

NEW VEHICLE EMISSION REDUCTION FOLLOWING EURO 5, 6 AND 7 VERSUS MITIGATION OF HIGH EMITTERS IN THE FLEET

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DIESEL'S SCANDAL LESSON LEARNED ?!?

„DEFEAT DEVICE“ AS BUZZWORD

News of March 2023: „...EuCJ decides on defeat devices...“ – referring to EU 715/2007

English: „Defeat device“ (from to defeat [Jur.]: to nullify, to cancel)



German: „Abschalteinrichtung“ => ‚switching-off mechanism‘

improper terminology: no ‚switch‘ but any reduction may be ‚defeating‘

unpassender Begriff: kein „Schalter“, sondern jede Minderung illegal

Bad definition by an auxiliary mean !

Define it directly!

Regulation of Euro 5 & 6 in EU 715/2007 – defeat device definitions

English

(10) in Art. 3: „Definitions“

‘defeat device’ means any element of design which senses temperature, vehicle speed, engine speed (RPM), transmission gear, manifold vacuum or any other parameter for the purpose of activating, modulating, delaying or deactivating the operation of any part of the emission control system, that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal vehicle operation and use

German

(10) in Art. 3: „Begriffsbestimmungen“

„Abschalteinrichtung“ ein Konstruktionsteil, das die Temperatur, die Fahrzeuggeschwindigkeit, die Motordrehzahl (UpM), den eingelegten Getriebegang, den Unterdruck im Einlasskrümmer oder sonstige Parameter ermittelt, um die Funktion eines beliebigen Teils des Emissionskontrollsystems zu aktivieren, zu verändern, zu verzögern oder zu deaktivieren, wodurch die Wirksamkeit des Emissionskontrollsystems unter Bedingungen, die bei normalem Fahrzeugbetrieb vernünftigerweise zu erwarten sind, verringert wird;

Any reduction (though gradually) may fulfill the definition of defeat device!

- ⇒ Literal necessity to obtain wherever maximum emission control, because otherwise taken as reduction!
- ⇒ Engineering compromises such as EGR or SCR-control with ambient temperature or humidity risk illegality

⇒ many engine developers stretched the ‚grey areas‘ = ‚legal limbo‘ extremely

⇒ e.g. turning down or shutting off emission control measures at low ambient temperatures

Source <https://eur-lex.europa.eu/legal-content/DE/TXT/?uri=celex:32007R0715>; July 14, 2022, underlining by author

Regulation of Euro 5 & 6 in EU 715/2007 – Requirements and Tests

Annex 1 Emission Limits for „CI“ = compression ignition = Diesel Engines:

NOx – emission limits defined to Euro5: 180 mg/km; Euro 6: 80 mg/km

English

(1) in Art. 5: „Requirements and Tests“
The manufacturer shall equip vehicles so that the components likely to affect emissions are designed, constructed and assembled so as to enable the vehicle, in normal use, to comply with this Regulation and its implementing measures.

German

(1) de Art. 5: „Anforderungen und Prüfungen“
Der Hersteller rüstet das Fahrzeug so aus, dass die Bauteile, die das Emissionsverhalten voraussichtlich beeinflussen, so konstruiert, gefertigt und montiert sind, dass das Fahrzeug unter normalen Betriebsbedingungen dieser Verordnung und ihren Durchführungsmaßnahmen entspricht.

Key question: „**What is „normal use“?**“

There is no definition within EU 715/2007 !



Implication:
⇒ there may be „abnormal“ use!

