NUCLEAR INDUSTRY GUIDANCE

NNVF Discussion Document - Guidance for the Visual Inspection of HEPA Filters

Issue 01

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Comments should, in the first instance, be sent to :-

Grant Hall
Bld C21.1
AWE(A), Aldermaston
Nr Reading
RG7 4PR
grant.hall@awe.co.uk

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RECORD OF REVISIONS

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1. GENERAL

This guidance provides specific information for the inspection and categorisation of visual defects on HEPA filters used for particulate abatement used within the nuclear industry.

A robust and comprehensive method of visual inspection for HEPA filters is required on a national basis for a number of reasons:-

(a) To provide consistent visual inspection of HEPA filters to a set standard throughout the industry.

(b) To create a consistent method of recording different types of defects to allow the continued surveillance of filter quality as used by the UK nuclear industry.

(c) To create a consistent basis for the training of staff in filter visual inspection who are installing HEPA filters.

Although the UK Nuclear Industry uses square, round and canister filters the same basic principle of visual inspection applies.

Following this guide will satisfy the visual checks required under Sellafield procedure SLP.1.06.59.02 How Do I Operate And Maintain High Efficiency Air (HEPA) Filtration.

2. BASIC VISUAL INSPECTION METHOD

The basic visual inspection can be broken down into nine logical stages which are detailed below:-

(a) Ensure the correct filter has been delivered from stores by inspection of the packaging label, prior to opening the packaging.

(b) Visual inspection of packaging for damage.

(c) Inspection of filter certificate and filter label.

(d) Confirm filter is as ordered from a visual inspection of the filter element.

(e) Inspection of manufacturing date for comparison with the shelf life.

(f) Inspection of casing.

(g) Inspection of seals

(h) Inspection of filter media and finger guards.

(i) Final sentencing of filter and recording of findings.

During the visual inspection as, detailed in this document, the packaging, the filter element and its accompanying paperwork, are inspected for signs of damage and/or missing information.

The Filter is inspected to ensure that it is the correct filter ordered/received, including the seal **c**onfiguration, e.g. on the larger square filters there are 5 gasket configurations denoted by suffixes to the ordering number. The filters are finally sentenced fit or not fit for use. With each type of defect a defect category is given to enable a consistent defect recording system to be used throughout the UK to enable historical, inter-site analysis, and consistent manufacturer feedback.

3. DEFECT CATEGORISATION

To enable the ongoing surveillance of HEPA filters used in the UK nuclear industry a common defect categorisation system has been proposed and agreement throughout the UK is still to be agreed. If a filter fails in more than one category then, two or more defect types may be recorded, i.e. failure in categories B, D and E.

At Sellafield filters which fail the visual inspection need to be reported under a “Condition Report” (see SLP 3.09.100 How do I Raise Condition Reports (CR) and Commence Investigations?). Each other licence site will have its own reporting system However only failed filters need to be reported.

The categories are as follows in Table 1.

Table 1. Filter Visual Inspection Defect Category.

Defect	Defect Letter Category
Wrong filter supplied (from packaging label)	A
Packaging damage	B
Filter certificate or labelling inconsistencies	C
Wrong filter in packaging	D
Filter past use by date	E
Casing defect	F
Seal defect	G
Filter media or finger guard defect	H
Miscellaneous defects not covered above	I

4. VALIDATION OF THE FILTER DELIVERED AGAINST THE ORDERED FILTER.

Before the filter is unpacked the packaging label should be inspected to ensure it is the filter which is expected. This can be carried out by a simple inspection of the packaging label as affixed by the manufacturer. The label may include the manufactures part number, the sites manufacturing code number, the sites stores number, a detailed description or all of the mentioned.

Each time a filter is handled outside of its protecting packaging, the risk of it being damaged is increased. Therefore handing outside its protective packaging should be avoided where possible, a simple check on receipt of the filter to determine the unit supplied is the one required can reduce damage potential when the filter requires re-packing.

Photo 1. Typical Manufacturers Packaging Label.

Incorrectly supplied filters should be returned to the stores for re-stocking and investigation.

This should be recorded as a Category A failure on the record of rejection sheet. Correctly ordered filters but incorrectly supplied will show deficiencies in the picking or storage process and incorrectly ordered filters will show deficiencies in the ordering process. Note: This is not the same as having the correct outer packaging but the wrong filter in the box which is a category D failure.

5. VISUAL INSPECTION FOR DAMAGE TO THE PACKAGING

The packaging material for the filter, i.e. its cardboard outer packer, should be inspected for signs of impact and water damage. Given that there are many types of packaging damage it is difficult to give guidance to what is acceptable.

If there is any amount of evidence of damage on the external packaging, it would highlight areas for a more focused inspection of the filter element. Additionally it may show that the current package is not robust enough for the task if there are multiple occasions where the packaging is damaged.

