GRF-Series Radial-Flow Round Bag-In/Bag-Out Filter Housings

High-Efficiency Air Filtration Products and Services for Control of Gaseous and Particulate Contaminants

A Wholly Owned Subsidiary of Flanders Corporation
Quality Assurance

Any industry that has dangerous process or exhaust gases and/or particulates has a vital concern for the health and safety of personnel. In addition to corporate concern, the United States Government has dictated that safety equipment meet minimum safety standards. Any equipment sold to meet these minimum standards has to be manufactured using accepted Quality Control procedures.

Flanders/CSC Corporation has developed a Quality Assurance program to assure that the product or service provided meets these standards. This program addresses the entire range of Flanders/CSC involvement, including the purchase of raw materials, the shortage of these raw materials, incorporation of these materials into a product or service, testing this product or service, and then shipping it to its destination.

The program of Flanders/CSC has been audited many times, and each time the program has been acceptable. An uncontrolled copy of the program manual is available with each request for Quality Assurance information. Like any dynamic document, the program is continually being revised to include recent issues of standards and specifications in order that Flanders/CSC may use the latest state-of-the-art methods in providing its products and services.

The Quality Assurance Program at Flanders/CSC Corporation has been audited and approved several times by the Nuclear Utilities Procurement and Inspection Committee, NUPIC. This committee was established by nuclear electric utilities to ensure that suppliers of goods and services can meet all applicable regulatory and quality requirements.

Notes:

1. As part of our continuing program to improve the design and quality of all our products, we reserve the right to make such changes without notice or obligation.

2. Flanders/CSC, through its limited warranty, guarantees that the products described herein will meet all specifications agreed to by the buyer and the seller.

3. ASME N509 Nuclear Power Plant Air-Cleaning Units and Components.

4. ASME N510 Testing of Nuclear Air Treatment Systems.

5. ASME AG-1 Code on Nuclear Air and Gas Treatment
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NOTICE . . . Compliance with installation and operation standards must be met to ensure quality performance.

HEPA filters are factory tested to meet the requirements of IEST RP-CC001.3 for Type A, B, C, D, E or F filters:

- Industrial Grade
- Nuclear Grade
- Pharmaceutical Grade
- Laminar Flow Grade
- Bio/Hazard Grade HEPA
- VLSI
- ULPA

Test results appear on both the filter label and upon the filter carton label. An additional quality assurance test report is kept on file and is available upon request.

Flanders/CSC recommends that all HEPA filters be tested in place by qualified personnel to ensure that the filters have been correctly installed.

Flanders/CSC service personnel are available for installations, supervision of installation, testing and certification of compliance to industry and government standards and instruction of the owner’s personnel in testing and maintenance procedures.

Flanders/CSC does not guarantee that its equipment will operate at the performance levels given on the identification labels or in the catalog specifications under all conditions of installation and use, nor does Flanders/CSC guarantee the suitability of its product for the particular end use which may be contemplated by the buyer.

For best results, it is recommended that the buyer supply complete information about the operating conditions of the ventilation system to Flanders/CSC for evaluation.

When the system components are supplied to the buyer or his agent for final installation and assembly in the field, it should be under the supervision of factory trained personnel.

Failure to adhere to this recommendation or failure of the buyer to have filters timely retested and serviced will nullify or limit any warranties which might otherwise apply and may result in a compromised installation.
The Flanders/CSC GRF-Series bag-in/bag-out filter housing allows for the installation of a single radial flow HEPA filter element in a low CFM ventilation system (e.g. glovebox, isolator).

The GRF-Series filter housings are designed for particulate filtration. The GRF-Series design allows the housing to be tested in place and is flexible in that it allows various arrangements of inlet and outlet ports to fit particular applications.

One of the primary uses of HEPA filters is for the containment of toxic materials. When filters become contaminated in-service with these materials, a method for their removal without direct operator contact is necessary. The bag-in/bag-out feature of the GRF-Series allows the operator to change filters without coming into direct contact with the toxic materials (such as viable organisms, radioactive dust, and carcinogens) that have been collected by the filter element during its service life. Air is supplied to and exhausted from the GRF-Series housing through round inlets and outlets that are connected to the owner’s pipe or ducting.

