

Markets with no or first level requirements for emission controls; based primarily on fundamental vehicle/engine performance and protection of emission control systems.

PROPERTIES	UNITS	LIMIT	
		Min.	Max.
Cetane Number		48.0	
Cetane Index ⁽¹⁾		48.0 (45.0) ⁽¹⁾	
Density @ 15°C	kg/m ³	820 ⁽²⁾	860
Viscosity @ 40°C	mm ² /s	2.0 ⁽³⁾	4.5
Sulphur	mg/kg ⁽⁴⁾		2000
T95	°C		370
Flash point	°C	55 ⁽⁵⁾	
Carbon residue	% m/m		0.30
CFPP or LTFT or CP	°C		Equal to or lower than the lowest expected ambient temperature ⁽⁶⁾
Water	mg/kg		500
Oxidation stability			
Method I	g/m ³		25
Method 2a (Rancimat, modified) ⁽⁷⁾ , or	hours	30	
Method 2b (Delta TAN) ⁽⁷⁾ , or	mg KOH/g		0.12
Method 2c (PetroOxy) ⁽⁷⁾	minutes	60	
FAME ⁽⁸⁾	% v/v		5%
Other biofuels ⁽⁹⁾	% v/v		⁽⁹⁾
Copper corrosion	rating		Class I
Ethanol/Methanol	% v/v		Non-detectable ⁽¹⁰⁾
Ash	% m/m		0.01
Particulate contamination, total	see test method		10
Appearance		Clear and bright; no free water or particulates	
Lubricity (HFRR wear scar dia. @ 60°C)	micron		460

Footnotes:

- ⁽¹⁾ Cetane Index is acceptable instead of Cetane Number if a standardized engine to determine the Cetane Number is unavailable and cetane improvers are not used. When cetane improvers are used, the estimated Cetane Number must be greater than or equal to the specified value and the Cetane Index must be greater than or equal to the number in parenthesis.
- ⁽²⁾ May relax the minimum limit to 800 kg/m³ when ambient temperatures are below -30°C.
- ⁽³⁾ May relax the minimum limit to 1.5 mm²/s when ambient temperatures are below -30°C or to 1.3 mm²/s when ambient temperatures are below -40°C.
- ⁽⁴⁾ The unit mg/kg is often expressed as ppm.
- ⁽⁵⁾ The minimum limit can be relaxed to 38°C when ambient temperatures are below -30°C.
- ⁽⁶⁾ If compliance is demonstrated by meeting CFPP, then the maximum must be no more than 10°C less than cloud point.
- ⁽⁷⁾ Methods 2a and 2b must be used with fuels containing FAME. Method 2c correlation data are based on fuels containing FAME.
- ⁽⁸⁾ For FAME, both EN14214 and ASTM D6751, or equivalent standards, should be considered. Where FAME is used, the blendstock should meet the B100 Guidelines published by the WWFC Committee, and fuel pumps should be labelled accordingly.
- ⁽⁹⁾ Other biofuels include HVO and BTL. Blending level must allow the finished fuel to meet all the required specifications.
- ⁽¹⁰⁾ At or below detection limit of the test method used.

Markets with requirements for emission controls or other market demands.

PROPERTIES	UNITS	LIMIT	
		Min.	Max.
Cetane Number		51.0	
Cetane Index ⁽¹⁾		51.0 (48.0) ⁽¹⁾	
Density @ 15°C	kg/m ³	820 ⁽²⁾	850
Viscosity @ 40°C	mm ² /s	2.0 ⁽³⁾	4.0
Sulphur	mg/kg ⁽⁴⁾		300
Trace metal ⁽⁵⁾	mg/kg		1 or non-detectable, whichever is lower
Total aromatics	% m/m		25
PAH (di+, tri+)	% m/m		5
T90 ⁽⁶⁾	°C		340
T95 ⁽⁶⁾	°C		355
Final Boiling Point	°C		365
Flash point	°C	55	
Carbon residue	% m/m		0.30
CFPP or LTFT or CP	°C		Equal to or lower than the lowest expected ambient temperature ⁽⁷⁾
Water	mg/kg		200
Oxidation stability			
Method 1	g/m ³		25
Method 2a (Rancimat, modified) ⁽⁸⁾ , or	hours	35	
Method 2b (Delta TAN) ⁽⁸⁾ , or	mg KOH/g	0.12	
Method 2c (PetroOxy) ⁽⁸⁾	minutes	65	
Biological growth ⁽⁹⁾			no growth
FAME ⁽¹⁰⁾	% v/v		5
Other biofuels ⁽¹¹⁾	% v/v		(11)
Ethanol/Methanol	% v/v		Non-detectable ⁽¹²⁾
Total acid number	mg KOH/g		0.08
Ferrous corrosion			Light rusting
Copper corrosion	rating		Class 1
Ash	% m/m		0.01
Particulate contamination, total	see test method		10
Particulate contamination, size distribution	code rating		18/16/13 per ISO 4406
Appearance		Clear and bright; no free water or particulates	
Injector cleanliness (Method 1)	% air flow loss		85
Lubricity (HFRR wear scar dia. @ 60°C)	micron		460

