

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

PROPERTIES	UNITS	LIMIT	
		Min.	Max.
'91 RON' <sup>(1)</sup>	Research Octane Number	91.0	
	Motor Octane Number	82.0	
'95 RON' <sup>(1)</sup>	Research Octane Number	95.0	
	Motor Octane Number	85.0	
'98 RON' <sup>(1)</sup>	Research Octane Number	98.0	
	Motor Octane Number	88.0	
Oxidation stability	minutes	360	
Sulphur	mg/kg <sup>(2)</sup>		1000
Trace metal <sup>(3)</sup>	mg/kg		I or non-detectable, whichever is lower
Oxygen <sup>(4)</sup>	% m/m		2.7 <sup>(5)</sup>
Aromatics	% v/v		50.0
Benzene	% v/v		5.0
Volatility			See Tables, page 8
Unwashed gums	mg/100 ml		70
Washed gums	mg/100 ml		5
Density	kg/m <sup>3</sup>	715	780
Copper corrosion	rating		Class I
Appearance		Clear and bright; no free water or particulates	
Carburettor cleanliness	merit	8.0 <sup>(6)</sup>	
Fuel injector cleanliness, Method 1, or	% flow loss		10 <sup>(6)</sup>
Fuel injector cleanliness, Method 2	% flow loss		10 <sup>(6)</sup>
Intake valve cleanliness	merit	9.0 <sup>(6)</sup>	

#### Footnotes:

- <sup>(1)</sup> Three octane grades are defined for maximum market flexibility; availability of all three is not needed.
- <sup>(2)</sup> The unit mg/kg is often expressed as ppm. Lower sulphur content preferred for catalyst-equipped vehicles.
- <sup>(3)</sup> Examples of trace metals include, but are not limited to, Cu, Fe, Mn, Na, P, Pb, Si and Zn. Another undesirable element is Cl. Metal-containing additives are acceptable only for valve seat protection in non-catalyst cars; in this case, potassium-based additives are recommended. No intentional addition of metal-based additives is allowed.
- <sup>(4)</sup> Where oxygenates are used, ethers are preferred. Methanol is not permitted.
- <sup>(5)</sup> By exception, up to 10% by volume ethanol content is allowed if permitted by existing regulation. Blendstock ethanol should meet the E100 Guidelines published by the WWFC Committee. Fuel pump labelling is recommended for gasoline-ethanol blends to enable customers to determine if their vehicles can use the fuel.
- <sup>(6)</sup> Compliance with this requirement can be demonstrated by the use of proper detergent additives in comparable-base gasolines.

Markets with requirements for emission controls or other market demands.

PROPERTIES	UNITS	LIMIT	
		Min.	Max.
'91 RON' <sup>(1)</sup>	Research Octane Number	91.0	
	Motor Octane Number	82.5	
'95 RON' <sup>(1)</sup>	Research Octane Number	95.0	
	Motor Octane Number	85.0	
'98 RON' <sup>(1)</sup>	Research Octane Number	98.0	
	Motor Octane Number	88.0	
Oxidation stability	minutes	480	
Sulphur	mg/kg <sup>(2)</sup>		150
Trace metal <sup>(3)</sup>	mg/kg		1 or non-detectable, whichever is lower
Oxygen <sup>(4)</sup>	% m/m		2.7 <sup>(5)</sup>
Olefins	% v/v		18.0
Aromatics	% v/v		40.0
Benzene	% v/v		2.5
Volatility			See Tables, page 8
Sediment (total particulate)	mg/l		1
Unwashed gums <sup>(6)</sup>	mg/100 ml		70
Washed gums	mg/100 ml		5
Density	kg/m <sup>3</sup>	715	770
Copper corrosion	rating		Class I
Appearance		Clear and bright; no free water or particulates	
Fuel injector cleanliness, Method 1, or	% flow loss		5
Fuel injector cleanliness, Method 2	% flow loss		10
Intake-valve sticking	pass/fail	Pass	
Intake valve cleanliness II			
Method 1 (CEC F-05-A-93), or	avg. mg/valve		50
Method 2 (ASTM D5500), or	avg. mg/valve		100
Method 3 (ASTM D6201)	avg. mg/valve		90
Combustion chamber deposits <sup>(6)</sup>			
Method 1 (ASTM D6201), or	% of base fuel		140
Method 2 (CEC-F-20-A-98), or	mg/engine		3500
Method 3 (TGA - FLTM BZ154-01)	% mass. @ 450°C		20

