

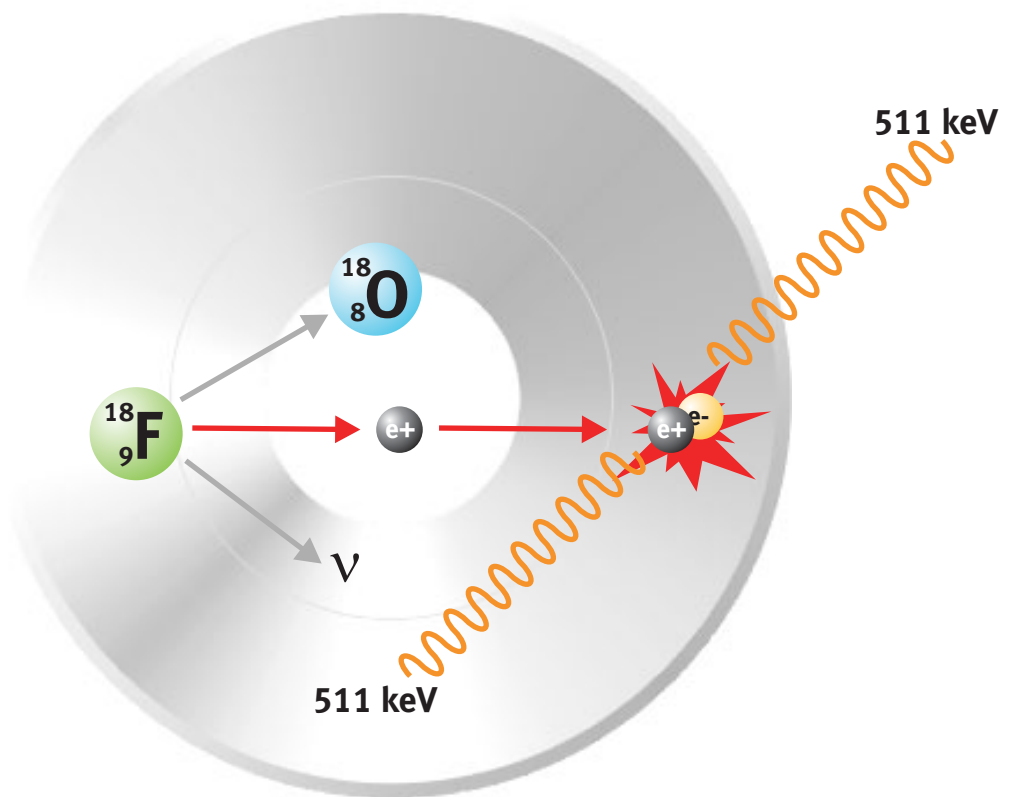
PET Effluent Stack Monitor

FHT 3511



The FHT 3511 measures the positron emitter activity concentration in the exhaust air of a stack by the 511 keV annihilation radiation of the positrons. Since every positron decays by emission of 2 such gamma rays emitted in opposite direction, only those events between the array of detectors can contribute to the coincident detection of these gamma rays.

- Stack monitoring specific for positron emitters (PET effluents)
- Extremely low coincidence background
- Signal-to-background ratio enhanced between 1 and 2 orders of magnitude (as compared to standard counting systems)
- Detection limits well below 1 kBq/m³



General

With each radioactive decay, F-18 or any other PET-nuclide emits a positron which annihilates via the simultaneous emission of two 511 keV gamma quanta under 180°.

For PET nuclides, e.g. F-18 and other positron emitters, extremely low and very reliable detection limits are achieved using coincidence counting.

The measured coincidence count rate is directly proportional to the activity of PET nuclides within the volume surrounded by the detector array. By means of a fast coincidence circuit, the measured background due to stochastic coincidences is kept extremely low (typically < 10 cps).

Coincidence counting improves the signal-to-background ratio by one to two orders of magnitude as compared to gross gamma or positron measurements.

Depending on the number and size of the detectors used, detection limits well below 1 kBq/m³ can be achieved.