Small amounts of impact damage where there has been no obvious sign of corresponding damage to the filter will be acceptable. A small amount of evidence that the outer packaging has been subjected to being lightly splashed with water could be acceptable, however if there are signs that the packaging has absorbed or been exposed to any standing water it should be rejected.

HEPA filter paper exposed to water looses a significant amount of strength and any evidence that the unit has been subject to water damage will require the filter to be rejected. Frost damage can also reduce filter paper strength, evidence that the filter has been insufficiently protected from environmental effects such as frost is harder to identify or quantify so any packaging degradation may need to be considered and rejected if required

Packaging Damage should be recorded as a Category B failure on the record of rejection sheet.

Photo 2. Acceptable 470 l/sec transport HEPA filter carton.

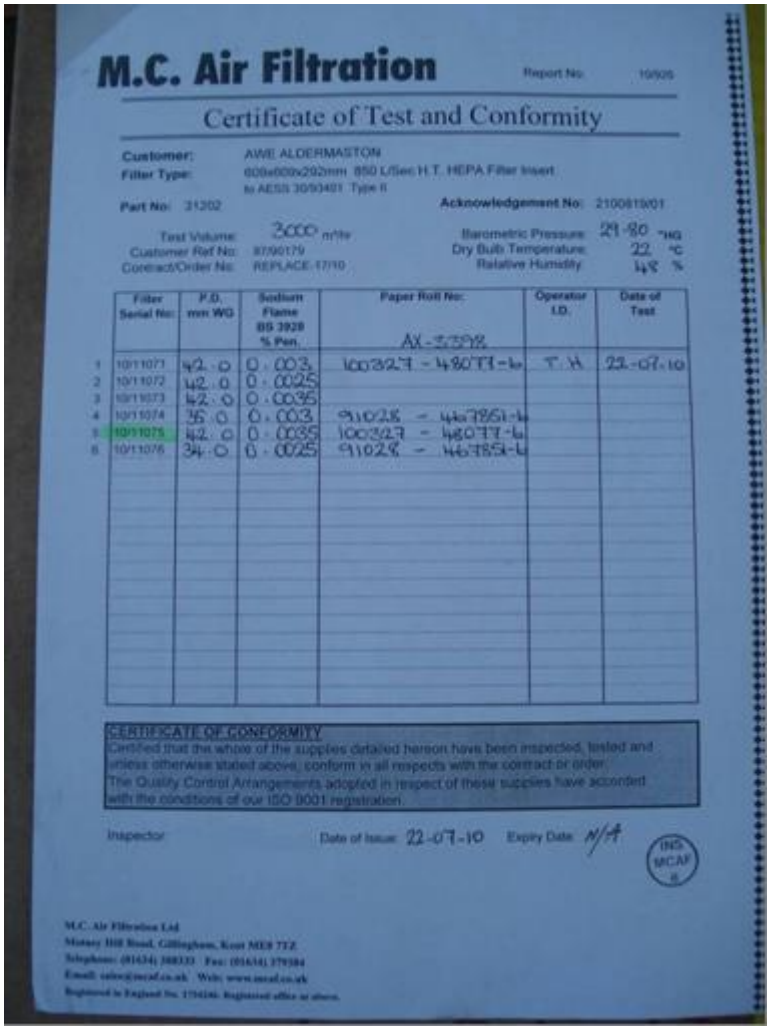
6. INSPECTION OF FILTER CERTIFICATE OR LABELLING

Each HEPA filter comes complete with an efficiency certificate from the manufacturer. This certificate should be checked against the serial number on the supplied filter. Often filters are certificated in batches and it is normal practice for the actual filter that the certificate has been issued against to be highlighted on the certificate.

If there are any discrepancies in the test certificate or filter labelling the filter should be rejected.

This should be recorded as a Category C failure on the record of rejection sheet.

Fig 1. Typical Manufacturers Filter Test Certificate



M.C. Air Filtration

Report No: 10/926

Certificate of Test and Conformity

Customer: AWE ALDERMASTON

Filter Type: 609x609x292mm 850 L/Sec H.T. HEPA Filter Insert to AEGS 30/93401 Type II

Part No: 31202 Acknowledgement No: 2100810/01

Test Volume: 3000 m³/hr Barometric Pressure: 29.80 "HG

Customer Ref No: 87/90179 Dry Bulb Temperature: 22 °C

Contract/Order No: REPLACE 17/10 Relative Humidity: 48 %

	Filter Serial No:	P.D. mm WG	Sodium Flame BS 3928 % Pen.	Paper Roll No: AX-2398	Operator I.D.	Date of Test
1	10/11071	42.0	0.003	100327 - 48077-b	T.H.	22-07-10
2	10/11072	42.0	0.0025			
3	10/11073	42.0	0.0035			
4	10/11074	36.0	0.003	91028 - 46785[illegible]		
5	10/11075	42.0	0.0035	100327 - 48077-b		
6	10/11076	34.0	0.0025	91028 - 46785[illegible]		

