Update on Fuel Quality Standards

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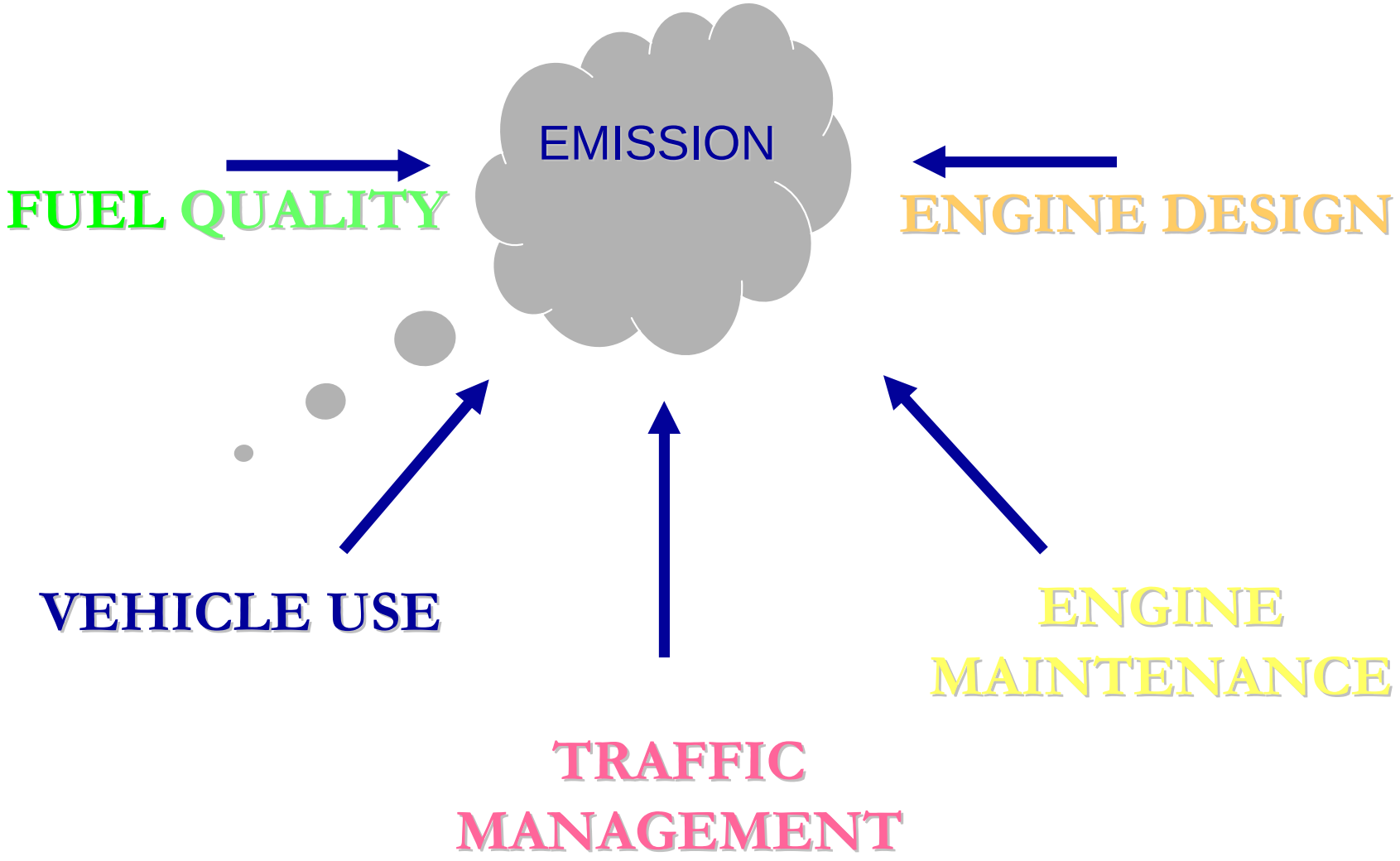
OUTLINE

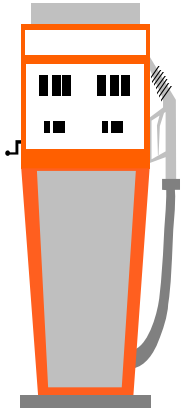
- **Mandate for Cleaner Fuel**
- Roadmap for Fuel Quality Improvement
  - Standards (PNS)
  - Enforcements
- Government Thrust/Plans
  - Research and Policy Development
  - Linkages

