



**Type Approval of H2 Engines**  
**Update on 87<sup>th</sup> GRPE Meeting**  
**Joint change proposals of EC & OICA**  
**for UN R49 & UN R85**

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# SCOPE OF AMENDMENT

- Allow emission type approval of **H2 fuelled HD vehicles and engines**
- **First step** with “lean” approach, should give a signal to industry to start invest
- Changes are reduced to a minimum needed for first type approvals and 07 series
  - **Dual fuel** applications are **excluded** (postponed to 2<sup>nd</sup> step “full” approach)
  - **Diluted measurement** is **excluded** (postponed to 2<sup>nd</sup> step “full” approach)
  - Based on already **implemented** measurement **devices**
  - **Fuel definition** added and **adaption of essential equations**
  - **Provisions for increased water content** in exhaust
    - Lean-burn engines proved to be within limits of conventional measurement devices during JRCs validation campaign



# 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 1<sup>st</sup> half of 2021.
- GRPE organized a WS on alt. propulsion technologies in the June 2021 session.
- EU COM restarted activities after COVID crisis in September 2021
- OICA introduced the informal DOCs on 85th GRPE meeting 11. January 2022
- OICA handed in the Working DOCs 8th March for 86th GRPE meeting June on the basis of an lean approach – amendment postponed
  
- **Close cooperation of EC/JRC/OICA/ACEA** in 2022 to finalize Working Documents and perform validation campaign (HD engines in lab and vehicles with PEMS)
  
- **EC/OICA handed in joint Working DOCs for 87th GRPE** meeting and additional informal DOCs with error corrections and clarifications



# OVERVIEW ON DOCUMENTS

- ECE/TRANS/WP.29/GRPE/2023/6
  - **Working Document**, joint proposal of EC/OICA to amend **R49 (07 series)**
- GRPE-87-30
  - **Informal Document** to update ECE/TRANS/WP.29/GRPE/2023/6
  - Error corrections and clarifications
  - Adaption to latest Addendums of R49
  - Integration of QCL devices for NH3 measurements (from EU-COM)
- GRPE-87-31
  - **Informal Document**, report on JRCs validation campaign
  
- ECE/TRANS/WP.29/GRPE/2023/7
  - **Working Document**, proposal of OICA to amend **R85**
- GRPE-87-16-Rev.1
  - **Informal Document** to update ECE/TRANS/WP.29/GRPE/2023/7
  - Small changes to ensure the coherence of wording



# PROPOSED CHANGES IN UN R49

## Regulation:

- Measurement of all emission species mandatory also for hydrogen fuelled engines (**changed since 86<sup>th</sup> GRPE**): NO<sub>x</sub>, CO, THC/NMHC, NH<sub>3</sub>, PM mass/number
- Labels introduced for hydrogen fuelled engines differing between PI / CI engines and gaseous / liquid hydrogen injection.
- Provisions for increased water content in exhaust gas: Devices shall comply with water content during testing.
  - Lean-burn engines proved to be within limits of conventional devices
- Dual-fuel engines with hydrogen excluded (postponed to 2<sup>nd</sup> step full approach)



# PROPOSED CHANGES IN UN R49

Annex 1-3:

- Minor changes to label hydrogen fuelled engines.
- [Adaption to latest Addendums of R49 series 07](#)



# PROPOSED CHANGES IN UN R49

## Annex 4 (Test procedure):

- Equations to calculate emissions adapted as they are normalized to the carbon content of the fuel.
- Definition of hydrogen as H<sub>2</sub> and thus carbon free.
- $u_{\text{gas}}$  values defined for emission calculation of hydrogen fuelled engines.
- Equations of dry/wet correction limited for hydrogen fuelled engines to applicable variants
- Carbon balance method excluded for engines fuelled with hydrogen
- CO analyser interference check adapted to near zero CO emission of hydrogen fuelled engines
- Carbon flow check to be performed with diesel engine before installation of hydrogen fuelled engines



# 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):

- CO<sub>2</sub> mass based method shall not apply to engines that are fuelled with a non-carbon fuel.
- Measurement of all emission species mandatory also for hydrogen fuelled engines (**changed since 86<sup>th</sup> GRPE**): NO<sub>x</sub>, CO, THC/NMHC, PM number
- Demand lambda measurement (lambda sensor) and air mass flow to replace carbon balance method for consistency check of EFM measurement



# 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 12 (CO<sub>2</sub> emissions and fuel consumption):

- CO<sub>2</sub> 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 CO<sub>2</sub> concentration (approx. 500ppm).*
  - *Main contributor for CO<sub>2</sub> emissions is intake air (approx. 410ppm ≈ 5g/kWh).*
  - *CO<sub>2</sub> 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 R85

Regulation:

- Allow H<sub>2</sub> as fuel for testing.
- Small changes to ensure the coherence of wording



## NEXT STEPS

- Adoption of Documents in the 87th GRPE session
- Start 2<sup>nd</sup> step to work on a “full” approach, including dual-fuel and diluted measurement