Crankcase Filtration - An Emissions Device or Air Filter?

Actually, it’s both. Donaldson Spiracle™ Systems filter contaminant and aerosols from blow-by gasses. For engine manufacturers, regulators now recognize that engine blow-by gas emitted from the crankcase is a major emissions source and requires that the vent be closed or filtered with high efficiency filtration.

Our Spiracle™ Crankcase Filtration Systems for closed (CCV) or open (OCV) ventilation systems reduce or eliminate harmful and unwanted crankcase emissions.

What’s the Right Intake System?

As you develop the future design of your engine or application, it is important to consider the filtration system. Depending on your objectives, it may be beneficial to choose from a catalog offering or partner with Donaldson for a filtration solution tailored to your needs.

Reasons to Select a Traditional System

- No or low budget for engineering collaboration, development time or cost, or component tooling
- Prefer to have parts readily available – want to avoid manufacturing lead times (8-12 weeks) and not interested in warehousing service parts
- Prefer an established brand for filtration

Reasons to Consider a Custom, Integrated System

- Engine design team is integrating new components that require a higher degree of filtration
- Looking for a system that does more; i.e. may include pre-cleaning, sensors, unique intake plenums
- Have budget for engineering collaboration, development time/cost
- Interest in component / supplier consolidation – solutions that bridge a wide range of engine/vehicles.
- Offering a unique solution with ease of maintenance

Molded Plastic Intake Systems

For more on Spiracle™ crankcase filtration technology, refer to the technical reference section.

Small, small extended and mid-sized standard models are available for engine blow-by flow ranges up to 300 lpm / 10.6 cfm and with blow-by mass flow rates up to 15 gms/hr.

For more on Spiracle™ crankcase filtration technology, refer to the technical reference section.
With the multitude of sizes and styles of air cleaners available from Donaldson, how do you choose the proper model that will reliably protect your engine and deliver maximum filter service life? Selection is based on two primary factors - airflow requirements of your engine and the environment the air cleaner will be operating in. Use our five-step selection method on the next few pages to make the right choice for your application:

1 Determine the combustion air requirements of the engine

For the most accurate engine airflow specifications, Donaldson recommends using the intake airflow rate specified by the engine manufacturer. If this information is not readily available, you can calculate your own numbers by using the preferred or alternative methods shown below. If the air cleaner may see excessive engine vibration, include a pulsation factor into your calculations.

**Ideal Method**
Obtain from Engine Manufacturer
For the most accurate engine airflow specifications, Donaldson recommends using the intake airflow rate specified by the engine manufacturer. This information may be obtained from the manufacturer.

**Preferred Method**
Engine Displacement Formula

4-Stroke (Cycle) Engine Formula

**English Units**
Airflow (CFM) = (Engine Size (CID) x RPM) x VE / 3456

**Metric Units**
Airflow (m³/min) = (Engine Size (Liters) x RPM) x VE / 2000

VE = Volumetric Efficiency - 4-Stroke*
- 0.90 for naturally aspirated gas engine
- 0.90 for naturally aspirated diesel engine
- 1.60 for turbo charged diesel engine
- 1.85 for turbo charged after cooled diesel engine

2-Stroke (Cycle) Engine Formula

**English Units**
Airflow (CFM) = (Engine Size (CID) x RPM) x VE / 1728

**Metric Units**
Airflow (m³/min) = (Engine Size (Liters) x RPM) x VE / 1000

VE = Volumetric Efficiency - 2-Stroke*
- 0.90 for naturally aspirated diesel engine
- 1.40 for scavenge blower diesel engine
- 1.90 for turbo charged diesel engine

**Alternative Method**
Engine Horsepower Formula

**English Units**
Airflow (CFM) = HP (SAE) x SA

**Metric Units**
Airflow (m³/min) = HP (SAE) x SA

SA = (Specific Airflow) per Horsepower
- 4-stroke naturally aspirated diesel engine - 2.0
- 4-stroke turbo charged diesel engine - 2.3
- 4-stroke turbo charged after cooled diesel engine - 2.3
- 2-stroke naturally aspirated diesel engine - 2.0
- 2-stroke scavenge blower diesel engine - 3.3
- 2-stroke turbo charged diesel engine - 3.6

The Pulsation Factor (PF)
On naturally aspirated** engines, intake airflow to the air cleaner can negatively affect the cubic displacement of the air into the engine. To compensate for the loss, we recommend you multiply the engine airflow by one of the following factors:

**Ideal Method**
Obtain from Engine Manufacturer
For the most accurate engine airflow specifications, Donaldson recommends using the intake airflow rate specified by the engine manufacturer. This information may be obtained from the manufacturer.