Factors Contributing to Pollution



Fuel and Vehicle Emissions

FUEL **VEHICLE** **EMISSION**



DOE **DOTC / LTO / MMDA / DTI / DOST** **DENR**

Cleaner Air Fuel Quality Mandate

RA 8749 - Clean Air Act of 1999

- set the specifications for all types of fuel and fuel-related products (Sec.26)
- set every two (2) years or thereafter or as the need arises, the specification of ULG and diesels shall be reviewed and revised (Sec. 26)

RA 9367 - Biofuels Act of 2006

- establish technical fuel quality standards for biofuels and biofuel-blended gasoline and diesel which comply with the PNS (Sec. 7c)

RA 8479 - Downstream Oil Industry Deregulation Act

- ensure a truly competitive market for petroleum products under a regime of fair price, adequate and continuous supply of environmentally, clean and high quality petroleum products

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Pre-Clean Air Act
Fuel Quality Standard

A. Gasoline

PROPERTY	1990	1993	1994	1998
Hydrocarbons:				
Alcohols (C_2 to C_4), % vol., max.			10	10
Aromatics, % vol., max.			55	45
Benzene, % vol., max.			5	4
Ethers (e.g. MTBE), % vol., max.			10	10
Lead Content, g/L, max.	**0.84**	**0.15**	**0.15/0.013**	**0.15/0.013**
Octane rating, min.				
Research Octane Number (RON)	81/93	81/93	81/93	81/93
Motor Octane Number (MON)				Report
Anti-Knock Index (AKI)				87.5
Vapor Pressure, @ 37.80C, kPa, max.	**85**	**85**	**85**	**85/80**
Sulfur, % mass, max.		**0.20**	**0.10**	**0.10**

Phase out lead in gasoline 9 mos. ahead of sked - MM

Pre Clean Air Act

RP Unleaded Program

- PNS 1990 – Reduction of lead in gasoline started as early as 1990
- Clean Air Pact of 1993 – Commitments of leaders of the petroleum industry and government agencies to pursue a comprehensive program of reducing the lead content of gasoline with end view of eventually totally eradicating the use of lead and introducing ULG and substantially reducing other pollutants in the gasoline and diesel fuel production.
- PNS 1119:1993 – urgent implementation of reduced lead gasoline from 0.6 gm/L to 0.15 gm/L in view of the MOA known as the Clean Air Pact of 1993
- PNS 1131:1994 – introduction of ULG environmental objective of eliminating pollutants to safeguard the health of the people.
- February 14, 1994 – Launching of ULG nationwide
- Sept 26, 1997 – Issuance of EO No. 446 mandating the phase-out of leaded gasoline not later than Jan. 2000 in metro manila and Jan. 1, 2001
- PNS 1131:1998 – Reduction of Aromatics, Benzene and Vapor Pressure
- June 23, 1999 - Signed into law the Republic Act No. 8749 known as Clean Air Act of 1999
- Dec. 23, 2000 – implemented the lead phase out

Clean Air Act
Fuel Quality Specifications

Unleaded Gasoline		
Aromatics	45% max	Jan. 1, 2000
Benzene	4% max	Jan. 1, 2000
AKI	87.5 min	Jan. 1, 2001
RVP	9 psi max	Jan. 1, 2001
Aromatics	35% max	Jan. 1, 2003
Benzene	2% max	Jan. 1, 2003
Automotive Diesel		
Sulfur	0.2% max	Jan. 1, 2001
Cetane No./Index	48 min	Jan. 1, 2001
Sulfur	0.05% max	Jan. 1, 2004
Industrial Diesel		
Sulfur	0.3% max	Jan. 1, 2001

Clean Air Act

Fuel Quality Standards Setting

Pre-Clean Air Act

BPS TC-12 (Technical Committee on Petroleum Products & Lubricants)

Clean Air Act

DOE-TCPPA Technical Committee on Petroleum Products & Additives)

Chairs	:	**DOE and DENR**
Members		
Government	:	**DOE, DENR, BPS-DTI, ITDI-DOST**
Fuel Sector	:	**Petron, Shell, Chevron, IPPCA**
Engine Suppliers/Manufacturers	:	**CAMPI, AMMDA, MDPPA**
Consumer Sector / NGO	:	**FilCar Foundation, AWMA**
Academe	:	**UP-NCTS, AIPSI**

The TCPPA follows standards development/review procedure of the Phil. Bureau of Product Standards which promulgates the Phil. National Standards (PNS)

