

Submitted by CITA
Under discussion in the IWG on PTI

Informal document **GRPE-78-04**
78th GRPE, 8-11 January 2019
Agenda item 4(a)

Tampering of Emission Control Systems

Tampering of Air Emission Control Systems

Content

Analysis and concept proposals to limit the tampering of emission systems

Main areas of fraud

- Exhaust Gas Recirculation (EGR)

- Selective Catalytic Reduction (SCR)

- Particulate Filter (DPF), both gasoline and diesel

- 3-way Catalytic Converters

Tampering of Air Emission Control Systems

Tampering of emission control systems consists in **modifications** aiming to

reduce operation costs,

Increase performances,

avoid the performance constraints of misuse and

reduce or eliminate repair costs

that **undermine** the benefits of new vehicles' **emission regulations**.

Tampering is both a **behavioural** and **technical** issue.

Tampering of Air Emission Control Systems

Today's perception

**Benefits of
tampering**

>

Costs

Tampering methods

EGR	
External zapping device	<ul style="list-style-type: none">• External black box plugged behind EOBD socket
Mechanical tampering	<ul style="list-style-type: none">• Physical change in the engine compartment<ul style="list-style-type: none">• blocking the gas tube with a baffle• sealing the hose to the vacuum actuator

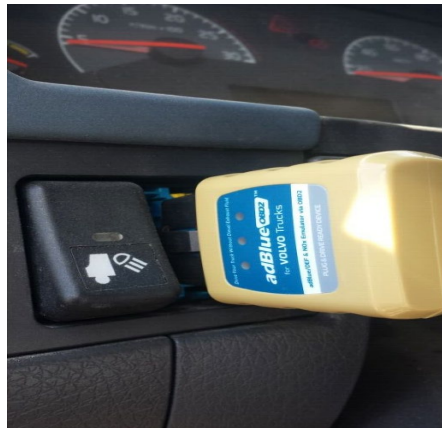


Tube blocked

Tampering methods

SCR	
SCR disconnected and ECU emulator	<ul style="list-style-type: none">• Reagent tank gauge showing exactly 25%, 50%, 75% or 100%• Reagent tank empty or level does not correspond with gauge (if lock fitted, is there a key to open it?)• Crystallisation and/or rust around the AdBlue tank cap and/or filler pipe when cap removed (only an indication, no proof for a manipulation)• Purchase/bill of AdBlue• Fuse removed/blown from SCR system• Modified wires in the harness• Soldered wires• Electronic device fitted in OBD-port or with wires spliced into the wiring from SCR ECU may be an emulator

Tampering methods



Tampering methods

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- US\$5 Million - US\$10 Million
- Above US\$100 Million
- US\$1 Million - US\$2.5 Million

adblue emulator

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\$ 10,000+ 90.6%

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6 Photos Video

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1 YR Shenzhen Talentcar Electronic Ltd.

Gold Plus Supplier Trade Assurance

Transaction Level

China (Mainland)

100 Transaction(s)(6 months) Response Rate

\$ 20,000+ 76.5%

Contact Supplier Chat Now!

11.11 Adblue Emulator for DAF Trucks OBD2 version emulator adblueobd2 for DAF auto diagnostic

4 YRS Changzhou Bestxun Electronic Co., L...

Gold Supplier Trade Assurance

www.alibaba.com on Nov 16th, 2018

Search words: "adblue emulator"

