

# Future Fuels and LNG

MAN Dual Fuel GenSets

**Paw Houmann-Poulsen**

Senior Specialist

Head of Promotion & Customer Support

Marine GenSets

**Disclaimer**

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# Future Fuels and Gases



	Residual Crude oil	Distillates VLSFO	Biofuel liquid	Biogas	LNG methane	LPG Butan	LPG Propan	Ethane	Biogas	LNG methane	Methanol	LPG Butan	LPG Propan	Ethane
Combustion proces	Diesel			Otto					Diesel					
Power output	100%			65-90%	92-95%	35-40%	60-65%	55-75%	100%					
Engine cost price	Low			Middle					New design	New design	New design Larger fuel pump	New design	New design	New design
TBO	Ref.	Double	Double	Double					Double					
Emission issue	NOx - SOx	NOx	NOx	Gas slip					No gas slip					
Cal. value [MJ/kg]	40,2	42,8	37,0	23-26	50,0	49,6	47,4	47,8	50,0	50,0	22,0	49,6	47,4	47,8
Energy Density [MJ/L]	38,6	40,3	33,0	16-18	28,7	25,3	27,5	24,0	28,7	28,7	15,9	25,3	27,5	24,0
Fuel consumption	Ref.	+ 0-1%	+ 0-1%	+ 8-15%					0-3%					
Fuels system	Single point injection			Gas admission Pilot fuel injection					Double direct injection Gas and Pilot fuel injection					

# ALTERNATIVE FUELS - PROPERTIES

Energy Storage Type	Specific Energy MJ/kg	Energy Density MJ/L	Required Tank Volume m <sup>3</sup> . <sup>1</sup>	Supply Pressure Bar	Injection Pressure Bar	Emmision Reduction Compared To HFO Tier II		
						SO <sub>x</sub>	NO <sub>x</sub>	CO <sub>2</sub>
HFO	40,5	35	1000	7-8	950	SO <sub>x</sub>	NO <sub>x</sub>	CO <sub>2</sub>
Liquefied natural gas (LNG -162 °C)	50	22	1590	300 METHANE	300 METHANE	90-99%	20-30%	24%
				380 ETHANE	380 ETHANE	90-97%	30-50%	15%
LPG (including Propane / Butane)	42	26	1346	50	600-700	90-100%	10-15%	13-18%
Methanol	18	15	2333	10	500	90-97%	30-50%	5%
Ethanol	26	21	1750	10	500			
Ammonia* (liquid -33 °C)	18,6	12,5	2800	50	600-700			
Hydrogen (liquid -253 °C)	142	10	3500					
Marine battery market leader Corvus battery rack	0,29	0,33	106.060					
Tesla model 3 battery Cell 2170*. <sup>2</sup>	0,8	2.5	14000					

- <sup>1</sup>: Given a 1000 m<sup>3</sup> tank for HFO. Additional space for insulation is not calculated for in above diagram. All pressure values given a high pressure Diesel injection principle.
- <sup>2</sup>: Values for Tesla battery doesn't contain energy/mass obtained for cooling/safety/classification . <https://insideevs.com/tesla-model-3-2170-energy-density-compared-bolt-p100d/>

**MAN Energy Solutions**  
Future in the making



# MAN Dual Fuel GenSets – Reality



Paw Houmann-Poulsen  
Promotion & Customer Support

# MAN Dual Fuel GenSets

## Advantages

### Power Range:

- L23/30DF      625 – 1,200 kW
- L28/32DF      1,000 – 1,800 kW

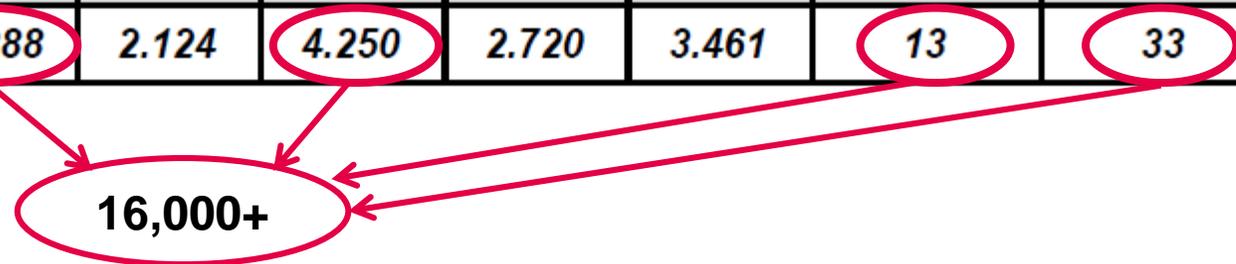
- Safe & Reliable Operation – design is based on engine types with decades of service experience
- Competitive CAPEX – simplified fuel injection system
- Flexible Installation – engine and GVU can be up to 90 – 100m apart
- Low Maintenance Cost – extended TBO



# MAN Holeby Marine Engines

Reference List per 01 January 2018

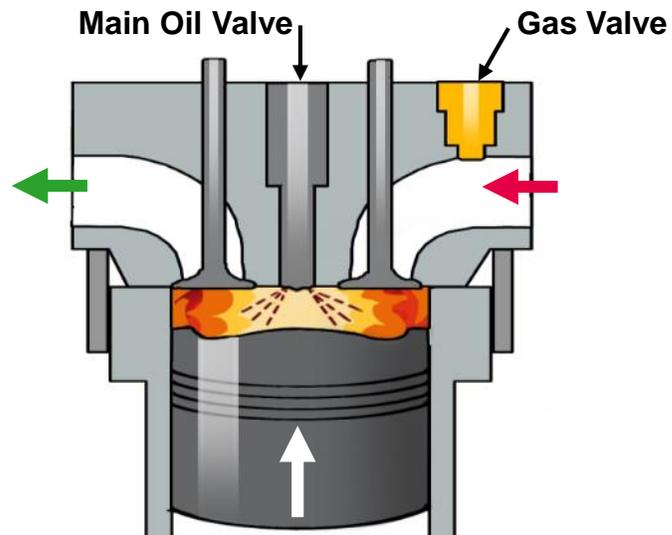
Engine Engine Maker	L16/24	L23/30	L21/31	L28/32	L27/38	L32/40	L23/30DF	L28/32DF	Total
CMP	1.015	3.733	614	405	219	44	12	12	6.054
CXZ/SQE	142		29						171
SXD	228		168			94			490
HND	170		32						202
Weichai	18		72		119	52			261
STX Korea	621	3.955	850	1.142	571	1.630	1	6	8.776
Doosan	5	910	113	34	112	633		15	1.822
Adria & Split		490	5		5				500
HCP/FSA	41	95	18	442	24	9			629
MDT FRH	12	391	59	264	447				1.173
MDT Holeby	217	526	66	632	84				1.525
MDT India			48		70	1			119
Others	265	2.188	50	1.331	1.069	998			5.901
<b>Total</b>	<b>2.734</b>	<b>12.288</b>	<b>2.124</b>	<b>4.250</b>	<b>2.720</b>	<b>3.461</b>	<b>13</b>	<b>33</b>	<b>27.623</b>