Clean Air Act
Fuel Quality Standard

COMPLETED

Gasoline

- **PNS 1131:2000 - ULG complying to CAA for 2000 specs**
- **PNS 1131:2001 - Multigrade ULG complying 2001 specs**
- **PNS 1131:2002 - ULG complying to CAA 2003**
- **PNS/DOE QS 001:2005 - ULG Motor Gasoline update of 2002**

Diesel

- **PNS 20:2000 - Diesel complying to CAA for 2001 specs**
- **PNS/DOE QS 004:2003 - Diesel complying to CAA for 2004 specs**

On-Going

- **DPNS/DOE QS 001:2009 - ULG Motor Gasoline update of 2005**

Clean Air Act
Fuel Quality Standard

Gasoline

PROPERTY	CLEAN AIR ACT			POST CLEAN AIR ACT	
	2000	2001 [a]	2003	2005	2009 [c]
Hydrocarbons:					
Alcohols (C_2 to C_4), % vol., max.	10	10	10	10 [b]	1 [b]
Aromatics, % vol., max.	45	45	35	35	35
Benzene, % vol., max.	4	4	2	2	2
Ethers (e.g. MTBE), % vol., max.	10	10	10	2	2
Lead Content, g/L, max.	0.013	0.013	0.013	0.005	0.005
Octane rating, min.					
Research Octane Number (RON)	81/93	81/87/93/95	81/87/93/95	81/93/95	81/93/95
Anti-Knock Index (AKI)	87.5	87.5	87.5	87.5	87.5
Vapor Pressure, @ 37.80C, kPa (psi), max.	85/62	85/62	85/62	85/62	85/62
Sulfur, % mass, max.	0.10	0.10	0.10	0.05	0.05

[a] multi-grade gasoline [b] ethanol [c] DPNS

Fuel Quality Standard

Other products

- **PNS/DOE QS 003:2003 – Two-stroke (2T) Lubricating Oil (considering vegetable basestocks)**
- **PNS/DOE QS 005:2005 – LPG/ Auto LPG**
- **PNS/DOE QS 006:2005 – Fuel Oil (Bunkers)**
- **PNS/DOE QS 009:2007 - Kerosene**

Petroleum Products Facility Standard Setting

- **BPS TC 68** "Technical Committee on Petroleum Processes and Facilities (TCPPF)"

- **DOE-TCPPF by virtue of MOA between DOE-OIMB and DTI-BPS**

Chairs	:	**DOE**
Members		
Government	:	**DOE-OIMB, DENR-EMB, DTI-BPS, DILG-BFP, DOLE (BWC, OSHC)**
Testing	:	**DOST-MIRDC**
Industry	:	**Petron, Caltex, Shell, Total, IPPCA (Seaoil, TWA)**
Prof. Association	:	**SOPI**

*****TWG's assist mother TC in the drafts formulation/deliberation***

Petroleum Product Facility Standard

COMPLETED PNS:

- Retail Outlets
  - ✓ PNS/DOE FS 1-1:2005 – Health, Safety and Environment
  - ✓ PNS/DOE FS 1-2:2005 – Underground Storage Tank
  - ✓ PNS/DOE FS 1-3:2005 – Piping System
  - ✓ PNS/DOE FS 1-2:2005 – Dispensing Pumps
- PNS/DOE FS 2:2006 – LPG Refilling Plant
- PNS/DOE FS 3:2006 – Auto-LPG Dispensing Stations
- PNS/DOE FS 4:2007 – LPP Depot

ON-GOING :

- DPNS/DOE FS ___:2006 – Portable Liquid Petroleum Product Containers
- DPNS/DOE FS ____:2007 – Storing and Handling of CME and CME-Diesel Blends at LPP Depots

Biofuels Act

biodiesel

Coconut

- 2007 mandate - 1% biodiesel blend
- 2009 mandate - 2% biodiesel blend

bioethanol

Sugarcane

- 2007 – voluntary sales of E-10
- 2009 mandate – ethanol blend (per PNS) to comprise 5% of the annual gasoline sales starting February 2009.
- 2011 mandate – 10% ethanol blend on all gasoline

Biofuels Act
Fuel Quality Standard (PNS)

BIODIESEL (B100)