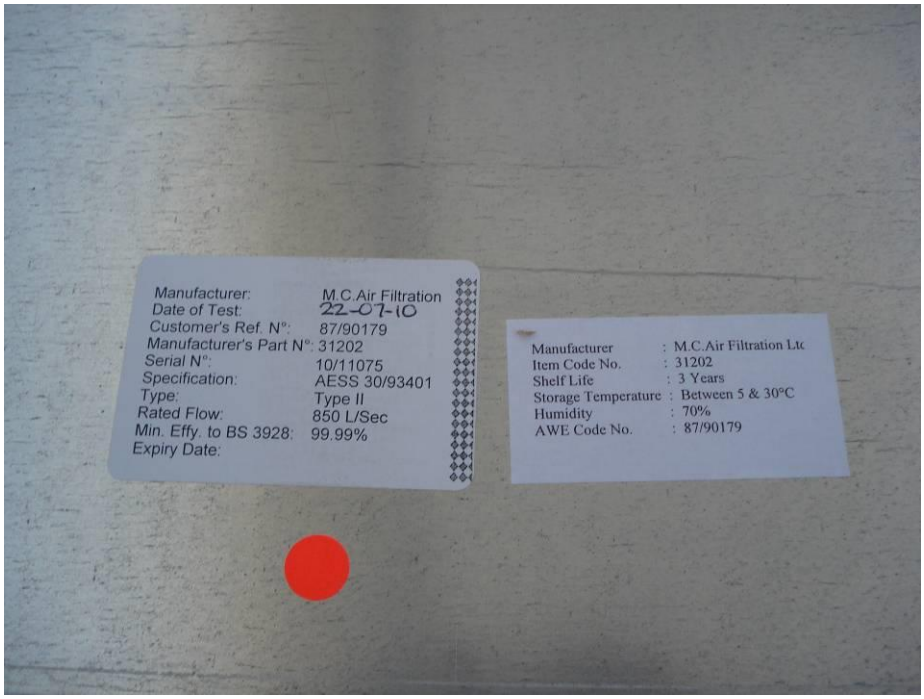
CERTIFICATE OF CONFORMITY

Certified that the whole of the supplies detailed hereon have been inspected, tested and unless otherwise stated above, conform in all respects with the contract or order. The Quality Control Arrangements adopted in respect of these supplies have accorded with the conditions of our ISO 9001 registration.

Inspector Date of Issue: 22-07-10 Expiry Date: N/A

M.C. Air Filtration Ltd

Photo 3. Typical Filter Label.



7. INCORRECT FILTER IN PACKAGING

If, on removal of the unit from the packaging, the filter is found to be different to the one annotated on the packaging labelling. it will need to be rejected, identifying why.

This should be recorded as a Category D failure on the record of rejection sheet..

The square type filters have five different configurations of gasket available. Table 1 details these filter types to help identify the correct filter has been supplied.

Table 1 Square Filter Gasket Types.

Gasket Supply	Suffix
Closed cell silicone rubber gasket fitted to one face	A
Closed cell silicone rubber gaskets fitted to both faces	B
No gasket	C
Glass fibre gasket fitted to one face	D
Glass fibre gaskets fitted to both faces	E

8. FILTER PAST USE BY DATE CHECK

The filter should be labelled with a manufacturing date and a manufacturer's shelf life. The manufacturer's shelf life may be longer or shorter than the inspecting establishment's shelf life. Should either the manufactures or inspecting establishments shelf life have expired then the filter should be marked up as having its shelf life expired and the rejection sheet marked up with a category E failure.

Although the shelf life inspection may be carried out at the same time as the other filter information inspection it needs to be categorised as a separate defect.

This inspection implies that the fitter understands the site policy on the shelf life of HEPA filters. Normally the filter needs to be less than two years old when fitted. If the filter is any older this will reduce the filters in service life.

9. INSPECTION OF THE CASING

The casings of all HEPA filters are made to a tolerance. Where felt appropriate the Case outer dimensions should be checked against the tables below. The squareness of the filter may also be checked by comparison with the corner measurements. For square filters the difference in the across corner measurement should not vary by more than 3mm.

Larger filters have a carry handle which should be present if normally fitted. The filter housing should have all its designed pop rivets, nuts and bolts, i.e. no obvious holes in the sides – see Photo 4 of a well made unit.

Where a defect occurs in the seal between filter paper and casing this should be marked as a casing defect.

If the casing has been dented from an impact or a canister sealing flange is damaged then this should be recorded as a category F casing defect

Table 2. Square Filter Tolerances And Dimensions.

Nominal Rating (litres/second)	Type	Overall Dimensions Across Faces	Overall Dimensions Between Faces (Excluding Seal(s))
100	Square Deep Pleat	304 +0, -2 mm X 304 +0, -2 mm	291 to 292 mm
250	Square Deep Pleat	609 +0, -2mm x 609 +0, -2mm	154 to 155 mm
500	Square Deep Pleat	609 +0, -2mm x 609 +0, -2mm	291 to 292 mm
850	Square Mini Pleat	609 +0, -2mm X 609 +0, -2mm	291 to 292 mm
470	Square Mini Pleat	609 +0, -2mm X 609 +0, -2mm	115 to 116 mm
150	Square Mini Pleat	441 +0, -2mm X 441 +0, -2mm	115 to 116 mm

Fig 2 Diagram of Square Filter Dimensions.

