Engine Technologies & After Treatment Solutions

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2nd CIMAC Circle at INMEX SMM India 2019

Emission Control for ships

Engine Technologies & After Treatment Solutions

Focus Areas

SO_x

NO_x

Focus Area: SOx Control

Focus Area: SOx Control – Global Sulphur Cap

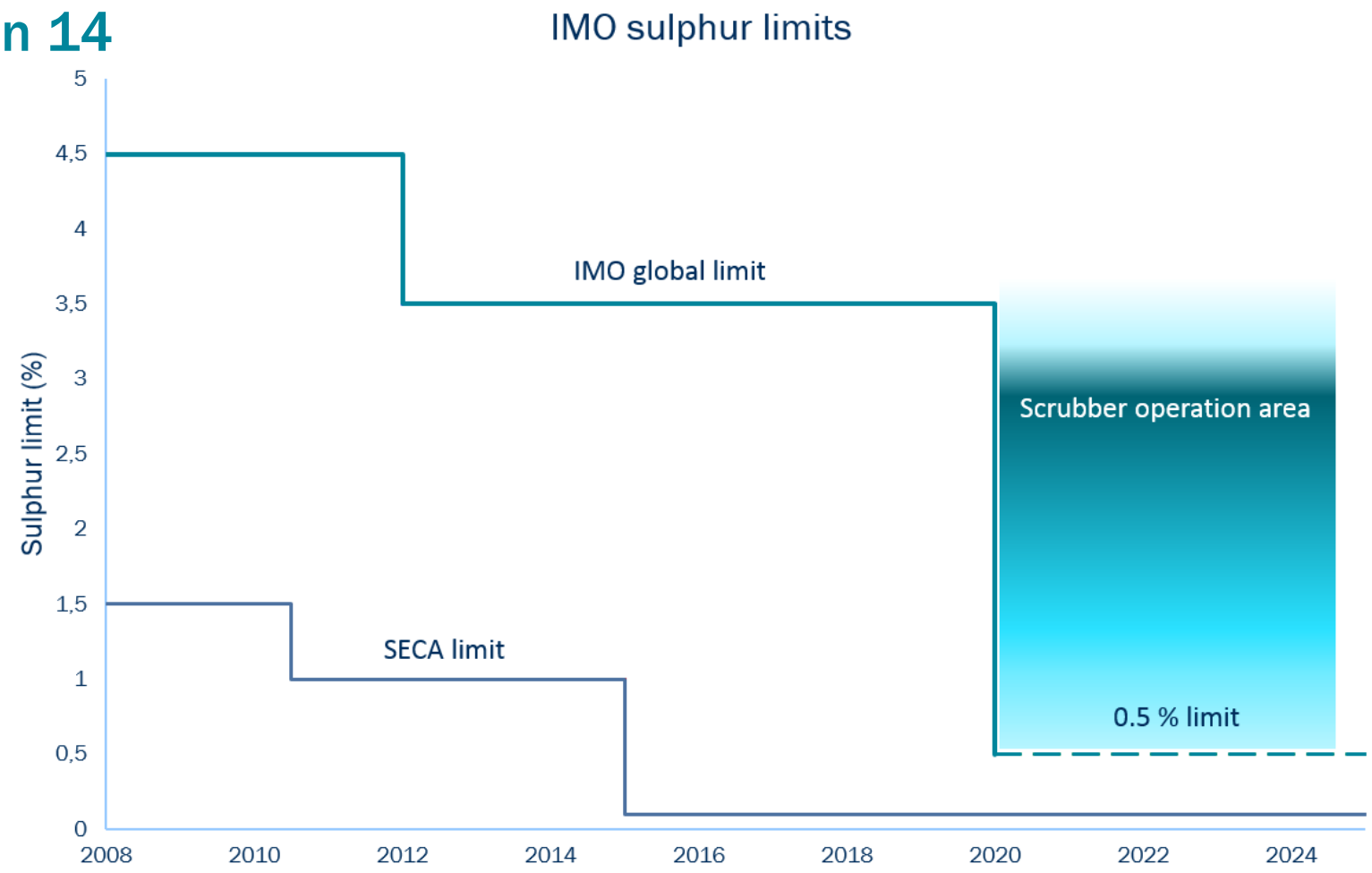
MARPOL Annex VI regulation 14

2010 1.5 % to 1.0% S in ECA

2012 max. 3.5 % S globally

2015 max. 0.1 % S in ECA

2020 max. 0.5 % S globally



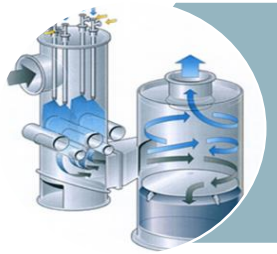
Focus Area: SOx Control – Global Sulphur Cap

Alternatives to comply

Destillate Fuels (MGO/MDO)

LNG
Use X-DF (dual fuel) engines

Low sulphur residual fuels (ULSFO, VLSFO)



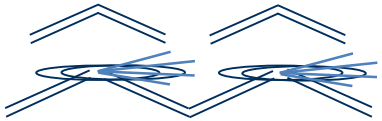
Scrubbers
Install an additional exhaust gas cleaning system.

