MITSUI E&S

Mitsui E&S DU Co., Ltd.

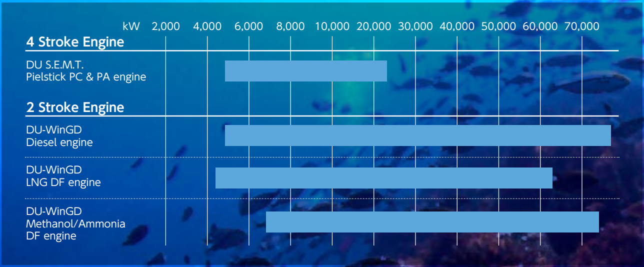
Mitsui E&S DU
Engine Program 2024

DU – WinGD
Low Speed 2-stroke Engines

DU – S.E.M.T Pielstick
Medium and High Speed 4-stroke Diesel Engines

Proven and trusted DU engine

信頼と実績の DU 製エンジン



2 ストロークエンジンは、Winterthur Gas & Diesel 社ライセンス契約の下で、ストロークエンジンは、SEMT 社（現 MAN Energy Solutions 社）とのライセンス契約の下で、弊社の兵庫県相生工場にて製造・組立・販売を行っております。その歴史は古く 2 ストロークエンジンは、1948 年、Winterthur Gas & Diesel 社の前身である SULZER と技術提携を結び、4 ストロークエンジンは、1964 年に SEMT 社と技術提携を結び、今日に至っております。

Under license agreement with Winterthur Gas & Diesel on the two-stroke engine and license agreement with MAN Energy Solutions on the four-stroke engine , we manufacture, assemble and sell those at our Aioi plant, Hyogo-pref, Japan. The relationship has a long history. We entered into a technical alliance with SULZER (current :WinGD) in 1948 and with SEMT (current MAN) in 1964.

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DU-S.E.M.T. Pielstick 4 stroke engine

ClassNK CMAXS LC-A (Digital solution)

低速エンジンの特長
Features of low speed engine

1. 低燃費と低 NOx 排出率の両立
Lower FOC and lower NOx emission

- コモンレール技術による先進の燃料噴射方式
  Advanced fuel injection by common-rail technology
- 低負荷連続運転への適用性
  Easier to apply lower load operation

2. 20 年以上の実績と確立した信頼性
Well confirmed reliability by more than 20 years experience

- 電子制御式低速エンジンの先駆者として世界をリードし、最も長い豊富な実績を持つ
  Longest track record for electrically-controlled low-speed common-rail engines in the world.

3. シンプルな構造
Simple and reliable structure

- コモンレール技術採用
  Common-rail technology applied
- 油圧生成部と制御部分を分離
  Simple and flexible control by separated hydraulic and control parts

4. スマートかつシンプルな制御システム
Smart and simple control concept

- 制御モジュールは 1 種類のみ
  Only one kind of computer module
- シンプルで汎用性の高い制御モジュール
  Simple and versatile computer module

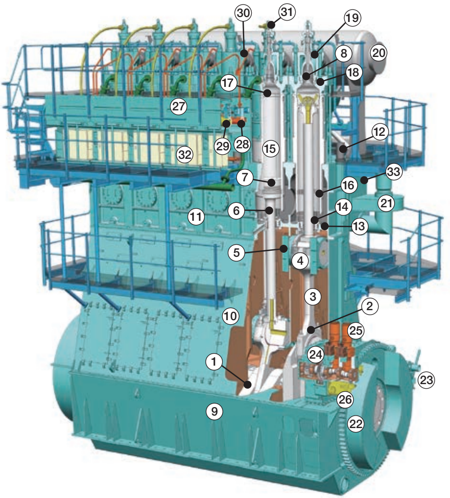
5. 自動状態診断システム LC-A との親和性
Bigger synergy effect with LC-A

- 自動状態診断による予防保全
  Preventive maintenance by the automatic condition diagnosis
- 迅速かつ的確なトラブルシューティング
  Quick and exact troubleshooting
- 状態に基づいた最適運航設定
  Optimum operation setting based on the actual condition

低速エンジンの構造

Structure of low speed engine

WinGD LOW-SPEED DIESEL MARINE ENGINES



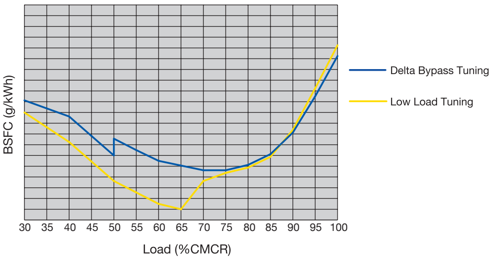
1. Crankshaft
2. Bottom end of connecting rod
3. Connecting rod
4. Crosshead
5. Crosshead guide shoes
6. Piston rod
7. Piston
8. Exhaust valve
9. Bedplate
10. Column
11. Cylinder block
12. Tie rods
13. Diaphragm
14. Piston rod gland
15. Cylinder liner
16. Scavenge air ports
17. Anti-polishing ring
18. Cylinder cover
19. Exhaust valve cage
20. Exhaust manifold
21. Auxiliary scavenge air blower
22. Flywheel
23. Turning gear
24. Supply unit
25. High-pressure fuel supply pumps
26. Servo oil pumps
27. Rail unit
28. Fuel oil rail with injection control units
29. Servo oil rail with exhaust valve control units
30. High-pressure pipes to fuel injection valves
31. Exhaust valve drive
32. Electronic cabinets
33. Scavenge air receiver

低速エンジンの性能
Performance of low speed engine

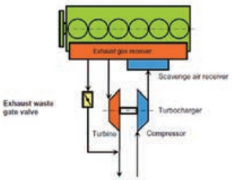
X 電子制御エンジンは、船舶の運航形態に合わせ、様々なチューニングを行うことができ、本船の燃料消費量削減に貢献することができます。

X electronically controlled engines can contribute fuel saving by a various tuning option to meet the actual operation of individual ship.

Tuning Option



デルタバイパスチューニング
Delta Bypass Tuning



デルタチューニングにおける燃費率を悪化させる事なく、より高い排気ガス温度と、それによる蒸気発生量の増加を狙うチューニングです。
排気ガスバイパス弁を設ける事が必要となります。

Delta Bypass Tuning is an engine tuning designed for increasing the exhaust gas temperature and steam production power without any penalty to the engine specific fuel consumption and performance while still complying with all existing emission legislation. Delta Bypass Tuning is achieved by adding one exhaust gas waste gate.

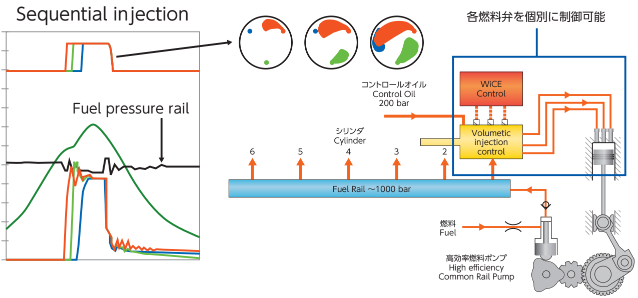
ローロードチューニング
Low Load Tuning

エンジン低負荷域での燃費性能を重視するチューニングです。排気バイパス弁を設け、高負荷域での過給機オーバースピードを抑えます。

This is the tuning for improvement of fuel consumption at low engine load. The exhaust waste gate can prevent the turbocharger overspeed at high engine load.

シーケンシャル燃料噴射による NOx 削減
NOx Reduction by Sequential Fuel Injection

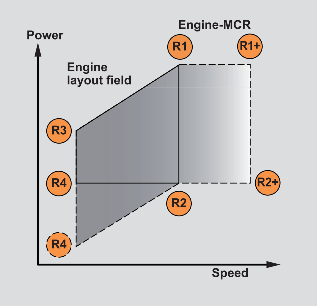
- 低燃費率と低 NOx 排出率の両立を可能とするコモンレールシステムによる技術。
  Common-rail technology can balance lower fuel consumption with further reduction of NOx emission.
- 高圧噴射による良好な燃焼を維持したまま、熱発生率を抑制。
  It can control the heat release rate with keeping good combustion under high-pressure injection.
- DU-WinGD エンジンのみが実現可能な燃料噴射形態。
  Only DU-WinGD engines can achieve such a fuel injection system.



エンジンレーティング
Engine Rating

エンジンのレーティングは、出力および回転数により決められたR1, R2, R3 及びR4ポイントの内側でエンジンの連続最大出力（MCR）が設定されます。

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



ISO Standard Reference Condition

大気圧 (Total barometric pressure at R1)	1.0bar
過給器ブロワ入口温度（Suction air temparature)	25℃
相対湿度（Relative humidity)	30%
空気冷却器冷却水温度（Cooling water tempreture before engine)	25℃

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

On the BSFC figures for DU-WinGD X-series engines and X-DF, stepwise tolerances have been introduced for the brake specific fuel and energy consumption (BSFC/BSEC) guarantee.

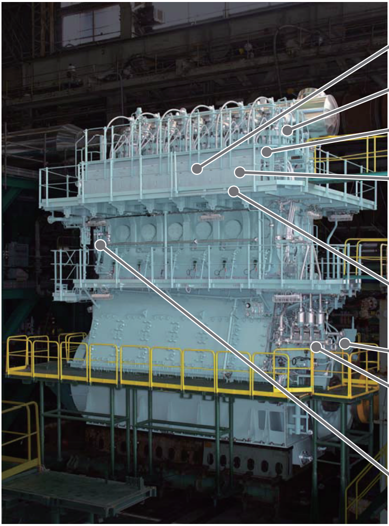
+5% tolerance for 100% to 85% engine load

+6% tolerance for 84% to 65% engine load

+7% tolerance for 64% to 25% engine load

All figures are quoted for ISO standard reference conditions (ISO 15550 and 3046).

低速エンジンの部品構成
Low speed engine System Arrangement



シリンダ内圧自動調整システム
ICC

燃料弁
Fuel Injection Valve

レールユニット
Rail Unit

制御システム
Control System

UNIC

WiCE

パルスジェット注油
Pulse Lubricating System

クランクアングルセンサー
Crank Angle Sensor

サプライユニット
Supply Unit
- 燃料ポンプ
- サーボオイルポンプ

機側操縦装置
Local Operation Box

DU-WinGD 6X52

低速エンジンの部品構成
Low speed engine System Arrangement

レールユニット
Rail Unit

燃料噴射と排気弁開閉タイミングの最適制御により、燃費改善や環境性能を向上することができる。

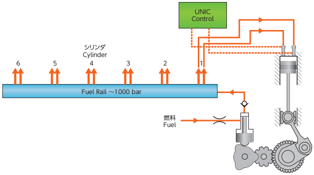
By the control of timing of fuel injection and exhaust valve, fuel consumption and the environmental advantage can be improved.

燃料噴射系 Fuel Injection

- 低負荷域でも高圧で燃料噴射可能
  High injection pressure even at low speed
- 各シリンダの燃料弁を 1 本単位で制御
  Control fuel injection for each fuel valve on each cylinder

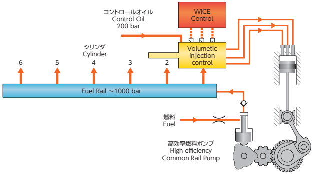
UNIC

- バルチラ 4 ストロークエンジンで豊富な実績
  Many experiences on Wärtsilä 4 stroke engine
- X-DF エンジンにも対応
  Availability for the X-DF engine



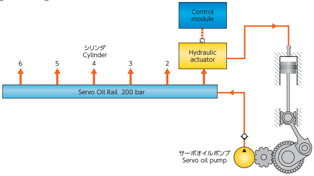
WiCE

- 燃料噴射は WiCE からの信号をレールバルブを介して制御
  WiCE system controls fuel valve action by rail valve



排気弁駆動系 Exhaust Valve Driving

- 排気弁開閉タイミングを自由に制御可能
  Free control for adjustment on opening-closing timing
- ストロークセンサによりフィードバック制御
  Feedback control of exhaust valve by stroke sensor
- RTA エンジン同様、油圧で開き、空気圧で閉まります。
  Reliable valve opening by hydraulic oil and valve closing by air spring same as in proven RTA engine



制御システム
Control System

UNIC

- CCM-20 制御ユニットを使用。 CCM-20 cylinder unit
- シリンダ油の制御を統合。 Control of cylinder lubrication integrated

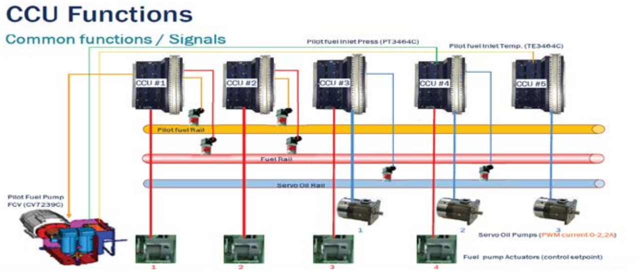
WiCE

DU-WinGD エンジンの最新制御システム下で、次の３つの制御ユニットから成る。
Under the latest DU-WinGD engine control system, WiCE comprises the following three types of control units.

- **Cylinder Control Unit (CCU):** 制御機能は次の通り。
  The control functions are as follows.
  Fuel injection control（燃料噴射制御）、Exhaust valve control etc.（排気バルブ制御など）

- **Main Control Unit (MCU):** 制御機能は次の通り。
  The control functions are as follows.
  Speed control（速度制御）、Auxiliary blowers etc（補助ブロア制御など）.

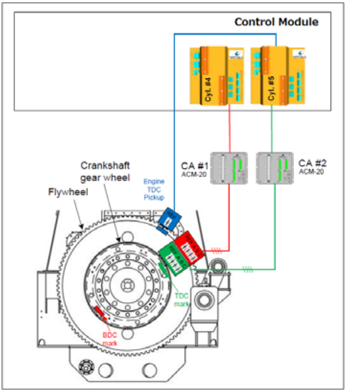
- **Gateway Unit (GTU):** 外部のシステムやサポートツール (PCS, AMS, *DCM, flex view) と繋ぐインターフェイス機能をもつ。エンジン制御システムと外部システムとのファイアアーウオール機能も有する。
  *DCM = Data Collection and Monitoring：DCM データを WiCE Control パネル上で閲覧可能。
  It provides the interfaces to communicate with external systems / support tools (PCS, AMS, *DCM, flexview), and a firewall between the engine control system and the off-engine system.
  *DCM data is available on WiCE Manual Control Panel.

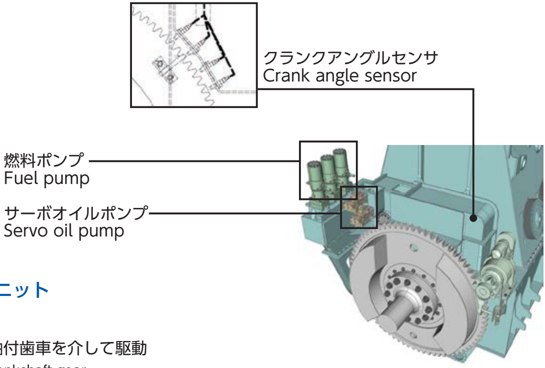


低速エンジンの部品構成
Low speed engine System Arrangement

クランクアングルセンサ
Crank Angle Sensor

- CAS はクランクケース内に内蔵
  CAS is built into crank case
- センサは、エンコーダ型から近接センサ型に変更
  CAS sensor changed from encoder type to proximity type
- 交換が簡単
  Simple procedure in case of pick up replacement





サプライユニット
Supply Unit

- クランク軸付歯車を介して駆動
  Drive by crankshaft gear
- 燃料とサーボオイルは一定圧力になるよう制御
  Keep fuel and servo oil pressure in control
- ポンプの１つが故障しても他のポンプで継続運転可能
  In case of one fuel/servo oil pump broken, M/E can operate by another one

燃料弁
Fuel Valve

FAST ノズル
Fuel Actuated Sacless Technology nozzle

従来型の燃料噴射弁は、燃料噴射後にノズル噴孔付近に燃料が一時的に残るため、これが燃料消費量悪化の要因の１つとなっていました。

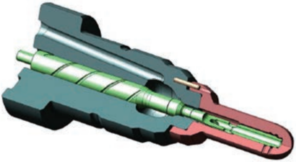
FAST 弁は、噴孔付近の構造を改善することで燃料残油がなくなり、燃料消費量の向上が図れます。

The conventional fuel injection valve is set to one of the factors of the fuel consumption aggravation because a small amount of fuel remains near the injection nozzle temporarily after fuel injection.

