Guidelines toward High Biodiesel Blend Diesel (eg B20) Specification in the APEC Region, Honolulu, Hawaii, USA. 19 March 2018

STATUS OF BIODIESEL IMPLEMENTATION IN MALAYSIA AND BIODIESEL SPECIFICATIONS

Harrison Lau Lik Nang, PhD
Group Leader of MPOB Biodiesel Working Group
Group Leader of Biodiesel Technology

Malaysian Palm Oil Board (MPOB)

Ministry of Plantation Industries and Commodities

Incorporated through Act of Parliament

MPOB

1 May 2000

R&D

Pioneering research and development, providing scientific and technological infrastructure

Enforcement & Licensing

To enhance the well-being of the Malaysian oil palm industry through research, development and excellent services & enforcement

PORIM **PORLA**

Renewable Energy Policy

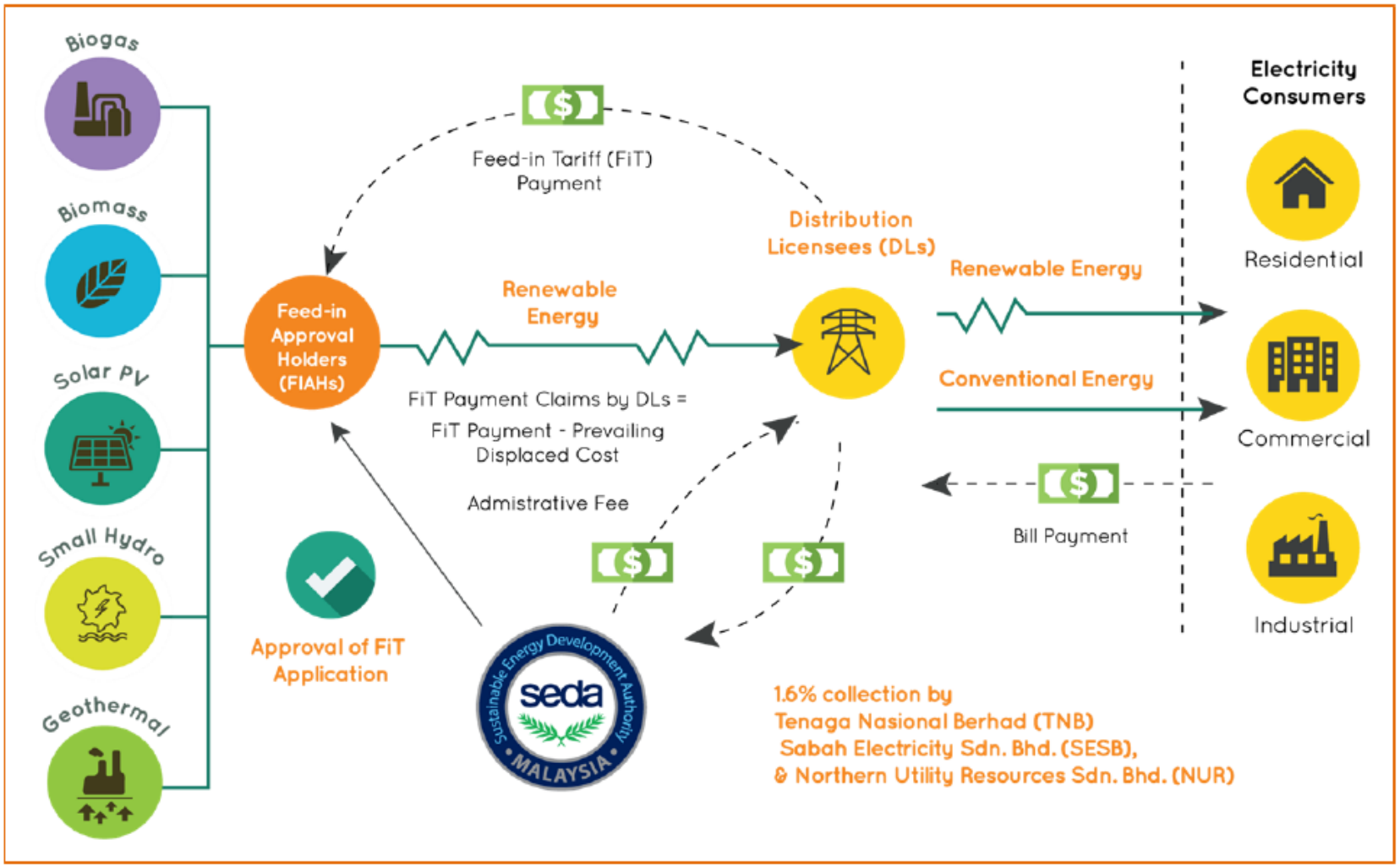
- National Renewable Energy Policy and Action Plan (2009)

- Naitonal Biofuel Policy (2006)