# Unique Injection Concept

Power to Trust

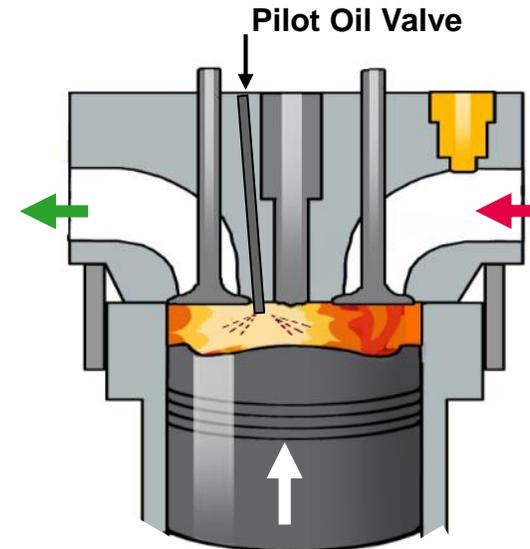
## “Holeby” Concept



Ignition by Pilot Oil  
via MAIN injector

- Low CAPEX
- Operation on MGO (DMA)
- Simple retrofit solution

## Conventional Concept

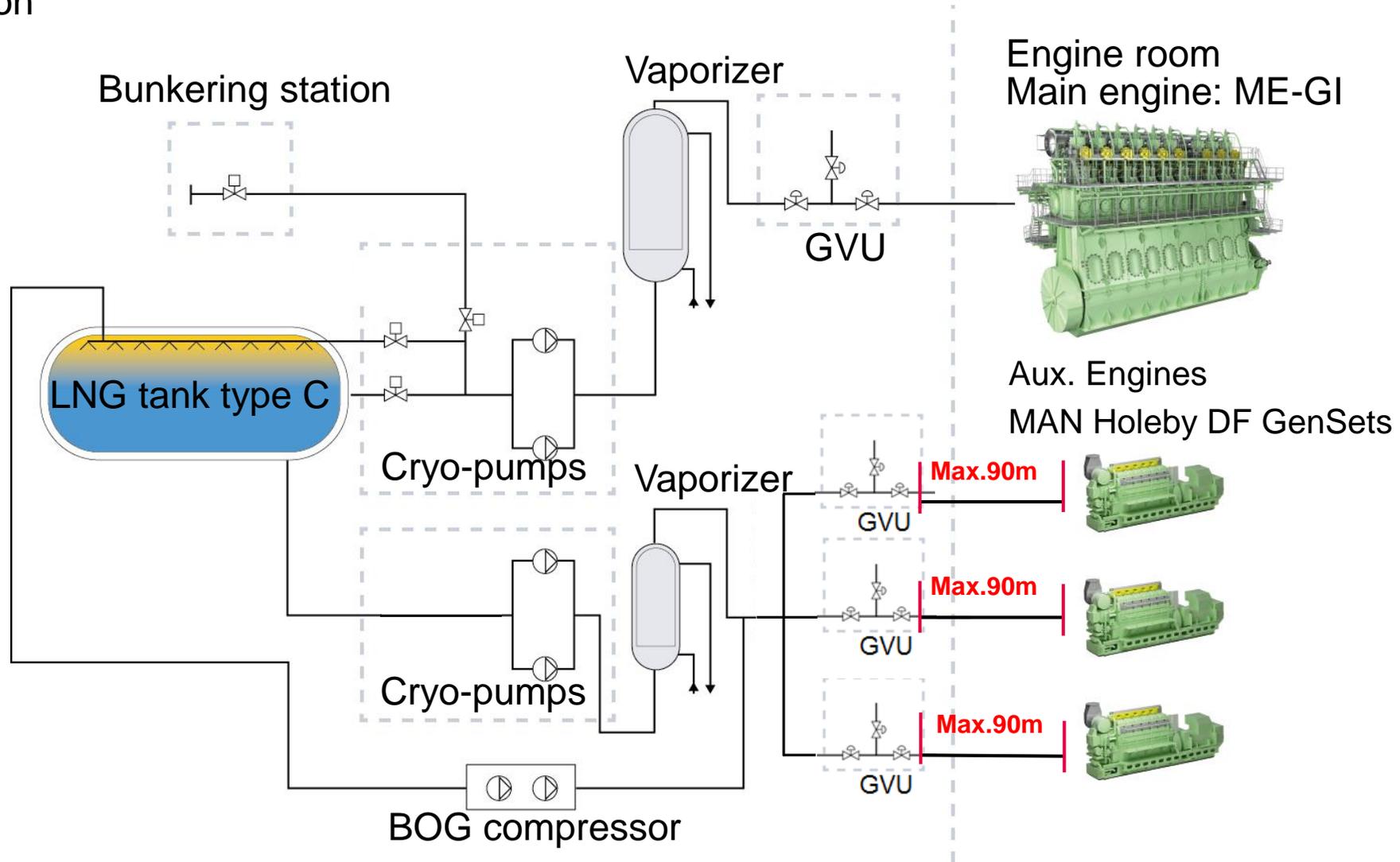


Ignition by Pilot Oil  
via PILOT injector

- High CAPEX
- Operation on HFO/MDO in diesel mode
- Special parts & common rail
- Complex retrofit solution

# LNG Supply System

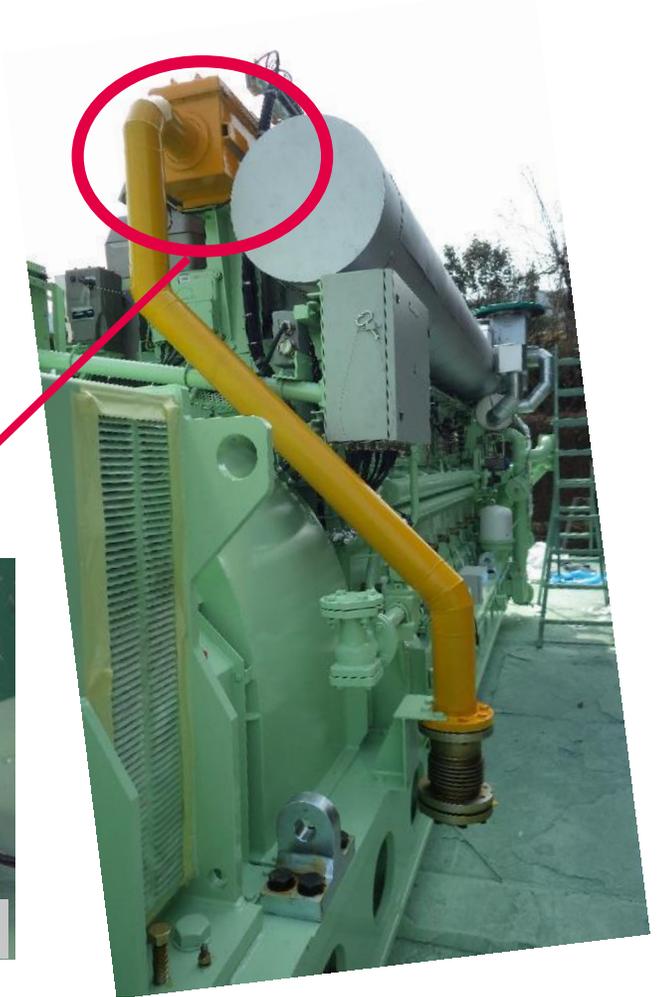
Flexible Installation



# Flexible Installation of GVU

## Unique Controlled Gas Pressure

- Each engine is equipped with a gas regulator valve on the gas supply pipe just before the engine which ensure constant gas pressure
- The unique engine design provides a flexible GVU-installation as it can be placed up to 90 – 100m from the engine



# TBO and Expected Lifetime

Up Time Any Time

- DF engines has significant better TBO's compared to engines running on conventional fuel types
- OPEX is therefore also lower
- OPEX can be estimated based on actually configuration
- TBO:

L28/32DF.....36,000hrs.

L23/30DF (720/750rpm)...32,000hrs.

L23/30DF (900rpm).....20,000hrs.

