

Find out more ... about the emissions legislation for diesel engines

Why are diesel fumes harmful?

The exhaust gases of diesel engines consist primarily of nitrogen oxides (NO_x), carbon monoxide (CO), hydrocarbons (HC), carbon dioxide (CO₂), particulate matter (PM) and water.

That means many components of diesel exhaust gases are toxic, carcinogenic or act as a greenhouse gas (CO₂ and particulate matter).

The main problem with soot particles:

Because of their small size, soot particles can travel into the human lung. It should be noted: The finer the particles, the more dangerous they are for humans. Because once they fall below a size of 10 microns, they are regarded as respirable, i.e. can enter the body via the lung surface.

In 2012, the World Health Organization classified diesel engine exhaust as being carcinogenic for humans!

Directive 97/68 / EC

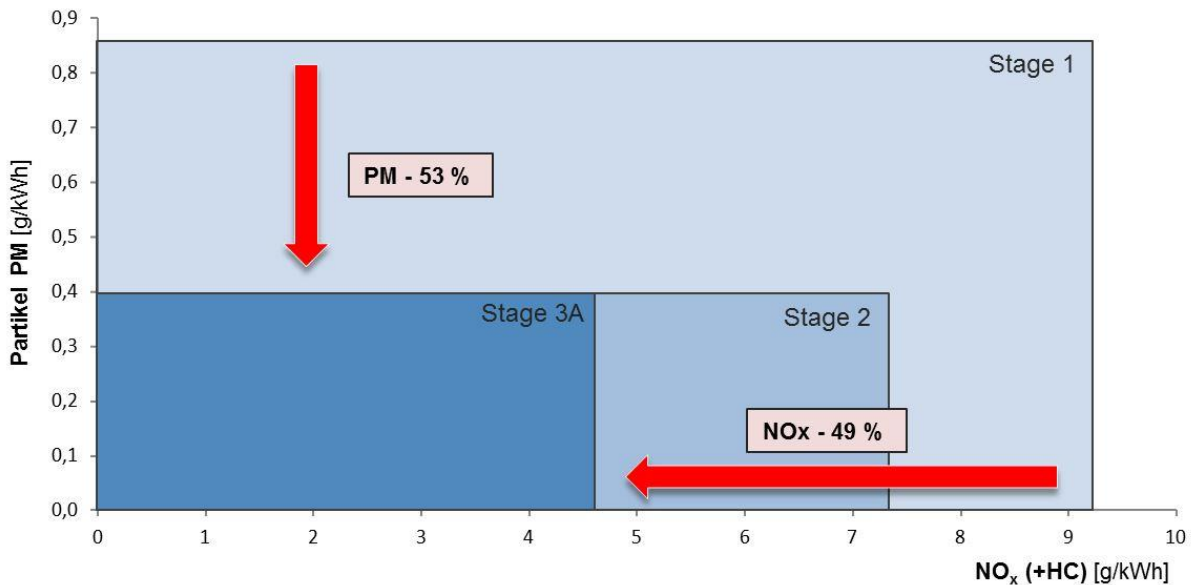
In the late 90s, regulations were introduced in Europe, the US and Japan that systematically reduce the concentration of pollutants in the exhaust gases of diesel engines. These emission limits have also applied to the diesel engines of road marking machines since then.

In Europe, Directive 97/68 /EC stipulates these limits. The individual emission limit values are scaled according to performance classes and become gradually more stringent through various stages.

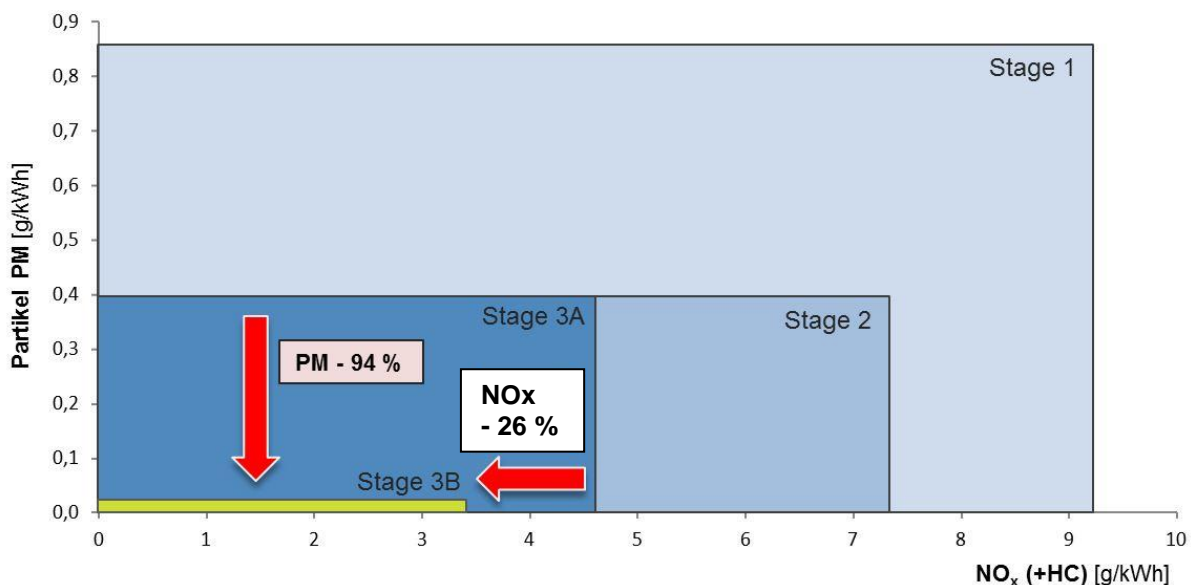
(The respective transition rules apply to the implementation of the individual stages).

