



Industrial Emissions



TCRTECORA®
POLLUTION CHECK

tcrtecora.com

2025

DECS® | Technical Presentation



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1. About TCR TECORA®



TCR TECORA® is an Italian Company based in Cogliate (MB) located in the northern belt of Milan Metropolitan Area.



TCR TECORA®

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TCR TECORA® Headquarter.

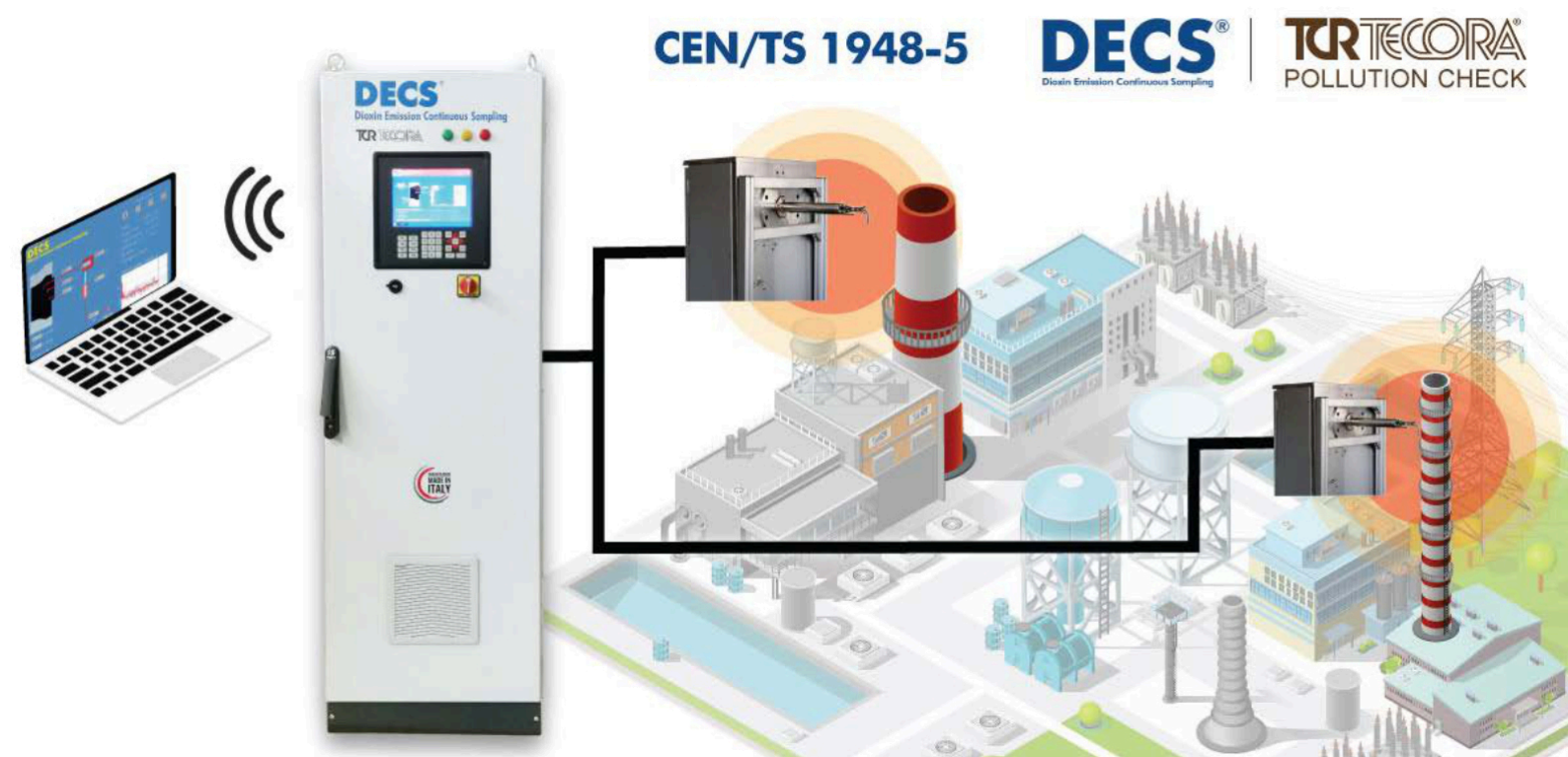
For more information about
TCR TECORA®, visit the website

[CLICK HERE](#)

2. Disclaimer

DECS® is a brand registered by **TCR TECORA®** with the Italian Patent and Trademark Office (UIBM n° 302012000067322), the European Union Office for Intellectual Property (EUIPO n° 004689428 - 009438417), the UK Office for Intellectual Property (UKIPO n° UK00904689428) and the World Intellectual Property Organization (WIPO n° 1552384). **DECS®** by **TCR TECORA®** is the only original brand in Italy, Europe, China, South Korea, and Turkey.

It is advisable to always check for the presence of the registered trademark ® which testifies to the guarantee of intellectual property of the equipment.



3. Sampler Design

3.1 General Operation

The aim of a sampler for the determination of the PCDD/F — dioxins and furans - is to sample these organic micropollutants in the most correct way as required by the Air Quality Technical Standards.

