Fuel Regulations in Australia (Source: Juhani Hellens, BP Australia)

This document summarises all the regulated specifications that apply to petrol / diesel fuels sold in Australia.
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Petrol Properties from 1 Jan 2002 (Petrol must not contain more than the amount mentioned in the table)

Property		Specification	Limit	Reason	Comment
RON (Research Octane Number)		ULP (Regular Unleaded Petrol)	91 min	Incorrect octane causes poor combustion and increases exhaust emissions RON indicates petrol's anti-knock performance at lower engine speed and typical acceleration conditions	Octane is reduced by contamination with diesel or kerosene.
		LRP (Lead Replacement Petrol)	96 min		
		PULP (Premium Unleaded Petrol) (& Ultimate – 98 Octane fuel)	95 min		
Sulphur[1]		ULP & LRP	500 ppm (max)	High sulphur levels cause bad smell (also know as the "rotten egg smell" – Hydrogen Sulphide) Sulphur reduces the efficiency of catalytic converters	Sulphur reduces life of exhaust catalysts leading to increased emissions with age.
		PULP	150 ppm (max)		
		WA (Western Australia)	150 ppm (max)		
Lead		All Grades	0.005 g/L (max)	Formerly used as an octane enhancer. Removed because adverse effects on health and lead prevents exhaust catalysts from working and fouls engines management systems that lower exhaust emissions	
Oxygen		All grades (Other than ethanol petrol blends)	2.7% volume/volume (max)	Compounds of hydrogen, carbon, and oxygen. These compounds can enter groundwater and contaminate drinking water.	
Phosphorus		ULP & PULP	0.0013 g/L (max)	Affects catalytic converters. LRP is exempt due Anti Valve Seat Recession Additives (AVSRs) which can contain phosphorus	Phosphorus attacks catalytic converters in the same way as Lead.
		LRP	-		
DIPE (Diisopropyl ether)		All Grades	1% by volume (max)	Octane enhancer, will mix readily with water and can enter groundwater & contaminate drinking water.	
TBA (Tertiary Butyl Alcohol)		All Grades	0.5 % by volume (max)	Octane enhancer can enter groundwater and contaminate drinking water.	
Aromatics[2]		All Grades	45% pool average over 6 months with a cap of 48%	Aromatics are fuel molecules that contain at least one benzene ring; common Aromatics include benzene, toluene and xylene. Aromatics are good source of octane. Fuel aromatic content can increase engine deposits and increase tailpipe emissions, including toxic benzene emissions.	Aromatics form deposits in the combustion chamber leading to improper combustion and increasing exhaust emissions.
		WA: All Grades	42.0 % vol/vol		
Benzene[3]		Rest of the States	5.0 % by volume	Benzene is a naturally occurring constituent of crude oil, research has shown benzene to be a carcinogen (cancer causing) therefore reduction of Benzene is preferred over other compounds (eg toluene and xylene), which have lesser health effects but are also good sources of octane. Benzene is classed as a poison and all products containing more than 1% must be marked as a poison for transport purposes	Petrol has been granted an exemption and is allowed up to 5% vol without carrying a poison label.
		SA: All Grades	4.9 % by volume		
		WA: All Grades	1.0 % vol/vol		
		QLD: All Grades	3.5% max vol average over 6 months (or 6 consecutive batches)		
Olefins[4]		WA: All Grades	18.0 % by volume	Olefins in the atmosphere contribute to ground level ozone formation (smog)	Olefins are linked to exhaust butadiene content, like benzene butadiene is a known carcinogen.
MTBE[5] (Methyl Tertiary Butyl Ether)		WA: All Grades	0.10% vol/vol	Octane enhancers, MTBE mixes readily with water and can enter groundwater & contaminate drinking water.	
ETBE (Ethyl Tertiary Butyl Ether) TAME (Tertiary Amyl Methyl Ether) & MTBE		QLD: All Grades	1% by volume.	See MTBE explanation	
TAME (Tertiary Amyl Methyl Ether)		SA: All Grades	1 % by volume		
RVP (Reid Vapour Pressure)		QLD (South East only)[6]	76 kPa Summer Monthly av.	Petrol must vaporise readily to allow easy starting and driveability. RVP is linked to Volatile Hydrocarbon emissions from a vehicle and are linked to smog production in the presence of sunlight.	
		WA (Perth only) & SA	67 kPa Summer Monthly av.		
		NSW (Sydney Only)	62 kPa Summer Monthly av.		
Proposed Operability Standards (Implemented September 2002)	MON (Motor Octane Number)	PULP	85.0 (min)	As for RON, incorrect octane causes poor combustion and increases exhaust emissions MON indicates the anti-knock performance of fuel under higher engine speed and higher load conditions.	
		ULP	81.0 (min)		
		LRP	82.0 (min)		
	Copper Corrosion (3 hrs @ 50°C)	All Grades	Class 1 (max)	The copper corrosion test indicates potential corrosion of copper, brass, or bronze fuel system components.	Poorly refined products with high sulphur tend to attack copper components of fuel systems.
	Existent Gum (washed)	All Grades	50mg/L (max)	Gum deposits on inlet systems restrict fuel flow producing incorrect combustion. Gums produce combustion chamber deposits, which cause poor combustions; power loss and increase exhaust emissions.	If petrol has oxidised, the gums formed will deposit on inlet systems & restrict fuel flows
	Induction Period	All Grades	360 mins (min)	Induction period indicates storage stability. Fuels with poor stability form insolubles that can block fuel filters	As for existent gum.
Parameters currently excluded	FVI (Flexible Volatility Index)	All Grades	As per seasonal & location tables	Flexible Volatility Index (FVI) measurers the tendency for vapour locking. This specification changes by location and season, based on factors like altitude and the expected ambient temperature range.	Excess vapour produces vapour lock in fuel lines and increases volatile emissions.
	Colour	ULP	Purple / Bronze	Dyes are used for easy identification of each of the various grades of petrol	Enables the customer to identify the grade of fuel.
		LRP	Red / Orange		
		PULP	Yellow		
	Appearance @ 20°C	All Grades	Clear & bright	Anything that causes a hazy appearance potentially will block filters resulting in fuel starvation, power loss and increased exhaust emissions	Normally associated with water and dirt.
	Driveability Index	-	-	Driveability Index predicts cold start and warmup driveability. As with FVI the specification changes by location and season.	
Ethanol		Standard (limit) to be set within 12 months.		Renewable resource, octane enhancer and contributes to reduction in greenhouse gas emissions. Ethanol absorbs water more readily than petrol	Excess water contamination can draw water into the engine.
Distillation		Distillation: FBP 210°C (max) 1 Jan 2005		Distillation properties of fuel are related to volatility. The high end of the distillation curve is the least volatile (heaviest) components, contribute to deposit formation and exhaust emissions.	