Coincidence Monitoring of PET Nuclides

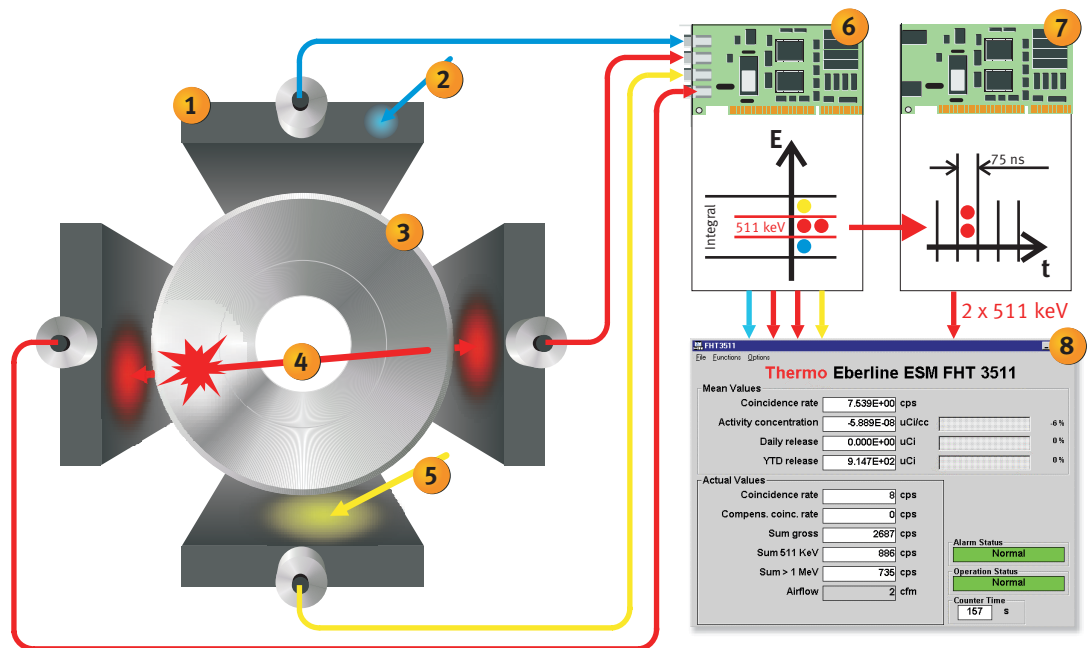
Using large area detectors with high gamma efficiency, the appropriate electronics measures both the single and the coincident count rates.

The background is subtracted on-line during the measurement of the positrons. Thus a reliable and sensitive analysis is performed even with backgrounds that vary during the measurement!

The calibration of the detector assembly is not influenced by the overall design and operation of the facility but only by the diameter of the duct and the size and spacing of the detectors.

Varying gamma backgrounds do not influence the coincidence technique used in the low level effluent monitoring.

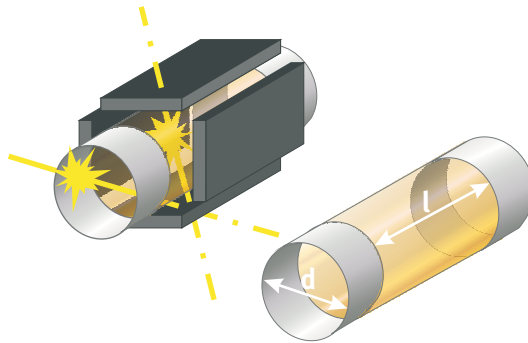
- Total rejection of gammas from outside the active detection volume
- No lead shielding necessary
- Easy calibration using a point check source (e. g. Ge-68)
- Large scintillation detectors are mounted outside the stack
- Versatile Windows based software for operation and report generation



- 1 15 l plastic scintillation detectors with integrated PMT and voltage divider
- 2 Gamma quant containing less than 511 keV
- 3 Defined Volumen by duct diameter and detector length
- 4 Coincidence (two 511 keV gamma quanta)
- 5 Gamma quant containing more than 511 keV
- 6 Detector card and threshold setting for 511 keV event separation
- 7 Card for the identification of coincidence events
- 8 FHT 3511 Windows based software for analysis, display and storage

