Technical Information Note 007

Remarks

Design gas feed pressure and BSGC data update for 2-stroke WinGD engines

Subject

WinGD Dual-Fuel engines

Date: 08 March 2018 Our Reference: 21344 / MOT001 / TIN Sheet: 1/5

Update of required design gas feed pressure and Brake Specific Gas Consumption (BSGC) data

1. Overview

Based on the consolidated experience from numerous Dual-Fuel (DF) engines which have passed Factory Acceptance Tests (FATs), WinGD has updated performance data in the GTD for its DF engines. This document gives some further explanations to the changes to the required design gas feed pressure and BSGC data.

2. Design gas feed pressure update

Based on operational experience from production engines on factory acceptance tests (FATs) and in service, the required design gas feed pressure at the gas valve unit (GVU) or integrated Gas Pressure Regulation unit (iGPR) inlet has been reduced. By this, installations can be further simplified without any compromise on engine performance and unnecessary gas compression losses can be minimised.

2.1. Applicable WinGD engines

The updated design gas feed pressure requirement applies to the following WinGD engine types:

Table 1: Applicable WinGD engines

Engine type	Design gas feed pressure update	
	Applicable	Not applicable
RT-flex50DF	●	
X-52DF	●	
X-62DF	●	
X-72DF	●	
X-82DF		●
X-92DF		●

2.2. Updated design gas feed pressure requirements

The updated design pressure requirements are outlined in Table 2 and Figure 1.

Table 2: Minimum design gas feed pressure at 100 % engine power

Rating line	LHV (MJ/Nm³)	Engine power (%)	Minimum gas pressure (barg)
R1 to R3	28	100	13.3
	32	100	12.6
	36	100	12.0
R2 to R4	28	100	11.0
	32	100	10.5
	36	100	10.0

