LOAD & HAUL
STAGE V ENGINE TECHNOLOGY

SANDVIK

PROVEN STAGE V ENGINE TECHNOLOGY FOR UNDERGROUND MINING

Sandvik is continuously developing its loaders and trucks. We are committed to offering low-emission loaders and trucks with state-of-the-art diesel engines for underground mines. Equipment and engine technology have taken huge leaps in reducing particulate emissions. Today, with our expertise and collaborative networks, we are delivering Stage V compliant loaders and trucks, in which the engine and equipment work as one.

Sandvik has hundreds of Stage V engine powered loaders and trucks operating underground.

Achieved through more than 10,000 hours of LHD testing in underground mining conditions at multiple customer sites in Europe, the new technology meets or exceeds the most stringent emission regulations in existence.*

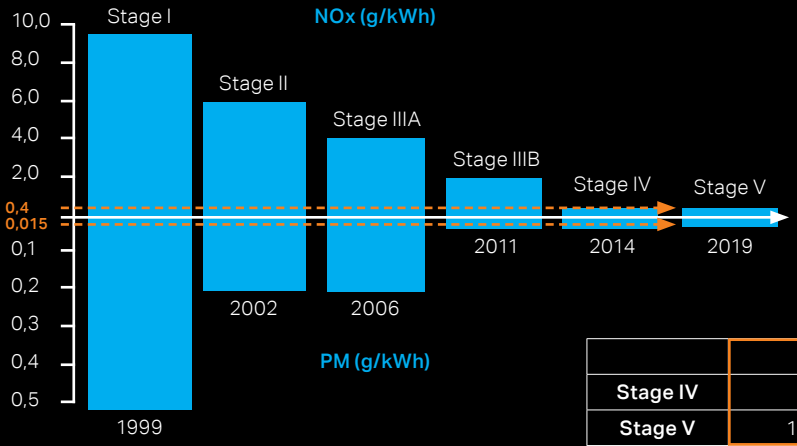
**Stage V engines are optionally available for selected Sandvik loaders and trucks in areas where ultra-low sulfur fuel and low-ash engine oil is available. For more information, please contact your local Sandvik representative.

*As of this printing: June 2023

REDUCED DIESEL EMISSIONS

REGULATION DEVELOPMENT FOR NON-ROAD DIESEL ENGINES, POWER RANGE 130 KW - 560 KW

The most significant benefit of Stage V compliant loaders and trucks is the reduced amount of particulate matter in the diesel exhaust, which helps improve air quality underground. The Stage V engine delivers the best in class ventilation rates to achieve lower ventilation costs.



25 times less particle mass than in Stage II engine emissions

	PN	PM (g/kWh)	NOx (g/kWh)
Stage IV	-	0,025	0,40
Stage V	$1x10^{12}$	0,015	0,40

PASSIVE REGENERATION

Reduction of diesel particles in Stage V engines with power range 130 kW - 560 kW is based on having Diesel Particulate Filter (DPF) technology as part of the engine's after-treatment system. Stage V engines from Volvo Penta utilize passive DPF regeneration which takes place during normal equipment operation. Exhaust temperature is maintained at an optimum level at all times while the filter is regenerated. Passive regeneration is most efficient in a temperature range of 250-450^{C}, which usually matches with the normal engine work cycle. This means that in normal operating conditions, there is no need to stop the equipment or manually start the regeneration. These actions are aimed to minimize equipment downtime.