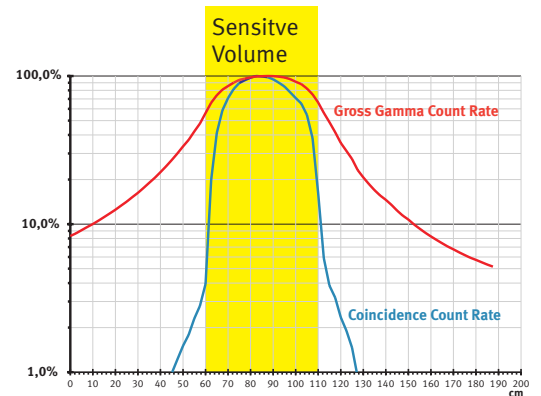
Virtual Gamma Shielding

- Only activity inside the sensitive volume contributes to the coincidence count rate
- Highly localised efficiency



Only positron annihilations inside the sensitive volume, as defined by the detector length "l" and the duct diameter "d", can contribute to the coincidence count rate. The gross gamma count rate however, may still add valuable information about the radiation process.

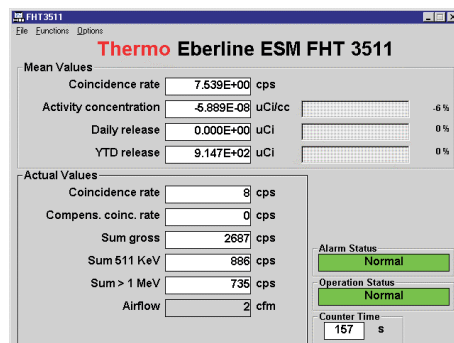
Relative response along a duct



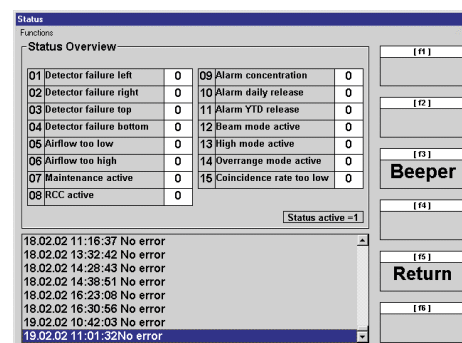
Highly localised efficiency: Coincidence counting takes place in a sharp, geometrically defined duct section.

Advanced Software Package

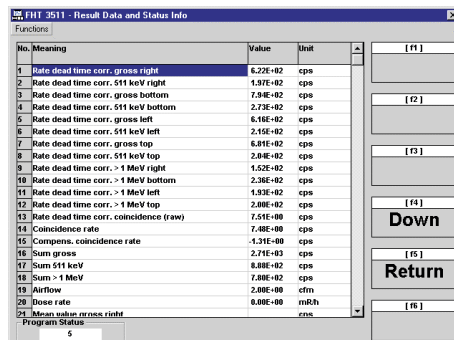
- On-line monitoring program FHT 3511
- Graphical display of last 24 h/6 days
- Immediate alarm generation
- DDE exchange with monitoring program (option)
- Data export to spreadsheet program (option)
- Advanced long term data storage and display program "NetView" (option)



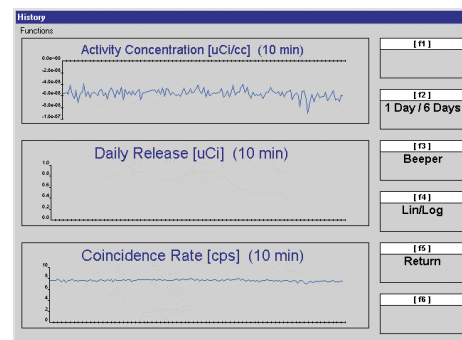
Pic. 1 : Main Screen



Pic. 2 : Status and Alarm Listing



Pic. 3 : Detailed Result Data



Pic. 4 : History

The Benefits are Striking

- Highly localised efficiency: The sensitive volume is outlined by the height of the detectors and the cross section of the duct itself.
- Only activity inside the sensitive volume contributes to the coincident count rate.
- Calibration is easy: All that needs to be done is to place a solid reference source onto the outer surface of the duct within the sensitive range of the detectors.
- The efficiency is not depending on the positron energy of the applied PET nuclide.
- Dynamic compensation of radon progeny.
- No dismantling of the air duct or use of gaseous sources required for calibration.
- No bypass loops with penetrations, pumps, valves, or lead shields.
- No sealing problems.
- No "cross-talk" from other ducts or processes.

