Air Intake System

General

The air cleaner is critical to the life of the engine. It prevents dust and debris from entering the engine air system causing premature engine wear and possible failure. When a two stage, dry type air cleaner is used, air passes through the outer, primary filter elements installed; both are required to fully protect the engine from contamination.

Air Cleaner Connections

Check the intake tubes between the air cleaner outlet and the turbocharger for cracks or wear and that all clamps are in place and are tight.

- Replace any worn or damaged tubes and tighten any lose clamps.

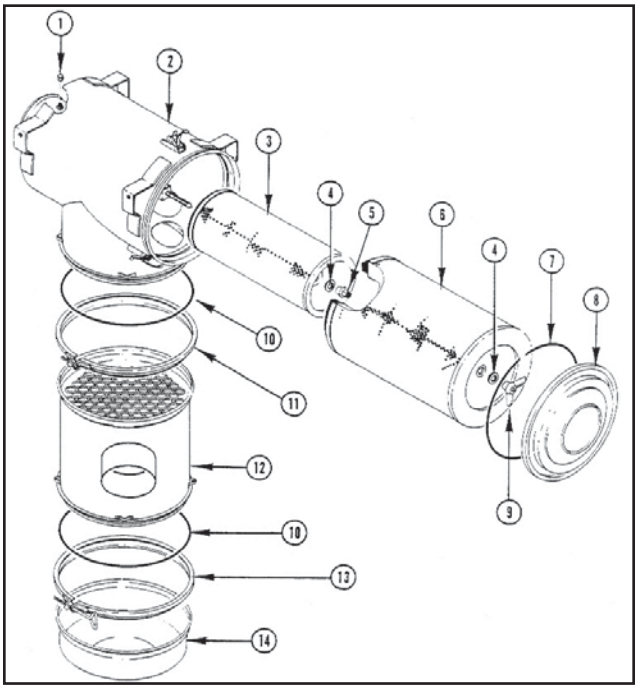

Figure 1 - Air Intake System (Typical)

Servicing the Air Cleaner

A rubber evacuator is installed on the bottom of the air cleaner housing to allow daily removal of debris from the air cleaner.

- Squeeze the evacuator to allow the debris to fall out.

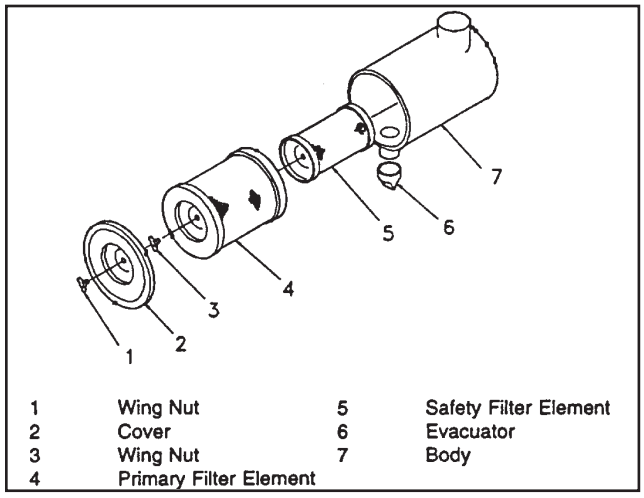

Figure 2 - Air Cleaner Assembly (Typical)

An indicator may be located on the air tube. It is provided to alert the operator that the elements are plugged and in need of service. Air cleaner service require ments will vary with your operating conditions. In extremely dusty conditions, this gauge should be constantly monitored, as frequent air cleaner service will be necessary.

1. Loosen the wing nut in the center of the air cleaner end cap and remove the end cap.
2. Remove the outer, primary air filter and clean the inside of the air cleaner housing thoroughly. Remove the evacuator tube and clean it and the evacuator.

IMPORTANT: DO NOT remove the inner, safety element UNLESS you are replacing it. It should be replaced each time the primary element is changed for the third time or if the primary element is ruptured. The safety element should not be cleaned or disturbed in any way.