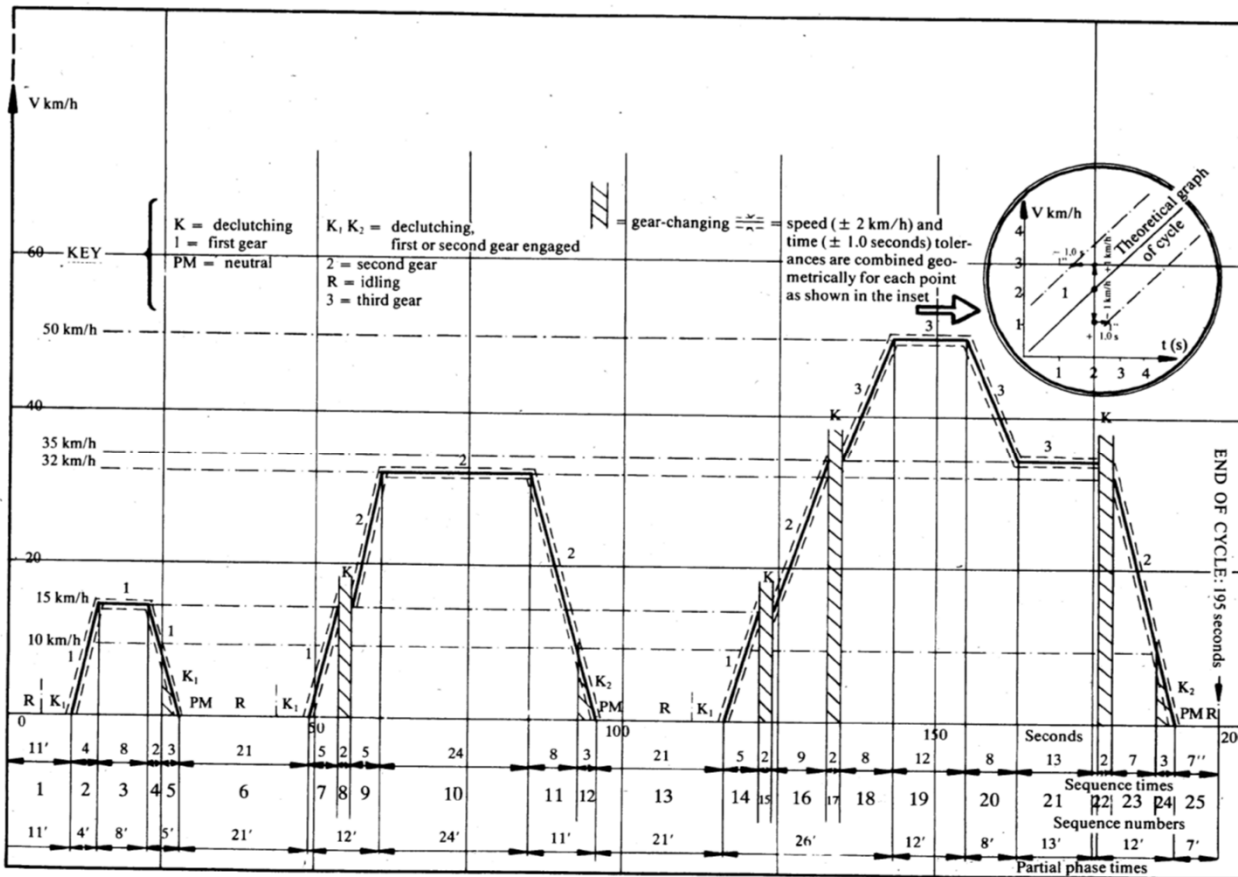
Many other terms, however, are defined within EU 715/2007:

„hybrid vehicle“, „biofuel“, „pollution control device“, „tailpipe emissions“, „reference mass“, „defeat device“, ...

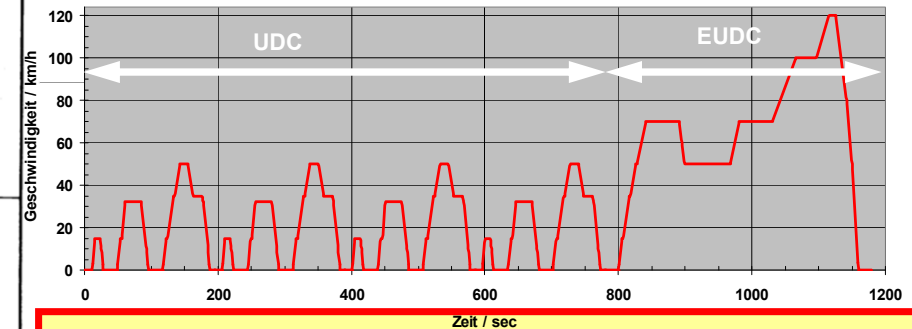
Many people claimed, that „normal use“ is the operation mode defined in the test procedure NEDC!

