

The new X72DF: Powering the next generation of LNG-fuelled ships

WinGD X72DF-1.1 / X72DF-1.2 / X72DF-2.1 / X72DF-2.2

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1 Introduction

WinGD, the marine industry's leading low-speed engine developer, introduces a new version of the popular X72DF engine model, which is prepared for the optional iCER (Intelligent Control by Exhaust Recycling) technology. The new engine will be designated either as the X72DF-1.1/1.2 (the non-iCER version) or the X72DF-2.1/2.2 (with the iCER application), highlighting a major step in the product development. The new engines follow the engine designation of WinGD. More details of the engine designation are available in the online [Low-speed Engines booklet](#).

The primary applications for the X72DF-1.1/1.2/2.1/2.2 engines follow the path of the X72DF, while introducing the new engine control system, WiCE (WinGD Integrated Control Electronics) which is a precondition for the optional iCER (X-DF2.0) interface. In addition, WinGD implemented several upgrades to the engine design with a strong focus on optimising the production costs.

1.1 Engine designation

The technology level is based on today's X72DF engine, shown in the 'X72DF-1.X' in the first digit. The second digit was chosen for the revision level, introducing the WiCE engine control system on the X72DF, and by these purposes becoming an 'X72DF-1.1'. The engine will also be available with an additional revision level, applicable for a further optimised 5- and 6-cylinder configuration. This further optimised configuration will be named an 'X72DF-1.2'. In conjunction with the iCER (X-DF2.0 technology application), the engines will be named as X72DF-2.1/2.2 versions.

1.2 Overview of the technical upgrades

The X72DF-1.1/1.2/2.1/2.2 engines contain several design upgrades which were already validated on other X-DF engines, along with some enhancements based on service experience learnings. Some of these include, for example:

- WinGD's new control system WiCE
- The new bedplate (lightweight) flexible main bearing girder design
- A modular scavenging concept
- Interface readiness for the optional iCER system
- Several smaller updates (not listed in detail here)
- Additionally, on the X72DF-1.2/2.2 version the engine will be more compact (with reduced engine length), a shorter thrust section, an optimised gear drive and a smaller supply unit is used.

Table 1-1: Comparison of the new X72DF engine executions

Engine name	X72DF-1.1/2.1	X72DF-1.2/2.2
Available cylinder numbers	5 to 8 / 5 to 7 ^{*)}	5 to 6
Rating field	Full size (e.g. as X72DF)	Reduced size
Bedplate concept	Standard length (with flexible main bearing girders)	Flexible main bearing girders, plus a shorter thrust section, resulting in reduced total engine length (approx. 300 mm)
Engine control system	WiCE	WiCE
Supply Unit (SU) concept	Standard (following X72DF) with X4 fuel pumps	Compact X62-S based SU with small size fuel pumps
Fuel gas supply system	GVU or iGPR	GVU or iGPR
Integrated Cylinder Lubricant Auto Transfer (iCAT) system	Optional	Optional

^{*)} For non-iCER versions, the 5- to 8-cylinder engines can be selected. For iCER versions, the 5- to 7-cylinder engines, with one turbocharger, can be selected.

1.3 Typical applications

WinGD is launching several executions of the X72DF engines for a better adaptation in several relevant ship applications, with the target to reduce the investment and operational cost, while keeping the emissions at the lowest possible level.

The following table provides examples of typical applications of the new X72DF executions:

Table 1-2: Examples of typical applications of the new X72DF executions

Engine type	Typical ship types	Benefits
X72DF-1.1 5- to 8-cylinder engines	Higher powered container vessels, tankers and bulkers	Upgraded engine design
X72DF-1.2 5- and 6-cylinder engines	LNGC > 150,000 m ³ Lower powered tankers and bulkers	Upgraded engine design
X72DF-2.1 5- to 7-cylinder engines	Higher powered container vessels, tankers and bulkers	Upgraded engine design iCER system provides lower gas consumption and reduced CH ₄ emissions for lowest GHG emissions
X72DF-2.2 5- and 6-cylinder engines	LNGC > 150,000 m ³ Lower powered tankers and bulkers	Upgraded engine design iCER system provides lower gas consumption and reduced CH ₄ emissions for lowest GHG emissions

