MITSUI E&S

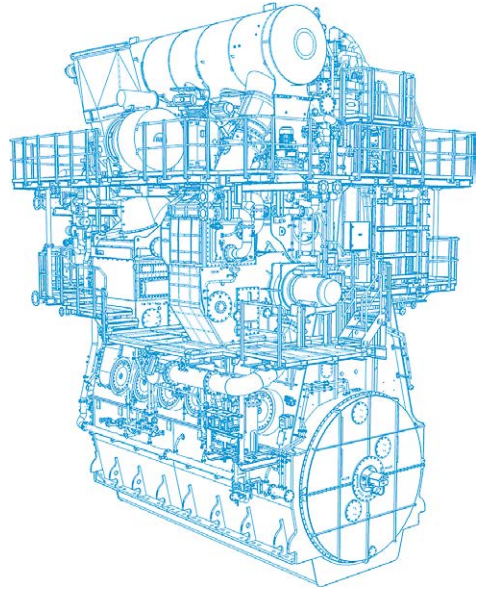
MITSUI-MAN B&W

MITSUI-MAN B&W TWO-STROKE MARINE DIESEL ENGINE ME Program 2019

MITSUI E&S
Mitsui E&S Machinery Co., Ltd.

TWO-STROKE MARINE DIESEL ENGINE

ME Program 2019



Mitsui E&S Machinery Co., Ltd. http://www.mes.co.jp

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累計生産 1億馬力への歩み

三井-MAN B&W ディーゼル機関

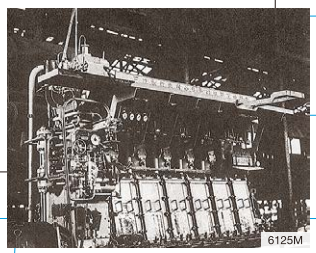
MITSUI-MAN B&W Diesel Engine History of 100 million Horsepower Production

三井E&Sマシナリーは、国内企業として初めて単一ブランドのディーゼル機関生産「累計一億馬力」を達成しました。1928年の1号機以来90年間のご愛顧に感謝し、世界トップメーカーとしての責任を今後も果たしてまいります。

Mitsui E&S Machinery is the first Japanese company to achieve single-brand diesel engine production "total 100 million horsepower." We thank you for your patronage for 90 years since the first engine in 1928, and will continue to fulfill our responsibilities as the world's top manufacturer.

1億馬力達成
2018
2015
次は2億馬力へ
8,000万馬力達成(2012)

三井-B&W ディーゼル機関 1号機
1st Mitsui-B&W diesel engine

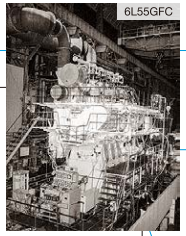


MC形機関1番機
1st MC type engine

二元燃料機関の連続製造
Continuous production of dual fuel engine utilizing methanol, LNG and ethane

5,000万馬力達成(2005)
2004

Tier III EGR適用1番機
1st Tier III engine with EGR



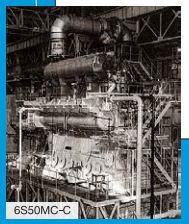
静圧過給方式導入
Introducing constant pressure turbocharging

1983
1978
1,000万馬力達成(1976)

Japan's 1st engine with turbocharger
日本初の過給機付

1997
3,000万馬力達成(1997)

世界初S-MC-C形
World's 1st S-MC-C type engine



初の電子制御機関
1st Mitsui-MAN B&W electronically controlled engine

1928 1953 1960 1970 1980 1990 2000 2010 2020

環境規制最前線

Summary of Environmental Regulation

国際海事機関（IMO）による環境規制は段階的に強化されており、機関の選択は規制に合わせることから始まると言っても過言ではありません。窒素酸化物（NOx）、硫黄酸化物（SOx）、温室効果ガス（GHG）に対する規制の現状と、三井E&Sマシナリーのソリューションをご紹介します。

Environmental regulations by the International Maritime Organization (IMO) have been tightened by stages, and it is no exaggeration to say that the choice of engines starts with meeting regulations. The targets of environmental regulations are nitrogen oxides (NOx), sulfur oxides (SOx) and greenhouse gases (GHG), so the next section introduce Mitsui E&S Machinery's solutions for each environmental regulation.

NOx Regulation 窒素酸化物の規制

NOx規制は船舶建造年に応じて段階的に強化されています。2011年から導入されたTier Ⅱ規制は海域に関わらず達成の必要があり、Tier Ⅰ規制の約20%のNOx削減が求められます。Tier Ⅲ規制はTier Ⅰに対して約80%の削減が必要で、排出規制海域（ECA）が対象です。既に規制が実施されている北米・カリブ海に続き、2021年からは北海・バルト海にも導入されます。現在の三井E&Sマシナリーの Tier Ⅲ機関にはEGRとSCRがあり、特にEGRの選択を推奨いたします。

北海なども80%削減に

Tier III Regulations Apply to North Sea

NOx regulations have been tightened by stages. Tier II regulations introduced from 2011 need to meet the regulations regardless of sea area, and require about 20% reduction of NOx from Tier I regulations. Tier III regulations require about 80% NOx reduction of Tier I regulations and are applicable to Emission Control Area (ECA). Following North America and the Caribbean where ECA have already been introduced, ECA will be introduced to the North Sea and the Baltic Sea from 2021. Currently Mitsui E&S Machinery's Tier III engines can select either EGR or SCR. We recommend to select the EGR as Tier III solution.

ソリューション Solution

EGR p.13

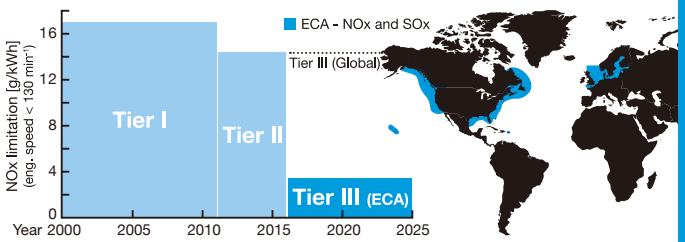
EGR（排気再循環）は排ガスの一部を冷却・清浄後に掃気管へ再循環させることで、掃気中の酸素含有量を下げ、NOx生成を著しく抑制する技術です。EGR技術を用いたEcoEGRを適用すると、一般海域における燃費改善も可能です。

In the Exhaust Gas Recirculation (EGR) system, part of the exhaust gas is recirculated to the scavenging receiver after cooling and cleaning. The oxygen content in the scavenging receiver decreases and NOx formation can be significantly suppressed. Applying a EcoEGR, one of EGR technology, makes it possible to improve fuel consumption in the NOx regulation global area.

SCR p.17

SCR（選択的触媒還元）は排ガス中のNOxを触媒によって窒素と水に還元して低減させる技術です。SCR反応器を設け、尿素水を還元剤として使用します。

In the Selective Catalytic Reduction (SCR) system, NOx generated in diesel engines can be reduced by catalytic reduction to a nitrogen and water. The SCR reactor is installed, and an urea solution is used as a reducing agent.



IMO NOx regulation and Emission Control Area (ECA)

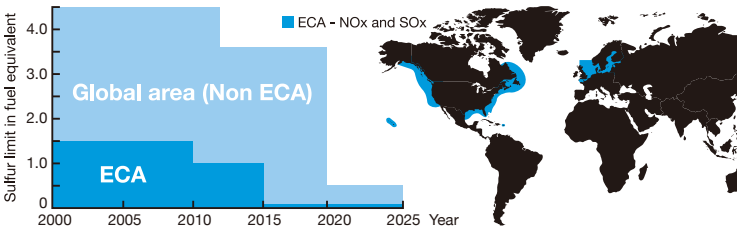
SOx Regulation 硫黄酸化物の規制

大気汚染の原因となるSOxは硫黄分を含む燃料油を燃焼させることで発生するため、燃料油中の硫黄含有率が規制対象になっています。排出規制海域（ECA）である北米・北海・バルト海では、0.1%S以下という厳しい規制が2015年から導入されており、一般海域においても2020年からは0.5%S以下という規制が導入されます。中国やEUは港内停泊中のSOx規制も導入しており、EUでは0.1%S以下、中国の長江デルタなどでは0.5%S以下の燃料油の使用が義務付けられています。

全世界で0.5%S以下に

0.5% Global Sulfur Cap from 2020

Sulfur Oxide causing air pollution is generated by burning fuel oil with the sulfur content. Therefore, the sulfur content in fuel oil is a subject to regulation. In North America, the North sea and the Baltic sea, which are Emission Control Areas (ECA), the strict regulations of not greater than 0.1%S have been introduced since 2015. In global area, the regulation of not greater than 0.5%S will be introduced from 2020. In China and EU, another regulation during berthing is introduced, applying sulfur contents of 0.1% or less in EU and of 0.5% or less in Yangtze River Delta of China is required.



IMO SOx regulation and Emission Control Area (ECA)

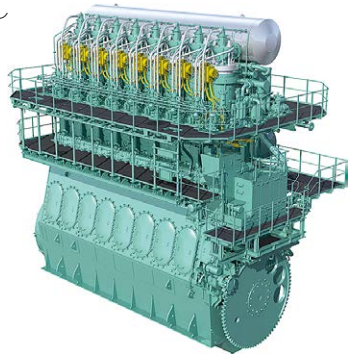
Solution ソリューション

二元燃料ディーゼル機関 p.19

Dual Fuel Diesel Engine

三井E&Sマシナリーが国内で初めて製造したLNG焚き機関（ME-GI）は、SOxがほぼ発生せず、GHGも同時に削減が可能です。二元燃料機関なので従来の重油も使用できます。

The dual fuel diesel engine using LNG, which Mitsui E&S Machinery Co., Ltd. has manufactured for the first time in Japan, generates almost No SOx, and GHG can be reduced simultaneously. The current fuel oil can be used for the duel fuel engine.



低硫黄燃料油

Low Sulfur Fuel Oil

2020年に世界で同時に規制が導入されることにより、低硫黄燃料油（≦ 0.5%S）の急激な需要増加が予想されます。様々な性状の燃料油が流通することが予想されますので、使用にあたってはご留意ください。

The demand of low sulfur fuel oil (0.5%S or less) will increase rapidly because the regulation of the sulfur content in fuel will be introduced from 2020. Please consider that fuel characteristics will be diversified when applying such fuel oil.

SOxスクラバ p.86

SOx Scrubber

排ガス脱硫装置（SOxスクラバ）を使用すれば、従来の硫黄含有率が高い燃料油の使用も認められます。既存船に追加搭載する場合は、機関の再チューニングを弊社で行います。

Introducing the Exhaust Gas Cleaning System (SOx scrubber) makes it possible to apply the current high sulfur fuel oil even under SOx regulation. When the SOx scrubber is installed to the ship in serve, we will re-tune the engine.

GHG Regulation 温室効果ガスの規制

気温上昇を2°C未満に抑えるというパリ協定に基づき採択されたIMOのGHG削減戦略は、2030年までに燃費効率を40%改善し、2050年までにGHG排出量を半減させるとしており、今後の機関選定に大きな制約を与えます。2019年4月現在の規制は、EEDI（エネルギー効率設計指標）に基づく新造船時のもので、一定のCO_2排出基準を満たす設計が必要です。現在はPhase1で、2013年比10%の削減ですが、2020年からは20%削減、2025年からは30%削減となる予定です。今後、新造船だけではなく既存船への規制が行われる可能性が高く、早いの段階でGHG削減を見すえた機関選定を行うことが重要です。

2030年までに燃費効率40%改善

40% Improvement in Fuel Efficiency by 2030

The IMO's GHG reduction strategy, adopted under the Paris Agreement to keep the temperature rise below 2 °C, requires 40% improvement in fuel efficiency by 2030 and halves GHG emissions by 2050. It will severely limit the choice of engines in the future. The regulation as of April 2019 is based on EEDI (energy efficiency design index) at the time of new shipbuilding, and a design that meets certain CO_2 emission standards is required. Currently Phase 1 is 10% reduction compared to Phase 0 in 2013, and it will be reduced by 20% from 2020, and will be reduced 30% from 2025. In the future, in order to ensure the effectiveness of the reduction, regulations are likely to apply to existing ships as well as new ships, and selecting the engine which can reduce GHG at an early stage is important.

ソリューション Solution

EcoEGR p.15

機関チューニングにおいて、NOx削減と燃費とはトレードオフの関係にあり、従来のNOx削減は燃費の悪化を招いてきました。しかし、EcoEGR機関では従来停止していたNOx一般海域でもEGRを用いるというチューニングを行うことで、NOx削減と燃費改善を同時に実現しています。

In engine tuning, NOx reduction and fuel consumption are in a trade-off relationship. Therefore, conventional NOx reduction has led to a worsening fuel consumption. However, for the engine with EcoEGR, NOx reduction and fuel consumption improvement can be realized simultaneously by tuning with EGR in NOx global area where EGR is stopped for the conventional EGR engines.

二元燃料ディーゼル機関 p.19

Dual Fuel Diesel Engine

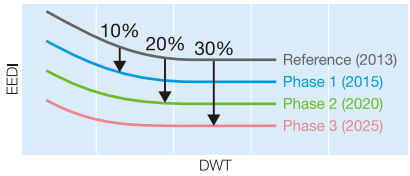
メタンやエタンといった燃料ガスや、LPGなどの低引火点燃料を使用可能な二元燃料機関は、大幅に温室効果ガスの排出を削減できます。また、燃料油のみでの運転も可能です。

The dual fuel engines can use fuel gas such as methane and ethane or low flashpoint fuel such as LPG, which can significantly reduce GHG. In addition, operation by fuel oil only is available.

THS2 p.18

排ガスの余剰エネルギーを油圧動力として回収し、それを機関内で使用することにより、最大2%燃費を削減し、EEDI改善に貢献します。

By recovering the surplus exhaust gas energy as hydraulic power and using it in the engine, fuel consumption can be reduced by max. 2%, thereby contributing to EEDI improvement.



EEDI regulation for GHG emission limit

新形機関 New Engine

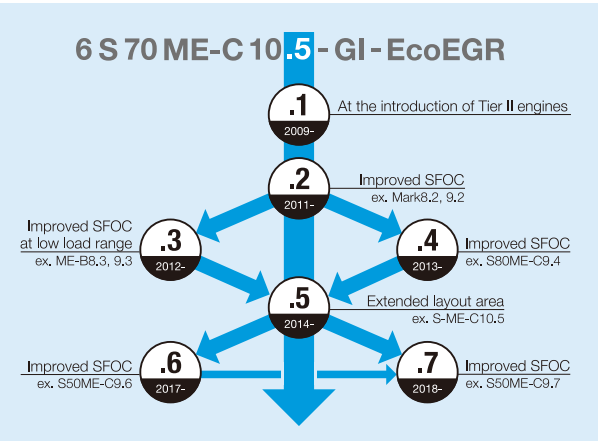
New Engine Type

新規計画の案件については、下表の新形機関の採用を推奨いたします。
For new project, the adoption of new engine types in below table are recommended.

New engine type	Conventional engine type	Feature of new engine type		
		Improved SFOC	Extended layout area	others
G95ME-C10.5	G95ME-C9.5	●		
G80ME-C10.5	G80ME-C9.5	●		Downsizing
S70ME-C10.5	S70ME-C8.5	●	●	Downsizing
S65ME-C8.6	S65ME-C8.5	●	●*	
G60ME-C10.5	G60ME-C9.5	●	●	
S60ME-C10.5	S60ME-C8.5	●	●	Downsizing
S50ME-C9.7	S50ME-C9.5/9.6	●	●	
S40ME-C9.5	S40ME-B9.5	●	●	Full electronicaly control
S35ME-B9.7	S35ME-B9.5	●	●	
S35ME-CR9.7-GI	S35ME-B9.5	●	●	Full electronicaly control

* Shifted layout area to lower power side

ドットナンバーの変遷
History of .(dot) Number



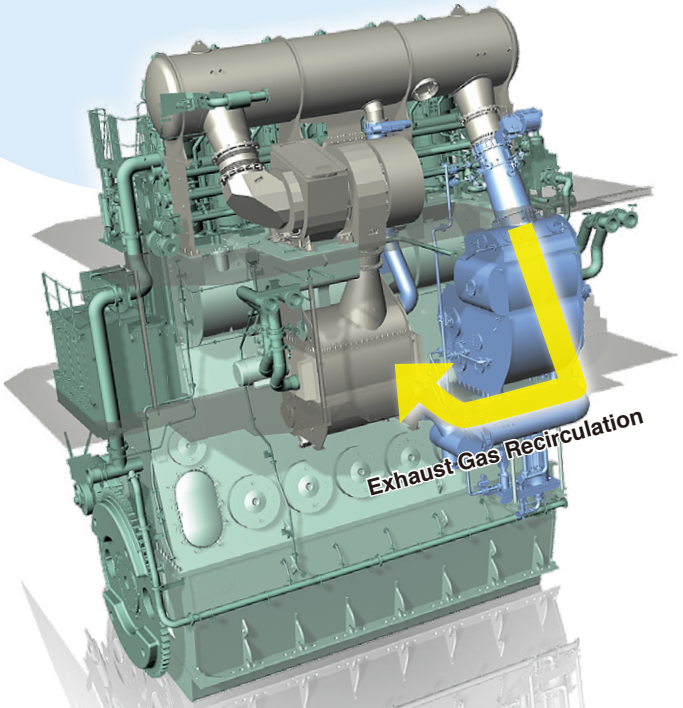
技術概要
TECHNOLOGY

経済性の高い NOx 削減システム

Highly Economical NOx Reduction System

EGR—排気再循環 For NOx

Exhaust Gas Recirculation



EGRシステムは、排ガスの一部を冷却および清浄した後、掃気レシーバへ再循環させます。これによって掃気中の酸素含有量が低下し、また、熱容量が増大し、その結果、燃焼温度最高点が低下しNOx生成が低減されます。機関形式や過給機台数により、Bypass matchingまたはT/C cut-out matchingのいずれかが適用されます。

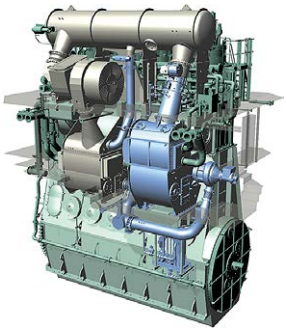
■ **Bypass Matching (EGRBP)**
過給機1台、シリンダボア70 cm以下の機関用

■ **T/C Cut-out Matching (EGRTC)**
過給機2台以上、シリンダボア80 cm以上の機関用

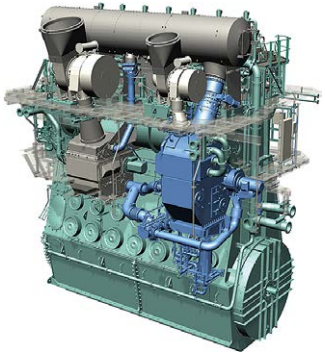
In the EGR system, after a cooling and cleaning process, part of the exhaust gas is recirculated to the scavenging air receiver. This replacement decreases the oxygen content and increases the heat capacity of the scavenge air, thus reducing the temperature peak of the combustion and the formation of NOx. Two different methods; bypass matching or T/C cut-out matching are used for the EGR systems depending on the engine type or the number of turbocharger.

- Bypass Matching (EGRBP)
  With only one turbocharger and used for the engines of cylinder bore 70 cm or smaller.
- T/C Cut-out Matching (EGRTC)
  With two or more turbochargers and used for the engines of cylinder bore 80 cm or larger.

6G60ME-C9.5-**EGRBP**



7G80ME-C9.5-**EGRTC**



EGRを適用することにより、上図の青色の部品が追加されます。
The blue part in the above figures shows the parts added by applying the EGR

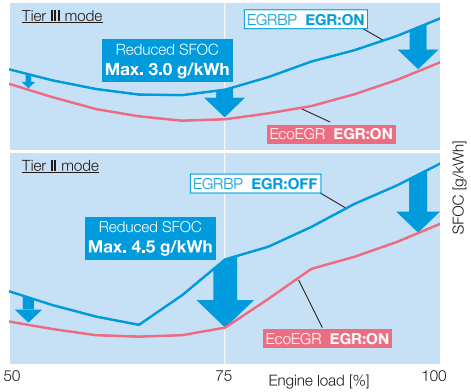
EGRで燃費もNOxも　改善する

Improvement of Fuel Consumption and NOx Emission with EGR

EcoEGR For NOx For GHG

従来の機関チューニングにおいて、燃料消費率とNOx排出とはトレードオフの関係にありました。この限界を打破する画期的なシステムがEcoEGRです。EcoEGRは「EGRのNOx低減機能を全海域で有効活用する」という設計思想を導入しています。機関チューニングを燃料消費率優先で最適化するとともに、Tier II、Tier III全海域でEGRを稼働しNOxを削減することによって、燃料消費率改善とNOx削減を両立させています。このシステムはEEDI改善に大きく貢献します。低硫黄燃料（≦ 0.5%S）を使用した場合に、特に大きな運航コスト節減効果があります。二元燃料機関でもEcoEGRは採用可能です（ME-GIE機関を除く）。

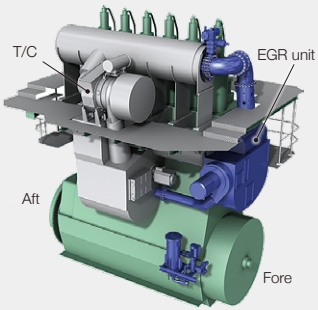
Specific fuel consumption and NOx emission were have been in a trade-off relation with conventional engine tuning. An EcoEGR system is one of breakthrough technology which overcomes this relationship. The EcoEGR has introduced a design concept of "effectively utilizing the EGR NOx reduction function in all sea areas". Both specific fuel consumption improvement and NOx reduction can be achieved by optimizing the specific fuel consumption preferentially while by operating EGR in all Tier II and Tier III emission control areas to reduce NOx. EEDI can be big improved by applying this system. Applying EcoEGR operation with low-sulfur fuels (≤ 0.5% S) extremely saves the running cost. The option of EcoEGR is also available for the dual fuel engines except for the ME-GIE type.



Comparison of SFOC curve with EcoEGR (ex. EGRBP vs EcoEGR)

EGRユニット配置
EGR Unit Arrangement

EGR bypass matching適用機関の場合、機関上に装備するEGRユニット（ブレスブレ、EGRクーラ、EGR用ミストキャッチャ）の配置は機関形式に依存します。各機関形式におけるEGRユニット配置は 次頁の表をご参照ください。



EGR unit arrangement at Fore end

For the engines with EGR bypass matching, EGR unit (Pre-spray, EGR cooler and EGR mist catcher) arrangement depends on the engine type. With regard to the EGR unit arrangement on each engine type, please refer next page.

Engine type		EGR matching	T/C arrangement	EGR unit arrangement
Cyl. bore	Concept			
80 or larger	ME-C	EcoEGR / EGRTC	Exhaust side	Exhaust side
70, 65	ME-C	EcoEGR / EGRBP	Exhaust side	Exhaust side
G60	ME-C	EcoEGR / EGRBP	Exhaust side	Exhaust side *
S60	ME-C	EcoEGR / EGRBP	Exhaust side	Fore end *,**
50, 45***	ME-C	EcoEGR / EGRBP	Exhaust side	Fore end *,**
			Aft end	Fore end *,**
46 or smaller	ME-B	EGRBP	Exhaust side	Aft end *
			Aft end	Exhaust side

* EGRユニット配置の代替案については、弊社までお問合せください。
** EGR "舶端側" 配置の場合、2次バランサ（舶側モーメントコンペンセータ）は装備不可となりますのでご留意ください。
*** S40ME-C9.5およびS35ME-CR9.7形機関のEGRユニット配置については、弊社までお問い合わせください。

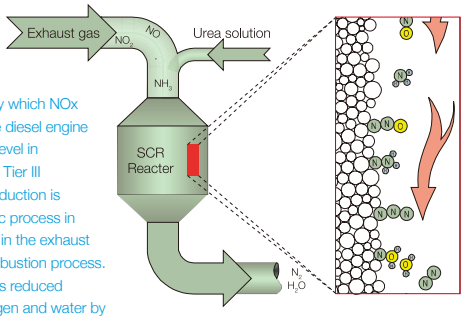
* For alternative design of EGR unit arrangement, please contact us.
** For the engines arranged at EGR unit at Fore end, the option of moment compensators arranged at Fore end is not available.
*** For EGR unit arrangement of S40ME-C9.5 and S35ME-CR9.7, please contact us.