The sac volume of FAST can be eliminated by improving the structure of fuel hole, and FAST can save fuel consumption.

特長 Features

- 約 1.0g/kWh の燃料消費率の低減
  Reduction of BSFC at approximately 1.0 g/kWh
- 炭化水素排出の低減
  Reduction of hydrocarbon emission
- 汚れの少ない燃焼室
  Cleaner combustion chamber
- スモーク生成の低減
  Reduction of smoke formation



統合型ソレノイド制御燃料弁
Integrated solenoid control fuel valve

- 燃料噴射弁は FAST ノズルを踏襲
  Following FAST nozzle
- 時間制御燃料噴射弁
  Time controlled fuel injection valves
- UNIC に対応
  Combined with UNIC control unit

パルスジェット注油
Pulse Jet Lubrication System

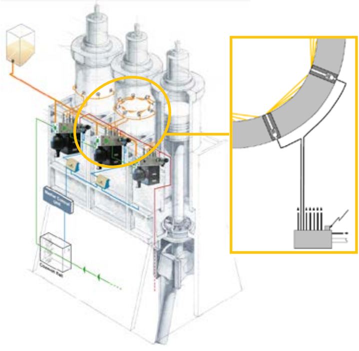
パルスジェット注油は従来の蓄圧式注油より、さらなる注油率低減を目的として開発された電子式注油システムです。

Pulse jet lubrication system was developed for the further reduction of cylinder lubrication feed rate compared to the conventional accumulator system.

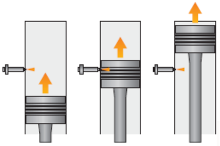
特長 Features

- 電子制御により最適なタイミングで注油が可能
  Optimized lubrication at the proper injection timing by the electronic control.
- リングパック通過時の効果的なライナ摺動面への注油
  Effective lubrication on the cylinder liner wall by oil injection as the ring pack of piston passes the injector.
- 低負荷状態でも適正な注油が可能
  Optimum lubrication even under low load operation
- 信頼性の高い注油ノズル
  Reliable oil quills
- シリンダー油ラインのヒーティング不要
  Not necessary to heat the cylinder oil line

Arrangement (Image)



Injection timing (Image)



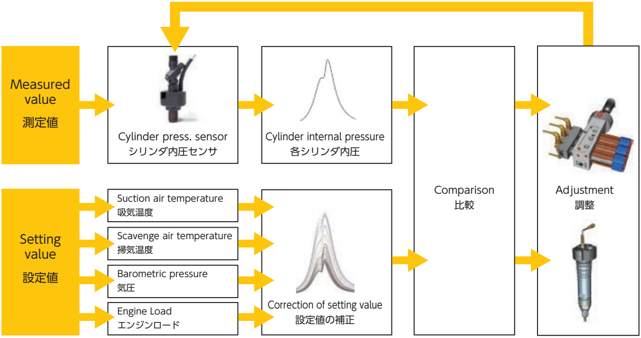
ICC
Intelligence Combustion Control System

シリンダ内最高圧力 (Pmax) を自動調整し、燃料性状の悪化や周囲環境の変化による燃費の悪化を防ぎます。

The ICC system automatically optimizes the peak firing pressure (Pmax) in all cylinders, which results in preventing the fuel efficiency from tending to deteriorate due to the degradation of fuel property or change of ambient condition.

仕組み How it works

- 指圧器弁に取り付けられたセンサからシリンダ内圧を常時監視
  Sensor on the pressure indicator valve monitors cylinder pressure constantly
- データは制御システム (UNIC, WiCE) にフィードバック
  The data is fed back to the control (UNIC, WiCE)
- シリンダ内最高圧力 (Pmax) を自動調整
  The peak firing pressure (Pmax) is optimized automatically



Overview

Tier-3 規制対応技術

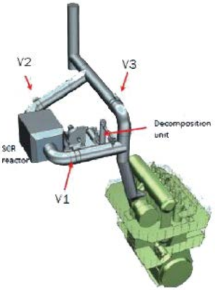
Technologies for IMO NOx Tier-3 regulations

2016 年以降適用の NOx 3 次規制では、NOx（窒素酸化物）排出規制海域において、1次規制に比べ 80% の NOx 排出量削減が義務付けられていますが、ディーゼルエンジン単体では難しく、選択触媒還元（SCR：Selective Catalytic Reduction）や排気再循環（EGR：Exhaust Gas Recirculation）などの NOx 削減装置の追加導入が必要になります。
これに加え、一般海域の SOx（硫黄酸化物）規制が、2020 年 1 月 1 日から開始され、船舶の燃料油の硫黄分許容限度は、3.5% m/m から 0.5% m/m に強化されました。
弊社 2 ストロークエンジンにおいては、これらの規制に対応するため、以下の対応策を取っております。

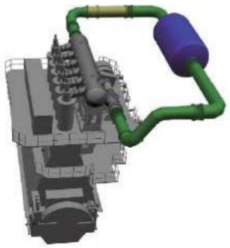
Under the IMO Tier 3 regulations effective from the 1st January 2016, an 80% reduction in NOx emission compared to the IMO Tier 1 values must be achieved in the ECA's (Emission Control Areas). To meet the IMO Tier 3 regulations on diesel engine, aftertreatment technologies such as SCR (Selective Catalytic Reduction) and EGR (Exhaust Gas Recirculation) are required.
In addition, the regulation limiting the Sulphur Oxides (SOx) content of marine fuels for open sea area came into effect on the 1st January 2020. The allowable limit was strengthened from 3.5% m/m to 0.5% m/m.
To comply with those regulations on our 2-stroke engines, we take the following measures.

Our Engine	Tier 3 Nox regulation	Sox regulation
Diesel Engine X series	LP SCR, HP SCR (conventional), HP iSCR (Integrated type)	Sox Scrubber or Low Sulphur Fuel
Dual Fuel Engine RT-flex/X series	SCR or EGR is NOT necessary. Engine meets Tier3 regulation	Any actions are NOT necessary on LNG fuel

従来型 外付 SCR
(Conventional external type of SCR)



(Low pressure SCR)


(High pressure SCR)

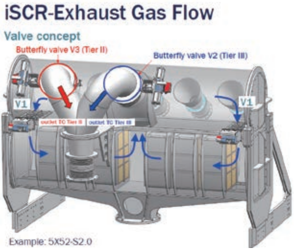
iSCR (エンジン内蔵型高圧式 SCR)
Integrated SCR (High pressure type of SCR)

これまで、従来型タイプの SCR では、船内の設置スペースの確保が一つの悩みとされてきました。iSCR(内蔵型 SCR) は、エンジン内の排気溜の中に設置されますので、船内配管設計も容易となり、SCR 設置スペース確保に関する悩みを解決できます。また、触媒の量も既存の SCR にくらべ大幅に削減されており、尿素使用量の削減も見込まれます。NOx 削減性能は従来型タイプの SCR と同様です。

On the conventional SCR, there has been a concern with the limited installation space of SCR on board.

The iSCR (Integrated SCR) is installed in the exhaust manifold inside the engine, which makes it easier to design the piping layout inside the ship, resulting in solving the bottleneck concerning the SCR installation space. Furthermore, the amount of catalyst is significantly reduced compared to the conventional SCR, and the reduction of urea consumption is also expected. NOx reduction performance is the same as conventional SCR type.

SCR is integrated into the exhaust manifold inside the engine.



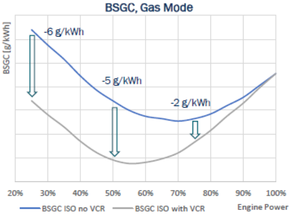
	Tier II	Tier III
Louvre valves V1	Closed	Opened
Butterfly valve V3	Opened	Closed
Butterfly valve V2	Closed	Opened

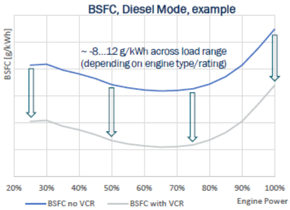
Overview

VCR 機構（可変圧縮比機構）
Variable Compression Ratio

VCR 機構は、油圧シリンダをピストン棒下部に組込、燃焼室の容積を調整することでエンジン出力に応じた最適な圧縮比に変更でき、大幅な燃費改善を実現します。

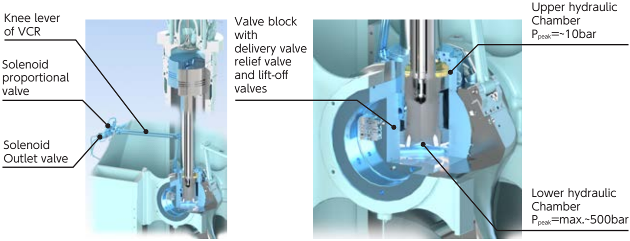
VCR mechanism incorporates a hydraulic cylinder at the bottom of the piston rod, and by adjusting the volume of the combustion chamber, the compression ratio can be changed to the optimal one according to the engine output, resulting in a significant improvement in fuel efficiency.



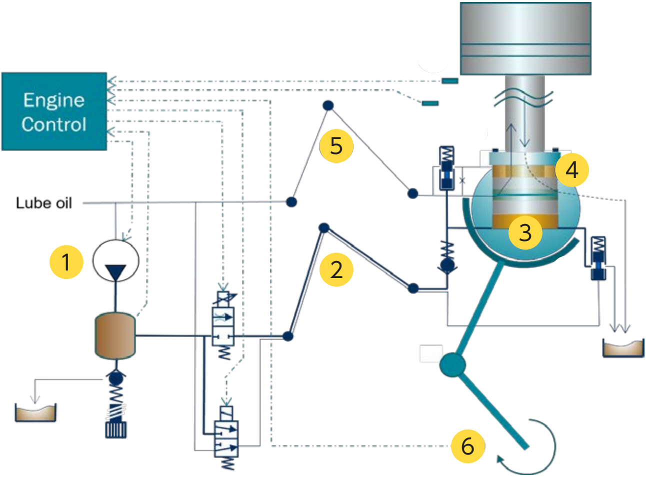


Savings with VCR, X-DF2.0		
Engine load [%]	BSGC reduction [g/kWh] ISO conditions	BSFC reduction ISO conditions
100%	0	~ -8...-12 g/kWh depending on engine type and rating (2 g/kWh higher than equivalent diesel engine, IMO avg.)
75%	-2	
50%	-5	
25%	-6	

Components – Elements on each Cylinder



System diagram and description



1	Feed pump 作動油供給ポンプ	Variable motor speed to minimize power consumption 消費電力を最小限に抑える可変モーター付き
2	Knee lever of VCR VCR 揺動管	Connects the proportional valve with the lower hydraulic chamber 作動油を下部油圧室へ供給する揺動管
3	Lower chamber 下部油圧室	Lift the piston rod depending on amount of oil in it オイル量によりピストンを押し上げる
4	Upper chamber 上部油圧室	Holds the piston down under any situation オイル量によりピストンを保持する
5	Knee lever for piston cooling ピストン冷却揺動管	Existing knee lever for usual piston cooling ピストン冷却用揺動管
6	Crank Angle Signal クランク角度信号	Existing engine crank angle signal used also for the VCR control クランク角信号で VCR 制御

VCR は WinGD と MES DU の共同開発品であり、X72DF, X62DF 及び X62DF-S エンジンに装備可能、今後、他機種にも展開していく予定です。

VCR technology was jointly developed by WinGD and MES DU, which can be installed on X72DF, X62DF and short-stroke X62DF-S engines, with plans to expand it to other models in the future.

プレスリリース
Press Release

VCR 機構 (Variable Compression Ratio System) 世界初号機を受注

2023 年 6 月 14 日

株式会社三井 E&S（所在地：東京都中央区、社長：高橋 岳之）のグループ会社である株式会社三井 E&S DU（所在地：兵庫県相生市、社長：匠 宏之）は、可変圧縮比機構（Variable Compression Ratio system、以下「VCR 機構」）を世界で初めて受注しました。

この VCR 機構は、日本郵船株式会社が株式会社大島造船所に発注した 2 隻の LNG 燃料大型石炭船用に搭載される主機「6X62DF-2.1」デュアルフューエルエンジンに組み込まれるもので、当該本船は 2025 年に竣工する予定です。

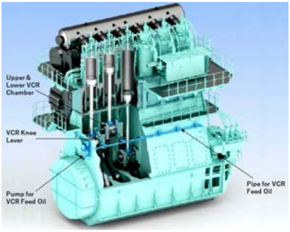
VCR 機構は、エンジン出力や LNG 燃料の性状に応じた最適圧縮比に調整することにより、運航負荷など使用条件にも依りますが、ガスモードでは約 3%、ディーゼルモードでは約 6%の燃費を改善することができ、船舶運航時の燃料費と CO2 の削減に大きく貢献します。

また、脱炭素化目標の達成に向け新しい燃料や技術を採用する際にも、さらには、既存船の性能改善の際にも、VCR は重要な役割を果たすことができます。

従来から圧縮比を可変することによる効果は周知されていましたが、複雑な構造による様々な制約のため、技術的に開発が困難でした。当社は、前身である株式会社播磨造船所時代の 1948 年から大型舶用低速エンジンの製造に携わっており、今まで培ってきた豊富な経験と、多岐にわたる産業分野で蓄積された最新の油圧、シール、潤滑、構造強度、制御などの卓越した技術を十分に応用し、様々な要素試験の積み重ねにより、このたび、当社が製造する大型舶用低速エンジンのライセンサであるウィンターツール ガス & ディーゼル社（所在地：スイス）と共に商用化することができました。

当社は、お客様の様々なニーズにお応えすべく、今後もウィンターツール ガス & ディーゼル社と連携し脱炭素社会の実現に貢献していきます。

【参考画像：VCR 機構部】



COMMON-RAIL GENERATION X LOW-SPEED ENGINE

DU – WinGD
Low Speed 2-stroke Engines

重油焚き機関
Fuel Oil Engines

ディーゼル機関名称規則
Diesel Engine Designation

Engine Designation

9X82-B

- Diesel engine version
- Bore size (cm)
- Engine type
- Number of cylinders

8X52-S2.0

- Revision level, based on new design features
- Technology level
- S: Short-stroke or P: Power generation or others to be defined
- Bore size
- Engine type
- Number of cylinders

WinGD X92-B

Cylinder bore	920 mm
Piston stroke	3468 mm
Speed	70-80 rpm
Mean effective pressure at R1	21.0 bar
Fuel specification (Fuel oil)	700 cSt/50℃ / ISO-F 8217:2017 / category ISO-RMK700

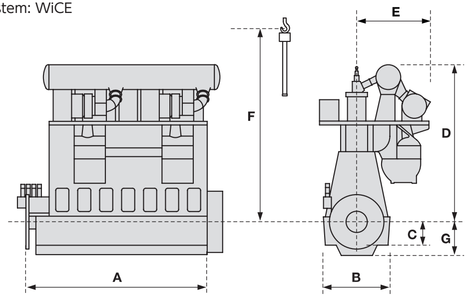
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	80 rpm		70 rpm			
	R1	R2	R3	R4		
6	38 700	27 900	33 900	24 420	11 755	1 120
7	45 150	32 550	39 550	28 490	13 345	1 260
8	51 600	37 200	45 200	32 560	14 935	1 380
9	58 050	41 850	50 850	36 630	17 960	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		F*	G
	5 550	1 900	13 150		15 640	2 970