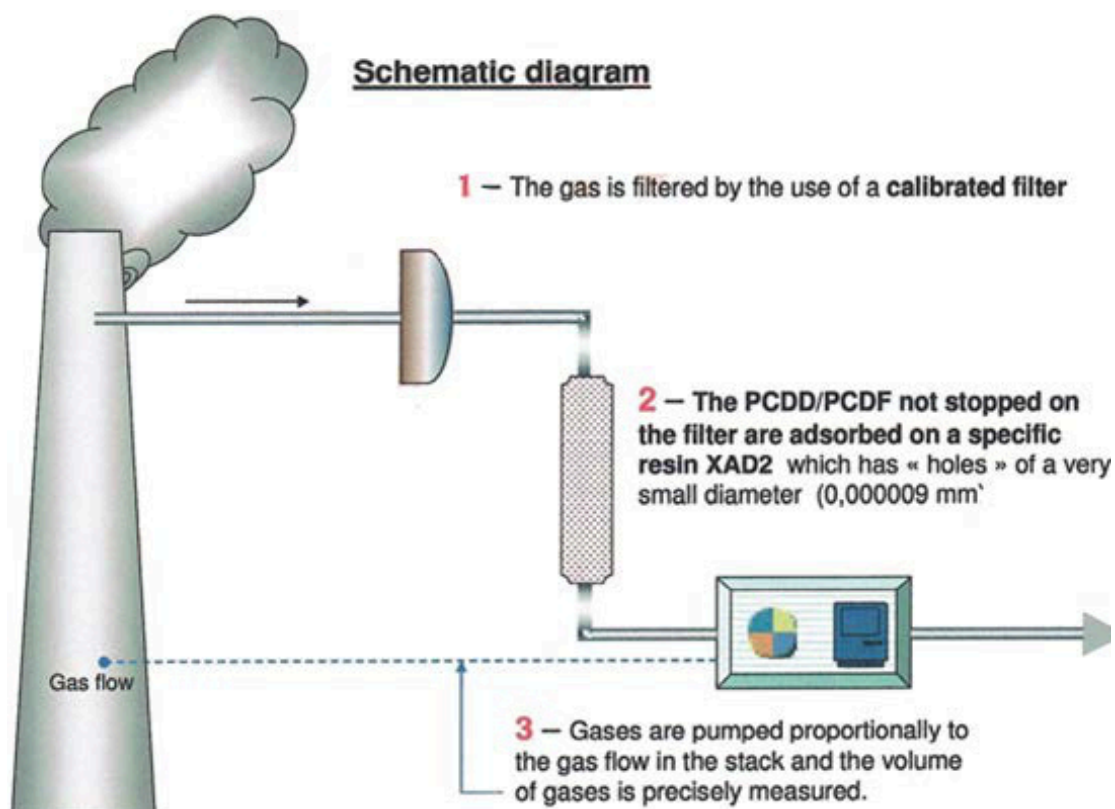
DECS® PCDD/F long-term sampling system complies with the requirements of European Technical Specification CEN/TS 1948-5: 2015. Stationary source emissions - Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs - Part 5: Long-term sampling of PCDDs/PCDFs and PCBs.

To sample PCDD/F, DECS® sampler operates in two stages:

- First stage: filtration which retains the "coarse fraction" PCDD/PCDF too big to be adsorbed on the resin of the second stage.
- Second stage: adsorption which retains the PCDD/PCDF not retained by the filter (pores of the resin are very small: 90 Å).

A sampler takes the gas proportionally to their flow in the stack. Sampled volume is measured.

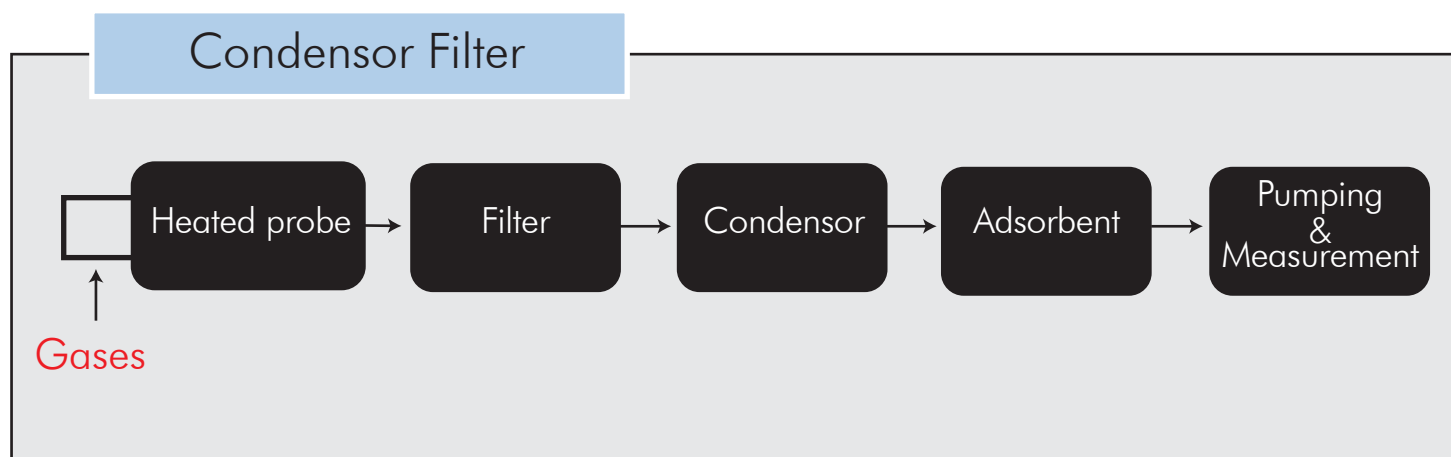
Schematic Diagram



3.2 DECS®

Sampling method used by the DECS® is known as of the "filter/condenser method". TCR TECORA® DECS® is fully compliant to the characteristics of this principle.

Filter condenser method is a principle recognized by European standards (5.2 CEN / TS 1948-5), USA (4.1 US EPA Method 23), China¹, Australia and others among the main world's areas.



In DECS®, an aliquot of gas is taken from the chimney as much as possible equal to the gas flow in the stack (isokinetism) by using a heated probe (to avoid condensations and the formation of solids in the probe).

Before the beginning of sampling, the probe is heated and purged to flow out the dust charged with PCDD/F which could have settled in startup phase of the incinerator.

The sample is filtered on a certified pre-weighed thimble filter, then cooled at a temperature lower than 20°C so that the adsorption on resin XAD2 is carried out in accordance with its specification. Before the beginning of sampling, the probe is heated and purged to flow out the dust charged with PCDD/F which could have settled in startup phase of the incinerator.



Thimble Filter



XAD 2 Column

¹Ni, Y., et al., 2009. Emissions of PCDD/Fs from municipal solid waste incinerators in China. Chemosphere 75, 1153–1158

Installation is fully automatic.