SCR—選択的触媒還元 For NOx

Selective Catalytic Reduction

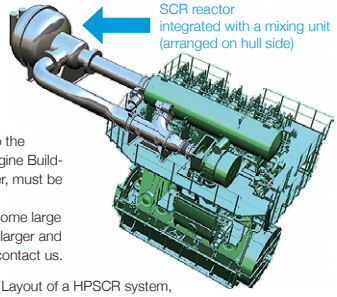
SCRは排ガスに含まれるNOxを窒素と水に還元し無害化する技術です。排ガスをSCR反応器へと導き、尿素水を還元剤とすることで、NOx Tier Ⅲ要件を満たします。SCRシステムには、高圧SCR（HPSCR）と低圧SCR（LPSCR）があります。HPSCRの反応器は過給機上流側に設置するため、機関の近くに配置されます。なお、SCR運転の間、使用する燃料の硫黄分を0.1%以下に制限する場合は、LPSCRを選択可能です。LPSCRは過給機出口後の排ガス管に接続されるため、機関からSCRを離して柔軟に配置することができます。

Selective Catalytic Reduction (SCR) is the one of an exhaust gas treatment methods by which NOx generated in a marine diesel engine can be reduced to a level in compliance with NOx Tier III requirements. NOx reduction is obtained by a catalytic process in SCR reactor installed in the exhaust gas line after the combustion process. In SCR reactor, NOx is reduced catalytically to a nitrogen and water by adding an urea solution as a reducing agent.
The SCR systems could be chosen as high-pressure SCR (HPSCR) or low-pressure SCR (LPSCR). HPSCR reactor is installed upstream the turbocharger(s). As the exhaust gas is led from the SCR reactor to the turbocharger, the system is arranged close to the engine. If restricting the sulfur content in a fuel during SCR operation to 0.1% S or less, the LPSCR system can be selected, In that system, SCR line is placed after the turbocharger which provides flexibility for arranging SCR installation.



注記 Note

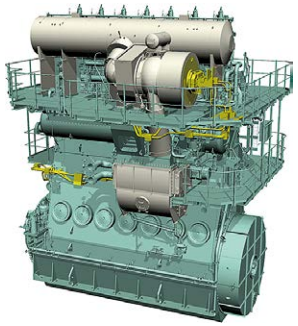
- SCRシステムは機関と連携しますが、SCR系統は機関支給品ではありません。システムは弊社からの仕様に基づく必要があります。
- 多シリンダかつシリンダボア90 cm以上の大形機関への高圧SCRの適用については、弊社までお問い合わせください。
- Although SCR system is closely related to the engine, the SCR line is not included in Engine Builder's scope of supply. The system, however, must be based on specifications from us.
- Regarding the application of HPSCR for some large bore engines with cylinder bore 90 cm or larger and with many cylinder configuration, please contact us.



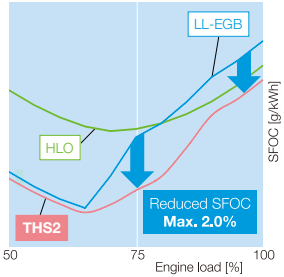
Layout of a HPSCR system,
as supplied by MAN Energy Solutions (MAN SCR-HP)

THS2—廃熱回収装置 For GHG

Turbo Hydraulic System type2



黄色着色部はTHS2追加機器
Yellow parts : added parts for THS2



Comparison of SFOC curve with THS2

燃料消費率を最大2%削減

Max. 2% Fuel Saving

舶用ディーゼル機関に搭載される過給機は、高効率化により排ガスの余剰エネルギーを有効利用することが可能です。弊社が独自に開発したTHS（Turbo Hydraulic System）は、その余剰エネルギーを油圧動力として回収・利用します。回収した油圧動力は機関内で使用され、燃料消費率を最大2%削減しEEDIを改善します。THSは一般的な廃熱回収装置と比較して非常にコンパクトで、機関室設計に大きな変更を必要としません。THS2は従来のTHSの技術を踏襲し、ME-C機関に特化したシステムで、Tier Ⅲ機関にも適用可能です。また、EcoEGRと併用できます。

The surplus exhaust gas energy can be utilized thanks to the recent improvement of the efficiency of turbocharger for the marine diesel engine. THS (Turbo Hydraulic System), developed independently by us, is a system which use a power hydraulically recovered from the surplus gas energy. Specific fuel consumption can be reduced by max. 2% and EEDI can be improved by the THS. The THS is very compact compared to traditional waste heat recovery system and consequently not requires large modification of the engine room. THS2 is a system specialized ME-C engine, following the conventional THS technology, and is also applicable to Tier III engine. Furthermore, it is used with EcoEGR at the same time.

THSの就航実績 Service Experience

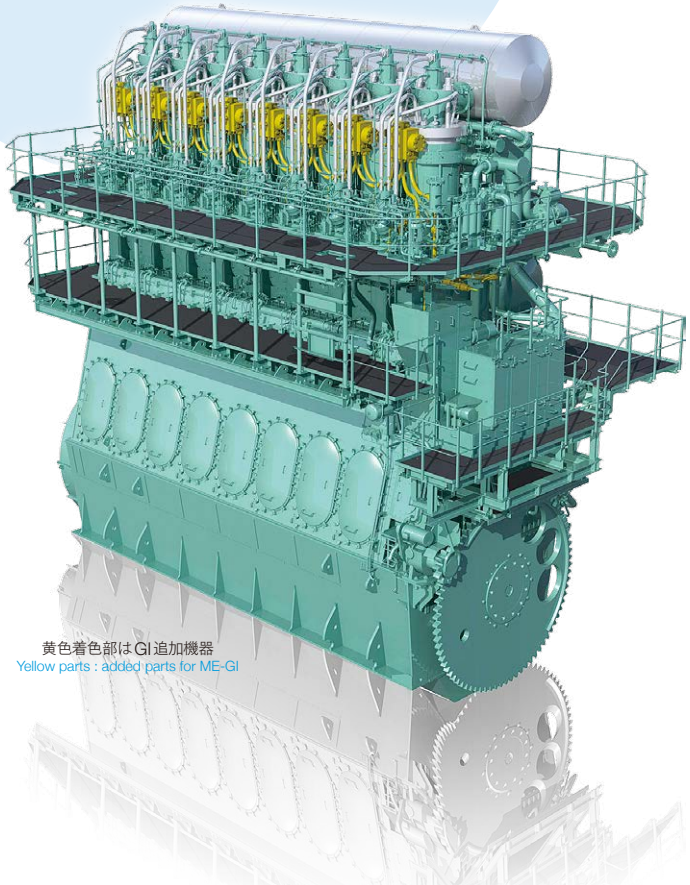
出荷済機関 Delivered Engine	20 (Since 2014)
建造予定 Ordered Engine	3 (From 2019)

燃料の転換で　規制を　　クリアする

Comply with the Regulations by Fuel Conversion

二元燃料ディーゼル機関 For GHG For SOx

Dual Fuel Diesel Engines



黄色着色部はGI追加機器
Yellow parts : added parts for ME-GI

弊社製造の機関は、メタン（天然ガス）、エタンといった燃料ガスやメタノール、液化石油ガス（LPG）などの低引火点燃料を焚ける「二元燃料ディーゼル機関」とすることが可能です。二元燃料ディーゼル機関は従来の重油焚き機関よりCO_2排出量が少ないため、EEDI規制の達成に大きく貢献し、また、そのような燃料ガスや低引火点燃料は硫黄分をほとんど含まないためSOx規制をクリアすることも可能です。さらに、ディーゼルサイクルを採用しているためメタンスリップが少なく、GHG排出削減に貢献します。このように二元燃料ディーゼル機関は、重油からの燃料転換によって多くの環境規制を達成できる次世代形機関です。

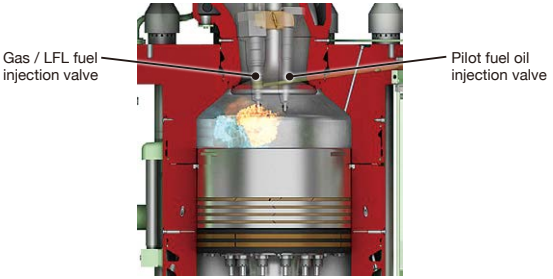
二元燃料ディーゼル機関は、メタンやエタンなどの燃料ガスを使用するGI（Gas Injection）形機関と、メタノールやLPGなどの低引火点（LFL）燃料を利用するLGI（Liquid Gas Injection）形機関があります。また、重油のみを使用する「燃料油運転モード」と、燃料ガス／LFL燃料と少量の燃料油（パイロット油）を使用する「二元燃料運転モード」の2つの運転モードがあります。

We can supply the "dual fuel diesel engine" which utilizes fuel gas such as methane (natural gas), ethane and low flashpoint fuel such as methanol and liquefied petroleum gas (LPG). The dual fuel diesel engines emit CO_2 less than conventional fuel oil burning diesel engines, and thus contribute significantly to the achievement of the EEDI regulations. In addition, using such fuel gas and low flashpoint fuel, which contains almost no sulfur, complies with SOx regulation. Furthermore, using the diesel cycle reduces methane slip and contributes to GHG emission reductions. The dual fuel diesel engines are next-generation engines that can comply with many environmental regulations by converting fuel from fuel oil.
The duel fuel diesel engines have two types, i.e. “GI” (gas injection) type engine which is applied fuel gas such as methane or ethane, and “LGI”(liquid gas injection) type engine which is applied LFL (low flash point) fuel such as methanol or LPG. Two running modes are available, i.e. “fuel oil mode” using only fuel oil and “dual fuel mode” using both fuel gas or LFL fuel and few fuel oil (as pilot oil).

使用燃料の種類により、下記のように燃料呼称が機関形式呼称に加わります。
Depending on the type of fuel utilized, the following fuel designation is added to the engine type designation.

燃料の種類 Fuel type	重油のみ Fuel oil only	メタン Methane	エタン Ethane	メタノール Methanol	液化石油ガス LPG
Fuel designation	(blank)	-GI	-GIE	-LGIM	-LGIP

Combustion chamber for ME-GI/LGI



二元燃料ディーゼル機関の仕様
Specification of Dual Fuel Diesel Engine

二元燃料ディーゼル機関を適用できる機種については、燃料ガス消費率等を31～73頁に記載します。GIE、LGIPおよびLGIM形機関については、本カタログでは一例を示します。なお、出力および回速速度は対応するME形機関と同一です。

Figures such as specific fuel gas consumption are included for engines where dual fuel diesel engines are applicable in table on page 31-73. As examples, GIE, LGIP and LGIM figures are shown in this engine program. Output and speed are the same as the corresponding ME type engines.

以下の燃料消費率の値を、二元燃料機関の表に示しています。
The following specific fuel consumption figures are shown in the tables for dual fuel engines:

重油運転モード Fuel oil mode	SFOC: 燃料油消費率 Specific fuel oil consumption
二元燃料運転モード Dual fuel mode	SGC: 燃料ガス消費率 Specific gas consumption
	SPOC: パイロット油消費率 Specific pilot oil consumption

注記 Note
- GI 形機関では、あらかじめ設定された値に従ってパイロット油と燃料ガスの比率を選択できる SDF (Specified Dual Fuel) 運転が可能です。(オプション)
- 二元燃料ディーゼル機関には低 BN と高 BN のシリンダ油が供給できるシリンダ油システムが必要です。
- GIE 形機関に IMO NOx Tier III 規制を適用する場合は、弊社までお問い合わせください。
- The GI engines can operate with fuel sharing, referred to as SDF (Specified Dual Fuel) operation, where the ratio between pilot oil and fuel gas can be selected according to preset values. (Option)
- The dual fuel engines are required a cylinder lubrication system which can supply both low and high BN lubricating oils.
- When applying IMO NOx Tier III regulation to the GIE engines, please contact us.

ニーズに応じた最適化
Optimization in Accordance with Customer Needs

燃料消費率の最適化 For GHG
Optimization of SFOC

「最もよく利用する負荷領域での燃料消費率（SFOC）を低減する」「船内での熱需要・電力需要に合わせる」など、お客様のニーズに合わせて燃料を効率よく活用する機関最適化方法をご提案します。Tier II機関では、最適化させる負荷範囲に応じて、下表の負荷範囲から選択することが可能です。部分負荷最適化（Part-load optimize）または低負荷最適化（Low-load optimize）を適用するためのチューニング方法は、以下の3つがあります。これらのチューニングにより、下のグラフのように部分負荷もしくは低負荷のSFOCは改善されますが、高負荷（High-load）でのSFOC悪化を伴います。

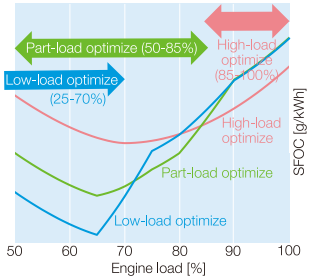
We propose engine optimization methods that utilize fuel efficiently in accordance with customer needs, such as "saving the specific fuel oil consumption (SFOC) in the load range most frequently used" and "adjusting to the heat and power demand on board". For Tier II engines, the load range to be optimized can be selected as below table. Three methods are available to achieve either Part-load optimize or Low-load optimize. These tunings improve the SFOC in part-load or low-load range shown as below figure, at the expense of a higher SFOC in the high-load range.

- EGB: Exhaust Gas Bypass
- HPT: High Pressure Tuning（only available on ME-C engines）
- EPT: Engine Process Tuning（only available on G95/G80/G60ME-C10.5）

Optimized load range

High-load optimize	85-100% load (Standard tuned engine)
Part-load optimize	50-85% load
Low-load optimize	25-70% load

SFOC curve with SFOC tuning



EGB Option Exhaust Gas Bypass

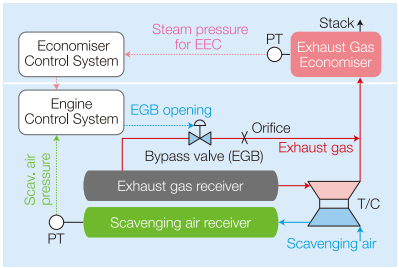
Bypass valve for EGB

EGBでは、高効率・高圧力比の過給機を選定します。それにより、対象とする負荷領域での掃気圧・Pmax（シリンダ内最大爆発圧力）を上昇させることが可能となり、SFOCが改善します。一方、高負荷域では過給機の過回転を防ぐために、排気レシーバ上に設置されたEGB弁を開いて排ガスを逃がします。EGB技術を導入時に、より柔軟に排ガス温度を調整する場合、Economiser Energy Control (EEC)を適用可能です。（オプション）

For the EGB, the turbocharger is selected to have high efficiency and high pressure ratio. This makes it possible to increase the scavenging air pressure and Pmax (maximum combustion pressure) in the target load range, and thus improving SFOC. In the high load range, the EGB valve installed on the exhaust receiver is opened to release the exhaust gas in order to prevent the overspeed of turbocharger. When the EGB technology is installed and if adjusting exhaust gas temperature more flexibly, an Economiser Energy Control (EEC) is available as an option.

EEC Option Economiser Energy Control

EECシステムはEGBシステム導入時に適用可能なEGB制御方法で、排ガスエコノマイザ（EGE）内のエネルギー（蒸気圧）を制御しています。EGE内の蒸気圧に応じて、最大一最小許容バイパスエリアの範囲内でEGB弁の開度を調整し、排ガス温度を最適化させます。例えば、開度を増大させる場合、機関のSFOCは悪化しますが、ボイラ側の追い焚き量を減らすことになり、船全体の運航コスト削減に貢献します。



System layout of EGB and EEC

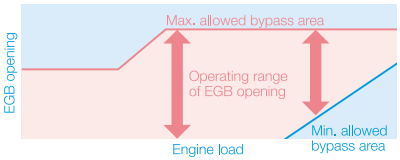


Image of operating range of EGB opening with EEC

The EEC system is an EGB control method which is applicable when EGB system is introduced, and controls the energy (steam pressure) in the exhaust gas economiser (EGE). The exhaust gas temperature will be optimized by adjusting the EGB valve position within the maximum and minimum allowable bypass area depending on the steam pressure in the EGE. For example, when increasing the opening of EGB valve, although the EEC system has a penalty of SFOC for the main engine, a higher exhaust gas temperature results in reducing the additional burning of the boiler and thus contributes to the running cost reduction of the whole vessel.

HPT Option High Pressure Tuning

HPTでは、高効率・高圧力比の過給機を選定します。それにより、対象とする負荷領域での掃気圧・Pmax（シリンダ内最大爆発圧力）を上昇させることが可能となり、SFOCが改善します。一方、高負荷域では過大な最大爆発圧力を防ぐために、排気弁の閉じるタイミングを遅らせます。HPTは排気弁タイミングを調整するため、ME-C形機関のみ採用可能です。HPTに追加機器は不要ですが、掃気圧力が上昇するため、幾つかの機関では構造変更と騒音対策が必要になることがあります。

For the HPT, the turbocharger is selected to have high efficiency and high pressure ratio. This makes it possible to increase the scavenging air pressure and Pmax (maximum combustion pressure) in the target load range, and thus improving SFOC. In the high load range, the exhaust valve closing timing is delayed in order to prevent the excessive maximum combustion pressure. Since the exhaust valve timing is adjusted, the HPT can be applied only for ME-C engines. The HPS does not require additional devices. However, as a consequence of the higher scavenging air pressure, some engines may need structural design changes and countermeasures to noise.

EPT Option Engine Process Tuning

EPT（Engine Process Tuining）はHPTとほぼ同じ特徴を持つチューニング方法です。G95ME-C10.5、G80ME-C10.5およびG60ME-C10.5形機関にのみに適用可能です。EPT適用機関では、チューニング方法が従来のEGB/HPTからEPTに置き換わります。なお、より高い排ガス温度が必要な場合には、御要求に応じてEECの適用も可能です。

EPT tuning is a tuning method with similar features to HPT tuning. EPT tuning is available only for G95ME-C10.5, G80ME-C10.5 and G60ME-C10.5. For these engines, the tuning method is replaced conventional EGB and HPT to the EPT. If requiring higher exhaust gas temperature, applying EEC is available on request

注記 Note

- 主管庁は運転モードを任意に移行することを認可していません。運航パターンが変わった際のモードの変更は、船籍国の代行機関（通常は船級）にそのことを報告し承認を受けた場合に許可されます。したがって長期的には、船主は１つの機関モードまたはそれ以外を選択できますが、主管庁に通知するという条件が付きます。
- これらのチューニング方法を適用すると、軸系捩り振動に影響を及ぼすことがありますので、弊社まで御相談ください。
- チューニング方法によっては過給機形式が変更となる可能性がありますので留意してください。
- Part-loadまたはLow-load optimizeを適用する場合、SFOC保証点を85%負荷未満とすることを推奨します。
- The authorities do not allow random shifting between the modes. A mode shift in case of a change in operating pattern is permitted if reported and approved by the flag state representative, usually a classification society. Hence, on a longer term basis, the owner can select one or the other of the modes for the engine, provided the authorities are informed.
- Applying these tuning methods may affect the torsional vibration aspect. Please contact us.
- The turbocharger type can be changed depending on engine tuning methods.
- When part-load or low-load optimized is applied, the SFOC guarantee point below 85% load is recommended.

各形式に適用可能なチューニング
Available Tuning Methods for Each Engine Type

Engine type	Available tuning method			
	EGB	EGB with EEC	HPT	EPT
G95ME-C10.5, G80ME-C10.5, G60ME-C10.5		Available		Available
ME-C engines with cyl. bore 40 cm or larger except for G95/G80/G60ME-C10.5**	Available	Available	Available	
S46ME-B8.5*	Available	Available		
Engines with cyl. bore 35 cm or smaller	NOT available**			

* S46ME-B8.5、G45ME-C9.5およびS40ME-C9.5形機関の場合、所定の過給機性能を満たす場合に限り、これらの機関チューニング方法を適用できます。
** ボア35 cm以下の機関の場合、High-load optimizeのみが選択されます。
* For S46ME-B8.5, G45ME-C9.5 and S40ME-C9.5 type engines, the these engine tuning methods are available as long as specified turbocharger requirements can be fulfilled.
** For the engines with cylinder bore 35 cm or smaller, only High-load optimize is available arranged at Fore end is not available.

WHR Option Waste Heat Recovery

WHRとは過給機の余剰効率を活用した廃熱回収装置の総称です。所定の過給機性能を満たす場合に限り、すべての機関形式にWHRを適用できます。WHRの例を以下に示します。

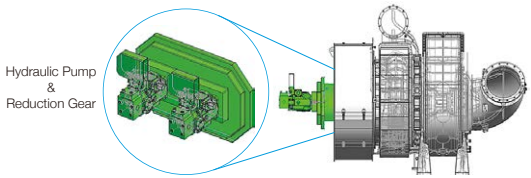
■ **Turbo Hydraulic System (THS)**
排ガスの余剰エネルギーを油圧として回収し、回収した油圧動力でクランク軸を加勢

■ **Turbo Hydraulic System type2 (THS2)**
排ガスの余剰エネルギーを油圧として回収し、ME形機関の高圧サーボ油として利用（18頁参照）

WHR is a generic term for waste heat recovery equipment that utilizes the surplus efficiency of the turbocharger. The WHR is available for all engine types, as long as specified turbocharger requirements can be fulfilled. An example of WHR is shown as below.

- Turbo Hydraulic System (THS)
  The surplus exhaust gas energy is recovered as hydraulic pressure, which assists the rotation of crank shaft.
- Turbo Hydraulic System type2 (THS2)
  The surplus exhaust gas energy is recovered as hydraulic pressure, which is used as high pressure servo oil for the ME type engines. (refer page 18)

Turbocharger with hydraulic pump and reduction gear for THS2



製品ラインナップ
PRODUCT LINEUP

機関形式命名規則
Engine Type Designation

6 S 70 ME-C 10.5 - GI - EcoEGR

Tier III technology

(blank)	Tier II only
EcoEGR	EGR in Tier III and Tier II mode
EGRBP	EGR with bypass matching
EGRTC	EGR with T/C cut out
HPSCR	High-pressure SCR
LPSCR	Low-pressure SCR

Fuel injection concept

(blank)	Fuel oil only
GI	Gas injection methane
GIE	Gas injection ethane
LGIM	Liquid gas injection methanol
LGIP	Liquid gas injection LPG

Dot (.) number

Mark number

Concept

ME-C	Electronically controlled
ME-B	Exhaust valve controlled by camshaft
ME-CR	Electronically controlled with common rail

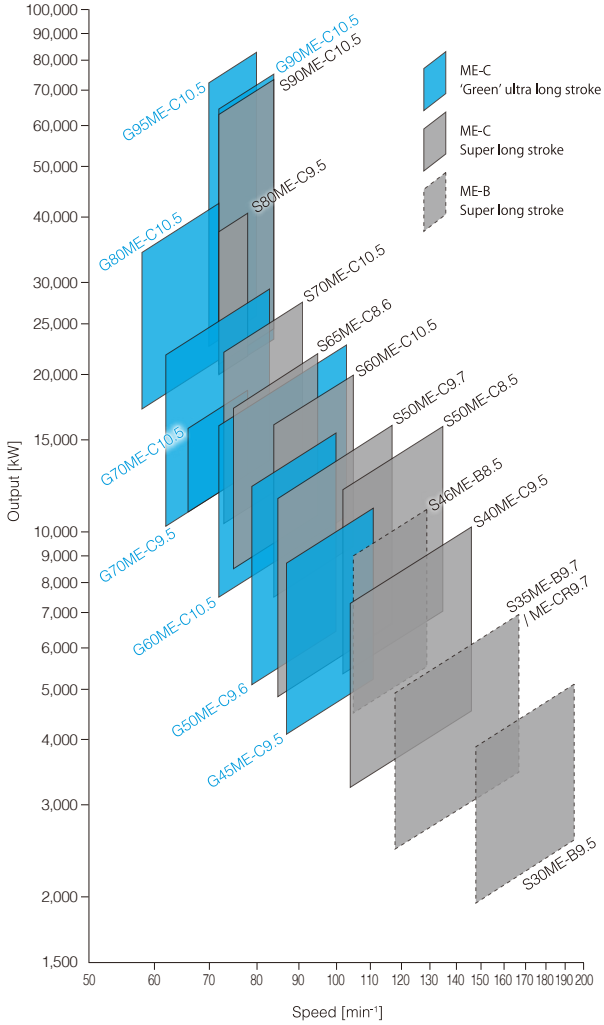
Diameter of piston in cm

Stroke/bore ratio

G	'Green' ultra long stroke
S	Super long stroke

Number of cylinders

出力・回転速度の範囲
Output and Speed Range



ME形機関

The ME Program

「燃費の削減」「NOx等の排出抑制」「部分負荷時の最適化」「シリンダ油消費量の削減」などを、電子制御による精密なコントロールにより、高いレベルへと引き上げるのがME形機関です。弊社が提供する機関はすべてME形機関です。ME-C／ME-CR形機関とME-B形機関とでは、下記のように電子制御部分が異なります。なお、ME-CとME-B形機関では、燃料油圧力ブースタによって個々のシリンダで燃料油を昇圧しますが、ME-CR形機関*では、コモンレール式燃料噴射システムによって燃料油を昇圧します。

*本カタログでは、ME-CR形はS35ME-CR9.7-GIのみに適用されます。

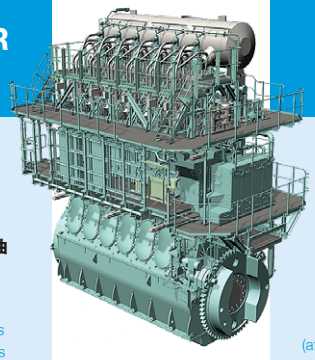
ME type engines can realize higher level of "reduction of fuel consumption", "reduction of NOx emissions", "optimization at part load" and "reduction of cylinder oil consumption" by a electronically precise control. The engines supplied by us are all ME type engines. The electronically control parts are different between ME-C / ME-CR type engine and ME-B type engine as follows. For the ME-C/ME-B type engines, the fuel oil is pressurized by a fuel oil pressure booster at individual cylinder, whereas for the ME-CR type engines, the fuel oil is pressurized by a common rail fuel oil injection system.

