Engine air filters, for very-dusty conditions?

Nigel A. Skeet
Oil Stain

Engine air filters, for very-dusty conditions?

Tue Jun 23, 2009 1:47 pm

Rumour has it, that there were factory-fitted, optional engine-air-filters (possibly cyclone air pre-cleaners), for one or more of, the South African specification, 1968~79 VW 1600 Type 2, 1972~79 VW 17/18/2000 Type 2, 1980~83 VW 16/2000 Type 25 and other 1980~92 VW Type 25s.

So far, I have discovered the following references with illustrations, on the VAGcat, VW Audi Gevaert on-line catalogue, but this does not really give much information about what the overall filter systems were like and how they were integrated into the vehicles.

http://www.vagcat.com/epc/cat/vw/T2/1980/4/49/53831/

CYCLONE AIR CLEANER WITH CONNECTING PARTS / 1.6ltr. / CT,CZ

http://www.vagcat.com/epc/cat/vw/T2/1980/4/49/53927/

CYCLONE AIR CLEANER WITH CONNECTING PARTS / 1.9ltr. / DF,DG,EY

http://www.vagcat.com/epc/cat/vw/T2/1980/4/49/53784/

AIR CLEANER / FOR DUSTY REGIONS / 2.0ltr. / CU

To the best of your knowledge, what was available?

Several years ago, I learned of an innovative cyclone air pre-cleaner, featured in the Autumn 1992 issue, of the Eureka on Campus, Design Engineering magazine, as illustrated below, but have since been unable to learn any more about it.

Mini-cyclone cleans up engine filter systems

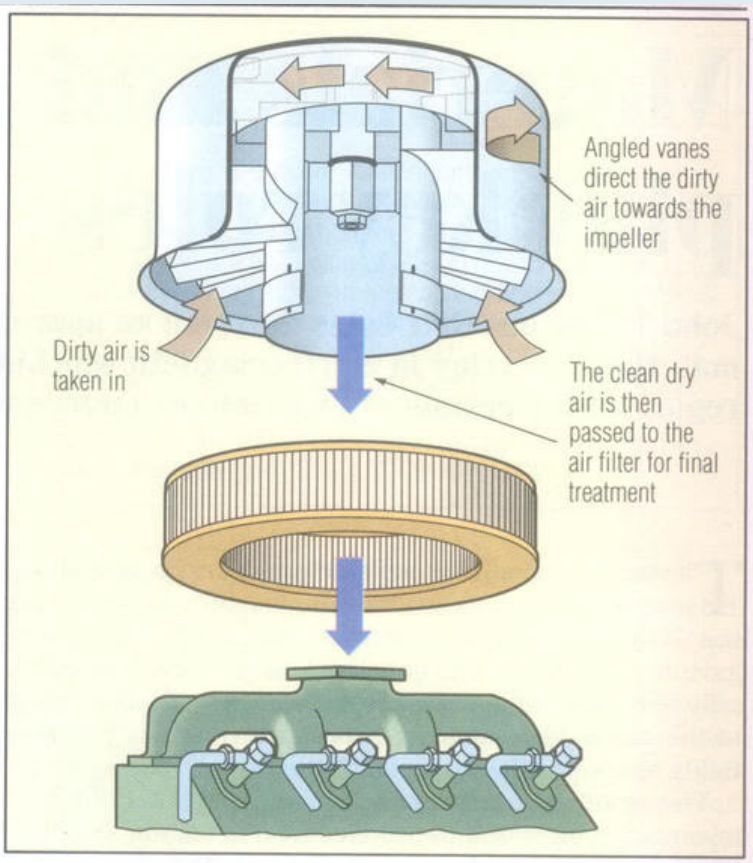
Problem: Every time an average engine uses one gallon of fuel, it breathes in 12,000 gallons of air which is full of dust, dirt and moisture. It takes just 8oz of dust to ruin an engine and a lot less to cause wear and damage.

In heavily polluted air conventional filters clog quickly.

Solution: Removing most of the harmful particles between 10-100µm before the air reaches the filter would significantly reduce the maintenance frequency and is claimed to prolong the maximum efficiency phase of an engine by up to 10 times. This is exactly what a device called Filter-Mate does.

Filter-Mate is a stainless steel enclosure containing a finely balanced impeller. As air is drawn into the housing it is redirected by angled vanes and spins the impeller. This creates a mini cyclone which throws as much as 95% of dirt and moisture out to atmosphere through a vent.

Applications: The main areas of application are for vehicles working in industrial or civil engineering environments. Static or mobile engines running in dirty surroundings are prime candidates for the technology and applications would include dumper trucks, tractors, gritting lorries, blasting compressors and quarrying machinery.



I am acquainted with the operating principles, of the cyclone air pre-cleaners, as discussed in text books, dealing with air handling & dust extraction, plus air filtering devices for automotive applications, but I have yet to find detailed information about what hardware is readily available, which would be compatible with the engine-compartment environment and engine inlet configurations, of the 1968~79 VW 1600 & 17/18/2000 Type 2s, with a single carburettor, twin carburettors or Bosch L/D - Jetronic electronic fuel injection.

