

TECHNICAL MANUAL Water Monitoring System WMS-EGCS for measuring

Polycyclic-Aromatic Hydrocarbons (PAH) pH / Temperature Turbidity



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1 Introduction

WMS-EGCS is a Water Monitoring System for measuring PAH, pH / Temperature and turbidity of the washwater at the inlet and outlet of the scrubber.

The WMS-EGCS plate contains two separate modules:

- ✓ Polycyclic-Aromatic Hydrocarbons (PAH) module with the FL200-EGCS version.
- ✓ pH / Temperature and Turbidity module with the PHYSEO transmitter.

2 Measurement principle and technical features

2.1 Technology

2.1.1 PAH Module

The measurement method is based on the fluorescence signal emitted by aromatic hydrocarbons when excited by specific UV light.

The UV source of the analyser is a xenon lamp which is ensured very low energy consumption and a long life time (more than ten years if a measurement is made every 1 minute) thanks to a specially designed feeding mode. Many successive flashes are started for each analysis and the average of all the results is calculated by the analyser in order to ensure the perfect reproducibility of the measurements.

In water effluent from exhaust gas cleaning systems, very low concentrations of PAH have to be detected. The fluorescent signal is then very weak. To optimize the performance of the analyser, a high sensitivity photomultiplier is used as a detector. During the measurement cycle, the intensity of the exciting radiation is measured in order to compensate for any turbidity variation or lamp intensity drift.

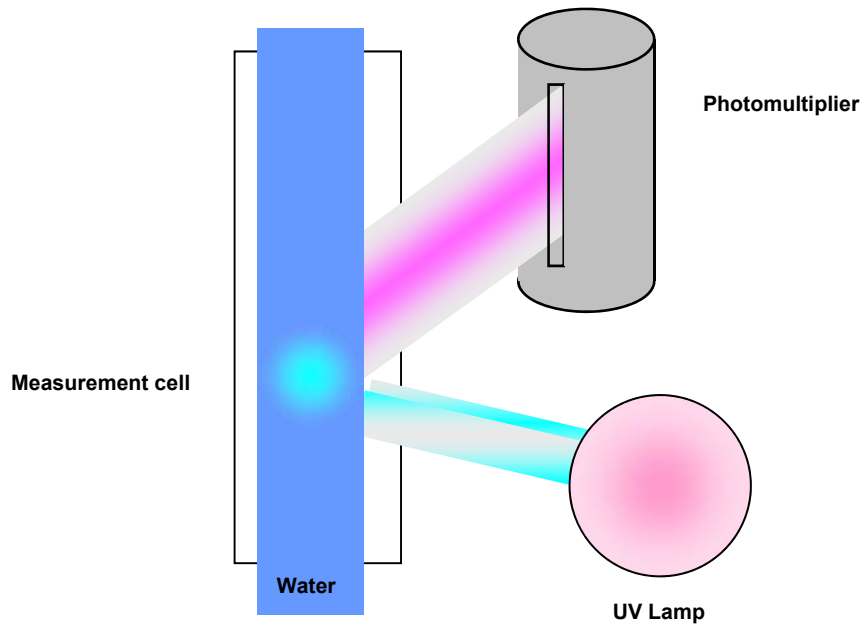
The lamp operation is controlled throughout the measurement cycle in order to ensure the highest stability and the repeatability of measurements.

The factory calibration which is carried out before delivery makes the analyser ready to be used on-site for quantitative measurements without any calibration.

An LCD panel displays the concentration of the substance to be measured. On the same screen, recording of previous measurement results is displayed.

The measurement results can be remotely transmitted using a 4-20 mA output. The variation range of this output can be set by the user.

Measurement principle



PAH Module with the FL200-EGCS version

2.1.2 pH / Temperature and Turbidity module

2.1.2.1 PHYSEO transmitter

PHYSEO is a compact transmitter allowing measurements of physicochemical parameters in water such as: pH, conductivity, dissolved oxygen, temperature, water level. Up to 4 parameters can be simultaneously monitored.

Measurement results are dated and stored in a static memory with a capacity of 10000 measurements. They can be transferred later via the RS232 or RS485 link on a PC without specific software.

Its stainless steel 316L enclosure insures maximal protection of the instrument whatever the conditions of environment while insuring a perfect recyclability at the end of life.