## L28/32DF

Component	Overhaul Recommendations, Maintenance and Expected Life Time	Time between overhauls (TBO) Hours **	Expected life time Hours
Main bearings	Inspection Retightening *	36.000	72.000
Connecting rod	Inspection	36.000	72.000
Big-end bearing	Inspection Retightening *	36.000	36.000
Camshaft	Inspection of cams surface	8.000	72.000
Piston	Overhaul and measuring of ring grooves	36.000	72.000
	Replacement of compression rings and scraper rings	36.000	36.000
Cylinder liner	Inspection, measuring and honing of running surface condition	36.000	72.000
Cylinder head		36.000	96.000
Valve clearance	Checking and adjustment	2.000	
Fuel injection valve	Checking, cleaning and adjustment of opening pressure <sup>3)</sup>	based on observation	6.000 <sup>3)</sup>
Inlet and Exhaust valve	Overhaul and regrinding of spindle	36.000	72.000
Valve seat ring	Exchange and grinding	36.000	36.000
Rotorcap	Function check of rotation	2.000	36.000
Valve guide	Measuring of inside diameter	36.000	72.000
Cylinder head nuts	Retightening *		
Fuel pump	Fuel pump barrel/plunger assembly. Overhaul based on operational observations		36.000
Gas System			
Gas train	Check of leakage test of gas train until inlet manifold with leakage spray	2.000	
	Pressure test and overhaul gas pipes and gas regulating unit	36.000	
Sogav	Gas injection nozzles	2.000	8.000
Rig saver	Function test of rig saver valve	2.000	
Lub. Oil pump	Overhaul	36.000	72.000
Cooling water pumps	Overhaul	36.000	64.000
Air Cooler	Cleaning and pressure testing	18.000	64.000
Compr. air system	Check of compressed air system, air starter	18.000	
Autolog reading	Check once a year or in connection with disassembly/assembly with alternator and coupling	once a year	
Lub. oil filter cartr.	Replacement based on observations of pressure drop		1.500
Regulating system	Function check of overspeed and shutdown devices. Check that the control rod of each individual fuel pump can easily go to "stop" position	quarterly	
Flexible mountings	Check anti-vibration mountings	quarterly	
Vibration damper	Check of condition and wear	36.000	
Turbocharger	Water washing of compressor side Dry cleaning of turbine side Air filter cleaning	based on observation based on observation based on observation	

# Approvals & Certificates

## L23/30DF IMO Tier III Certificate

**NOx Technical File**  
 Issued under the provisions of the Protocol of 1997 as amended by resolution MEPC. 176(58) in 2008 to the amendment of the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 relating thereto MARPOL 73/78, Annex VI. EEEEF4

**Engine Group Certification**  
**Engine Group: 23/30DFa**  
Tier II/III  
**Parent Engine: 5L23/30DF**  
**Engine no: 17090**

Engines of the engine group have to be equipped and adjusted according to the specifications given in engines technical file. The main parameters are listed below:

Engine speed	750 rpm
Engine power	125 kW / cylinder
Test cycles	E2 / D2
Mean effective pressure	16.8 bar
Electronic injection control	No
Variable injection timing	Yes
Exhaust gas re-circulation	No
Water injection/emulsion	No
Air injection	No
Exhaust after-treatment	No
Dual fuel	Yes, liquid and gaseous
Ignition in dual fuel mode	Pilot injection of liquid fuel
Variable turbocharger geometry	No
Max. inlet water temperature	
charge air cooler	36°C
Maximum charge air temperature	48°C (corresponding to 25°C sea water temp.) 70°C (with preheating at load below 30%)
Maximum exhaust back pressure	30 mbar
Liquid Fuel oil to be used on-board	DMA acc. to ISO 8217
Gaseous Fuel to be used on-board	LNG
Lubrication oil specification	SAE 30
Fuel cam plunger lift at TDC	Max. 5.81 mm (average value)
IMO identification numbers	according chapter 8



EXAMINED  
 EMAPP-G-173288-0001  
 SEE LETTER Date: 2018-01-11  
*A. A. S. Gullik*



## L28/32DF Type Approval Certificate

**DNV·GL**  
 Certificate No: TAM000011T

**TYPE APPROVAL CERTIFICATE**

**This is to certify:**  
**That the Dual Fuel Engine**  
 with type designation  
**L28/32DF**  
 Issued to  
**MAN Energy Solutions**  
**Copenhagen SV, Denmark**

is found to comply with  
**DNV GL Rules for classification, Ships - DNVGL-RU-SHIP-Pt4 Ch3 Sec1,**  
**Reciprocating Internal Combustion Engines**

**Application :**  
 Multi engine plant: electrical propulsion and auxiliary

Product approved by this certificate is accepted for installation on all vessels classed by DNV GL.

This Certificate is valid until **7th March, 2024**.  
 Issued at **Høvik** on **8th March, 2019**

DNV GL local station: **Copenhagen**  
 Approval Engineer: **Tage Olav Alexander Strøm**



for **DNV GL**  
 Signed by **Oddvar Deinboll**, The Head of Section  
 Location: DNV GL, Høvik, Norway  
 Signing Date: 03.03.2019, 10:56:41

**Oddvar Deinboll**  
 Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid. The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

Form code: TA 1411a      Revision: 2015-05      www.dnvgl.com      Page 1 of 3

Type approval and IMO Tier III certificate is achieved

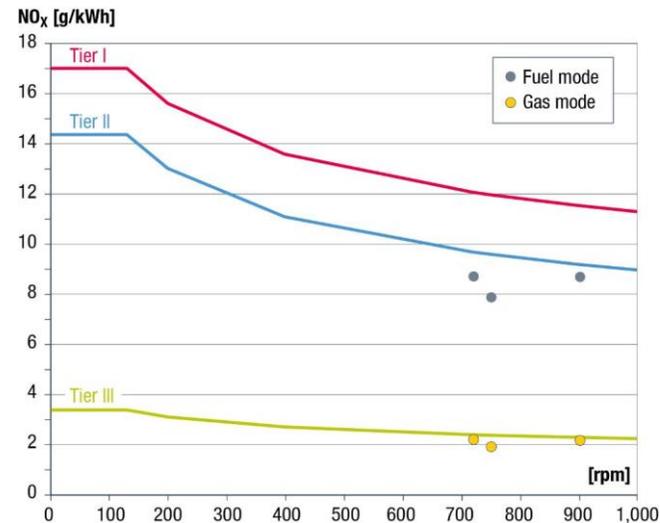
# L23/30DF IMO Tier III Compliant

## MAN Holeby Dual Fuel GenSets

- Verified Test results shows NO<sub>x</sub>-level well below limit
- Gas Mode: IMO Tier III
- Diesel Mode: IMO Tier II
- 110% power output in Diesel Mode
- 110% power output in Gas Mode
- Safe and reliable/stable operation

### Applications / Certificates

- IMO Tier III (Gas Mode)
- Marine GenSets (constant speed)
- Diesel Electric Propulsion (excl. DP)
- Power Stations/Plants
- WB 2007