Footnotes:

- (1) Cetane Index is acceptable instead of Cetane Number if a standardized engine to determine the Cetane Number is unavailable and cetane improvers are not used. When cetane improvers are used, the estimated Cetane Number must be greater than or equal to the specified value and the Cetane Index must be greater than or equal to the number in parentheses.
- (2) May relax the minimum limit to 800 kg/m³ when ambient temperatures are below -30°C. For environmental purposes, a minimum of 815 kg/m³ can be adopted.
- (3) May relax the minimum limit to 1.5 mm²/s when ambient temperatures are below -30°C or to 1.3 mm²/s when ambient temperatures are below -40°C.
- (4) The unit mg/kg is often expressed as ppm.
- (5) Examples of trace metals include, but are not limited to, Cu, Fe, Mn, Na, P, Pb, Si and Zn. Another undesirable element is Cl. No trace metal should exceed 1 mg/kg. No intentional addition of metal-based additives is allowed.
- (6) Compliance with either T90 or T95 is required.
- (7) If compliance is demonstrated by meeting CFPP, then the maximum must be no more than 10°C less than cloud point.
- (8) Methods 2a and 2b must be used with fuels containing FAME. Method 2c correlation data are based on fuels containing FAME.
- (9) Alternative test methods, with appropriate limits for no biological growth, can be used.
- (10) For FAME, both EN14214 and ASTM D6751, or equivalent standards, should be considered. Where FAME is used, the blendstock should meet the B100 Guidelines published by the WWFC Committee, and fuel pumps should be labelled accordingly.
- (11) Other biofuels include HVO and BTL. Blending level must allow the finished fuel to meet all the required specifications.
- (12) At or below detection limit of the test method used.

Markets with more stringent requirements for emission controls or other market demands.

PROPERTIES	UNITS	LIMIT	
		Min.	Max.
Cetane Number		53.0	
Cetane Index ⁽¹⁾		53.0 (50.0) ⁽¹⁾	
Density @ 15°C	kg/m ³	820 ⁽²⁾	840
Viscosity @ 40°C	mm ² /s	2.0 ⁽³⁾	4.0
Sulphur	mg/kg ⁽⁴⁾		50
Trace metal ⁽⁵⁾	mg/kg		1 or non-detectable, whichever is lower
Total aromatics	% m/m		20
PAH (di+, tri+)	% m/m		3.0
T90 ⁽⁶⁾	°C		320
T95 ⁽⁶⁾	°C		340
Final Boiling Point	°C		350
Flash point	°C	55	
Carbon residue	% m/m		0.20
CFPP or LTFT or CP ⁽⁷⁾	°C		Equal to or lower than the lowest expected ambient temperature
Water	mg/kg		200
Oxidation Stability			
Method 1	g/m ³		25
Method 2a (Rancimat, modified) ⁽⁸⁾ , or	hours	35	
Method 2b (Delta TAN) ⁽⁸⁾ , or	mg KOH/g		0.12
Method 2c (PetroOxy) ⁽⁸⁾	minutes	65	
Foam volume	ml		100
Foam vanishing time	sec.		15
Biological growth ⁽⁹⁾			no growth
FAME ⁽¹⁰⁾	% v/v		5
Other Biofuels ⁽¹¹⁾	% v/v		(11)
Ethanol/Methanol	% v/v		Non-detectable ⁽¹²⁾
Total acid number	mg KOH/g		0.08
Ferrous corrosion			Light rusting
Copper corrosion	rating		Class 1
Ash	% m/m		0.01
Particulate contamination, total	see test method		10
Particulate contamination, size distribution	code rating		18/16/13 per ISO 4406
Appearance		Clear and bright; no free water or particulates	
Injector cleanliness (Method 1)	% air flow loss		85
Lubricity (HFRR wear scar dia. @ 60°C)	micron		460

