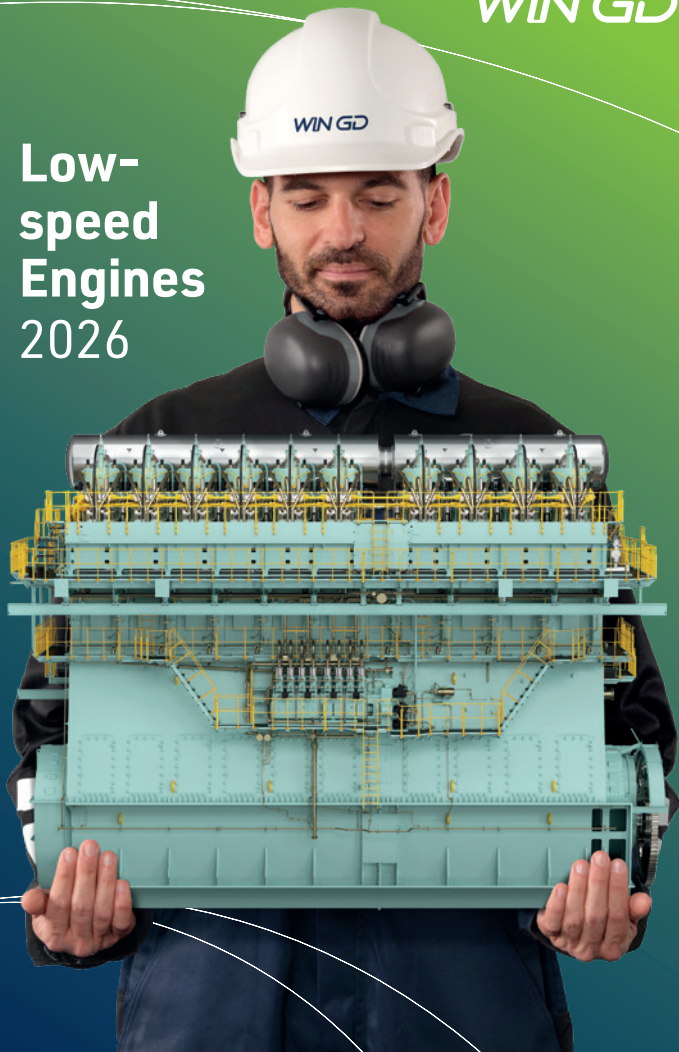


WINGD

Low- speed Engines 2026



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When referring to specific engines, the data may be subject to changes. These will be assessed individually according to the particular characteristics of each project.



Building the business case for decarbonised ship power

Now is the time for innovation leadership. WinGD is answering that call.

The postponement of IMO's Net Zero Framework in 2025 was a setback for shipping's clean energy transition, delaying the clarity, cohesion and incentive needed by ship owners, charterers and prospective fuel producers. It also made one thing unmistakably clear: the onus is on industry to prove that it can decarbonise effectively – and cost effectively – independently of a global regime.

WinGD continues to lead through engine innovation, delivering the propulsion technologies that enable shipowners to operate successfully regardless of the fuel path they choose, or the regulatory framework they operate within. Our technical expertise and solutions provide the flexibility and performance the global fleet needs to decarbonise.

The future of shipping will be written not in regulation alone, but in the application of safe, reliable and cost-effective clean-fuel capable ship technology, and the partnerships that drive it. WinGD is already powering that future.

Our growing engine portfolio showcases the latest advances in two-stroke technology for zero- and near-zero emissions fuels.

That offer is now supported by a global network of experts and technicians ready to support our customers through the complete lifecycle of their vessel.

Within these pages, you'll find the culmination of decades of innovation, collaboration, and a steadfast commitment to our customers.

From robust fuel flexibility to digital and energy solutions that optimise fleet performance, through to our retrofit and global service solutions, WinGD is the partner you can trust.

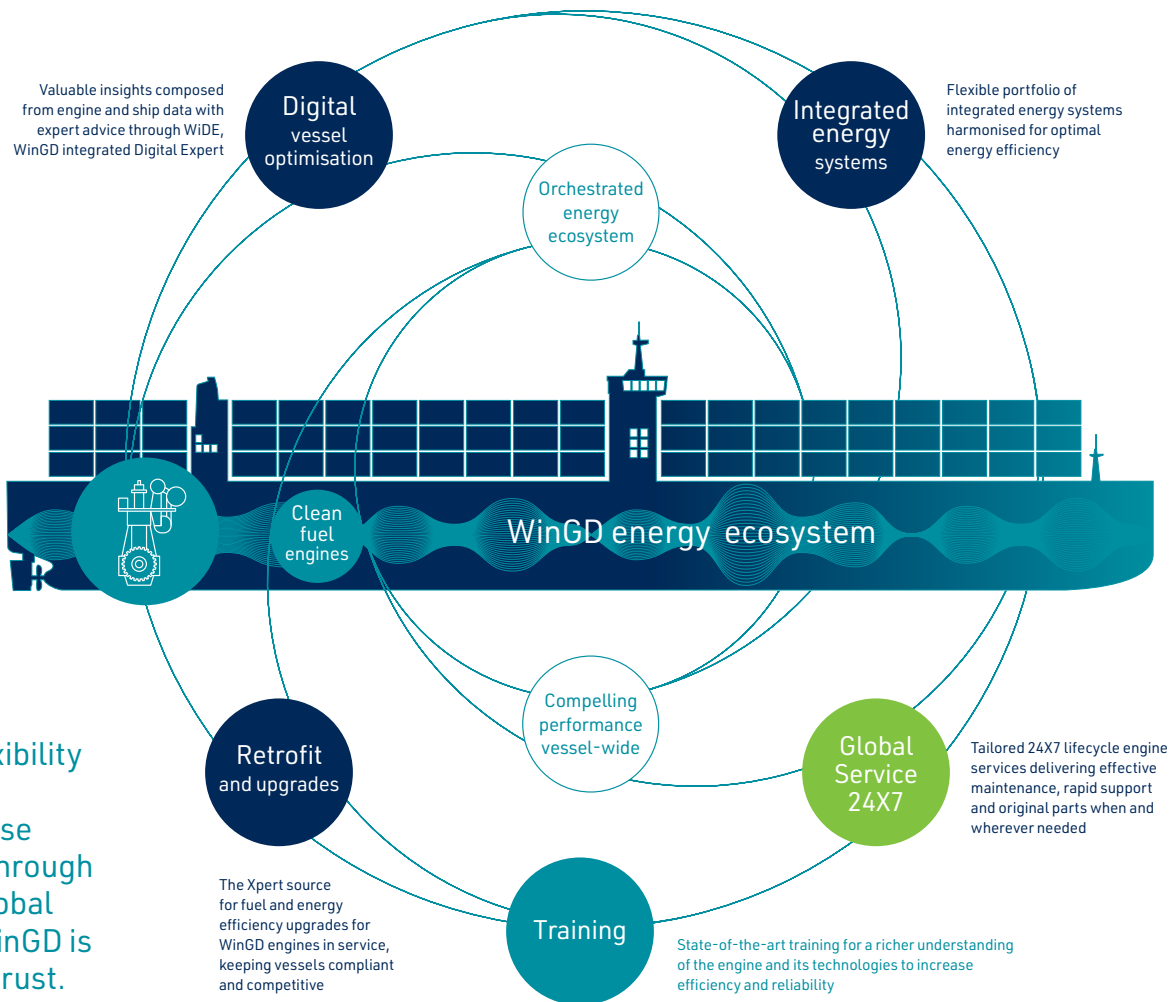
"Whether or not there is a framework, we will keep innovating. We will keep investing. And we will keep driving the technologies that make zero-emission shipping achievable."

Dominik Schneider, CEO, WinGD



The partner to trust throughout the life of your vessel

From robust fuel flexibility to digital and energy solutions that optimise fleet performance, through to our retrofit and global service solutions, WinGD is the partner you can trust.



Orchestrated solutions working together for compelling performance

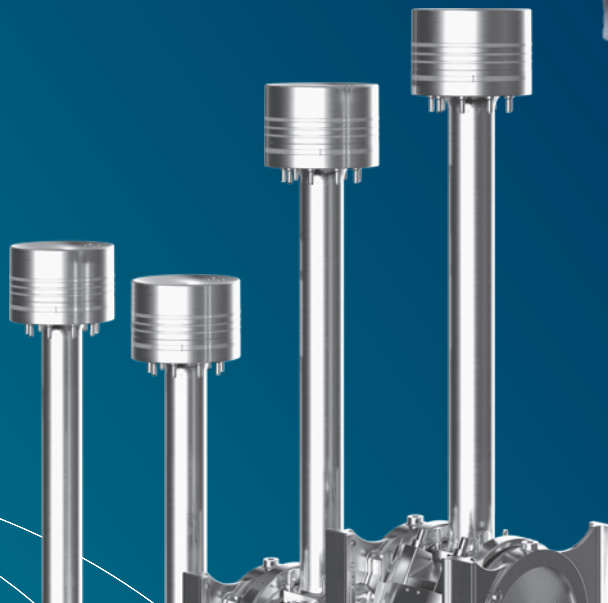
WinGD offers a wide range of solutions that support ship operators in making their vessels more efficient and more reliable.

Clean-fuel capable engines, hybrid energy management systems and digital optimisation solutions – combined with around the clock support and state-of-the-art training – work in harmony to deliver the performance that vessels need to meet the demands of the maritime market, today and in the future.

Beyond our proven product portfolio, WinGD's global network of engineers, service experts and training providers help customers use our solutions as safely, reliably and efficiently as possible – wherever, whenever and across the entire vessel lifecycle.

WinGD delivers quality ship owners can trust through:

- Engine design
- Reliable performance
- Reduced emissions
- Integrated energy solutions (X-EL)
- Digital optimisation (WiDE)
- Warranty service and support
- 24X7 customer support
- Crew training
- Global service network
- Retrofit and upgrades



From Sulzer to WinGD: A History of Engine Development

WinGD's history dates back to the late 1800s, bearing witness to remarkable progress and growth. Today as shipping faces daunting technical challenges, that heritage of innovation and expertise is more relevant than ever.

WinGD originated from the diesel engine business of Sulzer Corporation in Winterthur, established in 1834. On June 10 1898 the very first diesel engine – designed by Rudolf Diesel – was started in Winterthur, Switzerland, where WinGD is still headquartered today.

Powering merchant shipping for over a century

Manufacturing continued in Winterthur until 1986, when the last diesel engine left the Winterthur facility. While engine manufacturing centres moved to be as close to shipyards as possible, engine innovation research and design functions remained in Switzerland – and do to this day.

In November 1990 Sulzer established its Diesel Engine & Diesel Power Plant Division as a separate company, New Sulzer Diesel Ltd. A merger with Wärtsilä Diesel created Wärtsilä New Sulzer Diesel Corporation, later becoming Wärtsilä. In early 2015 Wärtsilä Switzerland Ltd., responsible for the low-speed, two-stroke engine within Wärtsilä, merged with China State Shipbuilding Corporation (CSSC), forming Winterthur Gas & Diesel Ltd (WinGD).

WinGD is powering the transformation to a sustainable future

Wärtsilä Corporation transferred its remaining shares of WinGD to CSSC, making WinGD 100% owned by CSSC from 2016.

From designing the first reversing two-stroke marine engine in 1905 to the world's biggest dual-fuel low-speed engines in 2020 – and designing the first ammonia-fuelled low-speed engine to be installed on a ship in 2025 – WinGD has continued to innovate with the aim of making shipping more efficient.

Along the way, it pioneered turbocharging on two-stroke engines in 1946 and the first electronically controlled low-speed engine with common-rail injection in 1998. It introduced the first low-speed gas engines for ships in 1972, pioneering fuel flexibility.

The modern X-DF dual-fuel LNG platform – supplemented with X-DF2.0 technologies iCER (intelligent Control by Exhaust Recycling) and VCR (Variable Compression Ratio) – has been in service since 2016 and boasts the best overall emissions footprint available today.

2025 saw the X-DF portfolio expand to include clean fuels including ammonia, methanol and ethanol, driving shipping's decarbonisation potential. The launch of Global Service by WinGD that same year brings unparalleled engine expertise and support to customers through a global service network.

Through the most advanced technologies in emissions reduction, fuel efficiency, hybridisation and digital optimization, WinGD continues to power shipping's transformation to a sustainable future.



Research and Testing



As engine designers, WinGD's expertise lies in technology innovation. As well as developing engines for new fuels and technologies to reduce air pollution, WinGD continuously seeks to improve both the efficiency and lifecycle costs of its engines.

To advance these concepts, WinGD has made considerable investments in expanding its research and development test facilities. These include the Engine Research and Innovation Centre in Winterthur and the Global Test Centre in Shanghai.

To learn more about WinGD's research and testing capabilities scan or click the QR code:



Merchant Ship Applications

WinGD's growing engine portfolio provides simple solutions to reduce emissions, fuel consumption and operating costs, improve safety and give shipowners and operators peace of mind.

WinGD offers fuel flexible, low-speed, dual-fuel X-DF engines and X-Engines. Supported by the most advanced technology in emissions reduction, automation and control, digitalisation and fuel efficiency, these engines provide simple, safe and flexible propulsion solutions.

The tables shown in the following pages provide an engine selection for a variety of vessel types.

Final engine choice is dependent on ship specification, investment and operating cost evaluation and preferred engine configuration.

For more information, download our Vessel Type Brochure at: www.wingd.com/news-media/brochures-papers



Tankers

TANKER TYPE	WINGD LOW-SPEED ENGINES			
	X52 X52-S	X62 X62-S	X72	X82
Small tanker	•			
Handysize tanker	•			
Panamax tanker		•		
Aframax tanker		•	•	
Suezmax tanker			•	
VLCC				•

X-DF portfolio engines are available as an alternative to X-Engines
X-EL Shaft generator solutions can be offered upon request



Name: Eneos Arrow
Vessel type: VLCC 311,000 dwt Crude oil tanker
Shipowner: JX Ocean
Shipyard: Japan Marine United, Ariake, Japan

Delivery: 2017
Main engine: 7X82

Container Vessels

CONTAINER VESSEL TYPE	WINGD LOW-SPEED ENGINES				
	X52 X52-S	X62 X62-S	X72	X82	X92
700 – 1,100 TEU	•				
1,100 – 1,400 TEU	•				
1,400 – 2,500 TEU		•			
2,500 – 4,500 TEU			•		
4,500 – 11,000 TEU				•	
> 11000 TEU					•

X-DF portfolio engines are available as an alternative to X-Engines

X-EL Shaft generator solutions can be offered upon request



Name: Jacques Saade
Vessel type: 23,000 TEU Container vessel
Shipowner: CMA CGM S.A.
Shipyard: Hudong-Zhonghua Shipbuilding (Group) Co., Ltd. China

Delivery: 2020
Main engine: 12X92DF

Bulk Carriers

BULK CARRIER TYPE	WINGD LOW-SPEED ENGINES			
	X52 X52-S	X62 X62-S	X72	X82
Handysize bulkers	•			
Handymax bulkers	•			
Ultramax bulkers	•			
Kamsarmax bulkers		•		
Panamax bulkers		•		
Capesize bulkers			•	
VLOC				•

X-DF portfolio engines are available as an alternative to X-Engines

X-EL Shaft generator solutions can be offered upon request



Name: Algoma Equinox
Vessel type: 39,400 dwt Bulk carrier
Shipowner: Algoma Central Corp., Canada
Shipyard: Nantong Mingde Heavy Industries, China

Delivery: 2013
Main engine: 5RT-flex50

Multipurpose Vessels

VESSEL TYPE	WINGD LOW-SPEED ENGINES	
	X52 X52-S	X62 X62-S
Small	•	
< 30,000 dwt	•	
> 30,000 dwt		•

X-DF portfolio engines are available as an alternative to X-Engines
X-EL Shaft generator solutions can be offered upon request



Name: Green Salvador
Vessel type: 77,000 dwt Multipurpose
Shipowner: CMB Financial Leasing, China
Shipyard: Cosco Shipping Heavy Industry (Dalian) Co., Ltd

Delivery: 2024
Main engine: 6X62-S2.0

Gas Carriers

LNG CARRIER TYPE	WINGD LOW-SPEED ENGINES		
	X52DF	X62DF	X72DF
<15,000	•		
15,000 – 30,000 m³	•		
30,000 – 60,000 m³		•	
60,000 – 170,000 m³			•
170,000 – 250,000 m³		• twin-engine	• twin-engine

LPG/AMMONIA CARRIER TYPE	WINGD LOW-SPEED ENGINES	
	X52DF-A/P	X62DF-A/P
< 50,000 m³	•	
> 50,000 m³		•

X-DF portfolio engines are available as an alternative to X-Engines
X-EL Shaft generator solutions can be offered upon request



Name: Greenergy Ocean
Vessel type: 174,000 CBM LNG Carrier
Shipowner: CNOOC & MOL
Shipyard: Hudong-Zhonghua Shipbuilding (Group) Co Ltd., China

Delivery: 2024
Main engine: Twin 5X72DF-2.1

WinGD Low-speed Engines

WinGD low-speed engines are the optimal propulsion solution for merchant vessels with directly driven propellers.

WinGD's well-proven electronically-controlled common-rail technology plays a key role in enabling shipowners to reduce fuel and lubricant costs, and minimise the emissions footprint.

The benefits to shipowners and operators are:

- Optimal power and speed for all ship types and sizes
- A wide range of engines is available for all major types of fuels
- Lowest possible fuel and cylinder lube oil consumption over the whole operating range, especially at part load
- Different tunings to suit particular sailing profiles
- Specific tunings to increase the exhaust gas temperature for increased steam production (when required)
- Full compliance with IMO NO_x and SO_x regulations
- High reliability and durability
- Long TBO's, up to five years between overhauls

- Reduced maintenance requirements resulting in low operational costs
- Competitive capital cost

WinGD offers **Integrated In-line Shaft Generator Solutions** that are:

- Matched with the main engines to enable optimum energy efficiency, operational cost, and sustainability in extended operational ranges
- Available for all types of merchant ships

For integrated battery-hybrid applications, please refer to pages 90-93.

