



HEPA Filtration in the Event of HT Excursions

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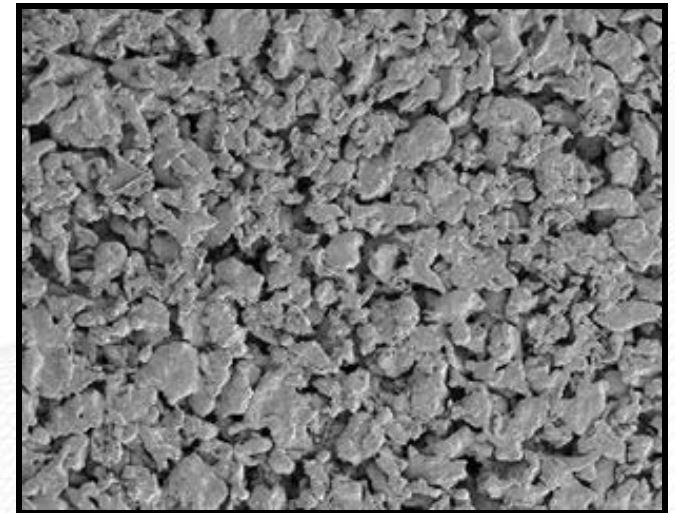
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Introduction

- As filtration technology advances, more complex areas of application open up and are satisfied
- Major among these is the possible amelioration of the effects of fire (and other HT excursions) in vent systems
- In addition, it is possible to continue operation during and after the fire/HT excursion by the use of self cleaning mechanisms associated with the filter system
- Explosions present a second hazard – shock waves and rapid pressure transients

Sintered Metal Powder (Porvair Sinterflo P range)

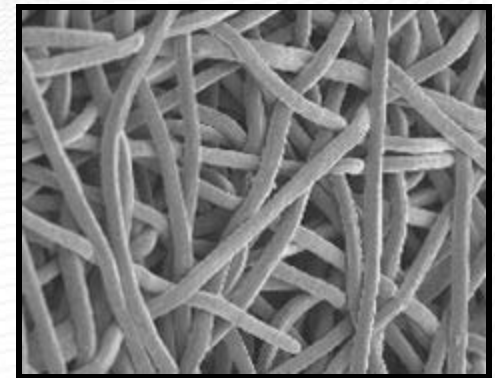
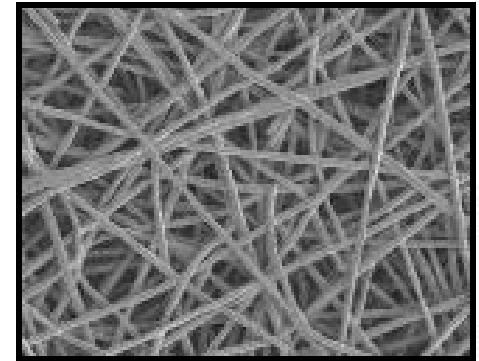
- Robust
- Can be back-washed in liquid systems
- Lower cost
- Depth type filtration
- Traditional, well understood product
- Elements can be specially designed to retrofit any existing system.



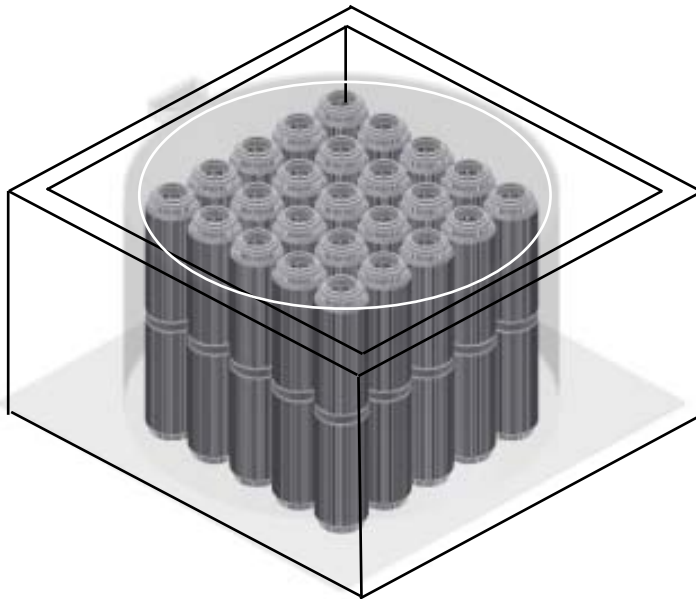
Sintered Metal Fibre (Porvair Sinterflo F range)

Sintered metal fibre media can be pleated to provide higher surface area elements.

- Number of elements can be reduced.
- Better cleanability.
- Lower pressure drop.
- Surface type filtration
- Elements can be specially designed to retrofit any existing system.
- Lower through life costs



Square SACT HEPA Filter for remote Change Location.

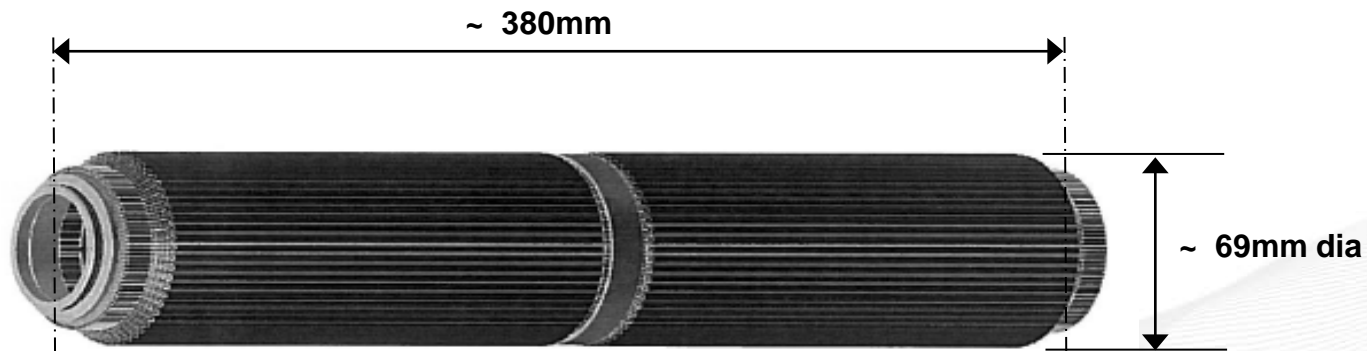


DF100 < 60kg

DF1000 > **60kg to heavy** for remote change application.