Renewable Energy Development in Malaysia

8th Malaysia Plan (2001 - 2005)	• RE introduced as the **5th Fuel** • Implied 5% RE in energy mix
9th Malaysia Plan (2006 – 2010)	• Small Renewable Energy Programme **(SREP)** • Government approved the **National RE Policy & Action Plan (NREPAP)** (Oct. 2010)
10th Malaysia Plan (2011-2015)	• Enactment of **RE Act 2011** & SEDA Act 2011 (27 & 28 April 2011) • Implementation of **Feed-in Tariff (FiT)** • 2015: Energy mix 43% coal, 40% gas, 14% large hydro, 2% RE, 1% oil
11th Malaysia Plan (2016-2020)	• Target RE (FiT) capacity of 2,080 MW • Implementation of **Large-Scale Solar (LSS)** programme • Implementation of **Net Energy Metering (NEM)** scheme

Feed-in Tariff Scheme (FiT)



National RE Policy Action Plan 2010 - targets

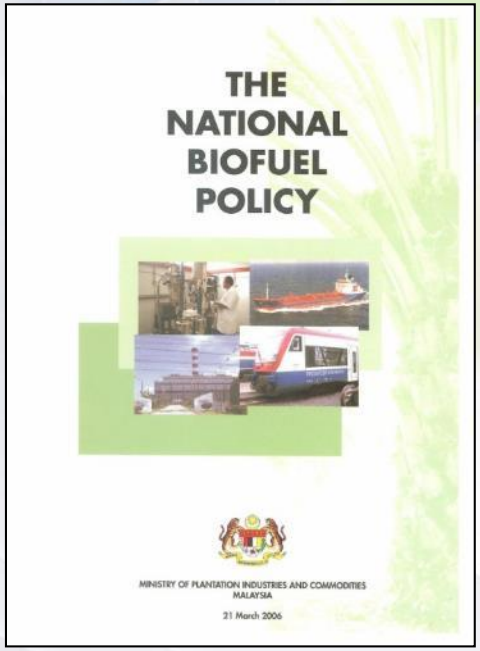
Year	Cumulative RE Capacity	RE Power Mix (vs Peak Demand)	Cumulative CO_2 avoided
2015	985 MW	5.5%	11.1 mt
2020	2,080 MW	11%	42.2 mt
2030	4,000 MW	17%	145.1 mt

Note; Target is based on FiT (levy imposed on 1.6% of electricity) users. It is being revised, to include other initiatives.

Source: SEDA

National Biofuel Policy

The National Biofuel Policy launched in March 2006.



Five (5) strategic thrusts :-

Thrust 1: Biofuel for Transport

Thrust 2: Biofuel for Industry

Thrust 3: Biofuel Technologies

Thrust 4: Biofuel for Export

Thrust 5: Biofuel for Cleaner Environment

Biodiesel in Malaysia

- Lab scale R&D – 1982
- Pilot plant built and commissioned – 1985
- Produces palm biodiesel for engine testing and market seeding
- Preliminary Field Trial (July 1984 – May 1985) : 8 taxis
- Exhaustive Field Trial (Phase I): 1986- 1989 : 31 diesel engines of different makes
- Exhaustive Field Trial (Phase II): 1990 – 1994: 36 buses
- Fully established palm biodiesel as diesel substitute in 1995

MPOB Palm Biodiesel Pilot Plant (3,000 TPA)

Palm Biodiesel and Phytonutrients Plants Built using MPOB Technologies

(A) Biodiesel Plants in Malaysia – 8 plants

Normal Grade Palm Biodiesel Plant (Pour Point 12 to 18 deg. C)

Johor, Malaysia (2006)

Selangor, Malaysia (2008)

Johor, Malaysia (2008)

Selangor, Malaysia (2009)

Sarawak, Malaysia (2014)

Winter Grade Palm Biodiesel Plant (Pour Point 0 to -21 deg. C)

Johor, Malaysia (2006)

Selangor, Malaysia (2007)

Selangor, Malaysia (2008)

(B) Biodiesel Plants Overseas – 4 plants

Normal Grade Palm Biodiesel Plant (Pour Point 12 to 18 deg. C)

South Korea (2007)

Thailand (2008)

Thailand (2015)

Colombia (2015)

(C) Phytonutrients Plants in Malaysia – 2 plants

Johor, Malaysia (2009)

Sarawak, Malaysia (2016)

Beginning of biodiesel industry: Launching of The World First Integrated Palm Biodiesel Plant (15 August 2005)

The government funded the construction of biodiesel In-line blending facilities at all petroleum depots in Malaysia (2011-2015)

Unloading area

Inline blending system

PME storage tanks

Biodiesel discharge pumps

Biodiesel Mandates in Malaysia

Implementation Date	% of Blending	State Involved	Sector
June – October 2011	B5	Putrajaya, Selangor, Kuala Lumpur, Negeri Sembilan and Melaka	Transportation and other subsidised sector
July 2013	B5	Johor	
October 2013	B5	Penang, Kedah, Perak and Perlis	
January 2014	B5	Pahang, Kelantan and Terengganu	
November – December 2014	B7	Whole Peninsular Malaysia	
January 2015	B7	Nationwide (Including Sarawak, Sabah and Labuan)	

Malaysian Biodiesel Plants and Capacity (2017)

Status	No. of Plants	Biodiesel Production Capacity (Tonnes/Year)
Commercial Production*	22	2,678,000
Not in commercial production**	9	675,740
Total	**31**	**3,353,740**

Note:

* On / off production.