Source <https://eur-lex.europa.eu/legal-content/DE/TXT/?uri=celex:32007R0715>; July 14, 2022 underlining by author

EU 715/2007 – Test NEDC „New“ European Driving Cycle



exactly defined velocity profile



NEDC does not at all represent „normality“ but is completely unrealistic, because

- too undynamic 0 – 50 km/h in 26 sec !
- not that much too slow $v_{\text{mean, UDC}} = 19 \text{ km/h}$

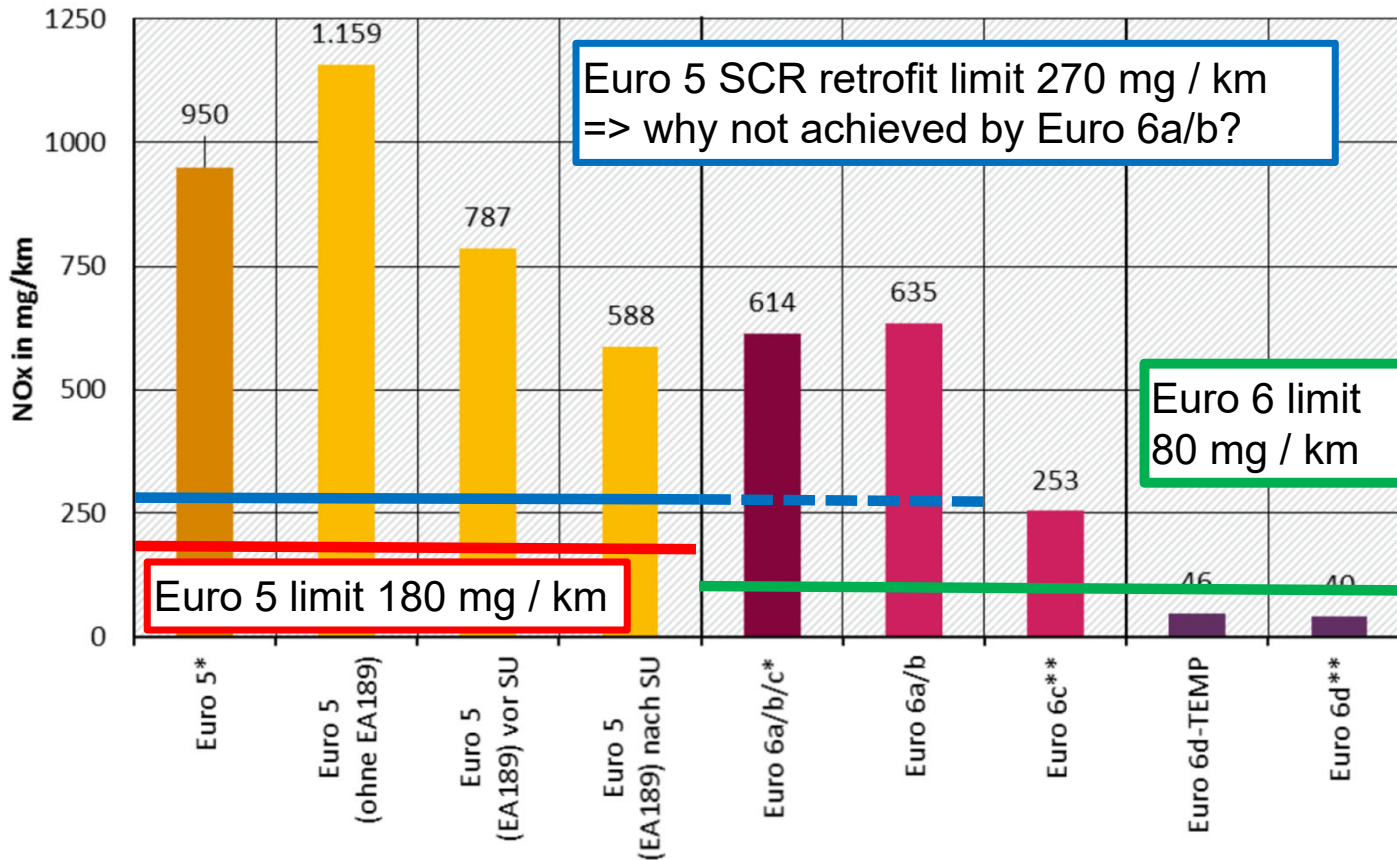
„official creep driving“ some claimed: „historic definition“