Brake specific fuel consumption (BSFC) in g/kWh					
Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		21.0	15.1	21.0	15.1
BSFC	Delta Tuning	162.8	156.8	161.8	157.8

Part load, % of R1	85	70	85	65
Tuning variant	Delta	Delta	Low-Load	Low-Load
BSFC	155.5	148.3	157.7	151.8

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Control System: WiCE



WinGD X82-2.0

Cylinder bore	820 mm
Piston stroke	3375 mm
Speed	58-84 rpm
Mean effective pressure at R1	22.0 bar
Fuel specification (Fuel oil)	700 cSt/50℃ / ISO-F 8217:2017 / category ISO-RMK700

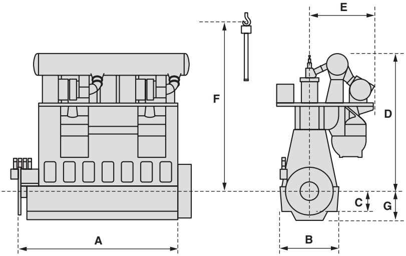
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	84 rpm		58 rpm			
	R1	R2	R3	R4		
6	33 000	24 000	22 800	16 560	10 426	805
7	38 500	28 000	26 600	19 320	11 866	910
8	44 000	32 000	30 400	22 080	13 306	1 020
9	49 500	36 000	34 200	24 840	14 746	1 160
Dimensions	B	C	D		F*	G
mm	5 050	1 800	12 310		15 250	2 700

Brake specific fuel consumption (BSFC) in g/kWh					
Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		22.0	16.0	22.0	16.0
BSFC	Delta Tuning	165.3	160.2	161.5	158.7

Part load, % of R1	85	70	85	65
Tuning variant	Delta	Delta	Low-Load	Low-Load
BSFC	158.0	151.7	154.2	149.7

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Control System: WiCE



WinGD X72-B

Cylinder bore	720 mm
Piston stroke	3086 mm
Speed	66-89 rpm
Mean effective pressure at R1	21.0 bar
Fuel specification (Fuel oil)	700 cSt/50℃ / ISO-F 8217:2017 / category ISO-RMK700

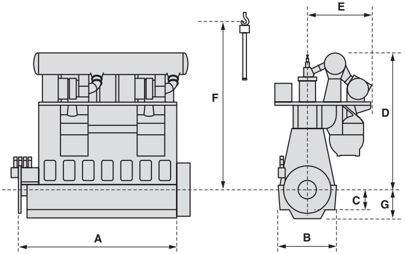
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	89 rpm		66 rpm			
	R1	R2	R3	R4		
5	19 600	14 300	14 550	10 600	8 085	481
6	23 520	17 160	17 460	12 720	9 375	561
7	27 440	20 020	20 370	14 840	10 665	642
8	31 360	22 880	23 280	16 960	11 960	716
Dimensions	B	C	D		F*	G
mm	4 780	1 575	10 790		13 750	2 455

Brake specific fuel consumption (BSFC) in g/kWh					
Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		21.0	15.3	21.0	15.3
BSFC	Delta Tuning	167.8	162.3	166.8	162.3

Part load, % of R1	85	70	85	65
Tuning variant	Delta	Delta	Low-Load	Low-Load
BSFC	160.5	153.5	159.5	150.7

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Control System: WiCE



WinGD X62-1.1

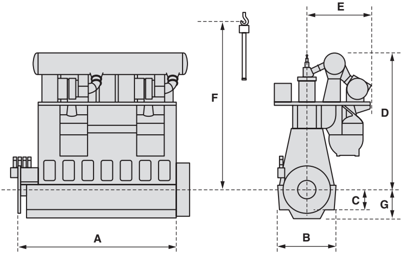
Cylinder bore	620 mm
Piston stroke	2658 mm
Speed	77-103 rpm
Mean effective pressure at R1	21.0 bar
Fuel specification (Fuel oil)	700 cSt/50℃ / ISO-F 8217:2017 / category ISO-RMK700

Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	103 rpm		77 rpm			
	R1	R2	R3	R4		
5	14 500	10 650	10 800	7 950	7 000	325
6	17 400	12 780	12 960	9 540	8 110	377
7	20 300	14 910	15 120	11 130	9 215	435
8	23 200	17 040	17 280	12 720	10 320	482
Dimensions	B	C	D		F*	G
mm	4 200	1 360	9 580		11 830	2 110

Brake specific fuel consumption (BSFC) in g/kWh					
Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		21.1	15.5	21.0	15.4
BSFC	Delta Tuning	167.8	162.3	166.8	162.3

Part load, % of R1	85	70	85	65
Tuning variant	Delta	Delta	Low-Load	Low-Load
BSFC	160.5	153.5	159.5	150.6

* Standard piston dismantling height can be reduced with tilted piston withdrawal.
* Control System: WiCE



WinGD X62-S2.0

Cylinder bore	620 mm
Piston stroke	2245 mm
Speed	82-108 rpm
Mean effective pressure at R1/R1+	22.0 bar
Fuel specification (Fuel oil)	700 cSt/50℃ / ISO-F 8217:2017 / category ISO-RMK700

Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight 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	B	C	D	D (iSCR)	F*	G
mm	3 440	1 295	8 575	9 020	10 230	1 835

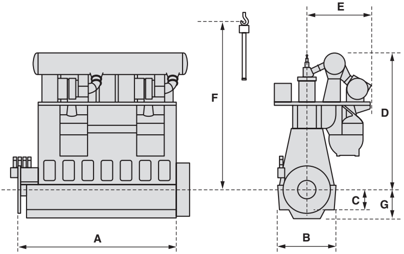
Brake specific fuel consumption (BSFC) in g/kWh

Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		22.0	15.8	22.0	15.8
BSFC	Delta Tuning	163.8	158.8	161.8	159.8

Part load, % of R1/R1+	85	70	85	65
Tuning variant	Delta	Delta	Low-Load	Low-Load
BSFC	156.5	150.3	154.5	148.8

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Control System: WiCE



WinGD X52-1.1

Cylinder bore	520 mm
Piston stroke	2315 mm
Speed	79-105 rpm
Mean effective pressure at R1	21.0 bar
Fuel specification (Fuel oil)	700 cSt/50℃ / ISO-F 8217:2017 / category ISO-RMK700

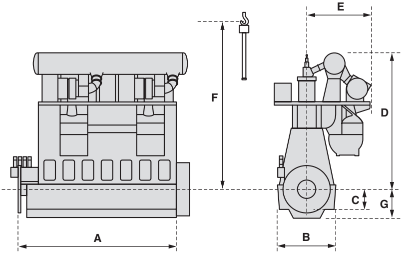
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	105 rpm		79 rpm			
	R1	R2	R3	R4		
5	9 050	6 800	6 800	5 100	5 985	217
6	10 860	8 160	8 160	6 120	6 925	251
7	12 670	9 520	9 520	7 140	7 865	288
8	14 480	10 880	10 880	8 160	8 805	323
Dimensions	B	C	D	D (iSCR)	F*	G
mm	3 514	1 205	8 415	8 760	10 350	1 910

Brake specific fuel consumption (BSFC) in g/kWh					
Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		21.0	15.8	21.0	15.8
BSFC	Delta Tuning	169.8	162.8	169.8	162.8

Part load, % of R1	85	70	85	65
Tuning variant	Delta	Delta	Low-Load	Low-Load
BSFC	162.5	154.3	162.5	151.8

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Control System: WiCE



WinGD X52-S2.0

Cylinder bore	520 mm
Piston stroke	2045 mm
Speed	85-120 rpm
Mean effective pressure at R1	22.0 bar
Fuel specification (Fuel oil)	700 cSt/50℃ / ISO-F 8217:2017 / category ISO-RMK700

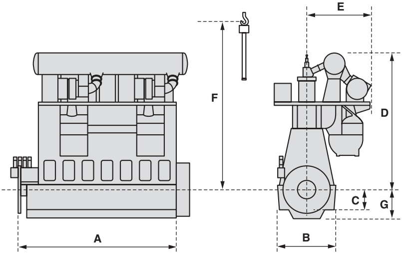
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	120 rpm		85 rpm			
	R1	R2	R3	R4		
5	9 550	6 850	6 775	4 850	5 485	190
6	11 460	8 220	8 130	5 820	6 345	215
7	13 370	9 590	9 485	6 790	7 205	245
8	15 280	10 960	10 840	7 760	8 065	275
Dimensions mm	B	C	D	D (iSCR)	F*	G
	3 100	1 185	7 775	8 000	9 340	1 675

Brake specific fuel consumption (BSFC) in g/kWh					
Full load					
Rating point		R1	R2	R3	R4
BMEP, bar		22.0	15.8	22.0	15.8
BSFC	Delta Tuning	163.8	157.8	162.8	160.8

Part load, % of R1	85	70	85	65
Tuning variant	Delta	Delta	Low-Load	Low-Load
BSFC	156.5	149.3	155.5	149.8

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Control System: WiCE



プレスリリース
Press Release

世界初のエンジン組込み型 SCR 装置（iSCR）搭載の新型エンジンを受注

2023 年 8 月 8 日

株式会社三井 E&S（所在地：東京都中央区，社長：高橋岳之）のグループ会社である株式会社三井 E&S DU（所在地：兵庫県相生市，社長：匠宏之）は、国内の造船所から、世界初 * の iSCR（integrated Selective Catalytic Reduction）装置を搭載した新型エンジン 5X52-S2.0 型ディーゼルエンジンを 2 台受注しました。

当該エンジンは、4 万重量トン型のばら積貨物船に搭載されるもので、その初号機は 2024 年 11 月に完成予定です。

この iSCR は、国際海事機関（IMO）の NOx（窒素酸化物）排出規制に対応するため、ライセンサである Winterthur Gas & Diesel 社が新たにリリースしたもので、排気溜り下の空きスペースを有効活用することで、機関室内のスペースを効果的に抑えることができます。これにより、船舶の設計上の制約を最小限に抑えつつ、効率的なスペース活用が可能となります。

また、造船所の艤装作業においても大きく貢献し、iSCR のスペース節約効果により、造船所の艤装作業をより迅速かつ効率的に行うことができます。その結果、船舶建造工程の短縮と艤装コスト削減が期待されます。

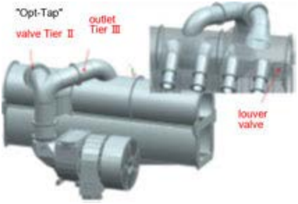
加えて、iSCR は熱損失が少ない特長を持っています。このため、従来型の SCR 装置に比べて触媒の数を少なくすることができます。触媒の数の削減は、エンジンのメンテナンスおよび運航コストの低減に大いに貢献します。

更に、当社が受注した X52S-2.0 は、従来シリーズ X52 よりもショートストローク型であり軽量且つコンパクトであるにもかかわらず、燃料消費率を 6g/kWh（R1 ポイント）改善しており、船舶の燃料費用の低減にも大きく貢献することができます。

当社は、お客様の様々なニーズにお応えすべく、今後もライセンサである Winterthur Gas & Diesel 社と連携し脱・低炭素社会の実現に貢献していきます。

* 注記：就航船テスト用プロトタイプ型は除く

【参考画像：X52S 画像】



LOW-SPEED LOW-PRESSURE

X-DF

DUAL-FUEL ENGINE

DU – WinGD
Low Speed 2-stroke Engines

LNG 焚き二元燃料機関

LNG Dual Fuel Engines

2ストローク 低圧デュアルフューエルエンジンの概要

Overview of 2-stroke low-pressure dual-fuel engine “X-DF”

X-DF エンジン（LNG 燃料）の特長

Advantages of X-DF Engine (LNG fuel)

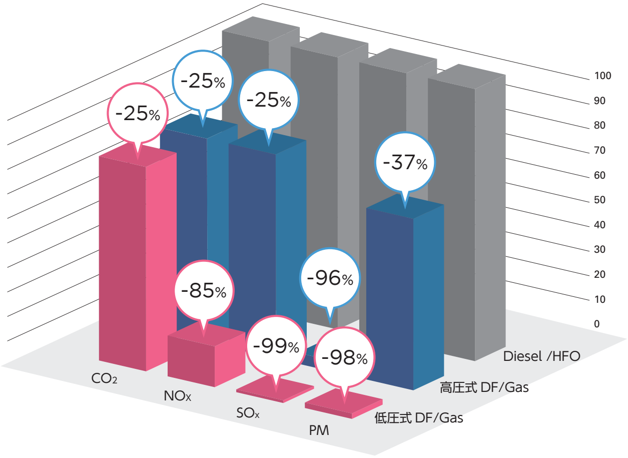
1. 予混合・希薄燃焼式を採用、SCR や EGR なしに IMO Tier Ⅲ規制値をクリア。
X-DF applies the pre-mixed lean burn technology and can meet IMO Tier Ⅲ requirement without the exhaust gas after-treatment.

2. 高圧コンプレッサ等を必要とせず、初期投資費用や運航費用を抑制。
X-DF has advantages of lower Capex and Opex due to no requirement of a high pressure compressor.

3. 低い圧力の LNG(13.3bar 以下) を利用し、安全性が高い。
For safety concerns, X-DF uses low-pressure LNG. (<13.3 bar)

4. ガスモードからディーゼルモードへ、瞬時に切り替え可能。
X-DF can switch from gas mode to diesel mode immediately.

5. 大型船舶用主機として実績のある、低速 2 ストロークエンジンでの実現。
X-DF is based on the low-speed two-stroke engine which is much proven in marine use.

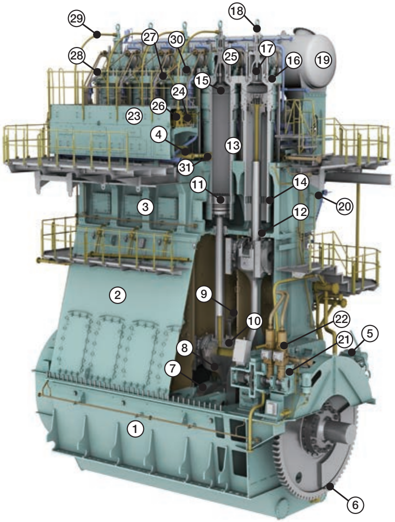


WinGD X DF Engine

デュアルフューエルエンジン "X-DF" の構造

Structure of X-DF engine

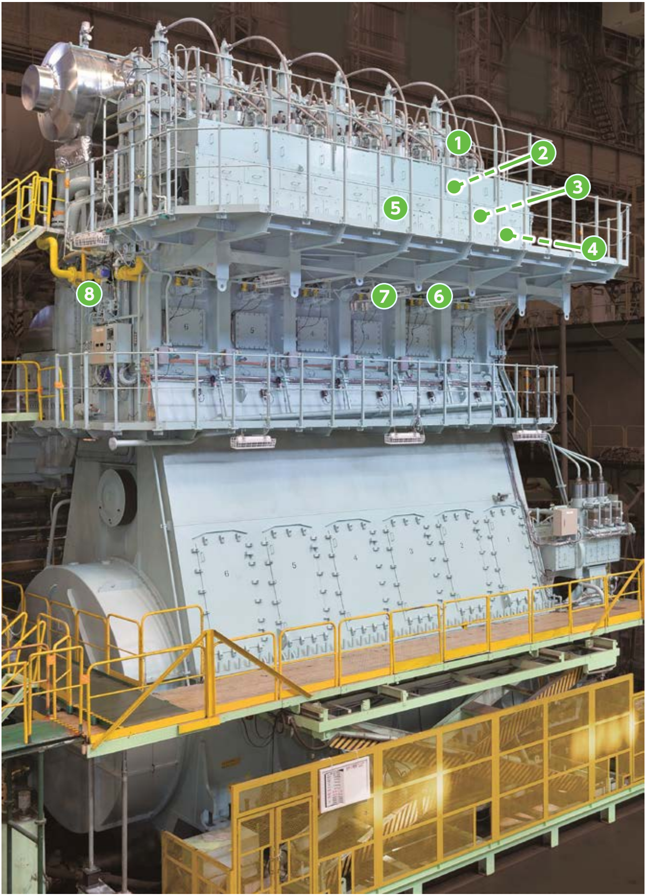
WinGD X-DF ENGINES



1. Bedplate
2. Column
3. Cylinder block
4. Tie rods
5. Turning gear
6. Flywheel
7. Crankshaft
8. Connecting rod
9. Knee lever for piston cooling & bearing lubrication
10. Crosshead
11. Piston
12. Gland box piston rod
13. Cylinder liner
14. Scavenge air ports
15. Anti-polishing ring
16. Cylinder cover
17. Exhaust valve
18. Exhaust valve drive
19. Exhaust manifold
20. Scavenge air receiver
21. Supply unit
22. Fuel pumps
23. Rail unit
24. Fuel oil rail with flow limiting valve
25. Fuel injection valves
26. Servo oil rail with exhaust VCU
27. High-pressure pipes to fuel injection valves
28. Starting air valve
29. Hydraulic pipe exhaust valve
30. Pilot injection valve
31. Gas admission valve

