SCR

Selective catalytic reduction

MAN Diesel

MAN Diesel

The responsible way in leading technology

MAN Diesel is the world's leading designer and manufacturer of low and medium speed engines – engines from MAN Diesel cover an estimated 50% of the power needed for all world trade. We develop two-stroke and four-stroke engines, auxiliary engines, turbochargers and propulsion packages that are manufactured both within the MAN Diesel Group and at our licencees.

More than ever before, MAN Diesel's development focus is the environmental performance of our engines. Using our unrivalled grasp of large engine technology, we aim to make our engines progressively cleaner, more powerful and more efficient.

Our absolute commitment to reducing emissions while increasing fuel efficiency and power density starts with our active partnership in the emissions law making process and ends with the delivery of engines that achieve an ideal synthesis of prime mover characteristics.

MAN Diesel Emissions Technology

Security for the future

Long term emissions perspective

At MAN Diesel, our policy is to guarantee the maritime industry a secure basis for the future.

In terms of engine emissions the goal is to provide our customers with engines that will meet the emissions limits prescribed in the International Maritime Organisation's IMO MARPOL 73/78 Annex VI.

Currently this means complying with IMO Tier II and IMO Tier III, the second and third stages of regulations governing emissions of oxides of nitrogen (NO_x).

Full ahead to IMO Tiers II and III

With this security of supply in mind, MAN Diesel announced its full range of IMO Tier II compliant low and medium speed diesels in 2008 – a full shipbuilding cycle ahead of IMO Tier II's 2011 introduction.

Now, to give the shipping industry clear, long term perspectives, MAN Diesel is offering solutions for compliance with IMO Tier III, even further ahead of its 2016 implementation date.

ECAs

Driving this early response is the prospect of individual countries and regions nominating so-called Emission Control Areas (ECAs) in advance of the IMO Tier III starting date.

Significantly, IMO Tier III retains the same limits for emissions of oxides of nitrogen (NO_x) as IMO Tier II for vessels on the high seas.

However, it prescribes far stricter limits in waters close to centres of population like landlocked seas, restricted sea lanes and straits, harbour approaches and coastal waters near environmentally sensitive areas.

Incentives

In addition to the early designation of ECAs, a number of National Governments are now offering incentives to ships operating at reduced NO_x emissions in their territorial waters.

SCR - the Panacaea

SCR - Selective Catalytic Reduction of NO_x

These developments have created immediate demand for engines with NO_x emissions in the IMO Tier III range, well before 2016.

Crucially, emissions upgrades are also offered for vessels already in service, as owners seek NO_x compliance in ECAs and qualification for incentives.

Tailored SCR retrofit - the MAN Diesel solution

To meet demand from engines already in operation, PrimeServ, MAN Diesel's global aftermarket organisation has introduced a brand new service:

- One-stop, single source, all inclusive retrofitting of SCR - designed and executed by the engine builder

OEM Competence in the retrofit market

With MAN Diesel PrimeServ as your main contractor, your NO_x issue gets the expert attention it deserves.

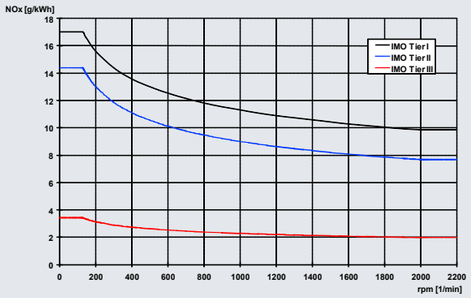
Correctly designed and under the right operating conditions, SCR is capable of reducing NO_x emissions to Tier III compliant levels without substantially affecting engine fuel consumption and performance.

However, since the majority of marine engines run on heavy fuel oils (HFO) with high sulphur content, the reliable operation of SCR presents a number of challenges. For example, without specific modifications, catalyst performance can be severely impaired or damage caused to the catalyst core.

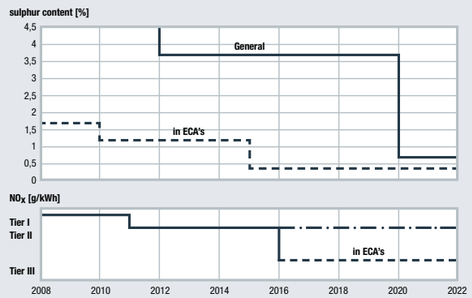
The necessary countermeasures are best designed and executed by the engine builder, taking advantage of the fund of knowledge which comes from designing and developing complete engines.