Engine Design

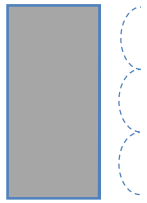
Piston running

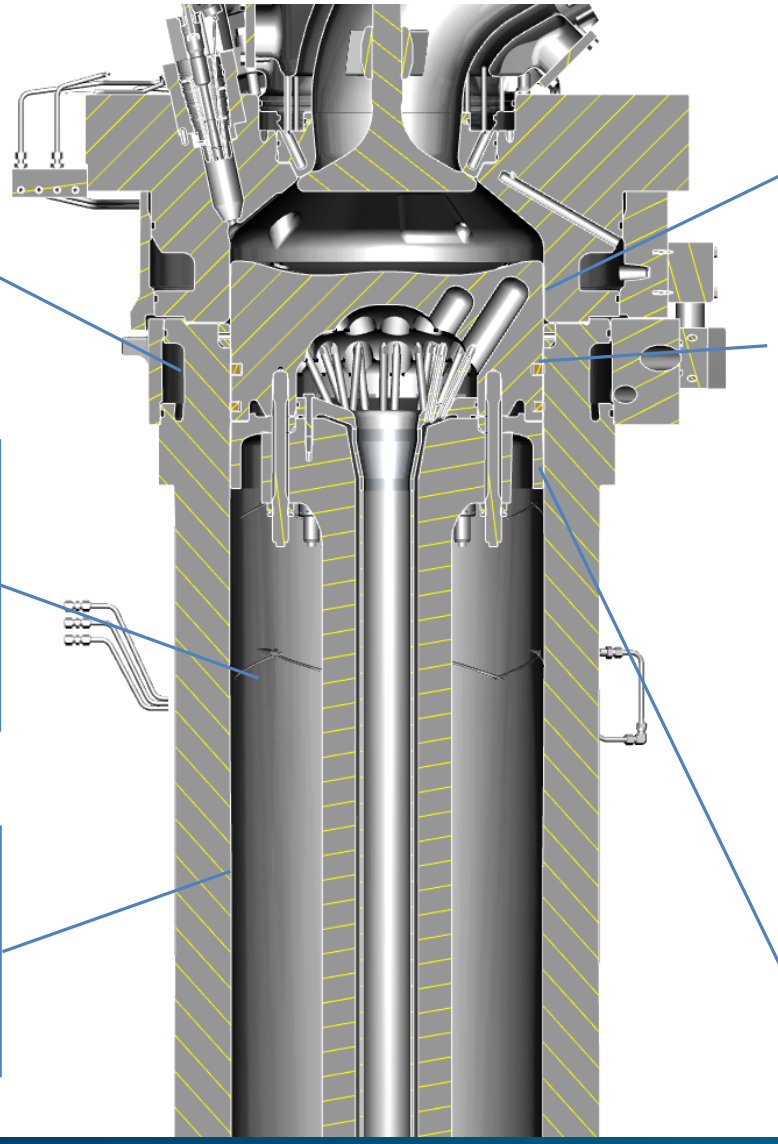
Optimized liner wall temperatures with individual liner design for diesel and DF engine

Pulse Lubricating System
+ lubricating oil grooves



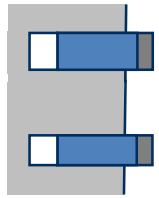
Liner plateau honed





Anti-polishing ring

2 piston rings
- Top ring gas-tight
- Cr-ceramic coated
- Pre-profiled



Piston ring grooves
with thick chromium layer

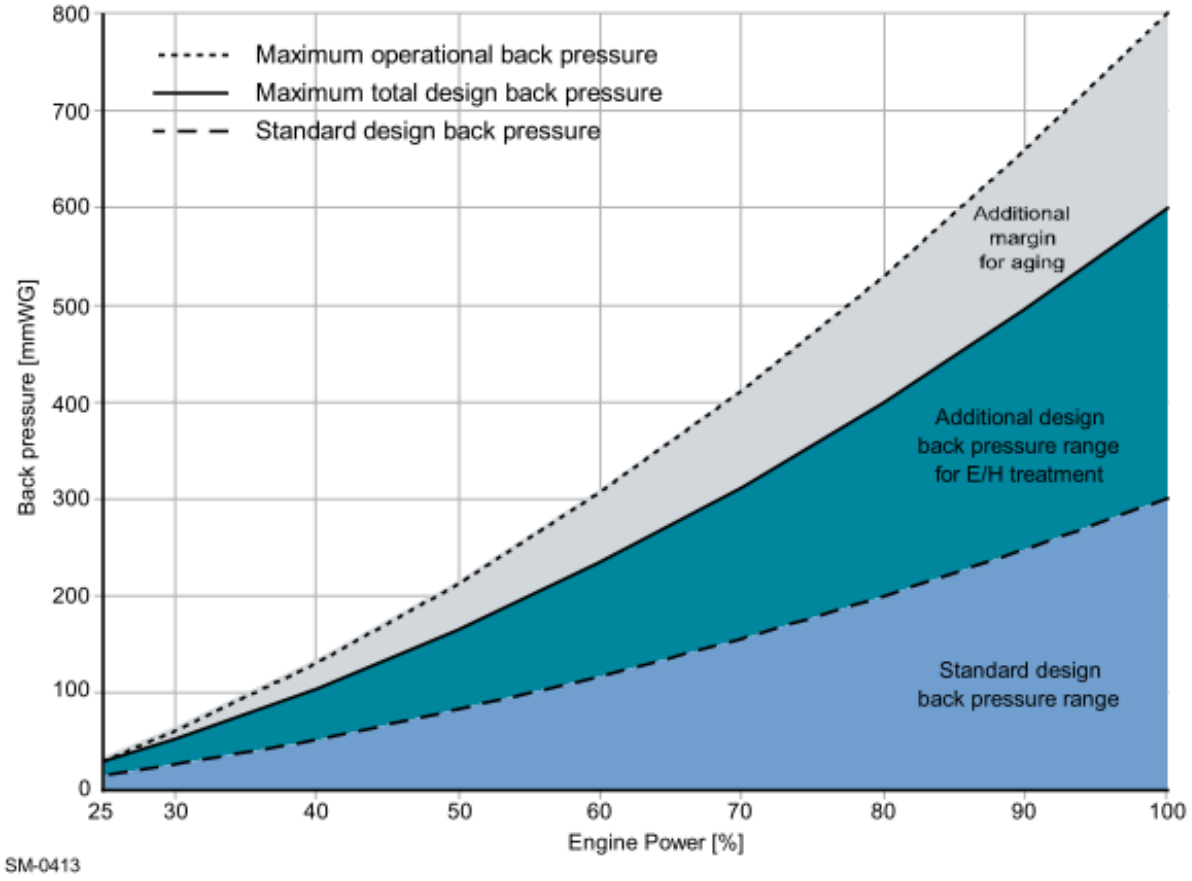
Piston skirt nitro carburized

Scrubber Installation Newbuilding

Backpressure limits

Standard back pressure [mmWC]	Maximum additional back pressure [mmWC]	Maximum total back pressure [mmWC]	Margin for aging
300.0	300.0	600.0	200.0