2 Main engine parameters

The X72DF-1.1/2.1 rating field will remain with the same power output and maximum cylinder pressure (200 bar) as the X72DF. The X72DF-1.1 will be available with 5 to 8 cylinders, while the X72DF-2.1 will be offered with 5 to 7 cylinders. Since most of the 5X72DF engines to date were contracted in the lower range of the rating field, it was decided to optimise the 5- (and 6-) cylinder execution for such low ratings. This allows for optimising key components of the engine structure such as a shorter thrust section, a smaller supply unit and an adopted gear drive. This further optimised engine has a reduced rating field and is called the X72DF-1.2/2.2.

2.1 X72DF-1.1/2.1 engine features

For the X72DF-1.1/2.1 engine launch, the performance figures from the X72DF will be used. These figures will be updated in one of the next GTD releases (expected late 2021-Q1), after having evaluated the full potential from a higher compression ratio concept (both for the X72DF-1.1 and X72DF-1.2 engines).

Note: Low-rated 5- and 6-cylinder configurations, which are available in the rating field of the X72DF-1.2 engine, are not recommended to be selected within the X72DF-1.1 rating field.

Table 2-1: X72DF-1.1/2.1 summary values for maximum continuous rating

X72DF-1.1/2.1 rating field	R1	R2	R3	R4
rpm	89	89	69	69
kW / cylinder	3225	2685	2500	2080

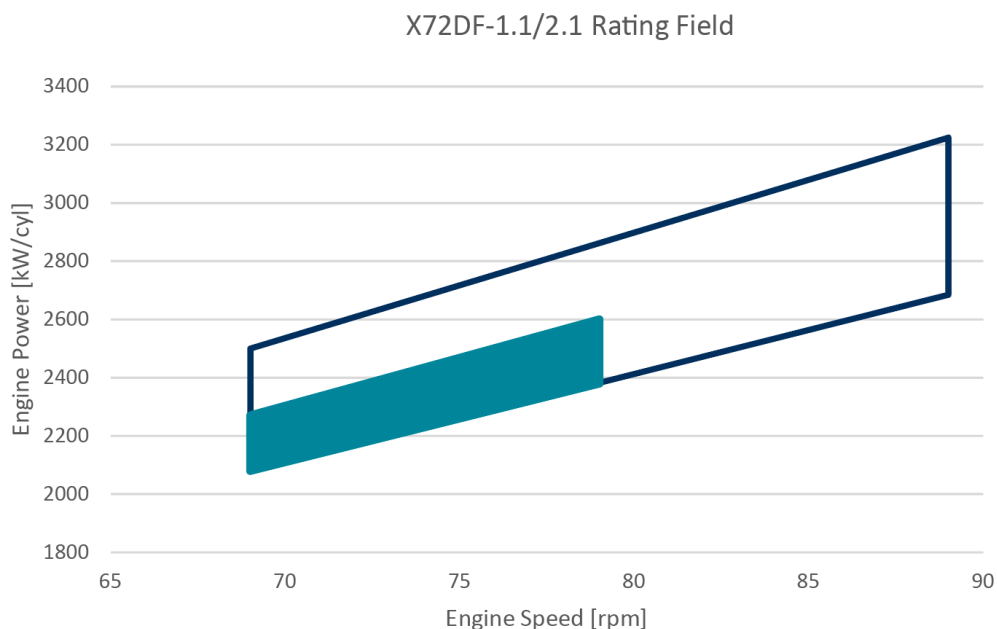


Figure 2-1: The layout field of both the X72DF-1.1 (5 to 8 cylinders) and the X72DF-2.1 (5 to 7 cylinders). The turquoise-marked field represents the smaller 5/6X72DF-1.2/2.2 engines' rating field.

2.2 X72DF-1.2/2.2 engine features

The X72DF-1.2/2.2 has an optimised rating field which ranges from 69 to 79 rpm. It also has a mean effective pressure limitation of 15.7 bar, which corresponds to a maximum power output of either 13,000 kW at 79 rpm (5 cylinder) or 15,600 kW at 79 rpm (6 cylinder). The X72DF-1.2/2.2 is available with 5- and 6-cylinder configuration.