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## SIEM Car Carrier

2+2 x 7500 PCTC

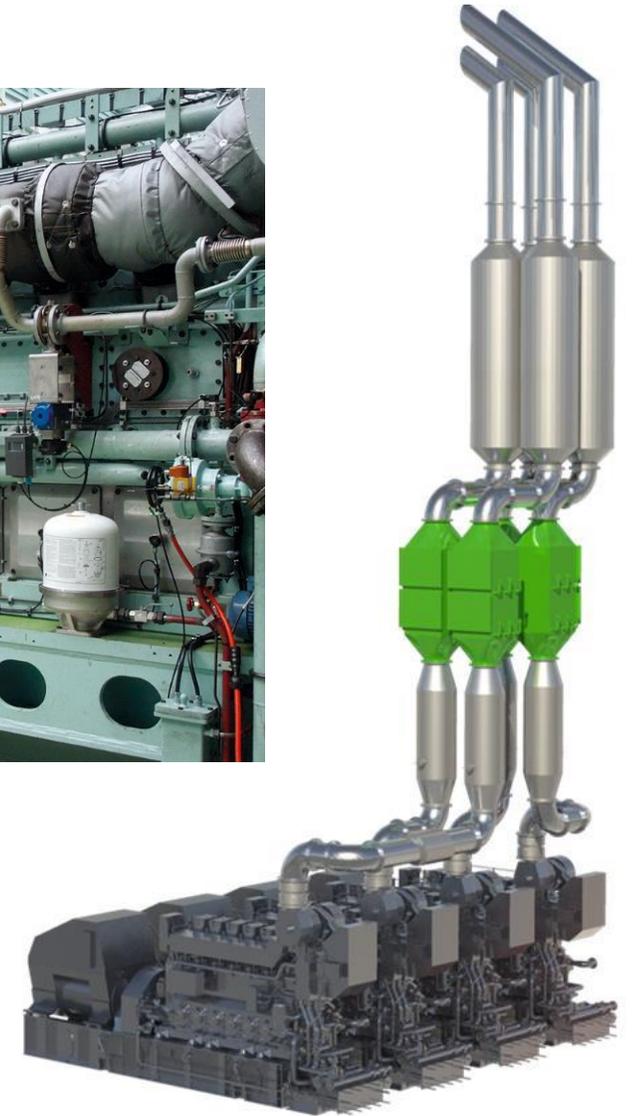


1 x 7L28/32DF + 2 x 9L28/32DF

# Full Fuel Flexibility – with LP SCR

## MAN Dual Fuel GenSets

- Gas Mode: IMO Tier III
- Diesel Mode: IMO Tier III
- 110% power output in Diesel Mode
- 110% power output in Gas Mode
- Safe and reliable/stable operation



# Operation Modes – L23/30DF

Comply to IMO Tier III in Gas Mode

## Diesel Mode (IMO Tier II)

Main fuel nozzle

MGO (DMA)

100%

**Diesel**

**No HFO!!!**



## Gas Mode (IMO Tier III)

Gas admission valve

Natural gas  
(vaporized LNG)

**Gas**

~ 98%

~ 2%

Pilot fuel via main fuel nozzle  
MGO (DMA)

**No HFO!!!**

# Operation Modes – L28/32DF

Comply to IMO Tier III in Gas Mode

## Diesel Mode (IMO Tier II)

Main fuel nozzle

MGO (DMA)

100%

**Diesel**

**No HFO!!!**



L28/32DF

## Gas Mode (IMO Tier III)

Gas admission valve

Natural gas  
(vaporized LNG)

**Gas**

~ 94%

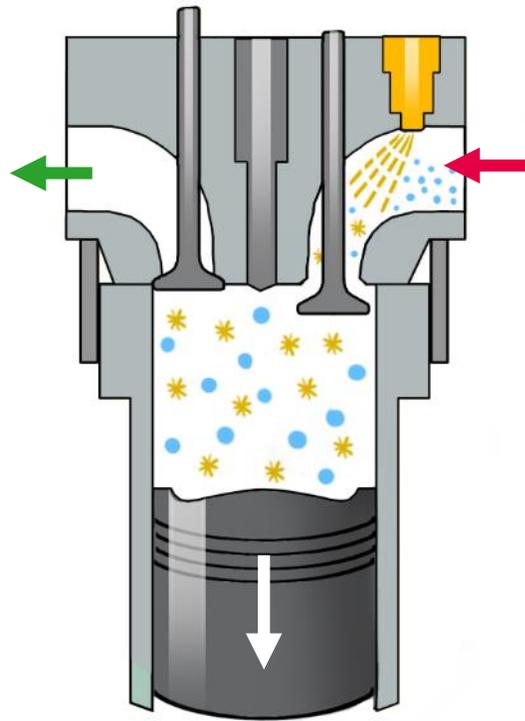
~ 6%

Pilot fuel via main fuel nozzle  
MGO (DMA)

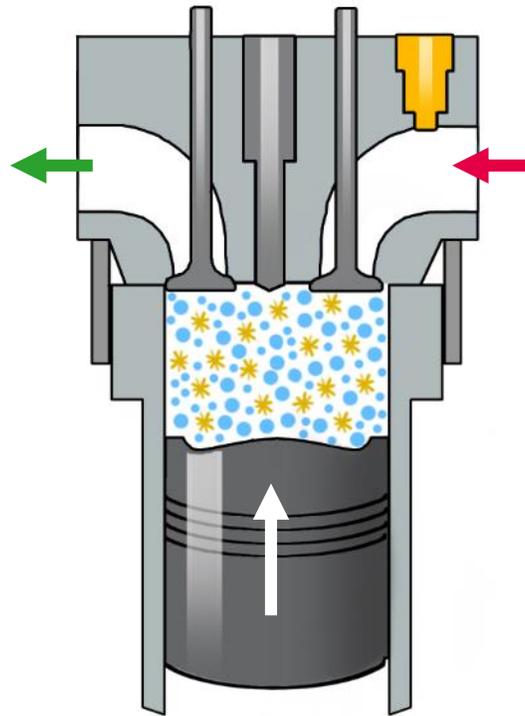
**No HFO!!!**

# Otto Cycle Process

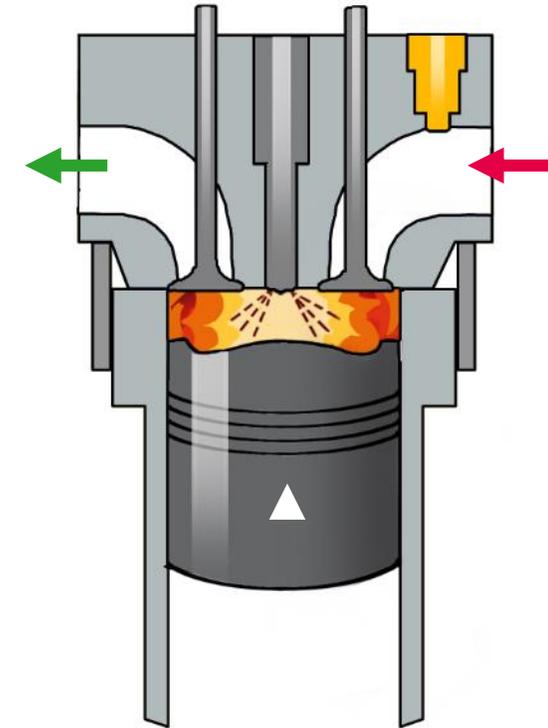
Low Injection Pressure with Individual Valves



