Self Cleaning HEPA Filtration In Arduous Environments

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World Class Filtration Solutions

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HEPA Filtration

- Established for many decades as a reliable means of controlling environmental release to a known degree
- Limited in application by chemistry, temperature, solids load and radioactivity
- Results in expensive to dispose of secondary or tertiary waste streams
- A small amount of dust results in a large volume for disposal

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HEPA Filtration in Arduous Environments

- Arduous Environments are here defined as
  - High Temperature (400 Celsius max [750 Fahrenheit] in oxidising flows)
  - High solids loads
  - High activity situations
  - Aggressive chemical streams
- 316L stainless filtration media meets all these needs (dependent upon chemical resistance
- Removes need to dispose of secondary or tertiary waste stream
- Returns to the user the small amount of dust which would other wise result in a large volume for disposal

Self Cleaning HEPA Filtration

- Pulsed Jet Filter Cleaning will return the collected solids to the user for removal and disposal
- Safe and reliable cleaning mechanism
- Industrially proven
- Systems can be adapted to provide remote maintenance

Self Cleaning HEPA Filtration

- Limited to 400 Celsius [750 Fahrenheit] in Oxidising Environments (up to 500 Celsius [930 Fahrenheit] in reducing atmospheres)
- Substantial DP penalty (possibly as high as 25 mbar [10” W.G] depending on solids load and cleaning cycle time)
- Equipment size and cost can be substantial
- Limited to atmospheres which are 316L compatible.

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Pulsed Jet HEPA Filtration

- Will maintain 99.97% + at 0.3 micron release levels in the long term
- Increases the range of applications within reach of direct HEPA filtration (removing the need for scrubbers etc.)
- Can simplify process design
- Dust return mechanism can be designed to meet the specific needs of the user for disposal in a controlled fashion

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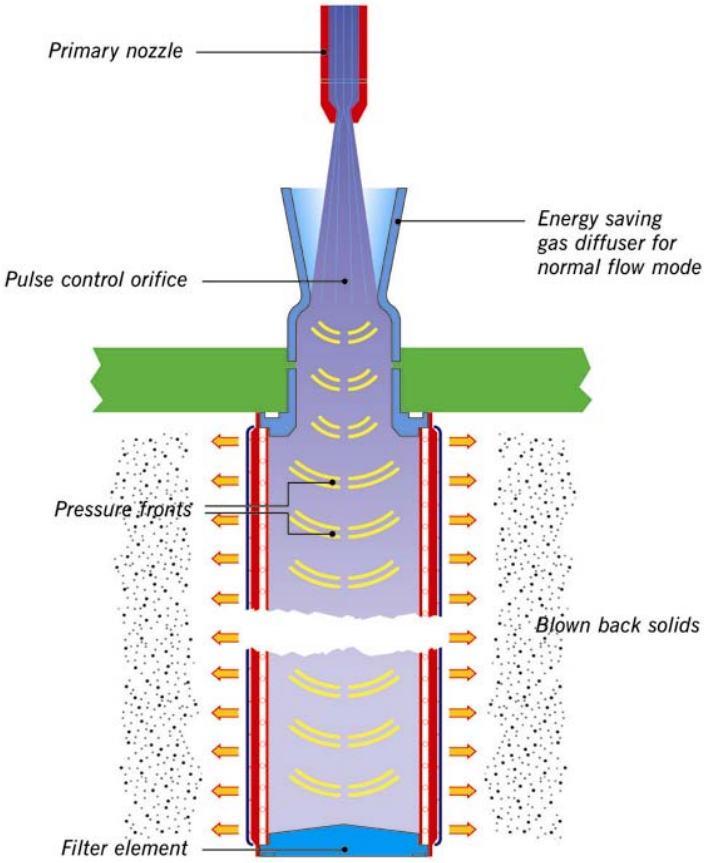
Pulsed Jet Filter Cleaning



Pulsed Jet Filter Cleaning;

- Cleaning pulse can be 0.25 second or less
- Cleans In-situ
- Doesn't Interrupt Process flow
- Returns Dust To the User
- Minimising Pressure Loss
- Operates at a stable DP Plateau
- Proven
- Reliable

