



Dual fuel conversion

MAN PrimeServ

For marine systems
with two-stroke
applications

Optimized equipment

Your partners for retrofit solutions

Reliability, greater efficiency and compliance with new environmental legislation are just some of the benefits our advanced retrofit solutions provide.

Your existing engines, machinery, auxiliary systems, instrumentation and control systems might be aging, but that doesn't mean they can't keep delivering value. Our comprehensive, tailored retrofit solutions can bring your assets up to date and keep them there, through continuous development and modernization.

Available for a wide range of engines, propulsion systems and turbochargers, our retrofits and upgrades will help you improve efficiency, boost performance, save on fuel and lube oil, while lowering maintenance costs and enabling more flexible operation.

MAN PrimeServ retrofits will also help you comply with increasingly stringent environmental regulations and put your operations on the road to energy transition and decarbonization. And it will benefit your employees by improving crew safety, ease of equipment operation and lower emissions onboard.

To reduce emissions from diesel engines, consider our dual fuel retrofit solutions in particular. In addition to improving environmental performance, these retrofits can help you save fuel and reduce operating costs.







The future is dual fuel

Increasingly strict limits on vessel emissions have given rise to new solutions for greener maritime operations. For example, gas has now become a truly viable bunker fuel option, paving the way for dual fuel systems that meet environmental legislation and make good financial sense.

LNG, ethane, LPG and methanol fuels reduce air pollution significantly, while largely eliminating SO_x and particulate emissions. A dual fuel configuration now lets you switch between diesel and gas as prices change, making the dual fuel approach more viable than ever.

Since any ME-C engine with a bore size of at least 50 can be converted for dual fuel operation, more than 3,000 vessels can now run on LNG (ME-GI) ethane (ME-GIE), LPG (ME-LGIP), methanol (ME-LGIM) and other low-emission fuels.

How a conversion works

Prior to the conversion itself, the product scope is determined during an on-site survey, and the engineering, procurement and production work is

started. Once the equipment has been shipped to the repair yard, MAN PrimeServ proceeds with the conversion working closely with shipyards around the world. Beside the engine conversion, the complete dual fuel system consists of a fuel gas supply system (FGSS) and bunker tank(s) or integration into an existing cargo system. The MAN PrimeServ scope is not limited to conversion of the main engine but can also include the gas systems in partnership with MAN Cryo or other prominent gas system providers in the world.

In these cases, MAN PrimeServ can offer the conversion on a turnkey basis, taking full responsibility of the entire conversion project.

We provide a complete dual fuel conversion package, including:

- Research and development
- Engineering
- Site survey
- Engine hardware
- Fuel gas supply system
- Installation supervision
- Testing and commissioning
- Project management

LNG or ethane

ME-GI/GIE engines enables you to operate on LNG (ME-GI) or ethane (ME-GIE), in addition to compliant conventional fuels.

The engine operates on the same principles as the conventional ME-C engine. It features the same operation profile and load response as the ME-C, and it's designed to secure no ethane slippage and knocking problems.

To deliver efficient gas injection, an ME-GI/GIE engine requires the LNG/ethane to be vaporized and supplied at approximately 300 bar. In addition to

the main engine retrofit, a gas valve train (GVT) has to be included with a fuel gas supply system (FGSS) that includes MAN Energy Solutions new developed PVU system.