#### Footnotes:

- (1) Three octane grades are defined for maximum market flexibility; availability of all three is not needed.
- (2) The unit mg/kg is often expressed as ppm.
- (3) 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.
- (4) Where oxygenates are used, ethers are preferred. Methanol is not permitted.
- (5) By exception, up to 10% by volume ethanol content is allowed if permitted by existing regulation. Blendstock ethanol should meet the E100 Guidelines published by the WWFC Committee. Fuel pump labelling is recommended for gasoline-ethanol blends to enable customers to determine if their vehicles can use the fuel.
- (6) To provide flexibility (for example, to enable the use of detergency additives that increase unwashed gum levels), the fuel may comply with either the Unwashed Gum limit or the Combustion Chamber Deposits limit.

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

PROPERTIES	UNITS	LIMIT	
		Min.	Max.
'91 RON' <sup>(1)</sup>	Research Octane Number	91.0	
	Motor Octane Number	82.5	
'95 RON' <sup>(1)</sup>	Research Octane Number	95.0	
	Motor Octane Number	85.0	
'98 RON' <sup>(1)</sup>	Research Octane Number	98.0	
	Motor Octane Number	88.0	
Oxidation stability	minutes	480	
Sulphur	mg/kg <sup>(2)</sup>		30
Trace metal <sup>(3)</sup>	mg/kg		1 or non-detectable, whichever is lower
Oxygen <sup>(4)</sup>	% m/m		2.7 <sup>(5)</sup>
Olefins	% v/v		10.0
Aromatics	% v/v		35.0
Benzene	% v/v		1.0
Volatility			See Tables, page 8
Sediment (total particulate)	mg/l		1
Unwashed gums <sup>(6)</sup>	mg/100 ml		30
Washed gums	mg/100 ml		5
Density	kg/m <sup>3</sup>	715	770
Copper corrosion	rating		Class I
Appearance		Clear and bright; no free water or particulates	
Fuel injector cleanliness, Method 1, or	% flow loss		5
Fuel injector cleanliness, Method 2	% flow loss		10
Particulate contamination, size distribution	Code rating		18/16/13 per ISO 4406
Intake-valve sticking	pass/fail	Pass	
Intake valve cleanliness II			
Method 1 (CEC F-05-A-93), or	avg. mg/valve		30
Method 2 (ASTM D5500), or	avg. mg/valve		50
Method 3 (ASTM D6201)	avg. mg/valve		50
Combustion chamber deposits <sup>(6)</sup>			
Method 1 (ASTM D6201), or	% of base fuel		140
Method 2 (CEC-F-20-A-98), or	mg/engine		2500
Method 3 (TGA FLTM BZ154-01)	% mass @ 450°C		20

#### Footnotes:

- (1) Three octane grades are defined for maximum market flexibility; availability of all three is not needed.
- (2) The unit mg/kg is often expressed as ppm.
- (3) 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.
- (4) Where oxygenates are used, ethers are preferred. Methanol is not permitted.
- (5) By exception, up to 10% by volume ethanol content is allowed if permitted by existing regulation. Blendstock ethanol should meet the E100 Guidelines published by the WWFC Committee. Fuel pump labelling is recommended for gasoline-ethanol blends to enable customers to determine if their vehicles can use the fuel.
- (6) To provide flexibility (for example, to enable the use of detergency additives that increase unwashed gum levels), the fuel may comply with either the Unwashed Gum limit or the Combustion Chamber Deposits limit.

Markets with highly advanced requirements for emission control; enables sophisticated NO<sub>x</sub> and particulate matter after-treatment technologies.