Air and Gas Intake



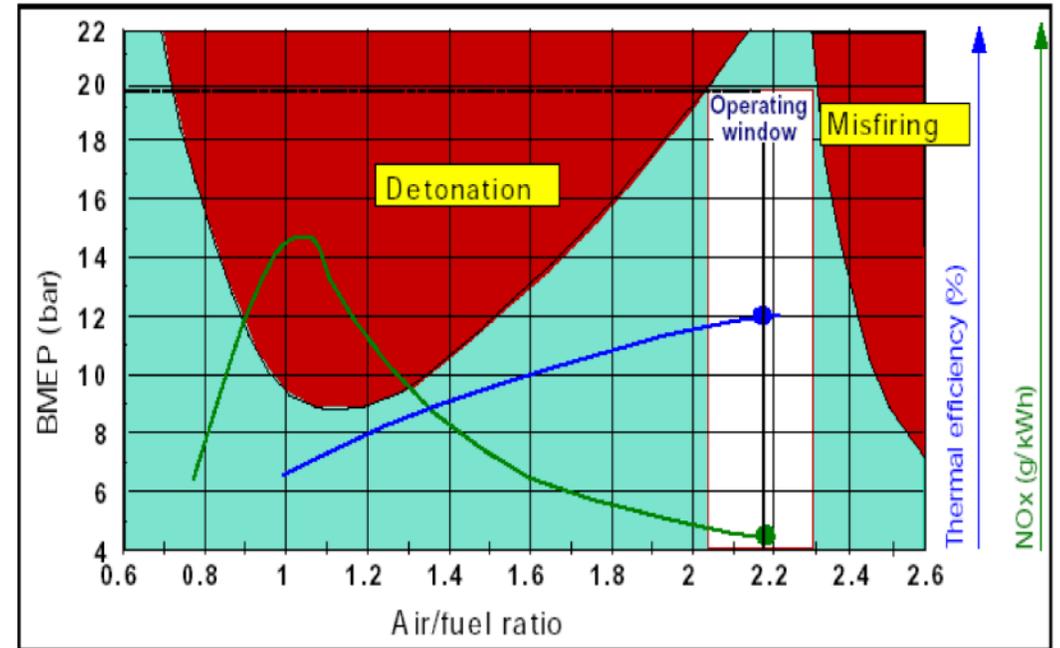
Compression



Ignition by  
Pilot Fuel

# Controlling the Combustion

- MEP must be below 20 bar and the air/fuel ratio is limited to reduce the risk of “knocking” and misfire.
- The engines types of classic design is already close to the required MEP, subsequently only minor power reduction.
- The engines types of compact design is far from the required MEP, subsequently a larger power reduction would be necessary.



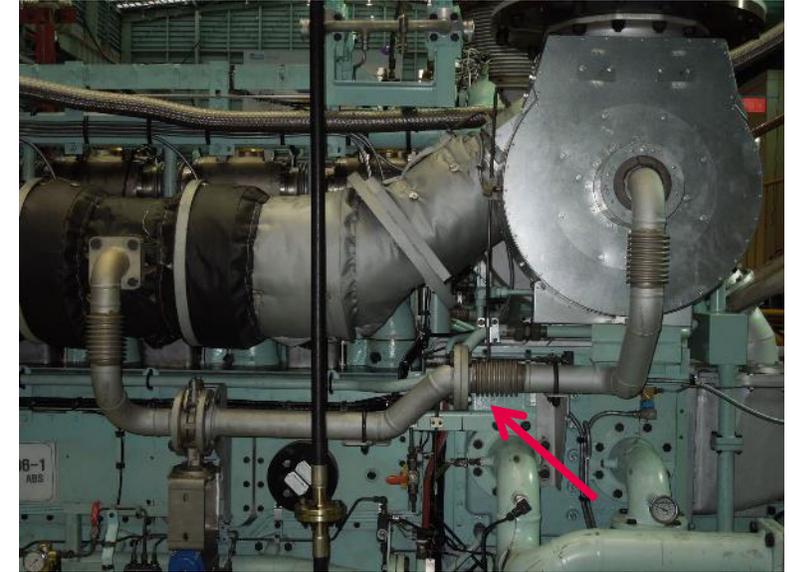
Engine type (HFO/MDO/MGO)	MEP (bar)
L23/30H	~18 - 20
L28/32H	~18 - 19
L16/24	~21 - 24
L21/31	~22 - 27
L27/38	~23 - 27

Engine type (DF)	MEP (bar)
L23/30DF	~16 - 18
L28/32DF	~16 - 17

# Controlling the Air/Fuel Ratio

## Waste Gate & Charge Air Pressure Sensor

- For correct operation in Gas Mode the air-fuel ratio is controlled by waste gate.
- The function of the waste gate is to bypass some of the exhaust gas to minimize the energy to the T/C which reduces the charge air pressure (lower compressor speed).
- Each Cylinder is equipped with a sensor which senses vibrations inside the cylinder.
- The signals are analyzed and knocking level is calculated and the control system optimizes combustion by means of the waste gate to the limit of minimum knocking.



# Methane Number

## Consequences

- A Methane Number (MN) of at least 80 is required to prevent knocking, maintain full load and performance data unchanged.
- If MN is close to 80 the engine will compensate it self first by activate the waste gate and second by retarded injection (maintain full load / slightly higher performance data).
- If the MN is below 80 the engine will only but automatically compensate by adding more pilot oil (MGO) (maintain full load / higher performance data).
- If MN is much below 80 the engine will switch to Diesel Mode if the control system are not able to compensate.
- If from beginning MN is expected to be much below 80 mostly it can be compensated by derating (1% per 1 MN) the engine, but this will of cause influence performance data and probably also “engine size”.
- MN and LCV do not influence NOx certificate as the FAT will to be conducted with ordinary LNG and is then valid for all other operational LNG.
- During test of L28/32DF (Tier 2) the DF engines were actually running on MN= $\sim$ 77-78 without problems (full load).

# Methane Number

## Consequences

- The power output is derated by 1% for each MN number below 80.  
Worst case scenario is max. 90% power output with MN=70.
- However, normally the Power Management System (PMS) will start up the next GenSet if more than approx. 80 – 85% load is needed.
- Therefore a MN=70 has no practical influence.



# MAN PrimeServ Academy

Hands On Training at Holeby Site

## DF Training Course

- 6 – 8 Superintendents per class
- Duration of Five Working Days

## For Hands On Practice

- DF components
- SaCoSone (DF version)
- GVU

## Qualified Superintendents

- MDT will issue certificate upon completion of test



COURSE: C00000724 - 28/32DF-GENSET Commissioning - one week course					
Location: INTERNAL	COURSE TITLE: 28/32DF-GENSET Commissioning - internal course			IMPLEMENTATION DATES: 09/2016	
	1 <sup>st</sup> day	2 <sup>nd</sup> day	3 <sup>rd</sup> day	4 <sup>th</sup> day	5 <sup>th</sup> day
08:30 – 09:15	Safety presentation	Gas Valve Unit	Safety concept Exercise	Firmware Updates on various modules	Commissioning Procedure: Software Setup
09:15 – 10:00	Welcome and introduction	GVU	Safety concept Exercise	Practical Exercise	Commissioning Procedure: Software Setup
10:00 – 10:15	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
10:15 – 11:00	Dual fuel engine vs Diesel engine	GVU practical session	SaCoSone	SaCoSone - Speed Governor & Limiters	Commissioning Procedure
11:00 – 11:45	Dual fuel engine in general	GVU practical session	SaCoSone	SaCoSone - Speed Governor & Limiters	Commissioning Procedure
11:45 – 12:45	Lunch	Lunch	Lunch	Lunch	Lunch
12:45 – 13:30	Mechanical parts for Dual Fuel	Safety concept for Dual Fuel	SaCoSone	SaCoSone - Speed Governor & Limiters	Documentation Workflows
13:30 – 14:15	Mechanical parts for Dual Fuel	Safety concept for Dual Fuel	SaCoSone	SaCoSone - Speed Governor & Limiters	Course Evaluation
14:15 – 14:30	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
14:30 – 15:15	PMI (P <sub>max</sub> )	Safety concept for Dual Fuel	SaCoSone / WAGO PLC	SaCoSone Practical Exercise	
15:15 – 15:30	PMI (P <sub>max</sub> )	Safety concept for Dual Fuel	SaCoSone / WAGO PLC	SaCoSone Practical Exercise	