Back in 1980, when I was driving on the unsurfaced, graded roads in South Africa, the passage of vehicles created large choking clouds of fine dust, which would need to be properly filtered out, to ensure reasonable engine life. Even the best paper-element air filters, are only about 99•5% effective and the earlier oil-bath air cleaners are about 95% effective, so it would be necessary to have some sort of air pre-cleaner, to remove the majority of large dust particles before fine-particle filtration.

More recently, two Dutch brothers from The Netherlands, drove a North American specification, 1979 VW 2000 Type 2 ASI Riviera campervan, from Amsterdam, in The Netherlands, to Beijing, in China, for the 2008 Olympic Games; encountering very dusty conditions en route.

According to the following book, Volkswagen M-Code 569, corresponding to an air filter for 1968~79 VW Type 2s (2000 cm^3, 70 bhp engine only) in dusty countries, was applicable to Australia & South Africa.

Vincent Molenaar & Alexander Prinz, "VW Transporter & Microbus: Specification Guide 1967~1979", The Crowood Press, 2005, ISBN 1-86126-765-7.

Does any one have a 1976~79 VW 2000 Type 2 with M-Code 569 and if so, I would be interested to see a comprehensive set of pictures, illustrating the external & internal features?

eben
Site Admin

Re: Engine air filters, for very-dusty conditions?

Tue Jun 23, 2009 2:10 pm

I know the 2.1 DJ W/C engines had a transparent dust trap that we had to clean every once in a while when driving through the desert in Namibia.

Bugger
Advertiser

Re: Engine air filters, for very-dusty conditions?

Tue Jun 23, 2009 4:39 pm

Where will this filter be used

I got a few of the Type 2 std airfilters that uses oil and their connecting hoses and as Eben said you can also use the 2.1 sand filter Cyclone to trap dust

---

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fig
Bus Driver

Re: Engine air filters, for very-dusty conditions?

Tue Jun 23, 2009 5:48 pm

A cyclone pre-filter was an option on baywindow pick-ups AFAIK. They were also standard fitment on 1975 Fleetline wide-bed single cabs. I've never seen them on a kombi or panelvan. Here is a 1971 double cab with one, you can just see it behind the cab on the right. I don't have any detail pics:

And here's one on a Fleetline bakkie:

fig
Kaapse Kombi Kult

"Whether you think you can or whether you think you can't, you're right." -- Henry Ford

eben
Site Admin

Re: Engine air filters, for very-dusty conditions?

Tue Jun 23, 2009 5:56 pm

Looks like a skoorsteen

Nigel A. Skeet
Oil Stain

Re: Engine air filters, for very-dusty conditions?

Wed Jun 24, 2009 12:13 pm

> **eben wrote:**
> I know the 2.1 DJ W/C engines had a transparent dust trap that we had to clean every once in a while when driving through the desert in Namibia.

> **Bugger wrote:**
> Where will this filter be used
>
> I got a few of the Type 2 std airfilters that uses oil and their connecting hoses and as Eben said you can also use the 2.1 sand filter Cyclone to trap dust

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And here's one on a Fleetline bakkie:

I don't have any definite destination plans at the moment, but whilst I am refurbishing, modifying and upgrading my 1973 VW "1600" Type 2 Westfalia Continental campervan, I am investigating how best I can make provision for engine-induction, dust filtration, for dusty environments, when and if I eventually travel to such regions again.

I am also compiling the information, for one of my detailed technical articles, on ALL aspects of air filtration, which I will post on the various VW forums and which hopefully will also be published in at least one of the recognised VW magazines, including VW Camper & Commercial and Transporter Talk.

Rumour has it, that I might soon be appointed to the position, as voluntary technical editor of Transporter Talk, but that has yet to be confirmed!

Nigel A. Skeet
Oil Stain

Re: Engine air filters, for very-dusty conditions?

Thu Jun 25, 2009 1:21 pm

Here's what I have compiled so far:

AIR-CONDITIONING FOR VOLKSWAGEN ENGINES: DUST EXTRACTION, PRE-HEATING AND COOLING

Compiled & Written by Nigel A. Skeet

CONTENTS

THE NECESSITY OF AIR FILTRATION

Under dusty operating conditions, unfiltered air will generally lead to carburettor faults, plus accelerated engine wear and damage to components such as pistons, piston rings, cylinder bores, inlet & exhaust valves and their guides. If dust, grit and other particulates, such as sand grains, enter the crankcase, they will contaminate the oil and become embedded in the bearing material, resulting in scored crankshaft & camshaft journals, plus similar damage to other moving parts, such as the oil pump, cam lobes & followers and valve-rockers.

http://en.wikipedia.org/wiki/Air_filter ... ir_filters

Sand is composed of silicates, related to silicon carbide, which is a well known abrasive grinding-wheel material, used for wearing away or cutting steel. An engine which would normally run on clean air, for 100,000 miles or more, without a rebuild, might only last 40,000 miles with unfiltered air, under moderate environmental conditions, running on concrete or asphalt (i.e. bitumen or tarmac) covered roads. In dusty or desert conditions, this mileage would be considerably reduced. It has been said, that the engines of circuit racing cars, running on asphalt covered track, are constantly exposed to air, laden with tiny wear-particles of asphalt and tyre-rubber.