Figure 1: Outlet Locations
The GRF-Series housing is designed for single filter replacement from the top of the unit. The housing can be installed for top access or side access. The housing can be supported in several ways such as mounting lugs, stands, and even supported by the inlet/outlet connections in some applications. The GRF-Series is designed to hold a single filter. For applications that require back-up filtration, two housings can be connected in series. These housings can be close together or far apart.

There is no specific diameter for inlet and outlet connections for the GRF-Series housing, since requirements vary considerably. The purchaser must specify the required sizes and lengths. The GRF-Series inlet and outlet connections can be tubing stub or pipe stub for welding, threaded pipe, flanged pipe, sanitary fittings, or other desired connections.

All welding is performed by qualified welders in accordance with ASME Section IX as specified in ANSI N509-1996 “Reaffirmed”, Section 7.3.

**Blu-Jel® Seal**

The filter-to-housing fluid seal is effected between the housing and the filter by means of a circular knife edge in the housing. The knife edge mates into a channel on the upstream end of the filter. The channel is filled with a viscous non-drying sealing compound.

See Figure 3 for Blu-Jel® Seal

**Figure 2: Radial Flow HEPA**

**Figure 3: Blu-Jel® Seal**
Housing Material
The standard GRF-Series filter housing is constructed from 14 and 11 gauge Type 304 stainless steel. Housings are also available in Type 304L, 316, and 316L construction. Some hardware on the housing will be 300 series stainless steel. All pressure retaining joints and seams are welded airtight per ASME Section IX, with no visible pores. All welds shall be free of burrs and sharp edges.

Temperature Rating
The standard housing is rated for 0-130 degrees F. High temperature bags, straps, and gaskets are available to go up to 400 degrees F.

Door Latches
A minimum of four tie-down latches are provided per access door. The latches pivot away from the bag-in/bag-out port after release so they do not impede the bag-in/bag-out process. The knob of the door latch is designed to spin free for door removal, but is captive on the threaded stud.

Pressure Rating
The standard housing is rated at positive and negative 10 inch water gage. Reinforcement can be added to reach higher pressures.

Leak Testing
The complete assembly pressure boundary is leak tested by the “Pressure Decay Method,” in accordance with ASME N510-1995 “Reaffirmed,” “Testing of Air-Cleaning Systems,” Paragraphs 6 and 7. Readings are recorded once a minute for five (5) minutes. Flanders/CSC’s standard acceptable maximum leak rate is 0.0005 CFM per cubic foot of housing volume at the design pressure for the housing pressure boundary.

Door Gasket
The door of the GRF-Series is sealed to the housing by means of a replaceable extruded closed-cell neoprene gasket adhered to the lip of the door. The gasket is designed to be field replaceable if needed.

Silicone gaskets are available as an option.

Test Ports
The housing has been designed to be in-place testable in accordance with ANSI 510-1995.

Testability requires the addition of optional test ports.
**Bag-In/Bag-Out Port**

The housing’s bag-in/bag-out port is designed so that a heavy duty PVC bag can be securely fastened around it after the original filter has been installed. When the door is eventually removed to change the filter, the bag provides a barrier between the operator and the contaminated filter. When the door is closed, the bag remains inside the door.

![Figure 4: Bagging Ring](image)

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**PVC Bag**

Each GRF–Series housing is provided with a durable, 8-mil thick translucent yellow PVC bag with a textured, non-sticking finish. The bag-in/bag-out procedure is described in detail in the G-Series Installations, Operation, Maintenance and Spare Parts Manual.

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**Security Strap**

A one-inch wide nylon security strap provided with each GRF-Series filter housing fits around the lip of the bag-in/bag-out port, in between the two ribs and over the mouth of the bag. This supplements the elastic band in the bag and helps reduce the possibility of the bag pulling away from the lip in case the filter is accidentally dropped during replacement.

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**Cinching Strap**

A cinching strap is provided with each bag to tie off the slack in the bag during the interval between filter changes. The cinching strap prevents the bag from being drawn into the housing during normal operations. The strap is cinched at a point near the lip of the bag-in/bag-out port, drawing the bag tightly across the port and allowing the slack to fall off to the outside. The slack is then folded flat and contained inside the door.
Filter Clamps

A stainless steel filter clamp secures the filter during operation. The clamps are spring-loaded and have a rod handle that is turned 90 degrees by the operator to lock the filter in the sealed position.

The filter clamping design is a variation of ASME AG-1 Section HA. AG-1 Section HA currently does not address radial flow filter housings: it is written for axial flow filter housings. The filter clamping design ensures Jel Seal filters are properly seated, but does not pull the filter off of the sealing surface stated for axial flow filters.