** Biodiesel plants which have completed but yet to commence production, and also includes those licensees in other stages and still valid under the Biofuel Industry Act, MPIC.

Malaysian Biodiesel
(Production, Exports and Export Earnings)

Year	Biodiesel Production (Tonnes)	Biodiesel Exports (Tonnes)	Biodiesel Export Earnings (RM Million)
June - Dec 2006	54,981	47,986	120.89
2007	129,706	95,013	253.20
2008	171,555	182,108	610.70
2009	222,217	227,457	605.75
2010	117,173	89,609	266.53
2011	173,220	49,999	179.72
2012	249,213	28,983	98.44
2013	472,129	175,032	502.61
2014	602,334	87,356	257.37
2015	673,532	178,942	483.57
2016	500,833	83,581	247.70
2017	720,410	235,291	777.66

Malaysian Biodiesel Industry Capacity Utilization (2017)

No.	Subjects	
1.	No. of plants in operation	16
2.	Total production capacity (tonnes/year)	2,060,000
3.	Total biodiesel production in 2017 (tonnes)	720,410
4.	Biodiesel production capacity utilisation (%)	35

Note :

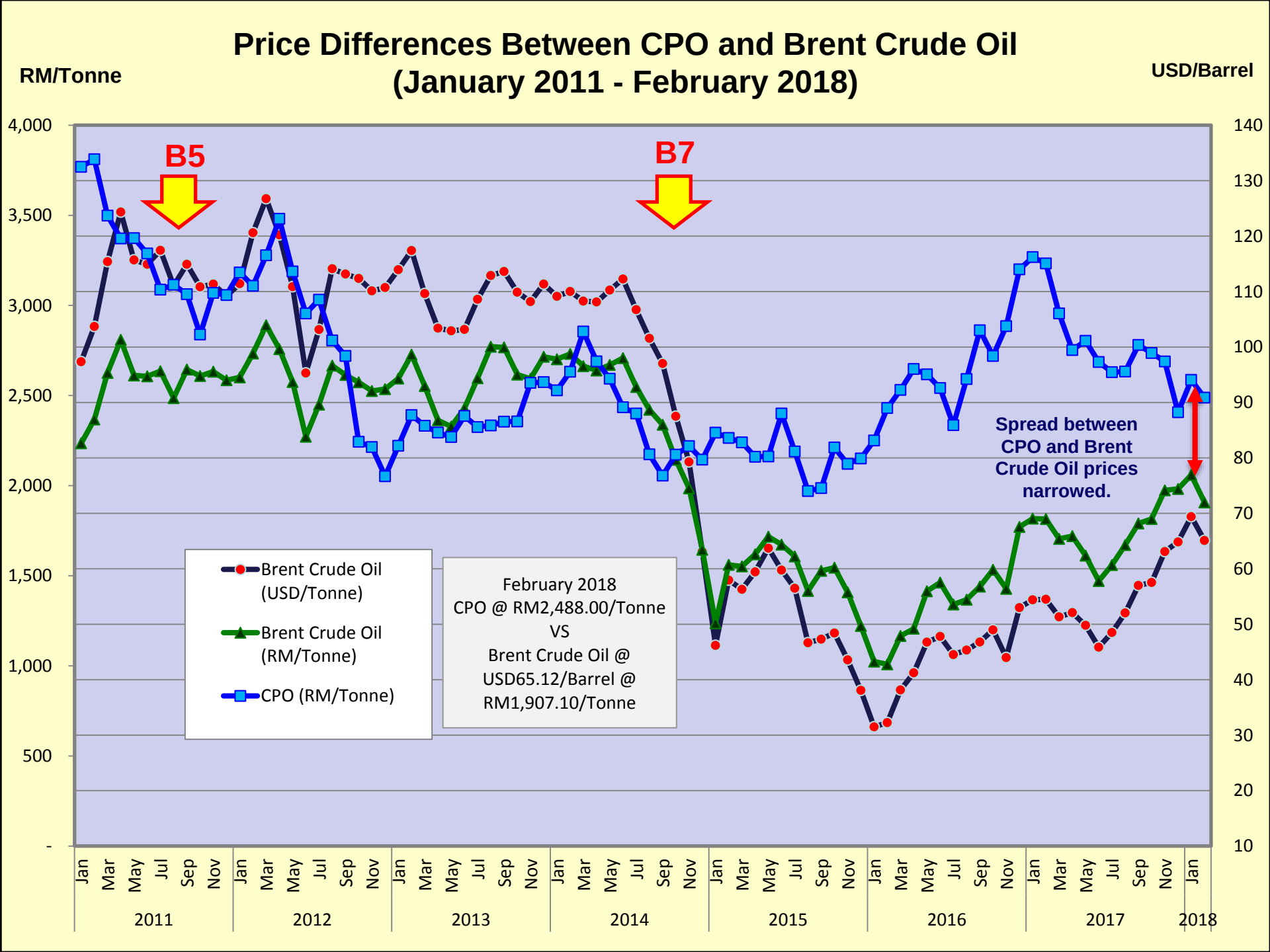
- Total no. of established biodiesel plants as end December 2017 was 31 (3.35 mil. tonnes/year of production capacity).

