Table 1 — Distillate and bio-distillate marine fuels

Characteristics	Unit	Limit	Category ISO-F-[m]							Test method(s) and references
			DMX	DMA	DFA	DMZ	DFZ	DMB	DFB	
General requirements			Clauses 5 to 10							
Kinematic viscosity at 40 °C	mm^2/s[a]	max.	5,500	6,000				11,00		ISO 3104
		min.	1,400	2,000		3,000		2,000		
Density at 15 °C	kg/m^3	max.	—	890,0				900,0		ISO 3675 or ISO 12185; see 6.1
Cetane index		min.	45,0	40,0	—	40,0	—	35,0	—	ISO 4264; see 6.19
Cetane number		min.	—	—	40,0	—	40,0	—	35,0	ISO 5165 or ASTM D6890/EN 15195 or ASTM D7668/EN 16715 or ASTM D8183/EN 17155; see 6.19
Sulfur content by mass	%	max.	Statutory requirements[b]							ISO 8754 or ISO 14596, ASTM D4294; see 6.3
Flash point	°C	min.	43,0	60,0						ISO 2719; see 6.4
Hydrogen sulfide	mg/kg	max.	2,00							IP 570; see 6.5
Acid number[c]	mg KOH/g	max.	0,5							ASTM D664; see 6.6
Existent total sediment (TSE) content by mass	%	max.	—					0,10[d]		ISO 10307-1; see 6.8

[a] $1\ mm^2/s = 1\ cSt$.

[b] The buyer is expected to define the maximum sulfur content according to relevant statutory limitations.

[c] See Annex E.

[d] If the sample is not clear and bright, the existent total sediment and water tests shall be required. See 6.8 and 6.11.

[e] If the sample is not clear and bright, the test cannot be undertaken and therefore, compliance with this limit cannot be shown.

[f] See 5.1 and Annex A. De minimis level amount of FAME means an amount not exceeding approximately 0,5 %.

[g] The seller shall report the FAME content according to the test method given or as per blend ratio (stating whether it is a mass or volume ratio).

[h] The value shall be reported according to the test method given.

[i] Pour point cannot guarantee operability for all ships in all climates. The buyer should confirm that the cold flow characteristics (pour point, cloud point, cold filter plugging point) are suitable for the ship's design and intended voyage. See 6.10.

[j] For some products, it is possible that this test does not work due to appearance, therefore other means to evaluate usability of the product should be considered.

[k] If the sample is dyed and not transparent, then the water limit and test method as given in 6.11 shall apply.

[l] This requirement is applicable to fuels with a sulfur content below 500 mg/kg (0,050 % by mass).

[m] These categories are defined in ISO 8216-1.

Table 1 *(continued)*

Characteristics		Unit	Limit	Category ISO-F-[m]							Test method(s) and references
				DMX	DMA	DFA	DMZ	DFZ	DMB	DFB	
Oxidation stability		g/m^3	max.	25	25	—	25	—	25[e]	—	ISO 12205; see 6.7
		h	min.	—	—	8,0	—	8,0	—	8,0[e]	EN 15751; see 6.7
Fatty acid methyl ester (FAME) content by mass or volume		%		[f]	[f]	Report[g]	[f]	Report[g]	[f]	Report[g]	ASTM D7963 or EN 14078/ASTM D7371; see 6.9
Net heat of combustion		MJ/kg		—	—	Report[h]	—	Report[h]	—	Report[h]	ASTM D240; see 6.18
Carbon residue content by mass – Micro method on the 10 % volume distillation residue		%	max.	0,30					—		ISO 10370
Carbon residue content by mass – Micro method		%	max.	—					0,30		ISO 10370
Cloud point[i]		°C	max.	–16	Report[h]				[j]	Report[h,j]	ISO 3015; see 6.10
Cold filter plugging point[i]		°C		—	Report[h]						EN 116 or EN 16329; see 6.10
Pour point (upper)[i]	Winter	°C	max.	—	–6				0		ISO 3016; see 6.10
	Summer	°C	max.	—	0				6		
Appearance				Clear and bright[k]					[d]		See 6.11

[a] 1 mm^2/s = 1 cSt.