**Preferred Method**
Engine Displacement Formula

4-Stroke (Cycle) Engine Formula

**English Units**
Airflow (CFM) = (Engine Size (CID) x RPM) x VE / 3456

**Metric Units**
Airflow (m³/min) = (Engine Size (Liters) x RPM) x VE / 2000

VE = Volumetric Efficiency - 4-Stroke*
- 0.90 for naturally aspirated gas engine
- 0.90 for naturally aspirated diesel engine
- 1.60 for turbo charged diesel engine
- 1.85 for turbo charged after cooled diesel engine

2-Stroke (Cycle) Engine Formula

**English Units**
Airflow (CFM) = (Engine Size (CID) x RPM) x VE / 1728

**Metric Units**
Airflow (m³/min) = (Engine Size (Liters) x RPM) x VE / 1000

VE = Volumetric Efficiency - 2-Stroke*
- 0.90 for naturally aspirated diesel engine
- 1.40 for scavenge blower diesel engine
- 1.90 for turbo charged diesel engine

2 Determine the dust condition for the engine/machine and typical operating environment

For example, a standby hospital generator set would probably see light dust; whereas, a rock crusher would almost always be surrounded by an extremely heavy dust concentration of large dirt particles. Our air cleaner selection chart, on the next page, is a visual guide to select your vehicle type and operating environment.

* The VE values are guidelines. It is always best to use manufacturer ratings when they are available. Electronic controls on modern engines can raise VE ratings to 2.0 or greater.

** No airflow adjustment is required for turbo-charged engines on Donaldson air cleaners with high pulsation filter media (i.e., Donaldson DuraLite™ ECB, ECC, ECD air cleaners).
### 3 Select an air cleaner series

Key design differences are color coded in our selection chart including PowerCore® filtration technology, axial seal, RadialSeal™ and disposable air cleaners.

<table>
<thead>
<tr>
<th>AIR CLEANER STYLES</th>
<th>PowerCore®</th>
<th>RadialSeal™</th>
<th>Axial Seal</th>
<th>Disposables</th>
</tr>
</thead>
</table>

Application notes, dimensional, locations of the inlet and outlet, and mounting configurations are appropriately considered at this step. These parameters are sometimes critical and may lead you to an alternative model or series that is better suited to your application.

#### Looking for Engine Airflow Reference Guide?

See Engine HP & Air Consumption Rating Guide Reference Section of this catalog.

Please note, this information IS NOT updated on any regular basis and should not be used for the application of retrofit emissions devices.

### 4 Choose a specific air cleaner family or series

Use the table of contents from this guide to locate the choices for a particular air cleaner family according to the cfm your engine needs. Refer to the Initial Airflow Restriction table for the style you’re considering. If there are two air cleaner models that fit your parameters, choose the one with the lowest restriction to ensure maximum service life from that air cleaner/filter.

### 5 Choose intake accessories

Even though they’re called accessories, things like inlet hoods, mounting bands, rubber connectors, and clamps are important parts of the overall intake system. See our accessories section for more information.
Donaldson has air cleaner housings that work in a variety of dust conditions and air flow patterns (A - D, and G).

For improved filtration reliability and quicker filter service compared to older axial seal style air cleaners, Donaldson recommends installing either PowerCore® air cleaners or housings with RadialSeal™ sealing technology - whenever possible.

**Flow Direction Legend**

<table>
<thead>
<tr>
<th>Description</th>
<th>Part No. Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>A = Air in the End, Out the Side</td>
<td>A042511, A112018</td>
</tr>
<tr>
<td>B = Air in the Side, Out the End</td>
<td>B045008, B120271</td>
</tr>
<tr>
<td>C = Air in the End, Out the Same End</td>
<td>C080025, C065003</td>
</tr>
<tr>
<td>D = Air in the End, Out the Opposite End</td>
<td>D100030, D055004</td>
</tr>
<tr>
<td>G = Air in the Side, Out the End</td>
<td>G290010, G110214</td>
</tr>
</tbody>
</table>

**Standard & Reverse Flow Filters**

These filters look exactly the same except there are dark lines viewable on the filter media of one of the filters. What’s different? One is a standard flow filter, the other reverse flow. They fit housings that have specific flow requirements and are not interchangeable even thought they look like they could be.

