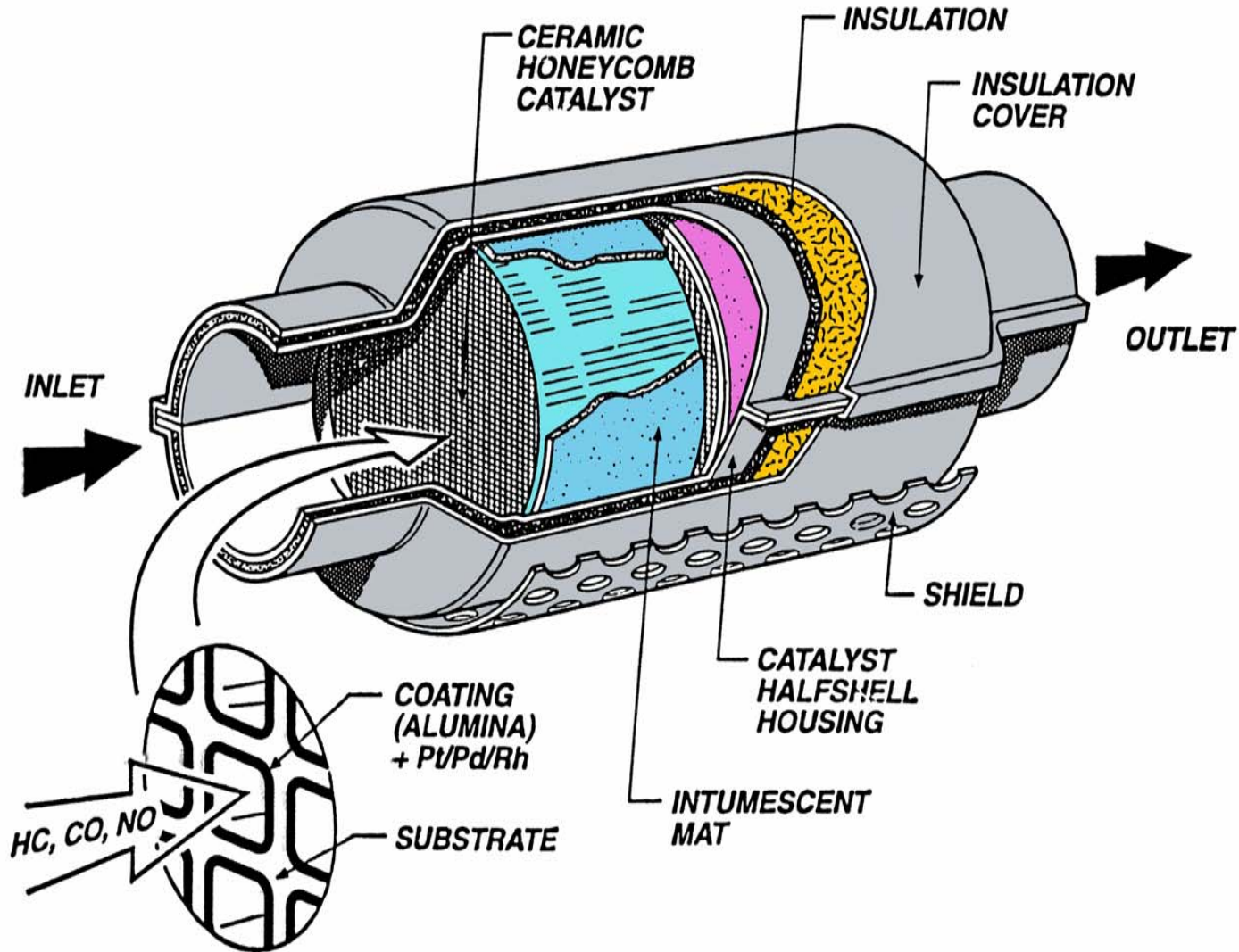




# **Vehicle Emission Standards and Enforcement: Recommendations for new and used vehicles in developing markets**

Stuart Rayner: National Association of Automobile Manufacturers of South Africa: Quito, February 2007