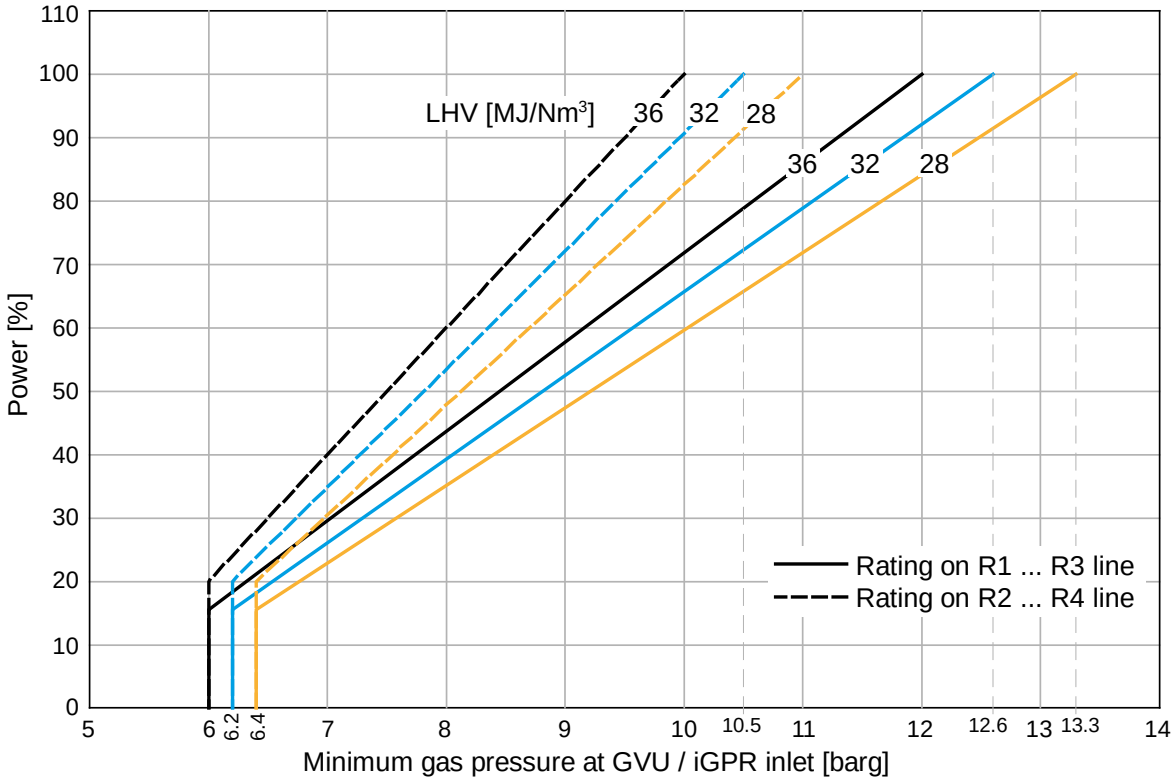

Figure 1: Updated design gas feed pressure requirements

2.3. Recommendations

WinGD recommends not to use the lowest possible Lower Heating Value (LHV) of 28 MJ/Nm³ for the layout of the compressors/pumps, since a combination of low heating value and full-load operation of the engine is very unlikely. Such a layout would only lead to a situation where compressors are running far from their design point in operation of the vessel, with a resulting reduction in efficiency. Even if designed for a higher LHV, the engine can still operate with quite high output if gas with LHV 28 MJ/Nm³ is supplied, e.g. more than 90 % power output, if designed for LHV 32 MJ/Nm³.

As the LHV depends on the LNG composition, ship owner and shipyard need to define in their building specification the value which serves as a basis for the fuel gas supply system design.

Recommended LHV to be used for layout:

- For liquefied natural gas carriers (LNGCs) running on Natural Boil-Off Gas (NBOG):
  A compressor layout for 32 MJ/Nm³ is sufficient for operation on 90 % engine load, even if the actual LHV drops as low as 28 MJ/Nm³ in an extreme case.
- For gas-fuelled ships running on forced boil-off gas (FBOG):
  The actual LHV is not expected to drop significantly below 36 MJ/Nm³, e.g. just to 35 MJ/Nm³ in some seldom cases, so a layout for 36 MJ/Nm³ is recommended. Usually the LHV as delivered to the engine is 36 MJ/Nm³ and above, considering the heavier hydrocarbon content in the LNG.

Especially for LNGCs with BOG compressors, the above-mentioned recommendations are expected to result in significant simplification of the fuel gas supply system. For engines rated close to the R2-R4 line, the required design gas pressure of less than 10.5 bar may even allow the selection of 4-stage centrifugal compressors instead of the previously typical 6-stage machines, resulting in considerably reduced investment cost. Same, potential savings are possible if piston compressors are applied, as well as savings for optimised screw compressor application.

WinGD also recommends the selection of a setup to run variable gas feed pressure adapted to engine load and LHV. Reducing the gas feed pressure accordingly will further reduce the power consumption of the compressors/pumps and thus minimise unnecessary losses. As additional benefit, stable low-load engine operation down to 5 % CMCR power is ensured.

For this purpose, the engine control system provides a signal with the currently required gas pressure to the Propulsion Control System (PCS), which can be used to control the fuel gas supply pressure delivered by the fuel gas supply system.

2.4. Previous design gas feed pressure requirements

The previous design gas pressure requirements are outlined in Figure 2 and are valid for the engines listed as "not applicable" in Table 1.