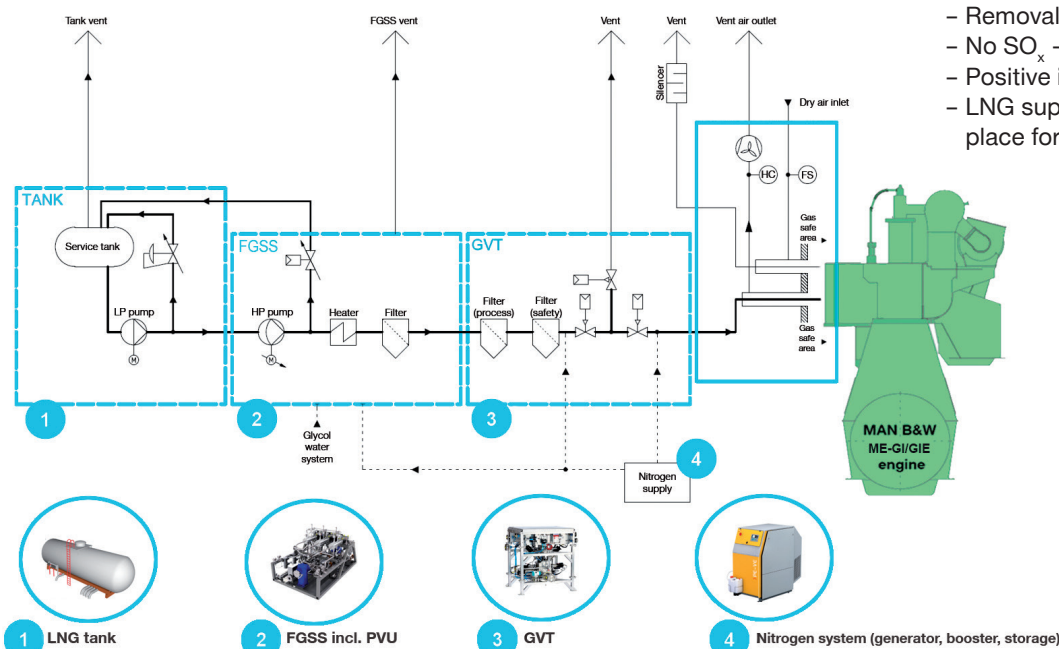
From our experience with ME-GI/GIE new-buildings, we have extensive knowhow and a full range of solutions, all of which we apply to your retrofitting project.

Main engine conversion scope

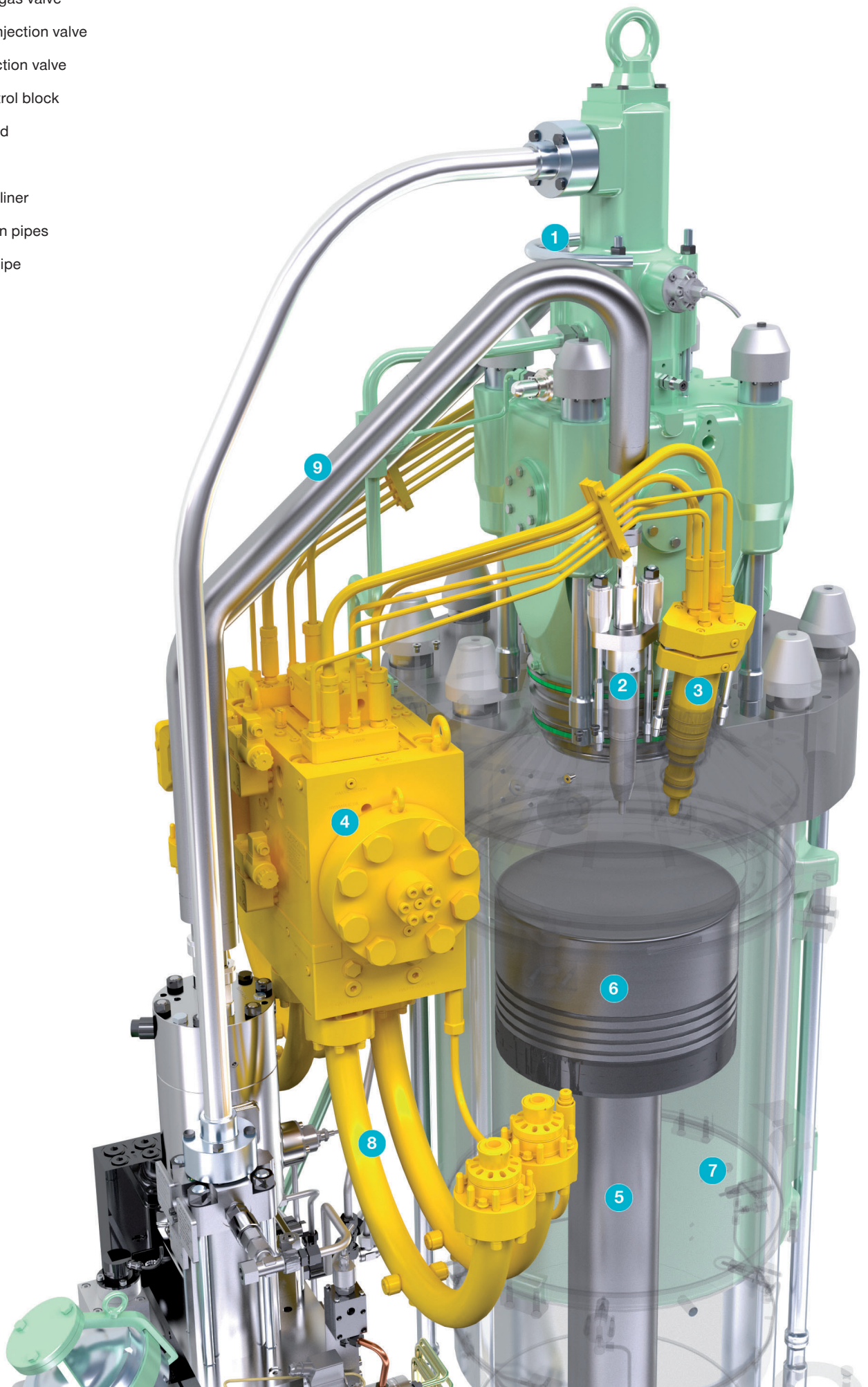
- Cylinder covers with gas injectors
- Gas control blocks
- Gas chain pipes (high-pressure double-wall pipes)
- Sealing oil system
- Add-on ME-GI/GIE control system