Cabinet Decision on Implementation of B10 for Transportation Sector (June 2016)

- Exemption for retail stations at highlands to continue supplying B7
- Exemption for Euro 5 diesel to be blended with 7% biodiesel

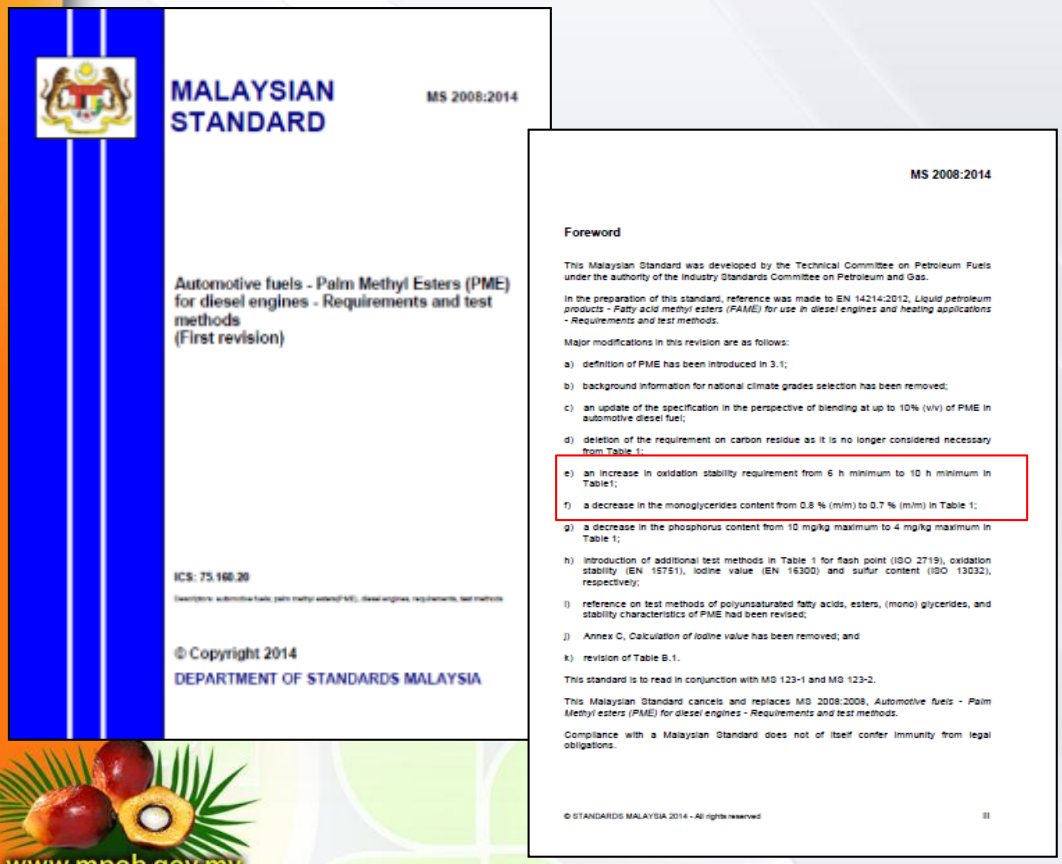
Currently there are about 10% of retail stations in Malaysia are selling both Euro 2M (B7) and Euro 5 diesel (B7).

Price Differences Between CPO and Brent Crude Oil (January 2011 - February 2018)



Malaysian Standard of Palm Methyl Ester (MS 2008)

- The first national PME standard published in 2008
- Developed based on EN 14214
- Adopted both ASTM and EN / ISO standard as test methods
- 1st revision published in 2014



MALAYSIAN STANDARD

MS 2008:2014

Automotive fuels - Palm Methyl Esters (PME) for diesel engines - Requirements and test methods
(First revision)

ICS: 75.160.20

DEPARTMENT OF STANDARDS MALAYSIA

Foreword

This Malaysian Standard was developed by the Technical Committee on Petroleum Fuels under the authority of the Industry Standards Committee on Petroleum and Gas.