X-DF 関連部品配置図（主機付部品）

Arrangement of X-DF Parts



1 パイロット噴射弁 Pilot fuel valve
予燃焼室 Pre-combustion chamber

2 ウエストゲート弁
Wastegate valve

3 ガス遮断弁
Gas shutoff valve

4 パイロット油供給ポンプ
Pilot fuel oil supply pump

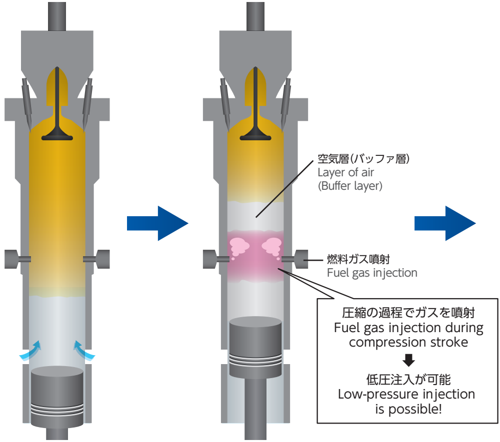
5 制御ユニット
Control unit

6 GAV
(Gas Admmision Valve)

7 ガス検知器
Gas detector

8 ガス放出弁 Gas release valve
ガス管 Gas pipe

X-DF の原理
Operating Cycle



燃料ガス噴射
Fuel gas injection

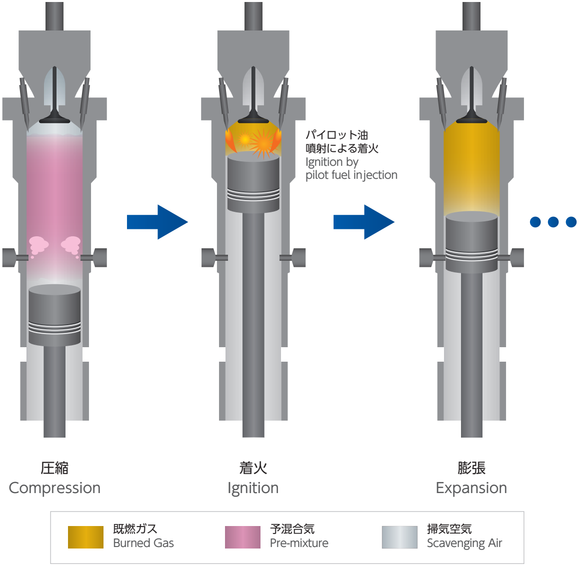
本方式はピストン圧縮によって燃焼室内圧力が上昇する前に、燃料ガスの噴射を完了するため、燃料ガスを高圧にする必要がありません。

Since fuel gas injection is finished before the cylinder pressure increases, high pressure gas injection is not needed.

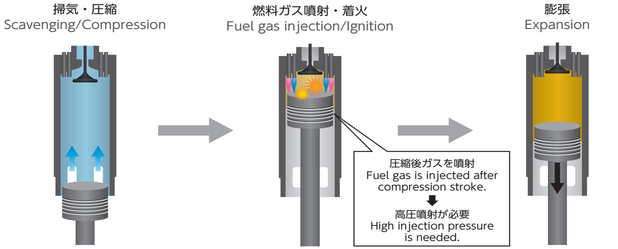
着火・燃焼
Ignition/Combustion

NOx 低減のためには希薄な予混合気を燃焼させる事が必要となりますが、希薄予混合気は着火し難いという特性があります。そこで、上死点近傍で極微量のパイロット燃料を噴霧することにより、希薄予混合への安定した着火を実現させています。

Low NOx can be achieved by lean burn technology. The lean pre-mixture is poor ignitable but can be ignited by a small quantity of pilot fuel oil at the end of compression.



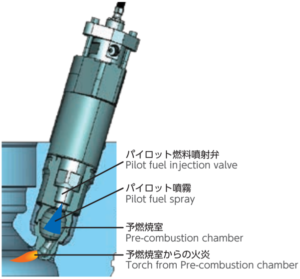
ディーゼル（拡散）燃焼方式
Diesel (Diffusive) Combustion System

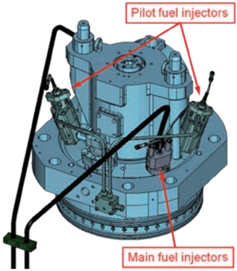


X-DF を支える技術
Key technologies of X-DF

パイロット着火技術
Micro pilot and Pre-chamber technology

- ディーゼルモード用の液体燃料弁の他に、パイロット燃料噴射弁を設置
  Pilot fuel injection valves are installed as well as Fuel injection valve for diesel operation
- コモンレールテクノロジーを採用
  Common-rail technology also applied
- 噴射量は 1% 以下 * *R1 最高出力時における投入エネルギー量に対する割合
  Pilot fuel quantity of less than 1% of heat release* *Supplied energy percentage at R1 rating point.
- 安定した燃焼性と低 NOx を両立
  Stable combustion and low NOx are achieved

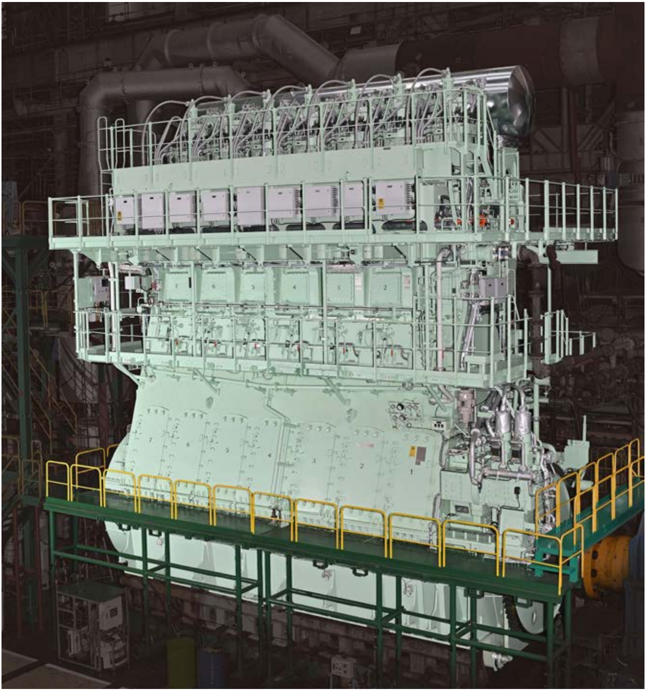




ガス噴射弁（GAV）
Gas Admission Valve

- 1 シリンダにつき 2 つのガス噴射弁を装備
  2x GAV per cylinder at mid stroke of cylinder liner
- ガス噴射弁は排気駆動用と同じサーボオイルにて駆動
  GAV actuated by servo oil same as exhaust valve driving
- 全負荷からアイドリングまで正確なガス供給を最適に制御
  Flexible gas admission control from ‘idling’ to full load
- 二重ガス配管による高い安全性
  Double-walled piping for enhanced safety

WinGD X-DF series



Engine Type	DU-WinGD 7X62DF-2.1	
Cylinder Bore (mm)	620	
Piston Stroke (mm)	2,658	
Rating Point	R1	R4
Speed (rpm)	103	80
Power (kW)	16,695	10,780
Number of Cylinders	7	

ガス圧力調整弁システム：船体設置 GVU と機関付 iGPR
Gas Valve Unit (GVU) & Integrated Gas Pressure Regulation (iGPR) System

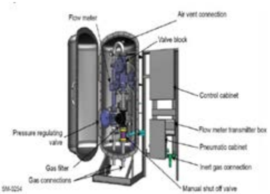
Gas Valve Unit (GVU)

- 船体設置 GVU の主な機能は、エンジンに供給するガス圧の調整を行ったり、ガス供給への危急停止等を迅速かつ確実に行うことにある。下記の絵の GVU は、密閉型タイプで機関室内の主機近傍に設置可能 .
  The main functions of the device are to regulate gas-feeding pressure to the engine, and to ensure a fast and reliable shutdown of the gas supply. The GVU of figures shown below is an enclosed type and can be placed near the main engine in the engine room.

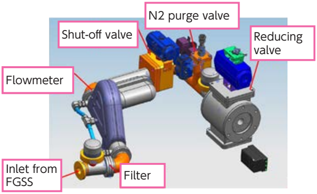
Integrated Gas Pressure Regulation（iGPR）System

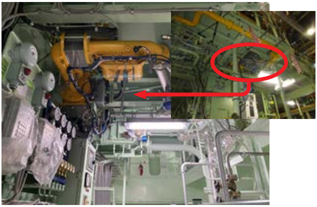
- 機関付 iGPR は、船体設置 GVU に対して、造船所様には、船体側の設置スペース削減。そして船主様には、メンテナンスが容易となるメリットがある。iGPR の主だった機能・性能は GVU と同じ。
  As shown in the figures below, iGPR is fitted on the engine as opposed to GVU on the hull side. The advantage of iGPR is to reduce installation space on the hull side for shipyard and to simplify maintenance for shipowner.　Main function and performance are same as GVU's.
- 安心・安全な二重管構造
  "Safe and secure" double-wall tube design

GVU on the hull side



iGPR on the engine



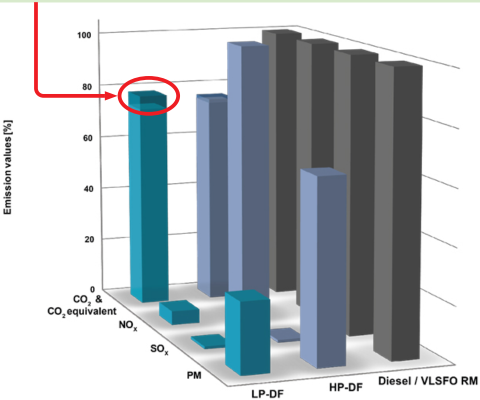


iCER
Intelligent Control by Exhaust Recycling (Option)

- 低圧予混合希薄燃焼方式 X-DF 機関の、ガス運転時メタンスリップ量約半減とガスおよびディーゼル運転時の燃費削減のため、低圧 EGR 方式を採用した iCER を開発。
  On the pre-mixed lean burn type of low-pressure X-DF engine, iCER that was developed with the low pressure EGR method is designed to reduce half of methane slip amount during gas operation and to improve fuel consumption during gas/diesel operation.
- メタン排出規則・規制はまだないが、GHG の更なる削減が可能
  While there are still no methane emission rules / regulations, further reduction of GHG could be achieved.

X-DF のメタンスリップは、CO2 全体の円内部分に相当。 X-DF のメタンスリップ排出量は 4st 機関に比べ元々少ないが、iCER 装備により現状のメタンスリップを約 1/2 までに削減できます。又、補機電力（FGSS や EGR 等）を含めたプラント全体として比較すると、高圧方式の CO2 排出量も低圧方式に近い値となる。

Methane slip of X-DF is equivalent to circled portion of total CO2. The methane slip emission of X-DF is generally lower than that of the 4st engine, but installation of iCER makes it possible to reduce the current level of methane slip by 50%. In addition, comparing the CO2 emission amount under the entire plant including auxiliary electric power (for FGSS, EGR, etc.), the CO2 emission amount of the high pressure type of DF engine is close to that of the low pressure type of our X-DF / flex50DF engine.



Technologies:
LP-DF: Dual-Fuel Engine in Gas Mode, operated according to the Otto-cycle combustion process with iCER technology
HP-DF: Dual-Fuel Engine in Gas Mode, operated occording to the Diesel-cycle combustion process
Diesel / VLSFO RM: Conventional Diesel Engine, operated with 0.5 % sulphur VLSFO RM (Residue Oil)

WinGD X DF Engine

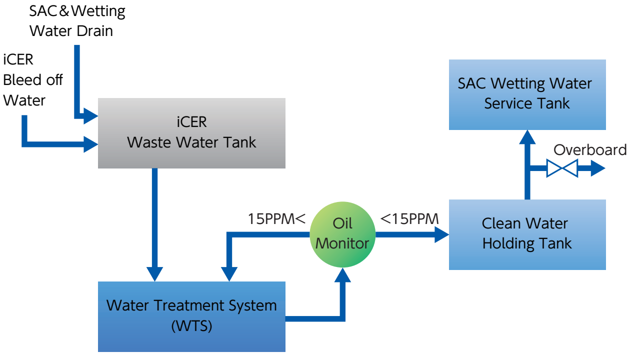
iCER
Intelligent Control by Exhaust Recycling

iCER off-engine type　　or　　iCER on-engine type

iCER の原理
過給機後の排気ガス一部（約 50%）を、EGC で冷却して過給機に戻し排気ガス再循環 (EGR) することでメタンスリップを半減、更にはガス燃料と液体燃料の燃費低減を図る。

Principle of iCER
iCER is a system which allows to improve X-DF performance regarding gas and liquid fuel consumption and environmental footprint, explicitly reducing the emission of unburned Methane. The main component of iCER is Exhaust Gas Cooler (EGC) which allows recirculation of exhaust gas to the engine. Water spray is used to cool the exhaust gas. Water circulates from EGC to a circulation tank from which it is pumped via a plate heat exchanger back to EGC.

WTS
Water Treatment System



iCER 運転時における iCER ブリードオフ水および SAC ドレン水 (ウェッティングウォータ含む) の油分濃度を船外排出基準値 (15ppm) 以下に制御する。

WTS controls the oil concentration below the standard value for overboard discharge (15PPM) of iCER bleed off water and SAC condensate water which including wetting water system for SAC during iCER operation.