ME-GI retrofit benefits

- Good environmental performance
- Lower NO_x and CO₂
- Removal of PM
- No SO_x – 2020 compliant
- Positive impact on EEDI
- LNG supply chain at major hubs in place for 2020



- 1 Exhaust gas valve
- 2 Fuel oil injection valve
- 3 Gas injection valve
- 4 Gas control block
- 5 Piston rod
- 6 Piston
- 7 Cylinder liner
- 8 Gas chain pipes
- 9 Fuel oil pipe



LPG or methanol

ME-LGIP/LGIM engine runs on your choice of LPG (ME-LGIP) or methanol (ME-LGIM).

The ME-LGIP/LGIM engines provide the electronic injection, operation profile and load response you know from your ME-C/ME-GI engines.

Thanks to favorable gas prices and availability, ME-LGIP/LGIM engines are being used with increasing frequency.

- Sealing oil system
- Add-on ME-LGIP/LGIM control system

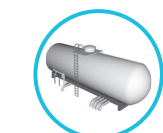
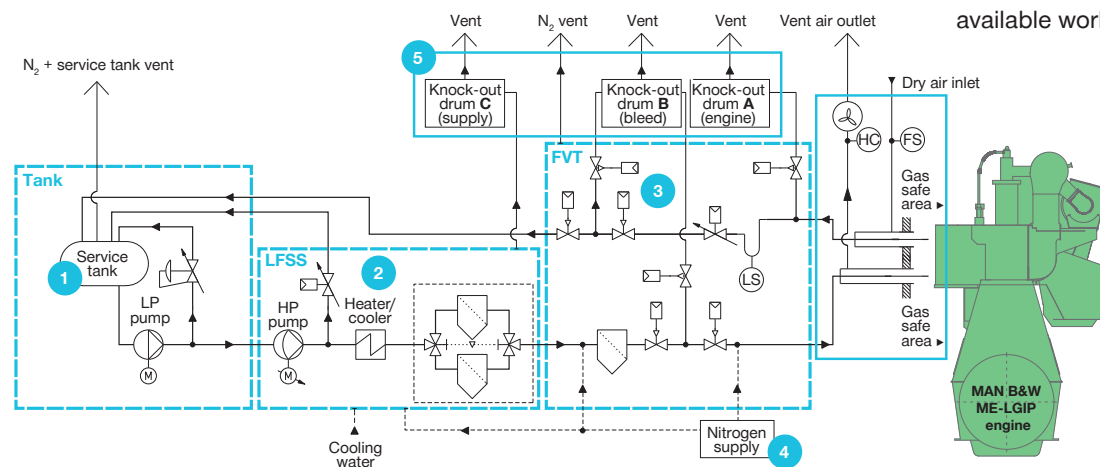
To provide efficient gas injection, ME-LGIP/LGIM engines use fuel booster injection valves (FBIV) to pressurize the LPG/methanol liquid up to 500 bar, just like an ME-C engine. In addition to the main engine retrofit, a fuel valve train (FVT) and a FGSS can provide liquid fuels to the ME-C engines.