Baffle Plate

The GRF-Series housing features a permanently welded baffle plate. The air entering the housing is diverted twice before reaching the filter element, creating a turbulent mixture suitable for in-place testing (with optional test ports in place).

Leak Testing

Both the filter sealing surface and the complete assembly pressure boundary are leak tested by the “Pressure Decay Method”, in accordance with ASME N510-1995 “Reaffirmed”, “Testing of Nuclear Air Treatment Systems”, paragraphs 6 and 7. Readings are recorded once a minute for 5 minutes. The maximum allowable leak rate for the filter-sealing surface is 0.0005 CFM per cubic foot of housing volume when tested at 10 inches water gage.

Quality Control/Quality Assurance

Flanders/CSC products are manufactured under a strict QA program that is highly respected throughout our industry. Our QA program incorporates quality control checks from receipt of materials through final clean up and packaging. Our shop process is set up to easily incorporate customer specified checks into our QC program.

Engraved ID Label

To facilitate reordering of critical replacement parts and components, each housing has a stainless steel label permanently engraved with the following information:

- manufacturer’s name
- housing model number
- filter model number (or filter size)
- change-out bag number
- manufacturer’s order number
- other pertinent data (when specified)
Construction Options

Static Pressure Taps
Static pressure taps allow the measurement of differential pressure across the filter. Taps consist of stainless steel 1/4 inch half-couplings with brass plugs, and are located on the inlet and outlet connections of the housing.

Test Ports
To allow in-place efficiency testing of the installed filter, an injection port (3/4 inch coupling with brass plug) is located on the inlet side of the housing. Sample ports (3/8 inch couplings with brass plugs) are located upstream and downstream of the filter.

Drain with Valve
For applications with a potential for moisture condensation, an optional drain valve assembly is available, consisting of a stainless steel 1/2 inch half-coupling with a stainless steel ball valve and brass plug.

Low Leak Test
The Low Leak Test required in the “Nuclear Air Cleaning Handbook, ERDA 76-21 (Table 4.5)” is offered as an alternative to the standard leak test. It is a considerably more stringent test, allowing a leak rate of no more than 0.2% of the housing volume per hour at a pressure of 10 inches water gage. This equates to 0.000033 CFM per cubic foot of housing volume.

High Pressure Design
Flanders/CSC can design special high-pressure GRF–Series housings capable of pressures up to 15 PSI positive or 14.7 PSI negative. Welds are performed per ASME Section IX.

Banding Kit
The F/CSC banding kit facilitates clamping off the bag between the housing and the spent filter. The kit contains a supply of 25 stainless steel bands and the tools necessary to perform banding operation. An instruction/procedure manual is included in the banding kit. The kit provides a simple, but extremely effective barrier during filter change-out.
Construction Options

Flanges
Flanges are available for bolting the inlet and outlet connections to the ventilation system. Available in ¼” thick stainless steel fabricated plate flange, or 150 lb. class stainless steel in standard NPS sizes. Special sizes and types are also available.

Bypass Piping
Bypass piping is often required on systems with redundant filters. Piping is installed on these systems to allow for complete isolation of the unit for filter change-out while the air is routed to the redundant filter. Isolation is provided by different styles of valves depending on duct configuration and flow rates.

Seismic Qualifications
Seismic qualification can be provided on the GRF-Series. The owner or design engineer should contact the factory with design requirements and specifications to insure that the manufacturer’s test results are in accordance with the seismic loading requirements of the owner’s facility and plant site.

The following information is required before Flanders/CSC can provide a quotation:

- design specifications and author
- project name
- project location
- required acceleration levels
- required response spectra curves

High Temperature Design
High temperature design is available to 400 degrees F. High temperature bags, straps, and gaskets are all available.

