Partrix Fire GmbH

Specialised Aspirating Smoke Detector developer and manufacturer

Nano smoke particle detection

The first ever Particle Charging Aspirating Smoke Detector

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Overview

Aspirating smoke detectors (ASD) have been recognised as the most effective solution for protecting people's safety, company properties and public infrastructure against unforeseeable fire threats.

At Partrix Fire, we believe that the earlier we detect the threat, the sooner we can react. That's why we consistently focus on improving and creating innovations for smoke particle detection technology in the fire alarm industry. With nearly 20 years of experience, Partrix Fire shares a great passion with its employees for developing outstanding ASD and has successfully implanted the first-ever nanoparticle detection technology in the latest portfolio.

▶ During the product development phase, extensive efforts have been conducted to meet EN54-20 requirements. All ranges of PNED ASDs have been subjected to the reliability prediction evaluation (Handbook MIL-HDBK-217, MIL-HDBK-217F) to deliver promising product quality, detection effectiveness, operation safety and long-term operation stability.

For most ASD, smoke particle detection is achieved by acquiring the scattered light intensity on the smoke particle. Scattered light intensity highly depends on the wavelength of the incident light, particle composition and refractive index. Smoke particles less than 150 nm reflect less light onto the photodetector, making it hard to be seen by the detector.

Unlike all ASD you can find on the market, particle charging ASD aims to impose a known net charge on each smoke particle. The net charge distribution is closely related to the size and surface area of the smoke particle. This is what makes it unique from other detection technologies. By precisely measuring the charging characteristic, particle charging ASD obtains smoke particle sizing and concentration analysation jointly, achieving exceptional detection performance and accuracy. With years of research and development in particle charging technology, Partrix Fire has obtained exclusive and independent intellectual property rights and patents for particle charging ASDs.

Models		PNED L Laser-scattering		PNED particle charging C-Pro		PNED particle charging C-Ultra	
		PNED L-P1	PNED L-P4	PNED C-Pro-P1	PNED C-Pro-P4	PNED C-Ultra-P1	PNED C-Ultra-P4
Number of Sampling Air Inlet Port(s)		1	4	1	4	1	4
Sensitivity Range		0.005 to 15%obs/m	0.005 to 15%obs/m	0 to 6000	0 to 6000	0 to 6000	0 to 6000
Response Threshold Value		Alert: 0.001% to 2.0% obs/m (0.0003% to 0.625% obs/ft)		Alert: 0 to 2000	Alert: 0 to 2000	Alert: 0 to 1000	Alert: 0 to 1000
		Action: 0.001% to 2.0% obs/m (0.0003% to 0.625% obs/ft)		Action: 0 to 2000	Action: 0 to 2000	Action: 0 to 1000	Action: 0 to 1000
		Fire 1: 0.001% to 2.0% obs/m (0.0003% to 0.625% obs/ft)		Fire 1: 1000 to 4000	Fire 1: 1000 to 4000	Fire 1: 500 to 2000	Fire 1: 500 to 2000
		Fire 2: 0.001% to 15.0% obs/m (0.0003% to 4.6875% obs/ft)		Fire 2: 2000 to 4000	Fire 2: 2000 to 4000	Fire 2: 1000 to 3000	Fire 2: 1000 to 3000
Maximum Length of Sampling Pipes (m) – Linear		100	400	100	400	100	400
		(328ft)	(1312ft)	(328ft)	(1312ft)	(328ft)	(1312ft)
Maximum Length of Sampling Pipes (m) – U Branch		200 (2×100)	800 (8×100)	200 (2×100)	800 (8×100)	200 (2×100)	800 (8×100)
		(656ft)	(2625ft)	(656ft)	(2625ft)	(656ft)	(2625ft)
Minimum Airflow Per Pipe		25L/min					
Operation Condition		-10 to 55°C (14°F to 131°F); Humidity: 5% to 95% RH, non-condensing					
Filter		Two-stage Filtration, Long-lifetime, Easy-to-replace					
Camera	Resolution	Resolution of the images for fast inspection initiated by fire event: 800 × 600 dpi; Resolution of images for reinspection: 2592 × 1944 dpi					
	Transmission rate	Rate on Camera Function enabled: 921.6 Kbp/s					
	Transmission	Transmission time		Baud rate		Resolution	
		12s		921.6 Kbp/s		2592 × 1944 dpi	
		4s				800 × 600 dpi	
Maximum Coverage Area (m^2)		2000	6500	2000	6500	2000	6500
		(21520 ft^2)	(69965 ft^2)	(21520 ft^2)	(69965 ft^2)	(21520 ft^2)	(69965 ft^2)
Number of Sampling Holes (Class A/B/C)		35/40/45	35/70/90	35/40/45	35/70/90	35/40/45	35/70/90
Relays Outputs		5					
Four Alarm Levels		Alert Action Fire 1 Fire 2					
Event Log (Events)		20000					
Airflow Monitoring		Independent ultrasonic airflow monitoring system					
Software		PNED Detector System Managing Software					