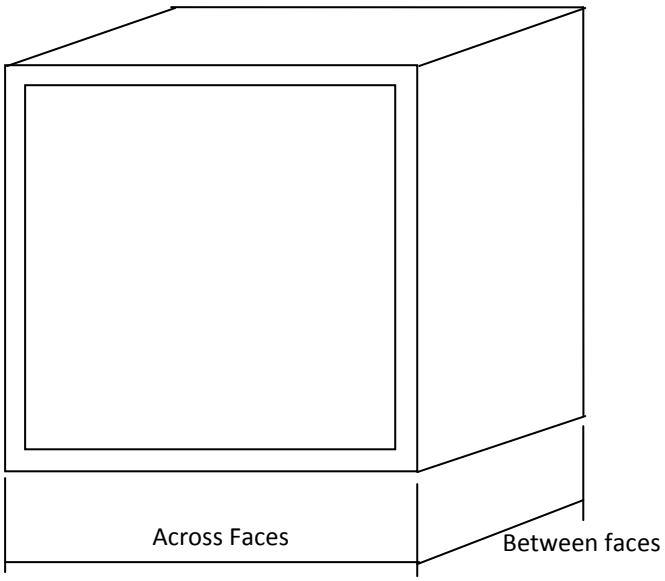
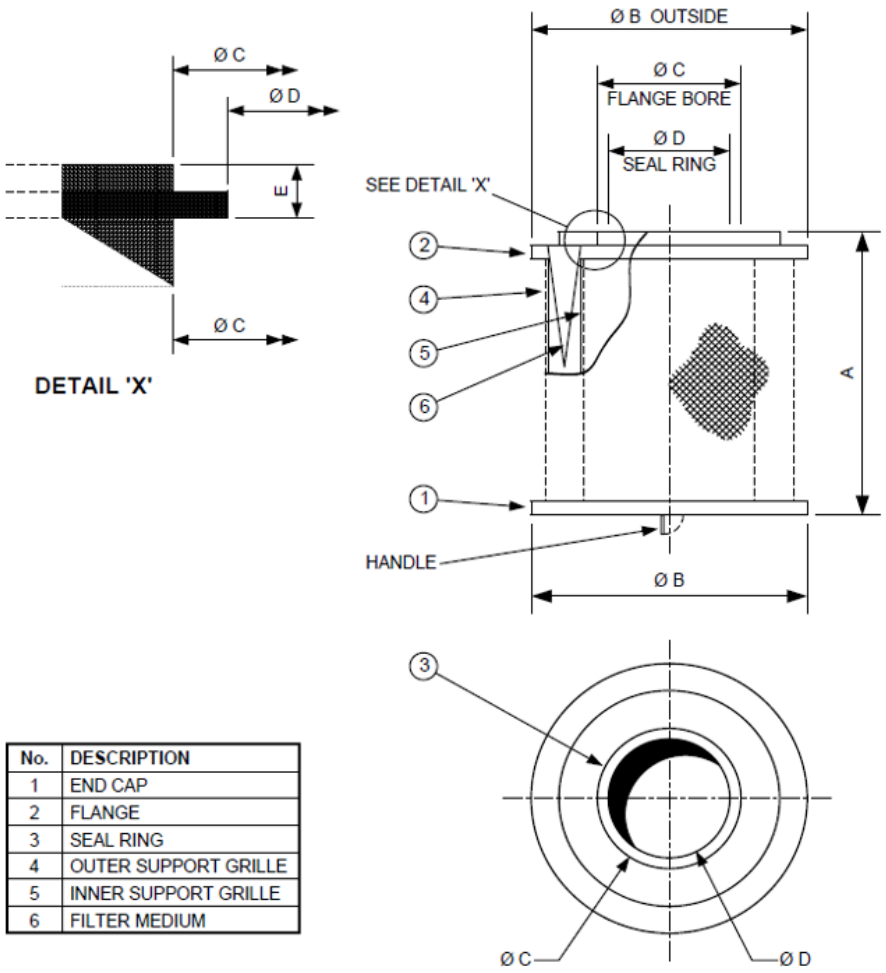


Fig 3 Diagram of Plug in Filter Dimensions.