World map ECA

IMO No_x limit curves according to engine speed

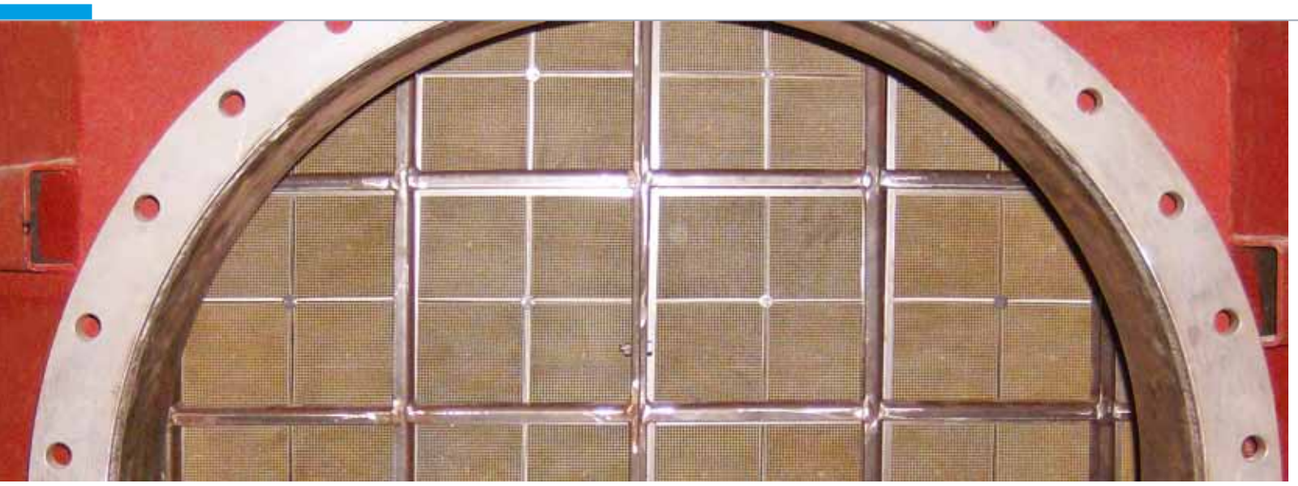


Implemenation schedule



Implementation Schedule SO_x & NO_x limits according to IMO MARPOL 73/78 Annex VI

MAN Diesel SCR System



The MAN Diesel SCR retrofit system

SCR - selective catalytic reduction to give it its full name - uses a reducing agent to transform the pollutant NO_x into environmentally benign nitrogen and water vapour.

Highly effective

Under the right preconditions SCR is capable of eliminating over 85% of the oxides of nitrogen produced during diesel engine combustion.

Readily installed

As an “aftertreatment” or “secondary” NO_x reduction measure. MAN Diesel PrimeServ is confident of readily retrofitting SCR on the vast majority of diesel engines aboard ships.

Urea - the MAN Diesel solution

In the retrofit systems offered by MAN Diesel PrimeServ an aqueous urea solution is sprayed into the engine exhaust gas stream in the presence of the catalyst.

Urea is safe to handle, and since its adoption in SCR systems for commercial vehicles, is produced in increasing quantities and distributed via a rapidly expanding supply infrastructure.

In the hot exhaust gases the urea solution decomposes to ammonia and carbon dioxide in the following reaction:

$$CO(NH_2)_2 + H_2O \longrightarrow 2NH_3 + CO_2$$

The ammonia converts the NO_x in the engine exhaust to nitrogen and water vapour in the following reaction:

$$NO_x,\ NH_3,\ O_2 \longrightarrow N_2,\ H_2O$$

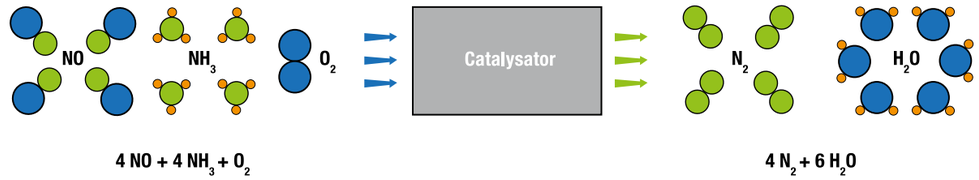
SCR in Operation

The main components of an SCR system are the reactor containing a number of catalyst cores, the urea supply system comprising tank, pump and dosing unit and a control unit . According to the application a NO_x measuring system may be included to achieve closed loop control of urea injection.

