

Low Cost Disposable Filters for Flue/Combustion Gas Analysis

MAP Application Solutions

Background

There are many requirements throughout industry where combustion / flue gases must be analyzed and recorded periodically for compliance to EPA regulations and to ensure maximum efficiency of the combustion device (burner / boiler).

Instrumentation used to perform this analysis are adversely effected by condensed contaminates, acidic and sulfuric gases and solid contaminates. These contaminates can skew the analysis but more importantly ruin the internals of the instrument to the point where a complete rebuild is required. Efficient removal of undesirable contaminates from a sample stream will ensure accurate analysis and trouble-free operation of the instrumentation.



Balston Disposable Filter Units

Application

Typical applications for sample filtration include stack gas or emissions sampling. These sampling applications have specific and unique filtration requirements depending on the analysis to be performed and the contaminates present in the sample stream. Quantitative measurement of excess oxygen, carbon dioxide and nitrogen oxides are unique to stack and flue gas sampling.

Coalescing filtration is used widely in most sampling applications as an initial filtration stage to remove all condensables. Additional secondary filtration requirements for removal of specific gas contaminates is best accomplished by using a specialized bed of adsorbent.

In most stack and flue gas sampling applications, instruments are most adversely affected by sulfur based acidic gases. These gases will condense and quickly corrode and ruin the sensitive sensors and internals of these instruments. The secondary filter recommendation for removal of these contaminate gases should be an adsorbent bed. In most applications a specialized formulation of sodium and calcium hydroxides is the ideal media to remove these gases.

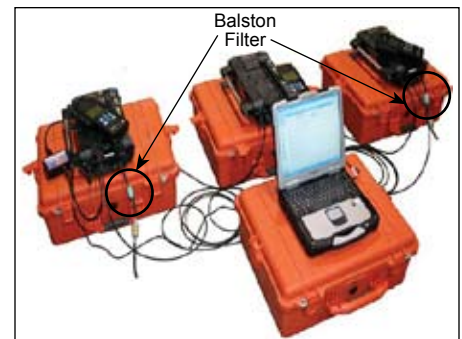
Case Study

A large company located in Michigan, specializing in combustion diagnostics and optimization relies on many of the instruments they manufacture to perform very specialized analysis in what is considered to be the most aggressive application found in industry – combustion / flue gas sampling. This company provides a diagnostic service that pinpoints areas where customers can reduce fuel costs, increase boiler efficiencies/generation and reduce NOx emissions.

One instrument that is manufactured by this company and used extensively to perform critical analysis is the MSCA or multi-stream combustion analyzer. Capable of sampling up to 12 flue gas streams simultaneously on a real time basis these instruments require high efficiency filtration to safe guard against the corrosive acidic vapor gases. Prior experience with inappropriate filtration resulted in costly rework of the instrumentation, additional travel and labor expenses to return to the test site and delayed service to their customers.

The Parker Balston disposable filter unit packed with a mixed sodium and calcium hydroxide adsorbent material are used on all these instruments. In applications where excessive condensate is expected, a Parker Balston disposable filter unit assembled with a high efficiency coalescing filter is installed upstream from the adsorbent filter which protects the adsorbent from becoming saturated and rendered inoperable. These filter combinations have resulted in flawless analysis with no downtime, no rework to the equipment and timely, expedient service to their customers.

Recognized as the industry leader in sample filtration and conditioning, Parker Balston flue gas filters are found in the majority of all instruments and analyzers as a supplied component.



Combustion Gas Analyzers



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Disposable Filter Units (DFUs)



Balston Disposable Filter Units

Balston brand disposable filter units (DFU) consist of a microfibre filter cartridge permanently bonded into a sealed plastic holder with 125 psig pressure ratings, temperatures to 275°F, and available in low and high flow models. The economical DFU offers all of the advantages of microfibre filter cartridges for high efficiency liquid and gas filtration, combined with the economics and convenience of complete disposability.

Features and Benefits

- Ideal for the following gas filtration applications:
 - Final filter for air logic devices
 - Protection of pneumatic components
 - Filtration of portable environmental sampling devices
 - Filtration of samples to on-line analyzers
 - Protection of Pneumatic temperature controls
- Ideal for the following liquid filtration applications:
 - Filtration of liquid with minimum holdup volume
 - Filtration of liquid samples to analyzers
- Additional applications in the following industries:
 - Instrument & Controls
 - HVAC
 - Dental
 - Automotive
 - Food Packaging



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Disposable Adsorption Units (DAUs)



Disposable Adsorption Units (DAUs) contain a bed of adsorbent granules. Utilizing a wide choice of adsorbents, the DAUs selectively remove vapors from air and other gases.