3.3 Filter Technology

Working conditions

All the Standards mentioned above demand filtration efficiency to be more than 99.5% for particles of $0.3\ \mu\text{m}$. (In the USA, it is 99.9%).

This efficiency can also be reached if the filtered gas is dry. Any moisture such as condensates drops down the efficiencies at values lower than 97% and moreover, which are not stables.

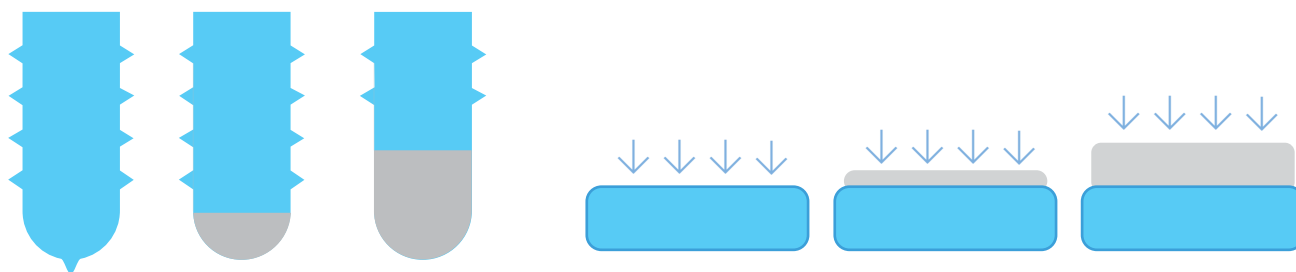
Therefore, it is necessary to filter a dry gas.

In DECS® technology, the gas is heated in the probe to eliminate any traces of condensate before filtering.



Filter capacity and pressure drop

Filtration could be made by using flat filter or thimble filter.



DECS® uses a quartz fiber thimble filter. This technology has two advantages:

- ▶ "Dust" could be "stored" to avoid plugging the installation;
- ▶ No pressure drops which could involve production of wrong values.

Filtration efficiency

As requested by US EPA, UE Technical Specifications, EPA and other authorities, the efficiency of the filter supplied by **TCR TECORA®** is officially certified:

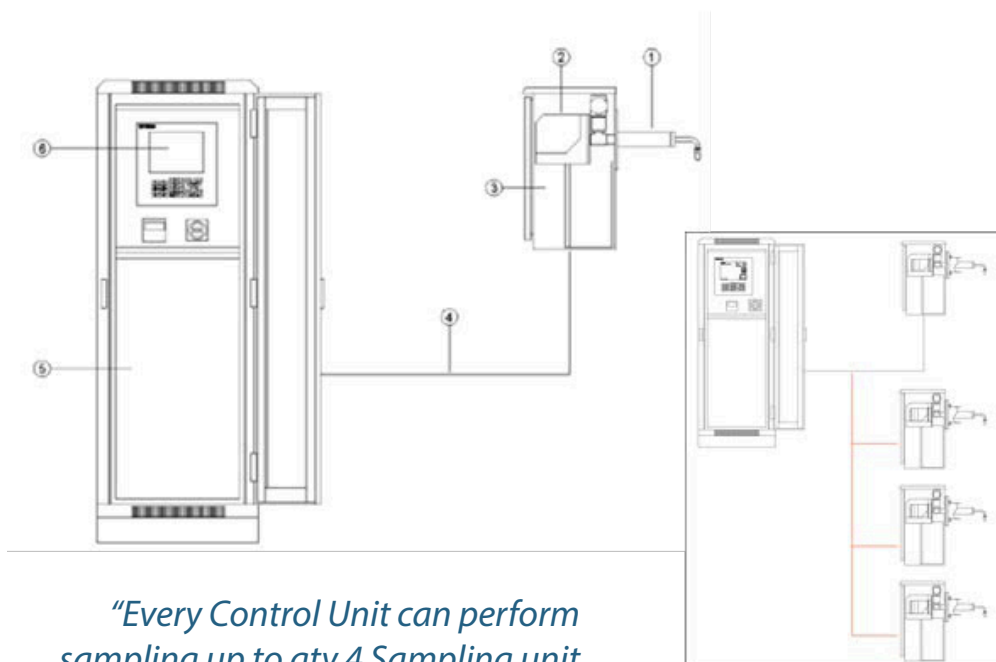
- ▶ Efficiency better than 99.9% for particles of $0.3\ \mu\text{m}$.

4. Equipment Presentation

4.1 General Description

The scope of supply for each line includes:

- 1) Heated probe with nozzle (titanium);
- 2) High-capacity thimble filter for particulate with official efficiency certificate (as requested by Standards);
- 3) Cartridge for adsorbent XAD2;
- 4) Pneumatic/electric connection between the units;
- 5) Control unit with system of measurement;
- 6) Control panel with color screen LCD, keyboard, printer, and port USB.



"Every Control Unit can perform sampling up to qty 4 Sampling unit"

"This means that every system can monitor up to 4 stack emissions".

To ensure operation under the best conditions, our scope of supply includes also for each line.

N° 3 Sampled
filter container
in titanium



N° 3 Cartridges
for XAD2 resins



N° 3
Transportation
Cases



4.2 Sampling Unit (SU)

Sampling unit is placed on the stack and coupled by a flanged port.

As previously mentioned DECS® is designed to comply with the sampling principle according to International Standards: CEN/TS 1948-5, US EPA Method 23, and all requirements of EN 13284-1 concerning materials and isokinetic condition application.

The sampling line consists of:

- ▶ Heated probe with titanium suction line, curve, and nozzle;
- ▶ Built-in Pitot tube and thermocouple are provided to measure flue gas velocity and temperature;
- ▶ Heated box with titanium filter holder with quartz high efficiency filter (thimbles available for large collection as well as flat diaphragm for short collection) according to EN 13284-1;
- ▶ Liquid cooled condenser and subsequent adsorbing trap containing XAD2 on the wet gas stream.