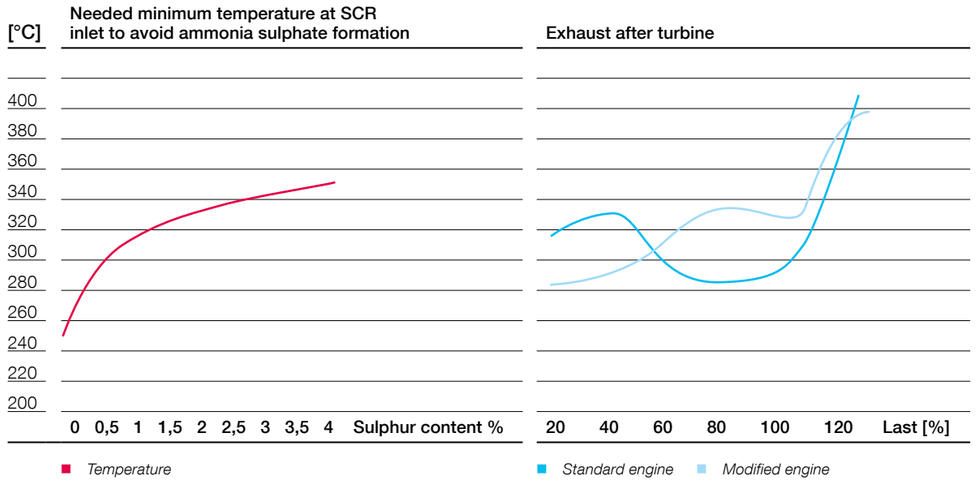
Exhaust gas temperature

In the case of MAN Diesel medium speed engines running on HFO with standard sulphur content, this system is augmented by a turbocharger bypass.

Also referred to as a "wastegate" this device is designed to maintain the engine exhaust gas temperature at a level which prevents the deposits of sulphates which can “mask” the catalyst and adversely affect the NO_x conversion efficiency of the SCR system.



$$4\ NO + 4\ NH_3 + O_2 \qquad 4\ N_2 + 6\ H_2O$$



The OEM Advantage

One contact for all emission relevant questions

Core technologies in-house

Designing an optimised SCR system requires mastery of a wide range of engine technologies:

- In-house design of the turbocharger system
- Integration of the SCR control system into the overall engine control system
- Adaptation of injection control from MAN Diesel with electronic fuel injection e.g. common rail
- Reliability of whole system
- Correct desingn of the by-pass system