Power Range for WinGD Low-speed Engines

WinGD DUAL-FUEL ENGINES

LNG

	Power (MW)	Speed (RPM)
X52DF-2.1	4 6 8 10 15 20 30 40 50 60 70 80	79-105
X52DF-S2.0	4 6 8 10 15 20 30 40 50 60 70 80	80-120
X62DF-S2.0	4 6 8 10 15 20 30 40 50 60 70 80	82-108
X62DF-2.1	4 6 8 10 15 20 30 40 50 60 70 80	80-103
X72DF-2.1	4 6 8 10 15 20 30 40 50 60 70 80	69-89
X72DF-2.2	4 6 8 10 15 20 30 40 50 60 70 80	69-79
X82DF-2.0	4 6 8 10 15 20 30 40 50 60 70 80	58-84
X92DF-2.0	4 6 8 10 15 20 30 40 50 60 70 80	70-80

LNG-HP

X82DF-HP-1.0	4 6 8 10 15 20 30 40 50 60 70 80	58-84
X92DF-HP-1.0	4 6 8 10 15 20 30 40 50 60 70 80	70-80

Ammonia

X52DF-A-S1.0	4 6 8 10 15 20 30 40 50 60 70 80	80-120
X52DF-A-1.0	4 6 8 10 15 20 30 40 50 60 70 80	79-105
X62DF-A-S1.0	4 6 8 10 15 20 30 40 50 60 70 80	82-108
X62DF-A-1.0	4 6 8 10 15 20 30 40 50 60 70 80	77-103
X72DF-A-1.0	4 6 8 10 15 20 30 40 50 60 70 80	66-89
X82DF-A-1.0	4 6 8 10 15 20 30 40 50 60 70 80	58-84

LPG

X52DF-P-1.0	4 6 8 10 15 20 30 40 50 60 70 80	79-105
X62DF-P-1.0	4 6 8 10 15 20 30 40 50 60 70 80	77-103

Methanol/Ethanol

X52DF-M-S1.0	4 6 8 10 15 20 30 40 50 60 70 80	80-120
X62DF-M-S1.0	4 6 8 10 15 20 30 40 50 60 70 80	82-108
X62DF-M-1.0	4 6 8 10 15 20 30 40 50 60 70 80	77-103
X72DF-M-1.0	4 6 8 10 15 20 30 40 50 60 70 80	66-89
X82DF-M-1.0	4 6 8 10 15 20 30 40 50 60 70 80	58-84
X92DF-M-1.0	4 6 8 10 15 20 30 40 50 60 70 80	70-80

WinGD DIESEL ENGINES

X52-1.2	4 6 8 10 15 20 30 40 50 60 70 80	75-105
X52-S2.0	4 6 8 10 15 20 30 40 50 60 70 80	80-120
X62-S2.0	4 6 8 10 15 20 30 40 50 60 70 80	82-108
X62-1.2	4 6 8 10 15 20 30 40 50 60 70 80	72-103
X72-1.2	4 6 8 10 15 20 30 40 50 60 70 80	63-89
X82-2.0	4 6 8 10 15 20 30 40 50 60 70 80	58-84
X92-1.1	4 6 8 10 15 20 30 40 50 60 70 80	70-80

X-DF1.0 LNG engines are available upon request.

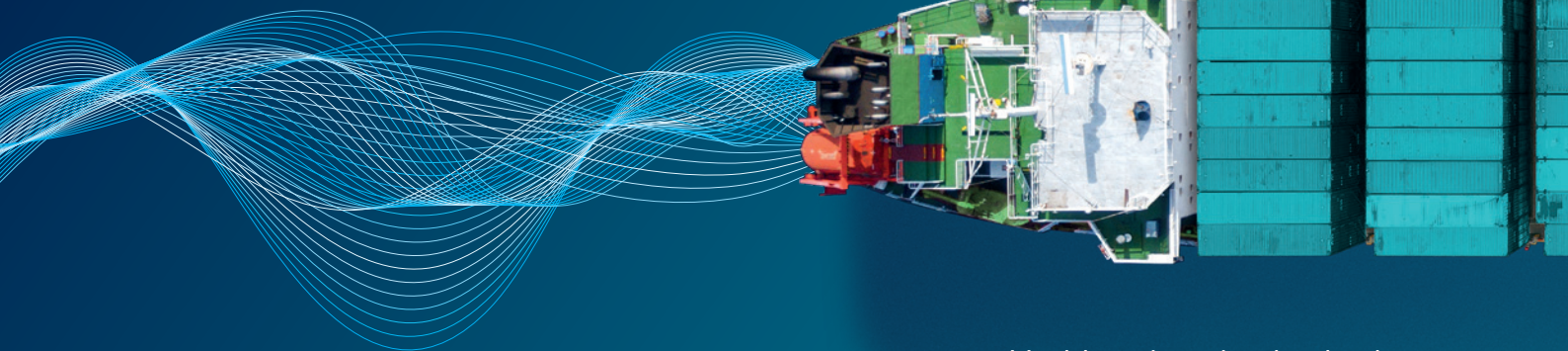
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The General Technical Data (GTD) program provides up-to-date information on WinGD low-speed engines.

WinGD Portfolio

Orchestrated solutions working together for compelling performance. Our emissions reduction, automation and control, energy management and digital optimisation solutions are founded on our deep engine and energy system expertise.

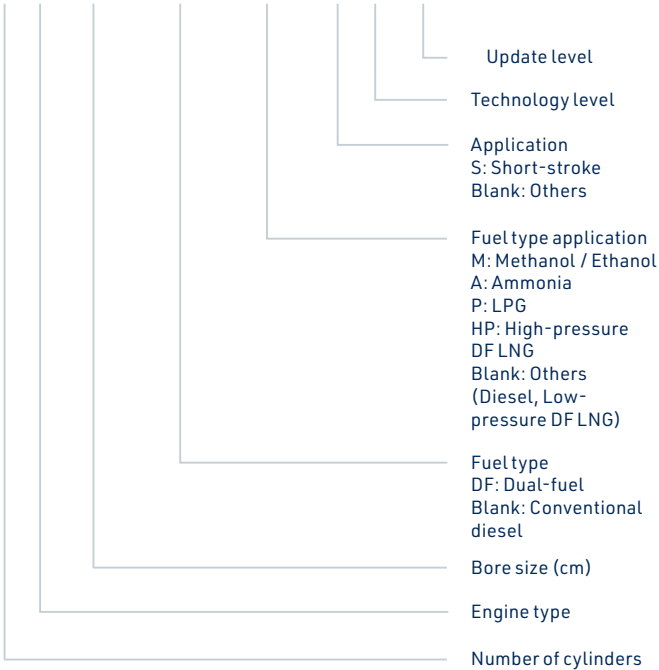
Combined with our high-performance engines they enable customers to get the best from their vessel-wide energy ecosystem – putting ship owners and operators firmly in control of their fleet's fuel consumption, emissions and performance.



Maritime decarbonisation is an ensemble effort. WinGD's orchestra of solutions work in harmony to deliver finely tuned efficiency.

Engine Designation

6X52DF-A-S1.0



Example engine designation 6X52DF-A-S1.0 representing a WinGD 6 cylinder, short-stroke engine for dual-fuel operation with ammonia and diesel.

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When referring to specific engines, the data may be subject to changes. These will be assessed individually according to the particular characteristic of each project.



X-DF by WinGD

X-DF LNG Engines

X52DF-2.1

IMO Tier III in gas mode

Cylinder bore	520 mm
Piston stroke	2 315 mm
Speed	79–105 rpm
Mean effective pressure at R1	17.3 bar
Stroke / bore	4.45

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	105 rpm	79 rpm				
	R1	R2	R3	R4		
5	7 450	6 200	5 600	4 650	5 985	217
6	8 940	7 440	6 720	5 580	6 925	251
7	10 430	8 680	7 840	6 510	7 865	288
8	11 920	9 920	8 960	7 440	8 805	323

Dimensions (mm)	B	C	D	D (ICER on-engine)
	F1	F2	F3	G
	3 514	1 205	8 415	9 855
	10 350	10 400	9 850	1 910

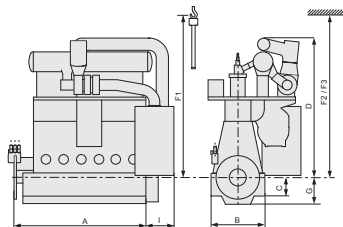
BRAKE SPECIFIC CONSUMPTIONS IN GAS MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 067	6 931	7 170	7 033
BSGC (gas)	g/kWh	140.1	137.1	142.1	139.1
BSPC (pilot fuel)	g/kWh	1.5	1.8	1.5	1.8

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	181.4	175.4	183.4	179.4

For definitions see page 66.



X52DF-S2.0

IMO Tier III in gas mode

Cylinder bore	520 mm
Piston stroke	2 045 mm
Speed	80–120 rpm
Mean effective pressure at R1	17.3 bar
Stroke / bore	3.93

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Length A* mm	Dry mass tonnes
	120 rpm	80 rpm					
	R1	R2	R3	R4			
5	7 500	6 250	5 025	4 150	5 485	6 565	190
6	9 000	7 500	6 030	4 980	6 345	7 415	215
7	10 500	8 750	7 035	5 810	7 205		245
8	12 000	10 000	8 040	6 640	8 065		275

Dimensions (mm)	B	C	D	D (ICER on-engine)
	F1	F2	F3	G
	3 100	1 185	7 725	8 590
	9 370	9 320	8 800	1 675

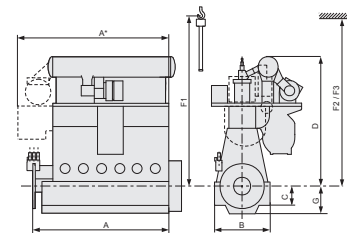
BRAKE SPECIFIC CONSUMPTIONS IN GAS MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 067	6 931	7 170	7 033
BSGC (gas)	g/kWh	140.1	137.1	142.1	139.1
BSPC (pilot fuel)	g/kWh	1.5	1.8	1.5	1.8

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	181.4	175.4	185.4	181.4
BSFC (VCR Tier II)	g/kWh	164.9	163.9	171.4	173.4

For definitions see page 66.



X-DF LNG Engines

X62DF-2.1

IMO Tier III in gas mode

Cylinder bore	620 mm
Piston stroke	2 658 mm
Speed	80–103 rpm
Mean effective pressure at R1	17.3 bar
Stroke / bore	4.29

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	103 rpm	80 rpm				
	R1	R2	R3	R4		
5	11 925	9 925	9 250	7 700	6 805	318
6	14 310	11 910	11 100	9 240	7 910	370
7	16 695	13 895	12 950	10 780	9 020	428
8	19 080	15 880	14 800	12 320	10 125	475

Dimensions (mm)	B	C	D	D (iCER on-engine)
	F1	F2	F3	G
	4 200	1 360	9 580	10 910
	11 775	11 775	10 950	2 110

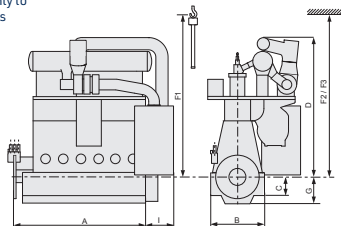
BRAKE SPECIFIC CONSUMPTIONS IN GAS MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	6 999	6 862	7 080	6 935
BSGC (gas)	g/kWh	139.3	136.4	140.9	137.8
BSPC (pilot fuel)	g/kWh	0.8	1.0	0.8	1.0

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	176.8	170.8	178.8	174.8
BSFC (VCR diesel Tier II)	g/kWh	166.8	165.8	167.8	165.8

For definitions see page 66.
iCER on-engine applies only to
5/6/7 cylinder applications



X62DF-S2.0

IMO Tier III in gas mode

Cylinder bore	620 mm
Piston stroke	2 245 mm
Speed	82–108 rpm
Mean effective pressure at R1	17.3 bar
Stroke / bore	3.62

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	108 rpm	82 rpm				
	R1	R2	R3	R4		
5	10 550	8 775	8 000	6 675	6 260	280
6	12 660	10 530	9 600	8 010	7 260	325
7	14 770	12 285	11 200	9 345	8 260	370
8	16 880	14 040	12 800	10 680	9 260	415

Dimensions (mm)	B	C	D	D (iCER on-engine)
	F1	F2	F3	G
	3 440	1 295	8 575	9 496
	10 300	10 300	9 680	1 835

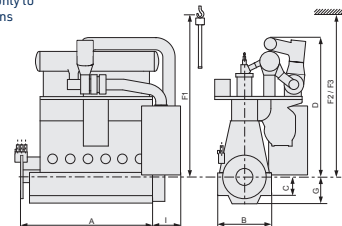
BRAKE SPECIFIC CONSUMPTIONS IN GAS MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 008	6 871	7 089	6 944
BSGC (gas)	g/kWh	139.1	136.4	140.9	137.8
BSPC (pilot fuel)	g/kWh	1.0	1.2	1.0	1.2

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	179.8	173.8	181.8	177.8
BSFC (VCR Tier II)	g/kWh	164.8	165.3	166.8	165.3

For definitions see page 66.
iCER on-engine applies only to
5/6/7 cylinder applications



X-DF LNG Engines

X72DF-2.1

IMO Tier III in gas mode

Cylinder bore	720 mm
Piston stroke	3 086 mm
Speed	69-89 rpm
Mean effective pressure at R1	17.3 bar
Stroke / bore	4.29

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	89 rpm	69 rpm				
	R1	R2	R3	R4		
5	16 125	13 425	12 500	10 400	8 230	495
6	19 350	16 110	15 000	12 480	9 520	580
7	22 575	18 795	17 500	14 560	10 810	642
8	25 800	21 480	20 000	16 640	12 105	716

Dimensions (mm)	B	C	D	D (iCER on-engine)
	4 780	1 575	10 790	11 755
	F1	F2	F3	G
	13 655	13 655	12 730	2 455

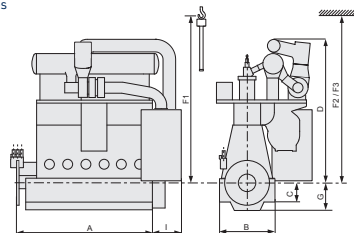
BRAKE SPECIFIC CONSUMPTIONS IN GAS MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	6 909	6 668	7 012	6 764
BSGC (gas)	g/kWh	137.7	132.8	139.7	134.7
BSPC (pilot fuel)	g/kWh	0.6	0.7	0.6	0.7

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	175.8	169.8	177.8	173.8
BSFC (VCR diesel Tier II)	g/kWh	166.3	166.3	167.8	165.8

For definitions see page 66.
iCER on-engine applies
only to 5/6 cylinder
applications



X72DF-2.2

IMO Tier III in gas mode

Cylinder bore	720 mm
Piston stroke	3 086 mm
Speed	69-79 rpm
Mean effective pressure at R1	15.7 bar
Stroke / bore	4.29

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	79 rpm	69 rpm				
	R1	R2	R3	R4		
5	13 000	11 900	11 350	10 400	7 875	484
6	15 600	14 280	13 620	12 480	9 165	565

Dimensions (mm)	B	C	D	D (iCER on-engine)
	4 780	1 575	10 790	11 755
	F1	F2	F3	G
	13 655	13 655	12 730	2 455

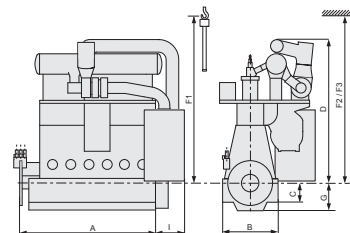
BRAKE SPECIFIC CONSUMPTIONS IN GAS MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	6 813	6 715	6 876	6 764
BSGC (gas)	g/kWh	135.7	133.7	137.0	134.7
BSPC (pilot fuel)	g/kWh	0.7	0.7	0.7	0.7

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	174.2	171.8	175.6	173.8
BSFC (VCR diesel Tier II)	g/kWh	166.0	166.0	166.7	165.8

For definitions see page 66.
Engine optimised for reduced rating field
and 5/6 cylinder applications



X-DF LNG Engines

X82DF-2.0

IMO Tier III in gas mode

Cylinder bore	820 mm
Piston stroke	3 375 mm
Speed	58-84 rpm
Mean effective pressure at R1	17.3 bar
Stroke / bore	4.12

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	84 rpm	58 rpm				
	R1	R2	R3	R4		
6	25 920	21 600	17 880	14 940	10 425	805
7	30 240	25 200	20 860	17 430	11 865	910
8	34 560	28 800	23 840	19 920	13 305	1 020
9	38 880	32 400	26 820	22 410	14 745	1 160
Dimensions (mm)	B		C		D	
	5 050		1 800		12 310	
	F1		F2*		F3*	
	15 080		-		-	
						G
						2 700

BRAKE SPECIFIC CONSUMPTIONS IN GAS MODE

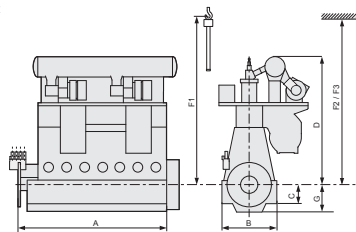
Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	6 807	6 559	6 905	6 657
BSGC (gas)	g/kWh	135.6	130.6	137.6	132.6
BSPC (pilot fuel)	g/kWh	0.6	0.7	0.6	0.7

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	177.2	171.2	179.2	175.2
BSFC (VCR Tier II)	g/kWh	168.7	166.7	166.7	165.7

For definitions see page 66.