3. Examine the primary filter element. If dust is present on the inside surface, or if it shows signs of damage, it MUST be replaced.
4. Blow compressed air through the element, from inside outward, to remove any particles from the element.
5. Wash the primary element in non-foaming detergent for approximately fifteen minutes then rinse with warm tap water from inside outward until the water that passes through the element is clear.
6. Allow the primary element to air dry then examine the condition using a bright light shining through the element from inside outward.

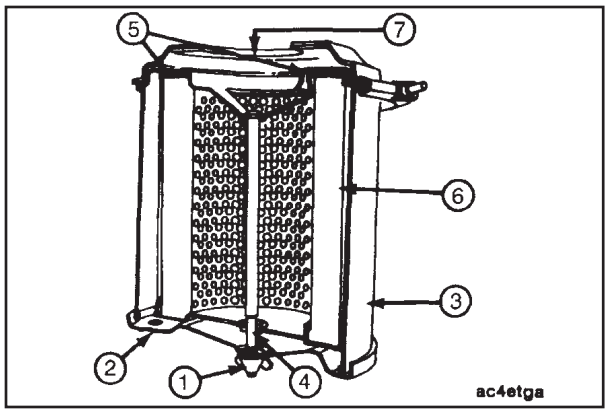

Figure 3 - Element Replacement

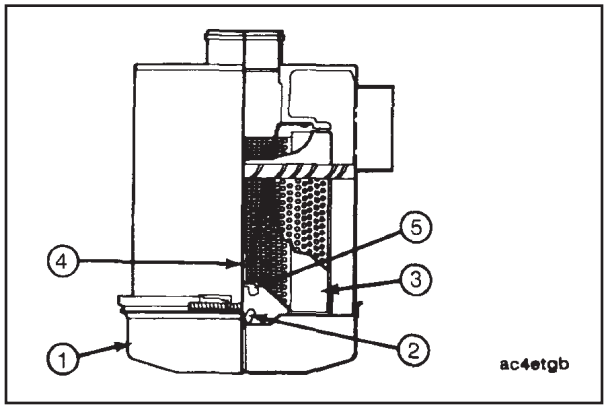

Figure 4 - Single - Heavy Duty Dry - Type Element

Servicing the Air Pre-Cleaner

- When the level of debris in the pre-cleaner bowl reaches the full line, remove the pre-cleaner, empty it and reinstall it. (See dust cap interval)

Air Cleaner Element

NOTE: The illustrations in this section show typical parts. The particular engine parts can vary.

Cleaning

The paper element (6) in a dry-type air cleaner can be cleaned several times by using compressed air to remove the dirt, approximately 207 kPa [30 psi]. Do not hold the air jet too close to the paper element when cleaning.

Elements that have been cleaned several times will finally clog and airflow to the engine will be restricted. After cleaning, check the restriction as previously described. Replace the element if necessary.

⚠ CAUTION

Caution: Holes, loose end seals, dented sealing surfaces and other forms of damage render the cleaner inoperative and require immediate element replacement.

Replacement

1. Remove the wing-nut (1) that secures the bottom cover (2) to the cleaner housing (3). Remove the cover.
2. Pull the element (6) down from the center bolt (4).

⚠ CAUTION

Caution: Pull the cover and the element straight out when removing them from the housing to avoid damage to the element.

3. Remove the gasket (5) from the outlet end (7) of the housing.

Single - Heavy Duty Dry-Type Element

Heavy-duty air cleaners (single and dual types) combine centrifugal cleaning with element filtering before air enters the engines.

Before disassembly, wipe dirt from the cover and the upper portion of the air cleaner. To clean the single types:

1. Loosen the wing bolt, and remove the band securing the dust pan (1).
2. Loosen the wing nut (2).
3. Remove the dust shield (3) from the dust pan (1). Clean the dustpan and shield.
4. Remove the wing nut (5) and secure the air cleaner primary element in the air cleaner housing. Inspect the rubber-sealing washer on the wing nut (4).
5. Clean the element from the clean air side with compressed air not exceeding 207 kPa [30 psi]. Inspect the element after cleaning. Install the cleaned primary element or a new element.
6. Make sure the gasket washer is in place under the wing nut before tightening.
7. Assemble the dust shield and dustpan again. Position them to the air cleaner housing and secure with the band.