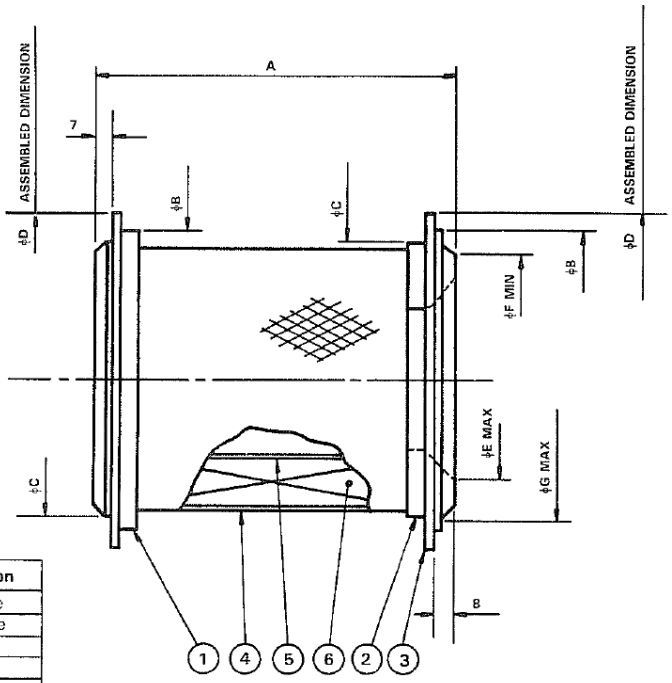


No.	DESCRIPTION
1	END CAP
2	FLANGE
3	SEAL RING
4	OUTER SUPPORT GRILLE
5	INNER SUPPORT GRILLE
6	FILTER MEDIUM

Table 3 Plug In Dimensions And Tolerances.

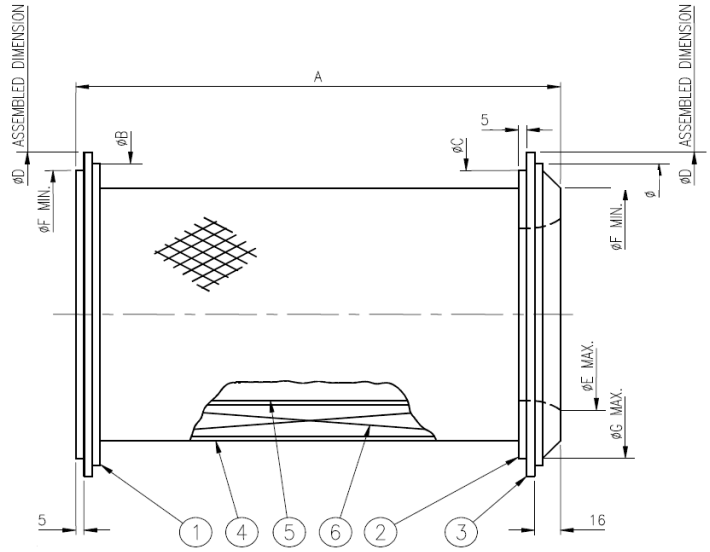
Nominal Flowrate Litres/second	Dimensions					Spigot Sealing Dim (Ref Only)
	A	Dia B	Dia C	Dia D	E Max	
470	335	518	357	340	15	350
950	624	518	357	340	15	350
Tolerance	+/-2	+/-1	+/-1	+/-1	+/-1	-0, +0.5

Fig 4 12.5 l/sec Push Through Filter Dimensional Details



No.	Description
1	Back flange
2	Front flange
3	Seal ring
4	Outer grille
5	Inner grille
6	Filter medium

Fig 5. 35, 75 and 160l/sec Push Through Filter Dimensional Details



No.	DESCRIPTION
1	BACK FLANGE
2	FRONT FLANGE
3	SEAL RING
4	OUTER GRILLE
5	INNER GRILLE
6	FILTER MEDIUM

Table 4. Push Through Filter Dimensions And Tolerances.

Nominal Flowrate Litres/sec	Dimension							Housing Seal Face Dia (Ref only)
	A	B	C	D	E Max	F Min	G Max	
12.5	150	131	120	146	75	110	120	135 +/-0.4
35	300	206.5	197	222	131	173	197	210 +/-0.4
75	375	246.5	236	262	157	212	236	250 +/-0.4
160	400	326.5	316	342	175	292	316	330 +/-0.4

Note 1. All dims in mm

Note 2. All tolerances +1.0mm and – 0.5mm except dimension A which is +/- 2.0mm.