[b] The buyer is expected to define the maximum sulfur content according to relevant statutory limitations.

[c] See Annex E.

[d] If the sample is not clear and bright, the existent total sediment and water tests shall be required. See 6.8 and 6.11.

[e] If the sample is not clear and bright, the test cannot be undertaken and therefore, compliance with this limit cannot be shown.

[f] See 5.1 and Annex A. De minimis level amount of FAME means an amount not exceeding approximately 0,5 %.

[g] The seller shall report the FAME content according to the test method given or as per blend ratio (stating whether it is a mass or volume ratio).

[h] The value shall be reported according to the test method given.

[i] Pour point cannot guarantee operability for all ships in all climates. The buyer should confirm that the cold flow characteristics (pour point, cloud point, cold filter plugging point) are suitable for the ship's design and intended voyage. See 6.10.

[j] For some products, it is possible that this test does not work due to appearance, therefore other means to evaluate usability of the product should be considered.

[k] If the sample is dyed and not transparent, then the water limit and test method as given in 6.11 shall apply.

[l] This requirement is applicable to fuels with a sulfur content below 500 mg/kg (0,050 % by mass).

[m] These categories are defined in ISO 8216-1.

Table 1 *(continued)*

Characteristics	Unit	Limit	Category ISO-F-[m]							Test method(s) and references
			DMX	DMA	DFA	DMZ	DFZ	DMB	DFB	
Water content by volume	%	max.	—					0,30[d]		ISO 3733
Ash content by mass	%	max.	0,010							ISO 6245
Lubricity, wear scar diameter (WSD) at 60 °C[l]	µm	max.	520					520[e]		ISO 12156-1

[a] 1 mm^2/s = 1 cSt.

[b] The buyer is expected to define the maximum sulfur content according to relevant statutory limitations.

[c] See Annex E.

[d] If the sample is not clear and bright, the existent total sediment and water tests shall be required. See 6.8 and 6.11.

[e] If the sample is not clear and bright, the test cannot be undertaken and therefore, compliance with this limit cannot be shown.

[f] See 5.1 and Annex A. De minimis level amount of FAME means an amount not exceeding approximately 0,5 %.

[g] The seller shall report the FAME content according to the test method given or as per blend ratio (stating whether it is a mass or volume ratio).

[h] The value shall be reported according to the test method given.

[i] Pour point cannot guarantee operability for all ships in all climates. The buyer should confirm that the cold flow characteristics (pour point, cloud point, cold filter plugging point) are suitable for the ship's design and intended voyage. See 6.10.

[j] For some products, it is possible that this test does not work due to appearance, therefore other means to evaluate usability of the product should be considered.

[k] If the sample is dyed and not transparent, then the water limit and test method as given in 6.11 shall apply.

[l] This requirement is applicable to fuels with a sulfur content below 500 mg/kg (0,050 % by mass).

[m] These categories are defined in ISO 8216-1.

Table 2 — Residual marine fuels with sulfur content below or at 0,50 % by mass

Characteristics	Units	Limit	Category ISO-F [j]				Test method(s) and references
			RMA 20-0,5 RMA 20-0,1	RME 180-0,5 RME 180-0,1	RMG 380-0,5 RMG 380-0,1	RMK 500-0,5 RMK 500-0,1	
General requirements			Clauses 5 to 10				
Kinematic viscosity at 50 °C[a]	mm^2/s[b]	max.	20,00	180,0	380,0	500,0	ISO 3104
		min.	2,000[c]	20,00	120,0	150,0	
Density at 15 °C	kg/m^3	max.	955,0	991,0		1 010,0	ISO 3675 or ISO 12185; see 6.1
CCAI		max.	860	870			See 6.2
Sulfur content by mass	%	max.	0,50 or statutory requirement, whichever is lower[d]				ISO 8754 or ISO 14596 or ASTM D4294; see 6.3
Flash point	°C	min.	60,0				ISO 2719; see 6.4
Hydrogen sulfide	mg/kg	max.	2,00				IP 570; see 6.5
Acid number[e]	mg KOH/g	max.	2,5				ASTM D664; see 6.6
Carbon residue content by mass – Micro method	%	max.	10,00	15,00	18,00	20,00	ISO 10370
Pour point (upper)[f]	°C	max.	6	30			ISO 3016
Water content by volume	%	max.	0,30	0,50			ISO 3733
Ash content by mass	%	max.	0,070	0,100		0,150	ISO 6245
Vanadium	mg/kg	max.	150	350		450	IP 501, IP 470 or ISO 14597; see 6.13

[a] Actual viscosity to be reported to the ship. For fuels with high pour point, the viscosity can be calculated provided that the kinematic viscosities at two temperatures are known.

