

EURO4
EURO5

ENVIRONMENT: WE LOOK AHEAD.



PRESS INFO

UK

IVECO

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ENVIRONMENT: WE LOOK AHEAD.

IVECO

I. IVECO AND THE ENVIRONMENT

Respect for the environment is one of the company's core values, in view of its importance for our clients and society in general.

Thanks to our ongoing commitment to research and development, Iveco designs and produces eco-compatible engines, taking into account factors such as fuel consumption, greenhouse gases, exhaust emissions, noise levels, durability, reliability, recycling and saving on materials and energy resources.

Our research work aims to do more than just ensure compliance with legal requirements, coming up with solutions which guarantee maximum efficiency, ever mindful of our clients' needs in terms of both performance and cost-effectiveness. Iveco dedicates particular attention to developing both its light, medium and heavy commercial vehicles and its passenger transport range and special applications. Iveco's approach to emission-reducing technologies is based on a far-reaching vision which takes into account developments in terms of emission limits, technology, availability of resources – and not least – optimising its investments. In this way Iveco is able to offer its clients the most advanced, and at the same time the most reliable solutions.



I.1 - IVECO STRATEGY

I.1.1 - LIGHT COMMERCIAL VEHICLE RANGE: THE DAILY

Conformity with future Euro 4 standards requires a considerable reduction in NOx and particulate emission levels.

The Iveco Daily is already able to meet these environmental requirements, satisfying the regulations which will soon be introduced.

In fact, the Iveco Daily offers a specific version, different from the Euro 3, incorporating EGR (Exhaust Gas Recirculation) technology together with a DPF (Diesel Particulate Filter) fitted on diesel engines.

EGR technology reduces NOx emissions by lowering the combustion temperature thanks to recirculation of a controlled quantity of exhaust gas that is cooled and reintroduced into the combustion chamber. The system is governed by the electronic engine control unit and uses an air flow measurer that is fitted on all speed and load ranges. Combustion temperature is lowered and formation of NOx remains under control.

Particulate is cut down to minimum levels thanks to treatment of the exhaust gas by the DPF, a self-regenerating type of particulate capturer.

Highly optimised combustion combined with multiple timing and high pressure injection mean a considerable saving in fuel while also achieving environmental objectives.

I.1.2 - MEDIUM COMMERCIAL VEHICLE RANGE: THE EURO CARGO

Iveco also chooses SCR for Eurocargo to comply with Euro 4 and Euro 5 Directives

In the first half of 2006 Iveco will begin marketing Eurocargo Euro 4&5 versions. All versions will be equipped with the SCR system and just like the heavy range will have an optimised tector engine, a urea tank, an AdBlue dosing system and a catalytic converter. And so the benefits of this technological choice will become available to Eurocargo customers. In addition to a reduction in fuel consumption, customers will find maintenance intervals compared with Euro 3 remain unchanged and, above all, right from the start it will be possible to choose between Euro 4 or Euro 5 versions.

The estimated consumption of AdBlue is about 1 litre every 20 litres of diesel fuel. While meeting environmental standards Iveco has once again chosen the best technology from a customer standpoint.

I.1.3 - PASSENGER TRANSPORT: IVECO IRISBUS

Irisbus, leader in the manufacture of clean vehicles

Irisbus is the leader in the entire low emissions public transport category, including natural gas powered vehicles, electric, hybrid and clean Diesel vehicles. For its Diesel buses, Irisbus has developed a new active regeneration particulate filter: the filter temperature is controlled electronically in order to ensure optimum emissions levels at all times and protect the filter from clogging and damage.

2. STRALIS EURO 4 – EURO 5

Iveco chooses SCR technology to ensure the medium and heavy commercial vehicle ranges comply with the Euro 4 and Euro 5 Directives

Cutting down nitrogen oxides in the exhaust system by means of an additive – AdBlue – is the solution Iveco has adopted on the medium and heavy range. This ensures respect for the environment while reducing running costs and, therefore, guaranteeing an increase in profitability – two fundamental factors for Iveco. Choosing this exhaust after-treatment method also means vehicles will meet emission standards established in the Euro 5 Directive ahead of time. By adopting SCR technology as early as the second half of 2005, Iveco will be able to supply vehicles that enable road transport operators to benefit from incentives approved by a number of European countries to encourage use of vehicles complying with Euro 4 & 5 emission levels in advance. .



2.1 – DILEMMA POSED BY THE EURO 4 AND EURO 5 DIRECTIVES

The Euro 4 Directive poses a problem for Iveco – and other manufacturers too – that is difficult to resolve, namely, to reduce particulate emissions by 80% and nitrogen oxides by 30% compared to Euro 3 levels. The Euro 5 Directive then requires a further 40% reduction for nitrogen oxides. Today, given current know-how and fuel injection technologies, action taken on the combustion front can only reduce the percentage of one pollutant by increasing the emissions of the other. This is why exhaust gases must be subjected to exhaust after-treatment in order to complete action taking place within the engine. The same situation exists as regards compliance with Euro 5 emission limits.