Subject to change without prior notice

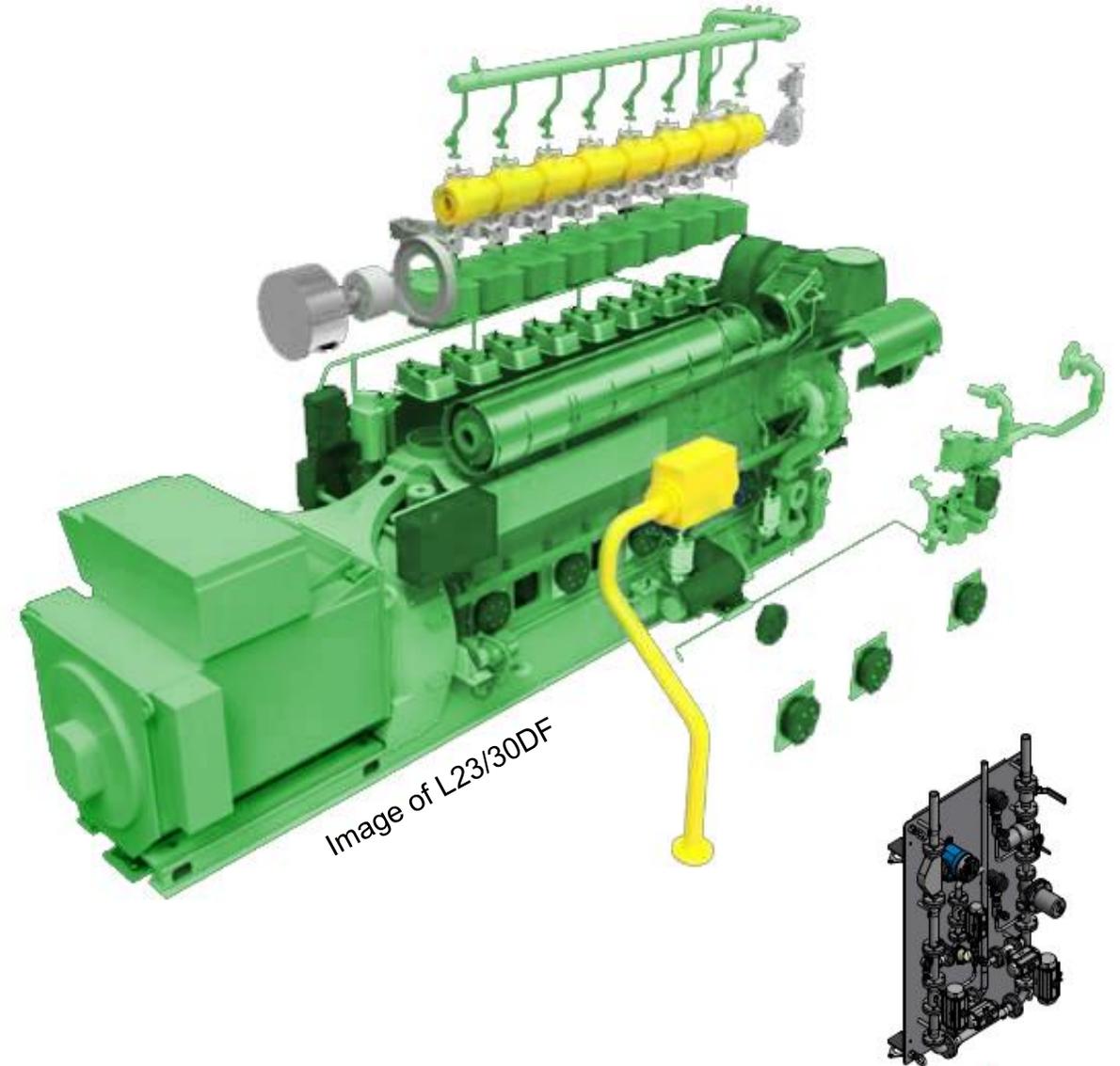


# Retrofit Solution

## Components for Dual Fuel Operation

### Modification and Major New Parts for Retrofit:

- Double Wall Pipe & Gas Pressure Regulator
- Cooling Water Pipe
- Gas Injection Valves & Fuel Pumps
- TurboCharger & Shut-off Valve
- Pistons & ConRods
- Waste Gate (air/gas ratio)
- Valve/valve seats & Camshaft
- Pressure Relieve Valves
- Dual Fuel/Knocking Control
- External Gas Valve Unit

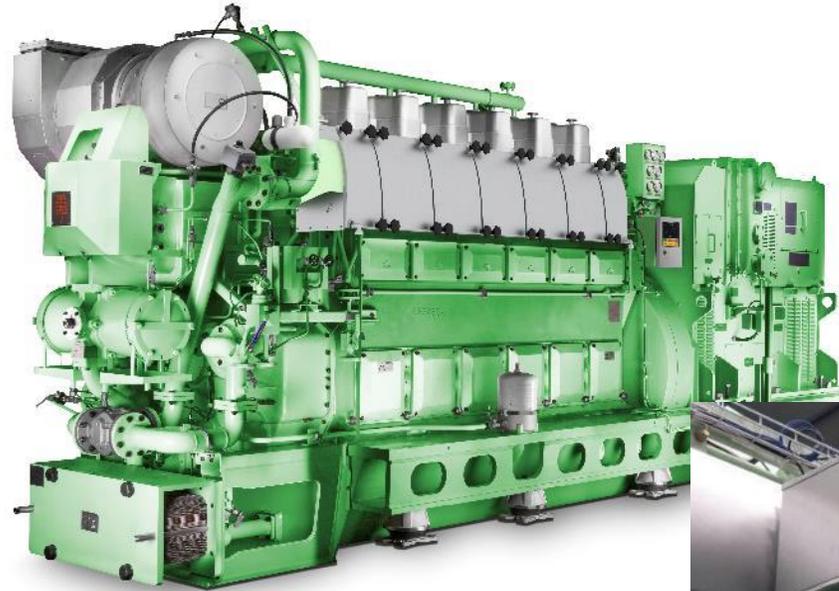


# Dual Fuel Ready Concept – Step 1

DFR-Components for 9L28/32H

## Major Components:

- Safety & Control System
- Regulator UG25000
- TurboCharger Model – TCR
- Pressure Relieve Valves
- Cooling Water System no. 5
- Cooling Water Pipe
- Gas Top Blocks
- Tacho Sensors
- PLO-function by Waste Gate – Optional



# Dual Fuel Ready Concept – Step 2

DFR-Components for 9L28/32DF

## Major Components:

- (Waste Gate)
- Fuel Pumps
- Gas Injection Valves
- Pistons & ConRods
- Camshaft
- Re-Matching of T/C
- Double Wall Injection Pipe
- Gas Pressure Control Valve
- Crankcase Monitoring System
- Gas Valve Unit (GVU)



# Reference List – Dual Fuel GenSets

February 2018

No. of ships	Opt.	No. of eng.	Engine	Mk	Gas	Ship Type	Cap.	Unit	Owner	Builder	Yard	Hull no.	Delivery year
2	3	5	8 L 70 ME-C	8.2	GI	Container	3100	TEU	Tote Maritime	Doosan	NASSCO	TOTE6495/96	2014
		15	9 L 28/32 DF	GenSets	Doosan								
2	2	2	8 S 70 ME-C	8.2	GI	Con-Ro	2400	TEU	Crowley	MES	VT Halter	2022, 2023	2015
	6	9	L 28/32 DF	GenSets	STX								
2	4	7	G 70 ME-C	9.2	GI	LNG tanker	175000	CBM	Elcano	MES	Imabari	8177/ 8188 # 1+2	2016
	8	7	L 35/44 DF	GenSets	MDT								
2	2	4	5 G 45 ME-C	9.5	GI	Bulk Carrier	25000	DWT	ESL Shipping	STX	Jinling S/Y	QS25000-1/2/3/4	2017
	4	5	L 23/30 DF	GenSets	CMP								
	8	8	L 23/30 DF	GenSets	CMP								
2	2	4	7 S 60 ME-C	10.5	GI	PCTC	7500		SIEM Car Carrier	HHI-EMD	Xiamen S/B		2018
	8	9	L 28/32 DF	GenSets	CMP								
	4	7	L 28/32 DF	GenSets	CMP								
	1	6	L 23/30DF	Test						STX-E			2018
1	3	6	L 35/44DF	GenSets		Dreger			Dragages-Ports	MDT	Damen Ship Repair		2018
2	2	7	G 80 ME-C	9.5	GI	Container	2700	TEU	Pasha	ND	Keppel Brownsville		2019
	6	6	L 35/44DF	GenSets	MDT								