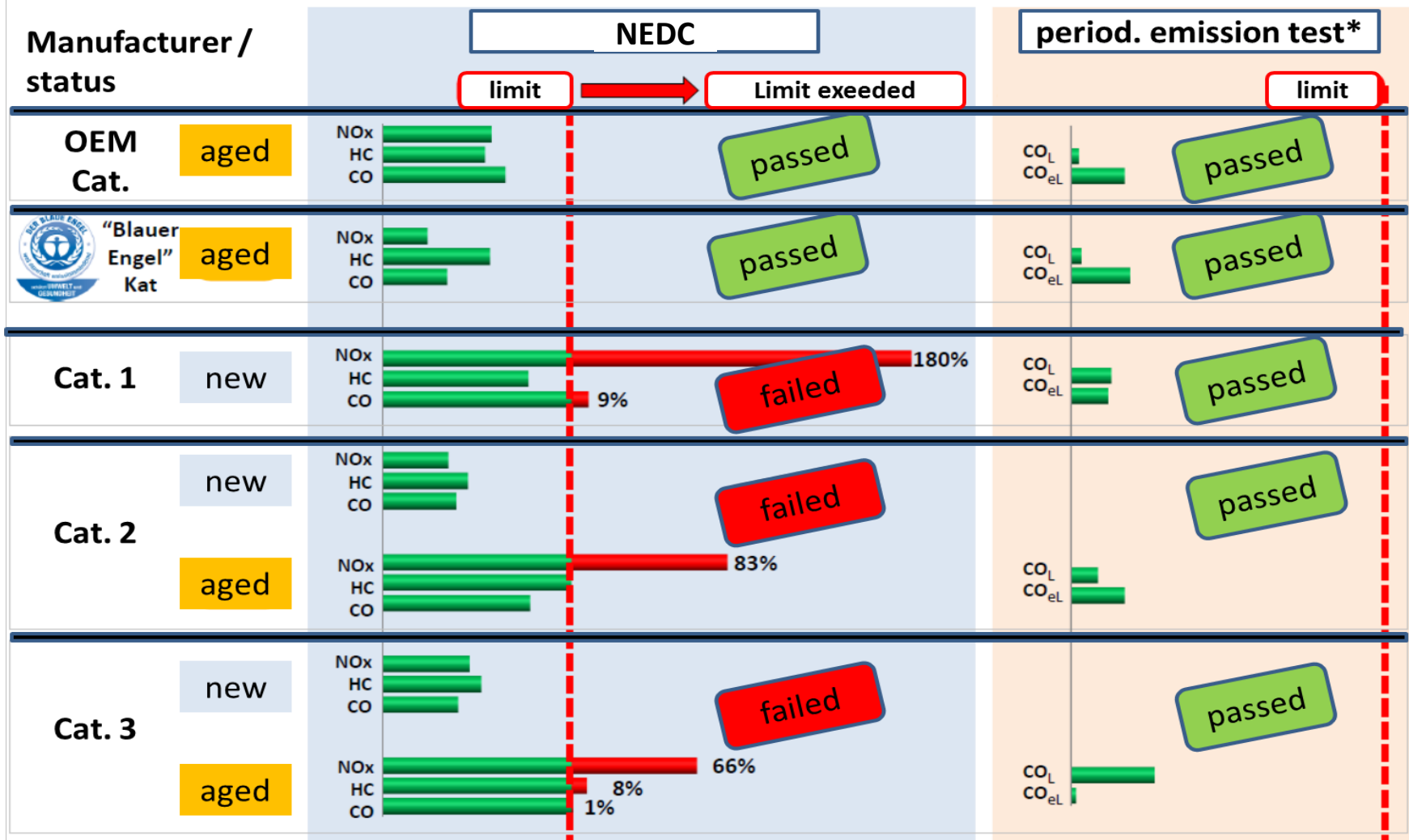
Tampering methods

DPF	
DPF removed, also with ECU set up	<ul style="list-style-type: none">• Missing part or visible alteration (e. g. welding seam) of the exhaust pipe• Soot in the exhaust of a Euro 5/6 vehicle, this may indicate DPF removal (only an indication, no proof for a manipulation)
DPF gutted, also with ECU set up	<ul style="list-style-type: none">• Soot in the exhaust of a Euro 5/6 vehicle, this may indicate DPF removal (only an indication, no proof for a manipulation)



Exemples of non-compliance

Petrol emissions 3-way catalysts: tests of TÜV NORD



*Messung der CO-Gehalts in Volumenprozent im Leerlauf (L) bei ca. 850 [1/min] mit einem Grenzwert von 0,3 Vol.% und im erhöhten Leerlauf (eL) bei 2.500 bis 3.000 [1/min] mit einem Grenzwert von 0,2 Vol.%. Messergebnisse des TÜV Nord; August 2015. Prüfstandsmessung nach Alterung des EEC Systems nicht durchgeführt, da bereits im Neuzustand durchgefallen. Prüffahrzeug: Euro-4 mit Ottomotor

How to make tampering more difficult?

