenstrom und Geschwindigkeit 4-20 mA / 500 Ohm
Stromeingänge:	Druck, Temperatur 4-20 mA / 100 Ohm
Statusmeldungen:	Relaiskontakt Grenzwert Relaiskontakt Störung Relaiskontakt Wartung
Integrationszeit des Messwertes:	1-180 s frei einstellbar
Max. Umgebungs-temperaturbereich:	-20..+50°C
Schutzart:	IP65
Maße:	265 x 300 x 240 mm (LxBxH)

Spülluftеinheit

Netzspannung:	230V, ±10%, 50 Hz
Leistungsaufnahme:	0,25 kW
Luftleistung bei 0 mm WS:	ca. 1,4 m³/min
Gewicht:	20 kg

Technical Data of D-FL 200

Measuring Heads

Length of the measuring range:	up to 11 m
Installation angle:	30°-60°
Measuring range:	0-5,000,000 m³/h according 0-40 m/s
Temperature range:	200°C max. 400°C max. (option)
Protection class:	IP65
Electrical connection:	15 m 50 m max. (option)
Weight:	15 kg per sensor

Evaluation Unit D-FL 200-10

Mains voltage:	115/230 V, ±10%, 50/60 Hz (other voltages on request)
Power consumption:	approx. 50 VA
Conventional error limit:	±2% of the measuring range
Output signal:	standard flow and velocity 4-20 mA / 500 Ohms
Current inputs:	pressure, temperature 4-20 mA / 100 Ohms
Status contacts:	relay LIMIT VALUE relay ERROR relay MAINTENANCE
Measuring value integration time:	1-180 s freely adjustable
Max possible ambient temperature range:	-20..+50°C
Protection class:	IP65
Measurements:	265 x 300 x 240 mm (LxWxH)

Purge Air Fan

Mains voltage:	230 V, ±10%, 50 Hz
Power consumption:	0.25 kW
Air output at 0 mm WH:	approx. 1.4 m³/min
Weight:	20 kg

Solutions for Emission and Combustion

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www.durag.de 02/2002 - All specifications subject to change without notice

D-FL 200

VEREWA

- C-14 Methode, keine messbare Abnahme der Aktivität
- Niedrigste Radioaktivität aller Beta-Messgeräte, einsetzbar ohne Anzeigepflicht
- Automatische Nullpunktkorrektur
- Vorkalibriert, keine Beeinflussung durch Partikelgröße und -farbe oder Wassertropfen
- Probengasfluss geregelt bei 1 - 3 m³/h
- Wahlweise Verdünnungssonde für hohe Konzentrationen oder nach Nasswäschern
- Wiederholtes Sammeln auf demselben Fleck, gesammelte Partikel verfügbar für Schwermetallanalytik
- Eignungsprüfung gemäß TA-Luft, 13. und 17. BImSchV.

- Safe, stable C-14 source, no measurable decay of activity
- Emits lowest amount of radioactivity of all beta gauges, usable in most countries without license
- Automatic zero correction
- Pre-calibrated, unaffected by particle size, color or moisture
- Venturi controlled sample flow rate @ 1 - 3 m³/h
- Optional dilution sample probe available for high concentrations or after wet scrubbers
- User selectable re-sampling on same spot, collected particulates available for heavy metal analysis
- German equivalency test for all burners incl. waste incinerators

CE

TÜV CERT DIN ISO 9001 zertifiziert

Extraktives Emissions Beta-Staubmeter F-904

Extractives Beta Gauge Particulate Monitor

F-904

Solutions for Emission and Combustion

DURAG GROUP

Messprinzip

Das Messprinzip des Emissions-Staubmessgerätes F-904 basiert auf der Absorption der von einer radioaktiven Quelle emittierten Betastrahlen (Elektronen) durch Partikel, die aus einem Abgasstrom gesammelt wurden. In Abhängigkeit ihrer Energie werden die emittierten Elektronen von jedem Material (Feststoff, Flüssigkeit, Gas) absorbiert. Die Absorptionskonstante (Effektivität der Absorption) beruht daher sowohl auf der Energie (in MeV) der emittierten Elektronen als auch auf der chemischen Zusammensetzung des absorbierenden Materials. Vereinfacht dargestellt kann man sagen: je niedriger die Energie der Elektronen, desto geringer die Substanzabhängigkeit der Absorption.

Im VEREWA F-904 werden ein oder zwei C-14 Flächenstrahler eingesetzt (die korrekte Schreibweise ist ^{14}C). Die Verwendung dieses Isotops bringt einige bedeutende Vorteile gegenüber dem Einsatz anderer in der Analytik gebräuchlicher Isotope: die sehr hohe Halbwertzeit von 5.730 Jahren, die geringe Energie der emittierten Elektronen von lediglich 0,156 MeV sowie der Zerfall in ein nichtradioaktives Element. Beim Einsatz einer C-14 Quelle ist die Beta-Absorptions-Messung des Staubgehalts nahezu unabhängig von der chemischen Zusammensetzung der Staubpartikel.

Mehr Einzelheiten über die Theorie der C-14 Strahlung und der –Absorption sind in dem Applikationsblatt mit dem Titel „Theorie der Beta Absorptionstechnik" enthalten.

Im Gegensatz zu optischen Staubmessgeräten (insbesondere Streulicht-Photometern) ist die Messung mit dem F-904 unabhängig von Partikelgröße, -farbe und spezifischem Gewicht. Das VEREWA F–904 ist ebenfalls speziell für den Einsatz nach Nasswäschern konzipiert und zeigt bei herabgesetztem Taupunkt des Messgases durch Verdünnung und durch Beheizung keine Querempfindlichkeiten gegenüber Wassertropfen oder Nebel im Probengas. Wegen der Korngrößenunabhängigkeit ist eine ortsspezifische Kalibrierung im Umfang wie bei optischen Staubmessgeräten nicht erforderlich. Das F-904 wird daher bereits im Werk vorkalibriert. Es kann auch ortsveränderlich eingesetzt werden, bzw. muss bei Änderung wesentlicher Betriebsparameter nicht neu kalibriert werden.

Messverfahren im F-904

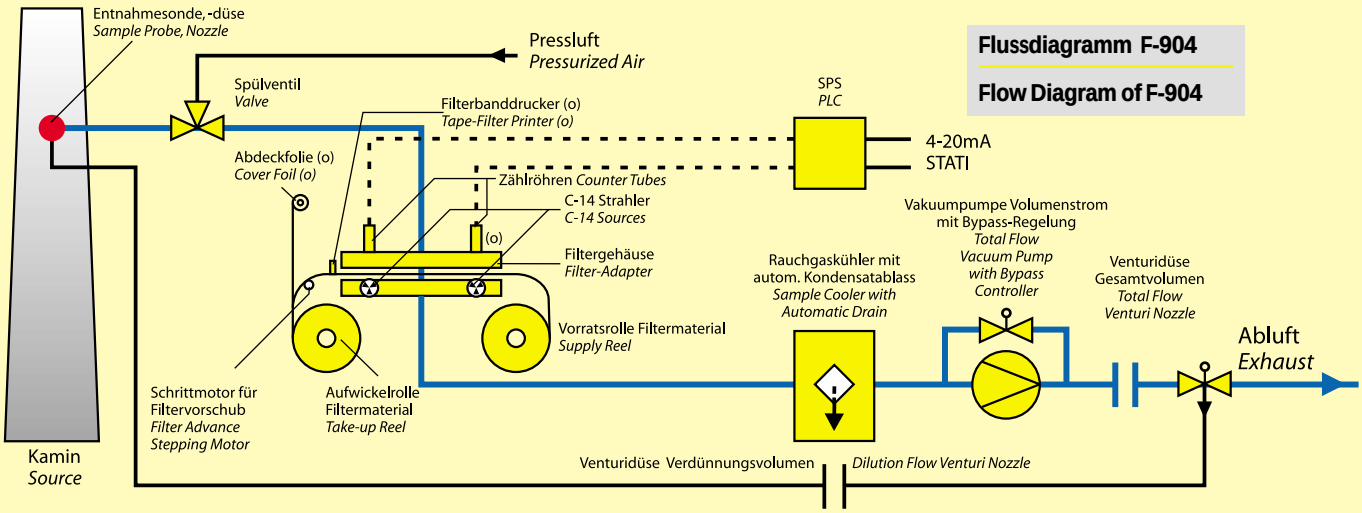
Im F-904 wird vor jedem Sammelzyklus die Impulsrate I_0 des unbeladenen Filterbandes gemessen (dies entspricht einer automatischen Nullpunktkorrektur), dann wird exakt auf diesem Filterflecken während einer vorher festgelegten Zeit Staub gesammelt und dann schließlich die Impulsrate I_1 des beladenen Filterbandes mit der Quellen/Zählrohr-Kombination gemessen. Die Differenz der beiden Impulsraten ist direkt proportional dem Massenzuwachs durch die Staubpartikel, die auf dem Filterband an dieser Stelle gesammelt wurden. Bei Einsatz eines zweiten Quellen/Zählrohr-Paares wird erreicht, dass das F 904 DD nahezu kontinuierlich Staub aus dem Probengas sammelt.

Aufbau des F-904

Bei der Entwicklung und dem Aufbau des Staub-Emissions-Gerätes VEREWA F-904 wurde besonderer Wert auf einfache Bedienbarkeit, Messgenauigkeit, geringen Wartungsbedarf und lange Gebrauchsdauer gelegt. Das F-904 findet gleichermaßen seinen Einsatz zur Staubmessung nach Verbrennungsprozessen aller Art, in Müllverbrennungsanlagen und in den verschiedensten Anwendungen der Prozessmesstechnik, sowohl in trockenen wie in nassen Rauchgasen.

Das Komplettgerät besteht aus der Probensonde (Material 1.4571 oder Titan), mit Niedervolt-Widerstandsheizung, mit oder ohne Verdünnung. An die Sonde schließt sich die beheizte Probenleitung aus 1.4571 an, die das beheizte Probengas zum Analysator und auf das Filterband führt, das gasdicht im beheizten Filterbandhalter liegt. C-14 Strahler und Detektoren (Geiger-Müller Endfenster-Zählrohre) sind außerhalb des Gasstroms links und rechts vom Probengasanschluss am Filterhalter befestigt. Dadurch findet keine Beeinflussung der Partikel im Gasstrom statt und es ist gewährleistet, dass sich die Staubpartikel gleichmäßig und eben auf dem Filterband abscheiden. Nach dem Filterhalter durchläuft das Probengas den Probengaskühler, in dem auf +4°C gekühlt und das Kondensat abgezogen wird. Dadurch wird das Messsignal in „Rauchgas trocken" angegeben. Durch die Pumpe und den Venturi-Durchflussregler wird der Gasstrom zum Geräteausgang geführt. Eventuell wird ein Teil des trockenen, staubfreien Probengases zur Verdünnung in die Probengassonde zurückgeführt. Elektronisch wird das gesamte Gerät von einer SPS gesteuert, die ebenfalls die Berechnung des Konzentrationssignals aus den Messsignalen (Differenz beider Impulsraten sowie des trockenen Gasvolumens) durchführt.

Auf der Hauptfrontplatte des Messgerätes befinden sich alle Bauteile , die eine regelmäßige Wartung benötigen (150 m Filterbandrollen). Darunter sind zwei kleinere Frontplatten montiert, die sämtliche elektrischen und elektronischen Komponenten, Schalter und Displays enthalten. Pumpe, Transformator für Sonden- und Probenleitungsheizung sowie Probengaskühler befinden sich am Boden des Gesamtschrankes.



Principle of Operation

The F-904 Extractive Beta Gauge Particulate Monitor determines particulate concentration by measuring the amount of radiation a sample absorbs when exposed to a radioactive source. In general, the more energy absorbed, the greater the particulate concentration. Depending on their energy, the emitted electrons will be absorbed by any material (solid, liquid, gas) within their reach. The absorption constant (efficiency of the absorption) therefore is based on both the energy (in MeV) of the emitted electrons and the chemical composition of the absorbing material. Simplified the correlation is, the lower the energy of the electrons, the lesser the absorption's dependence on the chemical composition of the absorbing material.

The F-904 incorporates a three step procedure to ensure accurate and reproducible particulate measurements. At the start of each measurement cycle, the F-904 measures the amount of radiation absorbed by an unloaded filter tape. This is in essence an automatic zero correction. Once this „zero reading" is taken, a sample is drawn through the filter tape at a controlled flow rate and any particulates in the gas stream deposited on the filter tape. After a pre-selected sample collection period, the F-904 again measures the amount of radiation absorbed by the loaded filter tape. The difference between the original zero reading and the final reading is directly proportional to the additional mass (i.e., dust particulates) collected on the tape.

The F-904 utilizes one or two flattop C-14* sources with a half life of 5.730 years. This particular isotope offers several advantages over other b-emitting isotopes in that its emitted electrons are very low energy (0.156 MeV) and decay into a nonradioactive chemical. In addition, beta absorption using a C-14 source is virtually independent of the chemical composition, size or color of the collected particulates and shows no interference from water droplets or fogging in the stack. As a result, there is no need for a site-specific reference calibration.

For more information on C-14 radiation and -absorption, refer to our Application Sheet entitled „Theory of Beta Absorption Technology".

* The actual name of this source is 14C. C-14 is used to simplify reading.

Design of the F-904

Long Life, Low Maintenance, Accurate Results.

VEREWA's Model F-904 Extractive Beta Gauge Particulate Monitor is designed to provide accurate particulate measurements in a wide variety of process and emission monitoring applications.

The instrument consists of five main modules:

Sample Probe - Sample enters the F-904 through either a stainless steel or titanium sample probe. These probes are suitable for either direct or diluted sample extraction and are heated.

Sample Collection/Measurement Assembly - Once the sample passes through the sample probe, it enters a heated sample line (stainless steel) and is directed onto a filter tape held in a heated, gas-tight holder. The C-14 sources and Geiger-Muller-Counter-Tube detectors are mounted on the holder outside of the gas stream to ensure even sample deposition on the filter tape. An optional Cover Foil is used to fix and secure the deposited particulates on the tape.

Sample Gas Cooler - Once the gas passes through the filter tape, it is routed to a downstream cooler to extract water (and thus allows reporting of dust concentration on a dry basis).

Pump/Flow Controller - A carbon vane rotary pump and flow controller (located downstream of the sample gas cooler) pull the sample stream through the sample probe, collection assembly and cooler at a flow rate of 1 - 3 cubic meters per hour.

On-Board Computer - All instrument functions are controlled by a powerful PLC, which also calculates the particulate concentration value from the gas volume and zero/final radiation absorption differential.

The F-904's major components are housed in a sturdy cabinet and are easy accessible for periodic inspection and maintenance.

Zulassungen

- **Eignungsprüfungsbericht Nr. 3.5.2/209/88-338529 RWTÜV**
- **BMU-Zulassung RdSch. v. 1.6.1990 IGI2**
- **Bauartzulassung: HH 1/98**
- **PTB Prüfschein Nr. 6.22-R202**
- **UBA Forschungsbericht: 91-10402171**

Registration

- **Test Report No. 3.5.2/209/88-338529 RWTÜV**
- **BMU-Approval RdSch. v.1.6.1990 IGI2**
- **Design Certificate: HH 1/98**
- **PTB Certificate No. 6.22-R202**
- **UBA Research Report: 91-10402171**

Anwendungsbereiche

Typische Applikationen des F-904 Emissions-Staubmessgerätes sind:

- Kohle- oder schwerölgefeuerte Kraftwerke
- Müllverbrennungsanlagen (Kommunal-, Industrie- und Sondermüll)
- Klärschlammverbrennung
- Emissions-Staubmessung nach Nasswäschern oder in sehr nassen Abgasen
- Messen und Sammeln von Staubpartikeln zur Schwermetallanalytik
- Messen sehr niedriger Staubkonzentrationen in Emissionen
- Emissions-Staubmessung in Schornsteinen mit geringem Durchmesser
- Staub-Konzentrations-Messungen in Prozessapplikationen
- Ortsveränderlicher Einsatz der portablen Geräteversion

Typical Applications

Typical applications of the F-904 Extractive Beta Gauge Particulate Monitor include:

- Coal and oil fired power plants
- Waste incinerators (urban, industrial and hazardous waste)
- Waste water sludge incinerators
- Dust monitoring after wet scrubbers
- Heavy metal analysis
- Small diameter stack monitoring
- Particulate monitoring in process applications (bag houses, etc.)
- Transportable version for mobile applications

Technische Daten F-904

Messbereiche	zwischen 0-1 und 0-2000 g/Nm³, wählbar
Geprüfte Messbereiche	0-5 bis 0-225 mg/Nm³
Nachweisgrenze	<0,3 mg/Nm³
Fehlergrenze	<±5% vom Messbereich
Zeitliche Änderung des Nullpunktes	autom. Nullpunktkorrektur
Zeitliche Änderung der Empfindlichkeit	<1% vom Messbereich / Woche
Verfügbarkeit	>95%
Einlaufzeit	30 min
Einstellzeit	2 min
Energieversorgung	230 V /50 Hz, 110V/60 Hz +10/-15 %, 5 kVA
Druckluftanschluss	6 bar, Instrumentenluftanschluss
Zul. Umgebungstemp.	0°C bis +50°C
Messwertausgang, Signale	4-20 mA (galvanisch getrennt), Statussignale (potentialfrei)
Strahler	1 oder 2 Kohlenstoff-14-Flächenstrahler
Halbwertzeit	5.730 Jahre
Gesamtradioaktivität	<12,5 µCi /Strahler
Detektor	1 oder 2 Geiger-Müller-Endfensterzählrohre
Filtermaterial	Glasfaser-Filter 99,95 % >0,3 µm, 150 m, 43 mm Vorschub
Filteradapter	25 - 80°C, thermostatisiert (Filterkonditionierung) , einstellbar
Teilvolumenstrom	max. 3 m³/h, einstellbar
Verdünnungsverhältnis	1:1 bis 1:9
Messzyklus	einstellbar, min. 5 Minuten
V/R Betrieb	max. 8 x (15 min Zykluszeit = 2 h Mittelwert)
Abmessungen (H x B x T)	2050 x 800 x 800 mm
Gewicht	ca. 250 kg
Gehäuse	Stahlblechschrank mit Fronttür
Schutzart	IP 55
Farbe	RAL 7032
Probenahmesystem	nach VDI 2066, Düsen-Ø 5-12 mm Entnahmesonde beheizt, isokinetische Probenahme, Verdünnungssystem, Rückspüleinrichtung, automatisches Absperrsystem, Werkstoff 1.4571 bzw. Titan
Pumpe	Rotationsvakuumpumpe, 3 m³/h, 60% Vakuum mit Gasvolumenregelung
Probengaskühler	Regeltemperatur +4°C, automatische Kondensatabsaugung

Specifications of F-904

Ranges	selectable between 0-1 and 0-2000 mg/Nm³
Certified Ranges	0-5 bis 0-225 mg/Nm³
Lower Detectable Limit	<0.3 mg/Nm³
Total Error	<±5% F.S.
Zero Drift	automatic zero control
Span Drift	<1% F.S. / Week
MTBF	>95 % availability
Startup Time	30 min
Power Supply	230 V /50 Hz, 110V/60 Hz +10/-15 %, 5 kVA
Pressurized Air	6 bar, Instrument Air
Temperature Range	0°C to +50°C(32 to 122°F)
Signal Output	4-20 mA, Status Signals
Source	1 or 2 C-14-Flat Top Sources
Half Lifetime	5.730 years
Total Activity	<12,5 µCi /source
Detector	1 or 2 Geiger-Müller-Counter-Tubes
Filter Material	Glass-Fiber-Filter 99.95% >0.3 µm, 150 m, 43 mm (1.7“) advance
Filter Adaptor	25 - 80°C (77 to 140°F), temperature controlled (pre-conditioning of tape) user adjustable
Sample Flow Rate	max. 3 m³/h, user adjustable
Dilution Ratio	1:1 to 1:9
Cycle Time	user selectable, min. 5 minutes
V/R Operation (Forward/Backward)	max. 8 cycles (2 h average @ 15 min. cycle time)
Dimensions (H x W x D)	2050 x 800 x 800 mm (81 x 31 x 31“)
Weight	250 kg (550 lbs.)
Cabinet	Steel Cabinet with Front Door
Protection	IP 55 (NEMA-type)
Color	RAL 7032 (grey)
Sampling System	acc. VDI 2066, nozzle-Ø 5-12 mm (0.2-0.5“), probe heated, isokinetic sampling, dilution, backflush, shut-off, material 1.4571 (SS) or titanium
Pump	Vacuum Rotary Pump, 3 m³/h, 60% vacuum, w/ flow control
Sample gas cooler	Temperature +4°C (39°F), automatic condensate drain

Solutions for Emission and Combustion

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F-904

LDS 6
In-situ Laser Gas Analyzer

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2	Application
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5	Function
7	Integration
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8	Technical specifications
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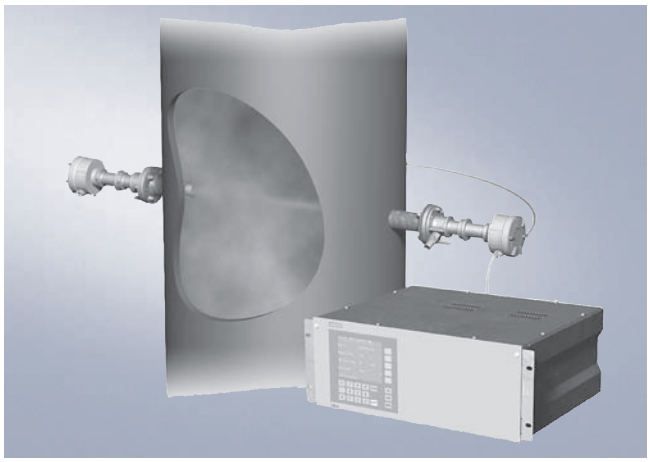
24	**Conditions of sale and delivery Export regulations**
24	**Contact addresses**

General

Overview

LDS 6 is a diode laser based gas sensor with a measuring principle based on the specific light absorption of different gas components. LDS 6 is suitable for fast and non-intrusive measurements of gas concentrations or temperatures in process or flue gases. One or two signals of up to three measuring points are processed simultaneously with one central analyser unit. The cross duct in-situ sensors at each measuring point can be separated up to 1 kilometer from the central unit by using fiber optic cables. The sensors are designed for operation under harsh environmental conditions and contain a minimum of electrical components. By connecting a bypass stream to a separate flow cell measurements can also be carried out extractively instead of in-situ.



LDS 6, typical installation with cross duct sensors

Benefits

The in-situ gas analyzer LDS 6 is characterized by a high operational availability, unique analytic selectivity and by a broad scope of suitable applications. LDS 6 enables the measurement of one or two gas components or - if desired - the gas temperature directly in the process

- At the presence of up to 100 vol.% steam
- At high levels of dust load (up to 100 g/Nm^3)
- In hot, corrosive, explosive, or toxic gases
- In applications showing strong varying gas compositions
- Under harsh environmental conditions at the measuring point
- Highly selective, i.e. mostly without cross interferences.

LDS 6 allows:

- Little installation efforts
- Minimum maintenance requirements
- High ruggedness and long-term stability
- Real-time measurements.

Moreover, the instrument provides warning and failure messages at:

- Need for maintenance
- Erroneous self calibration
- Bad signal quality
- Exceeding a lower or upper alarm level for the measurement variable
- Transmission exceeding upper or lower limit.

Application

Application areas

- Process optimisation
- Continuous emission monitoring for all kinds of fuels (oil, gas, coal, and others)
- Process measurements in power utilities and any kind of incinerator
- Process control
- Explosion protection
- Measurements in corrosive and toxic gases
- Quality control
- Environmental protection
- Plant and job safety.

Branches

- Power plants
- Waste incinerators
- Cement industry
- Chemical and petrochemical plants
- Automotive industry
- Glass and Ceramics production
- Research and development.

Special applications

- In addition to the standard combinations special applications are available upon request.

General

Design

LDS 6 consists of a central unit, accomplished by up to three pairs of cross duct sensors in a transmitter/ receiver configuration. The connection between the central unit and the sensors is established by a so-called hybrid cable, which contains optical fibers and copper wires. An additional loop cable connects both sensor parts.

Central unit

The central unit is housed in a 19"-rack with 4 holders for assembly

- in a swing gate
- in racks with or without telescope rails.

Display and control panel

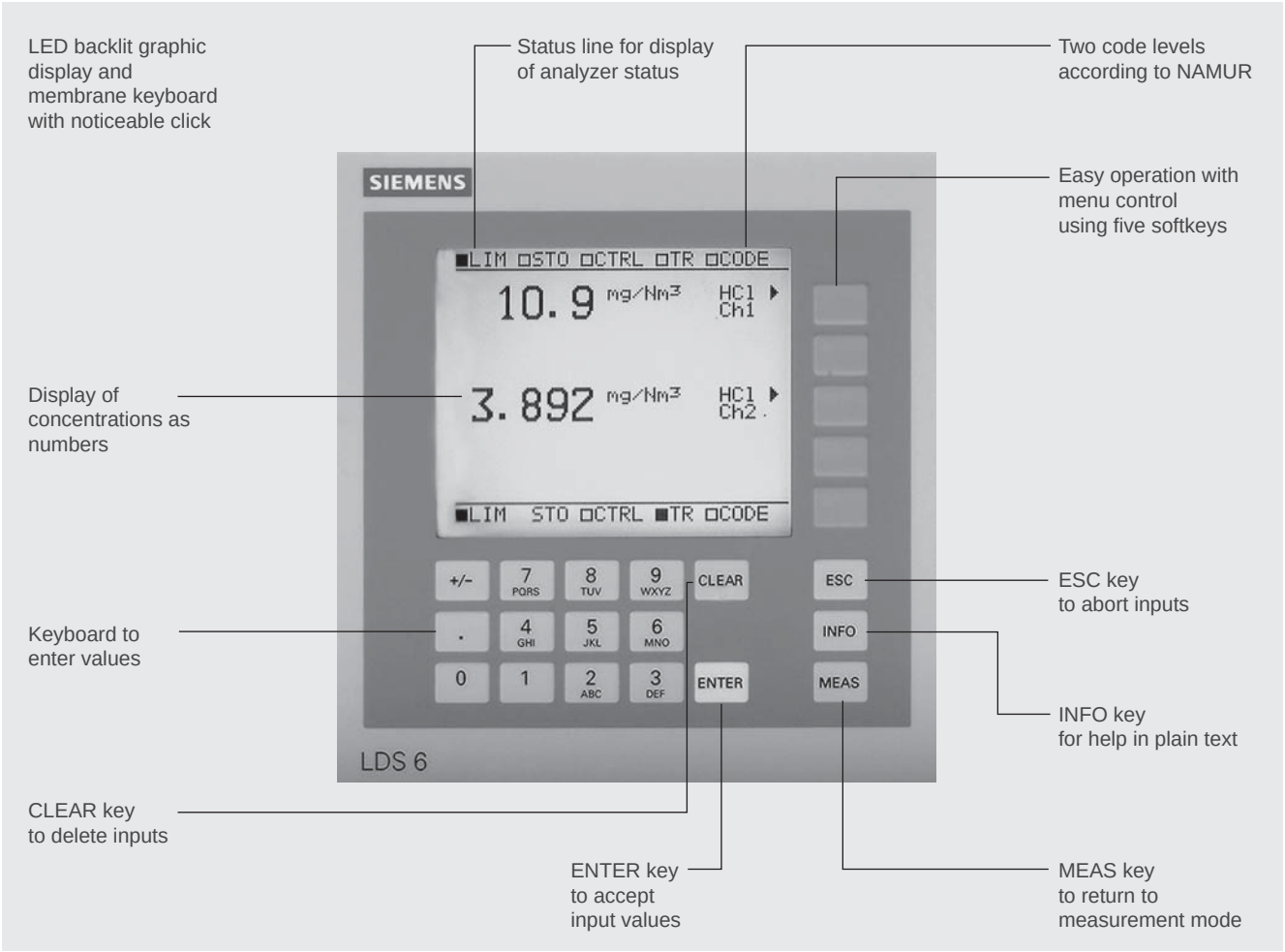
- Large LCD field for simultaneous display of measurement result and device status
- Contrast of the LCD field is adjustable via the menu
- LED illumination of the display
- Cleanable foil touch pad with soft-keys
- Menu-controlled operation for parameterization and diagnoses
- Operation help given in plain text.

Input and output connections

- One to three measurement channels with hybrid-connections for the sensors at the measuring points
- Per channel 2 analog inputs for process gas temperature and pressure
- Per channel 2 analog outputs for gas concentration(s) or gas temperature and concentration, respectively
- Per channel 6 freely configurable binary inputs for signalling of fault or maintenance request from external temperature or pressure transducers or purging failure.
- Per channel 6 freely configurable binary outputs (signalling of fault, maintenance request, function control, transmission limit alarm, concentration limit alarm, store analog output).

Communication

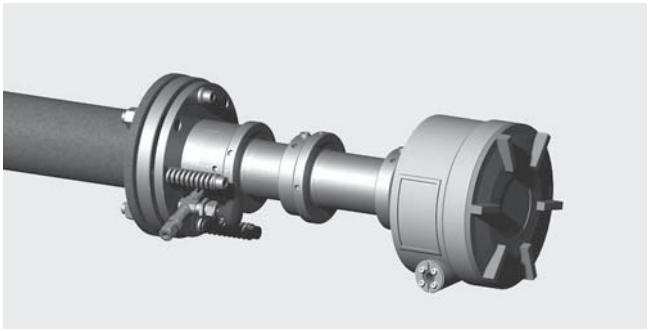
Network connection: Ethernet (T-Base-10) for remote diagnosis and maintenance.



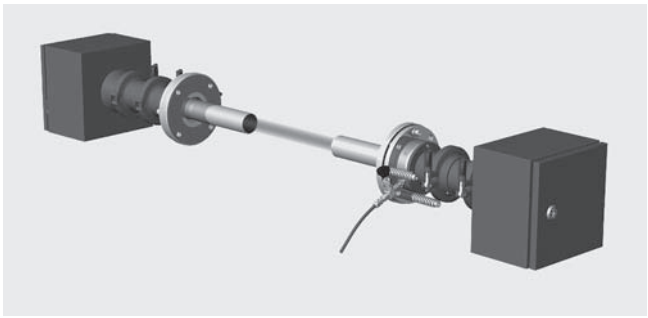
LDS 6 central unit, membrane keyboard and graphic display

General

Transmission sensors



Sensor CD 6 of the LDS 6 (non-EEx), transmitter or receiver unit



Sensor pair CD 3002 of the LDS 6 (EEx), transmitter and receiver unit

- In-situ cross duct sensors, configured as transmitter and receiver unit, connected via loop cable
- Sensor pair CD 6 for non-EEx environments, sensor pair CD 3002 for EEx environments
- Stainless steel, partially painted
- Protection class IP67 (non-EEx) sensor and IP65 (EEx)
- Adjustable window flanges with flange connection DN65/PN6, optional: ANSI 4“/150 lbs
- Purging facilities on the process and the sensor side, configurable application with purging gas connections for:
  - Instrument air
  - Air blower fan
  - Steam
  - Nitrogen
  - Any other suitable purging media
- Fast connectors for cleaning the measurement openings and the sensor window
- Optional Ex-protected version according to ATEX II 1GD EEx ia IIC T4.

Parts in contact with the process gases

The sensors normally do not come into contact with the process gas, since purging is applied at the process side. The material used for the tubes defining the purge volume in front of the sensor windows is selected according to the process conditions. Available tube materials are stainless steel (standard), Hastelloy, plastics (PP) and ceramics.

Hybrid- and loop cable

Combination of fiber optic cables and twisted copper wires to connect the sensors to the central unit. The hybrid cable connects the central unit with the transmitter unit of the sensor, the loop cable connects the transmitter and the receiver unit of the sensor.

