Determination Of Deterioration Factors

FAQ

Frequently Asked Questions

Regulation (EU) 2016/1628: EUROMOT guidance on alternative methods for establishing Deterioration Factors (DFs) for Stage V engines

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EUROMOT
The European Association of Internal Combustion Engine Manufacturers

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Does Regulation (EU) 2016/1628 and corresponding delegated Regulation (EU) 2017/654 require service accumulation deterioration factor (DF) testing of an engine of the same type, or where applicable selected from the same family, to that submitted for type-approval?

Not in all cases. Alternative methods are permitted for engine categories NRE, NRG, IWP, IWA, RLL, RLR, SMB, ATS and sub-categories NRS-v-2b and NRS-v-3.

Art. 25(1)(c) of Regulation (EU) 2016/1628 requires that deterioration factors (DFs) appropriate to the respective emission durability period (EDP) set out in Annex V of that Regulation are applied to the laboratory test results. The method for establishing those DFs is set out in Annex III to Regulation (EU) 2017/654, and, for engine categories NRE, NRG, IWP, IWA, RLL, RLR, SMB, ATS and sub-categories NRS-v-2b and NRS-v-3, the detailed requirements are set out in section 3 of that Annex.

There are three alternative methods provided. The first enables engine families that use similar emission reduction technology to share the same DFs, allowing an engine family to adopt the DFs from a different family, the second allows use of DFs established using alternative procedures and the third allows for use of *'assigned DF'* values set out in the Regulation. The Approval Authority responsible for granting the type-approval has in each case the discretion to permit these alternative approaches based upon supporting evidence provided by the manufacturer seeking type-approval.

DF testing is often the single most expensive part of the type-approval test procedures, especially for very large engines in categories with high EDP, due to the length of test required and amount of fuel consumed. EUROMOT recommends that, especially in the case of engine families for low sales quantity applications, such as inland waterways, Approval Authorities use the discretion afforded to them to permit the use of these alternative approaches to the extent permitted by Regulation, proportionate to the very limited impact associated with any uncertainty in the selected DF for such small quantities of engines.

1. Similar emission reduction technology

The decision whether to permit the use of DFs established for a different engine family *'…is based on the type of exhaust after-treatment system utilised or where no after-treatment is used, based upon the similarity of the technical characteristics of the emission control system. Engines of different bore and stroke, different configuration, different air management systems or different fuel systems may be considered equivalent in respect to emissions deterioration characteristics if the manufacturer provides data to the approval authority that there is a reasonable technical basis for such determination. In order to place engine families having similar technical specifications and installation for the exhaust after-treatment systems into the same engine after-treatment system family, the manufacturer shall provide data to the approval authority that demonstrates that the emissions reduction performance of such engines is similar.'*

It should be noted that the approval authority, assisted by the appointed Technical Service, has discretion on the level of similarity required. It is not required that the after-treatment or emission control system are identical, nor is it required that the emission reduction performance is identical.

Furthermore, point 3.2.5.2 of the Annex allows for the fact that the DFs may be taken from an engine category that has a different emission durability period, so long as those DFs are adjusted (by extrapolation or interpolation) to the emission durability period for the engine category to which they are to be applied. For example, an approval authority may allow DFs established for a 130 – 560 kW variable speed engine category NRE using an SCR & DPF to be applied to engine category IWP or IWA using an SCR & DPF, conditional upon extrapolating the results from 8000 hours EDP to 10000 hours EDP. In this case due allowance needs to be made for the fact that the emission limits for the different engine categories will differ, so the absolute tailpipe engine exhaust emission pollutant level of the engines may also differ. In case there are differences in, for example, the way in which the DPF is sealed into the housing for the category IWP/IWA engine compared with the category NRE engine, it may be necessary for the manufacturer to provide design information that shows the sealing system used on the inland waterway engine will be sufficiently effective over that emission durability period that the systems could be considered functionally similar. The requirements of points 3.2.2 to 3.2.4 necessarily apply to the engine (family) and corresponding category that is tested, not to any subsequent engine family that utilises the results of such testing.