ETBE, TAME and ETAE are not listed on the Australian Inventory of Chemical Substances (AICS). In accordance with the Industrial Chemicals (Notification and Assessment) Act 1989, these chemicals are currently prohibited from import and manufacture

[1] Australia: Sulphur: All Grades 150 ppm (max) by 1 Jan 2005
[2] Australia: Aromatics: All Grades 42% pool average over 6 months with a cap of 45% by 1 Jan 2005
[3] Australia: Benzene: All grades 1% max by vol by 1 Jan 2006
[4] Australia: Olefins: All grades 18% pool average over 6 months with a cap of 20% by 1 Jan 2004; All grades 18% max by vol by 1 Jan 2005
[5] Australia MTBE (Methyl tertiary-butyl ether): All grades 1% by volume (max) by 1 Jan 2004

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Diesel Properties from 1 Jan 2002[7] (Diesel must not contain more than the amount mentioned in the table)

Property		Limit	Reason	Comment
Sulphur[8]		500 ppm (max) (from 31 Dec 2002) QLD & WA: 500 ppm (max) SA: 1300 ppm (max)	Sulphur is associated with the level of particulate matter produced from the exhaust. Particulate matter is a pollutant and also disables exhaust catalysts that clean up diesel exhaust emissions. Diesel exhaust treatments work best with low sulphur or zero sulphur fuels.	Particulate matter has been linked to respiratory problems associated with air pollution due to vehicle exhaust.
Ash and suspended solids		100 ppm (max)	Ash contributes to combustion chamber and exhaust valve wear, which increases exhaust emissions.	Ash is reduced at the refinery.
Distillation – 95 % Recovered[9]		370° C (max)	High 95% recovered contributes to soot, particulate matter and unburnt fuel emissions. These impair the effectiveness of exhaust catalysts to reduce emissions	Product is made to the distillation spec at the refinery. Addition of used lubricating oil in excess of 5% increases distillation point
Cetane Index		46 (min)	Def: Cetane number measures how easily diesel fuel ignites. A high Cetane number indicates shorter ignition lag which in general results in smoother combustion, lower engine noise and cleaner burning fuel	Cetane is a function of the refining process, high cetane enables modern low emission fuel injection systems to operate at design levels to reduce emissions
Density[10]		820 to 860 kg/m^3	In general, high density gives more power and lower consumption; however in Diesel engines this results in higher smoke output. To reduce smoke – the average density has been lowered.	Addition of kerosene and heating oil lowers density
Viscosity		2.0 to 4.5 cSt @ 40°C	To optimise fuel injection spray pattern the viscosity needs to be controlled. High or too low viscosity impairs combustion, decreasing power output & fuel economy, which affect emissions performance.	Addition of kerosene and heating oil changes viscosity giving incorrect spar patterns and poor combustion
Proposed Operability Standards implemented September 2002)	Carbon Residue (10% Distillation residue)	0.2 % mass (max)	Def: measure of carbon-forming tendencies of diesel when heated under prescribed conditions. While not directly correlating with formation of deposits in fuel injectors and combustion chambers, this property is considered to be an indication of deposit-forming tendency.	Carbon residue is changed by addition of heavy components such as fuel oil and lubricating oil.
	Water & Sediment (only done if appearance test fails)	0.05 % vol (max)	The presence of water and sediment in diesel blocks fuel filters, leading to poor combustion and high exhaust emissions, it also promotes fungal growth.	High levels of free water and dirt indicate poor fuel management.
	Conductivity @ Ambient temp	50 pS/m (min) @ ambient temp	The management of the conductivity of diesel is necessary to avoid electrostatic charge build-up and spark formation during pumping and loading of tankers. Generally Diesel has a low electrical conductivity.	Important where switch loading is a normal practice.