- **PNS 2020:2003 – Coconut Methyl ESTER (B100)**

- **PNS/DOE QS 002:2007 - Fatty Acid Methyl Ester (B100)**

  - ✓ 96.5% FAME
  - ✓ 0.40% mass, min., Methyl Laurate (C12 ME)
  - ✓ JAMA / EN 14214 specs (oxidation stability, glycerides, group metals density, methanol, water)

BIODIESEL BLEND

- **PNS/DOE QS 004:2007 - FAME-blended diesel oils (B1)**
  - ✓ 0.7-1.2 % FAME
  - ✓ 0.40% mass, min., Methyl Laurate (C12 ME)

- **PNS/DOE QS 004:2009 - FAME-blended diesel oils (B2)**
  - ✓ 1.7-2.2 % FAME
  - ✓ 0.80% mass, min., Methyl Laurate (C12 ME)

Biofuels Act
Fuel Quality Standards

A. B100 (CME)

PROPERTY	2003	2007
Appearance		clear
Acid number, mg KOH/g, max.	0.50	0.50
Carbon residue on 100% sample, % mass, max.	0.050	0.050
Cetane number, min.	42	55
Cloud point, ^{O}C, max.	Report	5
Copper strip corrosion 3 hrs @ 50^{O}C, max.	No. 3	No. 1
Density @ 15^{O}C, kg/L		0.86-0.90
Distillation AET 90% recovered, ^{O}C, max	360	360
FAME content, % m/m, min.		96.5
Flash point, Pensky-martens ^{O}C min.	100.0	100
Glycerin, % mass, max.		
Free glycerin, % mass, max.	0.02	0.02
Total glycerin, % mass, max.	0.24	0.24
Glyceride content, % m/m, max.		
Monoglyceride content		0.80
Diglyceride content		0.20
Triglyceride content		0.20
Group Metals, mg/kg, max.		
Group I metals (Na + K)		5
Group II metals (Ca + Mg)		5
Methanol content, % m/m, max.		0.20
Methyl Laurate, % mass, min.		45
Oxidation Stability, 110 ^{0}C, hours, min.		6
Phosphorus, % mass, max.	0.001	0.001
Sulfated ash, % mass, max.	0.020	0.020
Sulfur, % mass, max.	0.050	0.050
Viscosity, kinematic @ 40 ^{O}C, mm^{2}/s	2.0 - 4.5	2.0 – 4.5
Water, % vol. max.		0.05
Water & sediments, % vol. max.	0.050	0.05

Biofuels Act
Fuel Quality Standards

B. FAME-Blended Diesel Oils

PROPERTY	2007		2009	
	ADO	IDO	ADO	IDO
Calculated cetane index, min . or Cetane number, min. or Derived cetane number, min	50		50	
Carbon residue on 10% Distillation residue, % mass, max.	0.15	0.35	0.15	0.35
Color, ASTM	2.5 max.	5.0 min	2.5 max.	5.0 min
Copper strip corrosion, 3 h at 50 ^{0}C, max.	No. 1	No. 1	No. 1	No. 1
Density at 15 ^{0}C, kg/L	0.820-0.860	0.880 max.	0.820-0.860	0.880 max.
Distillation, 90% recovered, ^{0}C, max	370	Report	370	Report
FAME [a], content, % volume.	0.7-1.2	0.7-1.2	1.7-2.2	1.7-2.2
Flash point, Pensky-Martens, ^{0}C, min.	55	55	55	55
Kinematic viscosity, mm^2/s at 40^{0}C	2.0-4.5	1.7-5.5	2.0-4.5	1.7-5.5
Lubricity, (HRFF), wear scar dia. @ 60 ^{0}C, micron, max.	460		460	
Methyl Laurate (C12 ME), % mass, min	0.40	0.40	0.8	0.8
Sulfur, % mass, max.	0.05	0.30	0.05	0.30
Water, % volume, max. [b]	0.05		0.05	
Water and sediment, % volume, max.	0.10	0.1	0.10	0.10

The standards also provide minimum specification for base diesel.

Biofuels Act
Fuel Quality Standard

BIOETHANOL (E100)

- PNS/DOE QS 007:2005 for Anhydrous Bioethanol Fuel

  - ✓ Bioethanol (99.3% purity)
  - ✓ Fuel Bioethanol (96.9% purity, denatured)

BIOETHANOL BLEND

- PNS/DOE QS 008:2006 for E-Gasoline (E-10)
  - ✓ 9.5 – 10 % fuel bioethanol
  - ✓ 3.5% oxygen content, max.