PHYSEO transmitter

2.1.2.2 pH / Temperature sensor

Features

- ✓ Combination pH/Temp sensor
- ✓ pH / Cartridge

Applications

- ✓ Urban wastewater treatment
- ✓ Industrial effluent treatment
- ✓ Surface water monitoring
- ✓ Sea water monitoring
- ✓ Drinking water



Description

The pH/Temp sensor has been designed to perform under hard conditions from pure mountains water, lakes and rivers, seawater and to wastewater.
This sensor has been designed also for handheld and in situ applications which have been the most difficult situations for a pH/Temp sensor in term of sensor resistance, quick time response, minimal flow dependence and low power consumption.

Specifications

pH / Temperature sensor	Specifications
Principle	pH : Combined electrode (pH/ref) : special glass, Ag/AgCl ref. Gelled electrolyte (KCl) Temperature : NTC
Measuring range	pH : 0 - 14 pH Temperature : 0 – +50°C
Resolution	pH : 0,01 pH Temperature : 0,01°C
Accuracy	pH : +/- 0,1 pH Temperature : +/- 0,5°C
Response time	< 5 s
Temperature compensation	Via NTC
Operating temperature	0°C to 50°C
Storage temperature	0°C to + 60°C
Dimensions	Diameter : 27 / 21 mm; Length : 207 mm
Weight	350 g (sensor + 3 m cable)
Material	PVC, special pH glass, platinum
Pressure	5 bar
Cable length	Standard 3 m
<i>Protection Type</i>	IP68

2.1.2.3 Turbidity sensor

Features

- ✓ IR optical sensor
- ✓ Ranges : 0 to 4000 NTU or 0 to 4500 mg/L
- ✓ Robust and waterproof (IP68)
- ✓ Ultra-low-power consumption
- ✓ ISO 7027 compliance (Nephelometry)

Applications

- ✓ Urban wastewater treatment (inlet / outlet)
- ✓ Sanitation network
- ✓ Industrial effluent treatment
- ✓ Surface water monitoring
- ✓ Drinking water



Description

The measuring principle is based on IR nephelometry / 850 nm (ISO 7027). The sensor can be calibrated with a formazine standard solution.

The NTU sensor integrates a low-cost optical technology, with a very few maintenance and no consumables.

Specifications

Turbidity sensor	Specifications	
Principle	Diffusion IR at 90°	
Measuring range	0 to 4000 NTU in 5 ranges: ✓ 0 – 50 NTU ✓ 0 – 200 NTU ✓ 0 – 1000 NTU ✓ 0 – 4000 NTU ✓ AUTOMATIC	0 to 4500 mg/L Calibration : ✓ Range 0-500 mg/L according to NF EN 872 ✓ Range >500 mg/L according to NF T 90 105 2
Resolution	0,01 to 1 NTU - mg/L	
Accuracy	< 5% of the reading	
Response time	< 5 s	
Temperature compensation	Via NTC	
Operating temperature	0°C to 50°C	
Storage temperature	-10°C to + 60°C	
Dimensions	Diameter : 27 mm; Length : 170 mm	
Weight	300 g (sensor + 3 m cable)	
Material	PVC, DELRIN, Quartz, PMMA, Polyamide	
Pressure	5 bar	
Cable length	Standard 3 m	
<i>Protection Type</i>	IP68	

2.2 Measurement range and accuracy

2.2.1 PAH Module

The measurement range is 0 to 400 µg/l Phenanthrene equivalent in water.

In clear water the accuracy is better than 5% of the reading or +/-5 µg/l Phenanthrene equivalent, whatever is greater.

The detection limit is 5 µg/l Phenanthrene equivalent in sea water.

A turbidity compensation system is installed in the optical bench. It allows measurement compensation even in turbid water up to 40 NTU. The loss of PAH detection sensitivity is less than 5% in the 0 – 40 NTU turbidity range, and will not exceed +/- 10 µg/l Phenanthrene equivalent at 40 NTU.

2.2.2 pH / Temperature and Turbidity module

Summarised in tables “*Specifications*” above.

2.3 Measurements processing and recording

The WMS-EGCS can measure continuously or using a batch method. In this last case, the measurement period can be set from 1 measurement each minute to one measurement every 720 minutes.

The measurements performed in the automatic mode are automatically stored in an internal memory.

Manual measurement cycles can be operated without updating neither alarm nor 4 – 20 mA, whatever the result is.