[b] $1\ mm^2/s = 1$ cSt.

[c] For fuels with viscosity in the range of 2 mm^2/s to 5 mm^2/s (2 cSt to 5 cSt), the minimum viscosity requirement of the engine should be checked against the original equipment manufacturers' recommendations.

[d] The buyer is expected to define the maximum sulfur content according to relevant statutory limitations.

[e] See Annex E.

[f] The buyer should confirm that this pour point is suitable for the ship's intended area of operation.

[g] This limit applies to 10 g of test specimen only. Failure to complete filtration of 10 g within 25 min means the fuel does not meet the specification. In such case and for information only, 5 g filtration results can be reported according to the test method.

[h] The value shall be reported in accordance with the test method given.

[i] See 5.1 and Annex A. De minimis level amount of FAME means an amount not exceeding approximately 0,5 %.

[j] These categories are defined in ISO 8216-1.

Table 2 *(continued)*

Characteristics	Units	Limit	Category ISO-F [j]				Test method(s) and references
			RMA 20-0,5 RMA 20-0,1	RME 180-0,5 RME 180-0,1	RMG 380-0,5 RMG 380-0,1	RMK 500-0,5 RMK 500-0,1	
Sodium	mg/kg	max.	50	100			IP 501, IP 470; see 6.14
Aluminium plus silicon	mg/kg	max.	40	60			IP 501, IP 470 or ISO 10478; see 6.15
Unrefined used lubricating oil (ULO) present: Calcium and zinc or Calcium and phosphorus	mg/kg		Calcium > 30 and zinc > 15 or Calcium > 30 and phosphorus > 15				IP 501 or IP 470, IP 500; see 6.16
Potential total sediment content by mass (TSP)	%	max.	0,10[g]				ISO 10307-2, Procedure A; see 6.8
Accelerated total sediment content by mass (TSA)	%		Report[h]				ISO 10307-2, Procedure B; see 6.8
Existent total sediment content by mass (TSE)	%		Report[h]				ISO 10307-1; see 6.8
Fatty acid methyl ester (FAME) content by mass or volume	%		[i]				ASTM D7963; see 6.9

[a] Actual viscosity to be reported to the ship. For fuels with high pour point, the viscosity can be calculated provided that the kinematic viscosities at two temperatures are known.

[b] 1 mm^2/s = 1 cSt.

[c] For fuels with viscosity in the range of 2 mm^2/s to 5 mm^2/s (2 cSt to 5 cSt), the minimum viscosity requirement of the engine should be checked against the original equipment manufacturers' recommendations.

[d] The buyer is expected to define the maximum sulfur content according to relevant statutory limitations.

[e] See Annex E.

[f] The buyer should confirm that this pour point is suitable for the ship's intended area of operation.

[g] This limit applies to 10 g of test specimen only. Failure to complete filtration of 10 g within 25 min means the fuel does not meet the specification. In such case and for information only, 5 g filtration results can be reported according to the test method.

[h] The value shall be reported in accordance with the test method given.

[i] See 5.1 and Annex A. De minimis level amount of FAME means an amount not exceeding approximately 0,5 %.

[j] These categories are defined in ISO 8216-1.