DECS® Sampling Unit provides utility functions:

- ▶ Leak test;
- ▶ Sampling line purging;
- ▶ Sampling line cleaning;
- ▶ Probe heating;
- ▶ Filter box heating;
- ▶ Sample cooling;
- ▶ All temperatures: in stack, probe, filter box, cooler condenser and other major parameters as pressures and differential;
- ▶ Pressure are measured, stored during sampling operation, in a mass storage memory and managed through an alarm supervision system.



4.3 Control Unit (CU)

Control Unit is composed by a standard industrial IP54 electric cabinet, equipped with an external graphic display for the supervision and control of the sampling operations.

Control Unit perform following functions:



2020

- ▶ Supervision and control of the automatic sampling operation by industrial programmable logic controller (PLC) and a LCD display with keyboard for the man machine interface;
- ▶ Isokinetic conditions;
- ▶ Gas sampling line with measurement devices for volume and flow;
- ▶ Gas conditioning device;
- ▶ Provide all input / output of the system and electrical protections;
- ▶ Alarm management.

The operating parameters and system configuration are available on the front LCD colour display. On the front of the cabinet is available an industrial functional flat keyboard to access at the supervision software to modify and input data.

DECS® system has is equipped with USB port for data downloading and system software upgrades by USB flash memory.

DECS® system provides three level of access to system software configuration:

- ▶ Operator level (only data and action related to the normal operations);
- ▶ Supervisory level (configuration parameters and alarms settings);
- ▶ Administration level (full access).

DECS® control cabinet provides as well visual and signal output information about his operating status: sampling operation, stand-by, and alarm condition. Those conditions are reported on the LCD display, on the three lamps on top of the cabinet and by digital output signal to any plant supervision data acquisition device.

To assure Standard compliance (CEN/TS 1948-5), there are available analogue inputs to acquire oxygen, gas flow rate, carbon dioxide and water vapor in gas.

DECS® can also communicate using Modbus TCP/IP protocol.

DECS® performs sampling system auto-calibration function.

5. DECS® Detailed Operation Description

5.1 General Operation Description

DECS® is a fully automatic long term sampling system which operates automatically during the sampling according to a pre-defined program without any supervision requirements.

To start sampling operation, the user shall provide sampling devices (filter cartridge with quartz filter and glass adsorbent trap) duly prepared by a lab with a defined standard spiking. The filters are tagged to track the sampling and analysis. The filters are installed in the sampling unit. The operator will check that all connections sampling line and refrigeration line are operating and will proceed to the sampling start. To start sampling operation, the user shall provide sampling devices (filter cartridge with quartz filter and glass adsorbent trap) duly prepared by a lab with a defined standard spiking. The filters are tagged to track the sampling and analysis. The filters are installed in the sampling unit. The operator will check that all connections sampling line and refrigeration line are operating and will proceed to the sampling start.

The operator from the front panel keyboard will define the sampling parameters for the incoming sampling campaign:

- ▶ Filters tags;
- ▶ Sampling duration (time or volume);
- ▶ Sampling starting time;
- ▶ Proceed to leak test;
- ▶ Other configuration parameters if required.



During the standby mode or inactivity, DECS® provides to seal off the sampling line from the stack corrosive and contaminating atmosphere with a back flush flow air purge.

As soon as the starting time occurs, DECS® automatically provide a leak test from Sampling Unit to dry gas meter and pump in Control Unit, to check sampling line leakages.

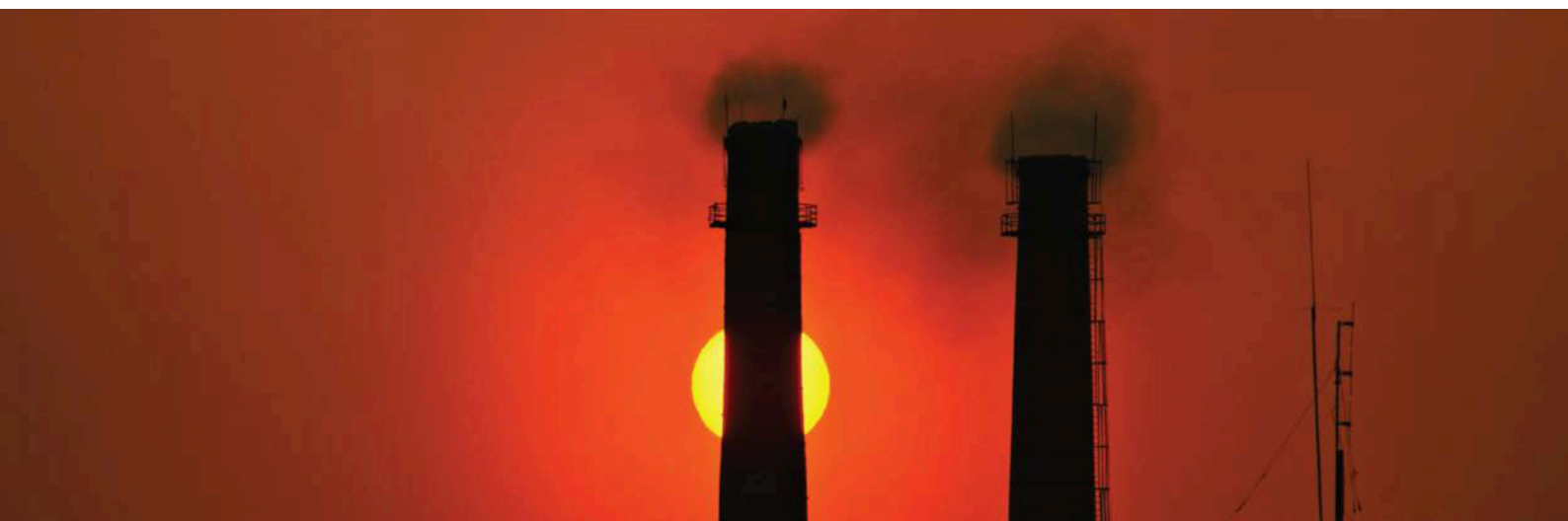
DECS® control the probe and the filter box heating to the set temperatures over the process dew point (recommended 125°C or more if necessary, for dry application).

As soon as the probe and the filters box and the trap reached the set temperature, DECS® sampling start and will continue for the programmed time or volume, except programmed stops for suction line cleaning or plant digital input for stop.