* Available on request



X92DF-2.0

IMO Tier III in gas mode

Cylinder bore	920 mm
Piston stroke	3 468 mm
Speed	70-80 rpm
Mean effective pressure at R1	17.3 bar
Stroke / bore	3.77

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	80 rpm	70 rpm				
	R1	R2	R3	R4		
6	31 920	26 580	27 930	23 250	11 755	1 120
7	37 240	31 010	32 585	27 125	13 345	1 260
8	42 560	35 440	37 240	31 000	14 935	1 380
9	47 880	39 870	41 895	34 875	17 960	1 630
10	53 200	44 300	46 550	38 750	19 550	1 790
11	58 520	48 730	51 205	42 625	21 215	1 960
12	63 840	53 160	55 860	46 500	22 875	2 140
Dimensions (mm)	B		C		D	
	5 550		1 900		13 140	
	F1	F2	F3		G	
	15 605		15 552		14 290	
					2 970	

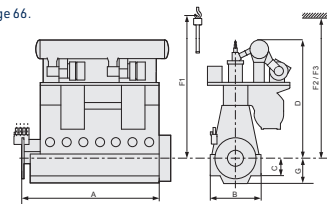
BRAKE SPECIFIC CONSUMPTIONS IN GAS MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	6 751	6 504	6 850	6 602
BSGC (gas)	g/kWh	134.6	129.6	136.6	131.6
BSPC (pilot fuel)	g/kWh	0.5	0.6	0.5	0.6

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	172.7	166.7	174.7	170.7
BSFC (VCR Tier II)	g/kWh	164.2	162.2	163.2	163.7

For definitions see page 66.



X-DF HP

by WinGD



X-DF LNG Engines

X82DF-HP-1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	820 mm
Piston stroke	3 375
Speed	58-84 rpm
Mean effective pressure at R1	22.0 bar
Stroke / bore	4.12

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	84 rpm	58 rpm				
		R1	R2	R3		
6	33 000	24 000	22 800	16 560	10 426	845
7	38 500	28 000	26 600	19 320	11 866	956
8	44 000	32 000	30 400	22 080	13 306	1 071
9	49 500	36 000	34 200	24 840	14 746	1 218
Dimensions (mm)		B		C	D	
		5 050		1 800	12 310	
		F1		F2*	F3*	G
		15 250		-	-	2 700

BRAKE SPECIFIC FUEL CONSUMPTION IN GAS MODE

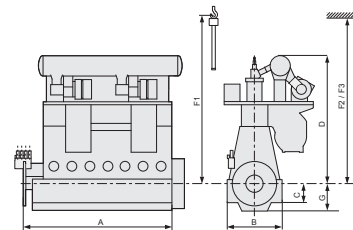
Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 144	6 926	6 981	6 862
BSGC (gas)	g/kWh	135.7	128.7	132.5	127.4
BSPC (pilot fuel)	g/kWh	8.4	11.5	8.4	11.5

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	167.3	162.2	163.5	160.7

For definitions see page 66.

* Available upon request



X-DF LNG Engines

X92DF-HP-1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	920 mm
Piston stroke	3 468
Speed	70-80 rpm
Mean effective pressure at R1	21.0 bar
Stroke / bore	3.77

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	80 rpm	70 rpm				
	R1	R2	R3	R4		
6	38 700	27 900	33 900	24 420	11 605	1 176
7	45 150	32 550	39 550	28 490	13 195	1 323
8	51 600	37 200	45 200	32 560	14 785	1 449
9	58 050	41 850	50 850	36 630	17 960	1 771
10	64 500	46 500	56 500	40 700	19 550	1 880
11	70 950	51 150	62 150	44 770	21 215	2 058
12	77 400	55 800	67 800	48 840	22 875	2 247
Dimensions (mm)	B		C		D	
	5 550		1 900		13 150	
	F1		F2		F3	
	15 640		15 650		14 360	
					G	
					2 970	

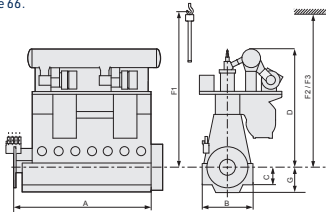
BRAKE SPECIFIC FUEL CONSUMPTION IN GAS MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 037	6 781	6 994	6 823
BSGC (gas)	g/kWh	133.7	125.9	132.9	126.7
BSPC (pilot fuel)	g/kWh	8.2	11.4	8.2	11.4

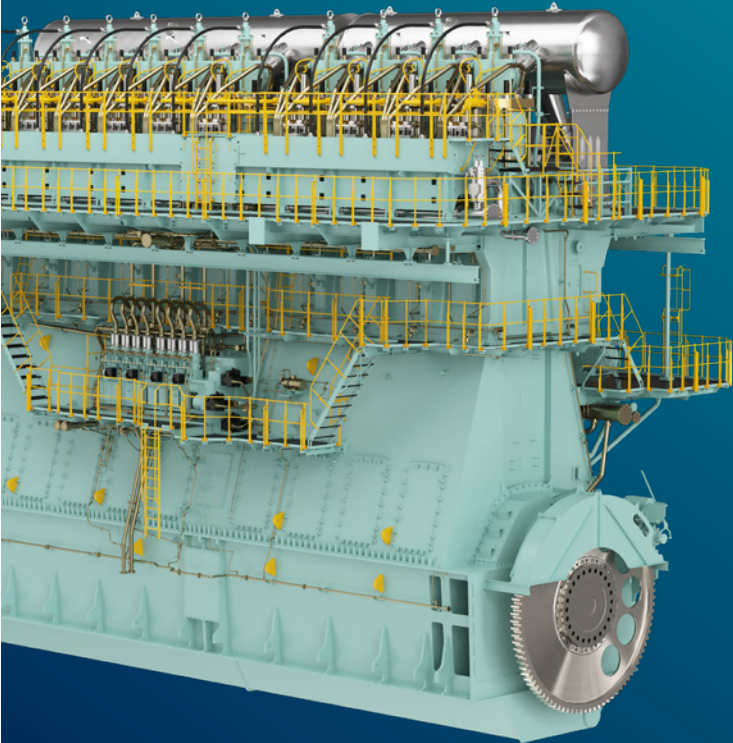
BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	164.8	158.8	163.8	159.8

For definitions see page 66.



For all vessels which do not require the same power density as large containerships, X-DF remains the optimal dual-fuel LNG concept





X-DF^A

by WinGD

X-DF Ammonia Engines

X52DF-A-1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	520 mm
Piston stroke	2 315 mm
Speed	79-105 rpm
Mean effective pressure at R1	21.0 bar
Stroke / bore	4.45

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Length A* mm	Dry mass tonnes
	105 rpm	79 rpm					
	R1	R2	R3	R4			
5	9 050	6 800	6 800	5 100	5 985	6 990	228
6	10 860	8 160	8 160	6 120	6 925	7 930	264
7	12 670	9 520	9 520	7 140	7 865		302
8	14 480	10 880	10 880	8 160	8 805		339
Dimensions (mm)	B		C		D		D (ISCR)
	3 514		1 205		8 415		8 760
	F1		F2		F3		G
	10 350		10 350		9 800		1 910

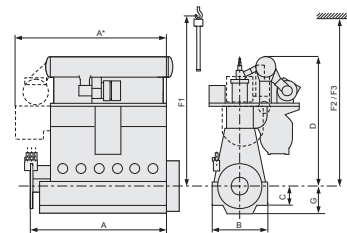
BRAKE SPECIFIC FUEL CONSUMPTION IN AMMONIA MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 294	6 995	7 294	6 995
BSGC (gas)	g/kWh	371.5	355.4	371.5	355.4
BSPC (pilot fuel)	g/kWh	9.0	9.0	9.0	9.0

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	170.8	163.8	170.8	163.8

For definitions see page 66.
ISCR available for
5- to 7-cylinder engines
with one TC on
exhaust side



X-DF Ammonia Engines

X52DF-A-S1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	520 mm
Piston stroke	2 045 mm
Speed	80-120 rpm
Mean effective pressure at R1	22.0 bar
Stroke / bore	3.93

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Length A* mm	Dry mass tonnes
	120 rpm	80 rpm					
	R1	R2	R3	R4			
5	9 550	6 850	6 400	4 550	5 485	6 565	200
6	11 460	8 220	7 680	5 460	6 345	7 415	226
7	13 370	9 590	8 960	6 370	7 205		357
8	15 280	10 960	10 240	7 280	8065		287
Dimensions (mm)	B		C		D		D (ISCR)
	3 100		1 185		7 775		8 000
	F1		F2		F3		G
	9 340		9 340		8 800		1 675

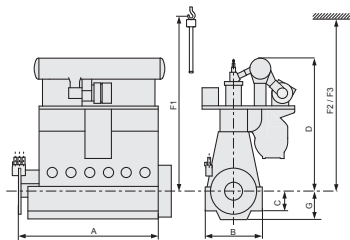
BRAKE SPECIFIC FUEL CONSUMPTION IN AMMONIA MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 038	6 782	7 081	6 995
BSGC (gas)	g/kWh	358.5	345.5	360.7	356.3
BSPC (pilot fuel)	g/kWh	8.7	8.3	8.7	8.6

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	164.8	158.8	165.8	163.8

For definitions see page 66.
iSCR available for
5- to 7-cylinder engines
with one TC on
exhaust side



X62DF-A-1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	620 mm
Piston stroke	2 658 mm
Speed	77-103 rpm
Mean effective pressure at R1	21.0 bar
Stroke / bore	4.29

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	103 rpm	77 rpm				
	R1	R2	R3	R4		
5	14 500	10 650	10 800	7 950	6 805	341
6	17 400	12 780	12 960	9 540	7 910	396
7	20 300	14 910	15 120	11 130	9 020	457
8	23 200	17 040	17 280	12 720	10 125	506
Dimensions (mm)	B		C		D	
	4 200		1 360		9 580	
	F1		F2		F3	
	11 830		11 830		11 005	
						2 110

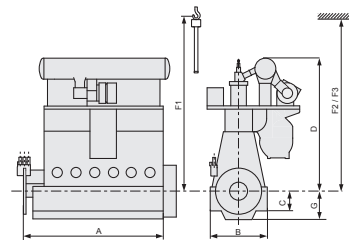
BRAKE SPECIFIC FUEL CONSUMPTION IN AMMONIA MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 209	6 974	7 166	6 974
BSGC (gas)	g/kWh	368.1	355.4	365.8	355.4
BSPC (pilot fuel)	g/kWh	8.5	8.5	8.5	8.5

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	168.8	163.3	167.8	163.3

For definitions see page 66.
iSCR available for
5- to 7-cylinder engines
with one TC on
exhaust side



X-DF Ammonia Engines

X62DF-A-S1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	620 mm
Piston stroke	2 245 mm
Speed	82-108 rpm
Mean effective pressure at R1	22.0 bar
Stroke / bore	3.62

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	108 rpm	82 rpm				
	R1	R2	R3	R4		
5	13 425	9 650	10 200	7 325	6 260	294
6	16 110	11 580	12 240	8 790	7 260	341
7	18 795	13 510	14 280	10 255	8 260	389
8	21 480	15 440	16 320	11 720	9 260	436
Dimensions (mm)	B		C		D	D (ISCR)
	3 440		1 295		8 575	9 020
	F1		F2		F3	G
	10 230		10 230		9 620	1 835

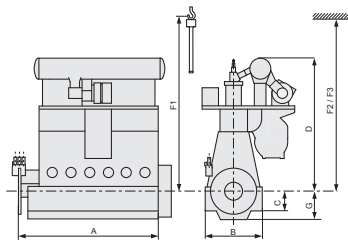
BRAKE SPECIFIC FUEL CONSUMPTION IN AMONIA MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 038	6 825	6 953	6 867
BSGC (gas)	g/kWh	358.5	347.7	354.2	348.9
BSPC (pilot fuel)	g/kWh	8.7	8.4	8.5	8.4

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	164.8	159.8	162.8	160.8

For definitions see page 66.
ISCR available for
5- to 7-cylinder engines
with one TC on
exhaust side



X72DF-A-1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	720 mm
Piston stroke	3 086 mm
Speed	66-89 rpm
Mean effective pressure at R1	21.0 bar
Stroke / bore	4.29

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	89 rpm	66 rpm				
	R1	R2	R3	R4		
5	19 600	14 300	14 550	10 600	8 085	505
6	23 520	17 160	17 460	12 720	9 375	589
7	27 440	20 020	20 370	14 840	10 665	674
8	31 360	22 880	23 280	16 960	11 960	752
Dimensions (mm)	B		C		D	
	4 780		1 575		10 790	
	F1		F2		F3	
	13 750		13 750		12 820	
						2 455

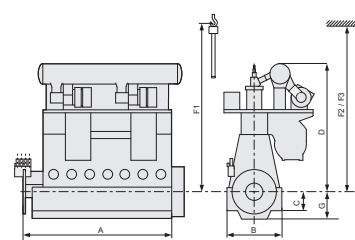
BRAKE SPECIFIC FUEL CONSUMPTION IN AMMONIA MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 209	6 974	7 166	6 974
BSGC (gas)	g/kWh	368.1	355.4	365.8	355.4
BSPC (pilot fuel)	g/kWh	8.5	8.5	8.5	8.5

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	168.8	163.3	167.8	163.3

For definitions see page 66.



X-DF Ammonia Engines

X82DF-A-1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	820 mm
Piston stroke	3 375
Speed	58-84 rpm
Mean effective pressure at R1	22.0 bar
Stroke / bore	4.12

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	84 rpm	58 rpm				
	R1	R2	R3	R4		
6	33 000	24 000	22 800	16 560	10 426	845
7	38 500	28 000	26 600	19 320	11 866	956
8	44 000	32 000	30 400	22 080	13 306	1 071
9	49 500	36 000	34 200	24 840	14 746	1 218
Dimensions (mm)	B		C		D	
	5 050		1 800		12 310	
	F1		F2*		F3*	
	15 250		-		-	
						2 700

BRAKE SPECIFIC FUEL CONSUMPTION IN AMMONIA MODE

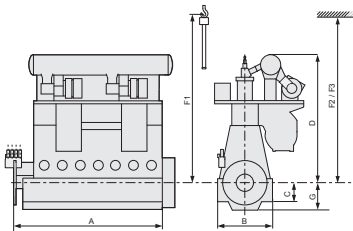
Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 102	6 884	6 940	6 820
BSGC (gas)	g/kWh	361.8	350.7	353.5	347.4
BSPC (pilot fuel)	g/kWh	8.7	8.5	8.5	8.4

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	166.3	161.2	162.5	159.7

For definitions see page 66.

* Available upon request



X-DF^P by WinGD

X-DF LPG Engines

X52DF-P-1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	520 mm
Piston stroke	2 315 mm
Speed	79-105 rpm
Mean effective pressure at R1	21.0 bar
Stroke / bore	4.45

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Length A* mm	Dry mass tonnes
	105 rpm	79 rpm					
	R1	R2	R3	R4			
5	9 050	6 800	6 800	5 100	5 985	6 990	228
6	10 860	8 160	8 160	6 120	6 925	7 930	264
7	12 670	9 520	9 520	7 140	7 865		302
8	14 480	10 880	10 880	8 160	8 805		339
Dimensions (mm)	B		C		D		D (ISCR)
	3 514		1 205		8 415		8 760
	F1	F2	F3	G			
	10 350		10 350		9 800		1 910

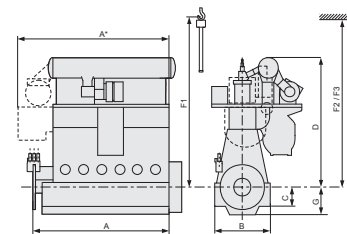
BRAKE SPECIFIC FUEL CONSUMPTION IN LPG MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 294	6 995	7 294	6 995
BSGC (gas)	g/kWh	150.2	143.7	150.2	143.7
BSPC (pilot fuel)	g/kWh	9.0	9.0	9.0	9.0

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	170.8	163.8	170.8	163.8

For definitions see page 66.
ISCR available for
5- to 7-cylinder engines
with one TC on
exhaust side



X-DF LPG Engines

X62DF-P-1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	620 mm
Piston stroke	2 658 mm
Speed	77-103 rpm
Mean effective pressure at R1	21.0 bar
Stroke / bore	4.29

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	103 rpm	77 rpm				
	R1	R2	R3	R4		
5	14 500	10 650	10 800	7 950	6 805	341
6	17 400	12 780	12 960	9 540	7 910	396
7	20 300	14 910	15 120	11 130	9 020	457
8	23 200	17 040	17 280	12 720	10 125	506
Dimensions (mm)	B		C		D	
	4 200		1 360		9 580	
	F1		F		F3	
	11 830		11 830		11 005	
						2 110

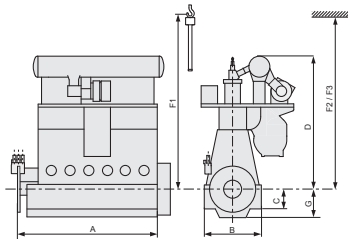
BRAKE SPECIFIC FUEL CONSUMPTION IN LPG MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 209	6 974	7 166	6 974
BSGC (gas)	g/kWh	148.5	143.6	147.6	143.6
BSPC (pilot fuel)	g/kWh	8.5	8.5	8.5	8.5

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	168.8	163.3	167.8	163.3

For definitions see page 66.
iSCR available for
5- to 7-cylinder engines
with one TC on
exhaust side



X-DFM/E

by WinGD

X-DF Methanol / Ethanol Engines

X52DF-M-S1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	520 mm
Piston stroke	2 045 mm
Speed	80-120 rpm
Mean effective pressure at R1	22.0 bar
Stroke / bore	3.93