Because the adsorbed vapor remains trapped in the solid bed, the DAU has a fixed upper limit of total weight of vapor which can be captured. It is usually not feasible

to regenerate the filter when it has reached its adsorption limit. DAUs should be used only when small quantities of vapor are to be removed.

Adsorbent	Grade	Use For
Carbon	000	Compressor oil vapors, C ₅ and heavier hydrocarbons, aromatics, oxygenated hydrocarbons, chlorinated organics, freons, carbon disulfide.
Silica Gel	101	Recommended only for water vapor.
Molecular Sieve Type 13X	103	Most C ₄ and lighter hydrocarbons, ethylene, propylene, acetylene, ethylene oxide, ammonia, mercaptans, sulfur hexafluoride, triethylamine, and smaller amines.
Mixed Sodium & Calcium Hydroxides	107	All acidic gases, including sulfur trioxide, sulfur dioxide, nitrogen dioxide, carbon dioxide, hydrogen sulfide, hydrogen chloride, phosphorus trichloride, boron trifluoride.

Selecting a Disposable Adsorption Unit

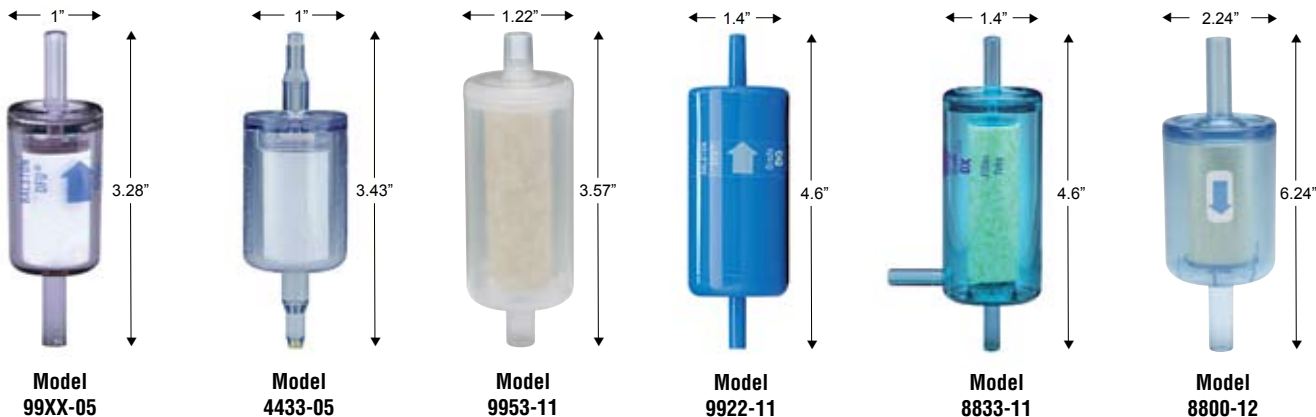
The following factors should be considered when selecting a DAU:

- 1 Solid adsorbents are effective only for vapors. Since liquids will damage or inactivate most solid adsorbents, the DAU must be preceded by an efficient coalescing filter.
- 2 In contrast with Microfibre Filters, which operate at their initial efficiency throughout their life, adsorbent cartridges have a limited holding capacity. When the adsorption capacity is reached, no further adsorption occurs. The limiting capacity, or "breakthrough" point, is not sharply defined, and the exit vapor concentration will increase rapidly as saturation is approached. To avoid unwanted vapor contaminants downstream, it is necessary to change the adsorbent cartridge well before it has reached its ultimate adsorption capacity.
- 3 Adsorption is reversible, if operating conditions change, a vapor may desorb rather than adsorb. For example, if a temporary surge in vapor impurity concentration causes a relatively high concentration to be adsorbed on the solid, a subsequent decrease in inlet vapor composition will result in desorption of vapor from the solid to the gas stream.
- 4 The efficiency of a given adsorbent for a given vapor depends upon the specific operating conditions. Therefore, again in contrast to filtration, it is not possible to assign a single efficiency rating to an adsorbent. While it is not possible to predict or guarantee an adsorption efficiency for any specific set of conditions, it is possible to enhance the conditions beneficial to adsorption and avoid conditions which interfere with adsorption. Conditions which aid adsorption are: low temperature, high pressure, low flow rate, and absence of competing vapors (particularly water vapor).