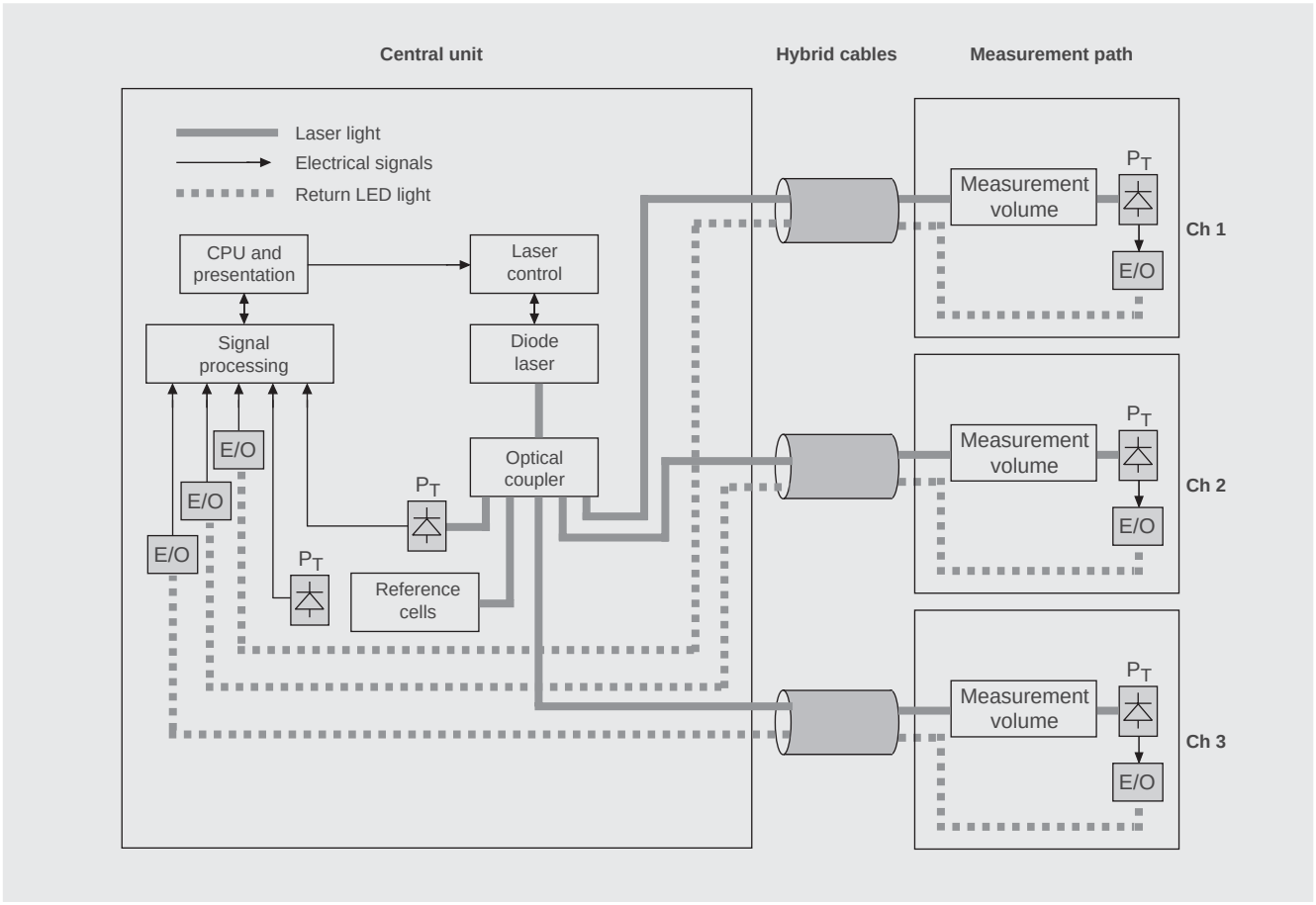
- Max. 1000 m distance between central unit and measuring point
- Hybrid and loop cable:
  - Multimode fiber-optic cable, provided with SMA connections for transmission of the measurement signal
  - Two-core copper cable, in twisted pair configuration, for +24 V supply of the receiver electronics
- Additionally for the hybrid cable:
  - Monomode fiber optic cable, configured double-sided with angle-polished E2000 connectors for the transmission of laser light
- Robust cable coating for mounting in open cable ducts or ductworks
- Oil-resistant polyurethane as jacket material.

Connections of the hybrid cable

Function

Working principle

LDS 6 is a gas analyzer employing single-line molecular absorption spectroscopy. A diode laser emits a beam of near-infrared light, which is sent through the process gas and detected by a receiver unit. The wavelength of the laser diode output is tuned to a gas specific absorption line. The laser is scanning continuously over this single absorption line with very high spectral resolution. The result is a fully resolved single molecular line which is analysed in terms of absorption strengths and line shape. The measurement is free of cross-interferences, since the quasi-monochromatic laser light is absorbed very selectively by only one specific molecular line in the scanned spectral range.

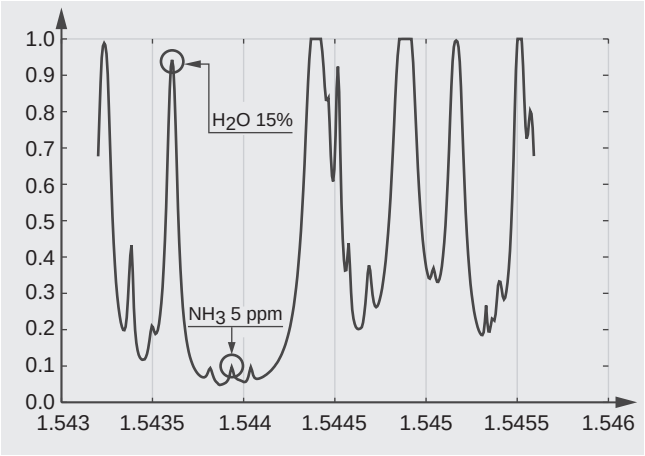


Basic design of the LDS 6

General

LDS 6 is connected to a measuring point by fiber optics. The laser light is guided by a single mode fibre from the central unit to the transmitter unit of the in-situ sensor. The sensor consists of a transmitter and a receiver; their distance defines the measurement path. In the receiver box, the light is focused onto a suitable detector. The detector signal is then transferred into an optical signal and is transmitted via a second optical fibre to the central unit, where the concentration of the gas component is determined from the detected absorption signal.

LDS 6 measures normally a single gas component. In some specific cases two components can be measured simultaneously, if their absorption lines are so close to each other that they can be detected within one laser scan (for example like water(H_2O) and ammonia (NH_3) in the spectrum shown.



Absorption spectra of water and ammonia

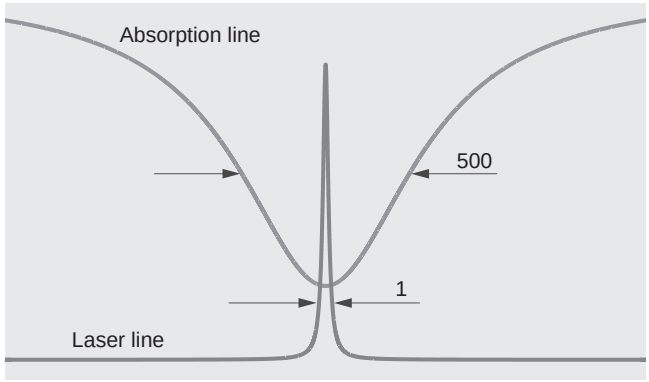
Moreover, in some applications it is possible to determine the gas temperature as a measurement value. In this case, the ratio of the absorbance of two characteristic lines of the same molecule measured at the same time in the same volume gives the actual temperature in the process gas.

Typical measurable gases for LDS 6 are:

- Oxygen / O2
- Hydro fluorine / HF
- Hydro chlorine / HCl
- Ammonia / NH_3
- Water vapour / H_2O
- Carbon monoxide / CO
- Carbon dioxide / CO_2.

By using an internal reference cell normally filled with the gas measured, the stability of the spectrometer is permanently checked in a reference channel.

By doing so, the continuous calibration of the instrument is guaranteed without the need of carrying out external re-calibrations by bottled test gases or reference cuvettes.



Typical spectral width of an absorption line compared to the width of the laser emission

Influences on the measurement

- **Dust load**: As long as the laser beam is able to give a suitable detector signal, the dust load of the process gases does not influence the analytical result. By applying a dynamic background correction, measurements can be carried out without any negative impact. Typical particle densities from below 1 mg/Nm^3 to 100 g/Nm^3 can be handled by the LDS 6. The varying dust loads are compensated by scanning the laser over the gas absorption line and the inherent background. At a scan position next to the absorption line, the instrument can "see" only absorption caused by the dust load where at the line center the signal is composed of the molecular absorption and the continuous, unspecific background absorption. While using a wavelength modulation technique, the actual measured transmission is always compared with the baseline. In the signal processing, a lock-in detection scheme delivers a signal only from the molecular line free of background.
  Dust load and path length are competing: the higher the dust load in the process, the shorter the max. path length possible.
- **Temperature**: The temperature influence on the absorption line strength is compensated by a correction factor determined during calibration. A temperature signal can be fed into the instrument from an external temperature sensor. The signal is then used for a mathematical correction of the influence of the temperature on the observed line strength.
  At high temperatures where thermal radiation of the gas and the dust is present or flames can occur in the measurement path, the detector is shielded with an optical band pass filter in front in order not to saturate it with the strong background radiation.
- **Pressure**: The gas pressure can affect the line shape of the molecular absorption line. LDS 6 uses a curve fitting algorithm to adapt to the resulting line shape. Additionally, an external pressure signal can be fed to the instrument to give a complete mathematical compensation for the pressure influence incl. the density effect.
- **Cross interferences**: Since LDS 6 derives its signal from a single fully resolved molecular absorption, cross interferences with other gases are quite unlikely. LDS 6 is therefore able to measure the desired gas components very selectively. In special cases, the composition of the process gas might have an influence on the shape of the absorption line features. This influence is compensated by analysing the full shape of the detected signal curve by customized algorithms.

- **Optical path length**: The absorption values analyzed by the LDS 6 are typically small. As a result of Lampert-Beer's law, the signal strength of the absorption lines can be approximated as being linear dependent on the optical path length within the gas. Therefore, the precision in determine the effective optical path length in the process might limit the overall precision of the measurement.
  As the sensor openings towards the process normally need to be purged to keep them clean over a long period of time, the thickness of the mixing zone between the purging media and the process gas and its concentration distribution need to be considered. In a typical cross duct installation with some meters of path, the influence of the purging gas on the effective path length can be neglected.
  Path length and load are competing: the higher the dust load in the process, the shorter the max. path length possible.

Maintenance and failure alarms

LDS 6 delivers warnings by relays:

- Need for maintenance (measurement value is not influenced)
- Operational fault (measurement value can be influenced).

Note

Individual requirements for the measuring point can make the utilization of special sensor equipment necessary. The possibilities for adapting the sensors are:

- Different purging media available like instrument air, ambient air, nitrogen or steam
- Different purging modes on process and sensor side
- Special materials of purging tubes and/or the sensor flanges
- Cooling or heating of the sensors
- EEx-proof sensor configurations

Essential characteristics

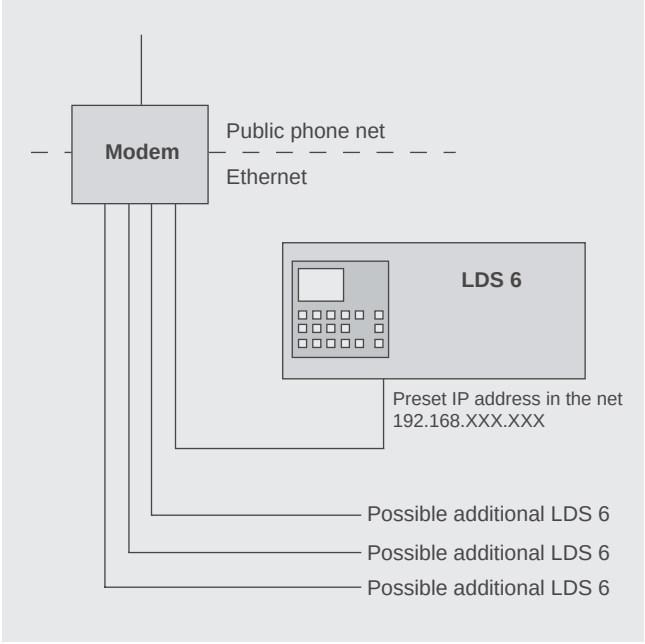
- Integrated self-calibration with an internal reference cell
- Negligible long-term drifts of zero and span
- Dynamic background correction for varying dust loads
- Galvanically isolated signal outputs of 4-20 mA (also inverted)
- Easy-to-handle with menu-driven operation
- Selectable time constants (response time)
- Two user levels with individual access codes for prevention of unwanted and unauthorised operations
- Operation conformity with NAMUR recommendations
- Monitoring of overall optical transmission
- Remote preventive maintenance, and service operations accessible via Ethernet
- Straightforward replacement of the central units, since connectors can easily be removed
- Deterioration- and corrosion-free sensor and central unit housing
- Easy operation with a numerical keypad and menu prompt
- Modular design, allows exchange of components in the field.

Integration

Communication

LDS 6 is capable to transmit and receive data via Ethernet connection by using the software LDScom. This installation and service tool is capable to check and adjust remotely instrument status and calibration parameters. If desired, almost a full system check can be done remotely. In case of service, information can be addressed via modem to Siemens service personnel, who take care of appropriate measures remotely.

This remote control capability is established by using a standard LAN modem.



External connection of LDS 6 via modem to establish remote maintenance capabilities

19" central unit

Technical specifications

Analytical performance	
Measuring range	internally adjustable
Minimum detection limits (20 °C, 1000 hPa, 1 m path length)	gas-depending: HF: 0.05 ppm HCl: 0.2 ppm NH_3: 0.3 ppm H_2O: 1 ppm
in combination with HF, HCl, NH_3	1000 ppm O_2: 200 ppm CO: 200 ppm CO_2: 200 ppm
Smallest recommended measuring range (20 °C, 1000 hPa, 1 m path length)	gas-depending: HF: 0 ... 2 ppm HCl: 0 ... 10 ppm NH_3: 0 ... 10 ppm H_2O: 0 ... 50 ppm
in combination with HF, HCl, NH_3	0 ... 5 Vol% O_2: 0 ... 1 Vol% CO: 0 ... 1 Vol% CO_2: 0 ... 1 Vol%
Largest recommended measuring range (20°C, 1 bar, 1 m path length or smaller)	gas-depending: HF: 0 ... 10 Vol% HCl: 0 ... 25 Vol% NH_3: 0 ... 100 Vol% H_2O: 0 ... 100 Vol%
in combination with HF, HCl, NH_3	0 ... 30 Vol% O_2: 0 ... 100 Vol% CO: 0 ... 100 Vol% CO_2: 0 ... 100 Vol%

The max. ranges possible with an analyser might be dependent on the measurement conditions and its individual configuration. In case, a required range is larger than 200 times the smallest range given above, please, contact Siemens to discuss your application.

General	
Concentration units	ppm, Vol%, mg/Nm^3 (EU/US)
Display	Digital concentration display (5 digits with floating decimal point)
Mounting orientation	Front plate vertical
Laser protection class	Class 1, safe to the eye
Laser power	varies with application
Certificates	CE mark, ATEX
Linearity	better than 1%
Accuracy	better than 2% of reading above the minimum detection limit
Configuration, housing	
Protection class	IP20 according to EN 60529
Dimensions	177x440x380 mm
Weight	approx 13 kg
Electrical properties	
Power supply	100 bis 240 VAC 50-60 Hz, automatically adjusted to the system
Power consumption	50 W
EMC-compatibility	According to EN 61326 and standard classification of NAMUR NE21
Electrical safety	According to EN 61010-1, overvoltage classification II
Fuse specifications	100 ... 240 V: 2.5T/250

Time parameters	
Warm-up temperature at 20 °C ambient	approx 15 min
Delay of display (T_{90})	< 1 s
Electrical time constant	0.3 (adjustable), typically 1 ... 3 s
Dead time	< 1 s
Response time	better than 3 s, application dependent
Electrical damping	1 bis100 s, selectable
Measurement behaviour	
Output signal fluctuation	2% of measurement value
Precision	< 2% ... < 5% of measurement value, application dependent
Zero point drift	negligible
Drift of measurement value	negligible
Deviation of linearity	< 1% of measurement value
Parameters of influence	
Ambient temperature	< 1%/10 K of measurement value
Ambient pressure	< 1%/50 hPa
Measurement gas pressure	< 2% change of reading upon change in pressure of 50 hPa
Power supply	< 1% at change of output signal range of ± 10%
Tilting	< 1% for non-horizontal mounting of the sensors below 15°
Electrical in- and outputs	
Number of measurement channels	1 ... 3, optional
Analog output	2, 4 ... 20 mA, potential-free, ohmic resistance max. 750 Ω
Analog inputs	2, designed for 4 ... 20 mA
Binary outputs	6, with changeover contacts, configurable, AC/DC 24 V/1 A, potential-free
Binary inputs	6, designed for 24 V, potential-free, configurable
Communication Interface	Ethernet 10BaseT (RJ-45)
Ambient conditions	
Temperature range	+5 ... +45 °C during operation, -40 ... +70 °C during transportation and storage
Humidity	< 85% RH, above dew-point
Ambient pressure	700 ... 1200 hPa

Ordering data

Order No. 7MB6021-0 ■■ 00-0 ■■

In-situ LDS 6 gas analyzer
19“ unit for installation in cabinets

Measured component	Application channel 1	
O_2 [1])	CEM	AA
	Combustion control	AB
	Safety-relevant areas	AC
	Process control	AD
O_2/temp [1])	Combustion control	BB
NH_3	CEM	CA
	SNCR-DeNOx	CE
	SCR-DeNOx	CF
	SCR-DeNOx / Automotive	CG
NH_3/H_2O	CEM	DA
	SNCR-DeNOx	DE
	SCR-DeNOx	DF
	SCR-DeNOx / Automotive	DG
HCl	CEM	EA
	Filter optimization	EH
	Trace gas detection (VCM, ...)	EJ
HCl/H_2O	CEM	FA
	Filter optimization	FH
HF [1])	CEM	GA
	Filter optimization	GH
HF/H_2O [1])	CEM	HA
	Filter optimization	HH
CO [1])	Combustion control	JB
	Safety-relevant areas	JC
	Process control (steel, ...)	JD
see channel 1 for the allowed combination	Application channel 2	
	CEM	A
	Combustion control	B
	Safety-relevant areas	C
	Process control (defined process)	D
	SNCR-DeNOx	E
	SCR-DeNOx	F
	SCR-DeNOx / Automotive	G
	Filter optimization	H
	Trace gas detection	J
	Channel 2 not equipped	X
see channel 1 for the allowed combination	Application channel 3 [1])	
	CEM	A
	Combustion control	B
	Safety-relevant areas	C
	Process control (defined process)	D
	SNCR-DeNOx	E
	SCR-DeNOx	F
	SCR-DeNOx / Automotive	G
	Filter optimization	H
	Trace gas detection	J
	Channel 3 not equipped	X
Language (supplied documentation, software)		
German		0
English		1
French		2
Spanish		3
Italian		4

1) To be released soon.

19" central unit

Further versions	Order code
Please add „-**Z**“ to Order No. and specify Order code	
Telescopic rails (2 off)	**A31**
Set of Torx tools, socket spanner	**A32**
Communication software (LDS6Com)	**K01**
LAN modem incl. cable	**K10**
D-sub to standard terminal connection, 15 pins (converter)	**K20**
D-sub to standard terminal connection, 25 pins (converter)	**K21**
Cable, D-sub 15 pins (1,5 m pin to pin)	**K22**
Cable, D-sub 25 pins (1,5 m pin to pin)	**K23**
TAG labels (customer-defined inscriptions)	**Y30**
FAT	**Y40**

				Standard application	Typical values	Resolution	Typical values	Resolution
Gas 1	**Gas 2**	**Code**	**Code**	**Comment**	**for range gas 1**	**Gas 1**	**for range gas 2**	**Gas 2**
O_2 [1])		A	A	CEM	0 ... 21 Vol%	0.1 Vol%	n.a.	n.a.
NH_3		C		flue gas, high accuracy	0 ... 25 ppm	0.3 ppm	n.a.	n.a.
NH_3	H_2O	D			0 ... 25 ppm	0.3 ppm	0 ... 30 Vol%	0.1 Vol%
HCl		E			0 ... 10 ppm	0.2 ppm	n.a.	n.a.
HCl	H_2O	F			0 ... 10 ppm	0.2 ppm	0 ... 30 Vol%	0.1 Vol%
HF [1])		G			0 ... 5 ppm	0.1 ppm	n.a.	n.a.
HF [1])	H_2O	H			0 ... 5 ppm	0.1 ppm	0 ... 30 Vol%	0.1 Vol%
O_2 [1])		A	B	Combustion control	0 ... 21 Vol%	0.1 Vol%	n.a.	n.a.
O_2 [1])	Temp.	B		high temperature calibration	0 ... 21 Vol%	0.1 Vol%	650°C ... 1200°C	± 30 K
CO [1])		J			0 ... 5 Vol%	0.1 Vol%	n.a.	n.a.
O_2 [1])		A	C	Safety relevant areas	0 ... 10 Vol%	0.1 Vol%	n.a.	n.a.
CO [1])		J		short response time	0 ... 10 Vol%	0.1 Vol%	n.a.	n.a.
O_2 [1])		A	D	Process control	0 ... 21 Vol%	0.1 Vol%	n.a.	n.a.
CO [1])		J		customized algorithm	0 ... 60 Vol%	0.1 Vol%	n.a.	n.a.
NH_3		C	E	SNCR-DeNOx	0 ... 50 ppm	1 ppm	n.a.	n.a.
NH_3	H_2O	D		high dynamics (e.g. municipal waste incinerator)	0 ... 50 ppm	1 ppm	0 ... 30 Vol%	0.1 Vol%
NH_3		C	F	SCR-DeNOx	0 ... 10 ppm	0.3 ppm	n.a.	n.a.
NH_3	H_2O	D		power plants, highest accuracy	0 ... 10 ppm	0.3 ppm	0 ... 30 Vol%	0.1 Vol%
NH_3		C	G	SCR-DeNOx / Automotive	0 ... 100 ppm	1 ... 2 ppm	n.a.	n.a.
NH_3	H_2O	D		engine lab	0 ... 100 ppm	1 ... 2 ppm	0 ... 30 Vol%	0.1 Vol%
HCl		E	H	Filter optimization	0 ... 2000 ppm at 1 m	2 ppm	n.a.	n.a.
HCl	H_2O	F		high dynamics (e.g. municipal waste incinerator)	0 ... 2000 ppm at 1 m	0.2 ppm	0 ... 30 Vol%	0.1 Vol%
HF [1])		G			0 ... 2000 ppm at 1 m	2 ppm	n.a.	n.a.
HF [1])	H_2O	H			0 ... 2000 ppm at 1 m	2 ppm	0 ... 30 Vol%	0.1 Vol%

Standard combination reference table

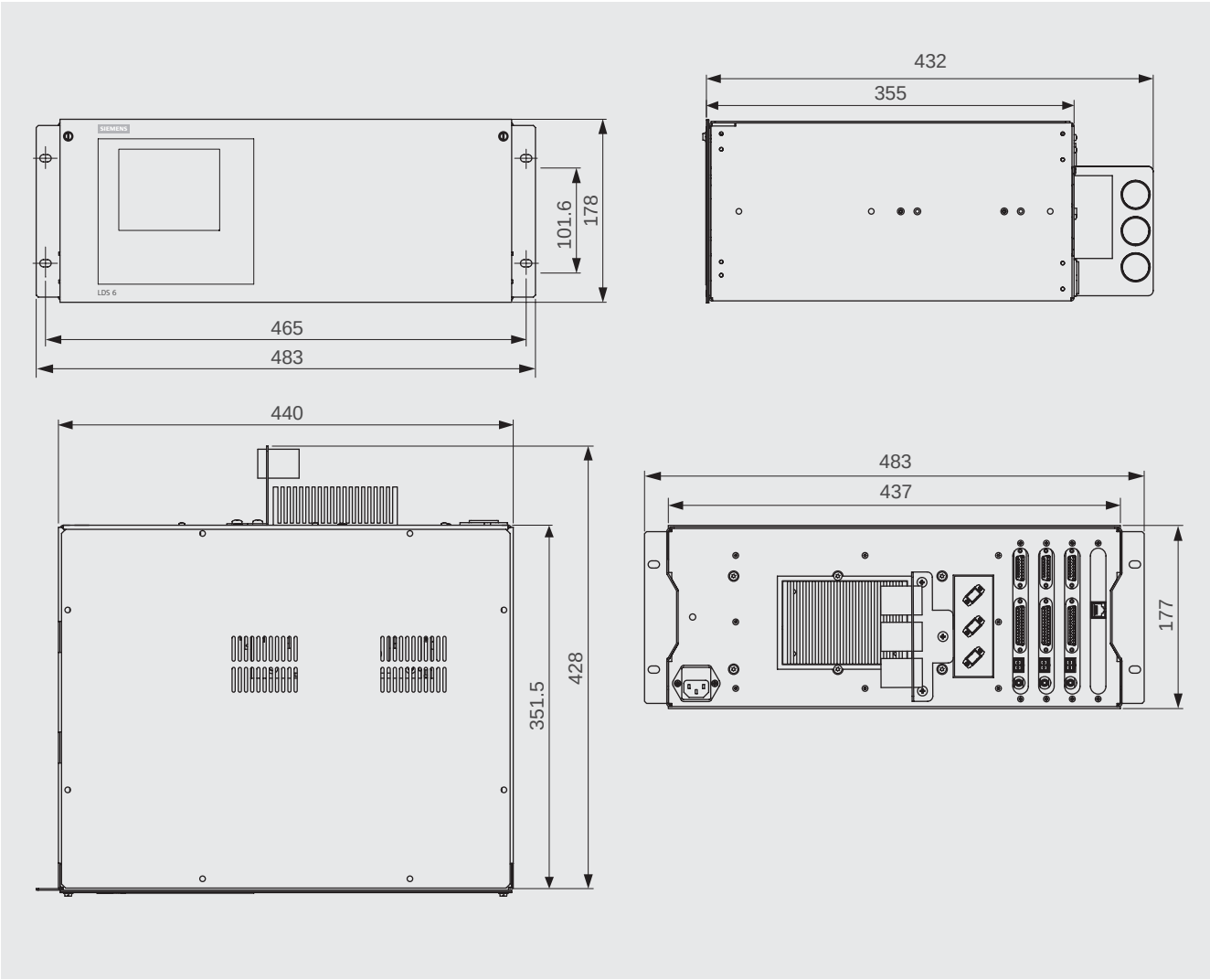
1) To be released soon.

				Typical values for		Typical values for		Typical	Purging mode		Purging media
Gas 1	**Gas 2**	**Code**	**Code**	**Temperature**	**Pressure**	**Path length**	**Dust load**	**integr. time**	**Default**	**Optional**	
O_2		A	A	< 150 °C	1000 hPa	1 ... 6 m	< 100 mg/Nm^3	30 s	D	B	N_2
NH_3		C		< 150 °C	1000 hPa	1 ... 6 m	< 100 mg/Nm^3	30 s	C	G	air
NH_3	H_2O	D		< 150 °C	1000 hPa	1 ... 6 m	< 100 mg/Nm^3	30 s	C	G	air
HCl		E		< 150 °C	1000 hPa	1 ... 6 m	< 100 mg/Nm^3	30 s	C	G	air
HCl	H_2O	F		< 150 °C	1000 hPa	1 ... 6 m	< 100 mg/Nm^3	30 s	C	G	air
HF		G		< 150 °C	1000 hPa	1 ... 6 m	< 100 mg/Nm^3	30 s	C	G	air
HF	H_2O	H		< 150 °C	1000 hPa	1 ... 6 m	< 100 mg/Nm^3	30 s	C	G	air
O_2		A	B	600 ... 1200 °C	1000 hPa	2 ... 6 m	< 20 g/Nm^3	10 s	E , F	G, H	steam + air, N_2
O_2	Temp.	B		600 ... 1200 °C	1000 hPa	2 ... 6 m	< 20 g/Nm^3	10 s	F	H	steam + N_2
CO		J		< 600 °C	1000 hPa	1 ... 6 m	< 20 g/Nm^3	10 s	E	G	air
O_2		A	C	< 150 °C	1000 hPa	1 ... 6 m	< 100 mg/Nm^3	2 s	D	B	N_2
CO		J		< 150 °C	1000 hPa	1 ... 4 m	< 20 g/Nm^3	2 s	E	G	air or N_2
O_2		A	D	< 150 °C	1000 hPa	1 ... 6 m	< 100 mg/Nm^3	10 s	D	B	N_2
CO		J		< 600 °C	1000 hPa	1 ... 4 m	< 20 g/Nm^3	2 s	E	G	air or N_2
NH_3		C	E	250 ... 350 °C	1000 hPa	2 ... 6 m	< 20 g/Nm^3	30 s	E	G	air
NH_3	H_2O	D		250 ... 350 °C	1000 hPa	2 ... 6 m	< 20 g/Nm^3	30 s	E	G	air
NH_3		C	F	300 ... 400 °C	1000 hPa	4 ... 8 m	< 20 g/Nm^3	30 s	E	G	air
NH_3	H_2O	D		300 ... 400 °C	1000 hPa	4 ... 8 m	< 20 g/Nm^3	30 s	E	G	air
NH_3		C	G	20 ... 650 °C	1000 hPa	1 m	< 2 g/Nm^3	2 s	C	A	air
NH_3	H_2O	D		20 ... 650 °C	1000 hPa	1 m	< 2 g/Nm^3	2 s	C	A	air
HCl		E	H	150 ... 250 °C	1000 hPa	1 ... 6 m	< 20 g/Nm^3	10 s	E	G	air
HCl	H_2O	F		150 ... 250 °C	1000 hPa	1 ... 6 m	< 20 g/Nm^3	10 s	E	G	air
HF		G		150 ... 250 °C	1000 hPa	1 ... 6 m	< 20 g/Nm^3	10 s	E	G	air
HF	H_2O	H		150 ... 250 °C	1000 hPa	1 ... 2 m	< 20 g/Nm^3	10 s	E	G	air

Standard combination reference table (continued)