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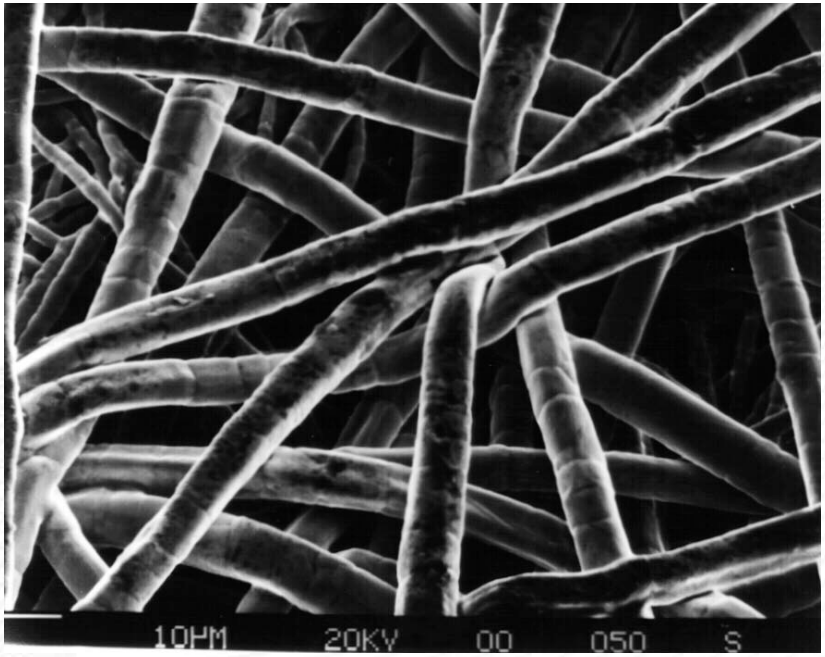
Pulsed Jet HEPA Filtration Filter Medium (Sintered Metal Fibre

- Random Laid (Non Woven) Matrix
- Metal Fibres range 1-30um
- Sinter-bonded - No Binders
- Pleatable
- High Porosity 60-80%



Pulsed Jet HEPA Filtration Filter Medium (Sintered Metal Fibre)