Footnotes:

- (1) Cetane Index is acceptable instead of Cetane Number if a standardized engine to determine the Cetane Number is unavailable and cetane improvers are not used. When cetane improvers are used, the estimated Cetane Number must be greater than or equal to the specified value and the Cetane Index must be greater than or equal to the number in parenthesis.
- (2) May relax minimum limit to 800 kg/m³ when ambient temperatures are below -30°C. For environmental purposes, a minimum of 815 kg/m³ can be adopted.
- (3) May relax minimum limit to 1.5 mm²/s when ambient temperatures are below -30°C or to 1.3 mm²/s when ambient temperatures are below -40°C.
- (4) The unit mg/kg is often expressed as ppm.
- (5) Examples of trace metals include, but are not limited to, Cu, Fe, Mn, Na, P, Pb, Si and Zn. Another undesirable element is Cl. No trace metal should exceed 1 mg/kg. No intentional addition of metal-based additives is allowed.
- (6) Compliance with either T90 or T95 is required.
- (7) If compliance is demonstrated by meeting CFPP, then it must be no more than 10°C less than cloud point.
- (8) Methods 2a and 2b must be used with fuels containing FAME. Method 2c correlation data are based on fuels containing FAME.
- (9) Alternative test methods, with appropriate limits for "no biological growth," can be used.
- (10) For FAME, both EN14214 and ASTM D6751, or equivalent standards, should be considered. Where FAME is used, the blendstock should meet the B100 Guidelines published by the WWFC Committee, and fuel pumps should be labelled accordingly.
- (11) Other biofuels include HVO and BTL. Blending level must allow the finished fuel to meet all the required specifications.
- (12) At or below detection limit of the test method used.

Markets with advanced requirements for emission control. Enables sophisticated NO_x and PM after-treatment technologies.

PROPERTIES	UNITS	LIMIT	
		Min.	Max.
Cetane Number		55.0	
Cetane Index ⁽¹⁾		55.0 (52.0) ⁽¹⁾	
Density @ 15°C	kg/m ³	820 ⁽²⁾	840
Viscosity @ 40°C	mm ² /s	2.0 ⁽³⁾	4.0
Sulphur	mg/kg ⁽⁴⁾		10
Trace metal ⁽⁵⁾	mg/kg		1 or non-detectable, whichever is lower
Total aromatics	% m/m		15
PAH (di+, tri+)	% m/m		2.0
T90 ⁽⁶⁾	°C		320
T95 ⁽⁶⁾	°C		340
Final Boiling Point	°C		350
Flash point	°C	55	--
Carbon residue	% m/m		0.20
CFPP or LTFT or CP ⁽⁷⁾	°C		Equal to or lower than the lowest expected ambient temperature
Water	mg/kg		200
Oxidation Stability			
Method 1	g/m ³		25
Method 2a (Rancimat, modified) ⁽⁸⁾ , or	hours	35	
Method 2b (Delta TAN) ⁽⁸⁾ , or	mg KOH/g		0.12
Method 2c (PetroOxy) ⁽⁸⁾	minutes	65	
Foam volume	ml		100
Foam vanishing time	sec.		15
Biological growth ⁽⁹⁾			no growth
FAME ⁽¹⁰⁾	% v/v		5 ⁽¹⁰⁾
Other biofuels ⁽¹¹⁾	% v/v		⁽¹¹⁾
Ethanol/Methanol	% v/v		Non-detectable ⁽¹²⁾
Total acid number	mg KOH/g		0.08
Ferrous corrosion			Light rusting
Copper corrosion	rating		Class 1
Ash	% m/m		0.001 ⁽¹³⁾
Particulate contamination, total	see test method		10
Particulate contamination, size distribution	code rating		18/16/13 per ISO 4406
Appearance		Clear and bright; no free water or particulates	
Injector cleanliness (Method 1)	% air flow loss		85
Injector cleanliness (Method 2)	% power loss		2
Lubricity (HFRR wear scar dia. @ 60°C)	micron		400

