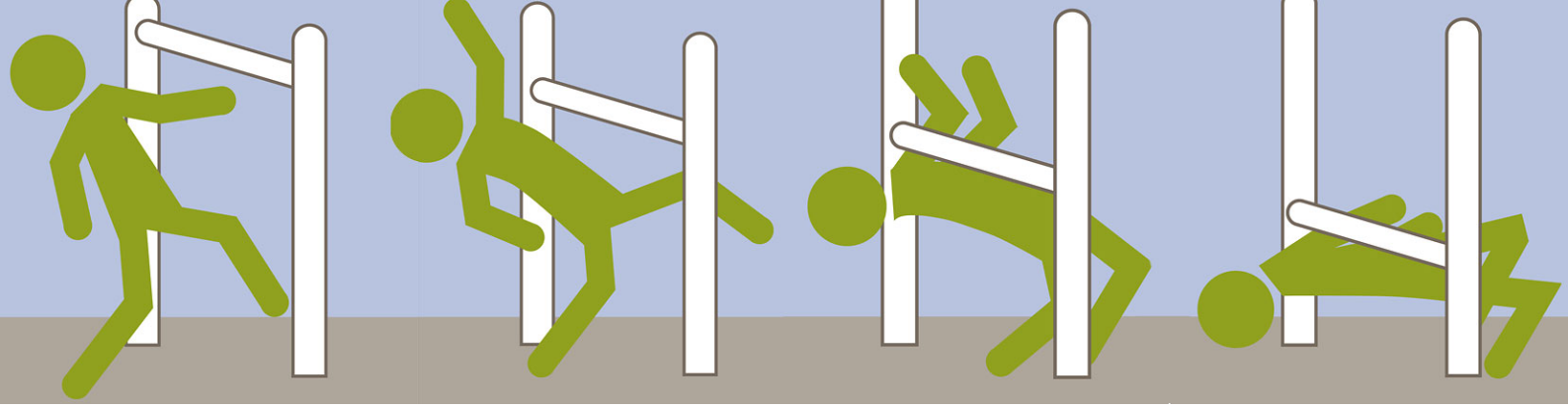


Legislation limbo

Words: Lucie Maluck | Pictures: Martina Ries

emissions, dpf

Do you know the feeling of trying to bend over backward further and further to get under the limbo bar? To begin with, it is nice and high so you only have to crouch a little to get underneath it. But as the dance progresses, the bar gets lower and lower. And very soon it is so low that you need to be a contortionist to get under without knocking it down. Such are the acrobatics that MTU engineers have been performing since 2000, when the environmental authorities started setting limits for pollutant emissions from off-highway diesel engines. To dance this kind of limbo, they need highly sophisticated technologies rather than physical agility and coordination.

In 2000, a new rail engine emitted around 0.25 g of soot particles per kWh. At 0.025 g per kWh, today's figure is a tenth of that. Over the same period, the emission of nitrogen oxides has fallen by around two-thirds. But the emissions limbo bar is to be lowered even further. The environmental authorities in Europe and America are currently engaged in discussions about future emissions limits. That further emissions stages are to be introduced is not in doubt. The only uncertainty is what exactly they will look like and when they will come into force. "The European Parliament will presumably reach a decision in the autumn on the new emissions limits that are to apply from 2019. In the US, the draft proposals are not yet available," explained Ulrich Beutke from Rolls-Royce Power Systems, who has been closely following developments in emissions legislation. But one thing is clear right now, and without the need for a crystal ball – the limbo dance with emissions legislation is set to continue. The bar will be lowered another notch or two and MTU researchers will once more have to find new ways of squeezing underneath it. As before, their aim with new emissions stages will be to develop engines that comply with requirements while remaining robust and as fuel-efficient as possible - a balancing act they have been accustomed to for some time.

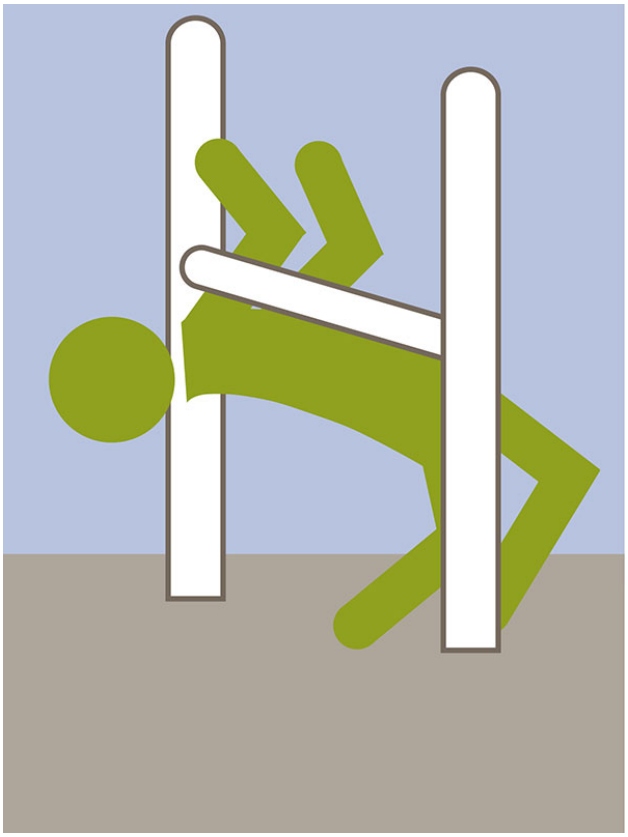
Emissions limits for soot particles and nitrogen oxide since 2000

