**Scania at INTERMAT 2009:**

**New engine range meets 2011 emission standards**

Scania launches a range of engines that complies with the Stage IIIB and Tier 4i regulations. With Scania-developed systems for engine management and emission control, the new range provides an outstanding blend of performance and operating economy. Prototype engines will be available for installation and approval as early as 2009.

The year 2011 will be significant for engine manufacturers and their customers. This is the year when the Stage IIIB and Tier 4i emission legislations for non-road applications come into effect, specifying NOx\(^1\) levels as low as 2.0 grammes per kWh. The new engine platform, to be launched at INTERMAT 20 April 2009, enables Scania customers to prepare well in advance for meeting the new regulations.

With the new engine platform, based on the successful range of modular truck and bus engines, Scania has secured control of all strategic steps in development and performance control. Basic engine development and manufacturing, as well as the development of engine management, fuel injection and emission control systems are all carried out in-house. This strategic move is motivated by demands and targets for performance and fuel economy, as well as to secure consistent environmental performance, robustness and convenience of operation.

Key characteristics of the new engine range are:

- Scania XPI common-rail fuel injection
- Revised bore and stroke for increased swept volume
- Increased combustion pressure
- Traditional easy-to-service Scania architecture with individual cylinder heads
- Scania engine management
- Waste-gate turbocharger
- Scania SCR exhaust aftertreatment
- Scraper ring to prevent coke build-up on top of the piston

**Scania XPI, common-rail fuel injection**

The new common-rail fuel injection system, Scania XPI (extra high-pressure injection), has been developed jointly with Cummins.

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\(^1\) NOx is a generic term for mono-nitrogen oxides (NO and NO\(_2\)). These oxides are produced during combustion.
- Up to 2400 bar injection pressure
- High injection pressure gives low particulate emissions
- Low combustion noise
- High torque at low revs
- Increased power output

The new common-rail system allows a high degree of freedom in terms of injection timing and pressure. Injection timing and duration are independent of the camshaft angle. High injection pressures are thus available at any time, irrespective of engine speed. It also opens the possibility to use several injection pulses. See below.

Control of the fuel injection system is all-electronic. This means that there are no lobes on the camshaft to actuate the fuel injectors, nor are there any tappets, pushrods or rocker arms for this purpose.

![Scania XPI schematic](image)

Scania XPI schematic
1. Low-pressure pump
2. Fuel filters with water separator
3. Inlet metering valve
4. High-pressure pump
5. Rail (accumulator)
6. Rail pressure sensor
7. Mechanical dump valve
8. Return rail
9. Electronically controlled fuel injector

Working principle of Scania XPI:
- Fuel is sucked from the tank by the low-pressure pump via a pre-filter with a water separator and via the cooling circuit for the engine management system to the main fuel filters. Water in the fuel is automatically drained back to the tank via a venturi device.
- The low-pressure pump supplies fuel via the inlet metering valve to the high-pressure fuel pump. The pumps, which are integrated into one unit together with the fuel metering valve, are driven by the timing gears of the engine.
- The high-pressure pump supplies fuel under operating pressure to the rail, i.e. the accumulator running the length of the engine on the cool side.
- The operating pressure is regulated by the amount of fuel admitted by the inlet metering valve, ranging from an idling pressure of around 500 bar to a peak pressure of 2400 bar. The average working pressure is around 1800 bar.
- The inlet metering valve is controlled electronically by the engine management system via a closed loop from a pressure sensor in the rail. A mechanical dump
valve on the rail prevents excess pressure build-up by sending fuel back to the tank via the return rail.

- The fuel injector for each cylinder is constantly fed with high-pressure fuel from the rail. Injection pulses are controlled electronically via a servo valve in the injector. The injector remains open as long as current is supplied from the ECU.
- The amount of fuel injected depends on the opening time and the pressure in the rail. The starting time of the pulse determines the start of injection.
- Fuel is injected into the combustion chamber through the injector nozzle.