Influence on engine performance data (e.g. bsfc) can be generated with latest version of GTD

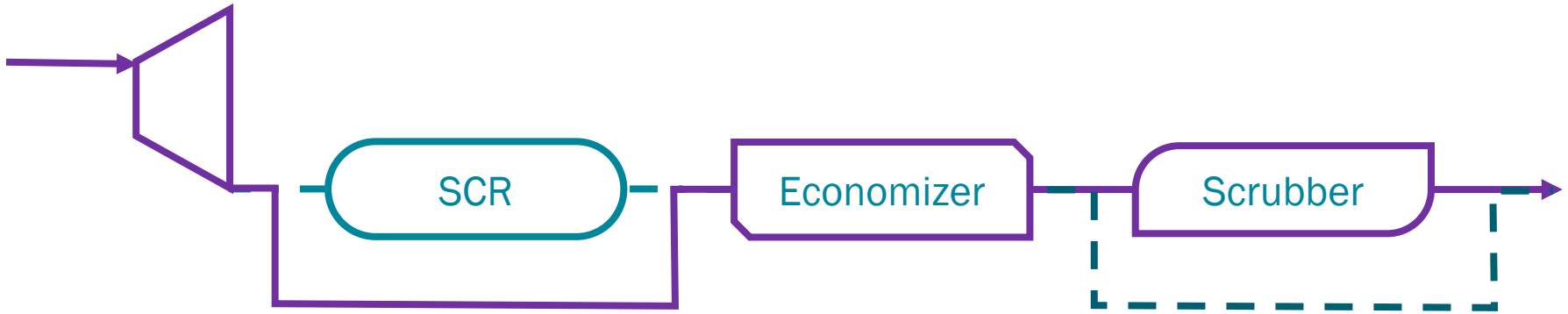


Scrubber Installation

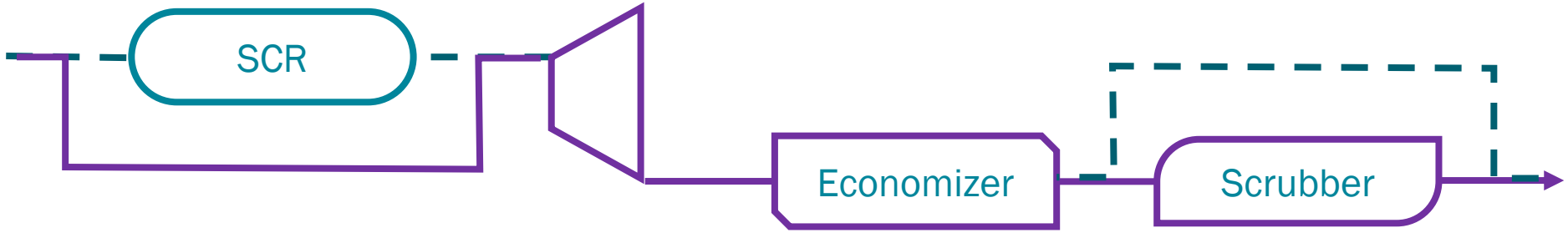
Engine Interface

Engines with Scrubber have the same configuration as TierII or TierIII engines. No special interface is needed, as Scrubber maker typically connect to and obtain necessary signals from the Propulsion Control System.

Scrubber with LP-SCR



Scrubber with HP-SCR



Operational Considerations for 2020 Compliant Fuels

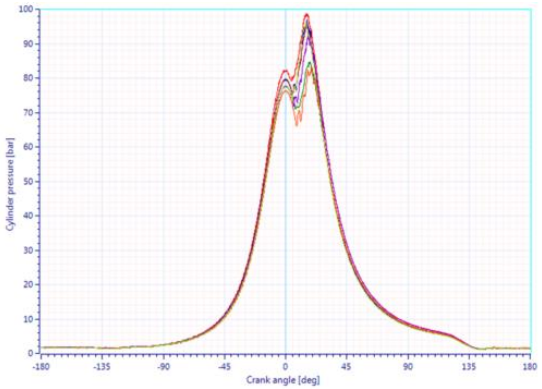
Purchase and bunkering of fuels

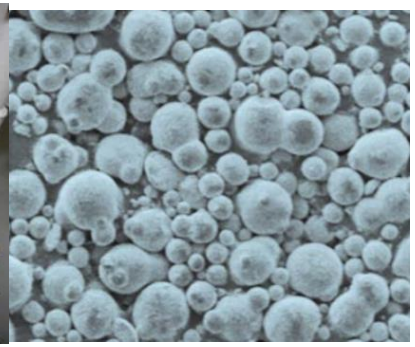
- WinGD recommends the use of **ISO 8217:2017 for purchasing** of fuel
- It is also advised to follow a proper **fuel management plan** which includes all steps prior to bunkering and until the fuel is used
- All **relevant fuel properties** including viscosity, pour point, cat fines concentration and total sediment potential should be **requested at bunkering**. If sufficient information is not available, a fuel sample should be sent to a laboratory for analysis
- **Optionally**: Perform on board "**Cleanliness Procedure**" according to ASTM D4740 to check potential of sludge formation of the fuel
- Prior to bunkering, **special attention** must be given to the fuel **cold flow properties** to ensure that these are suitable for the fuel system design and the planned ship routing

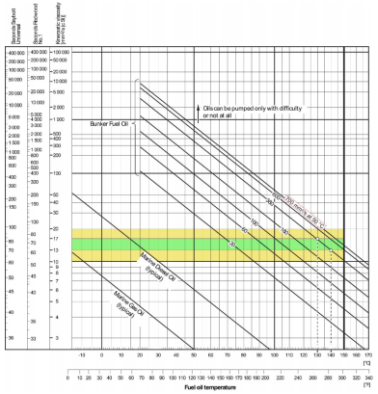
Operational Considerations for 2020 Compliant Fuels

Storage

- Ship operators should have a suitable **plan** for the **storage** of **different fuel batches**.
- Deliberate **blending** of these different fuels in the storage, settling or service tanks, **should be avoided**; that is, each newly bunkered fuel batch should be stored in a separate storage tank.
- In addition, it is recommended to check the fuel installation and prepare fuel management procedures which will **ensure minimal mixing** of **different fuel batches** during operation in the fuel system.
- In general, the **temperature** of the fuel in **storage** should be kept **at least 5-10 °C above** the **pour point** to ensure proper flow properties. However, **to avoid** potential **wax formation** with low viscosity VLSFO RM fuel grades, this fuel should be **maintained** at **15 °C above the pour point**.