The heated probe and filter box, during sampling operation temperature is kept under control and maintained constant to avoid condensation. Control system will keep under control the isokinetic conditions and log the isokinetic deviation. All other parameters and alarms are logged and trigger alarms in case of faulty operation, with possibility to send alarm by hardwired digital output or through the network. The alarms can be set to force different action from the sampling system to be defined by user.

Flue gas sample is sucked through the suction line into the quartz fiber filter, where all particles contained within the gas will be sampled. Heated probe/filter technique prevent particulate to move from the stack to the cooling device avoiding that the condensate and the adsorbent are overloaded, and it prevents potential losses of the particulates inside the condensate after the adsorbent stage.

The gas still hot leaves the filter box to enter the condenser device, which is a glass serpentine immersed in a glass jacket where the cooling liquid flow in counter flow, obtaining an efficient temperature exchange.



Liquid condenser makes the sample cool down quickly to a temperature less than 20°C, then the cooled gas together with the gas condensate go through the adsorbent cartridge, filled with an appropriate quantity of XAD2. XAD2 resin will capture all the micro-pollutants contained in the cooled gas and gas condensate.

After the adsorbing stage the sample led to the Control Unit through sampling line (protected from frost when installation is outdoor) and the gas is cooled and dried before reaching the dry gas meter and the pump.

The condensate separated in the Control Unit is collected and automatically discharged.

A relative humidity sensor makes the instrument able to monitor the gas drying system efficiency and to produce an alarm to prevent malfunctioning.

Flow and sampled volume measure are performed with two different measuring elements to ensure a data crossing, one dry gas meter used as reference measurement and an accurate mass flow meter to adjust the flow control system.



Data concerning flow, volume, isokinetic conditions, and stack measure is saved every 5 minutes and can be easily transferred on a flash memory USB compatible to any personal computer. The industrial PLC provides all data calculation in real time for the volume and flow at normalized and actual conditions. To prevent emergencies or system's stop during the sampling, a series of alarms are activated. Active alarms are displayable on the screen and their occurrence is stored to identify the stop cause. If the alarm which caused the stop returns to normal conditions the system restarts automatically.

During the stop periods the sampling line is closed by the ball valve and blown with back pressure air in order to avoid particulate overload once the sampling restarted.

When DECS® complete the sampling, the sampling line is intercepted, and suction line is thermally desorbed at high temperature and then blown with high pressure air.

If for any reason the sampling is suspended and thus the system is in standby mode, automatically the DECS® provides with a diagnostic which is capable of underlining system anomalies.

In case of power loss due to a black-out or accidental plant shut-down, a system recovery is managed by the software. A back up battery allows a PLC saving operation data before turning off.

The instrument restarts automatically, storing a message in which date, hour and non-programmed stop reason appear.

5.2 DECS® Utilities: leak test, purging and cleaning

5.2.1 General Operation Description

Leak test is performed automatically, by the system, to check eventual loss in the sampling line.

The leak test can be programmed each time before to start the sampling and/or when the sampling is completed and/or at regular intervals during the sampling.

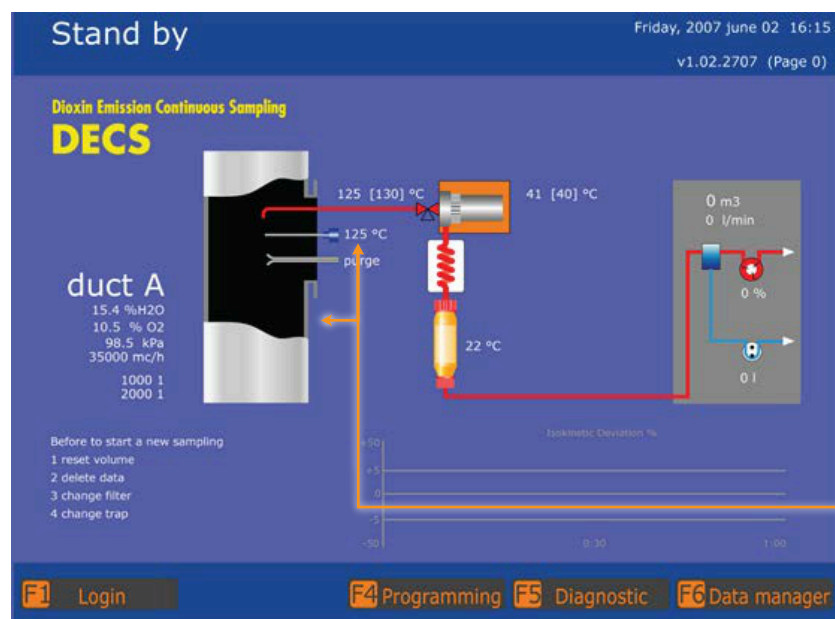
5.2.2 Purging

Purging air and high-pressure cleaning air blown in the suction line and the probe along with probe heating, avoid the probe to be contaminated during long term service and **made useless the need of the removal from the stack to make the suction line cleaning**.

5.2.3 Cleaning

At the start and at the end of the sampling operations the probe and the nozzle are cleaned with a flow of high-pressure air for few minutes. During stand by periods the probe and the nozzles are purged with air to avoid particulates and other pollutants to enter the probe to keep free from contamination and corrosion the nozzle and the suction line.

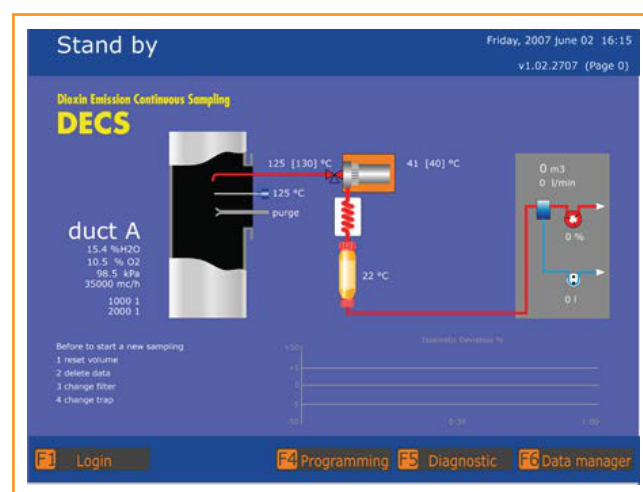
The Pitot tube is provided with an automatic air pressurized cleaning system, which works in cycles during sampling according to application requirements.