The first limits for the emission of soot particles and nitrogen oxides were introduced in the USA in 2000. MTU was well prepared because in-house development of the key technologies, such as fuel injection, turbocharging and electronic engine management, had been a tradition in over 105 years of company history. Development engineers increased the fuel injection pressure to improve fuel atomization so that it would mix better with the air and thus burn more completely. That meant that less soot was produced. They also increased the turbocharger boost pressure so that more fresh air was delivered to the engine, reducing particulate emissions even further. And they successfully lowered nitrogen oxide emissions by optimizing combustion.

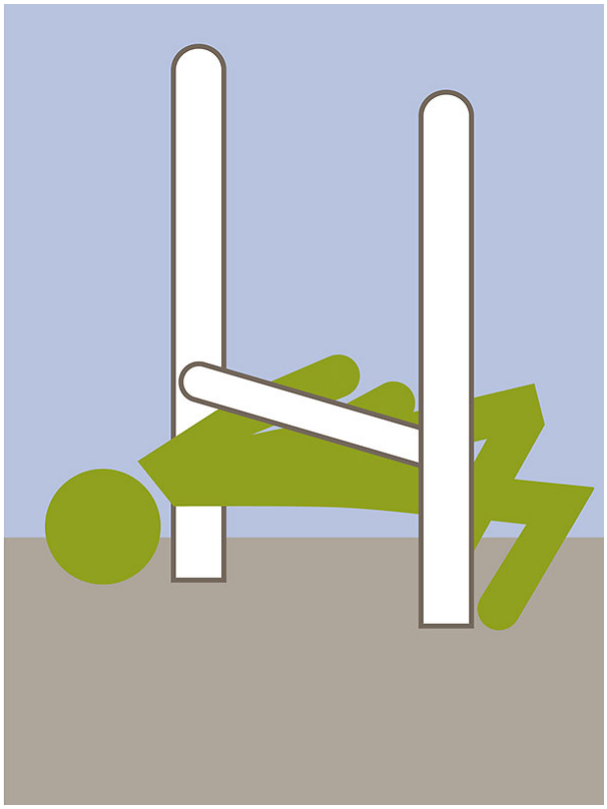
Clamping down on soot particles and nitrogen oxide

But then restrictions were tightened again. Indeed, the limbo bar was lowered repeatedly and more and more technologies were needed to avoid knocking it down. Even higher injection pressures and further combustion enhancements were employed to combat soot particles. The Miller process and a system for

recirculation of cooled exhaust gas were introduced to prevent nitrogen oxides from arising during fuel combustion. Engine electronics ensured that the systems worked in perfect harmony. "A balancing act," recalled Dr Marc Hehle. That is because if, for example, you change the injection timing so that the engine emits less nitrogen oxide, fuel consumption goes up. To counteract that, other technologies such as exhaust gas aftertreatment can be used. Furthermore, emissions and/or consumption reduction measures are even more effective if exhaust from the engine is cleaned by an SCR catalytic converter or diesel particulate filter. To date, however, MTU has installed diesel particulate filters as standard only on locomotive engines. Underfloor rail drives and industrial engines with outputs under 560 kW are equipped with an SCR system as standard.



Adding to the complication of low emission thresholds is the fact that there is no standardization of requirements worldwide, but rather a patchwork of legislative provisions. The restrictions vary according to engine application and country of use. In some instances the nitrogen oxide limit is especially low; in others the emphasis is on reducing particulate emissions or even both at the same time. In some countries there are also local regulations. "We developed different technologies for all the various requirements to enable us to stay within the limits," said Hehle. That means that his colleagues in series development are able to adapt engines and exhaust gas aftertreatment systems perfectly to the needs of the customers.



Particles to be counted instead of weighed

Continuing to achieve that in future obviously remains the aim of MTU development engineers. So they are waiting with bated breath for the new requirements to be announced by the environmental authorities in Europe and the USA. The European Commission is currently discussing the new Stage-V emissions standard, which is to lower the limits applying to inland waterway vessels, railcars and construction machinery, among others. And for some applications, there is a new, as yet unknown unit of measurement in the world of off-highway vehicles. Soot particles no longer have to be just under a certain weight, but also below a specific number. "We don't have any precise details of the emissions targets as yet," said Hehle, "but for a number of applications we are working on the assumption that we will have to use a diesel particulate filter to safely get under the bar," he revealed. Making the filter as compact, economical and fuel-efficient as possible is the next challenge faced by development engineers in the legislation limbo dance.

So they will have to contort themselves even further to refine technologies and fine-tune engines if they are to successfully squeeze under the next emissions obstacle.

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