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Models 9922-05, 9933-05, 4433-05 and 9900-05

The 99XX-05 models are the smallest Disposable Filter Units with 11.7 ml internal volume. These models are used in low flow gas or liquid sampling applications, such as liquids to specific-ion analyzers or gases to personal samplers. The model 9900-05-BK has a color indicating feature, which turns the cartridge red when saturated with oil. The model 4433-05 has 1/4" and 3/8" Barb Connections molded into the inlet/outlet ports.

Models 9922-11, 9933-11, and 8800-12

Models 9922-11, 9933-11, and 8800-12 are used for applications similar to the smaller DFUs (Models 9922-05 and 9933-05) which require greater solids holding capacity and can tolerate the increased retention time.

Model 8833-11

These Disposable Filter Units are used as continuous coalescing filters with a third port serving as the drain, slip-stream, or by-pass port.

Model 9953-11

This model snaps together for easy filter cartridge changeouts. It is designed primarily for low pressure or mild vacuum applications. It is ideal for capturing samples and perform analysis or record weights over time. If used with a X-tube, it is a very effective silencer to compress inlet noise to small pumps.

Parker Hannifin offers a manual drain valve for removal of coalesced liquids from the Type 8833-11-DX.

Drain Valve: 1/8" NPT (male) x 1/8" ID Tubing.
(Requires elbow part No. 11972). Part No. 20-125

Features and Benefits

- Prevent cross-contamination of samples
- Pressure ratings up to 125 psig
- Temperature to 275°F (135°C)
- Completely disposable, constructed of recyclable plastics



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Chemical Compatibility Models 9922-05, 9922-11, 8833-11, and 8800-12

Suitable: Water or steam to 200°F (135°C); concentrated nitric, sulfuric, and hydrochloric acids; chlorine (gas or liquid); sodium hypochlorite, ethylene oxide (gas or liquid); Freons; ammonia (gas, liquid, or aqueous solutions); hydrogen peroxide (all concentrations); bromine (dry and aqueous solutions); all chlorinated solvents except methylene chloride; all aromatic and aliphatic solvents; all alcohols and glycols; aniline; phenol.

Limited Use: Acetone, MEK, dioxane, furfural, methylene chloride.

Unsuitable: Water above 200°F (135°C), THF, DMF, ethylene diamine, chlorosulfonic acid, ethanolamine, pyridine, sulfur trioxide.

Chemical Compatibility Model 9933-11

Suitable: Water to 158°F (70°C); benzene, toluene, other aromatic hydrocarbons; hydrocarbon solvents and fuels, perchloroethylene; trichloroethylene, nitric acid (to 10%); sulfuric acid (to 40%); hydrochloric acid (to 10%); most salt solutions; sodium and potassium hydroxide (to 50%).

Limited Use: Water at 176°F (80°C); acetone; MEK, acetaldehyde; ammonia (to 25%).

Unsuitable: Water above 158°F (70°C); alcohols; glycols, phenol; aniline; DMF; concentrated acids; chlorine.



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Flow Rates

Flow Rates		Water Flow Rate, Gallons per Hour						
DFU Model	Volume of Housing Gallons	Liters	Initial Pressure Drop	Grade DQ, DX	Grade CQ, CX	Grade BQ, BX	Grade AQ	Grade AAQ
9922-05	0.003	0.01	1 psi	12	10	3	1.5	0.4
4433-05			5 psi	30	25	15	7.3	1.9
9933-05			1 psi	18	15	5	2.5	0.6
9922-11	0.0005	0.02	5 psi	45	37	26	12	3.1
9933-11			1 psi	54	44	13	6	1.4
8800-12			5 psi	129	106	56	26	6.5

Flow Rates		Air Flow at 2 psi drop, standard, cu. ft. per min. (SCFM) at indicated line pressure.						
Model	2 psig	20 psig	40 psig	60 psig	80 psig	100 psig	125 psig	
9953-11-DX, 8833-11-DX (7)	1.8	3.6	5.8	8.0	10.0	12.0	14.6	
9953-11-BX, 8833-11-BX	0.9	1.8	2.9	4.0	5.0	6.0	7.3	
9900-05-BK, 4433-05-BX	0.4	0.8	1.3	1.8	2.2	2.7	3.3	