Radial Flow HEPAs
99.97% efficient on 0.3 micron size particles

Radial Flow HEPA Filters
Radial Flow HEPA Filters are 99.97% efficient at 0.3 µ as tested on a Q107 penetrator in accordance with MIL STD 282 at 100% and 20% of rated flow. The filter media is Flanders proprietary Dimple Pleat® that is formed from a continuous sheet. Pleat alignment and spacing is maintained through the formation of the media such that no additional separator material is required. The pleated media is rolled into a cylinder and sealed into stainless steel end caps with solid polyurethane, along with a protective screen.
Ordering Information

Figure 7
GRF-Series Filter Housing: Ordering Information

GR1F Series Data Chart
(see preceding diagrams)

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Rated Flow</th>
<th>Filter Size</th>
<th>Est. Housing Wt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CFT</td>
<td>inches (nominal)</td>
<td>lbs</td>
</tr>
<tr>
<td>GR1F-D-304</td>
<td>50</td>
<td>5 O.D. x 6 3/4 L</td>
<td>90 **</td>
</tr>
<tr>
<td>GR1F-E-304</td>
<td>100</td>
<td>8 O.D. x 8 3/4 L</td>
<td>100 **</td>
</tr>
<tr>
<td>GR1F-F-304</td>
<td>150</td>
<td>8 O.D. x 12 3/4 L</td>
<td>100 **</td>
</tr>
<tr>
<td>GR1F-G-304</td>
<td>250</td>
<td>12 O.D. x 8 L</td>
<td>120 **</td>
</tr>
<tr>
<td>GR1F-H-304</td>
<td>500</td>
<td>16 O.D. x 10 L</td>
<td>150 **</td>
</tr>
<tr>
<td>GR1F-J-304</td>
<td>750</td>
<td>16 O.D. x 14 L</td>
<td>150 **</td>
</tr>
<tr>
<td>GR1F-K-304</td>
<td>1000</td>
<td>16 O.D. x 19 L</td>
<td>150 **</td>
</tr>
<tr>
<td>GR1F-M-304</td>
<td>1250</td>
<td>20 O.D. x 14 L</td>
<td>200 **</td>
</tr>
<tr>
<td>GR1F-N-304</td>
<td>1500</td>
<td>20 O.D. x 16 L</td>
<td>200 **</td>
</tr>
<tr>
<td>GR1F-Q-304</td>
<td>2000</td>
<td>20 O.D. x 21 L</td>
<td>200 **</td>
</tr>
</tbody>
</table>

** Estimated weight will vary depending on inlet / outlet size and style and other options.

Model Number Example:

**GRF1 - K - 304**

G-Series Housing
Radial Flow
Fluid Seal®
First Generation

Housing Construction Material
304 = Type 304 SST (Standard)
304L = Type 304L SST
316 = Type 316 SST
316L = Type 316L SST

Filter Size
D = 5 O.D. x 6 3/4 L
E = 8 O.D. x 8 3/4 L
F = 8 O.D. x 12 3/4 L
G = 12 O.D. x 8 L
H = 16 O.D. x 10 L
J = 16 O.D. x 14 L
K = 16 O.D. x 19 L
M = 20 O.D. x 14 L
N = 20 O.D. x 16 L
Q = 20 O.D. x 21 L

* Standard inlet / outlet length is 6” but any length and style can be supplied.

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<table>
<thead>
<tr>
<th>Model No.</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
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<td>16</td>
<td>14 1/16</td>
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<td>6 *</td>
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<td>25 *</td>
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<td>GR1F-F-304</td>
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<td>22</td>
<td>17 1/16</td>
<td>9</td>
<td>6 *</td>
<td>25 *</td>
</tr>
<tr>
<td>GR1F-G-304</td>
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<td>34</td>
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<td>28 *</td>
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<tr>
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<tr>
<td>GR1F-K-304</td>
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<td>24 1/16</td>
<td>11</td>
<td>6 *</td>
<td>32 *</td>
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<tr>
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<td>36 *</td>
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<tr>
<td>GR1F-Q-304</td>
<td>24</td>
<td>42</td>
<td>30 1/16</td>
<td>13</td>
<td>6 *</td>
<td>36 *</td>
</tr>
</tbody>
</table>
Housings

The filter housing shall be Flanders/CSC GRF-Series housing designed to accommodate radial flow HEPA filters. The housings shall be manufactured per the requirements of ASME AG-1 as stated herein. The housing shall be bag-in/bag-out design and shall be manufactured from 14 and 11 gauge type 304 stainless steel. The housing shall be adequately reinforced to withstand a positive or negative pressure of 10 inches water gage. The housing shall be cylindrical with a lid type door held in place by tie-down latches. The latches shall be manufactured in such a manner that they pivot away from the bag-out port after release so they do not impede the bag-in/bag-out process.

The inlet and outlet connections shall be specified by the customer.

