

WHEN SMOKE GETS IN YOUR EYES

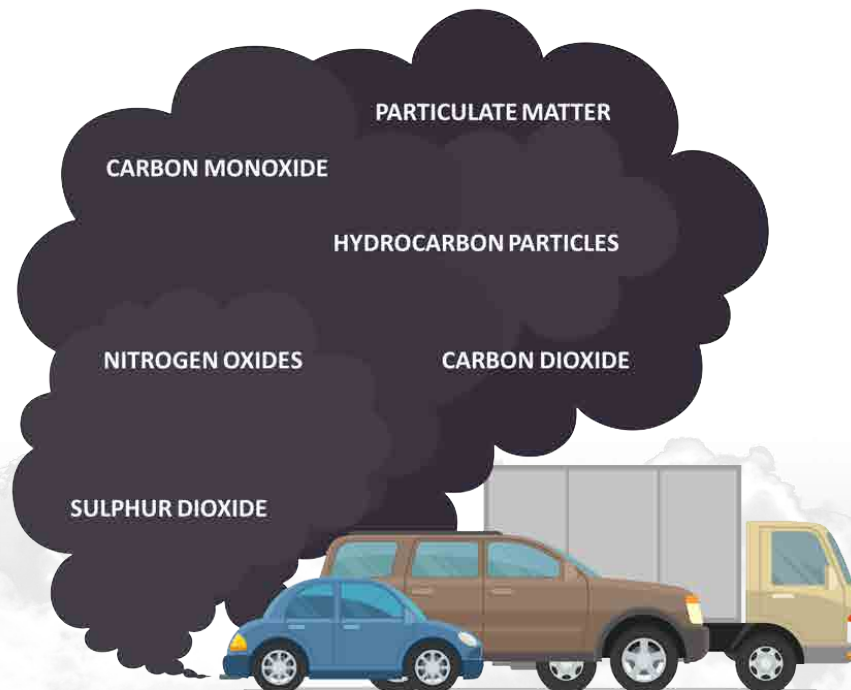
By Dave Scott

ABSTRACT

Just Google 'exhaust smoke' and be prepared to sift through approximately 22 100 000 results (0,41 seconds) – an exhausting info overload.

The author has been involved with trucks since 1966 and has never seen a driver fined for excessive exhaust smoke, or a truck owner taken to task for any abnormal emissions. And no wonder – the RTA regulations are so vague as to be unenforceable.

It is not only the exhaust emissions we see (mainly due to particulate matter) that are cause for concern, but the ones we do not see – carbon monoxide and dioxide, nitrogen oxides, hydrocarbon particles and sulphur dioxide – which are truly dangerous.



SOUTH AFRICAN RTA EXHAUST SMOKE REGULATIONS

209 (c) No person shall operate on a public road a motor vehicle - if the exhaust gas or smoke from the engine is so dense as to cause a nuisance to or obstruct the vision of other road users.

308 (1) (k) No person driving or having a vehicle on a public road shall – cause or allow the engine thereof to run in such manner that it emits smoke or fumes which would not be emitted if the engine were in good condition or ran in an efficient manner.

VISIBLE SMOKE

Distinction must be made between particulates and visible smoke: particulate matter is defined as anything that is collectable on a filter (**particulates may be present in exhaust emissions even though no visible smoke is apparent**); **the defining character of exhaust smoke is that it is comprised of solid or liquid aerosol particles that absorb or deflect light.**

Just because it is smoke free it does not mean a vehicle exhaust is 'clean'. Air contaminants that frequently pour out of exhaust systems – especially very old vehicles – are carbon dioxide, nitrogen dioxide, sulphur dioxide, particulates, ozone, benzene, toluene and xylene, 1,3-butadiene, formaldehyde and acetaldehyde, benzo(a)pyrene. For example - Benzene can be harmful if it is swallowed, inhaled, or touched. It is a member of a class of compounds known as hydrocarbons. Human exposure to hydrocarbons is a common problem.

<https://medlineplus.gov/ency/article/002720.htm>

There were about 1.446 billion vehicles on Earth in 2022 and South Africa's share of this by July 2022 was 11,897,500 on our roads – 0,82% of the world total. That means we only have an approximate 1% share of the global, polluted, climate-changing vehicle population. But a low stat base is no reason to ignore the issue, because badly tuned engines (petrol and diesel) are expensive to operate, at over R21/litre.