1 complete 900 l/s filter unit (600 x 600 x 380 deep) contains 25 inserts.

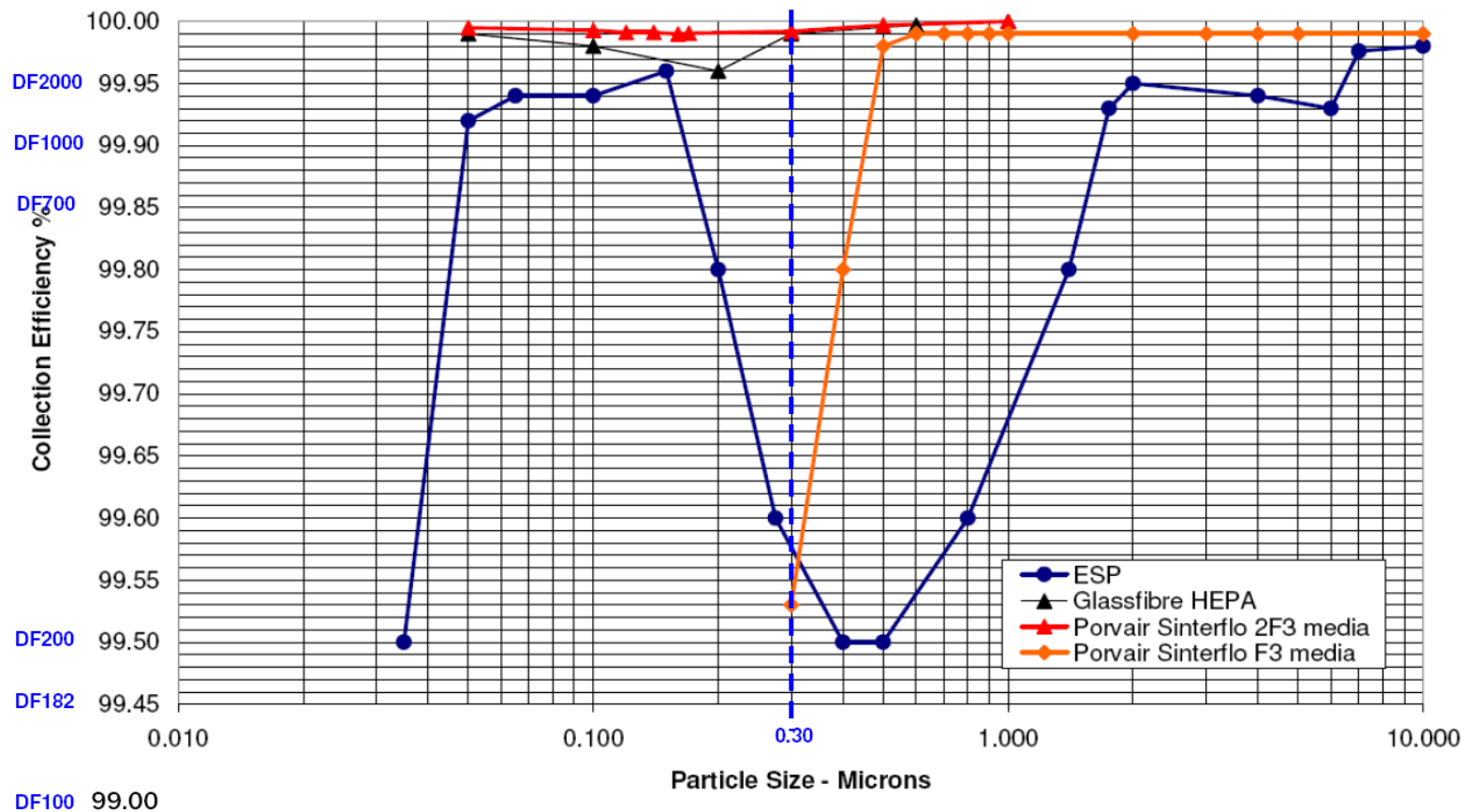
Typical Candle Filter Element 36m³/h DF 10² SACT Filter Insert



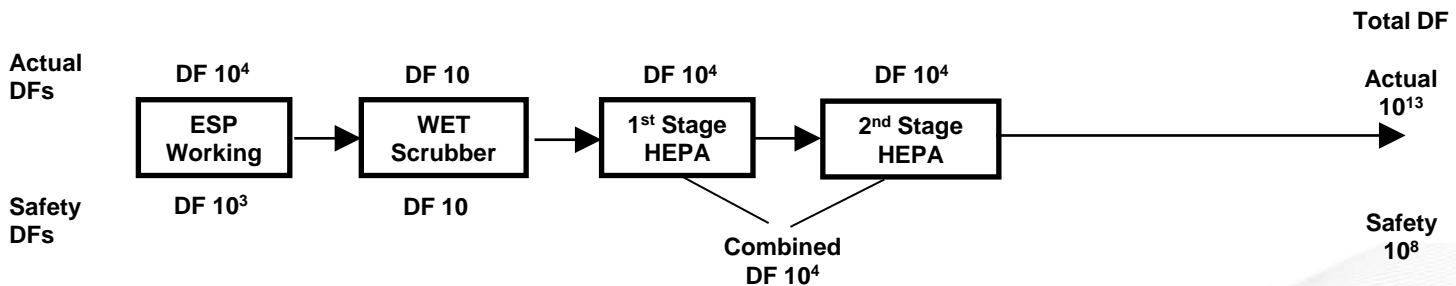
Normally used as a **RECLEANABLE** unit e.g. Pulse Jet Cleaning
DF100 @ 0.3micron (**single media layer filter**).