19" central unit

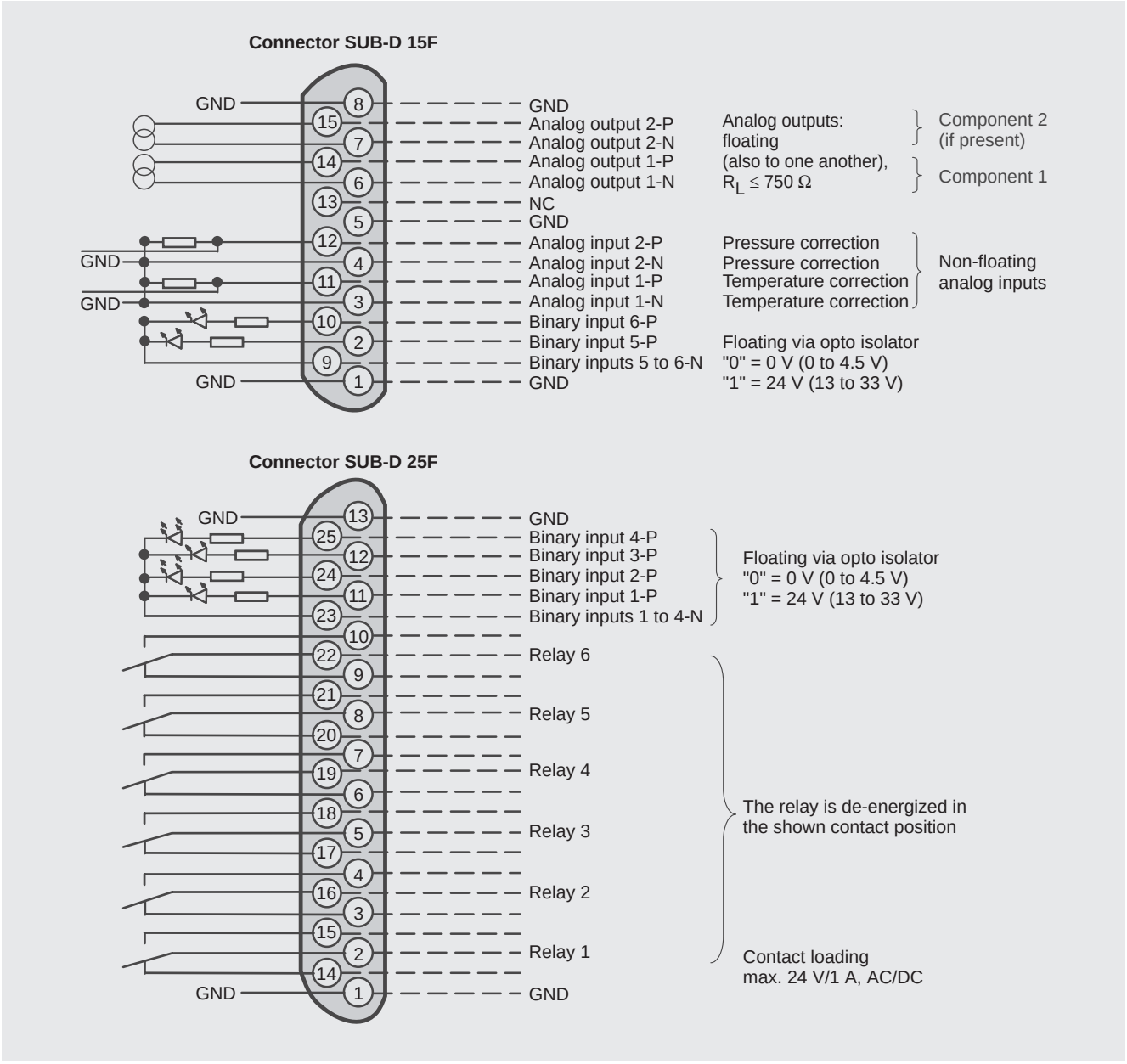
Dimensional drawings



LDS 6, 19“ central unit, dimensions in mm

Schematics

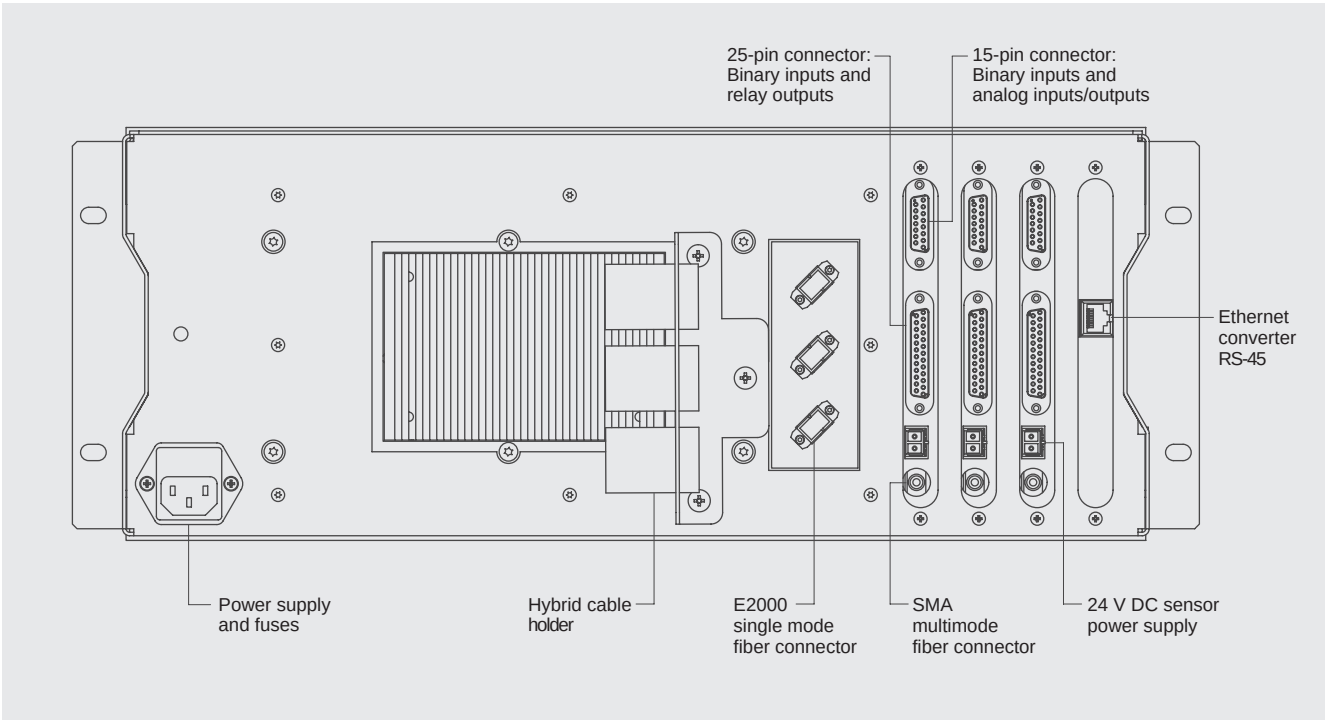
Pin assignment



LDS 6, 19“ central unit, pin assignment

19" central unit

Optical and electrical connections

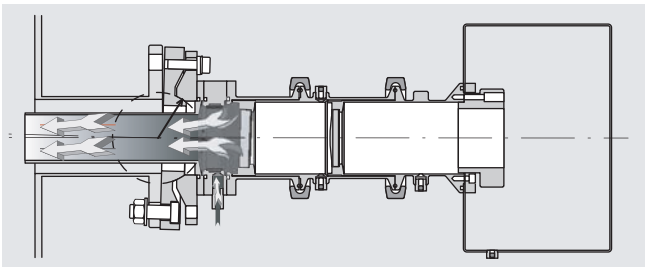


LDS 6, 19“ central unit, optical and electrical connections

Overview

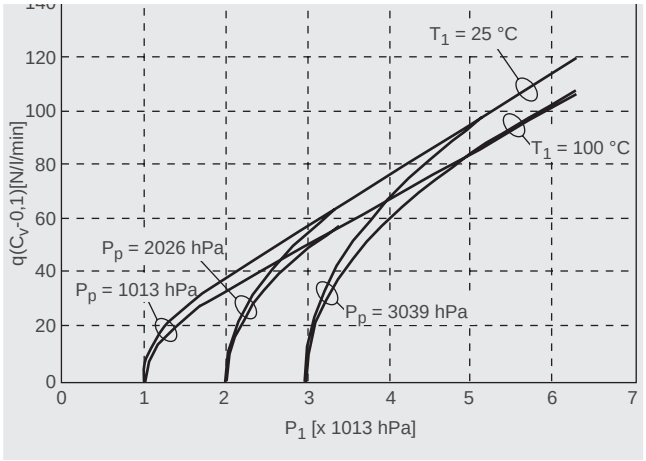
Sensors and cables for non-Ex applications

The standard sensor head consists of a transmitter and a receiver unit, which share the same mechanical dimensions. The transmitter unit provides a connector for the fiber optical cable. The receiver unit contains a photo detector and some basic electronic parts. The sensors are mounted onto flanges. Purging tubes that directly aim into the process stream are flushed with a purging media. The easiest possibility to avoid condensations on the optical surfaces and to keep them free of dust is the purging with instrument air or N_2, if inert purging is required. This standard purging method is suitable for low and medium dust loads in the process.



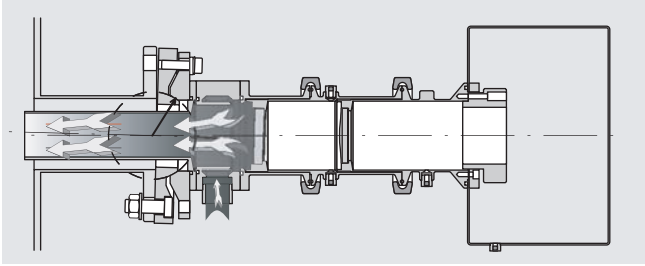
Purging of the mounting flange with instrument air

The following diagram can be used to derive the purging air flow as a function of the upstream pressure (P_1). There are two parameters in the diagram, i.e. the process pressure (P_p) and the temperature of the purge gas which is assumed to be air. The diagram shows the flow through a standard sensor head configured with a needle valve for non elevate purging flows.
In the case of elevated flows (without the needle valve) the resulting purge gas will be approx. 4 times higher.



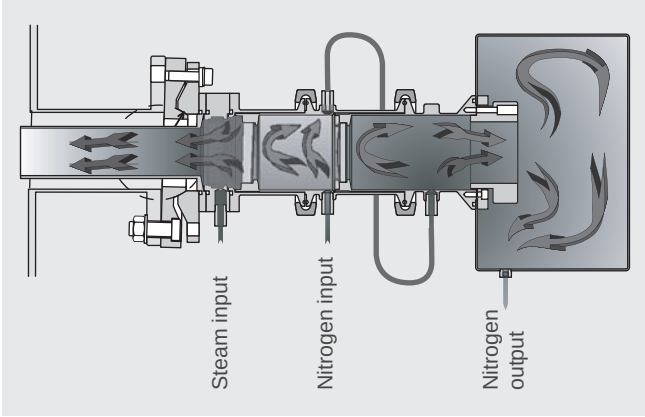
Purge air flow rate

For heavy dust loads in the process stream, the purging can be performed with forced air by an air blower. In this configuration, the sintered air inlet filter is replaced by a ring slit.



Mounting flange with forced-air purging

For the analyses of oxygen at low gas temperatures (< 600 °C) all ambient air has to be removed from of the measuring path. For this purpose, an inert gas like nitrogen or steam is used for purging on the process side in combination with a suitable inert gas purging of the sensor housing and wedge window module.



Purging example of an oxygen analyzer

The sensor can be removed easily from the flange for cleaning. Removing and re-mounting of the sensor does not require re-alignment.

The sensors are also available in an intrinsically safe EEx-version (EEx ia).

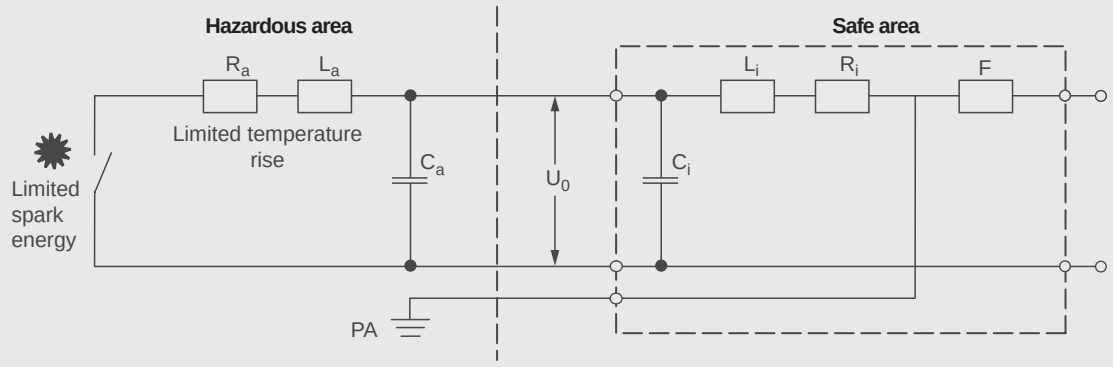
Sensors and cables

Sensors and cables for Ex applications

Intrinsic safety and intrinsically-safe circuit

Principles

The physical principle for the type of protection "Intrinsic safety" is that a certain minimum ignition energy is required to ignite an explosive atmosphere. In an intrinsically safe circuit, this minimum ignition energy is not present in the hazardous area, neither during normal operation nor in the event of a fault. The intrinsic safety of a circuit is achieved by limiting the current, voltage, power and temperature. Therefore the type of protection "Intrinsic safety" is limited to circuits with relatively small powers. To prevent sparks during closing or opening, the capacitance and inductance of an intrinsically-safe circuit are also limited depending on the maximum current and voltage values. No sparks or thermal effects which could lead to ignition of an explosive atmosphere occur either in normal operation or in the event of a fault. Therefore intrinsically-safe circuits may also be connected or disconnected during operation when live since the safety is also guaranteed in the event of a short-circuit or interruption. The following figure shows the block diagram of the type of protection "Intrinsic safety".



U_0	Max. output voltage	PA	Equipotential bonding
R_i	Internal resistance	R_a	External resistance
L_i	Internal inductance	L_a	External inductance
C_i	Internal capacitance	C_a	External capacitance
F	Fuse		

Block diagram for voltage/current limiting with type of protection "Intrinsic safety"

Intrinsically-safe electrical equipment and intrinsically-safe components of associated equipment are divided into categories ("Protection level"). A differentiation is made between the protection levels "ia" and "ib", where protection level "ib" also provides protection should one protective measure fail (fault redundancy 1) and protective level "ia" also provides protection should two protective measures fail (fault redundancy 2). The standard refers to so-called "countable faults" instead of protective measures. These refer to protective measures such as current limiting resistors, Zener diodes for voltage limiting, fuses, safe distances etc., i.e. all components or measures which handle an exactly defined safety function for the associated equipment.

Protection level	Description according to EN 50020	Installation
ia	The intrinsically-safe electrical equipment must not cause an ignition • During normal operation or with the existence of those non-countable faults which result in the most unfavorable condition. • During normal operation or with the existence of a countable fault plus those non-countable faults which result in the most unfavorable condition. • During normal operation or with the existence of two countable faults plus those non-countable faults which result in the most unfavorable condition.	Up to zone 0
ib	The intrinsically-safe electrical equipment must not cause an ignition • During normal operation or with the existence of those non-countable faults which result in the most unfavorable condition. • During normal operation or with the existence of a countable fault plus those non-countable faults which result in the most unfavorable condition.	Zone 2 Zone 1

Protection levels of electrical equipment and intrinsically-safe components

Minimum ignition curves

The so-called minimum ignition curves are used to assess an intrinsically-safe circuit and to determine the maximum capacitance and inductance values. They are included in the valid intrinsically-safe standards (EN 50020 or DIN EN 50020, and IEC 60079-11 or EN 60079-11). Minimum ignition curves exist for the resistive, capacitive and inductive circuits. Different minimum ignition curves are applied depending on the gas group for which an intrinsically-safe circuit is to be designed and take into account the minimum ignition energies of the gas groups.

Associated electrical equipment

Associated electrical equipment is a reference to equipment which contains one or more intrinsically-safe circuits but in which not all circuits are intrinsically-safe Associated electrical equipment usually has an isolating function, i.e. separating intrinsically-safe equipment from non-intrinsically-safe equipment within a signal circuit. Such devices include e.g.: safety barriers, isolating switching amplifiers, power supply units etc.

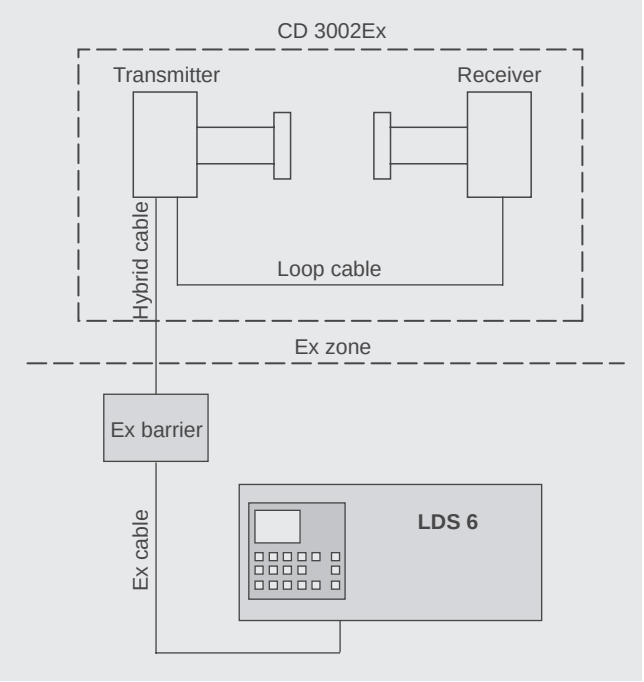
Associated electrical equipment is not explosion-proof and must therefore not be installed in the hazardous area. It only contains intrinsically-safe circuits which may be routed into the hazardous area. Associated electrical equipment is identified by a square bracket enclosing the "EEx" and the symbol for the type of protection, as well as absence of the temperature class, e.g. [EEx ia] IIC.

Cables

DIN / EN 60 079-14 (VDE 165, Part 1) must be observed when selecting and routing the cables. Particular attention must be paid to the characteristic values such as electric strength and minimum cross-section. In the case of intrinsically-safe circuits, the cable capacitance and inductance must be observed in addition, and must not exceed the values specified for the intrinsically-safe or associated equipment used (Co, Lo). The connection points and cables of intrinsically-safe circuits must be identified, e.g. in light blue, and be separated from the other connection points and cables of non-intrinsically-safe circuits.

Typical LDS 6 system set-up in explosion endangered zones

LDS 6 is capable to measure gases in EEx environment, provided that special care is taken about safety concerns. The central unit of LDS 6 always has to be located out of hazardous areas. Special EEx -type sensors (s. explosion protection tag), certified according to Ex II 1GD EEx ia IIC T4, allow the operation inside almost any EEx classified area. In between the connection of sensors and central unit an EEx barrier has to be applied. A typical sensor setup is given in the following figure.



Typical setup of LDS 6 in an explosion endangered area

Sensors and cables

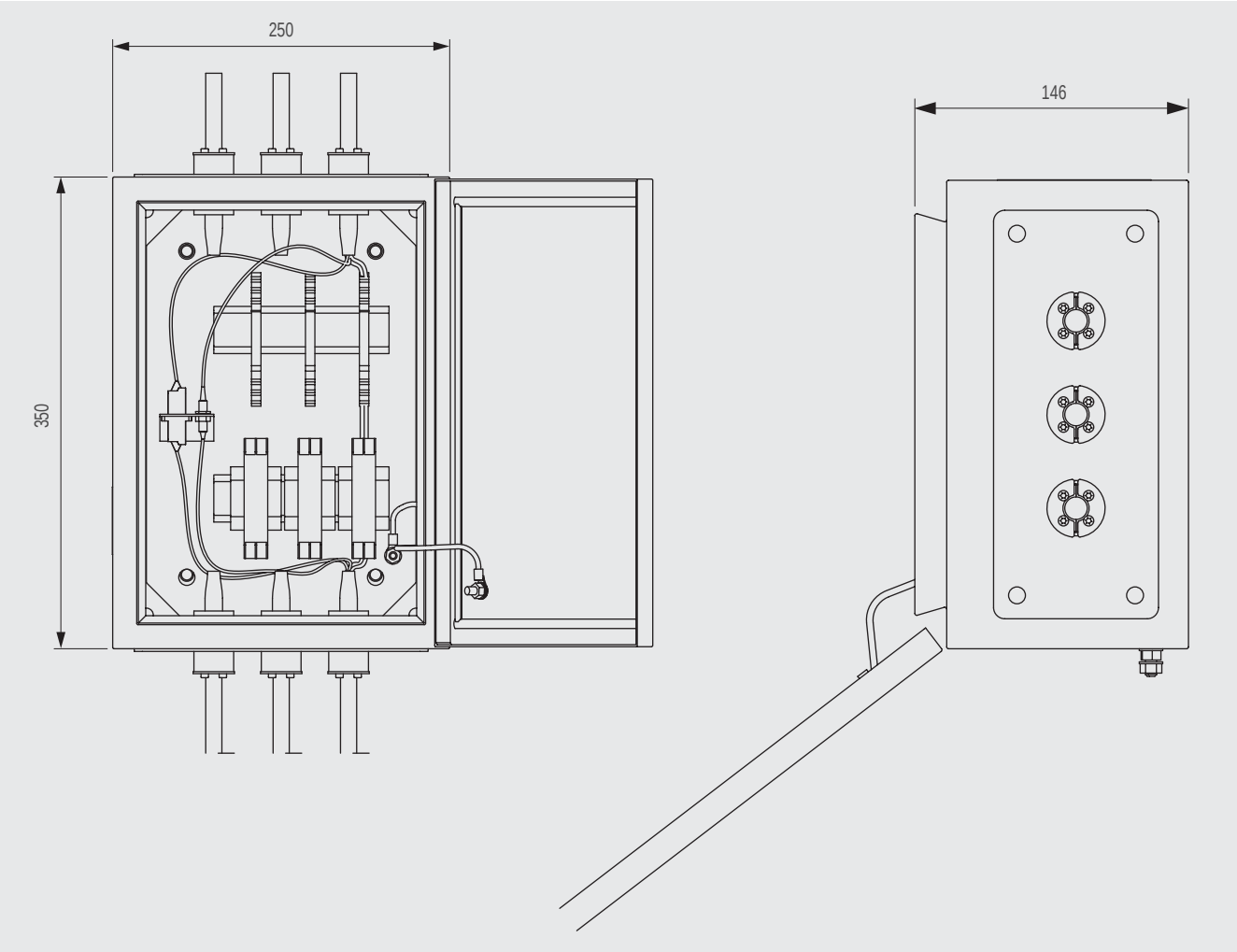
EEx barrier

The EEx barrier is part of the delivery of the EEx sensor CD 3002 Ex. It is meant for wall mounting close to the location of the LDS 6 central unit within an EEx safe environment. The EEx barrier defines the interface between the analyzer central unit and the intrinsically safe sensor heads and ensures under any circumstances that the total electrical energy transferred via the hybrid cable to the sensors is always less than needed to ignite combustible gas mixtures.

Technical specifications

Hazardous area output	
• Minimum output voltage	12.85 V at 45 mA
• Maximum output voltage	24 V from 170 Ω
• Current limit	45 mA
Max. current consumption (45 mA output)	90 mA at 24 V, 110 mA at 20 ... 35 V DC
Safety description	25 V, 170 Ω, 147 mA, U_m = 250 V_{rms} or DC

Dimensional drawings



LDS 6, sensors CD 3002 Ex, EEx barrier, dimensions in mm

Technical specifications

Sensors

General	
Setup	Transmitter and receiver unit, connected by a loop-cable
Interior material	stainless steel
Installation	horizontally to the optical axis, perpendicular or parallel to the gas flow
Laser protection class	Class 1, safe to the eye
Options	Inline-calibration path, air blower purging, steam purging
Ex-protection	optionally, according to ATEX II 1GD EEx ia IIC T4
Configuration, housing	
Protection classes	
• Sensors	
- non EEx sensor CD 6	IP67
- EEx sensor CD 3002	IP65
Dimensions	
• non EEx sensor CD 6	Diameter 163, D: 395 mm
• EEx sensor CD 3002	195x195x450 mm
• Purging tube	400 (370 net) x 44 x 40 mm 800 (770 net) x 44 x 40 mm 1200 (1170 net) x 44 x 40 mm
Weight	2 x ca 11 kg
Mounting	DN 65/PN 6 or ANSI 4"/150 lb
Electrical properties	
Power supply	24 V DC, supply from central unit via hybrid cable
Power consumption	approx 2 W during operation
Ambient environment	
Ambient temperature	
• Non EEx sensor CD 6	-30 ... +70 °C during operation, -40 ... +70 °C during storage and transportation
• EEx sensor CD 3002	-30 ... +60 °C during operation, -40 ... +70 °C during storage and transportation
Humidity	< 95% relative humidity, above dew point
Pressure	700 ... 1200 hPa
Measurement conditions	
Measurement path	1 m ... 12 m, longer or shorter paths lengths need to be confirmed by Siemens
Gas temperatures	-5 ... +1300 °C, application-dependent
Gas pressure	Ambient pressure +/- 50 hPa, higher or lower pressures need to be confirmed by Siemens
Dust load	up to 100 g/Nm^3, depending on particle size and measurement path length

Options	
Purging with instrument air	
• Pressure	2000 ... 8000 hPa
• Quality	instrument air, free of oil and water
• Maximum flow rate	500 l/min
• Dew point	benchmark: < -10 °C, application-dependent, condensation of the optics has to be avoided
Air blower fan (230 V: A5E00253147, 115 V: A5E00253148)	
• Maximum counter pressure	40 hPa
• Maximum flow rate	850 l/min
• Power consumption	370 W
Protection class (ventilator)	IP54
Steam purging	
• Steam conditioning	Overheated
• Maximum temperature	240 °C
• Minimum pressure	> 4000 hPa
• Maximum pressure	16000 hPa, refers to a volume flow of approx. 1100 l/min

Hybrid and loop cable

General	
Configuration hybrid cable	Two optical fibers and two twisted copper wires for 24 V DC in one cable. Mono mode light wave guide configured on both sides with angle polished E2000 connectors, multimode light wave guides configured on both sides with SMA connectors.
Coating	Oil-resistant polyurethane
Dimension	Diameter < 8 mm, length: up to 1000 m
Impact resistance	200 N/cm
Maximum tensile strength	500 N
Minimum bend radius	10 cm
Ambient conditions	
Ambient temperature	-40 ... +80 °C during operation
Humidity	< 95% relative humidity, above dew point

1) Please observe partial release for sale.

Sensors and cables

Ordering data

Order No. **7MB6022-** ■■■■■-■■■■

In-situ LDS 6 gas analyzer
Sensor pair (cross duct)

Ex protection	Sensor type	
Without	CD 6	0
According to ATEX II 1 GD	CD 3002	1
According to ATEX II 3 GD	CD 3002	2
Sensor type	Component	
Standard cross duct	O_2 [1]	A
	O_2/temp [1]	B
	NH_3	C
	NH_3/H_2O	D
	HCl	E
	HCl/H_2O	F
	HF [1]	G
	HF/H_2O [1]	H
	CO [1]	J
Purging mode, process side	Sensor side	
No purging	No purging	A
	Air or N_2, 1 ... 2 l/min	B
Instrument air or N_2 moderate flow: 300 ... 120 l/min	No purging	C
	Air or N_2, 1 ... 2 l/min	D
Air, N_2 or steam elevated flow: 300 ... 500 l/min	No purging	E
	Air or N_2, 1 ... 2 l/min	F
Air, blower fan or steam high flow: > 500 l/min	No purging	G
	Air or N_2, 1 ... 2 l/min	H
Purging tubes, material		
No purging tubes		0
Stainless steel		1
Hastelloy		2
Plastic (PP)		3
Ceramics		4
Purging tubes, length		
No purging tubes		0
400 mm (370 mm net)		1
800 mm (770 mm net)		2
1200 mm (1170 mm net)		3
Engine lab version		4
Flange type		
DN 65/PN 6		0
ANSI 4“ /150 lbs		1
Engine lab version		2
Hybrid cable	Length [m]	
Standard length	5	A
	10	B
	15	C
	20	D
	25	E
	30	F
	40	G
	50	H
	75	J
	100	K
	150	L
	200	M
Customized length		Z
No loop cable		X

1) To be released soon.

Ordering data

Order No.

In-situ LDS 6 gas analyzer
Sensor pair (cross duct)

7MB6022 - ■■■■■ - ■■■

Loop cable	Length [m]	
Standard length	5	A
	10	B
	15	C
	20	D
	25	E
	30	F
	40	G
	50	H
Customized length		Z
No loop cable		X

Language (supplied documentation)	
German	0
English	1
French	2
Spanish	3
Italian	4

Further versions

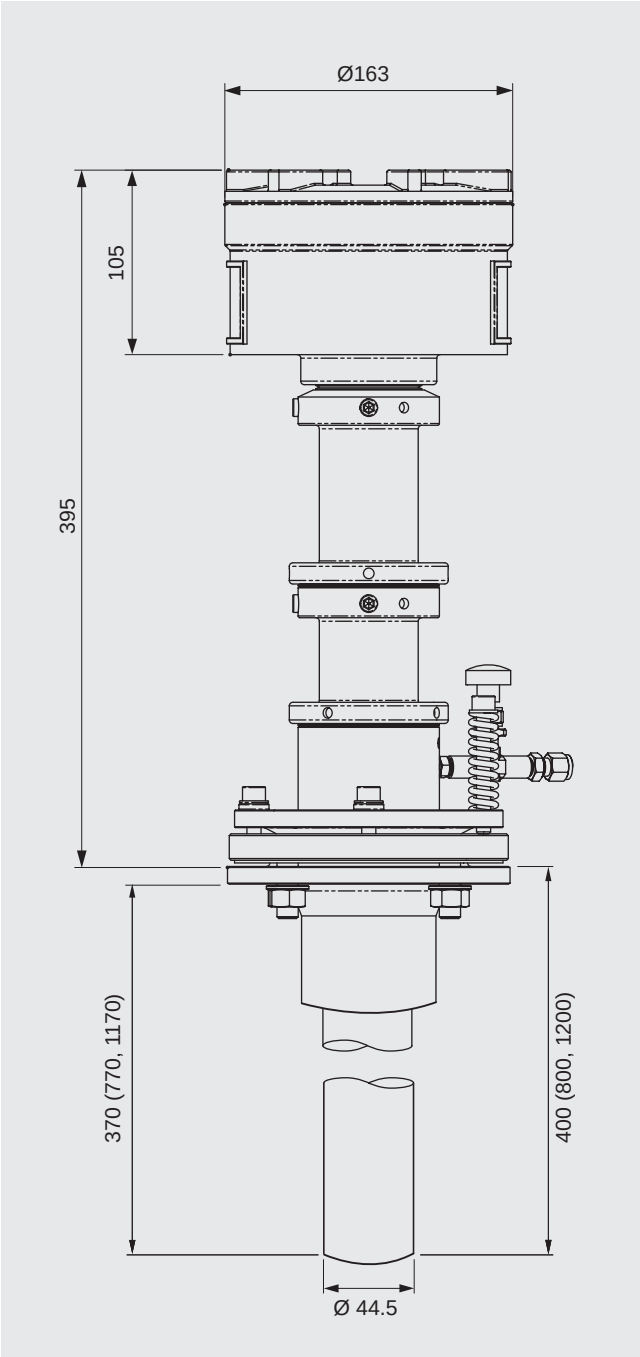
Order code

Please add „-**Z**“ to Order No. and specify Order code

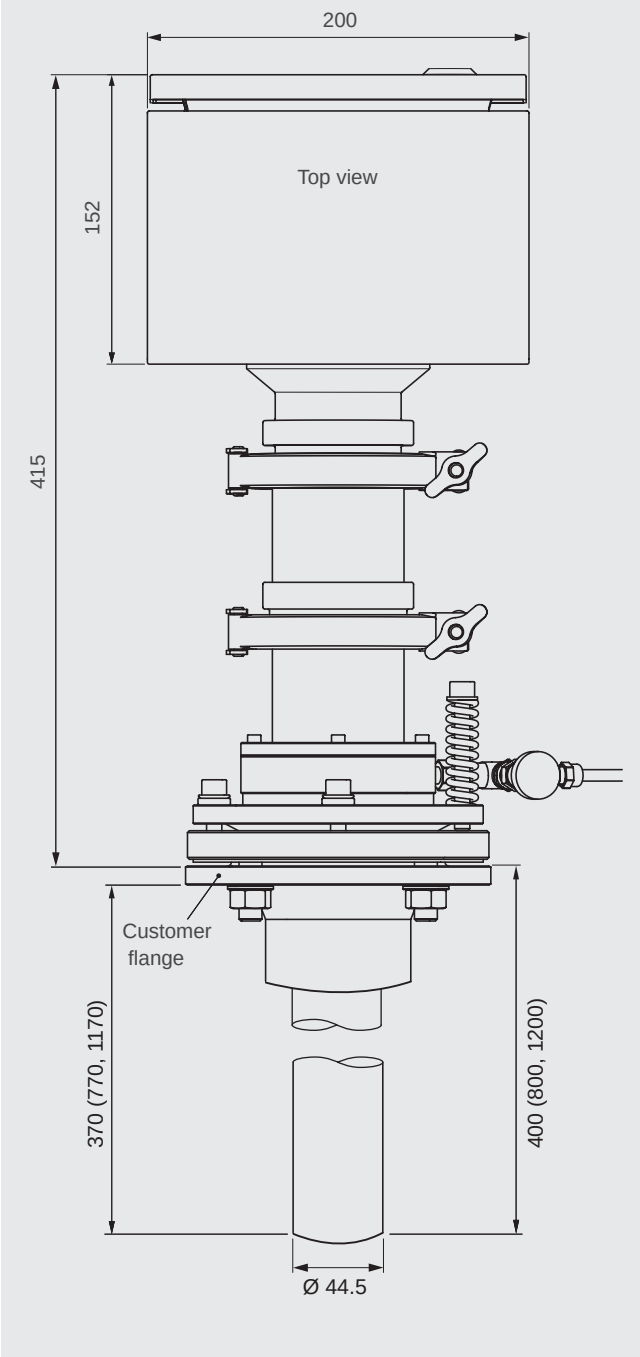
High pressure window flanges	
• Borosilicate glass, SS (1 pair)	**F01**
• Borosilicate glass, Hastelloy (1 pair)	**F02**
• Quartz glass, SS (1 pair)	**F03**
• Quartz glass, Hastelloy (1 pair)	**F04**
Hook spanner	**F10**
Alignment kit (additional)	**F11**
Process flanges, 1 pair (only for application code CG, DG)	**F20**
Air blower fan 230 V (only for purging mode G, H)	**L01**
Air blower fan 115 V (only for purging mode G, H)	**L02**
Needle valve, purging flows < 120 l/min, 1 pair	**L10**
External flow cell, SS, PTFE coated, 1 m path length, 1.2 l inner volume	**L20**
External heated flow cell, max. 200 °C, 1 m path length, 1.2 l inner volume	**L21**
External heated flow cell, max. 200 °C, 1 m path length, 1.2 l inner volume, mounted on rack with wheels	**L22**
Calibration verification kit (not available for gas code H. F)	**L23**
Weather shield, 1 pair	**L30**
Optical filter to reduce IR background	**L40**
Hybrid cable, customized length	**P1Y**
Loop cable, customized length	**Q1Y**
TAG labels (customized inscriptions)	**Y31**

Sensors and cables

Dimensional drawings



Non EEx sensor CD 6, dimensions in mm



EEx sensor CD 3002, dimensions in mm

Documentation

Manual	Order No.
Betriebsanleitung LDS 6 (German)	**A5E00295893**
LDS 6 Operating instructions (English)	**A5E00295894**
Instructions LDS 6 (French)	**A5E00295895**
Istruzioni operative LDS 6 (Italian)	**A5E00295896**
LDS 6 instrucciones de operación (spanish)	**A5E00362720**
Wartungsanleitung LDS 6 (German)	**A5E00295897**
LDS 6 Service instructions (English)	**A5E00295898**

Proposition of spare parts for a 2-year and a 5-year service

LDS 6 does not contain expandable parts, but some parts of the sensors might be stressed in the sensors. For this reason it is recommended for demanding applications to keep window modules and detector electronics on stock (piece counts given per measuring point, i.e. per sensor pair).