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Length A* mm	Dry mass tonnes
	120 rpm	80 rpm					
	R1	R2	R3	R4			
5	9 550	6 850	6 400	4 550	5 485	6 565	200
6	11 460	8 220	7 680	5 460	6 345	7 415	226
7	13 370	9 590	8 960	6 370	7 205		257
8	15 280	10 960	10 240	7 280	8 065		287
Dimensions (mm)	B		C		D		D (ISCR)
	3 100		1 185		7 775		8 000
	F1		F2		F3		G
	9 340		9 340		8 800		1 675

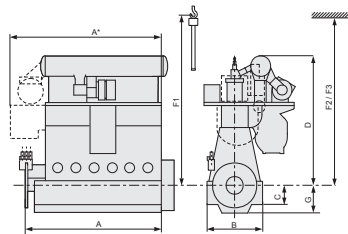
BRAKE SPECIFIC FUEL CONSUMPTION IN METHANOL/ETHANOL MODE

Rating point		R1	R2	R3	R4
BSEC (energy) M/E	kJ/kWh	6 897 / 7 038	6 645 / 6 782	6 940 / 7 081	6 855 / 6 995
BSGC (gas) M/E	g/kWh	329.2 / 248.8	316.6 / 239.8	331.4 / 250.3	327.1 / 247.3
BSPC (pilot fuel) M/E	g/kWh	8.1 / 8.7	8.1 / 8.3	8.1 / 8.7	8.1 / 8.6

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	164.8	158.8	165.8	163.8

For definitions see page 66.
iSCR available for
5- to 7-cylinder engines
with one TC on
exhaust side



X62DF-M-S1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	620 mm
Piston stroke	2 245 mm
Speed	82-108 rpm
Mean effective pressure at R1	22.0 bar
Stroke / bore	3.62

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	108 rpm	82 rpm				
	R1	R2	R3	R4		
5	13 425	9 650	10 200	7 325	6 260	294
6	16 110	11 580	12 240	8 790	7 260	341
7	18 795	13 510	14 280	10 255	8 260	389
8	21 480	15 440	16 320	11 720	9 260	436
Dimensions (mm)	B		C		D	D (ISCR)
	3 440		1 295		8 575	9 020
	F1		F2		F3	G
	10 230		10 230		9 620	1 835

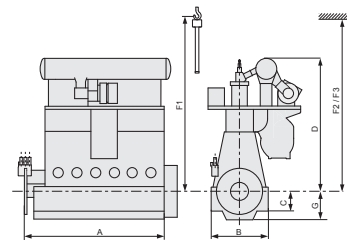
BRAKE SPECIFIC FUEL CONSUMPTION IN METHANOL/ETHANOL MODE

Rating point		R1	R2	R3	R4
BSEC (energy) M/E	kJ/kWh	6 897 / 7 038	6 688 / 6 825	6 812 / 6 953	6 731 / 6 867
BSGC (gas) M/E	g/kWh	329.1 / 248.8	318.7 / 241.3	324.9 / 245.8	320.8 / 242.8
BSPC (pilot fuel) M/E	g/kWh	8.1 / 8.7	8.1 / 8.4	8.1 / 8.5	8.1 / 8.4

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	164.8	159.8	162.8	160.8

For definitions see page 66.
iSCR available for
5- to 7-cylinder engines
with one TC on
exhaust side



X-DF Methanol / Ethanol Engines

X62DF-M-1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	620 mm
Piston stroke	2 658 mm
Speed	77-103 rpm
Mean effective pressure at R1	21.0 bar
Stroke / bore	4.29

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	103 rpm	77 rpm				
	R1	R2	R3	R4		
5	14 500	10 650	10 800	7 950	6 805	341
6	17 400	12 780	12 960	9 540	7 910	396
7	20 300	14 910	15 120	11 130	9 020	457
8	23 200	17 040	17 280	12 720	10 125	506
Dimensions (mm)	B		C		D	
	4 200		1 360		9 580	
	F1		F2		F3	
	11 830		11 830		11 005	
						2 110

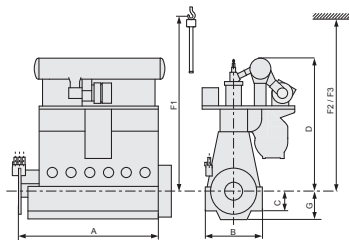
BRAKE SPECIFIC FUEL CONSUMPTION IN METHANOL/ETHANOL MODE

Rating point		R1	R2	R3	R4
BSEC (energy) M/E	kJ/kWh	7 064 / 7 209	6 633 / 6 974	7 021 / 7 166	6 833 / 6 974
BSGC (gas) M/E	g/kWh	337.2 / 254.9	325.6 / 246.6	335.0 / 253.4	325.6 / 246.6
BSPC (pilot fuel) M/E	g/kWh	8.3 / 8.9	8.3 / 8.6	8.3 / 8.8	8.3 / 8.6

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	168.8	163.3	167.8	163.3

For definitions see page 66.
iSCR available for
5- to 7-cylinder engines
with one TC on
exhaust side



X72DF-M-1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	720 mm
Piston stroke	3 086 mm
Speed	66-89 rpm
Mean effective pressure at R1	21.0 bar
Stroke / bore	4.29

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	89 rpm	66 rpm				
	R1	R2	R3	R4		
5	19 600	14 300	14 550	10 600	8 085	505
6	23 520	17 160	17 460	12 720	9 375	589
7	27 440	20 020	20 370	14 840	10 665	674
8	31 360	22 880	23 280	16 960	11 960	752
Dimensions (mm)	B		C		D	
	4 780		1 575		10 790	
	F1		F2		F3	
	13 750		13 750		12 820	
						2 455

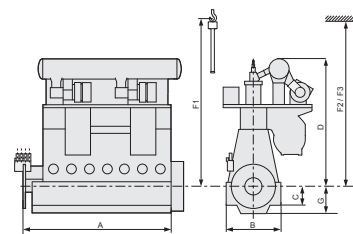
BRAKE SPECIFIC FUEL CONSUMPTION IN METHANOL/ETHANOL MODE

Rating point		R1	R2	R3	R4
BSEC (energy) M/E	kJ/kWh	7 065 / 7 209	6 835 / 6 974	7 023 / 7 166	6 835 / 6 974
BSGC (gas) M/E	g/kWh	336.4 / 254.9	325.4 / 246.6	334.4 / 253.4	325.4 / 246.6
BSPC (pilot fuel) M/E	g/kWh	8.7 / 8.9	8.4 / 8.6	8.6 / 8.8	8.4 / 8.6

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	168.8	163.3	167.8	163.3

For definitions see page 66.



X-DF Methanol / Ethanol Engines

X82DF-M-1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	820 mm
Piston stroke	3 375
Speed	58-84 rpm
Mean effective pressure at R1	22.0 bar
Stroke / bore	4.12

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	84 rpm	58 rpm				
	R1	R2	R3	R4		
6	33 000	24 000	22 800	16 560	10 426	845
7	38 500	28 000	26 600	19 320	11 866	956
8	44 000	32 000	30 400	22 080	13 306	1 071
9	49 500	36 000	34 200	24 840	14 746	1 218
Dimensions (mm)	B		C		D	
	5 050		1 800		12 310	
	F1		F2*		F3*	
	15 250		-		-	
					2 700	

BRAKE SPECIFIC FUEL CONSUMPTION IN METHANOL/ETHANOL MODE

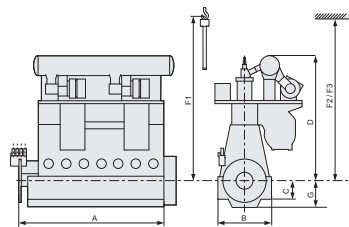
Rating point		R1	R2	R3	R4
BSEC (energy) M/E	kJ/kWh	6 961 / 7 102	6 748 / 6 884	6 799 / 6 940	6 684 / 6 820
BSGC (gas) M/E	g/kWh	332.2 / 251.1	321.5 / 243.4	324.1 / 245.4	318.3 / 241.1
BSPC (pilot fuel) M/E	g/kWh	8.2 / 8.7	8.2 / 8.5	8.2 / 8.5	8.2 / 8.4

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	166.3	161.2	162.5	159.7

For definitions see page 66.

* Available upon request



X92DF-M-1.0

IMO Tier II & Tier III (SCR)

Cylinder bore	920 mm
Piston stroke	3 468
Speed	70-80 rpm
Mean effective pressure at R1	21.0 bar
Stroke / bore	3.77

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	80 rpm	70 rpm				
	R1	R2	R3	R4		
6	38 700	27 900	33 900	24 420	11 605	1 176
7	45 150	32 550	39 550	28 490	13 195	1 323
8	51 600	37 200	45 200	32 560	14 785	1 449
9	58 050	41 850	50 850	36 630	17 960	1 771
10	64 500	46 500	56 500	40 700	19 550	1 880
11	70 950	51 150	62 150	44 770	21 215	2 058
12	77 400	55 800	67 800	48 840	22 875	2 247
Dimensions (mm)	B		C		D	
	5 550		1 900		13 150	
	F1		F2		F3	
	15 640		15 650		14 360	
					2 970	

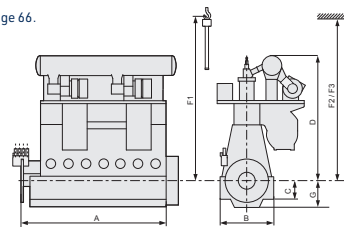
BRAKE SPECIFIC FUEL CONSUMPTION IN METHANOL/ETHANOL MODE

Rating point		R1	R2	R3	R4
BSEC (energy) M/E	kJ/kWh	6 855 / 6 995	6 603 / 6 739	6 812 / 6 953	6 645 / 6 782
BSGC (gas) M/E	g/kWh	327.3 / 247.3	314.6 / 238.3	325.1 / 245.8	316.8 / 239.8
BSPC (pilot fuel) M/E	g/kWh	8.0 / 8.6	8.0 / 8.3	8.0 / 8.5	8.0 / 8.3

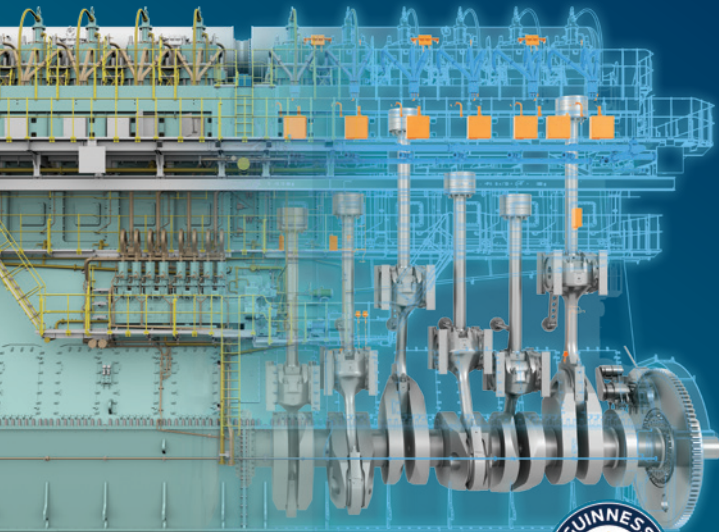
BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE

Rating point		R1	R2	R3	R4
BSFC (diesel Tier II)	g/kWh	163.8	157.8	162.8	158.8

For definitions see page 66.



Achieving a GUINNESS WORLD RECORDS™



The most powerful marine internal combustion Otto cycle engine commercially available is the WinGD 12X92DF

Designed by WinGD Ltd. Switzerland, **with a power output of 63.840 MW**, first built by CMD (CSSC-MES Diesel Co., Ltd) in China and verified on 17 September 2020.



X-Engines Diesel

X52-1.2

IMO Tier II & Tier III (SCR)

Cylinder bore	520 mm
Piston stroke	2 315 mm
Speed	75-105 rpm
Mean effective pressure at R1	21.0 bar
Stroke / bore	4.45

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Length A* mm	Dry mass tonnes
	105 rpm	75 rpm					
	R1	R2	R3	R4			
5	9 050	6 800	6 475	4 825	5 985	6 990	217
6	10 860	8 160	7 770	5 790	6 925	7 930	251
7	12 670	9 520	9 065	6 755	7 865		288
8	14 480	10 880	10 360	7 720	8 805		323
Dimensions (mm)	B		C		D		D (iSCR)
	3 514		1 205		8 415		8 760
	F1		F2		F3		G
	10 350		10 350		9 800		1 910

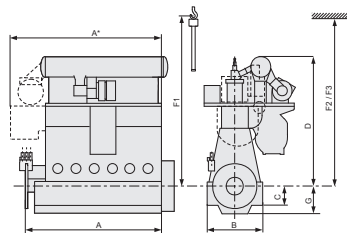
BRAKE SPECIFIC FUEL CONSUMPTION (BSFC) IN g/kWh

Rating point		R1	R2	R3	R4
BMEP, bar		21.0	15.8	21.0	15.8
BSFC (g/kWh)	Delta Bypass Tuning, 100% power, Tier II	169.8	162.8	169.8	162.8

R1 BSFC (g/kWh), Tier II	Power(%)				
	50	65	75	90	100
Delta Bypass Tuning	163.7	161.5	161.3	164.1	169.8
Low-load Tuning	160.2	158.0	161.3	164.5	170.8

For definitions see page 66.

iSCR available for
5- to 7-cylinder engines
with one TC on
exhaust side



X52-S2.0

IMO Tier II & Tier III (SCR)

Cylinder bore	520 mm
Piston stroke	2 045 mm
Speed	80-120 rpm
Mean effective pressure at R1	22.0 bar
Stroke / bore	3.93

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Length A* mm	Dry mass tonnes
	120 rpm	80 rpm					
	R1	R2	R3	R4			
5	9 550	6 850	6 400	4 550	5 485	6 565	190
6	11 460	8 220	7 680	5 460	6 345	7 415	215
7	13 370	9 590	8 960	6 370	7 205		245
8	15 280	10 960	10 240	7 280	8 065		275
Dimensions (mm)	B		C		D		D (iSCR)
	3 100		1 185		7 775		8 000
	F1		F2		F3		G
	9 340		9 340		8 800		1 675

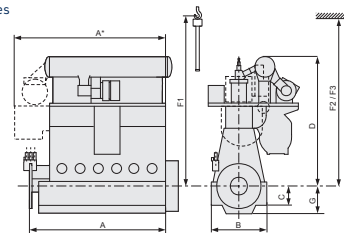
BRAKE SPECIFIC FUEL CONSUMPTION (BSFC) IN g/kWh

Rating point		R1	R2	R3	R4
BMEP, bar		22.0	15.8	22.1	15.7
BSFC (g/kWh)	Delta Bypass Tuning, 100% power, Tier II	163.8	157.8	164.8	162.8

R1 BSFC (g/kWh), Tier II	Power(%)				
	50	65	75	90	100
Delta Bypass Tuning	157.7	155.5	155.3	158.1	163.8
Low-load Tuning	154.2	152.0	155.3	158.5	164.8

For definitions see page 66.

iSCR available for
5- to 7-cylinder engines
with one TC on
exhaust side



X-Engines Diesel

X62-S2.0

IMO Tier II & Tier III (SCR)

Cylinder bore	620 mm
Piston stroke	2 245 mm
Speed	82–108 rpm
Mean effective pressure at R1	22 bar
Stroke / bore	3.62

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	108 rpm	82 rpm				
	R1	R2	R3	R4		
5	13 425	9 650	10 200	7 325	6 260	280
6	16 110	11 580	12 240	8 790	7 260	325
7	18 795	13 510	14 280	10 255	8 260	370
8	21 480	15 440	16 320	11 720	9 260	415
Dimensions (mm)	B		C		D	D (iSCR)
	3 440		1 295		8 575	9 020
	F1	F2	F3	G		
	10 230		10 230		9 620	1 835

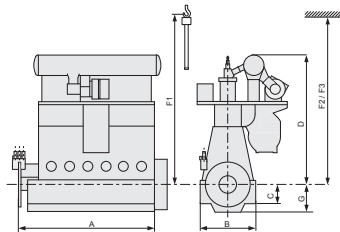
BRAKE SPECIFIC FUEL CONSUMPTION (BSFC) IN g/kWh

Rating point		R1	R2	R3	R4
BMEP, bar		22.0	15.8	22.0	15.8
BSFC (g/kWh)	Delta Bypass Tuning, 100% power, Tier II	163.8	158.8	161.8	159.8

R1 BSFC (g/kWh), Tier II

	Power(%)				
	50	65	75	90	100
Delta Bypass Tuning	155.7	154.7	155.3	158.1	163.8
Low-load Tuning	152.2	151.2	155.3	158.5	164.8

For definitions see page 66.
iSCR available for
5- to 7-cylinder engines
with one TC on
exhaust side



X62-1.2

IMO Tier II & Tier III (SCR)

Cylinder bore	620 mm
Piston stroke	2 658 mm
Speed	72–103 rpm
Mean effective pressure at R1	21.0 bar
Stroke / bore	4.29

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	103 rpm	72 rpm				
	R1	R2	R3	R4		
5	14 500	10 650	10 100	7 425	6 805	325
6	17 400	12 780	12 120	8 910	7 910	377
7	20 300	14 910	14 140	10 395	9 020	435
8	23 200	17 040	16 160	11 880	10 125	482
Dimensions (mm)	B		C		D	
	4 200		1 360		9 580	
	F1	F2	F3	G		
	11 830		11 830		11 005 2 110	

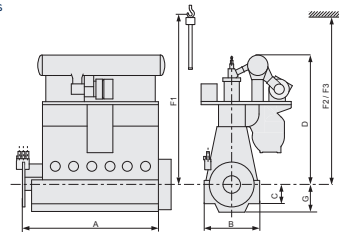
BRAKE SPECIFIC FUEL CONSUMPTION (BSFC) IN g/kWh

Rating point		R1	R2	R3	R4
BMEP, bar		21.0	15.5	21.0	15.4
BSFC (g/kWh)	Delta Bypass Tuning, 100% power, Tier II	167.8	162.3	166.8	162.3

R1 BSFC (g/kWh), Tier II

	Power(%)				
	50	65	75	90	100
Delta Bypass Tuning	160.7	158.8	159.3	162.1	167.8
Low-load Tuning	157.2	155.3	159.3	162.5	168.8

For definitions see page 66.
iSCR available for
5- to 7-cylinder engines
with one TC on
exhaust side



X-Engines Diesel

X72-1.2

IMO Tier II & Tier III (SCR)

Cylinder bore	720 mm
Piston stroke	3 086 mm
Speed	63–89 rpm
Mean effective pressure at R1	21.0 bar
Stroke / bore	4.29

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	89 rpm	63 rpm				
		R1	R2	R3		
5	19 600	14 300	13 900	10 100	8 085	481
6	23 520	17 160	16 680	12 120	9 375	561
7	27 440	20 020	19 460	14 140	10 665	642
8	31 360	22 880	22 240	16 160	11 960	716
Dimensions (mm)	B		C		D	
	4 780		1 575		10 790	
	F1		F2		F3	
	13 750		13 750		12 820	
						2 455

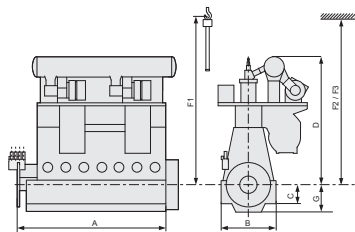
BRAKE SPECIFIC FUEL CONSUMPTION (BSFC) IN g/kWh

Rating point		R1	R2	R3	R4
BMEP, bar		21.0	15.3	21.0	15.3
BSFC (g/kWh)	Delta Bypass Tuning, 100% power, Tier II	167.8	162.3	166.8	162.3

R1 BSFC (g/kWh), Tier II

	Power(%)				
	50	65	75	90	100
Delta Bypass Tuning	160.7	158.8	159.3	162.1	167.8
Low-load Tuning	157.2	155.3	159.3	162.5	168.8

For definitions see page 66.