- VW beetle „export“ 34 HP of MJ 1967 managed 0 to 50 km/h in 10 sec!

⇒ justification to test and apply emission measures limited to low load operation

Source <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A01970L0220-20040501>; July 15, 2022

Nobody fulfilled NOx emission limit in normal use!



- ▶ with Euro 5 technology the limit value 180 mg/km in normal use was out of reach!
- ▶ A realistic limit value (e.g. 500 mg/km) politically not acceptable (since Euro 4 was already 250 – nominally!)
- ▶ VW Euro 5 EA189 „scandal“ engine below average in real emissions
- ▶ SW updates yield about 25 % reductions
- ⇒ Many other companies did sell vehicles with significantly higher real emissions, few consequences

Quelle: UBA 2019 auf Basis HBEFA 4.1

VW's actions remain unconceivably ignorant and unacceptable!

Regulation of Euro 5 & 6 in EU 715/2007 - preamble

English

(6)

“In particular, a considerable reduction in nitrogen oxide emissions from diesel vehicles is necessary to improve air quality and comply with limit values for pollution. ...”

The immission limits of yearly average to 40 $\mu\text{m}/\text{m}^3$ NO₂ enforced in 2010 have been defined in 2007!

Clear statement in the law to reduce the „real“ NO_x-Emissions, as they dominate NO₂-Immissions

⇒ Industry usually claims that politics should give goals and not define technologies how to achieve

The Euro 5 and 6 legislation 715/2007 was of bad quality:

lacking definitions, inappropriate testing norms (prior to Euro6d) and unrealistic unachievabel values!

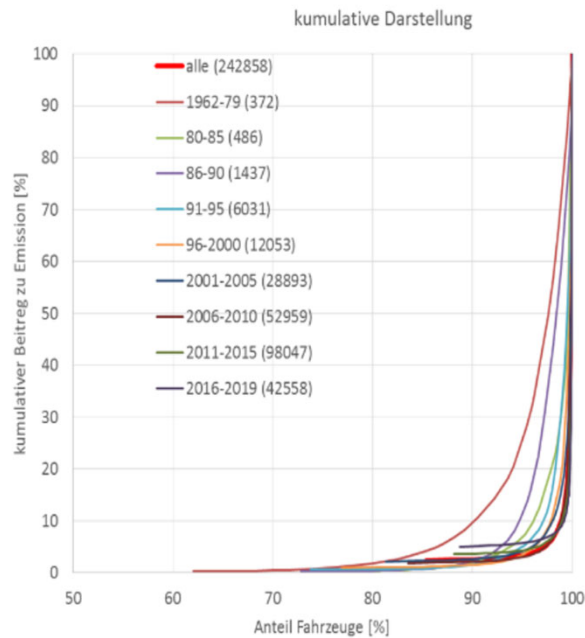
⇒ disregard of minimising real emissons showing lack of self-responsibility by self-deceiving industry

⇒ clarification by jurisdiction is counterproductive for required dynamics in progressing