- PNS/DOE QS 008:2008 for E-Gasoline (multigrade)
  - ✓ E10 (RON 93) & E10 (RON95)
  - ✓ 9.0 – 10 % fuel bioethanol

Biofuels Act
Fuel Quality Standards

A. E100

Property	Bio-ethanol	Fuel bio-ethanol
Appearance	Clear and bright, visibly free of suspended or precipitated contaminants	Clear and bright, visibly free of suspended or precipitated contaminants
Acidity / Alkalinity, pHe	6.5 – 9.0	6.5 – 9.0
Color		Dark Violet
Copper, as Cu, mg/kg, max.	0.1	0.1
Density @ 20 ^{0}C, kg/L, max.	0.7915	
Ethanol content, % v/v, min.	99.3	96.9
Denaturant*, % v/v, max.		1.96 – 2.44 **
Inorganic chloride content, mass ppm, max.	40	40
Methanol, % v/v, max.	0.5	0.5
Total acids (as acetic acid), % w/w, max.	0.007	0.007
Water content, %v/v, max.	0.5	0.5
*Only ULG per PNS is allowed ** 2% v/v at the point of denaturing		

Biofuels Act
Fuel Quality Standards

B. E10

Property	2007	2009	
	Premium	Premium	Premium Plus
Color	Violet	Violet	Violet
Copper corrosion, 3 hr @ 50 °C, max.	1	1	1
Density at 15 °C, kg/L	0.725 – 0.783	0.725 – 0.783	0.725 – 0.783
Distillation temperature, °C, at: 10% recovered, max. 50% recovered 90% recovered, max. End point, max. Residue, % volume, max	 70 70-110 180 215 2	 70 70-110 180 215 2	 70 70-110 180 215 2
Existent Gum, mg/100 mL, max.	4	4	4
Hydrocarbons [a]: Aromatics, % volume, max. Benzene, % volume, max. Ethanol (C2) [b], % volume	 35 2 9.5 – 10	 35 2 9,0 – 10	 35 2 9.0-10
Lead content, (not added) [c], g/L, max.	0.005	0.005	0.005
Octane rating, min. Research Octane Number (RON) Anti-knock index (AKI) [d]	 93 87.5	 93 87.5	 95
Oxygen content, % mass, max. [e]	3.5		
Sulfur, % mass, max.	0.05	0.05	0.05
Vapor pressure at 37.8 °C, kPa (psi), max.	62 (9)	62 (9)	62 (9)
Water content, % v/v, max.	0.1	0.1	0.1
The standards also provide minimum reference specifications for base gasoline.			

Fuel Quality Standards Development

On-going and Target Formulations

- **BIOETHANOL**
  - ✓ E-20 and E-85
  - ✓ Hydrous bioethanol
- **BIODIESEL**
  - ✓ B3/B5
  - ✓ B100 for Jatropha Methyl Ester
  - ✓ Generic B100
- **BUNKER and Emulsified FUEL**
- **EURO IV specs**

Enforcements

DOE - OIMB

- Monitoring
  - → **Fuel quality/quantity** ***(RA 8479 / RA 9367)***
  - **refining/marketing process, inventory, price** ***(RA 8479)***
- Additives Registration ***(RA 8479 / RA 8749)***
- Fuel Quality Standard Setting ***(RA 8749 / RA 9367)***
- Petroleum Facilities Standard Setting ***(MOA with BPS)***
- Regulate as necessary ***(RA7638)***

DOE - EUMB ***(RA 9367)***

- Accreditation Biofuels Manufacture
- Monitoring of Biofuels Manufacture/Marketing

DOE-ERTLS conducts testing of samples, DOE-Legal processes violations

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Research and Development

Biofuels Performance Testing Program

- **Vehicle Testing Facility**

  Assess performance of biofuels:

  - ✓ Test Protocol development
  - ✓ Baseline: gasoline/diesel fuel
    - 1% CME, 2% CME
    - 1% JME, 2% JME
    - CME + JME
    - 5% bioethanol
  - ✓ Higher blends (10% bioethanol, 5% CME/JME
  - ✓ Biofuels from alternative feedstocks

- **Analytical Testing**
  - ✓ Biofuel handling – storage, stability, etc.