X82-2.0

IMO Tier II & Tier III (SCR)

Cylinder bore	820 mm
Piston stroke	3 375 mm
Speed	58–84 rpm
Mean effective pressure at R1	22.0 bar
Stroke / bore	4.12

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	84 rpm	58 rpm				
		R1	R2	R3		
6	33 000	24 000	22 800	16 560	10 426	805
7	38 500	28 000	26 600	19 320	11 866	910
8	44 000	32 000	30 400	22 080	13 306	1 020
9	49 500	36 000	34 200	24 840	14 746	1 160
Dimensions (mm)	B		C		D	
	5 050		1 800		12 310	
	F1		F2*		F3*	
	15 250		-		-	
						G
						2 700

BRAKE SPECIFIC FUEL CONSUMPTION (BSFC) IN g/kWh

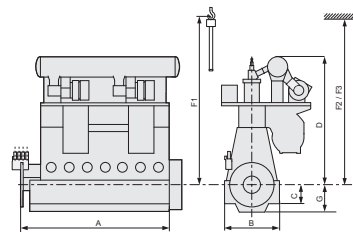
Rating point		R1	R2	R3	R4
BMEP, bar		22.0	16.0	22.0	16.0
BSFC (g/kWh)	Delta Bypass Tuning, 100% power, Tier II	165.3	160.2	161.5	158.7

R1 BSFC (g/kWh), Tier II

	Power(%)				
	50	65	75	90	100
Delta Bypass Tuning	159.2	157.0	156.8	159.6	165.3
Low-load Tuning	155.7	153.5	156.8	160.0	166.3

For definitions see page 66.

* Available upon request



X-Engines Diesel

X92-1.1

IMO Tier II & Tier III (SCR)

Cylinder bore	920 mm
Piston stroke	3 468 mm
Speed	70–80 rpm
Mean effective pressure at R1	21.0 bar
Stroke / bore	3.77

RATED POWER, PRINCIPAL DIMENSIONS AND MASS

Cyl.	Output in kW at				Length A mm	Dry mass tonnes
	80 rpm	70 rpm				
	R1	R2	R3	R4		
6	38 700	27 900	33 900	24 420	11 605	1 120
7	45 150	32 550	39 550	28 490	13 195	1 260
8	51 600	37 200	45 200	32 560	14 785	1 380
9	58 050	41 850	50 850	36 630	17 960	1 630
10	64 500	46 500	56 500	40 700	19 550	1 790
11	70 950	51 150	62 150	44 770	21 215	1 960
12	77 400	55 800	67 800	48 840	22 875	2 140

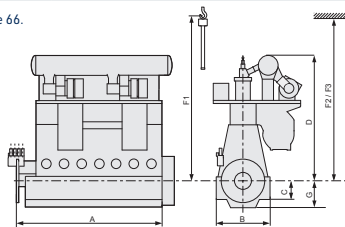
Dimensions (mm)	B	C	D	G
	F1	F2	F3	
	5 550	1 900	13 150	
	15 640	15 650	14 360	2 970

BRAKE SPECIFIC FUEL CONSUMPTION (BSFC) IN g/kWh

Rating point		R1	R2	R3	R4
BMEP, bar		21.0	15.1	21.0	15.1
BSFC (g/kWh)	Delta Bypass Tuning, 100% power, Tier II	162.8	156.8	161.8	157.8

R1 BSFC (g/kWh), Tier II	Power(%)				
	50	65	75	90	100
Delta Bypass Tuning	156.7	154.5	154.3	157.1	162.8
Low-load Tuning	151.6	149.6	153.8	157.5	163.8

For definitions see page 66.

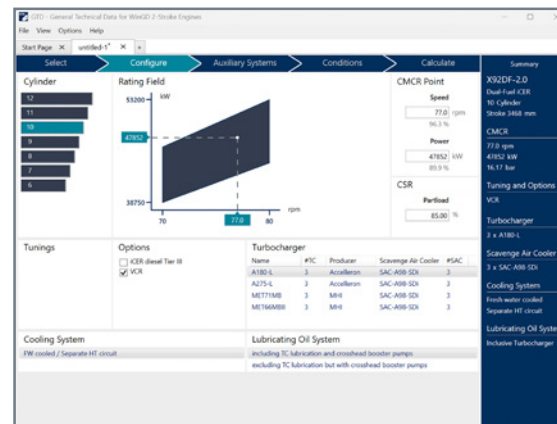


General Technical Data Application

WinGD's General Technical Data (GTD) application provides information to plan the layout of WinGD marine low-speed engines.

Create new projects in three simple steps:

1. Select an engine from the product portfolio
2. Define a configuration which meets the vessel requirements
3. Analyse the resulting performance data and export as a PDF



Start your next engine project by downloading GTD:
www.wingd.com/en/media/general-technical-data



Scan this QR code to visit the GTD page.
 The program is a desktop application and supported by all Windows operating systems from version 7.

Engine Definitions and Notes

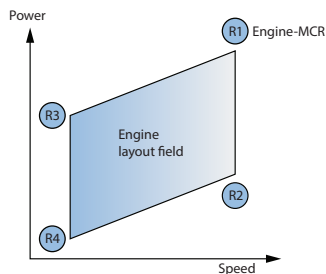
ISO Standard (ISO 3046-1) reference conditions

1.0 bar	Total barometric pressure at R1
25°C	Suction air temperature
30%	Relative humidity
25°C	Cooling water temperature before engine

Rating points

The engine layout fields for WinGD low-speed engines are defined by the power/speed rating points R1, R2, R3 and R4 (see diagram below).

R1 is the nominal maximum continuous rating (MCR) of an engine.



Any power and speed within the respective engine layout field may be selected as the Contracted-MCR (CMCR) point for an engine.

Dimensions and weights

- All dimensions and weights are not binding. For detailed information and updates, please visit:

www.wingd.com/products-solutions/engines

- A** Engine length from the coupling flange to the end of the bedplate
- A*** Engine length from the TC aft end to the end of the bedplate
- B** Width of the engine seating
- C** Distance from the centre of the crankshaft to the underside of the foot flange
- D** Distance from the centre of the crankshaft to the highest point of the engine
- F1** Minimum height for vertical removal of the piston
- F2** Minimum height for vertical removal of the piston with double-jib crane
- F3** Minimum height for tilted removal of the piston with double-jib crane
- G** Distance from the centre of the crankshaft to the lowest point of the engine
- The engine weight is a net value and excludes any liquids.

Fuel/energy consumption

All brake specific fuel consumptions (BSFC) and brake specific pilot fuel consumptions (BSPC) are quoted for fuel of lower calorific value 42.7 MJ/kg.

Brake specific gas consumptions (BSGC) are quoted for gas of lower calorific value 50.0 MJ/kg.

For other fuel types, the following reference lower calorific values are applied:

Ammonia	18.6MJ/kg
LPG	46.0MJ/kg
Methanol	19.9MJ/kg
Ethanol	26.8Mj/kg

Brake specific energy consumptions (BSEC) for dual-fuel engines are based on energy delivered to the engine as gas and liquid fuel for one kilowatt hour mechanical power output.

For all WinGD low-speed diesel and dual-fuel engines stepwise tolerances have been introduced for the brake specific fuel and energy consumption (BSFC/BSEC) guarantee, referring to ISO standard reference conditions (ISO 15550 and 3046):

- +5% tolerance for 100% to 85% engine power
- +6% tolerance for <85% to 65% engine power
- +7% tolerance for <65% to 50% engine power

The BSFC/BSEC guarantee is possible at one power point between 50–100%.

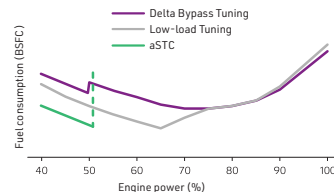
Available engine tunings

Delta Bypass Tuning and Low-load Tuning are available for certain WinGD low-speed diesel engines to provide optimum fuel consumption for different engine loads. Delta Bypass Tuning and Low-load Tuning focus on reducing fuel consumption in the operating range below 90% or 75% engine power.

The advanced technology of Steam Production Control (SPC) can be added to the Low-load and Delta Bypass Tuning to increase the steam production, while keeping the overall fuel consumption at a minimum.

Dual tuning is available on request and in cooperation with classification societies.

Automated Sequential Turbocharging (aSTC) is available as an option for X82-2.0 and X92-1.1 engines with multi-turbocharger configurations. aSTC significantly reduces the engine's consumption at low loads.



WinGD Technologies

X-DF Technology

X-DF^{by WinGD}

A proven and reliable engine platform for fuel flexible vessels

WinGD is a pioneer in modern dual-fuel technology for two-stroke marine engines, with LNG fuelled engines in operation since 2016. With well over 12 million running hours to date, the in-service experience behind X-DF far exceeds that of similar engine concepts.

Now the X-DF series is evolving, bringing the proven and reliable Diesel cycle performance of its X-Engines to offer ammonia and methanol/ethanol dual-fuelled engines, along with a high-pressure LNG concept tailored to large container vessels.

X-DF for LNG

Using WinGD's dual-fuel X-DF engines gives operators flexibility in reducing emissions. Fossil LNG offers an immediate 15-20% reduction in greenhouse gas emissions. By blending or replacing fossil LNG with carbon-neutral synthetic or bio-LNG, operators can reduce their emissions further without modification. All X-DF engines can be retrofitted for methanol/ethanol or ammonia, giving unrivalled choice in how operators meet their emissions targets.

The low-cost, highly efficient and reliable fuel injection concept used by WinGD's dual-fuel LNG engines offers several advantages over other dual-fuel engine concepts:

- Simple installation, low-cost auxiliary systems and low power consumption contribute to lower investment and life cycle costs
- Extremely small pilot fuel quantity, below 1% of total heat release
- Engines can be operated on gas down to very low loads
- Low NOX emissions, IMO Tier III compliant without exhaust-gas after-treatment, and close to zero SOX emissions
- Particulate matter emissions significantly reduced

X-DF-HP for LNG

High-pressure, dual-fuel LNG 82- and 92-bore engines for ultra-large container vessels (ULCV) are now available for order, with the first expected to enter service in 2028.

X-DF for ammonia and LPG

Ammonia-fuelled X-DF-A and LPG-fuelled X-DF-P dual-fuel engines are now available for order, with the first vessels using these engines to enter service in 2026.

X-DF for methanol and ethanol

WinGD's methanol-fuelled engines can now be adapted and certified for ethanol fuel, with the first ethanol-fuelled vessels expected to enter service in 2027.


The following pages provide concept overviews and availability.

Applications

X-DF technology is applicable on a variety of vessel types, including LNG carriers, chemical tankers, container ships and vessels operating worldwide including in Emission Control Areas (ECAs) such as those in place in the Baltic Sea, North America and Gulf of Mexico.

With the lowest overall emissions profile of any LNG engine concept, the X-DF engine is an attractive solution for companies looking for environmentally sustainable propulsion solutions.

All WinGD portfolio engines are built X-DF ready, making the conversion of low-speed diesel to fuel flexibility possible. Retrofitting can be combined with planned maintenance, during a standard docking period.



The pathway to carbon-neutral ship power

X-DF High Pressure Technology

X-DF HP

by WinGD

LNG fuelled propulsion optimised for ultra-large container vessels

X-DF-HP, available for order now, delivers the lowest GHG emissions and highest installation efficiency for large container vessel ship owners choosing LNG as fuel. The high-pressure X-DF-HP engine is optimised specifically for the container vessel segment, while the low-pressure X-DF concept continues to deliver the best CAPEX and OPEX for vessels that do not require the same power density.

The X-DF-HP concept will be familiar to operators of WinGD's well-established, highly efficient diesel-fuelled X-Engines. Notable features include comparable performance with X-Engines in both gas mode and diesel mode, low pilot fuel requirements precisely controlled by common rail injection and NO_x Tier III compliance in both modes with Selective Catalytic Reduction (SCR).

Injection concept

X-DF-HP is equipped with dual-fuel technology enabling it to operate either on LNG or diesel fuel. The engine operates according to the Diesel principle in both diesel mode and LNG mode. It is equipped with two separate fuel injection systems.

The diesel fuel injection system is used for diesel mode and remains active in gas mode for injecting a small amount of pilot fuel, needed for stable ignition of gas fuel.

Engine parameters

X-DF-HP engines have the same rating field as WinGD's diesel-fuelled engines and will be available with the same cylinder configurations. The mechanical design is based on the existing WinGD X-Engine portfolio, with the addition of a high-pressure gas fuel injection system.

IMO Tier III solutions

X-DF-HP engines are IMO Tier II NO_x compliant without exhaust gas aftertreatment in both diesel mode and gas mode. IMO Tier III compliance can be reached in both operating modes with high-pressure or low-pressure SCR.

Retrofit ready

All WinGD engines are built on a similar, robust platform capable of handling the high pressures and temperatures that may be needed for various alternative fuels. Conversion packages for converting diesel and LNG engines to X-DF-HP engines will be available shortly after newbuild engines are developed for the relevant bore size.



LNG avoids
FuelEU Maritime
penalties until at
least 2035



Superior
efficiency



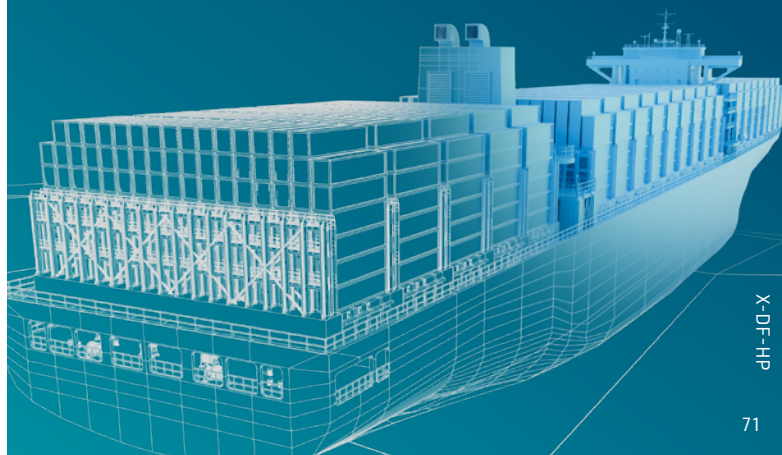
Proven
reliability



Lowest
CAPEX



Lowest
maintenance
costs



X-DF-HP

WinGD Technologies

Variable Compression Ratio (VCR) Technology

X-DF^{VCR} by WinGD

Compression without compromise for optimal efficiency on all fuels

Marine dual-fuel engines were conceived to enable the use of cleaner alternative fuels alongside conventional liquid fuel. However the use of two different fuels necessitates a design compromise that has prevented both fuels from being used with maximum efficiency, and which has been unavoidable until now. As each fuel has a different compression ratio at which ideal combustion is achieved, engine designers have had to choose which fuel to favour when setting this fixed parameter.

To redress this, WinGD and Mitsui E&S DU Co have developed Variable Compression Ratio (VCR) technology. VCR allows an engine's compression ratio to be dynamically adapted depending on current operation point, ambient condition and ideal combustion pressures.



This offers improved efficiency regardless of the fuel, and makes operating with both fuels more feasible.

Significant performance improvements

Testing of the VCR system has confirmed the following unique improvements:

Gas mode

- Reduction of consumption by 2-6 g/kWh depending on engine load, with particularly high reductions at part load.

- The combination of iCER and VCR allows further reduction of methane slip of up to 30%
- Diesel mode
- Reduction of fuel consumption by 8-12 g/kWh, depending on engine type and rating.