It was further stated that during a typical club event, engines could potentially ingest approximately 4 to 8 grammes of tyre & track debris, equivalent to 4,000 to 10,000 miles of ordinary road driving. In the engine, the rubber is transformed into gums, which promote piston-ring & groove fouling and sticking, plus retaining the ingested dust and grit, which rapidly becomes like a fine grinding paste. According to one source (see Eureka on Campus, Autumn 1992, Page 5) , it takes only 8 ounces (i.e. 227 grammes or 0•227 kg) of dust, to ruin an engine and considerably less, to cause wear and damage!

INTRODUCTION TO AIR-INTAKE FILTERS & SILENCERS

The typical automotive air cleaner, is designed to serve the dual roles of filtering out abrasive dust and grit, together with the suppression of noise, produced by the induction of air into the engine. Whatever method of air filtration is chosen, it must effectively clean all of the air inducted by the engine, at all speeds upto to full throttle, without causing excessive pressure drops across the air-filter housing and filtration medium. If there is a significant pressure drop, then the engine will suffer air starvation at high engine speeds, leading to diminished volumetric efficiency, together with reduced power and increased fuel consumption.

No air filter is 100% efficient, so air-borne dust, not retained by the air-filtration system will enter the engine, via the inlet manifold and some may enter through the crankcase breather. Although oil-bath air filters (standard on pre-1974 VW air-cooled engines) can trap a larger volume of heavy particles, paper element air-filters, are said to have greater filtration efficiencies (see T. K. Garrett et al, 2001, page 555) ; quoted as typically being in the range 91% to 99•7%, as determined according to British Standard BS 1701. Some heavy-duty, two-stage, commercial vehicle air cleaners (see Heinz Heisler, 1999, page 608) , are said to have overall filtration efficiencies as high as 99•9%

This would imply that for most cars and vans, not less than 0•3% of air-borne dust, will enter the engine and for vehicles with a basic oil-bath air cleaner, it might be more than 9%. Most of this dust will probably pass out of the engine with the exhaust, but some will inevitably find its way past the piston rings or via other routes, into the crankcase and thence the lubricating oil. Ultimately, the significant parameter, is the total mass and size distribution, of particles entering the engine, rather than the proportion (i.e. mass percentage) which is filtered out, so any filtration efficiencies, must be viewed in this context.

EXTREMELY DUSTY CONDITIONS

At 3,000 RPM (a typical engine speed, for cruising and maximum torque), a 2•0 litre engine consumes as much as 3,000 litres (i.e. 3•0 m^3) of air per minute. Outside the major towns and cities, in Africa, Asia, Australia, and the Middle East, plus Central & South America, unmade roads and tracks are common, over which the dust concentration of the atmosphere (see T. K. Garrett et al, 2001, page 555) , can be as high as 45 mg per litre (i.e. 45 g/m^3), during windy conditions or in the wake of passing vehicles.

Even on the unsurfaced, all-weather roads (i.e. formed using graded, crushed stone, as pioneered by the Scotsman, John London Macadam, but not surface-dressed with asphalt) in the Republic of South Africa, impenetrable clouds of choking red dust, are created in the wake of fast moving vehicles, as I know from personal experience, of following at a discrete distance, behind a pickup, at about 50 MPH, on such a road. Hence, on a busy road, at a cruising speed of 60 MPH, an engine lacking any air filtration, could potentially induct upto 135 grammes of dust, for each mile travelled; corresponding to 67•5 kg (more than my body mass!) over a distance of only 500 miles.

http://en.wikipedia.org/wiki/Macadam "

This is about the maximum distance, one could reasonably travel in a single day, assuming it were possible to maintain such a high average speed, on roads of this type. Even if an air filter were 99•9% efficient, about 0•07 kg (i.e. 70 grammes or 2½ ounces - more than a quarter of the quantity, which has been said to ruin an engine) of dust would be inducted into the engine, over the 500 mile journey, at least some of which, would find its way into the lubricating oil. Conversely, about 67•43 kg of dust, must either be allowed to fall to the ground or somehow be contained, which is probably impractical, if only because of the extremely large volume. Assuming the dust has a maximum packing density of 2500 kg/m^3 (likely to be much less, in practice), this corresponds to a minimum volume of 27 litres, which is nearly half the capacity of a 1968~79 VW Type 2 fuel tank.