Main engine conversion scope

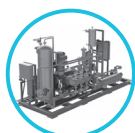
- Cylinder covers with gas injectors (FBIV-P)
- Gas control blocks
- Gas chain pipes (high-pressure double-wall pipes)

ME-LGIP retrofit benefits

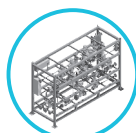
- Great environmental performance, Lower NO_x and CO_2
- Removal of PM
- Positive impact on EEDI
- No SO_x – 2020 compliant
- Supply chain in place worldwide (600-700 small LPG carriers in the market)
- Known LPG commodity prices available worldwide



1 LPG service tank



2 Low-flashpoint fuel supply system



3 Fuel valve train

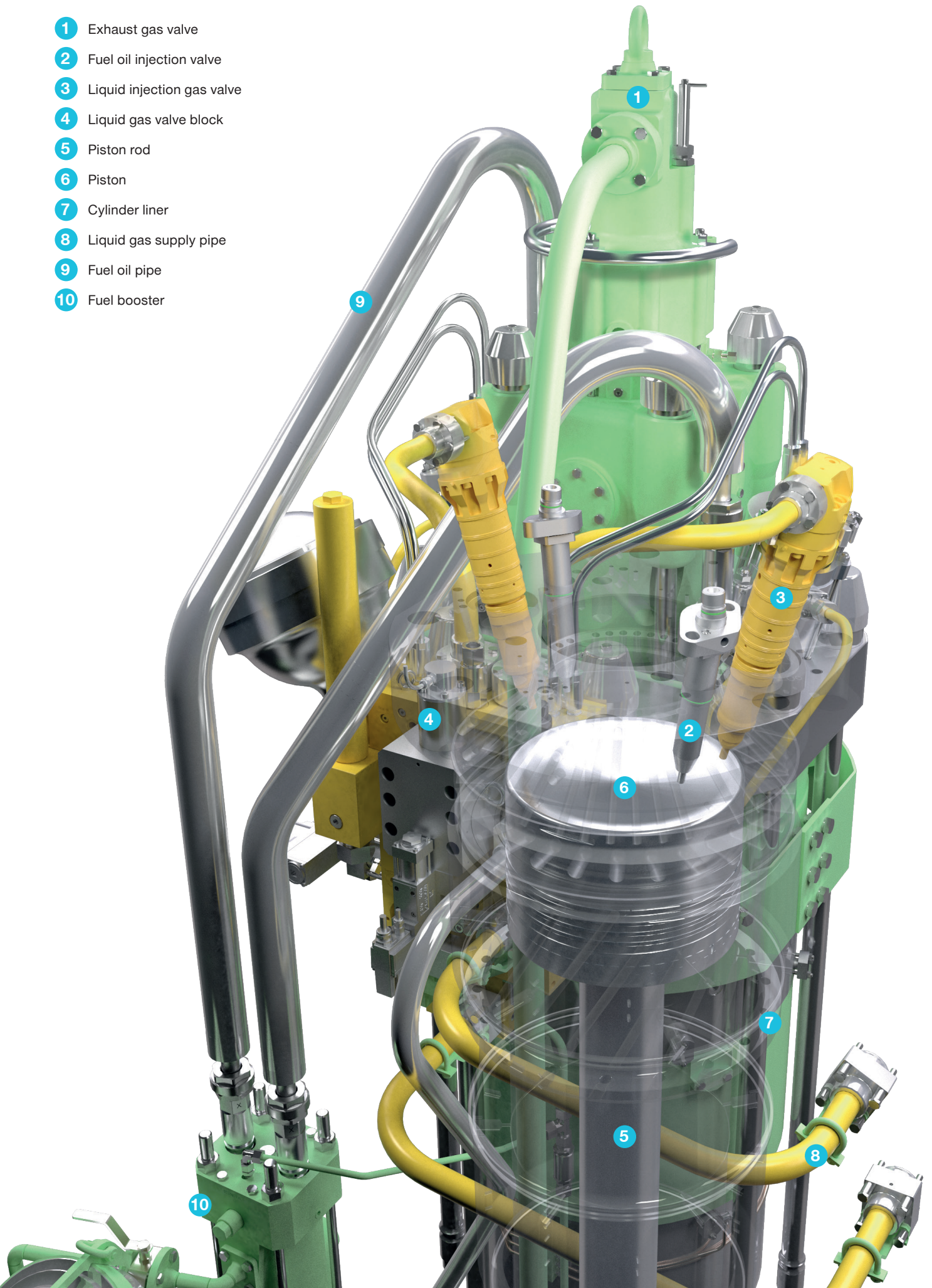


4 Nitrogen storage



5 Knock-out drums

- 1 Exhaust gas valve
- 2 Fuel oil injection valve
- 3 Liquid injection gas valve
- 4 Liquid gas valve block
- 5 Piston rod
- 6 Piston
- 7 Cylinder liner
- 8 Liquid gas supply pipe
- 9 Fuel oil pipe
- 10 Fuel booster



Pump Vaporiser Unit

The ME-GI/GIE Pump Vaporiser Unit (PVU) is a standardized high-quality pump unit for supply of LNG or ethane to MAN B&W two-stroke ME-GI/GIE engines. With a compact and intelligent design, the PVU provides a lean design and integration in the fuel gas supply system (FGSS).