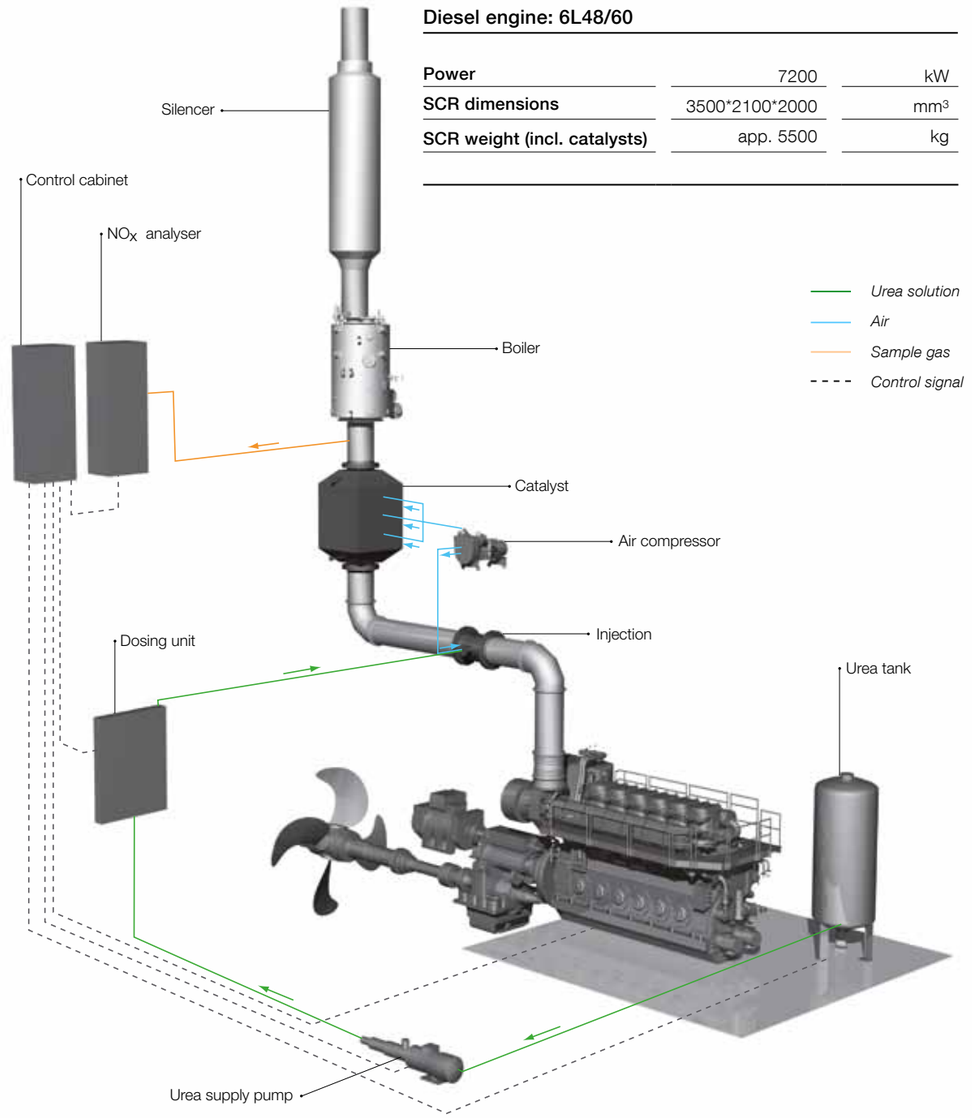
MAN Diesel total system competence

As the leading engine builder in the marine sector, MAN Diesel has unrestricted access to the know-how needed to design and execute highly efficient SCR systems for both new engines and retrofit applications on engines already in the field.

More:
In MAN Diesel's case, this clear "OEM Advantage" over other suppliers of SCR systems is further multiplied by our status as a global leader in the design and manufacture of exhaust gas turbochargers and fuel injection system for large engines.

The result:
MAN Diesel and its PrimeServ after-sales organisation is ideally placed to supply the optimum SCR system for your engine.

Typical Layout and Dimensions



Diesel engine: 6L48/60

Power	7200	kW
SCR dimensions	3500*2100*2000	mm^3
SCR weight (incl. catalysts)	app. 5500	kg

World Class After Sales Support

For marine propulsion and GenSets

PrimeServ – peace of mind for life

With more than 150 PrimeServ service stations and service partners worldwide, plus our growing network of PrimeServ Academies, the MAN Diesel after-sales organisation is committed to maintaining the most efficient and accessible after-sales organisation in the business.

PrimeServ's aim is to provide:

- Prompt delivery of high demand OEM spare parts within 24 hours
- Fast, reliable and competent customer support.
- Individually tailored O&M contracts
- Ongoing training and qualification of service personnel.
- Global service, open 24 hours-a-day, 365 days-a-year
- Diagnosis and troubleshooting with our high performance Online Service
- Retrofitting of the latest MAN Diesel engine and turbocharger technologies for improved operating economy and minmised emissions