Course Fibre Support Structure

Flow

Fine Fibre Structure - Surface Filtration

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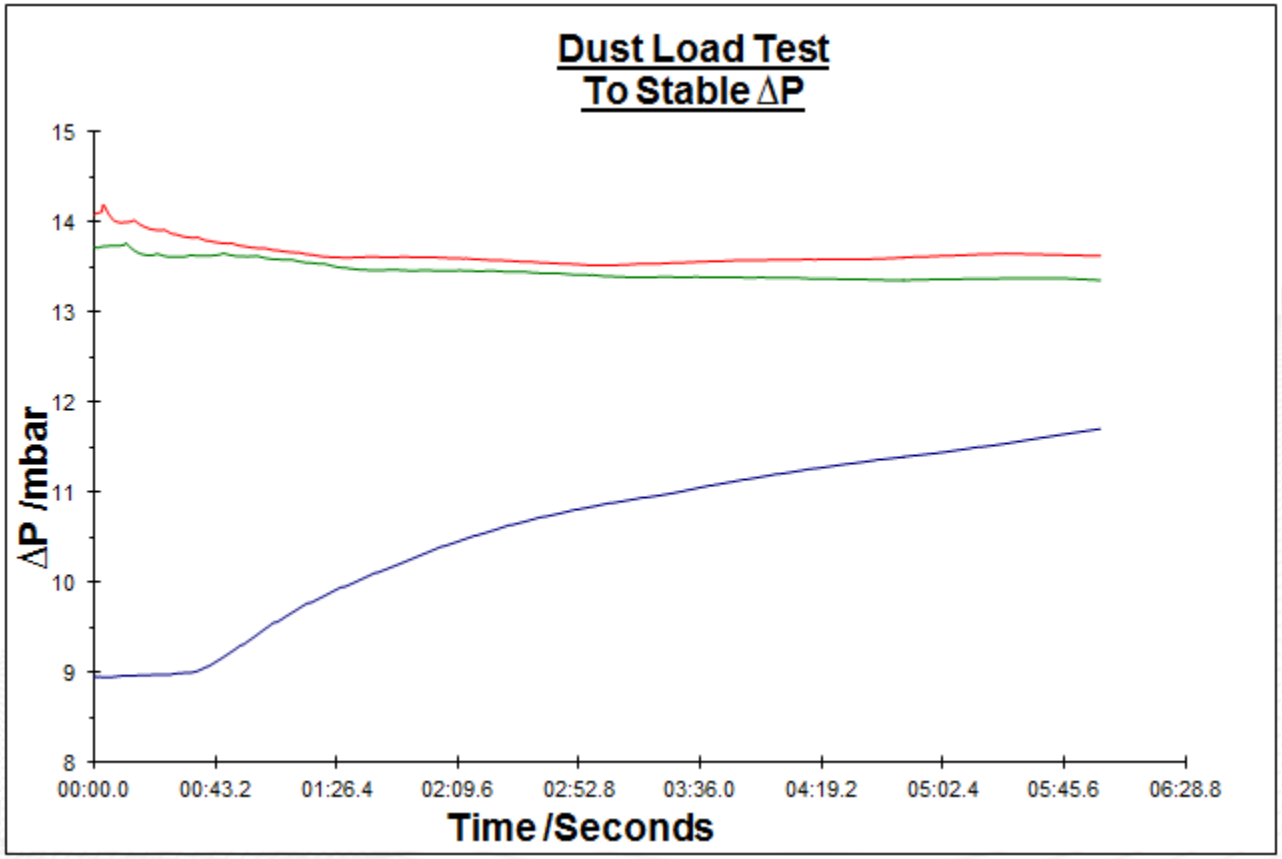
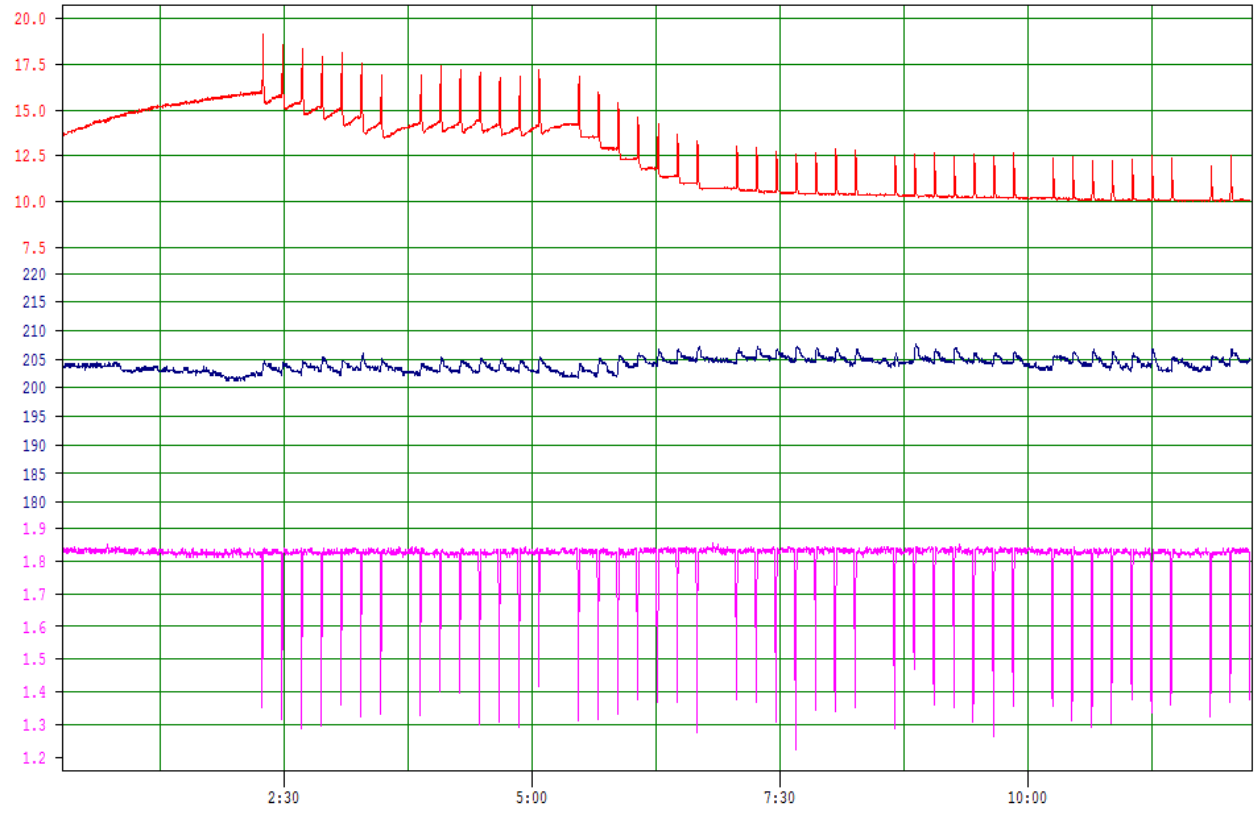
Pulsed Jet Filtration