In the preparation of this standard, reference was made to EN 14214:2012, *Liquid petroleum products - Fatty acid methyl esters (FAME) for use in diesel engines and heating applications - Requirements and test methods.*

Major modifications in this revision are as follows:

a) definition of PME has been introduced in 3.1;

b) background information for national climate grades selection has been removed;

c) an update of the specification in the perspective of blending at up to 10% (v/v) of PME in automotive diesel fuel;

d) deletion of the requirement on carbon residue as it is no longer considered necessary from Table 1;

e) an increase in oxidation stability requirement from 6 h minimum to 10 h minimum in Table1;

f) a decrease in the monoglycerides content from 0.8 % (m/m) to 0.7 % (m/m) in Table 1;

g) a decrease in the phosphorus content from 10 mg/kg maximum to 4 mg/kg maximum in Table 1;

h) introduction of additional test methods in Table 1 for flash point (ISO 2719), oxidation stability (EN 15751), iodine value (EN 16300) and sulfur content (ISO 13032), respectively;

i) reference on test methods of polyunsaturated fatty acids, esters, (mono) glycerides, and stability characteristics of PME had been revised;

j) Annex C, *Calculation of iodine value* has been removed; and

k) revision of Table B.1.

This standard is to read in conjunction with MS 123-1 and MS 123-2.

This Malaysian Standard cancels and replaces MS 2008:2008, *Automotive fuels - Palm Methyl esters (PME) for diesel engines - Requirements and test methods.*

Compliance with a Malaysian Standard does not of itself confer immunity from legal obligations.

Major modification in this revision is as follows:

- Deletion of the requirement on carbon residue
- An increase in oxidation stability requirement from 6 h minimum to 10 h minimum
- A decrease in the monoglycerides content from 0.8 % (m/m) to 0.7 % (m/m)
- A decrease in phosphorus content from 10ppm to 4 ppm

MS 2008:2014

Property	Unit	Limits		Test methods[a]
		Minimum	Maximum	
FAME content	% (m/m)	96.5[b]	-	EN 14103
Density at 15 °C[c]	kg/m³	860	900	ISO 3675[d] ISO 12185 ASTM D 4052 ASTM D 1298
Viscosity at 40 °C	mm²/s	3.50	5.00	ISO 3104[d] ASTM D 445
Flash point[e]	°C	120	-	ISO 2719[d] ISO 3679[f] ASTM D 93
Sulfur content	mg/kg	-	10.0	ISO 20846[d] ISO 20884 ISO 13032 ASTM D 5453
Cetane number[e,g]		51.0	-	ISO 5165[d] ASTM D 613 ASTM D 6890
Sulfated ash content	% (m/m)	-	0.02	ISO 3987[d] ASTM D 874
Water content	mg/kg	-	500	ISO 12937[d] ASTM E 203 ASTM D 6304
Total contamination	mg/kg	-	24	EN 12662[h]
Copper strip corrosion (3 h at 50 °C)	rating	Class 1		ISO 2160[d] ASTM D 130
Oxidation stability, 110 °C	hours	10.0	-	EN 14112[d] EN 15751
Acid value	mg KOH/g	-	0.50	EN 14104[d] ASTM D 664
Iodine value	g iodine/ 100 g	-	110	EN 14111[d] EN 16300
Linolenic acid methyl ester	% (m/m)	-	12.0	EN 14103
Polyunsaturated (≥4 double bonds) methyl esters	% (m/m)	-	1	EN 15779
Methanol content	% (m/m)	-	0.20	EN 14110
Monoglyceride content	% (m/m)	-	0.70	EN 14105[d] ASTM D 6584

MS 2008:2014

Property	Unit	Limits		Test methods[a]
		Minimum	Maximum	
Diglyceride content	% (m/m)	-	0.20	EN 14105[d] ASTM D 6584
Triglyceride content	% (m/m)	-	0.20	EN 14105[d] ASTM D 6584
Free glycerol	% (m/m)	-	0.02	EN 14105[d] EN 14106 ASTM D 6584
Total glycerol	% (m/m)	-	0.25	EN 14105[d] ASTM D 6584
Group I metal (Na + K) [f]	mg/kg	-	5.0	EN 14108[d] EN 14109 EN 14538
Group II metals (Ca + Mg)	mg/kg		5.0	EN 14538
Phosphorus content	mg/kg	-	4.0	EN 14107[d] ASTM D 4951
CFPP	°C	-	15	EN 116

[a] See 6.4.1

[b] The addition of non-PME components other than additives is not allowed, see 6.2.

[c] Density may be measured by ISO 3675 over a range of temperatures from 20 °C to 60 °C. Temperature correction shall be made according to the formula given in Annex C.