5.3 DECS® information on the synoptic view

Displayed parameters:

- ▶ In stack temperature;
- ▶ In stack flow;
- ▶ In stack abs. pressure;
- ▶ Gas water vapor content (data sent by the plant);
- ▶ Gas oxygen content (data sent by the plant);
- ▶ Gas CO₂ content (data sent by the plant);
- ▶ Heating probe temperature;
- ▶ Heating particulate filter temperature;
- ▶ Adsorbing cartridge temperature;
- ▶ Sampling flow;
- ▶ Gas sampled volume;
- ▶ Isokinetic deviation;
- ▶ Availability (ration between sampling elapsed time and plant run time);



5.4 Provided and acquired auxiliary signals

The control board allows the acquisition of the following analog or digital signals with inputs 4-20 mA:

Input

- ▶ Gas flow (as an alternative to DECS® Pitot tube measurement);
- ▶ Gas oxygen content (necessary to measure properly flowrate and consequently to adjust isokinetic flowrate);
- ▶ Necessary also to correct concentration according to oxygen reference);
- ▶ Gas oxygen dioxide (CO₂) content (necessary to measure properly flowrate and consequently to adjust isokinetic flowrate);
- ▶ Gas water vapor content (necessary to measure properly flowrate and consequently to adjust isokinetic flowrate);
- ▶ Others if required (shut-down, start-up).

Output

It is possible to remote the alarms through 3 relay NO contacts which communicates:

- ▶ Sampling running;
- ▶ Sampling in stand by;
- ▶ Sampler in alarm.

Besides, the system is available to be connected using Modbus TCP/IP protocol.



5.5 Measure report

In addition to Log file the measure report is recorded. The final report is a summary for all measure point and some instrument's setting.

Measure ID

Sampling ID	Sampling Identification number
Date Hour Start	Sampling date and starting hour
Date Hour Stop	Sampling date and stop hour
Total Elapsed Time	Sampling total time

Gas Specification

Gas Density	Gas density
Average Humidity	Gas humidity (min, max, avg)
Average O2	Gas oxygen, min, max avg (if equipped as outside signal)
Average CO2	Gas CO2, min, max avg, (if equipped as outside signal)
Stack Temperature	Gas temperature (min, max, avg)
Stack Pressure	Absolute stack pressure (min, max, avg)
Stack Gas Flowrate	Gas flow (min, max, avg)

Sampling Data

Isokinetic deviation	Final isokinetic diversion
Sampled Volume dry norm	Dried sampled volume
Sampled Volume wet norm	Wet sampled volume
Filter Temperature	Particulate filter averaged temperature
XAD2 Temperature	Adsorbing cartridge averaged temperature

Stack Volumetric Flowrate

Wet gas stack condition	Stack condition range
Wet gas normal condition	Wet condition range
Dry gas normal condition	Dry condition range

Availability of instrument: Ratio between sampling duration and plant running duration.

6. Technical Specification

Emission working limits

Stack temperature	$\leq 350^{\circ}\text{C}$ (design up to 400°)
Gas flow range	$2 \div 40$ m/s
Water vapor content	$\leq 50\%$ in volume (design up to saturation)
PM concentration limits	$150\text{mg}/\text{m}^3$
Dioxin & Furans concentration range	$0,0001\text{-}10\text{ng}/\text{m}^3$ I-TEQ
Programmable sampling time duration	6 hours till 8 weeks

Sampling unit ambient location limits

Ambient Temperature	$-15 + 50^{\circ}\text{C}$
General Protection	IP55

Control unit ambient location limits

Ambient Temperature	$0 + 40^{\circ}\text{C}$
Humidity	$10 \div 90\%$ related non condensing

Size and weight

Sampling unit (Probe excluded)	$810 \times 540 \times 360$ (h x b x l) - weight 35Kg
Control Unit	$1900 \times 600 \times 600$ (h x b x l) - weight 90Kg

Supply

Voltage	220 V 50 Hz
Power absorption	2 KW per line
Average consumption	1 KW per line
Frost protection in case of outdoor installation	$9\text{W} / \text{m}$
Compressed air consumption	$0.8 \text{ m}^3/\text{h}$
Compressed air consumption in stand by	$1.2 \text{ m}^3/\text{h}$
Compressed air pressure needed	from 5 to 10 Bar

Cooling System

Cooling device with closed circuit

Power consumption	$\leq 350^{\circ}\text{C}$ (design up to 400°)
Could be replaced by distribution network	$2 \div 40$ m/s

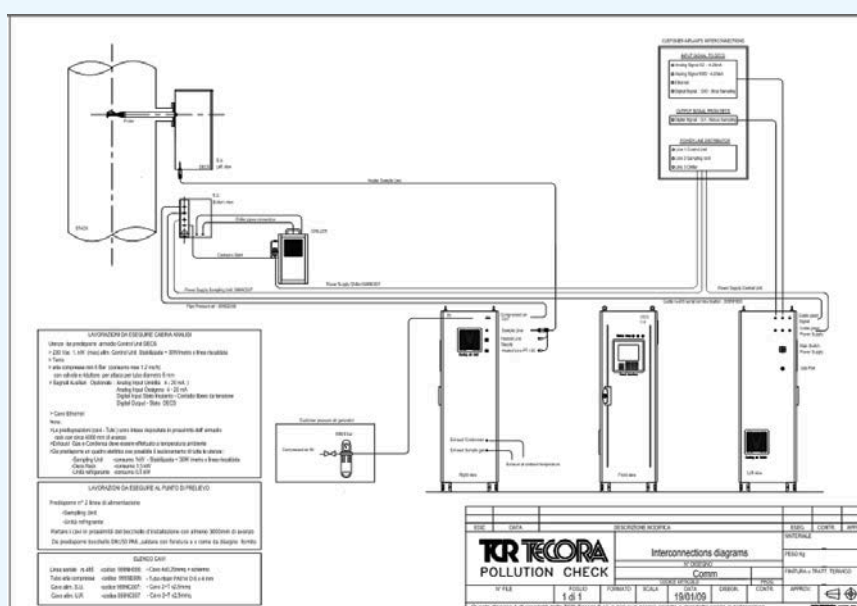
Maintenance Interval:

Two (02) on-site maintenance service per year:

- ▶ One (01) visit for control and cleaning if necessary;
- ▶ One (01) visit for complete maintenance with spare part replacement.