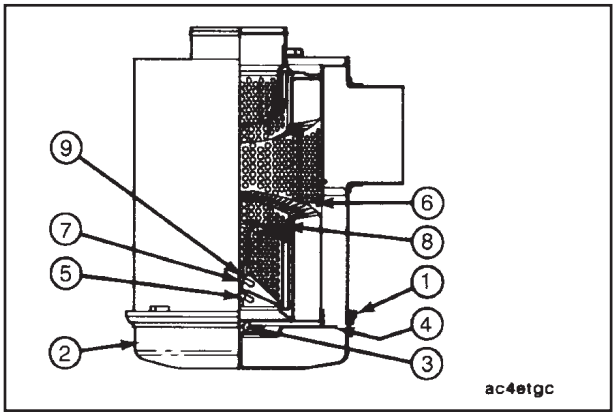

Figure 5 - Dual - Heavy Duty Dry - Type Element

Dual - Heavy Duty Dry-Type Element - Replacement

Heavy-duty air cleaners (single and dual types) combine centrifugal cleaning with element filtering before air enters the engines.

Before disassembly, wipe dirt from the cover and the upper portion of the air cleaner. To clean the dual types:

1. Loosen the wing bolt (1), and remove the band securing the dust pan (2).

2. Loosen the wing nut (3). Remove the dust shield (4) from the dust pan (2). Clean the dustpan and shield.

3. Remove the wing nut (5) and secure the air cleaner primary element (6) in the air cleaner housing. Inspect the rubber-sealing washer on the wing nut (9).

4. Clean the element from the clean air side with compressed air not exceeding 207 kPa [30 psi]. Inspect the element after cleaning. Install the cleaned primary element or a new element.

5. Make sure the gasket washer is in place under the wing nut before tightening.

6. Assemble the dust shield and dustpan again. Position them to the air cleaner housing and secure with the band.

On Dual Element Type Cyclopac Cleaner

1. Check the air restriction indicator. If the air restriction is excessive, disassemble the air cleaner, remove the wing nut (7) and replace the safety element (8).

2. Assemble the air cleaner as described above

Air Filter Service Indicator

This gauge indicates filter element condition without filter disassembly. The service sight gauge indicates filter contamination by showing “red” or “green” in the sight gauge. The visible amount of red on the indicator will increase as the dust in the element increases.

For maximum engine performance the filter should be changed or cleaned immediately after the “red” signal locks in full view.

- To reset the service gauge, press the button on the top of the gauge.

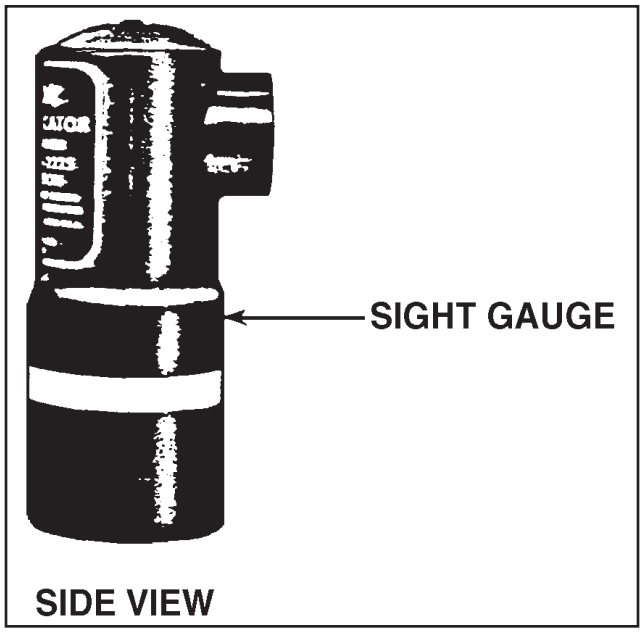

Figure 6 - Air Filter Service Indicator

Donaclone Air Filter

Service Intervals and Service Procedures for the Donaclone Air Filters are as follows:

Dust Cup Interval

Empty dust cup at regular intervals. Inspect dust cup daily until experience indicates the necessary frequency for dust cup service. Service Intervals may range from 4 to 120 hours. Do not allow dust level to build up to within 1/2" of bottom of tubes.

