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### Heavy Fuel Oil

The engine together with proper external feed system can be operated on heavy fuel oil of viscosity up to 700 cSt at 50 °C, which corresponds to the grades of CIMAC H700 (CIMAC Recommendation No. 21, 2003). However, the fuel should be cleaned and preheated before entering the engine with following specifications at least.

### Diesel Fuel Oil

The quality requirements for MDO shall be in accordance with CIMAC DA, DB, DC grade. If the engine is run on blended MDO(A-bunker diesel), i.e. CIMAC DC grade, a centrifugal treatment system should be prepared. For reference, specification for CIMAC DA, DB and DC is as follows:

Properties	Unit	Limit	HFO (CIMAC H700)	MGO (CIMAC DA)	MDO	
					(CIMAC DB)	(CIMAC DC)
Kinematic viscosity	mm <sup>2</sup> /s(cSt)	max	700 at 50 °C 12.0 ~18.0 <sup>(B)</sup>	1.5 ~ 6.0 at 40 °C 2.0 ~ 14.0 <sup>(B)</sup>	2.5 ~ 11.0 at 40 °C 2.0 ~ 14.0 <sup>(B)</sup>	4.0 ~ 14.0 at 40 °C 2.0 ~ 14.0 <sup>(B)</sup>
Density at 15 °C	kg/m <sup>3</sup>	max	991.0 1010.0 <sup>(A)</sup>	890.0	900.0	920.0
Flash point	°C	min	60	60	60	60
Pour point (Winter quality)	°C	max	30	-6	0	0
Carbon Residue	% mass	max	22 15 <sup>(B)</sup>	0.30 <sup>(C)</sup>	0.30	2.5
Asphaltenes	% mass	max	8	-	-	-
Ash	% mass	max	0.15 0.03 <sup>(B)</sup>	0.01 0.01 <sup>(B)</sup>	0.03 0.03 <sup>(B)</sup>	0.03 0.03 <sup>(B)</sup>
Total sediment, potential	% mass	max	0.10	-	-	-
Total sediment, existent	% mass	max	-	0.10	0.10	0.10
Water	% volume	max	0.5 0.2 <sup>(B)</sup>	-	0.3 0.2 <sup>(B)</sup>	0.3 0.2 <sup>(B)</sup>
Sulfur <sup>(D)</sup>	% mass	max	4.50 3.50 <sup>(B)</sup>	1.50	2.00	2.00
Cetane index	-	min	-	40	35	-
Vanadium	mg/kg	max	600 150 <sup>(B)</sup>	-	-	100
Sodium	mg/kg	max	100 30 <sup>(B)</sup>	-	-	50 30 <sup>(B)</sup>
Aluminum+Silicon	mg/kg	max	80 15 <sup>(B)</sup>	-	-	25 15 <sup>(B)</sup>
Solid Particles	mg/kg	max	20 <sup>(B)</sup>	20 <sup>(B)</sup>	20 <sup>(B)</sup>	20 <sup>(B)</sup>
	μm	max	5 <sup>(B)</sup>	5 <sup>(B)</sup>	5 <sup>(B)</sup>	5 <sup>(B)</sup>

(A) : Adequate purifying equipment for high density is required.

(B) : Limited value before engine inlet for operation.

(C) : 10% volume distillation bottoms

(D) : A sulfur limit of 1.5% m/m will apply in SOx Emission Control Areas designated by the IMO, when its relevant Protocol comes into force. There may be local variations.

Note 1: The following kinds of fuel are not to be used:

- 1) Bunker fuel including cat-fines
- 2) Bunker fuel including land-used lubricating oil waste
- 3) Bunker fuel including alkylation bottom oil (total acid<3, strong acid=0)

Note 2: Additional properties are specified by the engine manufacturer, which are not included in the CIMAC fuel quality. (CIMAC Recommendation No. 21, 2003)