Pressure =	4mbar @ design flow	Media =	sintered metal fibre
Gasket =	sintered metal fibre	Flow =	36m ³ /h
Fusion =	welded construction	Weight =	~ 0.93 kg

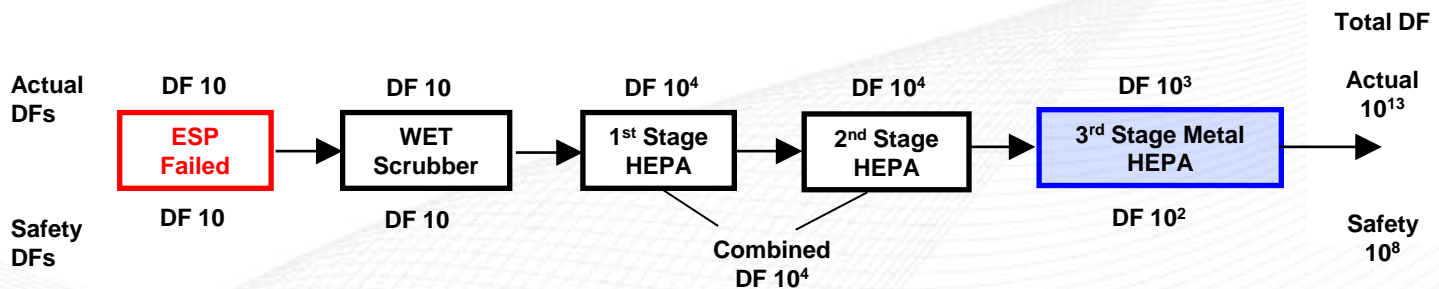
Collection Efficiency of Dust Particles. Comparison of ESP, Glassfibre HEPA & Metal Filter (2F3 & F3 media)



Decontamination Factors



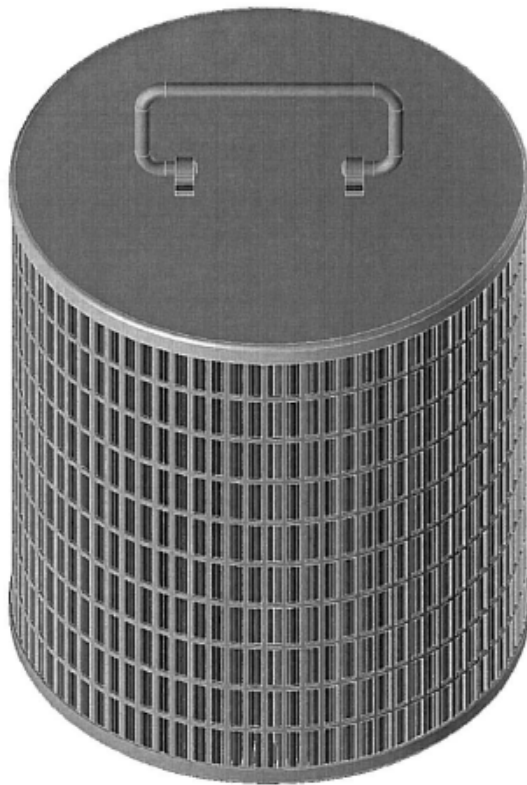
Current Plant DF claims



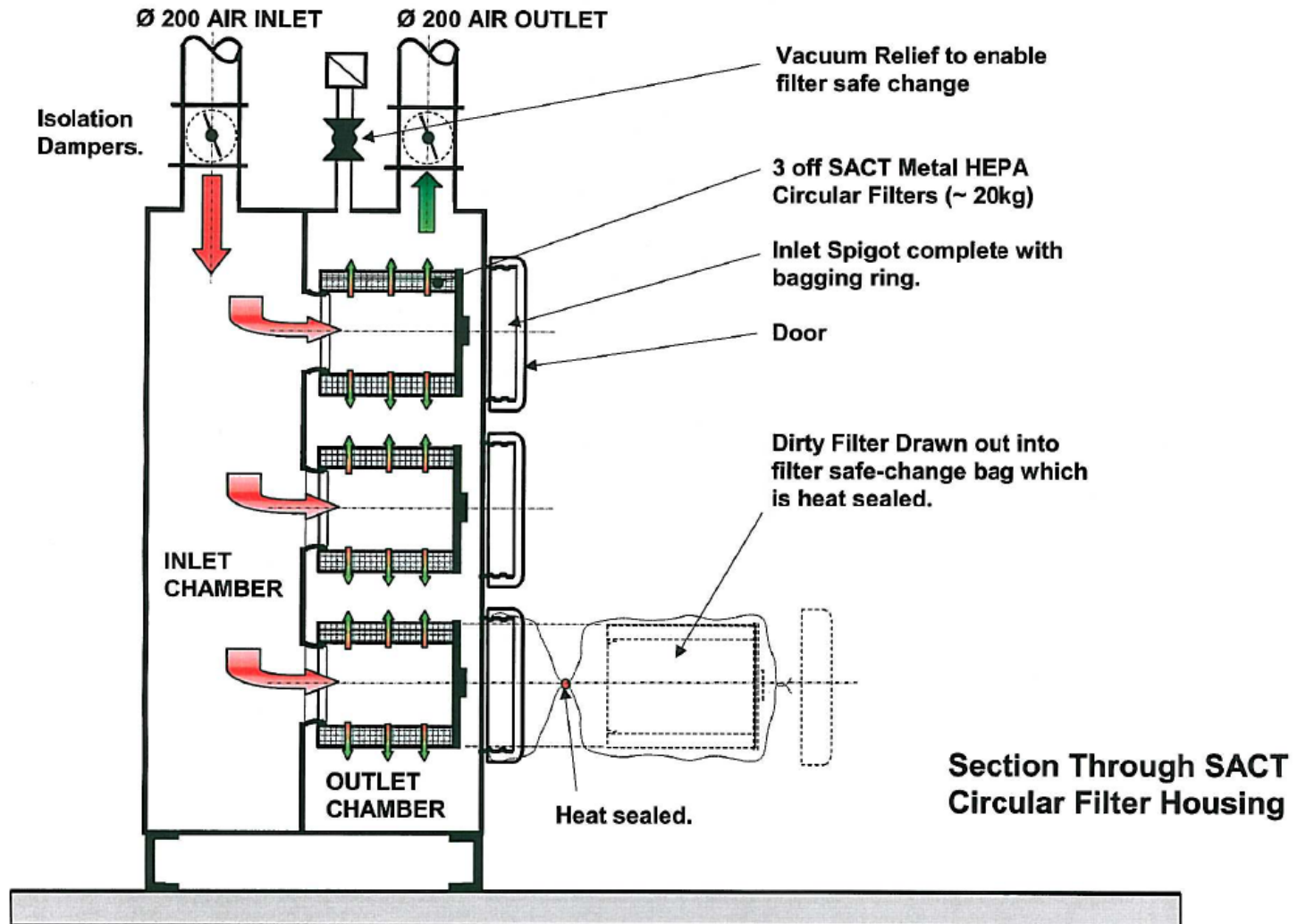
Plant DF Claims with ESP Failed and 3rd Stage SACT Filter Installed.