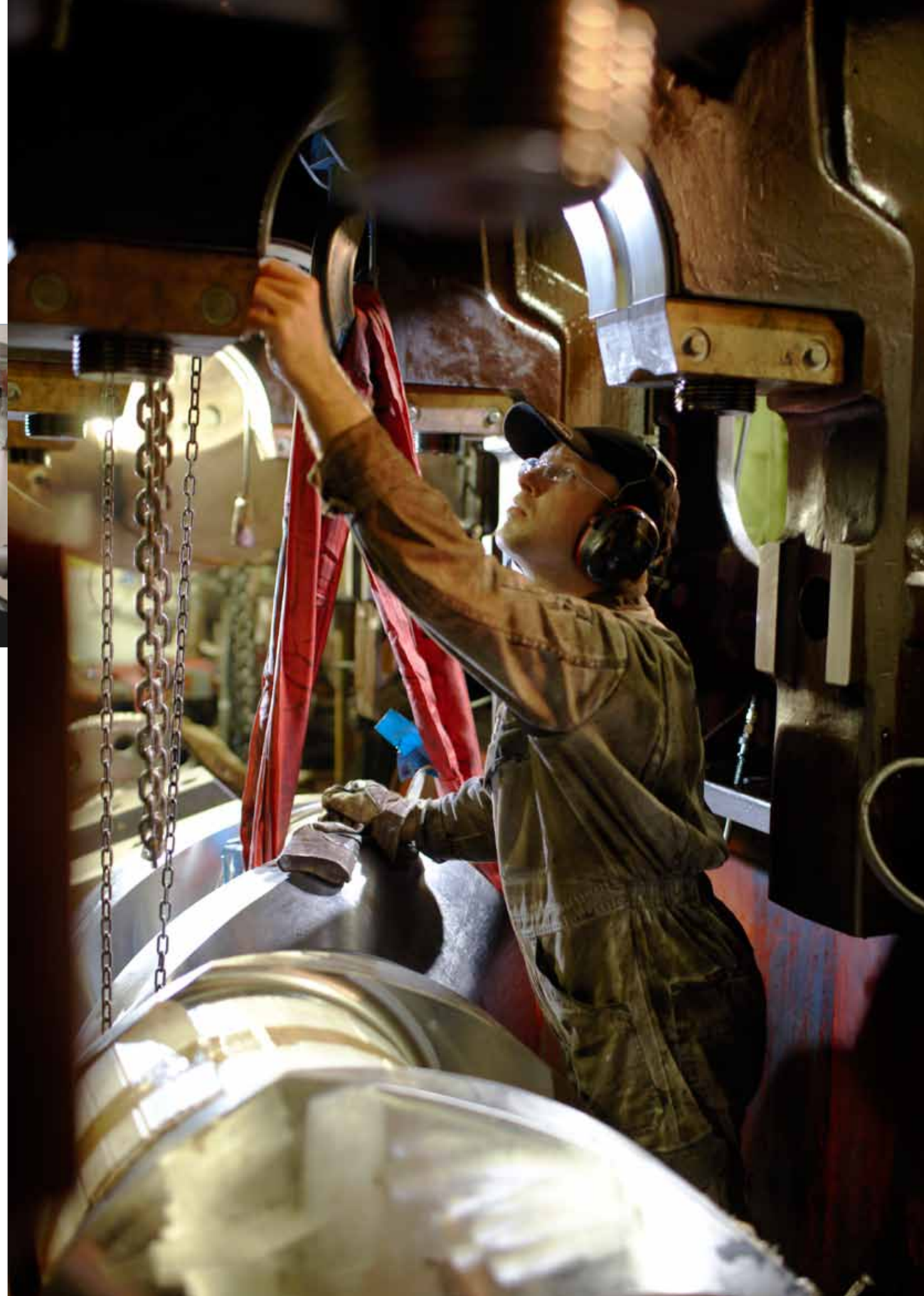
The PrimeServ offering

Based on almost 110 years of service experience with marine Diesel engines, our sophisticated logistics system ensures that all frequently requested spare parts are available worldwide within 24 hours. In addition, MAN Diesel Online Service helps to optimise maintenance cycles by the use of remote engine monitoring, diagnostics and calibration. The resulting condition-based maintenance (CBM) promotes high availability, increases operational safety, shortens downtimes and enhances the performance of MAN Diesel marine engines.

The bottom line: leaner operating costs and better planning.

When service is required, the MAN Diesel PrimeServ network responds to organise assistance as fast as possible. This guarantees rapid completion of maintenance work and high availability of MAN Diesel engines, GenSets, turbochargers, gears, propellers and marine propulsion packages.

In short: MAN Diesel PrimeServ gives you the benefit of our specialist expertise in marine power so that you can concentrate on your own core business.



MAN Diesel SE
86224 Augsburg, Germany
Phone +49 821 322-0
Fax +49 821 322-3382
marineengines-de@mandiesel.com
www.mandiesel.com

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