- How to Service: Stop engine, remove cup and empty dust. Inspect dust cup gasket. Replace the gasket if it is worn or damaged.

⚠ CAUTION

CAUTION: When replacing dust cup, be sure a seal is made between the dust cup and the Donaclone tube section. A leak at the dust cup will reduce dust removal efficiency.

Donaclone Tube Section Interval

At regular intervals (at least twice a year) inspection of the tube section should be made for dust plugging or damage to tubes. Inspect the lower end of the tubes at the time the dust cup is serviced.

- How to Service: Remove the dust cup and Donaclone tube section. Inspect both ends of the tube section. Light should be visible through each tube. Remove any dust deposit in or around the tubes with a stiff fiber brush, compressed air, or by washing tube section in soap and warm water not to exceed 150 deg. F. Tubes must be clean for correct operation. Inspect top and bottom gaskets. If gaskets are worn, damaged, or show evidence of leaks, replace them with approved new parts. Reassemble, making certain the tube section is straight and good seals are obtained at both the top and by dust cup.

⚠ WARNING

WARNING: Do not apply heat of any kind to the plastic tube section of the air cleaner.

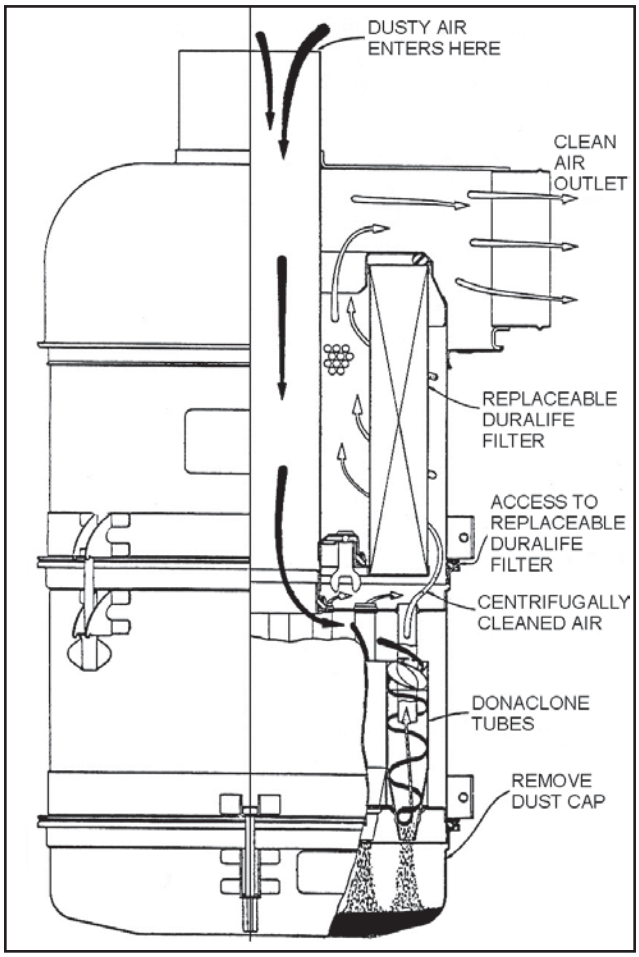

Figure 7 - Airflow

Filter Cartridge Interval

Excessive smoke and loss of power are good indications that the filter element should be replaced or cleaned. A better method is to measure the air restriction of the cleaner with a restriction indicator, a vacuum gauge, or water manometer at the restriction tap provided in the air cleaner, air transfer pipe, or blower intake. Replace or clean the filter element when the air restriction has reached 30" H_20 for diesel engines and 20" water for carburetted engines, or as recommended by the engine or equipment manufacturer. Air restriction is measure of maximum engine airflow. Maximum engine airflow occurs at high idle for naturally aspirated or mechanically supercharged diesel engines.

Maximum airflow for turbocharged engines occurs at rated engine speed and full load. After measuring restriction, be sure to replace tap plug securely. Filter element service periods will be indicated by any of these methods, and regular service can be established for any operation. Standby filter element, new or cleaned, will speed service and reduce downtime.