Figure 3
Comparison of Actual /Safety DF's
Tertiary Stage DF1000 Filter

296m³/h DF 10³ SACT Filter Insert



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View Inside Circular HEPA Filter Housing Conventional glass fibre filter



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Filter Testing

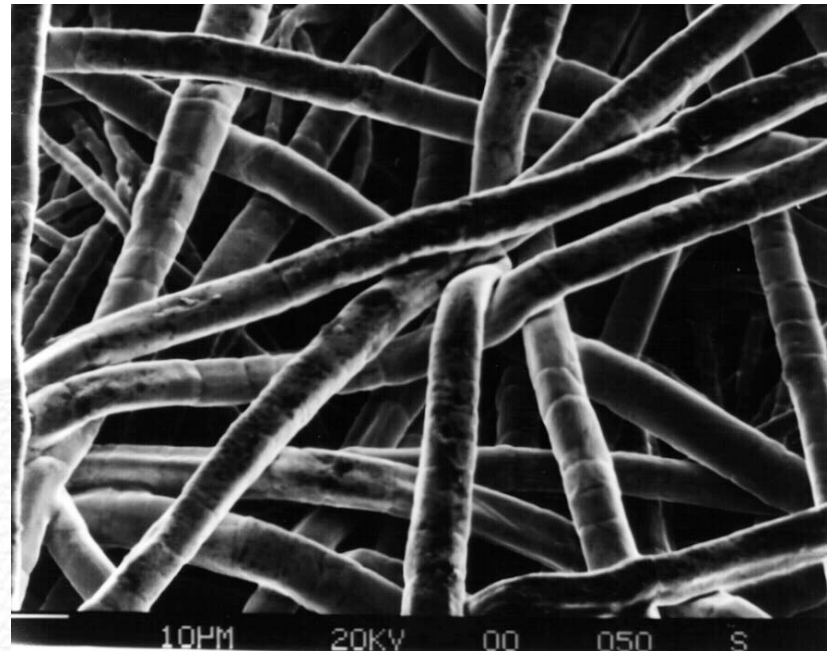
Glass fibre HEPA filters – Current requirements - filters are subjected to sodium flame test and come with a Factory test certificate complete with traceability.

SACT metal filter tested to prove:

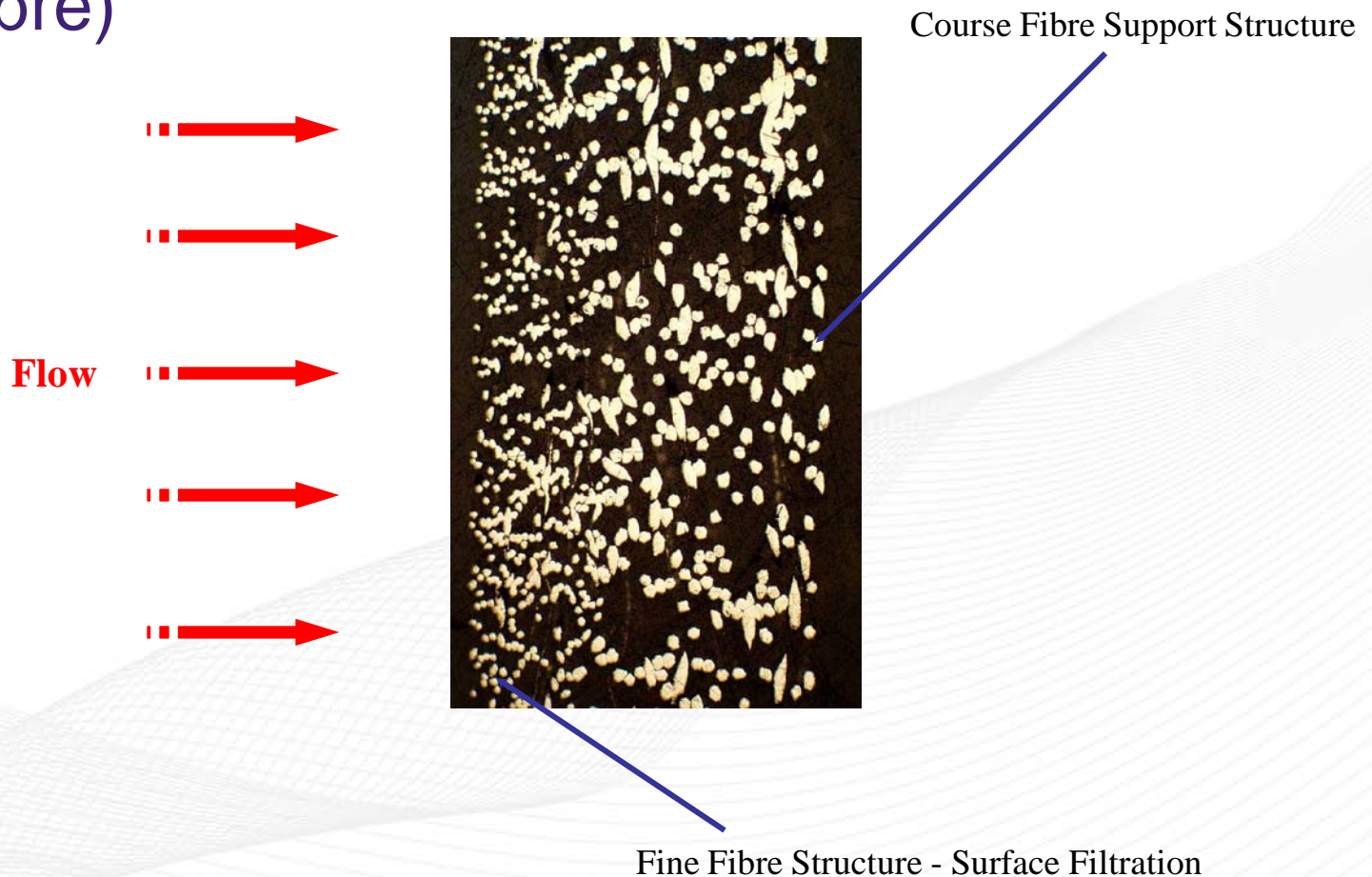
- Volumetric flow / pressure test.
- Efficiency test (DOP (ONDINA) not Sodium Flame).
- Dust Holding Capacity test (1.8g/min loading, size range 0.05 to 50 micron, Test dust - special mix of ISO 12103 A2 dust and Silica fumes. **Original test dust Acetylene Black 50% compressed - no longer available**).
- Saturation test (3barg steam (144°C) release 56kg/h).
- Structural Test (150mbar).
- Heat Soak Test (Oven test 500°C) followed by DOP test.
- Filter media - Elevated velocity test.