Relevant Documents

WinGD Guidelines and Letters

WinGD Tribology Fuels & Lubricants Page
www.wingd.com/en/technology-innovation/engine-technology/engine-design/tribology-fuels-lubricants

2020 IMO global 0.50 percent fuel sulphur regulation - WinGD operation guideline
www.wingd.com/en/documents/technical-information-notes/wingd_tin011-imo-2020-operation-guideline.pdf

Diesel Fuels for WinGD engines
www.wingd.com/en/documents/fuel-lubricants-water/diesel-fuels-for-wingd-engines-v2.pdf

Fuel Statement 0.1% ULSFO
https://www.wingd.com/en/documents/engine-operation/fuel-statement-0-1-ulsfo-v2.pdf

Lubricants for WinGD engines
www.wingd.com/en/documents/fuel-lubricants-water/lubricants-for-wingd-engines-v3.pdf

WinGD Piston Underside Drain Oil Analysis Tool
www.wingd.com/en/documents/engine-operation/wingd-piston-underside-drain-oil-analysis-tool-v2.xlsx

WinGD Guide for judging condition of relevant piston-running components
www.wingd.com/en/documents/engine-operation/wingd-guide-for-judging-condition-of-relevant-piston-running-components-v3.pdf

Focus Area: NOx Control

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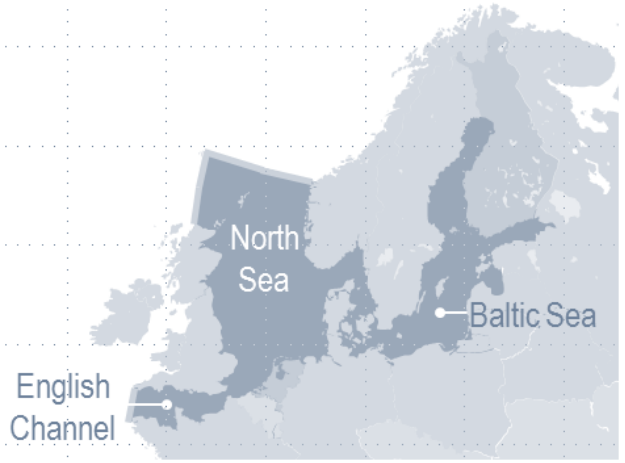
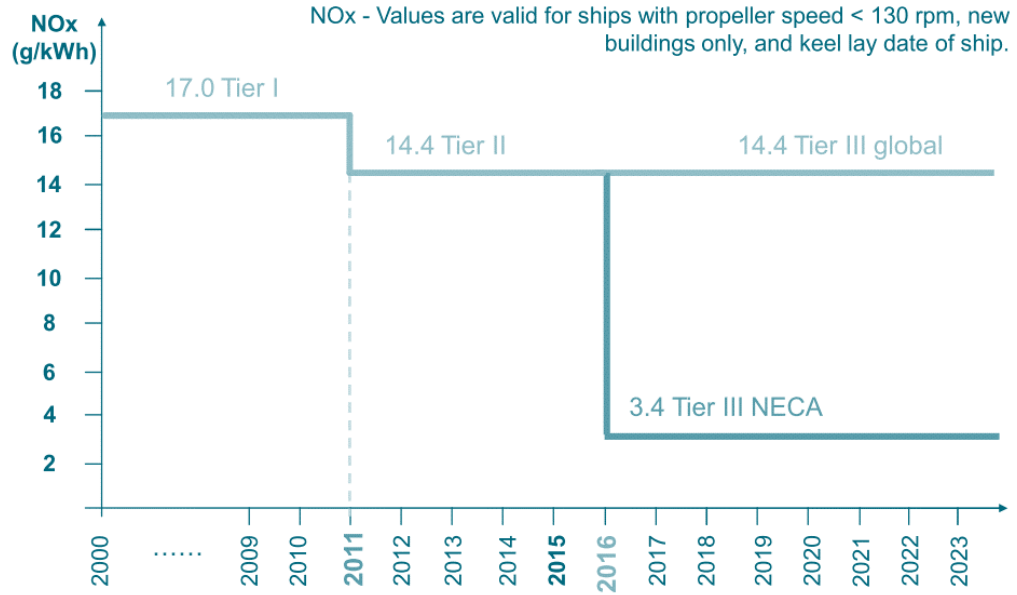
IMO/MARPOL Annex VI regulation 13 (NOx)

- The global Tier II NOx limit is 14.4 g/kWh at date.
- The NOx ECA (NECA) limit is 3.4 g/kWh.
- Effective date (keel lay of ship) 1.1.2016 for American NECA,
  1.1.2021 for North Sea & Baltic
  others after designation