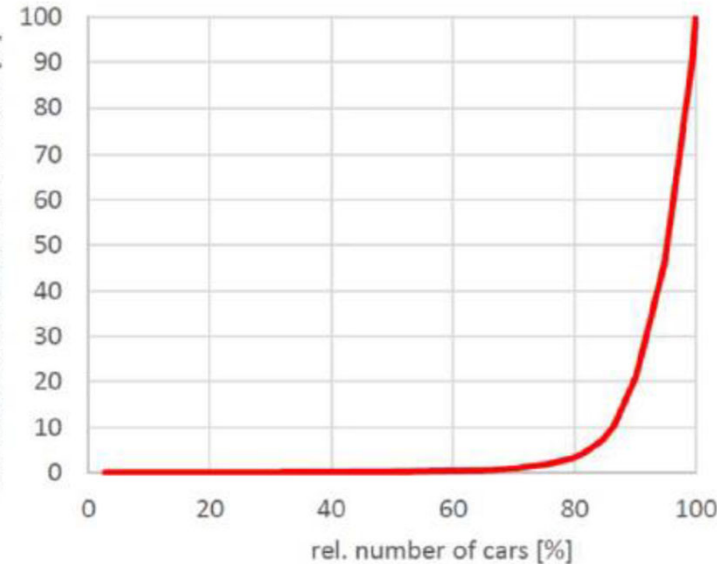
Quantitative distribution of high emitters

Distribution of particle number PN
of 400000 gasoline vehicles in Mexico City
Ref.: [AMay23] of [Domi18]

Distribution of particle number PN
at low idle of >1000 Diesel vehicles with DPF
in Zürich Ref.: [AMay23] of [Burt19]



High emitting vehicles in the fleet dominate emissions to a high degree: 90 % of emissions by 5 ... 15 % of vehicles in the fleet (referring to older emission standards)