Every steps is controlled by our quality system. FAT and SAT, commissioning, warranty, validation, data analisys and after sales management are services available from TCR TECORA® staff.



Technical explanation of cables / pipes / connections



Nozzle positioning, DN flange and counter-flange sizing

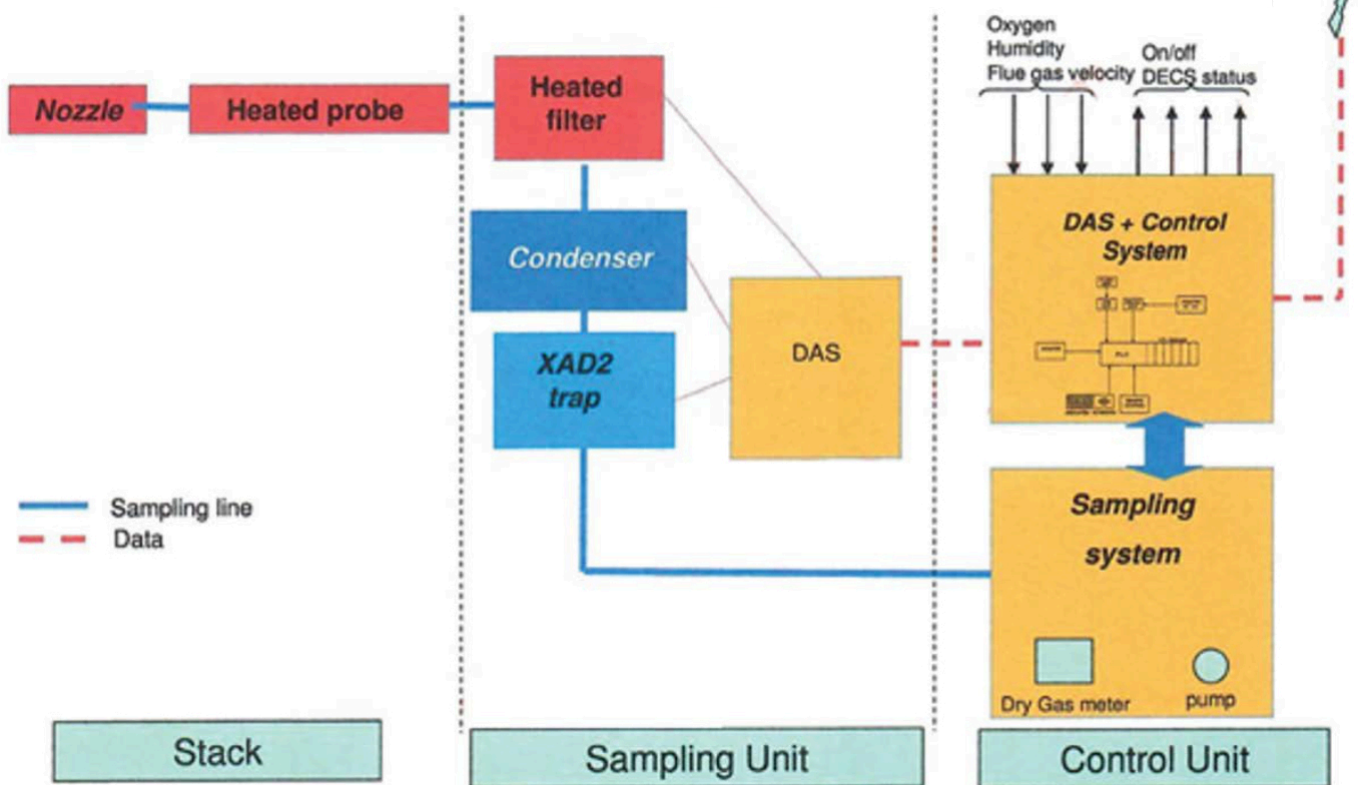


Cableway path



Calculation of the length of the cableway based on the specific conformation of the system

DECS[®] Functional Diagram



Customer battery limit:

Materials and services which are usually provided by the customer like scaffolding, instruments for gas welding, pressurized air, power and electric installation, masonry works, electrical and isolation works, conduit and external tubes, uplift system etc...

