

# Impact of the Stage V off-road emissions standard on agricultural engine lubricants

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Over one billion people work in the agriculture sector across the world; a staggering figure which accounts for almost 3 out of every 10 people employed and larger than the entire population of the EU and USA combined.

The importance the agricultural sector plays in our everyday lives cannot be underestimated. This sector uses over one third of the global land area and given the world's population is forecast to grow by more than 40% over today's 7.7 billion, our reliance on the agricultural sector will intensify.

It's essential for agricultural landowners to maximise productivity, efficiency and generate profits to enable future sustainability. While external factors exist, including unpredictable and adverse weather conditions, as well as changes to agricultural subsidies

and tariffs, there are many actions farmers can take which improve their business model.

Vehicle utilisation is paramount to farmers wanting to reduce the total cost of ownership and is relevant whether the equipment is owned, leased or when using an agricultural contractor. High performing machines with advanced engine hardware, sophisticated farming technologies and autonomous driving are increasingly being used to improve efficiency, precision and crop yield.

Likewise, higher performance lubricants which operate in more harsh applications, together with the move to lower viscosity and more fuel-efficient lubricants enable farmers to reduce the total cost of ownership of their equipment.

According to the Food and Agriculture Organization of the United Nations (FAO), agriculture greenhouse gas (GHG) emissions contributed approximately 5 billion metric tonnes of CO<sub>2</sub> to the atmosphere each year between 2005 and 2017. While a large proportion of the emissions generated are outside of the scope of agricultural hardware and lubricants, the industry has a significant role to play in reducing emissions and delivering a more sustainable and cleaner environment.

Exhaust emissions from all off-highway combustion engines (including farm tractors) are estimated by the European Commission to contribute approximately 15% of nitrogen oxides (NOx) and 5% of particulate matter (PM) to air pollution in Europe.

For off-highway diesel engines, European emissions standards apply to engines used in non-road mobile machinery (NRMM). Following the adoption of Directive 97/68/EC, generally referred to as the Stage I emissions standard and implemented in 1999, subsequent amendments and progressive tightening of limits have been made, culminating in the latest Stage V emission standard, formally adopted from Regulation (EU) 2016/1628.

Stage V is the world's most stringent emissions standard for off-highway diesel engines, even surpassing the US Tier 4 Final standards. Stage V introduces particulate number (PN) limits for the first time and mandates carbon monoxide (CO), hydrocarbon (HC), PM and NOx limits across a much broader range of engine kW power ratings. PM limits are also now 40% lower versus Stage IV for engines rated between 56-560 kW.

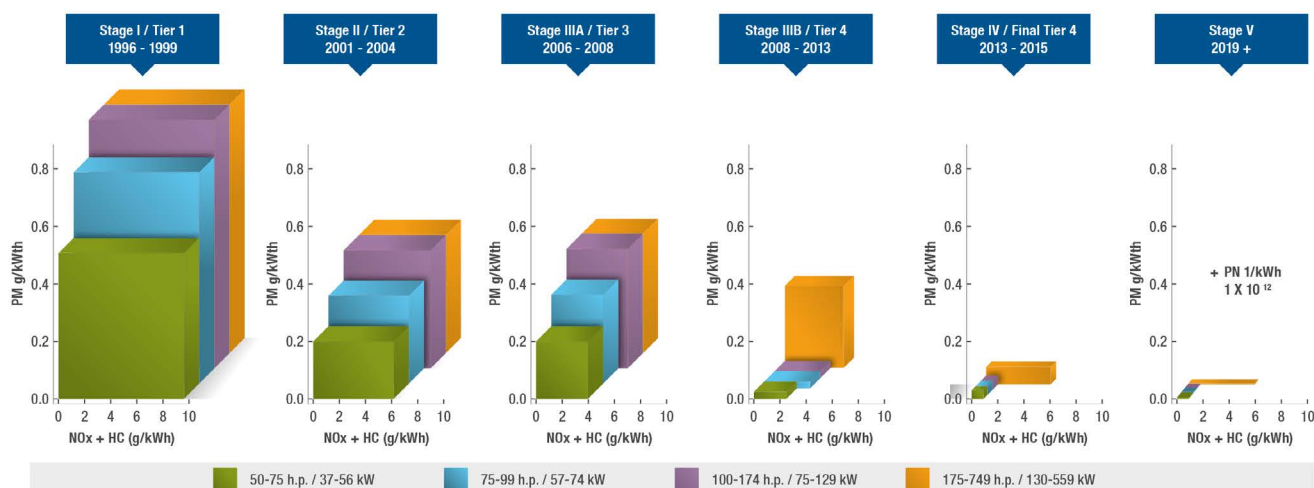


While the Stage V standard applies to many markets the most substantial impact is on diesel engine models widely used within construction and agriculture, with all equipment facing compliance irrespective of engine power output.

The progressive reductions in engine emissions of NRMM are significant, notably when comparing the latest Stage V against the original Stage I emissions limits. For a farm tractor with an engine size between 130 and 560kW, PM reductions of 72% and HC+NOx reductions of 94% show how strict legislation has become and reinforces the important role farm tractors have to play in a more sustainable, safer and cleaner future.

The tightening of emissions requirements has seen the Original Equipment Manufacturers (OEMs) adopt various hardware and after-treatment strategies.

## EPA AND EU OFF-HIGHWAY 50-749 H.P. HD ENGINES EMISSION REGULATIONS



**Fig 1:** EPA and EU off-highway 50-749 h.p. HD engines emission regulations



The Stage IIIB standard introduced a PM limit of 0.025 g/kWh and while it was intended to drive the introduction of Diesel Particulate Filters (DPFs), most OEMs met the PM limit without filters. A reduction in NOx to 0.4 g/kWh for the Stage IV standard triggered the widespread use of NOx after-treatment (typically urea-Selective Catalytic Reduction (SCR)) on affected categories of engines.

The latest Stage V standard poses new after-treatment system challenges for OEMs, with most requiring their equipment to feature a combination of Diesel Oxidation Catalyst (DOC), DPF and SCR. In comparison to Stage IV, compliance with the Stage V emissions standard will be nearly impossible to achieve without the use of a DPF.

These stringent requirements necessitate the correct engine lubricant formulation and performance additive technology selection to ensure efficient after-treatment system and engine performance. The widespread adoption of advanced after-treatment devices will significantly increase market demand for lubricants with lower levels of Sulphated Ash, Phosphorus and Sulphur (SAPS).

Lower SAPS engine lubricants with the correct OEM endorsed performance specifications prolong the life of costly after-treatment devices and maintain engine performance and durability. Use of an incorrect lubricant will lead to DPF problems as a rapid build-up of ash will eventually block the channels within the filter resulting in performance issues and potentially serious damage, unplanned downtime and expensive

repair costs for the farmer. OEMs recognise and specify high performance ACEA E6 or ACEA E9, API CK-4 and OEM approved engine lubricants to provide the correct level of protection for the lifetime of the tractor.

Stage V is applicable to all countries within the European Union. Consequently, the demand for lower SAPS engine lubricants is forecast to grow significantly, representing an opportunity for lubricant marketers targeting the agricultural sector.

Alongside the engine lubricant, the use of the appropriate dedicated universal tractor transmission oil (UTTO) enables the performance of the entire tractor to be optimised, including the clutches, final drives, wet brakes and hydraulic systems.

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