Pulsed Jet HEPA Filtration Filter Medium (Sintered Metal Fibre)

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

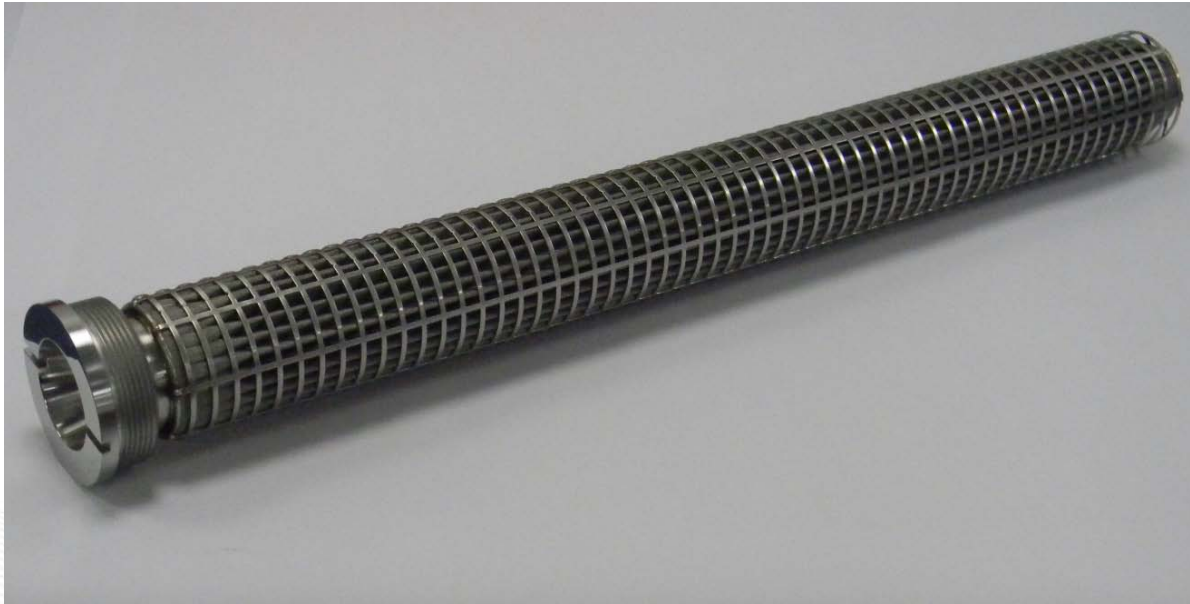


Pulsed Jet HEPA Filtration Filter Medium (Sintered Metal Fibre)



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Typical Pleated Sintered Metal Fibre Pulsed Jet Cleanable Filter Element