**Standard & Reverse Flow Filters**

<table>
<thead>
<tr>
<th>Flow Type</th>
<th>Description</th>
<th>Part No. Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Flow</td>
<td>Recognizable by dark stripes on the outer side of the filter media.</td>
<td></td>
</tr>
<tr>
<td>Reverse Flow</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Air in the End, Out the Side** (reverse flow filters)

**Light Dust - ERA**

Classic cylindrical design, black finish, cowl-mounted for vertical installation. Airflows to 1350 cfm. Page 46

**Light Dust - EBA Konepac™**

Same housing as original EBA but with cone shaped filter (Konepac), can be mounted either horizontally or vertically. Airflows to 1850 cfm. Page 61
Airflow Direction for Donaldson Air Cleaners

**Flow B**

**Air in the Side, out the End (standard flow filters)**

**Medium Dust - XRB**

The RadialSeal, plastic, two-stage air cleaner with side inlet for horizontal installation. Body diameters in 8”, 10” and 12”. Handles airflows of 265-630 cfm. Mount under hood or behind cab. Page 86

**Light and Medium Dust - FKB**

A compact housing high dust holding capacity, and comparable airflow to FPG. Two-stage filtration, side inlet, horizontal installation. Body diameters in 4”, 5” and 6”. Mount under hood or behind cab. Handles airflows from 70-207 cfm. Page 78

**Flow C**

**Air in and out the Same End (standard flow filters)**

**Light Dust - EBB**

A small housing with higher dust holding capacity and comparable airflow. Side inlet, horizontal installation. Airflows to 1640 cfm. Page 72

**Light Dust - ECB**

Disposable, small, lightweight and unitized (housing and filter in one). For high-vibration engines. Can be vertically or horizontally mounted. Airflows to 2118 cfm. Page 44

**Light Dust - ECC**

Disposable, small, lightweight and unitized (housing and filter in one). For high-vibration engines. Can be vertically or horizontally mounted. Airflows to 760 cfm. Page 44
Airflow Direction for Donaldson Air Cleaners

**FLOW D**

**Engine Air Filtration**

**OVERVIEW**

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**Air in the End, out Opposite End**

**Medium to Heavy Dust - PSD**

- Disposable, small, lightweight and unitized (housing and filter in one). For high-vibration engines. Can be vertically or horizontally mounted. Airflows to 915 cfm.
- Page 30

**Light Dust - ECD**

- Disposable, small, lightweight and unitized (housing and filter in one). For high-vibration engines. Can be vertically or horizontally mounted. Airflows to 185 cfm.
- Page 44

**INLET**

**OUTLET**

**FLOW G**

**Air in the Side, Out the End** (standard flow filters)

**Light Dust - EPG**

- Single stage filtration. Smaller than ECG and lightweight, sturdy, and totally plastic. Horizontal installation. Airflows to 1325 cfm.
- Page 50

**Light Dust - ECG Konepac™**

- Second generation Konepac with a cone-shaped filter has a long and narrow housing. Designed for horizontal installation; usually mounted under hood or behind cab. Airflows to 1600 cfm.
- Page 66

**Medium Dust - FPG**

- The first fully plastic air cleaner in our two-stage filtration line. Tangential inlet, with or without safety element, body diameters from 4" to 8". Handles airflows of 55 to 346 cfm. Flexible mounting – horizontally, vertically or at an angle.
- Page 94

**Medium Dust - FVG**

- A heavy-duty housing, our FVG has high airflow throughput and safety filter. Adds a vane in the inlet for a more aggressive first stage of cleaning. Horizontal mounting required. Airflows of 690 to 1200 cfm.
- Page 124

**INLET**

**OUTLET**

PSD units are small and compact with built-in mounting brackets. Can be vertically or horizontally mounted. Airflows to 915 cfm.