		2008	2009	2010	2011	2012	2013	2014	2015	2016	
		Emission Limits in g/kWh									
EU	19kW≤P<37kW	STAGE IIIA HC + NO _x = 7,5 PT = 0,6									
	37kW≤P<56kW	STAGE IIIA HC + NO _x = 4,7 PT = 0,4				STAGE IIIB HC + NO _x = 4,7 PT = 0,025					
	56kW≤P<75kW	STAGE IIIA HC + NO _x = 4,0 PT = 0,3				STAGE IIIB NO _x = 3,3 PT = 0,025			STAGE IV NO _x = 0,4 PT = 0,025		
	75kW≤P<130kW	STAGE IIIA HC + NO _x = 4,0 PT = 0,2				STAGE IIIB NO _x = 2,0 PT = 0,025			STAGE IV NO _x = 0,4 PT = 0,025		
	130kW≤P<560kW	STAGE IIIA HC + NO _x = 4,0 PT = 0,2				STAGE IIIB NO _x = 2,0 PT = 0,025			STAGE IV NO _x = 0,4 PT = 0,025		
US	< 8kW	TIER IV NO _x = - NMHC+NO _x = 7,5 PT = 0,4									
	8kW≤P<19kW	TIER IV NO _x = - NMHC+NO _x = 7,5 PT = 0,4									
	19kW≤P<37kW	TIER IV Interim NMHC+NO _x = 7,5 PT = 0,3				TIER IV NMHC+NO _x = 4,7 PT = 0,03					
	37kW SP< 75kW	37kW≤P<56kW	TIER IV Interim NMHC+NO _x = 4,7 PT = 0,3				TIER IV NMHC+NO _x = 4,7 PT = 0,02				
		56kW≤P<75kW	TIER III NMHC+NO _x = 4,7 PT = 0,4			TIER IV Interim NMHC+NO _x = 4,7 PT = 0,02		Transition year		TIER IV NO _x = 0,4 PT = 0,02	
		75kW≤P<130kW	TIER III NMHC+NO _x = 4,0 PT = 0,3			TIER IV Interim NMHC+NO _x = 4,0 PT = 0,02		Transition year		TIER IV NO _x = 0,4 PT = 0,02	
	130kW≤P<560kW	TIER III NMHC+NO _x = 4,0 PT = 0,2			TIER IV Interim NMHC+NO _x = 4,0 PT = 0,02			TIER IV NO _x = 0,4 PT = 0,02			

From Stage I through to Stage IIIA, the nitrogen oxides and the particulate mass were reduced by about 50 % (performance class 56-130 kW). This reduction could be realised completely with internal engine modifications:



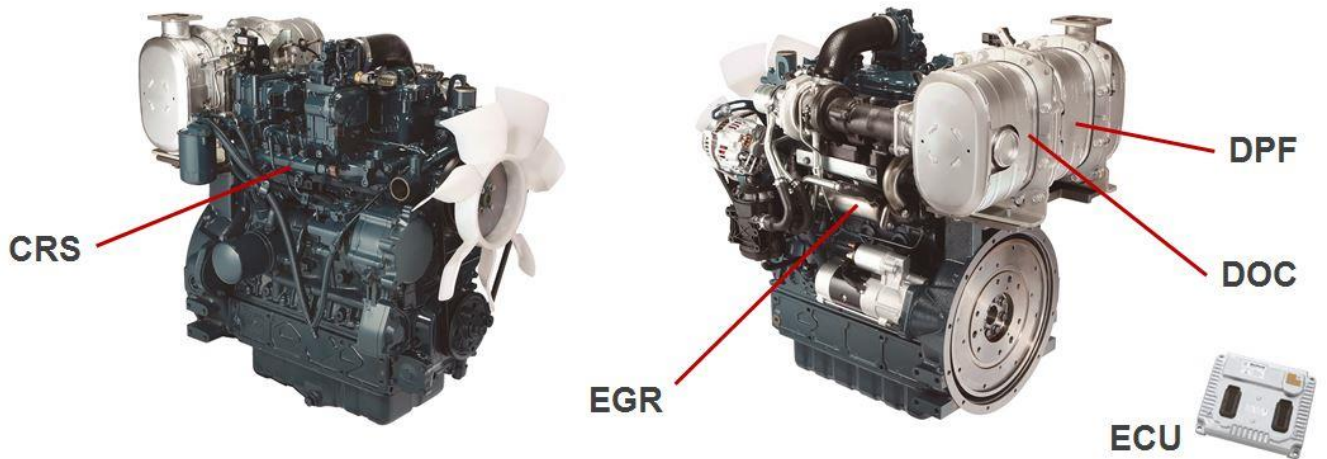
Now in implementation is stage IIIB. For engine development, this is the largest step so far in reducing the emissions. In the 56-130 kW performance class, particulate matter (diesel soot) must be reduced by 94 % and nitrogen oxides by 26 % compared to stage IIIA.



This reduction cannot be achieved with further internal engine modifications alone. Therefore from Stage IIIB, exhaust after-treatment systems will be used.

HOFMANN stage IIIB engines

The task of reducing pollutants to the stage IIIB level involves a whole package of measures:



Common-rail direct injection (CRS): high injection pressures, fine atomisation of the fuel. Using multiple injections, the combustion process is specifically controlled and adapted to different operating conditions. Raise the cleanliness and efficiency of combustion.

External exhaust gas recirculation (EGR): some of the exhaust gas from the combustion is fed back, reducing the nitrogen oxides.

Diesel Oxidation Catalyst (DOC): unburned fuel constituents are converted into harmless CO₂ and water. Here, the exhaust gas temperature increases, which is important for the diesel particulate filter.

Diesel Particulate Filter (DPF): Soot particles are collected and burnt off primarily as carbon dioxide. The degree of filtration is > 99 %.

Stage IIIB engines are currently available for the following machine types: H18-2, H26-4, H33-4

Note:

HOFMANN takes advantage of the provided transitional arrangements and provides the proven Stage IIIA engines in parallel for a certain length of time (flexibility scheme in accordance with 97/68/EC).

All customers in non-regulated countries still get the proven Stage II engine, of course – but without complex filter systems and without electronic engine controls.

DOC only or SCR only?

A note concerning the methods of measuring particulate emissions: Stage IIIB can also be complied with using DOC-only or SCR-only solutions. This means only with an oxidation catalyst or only with an SCR catalytic converter – a particulate filter is omitted here.

All of these approaches attempt to capitalise on a weakness of the currently prescribed measurement procedure for particulate mass. That is because, for the purposes of emissions legislation, the particulate mass is defined. That is the mass deposited on a defined analysis filter after a defined measuring method. The measured particulate mass is thus dependent on the analysis filter!

The approach taken by some motor manufacturers is to make the particulates so small that they can slip through the analysis filters. Technically this is done primarily by using even higher injection pressures.

But beware: the number of the smallest particulates increases significantly due to the higher pressures. And it is precisely these tiny particles that are particularly dangerous, as they can penetrate into the lungs.

Switzerland has therefore not only set a limit on the particulate mass, but has also set a particulate count, i.e. the number of particulates emitted is also limited. And this limit can be met in practice only by using a particulate filter. With stage V also the EU will introduce such a particulate number value as of 2019. Then, at the latest, DOC-only or SCR-only solutions will no longer be permitted!

Labour protection and air quality play an increasing role. Operators of mobile machines are, for example, also affected by the 'Directive on ambient air quality and cleaner air for Europe' (2008/50 / EC), known as the fine dust regulation. Municipalities have introduced local low-emission zones in accordance with this directive. Mobile machines are also becoming increasingly incorporated, allowing the use of particulate filters to be demanded. Operators of machines without particulate filters are then excluded from tenders.

The HOFMANN machines with Stage IIIB engine are of course suitable for low-emission zones according fine dust regulation.

HOFMANN selects the cleanest way (DOC and DPF) – for occupational safety and for the environment!

HOFMANN GmbH