Fig 6. 5 l/sec Canister

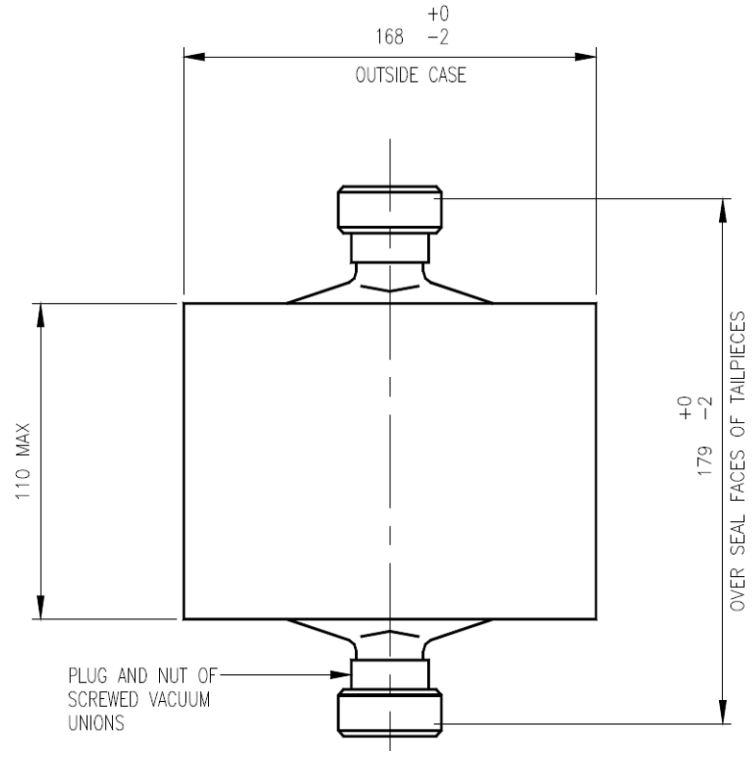


Fig 7. 25 l/sec Canister With 50mm Flanges

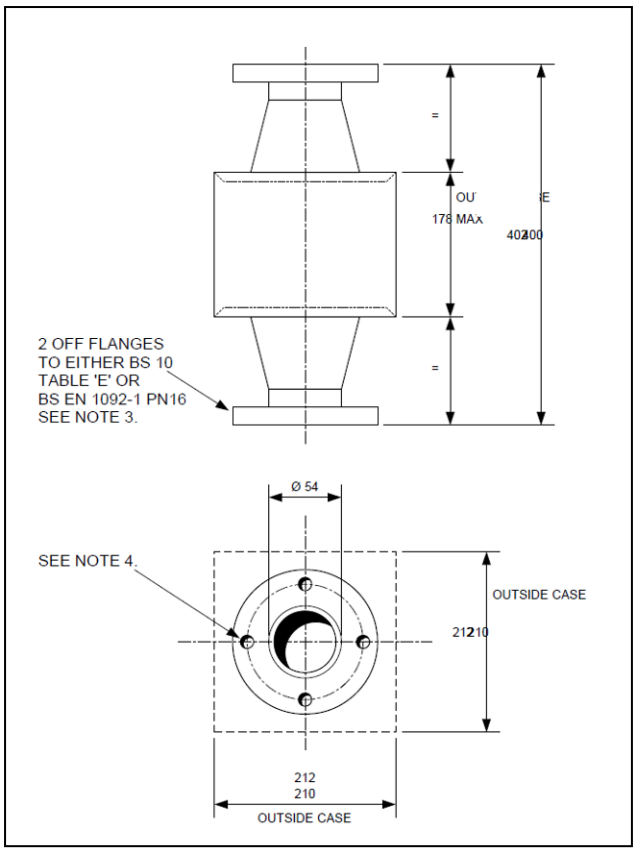


Photo 4 of an acceptable 470 l/sec square filter side.

Photo 5, 5 l/sec Canister Filter

10. INSPECTION OF SEALS (NOT INCLUDING PAPER TO CASING SEAL)

Seal defects normally fall into three categories which are:-

- The wrong seal fitted i.e. open cell rubber.

- The configuration, i.e. dual seals fitted to a square filter which should only have one seal fitted. In theory this should be identical to a category D failure of the wrong filter type being supplied. However, if this is the case then category D and category G failures should be recorded.

- Damage to the seal or another seal defects which will impair its sealing ability. This may include a small flash on push through filter seals, indentations or physical imperfections in a seal or the seal stuck to the internal packaging**. In each of these cases there should not be an attempt to repair the seal, the filter must be rejected.**

This should be recorded as a Category G failure on the record of rejection sheet.

Where a defect occurs in the seal between the filter media and casing this should be marked as a casing defect, Cat F defect.

If seals are supplied with canister filters, these should be inspected to ensure they are the correct seal and undamaged.

Photo 6, Push Through Filter With Part Of The Front Seal Missing.

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Photo 7 . Square Filter With Permanent Set Impression Flaw On The Seal.