**In-house engine management system**

To secure control of all aspects of engine performance, Scania has developed a new generation of engine management systems. The multitude of functions controlled includes fuel injection, exhaust aftertreatment, charge-air and engine operating temperature. The control unit is mounted on the cool side of the engine. The new engine management system also provides advanced on-board diagnostics that will be further developed over time and allows detailed logging of operational data for subsequent analysis.

**Engine architecture**

The new engine platform is a completely new design, yet it retains traditional Scania characteristics like individual cylinder heads, camshaft located high in the block and rear-mounted timing gears, as well as the familiar cyclone oil filter. Bore (9-, 13- and 16-litre) and stroke (13-litre) have been slightly altered and swept volume increased compared to current engines.

Important features for the industrial engine segment are high uptime, generous torque at low revs, good fuel economy and prompt engine response.

The cylinder block and other structural components have been redesigned for additional strength. There is a loose scraper ring at the top of the cylinder liners which removes the residual carbon from the edge of the piston crown and reduces the risk of cylinder liner wear.

**Scania SCR**

Scania has chosen to use SCR (Selective Catalytic Reduction) in combination with the common-rail fuel injection system, Scania XPI, for industrial off-road applications.

The function of the SCR system is based on the injection of a urea solution into the exhaust pipe and a hydrolysis catalyst. The urea solution forms ammonia from the heat of the exhaust gases and enters into the catalytic converter. When the NOx reacts with ammonia in the catalytic converter, the NOx molecules in the exhaust gases are converted into nitrogen and water.
Scania SCR is capable of reducing NOx emissions to the levels required by a number of future emission standards. As all OEMs need to rebuild their equipment due to the introduction of new emission control technologies, the majority are likely to adapt their designs to also meet the emission steps, Stage IV and Tier 4, entering into force in 2014.

To enable customers to meet the 2011 deadline with a mature OEM product, Scania will offer prototype engines for installation and approval as early as 2009. This will give OEMs using Scania engines the advantage of being well prepared for the years to come.

The emission legislation of 2014 will, as it looks today, most likely demand both SCR and some amount of EGR. Since several years, Scania is using EGR as well as SCR technology for trucks and buses. If the engine installation is adapted for SCR, only small modifications will be required for the next step. Scania SCR is ideal for industrial applications depending on the reduced need for performance calibration to different industrial applications and customers.

**AdBlue / DEF**

AdBlue or DEF (Diesel Exhaust Fluid in the US) are the commercial names of a mixture of water and urea. It is a non-toxic aqueous urea-solution that chemically reduces NOx-emissions from diesel-fuelled engines. When dissolved in water it is non-toxic and easy to handle.

With SCR, you need an additional tank for the urea solution. The supply of AdBlue or DEF on the market is gradually being extended and the majority of industrial applications operate locally with mobile fuel depots. SCR has been used to reduce NOx emissions in stationary and marine installations for two decades and in recent years has also found widespread use in automotive applications. The consumption of AdBlue or DEF in the aftertreatment system is 2-7 per cent of the diesel fuel consumption, depending on the application.
Scania provides all components in the SCR system, from the supply tank for AdBlue/DEF to the catalyst and the NOx sensor. Special materials are used because the urea solution is corrosive to metals such as non-alloyed steel and zinc coated steels.

AdBlue is classified under the minimum risk category of transportable fluids. AdBlue is guaranteed to meet the standards of ISO 22241 and DIN V 70070 and the CEFIC regulations to safeguard correct functioning of the SCR system. The urea solution has the following properties:

- Freezes at -11°C
- Crystallises above 100°C
- Consumption around 2-7% of fuel consumption for Stage IIIB and Tier 4i NOx-levels
- The urea solution is corrosive to some metals such as non-alloyed steel, copper, copper containing alloys and zinc coated steels
- No restrictions for transport on rail, road or sea

**Extended maintenance intervals**
Maintenance and oil-change intervals have been extended to 500 h. Shared components and systems between the different engine series reduce costs for parts stocking and maximise availability. Also training of staff is facilitated by the systems commonality between the engine series.