Table 3 — Bio-residual marine fuels

Characteristics	Units	Limit	Category ISO-F-[j]					Test methods(s) and references
			RF 20	RF 80	RF 180	RF 380	RF 500	
General requirements			Clauses 5 to 10					
Kinematic viscosity at 50 °C[a]	mm^2/s[b]	max.	20,00	80,00	180,0	380,0	500,0	ISO 3104
		min.	2,000[c]	20,00	80,00	120,0	380,0	
Density at 15 °C	kg/m^3	max.	955,0	991,0			1 010,0	ISO 3675 or ISO 12185; see 6.1
CCAI		max.	860	870				See 6.2
Sulfur content by mass	%		Statutory requirements[d]					ISO 8754 or ISO 14596 or ASTM D4294; see 6.3
Flash point	°C	min.	60,0					ISO 2719; see 6.4
Hydrogen sulfide	mg/kg	max.	2,00					IP 570; see 6.5
Acid number[e]	mg KOH/g	max.	2,5					ASTM D664; see 6.6
Carbon residue content by mass – Micro method	%	max.	10,00	15,00		18,00	20,00	ISO 10370
Pour point (upper)[f]	°C	max.	6	30				ISO 3016
Water content by volume	%	max.	0,30	0,50				ISO 3733
Ash content by mass	%	max.	0,070	0,100			0,150	ISO 6245
Vanadium	mg/kg	max.	150	350			450	IP 501, IP 470 or ISO 14597; see 6.13
Sodium	mg/kg	max.	50	100				IP 501, IP 470; see 6.14

[a] Actual viscosity to be reported to the ship. For fuels with high pour point, the viscosity can be calculated provided that the kinematic viscosities at two temperatures are known.

[b] 1 mm^2/s = 1 cSt.

[c] For fuels with viscosity in the range of 2 mm^2/s to 5 mm^2/s (2 cSt to 5 cSt), the minimum viscosity requirement of the engine should be checked against the original equipment manufacturers' recommendations.

[d] The buyer is expected to define the maximum sulfur content according to relevant statutory limitations.

[e] See Annex E.

[f] The buyer should confirm that this pour point is suitable for the ship's intended area of operation.

[g] This limit applies to 10 g of test specimen only. Failure to complete filtration of 10 g within 25 min means the fuel does not meet the specification. In such case and for information only, 5 g filtration results can be reported according to the test method.

[h] The value shall be reported in accordance with the test method given.

[i] The seller shall report the FAME content in accordance with the test method given or as per blend ratio (stating whether it is a mass or volume ratio).

[j] These categories are defined in ISO 8216-1.

Table 3 *(continued)*

Characteristics	Units	Limit	Category ISO-F-[j]					Test methods(s) and references
			RF 20	RF 80	RF 180	RF 380	RF 500	
Aluminium plus silicon	mg/kg	max.	40	60				IP 501, IP 470 or ISO 10478; see 6.15
Unrefined used lubricating oil (ULO) present: Calcium and zinc or Calcium and phosphorus	mg/kg		Calcium > 30 and zinc > 15 or Calcium > 30 and phosphorus > 15					IP 501 or IP 470, IP 500; see 6.16
Potential total sediment content by mass (TSP)	%	max.	0,10[g]					ISO 10307-2 Procedure A; see 6.8
Accelerated total sediment content by mass (TSA)	%		Report[h]					ISO 10307-2 Procedure B; see 6.8
Existent total sediment content by mass (TSE)	%		Report[h]					ISO 10307-1; see 6.8
FAME content by mass	%		Report[i]					ASTM D7963 or IP 631; see 6.9
Net heat of combustion	MJ/kg		Report[h]					ASTM D240; see 6.18

[a] Actual viscosity to be reported to the ship. For fuels with high pour point, the viscosity can be calculated provided that the kinematic viscosities at two temperatures are known.

[b] 1 mm^2/s = 1 cSt.

[c] For fuels with viscosity in the range of 2 mm^2/s to 5 mm^2/s (2 cSt to 5 cSt), the minimum viscosity requirement of the engine should be checked against the original equipment manufacturers' recommendations.

[d] The buyer is expected to define the maximum sulfur content according to relevant statutory limitations.

[e] See Annex E.

[f] The buyer should confirm that this pour point is suitable for the ship's intended area of operation.

[g] This limit applies to 10 g of test specimen only. Failure to complete filtration of 10 g within 25 min means the fuel does not meet the specification. In such case and for information only, 5 g filtration results can be reported according to the test method.

[h] The value shall be reported in accordance with the test method given.

[i] The seller shall report the FAME content in accordance with the test method given or as per blend ratio (stating whether it is a mass or volume ratio).

[j] These categories are defined in ISO 8216-1.