[d] See 6.4.2.

[e] See Annex B for precision data.

[f] A 2 ml sample and apparatus equipped with a thermal detection device shall be used.

[g] See 6.4.3.

[h] This test method developed for diesel fuel may show analytical problem when applied to PME. A more suitable test method in under development by CEN.

MS 123:2014 – Standard Revision on Diesel Fuel Part 1: Euro2M

MALAYSIAN STANDARD

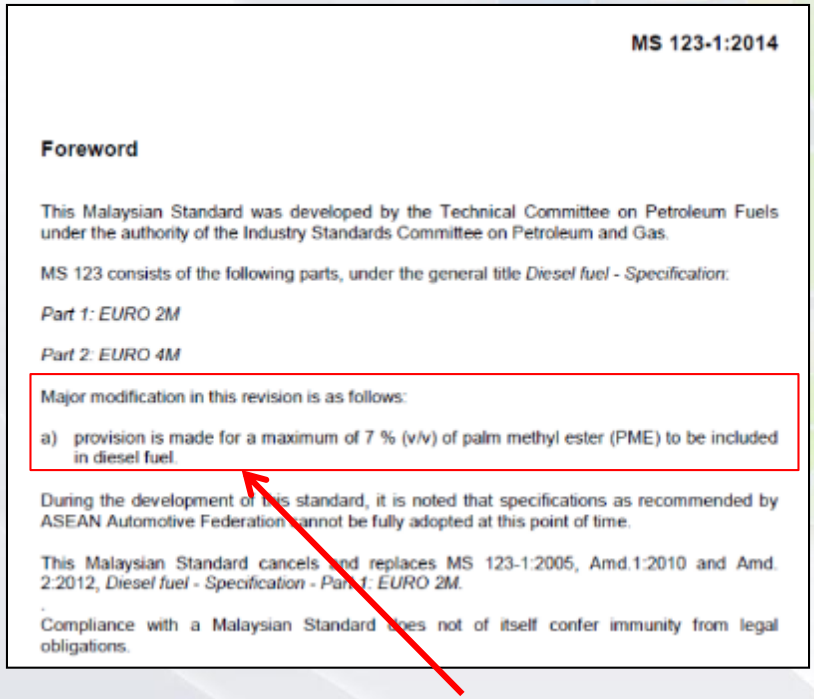
MS 123-1:2014

Diesel fuel - Specification - Part 1: Euro 2M
(Fourth revision)

ICS: 75.080

Descriptors: diesel, EURO 2M, specifications, test method

DEPARTMENT OF STANDARDS MALAYSIA



Foreword

This Malaysian Standard was developed by the Technical Committee on Petroleum Fuels under the authority of the Industry Standards Committee on Petroleum and Gas.

MS 123 consists of the following parts, under the general title *Diesel fuel - Specification*:

Part 1: EURO 2M

Part 2: EURO 4M

Major modification in this revision is as follows:

a) provision is made for a maximum of 7 % (v/v) of palm methyl ester (PME) to be included in diesel fuel.

During the development of this standard, it is noted that specifications as recommended by ASEAN Automotive Federation cannot be fully adopted at this point of time.

This Malaysian Standard cancels and replaces MS 123-1:2005, Amd.1:2010 and Amd. 2:2012, *Diesel fuel - Specification - Part 1: EURO 2M*.

Compliance with a Malaysian Standard does not of itself confer immunity from legal obligations.

Major modification in this revision is as follows:

a) provision is made for a maximum of 7 % (v/v) of palm methyl ester (PME) to be included in diesel fuel.

MS123:2014 (Part 1)

Table 1. General requirements for diesel fuel

Properties	Minimum	Maximum	Referee test method
Colour (ASTM)	-	2.5	ASTM D1500
Ash, mass %	-	0.01	ASTM D482
Cloud point, °C	-	19.0	ASTM D2500
Flash point, °C	60	-	ASTM D93
Kinematic viscosity at 40 °C, mm^2/s	1.5	5.8	ASTM D445
Copper corrosion (3 h at 100 °C)	-	1	ASTM D130
Water by distillation, vol %	-	0.05	ASTM D95
Sediment by extraction, mass %	-	0.01	ASTM D473
Carbon residue on 10 % bottoms, mass %	-	0.20	ASTM D189
Density at 15 °C, kg/L	0.810	0.870	ASTM D1298
Acid number, mg KOH/g	-	0.25	ASTM D664
Electrical conductivity, pS/m	50	-	ASTM D2624
Cetane index or Cetane number	49 49	- -	ASTM D976 ASTM D613
Physical distillation at 95 % recovered volume, °C or Simulated distillation at 95 % recovered mass, °C	- -	370 399	ASTM D86 ASTM D2887
Lubricity, µm	-	460	ASTM D6079
Total sulphur, mg/kg	-	500	ASTM D2622

NOTES:

1. No intentional additions of metallic additives are allowed.

2. Other test methods as specified in Annex B for determining the properties may be used, provided that they have been demonstrated to give the same degree of accuracy as the test methods listed. In the event of a dispute, the test method listed in this table is to be the referee method.