デュアルフューエル機関名称規則
Dual Fuel Engine Designation

7X52DF-S1.0

- Revision level, based on new design features
- Technology level
- S: Short-stroke or P: Power generation or others to be defined
- Fuel designation DF: Dual-fuel Blank: Standard engine
- Bore size
- Engine type
- Number of cylinders

WinGD X92DF-2.0 (with iCER)

Cylinder bore	920 mm
Piston stroke	3468 mm
Speed	70-80 rpm
Mean effective pressure at R1	17.3 bar

Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight 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		F*	G
	5 550	1 900	13 140		15 520	2 970

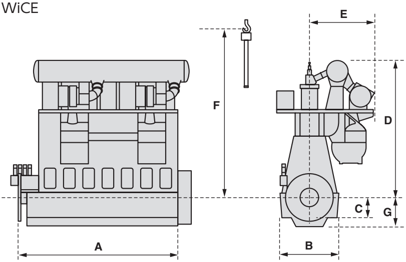
Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	134.6	129.6	136.6	131.6

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	0.7	0.8	0.7	0.8

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	174.2	168.2	176.2	172.2

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Control System: WiCE



WinGD X92DF

Cylinder bore	920 mm
Piston stroke	3468 mm
Speed	70-80 rpm
Mean effective pressure at R1	17.3 bar

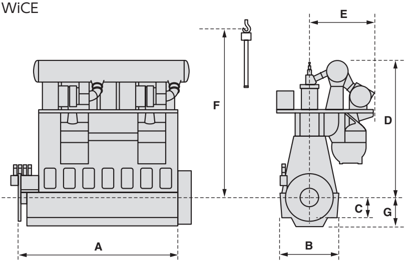
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	80 rpm		70 rpm			
	R1	R2	R3	R4		
6	31 920	26 580	27 930	23 250	11 755	1 120
7	37 240	31 010	32 585	27 125	13 345	1 260
8	42 560	35 440	37 240	31 000	14 935	1 380
9	47 880	39 870	41 895	34 875	17 960	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	B	C	D		F*	G
mm	5 550	1 900	13 140		15 520	2 970

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	141.2	136.2	143.2	138.2

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	0.7	0.8	0.7	0.8

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	180.9	178.9	180.9	178.9

* Standard piston dismantling height can be reduced with tilted piston withdrawal.
* Control System: WiCE



WinGD X82DF-2.0 (with iCER)

Cylinder bore	820 mm
Piston stroke	3375 mm
Speed	58-84 rpm
Mean effective pressure at R1	17.3 bar

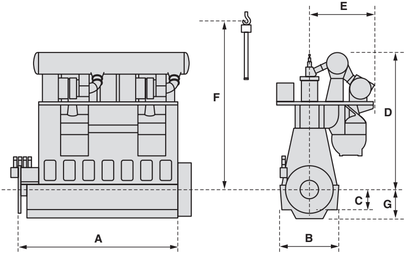
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	84 rpm		58 rpm			
	R1	R2	R3	R4		
6	25 920	21 600	17 880	14 940	10 425	805
7	30 240	25 200	20 860	17 430	11 865	910
8	34 560	28 800	23 840	19 920	13 305	1 020
9	38 880	32 400	26 820	22 410	14 745	1 160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

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	135.6	130.6	137.6	132.6

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	0.6	0.7	0.6	0.7

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	177.2	171.2	179.2	175.2

* Standard piston dismantling height can be reduced with tilted piston withdrawal.
* Control System: WiCE



WinGD X82DF-1.0

Cylinder bore	820 mm
Piston stroke	3375 mm
Speed	58-84 rpm
Mean effective pressure at R1	17.3 bar

Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight 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		F*	G
	5 050	1 800	12 310		15 080	2 700

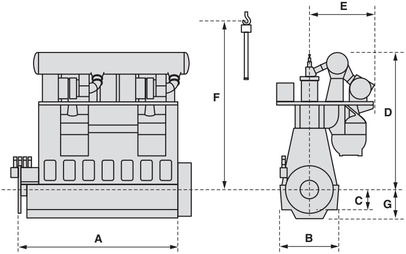
Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	141.8	136.8	143.8	138.8

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	0.6	0.7	0.6	0.7

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	183.9	181.9	183.9	181.9

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Control System: WiCE



WinGD X72DF-2.2 (with iCER)

Cylinder bore	720 mm
Piston stroke	3086 mm
Speed	69-79 rpm
Mean effective pressure at R1	15.7 bar

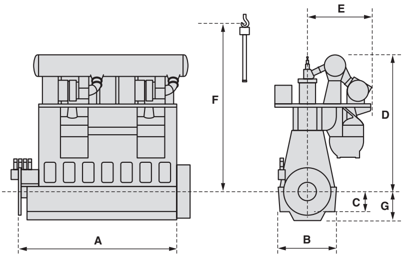
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	79 rpm		69 rpm			
	R1	R2	R3	R4		
5	13 000	11 900	11 350	10 400	7 875	484
6	15 600	14 280	13 620	12 480	9 165	565
Dimensions mm	B	C	D	D (iCER on Engine)	F*	G
	4 780	1 575	10 790	11 755	13 655	2 455

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	135.7	133.6	137.0	134.7

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	0.9	1.0	0.9	1.0

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	175.7	173.3	177.1	175.3

* Standard piston dismantling height can be reduced with tilted piston withdrawal.
* Control System: WiCE



WinGD X72DF-2.1 (with iCER)

Cylinder bore	720 mm
Piston stroke	3086 mm
Speed	69-89 rpm
Mean effective pressure at R1	17.3 bar

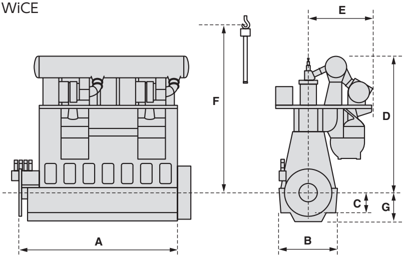
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	89 rpm		69 rpm			
	R1	R2	R3	R4		
5	16 125	13 425	12 500	10 400	8 230	495
6	19 350	16 110	15 000	12 480	9 520	580
7	22 575	18 795	17 500	14 560	10 810	642
8	25 800	21 480	20 000	16 640	12 105	716
Dimensions mm	B	C	D	D (iCER on Engine)	F*	G
	4 780	1 575	10 790	11 755	13 655	2 455

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	137.7	132.7	139.7	134.7

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	0.8	1.0	0.8	1.0

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	177.3	171.3	179.3	175.3

* Standard piston dismantling height can be reduced with tilted piston withdrawal.
* Control System: WiCE



WinGD X72DF-1.2

Cylinder bore	720 mm
Piston stroke	3086 mm
Speed	69-79 rpm
Mean effective pressure at R1	15.7 bar

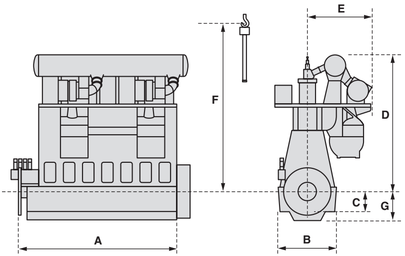
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	79 rpm		69 rpm			
	R1	R2	R3	R4		
5	13 000	11 900	11 350	10 400	7 875	470
6	15 600	14 280	13 620	12 480	9 165	550
Dimensions mm	B	C	D		F*	G
	4 780	1 575	10 790		13 655	2 455

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	140.3	138.2	141.5	139.2

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	0.9	1.0	0.9	1.0

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	180.8	180.0	180.9	180.0

* Standard piston dismantling height can be reduced with tilted piston withdrawal.
* Control System: UNIC



WinGD X72DF-1.1

Cylinder bore	720 mm
Piston stroke	3086 mm
Speed	69-89 rpm
Mean effective pressure at R1	17.3 bar

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	8 230	481
6	19 350	16 110	15 000	12 480	9 520	561
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	B	C	D		F*	G
mm	4 780	1 575	10 790		13 655	2 455

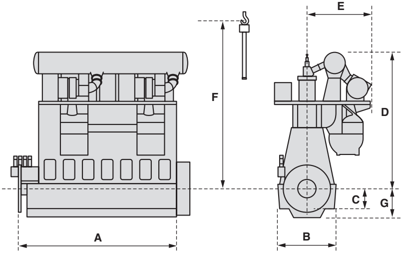
Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	142.3	137.3	144.3	139.2

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	0.8	1.0	0.8	1.0

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	182.0	180.0	182.0	180.0

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Control System: UNIC



WinGD X62DF-2.1 (with iCER)

Cylinder bore	620 mm
Piston stroke	2658 mm
Speed	80-103 rpm
Mean effective pressure at R1	17.3 bar

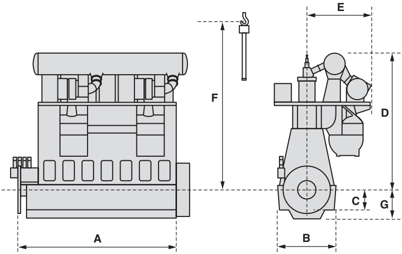
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	103 rpm		80 rpm			
	R1	R2	R3	R4		
5	11 925	9 925	9 250	7 700	6 805	318
6	14 310	11 910	11 100	9 240	7 910	370
7	16 695	13 895	12 950	10 780	9 020	428
8	19 080	15 880	14 800	12 320	10 125	475
Dimensions mm	B	C	D		F*	G
	4 200	1 360	9 580		11 775	2 110

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	138.8	133.9	140.9	135.9

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	1.0	1.2	1.0	1.2

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	178.3	172.3	180.3	176.3

* Standard piston dismantling height can be reduced with tilted piston withdrawal.
* Control System: WiCE



WinGD X62DF-1.1

Cylinder bore	620 mm
Piston stroke	2658 mm
Speed	80-103 rpm
Mean effective pressure at R1	17.3 bar

Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight 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	B	C	D		F*	G
mm	4 200	1 360	9 580		11 775	2 110

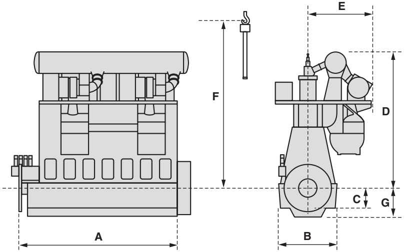
Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	142.5	137.5	144.5	139.5

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	1.0	1.2	1.0	1.2

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	182.0	180.0	182.0	180.0

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Control System: UNIC



WinGD X62DF-S2.0 (with iCER)

Cylinder bore	620 mm
Piston stroke	2245 mm
Speed	82-108 rpm
Mean effective pressure at R1	17.3 bar

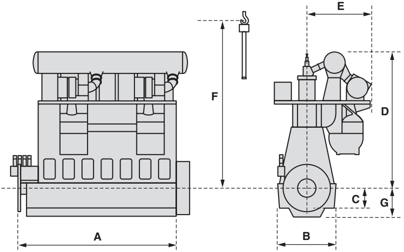
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	108 rpm		82 rpm			
	R1	R2	R3	R4		
5	10 550	8 775	8 000	6 675	6 260	280
6	12 660	10 530	9 600	8 010	7 260	325
7	14 770	12 285	11 200	9 345	8 260	370
8	16 880	14 040	12 800	10 680	9 260	415
Dimensions	B	C	D		F*	G
mm	3 440	1 295	8 575		10 300	1 835

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	138.8	133.9	140.9	135.9

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	1.0	1.2	1.0	1.2

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	178.3	172.3	180.3	176.3

* Standard piston dismantling height can be reduced with tilted piston withdrawal.
* Control System: WiCE



WinGD X62DF-S1.0

Cylinder bore	620 mm
Piston stroke	2245 mm
Speed	82-108 rpm
Mean effective pressure at R1	17.3 bar

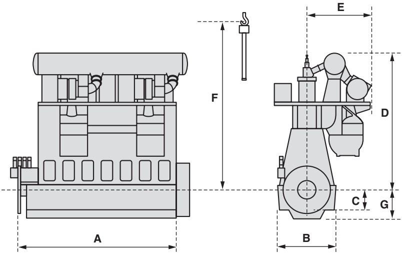
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	108 rpm		82 rpm			
	R1	R2	R3	R4		
5	10 550	8 775	8 000	6 675	6 260	280
6	12 660	10 530	9 600	8 010	7 260	325
7	14 770	12 285	11 200	9 345	8 260	370
8	16 880	14 040	12 800	10 680	9 260	415
Dimensions	B	C	D		F*	G
mm	3 440	1 295	8 575		10 300	1 835

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	142.4	137.5	144.5	139.5

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	1.0	1.2	1.0	1.2

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	182.0	180.0	182.0	180.0

* Standard piston dismantling height can be reduced with tilted piston withdrawal.
* Control System: WiCE



WinGD X52DF-2.1 (with iCER)

Cylinder bore	520 mm
Piston stroke	2315 mm
Speed	79-105 rpm
Mean effective pressure at R1	17.3 bar

Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight 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	B	C	D		F*	G
mm	3 514	1 205	8 415		10 350	1 910

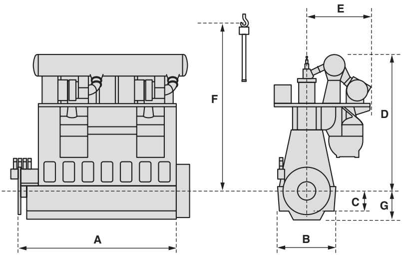
Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	140.1	135.1	142.1	137.1

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	1.5	1.8	1.5	1.8

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	181.4	175.4	183.4	179.4

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* Control System: WiCE



WinGD X52DF-1.1

Cylinder bore	520 mm
Piston stroke	2315 mm
Speed	79-105 rpm
Mean effective pressure at R1	17.3 bar

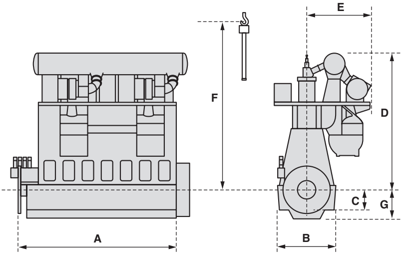
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	105 rpm		79 rpm			
	R1	R2	R3	R4		
5	7 450	6 200	5 600	4 650	5 985	217
6	8 940	7 440	6 720	5 580	6 925	251
7	10 430	8 680	7 840	6 510	7 865	288
8	11 920	9 920	8 960	7 440	8 805	323
Dimensions mm	B	C	D		F*	G
	3 514	1 205	8 415		10 350	1 910

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	142.7	137.7	144.7	139.7

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	1.5	1.8	1.5	1.8

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	184.1	182.1	184.1	182.1

* Standard piston dismantling height can be reduced with tilted piston withdrawal.
* Control System: UNIC



WinGD X DF Engine

WinGD X-DF series

Engine Type	DU-WinGD 8X52DF	
Cylinder Bore (mm)	520	
Piston Stroke (mm)	2,315	
Rating Point	R1	R4
Speed (rpm)	105	79
Power (kW)	11,920	7,440
Number of Cylinders	8	

WinGD X52DF-S2.0 (with iCER)

Cylinder bore	520 mm
Piston stroke	2045 mm
Speed	85-120 rpm
Mean effective pressure at R1	17.3 bar

Rated power, principal dimensions and weights

Cyl.	Output in kW at				Length A mm	Weight tonnes
	120 rpm		85 rpm			
	R1	R2	R3	R4		
5	7 500	6 250	5 325	4 425	5 485	190
6	9 000	7 500	6 390	5 310	6 345	215
7	10 500	8 750	7 455	6 195	7 205	245
8	12 000	10 000	8 520	7 080	8 065	275
Dimensions	B	C	D		F*	G
mm	3 100	1 185	7 725		9 340	1 675

Brake specific gas consumption (BSGC) in g/kWh

Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	140.1	135.1	142.1	137.1

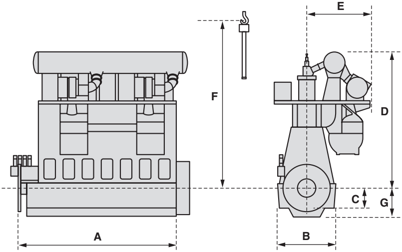
Brake specific pilot fuel consumption (BSPC) in g/kWh

Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	1.5	1.8	1.5	1.8

Brake specific fuel consumption (BSFC) in g/kWh

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

* Standard piston dismantling height can be reduced with tilted piston withdrawal.
* Control System: WiCE



WinGD X52DF-S1.0

Cylinder bore	520 mm
Piston stroke	2045 mm
Speed	85-120 rpm
Mean effective pressure at R1	17.3 bar

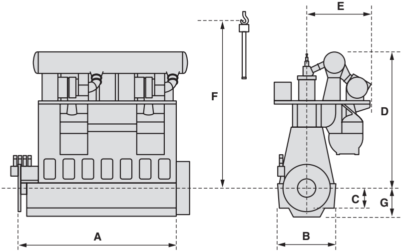
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	120 rpm		85 rpm			
	R1	R2	R3	R4		
5	7 500	6 250	5 325	4 425	5 485	190
6	9 000	7 500	6 390	5 310	6 345	215
7	10 500	8 750	7 455	6 195	7 205	245
8	12 000	10 000	8 520	7 080	8 065	275
Dimensions	B	C	D		F*	G
mm	3 100	1 185	7 725		9 340	1 675