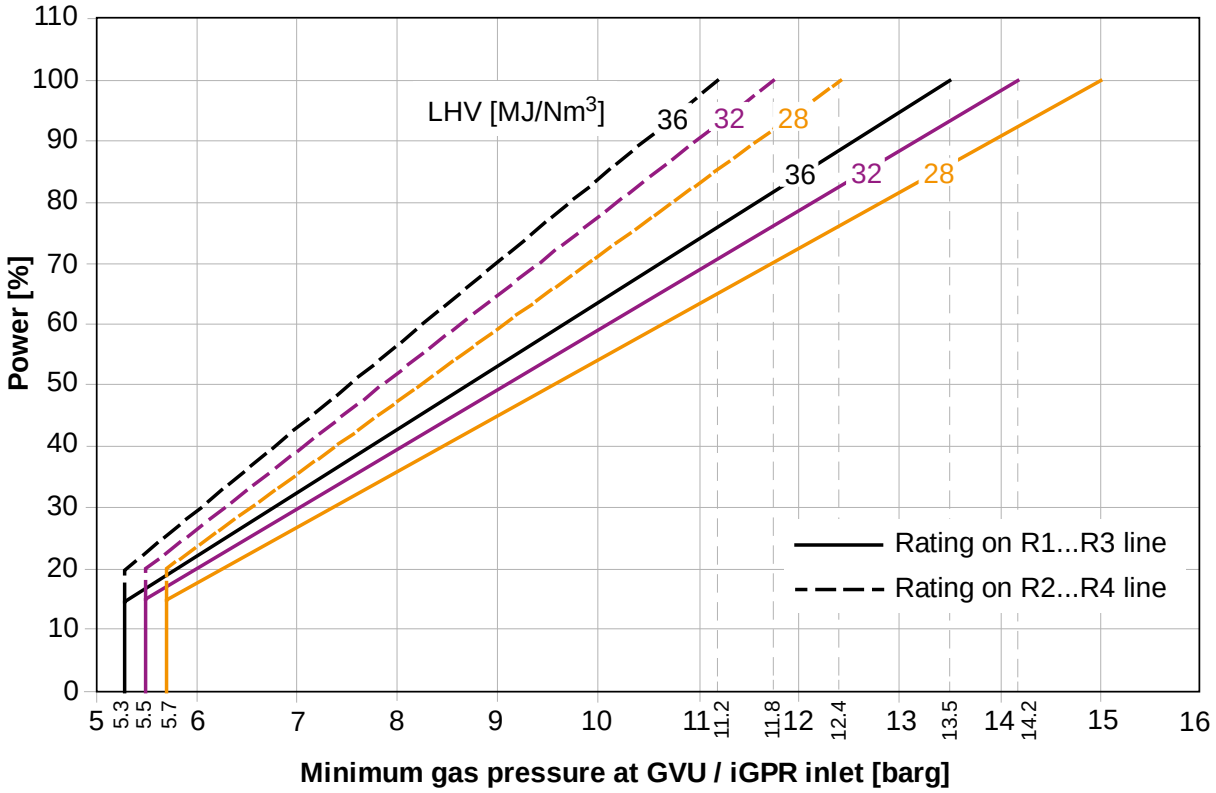

Figure 2: Previous design gas feed pressure requirements

The design gas feed pressure requirements for the WinGD X82DF and WinGD X92DF engines will be reviewed once more operational experience is available.

3. Update of consumption figures

3.1. Brake specific gas consumption (BSGC) in gas mode

The following four main changes have been included on all WinGD dual-fuel engines:

- For engines rated at lowest speeds in the rating field (R3-R4), the BSGC is 2 g/kWh higher compared to maximum speed rated engines (R1-R2)
- For engines rated at minimum brake mean effective pressure (BMEP) (R2-R4), the BSGC is 5 g/kWh less than at maximum brake mean effective pressure (R1-R3)
- Unified shape of consumption over load range independent of the engine rating, following the shape of R1 rated engines
- Increased BSGC at 50 % and 25 % load by 1 g/kWh and 2 g/kWh respectively to match the measured part load efficiency

The above changes are reflected in Figure 3 and Figure 4.