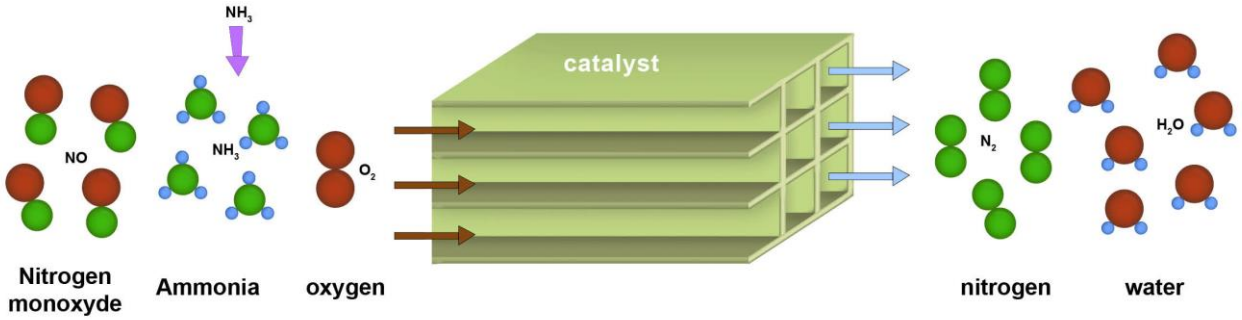




SCR

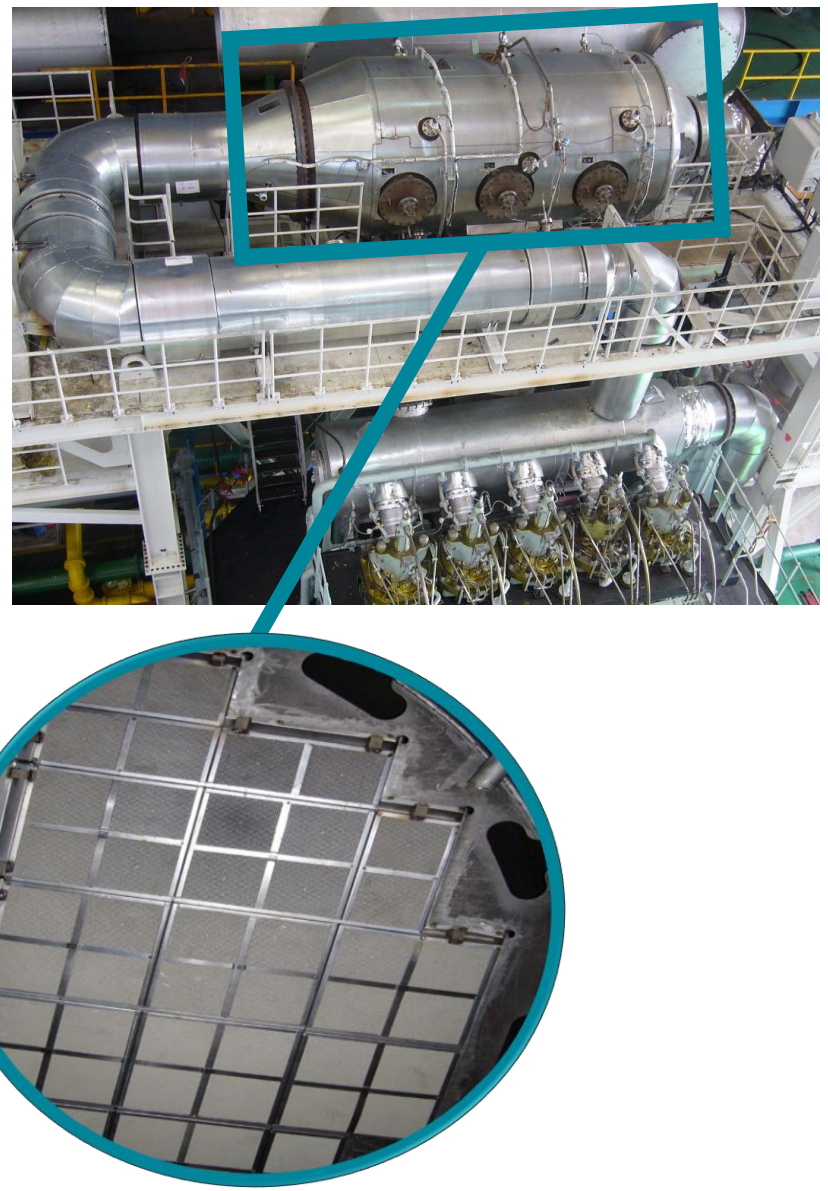
Basic Chemical Reaction Process

NOx Reduction



$$4\,NO + 4\,NH_3 + 0_2 \xrightarrow{\text{catalyst}} 4\,N_2 + 6\,H_2\,0$$

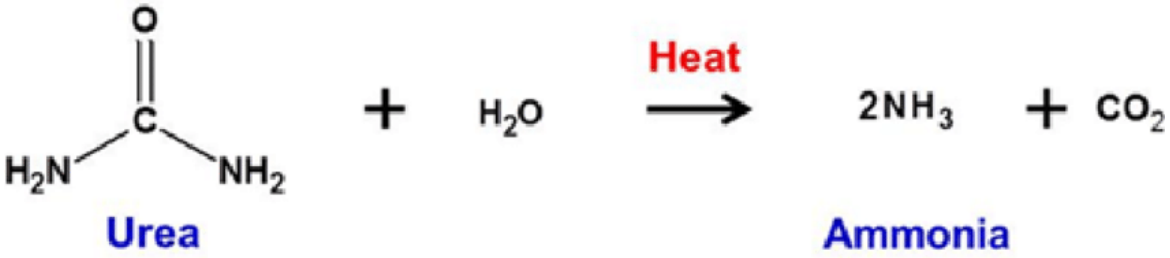
toxic — nontoxic

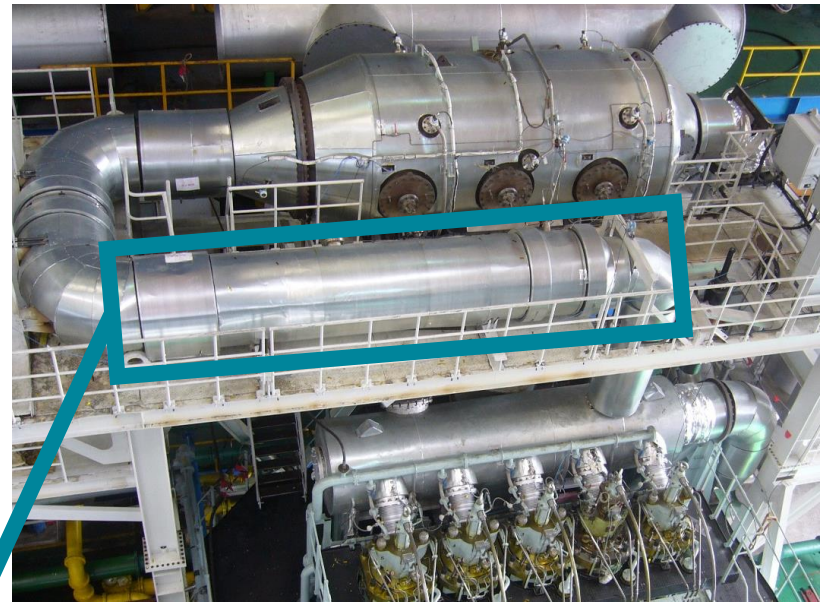


SCR

Basic Chemical Reaction Process

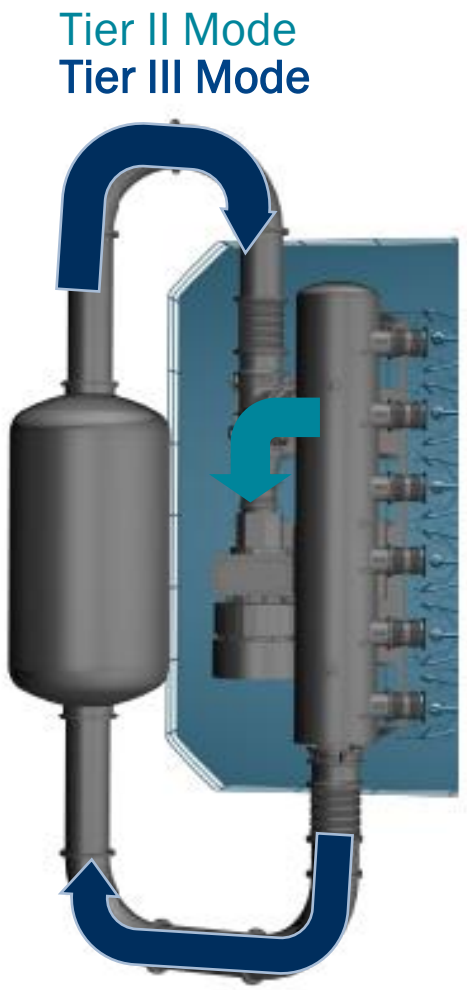
Urea Decomposition





High-Pressure SCR

- The SCR system is placed on the **high-pressure side, before th**
- Arrangement of the SCR system in the engine room close to th required.
- **WinGD provides valve interface, control specifications and guidelines**
- Adaptation for the entire engine portfolio in progress.
- Published engine performance data (GTD data).

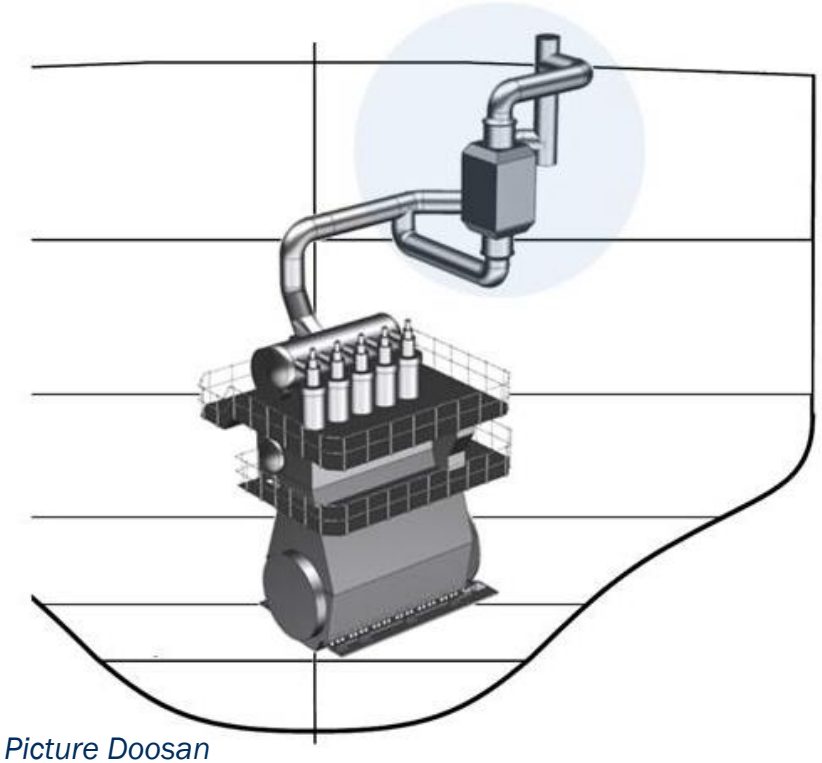


Low-Pressure SCR

- The SCR system is placed on the **low-pressure side, after the TC turbine,** giving high flexibility to arrange the SCR system anywhere in a vessel.
- **No engine modification is required**

- **WinGD provides interface specifications**

- Integration of LP-SCR control interface.
- Released for the entire engine portfolio.
- Published engine performance data (GTD data).



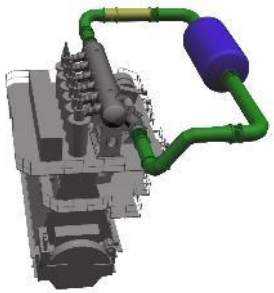
Picture Doosan

SCR Reference and Orderbook

Total 302 engines with SCR on order or delivered

- 142 WinGD Tier III engines are on order with high-pressure SCR and 160 with low-pressure SCR.
- These SCR's are fitted on engine size between 52 to 92 cm bore - foreseen to power Tankers, Bulkers and Container Vessels of different sizes.
- Of the 142 installations with HP SCR some 33 installation are in service.
- Of the 160 installations with LP SCR some 28 installation are in service.




