GFV 37-02

Status of the discussion New HDDF retrofit regulation

GFV Jan 13th 2015

Geneva

Overview

A new regulation will include the requirements for the type approval of **retrofit systems** intended to be fitted on a heavy duty diesel vehicle to enable its operation either in diesel mode or in dual-fuel mode.

Only Euro IV, Euro V and EEV vehicles included in the first release of the regulation.

Till now the principle and the structure of the new regulation have been discussed.

Issues to be considered

- Regulation for type approval of systems for retrofitting diesel vehicles to dual fuel operation, but references to R49: type approval of engines
- Tension between retrofit conversion effort/costs and environmental impact/benefit
- Level playing field for both retrofit system manufacturers and engine/vehicle manufacturers
- Euro IV, V and EEV diesel engines have limited diagnostic functionality and no NO_X closed loop control (difference with R115 for LDV's).
- CH_4 emissions

Principles

- retrofit system family and application range

- emission tests

  initial type approval

  extensions

Retrofit system family

“retrofit system family” means a manufacturer’s grouping of retrofit systems which through their design, as defined in this Regulation, have similar retrofitting characteristics

The approval will be considered valid for all the members of the retrofit system family.

Identification of the criteria defining the retrofit system family is under development.

Application range

“application range” means a grouping of engines to which the retrofit system is approved to be applied.

During the initial type approval, the manufacturer submits to tests one retrofit system (parent retrofit system) installed on a demonstration engine and a demonstration vehicle equipped with the same engine and retrofit system.

The initial application range of the retrofit system is the “R49” engine family of the demonstration engine.

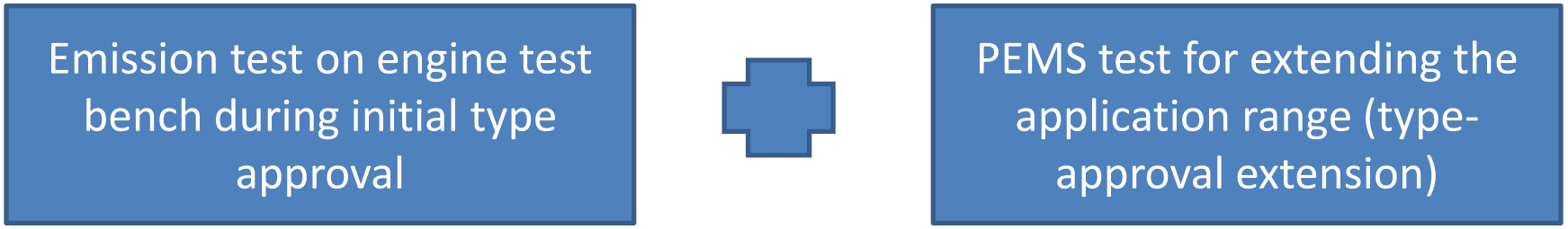
The application range may be extended to include other engines (or other engine families) by means of a formal extension of the initial type approval.

Emission Tests

Procedures

Performing emission tests must be practically feasible, hence some retrofit specific procedures have been developed in order to take into account specific difficulties without compromising the required effectiveness:

- obtaining engines to perform an engine test;
- compliance of ”older” engines;
- costs to perform engine tests on an engine test bench.



Emission Tests

Initial type-approval

The emissions shall be measured with engine bench tests, using a demonstration engine equipped with the retrofit system in both diesel mode and dual fuel mode:

- ETC
- ESC

DIESEL MODE REQUIREMENTS:
In diesel mode the pollutant emissions shall not exceed the original type approval limits of the engine.

Emission Tests

The CH_4 issue (1)

In addition to previous considerations, CH_4 emission is a real issue for diesel - CNG/LNG dual fuel retrofit systems.