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	142.7	137.7	144.7	139.7

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	1.5	1.8	1.5	1.8

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	184.1	182.1	184.1	182.1

* Standard piston dismantling height can be reduced with tilted piston withdrawal.
* Control System: WiCE



WinGD RT-flex50DF

Cylinder bore	500 mm
Piston stroke	2050 mm
Speed	99-124 rpm
Mean effective pressure at R1	17.3 bar

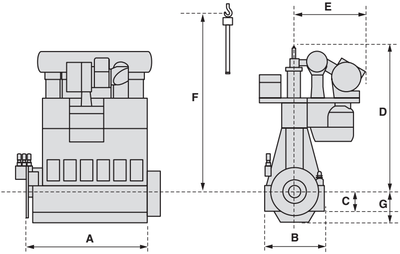
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	124 rpm		99 rpm			
	R1	R2	R3	R4		
5	7 200	6 000	5 750	4 775	5 576	200
6	8 640	7 200	6 900	5 730	6 456	225
7	10 080	8 400	8 050	6 685	7 336	255
8	11 520	9 600	9 200	7 640	8 216	280
Dimensions mm	B	C	D		F*	G
	3 150	1 088	7 646		9 270	1 636

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	142.7	137.7	144.7	139.7

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	1.5	1.8	1.5	1.8

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	184.1	182.1	184.1	182.1

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

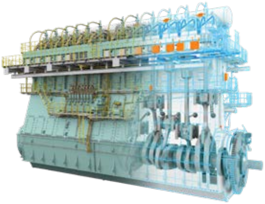


次世代燃料エンジン

Future Fuel Engine (Methanol / Ammonia)

ライセンサーである Winterthur Gas & Diesel (WinGD) は，次世代燃料エンジンに対応するために、従来のディーゼルに加えてメタノール／アンモニア噴射システムを有する“X-DF-M”および“X-DF-A”を開発しております。これらの新開発エンジンは、WinGD エンジンの特長であるコモンレール方式を踏襲しており、ディーゼル焚きモードのみならずメタノール／アンモニア焚きモードにおいても低燃費を実現しています。

In order to comply with the next-generation fuel engine, our licensor, Winterthur Gas & Diesel (WinGD) is developing the “X-DF-M” and “X-DF-A” engines having methanol/ammonia injection system in addition to conventional diesel engine. The developing engines follow the common-rail system, which is known as one of WinGD's key features, and achieve the low fuel consumption not only in diesel mode but also in methanol/ammonia mode.



これらエンジンの中で、アンモニア焚きエンジンとしては X52DF-A を 2024 年末に、メタノール焚きエンジンとしては X92DF-M を 2025 年中頃に、造船所に納入する予定です。今後、需要に合わせて他のボアサイズのエンジンの開発をすすめていく予定です。

Among those engines, the ammonia fuel engine X52DF-A and the methanol fuel engine X92DF-M will be shipped from engine builder respectively at the end of 2024 and the middle of 2025. In the future, WinGD would proceed with the development of engine having other size of bore in accordance with market's demand.

パイロット油は MGO、MDO を使用します。
一部機種には NOx 削減のため iSCR もオプションにて準備しています。

MGO and MDO are used as pilot fuel.
iSCR is also available for some engine models as an option in order to reduce NOx.

メタノール/アンモニア焚二元燃料機関名称規則
Methanol/Ammonia Fueled Engine Designation

7X52DF-M-S1.0

- Revision level, based on new design features
- Technology level
- S: Short-stroke or P: Power generation or others to be defined
- Fuel type application
  M: Methanol
  A : Ammonia
  Blank: Others
- Fuel designation
  DF: Dual-fuel
  Blank: Standard engine
- Bore size
- Engine type
- Number of cylinders

LOW-SPEED LOW-PRESSURE

X-DF

DUAL-FUEL ENGINE

DU – WinGD
Low Speed 2-stroke Engines

メタノール焚き二元燃料機関
Methanol Dual Fuel Engines

WinGD X92DF-M-1.0

Cylinder bore	920 mm
Piston stroke	3468 mm
Speed	70-80 rpm
Mean effective pressure at R1	21.0 bar

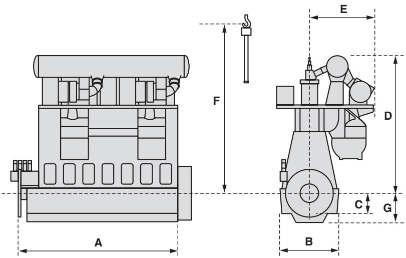
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	80 rpm		70 rpm			
	R1	R2	R3	R4		
6	38 700	27 900	33 900	24 420	11 755	1 176
7	45 150	32 550	39 550	28 490	13 345	1 323
8	51 600	37 200	45 200	32 560	14 935	1 449
9	58 050	41 850	50 850	36 630	17 960	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	B	C	D		F*	G
mm	5 550	1 900	13 150		15 640	2 970

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	327.3	314.6	325.1	316.8

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	8.0	8.0	8.0	8.0

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	163.8	157.8	162.8	158.8

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WinGD X82DF-M-1.0

Cylinder bore	820 mm
Piston stroke	3375 mm
Speed	58-84 rpm
Mean effective pressure at R1	22.0 bar

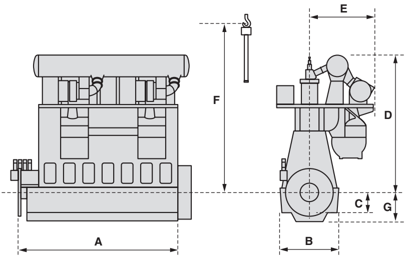
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	84 rpm		58 rpm			
	R1	R2	R3	R4		
6	33 000	24 000	22 800	16 560	10 426	845
7	38 500	28 000	26 600	19 320	11 866	956
8	44 000	32 000	30 400	22 080	13 306	1 071
9	49 500	36 000	34 200	24 840	14 746	1 218
Dimensions	B	C	D		F*	G
mm	5 050	1 800	12 310		15 250	2 700

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	332.2	321.5	324.1	318.3

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	8.2	8.2	8.2	8.2

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	166.3	161.2	162.5	159.7

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WinGD X72DF-M-1.0

Cylinder bore	720 mm
Piston stroke	3086 mm
Speed	69-89 rpm
Mean effective pressure at R1	21.0 bar

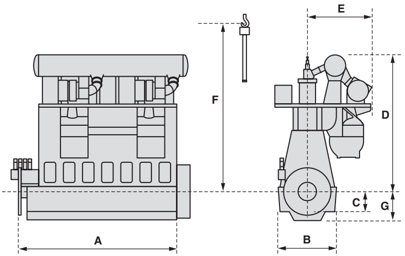
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	89 rpm		69 rpm			
	R1	R2	R3	R4		
5	19 600	14 300	14 550	10 600	8 085	505
6	23 520	17 160	17 460	12 720	9 375	589
7	27 440	20 020	20 370	14 840	10 665	674
8	31 360	22 880	23 280	16 960	11 960	752
Dimensions mm	B	C	D		F*	G
	4 780	1 575	10 790		13 750	2 455

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	336.4	325.4	334.4	325.4

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	8.7	8.4	8.6	8.4

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	168.8	163.3	167.8	163.3

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WinGD X DF Engine

WinGD X62DF-M-1.0

Cylinder bore	620 mm
Piston stroke	2658 mm
Speed	77-103 rpm
Mean effective pressure at R1	21.0 bar

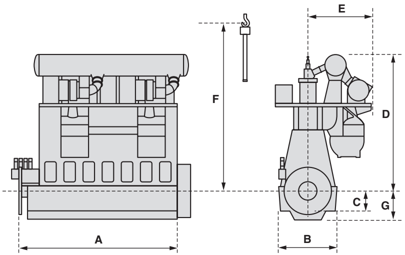
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	103 rpm		77 rpm			
	R1	R2	R3	R4		
5	14 500	10 650	10 800	7 950	7 000	341
6	17 400	12 780	12 960	9 540	8 110	396
7	20 300	14 910	15 120	11 130	9 215	457
8	23 200	17 040	17 280	12 720	10 320	506
Dimensions mm	B	C	D		F*	G
	4 200	1 360	9 580		11 830	2 110

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	336.4	325.4	334.4	325.4

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	8.7	8.4	8.6	8.4

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	168.8	163.3	167.8	163.3

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WinGD X62DF-M-S1.0

Cylinder bore	620 mm
Piston stroke	2245 mm
Speed	82-108 rpm
Mean effective pressure at R1	22.0 bar

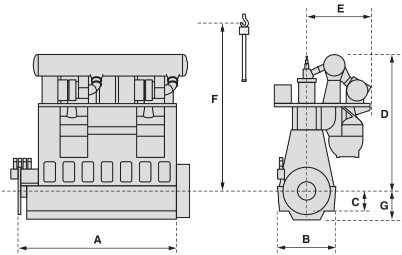
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	108 rpm		82 rpm			
	R1	R2	R3	R4		
5	13 425	9 650	10 200	7 325	6 260	294
6	16 110	11 580	12 240	8 790	7 260	341
7	18 795	13 510	14 280	10 255	8 260	389
8	21 480	15 440	16 320	11 720	9 260	436
Dimensions	B	C	D		F*	G
mm	3 440	1 295	8 575		10 230	1 835

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	328.4	318.5	324.4	320.4

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	8.5	8.2	8.4	8.3

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	164.8	159.8	162.8	160.8

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WinGD X52DF-M-S1.0

Cylinder bore	520 mm
Piston stroke	2045 mm
Speed	85-120 rpm
Mean effective pressure at R1	22.0 bar

Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	120 rpm		85 rpm			
	R1	R2	R3	R4		
5	9 550	6 850	6 775	4 850	5 485	200
6	11 460	8 220	8 130	5 820	6 345	226
7	13 370	9 590	9 485	6 790	7 205	257
8	15 280	10 960	10 840	7 760	8 065	287
Dimensions	B	C	D		F*	G
mm	3 100	1 185	7 775		9 340	1 675

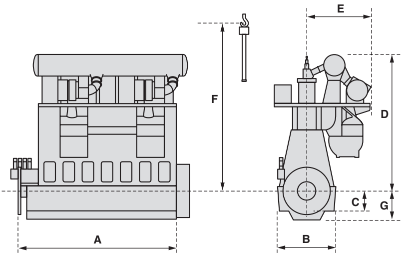
Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	328.8	316.8	326.8	322.8

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	8.5	8.2	8.4	8.3

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	164.8	158.8	163.8	161.8

* Standard piston dismantling height can be reduced with tilted piston withdrawal.

* No iSCR



WinGD X DF Engine

MES DU Website

https://www.mes.co.jp/du/

当社ウェブサイトにて、最新情報や技術資料をいつでもご覧いただけます。

The updated information and latest technical materials
on our website can be viewed at anytime.

LOW-SPEED LOW-PRESSURE

X-DF

DUAL-FUEL ENGINE

DU – WinGD
Low Speed 2-stroke Engines

アンモニア焚き二元燃料機関
Ammonia Dual Fuel Engines

WinGD X72DF-A-1.0

Cylinder bore	720 mm
Piston stroke	3086 mm
Speed	66-89 rpm
Mean effective pressure at R1	21.0 bar

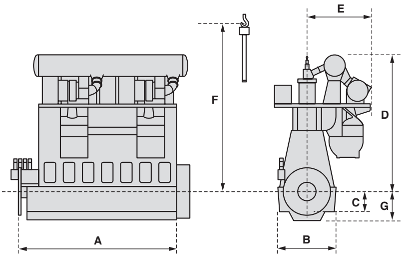
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	89 rpm		66 rpm			
	R1	R2	R3	R4		
5	19 600	14 300	14 550	10 600	8 085	505
6	23 520	17 160	17 460	12 720	9 375	589
7	27 440	20 020	20 370	14 840	10 665	674
8	31 360	22 880	23 280	16 960	11 960	752
Dimensions	B	C	D		F*	G
mm	4 780	1 575	10 790		13 750	2 455

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	368.1	355.4	365.8	355.4

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	8.5	8.5	8.5	8.5

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	168.8	163.3	167.8	163.3

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WinGD X62DF-A-1.0

Cylinder bore	620 mm
Piston stroke	2658 mm
Speed	77-103 rpm
Mean effective pressure at R1	21.0 bar

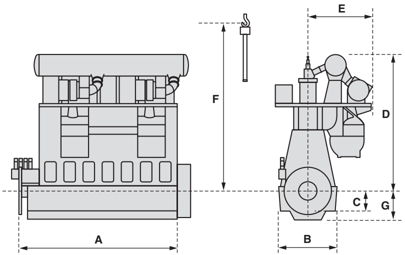
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	103 rpm		77 rpm			
	R1	R2	R3	R4		
5	14 500	10 650	10 800	7 950	7 000	341
6	17 400	12 780	12 960	9 540	8 110	396
7	20 300	14 910	15 120	11 130	9 215	457
8	23 200	17 040	17 280	12 720	10 320	506
Dimensions	B	C	D		F*	G
mm	4 200	1 360	9 580		11 830	2 110

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	367.2	355.3	365.0	355.3

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	8.9	8.6	8.8	8.6

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	168.8	163.3	167.8	163.3

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



WinGD X52DF-A-1.0

Cylinder bore	520 mm
Piston stroke	2315 mm
Speed	79-105 rpm
Mean effective pressure at R1	21.0 bar

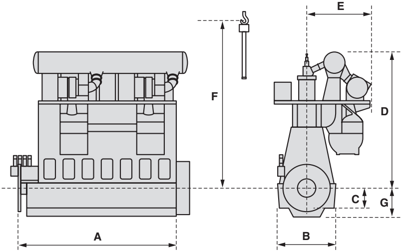
Rated power, principal dimensions and weights						
Cyl.	Output in kW at				Length A mm	Weight tonnes
	105 rpm		79 rpm			
	R1	R2	R3	R4		
5	9 050	6 800	6 800	5 100	5 985	228
6	10 860	8 160	8 160	6 120	6 925	264
7	12 670	9 520	9 520	7 140	7 865	302
8	14 480	10 880	10 880	8 160	8 805	339
Dimensions	B	C	D		F*	G
mm	3 514	1 205	8 415		10 350	1 910

Brake specific gas consumption (BSGC) in g/kWh				
Rating point	R1	R2	R3	R4
BSGC (Gas) g/kWh	371.5	355.4	371.5	355.4

Brake specific pilot fuel consumption (BSPC) in g/kWh				
Rating point	R1	R2	R3	R4
BSPC (Pilot fuel) g/kWh	9.0	9.0	9.0	9.0

Brake specific fuel consumption (BSFC) in g/kWh				
Rating point	R1	R2	R3	R4
BSFC (Diesel) g/kWh	170.8	163.8	170.8	163.8

* Standard piston dismantling height can be reduced with tilted piston withdrawal.



S.E.M.T. PIELSTICK PC MEDIUM-SPEED ENGINE

DU – S.E.M.T Pielstick
Medium and High Speed 4-stroke Diesel Engines

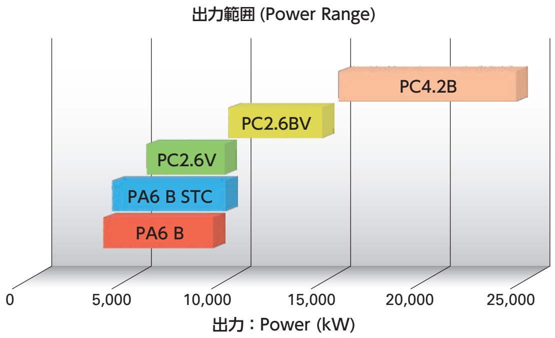
重油および軽油焚き機関
Fuel Oil Engines

出力範囲
Power range

DU-SEMT Pielstick

DU-SEMT Pielstick エンジンは、SEMT 社（現 MAN Energy Solutions 社）の開発したコンパクトかつ高出力のエンジンで、官公庁船用の主機、大きなエンジン室スペースが取れない客船、カーフェリー、RO／RO 船用の主機、そして陸上発電用の主機として活躍しています。DU は、1964 年の SEMT 社（仏）との技術提携以来、国内外で数多くの納入実績を持っております。

DU – SEMT Pielstick engine is a compact and high power engine developed by SEMT (current: MAN Energy Solutions), and is now in wide use as a main engine for government ships, assenger ships, car ferries, and RO/RO ships having difficulty in providing enough room space for a large engine. And the engine is also successfully used as a power plant's diesel generator. DU has a supply record of many engines in Japan and overseas since a technical alliance was formed with S.E.M.T. (France) in 1964.