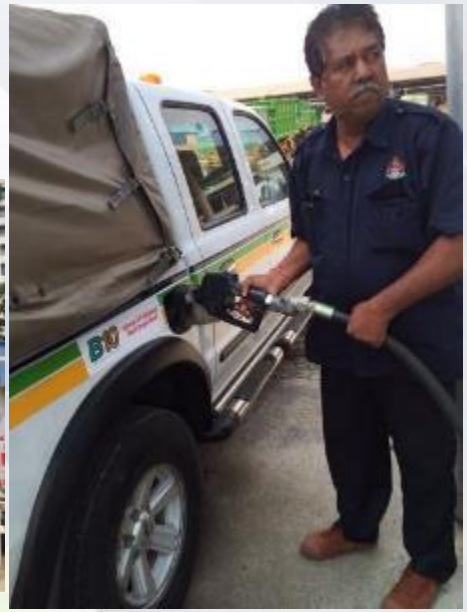
3. A suitable method for the separation and identification of Fatty acid methyl ester (FAME) is given in EN 14331.

MPOB B10/B20 Trial Projects

B10 Peugeot Car

B10 & B20 MPOB Vehicles

B10 with Alam Flora



B10 for DBKL vehicles

Transfer of skid tank to Alam Flora Transfer station, Taman Beringin for the use of extension B10 trial project for 10 trucks


NISSAN


WXK
3673

B10 / B20 MPOB Vehicles (since 2013): Breakdown of brand of vehicles in B10 Project

Model	Type	No. of Vehicles	Engine Maker
Mitsubishi	4 wheel drive	5	Japan
Ford	4 wheel drive	3	USA
Toyota	4 wheel drive	9	Japan
Hyundai	4 wheel drive	1	Japan
Ssangyong	4 wheel drive	1	Korea
Mercedes Benz	Passenger	1	Germany
Peugeot	Passenger	5	Germany
Mazda 6 (2017)	Passenger	1	Japan
Total		26	

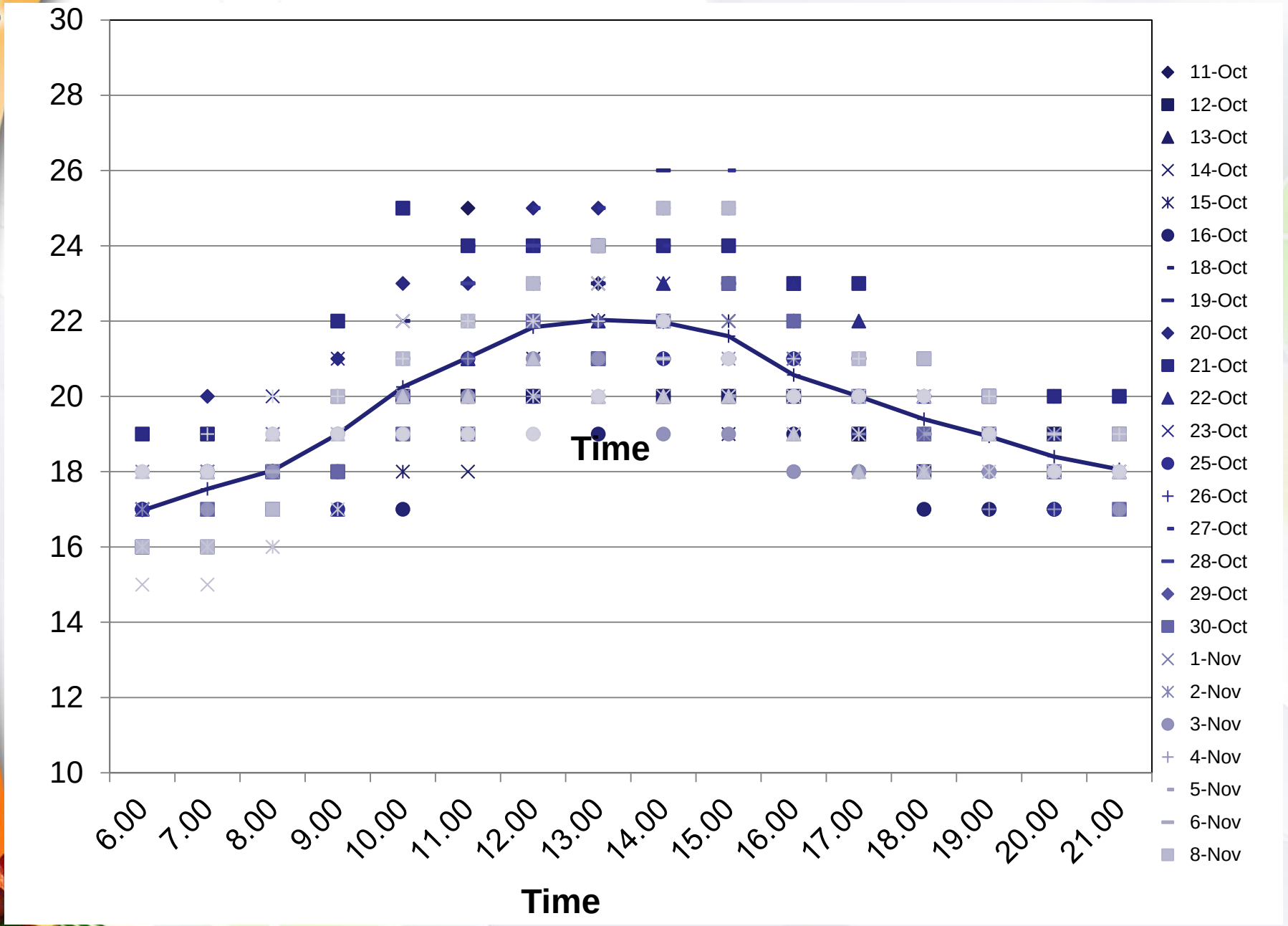
List of 50 KL City Hall Diesel Vehicles Involved in B10 Programme (2014)