Information

Tampering is, by definition, a modification. Availability of right information is essential to make tampering more difficult.

Marking

- ✓ Opacity plate. Ex: Reg 24 still allows to set the limit of 0,5 m⁻¹ in currently approved vehicles
- ✓ Marking of components. Ex: original equipment like catalytic converters shouldn't have an approval mark, whereas replacement parts are obliged to have them
- ✓ Marking of components. Ex: approval mark may be in the hidden part of a catalytic converter

Software

- ✓ Self-diagnosis features of software are cleared away when modifying ECU's software. It is essential a reliable method of identification: CALID and VALID

How to make tampering more difficult?

Access to the systems

Visual access

- ✓ Example: to the adblue tank

Mechanical access

- ✓ Example: to exhaust pipes

To sensors' readings

- ✓ Example: to the temperature sensors, since that is one of the parameters that regulate how emission control system works

To actuators' operation

- ✓ To check consistency between inputs and outputs

How to make tampering more difficult?

Conception of the system

- ✓ Ensuring self-diagnosis functions of the system
- ✓ Ensuring recording key event in an indelible way
- ✓ Tampering-proof designs, inspired in tachographs

References

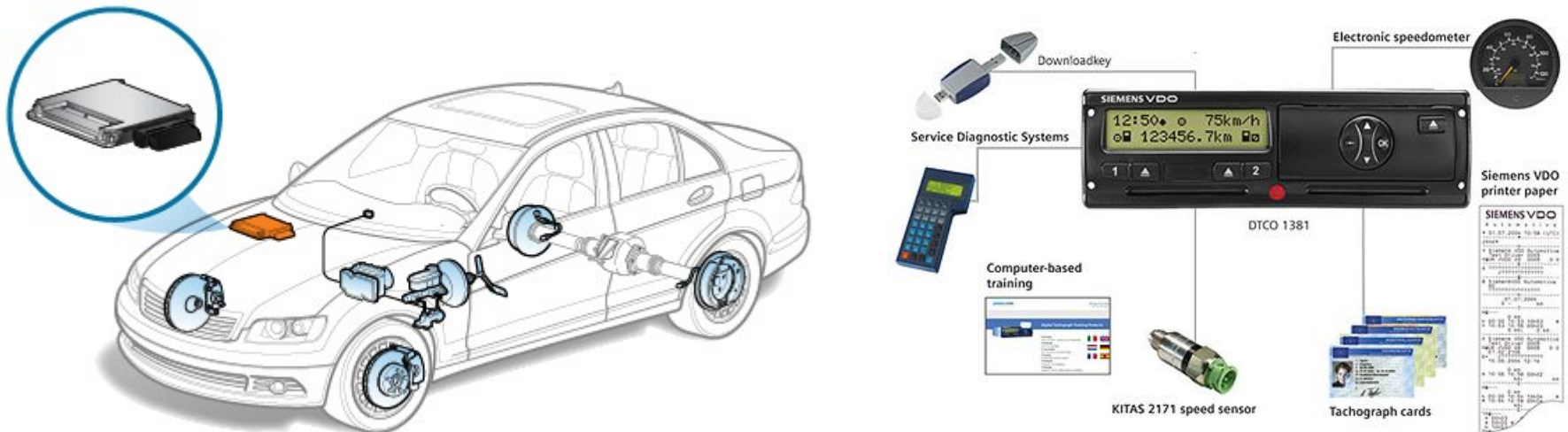
- ✓ Type II test should evolve according to technology and targeted emission: PN, NO_x, ...
- ✓ Event with current technology, type II test limits can be improved <http://citainsp.org/wp-content/uploads/2016/01/CITA-SET-Study-Sept-2015.pdf>

How to make tampering more difficult?