Advanced Software Package Included

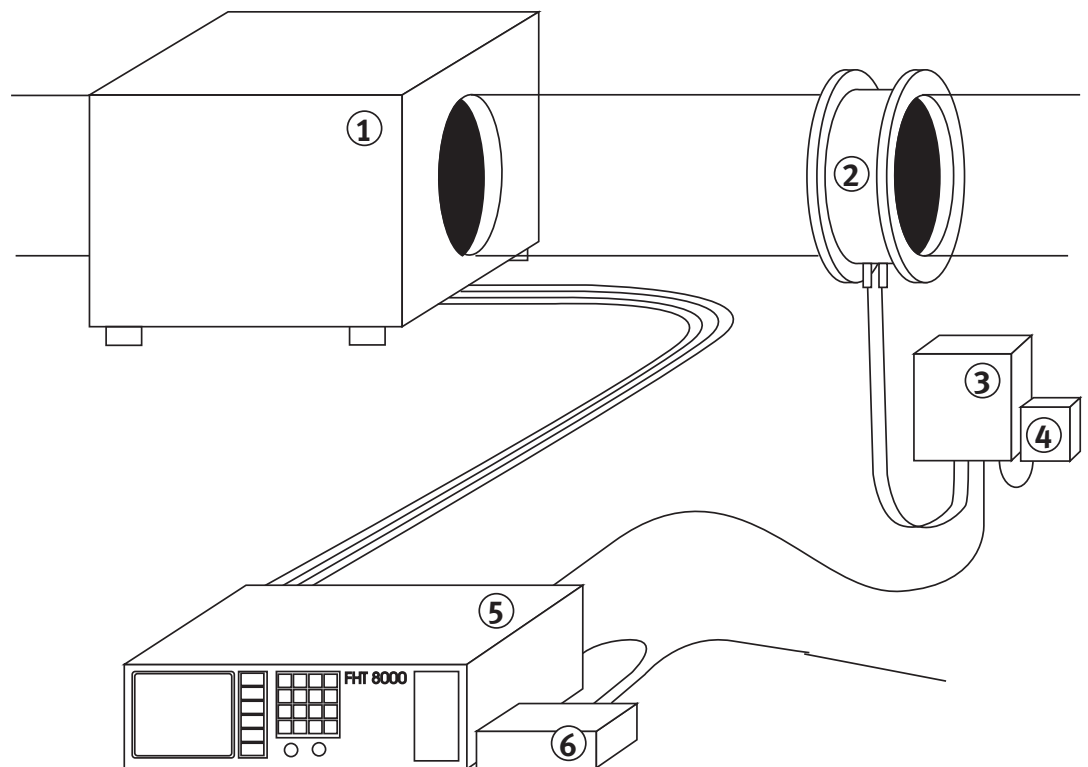
- On-line monitoring program "FHT 3511"
- Graphical display of last 24 h/6 days
- Immediate alarm generation

Optional

- Long term data storage and display program "NetView"
- DDE exchange with monitoring program
- Data export to spread sheet program

Scope of Equipment

- Stack monitor for in- and outdoor applications
- Measurement of the PET nuclides activity concentration plus gas flow out of one hand with **Thermo** components
- Data analysis, storage and display through the Windows based FHT 8000 unit
- On-line Service via modem connection



- 1 **Thermo** Eberline ESM PET Effluent Stack Monitor
- 2 **Thermo** Brandt DSK 1000 Gas Flow Sensor (Option)
- 3 **Thermo** Brandt SmartFlow Transmitter (Option)
- 4 24V Power Supply (Option)
- 5 **Thermo** Eberline ESM FHT 8000 incl. Network Card
- 6 Modem for On-line Services (Option)