PrimeServ Assist is an integrated part of the PVU and offers 24/7 monitoring as well as the option of servicing the unit remotely.

Embedded redundancy

With a compact and intelligent design, the PVU introduces a considerable saving in the complete FGSS. This is achieved by the simplifications implemented in the design, resulting in a reduced number of sub-systems and components. Due to the cryogenic pumps being actuated individually, embedded redundancy is enabled. This means that one pump cylinder can be taken out of service for overhaul, while the remaining two are fully operational and still able to provide up to 100% of the required capacity, depending on PVU and engine layout. In comparison, traditional crankshaft driven pumps requires two complete units to allow system redundancy.

Compact and intelligent design

Compared to conventional systems, the PVU offers a significant reduction in weight and size. This offers a further cost benefit considering installation costs, such as foundations, piping, cabling, and deck stiffening

Extended TBO

The PVU also offers savings to the vessels OPEX through significant increase in TBO compared to conventional high pressure pumps. For the cryogenic parts the TBO is 6,000 running hours and for the hydraulic parts TBO is 32,000 running hours.

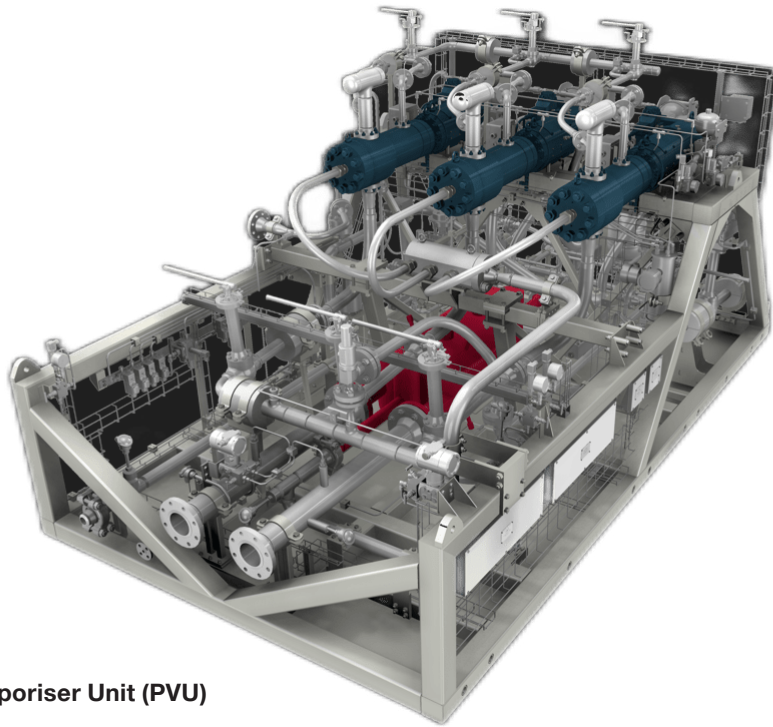
High reliability and easy maintenance

The PVU is designed for the highest standards of quality, hence ensuring the best reliability on the market. Easy maintenance is ensured by design with the operators in mind, providing easy access to exchange of spare parts.

MAN Energy Solutions strives to use the same components on the PVU as use on the ME-GI/GIE engines in order to minimize the amount of spare parts onboard. As an example, the controllers (MPC's) are identical and interchangeable with the once use on the main engine.