*In this catalog, ME-CR type applies to S35ME-CR9.7-GI only.

各形式の電子制御項目

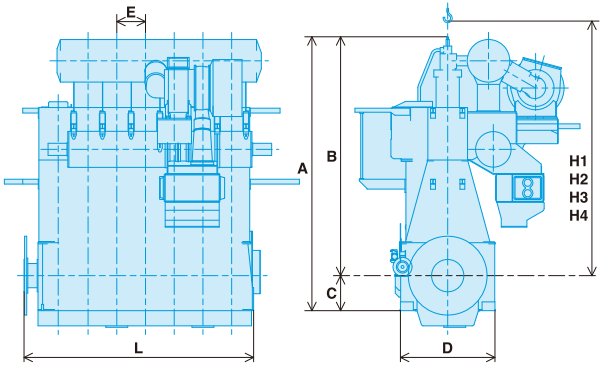
Electronically Controlled Item

ME-C ME-CR	ME-B
燃料噴射 始動空気弁 排気弁 シリンダ注油	燃料噴射 排気弁 (高負荷域のみ) シリンダ注油
Fuel Injection Starting Valves Exhaust Valves Cylinder Lubrication	Fuel Injection Exhaust Valves (at high-load range) Cylinder Lubrication



主要寸法・乾燥質量

Main Dimensions and Dry Masses



本カタログに記載している機関の主要寸法[mm]は、ガイダンス寸法です。解放高さ寸法は下記になります。

H1 垂直吊り高さ（シリンダカバー締付用スタッド付）
H2 斜め吊り高さ（シリンダカバー締付用スタッド付）
H3 斜め吊り高さ
（MAN Energy Solutions SE社ダブルジブクレーン使用の場合）
H4 垂直吊り高さ
（MAN Energy Solutions SE社ダブルジブクレーン使用の場合）

Tier III機関の機関質量は、機関上に直接搭載されるTier III技術関連部品の質量を含みます。機関質量は、標準過給機、標準回転勢車を装備した場合におけるものであり、モーメントコンペンセータ、チューニングホイール等といったオプション項目や設計点により、10%程度増量することがあります。

Main dimensions stated in this catalog are given in mm, for guidance only. Dismantling height;
H1: vertical lift, with cylinder cover studs.
H2: tilted lift, with cylinder cover studs.
H3: tilted lift, with using MAN Energy Solutions SE double-jib crane
H4: vertical lift, with using MAN Energy Solutions SE double-jib crane
The masses for Tier III engines include the masses of components of Tier III technology directly integrated on the engine. The masses are stated for engines with standard turbocharger(s), a standard turning wheel and can vary up to 10% depending on the design and options chosen such as moment compensators, tuning wheel, etc.

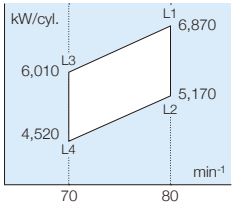
G95ME-C10.5 New Engine

Bore: 950 mm, Stroke: 3,460 mm

Engine Output [kW]

Cyl.	L1	L2	L3	L4
5	34,350	25,850	30,050	22,600
6	41,220	31,020	36,060	27,120
7	48,090	36,190	42,070	31,640
8	54,960	41,360	48,080	36,160
9	61,830	46,530	54,090	40,680
10	68,700	51,700	60,100	45,200
11	75,570	56,870	66,110	49,720
12	82,440	62,040	72,120	54,240

MEP L1-L3: 2.10 MPa
L2-L4: 1.58 MPa



Fuel Oil SFOC [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	159.5	158.6	163.0	155.5	152.5	156.0
Part load	EPT	157.5	157.1	165.5	153.5	151.0	158.5
Low load	EPT	155.5	158.1	165.5	151.5	152.0	158.5

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **G95ME-C10.5-EcoEGR**	Tier III	161.5	160.6	165.0	157.5	154.5	158.0
	Tier II	152.5	153.6	161.0	148.5	147.5	154.0
EGRTC* **G95ME-C10.5-EGRTC**	Tier III	161.5	161.6	167.0	157.5	155.5	160.0
	Tier II	155.5	158.1	165.0	151.5	152.0	158.0
HP SCR** **G95ME-C10.5-HPSCR**	Tier III	157.0	159.1	166.0	153.0	153.0	159.0
	Tier II	155.5	158.1	165.5	151.5	152.0	158.5
LP SCR **G95ME-C10.5-LPSCR**	Tier III	156.5	159.1	166.5	152.5	153.0	159.5
	Tier II	155.5	158.1	165.5	151.5	152.0	158.5

* The SFOC lower than 75% load in Tier II mode is the value with T/C cut-out

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H4
[mm]			2,060	5,380	***		15,900

***5-9 cyl.:1,574, 10-12cyl.: 1,574 / 1,670 (fore / aft of HPS chain drive)

Cylinders:		5	6	7	8	9	10	11	12
L [mm]		11,468	13,042	14,616	16,190	17,764	19,819	21,489	23,159
Dry Mass [t]		1,090	1,260	1,445	1,640	1,840	2,030	2,230	2,425
Added Dry Mass	EcoEGR [t]	11	13	14	15	29	29	31	33
	EGRTC [t]	11	13	14	15	29	29	31	33
	HP SCR [t]	10	15	15	15	**	**	**	**
	LP SCR [t]	-	-	-	-	-	-	-	-
	GI [t]	8	9	11	12	13	15	16	17

** Available on request for HPSCR

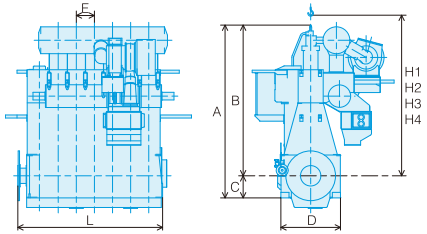
GI (Methane) SGC + SPOC, SFOC [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **G95ME-C10.5-GI**	Dual Fuel	129.5 / 129.9 + 3.9	129.5 / 130.8 + 2.9	136.3 / 136.3 + 2.4	125.0 / 125.4 + 5.1	123.5 / 124.8 + 3.9	129.6 / 129.6 + 3.2
	Fuel Oil	159.5	161.1	168.0	155.5	155.0	161.0

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR **G95ME-C10.5-GI-EcoEGR**	Tier III	Dual Fuel	134.6 + 3.9	134.6 + 3.0	138.8 + 2.5	130.0 + 5.2	128.6 + 4.0	132.1 + 3.3
		Fuel Oil	161.5	163.1	170.0	157.5	157.0	163.0
	Tier II	Dual Fuel	126.9 + 3.9	128.6 + 3.0	135.4 + 2.5	122.4 + 5.2	122.6 + 4.0	128.7 + 3.3
		Fuel Oil	152.5	156.1	166.0	148.5	150.0	159.0
EGRTC* **G95ME-C10.5-GI-EGRTC**	Tier III	Dual Fuel	134.5 + 4.0	135.4 + 3.0	140.5 + 2.5	130.0 + 5.3	129.4 + 4.0	133.8 + 3.3
		Fuel Oil	161.5	164.1	172.0	157.5	158.0	165.0
	Tier II	Dual Fuel	129.4 + 4.0	132.4 + 3.0	138.8 + 2.5	124.9 + 5.3	126.4 + 4.0	132.1 + 3.3
		Fuel Oil	155.5	160.6	170.0	151.5	154.5	163.0
HP SCR** **G95ME-C10.5-GI-HPSCR**	Tier III	Dual Fuel	130.7 + 4.0	133.3 + 3.0	139.6 + 2.5	126.2 + 5.3	127.3 + 4.0	133.0 + 3.3
		Fuel Oil	157.0	161.6	171.0	153.0	155.5	164.0
	Tier II	Dual Fuel	129.4 + 4.0	132.5 + 3.0	139.2 + 2.5	124.9 + 5.3	126.4 + 4.0	132.5 + 3.3
		Fuel Oil	155.5	160.6	170.5	151.5	154.5	163.5
LP SCR **G95ME-C10.5-GI-LPSCR**	Tier III	Dual Fuel	130.3 + 4.0	133.3 + 3.0	140.1 + 2.5	125.7 + 5.3	127.3 + 4.0	133.4 + 3.3
		Fuel Oil	156.5	161.6	171.5	152.5	155.5	164.5
	Tier II	Dual Fuel	129.4 + 4.0	132.5 + 3.0	139.2 + 2.5	124.9 + 5.3	126.4 + 4.0	132.5 + 3.3
		Fuel Oil	155.5	160.6	170.5	151.5	154.5	163.5



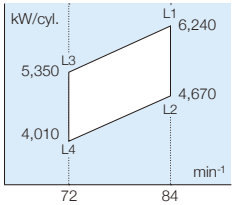
G90ME-C10.5

Bore: 900 mm, Stroke: 3,260 mm

Engine Output [kW]

Cyl.	L1	L2	L3	L4
5	31,200	23,350	26,750	20,050
6	37,440	28,020	32,100	24,060
7	43,680	32,690	37,450	28,070
8	49,920	37,360	42,800	32,080
9	56,160	42,030	48,150	36,090
10	62,400	46,700	53,500	40,100
11	68,640	51,370	58,850	44,110
12	74,880	56,040	64,200	48,120

MEP L1-L3: 2.15 MPa
L2-L4: 1.61 MPa



Fuel Oil SFOC [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	161.5	160.6	165.0	157.5	154.5	158.0
Part load	EGB/HPT	159.5	159.1	167.5	155.5	153.0	160.5
Low load	EGB/HPT	157.5	160.1	167.5	153.5	154.0	160.5

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **G90ME-C10.5-EcoEGR**	Tier III	163.5	162.6	167.0	159.5	156.5	160.0
	Tier II	154.5	155.6	163.0	150.5	149.5	156.0
EGRTC* **G90ME-C10.5-EGRTC**	Tier III	163.5	163.6	169.0	159.5	157.5	162.0
	Tier II	157.5	160.1	167.0	153.5	154.0	160.0
HP SCR** **G90ME-C10.5-HPSCR**	Tier III	159.0	161.1	168.0	155.0	155.0	161.0
	Tier II	157.5	160.1	167.5	153.5	154.0	160.5
LP SCR **G90ME-C10.5-LPSCR**	Tier III	158.5	161.1	168.5	154.5	155.0	161.5
	Tier II	157.5	160.1	167.5	153.5	154.0	160.5

* The SFOC lower than 75% load in Tier II mode is the value with T/C cut-out

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H4
[mm]	14,337	12,452	1,885	5,110	1,490	14,725	13,975

Cylinders:		5	6	7	8	9	10	11	12
L [mm]		9,920	11,410	12,900	14,390	16,550	18,040	19,530	21,020
Dry Mass [t]		892	1,034	1,162	1,316	1,477	1,619	1,786	1,915
Added Dry Mass	EcoEGR [t]	11	13	14	15	29	29	31	33
	EGRTC [t]	11	13	14	15	29	29	31	33
	HP SCR [t]	7	10	15	15	15	**	**	**
	LP SCR [t]	-	-	-	-	-	-	-	-
	GI [t]	7	8	9	10	12	13	14	15

** Available on request for HPSCR

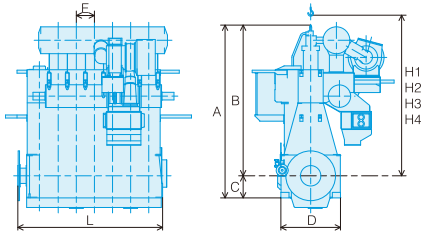
GI (Methane) SGC + SPOC, SFOC [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **G90ME-C10.5-GI**	Dual Fuel	131.2 / 131.6 + 3.9	131.2 / 132.5 + 3.0	138.0 / 138 + 2.5	126.6 / 127.1 + 5.2	125.2 / 126.4 + 4.0	131.3 / 131.3 + 3.3
	Fuel Oil	161.5	163.1	170.0	157.5	157.0	163.0

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR **G90ME-C10.5-GI-EcoEGR**	Tier III	Dual Fuel	136.2 + 4.0	136.3 + 3.0	140.5 + 2.5	131.7 + 5.3	130.2 + 4.1	133.8 + 3.3
		Fuel Oil	163.5	165.1	172.0	159.5	159.0	165.0
	Tier II	Dual Fuel	128.5 + 4.0	130.3 + 3.0	137.1 + 2.5	124.0 + 5.3	124.2 + 4.1	130.4 + 3.3
		Fuel Oil	154.5	158.1	168.0	150.5	152.0	161.0
EGRTC* **G90ME-C10.5-GI-EGRTC**	Tier III	Dual Fuel	136.2 + 4.0	137.1 + 3.1	142.2 + 2.5	131.6 + 5.4	131.0 + 4.1	135.5 + 3.4
		Fuel Oil	163.5	166.1	174.0	159.5	160.0	167.0
	Tier II	Dual Fuel	131.1 + 4.0	134.1 + 3.1	140.5 + 2.5	126.5 + 5.4	128.0 + 4.1	133.7 + 3.4
		Fuel Oil	157.5	162.6	172.0	153.5	156.5	165.0
HP SCR** **G90ME-C10.5-GI-HPSCR**	Tier III	Dual Fuel	132.4 + 4.0	135.0 + 3.1	141.3 + 2.5	127.8 + 5.3	128.9 + 4.1	134.6 + 3.4
		Fuel Oil	159.0	163.6	173.0	155.0	157.5	166.0
	Tier II	Dual Fuel	131.1 + 4.0	134.1 + 3.1	140.9 + 2.5	126.5 + 5.3	128.1 + 4.1	134.2 + 3.4
		Fuel Oil	157.5	162.6	172.5	153.5	156.5	165.5
LP SCR **G90ME-C10.5-GI-LPSCR**	Tier III	Dual Fuel	131.9 + 4.0	135.0 + 3.1	141.7 + 2.5	127.4 + 5.4	128.9 + 4.1	135.0 + 3.4
		Fuel Oil	158.5	163.6	173.5	154.5	157.5	166.5
	Tier II	Dual Fuel	131.1 + 4.0	134.1 + 3.1	140.9 + 2.5	126.5 + 5.4	128.1 + 4.1	134.2 + 3.4
		Fuel Oil	157.5	162.6	172.5	153.5	156.5	165.5



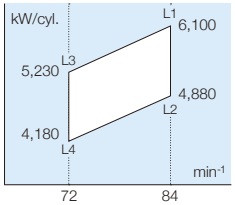
S90ME-C10.5

Bore: 900 mm, Stroke: 3,260 mm

Engine Output [kW]

Cyl.	L1	L2	L3	L4
5	30,500	24,400	26,150	20,900
6	36,600	29,280	31,380	25,080
7	42,700	34,160	36,610	29,260
8	48,800	39,040	41,840	33,440
9	54,900	43,920	47,070	37,620
10	61,000	48,800	52,300	41,800
11	67,100	53,680	57,530	45,980
12	73,200	58,560	62,760	50,160

MEP L1-L3: 2.10 MPa
L2-L4: 1.68 MPa



Fuel Oil SFOC [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	162.5	161.6	166.0	158.5	155.6	160.0
Part load	EGB/HPT	160.5	160.1	168.5	156.5	154.1	162.5
Low load	EGB/HPT	158.5	161.1	168.5	154.5	155.1	162.5

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **S90ME-C10.5-EcoEGR**	Tier III	164.5	163.6	168.0	160.5	157.6	162.0
	Tier II	155.5	156.6	164.0	151.5	150.6	158.0
EGRTC* **S90ME-C10.5-EGRTC**	Tier III	164.5	164.6	170.0	160.5	158.6	164.0
	Tier II	158.5	161.1	168.0	154.5	155.1	162.0
HP SCR** **S90ME-C10.5-HPSCR**	Tier III	160.0	162.1	169.0	156.0	156.1	163.0
	Tier II	158.5	161.1	168.5	154.5	155.1	162.5
LP SCR **S90ME-C10.5-LPSCR**	Tier III	159.5	162.1	169.5	155.5	156.1	163.5
	Tier II	158.5	161.1	168.5	154.5	155.1	162.5

* The SFOC lower than 75% load in Tier II mode is the value with T/C cut-out

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H4
[mm]	14,620	12,720	1,900	5,160	1,590	15,900	14,875

Cylinders:		5	6	7	8	9	10	11	12
L [mm]		10,085	11,675	13,265	14,855	17,725	19,315	20,905	22,495
Dry Mass [t]		953	1,104	1,255	1,446	1,626	1,771	1,942	2,088
Added Dry Mass	EcoEGR [t]	9	12	13	14	14	26	29	31
	EGRTC [t]	9	12	13	14	14	26	29	31
	HP SCR [t]	7	10	15	15	15	**	**	**
	LP SCR [t]	-	-	-	-	-	-	-	-
	GI [t]	7	9	10	11	12	13	15	16

** Available on request for HPSCR

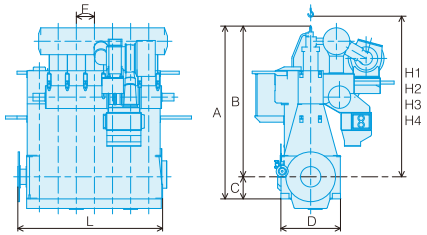
GI (Methane) SGC + SPOC, SFOC [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **S90ME-C10.5-GI**	Dual Fuel	132.0 / 132.4 + 3.9	132.0 / 133.3 + 3.0	138.8 / 138.8 + 2.5	127.8 / 128.2 + 4.9	126.3 / 127.6 + 3.7	133.1 / 133.1 + 3.1
	Fuel Oil	162.5	164.1	171.0	158.5	158.1	165.0

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR **S90ME-C10.5-GI-EcoEGR**	Tier III	Dual Fuel	137.1 + 4.0	137.1 + 3.1	141.3 + 2.5	132.8 + 5.0	131.4 + 3.8	135.7 + 3.2
		Fuel Oil	164.5	166.1	173.0	160.5	160.1	167.0
	Tier II	Dual Fuel	129.4 + 4.0	131.1 + 3.1	137.9 + 2.5	125.1 + 5.0	125.4 + 3.8	132.2 + 3.2
		Fuel Oil	155.5	159.1	169.0	151.5	153.1	163.0
EGRTC* **S90ME-C10.5-GI-EGRTC**	Tier III	Dual Fuel	137.0 + 4.0	137.9 + 3.1	143.0 + 2.6	132.7 + 5.1	132.2 + 3.9	137.3 + 3.2
		Fuel Oil	164.5	167.1	175.0	160.5	161.1	169.0
	Tier II	Dual Fuel	131.9 + 4.0	135.0 + 3.1	141.3 + 2.6	127.6 + 5.1	129.2 + 3.9	135.6 + 3.2
		Fuel Oil	158.5	163.6	173.0	154.5	157.6	167.0
HP SCR** **S90ME-C10.5-GI-HPSCR**	Tier III	Dual Fuel	133.2 + 4.0	135.8 + 3.1	142.2 + 2.5	128.9 + 5.0	130.1 + 3.8	136.5 + 3.2
		Fuel Oil	160.0	164.6	174.0	156.0	158.6	168.0
	Tier II	Dual Fuel	131.9 + 4.0	135.0 + 3.1	141.7 + 2.5	127.6 + 5.0	129.2 + 3.8	136.1 + 3.2
		Fuel Oil	158.5	163.6	173.5	154.5	157.6	167.5
LP SCR **S90ME-C10.5-GI-LPSCR**	Tier III	Dual Fuel	132.8 + 4.0	135.8 + 3.1	142.6 + 2.5	128.5 + 5.0	130.0 + 3.9	136.9 + 3.2
		Fuel Oil	159.5	164.6	174.5	155.5	158.6	168.5
	Tier II	Dual Fuel	131.9 + 4.0	135.0 + 3.1	141.7 + 2.5	127.6 + 5.0	129.2 + 3.9	136.1 + 3.2
		Fuel Oil	158.5	163.6	173.5	154.5	157.6	167.5



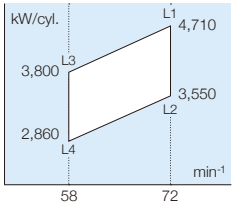
G80ME-C10.5 New Engine

Bore: 800 mm, Stroke: 3,720 mm

Engine Output [kW]

Cyl.	L1	L2	L3	L4
6	28,260	21,300	22,800	17,160
7	32,970	24,850	26,600	20,020
8	37,680	28,400	30,400	22,880
9	42,390	31,950	34,200	25,740

MEP L1-L3: 2.10 MPa
L2-L4: 1.58 MPa



Fuel Oil SFOC [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	160.5	159.6	164.0	156.5	153.5	157.0
Part load	EPT	158.5	158.1	166.5	154.5	152.0	159.5
Low load	EPT	156.5	159.1	166.5	152.5	153.0	159.5

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **G80ME-C10.5-EcoEGR**	Tier III	162.5	161.6	166.0	158.5	155.5	159.0
	Tier II	153.5	154.6	162.0	149.5	148.5	155.0
EGRTC* **G80ME-C10.5-EGRTC**	Tier III	162.5	162.6	168.0	158.5	156.5	161.0
	Tier II	156.5	159.1	166.0	152.5	153.0	159.0
HP SCR **G80ME-C10.5-HPSCR**	Tier III	158.0	160.1	167.0	154.0	154.0	160.0
	Tier II	156.5	159.1	166.5	152.5	153.0	159.5
LP SCR **G80ME-C10.5-LPSCR**	Tier III	157.5	160.1	167.5	153.5	154.0	160.5
	Tier II	156.5	159.1	166.5	152.5	153.0	159.5

* The SFOC lower than 75% load in Tier II mode is the value with T/C cut-out

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H4
[mm]	**	**	**	**	**	**	**

** Available on request

Cylinders:		6	7	8	9
L [mm]		**	**	**	**
Dry Mass [t]		898	1,002	1,115	1,283
Added Dry Mass	EcoEGR [t]	11	12	13	14
	EGRTC [t]	11	12	13	14
	HP SCR [t]	6	10	10	15
	LP SCR [t]	-	-	-	-
	GI [t]	7	8	9	9

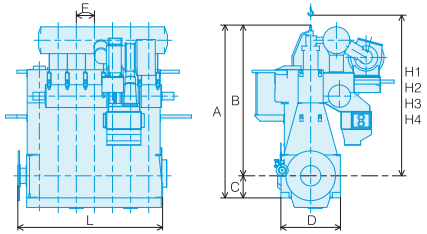
GI (Methane) SGC + SPOC, SFOC [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **G80ME-C10.5-GI**	Dual Fuel	130.3 / 130.8 + 3.9	130.4 / 131.7 + 3.0	137.1 / 137.1 + 2.4	125.8 / 126.3 + 5.1	124.4 / 125.6 + 3.9	130.5 / 130.5 + 3.2
	Fuel Oil	160.5	162.1	169.0	156.5	156.0	162.0