This performance brings diesel consumption to a similar level to a conventional diesel engine - eliminating the traditional compromise in diesel efficiency of a lean burn pre-mixed engine.

Automatic optimisation of engine efficiency independent of operating conditions, e.g.: under changing ambient conditions or for differences in operating points due to PTO, ALS or WASP systems.

Based on the performance improvements mentioned, the following fuel consumption, emissions and OPEX calculations have been made for some key vessel types.

The calculations for each mode assume that the engine has been running in the same mode for a full year at an assumed typical load profile.

Considering these potential savings and the further savings achieved under any future carbon pricing regime, WinGD anticipates very short payback periods for VCR technology regardless of the fuel used.

VCR is also available as a retrofit package for engines in service.

EXAMPLE CONSUMPTION & GHG EMISSIONS

Type of vessel	Engine type	Engine rating	Consumption savings		GHG reduction		Annual OPEX savings: fuel US\$/year	Annual OPEX savings: GHG US\$/year*	Annual OPEX savings: sum US\$/year*
			tons/year	%	tons/year	%			
174k cum LNGC	2x 5X72DF-2.2 VCR	2 x 12 129 kW	GM: 361	GM: -2.4%	GM: 1 655	GM: -3.7%	GM: -307 000	GM: -148 985	GM: -455 985
		75 RPM	DM: 1036	DM: -5.6%	DM: 3 260	DM: -5.6%	DM: -549 000	DM: -293 800	DM: -842 800
7000 CEU PCTC	7X62DF-S2.0 VCR	11 920 kW	GM: 163	GM: -2.3%	GM: 761	GM: -3.5%	GM: -138 700	GM: -64 490	GM: -203 190
		104.8 RPM	DM: 494	DM: -5.7%	DM: 1 555	DM: -5.7%	DM: -261 600	DM: -139 950	DM: -401 550
1900 TEU Feeder	6X62DF-S2.0 VCR	11 500 kW	GM: 146	GM: -3.1%	GM: 611	GM: -4.6%	GM: -124 000	GM: -54 990	GM: -178 990
		105 RPM	DM: 440	DM: -7.7%	DM: 1 385	DM: -7.7%	DM: -233 000	DM: -124 650	DM: -357 650
115k dwt BC	6X62DF-2.1 VCR	10 450 kW	GM: 121	GM: -2.3%	GM: 610	GM: -3.8%	GM: -103 000	GM: -54 900	GM: -157 900
		82 RPM	DM: 424	DM: -6.5%	DM: 1 336	DM: -6.5%	DM: -233 250	DM: -139 950	DM: -373 200

Fuel Prices: LNG = \$850; VLSFO = \$530
Typical operation profile used per vessel segment

GM: Continuous Gas Mode operation
DM: Continuous Diesel Mode operation

* based on carbon tax price = \$ 90

Variable Compression Ratio (VCR) Technology

X-DF^{VCR} by WinGD

Simple, sturdy and easy to install

VCR adjusts compression ratio by raising or lowering the piston rod. It features a hydraulic mechanism fitted to the crosshead pin, allowing for the position of the piston rod to be changed. The piston position is controlled by the amount of oil in the lower chamber located below the piston rod. The amount of oil is controlled by filling pressurised lube oil through a knee lever and by draining the lube oil from the lower chamber.

This simple, sturdy design has no impact on installation requirements or engine footprint and requires no specific maintenance between drydocking periods.

VCR is available as an option for a wide range of X-DF engines.

1 Feed pump

Electrically driven, it increases the engine lube oil pressure (4...5bar) to the feed pressure of 40...50bar. Variable motor speed to minimise power consumption.

2 Feed manifold

Distributes the lube oil to all cylinders.

3 Pressure control valve

Limits the pressure in the feed manifold.

4 Solenoid proportional valve

Controls the flow of oil to the lower chamber of each cylinder.

5 Knee lever of VCR

Connects the proportional valve with the lower hydraulic chamber.

6 Delivery valve

Spring loaded non-return valve.

7 Lower chamber

Lifts the piston rod depending on amount of oil in it.

8 Solenoid relief valve

Controls opening and closing of outlet valve.

9 Outlet valve

Releases oil from the lower hydraulic chamber to lower the position of the piston rod.

10 Upper chamber

Holds the piston down under any situation (e.g. engine start or malfunction of exhaust valve).

11 Lift-off v/v with filling orifice

Retains oil volume in upper chamber in case of low oil pressure in lower chamber to avoid lift-off of piston.

12 Knee lever for piston cooling

Existing knee lever for usual piston cooling.

13 Sensor for piston position

Measures piston timing and enables control of piston rod position.

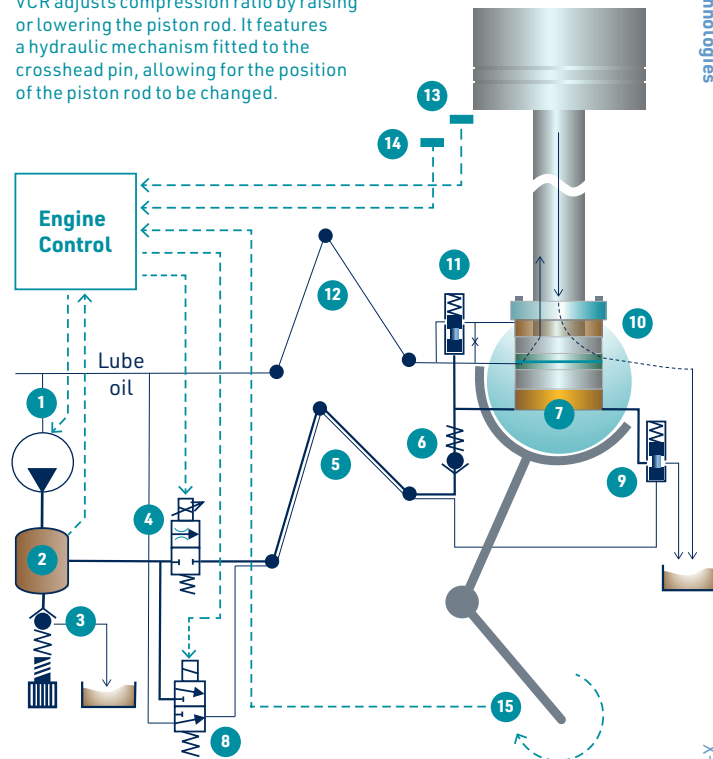
14 Sensor for air temperature

In piston underside. Measures scavenge air temperature close to the scavenging ports of each cylinder.

15 Crank angle signal

Existing engine crank angle signal used also for the VCR control.

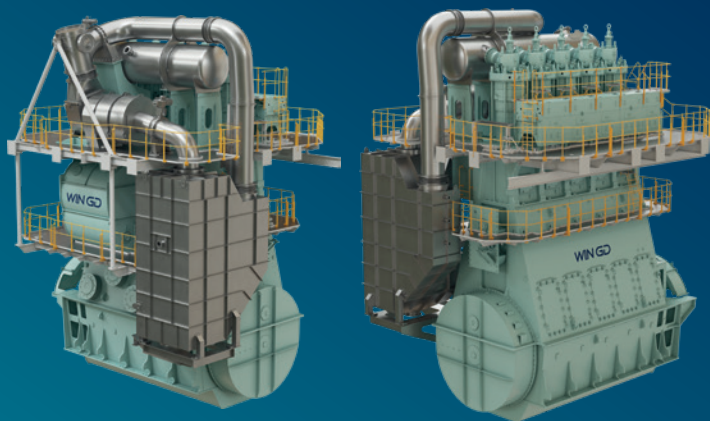
VCR adjusts compression ratio by raising or lowering the piston rod. It features a hydraulic mechanism fitted to the crosshead pin, allowing for the position of the piston rod to be changed.



X-DF2.0 Technology

X-DF2.0

by WinGD



Building on proven dual-fuel LNG performance

With X-DF2.0, WinGD builds on its proven, reliable dual-fuel LNG platform with even greater efficiency and emissions performance.

The technology - intelligent Control by Exhaust Recycling (iCER) - delivers superior combustion control,

using inert gas to adjust the gas/air mix improving both fuel consumption and emissions.

As well as reducing fuel consumption, iCER delivers a 50% reduction in methane slip in gas mode, while allowing Tier III compliance in diesel mode.



Reduced
methane slip
and CO₂ emissions



Lower
fuel consumption



Proven design
for reliability
and safety

iCER

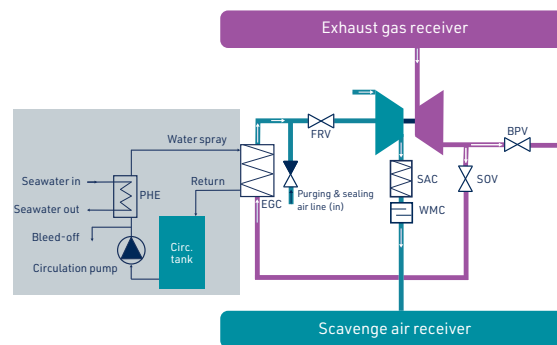
The iCER system is designed to cool and recirculate part of the exhaust gas. It is made up of a low-pressure exhaust recycling path with an efficient Exhaust Gas Cooler (EGC). When recirculated exhaust gas is mixed with scavenge air, carbon dioxide partly replaces the oxygen in the fresh air, reducing the mixture's reactivity during combustion.

This increases the ignition delay and stabilises the combustion speed. By raising resistance to auto-ignition and reducing combustion speed, iCER enables combustion control so that the compression ratio can be increased and thermal efficiency improved.

iCER On-engine

The iCER system is also available in an on-engine configuration, enabling the emissions reduction technology to be installed without impact on engine footprint. On-engine iCER offers the same advantages while simplifying testing, building and installation of the engine, as well as reducing the engine room space needed for emissions reduction equipment.

The EGC and all exhaust gas flow control components are installed on the engine, offering significant engine room design flexibility. The production-friendly design also minimises manufacturing and installation costs.



Abbreviation:

FRV Flow Regulating Valve
SOV Shut Off Valve
SAC Scavenge Air Cooler
BPV Back Pressure Valve

WMC Water Mist Catcher
EGC Exhaust Gas Cooler
PHE Plate Heat Exchanger

X-DF-A Technology

X-DF-A

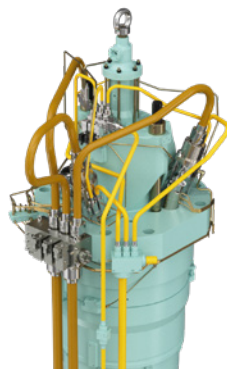
by WinGD

WinGD's first engine platform designed for carbon-free fuel

Available for order with the first engines delivered in 2025, X-DF-A enables deep-sea ship owners and operators to choose carbon-free ammonia for their main engines.

The engine platform deployed in X-DF-A engines will be familiar to operators of WinGD's well-established, highly efficient diesel-fuelled X-Engines. Notable features include comparable performance with X-Engines in both ammonia mode and diesel mode, low pilot fuel requirements precisely controlled through common rail injection and NO_x Tier III compliance in both modes with Selective Catalytic Reduction (SCR).

Safety has been a key priority during the development of engines using ammonia due to the inherent characteristics of the fuel. Already supported with Approval-in-Principle from several leading classification societies, X-DF-A delivers the assurance that ship owners and operators need to integrate ammonia-fuelled engines into vessel designs today.



Injection concept

The X-DF-A is a dual-fuel engine equipped with technology enabling the engine to operate either on ammonia or diesel fuel. The engine operates according to the diesel principle in both diesel mode and ammonia mode. It is equipped with two separate fuel injection systems. The diesel fuel injection system is used for diesel mode and remains active in ammonia mode for injecting a small amount of pilot fuel, needed for stable ignition of ammonia fuel.

Engine parameters

The ammonia engines have the same rating field as WinGD's diesel engines and will be available with the same cylinder configurations. The mechanical design is based on the existing WinGD X-Engine portfolio, with the addition of an ammonia fuel injection system including the additional servo oil system to drive it.



IMO Tier III solutions

The X-DF-A engines are IMO Tier II NO_x compliant without exhaust gas aftertreatment in both diesel mode and ammonia mode. IMO Tier III compliance can be reached in both operating modes with a high-pressure SCR (HP SCR) installed upstream of the turbochargers.

The HP SCR system can be installed off-engine or on-engine (iSCR) depending on the engine type. The on-engine option (iSCR) is available only for single turbocharger engines.

Retrofit ready

All WinGD engines are built on a similar, robust platform capable of handling the high pressures and temperatures that may be needed for various alternative fuels. Conversion packages for converting diesel and LNG engines to X-DF-A engines will be available shortly after newbuild engines are developed for the relevant bore size.

All X-DF-A engines can be ordered to be delivered ready to use LPG fuel (see X-DF-P engines, overleaf) and can subsequently be adapted for ammonia fuel with only minor modification.



Minimum
extra CAPEX



Highest efficiencies
in both fuel modes



Minimal pilot
fuel needed



100% safe and
secure operation

X-DF-P Technology

X-DF^P

by WinGD

WinGD's fuel-flexible solution for LPG and ammonia fuel

Available for order now for first engine delivery from end of 2027 onwards. The X-DF-P engines will enable LPG/Ammonia Carrier owners and operators to use LPG fuel for their main engines. The same fuel injection system concept is used as for the X-DF-A ammonia engine. This will allow a simple conversion to X-DF-A with only minor changes once ammonia fuel is available.

The engine platform deployed in X-DF-P engines will be familiar to operators of WinGD's well-established, highly efficient diesel-fuelled X-Engines. Notable features include comparable performance with X-Engines in both LPG mode and diesel mode, low pilot fuel requirements precisely controlled through common rail injection and NOx Tier III compliance in both modes with Selective Catalytic Reduction (SCR).

Safety has been key priority during the development of the engines, which follows the design principles of the X-DF-A engines using ammonia due to the inherent characteristics of the fuel. X-DF-P delivers the assurance that ship owners and operators need to integrate LPG-fuelled engines into vessel designs today.

Injection concept

The X-DF-P is a dual-fuel engine equipped with technology enabling the engine to operate either on LPG or diesel fuel. The engine operates according to the diesel principle in both diesel mode and LPG mode. It is equipped with two separate fuel injection systems.

The diesel fuel injection system is used for diesel mode and remains active in LPG mode for injecting a small amount of pilot fuel, needed for stable ignition of LPG fuel.

Engine parameters

The LPG engines have the same rating field as WinGD's diesel engines and will be available with the same cylinder configurations. The mechanical design is based on the existing WinGD X-Engine portfolio, with the addition of an LPG fuel injection system including the additional servo oil system to drive it.



IMO Tier III solutions

The X-DF-P engines are IMO Tier II NOx compliant without an exhaust gas aftertreatment in both diesel mode and LPG mode. IMO Tier III compliance can be reached in both operating modes with a high-pressure SCR (HP SCR) installed upstream the turbochargers.

The HP SCR system can be installed off-engine or on-engine (iSCR) depending on the engine type. The on-engine option (iSCR) is available for single turbocharger engines.

Retrofit ready

All WinGD engines are built on a similar, robust platform capable of handling the high pressures and temperatures that may be needed for various alternative fuels. This ensures that retrofitting between all fuels – including conventional liquid fuel, LNG, LPG, methanol and ammonia – is both technically and economically feasible, while ensuring comparable performance on any fuel.

Conversion packages for converting diesel and X-DF-A to X-DF-P engines or vice versa will be available shortly after newbuild engines are developed for the relevant bore size.



**Minimum
extra CAPEX**



**Highest efficiencies
in both fuel modes**



**Minimal pilot
fuel needed**



**100% safe and
secure operation**

X-DF-M/E Technology

X-DF^{M/E}

by WinGD

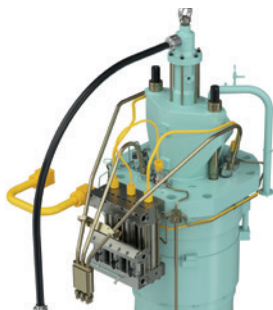
Methanol-and ethanol-fuelled capability based on proven engine performance

With the first methanol-fuelled engines delivered in 2025 and the first ethanol-fuelled engines available for order now, X-DF-M/E enables deep-sea ship owners and operators to choose from a range of fuels including carbon-neutral green methanol and attractively priced bio-ethanol.

The engine platform deployed in X-DF-M/E engines will be familiar to operators of the WinGD well-established, highly efficient diesel-fuelled X-Engines. Notable features include comparable performance with X-Engines in both methanol, ethanol and diesel modes, low pilot fuel requirements precisely controlled through common rail injection, and NO_x Tier III compliance in all modes with Selective Catalytic Reduction (SCR).

Methanol/ethanol technology

The engine operates according to the diesel principle in both diesel mode and methanol or ethanol mode. The base engine is a Diesel cycle X-Engine Diesel with an additional methanol or ethanol fuel injection system and additional servo oil system to drive it. The diesel fuel injection system is used when the



engine is running in diesel mode and to inject a small amount of pilot fuel in methanol/ethanol mode. The pilot fuel injection is required to have an accurate ignition of the methanol fuel at all engine loads.

Main engine parameters

The X-DF-M/E engines have the same rating field as WinGD's diesel engines and will be available with the same cylinder configurations.

IMO Tier III solutions

Methanol/ethanol-fuelled engines can meet IMO Tier II NO_x levels in both diesel mode and methanol/ethanol mode. Exhaust gas after treatment is required to meet IMO Tier III NO_x levels. SCR can be used for this.

SCR can be located either upstream the TC turbine (high-pressure SCR) or downstream (low-pressure SCR). On-engine SCR (iSCR) is also available for single turbocharger engines.