Description	Qty for 2 years	Qty for 5 years	Order No.
Non EEx sensors			
• Window module (quartz), for CD 6	1	2	**A5E00338490**
• Window module (engine), for CD 6	1	2	**A5E00338490**
• Sensor electronics (only O_2), for CD 6	1	1	**A5E00338533**
• Sensor electronics (most gases), for CD 6	1	1	**A5E00338540**
• Sensor electronics (most gases, high gain), for CD 6	1	1	**A5E00338541**
• Sensor electronics (only HCl), for CD 6	1	1	**A5E00338552**
EEx sensors			
• Window module (quartz), for CD 3002 (EEx)	1	2	**A5E00338594**
• Sensor electronics (only O_2), for CD 3002 (EEx)	1	1	**A5E00338563**
• Sensor electronics (most gases), for CD 3002 (EEx)	1	1	**A5E00338572**

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Export regulations

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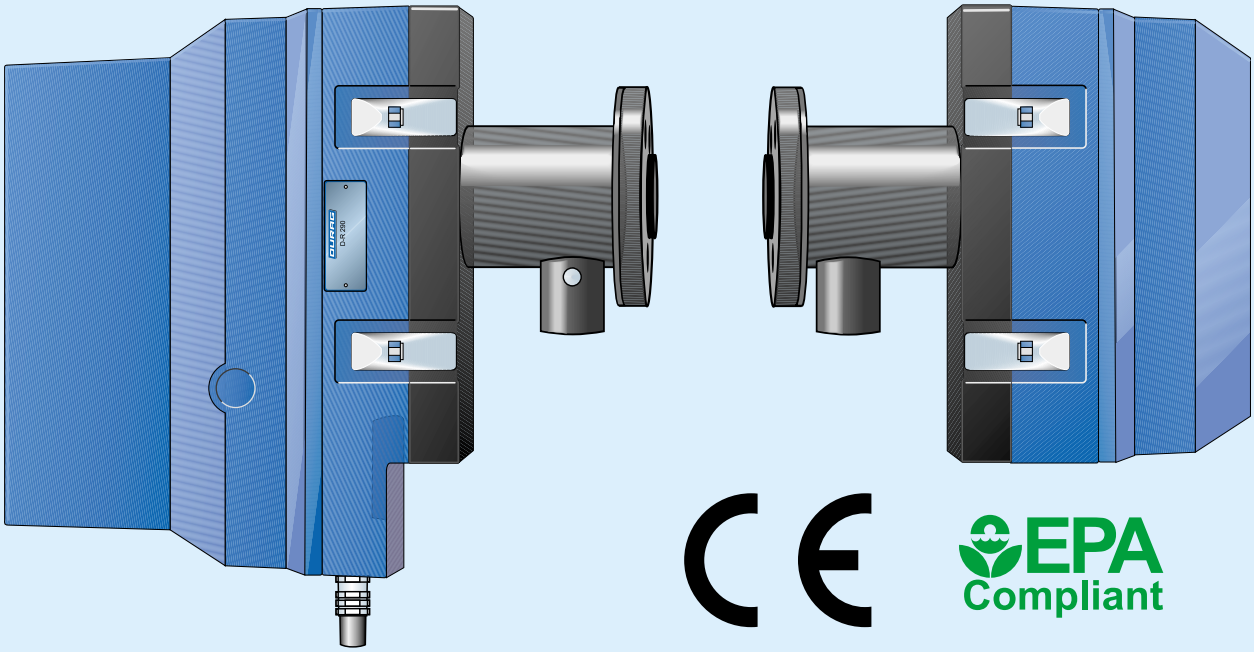


CE

EPA Compliant

- In-Situ-Messverfahren, kontinuierliche Messung
- Lange Lebensdauer durch Halbleiterlichtquelle
- Optimale Auswertung der Messsignale durch breitbandiges Spektrum einer (SWBD) Super-Breitbanddiode, dadurch stabilere Messung im Vergleich zu herkömmlichen Geräten mit LED's
- Leistungsstarke Mikroprozessortechnik
- Messwertanzeige über LC Display in Opazität oder Extinktion, kalibrierfähig in mg/m³
- Automatische Funktionstests mit Korrektur der Messwerte bezüglich der Verschmutzung
- Optik und Elektronik in einem hermetisch abgeschlossenen Gehäuse
- Einfache Justierung ohne zusätzliche Einrichtungen
- Wartungsarm durch optimale Spülluftführung
- Programmierung über das Bediendisplay oder über eine Bus-Schnittstelle
- Messdaten verfügbar als Analogsignal oder über eine Bus-Schnittstelle
- Zwei Analogausgänge mit umschaltbaren Messbereichen

DURAG Staubkonzentrationsmessgerät D-R 290

mit neuer Technologie

New Technology

DURAG D-R 290 Dust Concentration and Opacity Monitor

- In-situ measuring principle, continuous measuring
- Long life solid state light source
- Optimal evaluation of measuring signals due to wide band spectrum of a Super Wide Band Diode (SWBD). Measurement is more stable than with conventional LED systems
- High performance microprocessor technology
- LC Display in opacity or optical density, calibration capability in mg/m³
- Automatic zero and span check with soiling correction of measured values
- Optics and electronics in a hermetically sealed housing
- Simple alignment without special tools
- Reduced maintenance due to advanced purge air system
- Programming via control display unit or remote bus interface
- Data available as analog current or via bus interface
- Two analog output signals available with switchable ranges

50 JAHRE DURAG 50 YEARS Hegwein

Solutions for Emission and Combustion

DURAG Group

D-R 290

Transmission - Staub

Die fotoelektrische Messung der Transmission T (=Durchstrahlungsvermögen) beruht auf der Bestimmung der Schwächung des durch ein partikelhaltiges Gas gesandten Lichtstromes.

Verschiedene Systeme arbeiten mit einer schmalbandigen LED-Lichtquelle mit einer spektralen Empfindlichkeit zwischen 500 - 600 nm und nutzen direkt das von der LED ausgesendete Licht und haben daher eine stark temperaturabhängige Empfindlichkeit.

Die DURAG Super-Breitbanddiode SWBD mit einer wesentlich breiteren spektralen Empfindlichkeit von 400 - 700 nm führt zu einem stabileren Messsystem mit konstanteren Messergebnissen. Eine blaue Gallium-Nitrit-Diode in Verbindung mit eine Floureszenzschicht erzeugt ein weißes Licht, das neben dem langwelligen Licht der Lumineszenzstoffe auch die Emissionsbande der normalen Leuchtdiode enthält.

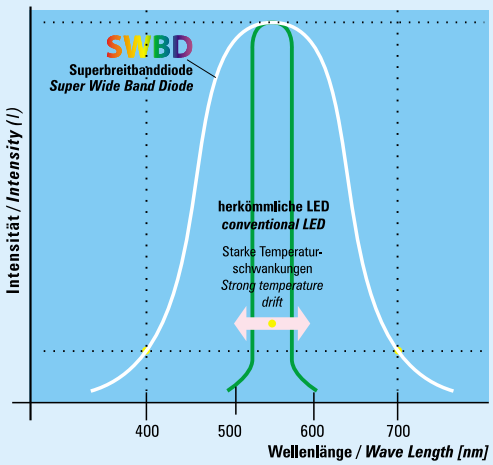
Ausgehend von der Transmission kann der Staubgehalt entweder als Opazität ***O*** oder als Extinktion ***E*** dargestellt werden.

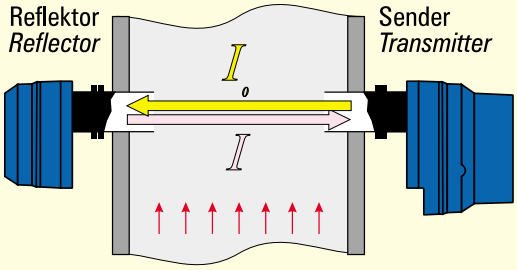
Die **Opazität** kann mit der Lichtauslöschung verglichen werden und zeigt prozentual die Menge des absorbierten Lichtes an. Die Opazitätsanzeige wird hauptsächlich in den USA und im asiatischen Raum verwendet. Der Vorteil der Opazität ist, dass die Geräte nicht kalibriert werden. Der Nachteil ist die Abhängigkeit des Messergebnisses von der Messstelle. Auch wenn eine Umrechnung von der Messstelle auf die Schornsteinmündung durchgeführt wird, so werden Einflüsse von z.B. der Farbe, der Größe und der Oberflächenbeschaffenheit der Partikel nicht berücksichtigt. Durch den nichtlinearen Zusammenhang zwischen dem Staubgehalt und der Opazität erhöht sich die Opazität bei Verdopplung des Staubgehaltes im oberen Bereich nur um ca. 15 %.

Die **Extinktion** verläuft durch die Logarithmierung linear mit dem Staubgehalt: Doppelter Staubgehalt bedeutet doppelte Anzeige des Gerätes. Die Extinktion wird in Europa und zunehmend auch im asiatischen Raum verwendet. Durch die Kalibrierung der Messstelle (nicht des Messgerätes) nach der VDI 2066 bzw. EPA CFR 40 Part 60 #5 wird eine exakte Anzeige des Staubgehaltes in mg/m³ ermöglicht. Der Extinktionskoeffizient k wird durch gravimetrische Vergleichsmessungen bestimmt. Nach dem Verfahren des kleinsten quadratischen Fehlers wird aus mindestens 15 Einzelmessungen die Kalibrierkurve für die Messstelle aufgestellt. Unter realen Betriebsbedingungen muss man davon ausgehen, dass derselbe Staubgehalt je nach Korngrößen- und Strömungsverteilung zu unterschiedlichen Anzeigen führen kann. Somit genügt es nicht, eine Kalibrierkurve anzugeben; es müssen auch die entsprechenden Unsicherheitsbereiche Y_1, Y_2 und Y_3, Y_4 berücksichtigt werden.

Spektrale Empfindlichkeit der neuen DURAG SWBD-Technologie

Spectral Sensitivity with DURAG's new SWBD Technology





I_0 - Intensität der Quelle *Source Intensity*

I - Empfangene Intensität *Received Intensity*

k - Extinktions-Konstante *Extinction Constant*

c - Konzentration *Concentration*

l - Messweglänge *Path Length*

Transmission *Transmission*

$$T = \frac{I}{I_0}$$

Lambert Beer's Gesetz *Lambert Beer's Law*

$$T = \frac{I}{I_0} = e^{-klc}$$

Opazität % *Opacity %*

$$O = 1\text{-}T$$

$$O\,[\%] = 1\text{-}T*100\%$$

Extinktion *Extinction (Optical Density)*

$$E = \lg\left(\frac{1}{T}\right) = \frac{k}{2.3} * c * l$$

$$c = \frac{1}{l} * \frac{2.3}{k} * \lg\left(\frac{1}{T}\right)$$

$$c = \frac{1}{l} * \frac{2.3}{k} * E$$

Staubkonzentration *Dust Concentration* in mg/m³ (Kalibrierung nach *Calibration reg.* VDI 2066, EPA CFR 40 Part 60 #5)

Grundlagen Transmission

Transmission Basics

Transmission - Dust

The photoelectric measurement of the transmission T (=irradiation capability) is based on the determination of the attenuation of light sent through a gas containing dust particles.

Several systems are implementing a narrow-band LED light source with a spectral response between 500 and 600 nm using the light which is directly emitted from the LED. Therefore the response is temperature dependent.

The DURAG Super Wide Band Diode SWBD, with a spectral response substantially enlarged to 400 - 700 nm, results in a more stable measuring system with results that are more constant. A blue Gallium Nitrite diode in connection with a fluorescent layer produces a white light, which contains the broad band of wavelengths associated with the luminescence material as well as the emission band of a normal light emitting diode.

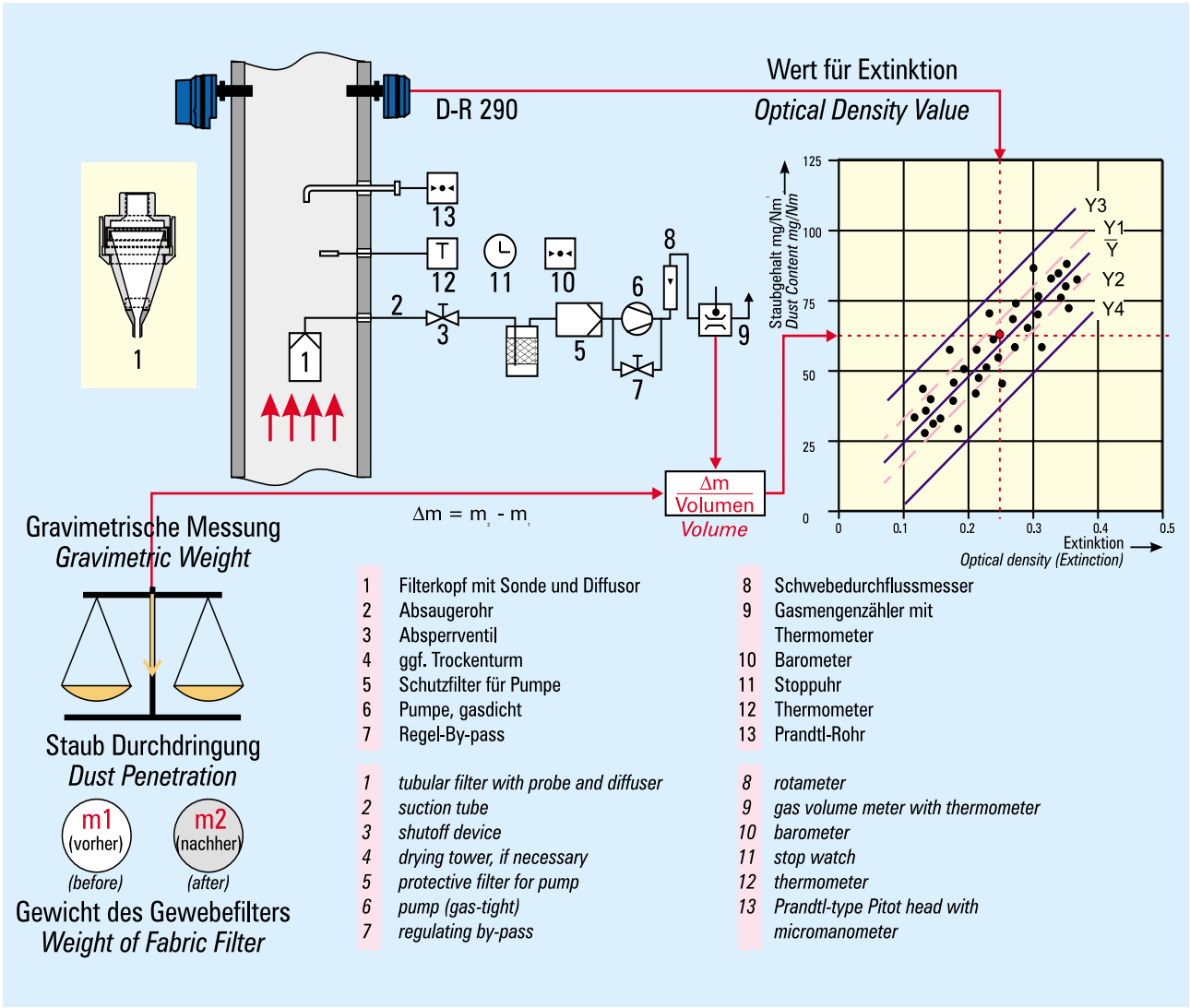
From the Transmission, the dust load can be displayed either as Opacity ***O*** or as Extinction (optical density) ***E***.

The **Opacity** can be compared with the attenuation of light and shows the percentage of absorbed light. The Opacity measurement is used mostly in the USA and Asia. The advantage of Opacity is that the measuring devices must not be calibrated. The disadvantage is the dependency of the measuring result from the measuring location. Although there is a re-calculation from the monitor location to the stack emission outlet, the influences from the color, the shape and the surface structure of the particles are not taken into account. Due to the non-linear relationship between the dust load and the opacity, the opacity is increased by only approx. 15% when doubling the dust load in the upper measuring range.

The **Extinction** (optical density) runs linear to the dust load due to taking the logarithm: Doubling the dust amount results in the display of the unit doubling. Extinction is used in European countries and increasingly also in Asia. By calibrating the measuring location (not the measuring device) according to VDI 2066 or EPA CFR 40 Part 60 #5, an exact display of the dust load in mg/m³ is achieved. The site depending extinction coefficient k is defined by gravimetric comparative measurements. According to the smallest quadratic error from at least 15 single measurements, the calibration curve is calculated for the measuring location. Under normal operating conditions we have to assume that the same dust load can lead to different readings depending on grain size and flow distribution. Therefore it is not sufficient to have a calibration curve , but also uncertainty ranges Y1,Y2 and Y3,Y4 have to be considered.

Kalibrierung von Staubmessgeräten

Calibration of Dust Meters



1	Filterkopf mit Sonde und Diffusor	8	Schwebedurchflussmesser
2	Absaugerohr	9	Gasmengenzähler mit Thermometer
3	Absperrventil	10	Barometer
4	ggf. Trockenturm	11	Stoppuhr
5	Schutzfilter für Pumpe	12	Thermometer
6	Pumpe, gasdicht	13	Prandtl-Rohr
7	Regel-By-pass		

1	*tubular filter with probe and diffuser*	*8*	*rotameter*
2	*suction tube*	*9*	*gas volume meter with thermometer*
3	*shutoff device*	*10*	*barometer*
4	*drying tower, if necessary*	*11*	*stop watch*
5	*protective filter for pump*	*12*	*thermometer*
6	*pump (gas-tight)*	*13*	*Prandtl-type Pitot head with micromanometer*
7	*regulating by-pass*		

Staubkonzentrationsmessgerät D-R 290

Anwendung

Das DURAG-Staubkonzentrationsmessgerät D-R 290 wird zur kontinuierlichen Messung der Stäube in Rauchgaskanälen und Staubabzugsleitungen eingesetzt. Nach TA Luft und 13. und 27. BImSchV ist es geeignet für

- Feuerungsanlagen mit Steinkohle-, Braunkohle-, Heizöl- und Mischfeuerungen
- Konverteranlagen, Asphaltmischanlagen und Anlagen zur Zementherstellung
- sowie alle Anlagen, bei denen die Staubkonzentration quantitativ gemessen werden soll.

Die Messwerte können sowohl in Opazität als auch in Extinktion (mg/m^3) angezeigt werden.

Das D-R 290 verfügt über zwei analoge Messwertausgänge. Jeder der Ausgängen hat zwei frei wählbare Extinktions- oder Opazitätsmessbereiche, die extern umschaltbar sind. Die Messbereiche sind frei wählbar von 0,1 bis 1,60 Extinktion oder von 20 bis 100 % Opazität. Über einen einstellbarern Korrekturfaktor kann die Opazität an der Schornsteinmündung angezeigt werden.

Zur ordnungsgemäßen Funktion führt das D-R 290 in einstellbaren periodischen Abständen einen Kontrollzyklus durch. Hierbei werden der Nullpunkt, die Verschmutzung der optischen Grenzflächen, sowie ein Referenzwert automatisch gemessen und angezeigt. Die nachfolgenden Messwerte werden, wenn notwendig, automatisch korrigiert. Übersteigt die Korrektur einen frei wählbaren Wert, so wird ein Meldesignal erzeugt. Durch eine Beheizung der optischen Abschlussscheiben wird eine Kondensation / Verschmutzung vermieden.

Grundlegende Eigenschaften

Das Gerät arbeitet im Zweistrahl-Wechsellichtverfahren nach dem Autokollimationsprinzip, d.h. der Lichtstrahl durchquert zweimal die Messstrecke. Die Lichtstrahlschwächung durch den Staubgehalt in der Messstrecke wird gemessen und ausgewertet.

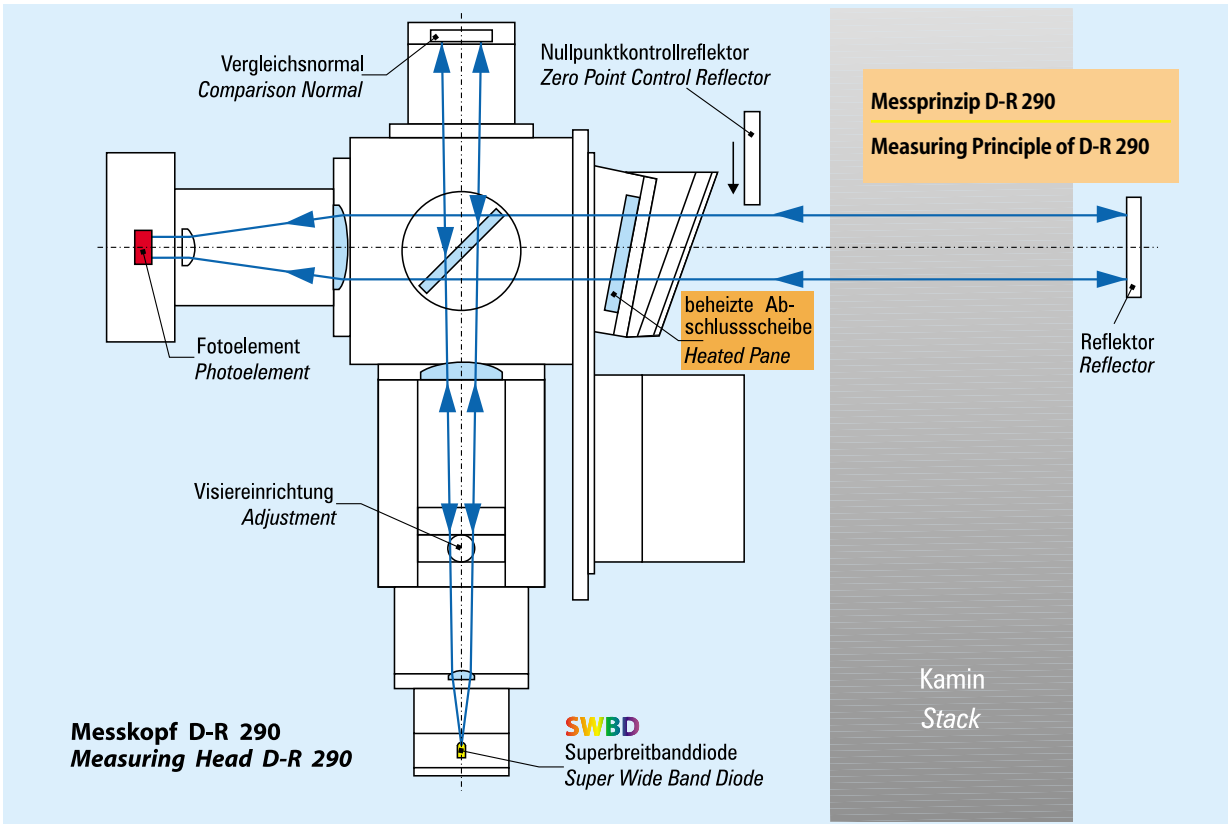
Ein Fotoelement empfängt abwechselnd den Mess- und den Vergleichslichtstrahl. Die Umschaltung zwischen Messlichtstrahl und Vergleichslichtstrahl erfolgt mittels eines Schrittmotors alle 2 min für die Dauer von 2 s. Für das vom Messlicht- und Vergleichslicht erzeugte Signal ist ein gemeinsamer Verstärker vorhanden, dadurch werden Temperatureinflüsse sowie die Langzeitdrift der Verstärker kompensiert. Das Sendelicht wird durch eine getaktete SWBD Super-Breitbanddiode ohne Beeinflussung durch Gleichlicht (Tageslicht usw.) erzeugt. Sie garantiert eine lange Lebensdauer. Durch das Breitbandverhalten der SWBD ist das Messergebnis unabhängig von Temperatur- und anderen Einflüssen. Durch die Verwendung der Breitbanddiode ist im Vergleich zu herkömmlichen Geräten mit schmalbandigen LED's eine stabilere Messung gewährleistet.

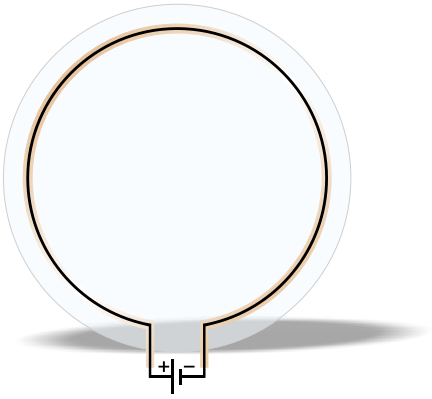
Lieferumfang

- Anbauflansche
- Messkopf
- Reflektor
- Anzeige- und Bedieneinheit
- 1 Spülluftgebläse

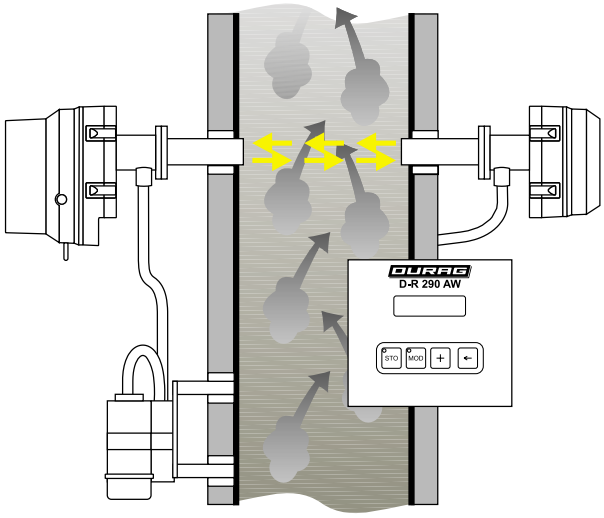
Zubehör optional

- Bus-Schnittstelle, z.B. Modbus, CAN-Bus o.a.
- Automatische Schnellschlussklappen zum Schutz des Messkopfes und des Reflektors beim Ausfall der Spülluft.
- Wetterschutzhauben, wenn die Geräte in ungeschützten Räumen montiert werden.
- Ex geschützte Ausführung für EEx p möglich.



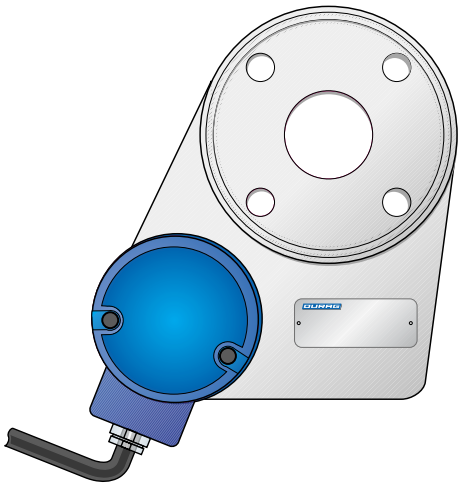


Beheizbare Abschlussscheibe des D-R 290



Systemkomponenten

System Components



Automatische Schnellschlussklappe

Automatic Fail Safe Shutter

Application

The DURAG D-R 290 Opacity and Dust Concentration Monitor is used for continuous opacity or dust monitoring of flue gas in stacks and ductwork. According to TA Luft and 13. and 27. BImSchV the D-R 290 is suitable for

- systems firing coal, fuel oil or a mixture of fuels
- converter plants, asphalt mixing plants and cement production plants
- any other type of plant requiring quantitative monitoring of opacity or dust concentrations.

Measured results can be displayed as opacity or optical density.

Principle of Operation

The D-R 290 operates according to the principle of auto-collimation (double-pass). The light beam crosses the measuring path twice. The system measures and evaluates the attenuation of the light beam caused by the dust in the measuring path.

A photoelement alternately receives the measurement and comparison light beam. Switching between the measurement beam and a comparison light beam proceeds through an electromagnetically actuated rotary diaphragm. For check value compensation, comparative measurements of 2 seconds in duration occur every 2 minutes. There is only 1 joint amplifier for the measuring and the comparator beams, thus compensating temperature influences as well as for amplifier long-term drift. The transmitted light is generated by a SWBD (Super Wide Band Diode) without the influence of other light sources, such as sunlight. An SWBD also has a long life span compared to traditional halogen lamps. Because of the broad band nature of the SWBD, the measurement results are not influenced by temperature or other factors. The use of the wide band diode also offers a more stable measurement than a conventional narrow band LED.

The D-R 290 is equipped with two analog measurement value outputs. Each of the outputs has two selectable extinction or opacity ranges. The measurement ranges are selectable from 0.1 to 1.6 for extinction, and from 20 to 100 % for opacity. Opacity computation of the opacity at the stack outlet by means of the stack correction factor possible.

For proper functioning the D-R 290 periodically performs a check cycle, measuring and indicating the zero point, the soiling of the optical boundary surfaces as well as a reference value automatically. If necessary, the subsequent measuring values will be corrected. If the correction surpasses a freely programmable value, a corresponding indication will be generated. Condensation and deposits are avoided by using a heated pane.

Scope of Delivery

- Mounting flanges
- Measuring head
- Reflector
- Display and operating panel
- 1 purge air fan

Optional Accessories

- Bus interfaces, Modbus, CAN bus for example
- Automatic fail safe shutters as a protection for the measuring head and reflector in case of an outage of the purge air
- Weather protection hoods when the instrument is mounted in an unprotected area
- Explosion proof execution with EEx-p protection methods possible.

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Technische Daten D-R 290

Messbereich bezogen auf
einen Meter Messweglänge ..... Von 0-200 mg/m³ bis maximal 0-4000 mg/m³
Kalibrierung: entsprechend VDI 2066
Lichtquelle ..... Super Breitbanddiode SWBD
Messbereich
Extinktionsbereich ..... von 0,1 bis 1,6 Ext.
Opazitätbereich ..... von 20 bis 100 %
Messbereichsumschaltung
Länge der Messstrecke ..... 0,5 - 12 m
Ausgangssignal ..... 2x 0-20 mA, Nullpunkt 4 mA
maximale Bürde ..... 500 Ohm
Busschnittstelle für Programmierung
und Messwerte ..... Modbus, CAN-Bus
Relaisausgänge ..... Alle Kontakte potentialfrei, 6x Status für z.B. Grenzwerte, Störung, Kontrollzyklus, usw.
Schaltleistung max. ..... 250 V, 100 VA
Eingänge ..... 6x Status für z.B. Eingabe frei, 2 Messbereichsumschaltung Störung Spülluft, Kontrollzyklus
Integrationszeit des
Ausgangssignales ..... 10 - 1800 s frei einstellbar
Temperaturbereiche
Zul. Umgebungstemperatur ..... 253-323 K (-20°C bis +50°C)
Abgastemperatur ..... oberhalb Taupunkt

Elektrische Daten

Netz ..... 90 - 264 V, 48 - 62 Hz
Leistung ..... ca. 30 W

Mechanische Daten

Schutzart IP65
Gewichte ..... Messkopf: ca. 10 kg
Reflektor: ca. 7 kg

Daten der Spülluftеinheit

Netz ..... 115/230 V, 50 Hz, 0,37 KW
115/230 V, 60 Hz, 0,43 KW
Förderleistung ..... ca. 80 / 90 m³/h
Maße ..... ca. 350 x 550 x 500 mm
Gewicht ..... ca. 12 kg

Specifications of D-R 290

Measuring range referring to
1 m measuring path length ..... From 0-200 mg/m³ up to 0-4000 mg/m³
Calibration: according to VDI 2066
Light source ..... Super wide band diode SWBD
Measuring range
Optical density ..... from 0.1 up to 1.6 Ext
Opacity ..... from 20 up to 100 %
range switching
Length of measuring path ..... 0.5 - 12 m
Output signal ..... 2x 0-20 mA; live zero 4 mA
Maximum load ..... 500 ohms
Bus interface for
programming and results ..... Modbus, CAN Bus
Relay outputs ..... all contacts voltage-free, 6x status for limit value, failure, control cycle, etc.
Maximum switching cap. ..... 250 V, 100 VA
Inputs ..... 6x status for input enable, 2x range selection, failure purge air, control cycle
Output signal integration time ... 10 - 1800 s freely programmable
Temperature ranges
permiss. ambient temp. ..... 253-323 K (-20°C to +50°C)
Flue gas temperature ..... above dew point

Electrical data

Power supply ..... 90 - 264 V, 48-62 Hz
Power consumption ..... approx. 30 W

Mechanical data

Protection class ..... IP65 / NEMA 4x
Weights ..... Measuring head: approx. 10 kg
Reflector: approx. 7 kg

Data on purge air unit

Power supply ..... 115/230 V, 50 Hz, 0.37 KW
115/230 V, 60 Hz, 0.43 KW
Blower output ..... approx. 80 / 90 m³ /hr.
Measurements ..... 350x550x500 mm (14x22x20 in.)
Weight ..... approx. 12 kg

Ausführliche Gerätebeschreibungen mit technischen Daten, Einstellanweisungen, Abmessungen und Anschlussplänen stehen auf Anforderung zur Verfügung.