NOTE: Donaldson air restriction indicators are available for permanent installations.

1. How to Service: Stop engine. Remove dust cup and Donaclone tube section. Remove filter element from air cleaner. If element is to be cleaned, inspect both filter cartridge gaskets before further use.

⚠ CAUTION

CAUTION: Proper seal of these gaskets is of the utmost importance. If they are damaged or show signs of leakage, they MUST be replaced.

2. Install a new filter element or a filter element cleaned by one of the recommended methods. Before replacing Donaclone tube section and dust cup, make certain element retention wing nuts are securely fastened.

IMPORTANT: Never operate the air cleaner without a filter element. Also, to obtain the maximum engineered performance and minimum service costs, use only approved filter elements.

Entire Air Cleaner Interval

Regular periodic inspection of the air cleaner must be made even though the service life may be extremely long due to light dust conditions. The engine manufacturers recommended engine oil change interval should be used as the interval for a thorough inspection of the entire air cleaner.

- How to Service: See the included **Inspection Check-Off List**. Check connections between air cleaner and engine for leaks. Proper inlet protection from rain, exhaust smoke and oil fumes must be maintained. Any inlet protecting screen must be kept clean. Never operate the air cleaner without a filter element. Remember this is a dry air cleaner. It does not require oil.

Diagnosis Procedures & Service Tips

The following information is a listing of diagnosis procedures and service tips.

Short Service Life

A short service life may occur if the inlet air contains carbon particles or oil fumes. A short service life may also be due to poor inlet location relative to the vehicle dust pattern. When the air cleaner is installed, the air inlet should be located in an area of a minimum dust concentration. If a short service life is experienced, even when the air cleaner inlet is properly located, check the following:

1. The gaskets between the dust cup and Donaclone tube section, upper body, and at the center tube must seal at all times. If leaks are evident, replace the gasket.

2. Inspect the Donaclone tubes to be sure they are not blocked by dust. Clean the tubes if they are plugged.

3. Check air cleaner inlet or inlet accessory for plugging, clean if required.

4. Use an air restriction indicator of proper calibration for plugging, clean if required.

Dust Passing the Air Cleaner

To insure engine protection all connections between air cleaner outlet and engine intake manifold must be tight and make positive seals. If the connections are properly maintained and there is still evidence of dust leaks:

1. Check to see if element is properly tightened in place.

2. Inspect the filter cartridge gaskets for leaks.

3. Inspect the filter cartridge for holes.

4. Check restriction tap for leaks.

5. Check for structural failures. If cartridge or gaskets are damaged or show signs of leaks, replace them with new approved parts.

Recommended Cleaning Methods

Although a Donaldson Duralife paper fitter is normally considered as an expendable element, proper and careful cleaning can extend its original life several times. Listed below are two accepted methods for cleaning filter elements. If the filter element contains substantial amounts of carbon or oil fumes, the water washing would be preferred over the compressed air. The filter element should be replaced after six cleanings or annually.

1. Compressed Air: Direct a jet of dry clean air against the downstream (inside) or clean air side of the filter element. Move nozzle up and down rotating element until no dust is visually being removed (time approximately 10 minutes). Direct air perpendicular to pleats using 100 psi maximum airflow nozzle or jet.

2. Washing: Clean the filter element by washing it in water using a non-foaming detergent. Donaldson D-1400 washing compound is recommended. Proportions are (2oz.) of cleaner to (1) gallon of water. For best mixing results use a small amount of cool tap water, and then add to warm (70 - 140 deg. F) water to give proper proportions. The warmer (100 deg. F) the solution the better the cleaning. Soak element for 15 minutes and then rotate element back and forth (2 minutes) to free element from dust deposits. Rinse the filter thoroughly with clean water. If a hose is used to wash or rinse the filter, be careful not to rupture the paper with the water jet. A maximum water line pressure of 40 psi is recommended. Rinse the filter element until drain water becomes clear. Proper rinsing is very important. Air dry the filter element thoroughly before further use (temperature 0 not to exceed 180 deg. F with air circulation)

IMPORTANT: After cleaning filter element, (using either of the previously recommended methods) inspect the filter element for the following damage.