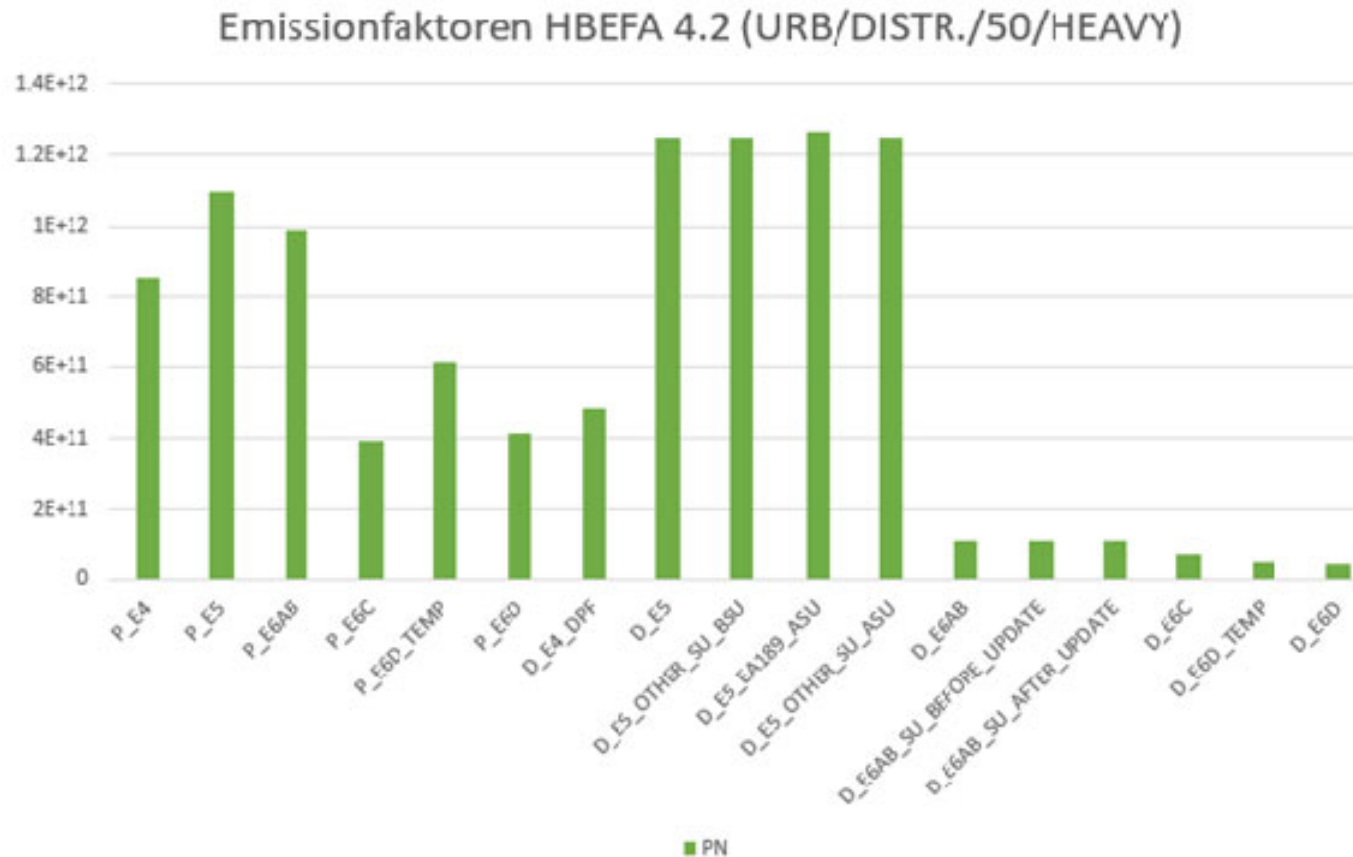


[AMay23] A.Mayer, J.Czerwinski, Th.Lutz, V.Hensel, L.Rubino, L.Larsen, M.Lehmann, J.Dumno, D.Engelmann; Highly efficient nanofilter system for large scale petrol engine retrofit, core part of the EU Horizon Project AeroSofld; FILTECH 2023 - Cologne 14-16 February 2023

[Burt19] Burtscher H. / FHNW et al; A new periodic technical inspection of particle emissions of vehicles; Emission Control Science and Technology July 2019

[Domi18] Dominguez C. / GESPA; Assessment of particle emission contributions from 400'000 in-

Effect of PN high emitters entering HBEFA 4



Preamble: I see HBEFA as a very valuable contribution !

However questions arouse:
Why show Euro 5 Diesel ~10 x higher PN emissions than Euro 6?

Clarification by communication with Prof. S. Hausberger, TU Graz:

- ,The PN value of Euro 5 Diesel included an undefined number of defect or manipulated DPF within the evaluated sample.
- Sane DPF (Euro 6) yield emissions often below $1 \cdot 10^{11}$.
- Defect DPF may show 100x or 300x higher PN emissions'

Diagram by Volker Diegmann, IVU-Umwelt GmbH, D-Freiburg i. Br.

Making the most out of Euro 7

Breakthrough Emission Reduction with Euro 6d - “d” (such as in RDE) is the key!

Undisputed progresses with Euro 7 draft:

- No distinction between engine types
- cut-off limit for PN lowered to 10 nm
- longer legal lifetimes 8 years / 160 Tkm
- faster effective emission reduction after cold start – however:

focus on extreme driving consumes capacity

⇒ clear definitions of bias drivings

⇒ ambitious goals for emission budgets

The Euro 7 legislation must yield effective emission reductions:

My proposals:

⇒ Contribution by OEMs & system suppliers to mitigate high emitters in the fleet such as

- Financing a fund proportional to # of vehicles
- Contribute to definition and introduction of PTI

⇒ trade in later introduction of Euro 7 for cheap cars

⇒ cut-off high dynamic driving after cold start by OEM

A reconcillation of interests I see as core part of democratic processes, especially legislation

⇒ Focus in negotiations to be put on environmental effectivity but not legal /political principles

References

- > Norm for Emission classes Euro 5 and Euro 6 (EU 715/2007)
<https://eur-lex.europa.eu/legal-content/DE/TXT/?uri=celex:32007R0715>; July 14, 2022
- > Deeper analysis published (in German):
„Das Diesel-Dilemma – Verantwortungen und Perspektiven“ by H. Koch-Groeber, Heilbronn,
Zeitschrift für Umweltpolitik & Umweltrecht, ZfU1/2020 41–68

THANK YOU FOR YOUR KIND ATTENTION!

For further questions and discussions please contact: koch-groeber@hs-heilbronn.de