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4	
			50%	75%	100%	50%	75%	100%
EcoEGR **G80ME-C10.5-GI-EcoEGR**	Tier III	Dual Fuel	135.4 + 4.0	135.4 + 3.0	139.6 + 2.5	130.9 + 5.2	129.4 + 4.0	133.0 + 3.3
		Fuel Oil	162.5	164.1	171.0	158.5	158.0	164.0
	Tier II	Dual Fuel	127.7 + 4.0	129.5 + 3.0	136.2 + 2.5	123.2 + 5.2	123.4 + 4.0	129.5 + 3.3
		Fuel Oil	153.5	157.1	167.0	149.5	151.0	160.0
EGRTC* **G80ME-C10.5-GI-EGRTC**	Tier III	Dual Fuel	135.4 + 4.0	136.3 + 3.1	141.3 + 2.5	130.8 + 5.3	130.2 + 4.1	134.6 + 3.3
		Fuel Oil	162.5	165.1	173.0	158.5	159.0	166.0
	Tier II	Dual Fuel	130.2 + 4.0	133.3 + 3.1	139.6 + 2.5	125.7 + 5.3	127.2 + 4.1	132.9 + 3.3
		Fuel Oil	156.5	161.6	171.0	152.5	155.5	164.0
HP SCR **G80ME-C10.5-GI-HPSCR**	Tier III	Dual Fuel	131.5 + 4.0	134.2 + 3.0	140.5 + 2.5	127.0 + 5.3	128.1 + 4.0	133.8 + 3.3
		Fuel Oil	158.0	162.6	172.0	154.0	156.5	165.0
	Tier II	Dual Fuel	130.3 + 4.0	133.3 + 3.0	140.1 + 2.5	125.7 + 5.3	127.3 + 4.0	133.4 + 3.3
		Fuel Oil	156.5	161.6	171.5	152.5	155.5	164.5
LP SCR **G80ME-C10.5-GI-LPSCR**	Tier III	Dual Fuel	131.1 + 4.0	134.1 + 3.0	140.9 + 2.5	126.6 + 5.3	128.1 + 4.0	134.2 + 3.3
		Fuel Oil	157.5	162.6	172.5	153.5	156.5	165.5
	Tier II	Dual Fuel	130.2 + 4.0	133.3 + 3.0	140.0 + 2.5	125.7 + 5.3	127.2 + 4.0	133.4 + 3.3
		Fuel Oil	156.5	161.6	171.0	152.5	155.5	164.5



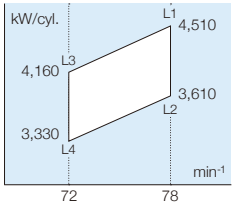
S80ME-C9.5

Bore: 800 mm, Stroke: 3,450 mm

Engine Output [kW]

Cyl.	L1	L2	L3	L4
6	27,060	21,660	24,960	19,980
7	31,570	25,270	29,120	23,310
8	36,080	28,880	33,280	26,640
9	40,590	32,490	37,440	29,970

MEP L1-L3: 2.00 MPa
L2-L4: 1.60 MPa



Fuel Oil SFOC [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	164.5	162.1	166.0	160.5	156.1	160.0
Part load	EGB/HPT	161.5	160.6	167.5	157.5	154.6	161.5
Low load	EGB/HPT	159.5	161.6	167.5	155.5	155.6	161.5

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **S80ME-C9.5-EcoEGR**	Tier III	166.5	164.1	168.0	162.5	158.1	162.0
	Tier II	157.5	157.1	164.0	153.5	151.1	158.0
EGRTC* **S80ME-C9.5-EGRTC**	Tier III	166.5	165.1	170.0	162.5	159.1	164.0
	Tier II	159.5	161.6	167.0	155.5	155.6	161.0
HP SCR **S80ME-C9.5-HPSCR**	Tier III	161.0	162.6	168.0	157.0	156.6	162.0
	Tier II	159.5	161.6	167.5	155.5	155.6	161.5
LP SCR **S80ME-C9.5-LPSCR**	Tier III	160.5	162.6	168.5	156.5	156.6	162.5
	Tier II	159.5	161.6	167.5	155.5	155.6	161.5

* The SFOC lower than 75% load in Tier II mode is the value with T/C cut-out

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H4
[mm]	14,386	12,496	1,890	5,150	1,334	15,640	15,500

Cylinders:		6	7	8	9
L [mm]		10,100	11,434	12,768	14,102
Dry Mass [t]		833	933	1,043	1,153
Added Dry Mass	EcoEGR [t]	11	12	13	14
	EGRTC [t]	11	12	13	14
	HP SCR [t]	6	10	10	15
	LP SCR [t]	-	-	-	-
	GI [t]	7	8	9	10

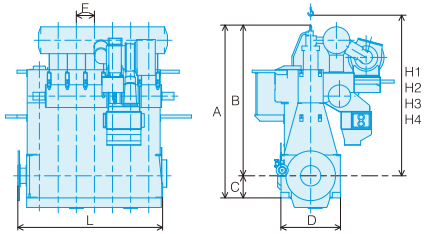
GI (Methane) SGC + SPOC, SFOC [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **S80ME-C9.5-GI**	Dual Fuel	133.7 / 134.1 + 3.9	132.5 / 133.8 + 3.0	138.8 / 138.8 + 2.5	129.5 / 129.9 + 4.9	126.7 / 128 + 3.7	133.1 / 133.1 + 3.1
	Fuel Oil	164.5	164.6	171.0	160.5	158.6	165.0

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR **S80ME-C9.5-GI-EcoEGR**	Tier III	Dual Fuel	138.8 + 4.0	137.6 + 3.1	141.3 + 2.5	134.5 + 5.0	131.8 + 3.8	135.7 + 3.1
		Fuel Oil	166.5	166.6	173.0	162.5	160.6	167.0
	Tier II	Dual Fuel	131.1 + 4.0	131.6 + 3.1	137.9 + 2.5	126.8 + 5.0	125.8 + 3.8	132.2 + 3.1
		Fuel Oil	157.5	159.6	169.0	153.5	153.6	163.0
EGRTC* **S80ME-C9.5-GI-EGRTC**	Tier III	Dual Fuel	138.7 + 4.0	138.4 + 3.1	143.0 + 2.6	134.5 + 5.1	132.6 + 3.9	137.3 + 3.2
		Fuel Oil	166.5	167.6	175.0	162.5	161.6	169.0
	Tier II	Dual Fuel	132.8 + 4.0	135.4 + 3.1	140.4 + 2.6	128.5 + 5.1	129.6 + 3.9	134.8 + 3.2
		Fuel Oil	159.5	164.1	172.0	155.5	158.1	166.0
HP SCR **S80ME-C9.5-GI-HPSCR**	Tier III	Dual Fuel	134.1 + 4.0	136.3 + 3.1	141.3 + 2.5	129.8 + 5.0	130.5 + 3.8	135.7 + 3.1
		Fuel Oil	161.0	165.1	173.0	157.0	159.1	167.0
	Tier II	Dual Fuel	132.8 + 4.0	135.4 + 3.1	140.9 + 2.5	128.5 + 5.0	129.6 + 3.8	135.2 + 3.1
		Fuel Oil	159.5	164.1	172.5	155.5	158.1	166.5
LP SCR **S80ME-C9.5-GI-LPSCR**	Tier III	Dual Fuel	133.6 + 4.0	136.3 + 3.1	141.7 + 2.5	129.4 + 5.0	130.5 + 3.8	136.1 + 3.2
		Fuel Oil	160.5	165.1	173.5	156.5	159.1	167.5
	Tier II	Dual Fuel	132.8 + 4.0	135.4 + 3.1	140.9 + 2.5	128.5 + 5.0	129.6 + 3.8	135.2 + 3.2
		Fuel Oil	159.5	164.1	172.5	155.5	158.1	166.5



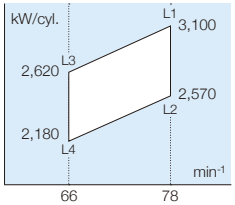
G70ME-C10.5

Bore: 700 mm, Stroke: 3,256 mm

Engine Output [kW]

Cyl.	L1	L2	L3	L4
5	15,500	12,850	13,100	10,900
6	18,600	15,420	15,720	13,080

MEP L1-L3: 1.90 MPa
L2-L4: 1.58 MPa



Fuel Oil SFOC [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	160.4	158.6	163.0	158.3	155.3	158.8
Part load	EGB/HPT	158.4	157.1	165.5	156.3	153.8	161.3
Low load	EGB/HPT	156.4	158.1	165.5	154.3	154.8	161.3

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **G70ME-C10.5-EcoEGR**	Tier III	162.4	160.6	165.0	160.3	157.3	160.8
	Tier II	153.4	153.6	161.0	151.3	150.3	156.8
EGRBP **G70ME-C10.5-EGRBP**	Tier III	163.4	162.6	168.0	161.3	159.3	163.8
	Tier II	156.4	158.1	166.0	154.3	154.8	161.8
HP SCR **G70ME-C10.5-HPSCR**	Tier III	157.9	159.1	166.0	155.8	155.8	161.8
	Tier II	156.4	158.1	165.5	154.3	154.8	161.3
LP SCR **G70ME-C10.5-LPSCR**	Tier III	157.4	159.1	166.5	155.3	155.8	162.3
	Tier II	156.4	158.1	165.5	154.3	154.8	161.3

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1
[mm]	12,733	10,983	1,750	4,470	1,044	

Cylinders:		5	6
L [mm]		7,513	8,557
Dry Mass [t]		521	586
Added Dry Mass	EcoEGR [t]	14	16
	EGRBP [t]	15	16
	HP SCR [t]	4	5
	LP SCR [t]	-	-
	GI [t]	5	6

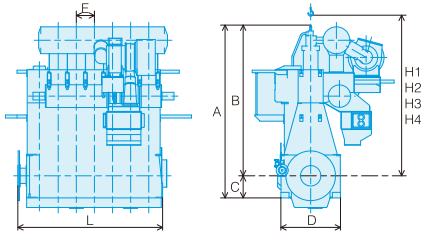
GI (Methane) SGC + SPOC, SFOC [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **G70ME-C10.5-GI**	Dual Fuel	130.4 / 130.6 + 3.9	129.8 / 130.5 + 2.9	136.3 / 136.2 + 2.4	127.9 / 128.2 + 4.7	126.5 / 127.3 + 3.6	132.3 / 132.3 + 2.9
	Fuel Oil	160.4	161.1	168.0	158.3	157.8	163.8

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR **G70ME-C10.5-GI-EcoEGR**	Tier III	Dual Fuel	135.4 + 3.9	134.6 + 3.0	138.8 + 2.5	132.8 + 4.7	131.3 + 3.6	134.7 + 3.0
		Fuel Oil	162.4	163.1	170.0	160.3	159.8	165.8
	Tier II	Dual Fuel	127.7 + 3.9	128.6 + 3.0	135.4 + 2.5	125.2 + 4.7	125.3 + 3.6	131.3 + 3.0
		Fuel Oil	153.4	156.1	166.0	151.3	152.8	161.8
EGRBP **G70ME-C10.5-GI-EGRBP**	Tier III	Dual Fuel	136.1 + 4.0	136.3 + 3.1	141.3 + 2.5	133.6 + 4.8	132.9 + 3.7	137.3 + 3.0
		Fuel Oil	163.4	165.1	173.0	161.3	161.8	168.8
	Tier II	Dual Fuel	130.2 + 4.0	132.4 + 3.1	139.6 + 2.5	127.7 + 4.8	129.1 + 3.7	135.6 + 3.0
		Fuel Oil	156.4	160.6	171.0	154.3	157.3	166.8
HP SCR **G70ME-C10.5-GI-HPSCR**	Tier III	Dual Fuel	131.5 + 4.0	133.3 + 3.0	139.6 + 2.5	129.0 + 4.8	130.0 + 3.6	135.6 + 3.0
		Fuel Oil	157.9	161.6	171.0	155.8	158.3	166.8
	Tier II	Dual Fuel	130.2 + 4.0	132.5 + 3.0	139.2 + 2.5	127.7 + 4.8	129.1 + 3.6	135.2 + 3.0
		Fuel Oil	156.4	160.6	170.5	154.3	157.3	166.3
LP SCR **G70ME-C10.5-GI-LPSCR**	Tier III	Dual Fuel	131.1 + 4.0	133.3 + 3.0	140.0 + 2.5	128.5 + 4.8	130.0 + 3.6	136.0 + 3.0
		Fuel Oil	157.4	161.6	171.5	155.3	158.3	167.3
	Tier II	Dual Fuel	130.2 + 4.0	132.4 + 3.0	139.2 + 2.5	127.7 + 4.8	129.1 + 3.6	135.1 + 3.0
		Fuel Oil	156.4	160.6	170.5	154.3	157.3	166.3



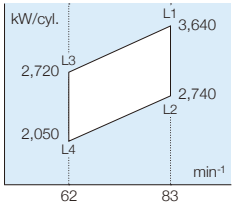
G70ME-C9.5

Bore: 700 mm, Stroke: 3,256 mm

Engine Output [kW]

Cyl.	L1	L2	L3	L4
5	18,200	13,700	13,600	10,250
6	21,840	16,440	16,320	12,300
7	25,480	19,180	19,040	14,350
8	29,120	21,920	21,760	16,400

MEP L1-L3: 2.10 MPa
L2-L4: 1.58 MPa



Fuel Oil SFOC [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	165.5	163.1	167.0	161.5	157.0	160.0
Part load	EGB/HPT	162.5	161.6	168.5	158.5	155.5	161.5
Low load	EGB/HPT	160.5	162.6	168.5	156.5	156.5	161.5

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **G70ME-C9.5-EcoEGR**	Tier III	167.5	165.1	169.0	163.5	159.0	162.0
	Tier II	158.5	158.1	165.0	154.5	152.0	158.0
EGRBP **G70ME-C9.5-EGRBP**	Tier III	168.5	167.1	172.0	164.5	161.0	165.0
	Tier II	160.5	162.6	169.0	156.5	156.5	162.0
HP SCR **G70ME-C9.5-HPSCR**	Tier III	162.0	163.6	169.0	158.0	157.5	162.0
	Tier II	160.5	162.6	168.5	156.5	156.5	161.5
LP SCR **G70ME-C9.5-LPSCR**	Tier III	161.5	163.6	169.5	157.5	157.5	162.5
	Tier II	160.5	162.6	168.5	156.5	156.5	161.5

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H2	H3
[mm]	13,410	11,660	1,750	4,760	1,260	14,820		12,800

Cylinders:		5	6	7	8
L [mm]		8,335	9,595	10,855	12,115
Dry Mass [t]		585	665	750	855
Added Dry Mass	EcoEGR [t]	15	16	17	18
	EGRBP [t]	14	16	17	18
	HP SCR [t]	4	5	6	7
	LP SCR [t]	-	-	-	-
	GI [t]	5	6	7	8

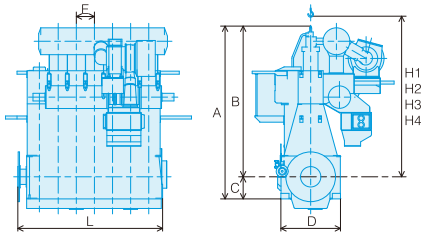
GI (Methane) SGC + SPOC, SFOC [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **G70ME-C9.5-GI**	Dual Fuel	134.5 / 135.0 + 4.0	133.3 / 134.6 + 3.0	139.6 / 139.6 + 2.5	130.0 / 130.5 + 5.3	127.3 / 128.6 + 4.0	133.0 / 133.0 + 3.3
	Fuel Oil	165.5	165.6	172.0	161.5	159.5	165.0

Tier III Engine

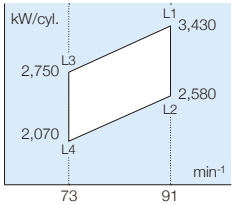
Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR **G70ME-C9.5-GI-EcoEGR**	Tier III	Dual Fuel	139.6 + 4.0	138.4 + 3.1	142.2 + 2.5	135.1 + 5.3	132.3 + 4.1	135.5 + 3.4
		Fuel Oil	167.5	167.6	174.0	163.5	161.5	167.0
	Tier II	Dual Fuel	131.9 + 4.0	132.4 + 3.1	138.7 + 2.5	127.4 + 5.3	126.4 + 4.1	132.1 + 3.4
		Fuel Oil	158.5	160.6	170.0	154.5	154.5	163.0
EGRBP **G70ME-C9.5-GI-EGRBP**	Tier III	Dual Fuel	140.4 + 4.1	140.1 + 3.1	144.7 + 2.6	135.8 + 5.4	134.0 + 4.2	138.0 + 3.4
		Fuel Oil	168.5	169.6	177.0	164.5	163.5	170.0
	Tier II	Dual Fuel	133.6 + 4.1	136.2 + 3.1	142.1 + 2.6	129.0 + 5.4	130.1 + 4.2	135.4 + 3.4
		Fuel Oil	160.5	165.1	174.0	156.5	159.0	167.0
HP SCR **G70ME-C9.5-GI-HPSCR**	Tier III	Dual Fuel	134.9 + 4.0	137.1 + 3.1	142.2 + 2.5	130.4 + 5.3	131.1 + 4.1	135.5 + 3.4
		Fuel Oil	162.0	166.1	174.0	158.0	160.0	167.0
	Tier II	Dual Fuel	133.6 + 4.0	136.3 + 3.1	141.7 + 2.5	129.1 + 5.3	130.2 + 4.1	135.0 + 3.4
		Fuel Oil	160.5	165.1	173.5	156.5	159.0	166.5
LP SCR **G70ME-C9.5-GI-LPSCR**	Tier III	Dual Fuel	134.5 + 4.0	137.1 + 3.1	142.6 + 2.5	129.9 + 5.4	131.0 + 4.1	135.9 + 3.4
		Fuel Oil	161.5	166.1	174.5	157.5	160.0	167.5
	Tier II	Dual Fuel	133.6 + 4.0	136.2 + 3.1	141.7 + 2.5	129.1 + 5.4	130.2 + 4.1	135.0 + 3.4
		Fuel Oil	160.5	165.1	173.5	156.5	159.0	166.5



Engine Output [kW]

Cyl.	L1	L2	L3	L4
5	17,150	12,900	13,750	10,350
6	20,580	15,480	16,500	12,420
7	24,010	18,060	19,250	14,490
8	27,440	20,640	22,000	16,560

MEP L1-L3: 2.10 MPa
L2-L4: 1.58 MPa



Fuel Oil SFOC [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	164.5	162.1	166.0	160.5	156.0	159.0
Part load	EGB/HPT	161.5	160.6	167.5	157.5	154.5	160.5
Low load	EGB/HPT	159.5	161.6	167.5	155.5	155.5	160.5

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **S70ME-C10.5-EcoEGR**	Tier III	166.5	164.1	168.0	162.5	158.0	161.0
	Tier II	157.5	157.1	164.0	153.5	151.0	157.0
EGRBP **S70ME-C10.5-EGRBP**	Tier III	167.5	166.1	171.0	163.5	160.0	164.0
	Tier II	159.5	161.6	168.0	155.5	155.5	161.0
HP SCR **S70ME-C10.5-HPSCR**	Tier III	161.0	162.6	168.0	157.0	156.5	161.0
	Tier II	159.5	161.6	167.5	155.5	155.5	160.5
LP SCR **S70ME-C10.5-LPSCR**	Tier III	160.5	162.6	168.5	156.5	156.5	161.5
	Tier II	159.5	161.6	167.5	155.5	155.5	160.5

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H4
[mm]	11,470	9,950	1,520	4,012	1,098		12,575

Cylinders:		5	6	7	8
L [mm]		7,446	8,544	9,642	10,740
Dry Mass [t]		424	502	563	634
Added Dry Mass	EcoEGR [t]	15	16	17	18
	EGRBP [t]	15	16	17	18
	HP SCR [t]	4	5	6	6
	LP SCR [t]	-	-	-	-
	GI [t]	5	6	7	7

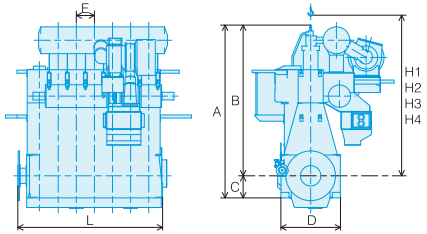
GI (Methane) SGC + SPOC, SFOC [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **S70ME-C10.5-GI**	Dual Fuel	133.7 / 134.1 + 3.9	132.5 / 133.8 + 3.0	138.8 / 138.8 + 2.5	129.2 / 129.6 + 5.2	126.4 / 127.7 + 4.0	132.1 / 132.1 + 3.3
	Fuel Oil	164.5	164.6	171.0	160.5	158.5	164.0

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR **S70ME-C10.5-GI-EcoEGR**	Tier III	Dual Fuel	138.8 + 4.0	137.6 + 3.1	141.3 + 2.5	134.2 + 5.3	131.5 + 4.1	134.6 + 3.4
		Fuel Oil	166.5	166.6	173.0	162.5	160.5	166.0
	Tier II	Dual Fuel	131.1 + 4.0	131.6 + 3.1	137.9 + 2.5	126.5 + 5.3	125.5 + 4.1	131.2 + 3.4
		Fuel Oil	157.5	159.6	169.0	153.5	153.5	162.0
EGRBP **S70ME-C10.5-GI-EGRBP**	Tier III	Dual Fuel	139.6 + 4.1	139.2 + 3.1	143.8 + 2.6	135.0 + 5.4	133.1 + 4.1	137.1 + 3.4
		Fuel Oil	167.5	168.6	176.0	163.5	162.5	169.0
	Tier II	Dual Fuel	132.7 + 4.1	135.4 + 3.1	141.3 + 2.6	128.2 + 5.4	129.3 + 4.1	134.6 + 3.4
		Fuel Oil	159.5	164.1	173.0	155.5	158.0	166.0
HP SCR **S70ME-C10.5-GI-HPSCR**	Tier III	Dual Fuel	134.1 + 4.0	136.3 + 3.1	141.3 + 2.5	129.5 + 5.3	130.2 + 4.1	134.6 + 3.4
		Fuel Oil	161.0	165.1	173.0	157.0	159.0	166.0
	Tier II	Dual Fuel	132.8 + 4.0	135.4 + 3.1	140.9 + 2.5	128.3 + 5.3	129.4 + 4.1	134.2 + 3.4
		Fuel Oil	159.5	164.1	172.5	155.5	158.0	165.5
LP SCR **S70ME-C10.5-GI-LPSCR**	Tier III	Dual Fuel	133.7 + 4.0	136.3 + 3.1	141.7 + 2.5	129.1 + 5.3	130.2 + 4.1	135.1 + 3.4
		Fuel Oil	160.5	165.1	173.5	156.5	159.0	166.5
	Tier II	Dual Fuel	132.8 + 4.0	135.4 + 3.1	140.9 + 2.5	128.3 + 5.3	129.4 + 4.1	134.2 + 3.4
		Fuel Oil	159.5	164.1	172.5	155.5	158.0	165.5



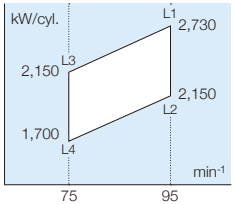
S65ME-C8.6 New Engine

Bore: 650 mm, Stroke: 2,730 mm

Engine Output [kW]

Cyl.	L1	L2	L3	L4
5	13,650	10,750	10,750	8,500
6	16,380	12,900	12,900	10,200
7	19,110	15,050	15,050	11,900
8	21,840	17,200	17,200	13,600

MEP L1-L3: 1.90 MPa
L2-L4: 1.50 MPa



Fuel Oil SFOC [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	164.4	161.6	165.5	161.4	156.9	159.9
Part load	EGB/HPT	161.4	160.1	167.0	158.4	155.4	161.4
Low load	EGB/HPT	159.4	161.1	167.0	156.4	156.4	161.4