# After leaded petrol phase out in SSA...the Catalytic Converter



# Issues : Catalytic Converter fitment and enforcement

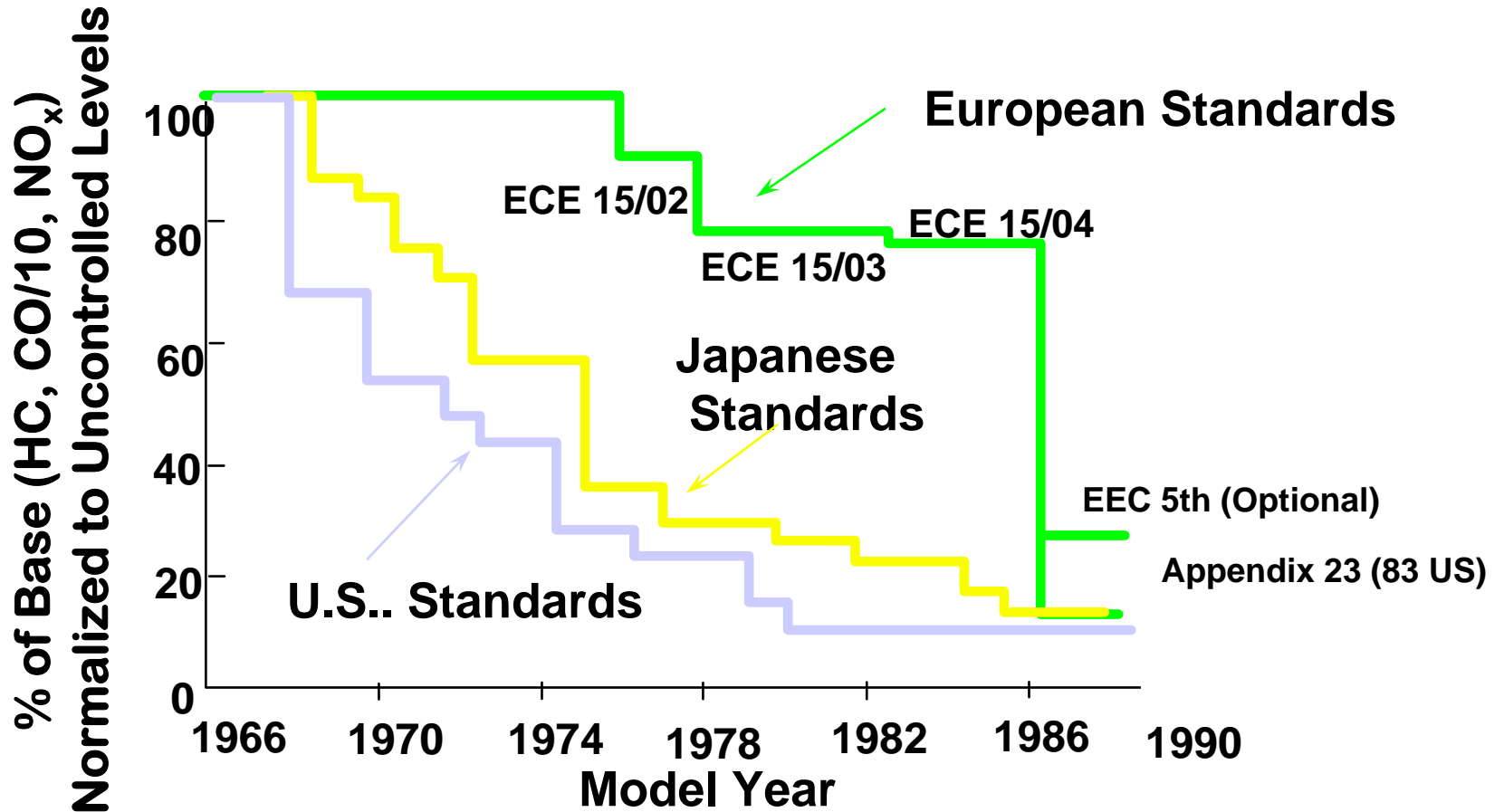
- For legislation how do we legally define a Catalytic Converter?
- How can we check that the Catalytic Converter is (still) fitted to a vehicle?
- If apparently fitted, how do we know it is functional?