Constraint

Maintain the desired level of environmental performance after retrofit

- No compromise on health affecting pollution
- No compromise on green-house gas pollution

Emission Tests

The CH_4 issue (2)

Difficulties

- To keep a balance between feasibility and complexity of the retrofit systems in order to permit the diffusion of the retrofit technology.
  - Example: Forcing the implementation of a CH_4 catalyst is generally considered as not economically viable on used vehicles (conversion of a GHG to another less reactive GHG at high costs and no guarantee on durability).

- Not to create an R49 “bypass” based on different limits.
  - Example: A retrofit-specific CH_4 limit could be detrimental for R49 approved dual fuel engines

- Not to introduce precedents concerning possible GHG limits.

Emission tests

Dual-fuel mode requirements (under development)

The manufacturer of the retrofit system could choose between two options:

- OPTION 1
  - All emission limits for dual-fuel mode as specified in the applicable R49 series of amendments apply
- OPTION 2
  - The NO_X, PM and CO emission limits for dual-fuel mode as specified in the applicable R49 series of amendments apply ;
  - The NMHC emissions shall not exceed the R49 limit (or those of the engine before retrofit);
  - The retrofit CO_2 ratio (back-to-back test):

$$\frac{CO_2 + CH_4(expressed\ in\ equivalent\ CO_2)}{CO_2\ of\ the\ original\ diesel\ engine} \leq 1$$

Type-approval extension

emission test

For a type approval extension, the emissions may be measured with a test procedure (retrofit specific) using a Portable Emission Measurement System mounted on a vehicle equipped with the retrofit system.

Back-to-back comparison between a test in diesel mode and a test in dual fuel mode.

Details of this procedure still to be developed and verified.

Type-approval extension

pollutants and limits

Pollutants to be monitored:

- NMHC
- CO
- NO_X
- PM

Requirement:

The emission value of each pollutant in dual fuel mode shall not exceed the corresponding value in diesel mode (tolerance to be defined).

$$MEASURED_{DF} <= MEASURED_{Diesel\ after\ conv.} + TOLERANCE$$

Type-approval extension

SCR vs EGR

Principle

An application range shall not be extended with an engine with EGR technology when the already approved application range includes engines with SCR technology, or vice versa.

An engine bench test procedure will be required.

Type-approval extension

different engine manufacturers

When the engine of the vehicle under test belongs to a different manufacturer than the engines already included in the application range, a simplified test in diesel mode before the conversion will be required. In this case the values in diesel mode after the conversion shall not exceed the values before the conversion.

$$MEASURED_{Diesel\ after\ conv.} <= MEASURED_{Diesel\ before\ conv.} + TOLERANCE$$

$$MEASURED_{DF} <= MEASURED_{Diesel\ after\ conv.} + TOLERANCE$$

Procedure in summary

In general the tests consist of:

- Engine emission tests and requirements on a demonstration engine
- Vehicle installation tests and requirements on a demonstration vehicle

A vehicle will be authorized to be retrofitted if:

- equipped with a member of the approved retrofit system family;
- its engine belongs to the application range;
- the installation requirements are met.

Complete retrofit system
vs
completED retrofit system (1)

From a business stand-point, there is a certain interest in having the possibility to type approve the part of the retrofit system to be fitted on the engine separately from the other system components.

Companies designing and manufacturing an engine retrofit system may not always be able to design and manufacture the complete retrofit system for each vehicle and each vehicle market.

Other companies may wish to complete an approved engine retrofit system by adding additional components specific for a vehicle or market.

Complete retrofit system
vs
completED retrofit system (2)

From a legal standpoint it is important that the authority approving the operation of a retrofitted vehicle only considers a single manufacturer that assumes responsibility for the emissions performance of the complete retrofit system.

To address this issue the introduction of a concept of complete and completED retrofit systems has been investigated.

Interface requirements and tests are required.

Next steps and time schedule

Many topics still need more investigation and discussion.

Monthly meetings are scheduled.

GFV have the following targets in order to complete the task:

- informal document to next GRPE (June 2015)
- formal document to GRPE in January 2016.

Retrofit Heavy Duty Dual Fuel

Thank You