PC & PA Engine

陸上発電

客船

官公庁船

出展：海上保安庁ホームページ

PC & PA エンジン ラインナップ
PC & PA Engine line-up

PC2.6V Engine 6,600kW to 8,800kW
Cylinder 12 to 16 / Engine speed 520min^{-1} / Cyl. Bore x stroke (mm) : 400 x 460

1982 年の販売以来、豊富な実績と根強い人気を持ち、官庁向け、フェリーや貨物船の主機関また発電所のディーゼル発電機など幅広いニーズに応える、信頼性の高いモデルです。

Since its launch in 1982, the PC2.6V has been gaining extensive experience and a strong reputation, and is a reliable model meeting a wide range of needs as the main engine for government vessels, ferries, cargo ships, and power plant's diesel generator.

PC2.6BV Engine 9,000kW to 13,500kW
Cylinder 12 to 18 / Engine speed 600min^{-1} /Cyl. Bore x stroke (mm) : 400 x 500

フェリー用・陸上発電用主機として、2004 年に販売されました。PC2.6V 型機関をベースに 高い信頼性を確保し、高出力でありながらコンパクトなエンジンです。従来モデルに比べて燃料消費率および潤滑消費率が向上しており、経済性の高いエンジンです。弊社では、2018 年にフェリー用主機関や離島の発電所のディーゼル発電機として納めました。

The PC2.6BV was launched in 2004 as a main engine for ferry and land power plant's diesel generator.

Based on the PC2.6V type engine, it ensures high reliability, and not only a high degree of power, but also compactness. Compared to the conventional model, the fuel consumption rate and the lubrication consumption rate are improved, which results in a highly economic efficient engine.

We have supplied the engines for a ferry and a remote island power plant diesel generator in 2018.

PC4.2BV Engine 15,000kW to 21,200kW
Cylinder 12 to 18 / Engine speed 428min^{-1} /Cyl. Bore x stroke (mm) : 570 x 660

1993 年に発売され、大型フェリー・RO/RO 船などの主機関や発電所の大規模なディーゼル発電機として採用されるモデルです。弊社では、2014 年に離島の発電所のディーゼル発電機として納めました。

PC4.2BV was launched in 1993 as main engine for large ferry, RO/RO ship and a large-scale of power plant's diesel generator. We have supplied the engine for a remote island power plant's diesel generator in 2014.

PC & PA Engine

PA6B STC Engine　4,860kW to 8,100kW

Cylinder 12, 16, 20 / Engine speed 1,050m^{-1} / Cyl. Bore x stroke 280mm x 330mm

PA6B STC エンジンは、回転数 1,050 rpm の高速エンジンで、最大 8,100 kW の出力を発揮します。また、小型・軽量・耐久性に優れたディーゼルエンジンで、艦船や巡視船に求められる性能特性を兼ね備えています。特に低負荷運転においては定評があり、約 20kW/cyl.（約 5% 負荷）以上の運転域ならば制限無く連続運転が可能です。

PA6B STC engine is a high-speed engine with a speed of 1,050 rpm and a maximum output of 8,100 kW. It is also a compact, lightweight, and durable diesel engine that combines the performance characteristics required for naval vessels and patrol boats. It has a particularly strong reputation for low-load operation, and can be operated continuously without restrictions in the operating range of approximately 20 kW/cyl. (approximately 5% load) or higher.

PA6B Engine　4,200kW to 7,400kW

Cylinder 12 to 20 / Engine speed 900m^{-1}, 1,000m^{-1} / Cyl. Bore x stroke 280mm x 330mm

PA6B は、回転数 1,000 rpm（50Hz）／ 900 rpm（60Hz）の高速エンジンで、最大 7,400 kW の出力を発揮します。

PA6B エンジンは燃費効率に優れ、電気推進システムに必要な大きな船内電力を効果的かつ経済的に提供します。

PA6B is a high-speed engine with a speed of 1,000 rpm (50 Hz)/900 rpm (60 Hz) and a maximum output of 7,400 kW.

PA6B engine is fuel efficient, and effectively and economically provides the large onboard power required for the electric propulsion system.

PA6B STC、PA6B エンジンともに、潤滑油ポンプ、冷却水ポンプ、燃料油ポンプ及び潤滑油冷却器、海水冷却器、潤滑油清浄機、燃料油こし器をエンジンに装備でき、ウェットサンプ式オイルパン、弾性支持も装備可能です。船内配置の上で省スペース化が可能なエンジンです。また、PA6B STC 、PA6B DG エンジンの実績としましては、世界各国の海軍で多くの艦艇や輸送船に搭載されており、日本においても艦船や巡視船への採用が期待されています。

Both PA6B STC and PA6B engines can be equipped with lubricating oil pumps, fuel oil pumps, cooling water pumps, lubricating oil cooler, sea water cooler, lubricating oil purifier and fuel oil strainer. The engine can be equipped with a wet sump oil pan and an elastic support.

PA6B STC and PA6B engines have been installed in many naval vessels and transports around the world, and are expected to be used in naval vessels and patrol boats in Japan.

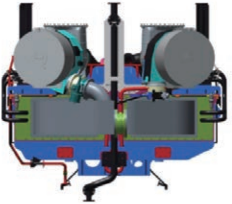
STC システム (PC2.6/PC2.6B)

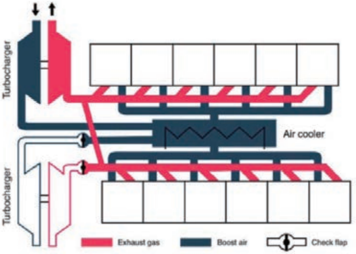
STC system

Sequential turbocharger（STC）とは、高負荷域では２つのターボチャージャーを稼働させる一方で、低負荷域においては、２つの内の１つのターボチャージャーを止めて過給効率を高めるシステムです。これにより、以下のメリットが得られます。

- 部分負荷時の燃料消費率の削減
- ターボラグの低減
- ターボチャージャーの寿命の延長

過給機２台のままで構成するシンプルな構造を持ち、長い歴史を持つ信頼性の高いシステムです。





The STC is the Sequential Turbocharger system. Only one turbocharger works at the low load operation, while the two turbochargers are used for the high load operations, which makes it possible to increase supercharging efficiency. That provides the following benefits:

- Reduction of fuel consumption rate at low load range
- Elimination of turbo lag
- Extension of turbocharger life

STC is a simple structure comprising of two turbochargers. It is highly reliable system with a long history.

PC & PA Engine

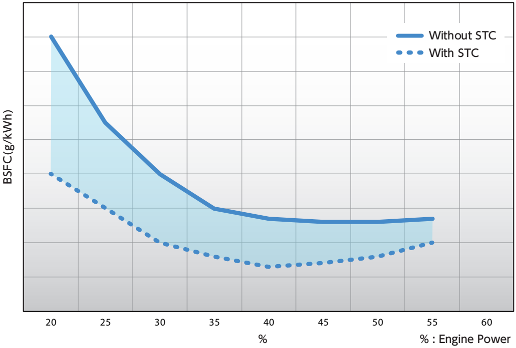
STC 搭載エンジンはすでに世界の海軍や保安庁・海岸警備隊向けの多くの船に採用されており高い信頼を得ています。

The engines with STC are already used on Navy and Coast Guard ships around the world and are highly trusted.

下記のリストは低負荷において、STC 有のエンジンと STC 無のエンジンの燃料消費量の比較を表したものです。エンジンモデルやサイズ・レーテイングによって異なりますが、20%～ 40%負荷運転において STC 有のエンジンは、STC 無のエンジンに比べて大幅な燃費削減（6 ～ 20g/kWh 減）が見られます。

The difference is 6 to 20 g/kWh during 20% to 40% load oepration.
(depending on engine type/rating)

Difference of BSFC between the engines with/without STC, example

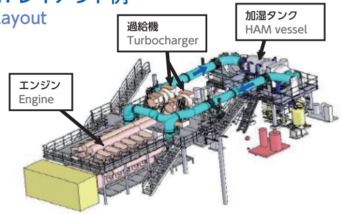


HAM システム
HAM system

排ガス中の窒素酸化物（NOx）をさらに低減し、エンジン性能を改善する実績のある技術です。陸上発電の排ガス規制に対しては、有効なシステムと考えております。

HAM system is a proven technology to enhance the engine performance by reducing NOx emission in the exhaust gas furthermore. We believe this is very effective system meeting emission regulation on the land power plant.

1. レイアウト例
Layout



HAM システムの“HAM”とは Humid Air Motor（吸気加湿装置）の頭文字をとったもので MAN Energy Solutions 社(旧 S.E.M.T. Pielstick 社）の技術です。

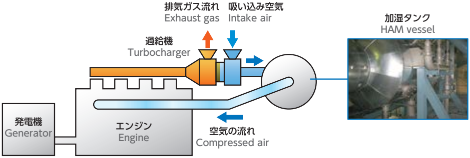
HAM is the technology of MAN Energy Solutions and stands for Humid Air Motor.

2. 原理
Principle

過給機からの高温高圧の過給空気を HAM ベッセルに通し、相対湿度 98% に上げます。水分を多く含んだ空気は通常の空気に比べ比熱が高くなるためエンジンで燃焼するときの燃焼が緩慢になりピーク温度が下がります。窒素酸化物の発生量は燃焼温度に比例するため、窒素酸化物の発生を低減させる効果を発揮します。

HAM ベッセルでの加湿時は蒸発水分が空気から蒸発潜熱を奪い空気温度を低下させるため、空気冷却器を省略することができます。

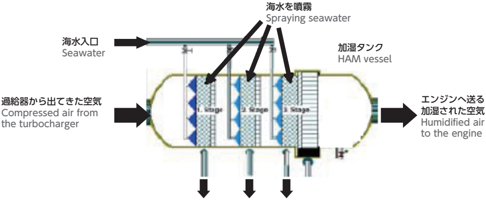
The compressed air from the turbocharger under high temperature and pressure is passed through HAM vessel where the relative humidity shall be increased up to 98%. The higher humidified air effect is a drop in peak combustion temperature in the combustion chamber. Since the amount of NOx emission created is in proportion to the combustion temperature, HAM system shows effectiveness in inhibiting the creation of NOx emission. On the HAM system, air cooler could be eliminated, because evaporated moisture tends to remove latent heat of vaporization from air during humidified operation of HAM system, which leads to decrease of air temperature.



3. 加湿タンク (HAM ベッセル) の構造
Structure of Humidification tank (HAM vessel)

エンジンに送る空気に水を噴霧することにより加湿する装置です。
蒸発水分で加湿を行うため、加湿用水として海水が使用できます。

HAM vessel is a humidifying device to atomize the water into the air to be sent to the engine. Sea water is acceptable as water for humidification, since it humidifies with the evaporative water.



4. 窒素酸化物低減効果 (理論値)
NOx Reduction Effect (Theoretical value)

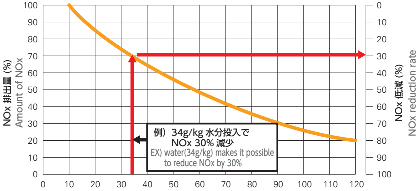
低減効果はエンジンに送られる空気に添加された水分量により決まり、理論的には下記カーブとなります。添加する水分量は HAM ベッセル出口の空気の絶対湿度を変化させる事で行います。ここに記載の低減率はその時点で排出している量からの数字であり、エンジンのチューニング変更を併せて行った場合などは、ここで示した低減率とは異なります。

The effectiveness of reducing NOx depends on the water amount added in the air to be sent to the engine, and shows as curve in the graph below theoretically.

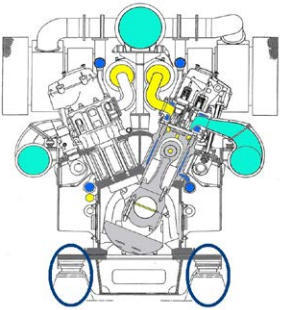
Water amount, to be added, is controlled by variation of the absolute humidity in the air at an outlet of the HAM vessel.

The NOx reduction rate described below is the value calculated on the basis of the amount of exhaust at that time, but is different from the value calculated under the change of engine tuning.

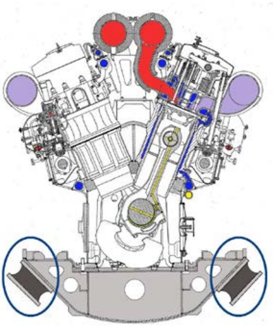
NOx と水分の影響
Correlation between NOx and water amount



弾性支持（オプション）
Elastic mount (Option)



垂直支持方式
Vertical support type



斜め支持方式
Slanting support type

船体または基礎に伝わる振動を大幅に低減できます。
垂直支持方式、斜め支持方式の２つの支持方式を準備しています。
垂直支持方式は据付が容易でメンテナンス性に優れており、防振性能は斜め支持方式の方が優れます。

Elastic mount can reduce greatly vibration to transmit the hull or the foundation.
The support is available in two types; a vertical support and a slanting support.

- The vertical support type is easy to install and has better maintainability.
- The slanting support type provides superior vibration reduction performance.

舶用向け・陸上発電向けエンジン 要目

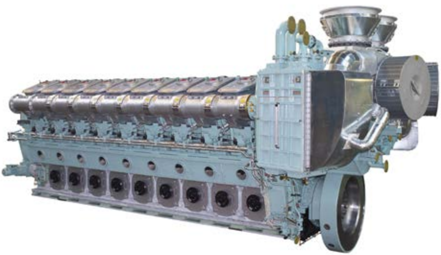
Engine specifications for marine propulsion and power plant generator

PC2.6V / PC2.6BV

		Engine model		PC2.6V			PC2.6BV			
		Number of cylinder		12	14	16	12	14	16	18
		Cyl. Bore × stroke	mm	400 x 460			400 x 500			
Main Engine for Marine	M.C.R.	Output	kW	6,600	7,700	8,800	9,000	10,500	12,000	13,500
			(PS)	8,970	10,470	11,960	12,240	14,280	16,320	18,350
		Engine speed	rpm	520			600			
		B.M.E.P.	MPa(bar)	2.19			2.39			
		Piston speed	m/s	7.97			10			
	N.O.R.	Output	kW	5,610	6,545	7,480	7,650	8,925	10,200	11,475
			(PS)	7,625	8,900	10,166	10,404	12,138	13,872	15,598
		Engine speed	rpm	493			568			
		B.M.E.P.	MPa(bar)	1.97			2.14			
		Piston speed	m/s	7.55			9.47			
Generating Set	50 /60 Hertz	Engine output	kW	-	-	-	8,100	9,450	10,800	12,150
		Generator output	kW	-	-	-	7,857	9,167	10,476	11,786
		Engine speed	rpm				600			
		B.M.E.P.	MPa				2.15			
		Piston speed	m/s				10			

N.O.R. shows 85% load of M.C.R

Starting system	Compressed air	
Cooling system	Cylinder Jacket : Fresh water	Piston : Lub. Oil
	Fuel valve : Fresh water	Air cooler: Fresh water or Sea water
Engine driven pump (Option)	Lubricating oil pump	
	High temperature cooling water pump	
Fuel oil	Diesel oil and / or Heavy fuel oil	



PC4.2BV

	Engine model			PC4.2BV			
	Number of cylinder			12	14	16	18
	Cyl. Bore × stroke		mm	570 x 660			
Main Engine for Marine	M.C.R.	Output	kW	15,900/15,000	18,550/17,500	21,200/20,000	-
			(PS)	21,620/20,390	25,220/23,790	28,820/27,190	-
		Engine speed	rpm	428			
		B.M.E.P.	MPa(bar)	2.20/2.08			
		Piston speed	m/s	9.4			
	N.O.R.	Output	kW	13,515/12,750	15,768/14,875	18,020/17,000	-
			(PS)	18,377/17,332	21,437/20,222	24,497/23,112	-
		Engine speed	rpm	405			
		B.M.E.P.	MPa(bar)	1.98/1.87			
		Piston speed	m/s	8.9			
Generating Set	50 Hertz	Engine output	kW	14,310/13,440	16,695/15,680	19,080/17,920	21,465
		Generator output	kW	13,880/13,037	16,190/15,210	18,505/17,382	20,820
		Engine speed	rpm	428			
		B.M.E.P.	MPa	1.98/1.86			
		Piston speed	m/s	9.4			
	60 Hertz	Engine output	kW	13,500/12,840	15,750/14,980	18,000/17,120	20,250
		Generator output	kW	13,095/12,455	15,275/14,531	17,460/16,936	19,642
		Engine speed	rpm	400			
		B.M.E.P.	MPa	2.00/1.90			
		Piston speed	m/s	8.8			

Engine output 欄内の右列記載値は高効率仕様を表します。

The values of engine outputs shown on the right side in each column are for the optimized efficiency spec.