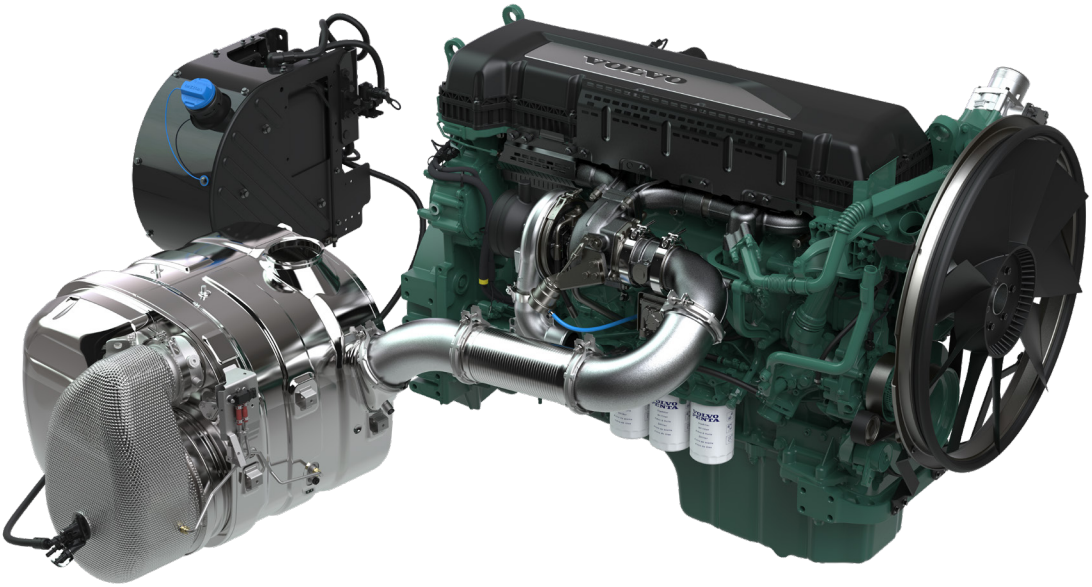
SELECTIVE CATALYTIC REDUCTION

The exhaust after treatment contains a Selective Catalytic Reduction system (SCR), which uses diesel exhaust fluid to reduce emissions of nitrogen oxide. The SCR, with the DPF, reduces emissions without sacrificing performance or fuel efficiency.

DESIGNED FOR UNDERGROUND PERFORMANCE

As a result of the collaborative development with Volvo Penta, the Stage V engine and Sandvik equipment work together to maintain productivity and reliability in the most challenging environments. Both the engine and the equipment come with proven track records from previous design solutions for underground use.

Without any compromise between the latest engine technology or the performance level of the equipment, the Stage V engine provides the same power output as the previous Stage IV / Tier 4f engines. Increased wiring protection, including a braided armour wiring harness, improves reliability. Further, all electrical hardware is specially designed for demanding conditions with corrosion, heat and water resistance. The exhaust aftertreatment system design fits perfectly in place in the robust equipment frame, allowing us to keep the main dimensions and weights unchanged.



HIGH AVAILABILITY

MODULATING ENGINE BRAKE

Volvo Penta Stage V engines are equipped with a modulating engine brake, enabling the operator to adjust the engine braking power, for better downhill speed control, and minimizing brake and transmission overheating and brake wear. The modulating engine brake and passive regeneration contribute to high uptime.

REDUCED OIL CONSUMPTION

Sandvik Load and Haul is committed to more sustainable operation of its equipment. As a concrete action, with the new Volvo Penta Stage V engines, the engine oil change interval is extended from 250 to 500 hours, decreasing annual oil consumption and improving productivity by increasing availability.

1000 times fewer particles per cm^3 than in Stage II engine emissions

REDUCED FUEL CONSUMPTION

The Stage V loaders and trucks are capable of operating with up to 3% reduced fuel consumption compared to the lower Stages, reducing total costs of ownership. The fuel and DEF (diesel exhaust fluid) tanks enable continuous operation for a full working shift without the need to stop and refuel. The optionally available Wiggins fast-filling system reduces fueling time by up to 80 % and eliminates fuel and oil spills.

Up to **3%** reduced fuel consumption compared to lower Stages*

* Test results are to be considered as results reached under certain controlled test conditions. These test results should not be treated as specifications and Sandvik does not guarantee, warranty or represent the outcome of test results in any or all circumstances.

BUILT-IN FIRE SAFETY

To mitigate fire risks relating to high temperatures, Sandvik loaders and trucks come are carefully designed, specifically keeping in mind tough underground mining conditions.

OUR BUILT-IN FIRE PREVENTION SOLUTIONS INCLUDE:

- Hot and cold side design for the engine area
- Separation of main hydraulics from the hot engine area
- Double-wall exhaust pipe and shielding on the exhaust system
- Turbocharger covers
- Overcurrent protection and covering on electrics
- Fire-resistant materials and components
- Circuit breakers in the operator's compartment

In addition to careful design, correct equipment use and maintenance practices have crucial importance for fire safety.

PROTECT YOUR EQUIPMENT WITH ECLIPSE® FROM SANDVIK

To further reduce the risks of fire, the optional fire suppression system Eclipse® works as an ideal backup. Eclipse® Sustain from Sandvik is a sustainable choice, as it is the world's first fluorine-free fire suppression liquid for mobile equipment.

SAFETY FIRST

Statistics from mobile equipment fires reveal the following critical steps for successfully suppressing devastating fires without reliance on operator intervention:

1. Automatic detection and activation

Early control of a fire is critical, as most large fires start out small and unnoticed

2. Automatic engine shutdown

Isolation of equipment power is key to interrupting the fuel supply feeding the fire

3. Extended discharge time

Liquid-agent fire suppression seals in flammable vapours and cools superheated surfaces to prevent re-ignition

All Eclipse™ fire systems feature fully automated activation and engine shutdown as standard features

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