



Type Approval of H2 engines

Change proposals for UN R49 & UN R85

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GRPE 85th Session 11-14 January 2022



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.



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



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 molar carbon to hydrogen ratio of zero.
 - *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 H_2 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 molar carbon to hydrogen ratio of zero.
 - *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 molar carbon to hydrogen ratio of zero.
- Omit measurement requirement for carbon based emissions for molar carbon to hydrogen ratio of zero.
- Demand O₂ concentration measurement 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 molar carbon to hydrogen ratio of zero.
- 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 molar carbon to hydrogen ratio of zero.



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 molar carbon to hydrogen ratio of zero
 - *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.



PROPOSED CHANGES IN UN R85

Regulation:

- Allow H₂ as fuel for testing.



NEXT STEPS

- OICA is actively supporting JRC and TU Graz to enable type approval of hydrogen combustion engines.
- Validation is planned on first part of 2022.
- Timeline to be discussed, OICA's intention is to finalize the change proposal and present a Working document in the June 2022 GRPE session
- Final formulas and different possibilities to calculate need some fine tuning (e.g. dry/wet equation, etc...)