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Principal Specifications, Ordering, Installation

Principal Specifications									
Model	9922-05	9900-05	4433-05	9933-05	9922-11	9933-11	8833-11	8800-12	9953-11
Inlet and Outlet Ports	1/4" Tubing	1/4" Tubing	1st Tier/Barb 1/4" Tube 2nd Tier/Barb 3/8" Tube	1/4" Tubing	1/4" Tubing	1/4" Tubing	1/4" Tubing	1/2" Tubing	0.32" OD
Drain	None	None	None	None	None	None	1/4" Tubing	None	None
Material of Construction	PVDF	Nylon	Nylon	Nylon	PVDF	Nylon	Nylon	Nylon	Polypropylene
Filter Cartridge Length	1.25" (3.2 cm)	1.25" (3.2 cm)	1.25" (3.2cm)	1.25" (3.2 cm)	2.25" (5.7 cm)	2.25" (5.7 cm)	2.25" (5.7 cm)	2.5" (5.71 cm)	2.28" 6.35 cm)
Maximum Temperature (1)	275°F (135°C)	230°F (110°C)	230°F (110°C)	230°F (110°C)	275°F (135°C)	230°F (110°C)	230°F (110°C)	150°F (66°C)	125°F (52°C)
Maximum Pressure (2)	125 psig	125 psig	125 psig	125 psig	125 psig	125 psig	125 psig	50 psi (5)	2 psi
Dimensions	1.0"D X 3.25"L (2.5 cm X 8 cm)	1.0"D X 3.25"L (2.5 cm X 8 cm)	1.0"D X 3.43"L (2.5 cm X 8.72 cm)	1.0"D X 3.25"L (2.5 cm X 8 cm)	1.4"D X 4.6"L (3.6 cm X 12 cm)	1.4"D X 4.6"L (3.6 cm X 12 cm)	1.4"D X 4.6"L (3.6 cm X 12 cm)	2.24"D X 6.24"L (5.69 cm X 15.85 cm)	1.22"D X 3.57"L (3.1 cm X 9.07 cm)

Ordering Information									
Model	9922-05	9900-05	4433-05	9933-05	9922-11	9933-11	8833-11	8800-12	9953-11
Box of 10 DFUs Available only in Q-grades	9922-05-□ (4)	9900-05-□ (4)	4433-05-□ (4)	9933-05-□ (4)	9922-11-□ (5)	9933-11-□ (5)	8833-11-□ (6)	8800-12-□ box of 1 (5)	9953-11-□ (5)
Box 10 DAU'S (3)	9922-05-□	N/A	4433-05-□	9933-05-□	9922-11-□	9933-11-□	N/A	N/A	N/A

Notes:

- 1** At 0 psig
2 At 110°F (43°C)
3 To designate adsorbent in the DAU, insert adsorbent numbers after DAU designation. For example, to obtain a miniature clear nylon DAU with carbon adsorbent, order 9933-05-000. Adsorbent numbers are listed on page 33.
4 Available only in Q grades.
5 Available in Q or X media.
6 Available only in X media.
7 9953-11 is designed for maximum pressure of 2 psig.
8 Pressure rating in liquid service is 70 PSIG maximum.

Installation Information

To pressure pipe or tubing: Compression fittings for 1/4" O.D. tubing may be obtained from the following manufacturers. Hoke, Inc. ("Gyrolok"); Crawford Fitting Co. ("Swagelok"); Parker-Hannifin Corp. ("CPI"); Legris, Inc. (push-on fittings); Jaco Mfg. Co. (plastic fittings). The following brass fittings which seal by O-ring compression and which may be completely recovered and reused when changing filters may be purchased from Parker/Balston:

Connector: 1/4" tubing to 1/4" NPT female - Part No. 11970 (1 per pkg.)

Connector: 1/4" tubing to 1/4" tubing - Part No. 11971 (1 per pkg.)

To low pressure plastic tubing: Tubing with 1/4" ID may be slipped over the DFU and fittings and held with tubing clamps. Parker Hannifin supplies plastic barbs to connect the DFU to smaller diameter plastic tubing. The connection is suitable for pressures to 50 psig.

DFU to 1/16" ID tubing: Part No. 14000 (bag of 20 barbs)

DFU to 1/8" ID tubing: Part No. 14001 (bag of 20 barbs)



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