



Type Approval of H2 engines

Update on 86th GRPE Meeting

Change proposals for UN R49 & UN R85

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HD VEHICLE TYPE APPROVAL

- EU type approval according to Reg.(EU) 2018/858 requires a certificate according to Reg.(EC) 595/2009 and its implementing measures.
- The combustion engine must be certified according to the implementing Reg.(EU) 582/2011 and Reg.(EU) 2017/2400 Annex V.
- Both implementing regulations are referring in specific chapters to UN R49.



SCOPE OF AMENDMENT

- Introduction of an LEAN Document fro Adoption in June
- In a first step this document should give a signal to Industry to start investment
- The Changes are reduce to minimum needed for first type approvals
 - Dual fuel applications are excluded
 - Diluted measurement is excluded
 - O₂ concentration measurement will be done by the use of an lambda Sensor or optionally air mass flow to replace carbon balance method by oxygen balance method for consistency check



CURRENT STATUS

- ACEA HD expert group on H2 ICE has been established in 2020 and has elaborated the necessary changes and amendments for UN R49 and UN R85 in order to enable the type approval of hydrogen combustion engines.
- ACEA experts brought the topic to OICA 1st half of 2021.
- GRPE organized a WS on alternative propulsion technologies in the June 2021 session.
- OICA made a presentation on H2-ICE for UN R49 and UN R85 amendments.
- COM restarted activities after COVID crisis in September 2021
- OICA introduced the Informal DOC's on 85th GRPE meeting 11. January 2022
(GRPE 85-28 (changes R49) & GRPE 85-25 (changes R85))
- OICA handed in the formal DOC's 8th March for 86th GRPE meeting June on the basis of an lean approach.
- **Further little updates done on document marked in Blue**



PROPOSED CHANGES IN UN R49

Regulation:

- Omission of requirement to measure all carbon based emissions (CO, THC / NMHC, CH₄, CO₂) as this is not reasonable for engines that are only fuelled with non-carbon fuels.
 - *Measurement of HC emissions with FID might pose safety issues, especially for PEMS.*
 - *All limits shall still apply, but only NO_x, NH₃, PM & PN shall be measured.*
- Labels to be introduced for hydrogen fuelled engines differing between PI / CI engines and gaseous / liquid hydrogen injection.



PROPOSED CHANGES IN UN R49

Annex 1-3:

- Minor changes to label hydrogen fuelled engines.



PROPOSED CHANGES IN UN R49

Annex 4 (Test procedure):

- Formulae to calculate emissions need adapted as they are normalized to the carbon content of the fuel.
- Definition of hydrogen as H₂ and thus carbon free.
- u_{gas} values defined for emission calculation of hydrogen fuelled engines.
- ~~➤ New formula to calculate the dilution factor for hydrogen fuelled engines.~~
- ~~➤ dry/wet correction for raw gas and diluted as well as test bench and PEMS~~
 - ~~▪ To be defined (procedures under discussion)~~



PROPOSED CHANGES IN UN R49

Annex 5 (Specification of reference fuels):

- Definition of reference fuel for hydrogen derived from ISO14687:2019 Grade D (Type I (gaseous) or II (liquid))
- Alignment with UN R154 (GRPE-84-07e_clean)
- This fuel grade is also recommended for the use in PEM fuel cell road vehicle applications.
- It is expected that there will be only one fuel grade for hydrogen in the market.
- Only one fuel grade will support the development of the hydrogen supply infrastructure.



PROPOSED CHANGES IN UN R49

Annex 6 (Measuring carbon monoxide emissions at idling speeds):

- This Annex shall not be applicable to engines that are fuelled with non-carbon fuels.
 - *Currently not applicable to CI engines and dual-fuel engines.*



PROPOSED CHANGES IN UN R49

Annex 8 (Conformity of in-service engines or vehicles):

- CO₂ mass based method shall not apply to engines that are fuelled with a non-carbon fuel.
- Omit measurement requirement for carbon based emissions for non-carbon fuels.
- Demand O₂ concentration measurement (lambda Sensor or optionally air mass flow) to replace carbon balance method by oxygen balance method for consistency check.



PROPOSED CHANGES IN UN R49

Annex 9A /B /C (On-board diagnostic systems (OBD)):

- OTL demonstration for CO shall not be required for engines that are fuelled with non-carbon fuels.
- Low level fuel detection shall be based on the state of the fuel (gaseous vs. liquid) in the tank instead of fuel type (diesel vs. gas)
- Other monitors shall be based on working principle (CI vs. PI engine) instead of fuel type (diesel vs. gas).



PROPOSED CHANGES IN UN R49

Annex 10 (Requirements to limit off-cycle emissions (OCE) and in-use emissions):

- Omit requirement to measure carbon based emissions in WNTTE test for engines that are fuelled with non-carbon fuels.



PROPOSED CHANGES IN UN R49

Annex 12 (CO₂ emissions and fuel consumption):

- CO₂ emissions in exhaust shall be calculated based on fuel consumption and composition of fuel for engines that are fuelled with non-carbon fuels
 - *Poor measurement accuracy at low CO₂ concentration (approx. 500ppm).*
 - *Main contributor for CO₂ emissions is intake air (approx. 410ppm ≈ 5g/kWh).*
 - *CO₂ emissions from engine are significantly below 1g/kWh.*
- *currently mentioned fuel consumption measurement systems (mass flow sensor, fuel weighting or Coriolis meter) are also suitable for hydrogen.*



PROPOSED CHANGES IN UN R49

~~Annex 15 (additional technical requirements for Diesel-Gas dual-fuel engines and vehicles):~~

~~➤ Molar component ratios, u_{gas} values need to be defined for Diesel-H₂ dual fuel engines.~~

This was included in Informal Doc but deleted for the Lean formal Document handed in for the June 22 GRPE Session

=> As an first step of the H2 ICE changes in R49 to adopt changes earlier



PROPOSED CHANGES IN UN R85

Regulation:

- Allow H₂ as fuel for testing.



NEXT STEPS

- Adaption of formal Documents in the June GRPE Session
- Start Step 2 to work on a Full approach
- After a discussion with the European commission it was agreed that we can not adopt this changes due to still not completed Vehicle measurements
- It was agreed to finalize this testing until End Q3 to hand in the formal Doc for an adoption as soon as possible
- OICA will support as much as possible to achieve that