Footnotes:

- (1) Cetane Index is acceptable instead of Cetane Number if a standardized engine to determine the Cetane Number is unavailable and Cetane improvers are not used. When Cetane improvers are used, the estimated Cetane Number must be greater than or equal to the specified value and the Cetane Index must be greater than or equal to the number in parenthesis.
- (2) May relax the minimum limit to 800 kg/m³ when ambient temperatures are below -30°C. For environmental purposes, a minimum of 815 kg/m³ can be adopted.
- (3) May relax the minimum limit to 1.5 mm²/s when ambient temperatures are below -30°C or to 1.3 mm²/s when ambient temperatures are below -40°C.
- (4) The unit mg/kg is often expressed as ppm.
- (5) Examples of trace metals include, but are not limited to, Cu, Fe, Mn, Na, P, Pb, Si and Zn. Another undesirable element is Cl. No trace metal should exceed 1 mg/kg. No intentional addition of metal-based additives is allowed.
- (6) Compliance with either T90 or T95 is required.
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- (11) Other biofuels include HVO and BTL. Blending level must allow the finished fuel to meet all the required specifications.
- (12) At or below detection limit of the test method used.
- (13) Limit and test method are under review to assure DPF endurance.

Markets with highly advanced requirements for emission control and fuel efficiency. Enables sophisticated NOx and PM after-treatment technologies.

PROPERTIES	UNITS	LIMIT	
		Min.	Max.
Cetane Number		55.0	
Cetane Index ⁽¹⁾		55.0 (52.0) ⁽¹⁾	
Density @ 15°C	kg/m ³	820 ⁽²⁾	840
Viscosity @ 40°C	mm ² /s	2.0 ⁽³⁾	4.0
Sulphur	mg/kg ⁽⁴⁾		10
Trace metal ⁽⁵⁾	mg/kg		1 or non-detectable, whichever is lower
Total aromatics	% m/m		15
PAH (di+, tri+)	% m/m		2.0
T90 ⁽⁶⁾	°C		320
T95 ⁽⁶⁾	°C		340
Final Boiling Point	°C		350
Flash point	°C	55	--
Carbon residue	% m/m		0.20
CFPP or LTFT or CP	°C		Equal to or lower than the lowest expected ambient temperature ⁽⁷⁾
Water	mg/kg		200
Oxidation stability, Method I	g/m ³		25
Foam volume	ml		100
Foam vanishing time	sec.		15
Biological growth ⁽⁸⁾		no growth	
FAME		Non-detectable	
Other Biofuels ⁽⁹⁾			⁽⁹⁾
Ethanol/Methanol	% v/v	Non-detectable ⁽¹⁰⁾	
Total acid number	mg KOH/g		0.08
Ferrous corrosion			Light rusting
Copper corrosion	rating		Class I
Ash	% m/m		0.001 ⁽¹¹⁾
Particulate contamination, total	see test method		10
Particulate contamination, size distribution	code rating		18/16/13 per ISO 4406
Appearance		Clear and bright; no free water or particulates	
Injector cleanliness (Method 1)	% air flow loss		85
Injector cleanliness (Method 2)	% power loss		2
Lubricity (HFRR wear scar dia. @ 60°C)	micron		400

Footnotes:

- ⁽¹⁾ Cetane Index is acceptable instead of Cetane Number if a standardized engine to determine the Cetane Number is unavailable and cetane improvers are not used. When cetane improvers are used, the estimated Cetane Number must be greater than or equal to the specified value and the Cetane Index must be greater than or equal to the number in parenthesis.
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- ⁽³⁾ May relax the minimum to 1.5 mm²/s when ambient temperatures are below -30°C or to 1.3 mm²/s when ambient temperatures are below -40°C.
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- ⁽⁷⁾ If compliance is demonstrated by meeting CFPP, then it must be no more than 10°C less than cloud point.
- ⁽⁸⁾ Alternative test methods, with appropriate limits for "no biological growth," can be used.
- ⁽⁹⁾ Other biofuels include HVO and BTL. Blending level must allow the finished fuel to meet all the required specifications.
- ⁽¹⁰⁾ At or below detection limit of the test method used.
- ⁽¹¹⁾ Limit and test method are under review to assure DPF endurance.