At this point manufacturers have two options. The percentage of nitrogen oxides in the combustion chamber can be reduced by lowering temperatures as a result of adding exhaust gases to air aspirated at the time of combustion. These gases, which replace part of the engine's air intake, must be carefully dosed and cooled inside a heat exchanger fed by the engine cooling system. Simultaneously, injection timing is retarded. However, any drop in combustion temperature causes a drop in engine efficiency. The other problem is a marked increase of particulate matter in the exhaust, especially in recirculated exhaust gases. This can lead to contamination of the lubricant, which must therefore have a greater particulate dispersion capacity. Particulate is treated after the engine stage by using a filter in the exhaust silencer. While these factors have little effect on low-capacity engines, the impact becomes significant as engine power increases. Exhaust gas recirculation is referred to as EGR. Recently this solution has been adopted by some manufacturers on medium and heavy trucks in order to meet Euro 4 standards. For Euro 5, given current technologies the EGR + particulate filter system is not sufficiently effective for high-powered engines, even though this solution doesn't require the addition of an additive to the exhaust. Compared to Euro 3, the EGR solution means an increase in vehicle weight.

The **SCR – Selective Catalytic Reduction** – solution is the alternative approach chosen by Iveco and the majority of medium and heavy commercial vehicle manufacturers. It consists of optimising engine combustion to achieve maximum reduction of the particulate content in exhaust gases. Engine performance is improved and this leads to lower fuel consumption. To eliminate the percentage of nitrogen oxides in exhaust gases that exceed the limit, first a reducing agent is added to the gases and then these are treated by a catalytic filter in the silencer. This procedure converts the nitrogen oxides into entirely harmless nitrogen and water vapour. The reducing agent is ammonia, stored in the form of a urea-based aqueous solution and marketed under the brand name AdBlue. SCR technology means that particulate filtration is superfluous inasmuch as this type of emission is cut down directly during the combustion phase, while the catalytic converter burns up the remaining particulate simultaneous with treatment of the nitrogen oxides.

Again in this case the vehicle weight increases compared with an equivalent Euro 3 version.



2.2 – WHY IVECO DECIDED TO ADOPT THE SCR SYSTEM

The SCR system chosen by Iveco represents the ideal compromise between two fundamental objectives engine designers had set themselves in order to meet customer requirements. On the one hand, improve engine performance to reduce fuel consumption and running costs, at the same time extending the life of engine components; on the other, comply with emission limits established by European authorities to safeguard the environment. Clearly, the progressive reduction in fuel consumption per tonne of goods transported means engines give off less CO₂, the gas responsible for warming the planet.

Iveco began studies on SCR reduction in 1994 at its Arbon Research and Development Centre in Switzerland (Iveco Motoren Vorschung) as a member of a consortium created together with other manufacturers. Iveco has also explored the EGR solution and adopted it on the light commercial vehicle range, given that for this type of use it represents the ideal compromise between various factors (consumption, weight, cost).

Given the high average annual kilometres travelled by medium and heavy vehicles, the benefit obtained by reducing fuel consumption became the top priority. Furthermore, the SCR approach has no negative effect on lubricant quality or the interval between oil changes. In fact the low particulate content in the combustion chamber further extends these intervals. Similarly, the system isn't sensitive to the sulphur content of diesel fuel.

Unlike EGR technology the SCR approach doesn't require increased use of the engine cooling system. Everyone knows that high powered vehicles need larger radiators and the size of these poses serious layout problems on heavy vehicles. Also, increasing fan performance drains power and negatively affects fuel consumption.

2.3 – A CHANCE TO ANTICIPATE THE EURO 5 DIRECTIVE

A basic advantage of the SCR system is that it can satisfy both Euro 4 and Euro 5 emission level requirements, which means Iveco has been able to develop a solution for both emission levels simultaneously. Thanks to the modern architecture of its engines, and especially the electronic control injector pumps operated by a camshaft located directly in the cylinder block, Iveco has been able to develop a new injection system with higher pressures and finer fuel atomisation. For Iveco Cursor engines AdBlue consumption is 4-5% for Euro 4, or around 1.5 l/100 km, and slightly higher for Euro 5. For instance, a urea consumption of 60 l gives an autonomy of over 3,500 km. The AdBlue injection system has been tested in extreme climate conditions to take into account the physical properties of this additive and, above all, its progressive crystallisation below -11°C. Test campaigns have been organised in Scandinavia and Spain, while numerous customer vehicles are undergoing long-term testing.