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**Medium to Heavy Dust - FRG**

This two-stage filtration housing is available in body diameters of 5" to 18". This style is the ideal upgrade from our older FWA, FWG, FHG and FTG housings. Horizontal mount required. Style A handles airflows up to 795 cfm and our new Style B handles airflows up to 1390 cfm.

*Page 105*

**Heavy Dust - FTG**

Two models available and designed for the engines on large equipment. Both have exact same airflow (from 1480 to 1870). Inlet tube position on housing body is only difference between the two models. *Page 119*

**Heavy (Severe) Dust - STG**

The efficient “T” design of the STG allows high airflow and strong two-stage filtration. Two styles available - one with a peripheral inlet and another with a tubular inlet. Handles airflows from 390 to 1760 cfm. Can be mounted vertically or horizontally.

*Page 140*

**Heavy (Severe) Dust - SSG**

These new models are replacing our older SRG models. Donaldson’s largest two-stage engine air cleaner, designed for the engines on large equipment. Handles airflows up to 4800 cfm per air cleaner. Multiple units can be used on very large equipment. The best protection for 500 to 3000+ horsepower diesel engines. This model uses RadialSeal™ sealing technology for filter retention.

*Page 130*
Donaldson offers a complete line of hydraulic and transmission filtration solutions that will keep your equipment operating at peak performance.

Air Cleaner Selection Steps...see pages 12/13 inside for complete details.
1. Determine the combustion air requirements of the engine
2. Determine the dust condition for the engine/machine and typical operating environment
3. Select an air cleaner series
4. Choose a specific air cleaner family or series
5. Choose intake accessories

Engine Displacement Formula

4-Stroke (Cycle) Engine Formula

Airflow (m³/min) = \( (\text{Engine Size (CID)} \times \text{RPM}) \times \frac{\text{VE}}{3456} \)

Metric Units

V = Volumetric Efficiency

Airflow = 1.85 for turbo charged after cooled diesel engine
0.90 for turbo charged diesel engine
1.60 for turbo charged naturally aspirated engine
1.40 for naturally aspirated engine
1.85 for turbo charged after cooled diesel engine
0.90 for turbo charged naturally aspirated engine
1.60 for turbo charged diesel engine
1.40 for naturally aspirated engine

2-Stroke (Cycle) Engine Formula

Airflow (m³/min) = \( (\text{Engine Size (CID)} \times \text{RPM}) \times \frac{\text{VE}}{1728} \)

Metric Units

V = Volumetric Efficiency

Airflow = 1.85 for turbo charged after cooled diesel engine
0.90 for turbo charged naturally aspirated engine
1.60 for turbo charged diesel engine
1.40 for naturally aspirated engine
1.85 for turbo charged after cooled diesel engine
0.90 for turbo charged naturally aspirated engine
1.60 for turbo charged diesel engine
1.40 for naturally aspirated engine

Engine Horsepower Formula

English Units

Airflow (CFM) = \( \left( \frac{\text{Engine Size (CID)} \times \text{RPM} \times \text{VE}}{1728} \right) \times \frac{\text{SA}}{1000} \)

Metric Units

Airflow (m³/min) = \( \left( \frac{\text{Engine Size (CID)} \times \text{RPM} \times \text{VE}}{3456} \right) \times \frac{\text{SA}}{2000} \)

Airflow (m³/min) = \( \left( \frac{\text{Engine Size (Liters)} \times \text{RPM}}{3456} \right) \times \frac{\text{SA}}{1000} \)

Power per Horsepower

SA = Specific Airflow per Horsepower

VE = Volumetric Efficiency - 4-Stroke

VE = Volumetric Efficiency - 2-Stroke

SA = (Specific Airflow) per Horsepower

VE = Volumetric Efficiency - 4-Stroke

VE = Volumetric Efficiency - 2-Stroke

5. Choose intake accessories

Engine Displacement Formula

4-Stroke (Cycle) Engine Formula

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Power per Horsepower

SA = Specific Airflow per Horsepower

VE = Volumetric Efficiency - 4-Stroke

VE = Volumetric Efficiency - 2-Stroke

SA = (Specific Airflow) per Horsepower

VE = Volumetric Efficiency - 4-Stroke

VE = Volumetric Efficiency - 2-Stroke

5. Choose intake accessories