HDDF retrofit systems
Type approval principles

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LPG
EXCEPTIONAL ENERGY

AEGPL EUROPE

Is a HDDF UN/ECE regulation desirable?

YES because it avoids several different national rules

YES if its requirements are attainable from retrofit operators (manufacturers and installers)

YES if its approach is R115-type.

YES if it will be developed in short time

Disregarding above conditions will lead to unfair competition and DF will not reach the intended market penetration.

Scope

New provisions should apply to
- retrofit systems designed for engines
- approved according EURO IV emission stage or later.

This means that all engines approved according R49/03 (row B1 and B2) and later should be included into the scope of the dual fuel retrofit regulation.

Note: current R115 includes all engines approved according **R49/04** and later, so in this case some Euro III engines are included, some others are excluded.

Older engines should follow national rules or included in a newer emission stage type approval (e.g. kit approved for Euro IV engines can be also installed in Euro III engines).

compound type approval: System & Engine

New provisions should be based on a two stage, compound type approval.
A retrofit system proves its suitability and is then ported to several families.

UNECE 115 regulation defines the retrofit system family which is also applicable to HDDF retrofit systems.
some adaptations are needed to the definition of the family

All components must be type approved according to
R67/01 (LPG) or R110 (CNG).

The engine family should be defined by technical aspects more than by the company manufacturing it.

The engine family

Following properties define the engine family more accurately than limiting a type approval to an engine manufacturer:

- Euro emission class (or earlier).
- Combustion cycle
- Main cooling medium (air, water)
- Specific power
- Method of air aspiration
- Fuel supply type (electronic yes/no, pump, common rail ...)
- Exhaust gas recirculation (EGR)
- Water injection
- Air injection
- Exhaust after-treatment systems
- Dual fuel class.

Testing engines without EGR, trap, catalyst or SCR includes engines with those devices.

Emission requirements

Dual fuel retrofit systems should be tested according to the original engine type approval. In general, during first homologation, dual fuel engine should comply the same EU-class limits of the original engine, with the comparable or simplified procedures.

- EURO IV: ESC + ETC + ELR cycles.
- EURO V/VI: ESC (WHSC) + ETC (WHTC) + ELR cycles.

Regarding HC, NMHC and CH4 should be measured separately and a GHG formula should be introduced.

Test sequence

Test sequence should consist of (once for each system):

- engine diesel test without DF equipment
- engine diesel test with DF equipment installed
- engine gas test with DF equipment installed

Following extensions (different engines, powers or calibrations) should have a simplified procedure, consisting of:

- Steady state test cycle (ESC or WHSC as applicable) or
- PEMS test for Euro VI or
- a simplified PEMS test for Euro V.
- The possibility to use SEMS in place of PEMS shall be investigated.

Dual Fuel classifications

The OEM Dual Fuel classification can be adopted for retrofit

Class A (DF-mode only) is not foreseen, as diesel mode should always be retained in a retrofit, as not to alter the original manufacturer's type approval.

Dual Fuel limits may vary according to original emission level:

- Up to Euro V (Included) FIXED limits (independent from GER): table 1 and table 2 of R49/05
- Euro VI, variable limits with GER according to OEM dual fuel provisions.

OBD

Since all retrofit HDDF vehicles will be approved for both diesel and dual fuel modes, simplified requirements for OBD are possible.

- Original OBD system is still active in both modes (diesel and dual fuel), gas ECU shall monitor gas emission-related components.
- R115 approach: in case of malfunction of a gas emission-related component, a switch back to diesel mode is required.
- To reach the compliance no modification to OEM ECU is required.

Durability

UNECE 115 regulation already includes durability requirements, which should apply also to HDDF retrofit systems (same OEM prescriptions).

To demonstrate the compliance with durability requirements, the deterioration factor listed in R49/05, annex 7, par. 3.6. can be used (the same concept apply also to future R49/06).

Alternatively the DFs can be determined once with the first engine test bench, according to current R49 methodology.

Conclusions

New provision for HDDF retrofit systems are desirable, but there is the concrete risk to build a not applicable regulations (OEM approach).

It must be clear that retrofit systems are neither OEM Engines nor vehicles. Therefore new applicable provisions should take into account a system based type approval.

Retrofit systems help the develop and diversify the fuel market as intended by the Commission

The schedule of work items should take into account real requirements claimed by retrofit operators, if supported by sensible regulations.