Total Dual Fuel GenSets: 63

Total no. of vessels: 21

# Recent Orders

L28/32DF

Owner: Wallenius Shipping

Yard: Yantai CIMC Raffles

Ship: 2 + 2 x 5,800ML RORO

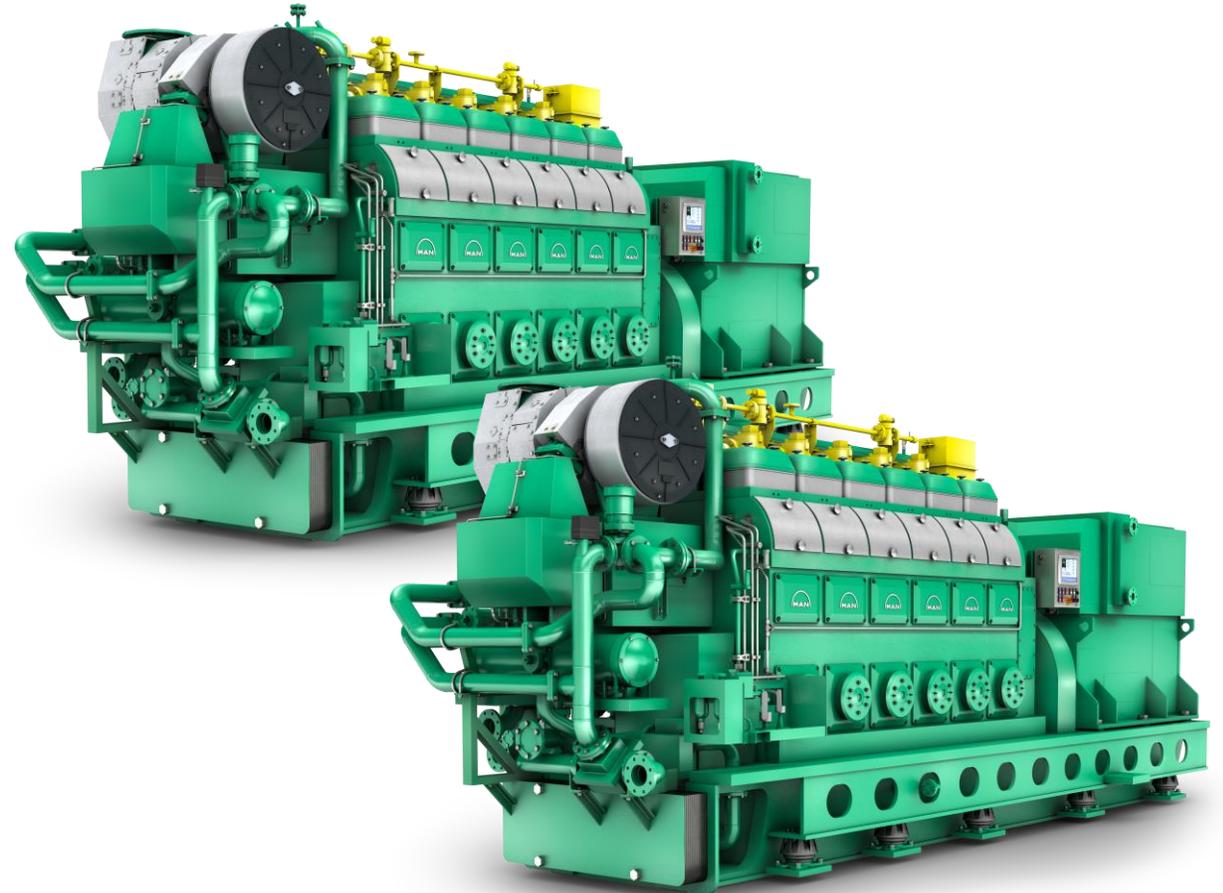
GenSets: CMP-MAN 2 x 9L28/32DF, 720rpm

Owner: United European Car Carriers

Yard: Jiangnan (group) S/Y

Ship: 2 + 2 x 3,600PCTC

GenSets: CMP-MAN 2 x 6L28/32DF, 720rpm



# Service Experiences

## Power To Trust

Total hrs.: 115,985

Gas hrs.: 51,247

- Bumpless switch between Diesel Mode and Gas Mode
- Trouble-free Load Step

### Isla Bella (March 2019)

Total hrs.: 33,872

Gas hrs.: 19,024

### Perla Del Caribe (March 2019)

Total hrs.: 41,611

Gas hrs.: 19,850

### El Coqui (February 2019)

Total hrs.: 15,673

Gas hrs.: 6,787

### Taino (March 2019)

Total hrs.: 7,133

Gas hrs.: 3,673

### Wiikki (May 2019)

Total hrs.: 9,270

Gas hrs.: 330

### Haaga (May 2019)

Total hrs.: 8,426

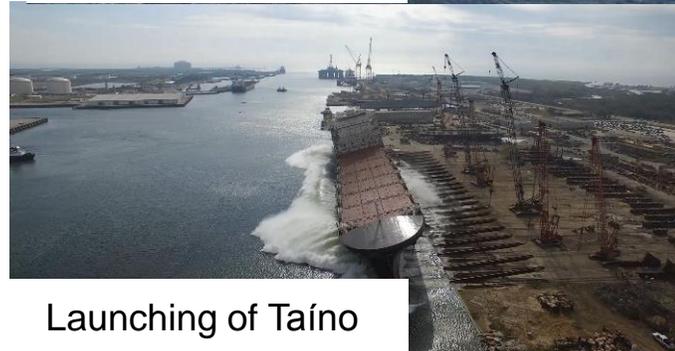
Gas hrs.: 1,583



Isla Bella



Perla Del Caribe



Launching of Taino



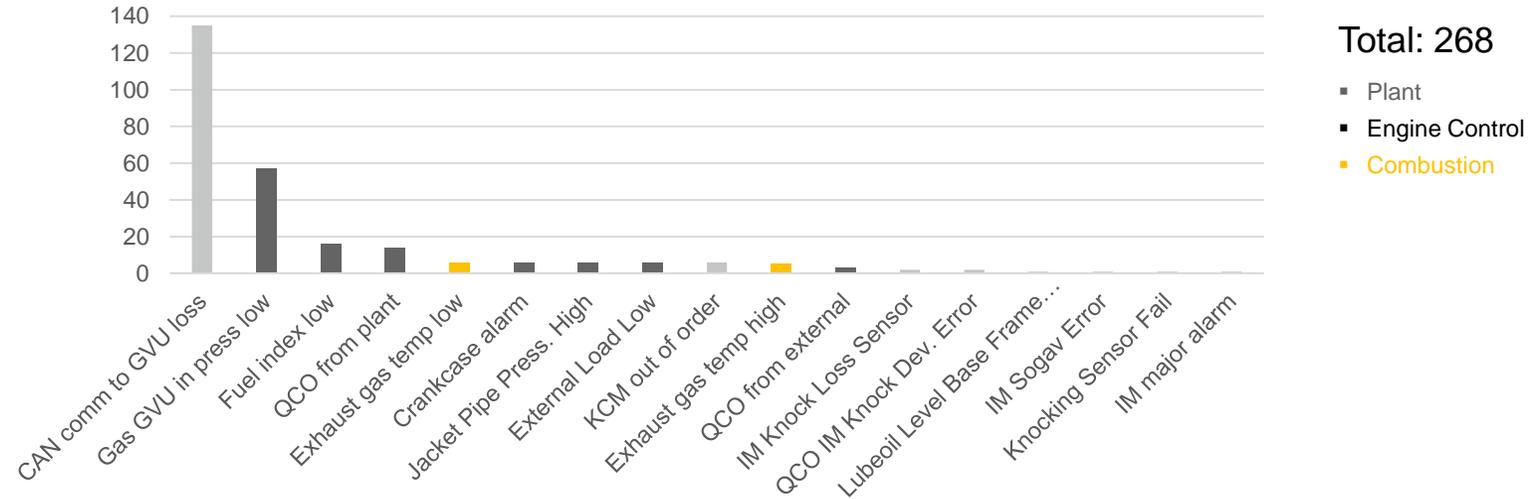
Launching of El Coqui



Wiikki and Haaga

# QCO Accumulated on TOTE vessels

Start Jan to End Apr 2018



TOTE vessels each 3 x 9L28/32DF

Not every QCO is resulting from a problem

e.g. low Gas pressure at GUV inlet is a common situation for given operation

- 102 are related to the vessels gas plant operation, and not related to engine system.
- 166 related to the engine operation and control system.
- 11 are related to in-cylinder combustion (exhaust gas temperature low or high)