Table 2-2: X72DF-1.2/2.2 summary values for maximum continuous rating

X72DF-1.2/2.2 rating field	R1	R2	R3	R4
rpm	79	79	69	69
kW / cylinder	2600	2380	2270	2080

X72DF-1.2/2.2 Rating Field (5 and 6 cylinder)

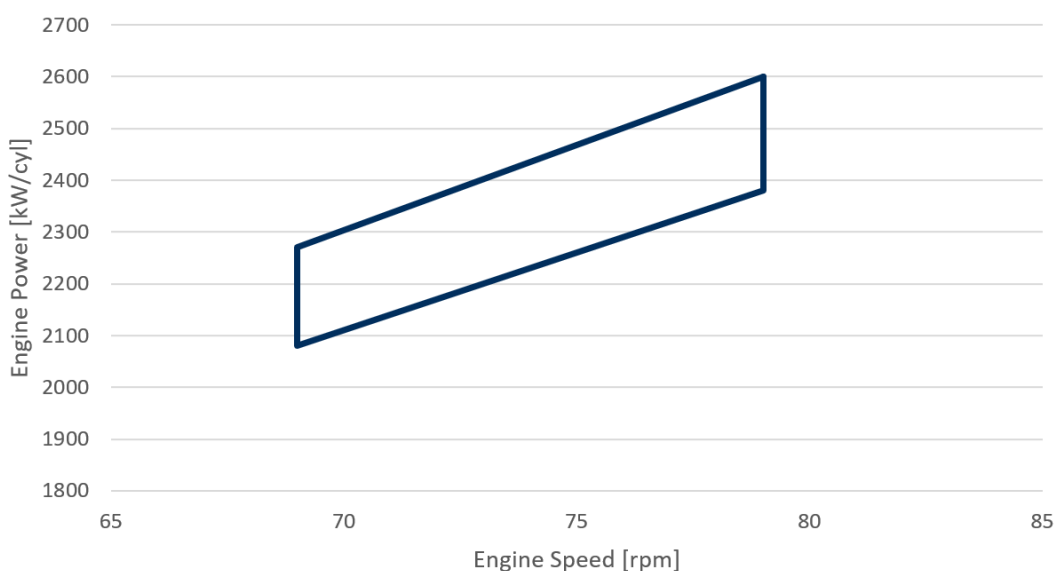


Figure 2-2: The layout field of the X72DF-1.2/2.2 (5 and 6 cylinder).

3 Timeline information

The first engine shoptest is targeted for 2022-Q1 with delivery expected to be in early 2022-Q2. The first cylinder configuration planned will be a fully optimised 5-cylinder configuration (both for standard and left execution) as either a 5X72DF-1.2 or a 5X72DF-2.2 engine.

Table 3-1: Project planning tools availability

Engine	X72DF-1.1	X72DF-1.2	X72DF-2.1	X72DF-2.2
GTD	2021-03			
MIM	2021-03		2021-01	2021-03
MIDS	2021-03		2021-02	2021-03
OM, MM, SPC	Subject to order	2022-04	Subject to order	

4 Interface with the WinGD X-DF2.0 technology (iCER system)

The engine upgrades introduced with the X72DF-1.1/1.2 are fully compatible with the optional X-DF2.0 technology that includes the introduction of the iCER system. Since several design groups are affected this must be checked in detail then.

The engine naming follows the concept mentioned in the Introduction part of this document. With the iCER having the Technology level 2.0, the combined engines will be named:

- X72DF-2.1 (for the X72DF-1.1 content, including the iCER system)
- X72DF-2.2 (for the compact 5- and 6-cylinder engines having the iCER system)