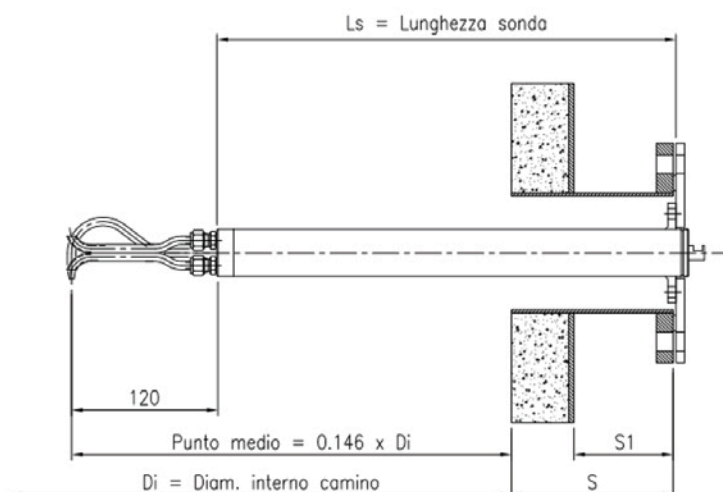
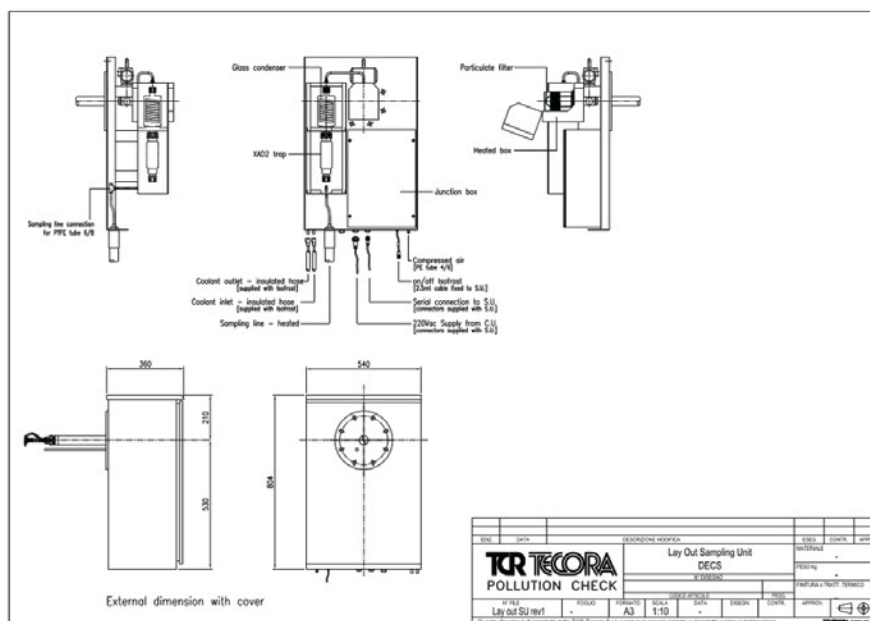
7.1 Sampling Unit

Sampling Unit is located on a DN 150 PN6 port (for other configurations please contact TCR TECORA®)

Port position and orientation must be defined to avoid perturbation on other measuring devices already installed.

Minimum port high: 800mm - Nominal 1300mm

Sampling Unit is available in two versions: Standard version in a cabinet



7.2 Cooling water or closed-circuit cooling device

Sampling Unit needs water to chill and condense the sample collected.

To do this, a closed-circuit cooling device can be installed. Place of cooler depends on condition on plant. It is better to put it as close as possible of Sampling Unit, but it could be placed in other position if ambient conditions make it necessary.

If required, a cooling water line positioned nearby could replace this system.

TCR TECORA® ISOFROST 2 & ISOFROST 3 (HV)

ISOFROST 2



ISOFROST 3
(High Volume)



Technical Features

Isofrost 2

Cooling device nominal power	> 400 W
Liquid tank capacity	4 liters
Cooling temperature set point	2 °C
Ri-circle pump nominal flow	5 lt/min
Max prevalence liquid pump	6 meters
Operating conditions	-20°C* +40°C
Power supply	220 VAC 50Hz (110 VAC)
Weight (without cooling liquid)	22Kg
Size	370 x 320 x 500 mm (LxPxH)
P/N Number	AC99-003-0010SP (-0011SP 110 VAC)

* For temperatures below 0°C, it is necessary to use an anti-freezing liquid

Isofrost 3

Cooling device nominal power	2610 BTU/hr > 765 W
Liquid tank capacity	18 liters
Cooling temperature set point	2 °C (adjustable e.g. 0°C)
Ri-circle pump nominal flow	5.5 lt/min
Max prevalence liquid pump	6 meters
Operating conditions	-20°C* +45°C - 95% UR
Power supply	230 VAC 50-60Hz (110 VAC)
Weight (without cooling liquid)	24Kg
Size	365 x 320 x 555 mm (LxPxH)
P/N Number	AC99-003-0012SP (0013SP 110 VAC)

* For temperatures below 0°C, it is necessary to use an anti-freezing liquid

Isofrost 2 (DECS® HT version) and Isofrost 3 are chiller for critical application; they are suitable for long sampling with very low maintenance. Isofrost 3 compare to Isofrost 2 allow to work with an open tank for side stream sampling.

7.3 Sampling unit and control unit connections

Regarding connections between Control Unit and Sampling Unit it is necessary a cable runway large of around 100 mm.

Besides hooks for vertical tracts, pipes and cable are needed.

In cable runway will be installed:

- ▶ 1 sampling tube PTFE 6*8 with frost protection if installation is outside;
- ▶ 1 tube for compressed air 4*6;
- ▶ 1 communication cable type Belden;
- ▶ 2 power cable to powered sampling unit and cooling device.

7.4 Control Unit

Control Unit should be positioned in an air-conditioned room. (If not, see option)

The control board and services set up are shown in the attached picture "control unit positioning".

To enable a good service please follow this indication:

Power Supply

An electric line positioned under the differential protection of 30 mA must be linked to the control board.

The protection devices interruption capacity in case of short circuit is 10KA.

Power supply	V. 230-50 Hz 1 fase +N +Earth
Power consumption	2 kVA

Pressurized Air

Instrument dry, oil free and particle free air.

Pressure	from 5 to 10 Bar
Connections	from 1/4" with ball valve

Auxiliary signals and alarms

Any signals as oxygen and humidity must be led to the control board.

8. Company Innovation & Continuous Improvement

With a view to constant technological improvement that has always distinguished TCR TECORA®, improvements and upgrades have been made to the DECS® System which can be divided into two categories.

- 1) Innovations in terms of data quality assurance: a special automated dynamic calibration option of 13C12 spiking standards for PCDD/F has been introduced. This innovation allows a timed dosing of the standard (spiking) throughout the sampling time. This results in a more representative sampling of PCDD/F and PCBdl;
- 2) Product innovation: the possibility, present by default in DECS®, to carry out a parallel sampling to PCDD/F (main stream) in side stream allows to carry out a biogenic CO₂ sampling in compliance with the EN 13833 technical standard. This possibility makes it possible to sample an important parameter for plants engaged in the fight against climate change such as biogenic CO₂.





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TCRTECORA[®]

POLLUTION CHECK



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