- **Vehicle performance Tests**
  - ✓ Validation study
  - ✓ Engine performance
  - ✓ Emission assessments
  - ✓ Engine component study

Source: DOST

Harmonization of Standards

Fuel Quality

- Conventional
- Alternative fuels

Facilities

- Gasoline stations
- LPG vehicles, parts / conversion kits
- Terminals
- Control equipment (correlation)

Codes of Practice

- LPG Vehicle Conversion
- Retail Operation
- Bulk Storage, Handling & Distribution

Benefits of harmonized biofuels quality standard

- Align readily local fuel standards to the WWFC vis-à-vis local emission regulations
- General biodiesel standard and its blends vis-à-vis emerging vehicle technologies
- Facilitate trade across borders ensuring supply availability

Linkages
Biodiesel Standard (B100)

Items	Units	U.S. ASTM D6751-07b	EU EN14214:2003	Japan JIS K2390:2008	EAS-ERIA BDF Standard (EEBS):2008
Ester content	mass%	-	96.5 min.	96.5 min.	96.5 min.
Density	kg/m3	-	860-900	860-900	860-900
Viscosity	mm2/s	1.9-6.0	3.50-5.00	3.50-5.00	2.00-5.00
Flashpoint	deg. C	93 min.	120 min.	120 min.	100 min.
Sulfur content	mass%	0.0015 max.	0.0010 max.	0.0010 max.	0.0010 max.
Distillation, T90	deg. C	360 max.	-	-	-
Carbon residue (100%) or Carbon residue (10%)	mass%	0.05 max. -	- 0.30 max.	- 0.3 max.	0.05 max. 0.3 max.
Cetane number		47 min.	51.0 min.	51.0 min.	51.0 min.
Sulfated ash	mass%	0.02 max.	0.02 max.	0.02 max.	0.02 max.
Water content	mg/kg	0.05[vol%] max.	500 max.	500 max.	500 max.
Total contamination	mg/kg	-	24 max.	24 max.	24 max.
Copper corrosion		No.3	Class-1	Class-1	Class-1
Acid value	mgKOH/g	0.50 max.	0.50 max.	0.50 max.	0.50 max.
Oxidation stability	hrs.	3 min.	6.0 min.	(**)	10.0 min. (****)
Iodine value		-	120 max.	120 max.	Reported (***)
Methyl Linolenate	mass%	-	12.0 max.	12.0 max.	12.0 max.
Polyunsaturated FAME (more than 4 double bonds)	mass%	-	1 max.	N.D.	N.D. (***)
Methanol content	mass%	0.2 max. (*)	0.20 max.	0.20 max.	0.20 max.
Monoglyceride content	mass%	-	0.80 max.	0.80 max.	0.80 max.
Diglyceride content	mass%	-	0.20 max.	0.20 max.	0.20 max.
Triglyceride content	mass%	-	0.20 max.	0.20 max.	0.20 max.
Free glycerol content	mass%	0.020 max.	0.02 max.	0.02 max.	0.02 max.
Total glycerol content	mass%	0.240 max.	0.25 max.	0.25 max.	0.25 max.
Na+K	mg/kg	5 max.	5.0 max.	5.0 max.	5.0 max.
Ca+Mg	mg/kg	5 max.	5.0 max.	5.0 max.	5.0 max.
Phosphorous content	mg/kg	10 max.	10.0 max.	10.0 max.	10.0 max.

(****) Need more data & discussion from 6 to 10 hrs.

Fuel Quality Standards Development

CAA

Biofuels Act of 2006

Clean Fuel Initiatives (WWFC)

Fuel Quality Regional Harmonization (WP 29 & Vehicle Harmonization)

Alternative Fuels / Energy Security & Sufficiency

Review & Formulate Standards Technical Committee on Petroleum Products & Additives (TCPPA)		Monitoring: Sampling & Testing
Int'l Fuel Quality Standards	Emission Stds/ Regulations	Field/On-site testing
R & D on Fuel Specification	Vehicle Technology Dev't.	Laboratory testing
Dev't in Fuel Additives	IRR for Standards	Local Supply and Demand

Multi-lateral bodies: ADB, JICA, JETRO etc.	Inter-agency Cooperation: DOE, DTI, BPS, DENR-EMB, DOTC DOF, BIR, BOC, TC, DOST, etc.	Others: Industry – Oil/Car NGO's, Academe

Issues & Concerns

- ✓ Price
- ✓ Supply Availability
- ✓ Investment Requirement And Climate
- ✓ Compatibility Of Fuel With Vehicle
- ✓ Fuel Quality Vs. Emission Standards
- ✓ Monitoring
- ✓ Local Research Facility

Thank you!