Key benefits

- Low cost LNG/ethane PVU with embedded redundancy
- Automatically controlled and integrated in MAN Energy Solutions dual fuel control system
- Time between overhaul (TBO) cryogenic parts is 6,000 running hours
- TBO hydraulic parts is 32,000 running hours
- Compact design providing minimal footprint and low weight
- Worldwide service surveillance 24/7 monitoring and control by PrimeServe Assist



Pump Vaporiser Unit (PVU)

PVU main data (LNG)

| PVU size | 3000 Mk. II | 5000 Mk. II | 8000 Mk. II |
|--|--------------------|-------------|--------------------|
| Maximum PVU Capacity (*1) [kg/h] @ 300 barG | 2700 | 4600 | 6900 |
| Max SMCR (*2) / max SMCR / [MW] | 18 | 31 | 46 |
| Glycol water flow / m_GW / [kg/h] | 81333 | 117180 | 175753 |
| Glycol water design heating duty / Q_GW / [kW] | 600 | 980 | 1700 |
| Air consumption / [l/min] | | 390 actual | |
| Nitrogen consumption / [kg/h] | | 2-2.5 | |
| PVU skid dimensions L x W x H / [mm] | 3700 x 2240 x 2000 | | 3900 x 2240 x 2000 |
| PVU skid weight / [ton] | 5.7 | 5.9 | 6.1 |

(*1) LNG density 450 kg/m³ as per "MSC 86/26/Add.1 Annex 11"

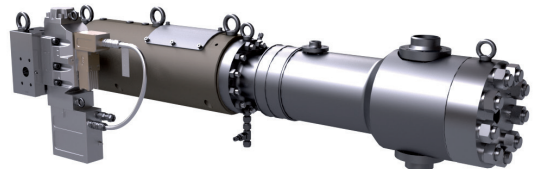
(*2) Max SMCR based on LHV=48.7MJ/kg; SGC=140g/kWh

PVU main data (ethane)

| PVU size | 4000E Mk. II |
|--|--------------------|
| Maximum PVU Capacity (*1) [kg/h] @ 400 barG | 3100 |
| Max SMCR (*2) / max SMCR / [MW] | 21 |
| Glycol water flow / m_GW / [kg/h] | 52635 |
| Glycol water design heating duty / Q_GW / [kW] | 370 |
| Air consumption / [l/min] | 390 actual |
| Nitrogen consumption / [kg/h] | 2-2.5 kg/h |
| PVU skid dimensions L x W x H / [mm] | 3700 x 2240 x 2000 |
| PVU skid weight / [ton] | 5.7 |

(*1) Specified density of fuel: 504 kg/m³

(*2) Max SMCR based on LHV=47.5MJ/kg; SGC=152g/kWh



MAN PrimeServ

Service with passion



MAN PrimeServ is the dedicated MAN Energy Solutions service brand. Via a network of over 100 service centers worldwide, MAN PrimeServ provides 24/7 service across the globe. Our range of services includes technical support, consulting and OEM spares, as well as maintenance, repair and comprehensive individualized service plans.



365

days a year

24

hours a day



MAN PrimeServ's aim is to provide

- Prompt delivery of high-demand OEM spare parts within 24 hours
- Fast, reliable and competent customer support
- Individually tailored O&M contracts
- Ongoing training and qualification of operators and maintenance staff
- Global service, 24 hours a day, 365 days a year
- Diagnosis and troubleshooting with our high-performance Online Service

MAN Energy Solutions and legacy brands

MAN PrimeServ is our brand name for high-quality aftersales support for the entire MAN Energy Solutions product portfolio. Through refinements to our products and repair techniques, we ensure and enhance our technological leadership and technical expertise as an Original Equipment Manufacturer (OEM) for the brands united under MAN Energy Solutions.



FAECKOCK BORSIG

SULZER
TURBO

B+V Industrietechnik



MAN Energy Solutions



Ruston

Paxman

Mirrlees
Blackstone

HALFORD
GENERATING SETS

B&W
MOTORS

Worldwide service

We offer retrofitting and upgrade services to bring engines and turbochargers already in service up to the very latest standards of performance and efficiency.

Represented in all key markets and major ports, with a network of more than 100 service centers, and with skilled field service managers at the ready to provide first-class technical support, MAN PrimeServ is fully primed to provide 24/7 service, wherever you are. In power plants, marine engines & systems and turbomachinery, offering reliable technical support when you need it most, our service solutions include OEM spare parts, engine and machinery maintenance and repairs, customized service agreements and individual consulting.

For existing equipment our holistic retrofit and modernization solutions keep your engines or turbochargers up-to-date and at optimal levels of reliability, availability and economic

efficiency. Through cutting edge digital technology we're able to hike performance and minimize downtimes, while our remote connections enable live data analysis, ensuring quick, effective solutions. MAN PrimeServ Academies provide expert training courses around the world, developing the operational and maintenance skills required.

For more information please visit
www.man-es.com/services



100

Service centers
worldwide



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