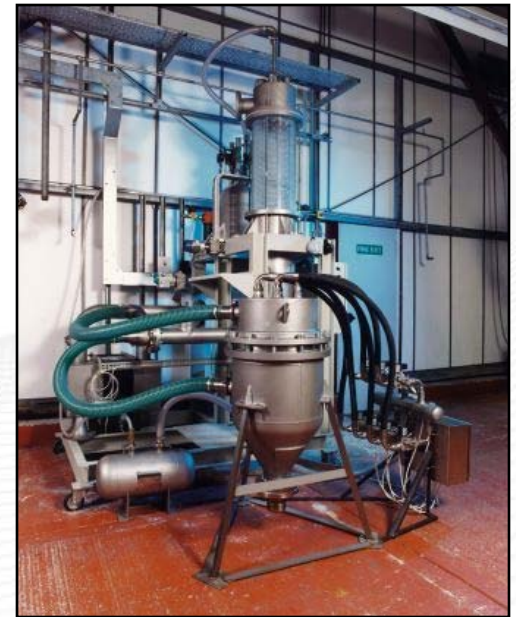


Typical Pulsed Jet Cleanable Filter system

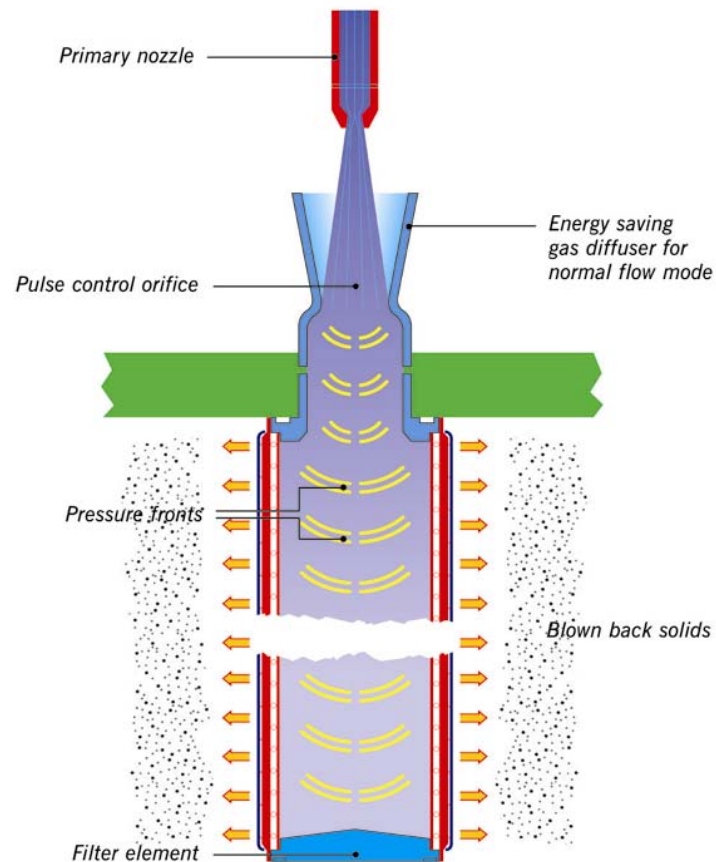


Glovebox pulsed jet
MOX pellet
grinding coolant (Air)
filter for BelgoNucleaire

The BelgoNucleaire filter
system under evaluation in
our test facility



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

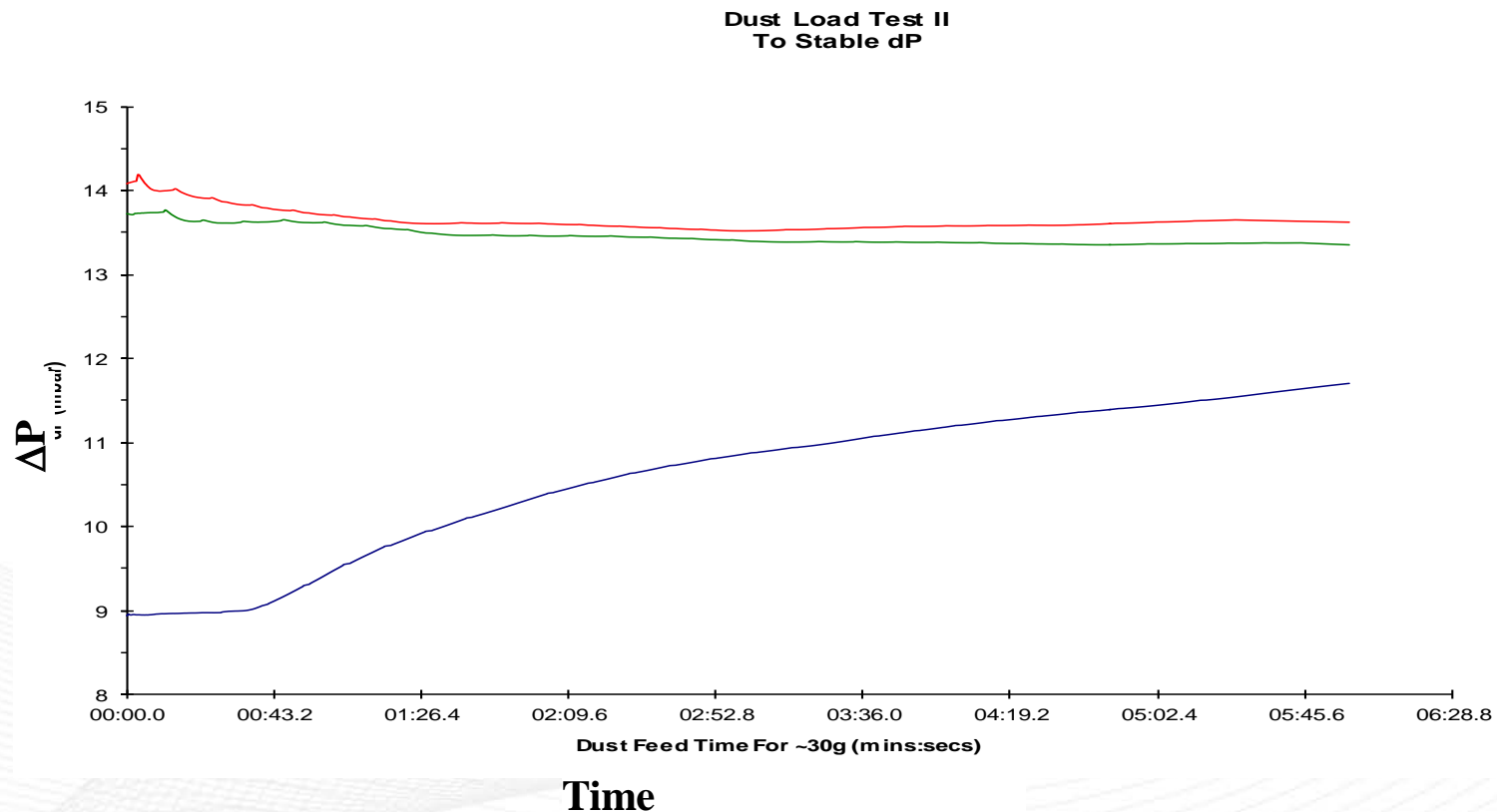
Filter Cleaning by Pulsed Jet

These time lapse images show the effect of an actual, single cleaning pulse. Total sequence time - less than 0.2 secs.