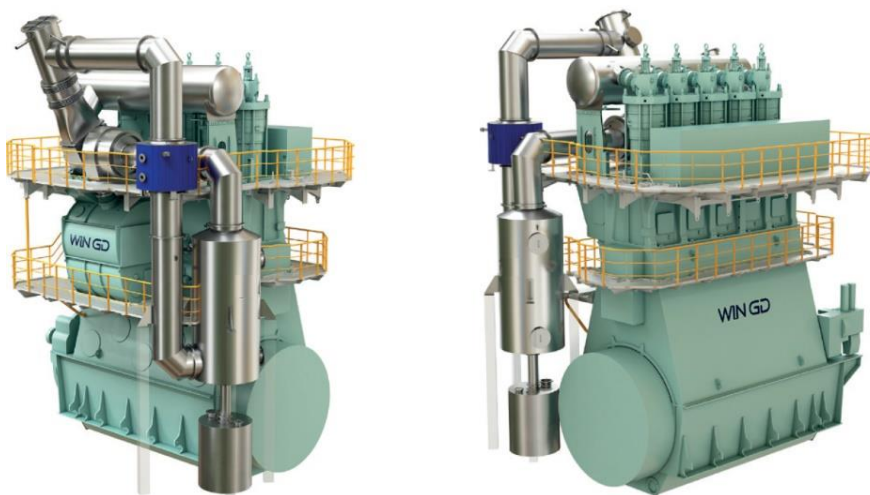
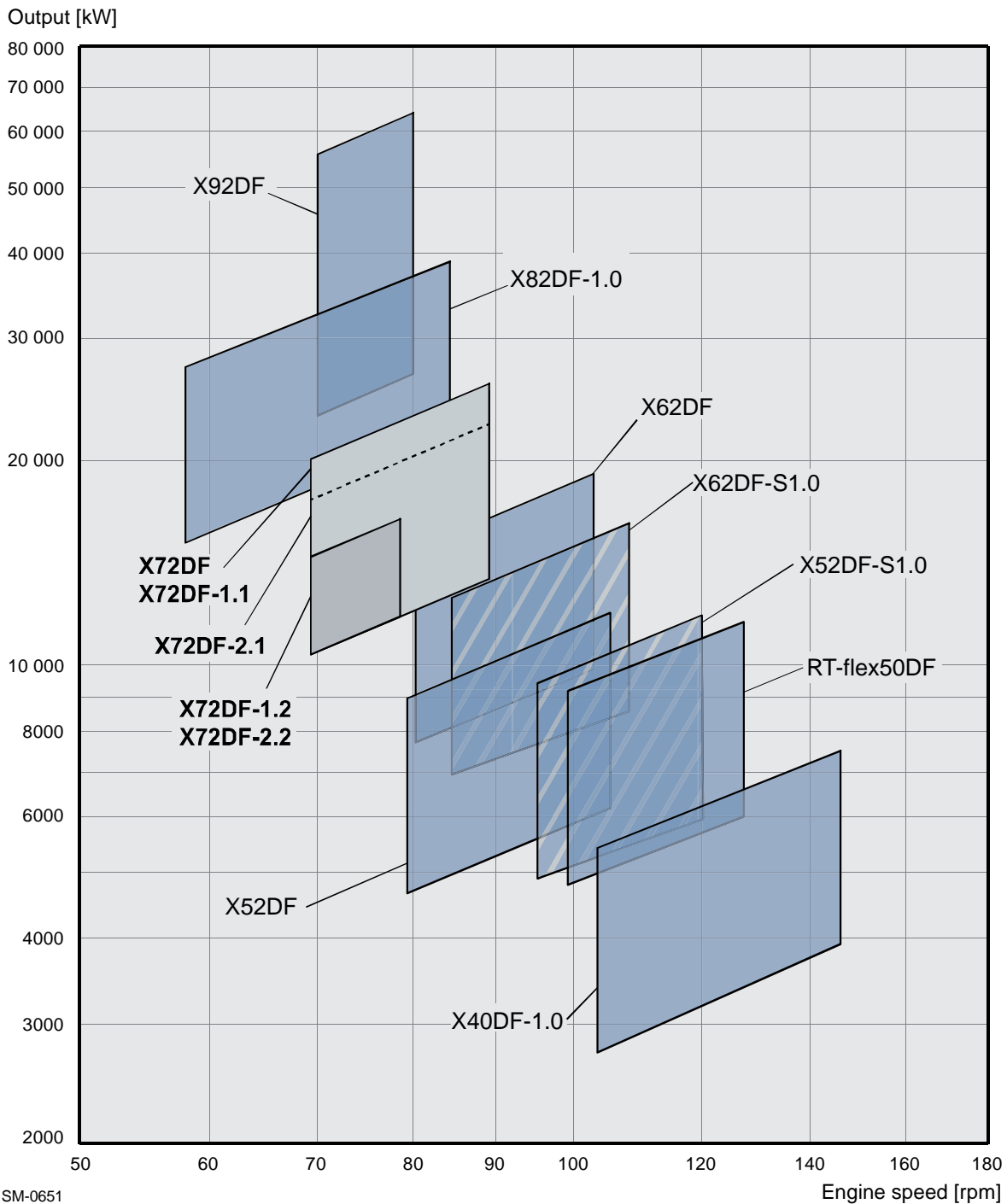