# Emission Testing: New vehicles

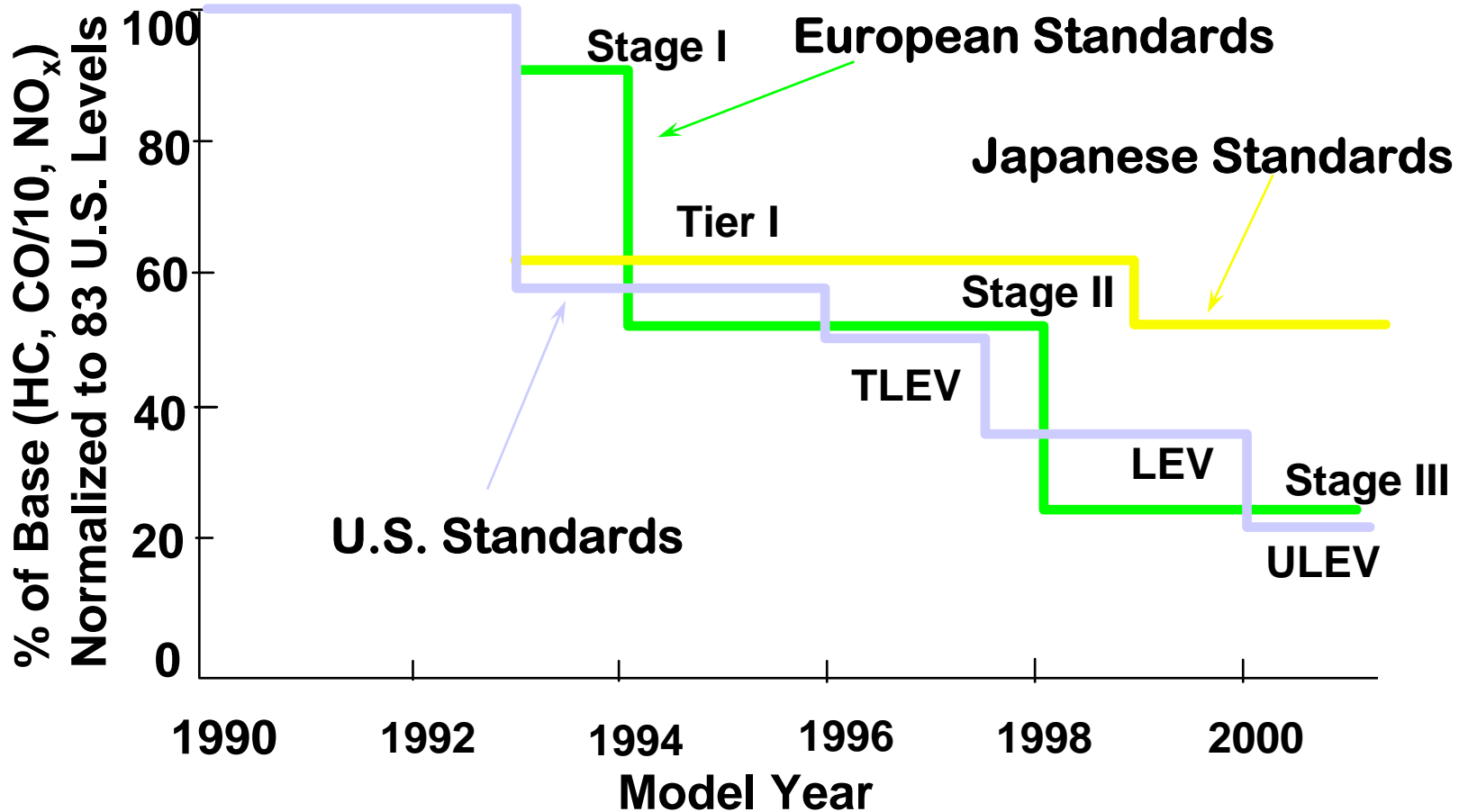
- UN ECE, EU and US emission requirements as applied to new models offered for sale in developed markets (Euro 1, 2, 3, 4 etc) require the use of a rolling road emissions test facility and environmental chamber. Supporting tests are required to determine the applicable load resistance to be applied to the rollers.
- Emission testing and certification is carried out on a 'Vehicle Type and Model' basis as such facilities and their use is very expensive. Individual testing is prohibitively expensive.
- Emission tests are different for EU, US and Japanese market vehicles

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# International Emission Standards



# Int' Emission Standards (Cont'd)



# Categories Link Sulfur to Emission Standards

WWFC Category	Emission Standards	Gasoline S ppm max	Diesel Fuel S ppm max
1	US Tier0; Euro1	1000	2000*
2	US Tier1; Euro2, Euro3	150	300
3	US/Cal LEV/ULEV; Euro3; JP2005	30	50
4	US Tier2, 2007/2010 HD On-Highway, Tier4 Non-road; Cal LEV-II; Euro4, Euro5 HD	10	10

Key Message: "Engine and vehicle technologies normally achieve improved performance and lower emissions with higher category fuels."