HEPA Filtration

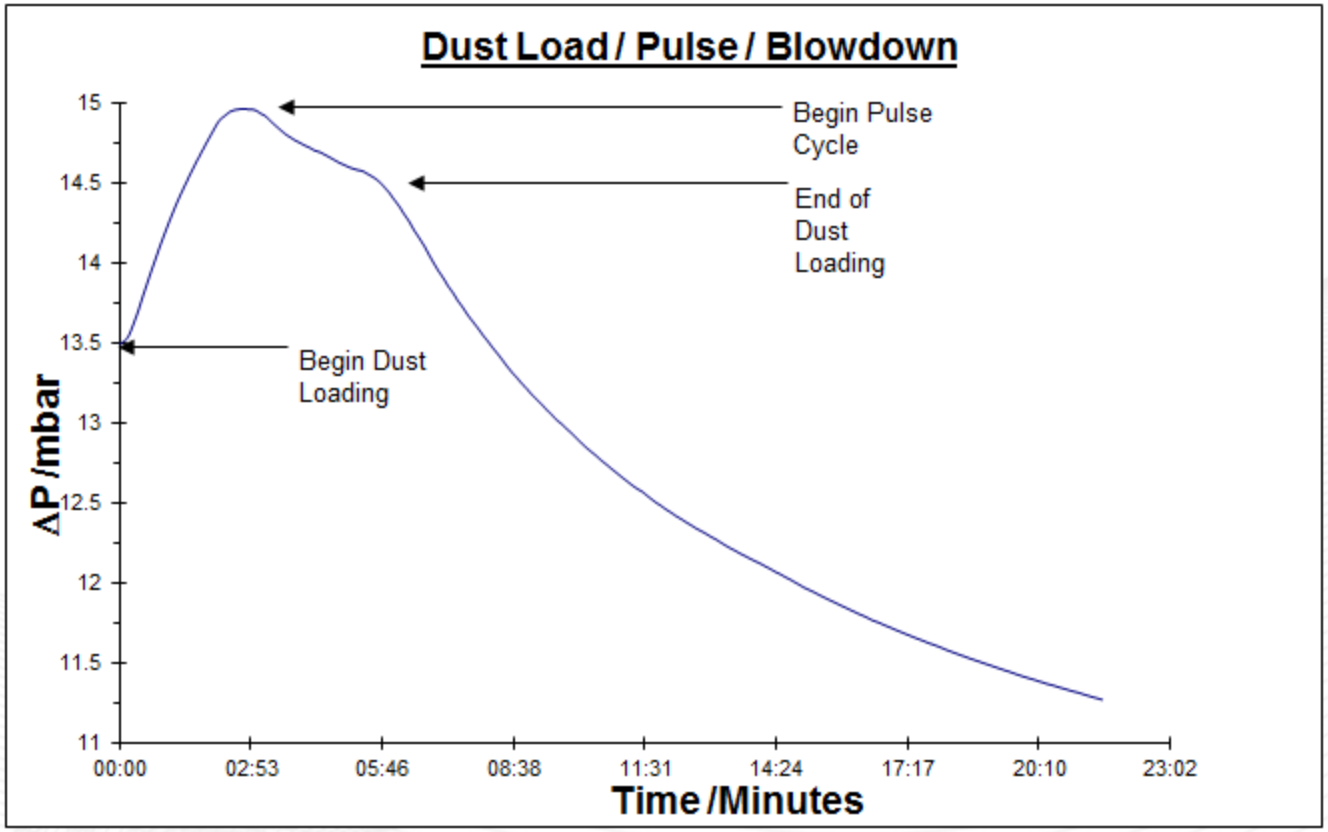


Δp mbar

Flow m^3/hr

Pulse Pressure barg

HEPA Filtration



Self Cleaning HEPA Filtration Proof of Concept Testing

- Porvair Filtration, building upon it's long term experience of Pulsed Jet self cleaning filters in the Nuclear Industry, developed the technology to provide reliable HEPA grade separation in gas streams
- The following is an abstract of some of that work, on test bed Pulsed Jet HEPA filter system at our UK research facility using high dust loading at ~ ambient T&P
- The results noted are at the pilot scale, but we know from our corporate experience that scale up is both possible and reliable

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Self Cleaning HEPA Filtration Proof of Concept Test Conditions