2.4 Measurements transmission

The measured values may be transmitted using:

- ✓ 4 analog current outputs without intermediate treatment.
- ✓ The RS232 link allows results downloading for a short distance. The transfer of the results for long distance is possible with the RS485 link.

2.5 Energy

The WMS-EGCS operates using mains 100 – 240 VAC, 50 – 60 Hz / 30 VA.

2.6 Display

Graphic LCD (65 mm x 105 mm). The measurements can be displayed on the screen showing all data stored in a form of list of values or graph.

2.7 Alarm relays

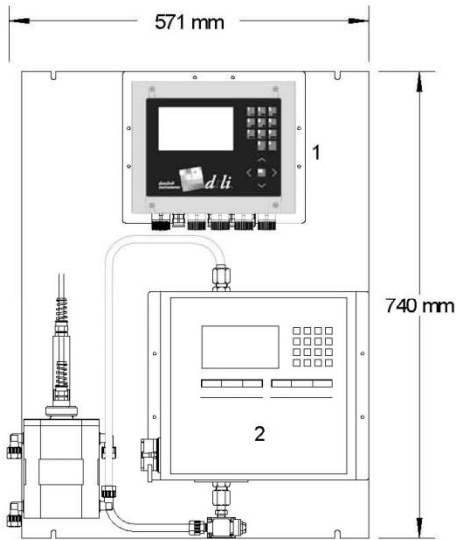
Nine relays are available on the connection board:

- ✓ 1 mains fault relay.
- ✓ 8 alarm relays (measurement fault, threshold or wide range alarm, function alarm).

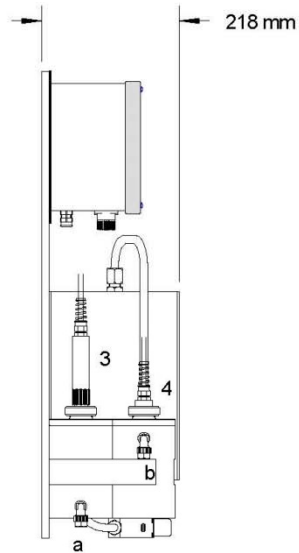
These relays are low power type relays. A second stage relay is to be installed in order to command a high power device.

3 Layout plans and technical data

3.1 The overall view of WMS-EGCS plate



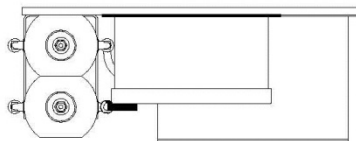
Front view of the plate



Left side view of the plate

- 1. Measurement transmitter
- 2. PAH analyser
- 3. pH probe
- 4. NTU probe

- a. Sample inlet Straight Union Tube 12 mm out
- b. Sample outlet Straight Union Tube 12 mm out