**Engine weights and dimensions**

<table>
<thead>
<tr>
<th>Engine type</th>
<th>Swept volume</th>
<th>L (mm)*</th>
<th>W (mm)</th>
<th>H (mm)</th>
<th>Dry weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC9</td>
<td>9.3-litre inline 5</td>
<td>1230</td>
<td>870</td>
<td>1200</td>
<td>900</td>
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<tr>
<td>DC13</td>
<td>12.7-litre inline 6</td>
<td>1400</td>
<td>900</td>
<td>1200</td>
<td>1000</td>
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<tr>
<td>DC16</td>
<td>16.4-litre V8</td>
<td>1300</td>
<td>1100</td>
<td>1200</td>
<td>1300</td>
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</tbody>
</table>

* Without fan

**Scania industrial engine range for EU Stage IIIB and US Tier 4i**

<table>
<thead>
<tr>
<th>Engine type</th>
<th>All-speed Performance</th>
<th>Engine type</th>
<th>Performance</th>
<th>Spec. fuel cons. at 1500 r/min</th>
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</thead>
<tbody>
<tr>
<td>Spec. fuel cons.</td>
<td>kW (hp)</td>
<td>r(min)</td>
<td>Rating*</td>
<td>Max. torque</td>
</tr>
<tr>
<td>DC9</td>
<td>202 (275)</td>
<td>2100</td>
<td>ICFN</td>
<td>1552</td>
</tr>
<tr>
<td></td>
<td>257 (350)</td>
<td>2100</td>
<td>ICFN</td>
<td>1800</td>
</tr>
<tr>
<td></td>
<td>294 (400)</td>
<td>2100</td>
<td>IFN</td>
<td>1967</td>
</tr>
<tr>
<td>DC13</td>
<td>257 (350)</td>
<td>2100</td>
<td>ICFN</td>
<td>1950</td>
</tr>
<tr>
<td></td>
<td>294 (400)</td>
<td>2100</td>
<td>ICFN</td>
<td>2157</td>
</tr>
<tr>
<td></td>
<td>331 (450)</td>
<td>2100</td>
<td>ICFN</td>
<td>2255</td>
</tr>
<tr>
<td></td>
<td>368 (500)</td>
<td>2100</td>
<td>IFN</td>
<td>2373</td>
</tr>
<tr>
<td>DC16</td>
<td>404 (550)</td>
<td>2100</td>
<td>ICFN</td>
<td>2632</td>
</tr>
<tr>
<td></td>
<td>478 (650)</td>
<td>2100</td>
<td>ICFN</td>
<td>2872</td>
</tr>
<tr>
<td></td>
<td>515 (700)</td>
<td>2100</td>
<td>IFN</td>
<td>2938</td>
</tr>
</tbody>
</table>

* ICFN: Continuous service, rated output available 1/1 h. Unlimited h/year service time at a load factor of 100%.

IFN: Intermittent service, rated output available 1/6 h. Unlimited h/year service time at a load factor of 80%.
## Introduction schedule

<table>
<thead>
<tr>
<th>Engine type</th>
<th>Performance</th>
<th>Emission class</th>
<th>Start of delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>202 kW (275 hp)</td>
<td>Stage IIIB / Tier 4i</td>
<td>September 2010</td>
</tr>
<tr>
<td>DC9</td>
<td>257 kW (350 hp)</td>
<td>Stage IIIB / Tier 4i</td>
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For further information about the engine range and availability of prototypes before introduction, please contact Bernt Gustavsson, Sales Director Industrial Engines, tel. +46 8 55380337, e-mail bernt.gustavsson@scania.com

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Scania is one of the world’s leading manufacturers of trucks and buses for heavy transport applications, and of industrial and marine engines. A growing proportion of the company’s operations consist of products and services in the financial and service sectors, assuring Scania customers of cost-effective transport solutions and maximum uptime. Employing more than 35,000 people, Scania operates in about 100 countries. Research and development activities are concentrated in Sweden, while production takes place in Europe and South America, with facilities for global interchange of both components and complete vehicles. In 2007, invoiced sales totalled SEK 84.5 billion and the net income amounted to SEK 8.6 billion.

Scania press releases are available on the Internet, www.scania.com