Typical Installations

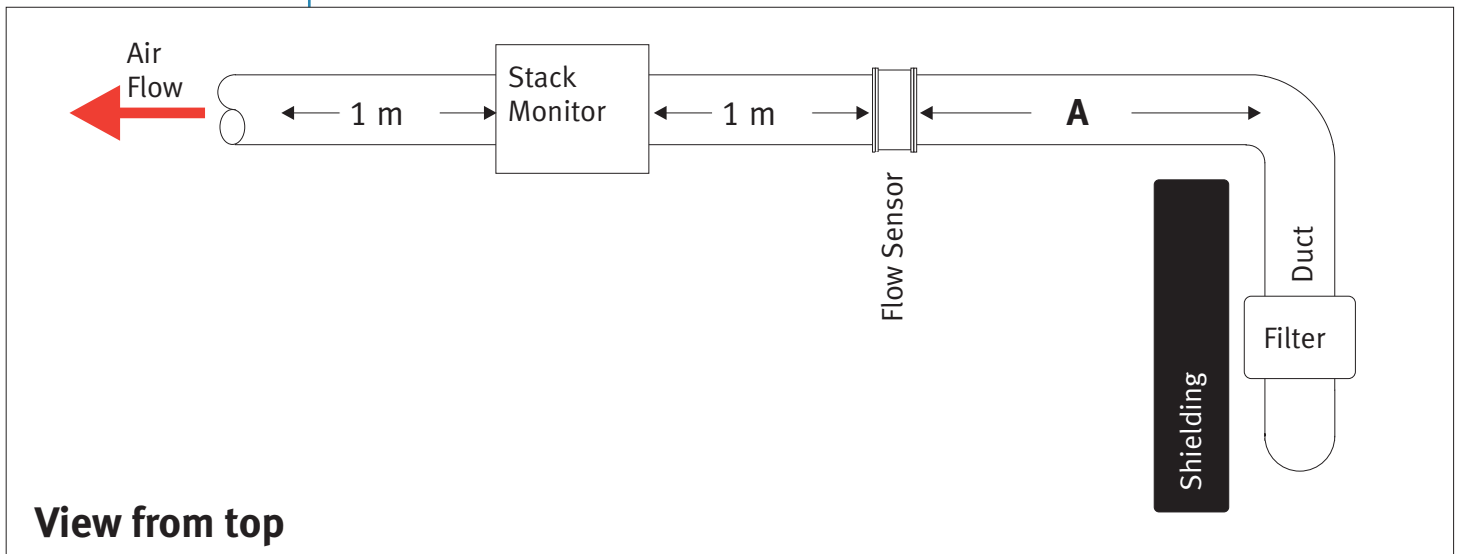


Pic.1 : PET Stack Monitor without panels



Pic.2 : PET Stack Monitor with Gas Flow Sensor in front. The transmitter for the Gas Flow Sensor is mounted at the PET Stack Monitor.