Top view of the plate

3.2 Summarised technical features of WMS-EGCS

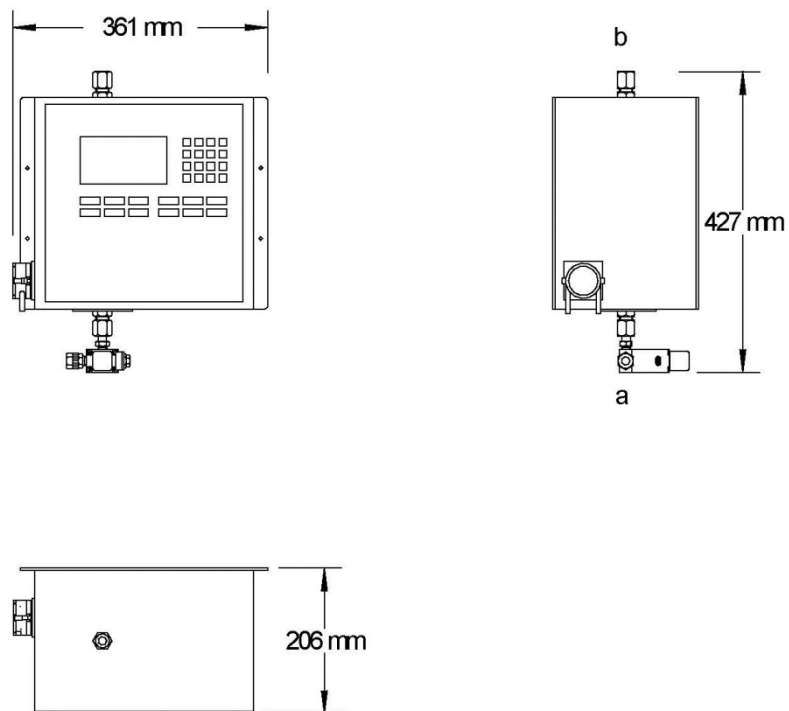
<i>Weight</i>	25 Kg
<i>Measuring range</i>	PAH : 0-400 µg/l Phenanthrene equivalent pH : 0 - 14 pH Temperature : 0 – +50°C Turbidity : 0 to 4000 NTU in 5 ranges (listed in “ <i>Specifications</i> ” table above)
<i>Accuracy</i>	PAH : 5% of reading or +/-5µg/l Phenanthrene equivalent pH : +/- 0,1 pH Temperature : +/- 0,5°C Turbidity : < 5% of the reading
<i>Power supply</i>	100-240V 50/60 Hz
<i>Analog current output</i>	Up to 4 isolated configurable 4-20 mA outputs with 12 bits resolution (0-20 mA operating mode allowable), 15 V max output voltage, 500 Ω max impedance
<i>Alarm relays</i>	Double contact relays (48 VAC or 48 VDC max, 3 AAC or 3 ADC max, 150 VA max) : <ul style="list-style-type: none"> • 1 main fault relay • 8 alarm relays (measurement fault, threshold or wide range alarm, function alarm) or external probe cleaning system command relays
<i>Communication</i>	Serial communication port: <ul style="list-style-type: none"> • RS232 link allows results downloading for a short distance • The Modbus RS485
<i>Display</i>	Graphic LCD (65 mm x 105 mm)
<i>Sample Pressure</i>	Max 2 bar
<i>Sample temperature</i>	> 1°C to 50°C
<i>Operating temperature</i>	0 to + 60°C
<i>Protection Type</i>	IP65

3.3 PAH module

3.3.1 Technical specifications

Weight	15 Kg
Enclosure	stainless steel 316L enclosure index of protection IP65
Water flow rate	typical 0.6 L/mn
Measurement cell volume	100 ml
Sample temperature	> 1 to 60°C
Operating temperature	0 to + 60°C

3.3.2 Dimensions



View of the FL200-EGCS version

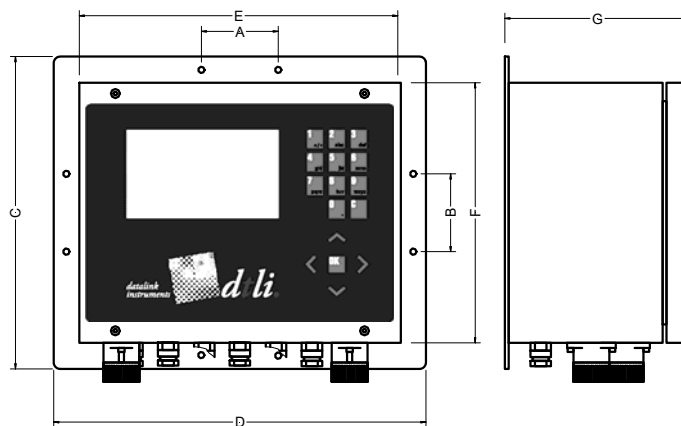
3.4 pH / Temperature and Turbidity module

3.4.1 PHYSEO transmitter technical specifications

Weight	5 Kg
Enclosure	stainless steel 316L enclosure index of protection IP65
Operating temperature	-10 to + 60°C

