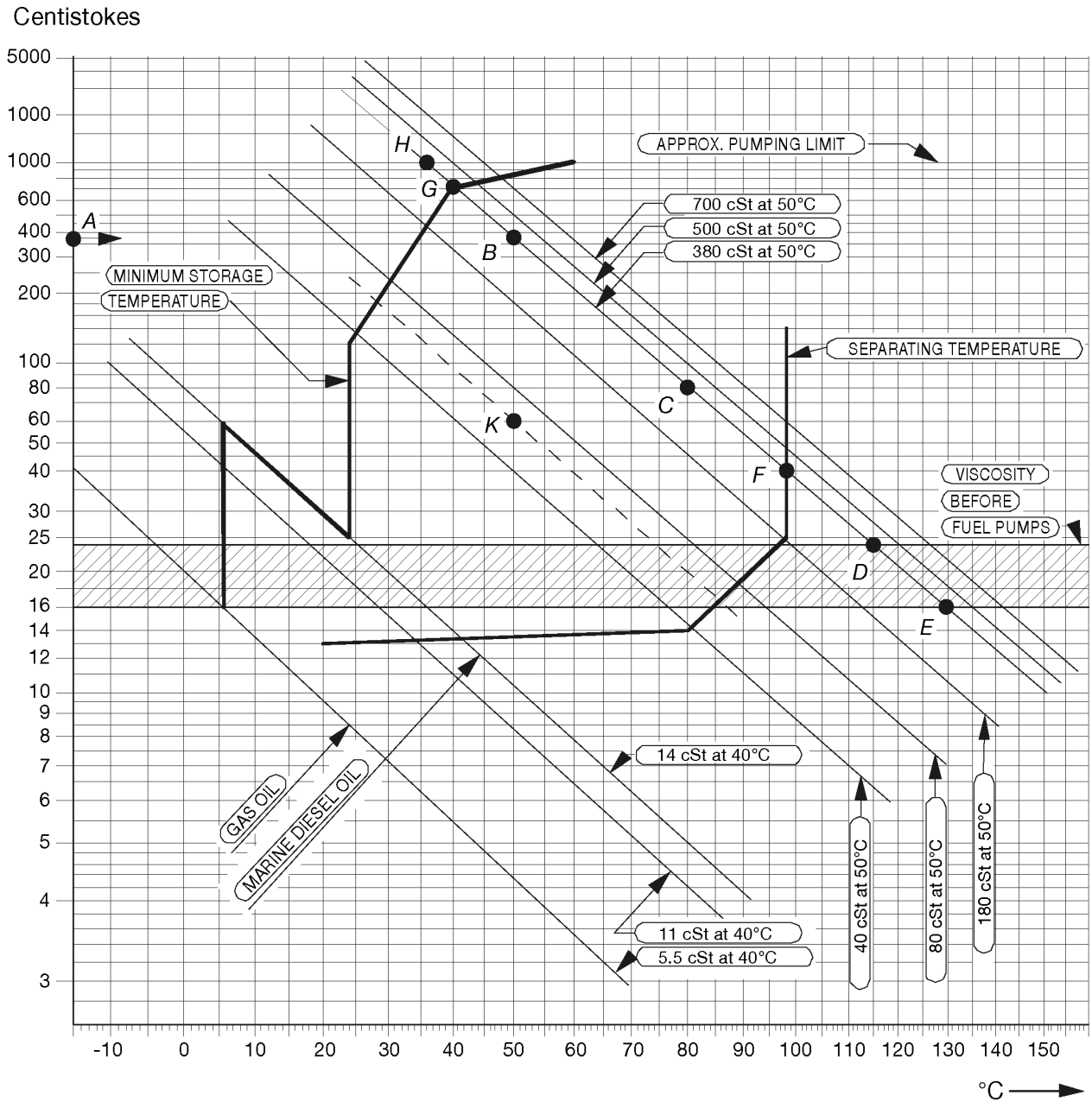
Figure 3.1 Fuel oil viscosity-temperature diagram



Example 1: A fuel oil with a viscosity of 380 cSt (A) at 50°C (B) or 80 cSt at 80°C (C) must be preheated to 115-130°C (D-E) before the fuel injection pumps, to 98°C (F) at the centrifuge and to minimum 40°C (G) in the storage tanks. The fuel oil may not be pumpable below 36°C (H).

To obtain temperatures for intermediate viscosities, draw a line from the known viscosity/temperature point in parallel to the nearest viscosity/temperature line in the diagram.

Example 2: Known viscosity 60 cSt at 50°C (K). The following can be read along the dotted line: Viscosity at 80°C = 20 cSt, temperature at fuel injection pumps 74-87°C, centrifuging temperature 86°C, minimum storage tank temperature 28°C.

3.2.3 Design considerations

When designing the fuel system the following matters shall be considered:

- The fuel feed system for HFO shall be of the pressurized type in order to prevent foaming in the return lines and cavitation in the circulation pumps.