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **S65ME-C8.6-EcoEGR**	Tier III	166.4	163.6	167.5	163.4	158.9	161.9
	Tier II	157.4	156.6	163.5	154.4	151.9	157.9
EGRBP **S65ME-C8.6-EGRBP**	Tier III	167.4	165.6	170.5	164.4	160.9	164.9
	Tier II	159.4	161.1	167.5	156.4	156.4	161.9
HP SCR **S65ME-C8.6-HPSCR**	Tier III	160.9	162.1	167.5	157.9	157.4	161.9
	Tier II	159.4	161.1	167.0	156.4	156.4	161.4
LP SCR **S65ME-C8.6-LPSCR**	Tier III	160.4	162.1	168.0	157.4	157.4	162.4
	Tier II	159.4	161.1	167.0	156.4	156.4	161.4

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H2	H3
[mm]	11,539	10,129	1,410	4,124	1,084	12,600		11,025

Cylinders:		5	6	7	8
L [mm]		7,188	8,272	9,356	10,440
Dry Mass [t]		390	460	522	587
Added Dry Mass	EcoEGR [t]	14	15	16	17
	EGRBP [t]	14	15	16	17
	HP SCR [t]	4	5	6	6
	LP SCR [t]	-	-	-	-
	GI [t]	5	5	6	7

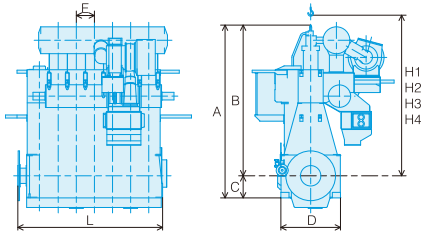
GI (Methane) SGC + SPOC, SFOC [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **S65ME-C8.6-GI**	Dual Fuel	133.7 / 134.1 + 3.9	132.0 / 133.3 + 3.0	138.3 / 138.3 + 2.5	130.2 / 130.6 + 5.0	127.4 / 128.7 + 3.8	133.0 / 133 + 3.1
	Fuel Oil	164.4	164.1	170.5	161.4	159.4	164.9

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR **S65ME-C8.6-GI-EcoEGR**	Tier III	Dual Fuel	138.7 + 4.0	137.1 + 3.0	140.9 + 2.5	135.2 + 5.1	132.4 + 3.9	135.5 + 3.2
		Fuel Oil	166.4	166.1	172.5	163.4	161.4	166.9
	Tier II	Dual Fuel	131.0 + 4.0	131.1 + 3.0	137.4 + 2.5	127.5 + 5.1	126.5 + 3.9	132.1 + 3.2
		Fuel Oil	157.4	159.1	168.5	154.4	154.4	162.9
EGRBP **S65ME-C8.6-GI-EGRBP**	Tier III	Dual Fuel	139.5 + 4.1	138.8 + 3.1	143.4 + 2.6	136.0 + 5.2	134.1 + 3.9	138.1 + 3.2
		Fuel Oil	167.4	168.1	175.5	164.4	163.4	169.9
	Tier II	Dual Fuel	132.7 + 4.1	134.9 + 3.1	140.8 + 2.6	129.2 + 5.2	130.2 + 3.9	135.5 + 3.2
		Fuel Oil	159.4	163.6	172.5	156.4	158.9	166.9
HP SCR **S65ME-C8.6-GI-HPSCR**	Tier III	Dual Fuel	134.0 + 4.0	135.8 + 3.0	140.9 + 2.5	130.5 + 5.1	131.2 + 3.9	135.5 + 3.2
		Fuel Oil	160.9	164.6	172.5	157.9	159.9	166.9
	Tier II	Dual Fuel	132.8 + 4.0	135.0 + 3.0	140.4 + 2.5	129.2 + 5.1	130.3 + 3.9	135.1 + 3.2
		Fuel Oil	159.4	163.6	172.0	156.4	158.9	166.4
LP SCR **S65ME-C8.6-GI-LPSCR**	Tier III	Dual Fuel	133.6 + 4.0	135.8 + 3.1	141.3 + 2.5	130.1 + 5.1	131.1 + 3.9	136.0 + 3.2
		Fuel Oil	160.4	164.6	173.0	157.4	159.9	167.4
	Tier II	Dual Fuel	132.7 + 4.0	135.0 + 3.1	140.4 + 2.5	129.2 + 5.1	130.3 + 3.9	135.1 + 3.2
		Fuel Oil	159.4	163.6	172.0	156.4	158.9	166.4



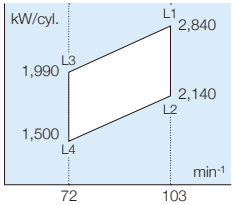
G60ME-C10.5 New Engine

Bore: 600 mm, Stroke: 2,790 mm

Engine Output [kW]

Cyl.	L1	L2	L3	L4
5	14,200	10,700	9,950	7,500
6	17,040	12,840	11,940	9,000
7	19,880	14,980	13,930	10,500
8	22,720	17,120	15,920	12,000

MEP L1-L3: 2.10 MPa
L2-L4: 1.58 MPa



Fuel Oil SFOC [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	161.5	160.6	165.0	157.5	154.5	158.0
Part load	EPT	159.5	159.1	167.5	155.5	153.0	160.5
Low load	EPT	157.5	160.1	167.5	153.5	154.0	160.5

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **G60ME-C10.5-EcoEGR**	Tier III	163.5	162.6	167.0	159.5	156.5	160.0
	Tier II	154.5	155.6	163.0	150.5	149.5	156.0
EGRBP **G60ME-C10.5-EGRBP**	Tier III	164.5	164.6	170.0	160.5	158.5	163.0
	Tier II	157.5	160.1	168.0	153.5	154.0	161.0
HP SCR **G60ME-C10.5-HPSCR**	Tier III	159.0	161.1	168.0	155.0	155.0	161.0
	Tier II	157.5	160.1	167.5	153.5	154.0	160.5
LP SCR **G60ME-C10.5-LPSCR**	Tier III	158.5	161.1	168.5	154.5	155.0	161.5
	Tier II	157.5	160.1	167.5	153.5	154.0	160.5

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H2	H3
[mm]			1,500	4,090	1,080	12,750		11,075

Cylinders:		5	6	7	8
L [mm]		7,390	8,470	9,550	10,630
Dry Mass [t]		395	439	491	543
Added Dry Mass	EcoEGR [t]	14	14	15	16
	EGRBP [t]	14	14	15	16
	HP SCR [t]	3	4	5	5
	LP SCR [t]	-	-	-	-
	GI [t]	5	6	7	7

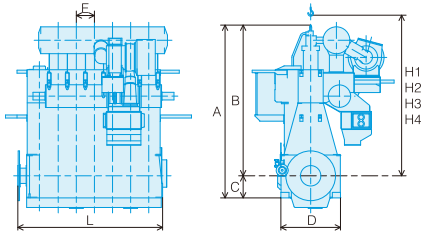
GI (Methane) SGC + SPOC, SFOC [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **G60ME-C10.5-GI**	Dual Fuel	131.2 / 131.6 + 3.9	131.2 / 132.5 + 3.0	138.0 / 138 + 2.5	126.7 / 127.1 + 5.2	125.2 / 126.5 + 4.0	131.3 / 131.3 + 3.3
	Fuel Oil	161.5	163.1	170.0	157.5	157.0	163.0

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR **G60ME-C10.5-GI-EcoEGR**	Tier III	Dual Fuel	136.2 + 4.0	136.3 + 3.0	140.5 + 2.5	131.7 + 5.3	130.2 + 4.0	133.8 + 3.3
		Fuel Oil	163.5	165.1	172.0	159.5	159.0	165.0
	Tier II	Dual Fuel	128.5 + 4.0	130.3 + 3.0	137.1 + 2.5	124.0 + 5.3	124.3 + 4.0	130.4 + 3.3
		Fuel Oil	154.5	158.1	168.0	150.5	152.0	161.0
EGRBP **G60ME-C10.5-GI-EGRBP**	Tier III	Dual Fuel	137.0 + 4.0	137.9 + 3.1	143.0 + 2.6	132.5 + 5.4	131.9 + 4.1	136.3 + 3.4
		Fuel Oil	164.5	167.1	175.0	160.5	161.0	168.0
	Tier II	Dual Fuel	131.0 + 4.0	134.1 + 3.1	141.3 + 2.6	126.5 + 5.4	128.0 + 4.1	134.6 + 3.4
		Fuel Oil	157.5	162.6	173.0	153.5	156.5	166.0
HP SCR **G60ME-C10.5-GI-HPSCR**	Tier III	Dual Fuel	132.4 + 4.0	135.0 + 3.1	141.3 + 2.5	127.8 + 5.3	128.9 + 4.1	134.6 + 3.3
		Fuel Oil	159.0	163.6	173.0	155.0	157.5	166.0
	Tier II	Dual Fuel	131.1 + 4.0	134.1 + 3.1	140.9 + 2.5	126.6 + 5.3	128.1 + 4.1	134.2 + 3.3
		Fuel Oil	157.5	162.6	172.5	153.5	156.5	165.5
LP SCR **G60ME-C10.5-GI-LPSCR**	Tier III	Dual Fuel	131.9 + 4.0	135.0 + 3.1	141.7 + 2.5	127.4 + 5.3	128.9 + 4.1	135.1 + 3.4
		Fuel Oil	158.5	163.6	173.5	154.5	157.5	166.5
	Tier II	Dual Fuel	131.1 + 4.0	134.1 + 3.1	140.9 + 2.5	126.5 + 5.3	128.1 + 4.1	134.2 + 3.4
		Fuel Oil	157.5	162.6	172.5	153.5	156.5	165.5



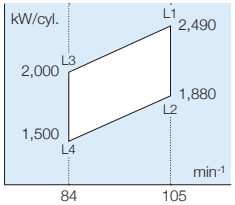
S60ME-C10.5 New Engine

Bore: 600 mm, Stroke: 2,400 mm

Engine Output [kW]

Cyl.	L1	L2	L3	L4
5	12,450	9,400	10,000	7,500
6	14,940	11,280	12,000	9,000
7	17,430	13,160	14,000	10,500
8	19,920	15,040	16,000	12,000

MEP L1-L3: 2.10 MPa
L2-L4: 1.58 MPa



Fuel Oil SFOC [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	164.5	162.1	166.0	160.5	156.0	159.0
Part load	EGB/HPT	161.5	160.6	167.5	157.5	154.5	160.5
Low load	EGB/HPT	159.5	161.6	167.5	155.5	155.5	160.5

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **S60ME-C10.5-EcoEGR**	Tier III	166.5	164.1	168.0	162.5	158.0	161.0
	Tier II	157.5	157.1	164.0	153.5	151.0	157.0
EGRBP **S60ME-C10.5-EGRBP**	Tier III	167.5	166.1	171.0	163.5	160.0	164.0
	Tier II	159.5	161.6	168.0	155.5	155.5	161.0
HP SCR **S60ME-C10.5-HPSCR**	Tier III	161.0	162.6	168.0	157.0	156.5	161.0
	Tier II	159.5	161.6	167.5	155.5	155.5	160.5
LP SCR **S60ME-C10.5-LPSCR**	Tier III	160.5	162.6	168.5	156.5	156.5	161.5
	Tier II	159.5	161.6	167.5	155.5	155.5	160.5

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H2	H3
[mm]	9,825	8,525	1,300	3,420	940	10,950		10,125

Cylinders:		5	6	7	8
L [mm]		6,502	7,442	8,382	9,322
Dry Mass [t]		293	332	369	425
Added Dry Mass	EcoEGR [t]	14	14	15	16
	EGRBP [t]	14	14	15	16
	HP SCR [t]	3	4	5	5
	LP SCR [t]	-	-	-	-
	GI [t]	5	5	6	7

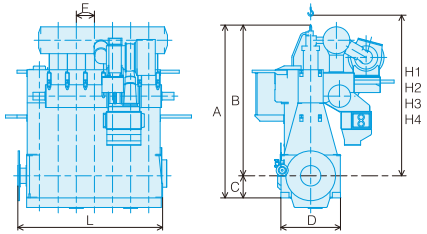
GI (Methane) SGC + SPOC, SFOC [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **S60ME-C10.5-GI**	Dual Fuel	133.7 / 134.2 + 3.9	132.5 / 133.8 + 3.0	138.8 / 138.8 + 2.5	129.2 / 129.6 + 5.2	126.5 / 127.7 + 4.0	132.1 / 132.1 + 3.3
	Fuel Oil	164.5	164.6	171.0	160.5	158.5	164.0

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR **S60ME-C10.5-GI-EcoEGR**	Tier III	Dual Fuel	138.8 + 4.0	137.6 + 3.1	141.3 + 2.5	134.3 + 5.3	131.5 + 4.0	134.6 + 3.3
		Fuel Oil	166.5	166.6	173.0	162.5	160.5	166.0
	Tier II	Dual Fuel	131.1 + 4.0	131.6 + 3.1	137.9 + 2.5	126.6 + 5.3	125.5 + 4.0	131.2 + 3.3
		Fuel Oil	157.5	159.6	169.0	153.5	153.5	162.0
EGRBP **S60ME-C10.5-GI-EGRBP**	Tier III	Dual Fuel	139.6 + 4.1	139.2 + 3.1	143.8 + 2.6	135.0 + 5.4	133.2 + 4.1	137.2 + 3.4
		Fuel Oil	167.5	168.6	176.0	163.5	162.5	169.0
	Tier II	Dual Fuel	132.7 + 4.1	135.4 + 3.1	141.3 + 2.6	128.2 + 5.4	129.3 + 4.1	134.6 + 3.4
		Fuel Oil	159.5	164.1	173.0	155.5	158.0	166.0
HP SCR **S60ME-C10.5-GI-HPSCR**	Tier III	Dual Fuel	134.1 + 4.0	136.3 + 3.1	141.3 + 2.5	129.6 + 5.3	130.2 + 4.0	134.6 + 3.3
		Fuel Oil	161.0	165.1	173.0	157.0	159.0	166.0
	Tier II	Dual Fuel	132.8 + 4.0	135.4 + 3.1	140.9 + 2.5	128.3 + 5.3	129.4 + 4.0	134.2 + 3.3
		Fuel Oil	159.5	164.1	172.5	155.5	158.0	165.5
LP SCR **S60ME-C10.5-GI-LPSCR**	Tier III	Dual Fuel	133.6 + 4.0	136.3 + 3.1	141.7 + 2.5	129.1 + 5.3	130.2 + 4.1	135.1 + 3.3
		Fuel Oil	160.5	165.1	173.5	156.5	159.0	166.5
	Tier II	Dual Fuel	132.8 + 4.0	135.4 + 3.1	140.9 + 2.5	128.3 + 5.3	129.4 + 4.1	134.2 + 3.3
		Fuel Oil	159.5	164.1	172.5	155.5	158.0	165.5



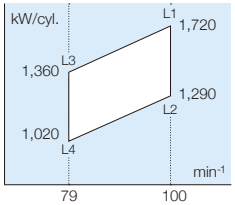
G50ME-C9.6

Bore: 500 mm, Stroke: 2,500 mm

Engine Output [kW]

Cyl.	L1	L2	L3	L4
5	8,600	6,450	6,800	5,100
6	10,320	7,740	8,160	6,120
7	12,040	9,030	9,520	7,140
8	13,760	10,320	10,880	8,160
9	15,480	11,610	12,240	9,180

MEP L1-L3: 2.10 MPa
L2-L4: 1.58 MPa



Fuel Oil SFOC [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	163.5	162.6	167.0	159.5	156.5	160.0
Part load	EGB/HPT	161.5	161.1	169.5	157.5	155.0	162.5
Low load	EGB/HPT	159.5	162.1	169.5	155.5	156.0	162.5

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **G50ME-C9.6-EcoEGR**	Tier III	165.5	164.6	169.0	161.5	158.5	162.0
	Tier II	156.5	157.6	165.0	152.5	151.5	158.0
EGRBP **G50ME-C9.6-EGRBP**	Tier III	166.5	166.6	172.0	162.5	160.5	165.0
	Tier II	159.5	162.1	170.0	155.5	156.0	163.0
HP SCR **G50ME-C9.6-HPSCR**	Tier III	161.0	163.1	170.0	157.0	157.0	163.0
	Tier II	159.5	162.1	169.5	155.5	156.0	162.5
LP SCR **G50ME-C9.6-LPSCR**	Tier III	160.5	163.1	170.5	156.5	157.0	163.5
	Tier II	159.5	162.1	169.5	155.5	156.0	162.5

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H2	H3
[mm]	9,962	8,757	1,205	3,776	872	11,300	10,649	9,775

Cylinders:		5	6	7	8	9
L [mm]		5,779	6,651	7,523	8,395	9,267
Dry Mass [t]		210	245	275	310	345
Added Dry Mass	EcoEGR [t]	6	8	9	10	12
	EGRBP [t]	6	8	9	10	12
	HP SCR [t]	4	4	5	6	6
	LP SCR [t]	-	-	-	-	-
	GI [t]	4	4	5	5	6

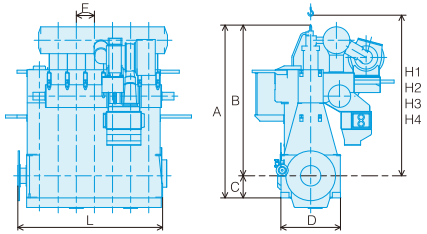
GI (Methane) SGC + SPOC, SFOC [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **G50ME-C9.6-GI**	Dual Fuel	132.8 / 133.3 + 4.0	132.9 / 134.2 + 3.0	139.6 / 139.6 + 2.5	128.3 / 128.7 + 5.3	126.8 / 128.1 + 4.0	133.0 / 133.0 + 3.3
	Fuel Oil	163.5	165.1	172.0	159.5	159.0	165.0

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR **G50ME-C9.6-GI-EcoEGR**	Tier III	Dual Fuel	137.9 + 4.0	138.0 + 3.1	142.2 + 2.5	133.3 + 5.4	131.9 + 4.1	135.5 + 3.4
		Fuel Oil	165.5	167.1	174.0	161.5	161.0	167.0
	Tier II	Dual Fuel	130.2 + 4.0	132.0 + 3.1	138.7 + 2.5	125.7 + 5.4	125.9 + 4.1	132.0 + 3.4
		Fuel Oil	156.5	160.1	170.0	152.5	154.0	163.0
EGRBP **G50ME-C9.6-GI-EGRBP**	Tier III	Dual Fuel	138.7 + 4.1	139.6 + 3.1	144.7 + 2.6	134.1 + 5.5	133.5 + 4.2	138.0 + 3.4
		Fuel Oil	166.5	169.1	177.0	162.5	163.0	170.0
	Tier II	Dual Fuel	132.7 + 4.1	135.8 + 3.1	143.0 + 2.6	128.1 + 5.5	129.7 + 4.2	136.3 + 3.4
		Fuel Oil	159.5	164.6	175.0	155.5	158.5	168.0
HP SCR **G50ME-C9.6-GI-HPSCR**	Tier III	Dual Fuel	134.0 + 4.0	136.7 + 3.1	143.0 + 2.6	129.5 + 5.4	130.6 + 4.1	136.3 + 3.4
		Fuel Oil	161.0	165.6	175.0	157.0	159.5	168.0
	Tier II	Dual Fuel	132.8 + 4.0	135.8 + 3.1	142.6 + 2.6	128.2 + 5.4	129.7 + 4.1	135.9 + 3.4
		Fuel Oil	159.5	164.6	174.5	155.5	158.5	167.5
LP SCR **G50ME-C9.6-GI-LPSCR**	Tier III	Dual Fuel	133.6 + 4.1	136.7 + 3.1	143.4 + 2.6	129.0 + 5.4	130.6 + 4.1	136.7 + 3.4
		Fuel Oil	160.5	165.6	175.5	156.5	159.5	168.5
	Tier II	Dual Fuel	132.7 + 4.1	135.8 + 3.1	142.6 + 2.6	128.2 + 5.4	129.7 + 4.1	135.9 + 3.4
		Fuel Oil	159.5	164.6	174.5	155.5	158.5	167.5



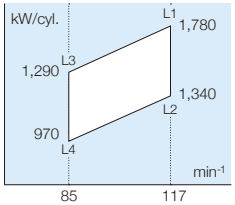
S50ME-C9.7 New Engine

Bore: 500 mm, Stroke: 2,214 mm

Engine Output [kW]

Cyl.	L1	L2	L3	L4
5	8,900	6,700	6,450	4,850
6	10,680	8,040	7,740	5,820
7	12,460	9,380	9,030	6,790
8	14,240	10,720	10,320	7,760
9	16,020	12,060	11,610	8,730

MEP L1-L3: 2.10 MPa
L2-L4: 1.58 MPa



Fuel Oil SFOC [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	161.5	160.6	165.0	157.5	154.5	158.0
Part load	EGB/HPT	159.5	159.1	167.5	155.5	153.0	160.5
Low load	EGB/HPT	157.5	160.1	167.5	153.5	154.0	160.5

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **S50ME-C9.7-EcoEGR**	Tier III	163.5	162.6	167.0	159.5	156.5	160.0
	Tier II	154.5	155.6	163.0	150.5	149.5	156.0
EGRBP **S50ME-C9.7-EGRBP**	Tier III	164.5	164.6	170.0	160.5	158.5	163.0
	Tier II	157.5	160.1	168.0	153.5	154.0	161.0
HP SCR **S50ME-C9.7-HPSCR**	Tier III	159.0	161.1	168.0	155.0	155.0	161.0
	Tier II	157.5	160.1	167.5	153.5	154.0	160.5
LP SCR **S50ME-C9.7-LPSCR**	Tier III	158.5	161.1	168.5	154.5	155.0	161.5
	Tier II	157.5	160.1	167.5	153.5	154.0	160.5

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H2	H3
[mm]	9,320	8,130	1,190	3,350	875	10,232		8,850

Cylinders:		5	6	7	8	9
L [mm]		5,757	6,632	7,507	8,382	9,257
Dry Mass [t]		193	223	259	289	320
Added Dry Mass	EcoEGR [t]	7	8	9	11	12
	EGRBP [t]	7	8	9	11	12
	HP SCR [t]	4	4	5	6	7
	LP SCR [t]	-	-	-	-	-
	GI [t]	4	4	5	5	6

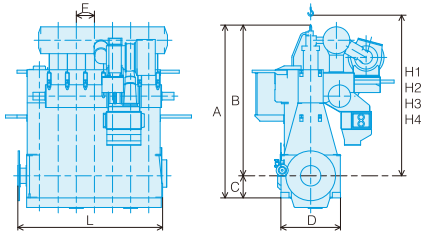
GI (Methane) SGC + SPOC, SFOC [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **S50ME-C9.7-GI**	Dual Fuel	131.2 / 131.6 + 3.9	131.2 / 132.5 + 3.0	138.0 / 138.0 + 2.5	126.7 / 127.1 + 5.2	125.2 / 126.5 + 4.0	131.3 / 131.3 + 3.3
	Fuel Oil	161.5	163.1	170.0	157.5	157.0	163.0

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR **S50ME-C9.7-GI-EcoEGR**	Tier III	Dual Fuel	136.2 + 4.0	136.3 + 3.0	140.5 + 2.5	131.7 + 5.3	130.2 + 4.0	133.8 + 3.3
		Fuel Oil	163.5	165.1	172.0	159.5	159.0	165.0
	Tier II	Dual Fuel	128.5 + 4.0	130.3 + 3.0	137.1 + 2.5	124.0 + 5.3	124.3 + 4.0	130.4 + 3.3
		Fuel Oil	154.5	158.1	168.0	150.5	152.0	161.0
EGRBP **S50ME-C9.7-GI-EGRBP**	Tier III	Dual Fuel	137.0 + 4.0	137.9 + 3.1	143.0 + 2.6	132.5 + 5.4	131.9 + 4.1	136.3 + 3.4
		Fuel Oil	164.5	167.1	175.0	160.5	161.0	168.0
	Tier II	Dual Fuel	131.0 + 4.0	134.1 + 3.1	141.3 + 2.6	126.5 + 5.4	128.0 + 4.1	134.6 + 3.4
		Fuel Oil	157.5	162.6	173.0	153.5	156.5	166.0
HP SCR **S50ME-C9.7-GI-HPSCR**	Tier III	Dual Fuel	132.4 + 4.0	135.0 + 3.1	141.3 + 2.5	127.8 + 5.3	128.9 + 4.1	134.6 + 3.3
		Fuel Oil	159.0	163.6	173.0	155.0	157.5	166.0
	Tier II	Dual Fuel	131.1 + 4.0	134.1 + 3.1	140.9 + 2.5	126.6 + 5.3	128.1 + 4.1	134.2 + 3.3
		Fuel Oil	157.5	162.6	172.5	153.5	156.5	165.5
LP SCR **S50ME-C9.7-GI-LPSCR**	Tier III	Dual Fuel	131.9 + 4.0	135.0 + 3.1	141.7 + 2.5	127.4 + 5.3	128.9 + 4.1	135.1 + 3.4
		Fuel Oil	158.5	163.6	173.5	154.5	157.5	166.5
	Tier II	Dual Fuel	131.1 + 4.0	134.1 + 3.1	140.9 + 2.5	126.5 + 5.3	128.1 + 4.1	134.2 + 3.4
		Fuel Oil	157.5	162.6	172.5	153.5	156.5	165.5



S50ME-C8.5

Bore: 500 mm, Stroke: 2,000 mm

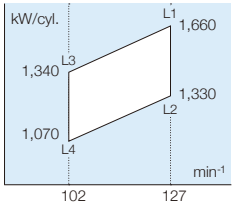
Engine Output* [kW]

Cyl.	L1	L2	L3	L4
5	8,300	6,650	6,700	5,350
6	9,960	7,980	8,040	6,420
7	11,620	9,310	9,380	7,490
8	13,280	10,640	10,720	8,560
9	14,940	11,970	12,060	9,630

* For 10 Cyl. engine (10S50ME-C8.5), please contact us.