# 1. QCO - Electrical Interference



Lost communication between engine and GVU

Communication cables changed

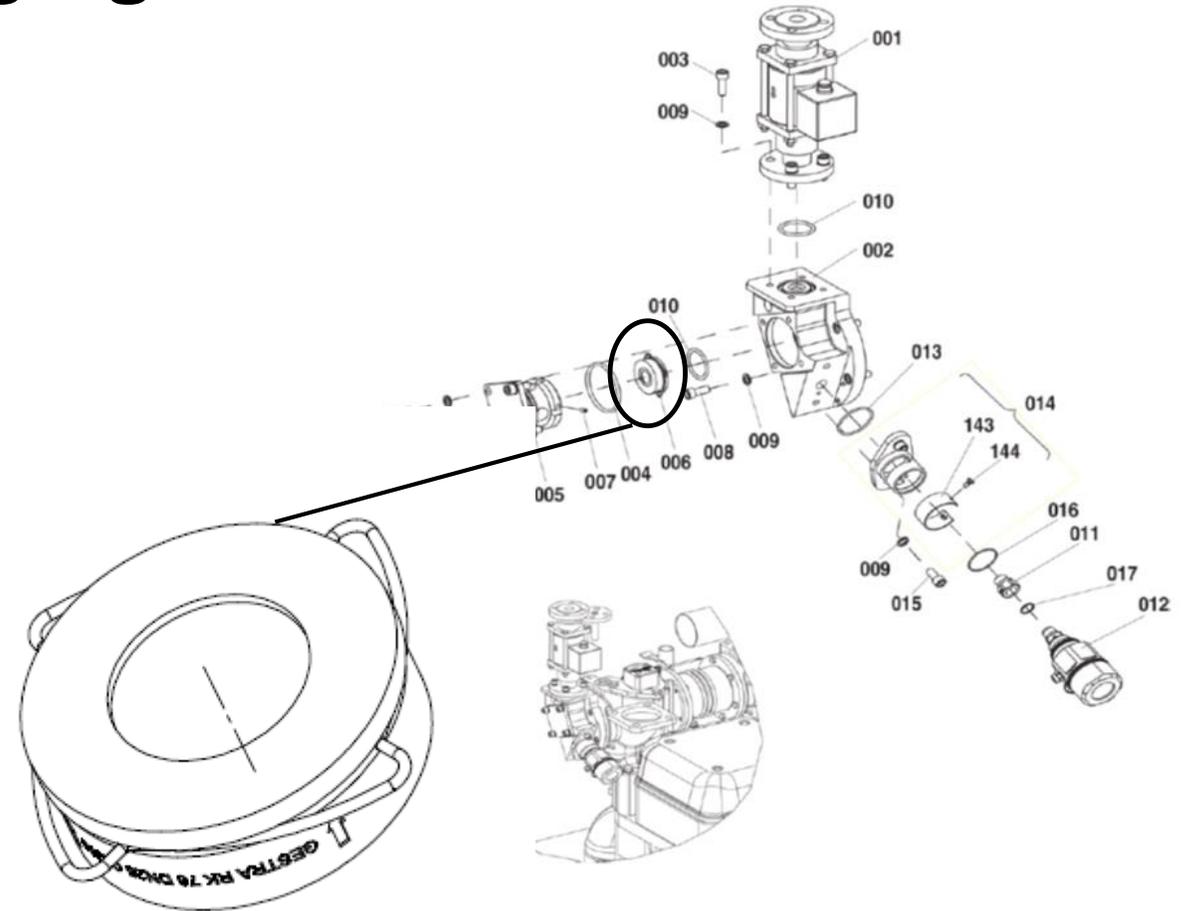
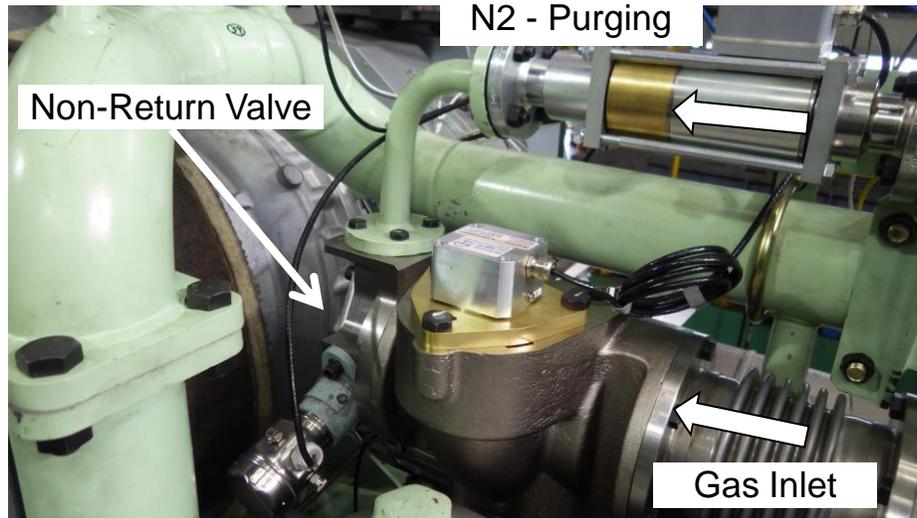
Cables relocated in order to avoid EMC interference

Updated SaCos software is presently in field test



# Weak Non-Return Valve – Purging

- Valve body in non return valve loosened from valve housing and fall in to the gas housing.
- New improved non return valve with fixed valve body introduced.



# 4. Burned Exhaust Gas Valves

- A/E #2:  
Burned outlet valves after 18 months in service
- Action:  
Overhauling of cylinder cover, correct valve adjustment and new lub. Oil with lower TBN level.
- A/E #2:  
Follow up inspection 12 months later  
Good condition



# 5. Knocking Sensor Fail

Knocking sensor fault caused by insufficient spot facing at cylinder cover, causing the knocking sensor body to rest at the edge of the casting.

Spot facing modified to avoid similar problem in the future.

Correct torque of mounting bolt are essential in order to ensure correct function of the knocking sensor.



# MAN Dual Fuel GenSets

## Summary

- L23/30DF in IMO Tier III compliance
- L28/32DF in IMO Tier III compliance
- Full Fuel Flexibility with SCR
- 45 x 4-stroke small bore DF-engines on order / delivered
- > 50,000 hours of service experience
- Safe & Reliable Operation – design is based on engine types with decades of service experience
- Competitive CAPEX – simplified LP fuel injection system
- Flexible Installation – up to 90 – 100m between engine and GPU
- Low Maintenance Cost – Up to TBO 36,000hrs
- L28/32H most suitable GenSet for DF Conversion with less 5% Power Reduction



**MAN Energy Solutions**  
Future in the making



# Thank you for your attention



Paw Houmann-Poulsen  
Promotion & Customer Support