DNV MANAGING RISK

ISO 8217 Fuel Standard, Fourth Edition 2010

For marine distillate fuels and for marine residual fuels.

MARINE DISTILLATE FUELS

Parameter	Unit	Limit	DMX	DMA	DMZ	DMB
Viscosity at 40°C	mm^2/s	Max	5.500	6.000	6.000	11.00
Viscosity at 40°C	mm^2/s	Min	1.400	2.000	3.000	2.000
Micro Carbon Residue at 10% Residue	% m/m	Max	0.30	0.30	0.30	-
Density at 15°C	kg/m^3	Max	-	890.0	890.0	900.0
Micro Carbon Residue	% m/m	Max	-	-	-	0.30
Sulphur [a]	% m/m	Max	1.00	1.50	1.50	2.00
Water	% V/V	Max	-	-	-	0.30 [b]
Total sediment by hot filtration	% m/m	Max	-	-	-	0.10 [b]
Ash	% m/m	Max	0.010	0.010	0.010	0.010
Flash point	0°C	Min	43.0	60.0	60.0	60.0
Pour point, Summer	0°C	Max	-	0	0	6
Pour point, Winter	°C	Max	-	-6	-6	0
Cloud point	°C	Max	-16	-	-	-
Calculated Cetane Index		Min	45	40	40	35
Acid Number	mgKOH/g	Max	0.5	0.5	0.5	0.5
Oxidation stability	g/m^3	Max	25	25	25	25 [c]
Lubricity, corrected wear scar diameter (wsd 1.4 at 60°C [d]	um	Max	520	520	520	520 [c]
Hydrogen sulphide [e]	mg/kg	Max	2.00	2.00	2.00	2.00
Appearance			Clear & Bright [f]			[b, c]

[a]	A sulphur limit of 1.00% m/m applies in the Emission Control Areas designated by the International Maritime Organization. As there may be local variations, the purchaser shall define the maximum sulphur content according to the relevant statutory requirements, notwithstanding the limits given in this table.
[b]	If the sample is not clear and bright, total sediment by hot filtration and water test shall be required.
[c]	Oxidation stability and lubricity tests are not applicable if the sample is not clear and bright.
[d]	Applicable if sulphur is less than 0.050% m/m.
[e]	Effective only from 1 July 2012.
[f]	If the sample is dyed and not transparent, water test shall be required. The water content shall not exceed 200 mg/kg (0.02% m/m).

MARINE RESIDUAL FUELS

Parameter	Unit	Limit	RMA [a]	RMB	RMD	RME	RMG				RMK		
			10	30	80	180	180	380	500	700	380	500	700
Viscosity at 50°C	mm^2/s	Max	10.00	30.00	80.00	180.0	180.0	380.0	500.0	700.0	380.0	500.0	700.0

Density at 15°C	kg/m³	Max	920.0	960.0	975.0	991.0	991.0	1010.0
Micro Carbon Residue	% m/m	Max	2.50	10.00	14.00	15.00	18.00	20.00
Aluminium + Silicon	mg/kg	Max	25	40		50	60	
Sodium	mg/kg	Max	50	100		50	100	
Ash	% m/m	Max	0.040	0.070			0.100	0.150
Vanadium	mg/kg	Max	50	150			350	450
CCAI	-	Max	850	860			870	
Water	% V/V	Max	0.30	0.50				
Pour point (upper) [b], Summer	°C	Max	6	30				
Pour point (upper) [b], Winter	°C	Max	0	30				
Flash point	°C	Min	60.0					
Sulphur [c]	% m/m	Max	Statutory requirements					
Total Sediment, aged	% m/m	Max	0.10					
Acid Number [e]	mgKOH/g	Max	2.5					
Used lubricating oils (ULO): Calcium and Zinc; or Calcium and Phosphorus	mg/kg	-	The fuel shall be free from ULO, and shall be considered to contain ULO when either one of the following conditions is met: Calcium > 30 and zinc >15; or Calcium > 30 and phosphorus > 15.					
Hydrogen sulphide [d]	mg/kg	Max	2.00					

[a]	This residual marine fuel grade is formerly DMC distillate under ISO 8217:2005.
[b]	Purchasers shall ensure that this pour point is suitable for the equipment on board, especially in cold climates.
[c]	The purchaser shall define the maximum sulphur content according to the relevant statutory requirements.
[d]	Effective only from 1 July 2012.
[e]	Strong acids are not acceptable, even at levels not detectable by the standard test methods for SAN. As acid numbers below the values stated in the table do not guarantee that the fuels are free from problems associated with the presence of acidic compounds, it is the responsibility of the supplier and the purchaser to agree upon an acceptable acid number.

Source: ISO 8217 Fourth Edition 2010-06-15
Petroleum products - Fuels (class F) - Specifications of marine fuels