	Oxidation Stability	25 mg/L (max)	Oxidation stability is an indication of diesel's storage stability. Prolonged storage of fuel can result in oxidation of diesel to form undesirable gums and sediment. This can cause filter plugging, combustion chamber deposits formation, and gumming or lacquering of injection system components with resultant sticking and poor spray pattern which causes incorrect combustion and high emissions.	Poor oxidation stability indicates poor refining or fuel that has been in storage too long.
	Colour	2 max	Diesel is naturally coloured and varies depending upon crude and blending components used.	Diesel containing "unstabilsed" cracked components go black when exposed to sunlight or stored extended time.
	Acidity	Total: 0.08 mg KOH/g (max) Strong: nil	Organic acids in diesel must be controlled to avoid corrosion of vehicle fuel systems. Strong acidity measures corrosive acidic components whilst total acidity measures all corrosive acidic components.	
	Copper Corrosion (3 hrs @ 50°C)	Class 1 (max)	The copper corrosion test indicates potential corrosion of copper, brass, or bronze fuel system components.	
	Flash Point	61.5°C (min)	Flashpoint is the lowest temperature at which diesel gives off just sufficient vapour to form a flammable mixture with air under standard conditions. Not directly related to engine performance, but important with safety precautions and legal requirements involved in fuel handling and storage.	Contamination with Petrol, Kerosene, or AVGAS lowers flashpoint. 0.5% of petrol or avgas will lower flash point by 10 deg C
	Filter Blocking Tendency	2.0 (max)	The filter blocking test measures the ability of diesel fuels to be filtered. Indicates how quickly filter can block or, as a measure of diesel deterioration	The presence of unstable fuel, fuel oil or trace water increases FBT.
	Lubricity	0.460 mm (max) (only for diesel with less than 500pp Sulphur	Diesel fuel lubricates some moving parts of diesel pumps and injectors. To avoid excessive wear, fuel must have some minimum amount of lubricity. Low lubricity can result in excessive pump wear and engine failure.	Low sulphur diesel fuels can have poor lubricity depending on the refinery process. Kerosene also has poor lubricity and addition of kerosene to diesel will lower the lubricity.
Parameters currently excluded	Cloud point & Cold Filter Plugging point (CFPP)	As outlined in AS3570 -1998	Def: Cloud point is a temperature at which wax crystals start to form and the fuel becomes cloudy. If cooled further the Cold Filter Plugging Point is reached in which these wax crystals block fuel filters and interrupt fuel supply. Adequate cold flow performance is important criteria for fuel quality in cooler regions.	Specified cloud points are produced using average minimum temperature. Unseasonal cold snaps and extreme events are not covered.
	Appearance @ 20°C	Clean and Bright	Appearance is a quick (and reliable) indicator of water or dirt contamination in the fuel. Water can result in higher corrosion and promote bacterial growth; these contaminants can result in filter blockage. Filter blockage causes a change in fuel supply resulting in improper injector flow and therefore improper combustion leading to excessive emissions. Hazy fuels also carry water through the filters into the sensitive injectors and fuel pumps where they cause serious damage	Hazy fuels indicate poor fuel management practice, fungal growth and lack of water draining

[6] QLD: Summer Monthly Average RVP: Summer 2001/2002: 76 KPa; Summer 2002/2003: 67 KPa
[7] Australia: Polyaromatic hydrocarbons (PAHs): 11% m/m (max) by 1 Jan 2006
[8] Australia: Sulphur: 50 ppm (max) by 1 Jan 2006
[9] Australia: Distillation 95 % Recovered: 360°C (max) 1 Jan 2006
[10] Australia: Density: 820 to 850 kg/m3 by 1 Jan 2006