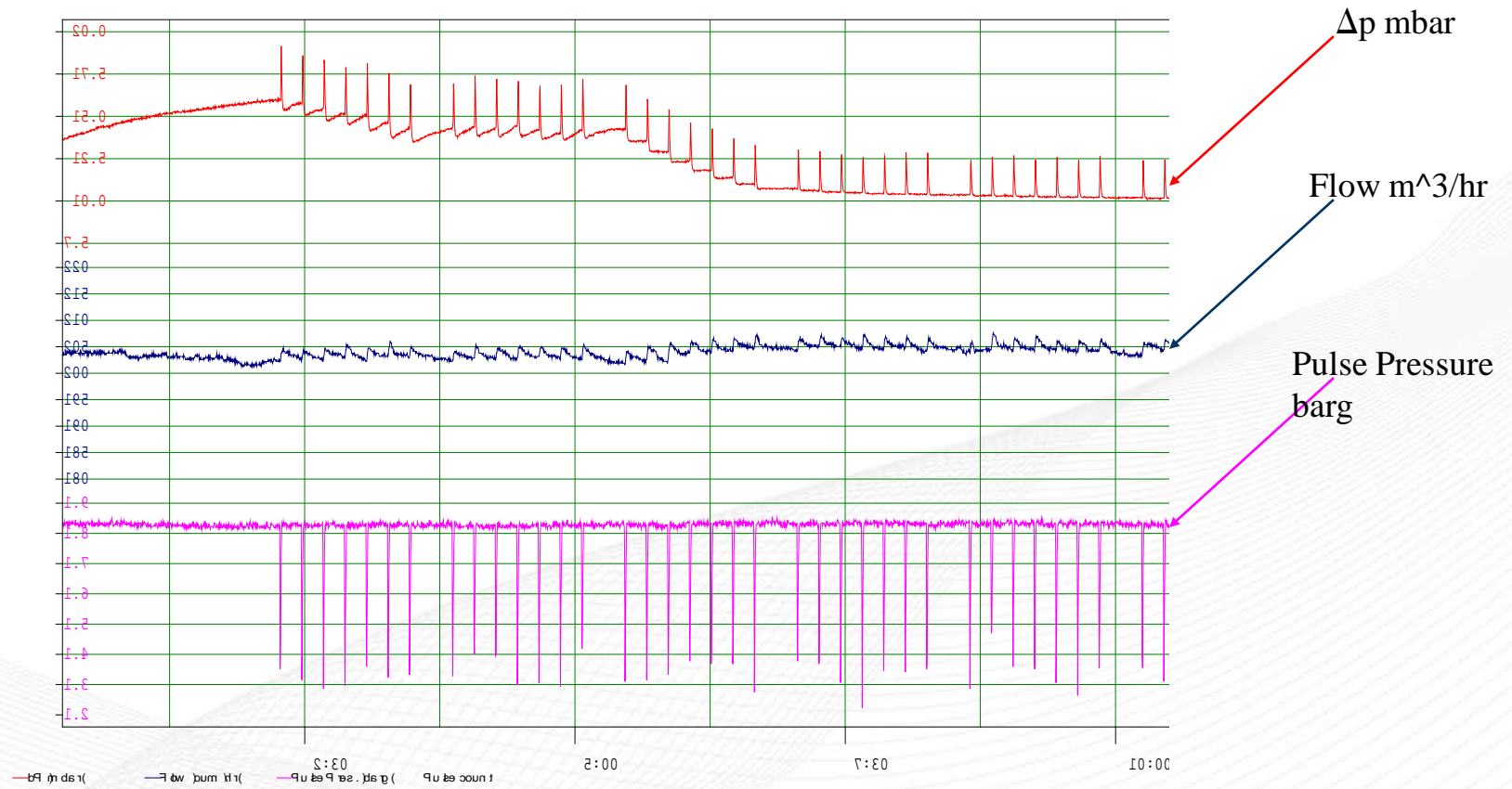


Pulsed Jet Filtration, Achieving the Stable Operating DP Plateau

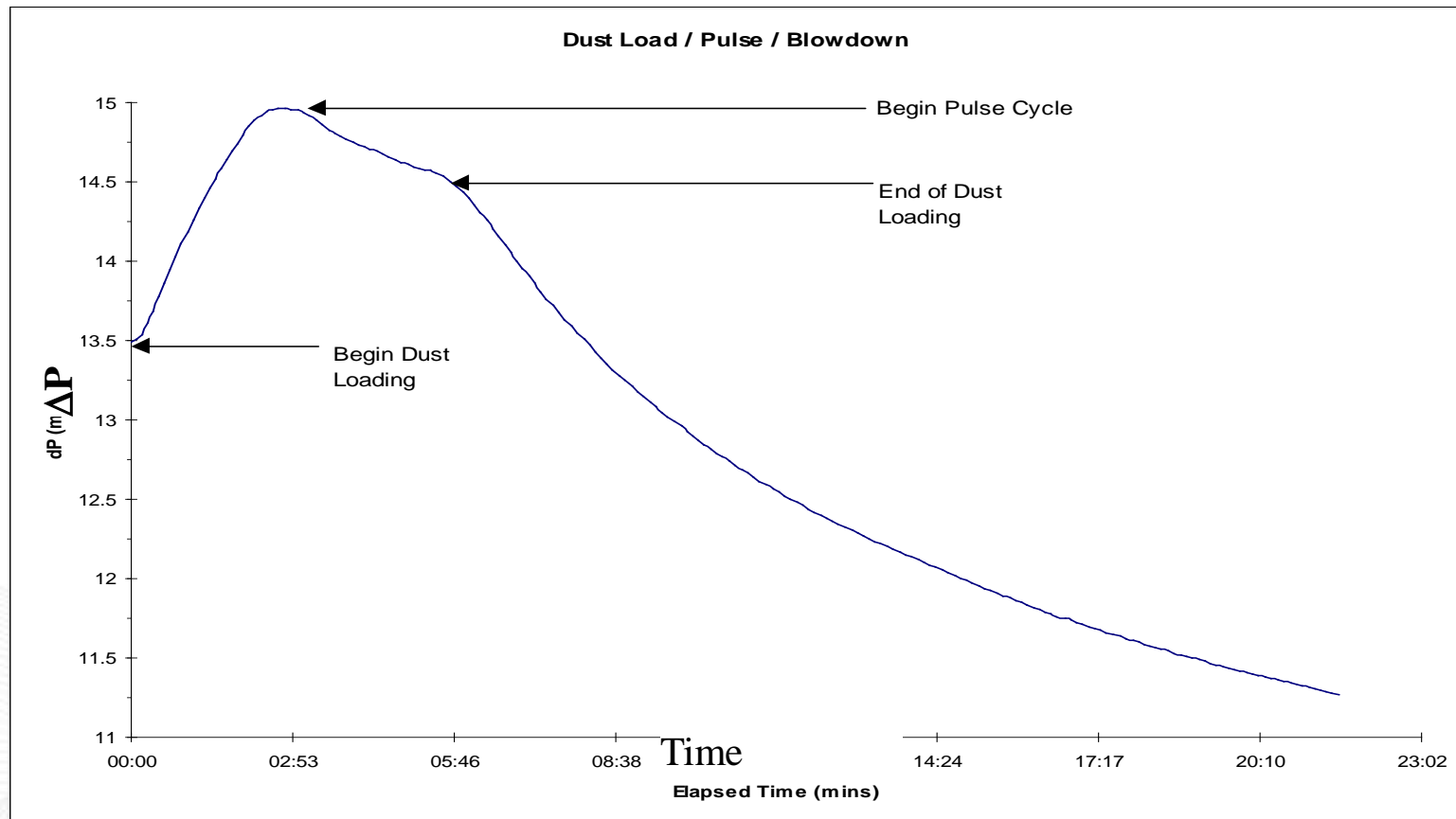
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Recovery after cleaning failure