It is debatable, whether conditions would be this dusty, over the whole journey, but it does illustrate, the very large quantities of dust, with which an engine and its air cleaning systems must cope, under some extreme operating conditions. If driving across a dusty desert, having no hard-surfaced road, it is recommended that the pre-1974 VW Type 2, with oil-bath air cleaner, should be checked at least weekly, if not daily (as stated in the various Haynes VW owners' workshop manuals); the sludge being cleaned out and the oil replaced as necessary. During his trek across the Sahara Desert, Arthur Barraclough (owner of the British VW Type 2 Owners' Club, 1995 van of the year) did this religiously each day, or so he told me! Even in non-desert regions, atmospheric dust concentrations can often be very high.

Bay Window Bus > Arthur Barraclough's, much vaunted, modified, 1970 VW Type 2

http://www.thesamba.com/vw/forum/viewtopic.php?t=196043

Although this analysis might seem unrealistic to many owners, a recent editorial in the British national press (see Matthew Hickley, Daily Mail, 1st August 2002, Pages 16~17), highlighted the problems of extremely dusty conditions, encountered in 2001, by the British Army, during Exercise Swift Sword, in the desert environment of Oman. The standard engine air filters, of the Challenger 2 main battle-tank, which normally require replacement only once per year, when operating in Europe, became clogged with fine sand, after only four hours, in the desert! However, it should be noted, that contrary to the advice of the army, these battle-tanks had not been modified for desert conditions, which would have included alternative air-filtration systems.

http://www.dailymail.co.uk/news/article ... fight.html

As mentioned earlier, any dust which enters the engine, could potentially find its way into the lubricating oil. Hence, such dusty conditions also require frequent changes of the lubricating oil & oil filter, in addition to changing and/or servicing the air cleaner. Frequent engine oil changes are particularly important for the VW 12/13/15/1600 Types 1, 2 & 3 (with the exception of the German built 1980~83 VW 1600 Type 25), which have no full-flow oil filter, only a course-mesh oil strainer.

DUST-SEPARATION MECHANISMS

For a dust particle to be removed from the air, it must experience a nett force, which is either greater or in a different sense, to that experienced by the entraining air. In all separators, the dust particle must move laterally, some distance across the air stream and then be entrapped by some means, so that it cannot re-enter the cleaned air. To be effective, the differential force on the dust particle, must be as great as possible and the required lateral distance through which the particle moves, must be a minimum.

Listed in the following table, are the most common types of dust separator and the minimum particle size they can typically remove from the air stream. Many of these are inappropriate for automotive applications, owing to the physical size or operational mode of the equipment, plus the particle-sizes which can readily be removed. The median average size, of outdoor dust, is said to be about 0•5 microns, so half the dust particles (not half the total mass of dust), will be smaller than 0•5 microns. Particles of less than 0•1 microns, are commonly regarded as smoke, which are subject to Brownian motion and cannot be removed by gravity separation.

Separator Type | Minimum Particle Size | Automotive Application

Gravity | 200 microns | Not practical
Inertial | 50~150 microns | Pre-cleaner for multi-stage
Centrifugal - Large Diameter Cyclone | 40~60 microns | Not practical
Centrifugal - Small Diameter Cyclone | 20~30 microns | Not practical
Centrifugal - Miniature Cyclone | not specified | Pre-cleaner for multi-stage
Centrifugal - Fan Type | 15~30 microns | Uncertain at present
Filter | 0•5 microns | Commonly used
Wet Scrubber | 0•5~2•0 microns | Not practical
Electrostatic Precipitator | 0•001~1•0 microns | Debatable practicality

OIL-BATH AIR CLEANERS

Although no longer widely used in Western countries, where low-maintenance, disposable, impregnated-paper, filter elements, of different shapes and sizes, are readily available, oil-bath air cleaners were the norm, for pre-1974, air-cooled VW engines; as was the case for my family's 1973 VW 1600 Type 2.

The oil-bath air cleaners fitted to VWs with air-cooled engines, are constructed so that all the intake air, is first drawn through the oil in the lower reservoir, in which the majority of airborne dust and grit will be trapped, forming a sludge in the bottom. The air and fine droplets of oil entrained by the air flow, together with any residual dust, pass through a wire-mesh filter element, which retains a further proportion of the remaining dust and oil.

http://en.wikipedia.org/wiki/Air_filter#Oil_Bath

In Third World countries, where replacement air-filter elements, are probably both expensive and difficult to obtain, the oil-bath air cleaner, is simple but more time consuming to maintain; requiring cleaning of the wire gauze, using a solvent such as petrol or paraffin (i.e. gasoline or kerosene), removal of the accumulated sludge (i.e. the trapped dust & grit) and replenishment of the oil.

Most mechanics in First World countries, would typically use fresh engine oil, of the viscosity range normally used for engine lubrication, under the prevailing climatic conditions, but lightly soiled engine-oil, drained from the sump, at the usual service interval, would probably be equally effective. If such oil is re-used in this way, any sludge should be allowed to settle out and the relatively clean oil, carefully decanted.