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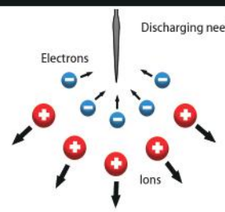
Nanoparticle charging technology can be commonly found in particle sizing and distribution instruments for laboratory applications, such as differential mobility analysers (DMAs). Similarly, PNED ASD C-Pro and C-Ultra apply particle charging technology to analyse smoke particle characteristics, including but limited to electromobility diameter d_m and the net charge on the particle surface.

By analysing the charging characteristics of particles, PNED can extend the detection range of nanoparticles past the limits of optical detection systems. In fact, it redefines the boundaries of very early fire warning, buying more time in which to take essential action to prevent fire threats.

1 Generating ions



Create positive discharging region

The positive discharge needle generates a high-voltage difference between ground electrode and discharging needle to ionise the air molecules, which releases positive ions to the outer discharging zone.

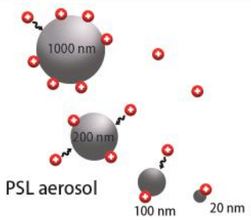
Deliver ions to the mixing chamber

Clean sheath air flows into the discharging zone and transports positive ions to the mixing chamber from the outer discharge zone.

Positive corona discharge

—— *High ion production*

2 Mixing & charging



Mixing and charging

Biasing electric field and airflow pattern contribute to the particle charging in the mixing chamber. They play a crucial role in the field-charging and diffusion charging mechanisms, respectively and can significantly affect the final charging efficiency by increasing the possibility of impact and attachment between ions and smoke particles.

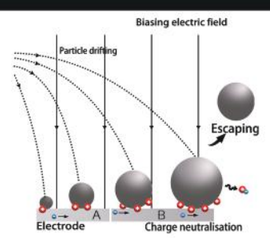
Main factors affect charge efficiency

—— *Particle size*
—— *Particle surface area*
—— *Electric field strength*
—— *Airflow pattern*
—— *Residence time*

Minimum size for effective charging

—— *Particle diameter >20nm* (PSL aerosol test proved)

3 Analysing



Particles drifting and landing

The motion of the charged particle in an electric field follows a trajectory path (drifting) that is affected by the net charge on the particle – in other words, the net charge on the particle surface or the electric mobility diameter d_m.

Charge neutralisation

Positively charged particles are neutralised on the receiving electrodes and create a voltage signal that can be measured and analysed for smoke detection. Multi-receiving electrodes collect charged particles and classify them into different categories following their size d_m.

Analysing characteristics

—— *Particle size d_m by travelling distance in the electric field.*
—— *Smoke concentration by total charges on the smoke particles*
—— *Environment cleanliness analysis by adding the time dimension*