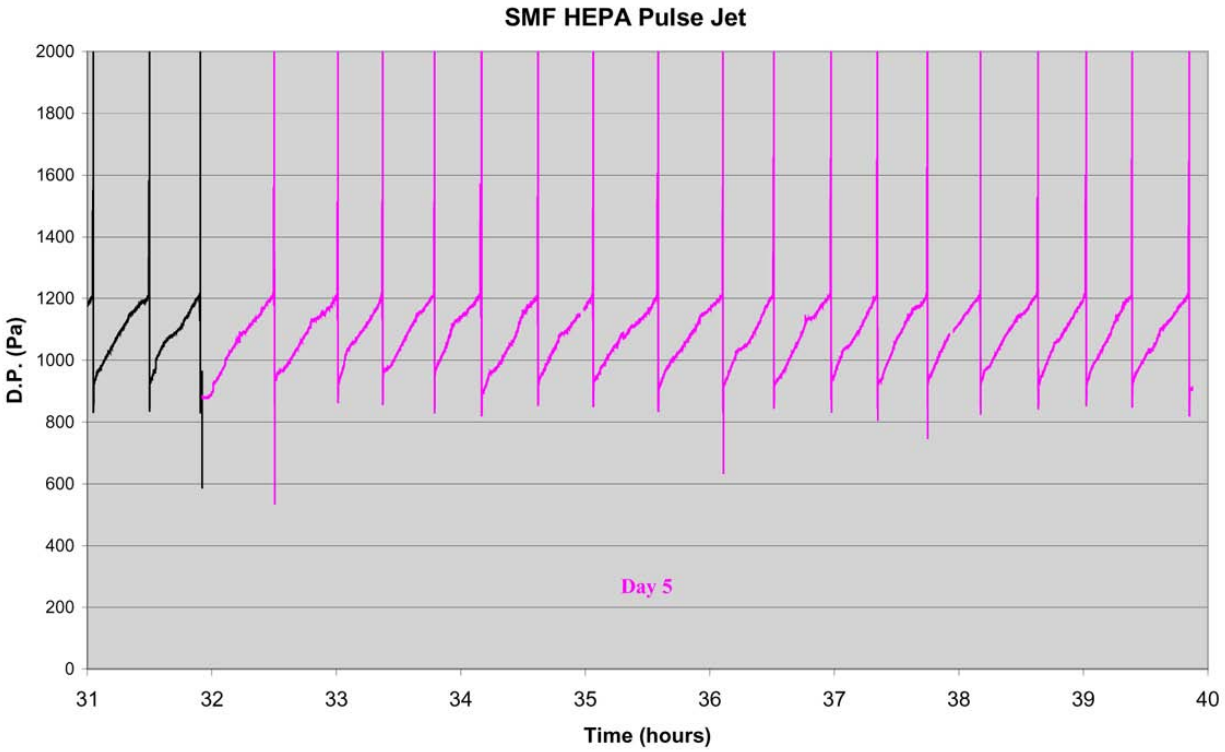
- Filter element filtration area - 0.3 m^2 (3.4 ft^2)
- Target efficiency 99.97% @ 0.3 microns (actual DOP tested efficiency (99.992% @ 0.3 microns)
- Test simulant used was Iron Oxide in the range 0 to 5 microns
- Air flow 32.4 m^3/hr (19.2 cfm)
- Dust rate 108.5 g/hr
- Clean DP 6.2 mbar [2.5” W.G]
- Initial DP set point to start cleaning cycle 12.1 mbar [4.8“ W.G]
- Adjusted DP set point to start cleaning cycle 18.1 mbar [7.3” W.G] (raised to see if increased DP would affect cleanability
- MPPS also measured (see certificates on last slide)

The Test Programme

The rig consisted of ;

- Air Flow (Fan and Ducting)
- The Filter Vessel
- The Pulsed Jet Cleaning System
- The Dust Injection System
- Dust Recovery and Measurement
- Instrumentation
- Data Logging

The Results



The Test Programme Proved That Reliable Pulsed Jet, Self Cleaning HEPA Filtration Could Be Achieved Under High Dust load Conditions Using a Fine Test Dust