PAPER, CLOTH & FOAM FILTER-ELEMENTS

I have yet to research this section in detail!

CYCLONE DUST SEPARATORS

As the name implies, cyclone separators employ the swirling vortical motion of air and the associated centrifugal effects, to remove dust particles from the airstream. The air flow is in the form of a vortex, which occur in nature, as tornados and water spouts, plus the miniature "dust devils", which are common in hot climates

Crudely speaking, a cyclone comprises an inner and outer cylinder, with an inverted cone at the bottom, which has a suitably sized dust-outlet hole, at the apex. Two distinct vortices, are formed inside the cyclone. One forms a large-diameter, downward swirling air-stream, in the outer cylinder and cone, whilst the other is an upward moving helix of smaller diameter, which extendes from the dust outlet at the bottom, through the inner cylinder to the air outlet.

http://en.wikipedia.org/wiki/Cyclonic_separation

http://en.wikipedia.org/wiki/File:Cyclone_separator.svg

Although at first sight, cyclones might seem to be unsuited to automotive use, the miniature cyclones, whose body diameters are less than about 4 inches (i.e. 100 mm), are claimed to have a separation efficiency of more than 99%, when separating dust of 5 microns average diameter. In general, the effectiveness of a cyclone at removing dust particles, is proportional to the square of the tangential air-velocity and inversely proportional to the cyclone radius. A heavy particle entering a cyclone, travels through a smaller angle than a light particle, before reaching the wall of the cyclone. Hence, the longer the cyclone and the greater the number of convolutions, of the vortical air stream, the smaller the size of particles, which can effectively be removed.

Dusty air enters the top of the outer cylinder, either via a horizontal inlet, tangential to the curved wall or axially, to which swirl is imparted in the latter case, by shaped guide vanes. The centrifugal effects of the air's resultant downward swirling motion, tends to concentrate most of the dust, in a thin layer of air, close to the wall of the outer cylinder. When the lower end of the inner cylinder is reached, the inner air layers, forming the bulk of the swirling air, progressively detach from the outer layer, escaping into the low-pressure region of the upward moving inner vortex.

The last vestiges of the inner layers, are deflected upward, when they reach the bottom of the inverted cone, taking the form of a smaller diameter vortex, inside the larger descending vortex. The thin layer of descending air, close to the outer wall, tends to pass out of the hole in the bottom of the inverted cone, carrying the concentrated dust with it. The now cleaner air of the inner vortex, ascends within the inner cylinder and passes out the top of the cyclone, to enter the next phase of air filtation, if any. It is these principles, which are employed in the now common, Dyson domestic vacuum cleaners.

A radically different cyclone design (see Eureka on Campus, Autumn 1992, Page 5) , called Filter-Mate, comprises a stainless steel enclosure, containing a finely balanced impeller. Air drawn into the housing, is redirected by angled vanes, causing the impeller to spin. This is said to create a mini-cyclone, which ejects upto 95% of dirt and moisture, out into the atmosphere, through a vent. The configuration of the Filter-Mate, is such that it appears to be intended almost exclusively, for use as a pre-cleaner, in conjunction with existing designs of annular filter element.

The major advantage of cyclone dust separators, is that they are immune from clogging, provided that the dust is dry and that there is no tendency to either coagulate or adhere to the internal surfaces of the cyclone itself. Hence, under most dusty road conditions, the cyclone can separate out extremely large quantities of dust, with little if any maintenance.

Although the cyclone might seem to be a panacea, it has the disadvantage of creating relatively high pressure losses, which would be considered unacceptable, for most European and North American roads, where the atmospheric dust concentration, is quite low. As a general rule, high efficiency cyclone dust separators, are only used as the first stage, of a dual or multi-stage air cleaner, for vehicles operating under adverse conditions, where the atmospheric dust concentration is high and conventional single stage, oil-bath or filter-element air cleaners, would allow too much dust to be inducted, as well as rapidly clogging.

ELECTROSTATIC PRECIPITATORS

Electrostatic precipitators, are a form of industrial air cleaner, for removing fine dust, soot, smoke and fumes and are typically used for applications such as plasticiser ovens, forge presses, die-casting machines, furnaces & boilers, cement kilns and various welding operations. Very small particle sizes can be removed, for which the cleaning efficiencies diminish from about 99% for 3 microns to about 80~85% for 0•1 micron. Unlike other methods of fine filtration, electrostatic precipitators appear to be relatively immune from clogging and cause only very small pressure drops, which is said to be usually less than 1 inch water gauge (i.e. 0•0735 in.Hg).