Anti-tuning control unit:

As the ABS system has, to avoid the tampering, it could be installed a little control unit for the emissions control (AdBlue, EGR, DPF...) where the activity of all these systems could be registered and read but not manipulated.

A system based on the electronic tachograph could be a solution, where the emissions systems events are recorded with the easy way of printing them but not modifying anything.



Annex – Anti tampering approaches beyond vehicle approval

Measuring of NOx

Engine unloaded

Identifies functioning of EGR, but requires knowledge of vehicle's design. CAPELEC / AVL method.

Engine loaded

Depending on the external conditions may identify EGR, adblue, and 3-way catalytic converter issues.

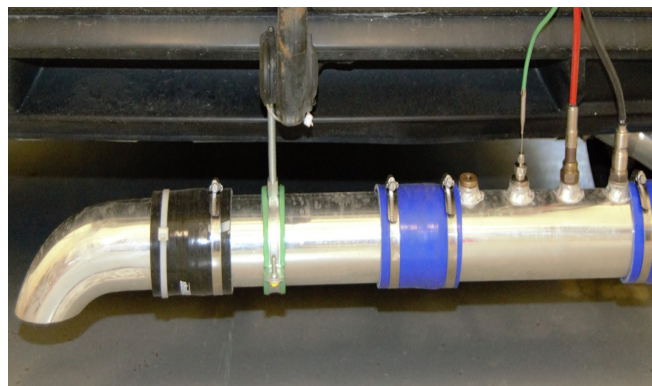
Requires reference information and has sensitivity to external factors like temperature, pressure and height.

Ongoing studies.

Annex – Anti tampering approaches beyond vehicle approval

“Mini-PEMS”

High variability of results



Remote sensing

Excellent tool for statistical analysis

Requires additional procedures, as those defined in this annex

Annex – Anti tampering approaches beyond vehicle approval

Measurement of PN

Development advanced

Solves the tampering with particle traps

Requires references to improve efficiency

Periodical and Road Side Inspections

Improvement of visual inspection within the current frame

Constraint of emissions' limits

Modification of national law

To forbid the use of tampered vehicles

To forbid the execution of tampering

To forbid the trade of tampered components

Annex – Anti tampering approaches beyond vehicle approval

The screenshot shows the Amazon website interface. At the top, the Amazon logo is on the left, and a search bar contains the text 'adblue emulator'. To the right of the search bar is a magnifying glass icon and the text 'New to Amazon? Click here to learn more'. Below the search bar, there are navigation links for 'Departments', 'Your Amazon.com', 'Today's Deals', 'Gift Cards', 'Registry', 'Sell', and 'Help'. On the right side, there are links for 'EN', 'Hello. Sign in', 'Account & Lists', 'Orders', and a shopping cart icon with a '0' inside.

The search results section displays a message: 'We found 0 results for "adblue emulator" Use fewer keywords or try these instead'. This message is circled in red. Below this message is a link: '"adblue" See all 22 results...'. The search results are organized into four columns, each showing a product image, title, author, price, and availability.

Product	Price	Availability
AD BLUE Diesel Emissions Fluid for SCR Code FOUR 1/2 gallons (2010-2013) by ADBLUE	\$ 115 ⁶⁸	Only 3 left in stock - order soon.
Die Diesel-Lüge: Die Hetzjagd auf Ihr Auto – und wie Sie sich wehren (German Edition) by Holger Douglas	\$ 10 ³⁹ Kindle Edition	Get it TODAY, Nov 18
SK Hand Tool KS Tools Disposable Filling Hose for AdBlue additives-drip Free, Clear	\$ 25 ⁷¹	Eligible for Shipping to Belgium
NOZZLE ASY PM27N by Motorcraft	\$ 9 ¹⁹	Eligible for Shipping to Belgium More Buying Choices \$5.08 (10 new offers)

www.amazon.com on Nov 18th, 2018

Search words: "adblue emulator"

Summary

- ✓ Fighting tampering is involves several stakeholders
- ✓ Tampering is both a behavioral and technical issue
- ✓ Vehicle design can improve to make tampering more difficult

Thank you for your attention
And
looking forward to your feedback