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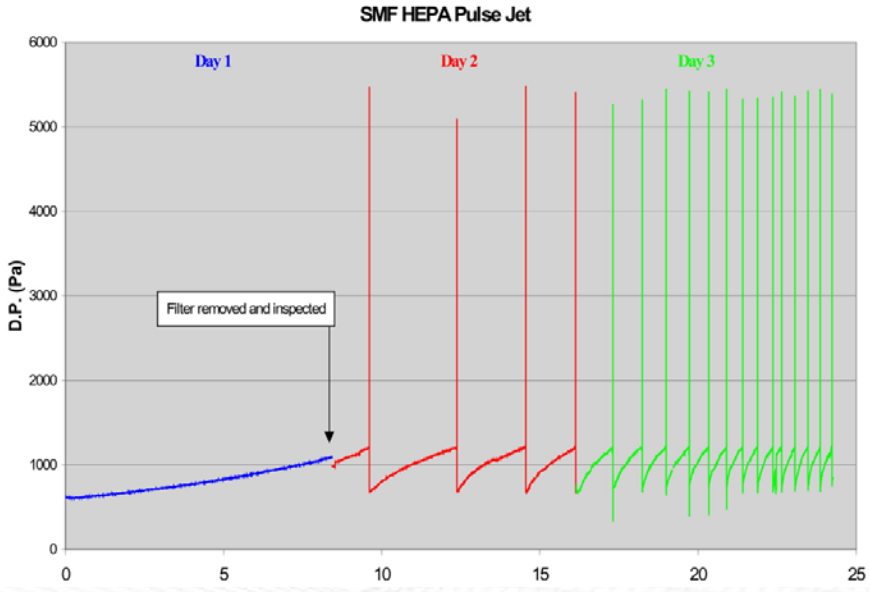
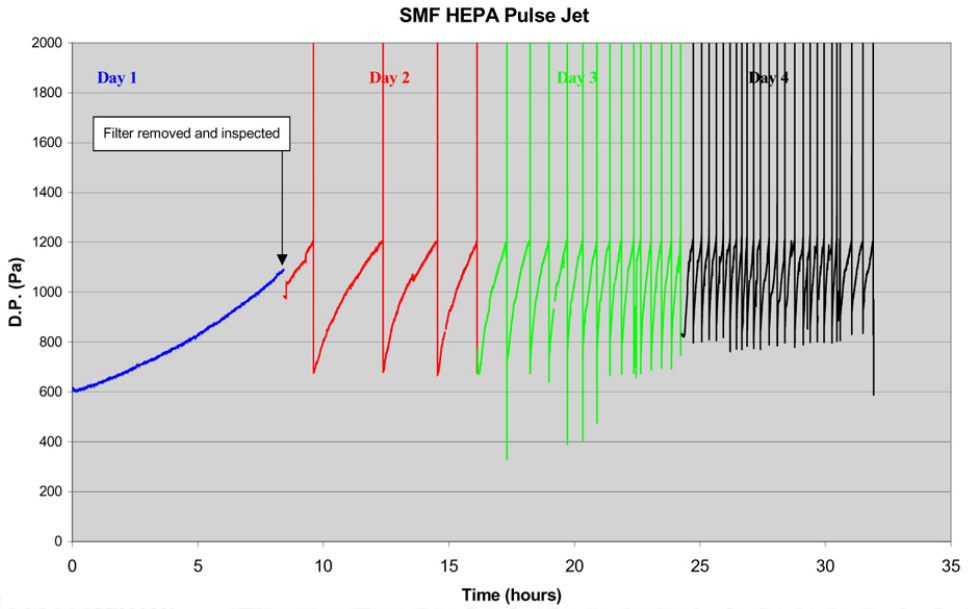
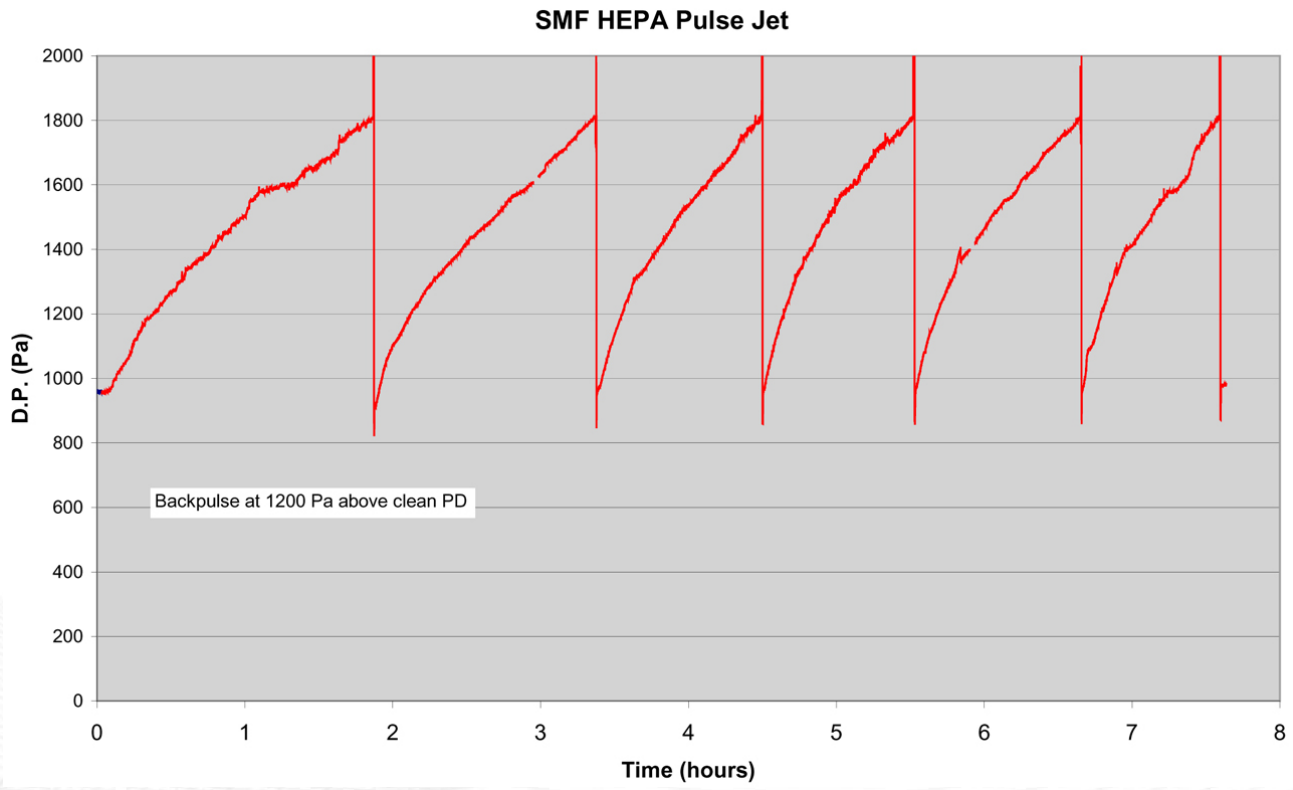
Evolution of the Stable Regime