Extensive descriptions of these units with specifications, setting instructions, dimensions and connection plans are available upon request.

Solutions for Emission and Combustion

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D-70469 Stuttgart, Germany

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Kollaustr. 105
D-22453 Hamburg, Germany

ORFEUS Combustion Engineering GmbH
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D-45128 Essen, Germany

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USA

D-R 290

Yleistietoa Pölyn mittaamisesta

Lisätiedot: PPM-SYSTEMS OY

ppm.espoo@ppmsystems.fi

www.ppmsystems.fi

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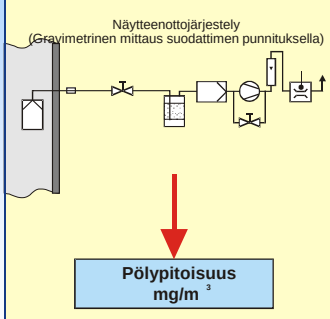
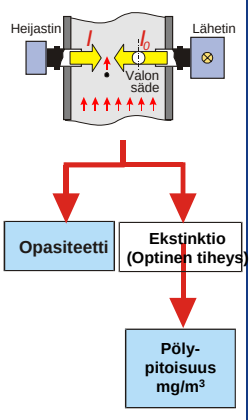
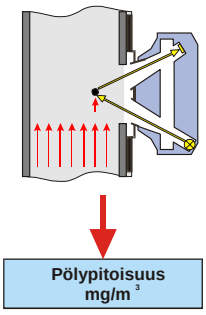
Pölypäästöjen mittaus

Vertailumenetelmä	Optinen mittaus	
● Kalibratointi VDI 2066 mukaan	● Transmissio	● Siroava valo







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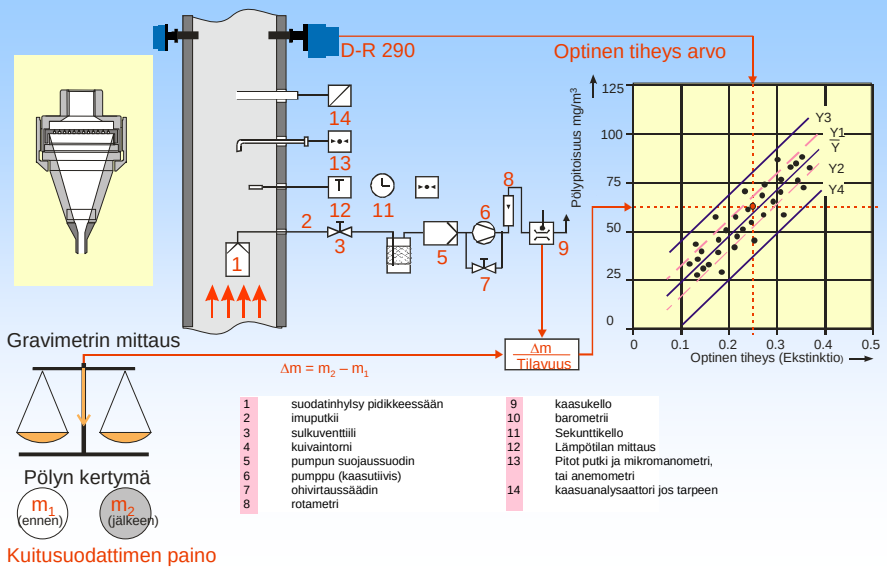
Pölymittarien kalibrointi (VDI 2066 mukaan)



1	suodatinhylsy pidikkeessään	9	kaasukello
2	imuputkii	10	barometrii
3	sulkuventtiili	11	Sekunttikello
4	kuivaintorni	12	Lämpötilan mittaus
5	pumpun suojaussuodin	13	Pitot putki ja mikromanometri,
6	pumppu (kaasutiivis)		tai anemometri
7	ohivirtaussäädin	14	kaasuanalysaattori jos tarpeen
8	rotametri		

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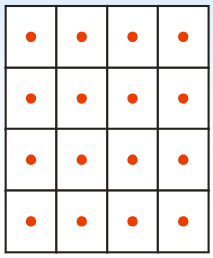
Pölymittarien kalibrointi (VDI 2066 mukaan)

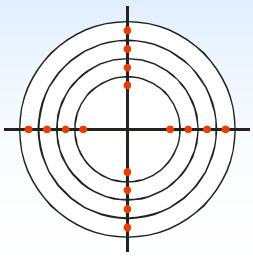
- **Epäsäännöllinen pölyjakauma mitattavan piipun poikkipinnalla**

- **Mittauspistejärjestely savukaasukanavassa:**

Neliskulmaisella poikkipinnalla



pyöreällä poikkipinnalla



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Transmissioon perustuvat mittaukset

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Transmissiomittalaitteiden mittausalueet

- **Pienin alue rippuu seuraavista tekijöistä**
  - partikkelikoko
  - Partikkelien laatu (lentotuhka, Klaubersuola jne.)
  - Efektiivinen mittausväli
- **Yleisluontoinen esimerkki**
  - voimalaitokset
  - Partikkelikoko noin 4 µm
  - Efektiivinen mittausväli 1 m
  - alue 0 - 300 mg/m^3 tai
  - alempi havaitsemisraja (LDL) 10 mg/m^3 eli 3% täydestä alueesta

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Pölypartikkelien koko

- Pussisuodattimet < 2 µm
- Voima- ja jätteenpolttolaitokset ~ 4 µm
- Vanhemmat sähkösuotimet 10 – 30 µm
- Syklooniierottimet 40 – 50 µm

Transmissiomittalaitteiden mittausalueet

Partikkelikoko	2	4	10	30	40 µm halk.
Havaitsemis-raja	5	10	25	75	100 mg/m³
Pienin alue	150	300	750	2,250	3,000 mg/m³
Suurin alue	2,400	4,800	12,000	36,000	48,000 mg/m³

Yllämainittu taulukko on lentotyhkalle, per metri efeketiivisatä mittausväliä

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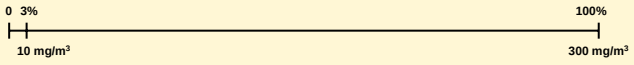
Esimerkit: Lentotuhka, partikkelikoko 4 µm

- **1 m efektiivinen mittaväli**
  - LDL: 10 mg/m³, Alue: 300 mg/m³



- **2 m efektiivinen mittaväli**
  - LDL: 5 mg/m³, Alue: 150 mg/m³

- **5 m efektiivinen mittaväli**
  - LDL: 2 mg/m³, Alue: 60 mg/m³

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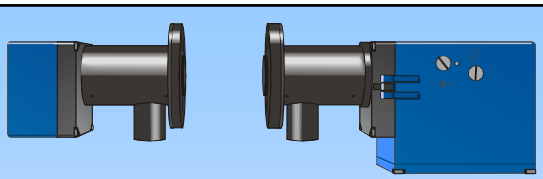
D-R 216 Opasiteettimittari



- Jatkuva in-situ opasiteettimittaus transmissioperiaatteella
- Helppo sovellutus
- Asennus ilman kalibrointia
- 0.4 - 6.25 m halkaisijallisille piipuille ja kanaville
- Alueet 0 - 25, 0 - 50, 0 - 100% läpinäkyvyyttä
- Optiona optiselle tiheydelle linearisoitu alue
- Tyyppihyväksytty “TA Luft”
- Tyypilliset sovellutukset:
  - Opasiteetin mittaus kaukolämpölaitoksilla
  - Pölynerotuksen ja pölysuodattimien toiminnan valvonta
  - Kemian teollisuuden prosessien valvonta

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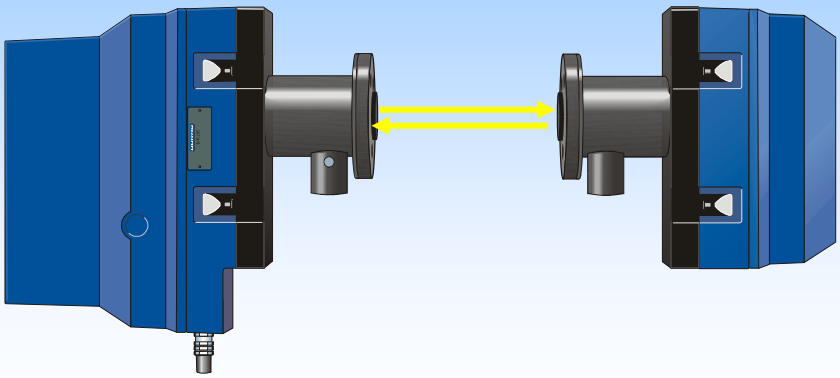
D-R 290 Pöly- ja Opasiteettimittari



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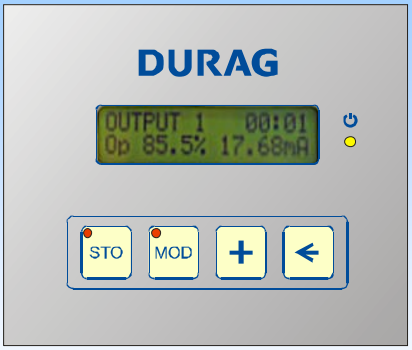
D-R 290 Kontrolliyksikkö



- **Näyttö**
  - mA viestille
  - Opasiteetille
  - Optiselle tiheydelle
  - mg/m³
- **Helppokäyttöinen**
- **Ohjelmointiin ei tarvita tietokonetta**
- **Datan syöttö vain neljällä näppäimellä kuten D-R 300-40 ssa**

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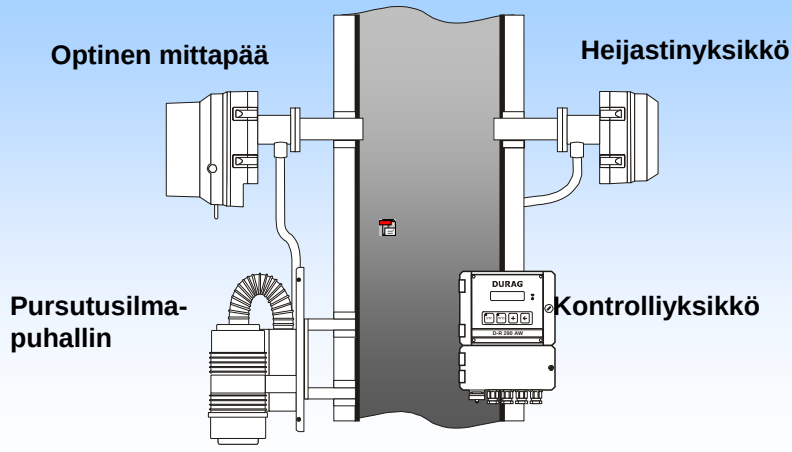
D-R 290 laitteiston komponentit



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D-R 290 Mittapään ominaisuudet

- Valolähteenä Super Wide Band Diode SWBD
- Vain 1 vastaanotin kaikille valoteille
- Tunteeton päivänvalolle
- Elektronically pulssitettu valonsäde 2 kHz taajuudella
- 2 askelmoottoria, nollaus ja alue/suljin
- Automaattikäynnistys pölyttömässä kanavassa
- EPA ja TÜV hyväksytty
- Lämmitetty ikkuna, ei kondensoitumisongelmia
- Kontrolliyksiköt sekä piippuun että etäkäyttöä varten
- Modbus liityntä
- Etäkäyttö
- Automaattinen sulkulaippojen toiminnan valvonta

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D-R 290 tekniset tiedot

Mittausalue	0-200 / 4000 mg/m³ per metri
Valolähde	Super wide band diode SWBD
Optinen tiheys	0.1 - 1.6 optista tiheyttä (Ext)
Opasiteetti	20 - 100%,
Mittausväli	1 - 12 m, vain kaksi heijastinta
Väyläliitäntä	Modbus
Lähtöviesti	2 x 0-20 mA, 4 mA Nollapiste
Alueenvaihto	Ulkoinen tai automaattinen
Relelähdöt ja -tulot	6 x tilatieto, potentiaalivapaana
Integrointiaika	5 – 1800 sekunttia
Ympäristölämpötila	-20° - +50° C
Syöttö	95-264 V, 48-62 Hz, 30 W (Laite) 115/230 V, 50/60 Hz, 400 W (Puhallin

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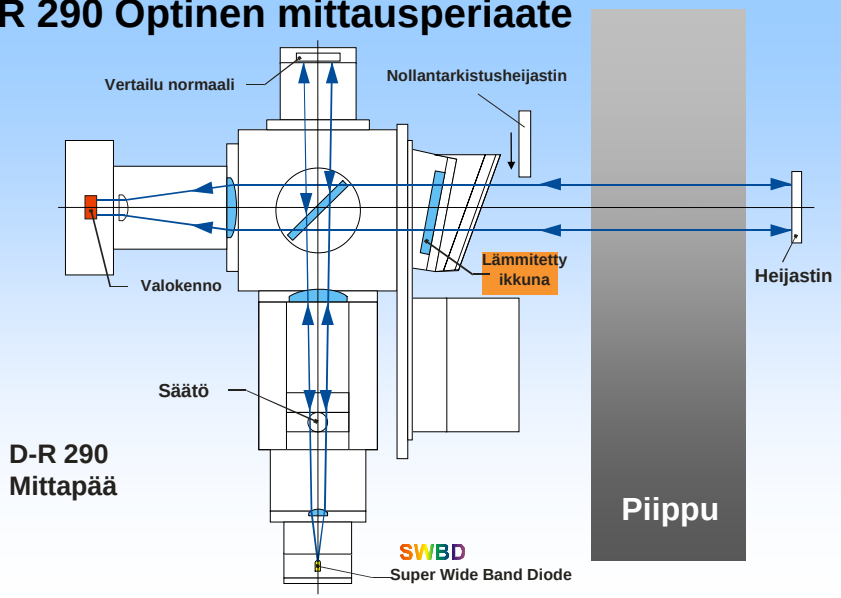
D-R 290 Optinen mittausperiaate



D-R 290
Mittapää

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D-R 290 Lineaarisuuden tarkistus

- Lineaarisuuden tarkistus piipussa
- Käytetään eri voimakkuuksisia optisia suotimia
- Suotimet pitää uudelleenkalibroida vuosittain

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Pölyn mittaus

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Partikkelien mittausmenetelmät

Tyyppi	Toimintatapa	Toimintaperiaate
Näytettä-ottava	jaksottainen	Gravimetrinen mittaus näytesuotimella (Referenssimenetelmä VDI 2066)
Näytettä-ottava	jaksottainen	Radiometrinen mittaus
Näytettä-ottava	jatkuva	Siroavan valon mittaus ohivirtauksessa
In-situ	jatkuva	Transmissiomittaus Siroavan valon mittaus
In-situ	jatkuva	Triboelektrinen menetelmä
In-situ	jatkuva	Partikkeli laskija (Transmissio)

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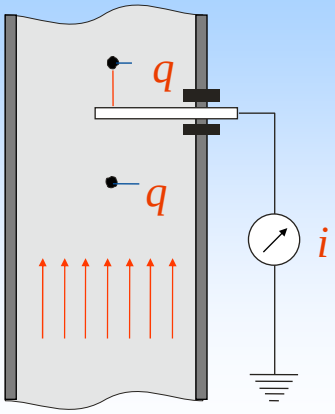
Pölymittaus, Triboelektrinen



$$q = \int i \times dt$$

DURAG:
- **D – FW 230**
- **D – FW 231**
- **D – FW 240**
- **D – RX 250**

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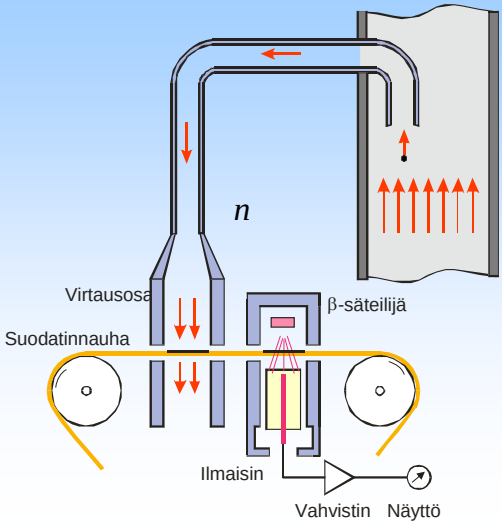
Betasäteilyyn perustuva mittaus



Verewa:
- **F 904K**
- **F 701**

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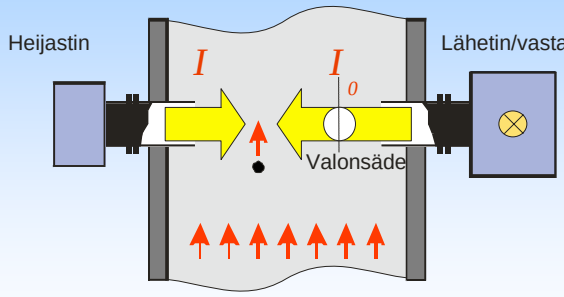
Optiset pölynmittausmenetelmät – Transmissio



DURAG:
- **D – R 216**
- **D – R 280-10**
- **D – R 281 AV**
- **D – R 290**

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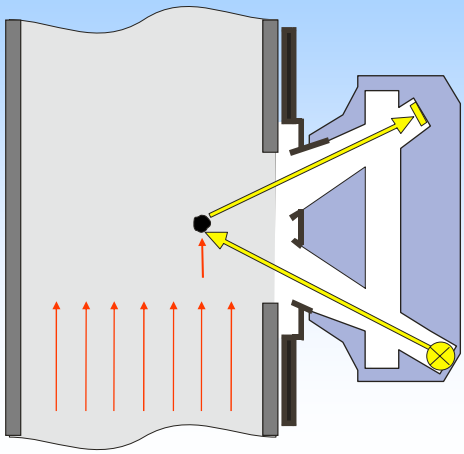
Optiset pölynmittausmenetelmät – Valon sironta



DURAG:
- **D – R 300**
- **D – R 300-40**

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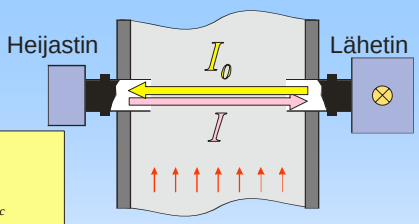
Transmissiomittaus



Transmissio $T = \frac{I}{I_0}$

Lambert Beer'in laki $T = \frac{I}{I_0} = e^{-klc}$

Opasiteetti %

$O = 1 - T$

$O[\%] = 100 - T \times 100\%$

Ekstinktio (Optinen tiheys)

$E = \lg\left(\frac{1}{T}\right) = \frac{k}{2.3} \times c \times l$

$c = \frac{1}{l} \times \frac{2.3}{k} \times \lg\left(\frac{1}{T}\right)$

$c = \frac{1}{l} \times \frac{2.3}{k} \times E$

Pölypitoisuus mg/m³
(Calibration reg. VDI 2066)

I_0 – Lähteen intensiteetti
I – Vastaanotettu intensiteetti
k - Ekstinktiovakio
c - Pitoisuus
l – Valotien pituus

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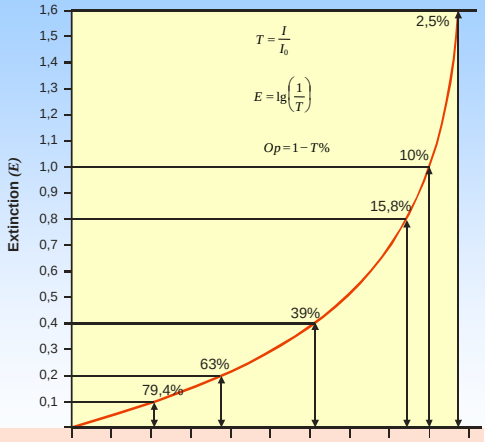
Ekstinktion, Transmission ja Ringelmann-asteikon erot



Transmissio *(T)* %	100	80	60	40	20	0
Opasiteetti *(Op)* %	0	20	40	60	80	100
Ringelmann	0	1	2	3	4	5

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Europpalaiset säädökset

Säädös	Polttoaine	Pölyn raja-arvo
EU Directive 2001/80 Uudet Isot laitokset (käytössä 27.11.2003 mennessä.) tai olemassaolevat (alkaen 01.01.2008)	Kiinteä, > 500 MW Kiinteä, 50 - 500 MW Neste, > 50 MW Kaasu, >50 MW	50 mg/Nm^3 (6% O_2) 100 mg/Nm^3 (6% O_2) 50 mg/Nm^3 (3% O_2) 5 / 10 / 50 mg/Nm^3 (3% O_2)
EU Directive 2001/80 Uudet isot laitokset Combustions	Kiinteä, 50 – 100 MW Kiinteä, > 100 MW Neste, 50 – 100 MW Neste, > 100 MW Kaasu, > 50 MW	50 mg/Nm^3 (6% O_2) 30 mg/Nm^3 (6% O_2) 50 mg/Nm^3 (3% O_2) 30 mg/Nm^3 (3% O_2) 5 / 10 / 30 mg/Nm^3 (3% O_2)
EU Directive 2000/76 Jätteenpolttolaitokset	Vrk keskiarvo Puolen tunnin keskiarvo	10 mg/Nm^3 (11% O_2) 30 mg/Nm^3 (11% O_2) tai 97% < 10 mg/Nm^3 (11% O_2)

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Erikoisehdot EU Directive 2001/80

Suuret polttolaitokset

(27.11.2003 mennessä käynnistyvät) tai olemassaolevat (01.01.2008 asti)

- Kaiiki kuukausikeskiarvot < raja-arvo
- 97% kaikistal 48 h keskiarvoista < 1,1 x raja-arvo

Uudet suuret polttolaitokset

- Kaikki vrk keskiarvot < raja-arvo
- 95% kaikista tuntikeskiarvoista < 2 x raja-arvo

- Kaikki arvot normalisoituina happipitoisuuteen

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Erikoisehdot EU Directive 2000/76

- Ei eroja varsinaisen ja osittaisen eikä ongelmajäte tai vaarattomien jätteiden polton välillä, (poikkeus: eläinten ruhojen poltto)
- Siirto kansalliseen lainsäädäntöön 28.12. 2002 mennessä
- Astuu voimaan uusilla laitoksilla 28.12.2002
- Astuu voimaan olemassaolevilla laitoksilla 28.12.2005
- Kaikki arvot normalisoituina happipitoisuuteen

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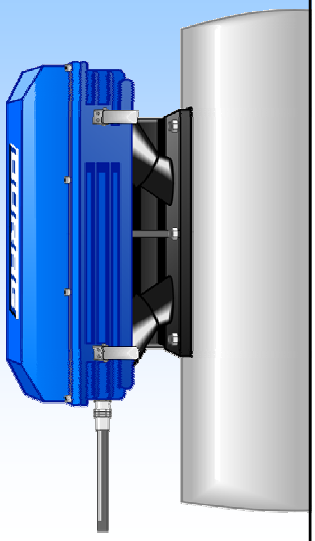
D-R 300 Pölypitoisuus ja nokilukumittari

- **In-situ mittaus suoraan savukaasuvirtauksesta**
- **Digitaalinen mittaviestien käsittely**
- **Suritekhoinen prosessori ohjelmistoineen**
- **Automaattinen tominnan valvonta ja mittausarvojen korjaus**
- **Automaattikalibrointi 4 tunnin välein**
- **Optikka ja elektroniikka hermeettisesti suljetussa**
- **kotelossa**
- **Huoltoystävällinen**
- **Pääsy kaikkiin aseteltaviin paramatreihin suoraan kontrolliyksiköltä**
- **Säätöihin ei tarvita erikoistyökaluja**
- **Automaattnen alueenvaihto 17. BImSchV mukaisesti**



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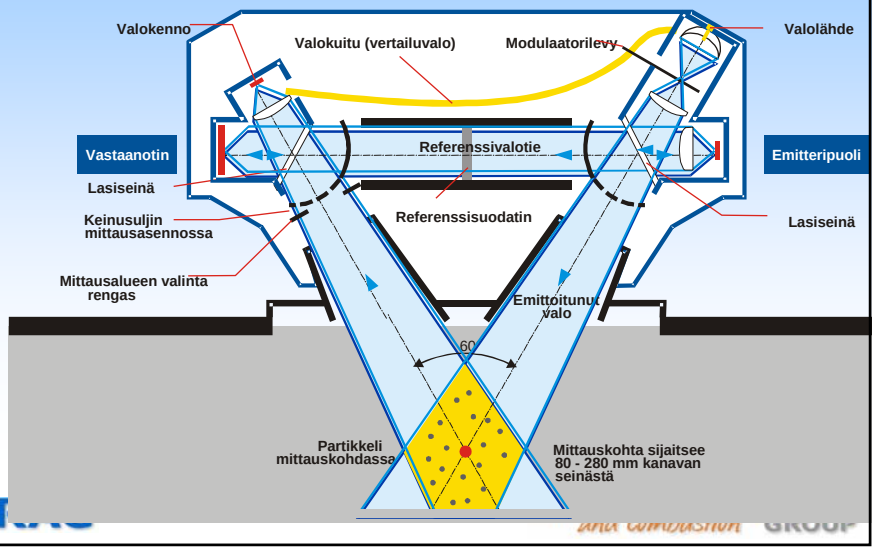
D-R 300 Optiikkakaavio



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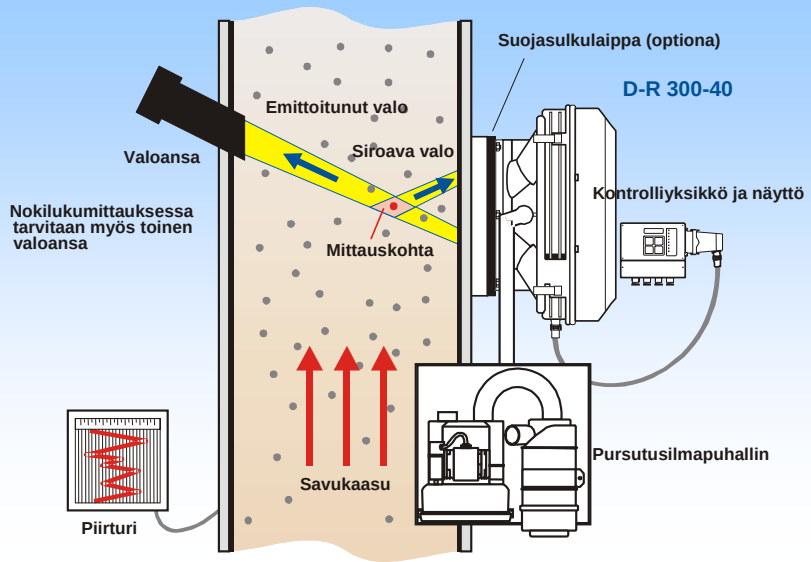
D-R 300 Järjestelmän komponentit



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	Opasiteetti	Pöly	Pöly / Opasit.	Pöly / Opasit.	Pöly / Opasit.	Pöly	Noki
Laite	D-R 216	D-R 280-10	D-R 280-10 OP	D-R 281 AV	D-R 290	D-R 300-40	D-R 300
TÜV	X	X	X		X	X	X
US/EPA				X	X		
suoraan kanavasta mittaava	X	X	X	X	X	X	X
Automaattinen nollan ja alueen tarkistus			X	X	X	X	X
Automattinen likaisten ikkunoiden kompensointi		X	X	X	X	X	X
Lämmitetty ikkuna	X	X	X	X	X	X	X
Suojasulkulaipat	X	X	X	X	X	X	X
Valon vaimenemiseen perustuv	X	X	X	X	X		
Valon sirontaan perustuva						X	X
Valolähde	Halogeeni	Halogeeni	Halogeeni	Halogeeni	LED	Halogeeni	Halogeeni
Kaksikanavakapasiteetti				X	X		
Mittausaluevalinta				X	X	X opt.	
Etäkäyttöyksikkö				X	X		
Modbus liityntä					X opt.		
Opasiteetti (1-tiemittaus)				X	X		
Opasiteetti(2-tiemittaus)	X	X	X	X	X		
Optinen tiheys		X	X	X	X		
Kalibrointi mg/m³		X	X	X	X	X	
Kalibrointi Nokiluvun mukaan							X
Mittausalueet	25..100 %	0.1..1.6 Ext	0.2..0.8Ext 25..100 %	0.1..1.6 Ext 20..100 %	0.1..1.6 Ext 20..100 %	1...1000 mg/m³	3 RZ
Havaitsemisraja kun piipun halkaisija on 1 metri		10 mg/m³	10 mg/m³	10 mg/m³	10 mg/m³	0.01 mg/m³	0.06 RZ
Havaitsemisraja kun piipun halkaisija on 5 metriä		2 mg/m³	2 mg/m³	2 mg/m³	2 mg/m³	0.01 mg/m³	0.06 RZ

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Valintakriteerit

- Halutun mittausalueen suhde kanavan halkaisijaan
  - Iso piippu + pieni pölypitoisuus: Transmissio / D-R 290
  - Suuri pölypitoisuus: Transmissio / D-R 290
  - Opasiteetin mittaustarve: D-R 216 / D-R 290
  - Matala pölypitoisuus + pieni piippu: Sirontan perustuva D-R 300-40
- Kastepisteen yläpuolella (kastepiste riippuu kaasun koostumuksesta)
- Lähellä kastepistettä: Lämmitetty pursutusilma
- Kastepisteen alapuolella: VEREWA F 904
- Korkea kaasun lämpötila
  - Lämpösuojus (maks. 55 C mittapäässä)
  - Suojasulkulaipat
  - Redundanttiset puhaltimet
- Paine piipin sisällä +/- 20 hPa (200 mm H2O) tavallisilla puhaltimilla
- Erittäin matalat ympäristölämpötilat: Laippa- ja pursutusilman lämmitys
- Jätteenpolttolaitos: D-R 300-40 Halar pinnoitteella (ja pursutusilman lämmitys)
- Täytä sovellutuskyselykaavake ja palauta maahantuojalle

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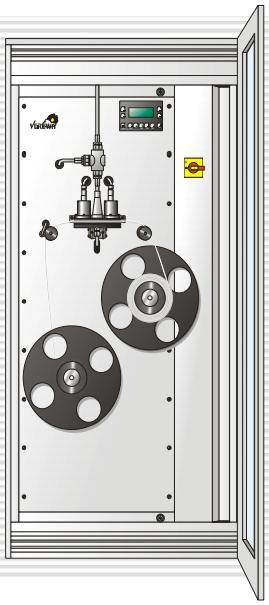
Solutions for Emission and Combustion DURAG GROUP