Status: 08.2019

SCR installation in workshop

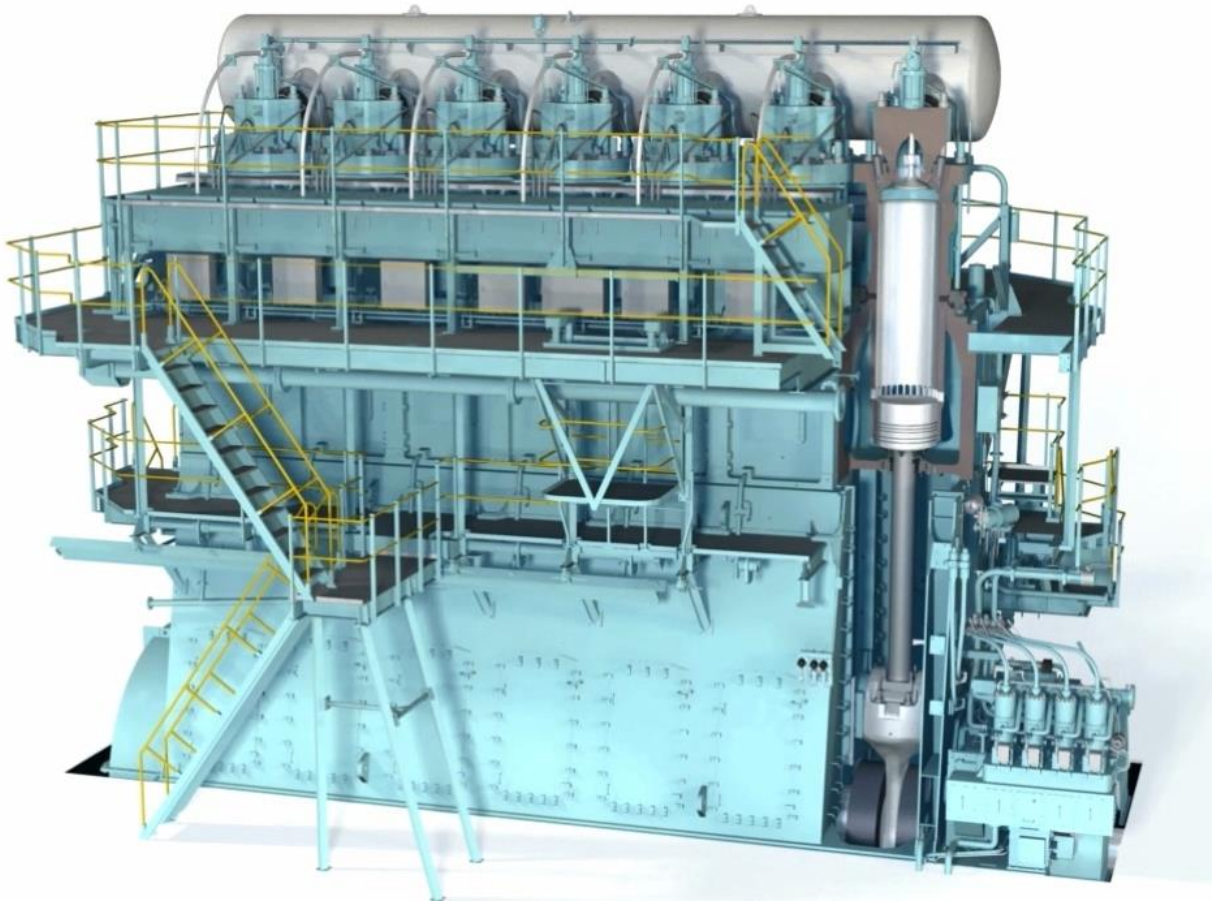
High Pressure SCR

Low Pressure SCR

Emission Compliance of X-DF engines

Low-pressure technology sets the standard

Maximum simplicity



The Principle

- Engine operating according to Otto process
- Pre-mixed ‘Lean-burn’ combustion technology
- Low-pressure gas admission at ’mid-stroke’ location
- Ignition by pilot-fuel into pre-chambers

The main merits with low gas pressure < 13bar

- Simple and reliable gas supply system
- Simple gas sealing
- Wide selection of proven compressors / cryogenic pumps

Lean Burn ‘Otto’ combustion means

IMO Tier III compliance:

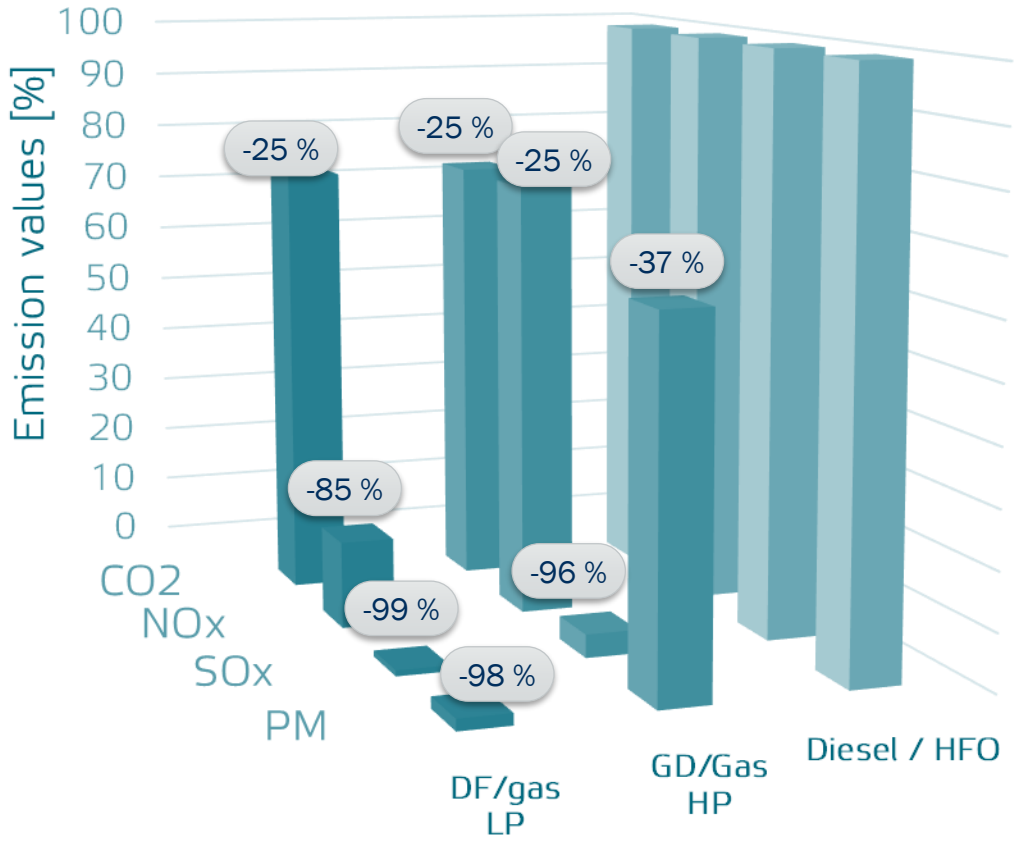
- Without additional equipment (EGR/SCR)
- Without additional fuel consumption
- Without compromised component reliability