So Iveco is ready to offer heavy Stralis vehicles in both a Euro 4 and Euro 5 version simultaneously. Iveco expects demand for these vehicles will come mainly from countries offering financial incentives for adopting the European Directives ahead of the date fixed for their introduction. Germany, Switzerland and Austria are good examples.



2.4 – IVECO EURO 4 AND EURO 5 MODELS AVAILABLE BEFORE RELEVANT MANDATORY DATES

Euro 4 & 5 models are available before the mandatory dates to adopt the relevant standards, they comply with current regulations (EEC 88/77-EC/1999/96-EC 2001/27) and as a priority respond to demand in markets offering financial incentives. These are the models: 4x2 tractors and 6x2 trucks, both available in two engine versions – 430 HP Cursor 10 or 480 HP Cursor 13 – all outfitted with the Stralis Active Space cab. Initial deliveries are forecast for September 2005. Because of heavy demand from Germany and Austria (in general, those countries offering incentives), deliveries for other countries in which road transport operators wish to anticipate the Euro 5 Directive will begin in November this year.

Models:

	Wheelbase	430 HP Cursor 10 engine	480 HP Cursor 13 engine
Tractor	3500 – 3800 mm	AS 440 S 43 T/P	AS 440 S 48 T/P
Truck	4500 – 4800 mm	AS 440 S 43 Y/PS	AS 440 S 48 Y/PS

Euro 4 and Euro 5 versions will be subject to price variations from country to country.

2.5 - SCR SYSTEM INSTALLATION ON THE VEHICLE

The AdBlue tank (standard tank capacity 60 litres, but also available in 45 and 120-litre versions) is located on the right-hand side between the wing and fuel tank. The diameter of the tank tube is small enough to prevent accidental introduction of the diesel nozzle. The AdBlue gun has a valve at the end that is released by magnets located on the tank entry point and so it's impossible to accidentally fill up another tank (for instance, the main fuel tank) with AdBlue. The AdBlue intake duct – a level gauge is also installed on this – is surrounded by a hose in which engine water circulates. Opening of the heating system is regulated by a temperature sensor. The AdBlue filter system includes a pre-filter on the tank and a fine-mesh filter located on the pump intake. The latter is positioned under the rear cab suspension bar inside a sealed casing that also contains the control unit for dosing the AdBlue. Ducts are in stainless steel or plastic insensitive to the oxidising effect of AdBlue. They are heated by engine water (between the tank and pump) and an electric coil (between the pump and dosing module located along the chassis). The dosing module, which is fed with compressed air and AdBlue, is connected to an injector located on the exhaust pipe. The entire AdBlue storage, dosing and injection system has been subjected to testing in extreme climate conditions, both in Scandinavia and Spain, to ensure system reliability complies with European regulations.

The quantity of AdBlue to be injected is calculated by a control unit (dosage unit) that receives various types of input, for instance, the temperature of exhaust gases in the catalytic converter, quantity of fuel injected in the engine, flow of aspirated air and environmental conditions. The catalytic converter, together with the silencer, is located underneath the battery casing and comprises ceramic elements containing rare metals. The temperature in proximity to the catalytic converter is measured by two probes, one at the intake and one at the outlet of the silencer, to check atomisation of the AdBlue. The catalytic converter/silencer casing is insulated to protect adjacent components from high temperatures.



2.6 – CONTROL OF SCR SYSTEM OPERATION

Current regulations (EEC 88/77-EC/1999/96-EC 2001/27) allow registration of Euro 3 vehicles and also those with Euro 4 or Euro 5 emission levels, however, they don't establish any other constraints for the emission control system.

The European Commission therefore focused on the problem of emission control system efficiency and effectiveness over time. It then prepared the Directive concerning Euro 4 emissions, due for publication halfway through 2005. The Euro 4 Directive not only establishes emission levels, it also defines the characteristics of the emission control system, independent of the technology adopted.

Euro 4 vehicles coming into service after October 1, 2006 (October 1, 2005 for new type approvals) will have to be fitted with a diagnostics system (On Board Diagnostics) covering operation of the emission reduction system. So in the case of SCR a telltale will have to light up when the AdBlue level drops below a certain value (minimum 10% of the tank capacity). An 'irregular engine operation' telltale will light up when the tank is empty. Iveco Stralis Euro 4 models offered this year will already be fitted ahead of time with both these telltales and an AdBlue level gauge, which can be consulted using the OBD menu on the instrument panel display. The OBD is already able to identify and store details of system malfunctions.

One year after introduction of phase one – from October 1, 2007 for new registrations (starting October 1, 2006 for new type approvals) – all Euro 4 vehicles must be equipped with a system 'encouraging conformity with the law', again, independent of the technology adopted. If the nitrogen oxide content exceeds the maximum permissible value by a certain measure the warning 'irregular engine operation' will appear on the instrument panel and this anomaly will be recorded by the on-board computer. If the pre-alarm level is continuously exceeded (or for SCR vehicles, if the tank is empty) this will initiate a procedure governed by the electronic fuel injection management system to reduce engine torque. This reduction will take place after the vehicle's ignition is next turned off. Again in accordance with the new Euro 4 regulations, the manufacturer must ensure that N3 > 16t category vehicles comply with polluting emission levels for 500,000 km or 7 years (N3 < 16t, 250,000 km - 6 years).