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Models	PNED L Laser-scattering		PNED particle charging C-Pro		PNED particle charging C-Ultra	
Pipe System Layout Design Software	PNED PIPE					
LED Indicator	Four-level fire warnings, power indicator, smoke concentration indicator, fault display, fire warning time, silence, isolate, reset, self-test					
Communication between PNED Net	RS485					
IP Rating	IP40					
Maximum Detector number in PNED Net	100					
Maximum Length of PNED Net (Built-in RS485 Repeater for each detector)	The maximum transmission distance between two detectors with the camera is 200m. Optional RS485 repeaters can be added to the network to extend the transmission distance. Up to 100 detectors can be connected to the network with a transmission rate of 921.6 kbp/s The maximum transmission distance between two detectors without the camera is 1200m. Up to 100 detectors can be connected to the network with a transmission rate of 9600 bp/s					
Dimension (HWD, Non-camera)	Single-pipe: 358mm × 227mm × 121mm (14.0in × 8.9in × 4.8in)					
	Four-pipe: 396mm × 253mm × 118mm (15.6in × 10.0in × 4.6in)					
Operating Voltage	DC 18 to 30V, Standard DC 24V					
Fan Speed Range (rpm)	6500 to 20000	1500 to 8300	6500 to 20000	1500 to 8300	6500 to 20000	1500 to 8300
Maximum Power Consumption at Standby	16.1W	23.3W / 15.1W / 27.1W	16.1W	24.0W / 16.6W / 29.8W	16.3W	24.2W / 16.8W / 30.0W
Fan Speed Setting (rpm)	6500	20000 / 1500 / 8300	6500	20000 / 1500 / 8300	6500	20000 / 1500 / 8300
Net Weight	3.4kg	4.4kg	4.2kg	5.0kg	4.2kg	5.0kg
Sensitivity Criteria	Obscuration		The characteristic value of the total surface area associated with the electric mobility diameter at a constant airflow rate			
Sensitivity Unit	%OBS/m		CSEA			
Pipe Dimensions (mm) OD	Outer Diameter: 25mm (3/4 in IPS)					
Cleanliness Monitoring					ISO 14644 Class 8 / Class 7 / Class 6	
Cleanliness characteristic by electromobility and surface integration over time					0 to 360000 CSEA/min	
Maximum Load of the Output Relays	30V, 2A					
Input	Power Wire: 0.75 to 2.5mm² (18AWG to 13AWG) Belden Cable 9841 or equivalent RS485 0.2mm²(24AWG), 120Ω impedance					
Enclosure	Flame Retardant ABS + PC					
Enclosure Color	Grey Front Cover / Red Casing		White Front Cover / Red Casing		Black Front Cover / Red casing	
Built-in gaseous monitoring system	Four pipeline PNED ASD have exclusive built-in CO2 and VOC sensors for each channel that is able to address which channel is carrying the smoke after sending out the fire alarm signal					

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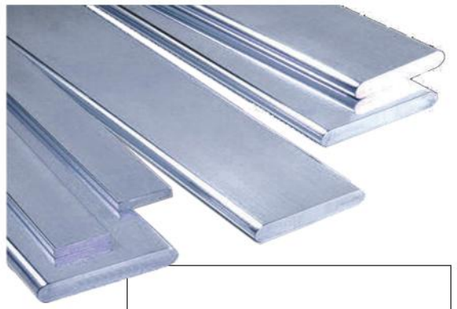
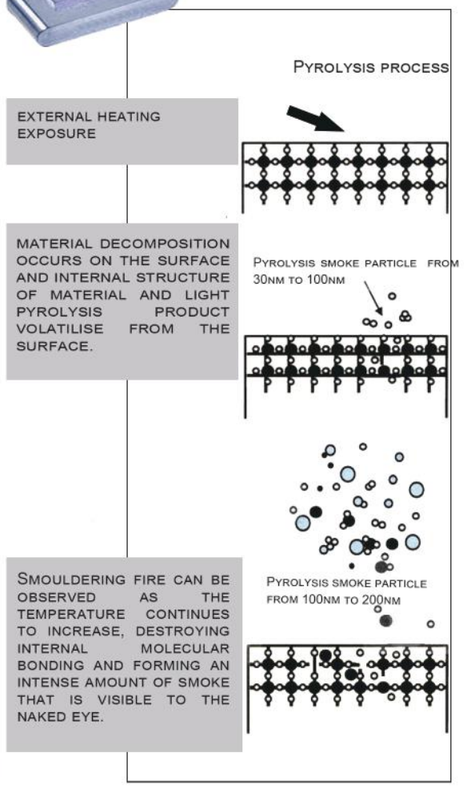
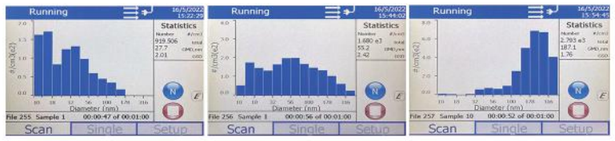
Pyrolysis stage

The pyrolysis stage is defined as the thermal decomposition of materials at a specific temperature that usually lies between 100 to 200℃. A large number of nano-scaled particles are generated and released into the surrounding environment during the pyrolysis stage, creating the earliest sign of the fire hazards. However, detecting such sign is a huge challenge because these particles are particularly small with very complex characteristics.





Particle size distribution



PVC's smoke particle development process can be clearly observed via the display screen of the particle distribution instrument TSI SMPS 3910. During the entire process, both particle diameter and concentration create an obvious sign of the overheated state that should be immediately put into further action. Otherwise, it may cause severe fire disasters and unaffordable losses without interference.