Figure 4-1: Example of an iCER system arrangement

5 Appendix

A Rating field comparison

A.1 WinGD portfolio engine rating field, with the new X72DF-1.1/1.2 and X72DF-2.1/2.2 (iCER) engines



B Key engine figures

B.1 X72DF-1.1 Key dimensions and consumption figures

Note: Data will be updated in 2021-Q1

X72DF-1.1

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 WEIGHTS

Cyl.	Output in kW at				Length A mm	Weight tonnes
	89 rpm	69 rpm				
	R1	R2	R3	R4		
5	16 125	13 425	12 500	10 400	8 085	481
6	19 350	16 110	15 000	12 480	9 375	561
7	22 575	18 795	17 500	14 560	10 665	642
8	25 800	21 480	20 000	16 640	11 960	716
Dimensions (mm)	B		C		D	
	4 780		1 575		10 790	
	F1		F2		F3	
	13 655		13 655		12 730	
						G 2 455

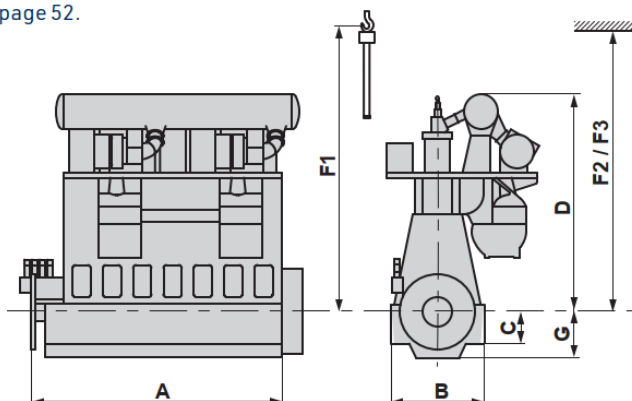
BRAKE SPECIFIC CONSUMPTIONS IN GAS MODE (FIGURES TO BE UPDATED)

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 150	6 906	7 248	7 004
BSGC (gas)	g/kWh	142.3	137.3	144.3	139.2
BSPC (pilot fuel)	g/kWh	0.8	1.0	0.8	1.0

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE (FIGURES TO BE UPDATED)

Rating point		R1	R2	R3	R4
BSFC (diesel)	g/kWh	182.0	180.0	182.0	180.0

For definitions see page 52.



B.2 X72DF-1.2 Key dimensions and consumption figures

Note: Data will be updated in 2021-Q1

X72DF-1.2

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 WEIGHTS

Cyl.	Output in kW at				Length A mm	Weight tonnes
	79 rpm	69 rpm				
	R1	R2	R3	R4		
5	13 000	11 900	11 340	10 400	7 785	470
6	15 600	14 300	13 600	12 480	9 075	550
Dimensions (mm)	B		C		D	
	4 780		1 575		10 790	
	F1		F2		F3	
	13 655		13 655		12 730	
						G
						2 455

BRAKE SPECIFIC CONSUMPTIONS IN GAS MODE (FIGURES TO BE UPDATED)