Recovery after cleaning failure

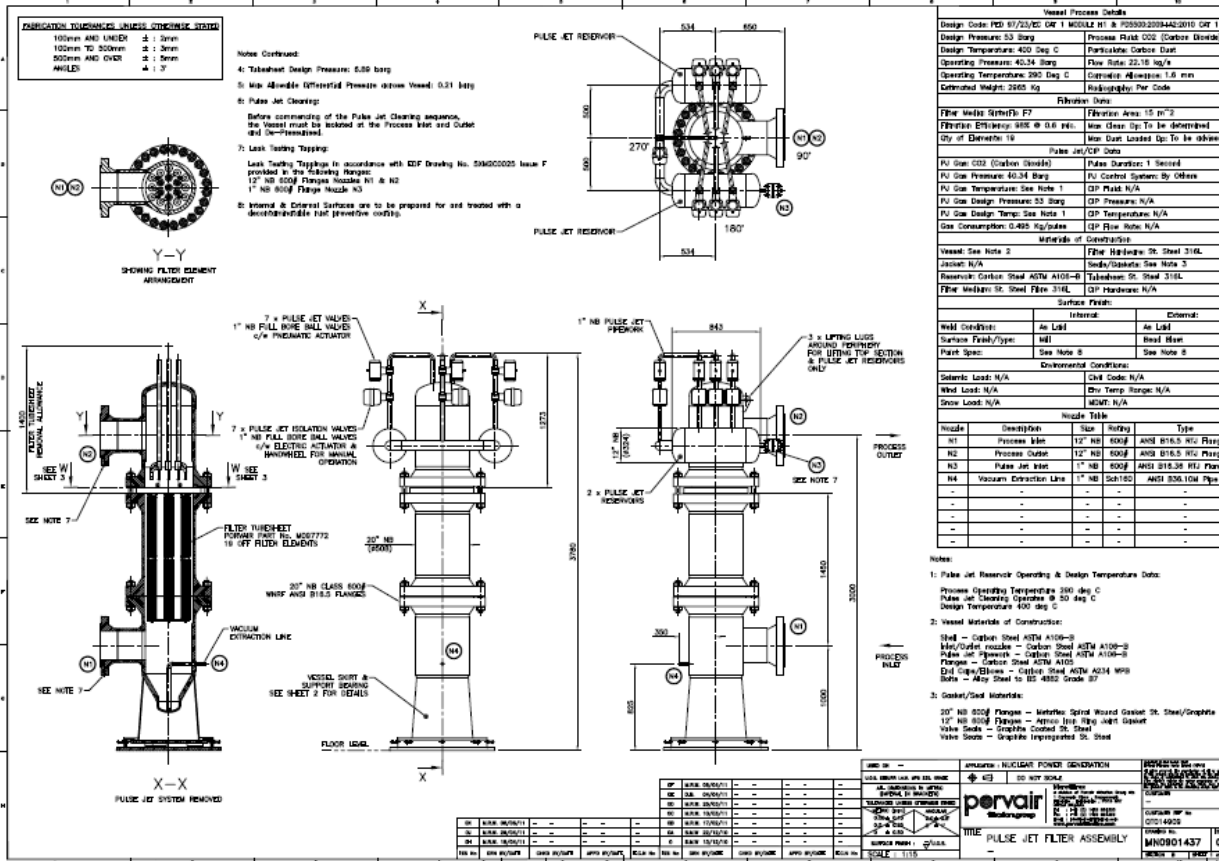


HT Filtration



Pulsejet HEPA filter train for
Bulk Vitrification Demonstration
Project (melter off gas),
Hanford site

HT/HP Filtration

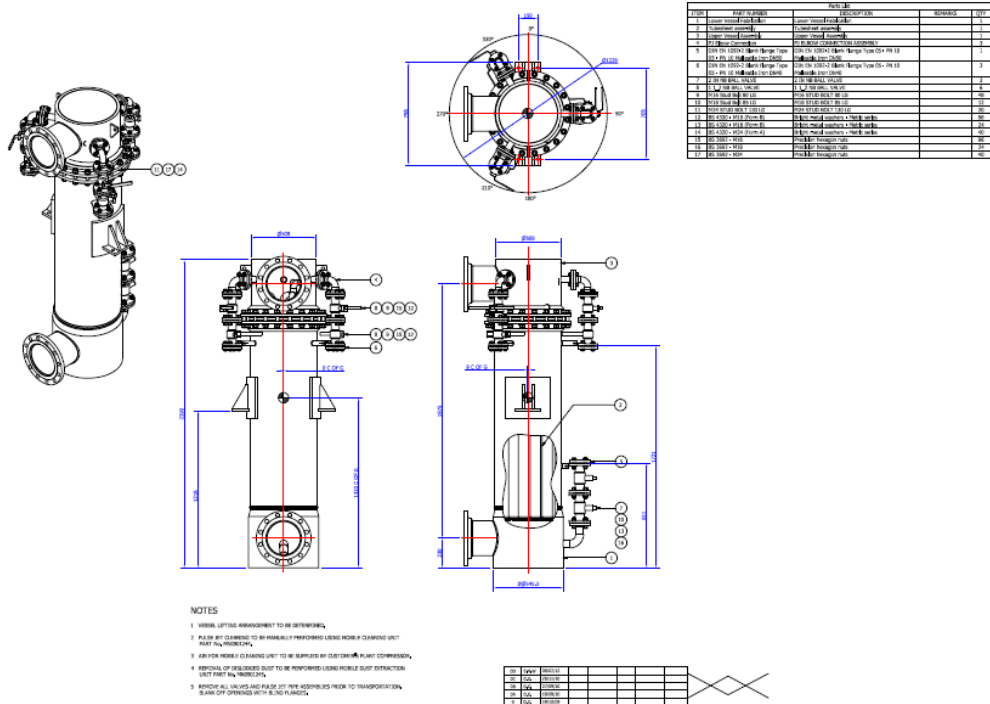


A 600 psi, 500 celcius pulsed jet filter for EdF in the UK.

An interesting complication of HT operation is the effect expansion has on nozzle loads.

This system sits on bronze bearings, allowing it to move

PJ Filtration system designed to accommodate and vent a conventional explosion and remain entirely operative through the event and after.



HT/HP PJ system with water wash facility



Evaporation vapor Pulsejet filter
for Bulk Vitrification
Demonstration Project, Hanford
site

Fuel Factory PJ General Vent system



Powder recovery HEPA grade filtration system for a European nuclear fuel manufacturing facility



Fuel Factory PJ General Vent system



Powder recovery HEPA grade filtration system for a European nuclear fuel manufacturing facility

Challenges

Often Geometric dimensions specific to enable manoeuvrability into final location create issues

Weight of filter inserts (non-PJ type) 20kg (~ 4 x heavier than glass fibre equivalent).

Housing pressure capability – much higher than conventional as Metal filter can withstand full fan head pressure 150mbar (in the specific case of the SACT project)

Filter wiper seal (as in radial flow type inserts) subjected to much higher pressure than conventional glass fibre units.

Filter insert PD clean 5mbar compared with 2.5mbar conventional glass fibre HEPA filter.

Reliability of efficiency at temperature – how can it be proven

Summary and Conclusions

Installing the metal filter is a bespoke solution to a specific problem on a specific system.

Pros - Benefits over glass fibre filter:

- Can handle more onerous gas stream challenge. Will not fail when saturated.
- Higher DF claim when run in series with glass fibre filter rather than two glass fibre filters (diversity in material).
- Can withstand much higher system pressures.
- All metal, Temperature resistant.
- Can be re-cleanable (pulse jet application).

Cons

- Cost typical glass fibre unit £400, Metal filter £15K.
- Weight can be many times the weight of glass fibre filter.
- Possible higher disposal costs.
- Higher pressure drop than glass fibre filter.

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