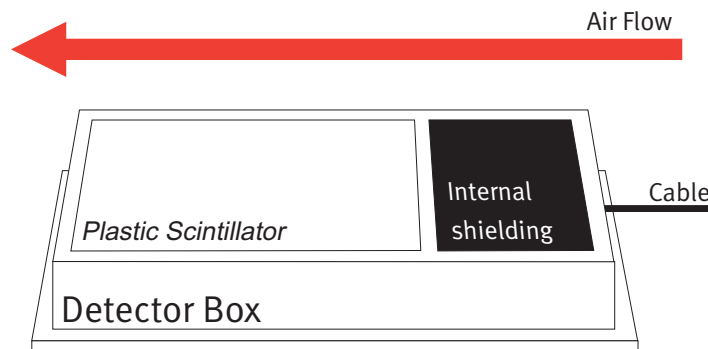
Installation Guidelines



Duct Diameter	A (min.)
12"	1,5 m
16"	2,0 m
20"	2,5 m
24"	3,0 m

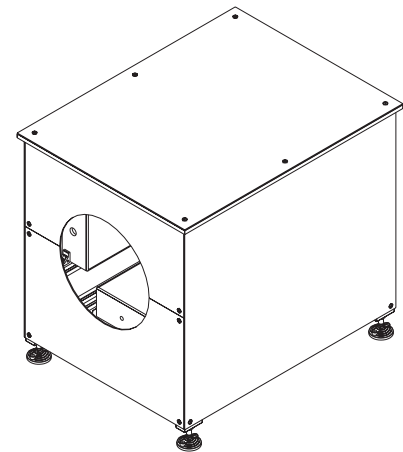
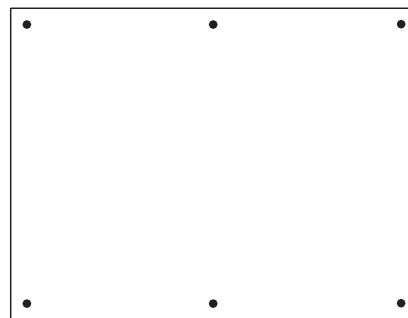
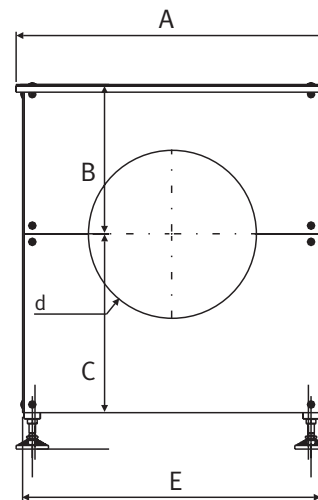
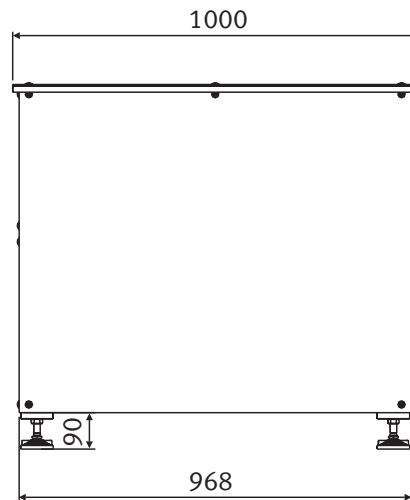
Internal Shielding

- Detector box includes aligned shielding.
- No further shielding required at the monitor



FHT 3511 Detector Racks

- Sturdy aluminum frame
- Stainless steel fittings
- Corrosion free
- Suitable for in- and outdoor applications
- White, UV-stabilized PVC cover panels with increased impact strength
- Variable height with easily adjustable feet



Type	FHT3511	FHT3511 A	FHT3511 B	FHT3511 D
Duct diameter	12"	16"	20"	24"
Approx. weight	304.8 mm 250 kg	406.4 mm 250 kg	508.0 mm 280 kg	609.6 mm 280 kg
Dimensions				
A	768 mm	768 mm	973 mm	973 mm
B	368 mm	368 mm	471 mm	471 mm
C	531 mm	531 mm	633 mm	633 mm
d	310 mm	410 mm	513 mm	615 mm
E	736 mm	736 mm	941 mm	941 mm

Radiation Measurement & Protection

Thermo
 ELECTRON CORPORATION

In principle, the FHT 8000 consists of two functional blocks: Block one comprises the measurement modules for the measured data acquisition, block two consists of a PC-compatible computer which processes and displays the measured values.

- PC compatible control- and evaluation computer
- Hard disk
- 3.5" floppy disk
- CD-ROM drive
- 2 serial and 1 parallel interfaces
- Operating system MS-DOS and Windows 9x
- Measurements are controlled by a subprocessor
- 19" cabinet with and without integrated VGA-LCD (6,5")
- Keyboard on the front panel for easy controlling of the measurement task
- LEDs for a status displaysound
- Transmitter for acoustic alarms

The unit configured in line with the 19-inch dimension specifications is a measured value acquisition and evaluation system designed for nearly all measurement tasks of spectro-radiometry. The integration of a PC-compatible computer makes it possible to flexibly process and graphically represent the measured data. It is also easily possible to further process or to transfer measured value data to any external PC.

A 6,5" colour LCD in VGA quality is integrated in the cabinet. An alternative version without a LCD is available. In this case, a separate monitor can be connected to the unit. The system operating under MS-DOS and Windows controls the measurement functions running in a sub-processor, processes the results and accepts the representation of the user interface.

The evaluated measured values can be monitored for limit values and if those are exceeded, an alarm will be triggered.