N.O.R. shows 85% load of M.C.R

注）上記の出力は
- 周囲温度 25℃、大気圧 0.1MPa（760 mm Hg)
- 冷却水温度 25℃
- 排ガス排圧 2.45KPa (250mmAq) の場合を示します。
- プラントの運転負荷、時間等の諸条件によっては最大出力を制限せざる得ない場合がございます。
- 発電機出力は発電効率を 97%として計算しています。
- ご不明の点は、弊社営業部又は技術部にお問い合わせください。

Remarks

The value above is based on the following conditions;
- Ambient temp. 25℃, Atmospheric press 0.1MPA 760 mmHg)
- Cooling sea water temp. 25℃ .
- Exhaust back pressure 2.45kPa (250mmAq.)
- The maximum power mentioned above is subject to limits depending on operating load and time etc.
- The generator efficiency 97%
- For more information, please contact our Sales department or technical department.

船用向けエンジン 要目

Engine specifications for marine propulsion

PA6B STC / PA6B

					PA6B STC		
	Engine model				PA6B STC		
	Number of cylinder				12	16	20
	Cyl. Bore × stroke			mm	280 x 330		
Main Engine for Marine	M.C.R.	Output		kW	4,860	6,480	8,100
				(PS)	6,630	8,800	11,045
		Engine speed		rpm	1,050		
		B.M.E.P.		MPa(bar)	2.28		
		Piston speed		m/s	11.5		
	N.O.R.	Output		kW	4,131	5,593	6,885
				(PS)	5,636	7,625	9,388
		Engine speed		rpm	995		
		B.M.E.P.		MPa(bar)	2.07		
		Piston speed		m/s	10.9		

				PA6B			
	Engine model			PA6B			
	Number of cylinder			12	16	18	20
	Cyl. Bore × stroke		mm	280 x 330			
GenSet for Electric Propulsion	Frequency 60Hz	Output	kW	4,200	5,600	6,300	7,000
			(PS)	4,074	5,432	6,111	6,790
		Engine speed	rpm	900			
		B.M.E.P.	MPa(bar)	2.30			
		Piston speed	m/s	9.9			
	Frequency 50Hz	Output	kW	4,440	5,920	6,660	7,400
			(PS)	4,307	5,742	6,460	7,178
		Engine speed	rpm	1,000			
		B.M.E.P.	MPa(bar)	2.18			
		Piston speed	m/s	11.0			

注）上記の出力は

- 周囲温度 25℃、大気圧 0.1MPa（760 mm Hg)
- 冷却水温度 25℃
- 排ガス排圧 2.45KPa (250mmAq) の場合を示します。
- プラントの運転負荷、時間等の諸条件によっては最大出力を制限せざる得ない場合がございます。
- PA6B は発電周波数 60Hz を想定した仕様です
- ご不明の点は、弊社営業部又は技術部にお問い合わせください。

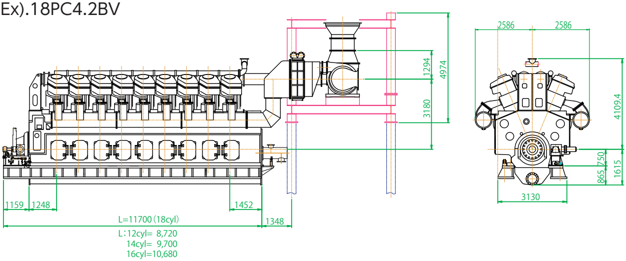
Remarks

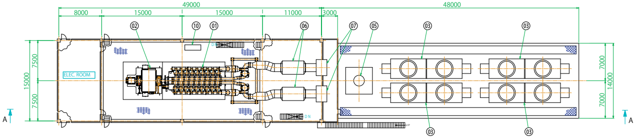
The value above is based on the following conditions;

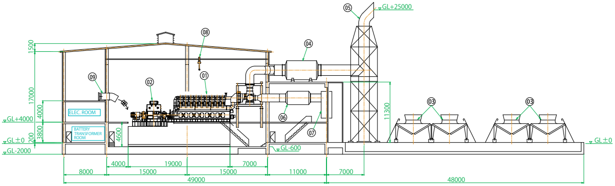
- Ambient temp. 25℃ , Atmospheric press 0.1MPA (760 mmHg)
- Cooling sea water temp. 25℃ .
- Exhaust back pressure 2.45kPa (250mmAq.)
- The maximum power mentioned above is subject to limits depending on operating load and time etc.
- PA6 B : The principal is considered in 60Hz of generating frequency
- For more information, please contact our Sales department technical department.

陸発向け配置
Generation layout for power plant

Ex).18PC4.2BV



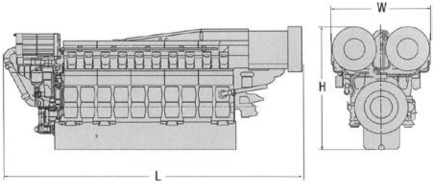




A-A

No.	DESCRIPTION	QTY	APPROX. WEIGHT kg/1UNIT
1	DIESEL ENGINE (18PC4.2B)	1	330000
2	GENERATOR	1	120000
3	COOLING WATER / LUBE OIL RADIATOR	4	
4	EXHAUST GAS SILENCER	1	12400
5	STACK	1	
6	INTAKE AIR SILENCER	2	8000
7	INTAKE AIR FILTER	2	4000
8	CRANE (5 ton)	1	
9	VENTLATION FAN	2	
10	INSTRUMENT PANEL	1	300

寸法・重量
Dimensions and weight



PC2.6V	DIMENSION (mm)				WEIGHT (ton) *2
	L	H	W	ピストン抜き高さ *1	
12PC2.6V	8,401	3848	3,322	3,510	78
14PC2.6V	9,141	3848	8,280	3,510	86
16PC2.6V	10,306	4163	9,205	3,510	95

PC2.6BV	DIMENSION (mm)				WEIGHT (ton) *2
	L	H	W	ピストン抜き高さ *1	
12PC2.6BV	8,350	4,794	4,574	2,831	100
14PC2.6BV	9,090	4,794	4,574	2,831	110
16PC2.6BV	9,800	4,794	4,574	2,831	120
18PC2.6BV	10,500	4,794	4,574	2,831	130

PC4.2BV	DIMENSION (mm)				WEIGHT (ton) *2
	L	H	W	ピストン抜き高さ *1	
12PC4.2BV	12,228	5,725	5,642	3,660	258
14PC4.2BV	13,208	5,725	5,642	3,660	295
16PC4.2BV	14,188	5,725	5,642	3,660	325
18PC4.2BV	15,168	5,725	5,642	3,660	355

PA6 B STC	DIMENSION (mm)				WEIGHT (ton) *2
	L	H	W	ピストン抜き高さ *1	
12PA6 B STC	6,035	3,170	2,444	2,000	31
16PA6 B STC	6,948	3,170	2,444	2,000	37
20PA6 B STC	8,167	3,620	2,714	2,000	43

PA6 B	DIMENSION (mm)				WEIGHT (ton) *2
	L	H	W	ピストン抜き高さ *1	
12PA6 B	5225	2850	2866	2400	28
16PA6 B	6005	2850	2866	2400	37
18PA6 B	6465	2850	2866	2400	42
20PA6 B	6925	2850	2866	2400	46

注)
*1. ピストン抜き高さは要具吊上げ位置を示す。
*2. 過給機・空気冷却器ユニットを含む重量です。

Remarks
*1. Piston overhaul height indicates lifting piston of tool.
*2. The weight also inclueldes the turbo-charger and air-cooler

相生工場
Aioi Factory

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5292, Aioi, Aioi-shi, Hyogo 678-0041, Japan

部品センター
倉庫

機械工場

組立工場

Class NK CMAXS LC-A

ClassNK CMAXS LC-A (Digital Solution)

ClassNK コンサルティングサービスとの共同によって LC-A を発展させ、CMAXS LC-A を統合サポートプラットフォームとし、船内にある各機器の一元管理を可能としました。

CMAXS LC-A is developed based on LC-A support system together with Class NK Consulting Service. It can manage machines on board as the integrated platform.

特長
Features

1. 船内の各機器に対して CMAXS LC-A の機能 (状態診断、トラブルシューティング、保守管理など) を適用可能。これにより、機器毎に異なるシステムを導入する必要がありません。

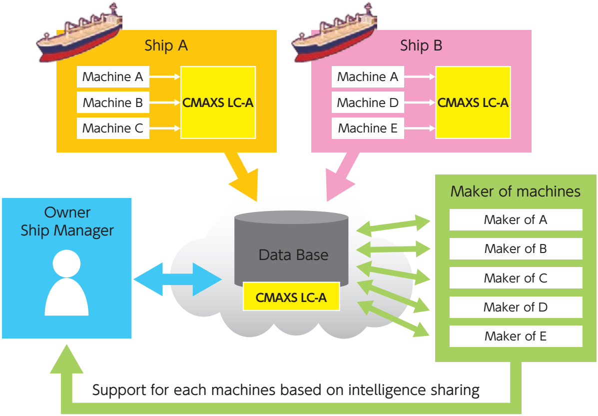
   Each machine can apply CMAXS LC-A functions (condition diagnosis, trouble shooting, maintenance management etc). It is not necessary to introduce the different system depending on machine.

2. 各船の情報は陸上のサーバーにて一括管理されます。

   All data from the ship is stored in management server at shore side.

3. 船主 / 管理会社と機器メーカーが情報を共有することで円滑かつ的確なサポートを可能とします。

   Smooth and accurate support is achieved by intelligence sharing between owner/ship manager and manufactures.

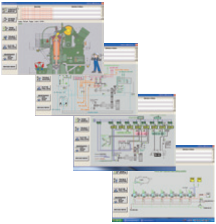


ClassNK CMAXS LC-A

1. 保守管理と予防保全
Condition Based Maintenance & Preventive Maintenance

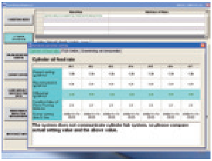
- 自動状態診断システムは、関連する測定結果、検査結果に基づき状態指数を算出します。
  Automatic condition diagnosis system calculates Condition index by related measurements and inspection results according to developed logic.
- 状態指数がある値を超えた場合、警告を示すと同時に、トラブルシューティングのためにエキスパート・システムに情報を送ります。
  If Condition index is over the certain value, the system shows warning on PC screen and sends the information to Expert system for troubleshooting.
- 状態指数は、予防保全システムと保守管理システムからも参照し、オーバーホールの時期や検査の最適化にも使用されます。
  Condition index is sent to Preventive maintenance system and Maintenance management system for optimization of inspection or overhaul timing.

自動状態診断
Automatic condition diagnosis



2. 最適オペレーションの設定
Condition Based Optimum Operation Setting

- 自動状態診断システムは、各部の状態指数を算出します。
  Automatic condition diagnosis system calculates Condition index of each part.
- 最適運転システムは算出された状態指数などに基づき、注油率や燃料噴射タイミングなどの最適設定値 を算出します。
  Optimized operation system calculates and shows optimum value of each settings, according to Condition indexes and developed logic.



予防保守
Preventive maintenance

- 傾向診断
  Trend diagnosis
- メンテナンス予測
  Maintenance prediction
- その他
  Etc.

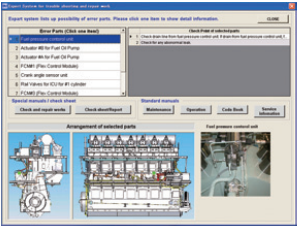
最適なオペレーション
Optimized operation

- 最適なシリンダ注油量
  Optimum cylinder oil feed rate
- 最適な噴射時期
  Optimum injection timing
- その他
  Etc.

3. トラブルシューティング
Troubleshooting

- エキスパートシステムは異常情報を検知すると、各種測定値などの情報に基づき、自動的に推定故障部品、要因をリストアップします。
  When Expert system receives information of abnormality, then it lists up estimated failure parts and factor automatically.
- 推定故障部品、要因が何処であるかをイラスト上に示すとともに、その写真を表示します。
  Expert system indicates where the parts are installed on engine with picture.
- 対応するチェックと復旧作業のための作業要領書を抽出、表示します。
  Expert system shows special instructions for checking and recovery work.
- 対応する取扱説明書、コードブックを抽出、表示します。
  Expert system shows relative instruction manuals and code book, too.

迅速な復旧 Quick recovery

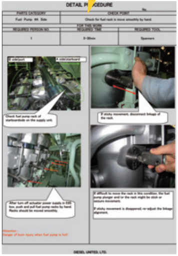


エキスパートシステム
Expert system

- トラブルシューティング
  Troubleshooting
- 修理方法
  How to repair
- その他
  Etc.

多くの写真付きで、
非常に分かりやすくした要領書
Very plain instruction with many pictures

通常の取扱説明書
Related standard instruction, code book, etc.



チェックと復旧作業のための作業要領書
Special instructions for checking and recovery work

4. 保守管理
Maintenance Management

1. 保守管理システムで管理するもの
Managing following information

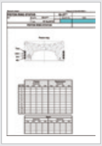
- 保守、検査スケジュール
  Maintenance and inspection schedule
- 保守、検査結果とレポート作成補助、履歴管理
  Inspection results and reports
- その他 Etc.

2. 保守管理システムで得られる情報
Showing following information

- 保守作業による消耗部品
  Consumable parts by maintenance work
- 関連する取扱説明書、コードブックなど
  Related instructions, code book, etc.

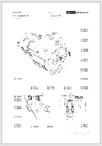
作業に必要な情報を 自動抽出
Distiling related instructions for work

Check Sheet
Report Sheet



Instruction

Code book

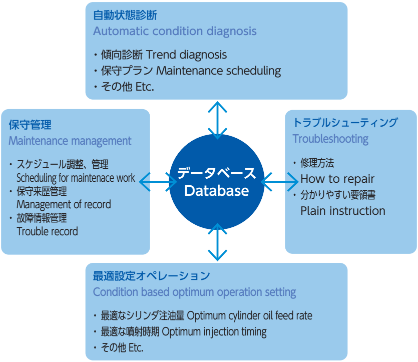


Consumable
parts list

作業時間・人数
Manpower
Etc.

5. 各機能の連携
Seamless Combination

- 各機能は単一のデータベースにて情報を共有しており、各機能のシームレスな連携が確立されています。
  As for each function, information is shared by a data base, and seamless cooperation of each function can be established.
- 容易な操作で的確な情報を提示します。
  The accurate information can be shown by an easy operation.



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