VEREWA F-904 Emissio / Prosessipölymittari



Toimiva ratkaisu märkien savukaasujen pölymittaukseen

sli_f904_01

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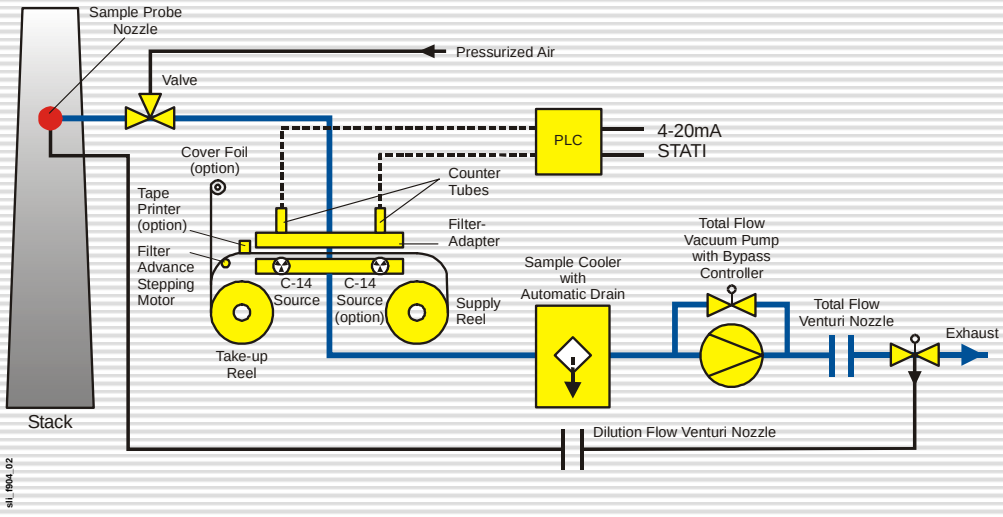
F-904 Flow Diagram



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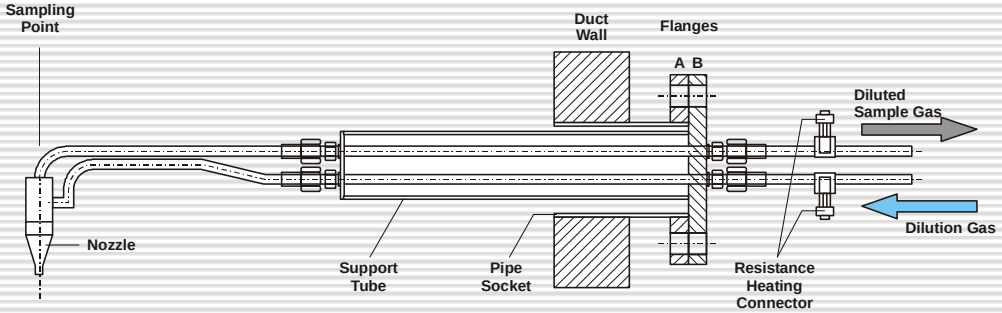
Sample Gas Probe for F-904



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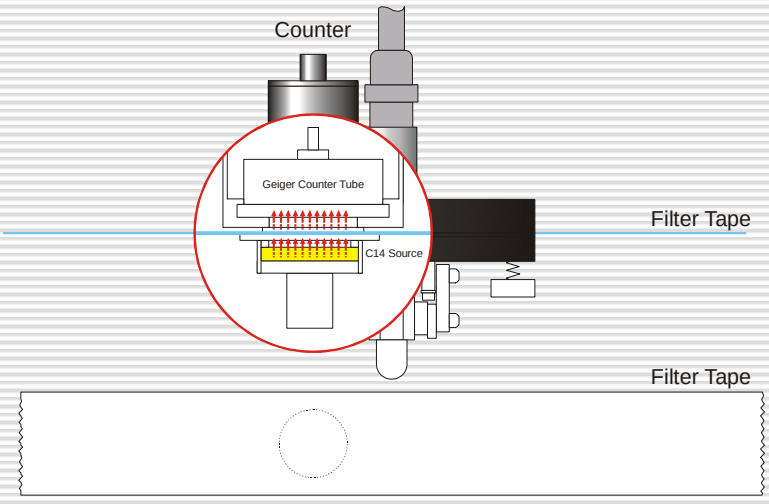
VEREWA

Smart Solutions for DURAG Combustion and Emission GROUP

F-904 Cycle Step 1: Measuring the Clean Filter (Zero Check)



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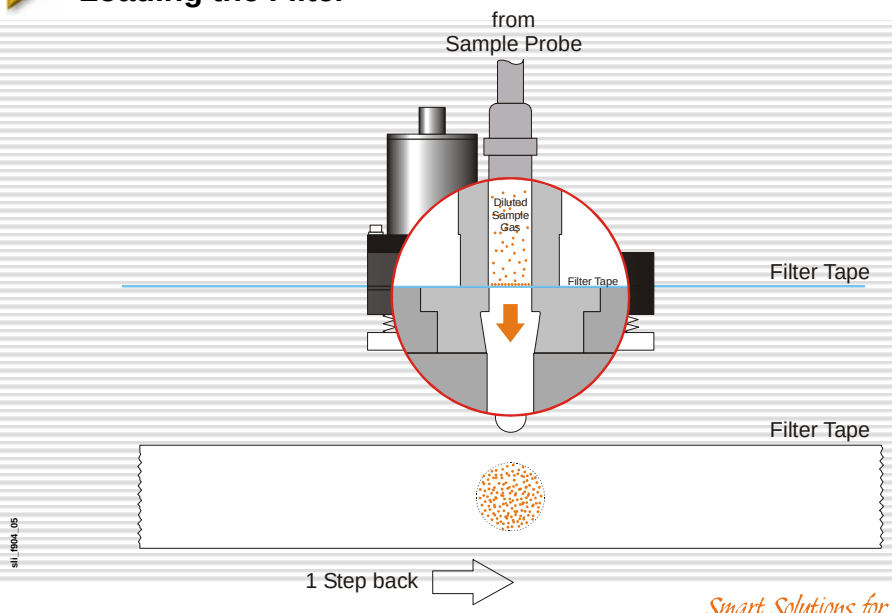
F-904 Cycle Step 2: Loading the Filter



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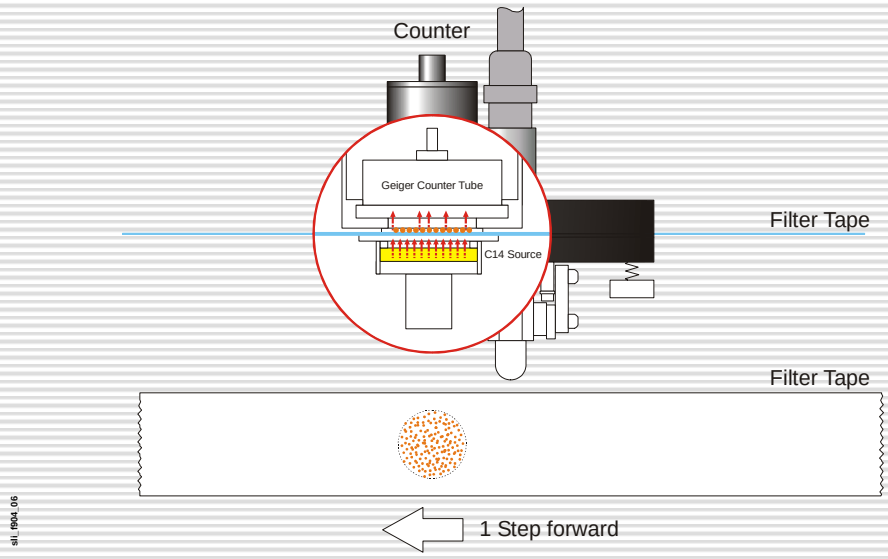
F-904 Cycle Step 3: Measuring the Loaded Filter



sil_f904_06

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Location of Sample Probe and F-904

Type of Particles	Distance Sample Probe to Analyzer		
	short < 5 m	medium 5 to 20 m	long 20 to 40 m
Size Small (majority below 10 µm)	excellent	excellent	good
Size Large	good	ok	bad
Dry Particles / no Condensation	excellent	excellent	good
Wet & Sticky Particles / condensation	good	ok	bad

sli_f904_07

Smart Solutions for DURAG Combustion and Emission GROUP

Selection of Sample Probe

Type of Particles	Dilution	No Dilution
Small & Dry	good	good
Large & Wet	good	very bad
Concentration		
Low (< 50 mg/m³)	good	good
Medium (50 to 200 mg/m³)	good	bad
High (> 200 mg/m³)	good	very bad
Distance Probe to Analyzer		
Short (≤ 5 m)	good	good
Medium (5 to 20 m)	good	bad
Long (20 to 40 m)	good	very bad
Sample Gas		
Dry, above dewpoint	good	good
Wet, at or below dewpoint	good	very bad

sli_f904_08

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Comparison of Emission Particulate Monitoring Methods

Condition	β-GAUGE (904)	Opacity	Scattered Light
Concentration High (> 100 mg/m³)	ok	good	ok
Concentration Low (< 100 mg/m³)	good	bad	good
Dry Stack (above dew point)	good	good	good
Wet Stack (below dew point)	excellent	very bad	very bad
Humidity (non-condensing) constant	good	good	good
Humidity (non-condensing) varying	good	bad	very bad
Stack Diameter Large (> 3 m)	ok	good	bad
Stack Diameter Small (< 3 m)	good	ok	good
Particle Size constant	good	good	good
Particle Size varying	good	not ok	bad
Particle Color constant	good	good	good
Particle Color varying	good	not ok	very bad
Particle Density constant	good	good	good
Particle Density varying	good	not ok	bad
Gas Velocity constant	good	good	good
Gas Velocity varying (> ± 10 m/s)	not ok	good	good

sli_f904_09

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Comparison VEREWA F-904 vs. Heated By-Pass Optical Instruments

Parameter	F-904	Kilpailija 1	Heated By-Pass
Official Equivalency Approval (standard instrument)	Germany/Europe US-EPA Compliant	unknown	Germany Europe US-EPA (CH)
Signal reported in mg/Nm³, dry basis	yes	no (actual m³ wet)	no (actual m³ wet)
Calibration	factory precalibrated	only on-site alibration	only on-site calibration
Total Radiation, C-14 source	< 12.5 µCi (below regulation limit!)	N/A	N/A
flow velocity in sample line (low velocity = subject to clogging!)	app. 20 m/sec.	app. 3 – 5 m/sec.	app. 3 – 5 m/sec.
flow control	venturi	none	-
dilution for high concentration or wet gas	yes	no	no
max. water condensate (g/m³) in sample gas	app. 300	10	10 - 30
false measurement at concentrations > 300 mg/m³	no	yes	yes
heated sample probe	yes	no	no
power requirement for heating of sample line	0,1 kW/m	2,5 kW/m	5 – 8 kW/m
possible length of sample line	25 m	1	5 – 8 m
possible to be installed in instrument shelter	yes	no	typically no
sample gas chiller	yes	no	no
dust sampling for secondary analysis (Heavy Metals)	yes	no	no
Interference due to particle color and size variations	no	yes	yes
overall weight	medium	low	medium (CH) very high (D)
initial cost (F-904 = 100)	100	approx. 100	150 - 200
cost of ownership (operational cost)	low	high (due to high power requirement!)	very high (due to high power requirement!)

CH = Sigrist ; D = Sick

sli_f904_10

Smart Solutions for Combustion and Emission DURAG GROUP

F-904 / F-904 K Application List

VEREWA's Emission Dust Monitors, models F-904 and F-904-K are used for automatic dust monitoring in various emission and process applications in the following countries:

Austria	Belgium	China	Czech Republic
Finland	France	Germany	Hungary
Italy	Korea (South)	Netherlands	Poland
Portugal	Spain	Switzerland	Taiwan
UK USA			

VEREWA's Emission Dust Monitors, models F-904 and F-904-K are successfully used for automatic dust monitoring in the following industries and applications:

Blast Furnace Gas (Steel Industry)	Cement Industry
Chemical Industry	Coal Fired Power Plants
Fertilizer Manufacturing Plants	Heavy Metal Refineries
Industrial Waste Incinerators	Municipal Waste Incinerators
Paper Mills	Refinery Sludge Incinerators
Sugar Mills (Beet Drying)	Waste Water Sludge Incinerators
Wet Stacks (below dew point) (marked "wet")	

sli_f904_11

Smart Solutions for Combustion and Emission DURAG GROUP

F-904 / F-904 K User List I

Waste Incineration (Municipal, Industrial, Hazardous, Sludge)

- Berliner Stadtreinigung, Germany (8 units)
- Cegelec, Belgium
- CFE, Belgium (4 units in several plants)
- Ciba Geigy, Germany (wet)
- Dynamit Nobel, Germany (wet)
- Elf Atochem, France (wet)
- Ecochem, Finland (wet)
- FIAT / Stureco Incinerator, Italy (wet)
- Gesellschaft für Sondermüllbeseitigung, Germany (3 units)
- Hovione Incinerator, Portugal (wet)
- Intradel, Belgium (4 units in several plants)
- JRC – European Commission Joint Research Center, Ispra, Italy (Reference Instrument)
- KVA Thurgau, Switzerland (2 units)
- Müllheizkraftwerk Würzburg, Germany (2 units)
- Müllverbrennung Bielefeld, Germany (3 units)
- Sotradec, Belgium (4 units in two plants)
- Termizo a.s., Liberec, Czech Republic (wet)
- Tredi, France (wet)

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F-904 / F-904 K User List II

Power Plants

- Dae Woo, Korea
- Erdölchemie / Bayer AG, Germany
- Mechanical Systems (for US-EPA), USA (2 units)
- Midwest Research Institute (for US-EPA), USA
- Stadtwerke Bremen, Germany
- Yukong Industries, Korea

Steel Plants, Metal Refineries (Emission, BFG)

- Bao Shan Steel Plant, China
- British Steel, UK
- China Steel, Taiwan
- Preussag Stahl, Germany (2 units)
- Voest-Alpine Stahl, Austria

Pulp & Paper, Sugar

- Schwäbische Zellstoff AG, Germany (wet)
- Zucker Nord, Germany

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F-904 / F-904 K User List III

MISC. Industrial
(e.g. Chemical Industry, Refineries, Reference Institutes)

- BASF AG, Germany (2 units)
- ENICHEM Assemini, Italy (wet)
- ENICHEM P.to Torres, Italy (wet)
- ESSO AG, Germany (wet)
- Gemini Scientific, China
- Guano Werke, Germany
- OHNÚT, Czech Republic
- SPENT, Qatar (wet)
- Zaklady Azotowe Wloclawek

sli_f904_14

Smart Solutions for DURAG Combustion and Emission GROUP

In-Situ Gas Analyzer LDS 6

Process Analytics

LDS 6

SIEMENS

CGA Series 6: The Best of Two Worlds!

Process Analytics

LDS 6

extractive		in-situ
Ultramat 6, Oxymat 6, ...		**LDS 6**
Wide range of gases / applications		Limited range of gases / applications
Max. 4 components simultaneously		Max. 2 components simultaneously
Gas sampling / conditioning	⇨	No sampling, no conditioning
Const. measuring conditions		Measuring at process conditions
Point-like probing		Line-of-sight measurement
Possible cross interferences		No cross interferenceS
Dust filters	⇨	High dust loads, high dynamics allowed
Gas coolers: dry gas analysis		Wet gas analysis
Delay time by sampling	⇨	Real time measurement
Field housing for Ex zones, EEx p		Intrinsically safe sensors, EEx ia

SIEMENS

LDS 6: In-situ at Its Best!

Process Analytics

LDS 6

Conventional in-situ	In-situ with laser
IR, UV-VIS, ZrO_2	**Tuneable diode laser**
Sensitive to dust and/or alignment	Insensitive to dust & misalignment!
Cross interference very likely:	No cross interferences!
→ H_2O, CO_2, SO_2, CO, HC	
Limited lifetime of light source, probe	⇒ Life time of diode laser (> 6 y)!
Expensive and limited fibre coupling	⇒ Inexpensive and almost unlimited fibre coupling!
Off-line calibration by test gases	Self calibration by build-in ref. cell!
Delay due to signal treatment	⇒ Real-time measurement!
ZrO_2-Probe: point like measurement	⇒ Line-of-sight measurement!

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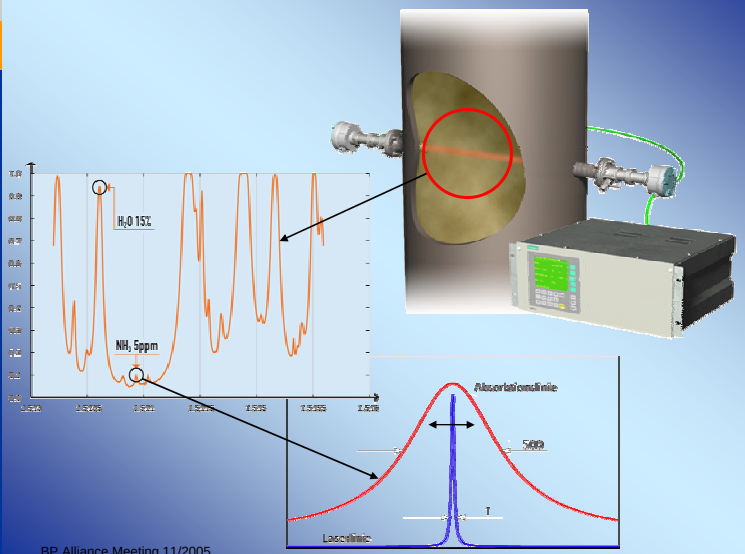
In-Situ Single Line Absorption Spectroscopy

Process Analytics

LDS 6



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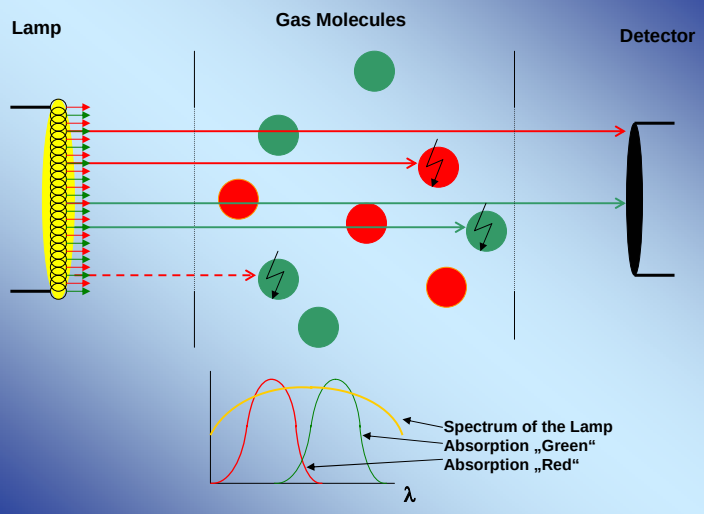
Absorption of White Light

Process Analytics

LDS 6



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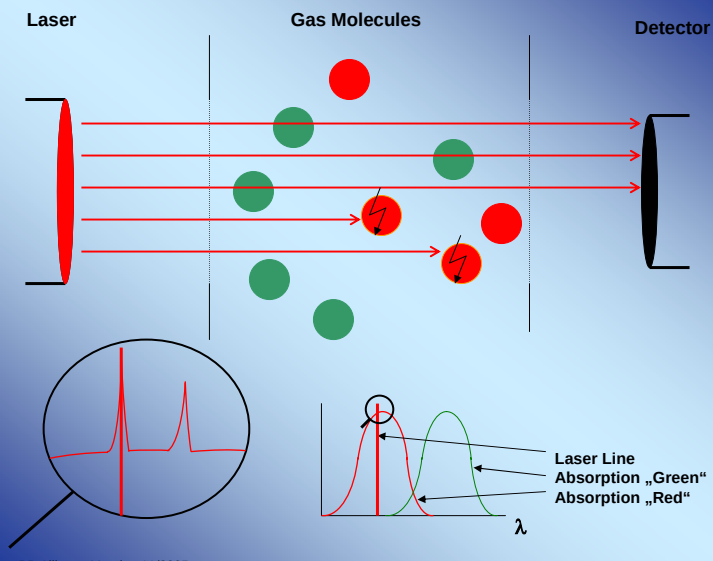
Absorption of Laser Light

Process Analytics

LDS 6



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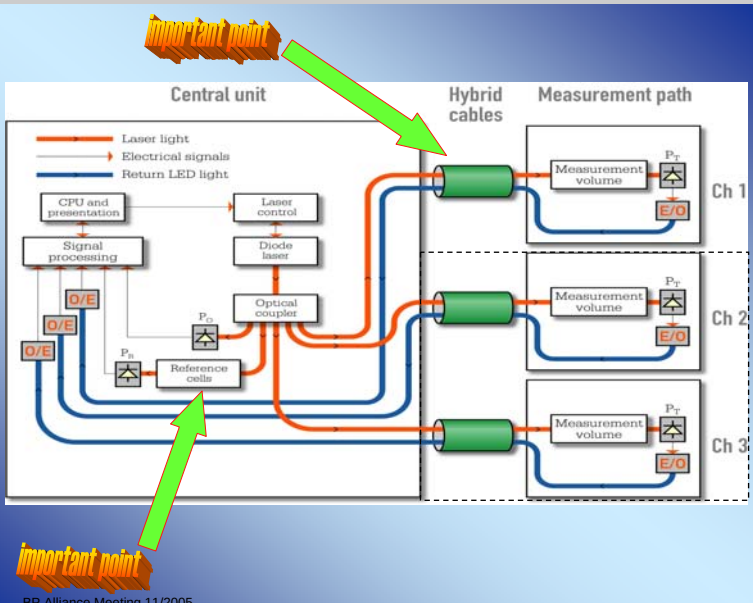
The LDS 6 Analyser System

Process Analytics

LDS 6



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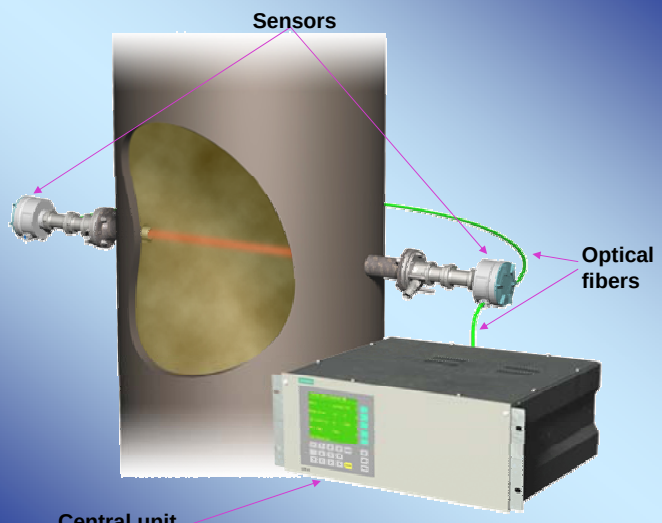
Process Instrumentation and Analytics

Process Analytics

LDS 6



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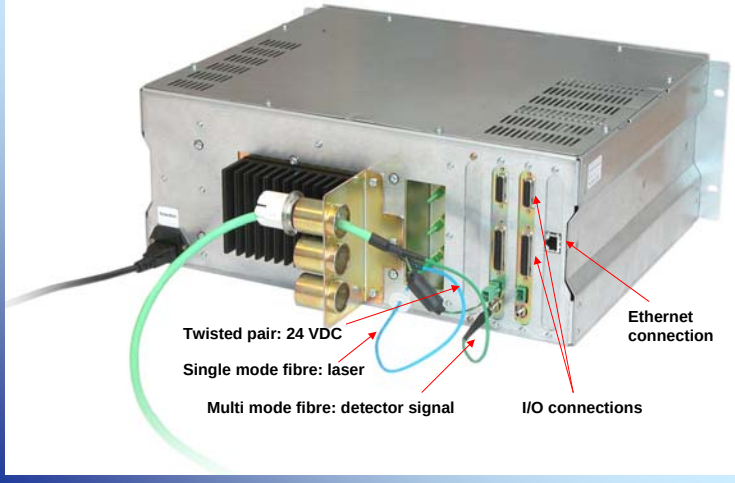
LDS 6 – Technical Features

Process Analytics

LDS 6

Central unit - connections



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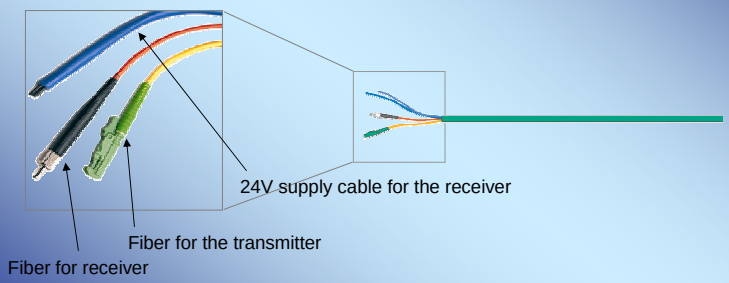
Hybrid Cable

Process Analytics

LDS 6

Allow to remote the sensors at <1000m distance from the central unit, which stay then in a safe and cool area



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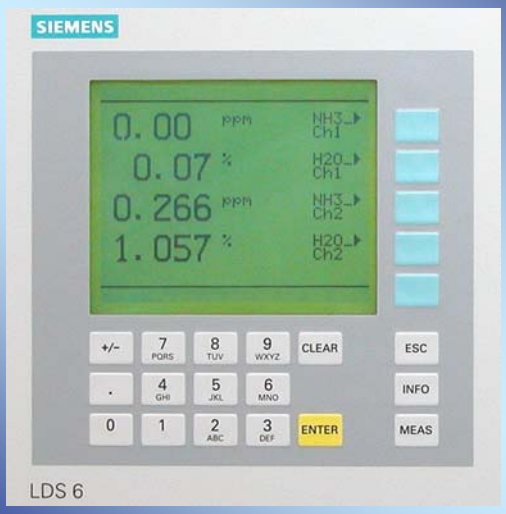
LDS 6 – Technical Features

Process Analytics

LDS 6

Central unit key pad



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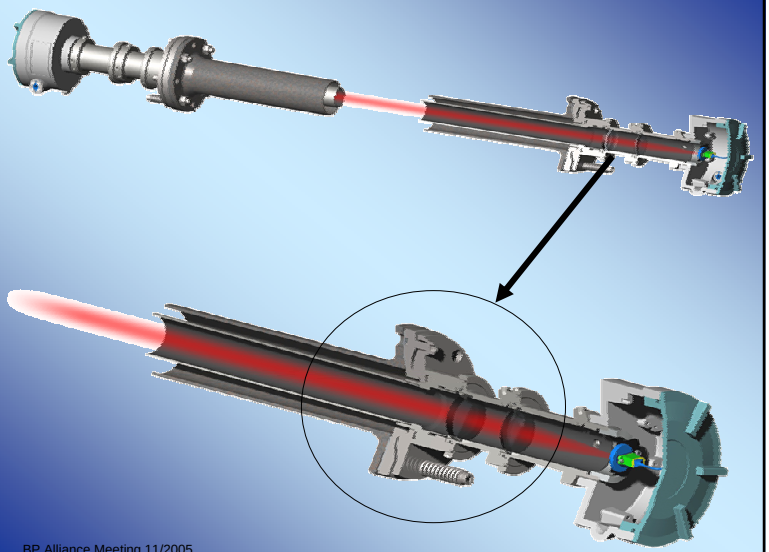
Design of the new sensors

Process Analytics

LDS 6



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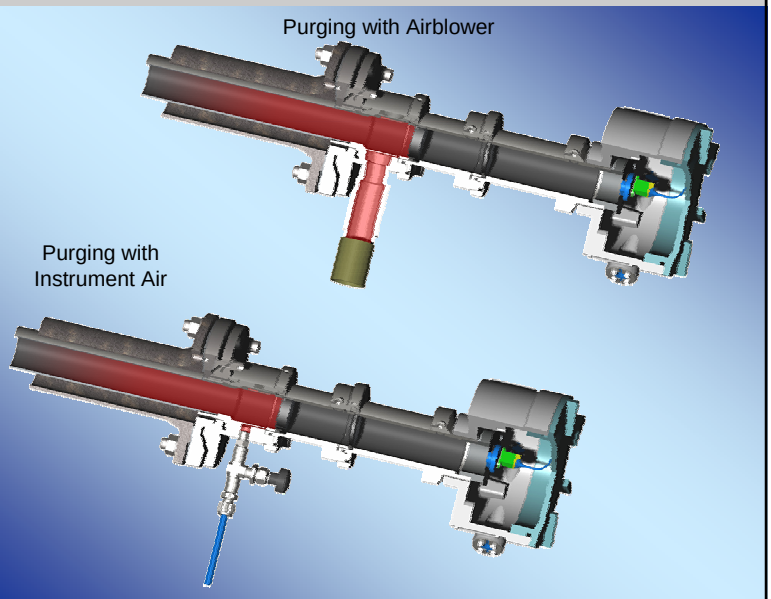
Process Instrumentation & Analytics

Process Analytics

LDS 6

Purging process side



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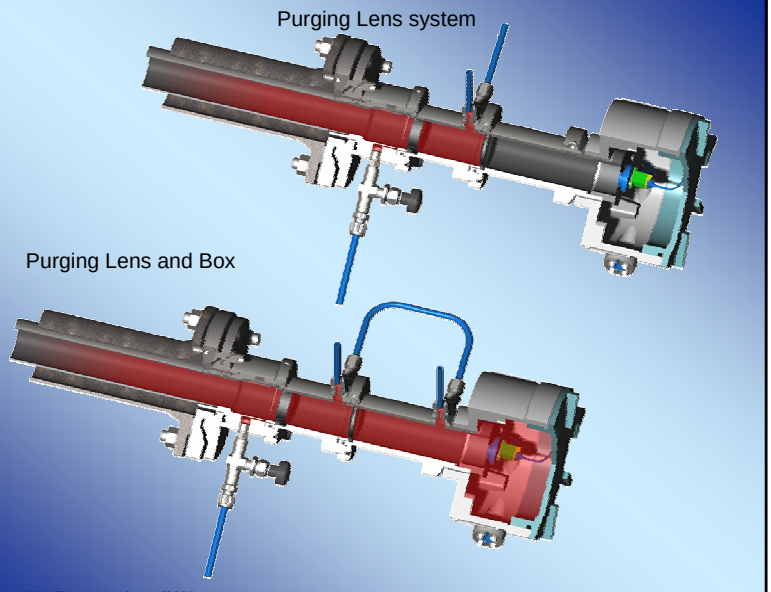
Process Instrumentation & Analytics

Process Analytics

LDS 6

Purging sensor side



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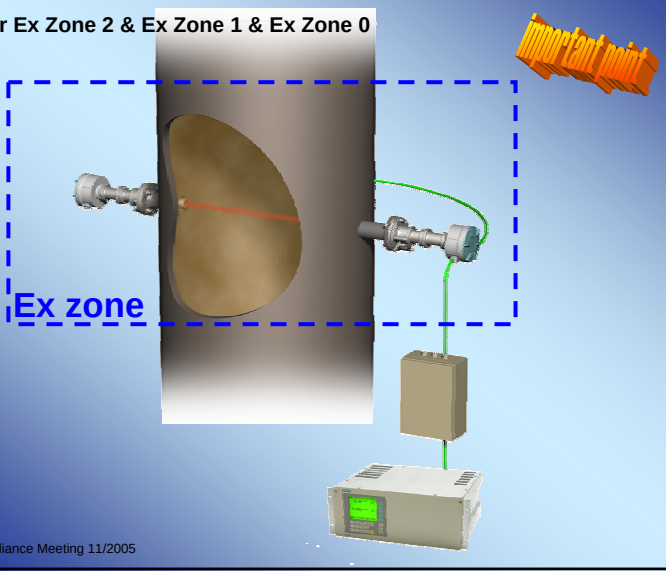
LDS 6 – Technical Features

Process Analytics

LDS 6

Hazardous area – Ex II 1GD EEx ia IIC T4

For Ex Zone 2 & Ex Zone 1 & Ex Zone 0



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We can achieve this performances !