X-DF Engines

Environmental aspects

- Benchmarking environmentally-friendly low-pressure technology

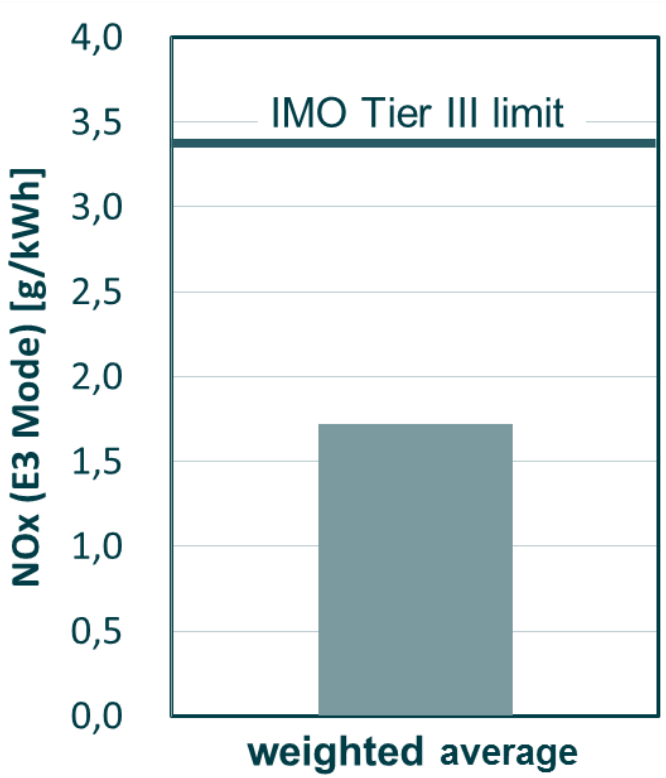
- Almost SOX free emission
- NOx emission Tier III compliant
- Almost PM free emission

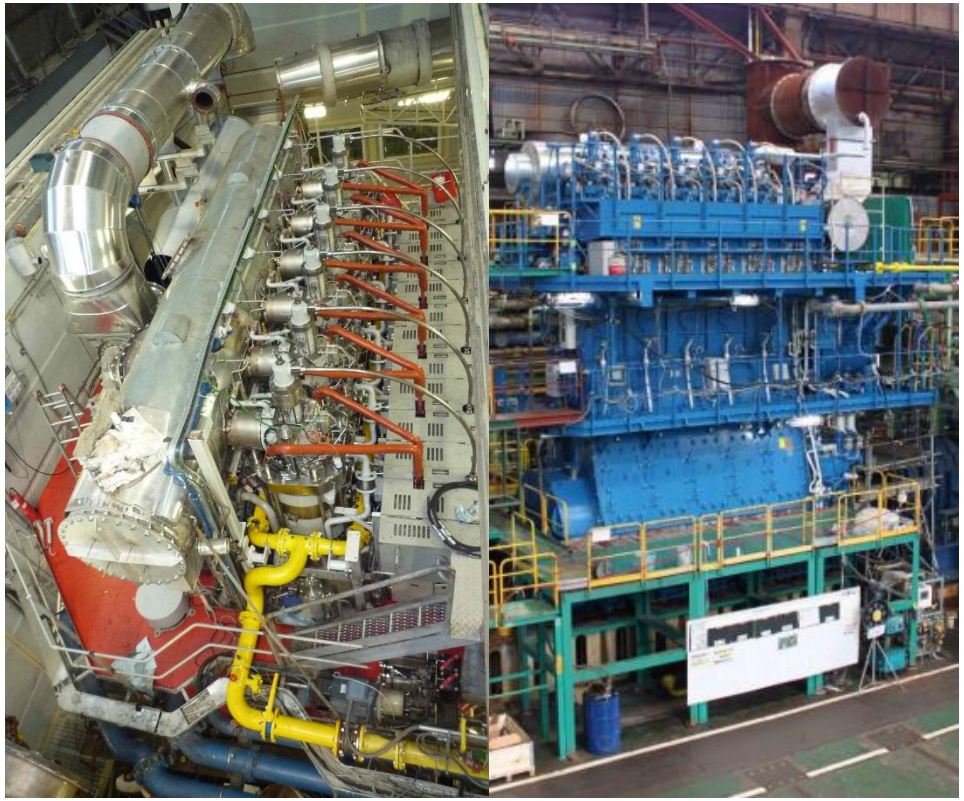


X-DF Engines

NOx compliance of X-DF engines

- X-DF engines are Tier III compliant in gas mode
- NO_X levels on gas at about half of IMO Tier III limit





Conclusions

Conclusion

Emission Control for Ships

Today : Compliance with existing regulations

- NOx: Multiple solutions available
- SOx: Scrubbing technology available
- Use of low-Sulphur fuels is current standard for low-speed engines operated in SECA
- X-DF low pressure gas engines: Lowest overall emission footprint - meet IMO TIER III requirements without exhaust gas after-treatment

Tomorrow: Prepare for future regulations

- Continuous development of key engine components related to combustion to further reduce emissions beyond existing regulations, increase efficiency (reduce fuel consumption) and offer full fuel flexibility.
- Use the most advanced tools and methods to provide competitive technologies and designs and co-operate with industry partners and Universities

Thank you
Questions and answers

WinGD in a nutshell

Cooperation with Rudolf Diesel started in 1893

Winterthur Gas & Diesel Ltd. (WinGD) is a leading developer of 2-stroke low-speed gas and diesel engines used for propulsion power in merchant shipping.

WinGD started the development of large diesel engines under the name “Sulzer” already in 1898.

WinGD’s target is to set the industry standard for reliability, efficiency and environmental friendliness.

WinGD provides designs, licences and technical support to manufacturers, shipbuilders and ship operators worldwide.

Employees: 353 (from 35 different nations) worldwide

Contact information

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