PROPERTIES	UNITS	LIMIT	
		Min.	Max.
'91 RON' <sup>(1)</sup>	Research Octane Number	91.0	
	Motor Octane Number	82.5	
'95 RON' <sup>(1)</sup>	Research Octane Number	95.0	
	Motor Octane Number	85.0	
'98 RON' <sup>(1)</sup>	Research Octane Number	98.0	
	Motor Octane Number	88.0	
Oxidation stability	minutes	480	
Sulphur	mg/kg <sup>(2)</sup>		10
Trace metal <sup>(3)</sup>	mg/kg		1 or non-detectable, whichever is lower
Oxygen <sup>(4)</sup>	% m/m		2.7 <sup>(5)</sup>
Olefins	% v/v		10.0
Aromatics	% v/v		35.0
Benzene	% v/v		1.0
Volatility		See Tables, page 8	
Sediment (total particulate)	mg/l		1
Unwashed gums <sup>(6)</sup>	mg/100 ml		30
Washed gums	mg/100 ml		5
Density	kg/m <sup>3</sup>	715	770
Copper corrosion rating			Class I
Silver corrosion rating			Class I
Appearance		Clear and bright; no free water or particulates	
Fuel injector cleanliness, Method 1, or	% flow loss		5
Fuel injector cleanliness, Method 2	% flow loss		10
Particulate contamination, size distribution	Code rating		18/16/13 per ISO 4406
Intake-valve sticking	pass/fail	Pass	
Intake valve cleanliness II			
Method 1 (CEC F-05-A-93), or	avg. mg/valve		30
Method 2 (ASTM D5500), or	avg. mg/valve		50
Method 3 (ASTM D6201)	avg. mg/valve		50
Combustion chamber deposits <sup>(6)</sup>			
Method 1 (ASTM D6201), or	% of base fuel		140
Method 2 (CEC-F-20-A-98), or	mg/engine		2500
Method 3 (TGA FLTM BZ154-01)	% mass @ 450°C		20

#### Footnotes:

- (1) Three octane grades are defined for maximum market flexibility; availability of all three is not needed.
- (2) The unit mg/kg is often expressed as ppm.
- (3) 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.
- (4) Where oxygenates are used, ethers are preferred. Methanol is not permitted.
- (5) By exception, up to 10% by volume ethanol is allowed if permitted by existing regulation. Blendstock ethanol should meet the E100 Guidelines published by the WWFC Committee. Fuel pump labelling is recommended for gasoline-ethanol blends to enable customers to determine if their vehicles can use the fuel.
- (6) To provide flexibility (for example, to enable the use of detergency additives that increase unwashed gum levels), the fuel may comply with either the Unwashed Gum limit or the Combustion Chamber Deposits limit.

Markets with highly advanced requirements for emission control and fuel efficiency. Enables technologies that can help increase vehicle and engine efficiency, in addition to enabling sophisticated NO<sub>x</sub> and particulate matter after-treatment technologies.

PROPERTIES	UNITS	LIMIT	
		Min.	Max.
'95 RON'	Research Octane Number	95.0	
	Motor Octane Number	85.0	
'98 RON'	Research Octane Number	98.0	
	Motor Octane Number	88.0	
Oxidation stability	minutes	480	
Sulphur	mg/kg (1)		10
Trace metal (2)	mg/kg		1 or non-detectable, whichever is lower
Oxygen (3)	% m/m		2.7 (4)
Olefins	% v/v		10.0
Aromatics	% v/v		35.0
Benzene	% v/v		1.0
Volatility		See Tables, page 8	
Sediment (total particulate)	mg/l		1
Unwashed gums (5)	mg/100 ml		30
Washed gums	mg/100 ml		5
Density	kg/m <sup>3</sup>	720	775
Copper corrosion	rating		Class I
Sulphur corrosion	rating		Class I
Appearance		Clear and bright; no free water or particulates	
Fuel injector cleanliness, Method 1, or	% flow loss		5
Fuel injector cleanliness, Method 2	% flow loss		10
Particulate contamination, size distribution	Code rating		18/16/13 per ISO 4406
Intake-valve sticking	pass/fail	Pass	
Intake valve cleanliness II			
Method 1 (CEC F-05-A-93), or	avg. mg/valve		30
Method 2 (ASTM D5500), or	avg. mg/valve		50
Method 3 (ASTM D6201)	avg. mg/valve		50
Combustion chamber deposits (5)			
Method 1 (ASTM D6201), or	% of base fuel		140
Method 2 (CEC-F-20-A-98), or	mg/engine		2500
Method 3 (TGA FLTM BZ154-01)	% mass. @ 450°C		20

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- (3) Where oxygenates are used, ethers are preferred. Methanol is not permitted.
- (4) By exception, up to 10% ethanol by volume is allowed where permitted by existing regulation. Blendstock ethanol should meet the E100 Guidelines published by the WWFC Committee. Fuel pump labelling is recommended for gasoline-ethanol blends to enable customers to determine if their vehicles can use the fuel.
- (5) To provide flexibility (for example, to enable the use of detergency additives that increase unwashed gum levels), the fuel may comply with either the Unwashed Gum limit or the Combustion Chamber Deposits limit.