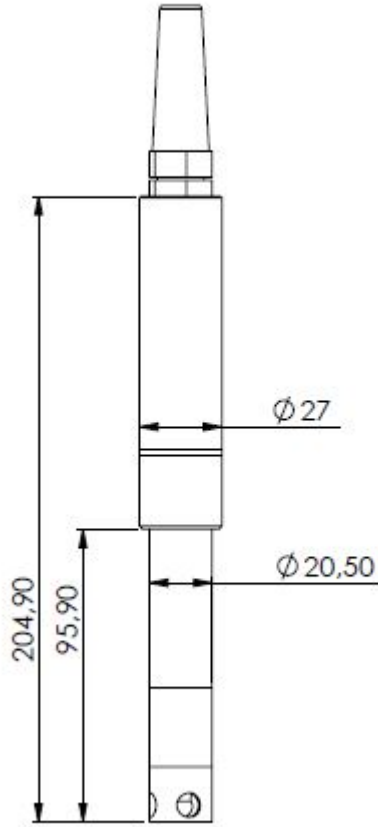
3.4.2 Dimensions of PHYSEO transmitter

A	60 mm	E	259 mm
B	60 mm	F	209 mm
C	240 mm	G	145 mm
D	290 mm	-	-

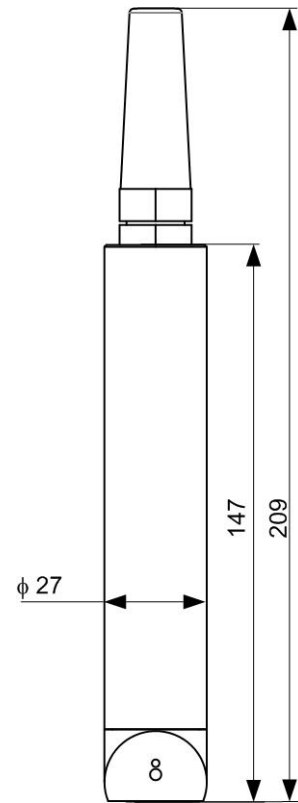


View of PHYSEO transmitter

3.4.3 Dimensions of pH / Temperature and Turbidity sensors



pH / Temperature sensor



Turbidity sensor

4 Recommendation for maintenance and routine checking

4.1 *Soft checking recommendation*

4.1.1 Description

Any automatic analysis system requires a minimum checking operation even if no corrective action is operated. The automatic operation ensures the daily and repetitive measurements and cleaning, but an operator control still remains necessary.

The routine check-up can be summarized as follows:

- ✓ Visual control of the PAH module measurement cell.
- ✓ Cleaning of the PAH module measurement cell using the cleaning system.
- ✓ Zero checking / adjustment on a zero solution.
- ✓ Visual control of sensors dirtying.
- ✓ To clean the sensors if it is necessary.
- ✓ To run a measurement cycle on the process water.

4.1.2 Periodicity

Once a month.

4.1.3 Duration

Less than 15 minutes.

4.1.4 Operator

Local operator.

4.2 *Calibration checking*

4.2.1 Description

This operation is to be done after the soft check-up. It consists in a measurement using a standard solution. The standard solutions are as following:

- ✓ To check the PAH module with Phenanthrene standard solution.
- ✓ To check the pH sensor with standard buffer solutions (pH 4, 7 or 10).
- ✓ To check the Turbidity sensor with a standard solution of Formazine or a known sample.

In the case of a difference between the measured value and the standard, an automatic calibration cycle has to be done.

4.2.2 Periodicity

Every 3 months.

4.2.3 Duration

Less than 30 minutes.

4.2.4 Operator

Local operator.

4.3 Yearly preventive maintenance

4.3.1 Description

This maintenance is not necessarily required but is strongly recommended. If the check-up operations described above are correctly made, the measurement performance of the analyser will be maintained for a long time. However, a detailed cleaning process is sometime required, depending on water environment incidences. The preventive maintenance visit allows a detailed inspection of all optical and hydraulic parts.

From our experience, we observe that analysers which are preventively maintained show a better reliability over several years.

4.3.2 Periodicity (*facultative*)

Once a year.

4.3.3 Duration

1 day (trip not included).

4.3.4 Operator

DTLI technician or DTLI representative.

5 Operational limits

5.1 Electromagnetic compliance

The system proposed fully complies with EM standards in industrial field. The wirings should be performed with shielded cable and the shield should be connected to the plate frame.

5.2 Temperature

The PAH module is designed to be operated with liquid water whose temperature must necessarily be kept between 1 and 60°C. Apart from this range of temperature, measurements will be less reliable.

Freezing conditions would lead to strong damage.

The pH/ temperature and Turbidity sensors are designed for a use in liquid water whose temperature is necessarily maintained in the 1 – 50°C range. If the temperature is higher than 50°C the measurement will not be reliable.

5.3 Interference

For the PAH module, all fluorescent species that emit in the 300 – 400 nm range could interfere with the measurement (styrol for instance).

For the pH/Temperature and Turbidity module, due to their measurement principles there is no particular interferences.