GUIDANCE NOTES
GD34-2022

China Classification Society

GUIDELINES ON CALCULATION AND VERIFICATION OF THE ENERGY EFFICIENCY DESIGN INDEX (EEDI) OF INTERNATIONAL SEA-GOING SHIPS

RCN No.1, 2024

Effective from 1 August 2024

Beijing

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2.3 Definition and selection of parameters in Attained EEDI calculation formula

2.3.1 Carbon conversion factor (C_F)

2.3.1.2 In case of a ship equipped with a dual-fuel main or auxiliary engine, the C_F-factor for gas fuel and the C_F-factor for fuel oil are to apply and be multiplied with the specific fuel consumption of each fuel at the relevant EEDI load point.

(1) The fuel availability of gas fuel is to be calculated in accordance with the formula below:

$$f_{DFgas} = \frac{\sum_{i=1}^{ntotal} P_{total(i)}}{\sum_{i=1}^{ngasfuel} P_{gasfuel(i)}} \times \frac{V_{gas} \times \rho_{gas} \times LCV_{gas} \times K_{gas}}{\left(\sum_{i=1}^{nLiquid} V_{liquid(i)} \times \rho_{liquid(i)} \times LCV_{liquid(i)} \times K_{liquid(i)} \right) + V_{gas} \times \rho_{gas} \times LCV_{gas} \times K_{gas}}$$

$$f_{DFliquid} = 1 - f_{DFgas}$$

where:

f_{DFgas} – the fuel availability ratio of gas fuel corrected for the power ratio of gas engines to total engines, f_{DFgas} is not to be greater than 1;

V_{gas} – the total net gas fuel capacity on board in m^3. If other arrangements, like exchangeable (specialized) LNG tank-containers and/or arrangements allowing frequent gas refueling are used, the capacity of the whole LNG fuelling system is to be used for V_{gas}. The boil-off rate (BOR) of gas cargo tanks can be calculated and included to V_{gas} if it is connected to the fuel gas supply system (FGSS);

V_{liquid} – the total net liquid fuel capacity on board in m^3 of liquid fuel tanks permanently connected to the ship's fuel system. If one fuel tank is disconnected by permanent sealing valves, V_{liquid} of the fuel tank can be ignored;

ρ_{gas} – the density of gas fuel in kg/m^3;

ρ_{liquid} – the density of each liquid fuel in kg/m^3;

LCV_{gas} – the low calorific value of gas fuel in kJ/kg;

LCV_{liquid} – the low calorific value of liquid fuel in kJ/kg;

K_{gas} – the filling rate for gas fuel tanks;

K_{liquid} – the filling rate for liquid fuel tanks;

P_{total} – the total installed engine power, P_{ME} and P_{AE} in kW;

$P_{gasfuel}$ – the dual fuel engine installed power, P_{ME} and P_{AE} in kW;

Normal density, Lower Calorific Value and filling rate for tanks of different kinds of fuel are shown inTable 2.3.1.2.

Parameter Default Values **Table 2.3.1.2**

Type of fuel	Density (kg/m^3)	Lower Calorific Value (kJ/kg)	Filling rate for tanks
Diesel/Gas Oil	900	42700	0.98
Heavy Fuel Oil	991	40200	0.98
Liquefied Natural Gas (LNG)	450	48000	0.95*

*~~subject to verification of tank filling limit~~ Subject to verification of tank loading limit in the IGF and/or IGC Codes, where applicable, corresponding to the normal density used in the calculation of f DFgas。

(2) If the total gas capacity is at least 50% of the fuel capacity dedicated to the dual fuel engines, namely $f_{DFgas} \geq 0.5$, then gas fuel is regarded as the "primary fuel", and $f_{DFgas} = 1$ and $f_{DFliquid} = 0$ for each dual fuel engine.

(3) If $f_{DFgas} < 0.5$, gas fuel is not regarded as the "primary fuel". The C_F and SFC in the EEDI calculation for each dual fuel engine (both main and auxiliary engines) are to be calculated as the weighted average of C_F and SFC for gas and liquid mode, according to f_{DFgas} and $f_{DFliquid}$, such as the original item of $P_{ME(i)}$ $C_{FME(i)}$ $SFC_{ME(i)}$ in the EEDI calculation is to be replaced by the formula below:

$$P_{ME(i)} (f_{DFgas(i)} (C_{FME\ pilot\ fuel(i)} \ SFC_{ME\ pilot\ fuel(i)} + C_{FME\ gas(i)} \ SFC_{ME\ gas(i)}) + f_{DFliquid(i)} C_{FME\ liquid(i)} \ SFC_{ME\ liquid(i)})$$