They operate by causing ionisation of the air and particles to be removed, which then experience strong electrostatic forces, from a DC electric field of circa 11,000 to 15,000 volts (typical of a two-stage precipitator) or 40,000 to 75,000 volts (typical of a single-stage, heavy-duty precipitator). The two-stage electrostatic precipitator, is limited to applications with low particle concentrations, of usually less than 0•025 grains per cubic foot (i.e. 0•0572 g/m^3 or 0•0000572 kg/m^3), but the two-stage units can cope with significantly more.

http://en.wikipedia.org/wiki/Electrostatic_precipitator

Assuming one would only contemplate using this relatively expensive air cleaner technology, for very dusty automotive applications (i.e. approaching an estimated maximum 45 g/m^3 dust concentration), then it would probably be essential to pre-clean the inducted air to a large extent, before passing the dust-laden air through an electrostatic precipitator. Following a cyclone pre-cleaner, or cyclone pre-cleaner & paper-element filter combination, about 5% and 0•1% respectively, of the total dust

mass would remain in the air stream, resulting in maximum dust concentrations of circa 2•25 g/m³ and 0•045 g/m³ respectively.

This latter figure, is slightly less than the 0•0572 g/m³ maximum, for a two-stage, "low-voltage" precipitator. Hence, if an electrostatic precipitator were located after a cyclone pre-cleaner & paper-element filter combination, then a two-stage unit would probably cope with the maximum likely dust concentrations, but otherwise, a single-stage, "high-voltage" unit, would be essential.

If it were practical, electrostatic precipitators would be useful as the second or third stage dust separator, as part of a multi stage, automotive air cleaner. This device is capable of removing a substantial proportion of fine dust, after the larger dust particles have been removed by other means, such as a cyclone and/or filter element or oil-bath air cleaner. To the best of my knowledge, electrostatic precipitators have yet to be used for automotive applications; probably for reasons of financial cost, the necessary technical sophistication and the high-voltage electric fields needed, for effective operation.

However, it is conceivable, that some way might have been found, to produce such a device for modern military vehicles, operating in hostile environments. In order for an electrostatic precipitator to function, the dust particles must first acquire an electrical charge and then be subjected to an intense electric field, requiring an extremely high voltage DC supply. Automotive alternators, typically generate a three-phase AC supply, with a regulated EMF of 13 to 14½ volts. This, followed by a step-up transformer and smoothed full-wave rectifier, would be needed to obtain a high DC voltage.

These days, such a power supply would be relatively simple to construct, but there is a safety issue to consider, with regard to the possibility of electrical discharge, in the presence of a combustible fuel vapour & air mixture, within the engine induction system, including the air cleaner. It has been stated (see Bill Fisher, 1970, page 30) that a fog of atomised petrol (i.e. gasoline) stands off, by about 6~8 inches (i.e. 150~200 mm) above the carburettor, at high engine RPM. If such a fuel fog, did pose an explosion or fire hazard, then it might be advisible to use a remote-mounted air cleaning system, with first, second and third stages, being a cyclone, electrostatic precipitator and filter element respectively.

MULTI-STAGE AIR CLEANERS

As mentioned earlier, the significant parameter in relation to air cleaning, is the total mass and size distribution, of particles entering the engine, rather than the proportion (i.e. mass percentage) which is filtered out. There is also the consideration that different dust separation techniques, are better suited to some dust particle size ranges than others. Under adverse conditions of high atmospheric dust concentration, it is necessary to clean the inducted air in discrete stages, beginning with the removal of the larger particles, which often constitute more than half the total mass of dust.

It has been said (see Eureka on Campus, Autumn 1992, Page 5) , that removing most of the harmful particles (in the size range 10~100 microns) from the inducted air, before it enters the air filter, would significantly reduce the required maintenance frequency and is claimed to prolong the peak efficiency period of an engine, by a factor of upto 10 times. The initial stage of a multi-stage air cleaner, typically involves a bank of several miniature cyclones in parallel or some other form of centrifugal or inertial pre-cleaner, such as the Filter-Mate; an air-flow driven, impeller type device, mentioned earlier.

Extracted dust particles, are then either vented to the outside air or collected in a large detachable container. The final stage would normally be either a replaceable, impregnated paper-element filter or an oil-bath air cleaner. If it were practical to incorporate an electrostatic dust-separator, this would probably form an intermediate stage.

One example of a commercial vehicle, two-stage air cleaner (see Heinz Heisler, 1999, page 608), described as a heavy-duty, duo-dry air cleaner, comprises several miniature cylone (with helical guide vanes) pre-cleaners in parallel, followed in series, by a single, conventional, annular-shaped, replaceable impregnated paper filter element. Upto 99•9% overall efficiency, is claimed for this air-cleaner design; for which approximately 95% of the dust, is removed by the cyclones. These cyclones are said to be fully effective at both low and high air velocities; corresponding to low and high engine speeds.

SILENCING ACOUSTIC NOISE

Silencing the intake noise, is achieved by inducting the air, through a tapered intake tube, of tuned length and diameter (to form a Helmholtz resonator), into a large-capacity, air-resonance chamber. By resonating in antiphase to the noise, the Helmholtz resonator counteracts that frequency of noise. Despite the damping effect of the air-resonance chamber and the air-filter medium, this anti-sound phenomenon, is only effective over a narrow frequency spectrum and hence narrow range of engine speeds, which need to be carefully considered by the designer, to give the greatest benefit.

