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# Porous Tube Thermodiluter

Model 3098



## Characterizing advanced combustion designs and solid particle emissions from modern engines.

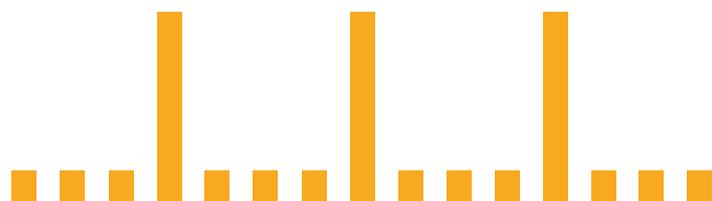
The Porous Tube Thermodiluter (PTT) 3098 is the next generation sample conditioning system specifically designed for the Engine Exhaust Particle Sizer™ (EEPS™) 3090 to characterize advanced combustion designs and solid particle emissions from modern engines, either before or after emission control devices. The PTT design has no moving parts and mimics the atmospheric dilution process eliminating the potential of particle interaction with the diluter walls. This coupled with operating at a high flow rate minimizes losses of the sub-23 nm particles, improving the response time and accuracy of the number concentration measurement provided by the EEPS™ spectrometer. The PTT can be addressed through the user friendly EEPS™ software that has been extended to fully control the complete system, or it can be integrated in the test bench host system through AK-protocol.

### Applications

- Sub-23 nm solid particle emissions for post Euro 6/VI engines
- Cold start engine emissions in Gasoline Direct Injection (GDI) engines
- Exhaust after-treatment (DPF or GPF) characterization
- Pre-DPF/GPF sampling with optional Pressure Reducing Module (PN 3098-PR)
- Non-exhaust nanoparticle emissions (brake and tire wear)
- Measurement of non-volatile particulate matter (PM) emissions from aircraft turbine engines
- Non-road mobile machinery emissions

### Features and Benefits

- Robust dilution design: porous tube diluters without moving parts to wear out or small orifices to clog
- PMP-type (hot dilution-catalytic stripper-cold dilution) sample conditioning at ambient pressure for measurement of solid particles
- Low thermophoretic and diffusional losses that are corrected for in the measured size distribution by the EEPS spectrometer
- Low cost of ownership with swappable flow controller module (only flow control module needs to be calibrated annually)
- AK-serial command protocol for integration in test cell systems with host controller
- Reliable and accurate dilution performance: well controlled/stable/accurate dynamic dilution ratio
- Easy to use: Integrated control of PTT and EEPS spectrometer from single user interface



## Specifications

# Porous Tube Thermodiluter

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### Particle Size Range

5 to 560 nm

### Particle Concentration Range

Up to  $1 \times 10^9$  P/cc at inlet of primary diluter with 500:1 total dilution ratio

### Inlet Sample Flow Rate

0.25 to 5 L/min (determined by dilution ratio and temperature/pressure conditions)

### Diluted Flow Rate

10 L/min

### Dilution Ratio Range

10:1 to 500:1

### Differential Pressure

+100 to -80 mbar without pressure reducing accessory  
< 3 bar with optional pressure reducing module

### Raw Gas Temperature Range

0 to 500°C (consult with factory for higher temperatures)

### Response Time

< 1.8 sec T10 to T90 (complete system; response time based on total number concentration response)

### Output Data Rate

10 Hz

### Heated Sample Line Temperature

OFF to 200°C (default is 150°C)

### Particle Penetration

Size dependent penetration determined experimentally from 5.6 nm to 560 nm for the complete system at nominal operating conditions (heated sample line at 150°C and catalytic stripper at 350°C). Particle penetration correction applied to EEPS spectrometer size distribution.

### Volatile Particle Remover

>99% removal at 30 nm with tetracontane

### Operating Temperature

0 to 40°C

### Operating Ambient Pressure

70 to 103 kPa

### Humidity

0-90% RH (non-condensing)

### Dilution Air Supply Requirements

Air or N<sub>2</sub> @ 80 psi and 25°C; ~30 SLPM

### Communications

Diluter to PC: RS232 with serial commands. AK protocol via Ethernet  
EEPS to Diluter: RS232 serial commands

### Size at Base (H x W x D)

1.65 m x 0.55 m x 0.82 m

### Weight

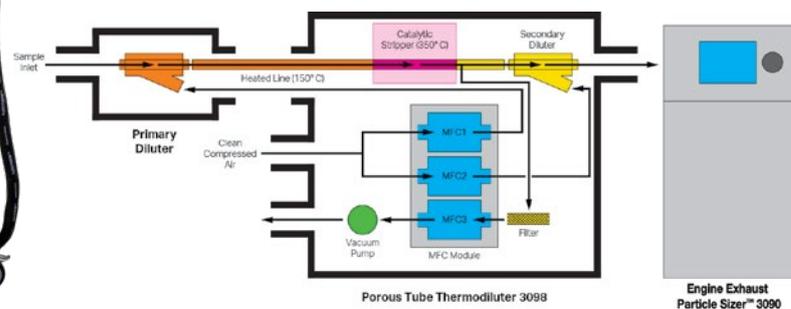
140 kg (308 lb)

### Sample Inlet

1/4-in for raw undiluted gas

### Power Requirements

100-120 VAC, 50/60 Hz or 200-240 VAC, 50/60 Hz; <1500 W



Specifications are subject to change without notice.

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## To Order

### Porous Tube Thermodiluter

#### Specify

3098S

3098M

3098L

#### Description

Porous Tube Thermodiluter, w/2.5 m sample line

Porous Tube Thermodiluter, w/4.0 m sample line

Porous Tube Thermodiluter, w/6.0 m sample line

#### Accessories

3074B

3098-KIT

3098-PR

3098-MFC

3098-2.5 MHSL

3098-4.0 MHSL

3098-6.0 MHSL

Filtered Air Supply

Accessory Kit (HEPA filters)

Pressure Reducing Module

Mass Flow Control Module (3 MFCs)

Heated Sample Line, 2.5 m

Heated Sample Line, 4.0 m

Heated Sample Line, 6.0 m