Process Analytics

LDS 6

- Min. 99% availability
- In-situ, no gas sampling
- Response time < 1 – 3 s
- Dust loads up to 100 g/Nm^3, fast changing
- Gas temperatures up to 1500 °C, fast changing
- High selectivity, **no** cross interference
- Complex gas mixture, changing
- Easy installation, low maintenance
- Self calibration
- Automatic gain compensation
- Accuracy 2% of the reading or the sensitivity whichever the largest

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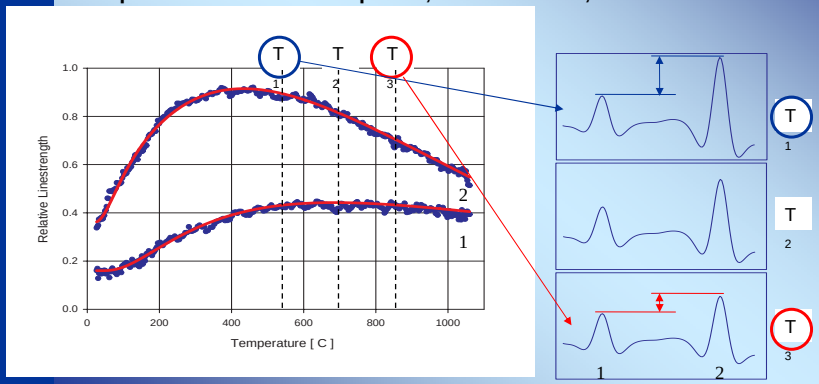
In-Situ Measurement of Gas Temperatures by TDLAS

Process Analytics

LDS 6

Non-contact measurement of high temperatures by using the relative absorption strength of two O_2 lines:

- **Very fast determination of the O_2 concentration and the gas temperature in the same gas volume at the same time**
- **No influence on the temperature measurement by radiation of particles or molecular species, no wall effects, no drifts**



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Process Instrumentation and Analytics

Measuring Ranges and Minimum Detection Limits

Process Analytics

LDS 6

Gas	Measuring range Min.	Max.	Minimum detection limit (at 20°C, 1 bar, 1 m)
O_2 / T	0 – 1 Vol% 550°C – 1300°C	0 – 100 Vol%	500 ppmv; at min. 0,1 Vol% O_2
NH_3 / H_2O	0 – 10 ppmv 0 – 5 (30) Vol%	0 – 100 Vol%	0,3 ppmv 0,1 Vol%
HCl / H_2O	0 – 10 ppmv 0 – 5 (30) Vol%	0 – 25 Vol%	0,2 ppmv 0,1 Vol%
HF / H_2O	0 – 2 ppmv 0 – 5 (30) Vol%	0 – 10 Vol%	0,05 ppmv 0,1 Vol%
CO / CO_2	0 – 1 Vol% 0 – 1 Vol%	0 – 100 Vol% 0 – 100 Vol%	200 ppmv 200 ppmv
H_2O	0 – 10 ppmv	0 – 100 Vol%	0,3 ppmv

Reminder : the sensitivity improves with the length of gas crossed
Ex : NH3 sensitivity 0,2 ppm per 1m, if 2m sensitivity=0,1ppm !
It is directly proportionnal

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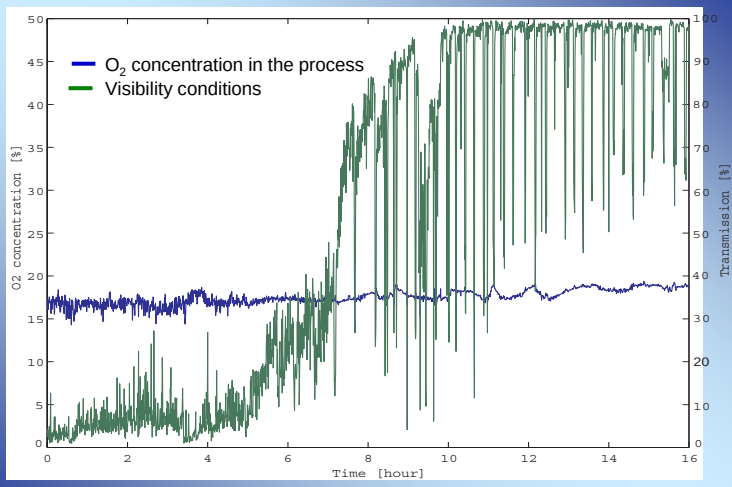
In-Situ Gas Analysis in High Dust Loads

Process Analytics

LDS 6



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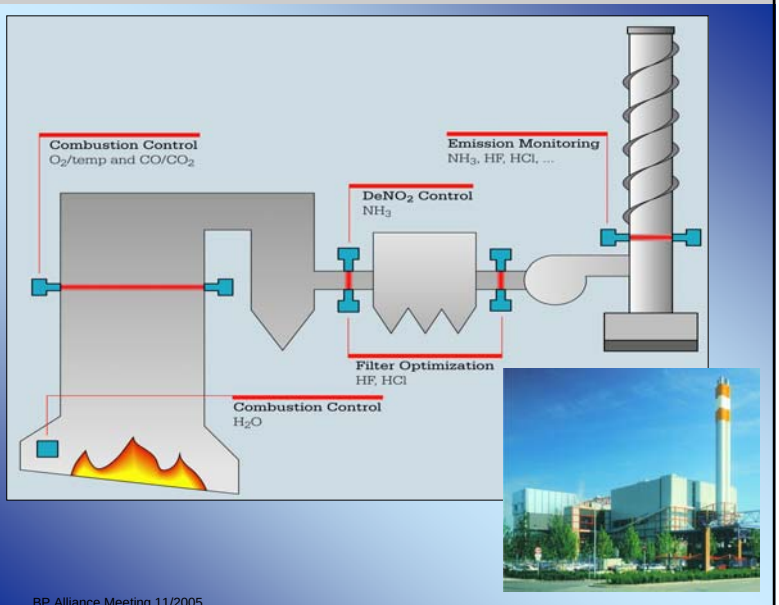
Applications in Combustion Industry

Process Analytics

LDS 6



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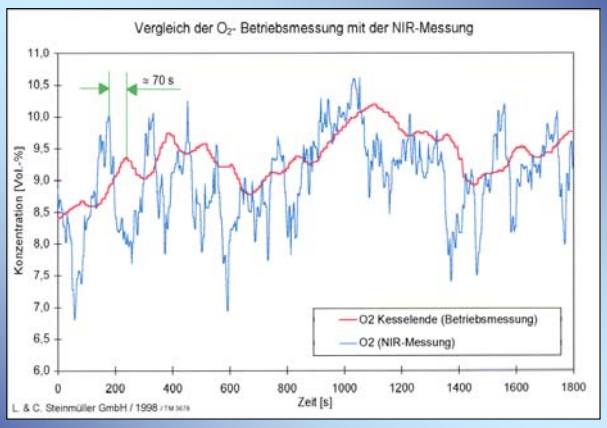
Application: Combustion Control in MWI

Process Analytics

LDS 6

Results:

- Approximately 70 s time delay
- Better resolution of changes in the process conditions



ZrO_2

LDS

(Data by courtesy of BBP Environment GmbH, 1998)

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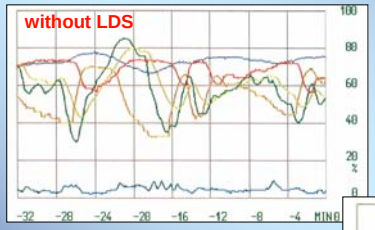
Process Instrumentation and Analytics

Application: Combustion Control in MWI

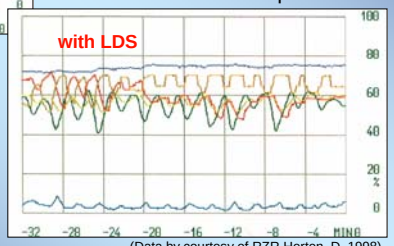
Process Analytics

LDS 6

Better control of the combustion process by fast closed loop measurements of O_2:



- Less excess air of approx. 10 %
- Better energy efficiency
- Lower costs for gas cleaning due to less gas flow
- Less HT corrosion
- More stable steam production



steam production
primary air
secondary air
O_2
CO

(Data by courtesy of RZR Herten, D, 1998)

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BP Alliance Meeting 11/2005

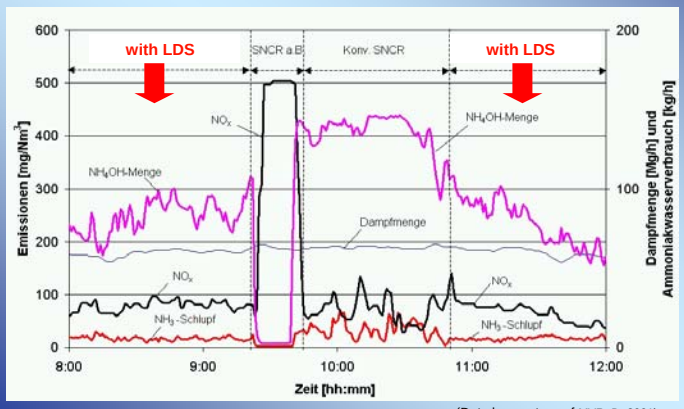
Application: Optimisation of SNCR de-NOx plants

Process Analytics

LDS 6

Optimisation of SNCR de-NOx plants by fast in-situ measurements of the NH_3 slip:

- Reduction of NOx emissions
- Less ammonia consumption by 25 – 30 %
- Less ammonia slip by 50 – 70 %
- Less ammonia salt formation on cold surfaces



(Data by courtesy of MVR, D, 2001)

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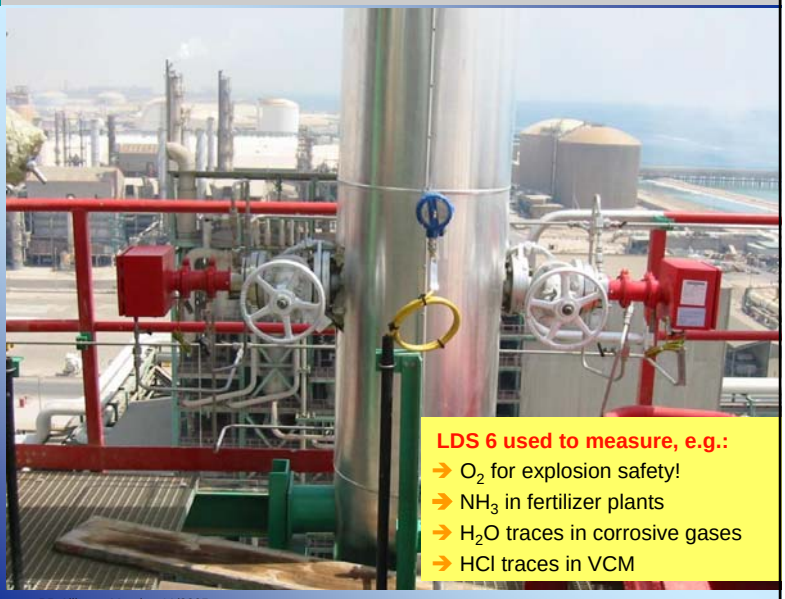
Applications in Chemicals / HPI

Process Analytics

LDS 6



LDS 6 used to measure, e.g.:

- O_2 for explosion safety!
- NH_3 in fertilizer plants
- H_2O traces in corrosive gases
- HCl traces in VCM

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Technology
"Value Proposition"

Process Analytics

LDS 6

LDS controlled combustion in Aluminum recycling furnaces of steel plants

- fast in-situ measurement of O_2 at furnace outlet
- optimized, software controlled combustion on the basis of LDS measured values (patented process by Air Liquide)

This is resulting in

- savings on oxygen consumption
- higher Aluminum recovery rate by avoiding extra oxidation

Payback of the LDS system can be achieved within one year!

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Process Instrumentation and Analytics

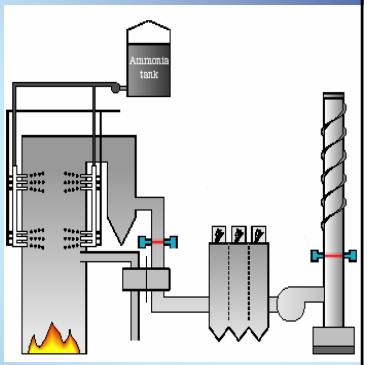
Technology
"Value Proposition"

Process Analytics

LDS 6

Optimized SNCR DeNOx Processes

- measurement of NH_3 and moisture
- controlling and minimizing the ammonia slip as well as the total NOx emission



Cost saving facts:

- minimized slag built-up on pre-heaters
- significant less consumption of NH_3 and urea
- minimized corrosion
- possible recycling of fly ash due to minimized NH_3-concentration

More than 60 installations worldwide prove that we do it right!

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Technology
"Value Proposition"

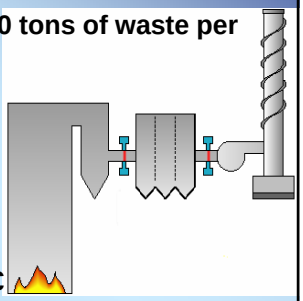
Process Analytics

LDS 6

Bag house filter control in waste incineration plants

- measurement of HCl at the filter inlet and outlet
- optimize lime consumption and reduce production of fly ash

Example: Plant with two lines, 200.000 tons of waste per year



- **Save 22% lime for neutralization:**
  11 kg/t_{waste} instead of 14 kg/t_{waste}
  1 kg lime costs 0,15 €
  Save 92.000 €/year on lime!
- **Save 22% fly ash disposal cost:**
  1 ton of fly ash disposal costs 340 €
  Save 210.000 €/year on fly ash disposal cost!

Return on LDS-investment: 3,6 months only!

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Process Instrumentation and Analytics

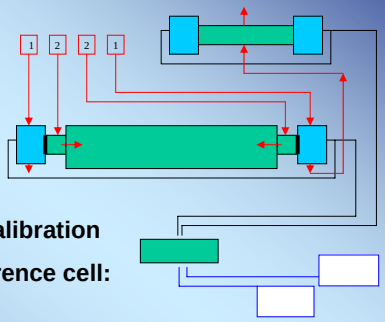
Technology
"Value Proposition"

Process Analytics

LDS 6

Optimizing the dryness of a Chlorine process

- measurement of trace moisture in Chlorine
- controlling the moisture in real time after the drying tower in the chlorine process



Cost saving facts:

- **Stable & Reliable Measurement compared to the P2O5 sensors**
- **Permanently calibrated system**
- **No cleaning, no fouling, no recalibration**
- **Additional benefit with the reference cell: purge nitrogen monitoring**
- **Potential for process optimisation, e.g. H2SO4 savings**

6 installations are running in the moment!

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Technology
"Value Proposition"

Process Analytics

LDS 6

Measurement of HCl in Vinyl Chloride Monomer plants

- measurement of HCl at product outlet
- usually, the HCl level is 0 ppm, HCl in the outlet is an evidence for the drift of the process which can lead to the destruction of the entire plant
- currently differential conductivity measurements is used which typically is a maintenance nightmare
- LDS can be used in combination with a measurement cell (extractive measurement after vaporization)

- Due to built-in reference cell, LDS makes sure not to sleep away – risk that is always given at 0 ppm measurements

LDS pays back quickly since maintenance costs can be cut-off significantly!

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Technology
"Preventive Maintenance"

Process Analytics

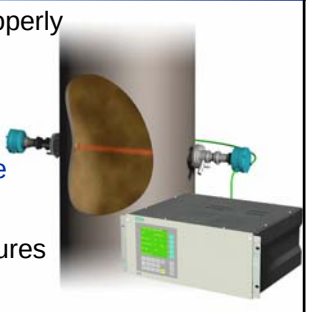
LDS 6

The LDS alarm system

- Maintenance request: Action by operator required
- Fault: Analyzer does not measure properly

The LDS monitoring system

- laser: current, intensity
  get information on the condition of the laser diode well-timed
- PCBs: supply voltages and temperatures
- potential leakage of reference cell



- transmission of measuring path
  no need to clean the lenses before there is really required
- alarm if there is a fault on the external signals (pressure, temperature)

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Application: Safety Surveillance of ESP (E-Filter)

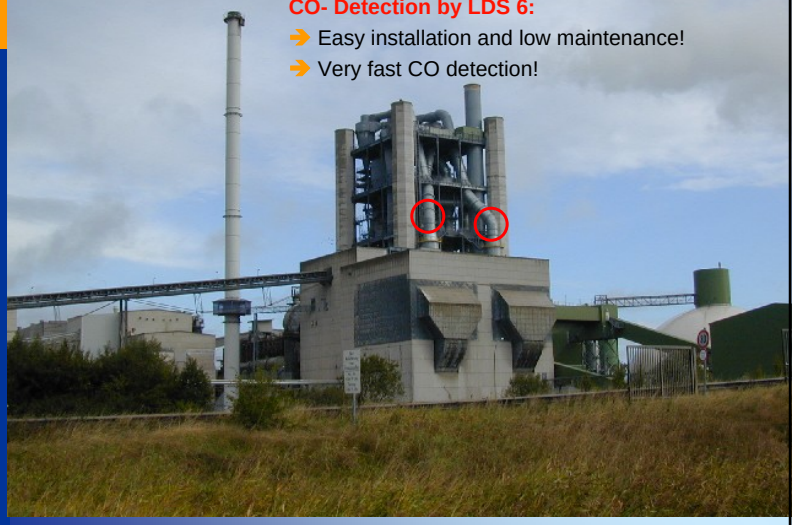
Process Analytics

LDS 6

The threat: Explosion of CO/air mixtures in ESP e.g. in cement plants:

CO- Detection by LDS 6:

- Easy installation and low maintenance!
- Very fast CO detection!



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Application: Safety Surveillance of Coal Silos

Process Analytics

LDS 6

The threat: Self-ignition of coal in silos e.g. for cement plants:

CO- Detection by LDS 6:

- Easy installation and low maintenance!
- Very fast CO-detection!

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Application: Control of Electric Arc Furnaces

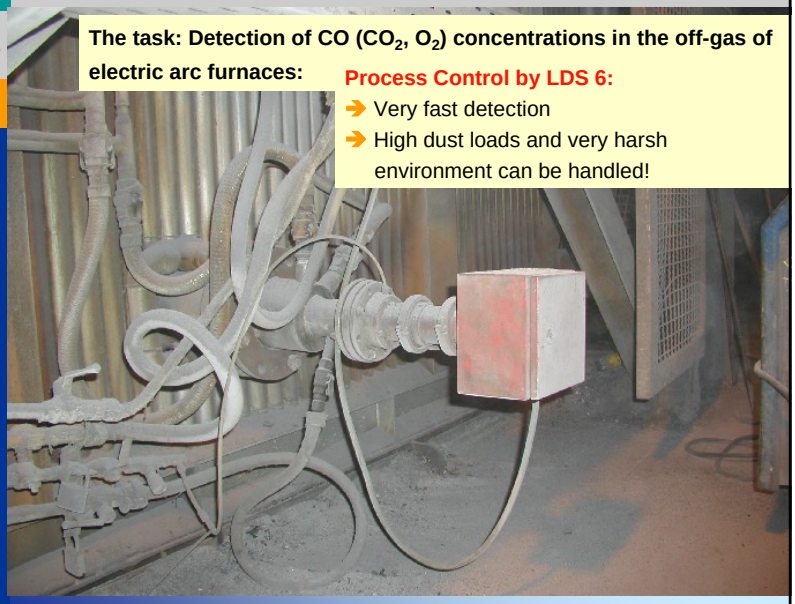
Process Analytics

LDS 6

The task: Detection of CO (CO_2, O_2) concentrations in the off-gas of electric arc furnaces:

Process Control by LDS 6:

- Very fast detection
- High dust loads and very harsh environment can be handled!



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Technology Customer Benefits

Process Analytics

LDS 6

Conventional in-situ		In-situ with laser
IR, UV-VIS, ZrO_2		**Tuneable diode laser**
Sensitive to dust and/or alignment		Insensitive to dust & misalignment!
Cross interference very likely:		No cross interferences!
→ H_2O, CO_2, SO_2, CO, HC		
Limited lifetime of light source, probe	→	Life time of diode laser (> 6 y)!
Expensive and limited fibre coupling	→	Inexpensive and almost unlimited fibre coupling!
Off-line calibration by test gases		Self calibration by build-in ref. cell!
Delay due to signal treatment	→	Real-time measurement!
ZrO_2-Probe: point like measurement	→	Line-of-sight measurement!

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Examples of Reference Installations

Process Analytics

LDS 6

Combustion Control

- RZR Herten, D
- Petacalco Power Plant, Mexico
- AMK Iserlohn
- EGK Krefeld
- LONZA AG, Visp, CH

DeNOx-Optimisation

- MVR Hamburg, D
- Amagerverket, DK
- Vestforbranding, DK
- LONZA AG, Visp, CH
- MIRO, Karlsruhe, D
- SHELL, Gothenburg, S

Filter Optimisation

- MVV Mannheim, D
- KummuneKemi, DK
- LAB, F
- ISAL, Iceland
- MVA Niklasdorf, A

Emission Monitoring

- ISAL, Iceland
- PUM – Sollac, Reims, F
- Slovalco, Slovakia
- AluChemie, NL

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Process Instrumentation and Analytics

Process Analytics

LDS 6

Thank you very much for your attention

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Syyskuu 2005

PPM - SYSTEMS OY

- Yrityksen liikeidea on harjoittaa taloudellisesti kannattavaa liiketoimintaa, toimittamalla asiakaskunnalleen korkealaatuisia mittalaitteita ja niihin liittyviä palveluita tuottavuuden, turvallisuuden ja elinympäristömme laadun parantamiseksi.
- Hankimme toimeentulomme perinteisin menetelmin, valehtelematta ja varastamatta, ansaitsemalla sen.

Syyskuu 2005

PPM - SYSTEMS OY

Toimintoja seuraavilla prosessianalyyttisillä alueilla

- Ilmanlaadun valvonta ja järjestelmät
- Kaasuanalysaattorit
- Kaasuhälyttimet
- Liekin valvonta
- Prosessikaasukromatografit
- Pölynäytteenottimet ja analysaattorit
- Savukaasuanalysaattorit ja valvontajärjestelmät
- Sytyttimet
- Vesi- ja nesteanalysaattorit

Syyskuu 2005

PPM - SYSTEMS OY Päämiehet aakkosjärjestyksessä
alphabetical order

- ***Barben Analytical Technologies (BAT)*** pH- ja redox-anturit
- ***Bühler M&R Technik*** Näytepumput, -sondit ja kompressorijäähdyttimet
- ***Controle Analytique*** Jäännös-N2 yms. epäpuhtausmittaukset kaasuista
- ***Durag / Hegwein/Verewa*** Liekinvartijat, sytyttimet ja pölymittarit
- ***Industrial Scientific Corporation (ISC)*** Kaasuhälyttimet
- ***K-Patents*** Prosessirefraktometrit (vain Venäjä ja IVY)
- ***Knick Process Analytics*** pH-, redox-, johtokyky ja liuenneen happen lähettimet
- ***Oxford Instruments Analytical Oy*** siirrettävät alkuaineanalysaattorit, (vain Venäjä ja IVY)
- ***Monitek (G.A.S.)*** Sameus- väri-, ja kiintoainemittarit
- ***M&W Asketeknik ApS*** Hiilipölyn virtausmittarit ja lentotuhkan hiilianalysaattorit
- ***Nametre (G.A.S.)*** Prosessiviskometrit
- ***O'Brien Corp*** Lämpösaatetut näyte- ja impulssiputket ja lämmitetyt laitekotelot (myös ATEX)
- ***Orbisphere Laboratories*** **(Hach U.A.)**Liuenneen happen, vedyn, otsonin ja O_2:n mittarit
- ***Photovac Inc.*** Kannettavat kaasukromatografit, PID ja FID analysaattorit
- ***Siemens A&D PI*** Prosessikromatografit, kaasuanalysaattorit ja HF, HCl ja NH3 laserdiodifotometri
- ***Teledyne API*** CO, CO2, NOx, O3 ja SO2 analysaattorit ilmanlaatumittauksiin
- ***Tytronics (G.A.S.)*** Prosessititraattorit ja -kolorimetrit
- ***Universal Analyzers*** Näytteenkäsittelyn komponentit

Hajukaasujen VOC- ja TRS-mittalaitteisto

PPM systems
Analyysilaitteita, kaasuhälyttimiä liekinvartijoita ja sytyttimiä
www.ppmsystems.fi

Tilanne 1/2

- Korkeat syttyvien komponenttien pitoisuudet hajukaasuissa aiheuttavat vuosittain useita vaaratilanteita ja jopa räjähdyksiä puunjalostusteollisuudessa
- Koska mittauskohde on varsin vaikea, on markkinoilla ollut ainoastaan yksi mittaukseen soveltuva laite, joka mittaa kaikkien palavien summaa alueella 0-100% LEL

Tilanne 2/2

- PPM-Systems Oy sai vuoden 2000 alussa haasteen kehittää toimiva palavien hiilivetyjen ja rikkiyhdisteiden mittalaitteisto, jolla voidaan luotettavasti valvoa ***kummatkin*** pitoisuudet ***erikseen***
- Kesällä 2001 toinen ja lopullinen versio oli valmis ja noin 6 kuukauden käyttöjakson jälkeen laitteisto dokumentoitiin ja patenttihakemus jätettiin viranomaisille
- Tammikuusta 2002 alkaen TRS-, HC- ja LEL-data tehtaan automaatiojärjestelmään ja valvomonäytölle

Räjähdysrajoja

KOMPONENTTI	KAAVA	LEL, ppm	30% LEL, ppm
Tärpätti	$C_{10}H_{16}$	8 000	2 400
Metanoli	CH_3OH	67 000	20 100
Rikkivety	H_2S	43 000	12 900
Metyylimerkaptaani	CH_3SH	39 000	11 700
Dimetyylisulfidi	$(CH_3)_2S$	22 000	6 600
Dimetyylidisulfidi	$(CH_3)_2S_2$	11 000	3 300

Ominaisuudet ja hyödyt

- Laitteisto turvaa laitoksen toiminnan ja antaa mahdollisuuden korjaaviin toimenpiteisiin, jos TRS tai VOC –pitoisuudet lähestyvät jostain syystä vaarallisia arvoja
- Erilliset mittaukset antavat käyttäjälle mahdollisuuden paikallistaa häiriön syy ja synty paremmin kun kaikkien syttyvien summaa mittaava laite
- Laitteisto ei tarvitse polttokaasuja kuten vetyä - ainoastaan kuivaa instrumentti-ilmaa laimennusta ja jatkuvatoimista vertailureferenssiä varten

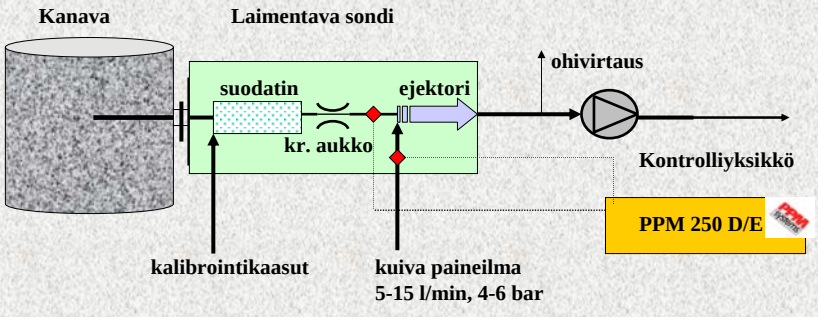
Sovelluskohteet

- Laimeiden ja väkevien hajukaasujen mittaus
  VOC 0..50% - 0..150% LEL esim. tärpättinä
  TRS 0..50% - 0..150% LEL esim. DMDS:na
- Liuotinpäästöjen mittaus painolaitoksilla ja kemianteollisuudessa
- Päästömittaukset
  VOC 0..200 ppm – 0..20 000 ppm esim. metaanina
  TRS 0..200 ppm – 0..20 000 ppm esim. rikkivetynä
- Korvaava menetelmä liekki-ionisaatiomenetelmälle (FID) yli 100 ppm pitoisuuksien mittaamiseen

Laitteistokokoonpano

- Lämmitetty laimennussondi
- Näytelinja (eri vaihtoehtoja)
- Laimennusjärjestelmä
- TRS-konvertteri
- Näytteenkäsittelyjärjestelmä
- 2-kanavainen NDIR – analysaattori
- Analysaattorikaappi jäähdyttimellä

Laimennusjärjestelmä



- laimennussuhteet: 10 : 1 – 250 : 1
- laimennus vakiolämpötilassa (200 °C)

Tekniset tiedot 1/2

- Mittausperiaate 2 x 2-säde NDIR fotometria laimennetulle, konvertoidulle ja kuivatulle näytteelle.
- Alueet hajukaasuille: 0…50 – 0…150 % LEL
  HC (esim. tärpättinä) ja TRS (esim. DMS:na)
- Alueet päästömittauksiin: 0…200 – 0…20 000 ppm
  HC (esim. metaanina) ja TRS (esim. H2S:na)
- Kokonaistarkkuus < +-5 % alueesta
- Automaattinollaus ilman apukaasua vakiona
- Automaattinen alueentarkistus tai –viritys haluttaessa ilman lisähintaa (kaasu tarvitaan)

Tekniset tiedot 2/2

- Lähdöt 2 x 4…20 mA ja RS 485, 2 aseteltavaa rajaa kummallekin mitattavalle komponentille, vikahälytys
- Näytteenottosondin liityntä: NS 65 NP 16 laippa
- Näytteenottosondin etäisyys alle 25 m kaapista, näytteen lämpötila +5 … 250 °C
- Ympäristölämpötila: sondi – 30 … + 60 C, kaappi
  –10…+50 C
- Syötöt: 230 V 50 Hz ja Instr.ilma 4-8 bar 5 l/min
- Laite täyttää samat turvallisuusvaatimukset, kuin varsinainen hajukaasujen käsittelyjärjestelmäkin.