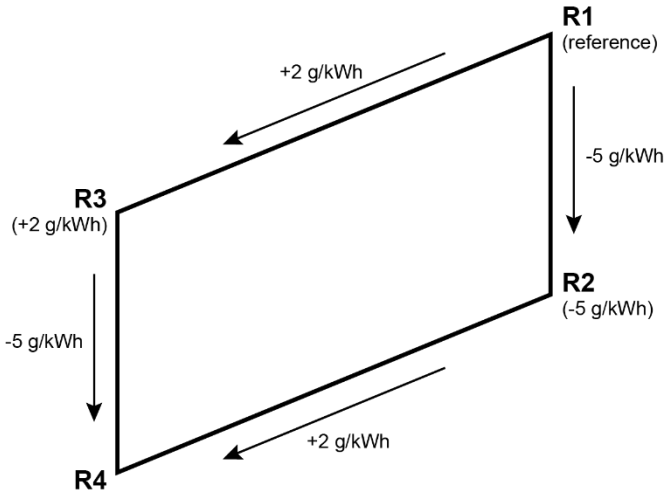

Figure 3: Change of BGSC compared to R1 reference

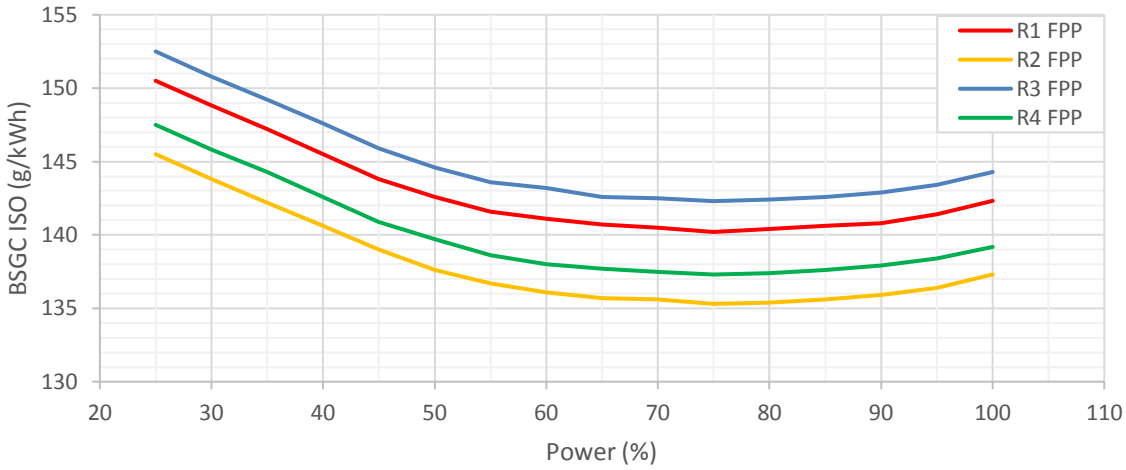

Figure 4: Example of a WinGD X72DF engine comparison of BSGC over load on different engine ratings

Through an updated approach of applying an increased compression ratio at low-rated engines, significant performance benefits can be achieved by selecting a rating at reduced BMEP. This is shown in Figure 5, which illustrates the updated BSGC of an R2 rated WinGD X72DF engine.

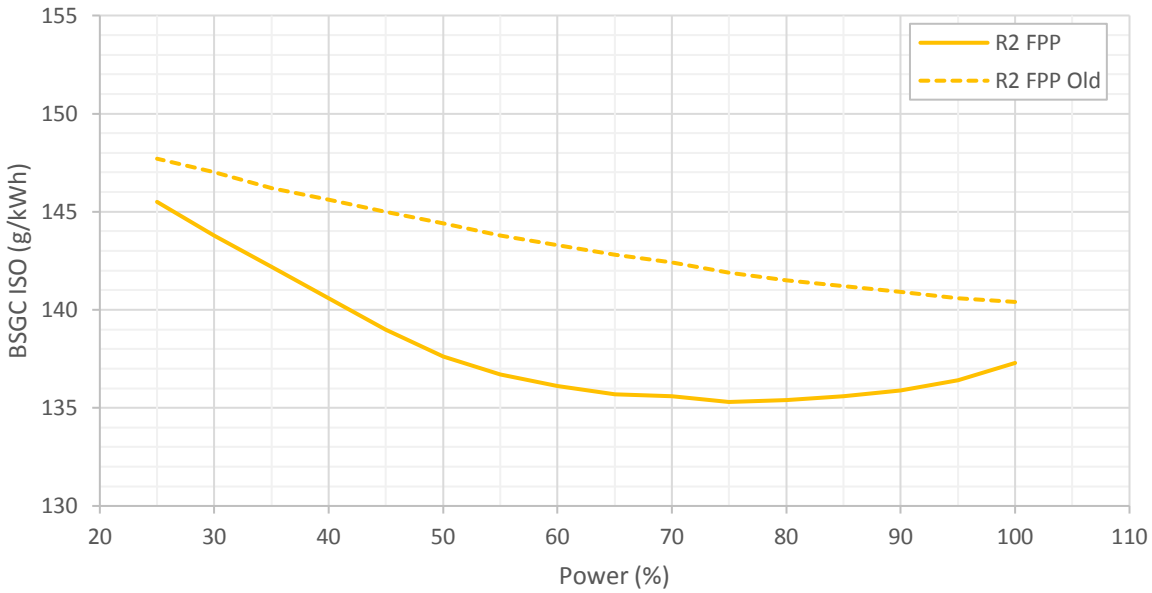

Figure 5: Comparison of previous and current BSGC over load on R2 rated W-X72DF engine

3.2. Update of brake specific fuel consumption (BSFC) in diesel mode

BSFC figures were increased by 2 g/kWh for high BMEP-rated engines (R1 to R3), while the figures for low rated engines (R2 to R4) remain unchanged.

4. Further information

For further detail and information regarding the above changes please consult the relevant chapter located in the Marine Installation Manuals (MIMs) of individual engine types. The MIMs can be found on the WinGD corporate webpage using the following link:

https://www.wingd.com/en/products/

For the latest performance data on individual engine types please consult the general technical data (GTD) software package. the latest version of GTD can be downloaded from the corporate webpage using the following link:

https://www.wingd.com/en/media/general-technical-data/

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