This engine type has the extended layout area, please see page 86

MEP L1-L3: 2.00 MPa
L2-L4: 1.60 MPa



Fuel Oil SFOC [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	168.5	166.1	170.0	164.5	160.1	164.0
Part load	EGB/HPT	165.5	164.6	171.5	161.5	158.6	165.5
Low load	EGB/HPT	163.5	165.6	171.5	159.5	159.6	165.5

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **S50ME-C8.5-EcoEGR**	Tier III	170.5	168.1	172.0	166.5	162.1	166.0
	Tier II	161.5	161.1	168.0	157.5	155.1	162.0
EGRBP **S50ME-C8.5-EGRBP**	Tier III	171.5	170.1	175.0	167.5	164.1	169.0
	Tier II	163.5	165.6	172.0	159.5	159.6	166.0
HP SCR **S50ME-C8.5-HPSCR**	Tier III	165.0	166.6	172.0	161.0	160.6	166.0
	Tier II	163.5	165.6	171.5	159.5	159.6	165.5
LP SCR **S50ME-C8.5-LPSCR**	Tier III	164.5	166.6	172.5	160.5	160.6	166.5
	Tier II	163.5	165.6	171.5	159.5	159.6	165.5

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H2	H3
[mm]	8,707	7,619	1,088	3,150	850	9,500	8,828	8,250

Cylinders:		5	6	7	8	9
L [mm]		5,589	6,439	7,289	8,139	8,989
Dry Mass [t]		180	210	240	270	295
Added Dry Mass	EcoEGR [t]	6	7	9	10	11
	EGRBP [t]	6	7	9	10	11
	HP SCR [t]	3	4	5	5	6
	LP SCR [t]	-	-	-	-	-
	GI [t]	4	4	5	5	6

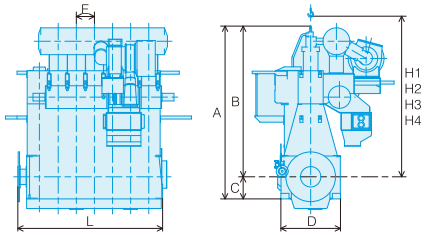
GI (Methane) SGC + SPOC, SFOC [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **S50ME-C8.5-GI**	Dual Fuel	137.0 / 137.5 + 4.0	135.8 / 137.1 + 3.1	142.2 / 142.2 + 2.5	132.8 / 133.2 + 5.0	130.1 / 131.3 + 3.8	136.5 / 136.5 + 3.2
	Fuel Oil	168.5	168.6	175.0	164.5	162.6	169.0

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR **S50ME-C8.5-GI-EcoEGR**	Tier III	Dual Fuel	142.1 + 4.1	140.9 + 3.1	144.7 + 2.6	137.8 + 5.1	135.1 + 3.9	139.0 + 3.2
		Fuel Oil	170.5	170.6	177.0	166.5	164.6	171.0
	Tier II	Dual Fuel	134.4 + 4.1	134.9 + 3.1	141.3 + 2.6	130.1 + 5.1	129.1 + 3.9	135.6 + 3.2
		Fuel Oil	161.5	163.6	173.0	157.5	157.6	167.0
EGRBP **S50ME-C8.5-GI-EGRBP**	Tier III	Dual Fuel	142.9 + 4.2	142.6 + 3.2	147.2 + 2.6	138.6 + 5.2	136.8 + 4.0	141.5 + 3.3
		Fuel Oil	171.5	172.6	180.0	167.5	166.6	174.0
	Tier II	Dual Fuel	136.1 + 4.2	138.7 + 3.2	144.6 + 2.6	131.8 + 5.2	132.9 + 4.0	139.0 + 3.3
		Fuel Oil	163.5	168.1	177.0	159.5	162.1	171.0
HP SCR **S50ME-C8.5-GI-HPSCR**	Tier III	Dual Fuel	137.4 + 4.1	139.6 + 3.1	144.7 + 2.6	133.1 + 5.1	133.8 + 3.9	139.0 + 3.2
		Fuel Oil	165.0	169.1	177.0	161.0	163.1	171.0
	Tier II	Dual Fuel	136.1 + 4.1	138.8 + 3.1	144.3 + 2.6	131.8 + 5.1	133.0 + 3.9	138.6 + 3.2
		Fuel Oil	163.5	168.1	176.5	159.5	162.1	170.5
LP SCR **S50ME-C8.5-GI-LPSCR**	Tier III	Dual Fuel	137.0 + 4.1	139.6 + 3.1	145.1 + 2.6	132.7 + 5.1	133.8 + 3.9	139.4 + 3.2
		Fuel Oil	164.5	169.1	177.5	160.5	163.1	171.5
	Tier II	Dual Fuel	136.1 + 4.1	138.8 + 3.1	144.3 + 2.6	131.8 + 5.1	133.0 + 3.9	138.6 + 3.2
		Fuel Oil	163.5	168.1	176.5	159.5	162.1	170.5



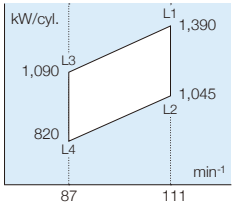
G45ME-C9.5

Bore: 450 mm, Stroke: 2,250 mm

Engine Output [kW]

Cyl.	L1	L2	L3	L4
5	6,950	5,225	5,450	4,100
6	8,340	6,270	6,540	4,920
7	9,730	7,315	7,630	5,740
8	11,120	8,360	8,720	6,560

MEP L1-L3: 2.10 MPa
L2-L4: 1.58 MPa



Fuel Oil SFOC [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	168.5	166.1	170.0	164.5	160.0	163.0
Part load	EGB/HPT	165.5	164.6	171.5	161.5	158.5	164.5
Low load	EGB/HPT	163.5	165.6	171.5	159.5	159.5	164.5

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **G45ME-C9.5-EcoEGR**	Tier III	170.5	168.1	172.0	166.5	162.0	165.0
	Tier II	161.5	161.1	168.0	157.5	155.0	161.0
EGRBP **G45ME-C9.5-EGRBP**	Tier III	171.5	170.1	175.0	167.5	164.0	168.0
	Tier II	163.5	165.6	172.0	159.5	159.5	165.0
HP SCR **G45ME-C9.5-HPSCR**	Tier III	165.0	166.6	172.0	161.0	160.5	165.0
	Tier II	163.5	165.6	171.5	159.5	159.5	164.5
LP SCR **G45ME-C9.5-LPSCR**	Tier III	164.5	166.6	172.5	160.5	160.5	165.5
	Tier II	163.5	165.6	171.5	159.5	159.5	164.5

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H2	H3
[mm]	9,063	7,894	1,169	3,260	784	10,220		9,250

Cylinders:		5	6	7	8
L [mm]		5,209	5,993	6,777	7,561
Dry Mass [t]		163	183	206	234
Added Dry Mass	EcoEGR [t]	5	6	7	8
	EGRBP [t]	5	6	7	8
	HP SCR [t]	3	3	4	5
	LP SCR [t]	-	-	-	-
	GI [t]	4	4	5	5

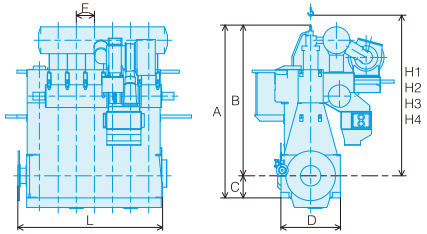
GI (Methane) SGC + SPOC, SFOC [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **G45ME-C9.5-GI**	Dual Fuel	137.0 / 137.5 + 4.0	135.8 / 137.1 + 3.1	142.2 / 142.2 + 2.5	132.5 / 132.9 + 5.4	129.8 / 131.1 + 4.1	135.5 / 135.5 + 3.4
	Fuel Oil	168.5	168.6	175.0	164.5	162.5	168.0

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR **G45ME-C9.5-GI-EcoEGR**	Tier III	Dual Fuel	142.1 + 4.1	140.9 + 3.1	144.7 + 2.6	137.5 + 5.4	134.8 + 4.2	138.0 + 3.4
		Fuel Oil	170.5	170.6	177.0	166.5	164.5	170.0
	Tier II	Dual Fuel	134.4 + 4.1	134.9 + 3.1	141.3 + 2.6	129.9 + 5.4	128.9 + 4.2	134.6 + 3.4
		Fuel Oil	161.5	163.6	173.0	157.5	157.5	166.0
EGRBP **G45ME-C9.5-GI-EGRBP**	Tier III	Dual Fuel	142.9 + 4.2	142.6 + 3.2	147.2 + 2.6	138.3 + 5.5	136.5 + 4.2	140.5 + 3.5
		Fuel Oil	171.5	172.6	180.0	167.5	166.5	173.0
	Tier II	Dual Fuel	136.1 + 4.2	138.7 + 3.2	144.6 + 2.6	131.5 + 5.5	132.6 + 4.2	137.9 + 3.5
		Fuel Oil	163.5	168.1	177.0	159.5	162.0	170.0
HP SCR **G45ME-C9.5-GI-HPSCR**	Tier III	Dual Fuel	137.4 + 4.1	139.6 + 3.1	144.7 + 2.6	132.8 + 5.4	133.6 + 4.2	138.0 + 3.4
		Fuel Oil	165.0	169.1	177.0	161.0	163.0	170.0
	Tier II	Dual Fuel	136.1 + 4.1	138.8 + 3.1	144.3 + 2.6	131.6 + 5.4	132.7 + 4.2	137.6 + 3.4
		Fuel Oil	163.5	168.1	176.5	159.5	162.0	169.5
LP SCR **G45ME-C9.5-GI-LPSCR**	Tier III	Dual Fuel	137.0 + 4.1	139.6 + 3.1	145.1 + 2.6	132.4 + 5.5	133.5 + 4.2	138.4 + 3.4
		Fuel Oil	164.5	169.1	177.5	160.5	163.0	170.5
	Tier II	Dual Fuel	136.1 + 4.1	138.8 + 3.1	144.3 + 2.6	131.5 + 5.5	132.7 + 4.2	137.5 + 3.4
		Fuel Oil	163.5	168.1	176.5	159.5	162.0	169.5



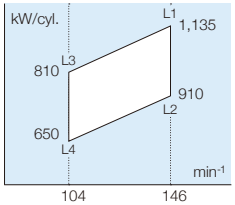
S40ME-C9.5 New Engine

Bore: 400 mm, Stroke: 1,770 mm

Engine Output [kW]

Cyl.	L1	L2	L3	L4
5	5,675	4,550	4,050	3,250
6	6,810	5,460	4,860	3,900
7	7,945	6,370	5,670	4,550
8	9,080	7,280	6,480	5,200
9	10,215	8,190	7,290	5,850

MEP L1-L3: 2.10 MPa
L2-L4: 1.68 MPa



Fuel Oil SFOC* [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	170.5	168.1	172.0	166.5	164.1	168.0
Part load	EGB/HPT	167.5	166.6	173.5	163.5	162.6	169.5
Low load	EGB/HPT	165.5	167.6	173.5	161.5	163.6	169.5

* The SFOC excludes the consumption of the electric HPS

Tier III Engine

Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
EcoEGR **S40ME-C9.5-EcoEGR**	Tier III	172.5	170.1	174.0	168.5	166.1	170.0
	Tier II	163.5	163.1	170.0	159.5	159.1	166.0
EGRBP **S40ME-C9.5-EGRBP**	Tier III	173.5	172.1	177.0	169.5	168.1	173.0
	Tier II	165.5	167.6	174.0	161.5	163.6	170.0
HP SCR **S40ME-C9.5-HPSCR**	Tier III	167.0	168.6	174.0	163.0	164.6	170.0
	Tier II	165.5	167.6	173.5	161.5	163.6	169.5
LP SCR **S40ME-C9.5-LPSCR**	Tier III	166.5	168.6	174.5	162.5	164.6	170.5
	Tier II	165.5	167.6	173.5	161.5	163.6	169.5

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H2	H3
[mm]	7,430	6,480	950	2,650	700	8,250		7,200

Cylinders:		5	6	7	8	9
L [mm]		4,698	5,398	6,098	6,798	7,498
Dry Mass [t]		107	126	142	157	189
Added Dry Mass	EcoEGR [t]	4	5	6	7	7
	EGRBP [t]	4	5	6	7	7
	HP SCR [t]	2	3	3	4	4
	LP SCR [t]	-	-	-	-	-
	GI [t]	3	3	4	4	5

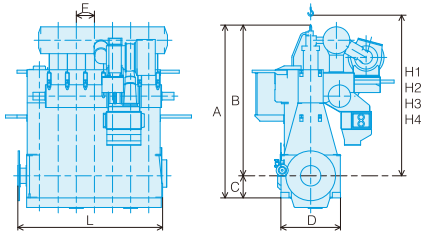
GI (Methane) SGC + SPOC, SFOC* [g/kWh]

Tier II Engine

Optimized load range **Engine type**	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load **S40ME-C9.5-GI**	Dual Fuel	138.7 / 139.1 + 4.1	137.5 / 138.8 + 3.1	143.8 / 143.8 + 2.6	134.4 / 134.9 + 5.1	133.4 / 134.7 + 3.9	139.9 / 139.9 + 3.2
	Fuel Oil	170.5	170.6	177.0	166.5	166.6	173.0

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR **S40ME-C9.5-GI-EcoEGR**	Tier III	Dual Fuel	143.8 + 4.1	142.6 + 3.2	146.4 + 2.6	139.5 + 5.2	138.5 + 3.9	142.4 + 3.3
		Fuel Oil	172.5	172.6	179.0	168.5	168.6	175.0
	Tier II	Dual Fuel	136.1 + 4.1	136.6 + 3.2	143.0 + 2.6	131.8 + 5.2	132.5 + 3.9	139.0 + 3.3
		Fuel Oil	163.5	165.6	175.0	159.5	161.6	171.0
EGRBP **S40ME-C9.5-GI-EGRBP**	Tier III	Dual Fuel	144.6 + 4.2	144.2 + 3.2	148.9 + 2.7	140.3 + 5.3	140.2 + 4.0	144.9 + 3.3
		Fuel Oil	173.5	174.6	182.0	169.5	170.6	178.0
	Tier II	Dual Fuel	137.7 + 4.2	140.4 + 3.2	146.3 + 2.7	133.4 + 5.3	136.3 + 4.0	142.4 + 3.3
		Fuel Oil	165.5	170.1	179.0	161.5	166.1	175.0
HP SCR **S40ME-C9.5-GI-HPSCR**	Tier III	Dual Fuel	139.1 + 4.1	141.3 + 3.2	146.4 + 2.6	134.8 + 5.2	137.2 + 3.9	142.4 + 3.3
		Fuel Oil	167.0	171.1	179.0	163.0	167.1	175.0
	Tier II	Dual Fuel	137.8 + 4.1	140.4 + 3.2	145.9 + 2.6	133.5 + 5.2	136.4 + 3.9	142.0 + 3.3
		Fuel Oil	165.5	170.1	178.5	161.5	166.1	174.5
LP SCR **S40ME-C9.5-GI-LPSCR**	Tier III	Dual Fuel	138.6 + 4.2	141.3 + 3.2	146.8 + 2.6	134.3 + 5.2	137.2 + 4.0	142.8 + 3.3
		Fuel Oil	166.5	171.1	179.5	162.5	167.1	175.5
	Tier II	Dual Fuel	137.8 + 4.2	140.4 + 3.2	145.9 + 2.6	133.5 + 5.2	136.4 + 4.0	142.0 + 3.3
		Fuel Oil	165.5	170.1	178.5	161.5	166.1	174.5



S35ME-CR9.7-GI

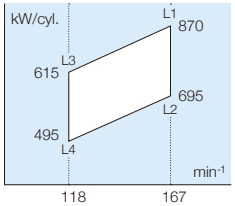
New Engine

Bore: 350 mm
Stroke: 1,550 mm

Engine Output [kW]

Cyl.	L1	L2	L3	L4
5	4,350	3,475	3,075	2,475
6	5,220	4,170	3,690	2,970
7	6,090	4,865	4,305	3,465
8	6,960	5,560	4,920	3,960

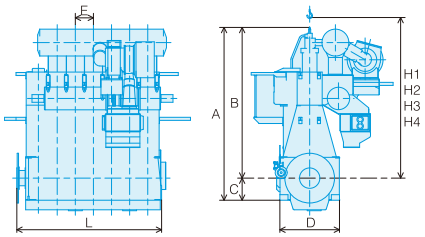
MEP L1-L3: 2.10 MPa
L2-L4: 1.68 MPa



Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H2	H3
[mm]	6,501	5,670	831	2,300	612	7,200		6,275

Cylinders:		5	6	7	8
L [mm]		4,107	4,719	5,331	5,943
Dry Mass [t]		81	90	99	111
Added Dry Mass	EcoEGR [t]				
	EGRBP [t]				
	HP SCR [t]	2	2	3	3
	LP SCR [t]	-	-	-	-
	GI [t]				



GI (Methane) SGC + SPOC, SFOC* [g/kWh]

Tier II Engine

Optimized load range / Engine type	Mode	L1 / L3			L2 / L4		
		50%	75%	100%	50%	75%	100%
High load S35ME-CR9.7-GI	Dual Fuel	132.8 / 133.2 + 8.0	132.4 / 133.7 + 6.1	139.2 / 139.2 + 5.0	127.7 / 128.2 + 10.0	127.7 / 129 + 7.6	134.7 / 134.7 + 6.3
	Fuel Oil	167.5	165.1	169.0	163.5	161.1	165.0

* The SFOC excludes the consumption of the electric HPS

Tier III Engine

Tier III technology / Engine type	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR S35ME-CR9.7-GI-EcoEGR	Tier III	Dual Fuel	137.8 + 8.1	137.4 + 6.2	141.7 + 5.1	132.6 + 10.2	132.7 + 7.8	137.1 + 6.4
		Fuel Oil	169.5	167.1	171.0	165.5	163.1	167.0
	Tier II	Dual Fuel	130.1 + 8.1	131.4 + 6.2	138.2 + 5.1	124.9 + 10.2	126.7 + 7.8	133.7 + 6.4
		Fuel Oil	160.5	160.1	167.0	156.5	156.1	163.0
EGRBP S35ME-CR9.7-GI-EGRBP	Tier III	Dual Fuel	138.5 + 8.3	139.0 + 6.3	144.1 + 5.2	133.3 + 10.4	134.3 + 7.9	139.6 + 6.5
		Fuel Oil	170.5	169.1	174.0	166.5	165.1	170.0
	Tier II	Dual Fuel	131.7 + 8.3	135.2 + 6.3	141.6 + 5.2	126.5 + 10.4	130.4 + 7.9	137.0 + 6.5
		Fuel Oil	162.5	164.6	171.0	158.5	160.6	167.0
HP SCR S35ME-CR9.7-GI-HPSCR	Tier III	Dual Fuel	133.1 + 8.1	136.1 + 6.2	141.7 + 5.1	127.9 + 10.2	131.4 + 7.8	137.1 + 6.4
		Fuel Oil	164.0	165.6	171.0	160.0	161.6	167.0
	Tier II	Dual Fuel	131.8 + 8.1	135.3 + 6.2	141.2 + 5.1	126.7 + 10.2	130.5 + 7.8	136.7 + 6.4
		Fuel Oil	162.5	164.6	170.5	158.5	160.6	166.5
LP SCR S35ME-CR9.7-GI-LPSCR	Tier III	Dual Fuel	132.7 + 8.2	136.1 + 6.2	142.1 + 5.1	127.5 + 10.2	131.4 + 7.8	137.5 + 6.4
		Fuel Oil	163.5	165.6	171.5	159.5	161.6	167.5
	Tier II	Dual Fuel	131.8 + 8.2	135.3 + 6.2	141.2 + 5.1	126.6 + 10.2	130.5 + 7.8	136.7 + 6.4
		Fuel Oil	162.5	164.6	170.5	158.5	160.6	166.5

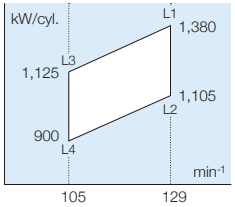
S46ME-B8.5

Bore: 460 mm, Stroke: 1,932 mm

Engine Output [kW]

MEP L1-L3: 2.00 MPa
L2-L4: 1.60 MPa

Cyl.	L1	L2	L3	L4
5	6,900	5,525	5,625	4,500
6	8,280	6,630	6,750	5,400
7	9,660	7,735	7,875	6,300
8	11,040	8,840	9,000	7,200



Fuel Oil SFOC* [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	169.5	167.2	170.0	165.5	163.2	166.0
Part load	EGB	166.5	165.7	171.5	162.5	161.7	167.5
Low load	EGB	164.5	166.7	171.5	160.5	162.7	167.5

* The SFOC excludes the consumption of the electric HPS

Tier III Engine**

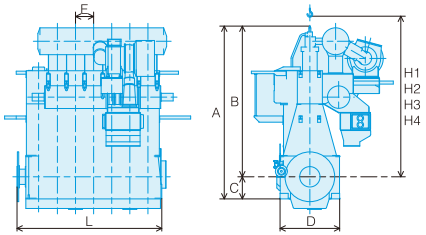
Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
HP SCR **S46ME-B8.5-HPSCR**	Tier III	166.0	167.7	172.0	162.0	163.7	168.0
	Tier II	164.5	166.7	171.5	160.5	162.7	167.5
LP SCR **S46ME-B8.5-LPSCR**	Tier III	167.5	167.7	172.5	163.5	163.7	168.5
	Tier II	164.5	166.7	171.5	160.5	162.7	167.5

** Available on request for EGR

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H2	H3
[mm]	8,117	7,131	986	2,924	782	9,150	8,480	7,900

Cylinders:		5	6	7	8
L [mm]		5,146	5,928	6,710	7,492
Dry Mass [t]		159	177	199	219
Added Dry Mass	HP SCR [t]	3	3	4	5
	LP SCR [t]	-	-	-	-



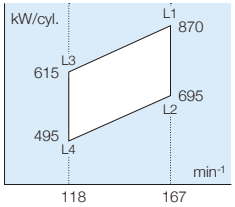
S35ME-B9.7 New Engine

Bore: 350 mm, Stroke: 1,550 mm

Engine Output [kW]

MEP L1-L3: 2.10 MPa
L2-L4: 1.68 MPa

Cyl.	L1	L2	L3	L4
5	4,350	3,475	3,075	2,475
6	5,220	4,170	3,690	2,970
7	6,090	4,865	4,305	3,465
8	6,960	5,560	4,920	3,960



Fuel Oil SFOC* [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	169.5	167.2	170.0	165.5	163.2	166.0