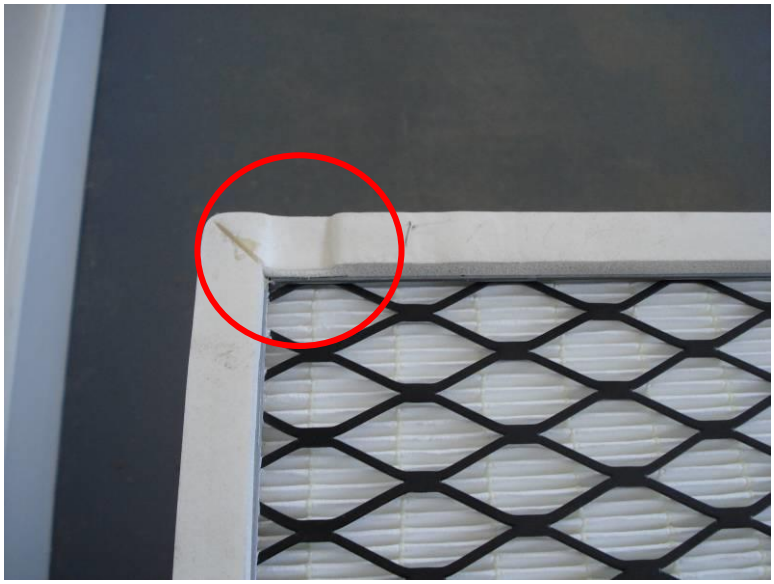
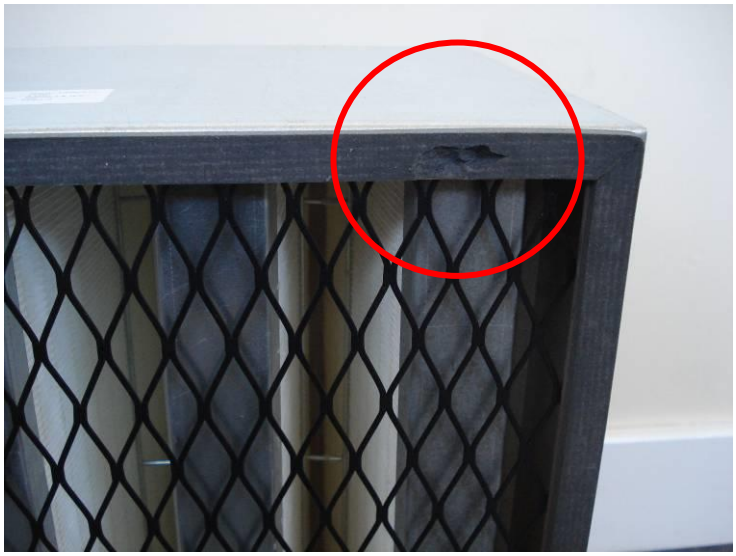


Photo 8. Seal Permanent Damage On A 850 l/sec Filter



11.INSPECTION OF FILTER MEDIA AND FINGER GUARD

Damage to the filters finger guard may result in damage to the filter media. Therefore finger guard and media damage have been grouped into the same reject category.

Any visible damage to the finger guard which impacts upon the media paper will result in the filter being rejected.

Filter media rejections can include, but is not exclusive to:-

- Filter pleats are not even (uneven pleats may decrease the dust holding capacity and life).

- Tears in the paper. Tears can sometimes be caused if the filter is accidentally dropped and the self weight of the papers exceeds the strength of the paper, this is normally described as pleat shear.

- Paper discolouration indicating contamination or interference.

These should be recorded as a Category H failure on the record of rejection sheet.

Photo 9 Finger Guard Damage To A High Temperature Plug In Filter (Note; The Low Temperature Version Of This Filter Has Black Polyurethane End Caps)

Photo 10. Filter Paper Damage Behind The Finger Guard.