Recovery Regime at Higher Initiation Pressure



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Conclusions

- Efficiency Tests prove HEPA Efficiency Before and After the Test Programme
- DP data Proves That Stable Long Term Operation is Possible
- Subsequent Work On MPPS Shows Actual Efficiency at MPPS for the Filter Medium is better than 99.98% @ 0.14/0.16 microns
- Work is on-going
- Concept is proven
- Self Cleaning metallic filtration for arduous environments is an industrial reality.

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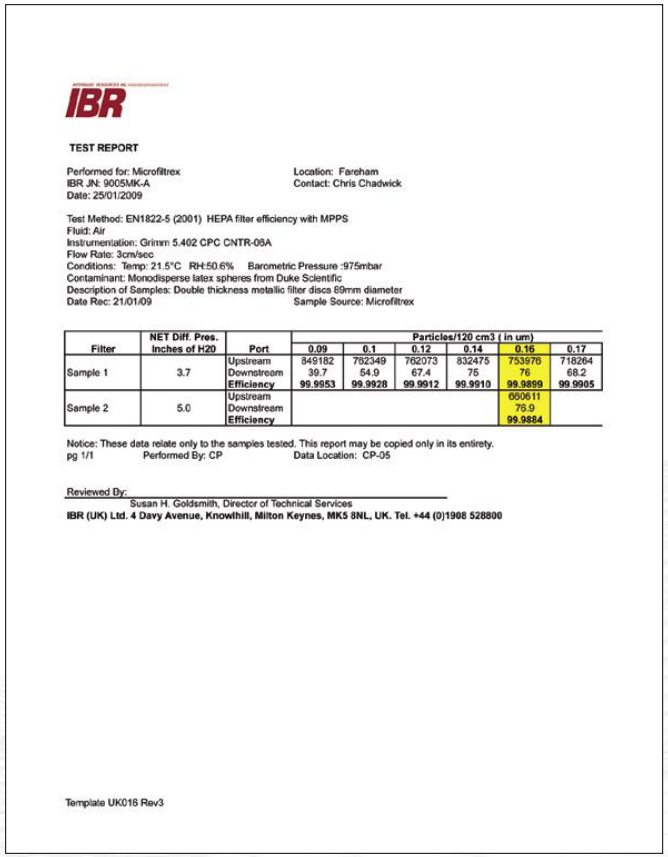
MPPS