As air enters the housing, a baffle plate turns the air downward. At the point where air hits the bottom of the housing, the air turns upward and passes through the filter element. The air exits the filter in a radial pattern and then moves out of the filter housing. This design has been developed over time to provide enough air turbulence for good in-place testing without creating excessive pressure drop.

To accommodate jel seal radial flow HEPA filters, the housing shall incorporate a round knife edge that mates into the jel filled perimeter channel on the face of the filter. Access to the filter shall be from the top or side of the housing depending on the mounting arrangement. Prior to leaving the factory, each knife edge shall be checked with an alignment gage to insure proper engagement with the filter. The filter shall be held in place by a spring loaded filter sealing clamp. The filter sealing clamp shall be designed to operate through the change-out bag and shall have a positive stop in the sealed position. The clamps shall be constructed of 300 series stainless steel. All change-out operations shall be within the bag so there is a barrier between the worker and the filter at all times.

All pressure retaining weld joints and seams shall be continuously welded with no pores allowed. Joints and seams requiring only intermittent welds, such as reinforcement members, shall not be continuously welded. As a minimum, joints and seams shall be wire brushed and/or buffed to remove heat discoloration, burrs, and sharp edges. All weld joints and seams that are a portion of any gasket sealing surface (e.g. access door surface and duct connecting flanges) shall be ground smooth and flush with the adjacent base metal.

All welding procedures, welders, and welder operators shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX. All production welds shall be visually inspected per Flanders/CSC procedure number P-122, “Visual Inspection of Welds”, which incorporates the workmanship acceptance criteria described in sections 5 and 6 of ANSI/AWS D9.1-1990, “Sheet Metal Welding Code”.

All hardware on the housing and mechanical components of the filter sealing mechanism shall be 300 series stainless steel, except for the cast aluminum access door knobs.

The housing shall have a bagging ring around the filter access port. The bagging ring shall have two (2) continuous ribs to secure the PVC change-out bag. The outer edge of the ring shall be hemmed to prevent the bag from tearing. Each access port and bagging ring shall be covered by a door having an extruded neoprene gasket that is manually replaceable after the door has been removed. When closed the door shall not press against the bag-out port and PVC bag, thus eliminating the possibility of the bag being cut by this pressure.
One (1) PVC change-out bag shall be furnished for each filter access port. Each bag shall have its stock number rolled into the hem. The PVC bag material shall be 8 mil thick, amber in color, with a translucent, matte, textured finish and shall not stick together. For visibility during change-out, the bag shall include approximately 12 inches of transparent PVC at the mouth. Three (3) glove sleeves shall be built into the bag to facilitate handling the filter during change-out. An elastic shock cord shall be hemmed into the mouth of the bag so that it fits securely when stretched around the bagging ring. To prevent the bag from sliding off the bagging ring during the change-out operation, one (1) nylon security strap shall be provided with each filter access port. A cinching strap shall also be provided with each bag-out port to tie off the slack in the bag while the ventilation system is operating.

The filter housing shall be manufactured under a quality assurance program that meets the Assurance Program Requirements for Nuclear Facilities™. The housing shall be tested for filter fit, operation of the filter sealing clamps, knife edge alignment, and leak tightness before leaving the factory. Both the filter sealing surface and the complete assembly pressure boundary shall be leak tested by the “Pressure Decay Method” in accordance with ASME N510-1995, “Testing of Air Cleaning Systems”, Paragraphs 6 and 7. Pressure readings shall be recorded at one (1) minute intervals for five (5) minutes. There shall be a maximum leakage rate of 0.0005 CFM per cubic foot of housing volume at 10 inches water gage for the filter sealing surface. Additionally there shall be a maximum leakage rate of 0.0005 CFM per cubic foot of housing volume at 10 inches water gage for the housing pressure boundary.
Important Notice

For best results in the application of Flanders/CSC® products, it is recommended that the buyer supply complete information about the operating conditions of the ventilation system to Flanders/CSC® for prior evaluation. Flanders/CSC® does not guarantee that its equipment will operate at the performance levels given on the identification labels or in the catalog specifications under all conditions of installation and use, nor does Flanders/CSC® guarantee that suitability of its product for the particular end use which may be contemplated by the buyer. When the system components are supplied to the buyer or his agent for final installation and assembly in the field, it should be under the supervision of factory trained personnel who are equipped to test the installation and certify its performance and conformance to industry accepted specifications. Failure to follow these procedures may result in a compromised installation.