As well as minimising pressure loss, a conical-taper or preferably a bell-mouth entry, also helps to minimise induction roar, at the entry to a carburettor, fuel-injection throttle body or air cleaner.

COMBUSTION-AIR PRE-HEATING

Combustion air pre-heating can be very important under some circumstances. In cold weather, it provides a quicker engine warm-up time and promotes improved petrol (i.e. gasoline) vaporisation, which gives better part-throttle economy under cruise conditions. It is also especially important for air-cooled VW engines, which are very prone to inlet manifold and carburettor icing, under cold, damp conditions. This is particularly true of single-carburettor installations, but although twin-carburettors are less susceptible, they are not immune, as discovered by two fellow British owners; one having a 1973 VW 1700 Type 2, with two single-choke Weber carburettors and the other, a VW 1600 Beetle, with two Dellorto carburettors.

During the two winter seasons in southern England, for which I used my 1973 VW 1600 Type 2, with single Minnow Fish carburettor and directly mounted, paper-element, pancake air filter, I encountered severe icing problems with the carburettor and inlet manifold, despite the inlet-manifold, exhaust pre-heating. Knowing that the Minnow Fish was more prone to icing than the standard Solex carburettor (owing to more efficient fuel vaporisation from the three jets in the throttle butterfly), I had installed the recommended 12V, 90W electric de-icing element, which fitted inside the carburettor intake horn.

Although the electric heating element, got exceedingly hot, it seemed to have little effect on ice formation, which on occasions, was probably 1 to 2 mm thick, on the outside of the inlet manifold down-pipe, below the carburettor. I shudder to think how much ice had formed inside the inlet manifold! The van also consumed fuel at an alarming rate and sounded more like an asthmatic, single-cylinder, two-stroke lawnmower engine, than a VW flat-four. Fuel dilution of the engine oil was so bad, that on one particularly cold, damp day, after a daily round trip of 32 miles, the dipstick reading increased by about 1 litre; indicating that there was 2½ litres of oil and 1 litre of petrol (i.e. gasoline) in the sump.

At one stage, icing became so severe, that the engine stalled whenever I eased my foot off the accelerator, to slow down or change gear. This necessitated me braking with my left foot and keeping my right foot on the accelerator, to prevent stalling. Stopping at road junctions, proved even more of a challenge, because I had to slow

down, change gear and come to a halt, whilst keeping my right foot on the accelerator the whole time, taking care not to over rev the engine. This involved alternately braking and changing down a gear; ending with me changing into neutral at just under 5 MPH and bringing the vehicle to a halt, by means of the hand brake!

In the end, the only way I could overcome the icing, was to blank off most of the pancake, paper element air filter, on top of the carburettor; directing pre-heated air, from around cylinder No. 2, towards the unobstructed portion. Despite these measures, it was often necessary to drive the first mile or so, until icing became noticeable, stop the engine and allow the now warm engine compartment environment, to thaw the ice, then finally restart the engine and resume my journey. Clara L. Williams, who lives near Seattle, in western Washington State, USA, had similar experiences with her 1961 and 1967 Split-Screen VW Type 2s, which she has photographed and hopes to display sometime on her website.

As well as serving to inhibit carburettor icing, pre-heating the air also provides other benefits, as documented in the Haynes manual for Weber carburettors (see Rev. Paul MacCarty, Transporter Talk, April 2000, Pages 40 & 41). In the first chapter, dealing with general carburation, it is reported to state that, "Some cars are equipped with a vacuum assisted, thermostatically controlled air cleaner, which ensures a supply of warm air to the carburettor when needed and helps to eliminate poor low speed performance and flat spots". For the air-cooled VW engines, this type of warm-air supply, is a feature of both the remote-mounted, standard oil-bath air cleaners and the paper-element filter units which superceded them, on post-1973 model vehicles.

Warm-air intake systems (see T. K. Garrett et al, 2001, Pages 483~486 & 526~527) , plus either inlet-manifold, exhaust-gas heating or electric hedgehog heaters, to improve combustion in cold conditions, are a standard feature on most Volkswagens, with either air-cooled or water-cooled engines; especially those with a single carburettor. The 1968~79 VW 1600 Type 2 and 1980~83 VW 1600 Type 25, both have inlet-manifold, exhaust-gas heating, whilst the 1983~92 VW 1900 Type 25 has an electric hedgehog heater.

MINIMISING PRESSURE LOSS & MAXIMISING AIR FLOW

The air induction process for any engine, starts with the air cleaner system and its associated housing. Unfortunately, the compromises made in the design (see David Vizard, 1981), to satisfy acoustic noise reduction and provide combustion air pre-heating, tends to reduce the air-flow rate into the engine and hence limits the maximum power. Except under circumstances where improved fuel vaporisation is necessary, this can also result in increased fuel consumption.