\*3000 ppm allowed as transitional limit

# Typical test facility for EU Type Approval testing and certification

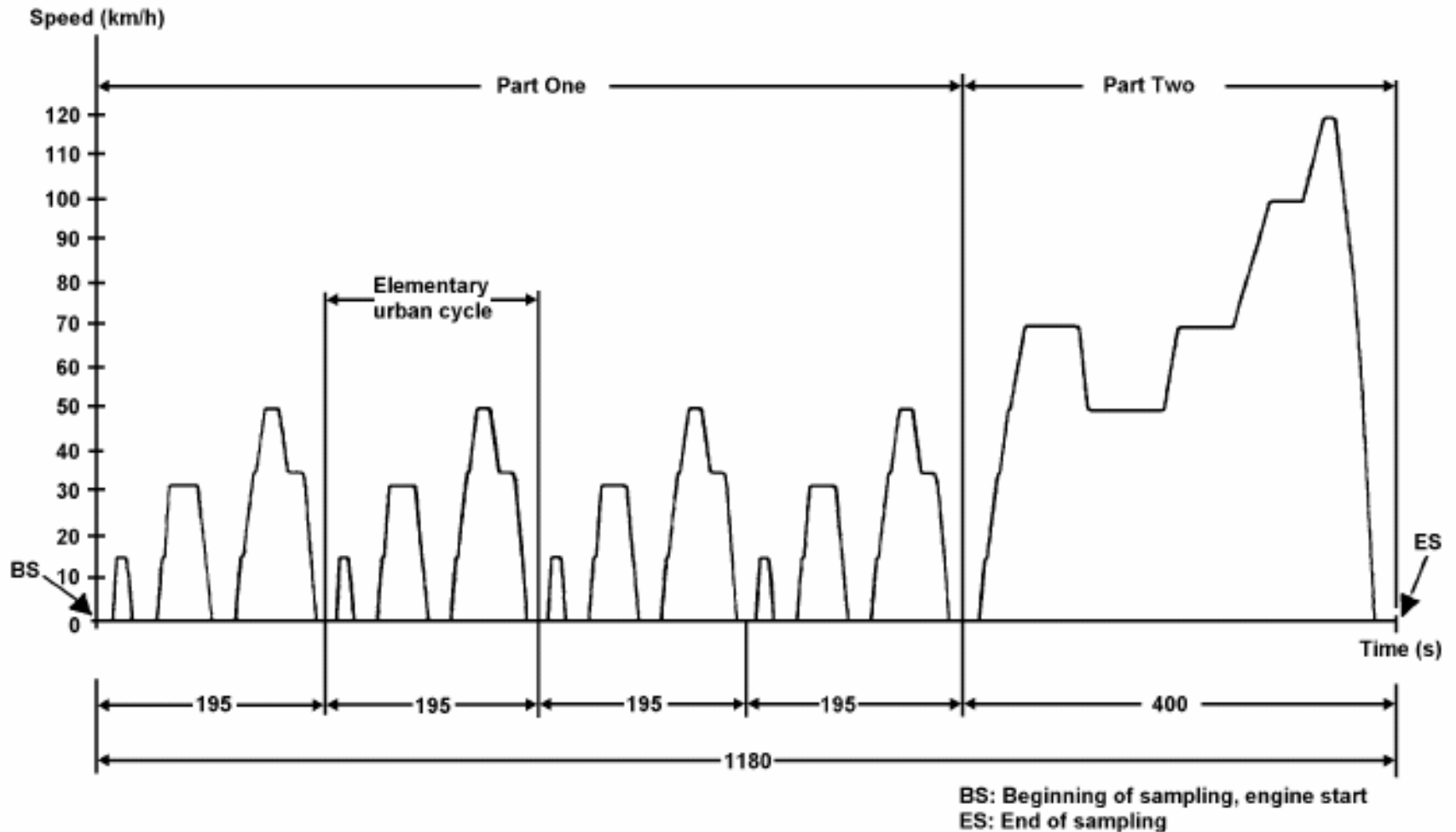


3 Bench Test Cell, Horiba



Picture: SABS: EAST LONDON, S AFRICA

# Emission Test: Drive Cycle



# Vehicle emissions: test loads, durability and evaporative loss

- The load to be applied to the dynamometer rollers is determined through a ‘coast down’ test or in some instances the vehicle mass.
- Specified maximum tailpipe limits must be met after either 100,000 or 120,000 km.
- The stationary evaporative emissions from the fuel tank and fuel system are measured separately using a different test facility

# Emission Testing: Used vehicles

- Used vehicle emission requirements are generally controlled in developed markets by a test conducted at the periodic Roadworthy Inspection.
- In the case of vehicles operating in Europe the 'in service' test is prescribed in terms of EC Directive 96/96.