1. **Dust on downstream (inside) or clean air side.**
2. **Slightest ruptures.**
3. **Damaged gaskets.**

Detect Paper Ruptures

A good method to detect paper ruptures is to place a light inside the fitter element. Inspection of the element on the outside will then disclose any holes or ruptures. Any hole in the filter element, even the smallest, will pass dust to the engine and cause engine wear.

Effectiveness of Cleaning

To determine the effectiveness of cleaning, the air flow restriction of a cleaned element can be compared to that of a new element. Measure the restriction using a water manometer or vacuum gauge at maximum engine airflow.

Types Of Dust

Some types of dust (airborne asbestos fibers, for instance) can form a thick cake on the filter, but actually improve cleaning efficiency and add very little restriction. On the other hand, very fine dust may hardly show on the filter surface, but plug the filter completely.

Remove Liquid Contaminants

Air cleaners are designed to remove solid contaminants from the air. But liquids can be airborne too. Mist, fog, snow and rain can be sucked into the air intake system through the inlets or leaks. Rain, especially, can create special problems:

1. Through Air Inlet: An unprotected snorkel inlet will allow quantities of rain to enter. Proper shielding with a baffled cap will reduce rain intake to a point where under most operating conditions; it may never be a problem.

2. Snorkel Leaks: Pipes can crack or rust through, or joints can separate, allowing water to enter. It is good procedure to inspect snorkel tube at regular intervals.

Soot In the Air Cleaner

The “dirtiest” dirt for a dry type air cleaner to handle is soot, chiefly from diesel engines. A rapid rise in restriction, or sudden plugging of the air cleaner could be the tip-off for soot contamination. A little more than an ounce will do it, because soot particles are coated with gum and varnish which “glues” them into pores of filter element.

- How to Test for Soot: If soot is entering the air cleaner, enough will stick to the inlet to indicate you have a problem. Wipe the inlet with your fingers for evidence. Check further by examining the element itself. If it is black (and your equipment isn’t working in coal), you have soot, or its undesirable relative, crankcase fumes.

INSPECTION CHECK-OFF LIST

At every engine oil change, inspect the following for damage or leaks. Take the necessary corrective measures.

_____ Body to outlet joint.

_____ Cover to center tube.

_____ Dust cup and Donaclone tube section retainer assemblies.

_____ Element retaining wing nuts and bolts.

_____ Dust cap gasket.

_____ Donaclone tubes (plugging).

_____ Connections between air cleaner and engine.

_____ Restriction tap (tightness).

_____ Structural damage.

_____ Filter element gaskets (2).

_____ Filter element. Inlet protecting screen (plugging)

NOTE: The basic operating principles stated here are applicable to all dry type air cleaners with one exception not all manufacturers recommend "washing" their filter element.

Service Tips

1. To begin with, let restriction levels be your guide. Use a Service Gauge or Restriction Indicator.

2. Service elements only when restriction reaches the service level recommended by your engine or equipment manufacturer. It is only above that point that air cleaner restriction begins to reduce engine performance levels.

3. If engine performance is poor, but restriction is still within limits, **don't change that element!** The air cleaner is probably not at fault.

4. To get those service hours out of each filter element make sure the air inlet is away from any heavy dust clouds caused by operation. And make sure exhaust carbon can not enter the air cleaner.

5. Check that all connections are tight and leak-free and that breakaway joints both intake and exhaust, are aligned and sealed.

6. Make sure the vacuator valve is not damaged or plugged. Is the cap joint sealed? This should take care of most air cleaner related problems.

7. When restriction readings finally indicate a change, remove the primary element carefully. Use a damp cloth to wipe out all excess dust in the air cleaner.

8. If you reuse elements, clean them with care. Rapping, tapping, or pounding dust out of them is dangerous. Severe damage to the filter will result.

9. Thorough cleaning with air or water is recommended in many cases. But be careful. Too much pressure can break the filter paper and destroy the element.

10. Carefully check new or properly cleaned elements for damage before installing.

11. **Never attempt to clean a safety element.** Change safety elements after three primary element changes or as indicated by Safety Signal Service Indicator.

12. Then make it a habit not to disturb until restriction again reaches the service limit.