* The SFOC excludes the consumption of the electric HPS

Tier III Engine**

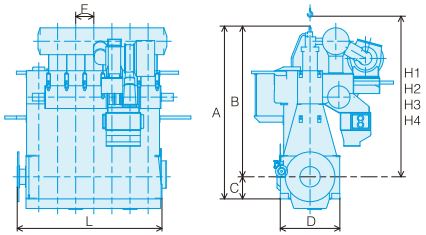
Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
HP SCR **S35ME-B9.7-HPSCR**	Tier III	172.0	169.2	171.5	168.0	165.2	167.5
	Tier II	170.5	168.2	171.0	166.5	164.2	167.0
LP SCR **S35ME-B9.7-LPSCR**	Tier III	171.0	168.7	171.5	167.0	164.7	167.5
	Tier II	170.5	168.2	171.0	166.5	164.2	167.0

** Available on request for EGR

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H2	H3
[mm]	6,501	5,670	831	2,300	612	7,200		6,275

Cylinders:		5	6	7	8
L [mm]		4,107	4,719	5,331	5,943
Dry Mass [t]		81	90	99	111
Added Dry Mass	HP SCR [t]	2	2	3	3
	LP SCR [t]	-	-	-	-



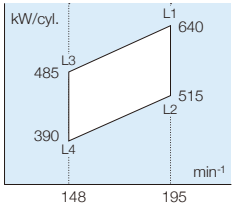
S30ME-B9.5

Bore: 300 mm, Stroke: 1,328 mm

Engine Output [kW]

MEP L1-L3: 2.10 MPa
L2-L4: 1.68 MPa

Cyl.	L1	L2	L3	L4
5	3,200	2,575	2,425	1,950
6	3,840	3,090	2,910	2,340
7	4,480	3,605	3,395	2,730
8	5,120	4,120	3,880	3,120



Fuel Oil SFOC* [g/kWh]

Tier II Engine

Optimized load range	Tuning	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load	-	175.5	173.2	176.0	171.5	169.2	172.0

* The SFOC excludes the consumption of the electric HPS

Tier III Engine**

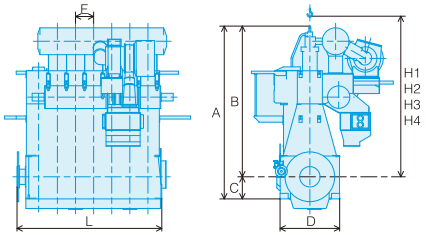
Tier III technology **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
HP SCR **S30ME-B9.5-HPSCR**	Tier III	177.0	174.2	176.5	173.0	170.2	172.5
	Tier II	175.5	173.2	176.0	171.5	169.2	172.0
LP SCR **S30ME-B9.5-LPSCR**	Tier III	176.0	173.7	176.5	172.0	169.7	172.5
	Tier II	175.5	173.2	176.0	171.5	169.2	172.0

** Available on request for EGR

Main Dimensions and Mass

Dimensions:	A	B	C	D	E	H1	H2	H3
[mm]	5,604	4,892	712	1,980	538	6,300		5,625

Cylinders:		5	6	7	8
L [mm]		3,703	4,241	4,779	5,317
Dry Mass [t]		61	69	77	86
Added Dry Mass	HP SCR [t]	1	2	2	2
	LP SCR [t]	-	-	-	-



G60ME-C10.5-GIE Alternative Fuel

GIE (Ethane) SGC + SPOC, SFOC [g/kWh]

Bore: 600 mm
Stroke: 2,790 mm

Tier II Engine

Optimized load range **Engine type**	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load **G60ME-C10.5-GIE**	Dual Fuel	144.2 + 4.1	146.1 + 3.1	150.5 + 2.6	139.4 + 5.4	139.7 + 4.1	143.5 + 3.4
	Fuel Oil	161.5	163.1	170.0	157.5	157.0	163.0

Tier III Engine

Tier III technology **Engine type**	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
HP SCR **G60ME-C10.5-GIE-HPSCR**	Tier III	Dual Fuel	141.9 + 4.1	146.5 + 3.2	153.2 + 2.6	137.1 + 5.5	140.1 + 4.2	146.1 + 3.4
		Fuel Oil	159.0	163.6	173.0	155.0	157.5	166.0
	Tier II	Dual Fuel	140.6 + 4.1	145.6 + 3.2	152.7 + 2.6	135.7 + 5.5	139.2 + 4.2	145.7 + 3.4
		Fuel Oil	157.5	162.6	172.5	153.5	156.5	165.5
LP SCR **G60ME-C10.5-GIE-LPSCR**	Tier III	Dual Fuel	141.5 + 4.1	146.5 + 3.2	153.6 + 2.6	136.7 + 5.5	140.1 + 4.2	146.6 + 3.5
		Fuel Oil	158.5	163.6	173.5	154.5	157.5	166.5
	Tier II	Dual Fuel	140.6 + 4.1	145.6 + 3.2	152.7 + 2.6	135.8 + 5.5	139.2 + 4.2	145.7 + 3.5
		Fuel Oil	157.5	162.6	172.5	153.5	156.5	165.5

Added Dry Mass

Cylinders:		5	6	7	8
Added Dry Mass	HP SCR [t]	3	4	5	5
	LP SCR [t]	-	-	-	-
	GIE [t]	5	6	7	7

Output/speed range, main dimensions and dry masses are the same as "G60ME-C10.5" (please see page 49)

G60ME-C10.5-LGIP Alternative Fuel

LGIP (LPG) SGC + SPOC, SFOC [g/kWh]

Bore: 600 mm
Stroke: 2,790 mm

Tier II Engine

Optimized load range / Engine type	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load G60ME-C10.5-LGIP	Dual Fuel	142.6 + 7.9	143.5 + 6.0	148.6 + 5.0	136.5 + 10.4	136.1 + 8.0	140.6 + 6.6
	Fuel Oil	161.5	160.6	165.0	157.5	154.5	158.0

Tier III Engine

Tier III technology / Engine type	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR G60ME-C10.5-LGIP-EcoEGR	Tier III	Dual Fuel	144.4 + 8.0	145.3 + 6.1	150.4 + 5.0	138.3 + 10.6	137.8 + 8.1	142.3 + 6.6
		Fuel Oil	163.5	162.6	167.0	159.5	156.5	160.0
	Tier II	Dual Fuel	136.0 + 8.0	138.8 + 6.1	146.7 + 5.0	129.9 + 10.6	131.3 + 8.1	138.6 + 6.6
		Fuel Oil	154.5	155.6	163.0	150.5	149.5	156.0
EGRBP G60ME-C10.5-LGIP-EGRBP	Tier III	Dual Fuel	145.2 + 8.1	147.1 + 6.2	153.1 + 5.1	139.0 + 10.8	139.6 + 8.2	145.0 + 6.8
		Fuel Oil	164.5	164.6	170.0	160.5	158.5	163.0
	Tier II	Dual Fuel	138.7 + 8.1	142.9 + 6.2	151.2 + 5.1	132.5 + 10.8	135.4 + 8.2	143.2 + 6.8
		Fuel Oil	157.5	160.1	168.0	153.5	154.0	161.0
HP SCR G60ME-C10.5-LGIP-HPSCR	Tier III	Dual Fuel	140.1 + 8.1	143.9 + 6.1	151.3 + 5.0	134.0 + 10.7	136.4 + 8.1	143.2 + 6.7
		Fuel Oil	159.0	161.1	168.0	155.0	155.0	161.0
	Tier II	Dual Fuel	138.7 + 8.1	143.0 + 6.1	150.8 + 5.0	132.6 + 10.7	135.4 + 8.1	142.8 + 6.7
		Fuel Oil	157.5	160.1	167.5	153.5	154.0	160.5
LP SCR G60ME-C10.5-LGIP-LPSCR	Tier III	Dual Fuel	139.7 + 8.0	143.9 + 6.1	151.7 + 5.1	133.5 + 10.7	136.4 + 8.1	143.7 + 6.7
		Fuel Oil	158.5	161.1	168.5	154.5	155.0	161.5
	Tier II	Dual Fuel	138.7 + 8.0	143.0 + 6.1	150.8 + 5.1	132.6 + 10.7	135.4 + 8.1	142.8 + 6.7
		Fuel Oil	157.5	160.1	167.5	153.5	154.0	160.5

Added Dry Mass

Cylinders:		5	6	7	8
Added Dry Mass	EcoEGR [t]	14	14	15	16
	EGRBP [t]	14	14	15	16
	HP SCR [t]	3	4	5	5
	LP SCR [t]	-	-	-	-
	LGIP [t]	5	6	7	7

Output/speed range, main dimensions and dry masses are the same as "G60ME-C10.5" (please see page 49)

S60ME-C10.5-GIE Alternative Fuel

GIE (Ethane) SGC + SPOC, SFOC [g/kWh]

Bore: 600 mm
Stroke: 2,400 mm

Tier II Engine

Optimized load range / Engine type	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load S60ME-C10.5-GIE	Dual Fuel	146.9 + 4.1	147.4 + 3.1	151.4 + 2.6	142.1 + 5.4	141.1 + 4.1	144.4 + 3.4
	Fuel Oil	164.5	164.6	171.0	160.5	158.5	164.0

Tier III Engine

Tier III technology / Engine type	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
HP SCR S60ME-C10.5-GIE-HPSCR	Tier III	Dual Fuel	143.7 + 4.1	147.8 + 3.2	153.2 + 2.6	138.9 + 5.5	141.5 + 4.2	146.1 + 3.4
		Fuel Oil	161.0	165.1	173.0	157.0	159.0	166.0
	Tier II	Dual Fuel	142.4 + 4.1	147.0 + 3.2	152.7 + 2.6	137.6 + 5.5	140.6 + 4.2	145.7 + 3.4
		Fuel Oil	159.5	164.1	172.5	155.5	158.0	165.5
LP SCR S60ME-C10.5-GIE-LPSCR	Tier III	Dual Fuel	143.3 + 4.1	147.8 + 3.2	153.6 + 2.6	138.5 + 5.5	141.5 + 4.2	146.6 + 3.4
		Fuel Oil	160.5	165.1	173.5	156.5	159.0	165.5
	Tier II	Dual Fuel	142.4 + 4.1	147.0 + 3.2	152.7 + 2.6	137.6 + 5.5	140.6 + 4.2	145.7 + 3.4
		Fuel Oil	159.5	164.1	172.5	155.5	158.0	165.5

Added Dry Mass

Cylinders:		5	6	7	8
Added Dry Mass	HP SCR [t]	3	4	5	5
	LP SCR [t]	-	-	-	-
	GIE [t]	5	5	6	7

Output/speed range, main dimensions and dry masses are the same as "S60ME-C10.5" (please see page 51)

S60ME-C10.5-LGIP Alternative Fuel

LGIP (LPG) SGC + SPOC, SFOC [g/kWh]

Bore: 600 mm
Stroke: 2,400 mm

Tier II Engine

Optimized load range / Engine type	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load S60ME-C10.5-LGIP	Dual Fuel	145.4 + 7.9	144.9 + 6.0	149.5 + 5.0	139.3 + 10.5	137.4 + 8.0	141.5 + 6.6
	Fuel Oil	164.5	162.1	166.0	160.5	156.0	159.0

Tier III Engine

Tier III technology / Engine type	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR S60ME-C10.5-LGIP-EcoEGR	Tier III	Dual Fuel	147.1 + 8.0	146.7 + 6.1	151.3 + 5.0	141.0 + 10.6	139.2 + 8.1	143.3 + 6.7
		Fuel Oil	166.5	164.1	168.0	162.5	158.0	161.0
	Tier II	Dual Fuel	138.8 + 8.0	140.2 + 6.1	147.6 + 5.0	132.7 + 10.6	132.7 + 8.1	139.5 + 6.7
		Fuel Oil	157.5	157.1	164.0	153.5	151.0	157.0
EGRBP S60ME-C10.5-LGIP-EGRBP	Tier III	Dual Fuel	147.9 + 8.1	148.4 + 6.2	154.0 + 5.1	141.8 + 10.8	140.9 + 8.2	145.9 + 6.8
		Fuel Oil	167.5	166.1	171.0	163.5	160.0	164.0
	Tier II	Dual Fuel	140.5 + 8.1	144.3 + 6.2	151.2 + 5.1	134.3 + 10.8	136.7 + 8.2	143.1 + 6.8
		Fuel Oil	159.5	161.6	168.0	155.5	155.5	161.0
HP SCR S60ME-C10.5-LGIP-HPSCR	Tier III	Dual Fuel	142.0 + 8.0	145.3 + 6.1	151.3 + 5.0	135.8 + 10.7	137.8 + 8.1	143.3 + 6.7
		Fuel Oil	161.0	162.6	168.0	157.0	156.5	161.0
	Tier II	Dual Fuel	140.6 + 8.0	144.3 + 6.1	150.8 + 5.0	134.5 + 10.7	136.9 + 8.1	142.8 + 6.7
		Fuel Oil	159.5	161.6	167.5	155.5	155.5	160.5
LP SCR S60ME-C10.5-LGIP-LPSCR	Tier III	Dual Fuel	141.5 + 8.0	145.3 + 6.1	151.7 + 5.1	135.4 + 10.6	137.8 + 8.1	143.7 + 6.7
		Fuel Oil	160.5	162.6	168.5	156.5	156.5	161.5
	Tier II	Dual Fuel	140.6 + 8.0	144.3 + 6.1	150.8 + 5.1	134.5 + 10.6	136.9 + 8.1	142.8 + 6.7
		Fuel Oil	159.5	161.6	167.5	155.5	155.5	160.5

Added Dry Mass

Cylinders:		5	6	7	8
Added Dry Mass	EcoEGR [t]	14	14	15	16
	EGRBP [t]	14	14	15	16
	HP SCR [t]	3	4	5	5
	LP SCR [t]	-	-	-	-
	LGIP [t]	5	5	6	7

Output/speed range, main dimensions and dry masses are the same as "S60ME-C10.5" (please see page 51)

G50ME-C9.6-GIE Alternative Fuel

GIE (Ethane) SGC + SPOC, SFOC [g/kWh]

Bore: 500 mm
Stroke: 2,500 mm

Tier II Engine

Optimized load range / Engine type	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load G50ME-C9.6-GIE	Dual Fuel	146.0 + 4.1	147.9 + 3.1	152.3 + 2.6	141.2 + 5.5	141.5 + 4.2	145.2 + 3.4
	Fuel Oil	163.5	165.1	172.0	159.5	159.0	165.0

Tier III Engine

Tier III technology / Engine type	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
HP SCR G50ME-C9.6-GIE-HPSCR	Tier III	Dual Fuel	143.7 + 4.2	148.3 + 3.2	155.0 + 2.6	138.8 + 5.6	141.8 + 4.3	147.9 + 3.5
		Fuel Oil	161.0	165.6	175.0	157.0	159.5	168.0
	Tier II	Dual Fuel	142.3 + 4.2	147.4 + 3.2	154.5 + 2.6	137.5 + 5.6	140.9 + 4.3	147.4 + 3.5
		Fuel Oil	159.5	164.6	174.5	155.5	158.5	167.5
LP SCR G50ME-C9.6-GIE-LPSCR	Tier III	Dual Fuel	143.2 + 4.2	148.3 + 3.2	155.4 + 2.6	138.4 + 5.6	141.8 + 4.3	148.3 + 3.5
		Fuel Oil	160.5	165.6	175.5	156.5	159.5	168.5
	Tier II	Dual Fuel	142.3 + 4.2	147.4 + 3.2	154.5 + 2.6	137.5 + 5.6	140.9 + 4.3	147.4 + 3.5
		Fuel Oil	159.5	164.6	174.5	155.5	158.5	167.5

Added Dry Mass

Cylinders:		5	6	7	8	9
Added Dry Mass	HP SCR [t]	4	4	5	6	6
	LP SCR [t]	-	-	-	-	-
	GIE [t]	5	5	6	6	7

Output/speed range, main dimensions and dry masses are the same as "G50ME-C9.6" (please see page 53)

G50ME-C9.6-LGIM Alternative Fuel

LGIM (Methanol) SGC + SPOC, SFOC [g/kWh]

Bore: 500 mm
Stroke: 2,500 mm

Tier II Engine

Optimized load range / Engine type	Mode	L1 - L3			L2 - L4		
		50%	75%	100%	50%	75%	100%
High load G50ME-C9.6-LGIM	Dual Fuel	322.4 + 13.3	327.2 + 10.1	340.4 + 8.4	304.3 + 17.7	306.9 + 13.5	319.4 + 11.1
	Fuel Oil	163.5	162.6	167.0	159.5	156.5	160.0

Tier III Engine

Tier III technology / Engine type	Mode		L1 - L3			L2 - L4		
			50%	75%	100%	50%	75%	100%
EcoEGR G50ME-C9.6-LGIM-EcoEGR	Tier III	Dual Fuel	326.3 + 13.4	331.3 + 10.2	344.5 + 8.5	308.1 + 17.9	310.9 + 13.7	323.4 + 11.3
		Fuel Oil	165.5	164.6	169.0	161.5	158.5	162.0
	Tier II	Dual Fuel	307.0 + 13.4	316.2 + 10.2	335.9 + 8.5	288.8 + 17.9	295.9 + 13.7	314.8 + 11.3
		Fuel Oil	156.5	157.6	165.0	152.5	151.5	158.0
EGRBP G50ME-C9.6-LGIM-EGRBP	Tier III	Dual Fuel	328.0 + 13.7	335.2 + 10.4	350.6 + 8.6	309.6 + 18.2	314.7 + 13.9	329.4 + 11.5
		Fuel Oil	166.5	166.6	172.0	162.5	160.5	165.0
	Tier II	Dual Fuel	312.9 + 13.7	325.5 + 10.4	346.3 + 8.6	294.6 + 18.2	305.0 + 13.9	325.1 + 11.5
		Fuel Oil	159.5	162.1	170.0	155.5	156.0	163.0
HP SCR G50ME-C9.6-LGIM-HPSCR	Tier III	Dual Fuel	316.3 + 13.6	327.8 + 10.3	346.5 + 8.5	298.0 + 18.1	307.4 + 13.8	325.4 + 11.3
		Fuel Oil	161.0	163.1	170.0	157.0	157.0	163.0
	Tier II	Dual Fuel	313.1 + 13.6	325.7 + 10.3	345.5 + 8.5	294.8 + 18.1	305.3 + 13.8	324.4 + 11.3
		Fuel Oil	159.5	162.1	169.5	155.5	156.0	162.5
LP SCR G50ME-C9.6-LGIM-LPSCR	Tier III	Dual Fuel	315.3 + 13.5	327.8 + 10.3	347.6 + 8.5	297.1 + 18.1	307.4 + 13.8	326.4 + 11.4
		Fuel Oil	160.5	163.1	170.5	156.5	157.0	163.5
	Tier II	Dual Fuel	313.2 + 13.5	325.7 + 10.3	345.5 + 8.5	294.9 + 18.1	305.3 + 13.8	324.3 + 11.4
		Fuel Oil	159.5	162.1	169.5	155.5	156.0	162.5

Added Dry Mass

Cylinders:		5	6	7	8	9
Added Dry Mass	EcoEGR [t]	6	8	9	10	12
	EGRBP [t]	6	8	9	10	12
	HP SCR [t]	4	4	5	6	6
	LP SCR [t]	-	-	-	-	-
	LGIM [t]	7	7	8	9	10

Output/speed range, main dimensions and dry masses are the same as "G50ME-C9.6" (please see page 53)

従来形機関

Conventional Engines

以下に記載する機関は、より効率の高い新形機関に将来的に置き換えられるため、今後のカタログには掲載しない予定です。しかしながら、これら機種は個別対応として今後も製造可能です。新たなプロジェクトに対しては、より新しい機関形式の選定を推奨いたします。Tier Ⅱ機関, Tier Ⅲ機関および二元燃料機関としての対応可否については、弊社までお問い合わせください。

The engines listed below shall be replaced by newer and more efficient engines in future, consequently, are not scheduled to be listed in a future catalog. However, we will continue to produce these engine models as individual case. For new project, selection of latest engine type is recommended. For availability for Tier II, Tier III and dual fuel engines, please contact us.

G95ME-C9.5

Bore: 950 mm, Stroke: 3,460 mm

5 - 12 cyl.		L1	L2	L3	L4
Output / cyl.	kW	6,870	5,170	6,010	4,520
Speed	min-1	80	80	70	70
MEP	MPa	2.10	1.58	2.10	1.58
SFOC (Tier II, High load)	g/kWh	166.0	159.0	166.0	159.0

G80ME-C9.5

Bore: 800 mm, Stroke: 3,720 mm

6 - 9 cyl.		L1	L2	L3	L4
Output / cyl.	kW	4,710	3,550	3,800	2,860
Speed	min-1	72	72	58	58
MEP	MPa	2.10	1.58	2.10	1.58
SFOC (Tier II, High load)	g/kWh	166.0	159.0	166.0	159.0

S65ME-C8.5

Bore: 650 mm, Stroke: 2,730 mm

5 - 8 cyl.		L1	L2	L3	L4
Output / cyl.	kW	2,870	2,290	2,330	1,860
Speed	min-1	95	95	77	77
MEP	MPa	2.00	1.60	2.00	1.60
SFOC (Tier II, High load)	g/kWh	169.0	163.0	169.0	163.0

G60ME-C9.5

Bore: 600 mm, Stroke: 2,790 mm

5 - 8 cyl.		L1	L2	L3	L4
Output / cyl.	kW	2,680	2,010	1,990	1,500
Speed	min-1	97	97	72	72
MEP	MPa	2.10	1.58	2.10	1.58
SFOC (Tier II, High load)	g/kWh	167.0	160.0	167.0	160.0

S60ME-C8.5

Bore: 600 mm, Stroke: 2,400 mm

5 - 8 cyl.		L1	L2	L3	L4
Output / cyl.	kW	2,380	1,900	1,900	1,520
Speed	min-1	105	105	84	84
MEP	MPa	2.00	1.60	2.00	1.60
SFOC (Tier II, High load)	g/kWh	169.0	163.0	169.0	163.0

S50ME-C9.6

Bore: 500 mm, Stroke: 2,214 mm

5 - 9 cyl.		L1	L2	L3	L4
Output / cyl.	kW	1,780	1,420	1,350	1,080
Speed	min-1	117	117	89	89
MEP	MPa	2.10	1.68	2.10	1.68
SFOC (Tier II, High load)	g/kWh	167.0	161.0	167.0	161.0

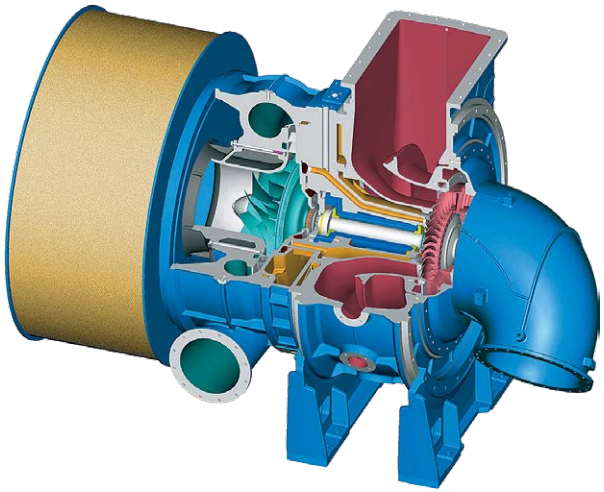
S50ME-C9.5

Bore: 500 mm, Stroke: 2,214 mm

5 - 9 cyl.		L1	L2	L3	L4
Output / cyl.	kW	1,780	1,420	1,350	1,080
Speed	min-1	117	117	89	89
MEP	MPa	2.10	1.68	2.10	1.68
SFOC (Tier II, High load)	g/kWh	169.0	163.0	169.0	163.0

排ガス過給機

Exhaust Gas Turbochargers



特長 Features

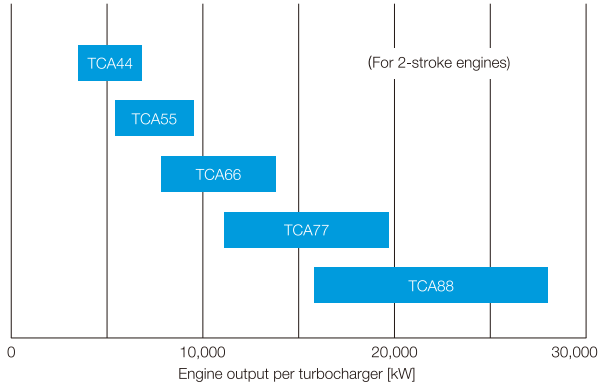
TCA形過給機（軸流タービン形）の形式および台数は、機関出力に応じて選択することができます。主な特徴は以下のとおりです。