The front panel is provided with LEDs which annunciate alarms and error messages in a striking way. Acoustic alarms are triggered by means of an integrated sound transmitter. External units such as horns and pumps etc. can be controlled via digital inputs/outputs and sensor states can be recorded. The use of an analog module makes it possible to record voltage signals and to output current signals from 0-20 mA. A data recording over a long period of time is possible by storage onto the integrated hard disk. Documentation of the measured value data is possible by connecting a standard-PC-printer. A data transfer to a higher-level computer is performed via a floppy disk or a V24-interface which also allows to remotely control the unit. If a dial modem is connected, it is not only possible to exchange data but to update the software.

The unit is easily operated via the keyboard on the front panel. In addition, a PC keyboard and a mouse can be connected.



Cabinet type: desktop with stands, integratable into a 19" rack

Width without fixing bracket: 448 mm

Width with fixing bracket: 483 mm

Height: 178 mm

Depth: 415 mm

Mounting depth with room for connector: 480 mm

Weight approx. 13 kg

Power supply:
Voltage: 240 V (180V - 270V) AC
[120 V (90V - 135V)AC]

Power consumption without monitor:
approx. 56 W

Mains fuse: 10 A (T) Ambient conditions

Ambient temperature: 0 - 40 degrees Celsius

Relative air humidity: 10% - 90%
(not condensing)

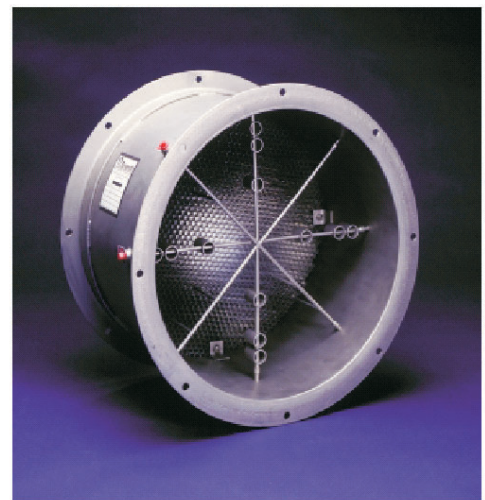
All out of one hand: Thermo Brandt Instruments equipment for reliable gas flow measurement as option for PET effluent stack monitor installations.

- Accuracies as low as $\pm 1.0\%$ of reading.
- Repeatabilities of $\pm 0.1\%$ of reading.
- Maximum turn-down of 25:1.
- 12 inch flange to flange dimension.
- Circular, rectangular and oval duct configurations available.
- High performance at ultra low spans
- Thermal compensated output
- Password protection
- LCD display and integral keypad
- Programmable alarms
- RTD input

Thermo Brandt's DSK1000 Series Air/Gas Flow Sensor is a pitot averaging air & gas flow measuring station with "Integral Flow Straighteners" designed for industrial process air and gas flow measurement.

The DSK1000 Series is ideal for process control applications where high repeatability must be maintained even when there is very little straight run of pipe available.

The integral flow straighteners eliminate the effects of turbulence while providing the equivalent of 7-9 diameter of straight run. The multi-point pitot array features Thermo Brandt's patented "Kiel Shrouded" impact ports and "Hemispherical Static Wands" positioned parallel with the flow stream for true static measurement.



Brandt Instruments' MST2000 Series Loop Powered Multivariable SMARTFLOW™ Transmitter sets new standards for draft range Differential Pressure / Mass Flow measurement of Air and Gas Flows. Combining Brandt's twenty plus years of experience in industrial process control with state of the art digital signal processing technology, the MST2000 is the most versatile, reliable, cost-effective and simplest to operate loop powered multivariable transmitter in the industry.

The MST2000 is a HART® compatible, loop powered (two wire) device available in either a compact, NEMA 1 configuration for wall or panel mounting or a rugged fiberglass NEMA 4X enclosure for hostile environments. With a turndown capability of 10:1 the available draft ranges can be turned as low as 0.01 Inches W.C. full scale. Fully programmable and user friendly, the MST2000 is capable of producing and displaying signals for Differential Pressure (Inches of Water Column) or for Flow (ACFM, SCFM, Lb/Hr).

Thermo Electron

Radiation Measurement & Protection



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