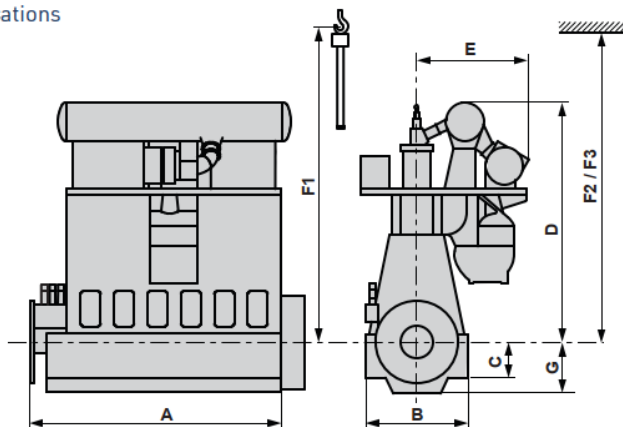
Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 080	6 955	7 113	7 004
BSGC (gas)	g/kWh	140.8	138.2	141.5	139.2
BSPC (pilot fuel)	g/kWh	0.9	1.0	0.9	1.0

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE (FIGURES TO BE UPDATED)

Rating point		R1	R2	R3	R4
BSFC (diesel)	g/kWh	181.2	180.2	181.1	180.0

For definitions see page 52.

Engine optimised for reduced rating field
and 5/6 cylinder applications



B.3 X72DF-2.1 Key dimensions and consumption figures

Note: GTD data available

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 WEIGHTS

Cyl.	Output in kW at				Length A mm	Weight tonnes
	89 rpm	69 rpm				
	R1	R2	R3	R4		
5	16 125	13 425	12 500	10 400	8 085	481
6	19 350	16 110	15 000	12 480	9 375	561
7	22 575	18 795	17 500	14 560	10 665	642
Dimensions (mm)	B		C		D	
	4 780		1 575		10 790	
	F1		F2		F3	
	13 655		13 655		12 730	
						G
						2 455

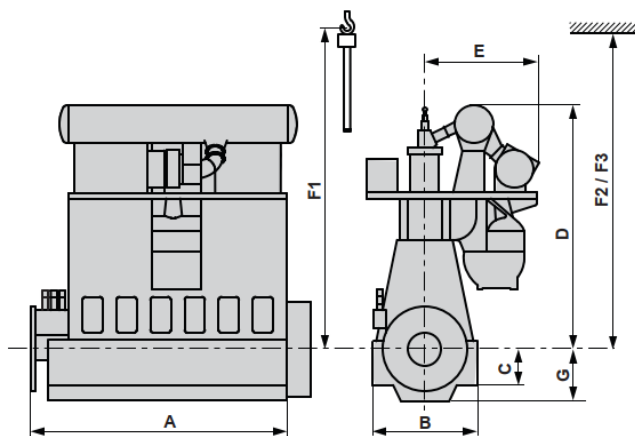
BRAKE SPECIFIC CONSUMPTIONS IN GAS MODE

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	7 021	6 778	7 119	6 876
BSGC (gas)	g/kWh	139.7	134.7	141.7	136.7
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)	g/kWh	179.2	173.2	181.2	177.2

For definitions see page 52.



B.4 X72DF-2.2 Key dimensions and consumption figures

Note: Data will be updated in 2021-Q2

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 WEIGHTS

Cyl.	Output in kW at				Length A mm	Weight tonnes
	79 rpm	69 rpm				
	R1	R2	R3	R4		
5	13 000	11 900	11 340	10 400	7 785	470
6	15 600	14 300	13 600	12 480	9 075	550
Dimensions (mm)	B		C		D	
	4 780		1 575		10 790	
	F1		F2		F3	
	13 655		13 655		12 730	
						G 2 455

BRAKE SPECIFIC CONSUMPTIONS IN GAS MODE (FIGURES TO BE UPDATED)

Rating point		R1	R2	R3	R4
BSEC (energy)	kJ/kWh	6 925	6 827	6 985	6 876
BSGC (gas)	g/kWh	137.7	135.7	138.9	136.7
BSPC (pilot fuel)	g/kWh	0.9	1.0	0.9	1.0

BRAKE SPECIFIC FUEL CONSUMPTION IN DIESEL MODE (FIGURES TO BE UPDATED)

Rating point		R1	R2	R3	R4
BSFC (diesel)	g/kWh	177.6	175.2	179.0	177.2

For definitions see page 52.

Engine optimised for reduced rating field
and 5/6 cylinder applications