Ethanol fuel

The X-DF-M/E engines can be adapted and certified to operate on ethanol fuels with deliveries for new builds and retrofit applications starting in 2027.

Retrofit ready

All WinGD engines are built on a similar, robust platform capable of handling the high pressures and temperatures that may be needed for various alternative fuels.



This ensures that retrofitting between all fuels – including conventional liquid fuel, LNG, methanol and ammonia – is both technically and economically feasible, while ensuring comparable performance on any fuel.

Conversion packages for converting diesel and LNG engines to X-DF-M/E engines will be available shortly after new build engines are developed for the relevant bore size.



Minimum
extra CAPEX



Highest efficiencies
in both fuel modes



Minimal pilot
fuel needed



100% safe and
secure operation

WICE

WinGD Integrated Control Electronics (WiCE) delivers robust connectivity and advanced security for marine engines, enabling sophisticated control strategies and seamless integration with other ship systems.

Modern ship operations require more from engine control systems. Beyond managing basic functions, these systems must monitor and regulate emissions performance, ensure engines operate harmoniously with a broad array of auxiliary equipment, and enable data connectivity—both with auxiliary systems and with broader ship and fleet networks.

Cybersecure

WiCE is secured through measures such as restricted permissions with multi-factor authentication, software authenticity verification, backup and rollback functionality, cybersecurity event logging, and traffic monitoring. As a result, the control system complies with IACS UR E27 (applicable to ships contracted for construction on or after 1 July 2024) and has already been assessed and approved by DNV. Approvals from additional classification societies are planned, facilitating the seamless integration of the controls into vessel computer-based system (CBS) infrastructures.



Continuous monitoring for potential vulnerabilities ensures a secure lifecycle for the control system.

Modular and upgradable

WiCE is designed for an increasingly connected and data-driven ship operating environment. The system – comprising a main control unit, cylinder control unit, and communication gateway unit – is fully modular in both software and hardware, making it easily adaptable to future needs. Each unit can be independently verified and validated, allowing updates or replacements without affecting the functionality of other units.

Enhanced connectivity

WiCE features a dedicated communication gateway unit, enabling connections to diagnostic systems and the receipt of software updates without compromising the integrity of mission-critical engine control. Its powerful communication bus ensures rapid, secure, and seamless data exchange among system units.



IMO Tier III Solutions

WinGD offers a range of solutions for vessels that need to comply with IMO Tier III NO_x emission limits in specified NO_x Emission Control Areas.

X-DF

Using LNG is a viable solution for dealing with both IMO Tier III NO_x standards and requirements for SO_x. X-DF engines operating in gas mode meet Tier III limits without aftertreatment, while engines with X-DF2.0 technology comply in both gas and diesel modes.

X-Engines

For diesel engines, WinGD offers three abatement options using selective catalytic reduction (SCR) technology, which uses a reductant (typically ammonia generated from urea) and a catalyst to remove NO_x from exhaust gas.

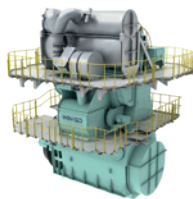
High Pressure SCR

The SCR reactor is located before the turbine, allowing the reactor to be designed in the most compact way due to the higher density of the exhaust gas. WinGD has developed high pressure SCR solutions for X-Engines with single and multi-turbocharger applications.

All WinGD low-speed engines included in this booklet are fully compliant with IMO NO_x limits specified in Annex VI of the MARPOL 73/78.

Low Pressure SCR

The SCR reactor is located after the turbine. Low-pressure SCR is typically larger than the high pressure solution but can be integrated into the exhaust stream system. WinGD's interface specification for low-pressure SCR covers all known low-pressure SCR system providers.



Integrated SCR (iSCR)

Integrated SCR (iSCR) is installed 'on engine' to meet demand for a smaller, more compact solution to fulfil Tier III emission regulations. The reactor is integrated directly to the exhaust manifold, providing high-pressure operation (HP-SCR) while promoting higher operation temperatures for more efficient catalysis. The compact design has minimal external piping. The iSCR is available for selected WinGD low-speed diesel engines.

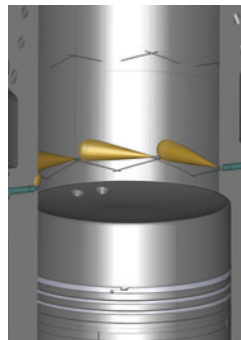


Click or scan
the QR code to
find out more

Cylinder Lubrication

Pulse Jet Cylinder Lubricating System

WinGD's Pulse Jet system optimises piston running by providing a homogeneous lubricant distribution on the cylinder liner surface. Regular injections at minimal lubricant feed rate enable operational expenses at the lowest possible level.



WinGD Piston Running Concept with Pulse Jet Cylinder Lubrication System

The Pulse Jet system ensures safe lubrication and acid-neutralisation for piston rings and the cylinder liner running surface. Spray angles and electronically controlled injection timing are tailored to achieve homogeneous lubricant distribution. Zig-zag-shaped grooves on several levels provide further distribution of the freshly injected lubricant in the upper stroke area. Specifically designed piston rings further support the oil film conditioning.

Cylinder Lubricating Oils

Using the Pulse Jet system with WinGD-validated lubricants is the prerequisite to achieving extended time between overhauls of piston rings and cylinder liners with outstanding reliability and engine availability. By applying regular laboratory and on-board analysis of piston underside drain oil samples, lubricant consumption can be reduced to the minimum for the engine's specific operating conditions.

Easily understandable documentation gives guidance for selecting and using the right cylinder lubricant for diesel, gas, and all other emerging marine fuels.



WinGD Lubricants
Guideline

Click or scan
the QR code to
find out more



Validated engine
oils for WinGD
engines

Click or scan
the QR code to
find out more



Name: Eagle Bintulu
Vessel type: LNG dual fuelled Aframax Tanker
Shipowner: AET
Shipyard: Samsung Heavy Industry Co. Ltd.

Managers: Eaglestar
Delivery: 2018
Main engine: 6X62DF

Steam Production Control

In order to improve the steam production on board via the exhaust gas economiser, X-Engines can be equipped with a controlled exhaust gas bypass valve.

Such a valve can be opened on demand when the exhaust gas temperature is lower than the target temperature, or when the steam pressure is lower than required.

As a consequence of the exhaust gas bypass opening, the exhaust gas temperature increases and steam production through the boiler is increased.

As an example, **Figure 1** shows the same X-Engine with and without the variable bypass. With the variable bypass it is possible to target exactly the minimum steam production needed if the exhaust gas temperature is lower than that required. Where no variable bypass is installed, it is necessary to switch on the thermal boiler to reach the targeted steam production.

Figure 2 indicates clearly that increasing the steam production with an engine variable bypass is more efficient than switching on the thermal boiler, and fuel consumption savings of 2-6 g/kWh are possible.

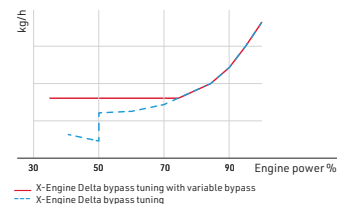


Figure 1

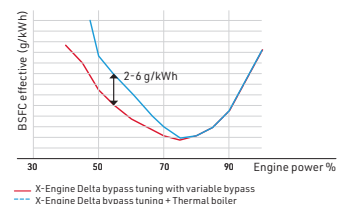


Figure 2

Engineered to **X-EL** by WinGD

Integrated Energy Solutions

Electric and hybrid power technologies offer exceptional optimisation potential for today's vessels, helping to improve fuel efficiency and reduce emissions while improving reliability and load response across an integrated power system.

Shaft generators and hybrid systems

WinGD takes a holistic approach to designing power solutions that go far beyond the main engine. Optimally sized electric components and sub-systems are incorporated and configured to suit individual vessel characteristics and operating profiles.

The proprietary X-EL Energy Manager maintains optimal operating efficiency – ensuring that vessels built or retrofitted today are prepared to face operational and regulatory challenges across their lifetime.

Advisory Services

WinGD's technical experts will help mitigate risks and uncertainties throughout the lifecycle of a fleet, from feasibilities and early decisions, through design and implementation, to in-service advisory, diagnostics, and performance monitoring.

WinGD's simulations-based toolchain is used for conducting energy efficiency studies at the feasibility stage, providing accurate

quantitative predictions of system performance and the savings associated in multiple scenarios.

As an outcome, the optimum system topology and control strategies of an integrated hybrid system can be determined to fulfil operational and commercial requirements.

The transient-capable physical main engine models embedded have a distinctive advantage over the commonly used map-based approach.

Advisory for System Integration

- Energy efficiency analyses and studies
- Virtual integration and transient operation of the complete hybrid system enabling early risk management
- Recommendation for topology, components selection, control strategy:
- Quantitative economic feasibility (CAPEX, OPEX, ROI, TCO)

Integrated Energy Systems

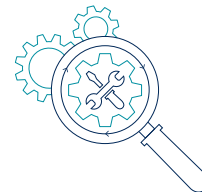
- All items included in "Advisory for System Integration"
- System architecture and control strategy definitions, implementation, and validation
- Selection of the key system components (e.g. PTO/PTI, Battery Pack, Power Converters, DC-Link, etc.)
- WinGD Hybrid Control System for holistic energy management with active control logic among the main engine and the rest of the key system components
- End-to-end project management for delivery of a turn-key integrated hybrid powerpack



Control Strategy



System Topology



Lifecycle Management

X-EL Integrated Energy Solutions

Shaft generator and hybrid power arrangements integrated by WinGD are all governed by the state-of-the-art X-EL Energy Manager.

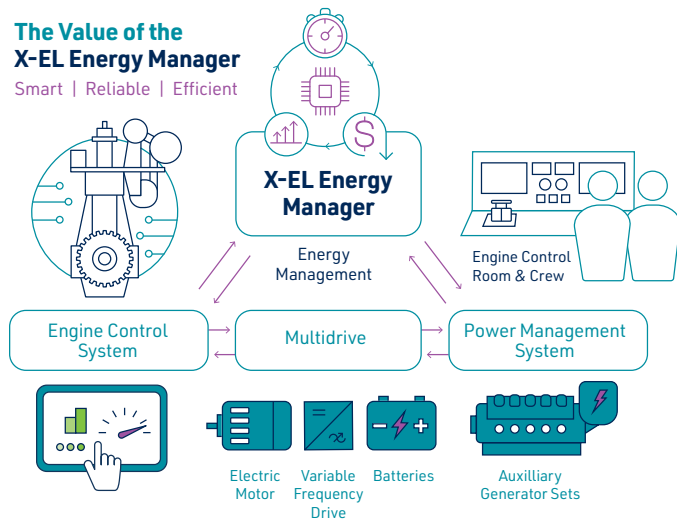
Validation and tuning of its control and optimisation logic take place at an early stage in development due to the simulation and development toolchain. This enables customers to assess the build and operation of the power arrangement in digital form,

simplifying the physical integration, commissioning, and testing of the systems.

The X-EL Energy Manager sets new standards for vessel energy optimisation. It is a universal solution to control a wide range of hybrid energy system variants and aims at operating the system in an optimal state.

The Value of the X-EL Energy Manager

Smart | Reliable | Efficient



You will find contacts for information or for a dedicated advisory study at electrification@wingd.com

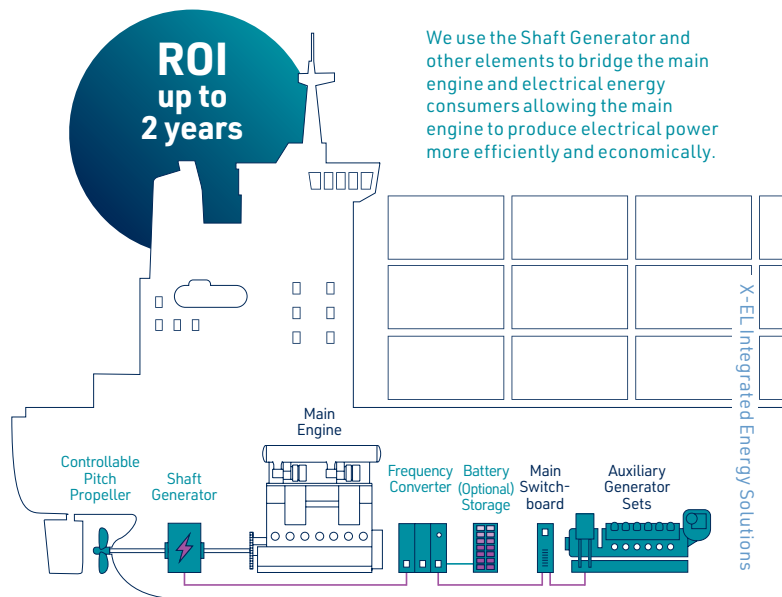
High operational flexibility

- Intelligently optimised power production and consumption on board at any given moment, considering various factors, such as actual cargo capacity utilisation, ship speed demand, environmental conditions and route

Optimal energy resources utilisation

- Maximised usage of the main engine and alternative energy resources in a hybrid setup for electrical power production

- Minimised running hours of the Auxiliary Engines, or operated with the highest possible efficiency when needed
- Ensured safe no-auxiliary-engines operation during ocean crossing and optimal energy production for safe manoeuvring
- Improved system performance and stability in transient conditions



We use the Shaft Generator and other elements to bridge the main engine and electrical energy consumers allowing the main engine to produce electrical power more efficiently and economically.

WiDE (WinGD integrated Digital Expert)

WiDE^{by WinGD}

WinGD's integrated Digital Expert (WiDE) system is a comprehensive engine monitoring, diagnostics and advisory system that delivers optimisation and predictive maintenance insights and enables remote support and troubleshooting assistance for crews and onshore teams.

WiDE constantly collects engine and ship data, making them available both onboard and onshore. Data is analysed to provide valuable insight on the status of the engine's components, to anticipate alarms and to facilitate daily crew operations.

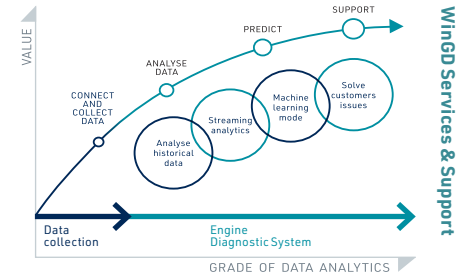
These capabilities are integrated into a user-friendly onboard system comprising state-of-the-art hardware, software and data analytics techniques, supported by robust and cyber secure ship-to-shore connectivity.

All WinGD engines are delivered with the hardware and monitoring software needed for WiDE. Additional analysis and expert services are available on subscription.



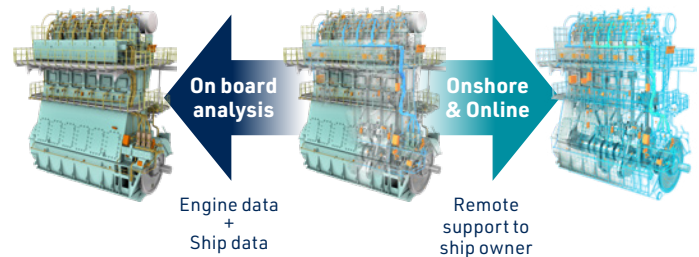
The engine's digital twin enables expert engine analysis

Using the power of modern digital data monitoring, WiDE delivers customers valuable information and access to remote support to assist in optimising the ship's performance.



Key Benefits

- Performance monitoring and optimisation advice tailored specifically for your engine
- Predictive troubleshooting minimises sub-optimal running, increases engine availability and streamlines maintenance planning
- Availability of key performance indicators on ship and onshore, speeding up communication and benefitting fleet monitoring
- Enhanced remote services support crew interventions on board and, through WinGD 24x7, offer around-the-clock technical assistance from WinGD experts when required
- Real-time engine data sharing enhances integration with energy management and voyage optimisation systems
- Connected performance management and diagnostics prepare for increased engine operation automation



WiDE (WinGD integrated Digital Expert)



Optimisation

WiDE diagnostics are based on a thermodynamic engine model which constantly calculates the ideal engine performance for real-time operational parameters and environmental conditions. The deviation between actual and ideal engine performance is quantified, potential sources are identified and solutions recommended.

Troubleshooting

Potential problems are reported by WiDE's troubleshooting app, identifying the part involved, automatically providing a list of alarms with drawings and documents for the affected components. Detailed instructions for prevention are displayed using extracts from the engine manual.

Remote Support

Enhanced troubleshooting is provided remotely by WinGD Operations Experts. The WinGD 24x7 support centre offers

around-the clock support in the event of a problem and provides regular reports on the health status of the machinery, including recommendations for optimal engine operations.

CII Compliance and hull efficiency

Future updates will include the possibility to calculate the vessel CII rating. Further modules will allow to monitor hull and propeller fouling.

Operators can drill down into current vessel ratings to see whether engine operation can be optimised to improve CII rating.

Online Platforms

Data from WiDE are available on a dedicated online platform which provides access to historical engine, ship and fleet data – including the ability to download and visualise data.

Additionally, WiDE Online provides an extended view and analysis of current engine status, including engine speed and performance, subsystems state and faults identified.



In Xpert hands



Global Service by WinGD

Tailored 24X7 lifecycle support

Backed by Swiss engineering excellence and a legacy of high-performance engine design you can trust, WinGD Xperts deliver the effective maintenance, rapid support and original parts you need to keep your engines running – whenever you need it, wherever you are.

Driven by our global headquarters in Winterthur and supported by local service hubs for rapid delivery of parts and service across the world, Global Service by WinGD offers three streams of service to our customers and end users:



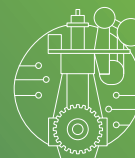
Genuine spare parts

Genuine, high-quality spare parts (new and reconditioned) delivered via fast, flexible shipping wherever and whenever you need it – ensuring minimal downtime, reduced maintenance costs and efficient inventory management.