Governments in the various European countries will have to introduce a control procedure to be carried out by authorised operators who will check the on-board computer's memory to ensure the engine has always operated in conformity with Euro 4 regulations.



2.7 – WHAT IS ADBLUE?

AdBlue is the name used internationally for an additive developed for the chemical and motoring sectors.

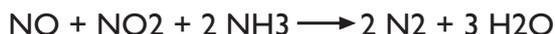
It's an extremely high purity, 32.5% aqueous solution of urea (minimum 31.8% - maximum 33.3%) that transforms nitrogen oxides into nitrogen (N₂) and water vapour (H₂O) by means of chemical reduction.

Content of various metals must not exceed 0.2 mg/kg for each of them in order not to contaminate the catalytic converter. This means AdBlue cannot be substituted by urea used in agriculture. The composition and quality standards are regulated by DIN 70070.

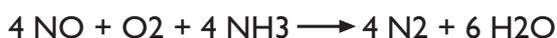
AdBlue is an odourless, colourless synthetic product: it is not considered a dangerous substance inasmuch as it's neither flammable nor toxic.

Principle underlying catalytic reduction of nitrogen oxides. AdBlue

SCR technology has been in use since the early '80s in thermal and fossil fuel power stations, on gas turbines, locomotive diesel engines and large marine power units. In all these applications combustion is optimised with the dual aim of achieving improved performance and direct reduction of particulate emissions. Post-treatment is based on a simple principle: the chemical reaction of ammonia (NH₃) with the nitrogen oxides NO and NO₂ to produce two harmless substances – water vapour (H₂O) and nitrogen (N₂). These are the relevant formulas:



And for any residual oxygen present in the exhaust gases



In very large systems ammonia is drawn directly from pressurised tanks. With regards to road vehicles, the use of pure ammonia has been studied but in the end was abandoned because of problems of storing it on board trucks and in refilling stations. The normalised urea technique in the form of a solution – AdBlue – was preferable for two reasons: this product is not categorised as a dangerous substance, there is no danger in the event of spills and it's easy to store both on board vehicles and at transporter premises, despite the limitation that it crystallises at temperatures below -11°C.



2.8 – DISTRIBUTION OF ADBLUE

A European-wide distribution network is being set up to cover the rapid expansion forecast for the number of vehicles equipped with SCR.

Producers of AdBlue are able to set up a direct distribution system for transporters with large vehicle fleets. They also supply fuel companies and there is a plan to install AdBlue pumps alongside diesel pumps. A number of stations are already operative in Germany and others are being introduced in several other European countries.

To ensure widespread distribution and an appropriate level of service for customers right from the start, Iveco is organising the supply of AdBlue to its dealer network in cooperation with a leading international partner.

The agreement currently being finalised calls for distribution of AdBlue throughout Europe, with a level of service guaranteeing supply of the product within 48 hours after a request. This will be achieved thanks to the approximately 112 distribution points made available by our supplier and operative throughout Europe starting 2006. There will be three different distribution and stocking systems: 10-litre disposable cans, 1,000-litre returnable containers (IBC) and about 4,000-litre containers (MiniBulk) that can be refilled with bulk product.



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3. IVECO MOTORS

One of the world's leading engine manufacturers, Iveco Motors is renowned for its advanced technology and high performance, the result of ongoing research and development. In the past five years all Iveco Motors engine families (light, medium, heavy) have been completely renewed.

Iveco Motors is one of the few engine manufacturers worldwide that can count on a complete range of units spanning a power output from 40 to 1765 kW, suitable for all types of application fields: vehicle, agricultural, industrial, marine, railway and power generation.

The production trend at Iveco Motors is growing, with approximately 435,000 units produced in 2004, 15% more than the previous year. About 40% of these engines are used to equip Iveco vehicles while the remainder are destined for the open market.

Iveco Motors engines are produced at nine plants (six in Europe and one in Brazil, Argentina and China), while there are five research and development centres located in Italy, France, Switzerland and Spain.

Iveco Motors is organised in five divisions (France, Germany, UK, Sweden and USA) and has a more than 350-strong network of distributors and about 1,150 service points.

Iveco Motors has always been attentive to respect for the environment, developing advanced technologies to reduce emissions and with solutions representing maximum effectiveness in terms of economy and performance. The Iveco Motors range also includes vehicle and stationary natural gas powered units with emission levels well below Euro 5 and EEV (Environmentally Enhanced Vehicle) limits.

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