- 高効率
- 低騒音
- メンテナンスが容易
- 構成部品の信頼性向上および長寿命化
- 堅牢な飛散防止エリアの確保
- 機関への組付けの簡略化

The type and number of axial flow turbine turbochargers, so-called TCA type turbocharger, can be selected according to the required engine output.
Main features are

- High efficiency
- Low noise emission
- Easy maintenance
- Reliability and extended lifetime of the components
- Massive containment area
- Simple installation to the engine

過給機適用範囲 Turbocharger Program



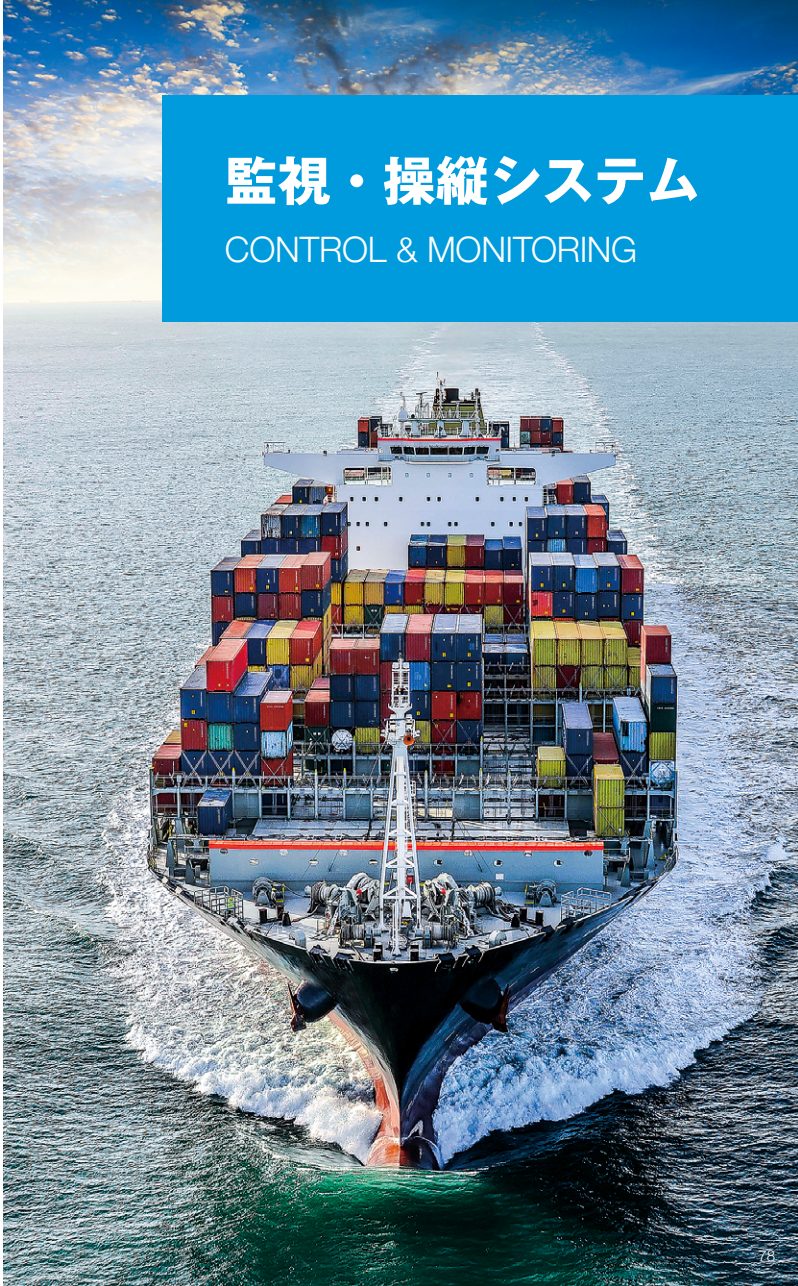
TCAシリーズの仕様 TCA Series Program

Turbine type	Axial flow turbine
Max. permissible temp.	500 °C
Pressure ratio	up to 4.4

Type	Supercharged engine output [kW]	Mass [kg]
TCA44	3,500 - 6,800	1,970
TCA55	5,400 - 9,500	3,320
TCA66	7,800 - 13,800	5,262
TCA77	11,100 - 19,700	8,718
TCA88	15,800 - 28,000	13,734

* Ie = 8.0 kg/kWh

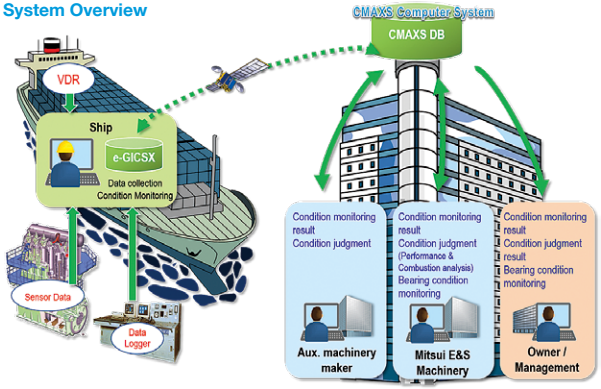
監視・操縦システム
CONTROL & MONITORING



CMAXS e-GICSX

機関状態監視システム

システムイメージ
System Overview



IoT/M2M とビッグデータを活用
Engine Monitoring by Utilizing IoT/M2M and Big Data Analysis

CMAXS e-GICSXはIoT/M2Mおよびビッグデータ解析等の技術を取り入れた次世代機関状態監視システムで、日本海事協会と共同研究開発しました。機関に設置された複数のセンサデータに、気象・海象等の航海データなどの情報を加え、そのビッグデータを最新の解析技術を用いて船内で解析・監視することで、早期に的確な異常診断を行います。また、船内の異常診断結果を陸上で解析する性能診断に反映することで、高精度な状態診断を行います。
なお、CMAXS e-GICSXはNKCSを契約窓口とし、データはNKCSのCMAXSデータベースに保管されます。

CMAXS e-GICSX is next generation engine monitoring system by utilizing IoT/M2M and big data analysis technology, developed jointly with ClassNK. This system provides early detection of abnormalities by using sophisticated algorithms which can analyze big data collected from not only main engine sensors but also navigation data, such as weather and sea conditions. By merging together the onboard monitoring and engine performance results, this system can provide high accuracy condition judgment.
Contractor is NKCS, and the data is stored in CMAXS Database which is managed by NKCS.

MITSUI E&S
Mitsui E&S Machinery Co., Ltd.

ClassNK
Consulting Service

特長 Features

- 早期の機器異常検知による故障時損失の最小化
- 機器の実状態に基づく予防保全の実現
- 部品の延命化によるライフサイクルコストの削減
- センサデータ自動取得による信頼性の高いデータ取得および自動化による乗組員作業負荷の低減
- 本船から収集した情報をCMAXSデータベースで管理することによる、本船・船主・船舶管理会社およびメーカ間の情報共有

- Minimize losses by early detection of machinery malfunction.
- Preventive machinery maintenance based on extensive data/information obtained from a wide variety of equipment.
- Reduction of life-cycle cost.
- Higher reliability of data and reduction of ship crew man power for reporting operation status and conditions to ship company by automatic data collection and data transmission.
- Sharing data and monitoring/analysis results among ship company, the ship, and manufacturer.

e-GICS Advance

機関性能診断システム

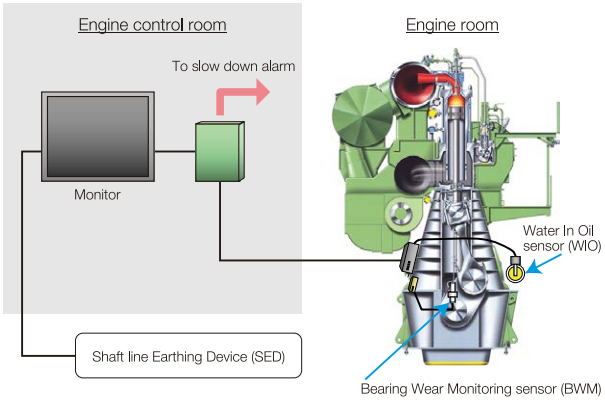
オンラインで性能・燃焼診断
Online Engine Performance & Combustion Analysis Service

e-GICS AdvanceはIoT/M2M技術を活用した機関性能診断システムです。機関から自動で運転データを採取し、陸上の弊社e-GICSデータサーバで性能診断および燃焼診断を行ないます。e-GICS Advanceは弊社を契約窓口とし、データは弊社のe-GICSデータサーバに保管されます。CMAXS e-GICSXおよびe-GICS Advanceの詳細についてはアフターサービス事業のテクノサービス事業部までお問い合わせ願います。

e-GICS Advance is engine performance and combustion analysis system by using IoT/M2M technology, developed by ourselves. Engine operation data is automatically collected and sent to shore, to perform the performance & combustion analysis by our e-GICS database.
Contractor is MES, and the data is stored in e-GICS Database which is managed by us.
For the detail, please contact Technoservice Div. in charge for the after-sales service business.

BCM Option

Bearing Condition Monitoring System



摩耗・油中水分監視で事故防止

Monitoring Bearing Wear and Water in Oil

BCMは、クロスヘッド軸受、クランクピン軸受、主軸受の摩耗状態および油中水分を監視することで、クランク軸および上記軸受の重大事故の未然防止を図るシステムです。本システムは、ABS、BV、DNV GL、LRおよびNKの各船級協会の形式承認を取得しています。
また、船級協会によっては、BCMを装備し、そのモニタ値が正常範囲にある間、軸受の解放点検間隔の延長や省略を認めています。
BCMは次のシステムより構成されています。

- ■軸受摩耗センサ（BWM）
- ■油中水分センサ（WIO）
- ■軸アース装置（SED）監視（追加オプション対応）

The Bearing Condition Monitoring system (BCM) can be optionally installed to prevent the severe damage of the crankshaft and the crank-train bearings (main, crankpin and crosshead bearings). BCM is type approved by ABS, BV, DNV GL, LR and NK.
Some of those classification societies have already approved an extension of interval or an omission of bearing overhaul while BCM indication is within the normal operation range.
The BCM is composed of the following sub-systems.

- Bearing Wear Monitoring (BWM)
- Water In Oil monitoring (WIO)
- Monitoring of Shaft line Earthing Device (SED) (further option)

機関遠隔操縦装置 BMS-2000Ⅲ ME Option EMS-200Ⅲ ME

Engine Remote Control System

ME形機関をリモート操縦

Remote Control System for ME Engine

電子制御形舶用ディーゼル機関（ME形機関）のために開発された遠隔操縦装置です。ME制御装置と連携して機関の遠隔操縦を実現し、機関の保護機能、船橋・制御室・機側間のテレグラフ通信機能を持っています。
本システムは、各船級(ABS、BV、DNV GL、LR、NK)の形式承認、CEマーキングを取得しています。

The BMS-2000IIIME/EMS-200IIIME is a remote control system developed for electronically controlled marine diesel engines (ME Engine). It works in close cooperation and conjunction with the ME control system to remotely control and protect the engine, and communicating between the bridge, the control room and the engine side by the telegraph system.
The systems are type-approved by ABS, BV, DNV GL, LR and NK also obtained CE-marking.

特長 Features

- ■W/H, C/Rに大形カラー液晶表示を採用
- ■卓内配線作業の効率化
- ■高信頼性機器の継続使用
- ■その他
  - ・ABS、BV、DNV GL、LR、NKの形式承認を取得
  - ・Pre-warning Shut Down and Slow Downを標準装備
  - ・テレグラフログ機能、警報履歴画面、設定値変更履歴画面を標準装備

- Adoption of enlarged color LCD to W/H and C/R
- Effective wiring works in console
- Continuous use of higher reliable articles
- Others
  Type approved system by ABS, BV, DNV GL, LR, NK
  Standard of pre-warning shut down and slow down
  Standard of telegraph log and alarm history and parameter change history.

システム構成 Composition of System

BMS-2000Ⅲ MEは次の3つのシステムより構成されています。

■遠隔制御システム（RCS）
ME制御装置と連携して、機関の始動・停止・逆転等機関の制御を行います。

■機関保護システム（EPS）
機関を保護する安全装置です。

■テレグラフシステム（ETS）
船橋・制御室・機側間の通信を行います。

The BMS-2000IIIME is composed of the following three sub-systems.

- Remote Control System (RCS)
  Works together with the ME Control System (ME-ECS) to control the engine for starting, stopping or reversing.
- Engine Protecting System (EPS)
  Protects the engine from damage.
- Engine Telegraph System (ETS)
  Communicates between the bridge, the control room and the engine side through the telegraph lines.

本監視システムを製造する三井造船システム技研株式会社は、2018年4月1日から「三井E&Sシステム技研株式会社」に社名変更いたしました。

Company name was changed from “Mitsui Zosen Systems Research Inc.” to “Mitsui E&S Systems Research Inc.” on April 1, 2018.

技術補足
TECHNICAL SUPPLEMENT

機関出力
Engine Output

本カタログに記載している機関出力は kWです。kWとPS（メートル馬力）との換算は、1 PS = 75 kgfm/s = 0.7355 kW です。各機関の諸元表に記載している機関出力は、下記の熱帯条件においても有効です。

The engine output figures in the catalog are stated in kW. For conversion between kW and PS (metric horsepower), please note that 1 PS = 75 kgfm/s = 0.7355 kW. The engine output stated in the tables is available up to tropical conditions at sea level, i.e.:

過給機ブロワ入口温度 Turbocharger blower inlet temperature	45 °C
空気冷却器冷却水入口温度 Air cooler cooling water inlet temperature	32 °C
大気圧 Atmospheric pressure	1,000 hPa

燃料消費率の条件
SFOC condition

本カタログに記載している燃料消費率は、下記の条件によるものです。

The SFOC figures stated in this catalog are based on the following condition.

ISO 15550:2002 and ISO 3046-1:2002

過給機ブロワ入口温度 Turbocharger blower inlet temperature	25 °C
空気冷却器冷却水入口温度 Air cooler cooling water inlet temperature	25 °C
大気圧 Atmospheric pressure	1,000 hPa

燃料油低発熱量（LCV） Fuel oil lower caloric value (LCV)	42,700 kJ/kg
過給機出口後の排気背圧（連続最大出力時） Exhaust gas back pressure (at the Maximum continuous rating)	3.0 kPa

GI形、LGI形機関における使用燃料の低発熱量は次のとおりです。

The LCV figures of fuel utilized for GI type and LGI type engines are as follows.

燃料の種類 Fuel type	Fuel designation	低発熱量 LCV [kJ/kg]
メタン Methane	-GI	50,000
エタン Ethane	-GIE	47,500
メタノール Methanol	-LGIM	19,900
LPG	-LGIP	46,000

SFOC保証のトレランス
SFOC Guarantee Tolerance

50%～100%の範囲の負荷点でSFOC保証点を選択可能です。SFOC保証のトレランスは次のとおりです。

We offer the option of selecting the SFOC guarantee at a load point in the range between 50% and 100%. SFOC guarantee tolerances are as follows:

100% - 85%	+5% Tolerance
< 85% - 65%	+6% Tolerance
< 65 % - 50 %	+7% Tolerance

SFOC保証可能な運転モード
Available Operating Modes for SFOC guarantee

SFOC保証は、1つの負荷点かつ1つの運転モードに対してのみ与えられることに留意してください。対応可能な運転モードは以下の表のとおりです。

The SFOC guarantee point can only be given in one (1) load point and in one (1) operating mode. Available operating modes are as follows.

Available operating mode for SFOC guarantee

IMO NOx	二元燃料機関 Dual fuel engine	Tier III技術 Tier III technologies	SFOC保証対応可能な運転モード Available operating mode for SFOC guarantee			
			重油モード Fuel oil mode		二元燃料運転モード* Dual fuel mode	
			Tier III	Tier II	Tier III	Tier II
Tier II engine	Without	Without		Available		
	With	Without		Available		Available
Tier III engine	Without	With	Available	Available		
	With	With	Available	Available	Available	Available

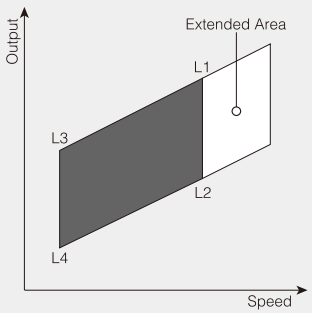
* 二元燃料運転モードの場合は、パイロット油消費量とパイロット油の低発熱量で換算されたガス/LFL燃料消費率の合計値で保証されます。

* Specific fuel consumption at dual fuel mode can be guaranteed by the sum of specific pilot oil consumption and specific gas/LFL fuel consumption; specific gas / LFL fuel consumption is converted by lower calorific value of pilot oil.

レイアウトダイアグラム
Layout Diagram

右図のL1、L2、L3、L4点で定義されるレイアウトダイアグラム内の任意の点をMCRとして選ぶことで、船舶の計画にあたって最も適した出力および回転速度の組み合わせを得ることができます。各機関形式におけるレイアウト点(L1、L2、L3、L4点)の出力および回転速度については、諸元表をご参照ください。

Any MCR point can be chosen within the right layout area defined on L1, L2, L3 and L4 point to obtain an optimum point (combination of output and speed) for laying out the propeller, engine and ship. For engine output and speed of layout points (L1, L2, L3 and L4 point) in each engine type, please refer the page of each engine type.



レイアウトダイアグラムの拡張
Layout Diagram with Extended Area

S50ME-C8.5形機関は、御要求によりL1-L2回転速度を左下図のように増加させることが可能です（MEPは変更されません）。

S50ME-C8.5 type engines with increased speed and unchanged MEP are available on request.

Engine type	L1-L2 speed [min-1]	L1 output [kW/cyl.]	L2 output [kW/cyl.]
S50ME-C8.5	127	1,660	1,330
S50ME-C8.5 with Extended Area	135	1,770	1,410

高硫黄燃料とSOxスクラバ適用
Application of High-Sulfur Fuels and SOx Scrubbers

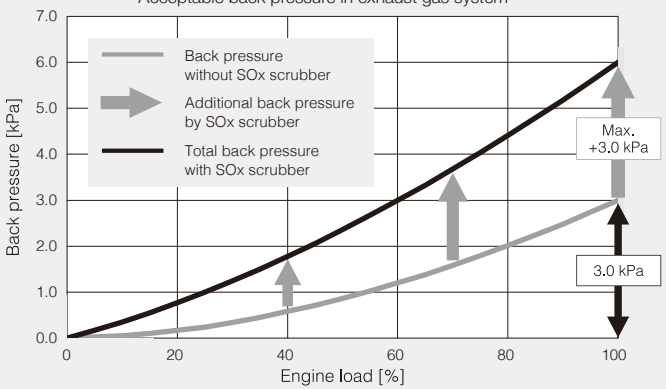
本カタログに記載されている全ての機関に対してSOxスクラバを適用させることができます。SOxスクラバ設置は排気背圧の増大を招き、機関性能に影響を及ぼします。従って、SOxスクラバ設置による排気背圧の増大を100%負荷で3.0 kPa以内にする必要があります。

SOx scrubbers can be applied to all engines in this catalog. A SOx scrubber installation will increase the back pressure, thereby affecting engine performance. Accordingly, we require that a SOx scrubber installation does not increase the back pressure by more than 3.0 kPa at 100% load.

注記
・SOxスクラバを適用する場合、過給機の仕様を変更する必要があります（場合によっては過給機形式が変更となる可能性もあります）。SOxスクラバを搭載する場合は、弊社までご相談ください。
・EGRまたは高圧SCRを適用したTier III機関において、NOx ECA内で高硫黄燃料油を使用する場合、EGR、高圧SCRシステムを高硫黄燃料仕様にする必要があります。EGRおよび高圧SCRについては13～17頁を参照下さい。

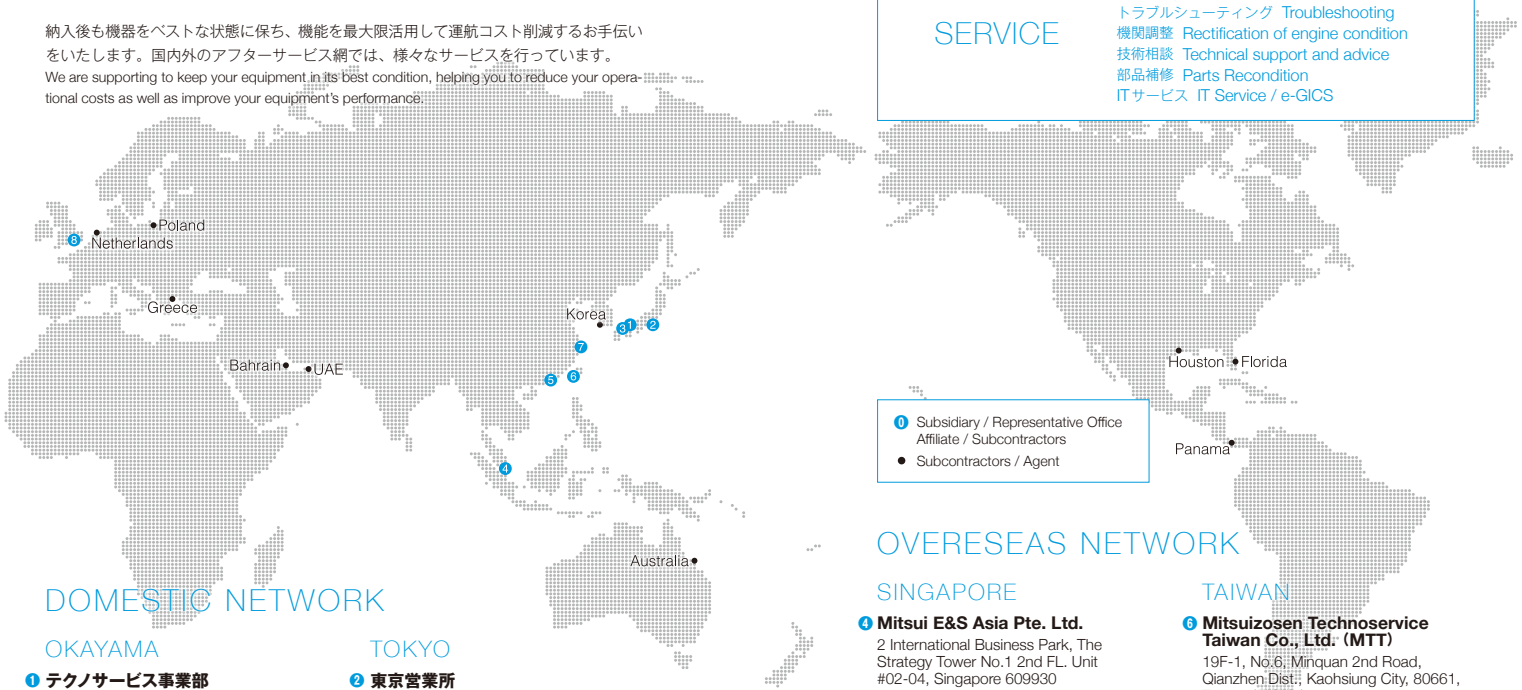
Note:
- In the case of applying SOx scrubbers, the specification of turbochargers must be changed. (In some cases, the turbocharger type can be changed) In the case of installing SOx scrubber, please contact us.
- For Tier III engines applying EGR or High-pressure SCR, in the case of using high-sulfur fuel in NOx ECA, high-sulfur EGR or SCR system are required. For EGR and high-pressure SCR, please refer pp.13-17.

Acceptable back pressure in exhaust gas system



AFTER SERVICE NETWORK

納入後も機器をベストな状態に保ち、機能を最大限活用して運航コスト削減するお手伝いをいたします。国内外のアフターサービス網では、様々なサービスを行っています。
We are supporting to keep your equipment in its best condition, helping you to reduce your operational costs as well as improve your equipment's performance.



SERVICE

- 点検・整備 Inspection & Maintenance
- 修理 Repair
- トラブルシューティング Troubleshooting
- 機関調整 Rectification of engine condition
- 技術相談 Technical support and advice
- 部品補修 Parts Recondition
- ITサービス IT Service / e-GICS

0 Subsidiary / Representative Office
Affiliate / Subcontractors
● Subcontractors / Agent

DOMESTIC NETWORK

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