**EC: Motor vehicle equipped with positive-ignition (petrol) engines where the exhaust emissions are not controlled by an advanced emission control system such as a three-way catalytic converter**

1. Visual inspection of the exhaust system in order to check that there are no leakages.
2. After a reasonable period of engine conditioning (taking account of the vehicle manufacturer's recommendations) the carbon monoxide (CO) content of the exhaust gases is measured when the engine is idling (no load). The maximum permissible CO content in the exhaust gases is that stated by the vehicle manufacturer. Where this information is not available as a reference value, **the CO content must not exceed 4.5%.**

## **EC : Where the exhaust emissions are controlled by an advanced emission control system such as a three-way catalytic converter**

1. Visual inspection of the exhaust system in order to check that there are no leakages and that all parts are complete.
  2. Visual inspection of the emission control system in order to check that the required equipment has been fitted.
  3. Determination of the efficiency of the vehicle's emission control system by measuring the lambda value and the CO content of the exhaust gases in accordance with Section 4 or with the procedures proposed by the manufacturers and approved at the time of homologation. For each of the tests the engine is conditioned in accordance with the vehicle manufacturer's recommendations.
  4. Exhaust pipe emissions - limit values
    - (a) Measurement at engine idling speed: The maximum permissible CO content in the exhaust gases is that stated by the vehicle manufacturer. **Where this information is not available, the maximum CO content must not exceed 0,5% vol.**
    - (b) Measurement at high idle speed, engine speed to be at least 2 000 revs/min.: The maximum permissible CO content in the exhaust gases is that stated by the vehicle manufacturer at high idle speed. **Where this is not available, the maximum CO content must not exceed 0,3% vol.**
- The air/fuel ratio, Lambda shall be =  $1 \pm 3\%$  or in accordance with manufacturer's specifications.

# Industrial 'high volume' CO tester



# Typical CO meter as used by automotive Dealers

- Inexpensive
- Well proven
- Already available at most auto dealerships
- Portable
- Simple to use



Photo: Horiba





## **EC : Motor vehicles equipped with diesel engines**

(a) **Exhaust gas opacity** to be measured during free acceleration (no load from idle up to cut-off speed) with gear lever in neutral and clutch engaged.

(b) Vehicle preconditioning:

1. Vehicles may be tested without preconditioning although for safety reasons checks should be made that the engine is warm and in a satisfactory mechanical condition.
2. No vehicle will be failed unless it has been preconditioned according to the following requirements.
3. Engine shall be fully warm, for instance the oil temperature measured by a probe in the oil level dipstick tube to be at least 80° C, or normal operating temperature if lower, or the engine block temperature measured by the level of infrared radiation to be at least an equivalent temperature. If, owing to vehicle configuration, this measurement is impractical, the establishment of the engine's normal operating temperature may be made by other means, for example by the operation of the engine cooling fan.
4. Exhaust system shall be purged by at least three free acceleration cycles or by an equivalent method.

(c) Test procedure:

1. Visual inspection of the relevant parts of the motor vehicle's emission system to check that there are no leaks.
2. Engine, and any turbo-charger fitted, to be at idle before the start of each free acceleration cycle. For heavy-duty diesels, this means waiting for at least 10 seconds after the release of the throttle.
3. To initiate each free acceleration cycle, the throttle pedal must be fully depressed quickly and continuously (in less than one second) but not violently, so as to obtain maximum delivery from the injection pump.

Coeff of Absorption Limit Values (or equivalent)

**Normally Aspirated diesel**

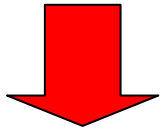
**2.5 /m**

**Turbocharged diesel**

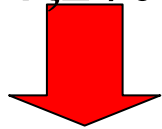
**3.0 /m**

# DIESEL VEHICLE EMISSION TESTING (Cape Town)

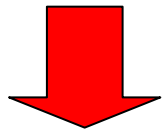
failure rate  
17% - 2000



7.2% - 2003



1.8% - 2005



1.07% - 2006



# New Vehicles: Other factors

- While many used vehicles entering leaded petrol markets are catalyst equipped this would generally not be the case for new vehicles.
- Sufficient warning (18 months) needs to be given to new vehicle importers and dealers of an impending legislation change to allow re-establishment of model specifications for the country concerned.
- For new vehicles an OEM supplied emissions test certificate/UN ECE Approval should be considered as satisfying the tailpipe emissions requirement, however the CO meter test could also be applied.

# Proposal: 'New vehicle standards for new vehicles, Used vehicle standards for used vehicles'

- A simple, low cost carbon monoxide (CO) tailpipe test as applied as part of a roadworthy test in European markets to petrol engine vehicles is an effective indicator of whether a catalytic converter is fitted and is functional and should be considered as a requirement for all used (and new?) vehicles entering developing lead free markets.
- Diesel vehicle emissions can be significantly reduced by the adoption and sustained enforcement of 'low cost' opacity requirements. States/cities should be encouraged to adopt such measures as a first step to reducing visible smoke emissions.

**End**

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