Efficient, well-maintained diesel engines do not emit clouds of smoke. Modern, turbo-intercooled, electronically managed diesel engines are designed to operate with clear exhaust gases at any altitude. The reduction in exhaust back-pressure with increasing altitude speeds up turbine and compressor activity to counter the effects of higher altitudes. Apart from obvious environmental problems caused by diesel fuel exhaust fumes the real issue is that fuel is being wasted through incomplete combustion. In addition, exhaust smoke accelerates servicing requirements and engine wear rates. Exhaust smoke is costly.

Global warming – climate control – is all about fuel consumption and not to be confused with emission standards which focus on clean-air fuels and emission controls.

EUROPEAN EXHAUST STANDARDS COMPONENTS	GREENHOUSE GASES
<ul style="list-style-type: none"> • Particulates - PM • Nitrogen oxides - NOX • Carbon monoxide - CO • Non-methane hydrocarbons - NMHC • Opacity 	<ul style="list-style-type: none"> • CO₂ – carbon dioxide • CH₄ – methane (24-25 kg CO₂ equivalent) • N₂O - nitrous oxide (298 kg CO₂ equivalent) • H-FKW – hydrofluorocarbons (15.000 kg CO₂ equiv) • SF₆ – sulphur hexafluoride (22.800 kg CO₂ equiv)

While mandatory vehicle emission standards have been in place in many countries for several years, South Africa has only introduced emission specifications for new passenger car models approved for sale with effect from 2005, and for all new vehicle models (passenger cars, SUVs, LDVs and on-road trucks) with effect from 2006. As from 2008, all new vehicles sold need to comply with Euro 2 emissions specifications (as modified). This lags the introduction of enabling unleaded petrol, which has been marketed in South Africa since 1996.

Here are the main types of diesel exhaust smoke encountered on the road –

BLACK EXHAUST SMOKE



This is very visible, resulting from large soot particles, indicating incomplete combustion due to localised rich mixtures in a combustion chamber. Here are the main causes of black smoke:

- Incorrect injector pressures – generally too low
- Poor injector spray pattern
- Out-of-spec injection timing
- Over-fuelling – wrong spill rate or governor setting
- Inadequate air supply – blocked air filters or intercoolers or worn turbochargers.
- Abnormally high diesel fuel cetane number

In summary, the most common causes of black smoke are faulty injectors, a faulty injector pump, a bad air filter (causing not enough oxygen to be supplied), a bad EGR (exhaust gas recirculation) valve (causing the valves to clog) or even a bad turbocharger.

Sooting crankcase lubricants causes thickening that can end up in gelling and bearing failure. It also accelerates ring sticking, carbon and sludge deposits as well as engine wear rates.

WHITE EXHAUST SMOKE



Typically pale grey in colour, this is caused by visible liquid fuel particles in an exhaust. This indicates that fuel is passing through a combustion chamber without vaporising or igniting. Constant thick white smoke is usually a sign that coolant is being burnt. The main causes of white smoke are –

- Low diesel fuel cetane number – check for blending with illuminating paraffin.
- Engine is over-cooling.
- Misfires
- Burned valves.
- Late injection timing
- Poor injector spray pattern – fuel impingement on cylinder walls
- Low compression

Not all unburned fuel passes out of an engine. Some fuel condenses, causing fuel dilution. White smoke will cause higher engine wear rates, particularly of both rings and liners.





BLUE EXHAUST SMOKE

Blue smoke is not diesel fuel related. This comes from burning excessive amounts of crankcase lubricant in combustion chambers. Typical causes are:

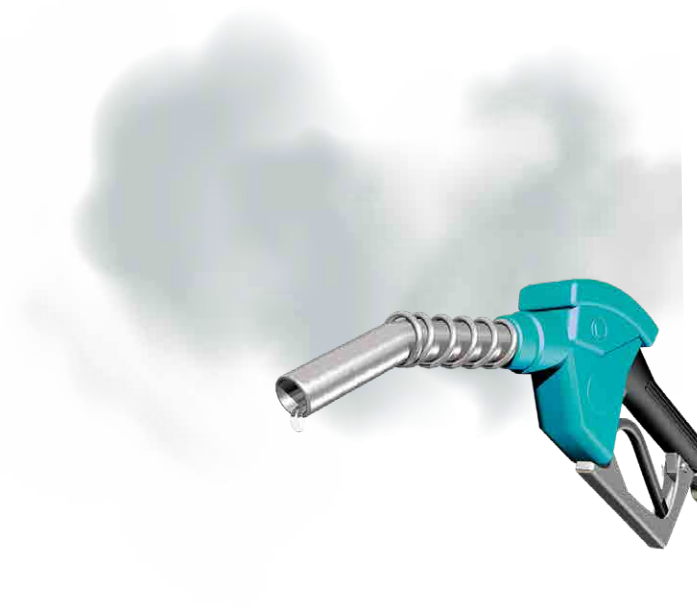
- Worn rings.
- Worn valve guides.
- Incorrect honing pattern.

And do not expect exhaust smoke to arrive in distinct black, white, or blue clouds – it could be a mixture of all three depending on the technical problems that are present.

Drivers have an important role to play as foundation observers of exhaust smoke. Does a driver debriefing include a check-item that covers exhaust smoke? If there is visible smoke, when does it occur – on start-up, acceleration, deceleration and what is the colour? Excessive exhaust smoke must be reported and recorded. There must be an exhaust smoke SOP (Standard Operating Procedure) in the driver's job description.



The evidence of a wide-spread malpractice in diesel fuel adulteration is found in reported sales of illuminating paraffin (kerosene). Press reports on paraffin data in South Africa point to a two-fold increase in kerosene consumption over the past three years (2020 to 2022), from 600,000 kilolitres annually to over 1.2 million kilolitres. Does this mean that the number of consumers using paraffin for cooking and lighting has doubled during this period? Evidence of excessive kerosene in fuel will not be readily visible at start up – just a loud, cold, engine knock. The lack of fuel lubricity in kerosene will be evident with increasing engine mileage as abnormal wear sets into engine combustion components – here comes exhaust smoke, and engine failure is the ultimate indicator.



A 16-page Government Gazette No. 11331 dated 31 August 2021, repealed the Regulations regarding petroleum products, specifications and standards that were published under Government Notice No. R.627 in 23 June 2006, to make the Regulations as per the schedule that was attached. 10ppm sulphur diesel and biodiesel figure strongly in this Gazette. This was all to come into effect on 01 September 2023. But this was all upended in Gazette No 11446 dated 24 June 2022 when the Minister of Mineral and Energy Resources amended the effective date of 01 September 2023 to **JULY 2027**. **The clean air fuels implementation is now four years out.** Cough.....



So why worry about exhaust emissions?

Without publishing a thesis, here are a few practical starting points:

- Conduct MBWA (Management By Wandering Around) at cold start to spot and record smoke offenders.



- Train the drivers to observe and report exhaust smoke on defect reports and start-up check lists.
- Overfilling on engine lube dipsticks is an evil that will promote blue smoke.



- Track and reconcile individual vehicle oil and coolant consumption with excessive smoke reports. Modern coolant systems are sealed, and expansion tanks should not require constant topping-up. Coolant loss is evident in white exhaust smoke.



- It is important to know when smoke is generated – usually a tell-tale sign of damaged piston rings occurs when bluey-grey smoke leaves the exhaust while the vehicle is accelerating.

An ‘expert’ observation from someone out there was that ‘Electronics work with smoke. When the smoke escapes, electronics stop working!’ This brings everything to a grinding halt. But not so with exhaust smoke, which gets tolerated every day – visible on the road – until engine failure and costly downtime.

It is also an environmental issue – accepting exhaust smoke without countermeasures flies in the face of climate care, which has become the major issue of our time.



About the writer...



Dave Scott is an award-winning journalist and author, with a career spanning over 50 years in the transport industry. He is a member of the SA Institute of Tribology (SAIT) and editor of their newsletter, taking a keen interest in the application of lubricants to road transport maintenance and the cost of ownership. He also serves as the technical correspondent for FleetWatch magazine and the truck correspondent for AutoForum magazine and has done for many years.

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