It should be noted that the use of DFs established for other engine families with similar emission reduction technology includes those DFs established using alternative procedures, as explained in the next sub-section. This also provides the possibility to use DFs established for a previous emission stage, where there is sufficient similarity in technology and emission reduction performance.

Reference: Regulation (EU) 2017/654, Annex III, section 3.1.2

2. Alternative procedures

This allows the Approval Authority to authorise use of DF values that have been established by alternative procedures to those set out in points 3.2.2 to 3.2.5 of the Annex, if the manufacturer requests this and is able to *'demonstrate to the satisfaction of the approval authority that the alternative procedures used are not less rigorous than those set out in points 3.2.2 to 3.2.5.'*

This means the Approval Authority could authorise alternative approaches for (i) accumulating service hours on the test engine, including the number and spacing of the test points, (ii) the engine tests required, (iii) how the results are reported, and (iv) how the DFs are determined from the results of the tests.

As an example, DF tests conducted to satisfy other regulatory bodies such as the US Environmental Protection Agency (EPA) or California Air Resources Board (ARB) are usually not less rigorous than those set out in the Annex. However, the authorisation is not limited to tests conducted for other regulatory bodies; an Approval Authority may agree with specific alternative procedures put forward by a manufacturer specifically for determination of DFs for a Stage V type-approval. The authorisation to permit alternative procedures does not allow the manufacturer to avoid the general principle that appropriate DFs must be established.

Reference: Regulation (EU) 2017/654, Annex III, point 3.2.1.1.

3. Assigned deterioration factors (DFs)

'As an alternative to using a service accumulation schedule to determine DFs, engine manufacturers may select to use assigned multiplicative DFs, as given in Table 3.1.' of Annex III.

It should be noted that assigned DFs are an alternative to running a DF test, not for use in combination with running a service accumulation DF test. The exception to this is where there are DF results established for an engine family using similar emission reduction technology, that were used for a previous type-approval issued before the Stage V type-approval deadline for the engine category concerned, for which a DF for PN was not established. In this case the assigned DF for PN may be combined with the previously measured DFs for the other pollutant emissions. The resulting DFs can be either additive or multiplicative.

In any case, *'Where assigned DFs are used, the manufacturer shall present to the approval authority robust evidence that the emission control components can reasonably be expected to have the emission durability associated with those assigned factors. This evidence may be based upon design analysis, or tests, or a combination of both.'* It should be noted that as stated in this sentence that it is sufficient to provide design analysis for this purpose. It is not required to provide test data for this purpose, rather this is optional.

The assigned DF values and their use instead of measured values originates in the Euro VI truck legislation, where the use of SCR and DPFs is prevalent. In that corresponding legislation there is no requirement for robust evidence. In the case of the NRMM engine emission Regulation it is understood that this check on *'robust evidence'* was introduced to ensure that, given the wider range of technology employed in NRMM engine applications, manufacturers did not seek to use these assigned values for technologies unsuited to those applications. In that context it should not be expected that the assigned DFs match exactly the DF that would be obtained during a service accumulation schedule, but rather that there is limited impact associated with any uncertainty between the former and the latter.

For example, it could be concluded that the use of short-life disposable particulate filters incapable of remaining durable for the prescribed EDP, or the omission of a DPF entirely, could be inappropriate technologies for a PN assigned multiplicative DF of 1.0, unless there is strong evidence to the contrary. Whereas, it could be concluded that if the manufacturer provides design analysis demonstrating use of well-established emission control technologies such as SCR and DPF, obtained from a supplier with good production control, with design features intended to maintain or increase their robustness in NRMM applications, then the assigned DFs could be considered appropriate, without the need for test data.

In some circumstances a manufacturer may decide to use the assigned DF at initial type-approval, but later conducts service accumulation DF testing. In that case, when DFs from a service accumulation DF test become available, the manufacturer may decide to obtain an extension to the type-approval to substitute these service accumulation DFs in place of the assigned DFs. In this case it is not necessary to repeat the engine emission test, but only re-calculate the final emission results.

Reference: Regulation (EU) 2017/654, Annex III, section 3.2.5.