It has been said, that most manufacturers are more concerned with ease of air cleaner installation and minimisation of induction roar, than they are with maximising available power and/or fuel economy.

The inlet-manifold, exhaust pre-heat connections (during summer use, when petrol usually vaporises easily, it is better to block these off, to maximise air density; increasing both torque and power), for the Scat 'Monza' exhaust silencer, had also been drilled through, to provide whatever exhaust heat was available.

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Mini-cyclone cleans up engine filter systems, Eureka on Campus - Engineering Materials & Design, Findlay Publications Ltd., Volume 5, Number 1, Autumn 1992, Page 5.

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Last edited by Nigel A. Skeet on Sat Jun 27, 2009 1:09 pm, edited 2 times in total.

eben
Site Admin

Re: Engine air filters, for very-dusty conditions?

Thu Jun 25, 2009 3:04 pm

Good stuff nigel. You can never know too much
Thanks for sharing.

mikefenton
Oil Stain

Re: Engine air filters, for very-dusty conditions?

Mon Jul 06, 2009 5:35 pm

hey my dc has got one of those!

My mechanic told me, "I couldn't repair your brakes, so I made your horn louder."

Nigel A. Skeet
Oil Stain

Re: Engine air filters, for very-dusty conditions?

Tue Jul 07, 2009 1:26 pm

> **eben wrote:**
> Good stuff nigel. You can never know too much
> Thanks for sharing.

You're welcome! I hope to update the information, as I discover more, but I was hoping the brethren in South Africa would contribute some more about their past & present experiences, of driving on dusty roads, plus the filtration systems used.

> **mikefenton wrote:**
> hey my dc has got one of those!

What is a dc and what is it that it has?

eben
Site Admin

Re: Engine air filters, for very-dusty conditions?

Tue Jul 07, 2009 1:31 pm

dc= double cab

mike gooi us some pictures please

mikefenton
Oil Stain

Re: Engine air filters, for very-dusty conditions?

Tue Jul 07, 2009 2:53 pm

will post pics wed or thurs, just waiting to get the camera from my dad.
Looks like the previous owner put their own kind of filter on, but if im not mistaken the original is in the back, tho i think its broken

My mechanic told me, "I couldn't repair your brakes, so I made your horn louder."

mikefenton
Oil Stain

Re: Engine air filters, for very-dusty conditions?

Wed Jul 08, 2009 7:39 pm

managed to take a few pics this evening. they night time so not the best shots. will be playing around with the dc on sat so i can take some more pics then if you want?

looks like ths is the pipe that comes from the outside

where it ends in the engine bay (remember i have no engine)

the pipe going through the load bin

The original filter all bust up

the current filter

My mechanic told me, "I couldn't repair your brakes, so I made your horn louder."

Nigel A. Skeet
Oil Stain

Re: Engine air filters, for very-dusty conditions?

Sun Jul 19, 2009 12:09 pm

In the following topic thread, I discovered a picture of what was described as an oil-bath air cleaner, but unlike any 1968~74/75 VW 1600 Type 2, oil-bath air cleaner that I have ever seen!

Could this be a combined cyclone air pre-cleaner & oil-bath air cleaner, specifically for the South African market!?!

Board index » General » Projects » 1970 Westfalia Rolling Resto

http://www.aircooledvwsa.co.za/viewtopi ... 23&t=10761

> **mikefenton wrote:**
> managed to take a few pics this evening. they night time so not the best shots. will be playing around with the dc on sat so i can take some more pics then if you want?
>
> looks like ths is the pipe that comes from the outside
>
> 
>
> where it ends in the engine bay (remember i have no engine)
>
> 
>
> the pipe going through the load bin
>
> 
>
> The original filter all bust up
>
> 
>
> the current filter
>
> 

A useful looking set of pictures, thank you Mike.

What does the internal configuration of the original, damaged air filter look like?

If by any chance you could measure the lengths & internal diameters, of straight sections of ribbed hose and smooth duct, plus the radius of curvature of any bends, I could estimate the pressure loss in the system, for a range of engine speeds. I suspect, that such a long ducting system, from rearward of the cab to the engine compartment, would probably result in quite significant pressure losses.

Dawie
Carburettor

Re: Engine air filters, for very-dusty conditions?

Sun Jul 19, 2009 5:54 pm

Air filter (in the 65 Kombi we had when i was a child) was similar to the one in above photo. Was just a massive oilbath unit,plenty wires inside, dont think it was cyclone. (Opened it to see what's inside while still in primary school).Think it was made by MANN. Dont know if that size was standard or optional and wich years had them. Fig will know.

Do'nt assume anything- (While doing fault-finding).
"Things should be as simple as possible, BUT NO SIMPLER THAN THAT."
"If something can go wrong, it will go wrong" (Murphy's law).

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