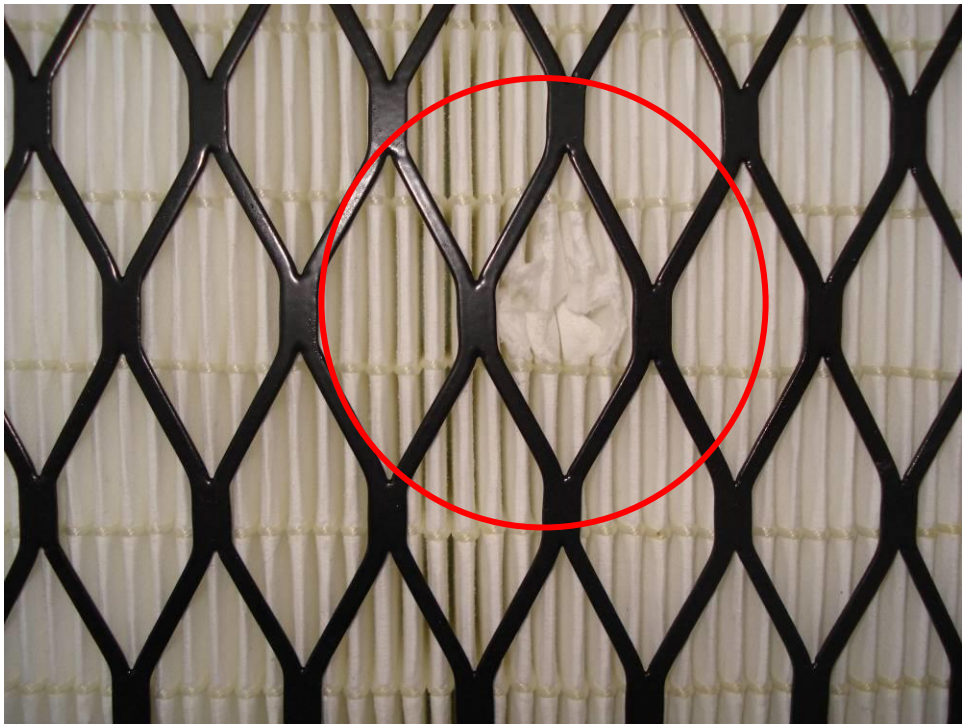
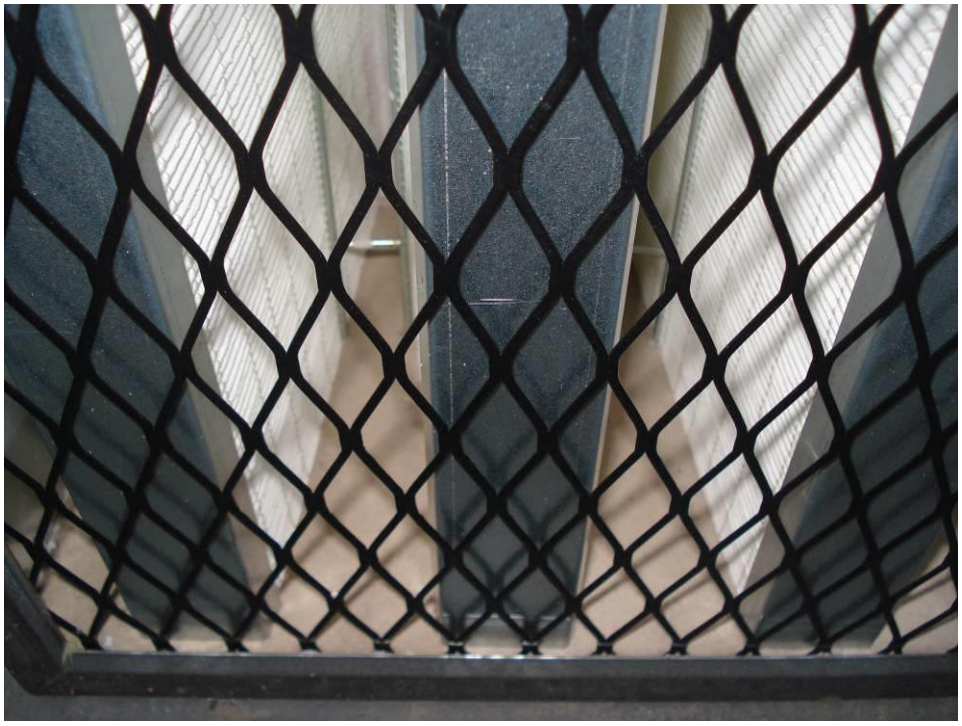


Photo 11. Perfectly Spaced Machine Folded Mini Pleat Media In A 850 l/sec Housing



12.MISCELLANEOUS CAUSES FOR REJECTION.

This guidance has identified a number of the normal identified filter rejection categories but may not cover every possible defect than can occur. If the cause for filter rejection is not within the above criteria it should be rejected as a Cat I failure on the reject sheet and the cause fully detailed.

13.FINAL SENTENCING OF FILTER

Should the filter pass this visual inspection standard then it will be sentenced for active service.

Rejected filters should be clearly and permanently marked as such to prevent them accidentally returning to stores for re-issue. The record of rejection should be attached to the filters certificate and arrangements should be made to return the filter to the manufacturer.

A copy of the filter rejection form should be sent to the site Technical Authority for HEPA filters for collation and for the information to be reviewed and rejection rates should be made available for the industry.

Filters which have no identified flaws do not require a filter rejection form to be generated.

If there are uncertainty as to if a defect is significant enough to cause the filter to be rejected then advice should be sought from the site Technical Authority for HEPA filters.

14. ANNEX A. EXAMPLE OF A FILTER REJECTION CATEGORISATION SHEET.

Filter Inspected By		
Site		
Date		
Filter Type		
Serial Number		
Correct Filter Supplied By Stores (From Outer Packaging Label)	Pass/Fail	Cat A
Packaging Damage	Pass/Fail	Cat B
Wrong Filter In Packaging	Pass/Fail	Cat C
Filter Certificate And Labelling Inconsistencies.	Pass/Fail	Cat D
Filter Past Shelf Life	Pass/Fail	Cat E
Casing Defect	Pass/Fail	Cat F
Seal Defect	Pass/Fail	Cat G
Filter Media Or Finger Guard Defect	Pass/Fail	Cat H
Miscellaneous Defects Not Covered Above.	Pass/Fail	Cat I

15.ANNEX B – RECORDING FORMAT.

To be able to correlate filter defect statistics between the licence sites a common data base format will allow easy and direct comparison. A common data base format will therefore need to be developed between the different licence sites. Once agreed this annex will be modified to reflect this agreement.