Field service by the Xperts

Fast, responsive field service by expert engineers for maintenance, troubleshooting and customised solutions – maximising uptime and ensuring safe, efficient operation worldwide.



Comprehensive technical support

Expert services including scheduled maintenance and performance, emissions and compliance optimisation – safeguarding engine reliability, minimising total overall costs and extending operational life.

Trust is everything

Global Service by WinGD

Service you can trust for optimised operations across your engine lifecycle

With Global Service by WinGD customers can harness our legacy of engine design excellence and portfolio of engine optimisation solutions to secure the long-term success of their operations. WinGD offers all services to meet engine operators needs, which can be integrated into tailored maintenance agreements.

With capabilities in digital optimisation, upgrades, and future-focused retrofits, WinGD ensures engines meet evolving standards of performance, fuel efficiency and emissions – delivering long, productive lives and empowering your sustained success.

Contact your local WinGD representative today to learn how:

- Our original spare parts ensure long-term performance and reliability
- Our digital solutions provide real-time advisory and predictive maintenance to support troubleshooting, prevent engine failures and reduce downtime
- Our scheduled maintenance plans help avoid unexpected break downs and keep vessels operational for longer
- Our technical support can help you optimise and maintain engine and power configurations in line with current and emerging emissions regulations
- Our comprehensive service offering reduces total cost of ownership, saving on repairs, fuel, compliance costs and operational inefficiencies

wingd.com/service-support/global-service-by-wingd

Engines under warranty

The primary contacts for issues during the engine warranty period are the delivering yards and engine manufacturers. For direct assistance by WinGD, claims can be forwarded to: warranty@wingd.com

Other service providers

WinGD engine users can also access in-service support from the service providers listed on page 112.



Engine Retrofits & Upgrades

Tailored solutions for existing WinGD engines to extend vessel compliance, maintain peak performance and reduce operating costs.

Maritime emissions and energy intensity regulations – including the EU Emissions Trading System, FuelEU Maritime and imminent IMO mid-term measures for reducing greenhouse gas emissions – are raising the baseline for vessel operating costs. In the future it will be these costs, rather than the durability of a vessel and its machinery, that will determine how long it can be operated profitably.

By focusing on optimising the efficiency of existing engines and adapting them to lower carbon fuels, operators can both reduce operating costs (OPEX) and extend the viable life of their current fleet – ensuring that today's vessels remain compliant and competitive. WinGD provides a one-stop-shop for fuel conversions and energy efficiency upgrades for its engines already in service.

WinGD engines are designed to be upgradable, with a modular design approach and a common base platform across engines for all fuel types. Similarly, WinGD control, monitoring, emissions abatement and efficiency technologies are designed for both existing and new engines.

With retrofit-ready engines and upgrade solutions from the same original designer, WinGD leverages its unique product expertise and existing supplier and project partner network to significantly reduce the cost and duration of your upgrade or retrofit.

Upgrades offered include:

Injection system retrofits – turn a single-fuel diesel engine into an LNG, methanol or ammonia dual-fuel engine.

X-DF2.0 upgrades – add iCER and/or VCR technology to existing X-DF LNG fuelled engines for enhanced diesel and gas mode efficiency and lower methane slip (pages 76-77).

Engine derating – increase engine efficiency by reducing maximum power output and thus lower the specific fuel consumption.

X-EL Energy Management System retrofits – boost operational flexibility, improve your EEXI figures, reduce fuel consumption and emissions with installation of shaft generators, battery packs, DC bus components and WinGD's advanced energy management system (pages 90-93).

Digital optimisation – install our WiDE integrated digital expert on any WinGD engine for higher engine efficiency, condition-based maintenance and remote troubleshooting support by WinGD experts (WiDE, pages 94-97).

Engine control system update – upgrade to the latest cyber security standards and enable advanced tunings, control functionalities and extended auxiliary system compatibility with WinGD integrated Control Electronics (WiCE, page 84).



Intelligent Control
by Exhaust Recycling
(iCER) technology



Variable
Compression
Ratio (VCR)
technology

With cutting-edge upgrade solutions straight from the engine designer, **operators can improve the efficiency and service life of their WinGD engines** while reducing operational costs and contributing to a more sustainable future.

Lubrication system upgrades – reduce oil consumption with the latest WinGD tribology concepts, including cylinder lube, and high-pressure crosshead lubrication oil systems (page 87).

Advanced engine tuning upgrades – re-tune the engine to optimise the combustion process based on principles applied on newer engine types and improve efficiency while complying with Tier II/Tier III limits.

Contact email:
retrofit.solutions@wingd.com



WinGD retrofit
solutions

Training

The fuel flexible engines of today and tomorrow require crew who are confident operating the latest innovation and technology.

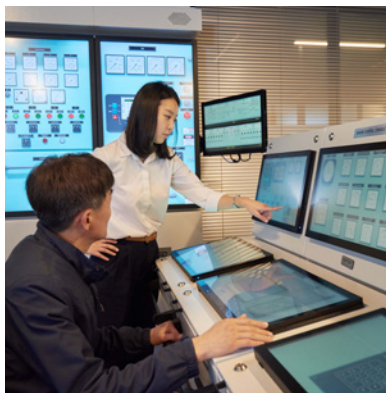
From basic engine operation to advanced optimisation, WinGD provides a range of training solutions across a wide network of global locations and online, giving your crew the skills they need to operate WinGD engines safely, reliably and efficiently.

Certified Instructors

WinGD training courses are conducted by professional, STCW-95 certified instructors. Trainers explain the theory and functionality of all WinGD engines using modern training methods, helping crews and onshore support teams understand the design, function and repair and maintenance procedures for key components.

Global Network

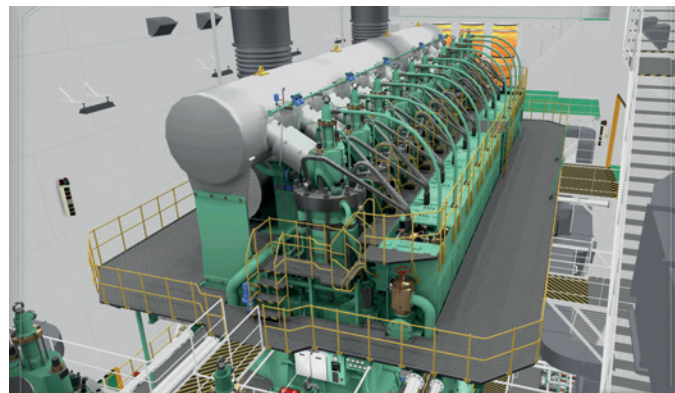
WinGD operates three dedicated training facilities, with a growing number of centres operated by authorised WinGD training partners. Our wide network at key global shipping and crewing hubs makes it easy to incorporate training into your crew schedules whether travelling from their home locations or directly from vessels.



See our full list of training locations and partners at www.wingd.com/service-support/training/course-specifications

Expert Knowledge

Training courses are standardised, centrally coordinated and certified by WinGD. Theoretical and practical expert knowledge covers the full range of WinGD products.



WinGD Xpert engine room simulator

Courses

Specialised, product-specific courses in varying levels are available.

- Engine Theoretical course (3 days)
- Engine Operation Advanced course (5 days)
- Engine technology specialised courses (depending on the topic, 1-2 days)

Customised courses covering specific areas of interest, can be arranged on request. All types of courses can be offered to best suit the trainee regarding course content, level, duration, language and location.

See the list of courses at www.wingd.com/service-support/training/training-facilities

or email: training@wingd.com



Simulation Software

WinGD training courses offer high efficiency learning through perfectly-balanced human and technology factors. Using a wide range of simulation software and hardware as well as real engine parts, the participants will benefit through hands-on, real-life scenarios.

Engine Room Simulators

By providing a realistic setting for training in day-to-day engine operations and troubleshooting, the simulators allow crew to experience challenging scenarios such as black-outs and fires in a safe and controlled environment.

Training hosted outside of WinGD Training Centres are supported by Full Mission Simulators or similar Engine Room Simulator software.

Global Coverage

Working together with a global network of authorised Training Partners, training courses are available at a location best suited to the customer. This flexibility allows WinGD to provide training courses wherever it best achieves the desired outcomes, to optimise a ship's operation and to reduce the travelling time and expenses of the participants.

If travel to a Training Centre is not possible, instructors are available to perform training sessions on board the ships (anchored, at shipyards or during voyage) and Crewing Agents' offices.

A list of upcoming sessions can be found online at wingd.com or by request at: training@wingd.com

Contacts

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Schützenstrasse 3, 8400 Winterthur,
Switzerland

Tel: +41 52 264 8844
Email: info@wingd.com

Engine Research & Innovation Centre
WinGD Ltd.

Building 650 Sulzer Allee
19 / Sulzer Industriepark
8404 Oberwinterthur, Switzerland

Tel: +41 52 264 8808
Email: info@wingd.com

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(Shanghai) Co., Ltd.

Room 601-604, Building 2,
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No.601 Donggao Road,
Pudong New Area, Shanghai, P.R. China
Tel: +86 21 61681958
Email: china@wingd.com

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Dalian International Ocean Building
No.11 Yu Guang Street, Zhongshan
District, Dalian, Liaoning Province
116001 P.R. China

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Hong Kong Branch

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19 Des Voeux Road Central, Hong Kong
Tel: +852 2522 7355
Email: hongkong@wingd.com



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12F. No. 101, Sec 2, Nanjing East. Road,
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Email: hsinyi.liu@wingd.com

Japan

WinGD Ltd.

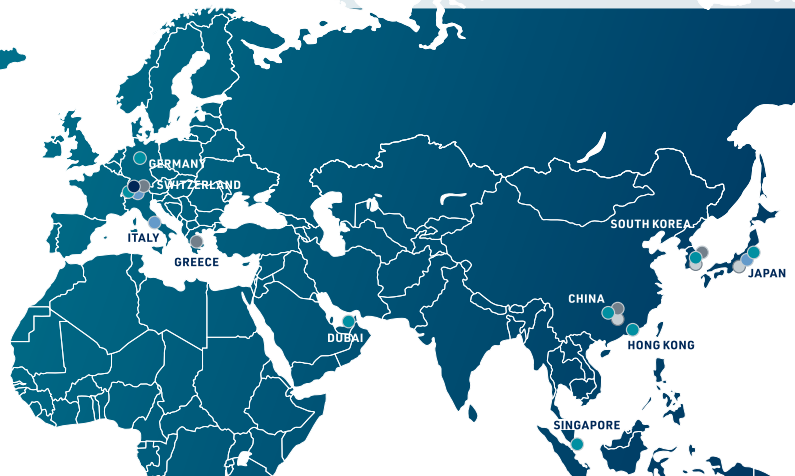
Tokyo

BUREX Kyobashi Bldg. #601,
7-14 Kyobashi 2-Chome, Chuo-ku,
Tokyo 104-0031, Japan

Tel: +81 3 6271 0057
Email: japan@wingd.com

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20070-000 Rio de Janeiro, RJ Brasil

Tel: +55 21 2206 2500

Email: Lucas.correa@wartsila.com

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1 Lake Road, Port Colborne,
ON L3K 1A2, Canada

Tel: +1 905 834 8275

Email: rgair@allmind.com

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Cass Technava Ltd.

4, Riga Fereou Str.
Omega Court, 5th Floor, Flat 51
3095 Limassol, Cyprus

Tel: +357 25 81 99 21

Email: info@cass-technava-cy.com

Egypt, Iraq, Kuwait, Oman,
Saudi Arabia, UAE

AIB Group FZE LLC.

Business Centre, Sharjah Publishing City
Free Zone, Sharjah, UAE

Tel: +971 56 683 43 89

Email: ibrahim@aibgroup.me

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Eiken Maritime AS

Øvre Langgate 57-59
NO-3110 Tønsberg, Norway

Tel: +47 33 48 31 00

Email: post@eikenmaritime.no

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Technava S.A.

6-8 Agias Kyriakis Str., 175 64
Paleo Faliro, Greece

Tel: +30 210 41 13 916

Italy & Monaco

STU srl

Via G. Casaregis 22/1, 16129 Genova, Italy

Contact person:

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Email: d.gravina@st-united.eu

Tel: +39 010 586 671

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Wärtsilä Netherlands B.V.

Havenstraat 21 (Harbour number 519)
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Tel: +31 (0) 88 980 3000

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Wärtsilä Polska Sp. z o.o. Marine Solutions

Ul. Twarda 12, 80-871 Gdansk, Poland

Tel: +48 58 347 85 00

Email: contact.poland@wartsila.com

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Wärtsilä Vostok LLC

Marine Solutions & Services Office

Business centre Linkor 36 A
Petrogradskaya naberezhnaya
197101 St. Petersburg, Russia

Tel: +7 812 448 3248

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Wärtsilä Ibérica S.A. Marine Solutions & Services Office

Poligono Industrial Landabaso s/n
ES-48370 Bermeo, Spain

Tel: +34 946 170 100

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Bulutlu Marine

Postane Mah. Beyzade Sok. No:4
34940 Tuzla Istanbul, Turkey

Tel: +90 216 510 4797

Email: info@bulutlumarine.com

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Wärtsilä UK Ltd.

Marine Solutions & Seals and Bearings Product Company UK (PCUK)

4 Marples Way, Havant Hampshire
PO9 1NX, United Kingdom

Tel: +44 239 240 01 21

Vietnam

Viet Phong Industrial Services Co., Ltd.

4th floor, New Skyline Tower, Lot CC2
Van Quan – Yen Phuc New Urban Area,
Van Quan Ward, Ha Dong District,
Ha Noi, Vietnam

Tel: +84 91 568 28 58

Email: sales@vpis.vn

WinGD Global Service Partner

Wärtsilä Services Switzerland Ltd. 24/7 operational support

For questions regarding operational issues
please call or contact:

+41 52 550 01 11

technicalsupport.chts@wartsila.com

Wärtsilä Services Switzerland Ltd. Field service

If you require Wärtsilä field service please contact:

+41 79 255 68 80

Ch.Fieldservice@wartsila.com

Wärtsilä spare parts

If you need Wärtsilä spare parts and/or tools,
please contact your nearest Wärtsilä representative
or your key account manager.



Engine Builder Service Contacts

China

CSSC Marine Service Co., Ltd. (CMS)

(Servicing for HHM, CMD & CMP
manufactured engines)

Warranty claims/Service

Tel: +86 21 6075 0962
+86 131 2079 4000
(Available 24/7)

Email: service.sha@csscservice.com

Spare parts:

Tel: +86 21 6075 0962 (direct)
+86 21 5131 0006 Ext. 6622
Tel: +86 137 6459 0349 (Mr. Xu)
Email: sales.sha@csscservice.com

CSSC Engine Co., Ltd. (CSE)

(Servicing for DMD, YMD & QMD
manufactured engines)

Technical service and spare parts

Contact: Mr. Yu Rancai

Office: +86 532 8670 8080 ext. 8602
Email: technicalservice@cse.com.cn

Yuchai Marine Power Co., Ltd. (YCMP)

Tel: +86 756 5598086
Email: service@ycmp.com.cn

Japan

Hitachi Zosen Marine Engine Co., Ltd.

7-89 Nankokita 1-chome, Suminoe-ku
Osaka 559-8559, Japan

Tel: +81 6 6569 0502
Email: de-hzds@hitachizosen.co.jp

Mitsui E&S DU Co., Ltd. (MESDU)

Technical Support

Tel: +81 791 24 2286
Email: du-after@mes.co.jp

Parts Sales

Tel: +81 791 24 2285
Email: du-parts-a@mes.co.jp

Japan Engine Corporation (J-ENG)

(for spare parts and service engineers)
(Head Quarters & Plant)

Tel: +81 78 949 0804
Email: service@j-eng.co.jp

South Korea

HD Hyundai Heavy Industries Co., Ltd.

Tel: +82 52 202 7281
Email: enginesales@hd.com

Hanwha Engine Co., Ltd

Tel: +82 10 3559 8836
Email: service.engine@hanwha.com

WiDE by WinGD



Emergency Support

+41 52 264 8604

technical.request@wingd.com

WinGD Engine Builders

China

CSSC Power (Group) Co., Ltd (CPGC)

CSSC-MES Diesel Co., Ltd. (CMD)

No.6, Xinyuan Rd (S), Pudong New Area,
Shanghai, China, 201306

Tel: +86 21 31777072

Hudong Heavy Machinery Co., Ltd. (HHM)

9/F, North Building, No. 1333 Lai Yang
Road, Pudong New District,
Shanghai 201208, P.R. China

Tel: +86 21 31777071

CSSC Engine Co., Ltd. (CSE) CSE (Headquarter)

9/F, North Building, No. 1333 Lai Yang
Road, Pudong New District,
Shanghai, China, 201208

Tel: +86 532 86708080-8502

Email: sales@cse.com.cn

Dalian Marine Diesel Co., Ltd (CSE-DMD)

No. 1-2 Haifang Street, Xigang District,
Dalian, Liaoning, China, 116021

Tel: +86 411 84411558

Email: dmd@onlineln.cn

Yichang Marine Diesel Engine Co., Ltd (CSE-YMD)

No. 93, Xinling 2 Road, Yichang Hubei,
China, 443002

Tel: +86 717 6468689

Email: business@ymd.com.cn

Yuchai Marine Power Co Ltd. (YCMP)

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Park, Qianwu Town, Doumen District,
Zhuhai, China, 519175

Tel: +86 756 559 8023

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Committed to the decarbonisation of marine transportation through sustainable energy systems.

WinGD designs marine power ecosystems utilising the most advanced technology in emissions reduction, fuel efficiency, digitalisation, service and support. With their two-stroke low-speed engines at the heart of the power equation, WinGD sets the industry standard for reliability, safety, efficiency and environmental design.

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