Mitä uutta viimevuodesta

- Kaikki mittausparametrit nähtävissä laitteisaton ovea avaamatta
- Näytteen virtaus laitteen sisällä nopeutettu → lyhempi vasteaika

Mitä ”Sunilan pamauksesta” opittiin

- Häiriötilanne saattaa syntyä äärimmäisen nopeasti
- Pelkän hajukaasuanalysaattori varaan ei laitoksen turvallisuutta ole syytä jättää jollei käytetä redundanttista järjestelmää.
- Mittapiste on valittava huolella
- Analysaattori on sijoitettava mahdollisimman lähelle mittapistettä vasteajan minimoimiseksi
- Kaikki lukitukset on testattava

Ultrasonic Flow Monitoring

D-FL200
D-FL 200 T

Ultrasonic Flow Monitor

DURAG

Solutions for Emission and Combustion DURAG GROUP

Ultrasonic Flow Monitoring

Stack Volume Flow Monitoring

- Continuously monitoring the volume flow
- Ultrasonic differential method
- Up to 11 m measuring path length
- Ease installation
- Measuring range up to 40 m/s
- Automatically performed control cycles
- Independent to temperature or pressure change
- No moving parts
- Minimal maintenance necessary
- Easy-to-service

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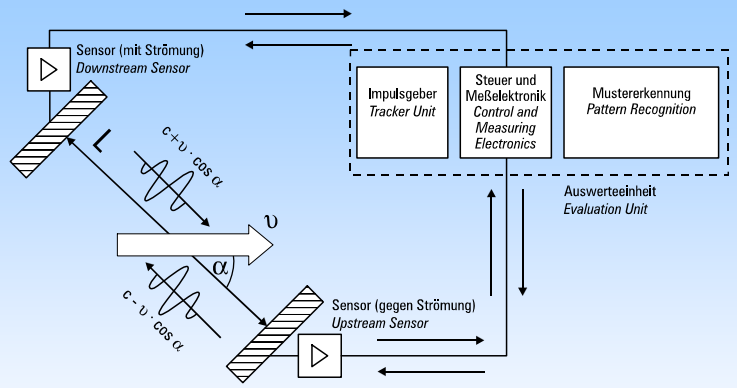
Solutions for Emission and Combustion DURAG GROUP

Ultrasonic Flow Monitoring

Measuring Principle of Ultrasonic Flow Monitoring



$$t_+ = \frac{L}{c + v \cdot \cos\alpha}$$ with flow

$$t_- = \frac{L}{c - v \cdot \cos\alpha}$$ against flow

$$v = \frac{L}{2 * \cos\alpha} \cdot \frac{t_- - t_+}{t_- \cdot t_+}$$ resulting gas velocity

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Ultrasonic Flow Monitoring

Formulas

Transit time

- t+ with the flow
- t- against the flow
- c Sonic velocity
- v Gas velocity
- L Measuring path length
- A Angle of installation

$$t_+ = \frac{L}{(c + v \cdot \cos\alpha)} \qquad t_- = \frac{L}{(c - v \cdot \cos\alpha)}$$

$$c = \frac{L}{2} \cdot \frac{t_- + t_+}{t_- \cdot t_+} \qquad v = \frac{L}{2 \cdot \cos\alpha} \cdot \frac{t_- + t_+}{t_- \cdot t_+}$$

$$c = 331{,}6\frac{m}{s} \cdot \sqrt{\frac{T}{273K}}$$

Flow

- Q Flow under working conditions
- Qn Normalized flow
- k Correction factor
- α Stack diameter
- P Absolute pressure
- T Temperature [K]
- Pn 1013.25 hPa
- Tn 273.15 K

$$Q = k \cdot A \cdot v$$

$$Q_n = Q \cdot \frac{P}{P_n} \cdot \frac{T_n}{T}$$

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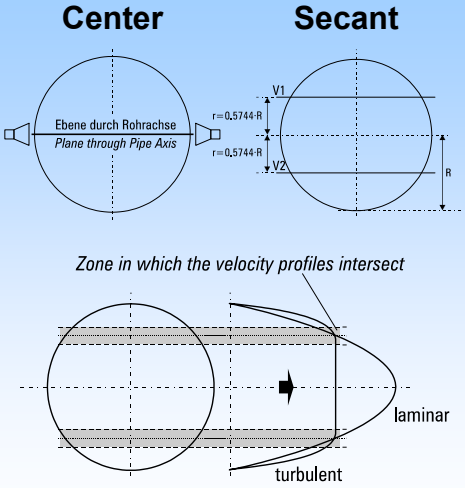
Ultrasonic Flow Monitoring

Flow Profile



- **Standard: Measuring plane through the pipe axis**

Advantages of the secant Measuring

- **Smaller Measuring path length**
- **The influence of the flow profile is minimized**

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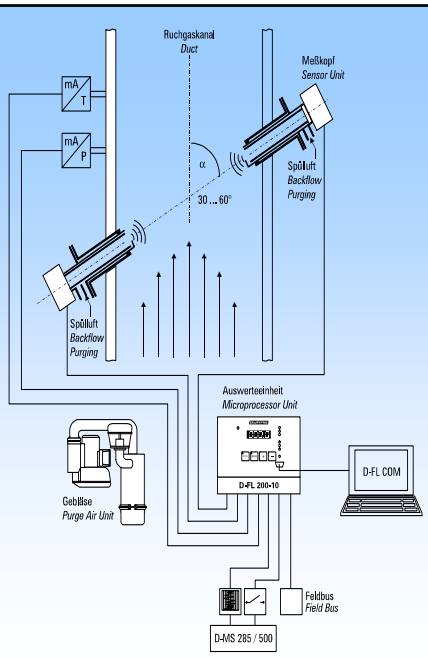
Ultrasonic Flow Monitoring

Duct Application

- **One purge air unit for two sensors**
- **For aggressive gasses bigger purge air available**
- **Temperature and pressure measurement optional**
- **Software tool D-FL COM for programming and diagnosis**
- **Additional digital in-/output module optional available**
- **Bus interface type Modbus optional available**



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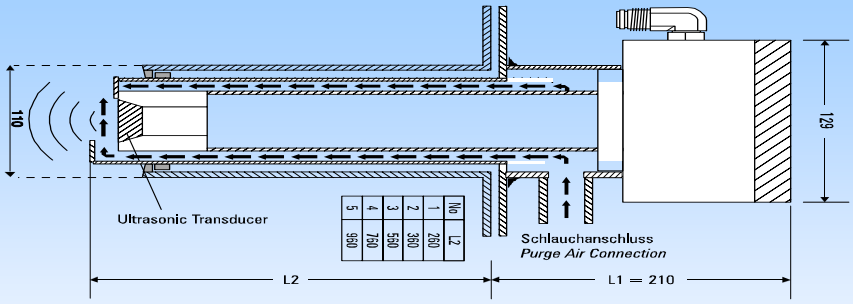
Ultrasonic Flow Monitoring

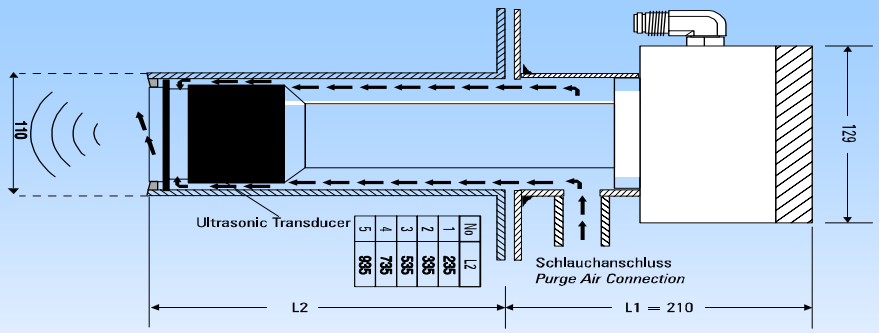
Sensors 50 kHz / 41 kHz



- Decoupling the sensors from the gas with purge air
- Cooling the sensors
- Purge air flow perpendicular to the sensors

Ultrasonic Flow Monitoring

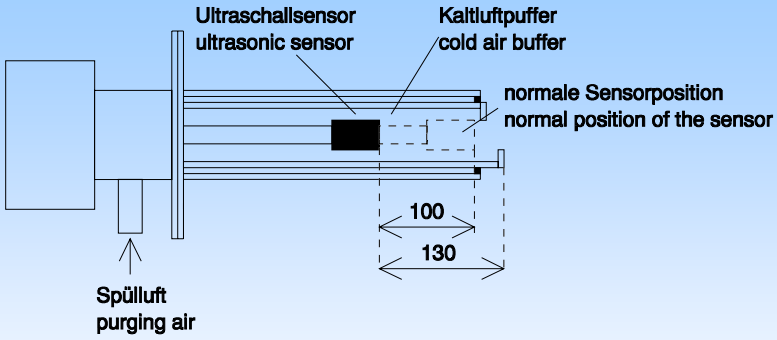
Sensor 30 kHz



- Fits into the standard welding flange
- Purge air flow perpendicular to the sensors

Ultrasonic Flow Monitoring

High Temperature Application



- Normal temperature up to 250 °C with normal sensor position
- 100 mm cold air buffer for high temperature application
- Purge air flow supervision necessary for high temperature

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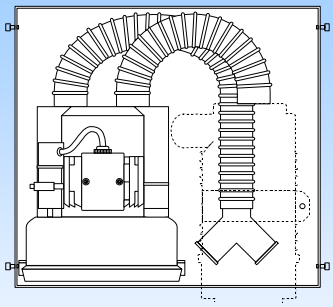
Ultrasonic Flow Monitoring

Purge Air Unit

- Preventing the surfaces from getting dirty
- Protecting the system against the heat of the flue gas
- The intake air must be as dry and dust-free as possible
- Temperature of the intake air must be below 40°C
- If the purge air system is being mounted outdoors, weather protective hoods are available



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Ultrasonic Flow Monitoring

Sensor Selection

- Sensor 1 can be supplied with a Teflon coating
- Sensor 2 is normally used for standard applications
- Sensor 3 is used for big stacks (more expensive)

	Maximum measuring path length, standard flue gas		
Temperature	Measuring head 1 (50 kHz)	Measuring head 2 (41 kHz	Measuring head 3 (30 kHz)
up to 80°C / 176°F	5m / 197 in	8m / 315 in	11m / 433 in
up to 120°C / 248°F	4m / 157 in	6,5m / 256 in	8,0m / 315 in
up to 160°C / 320°F	3m / 118 in	5m / 197 in	6m / 236 in
> 160°C / 320°F	2m / 79 in	3,5m / 138 in	4,5m / 177 in

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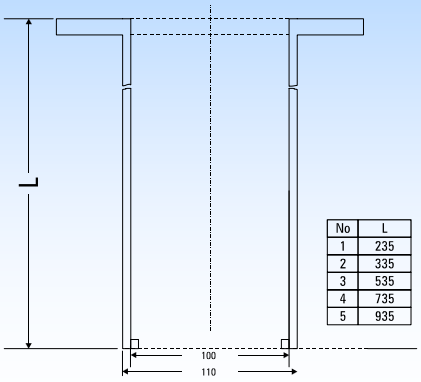
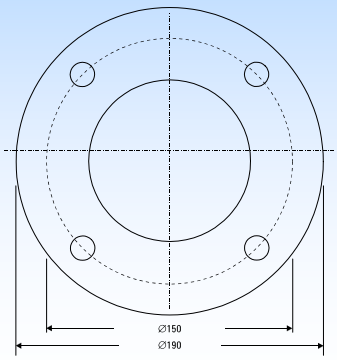
Ultrasonic Flow Monitoring

Flange

- Suitable for sensor 1, 2 and 3
- Available in different lengths
- Standard material 1.4571 (stainless steel)



No	L
1	235
2	335
3	535
4	735
5	935



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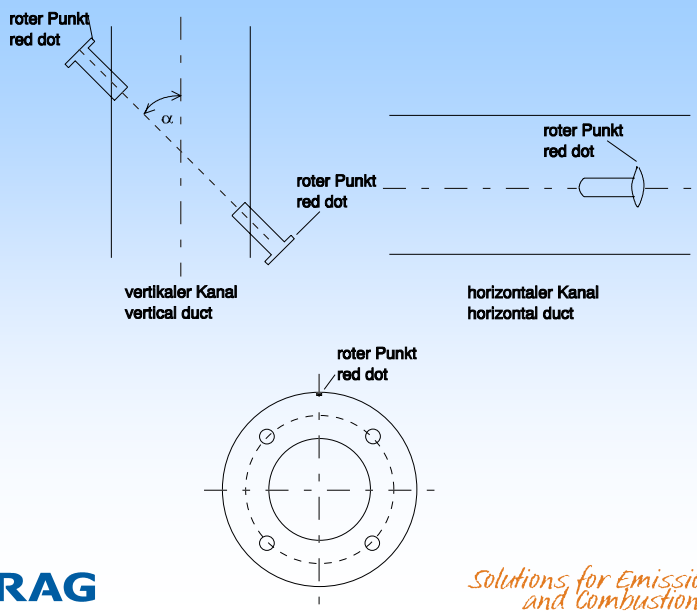
Ultrasonic Flow Monitoring

Welding Flange



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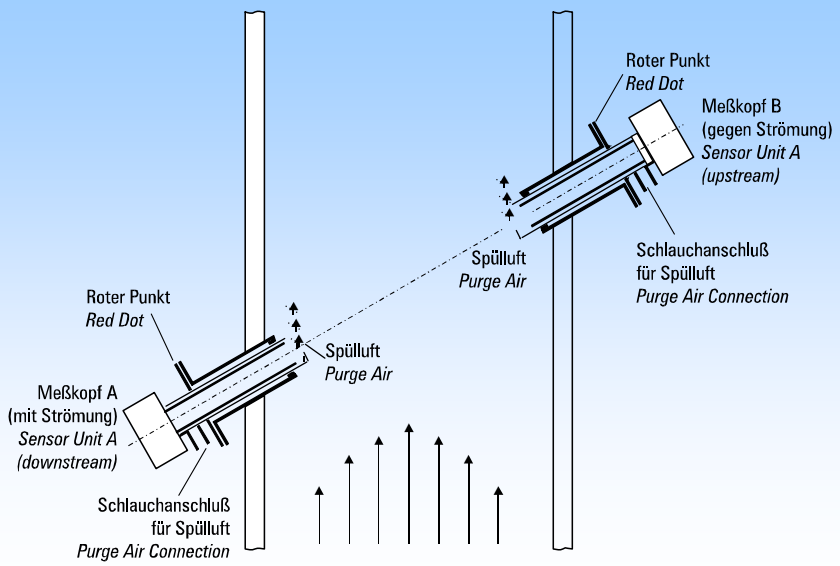
Ultrasonic Flow Monitoring

Installation Duct



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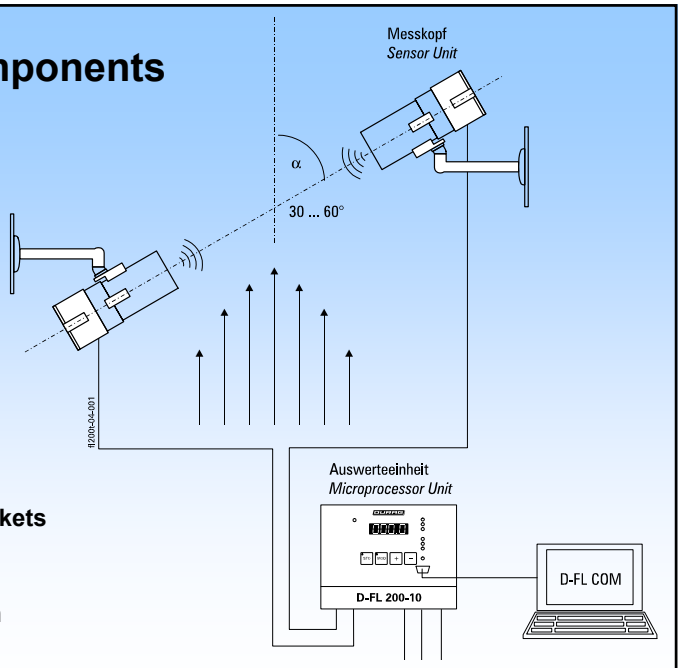
Ultrasonic Flow Monitoring

System Components



- 2 Mounting Brackets
- 2 Sensor Units
- Evaluation Unit
- Control Program

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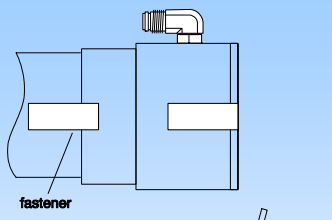
Ultrasonic Flow Monitoring

Cleaning and exchanging the sensor

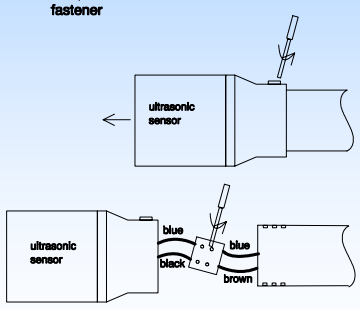
Cleaning

- Set D-FL 200-10 into maintenance mode
- Unlock fasteners and remove sensor unit
- Clean sensor with cleaning alcohol
- Re-install sensor
- Set D - FL 200-10 into measuring mode again



Exchanging

- Switch off D-FL200-10
- Open fasteners and remove sensor
- Unlock fastening screw and pull off the transducer
- Remove old and connect new sensor
- Re-install sensor and switch on the system



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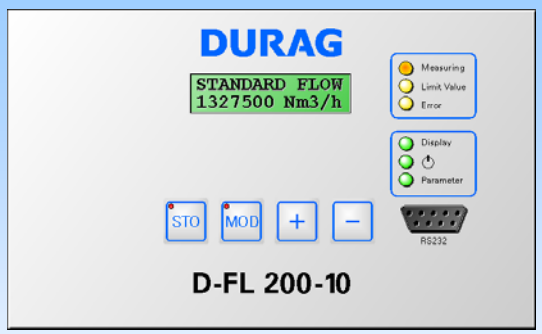
Ultrasonic Flow Monitoring

Front Panel of the Evaluation Unit



- **Measuring** — The system is in measuring mode
- **Limit Value** — The limit value standard flow is exceeded
- **Error** — Error has occurred

- **Display** — Selecting display function
- **Maintenance** — The Maintenance Contact is activated (closed)
- **Parameter** — Parameters may be entered

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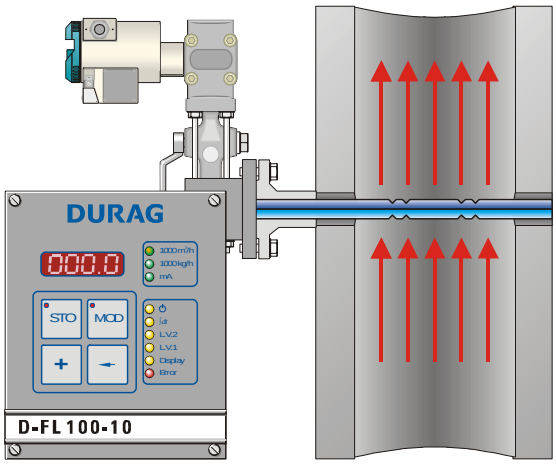
Soodakattilapäivät

01.12.2005

Paine-eroon perustuva virtausmittaus

Yleiskuvaus

- Virtausmäärä-mittaus paine-eromittaukseen perustuvalla anturilla
- Mikroprosessorilla varustettu laskentayksikkö D-FL 100-10 (optio)
- Säädettävät parametri
- Kuormasta riippumaton virtalähtö näyttöä ja järjestelmää varten



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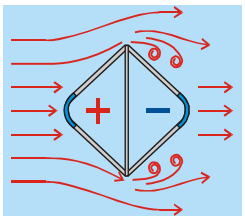
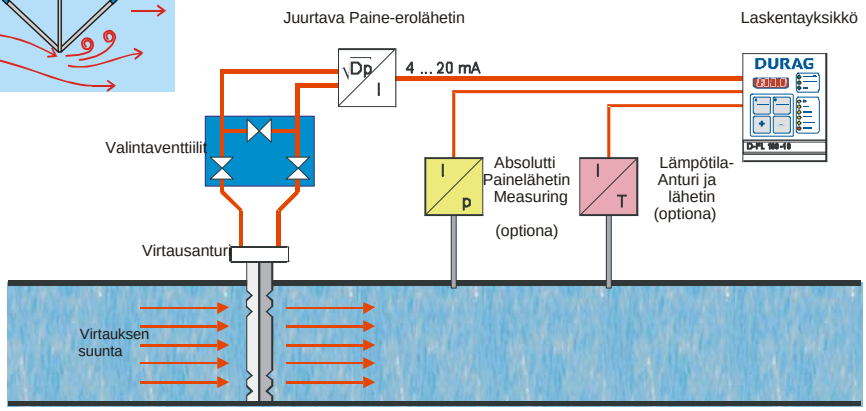
Mittausperiaate



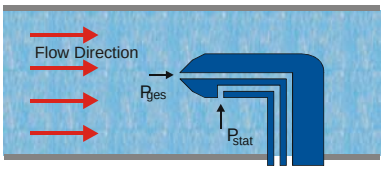


Peruste: Bernoullin yhtälö

$$\Delta P = P_{ges} - P_{stat} = \frac{\rho(T, P_{stat})}{2} v^2$$

ΔP	paine-ero
P_{ges}	dynaaminen paine (virtauksen puolella)
P_{stat}	staattinen (referenssi) paine
ρ	kaasun tiheys
v	nopeus

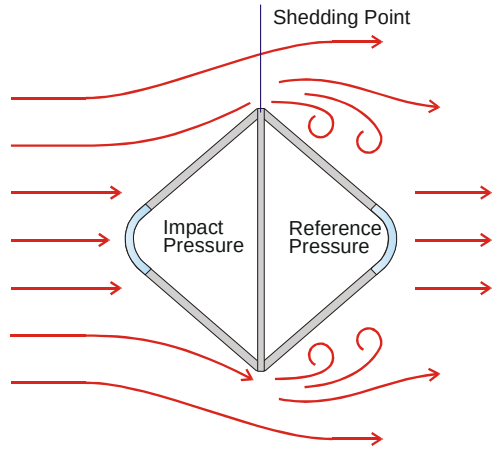
Pitot putken aukko



$$V = A \cdot \sqrt{\frac{2\Delta P}{\rho}}$$

V	tilavuusvirta
A	poikkipinta-ala

Mittausperiaate



Cross Section of the Differential Pressure Bar

$$V = A \cdot k \sqrt{\frac{2\Delta P}{\rho}}$$

V	tilavuusvirta
A	poikkipinta-ala
k	korjauskerroin 0.5 ... 0.7

Yhtälöt

Tiheys

$$\rho = \rho_n \frac{P}{P_n} \frac{(T_n + 273{,}15)}{(T + 273{,}15)}$$

ρ_n	normaalitiheys vakio-olosuhteissa
P_n	normaalipaine = 1,013 x 105 Pa
P	mittaustapahtuman paine Pa:na
T_n	normaalilämpötila = 0°C
T	mittaustapahtuman lämpötila °C

Tilavuusvirta

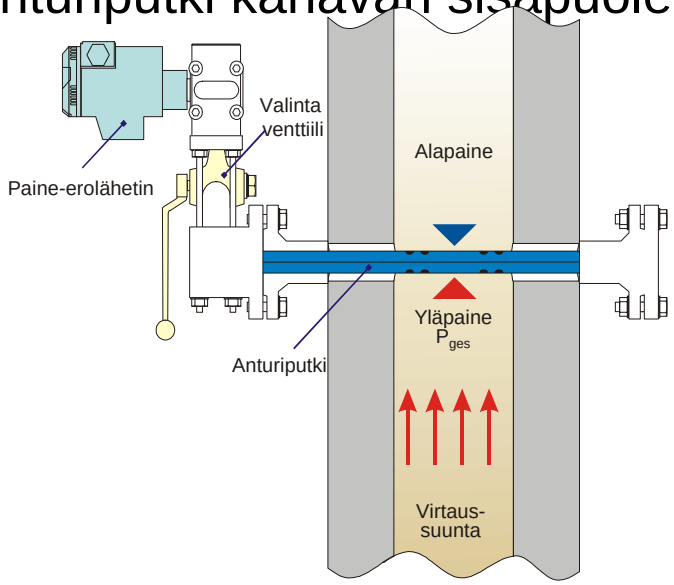
$$V = V_n \frac{P_n}{P} * \frac{T + 273{,}15}{T_n + 273{,}15}$$

Normalisoitu Tilavuus-virta

$$V_n = A * k * \sqrt{\frac{2\Delta P}{\rho_n}} * \sqrt{\frac{T_n + 273{,}15}{T + 273{,}15}} * \frac{P}{P_n}$$

k = korjauskerroin

Anturiputki kanavan sisäpuolella



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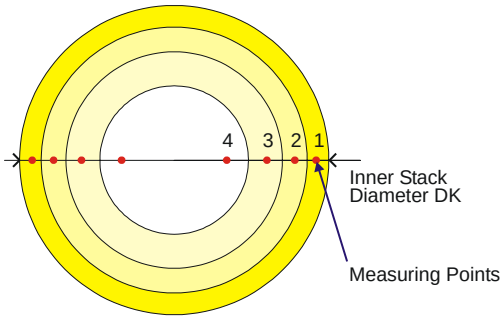
Keskiarvoistus kanavan poikki



Poikkipinta-ala jaettuna saman pinta-alan omaaviin renkaisiin

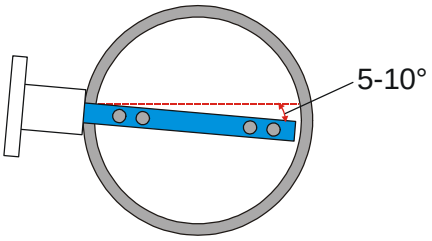
$$D_{ab} = \frac{D_K}{2}\left(1 - \sqrt{\left(1 - \frac{2i-1}{2n}\right)}\right)$$

D_{ab}	Etäisyys mittauspisteestä kanavan tai piipun seinämään
D_K	kanavan/piipun sisähalkaisija
i	kanavan/piipun halkaisija
n	Laskettavien alojen määrä

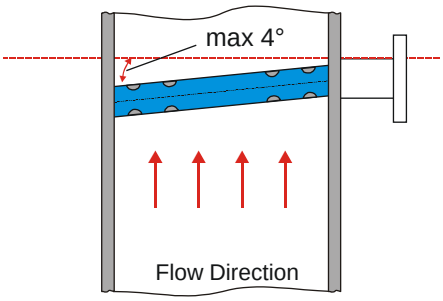
sll_ft100_uk_07_02

Anturiputken asennus kanavaan

vaakakanava



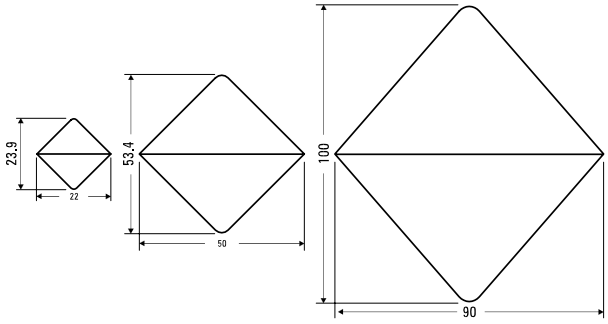
pystykanava
installation



Kosteudesta johtuen peine-erolähetin on syytä asentaa anturiputkea ylemmäs

sill_ft100_uk_12_02

Anturiputken valinta



Putki #	1	2	3
Pituus [mm]	300-2000	2000-4000	>4000
Asennus	Putki ja letku	Putki ja letku	Letku
Maks. pöly	30 mg/m^3	< 100 mg/m^3	

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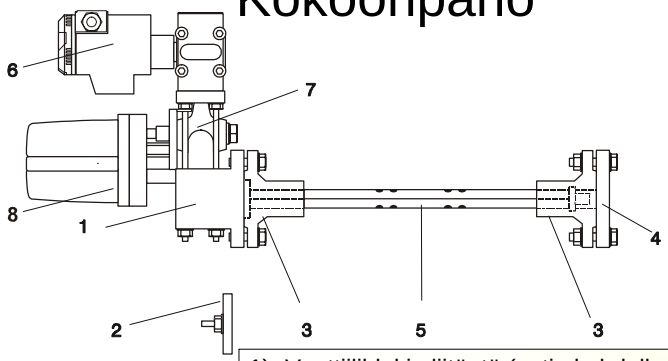
Kokoonpano



1) Venttiiliblokin liitäntä (optio kohdalle 2)
2) Adapteri letkuliitännälle (vaihtoehto kohdalle 1)
3) Asebnnuslaipat
4) Vastakappale
5) Paine-eron mittausputki
6) Paine-erolähetin
7) Valintaventtiili (optiona)
8) Servomoottori

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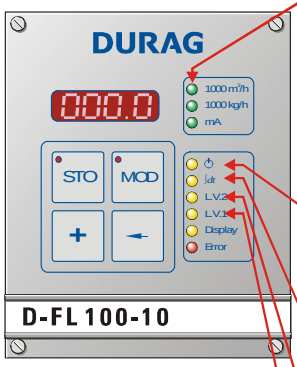
Laskentayksikkö D-FL 100-10



Näytössä näkyvät:
- tilavuusvirta 1000 m3/h
- massavirta 1000 kg/h
- virtalähtö 4-20 mA

Paine-ero hPa
Absoluttipaine hPa
Lämpötila °C

Stand by: laite huollossa, paine-erolähettimen nollaus

Integrointiaika sekunneissa

2. raja-arvo

1. raja-arvo

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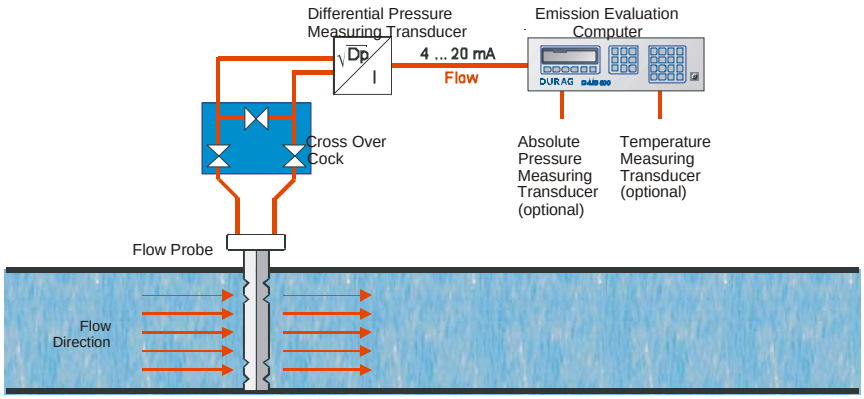
Systems with Evaluation Unit D-MS 285 or D-MS 500



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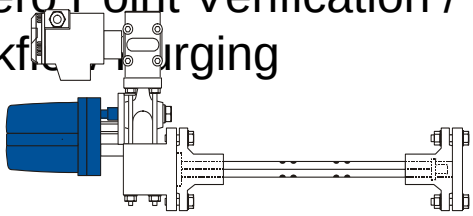
Tiedot

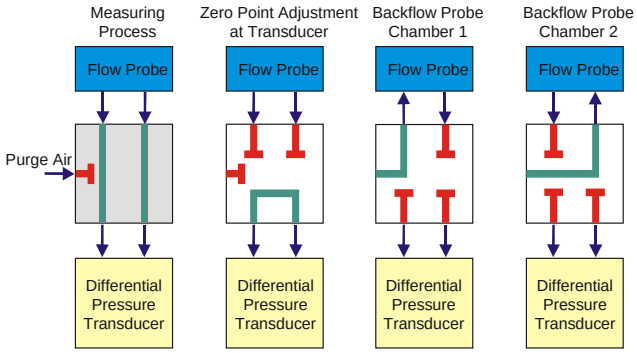
- Kanavan halkaisijat 0.3 - 8 m
  (Anturi I: 0.3 to 2 m, Anturi II: 2 - 4 m; Anturi 3 III: 4 - 8 m
- Minimivirtausnopeus 3 m/s
- Kastepistelämpötilan yläpuolella oleville kaasuille
- Lämpötilat 400°C asti haponkestävää 1.4571 terästä
- Lämpötilat 700°C asti Inconel 602 2.4816:a
- Happamille kaasuille Hastelloy C276 2.4819
- Taattu tarkkuus parempi kuin ±2% VDI 2066:n mukaan
- Lähetin voidaan asentaa anturiputkeen taikka erikseen
- Valintaventtiili nollausta ja takaisinpuhallutusta varten
- Pitkä huoltoväli, yli 3 kk
- Pölypitoisuuksille 150 mg/nm3 asti ilman automaattitakaisinpuhallutusta
- Mikroprosessorilla varustettu laskentayksikkö lämpötila- ja absoluuttipainekorjausta varten
- Myös DURAGin Emission Evaluator D-MS 285 / D-MS 500 voidaan käyttää lämpötila- ja painekorjaukseen (vaihtoehto laskentayksikölle)
- Erittäin vankka rakenne
- Tehdaskalibroidut lähettimet
- Helppo asentaa

sil_it100_uk_14_01

Automatic Zero Point Verification / Backflow Purging



Possible Settings of the Switching Valve



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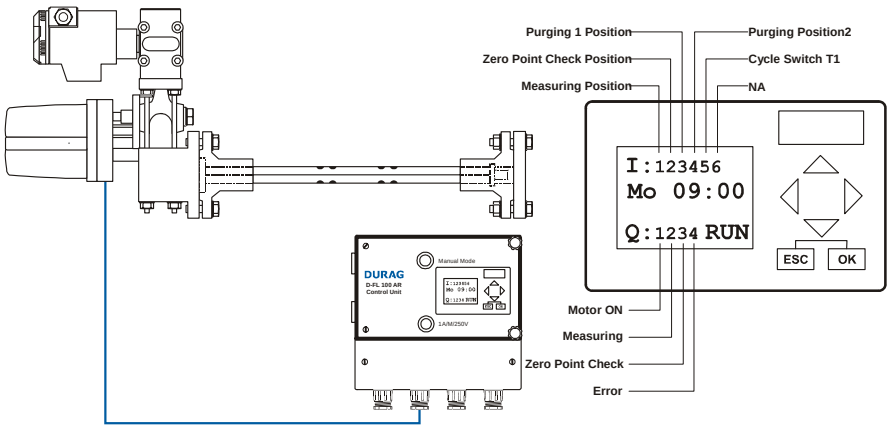
Automaattinen Pursutusyksikkö D-FL 100 AR



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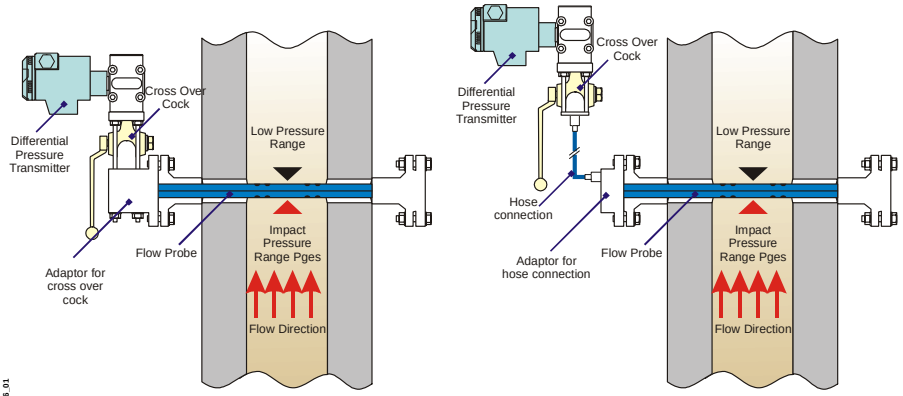
Asennusvaihtoehdot

Virtausanturi ja lähetin yhteen asennettuina

Erilleen asennettu
ΔP- lähetin



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