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TEST REPORT

Performed for: Microfiltrex
IBR JN: 9005MK-A
Date: 25/01/2009

Location: Fareham
Contact: Chris Chadwick

Test Method: EN1822-5 (2001) HEPA filter efficiency with MPPS
Fluid: Air
Instrumentation: Grimm 5.402 CPC CNTR-06A
Flow Rate: 3cm/sec
Conditions: Temp: 21.5°C RH:50.6% Barometric Pressure :975mbar
Contaminant: Monodisperse latex spheres from Duke Scientific
Description of Samples: Double thickness metallic filter discs 89mm diameter
Date Rec: 21/01/09 Sample Source: Microfiltrex

Filter	NET Diff. Pres. Inches of H20	Port	Particles/120 cm3 (in um)					
			0.09	0.1	0.12	0.14	0.16	0.17
Sample 1	3.7	Upstream	849182	762349	762073	832475	753976	718264
		Downstream	39.7	54.9	67.4	75	76	68.2
		Efficiency	**99.9953**	**99.9928**	**99.9912**	**99.9910**	**99.9899**	**99.9905**
Sample 2	5.0	Upstream					660611	
		Downstream					79.9	
		Efficiency					**99.9884**	

Notice: These data relate only to the samples tested. This report may be copied only in its entirety.
pg 1/1 Performed By: CP Data Location: CP-05

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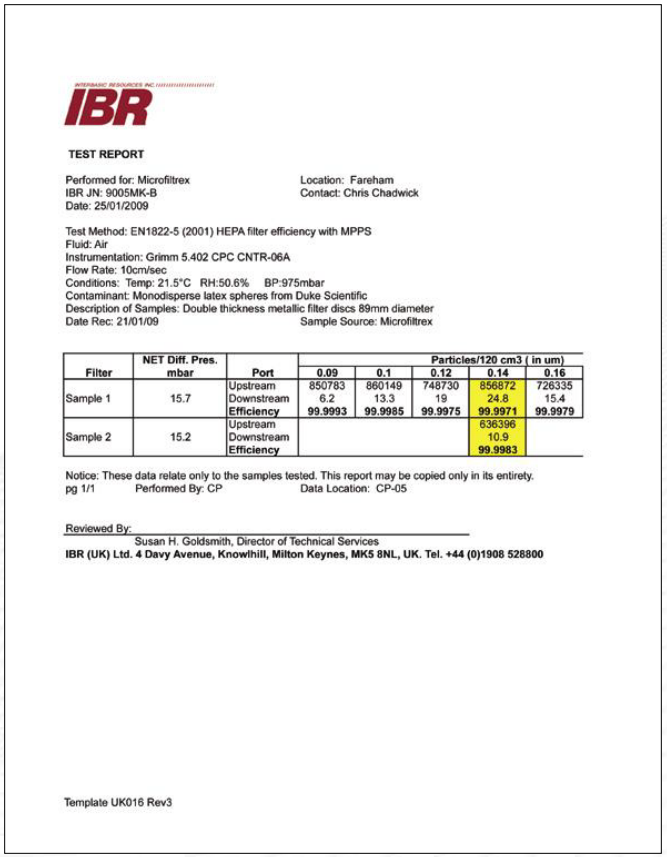

IBR

TEST REPORT

Performed for: Microfiltrex
IBR JN: 9005MK-B
Date: 25/01/2009

Location: Fareham
Contact: Chris Chadwick

Test Method: EN1822-5 (2001) HEPA filter efficiency with MPPS
Fluid: Air
Instrumentation: Grimm 5.402 CPC CNTR-06A
Flow Rate: 10cm/sec
Conditions: Temp: 21.5°C RH:50.6% BP:975mbar
Contaminant: Monodisperse latex spheres from Duke Scientific
Description of Samples: Double thickness metallic filter discs 89mm diameter
Date Rec: 21/01/09 Sample Source: Microfiltrex

Filter	NET Diff. Pres. mbar	Port	Particles/120 cm3 (in um)				
			0.09	0.1	0.12	0.14	0.16
Sample 1	15.7	Upstream	850783	860149	748730	856872	726335
		Downstream	6.2	13.3	19	24.8	15.4
		Efficiency	**99.9993**	**99.9985**	**99.9975**	**99.9971**	**99.9979**
Sample 2	15.2	Upstream				636396	
		Downstream				10.9	
		Efficiency				**99.9983**	

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