Why particle charging ASD

The fundamental principle of particle charging ASD is to measure the total charges on the smoke particle surface and the travelling distance in the electric field. With the unique mechanism, particle-charging ASD allows smoke particles down to 20 nm to be charged and detected efficiently. By combining all features, we introduce a new measuring unit, CSEA, to provide reference to the sensitivity of particle charging ASD. Built on the latest particle charging technology and multiple innovation capabilities, PNED C-Pro and C-Ultra achieve optimised performance that makes them capable of revealing fire threats at the pyrolysis stage of fire.

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PNED Net

PNED Net is a local networking system that allows data transmission across each device, delivering critical fire alarm signals to the PNED DSMS monitoring platform and Fire Alarm Control Panels (FACP). PNED Net is fully compatible with the existing RS485 networks and is able to transmit images across the network.

- Maximum of 100 devices for a single loop
- RS 485 transmission line
- Maximum distance between each device is 200 meters (During high-speed transmission at 921.6 kbp/s)
- Built-in RS485 repeater

On-field quick inspection

PNED ASD offers an optional camera to quickly inspect fire threats where the detector is installed, allowing counter measurement to be made before taking action.

- Three fixed shooting angles within 180°
- Flashing light for dim environment
- Maximum resolution 2592 ×1944 dpi

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- Laser scattering technology
- Optional camera available
- Wide-range application
- Airflow monitoring system
- Early fire detection

PNED Laser scattering ASD

The PNED L range utilises laser-scattering technology to deliver customers great value and fulfil high expectations for early fire warning. Partrix Fire believes that reliability and performance-based design are the keys to delivering our value. Therefore, PNED L was subjected to extensive work during the design phase to accommodate consistent detection performance and long-term operation stability. A unique large-particle rejection algorithm prevents damage to the optical elements from nuisance particles. It is an ideal choice for protecting lives and business continuity for all ranges of applications.

Applications:

Transformer, Food processing, Historical architecture, Administrative building, Correctional facility

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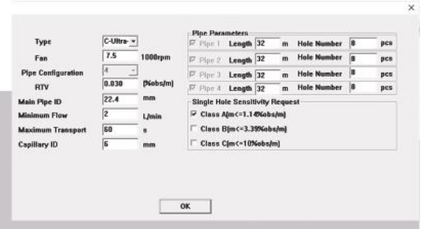
Detector System Managing Software

PNED DSMS is the monitoring platform for PNED ASD that provides a one-stop software solution for users to configure, monitor, control and maintain all ranges of PNED ASD. The user-friendly UI and simple-to-use features help operators quickly master the software.

- *Multiple access levels for more secure data protection*
- *One-stop network configuration*
- *Customisable monitoring platform for visually inspecting detector on the map*

PNED Pipe

PNED Pipe is a pipeline simulation software specially designed for configuring the pipeline network. It is integrated with a complete dynamic airflow model, providing an important design platform for a high-standard pipeline network.



- *Sampling point optimisation*
- *Sensitivity calculation*
- *Calculating length for pipework*

By Partrix Fire GmbH

- Particle-charging technology
- Early detection at pyrolysis stage
- Optional camera available
- Wide-range application
- Self-cleaning system

PNED C-Pro

PNED C-Pro is the first-ever particle charging aspirating smoke detector. It offers an extra-large detection range for nano smoke particles from 20 nm to several micrometres, which covers a large variety of smoke particles released at the pyrolysis stage of fire. The self-cleaning function periodically conducts internal cleaning tasks for the collector, charger and built-in pipe system, reducing the maintenance costs significantly and extending the service life.

Applications:

Warehouse, Hospital, Data centre, Logistic, Pharmacy, Surgical room, Electricity power plant, Energy storage room

PNED® Aspirating Smoke detector

By Partrix Fire GmbH

- Particle-charging technology
- Early detection at pyrolysis stage
- For clean environment application
- Contamination level monitoring
- Optional camera available
- Self-cleaning system
- Ultra-high sensitivity

PNED C-Ultra

PNED C-Ultra is the premium detector in the PNED C range. Enhanced particle charging technology performs exceptionally high sensitivity, which is ideal for applications with large airflow rates, controlled environments, and high-frequency ventilation systems. Except for the advantages of sensitivity and maintenance cost, PNED C-Ultra has deployed an advanced algorithm for real-time monitoring of the environment contaminates. Up to Class 6 cleanliness standards in compliance with the ISO 14644 regulation can be successfully monitored by PNED C-Ultra.

Applications:

Laboratory, Cleanroom, Semiconductor manufacturing plant, Bioengineering, Aerospace lab.