No.	Registration No	Type of Vehicles	Model
1	WWT2270	Excavator & Backhoe, Wheeled	Case 580N
2	WWS8562	Tractor Shovel, Wheeled	Komatsu WA200-5
3	WSD0371	Excavator, Wheeled	Hitachi ZX210W-3
4	WSR7809	Excavator & Backhoe, Wheeled	Case 580M
5	WSN3014	Tractor Shovel, Wheeled	Komatsu WA250-3A
6	WRV4893	Excavator & Backhoe, Wheeled	JCB 3CX
7	WPY9079	Tractor Shovel, Wheeled	TCM L20-3
8	WJM9072	Tractor Shovel, Wheeled	Dressta 515C
9	WRF7421	Transporter (Vehicle Carrier)	Hicom MTB170UV
10	WWJ1787	Flatbottom Lorry with Taillift	Hino GD1JLPA
11	WRP4169	Tipper, End with High Side	Hino GD1JLPA
12	WRN7045	Flatbottom Lorry with Taillift	Nissan LKC214N
13	WRK3697	Tipper, End with High Side	Hino GD1JLPA
14	WRG6221	Patching Lorry	Nissan LKC214N
15	WPA9372	Tipper, End with High Side	Nissan LKA211N
16	WMT2813	Tipper, End with High Side	Nissan LKA211N
17	WMT3847	Tipper, End with High Side	Nissan LKA211N
18	WKT4002	Tipper, 3-way 5-ton	Isuzu FSR33H
19	WKN4023	Tipper, End with High Side	Nissan LKA211N
20	WKC2762	Flatbottom Lorry, 2.5 ton with Taillift	Hicom Perkasa MTB150DX
21	WKA3235	Tipper, End 5 ton with Crane	Isuzu FSR33L
22	WJX7265	Tipper, 3-way 5-ton	Nissan LKA211N
23	WJF1941	Tipper, 3-way 5-ton	Nissan LKA211N
24	WJD4302	Tipper, 3-way 5-ton	Nissan LKA211N
25	WHX7665	Tipper, 3-way 5-ton	Nissan LKA211N
26	WHT4136	Tipper, End 5 ton	Nissan LKA211N
27	WND8796	Aerial Platform	Hicom Perkasa MTB170UV
28	WSL3715	Aerial Platform	Nissan-Bizzocchi Autel NU41H5/187HP 18.0M
29	WSL3708	Aerial Platform	Nissan-Bizzocchi Autel NU41H5/187HP 18.0M
30	WSK4209	Tanker, Water	Nissan LKC214N(UBS)
31	WQX5295	Tanker, Water	Nissan LKC214N(UBS)
32	WNT1074	Tanker, Water	Nissan LKA211N
33	WMU6791	Tanker, Water	Isuzu FSR33H
34	WKH8583	Recovery Truck	Volvo FM10 6x2
35	WNG0180	Tow Truck with Axle Lift	Nissan NU41H5
36	WVX8040	Pick-up Truck with Crew Cab	Nissan Frontier
37	WPP8657	Pick-up Truck with Crew Cab	Ford Ranger UT5L
38	WPP8659	Pick-up Truck with Crew Cab	Ford Ranger UT5L
39	WNP1847	Pick-up Truck with Crew Cab	Ford Ranger UT5K FM1
40	WNP1866	Pick-up Truck with Crew Cab	Ford Ranger UT5K FM1
41	WMP6511	Pick-up Truck	Toyota Hilux Single Cab (M)
42	WML8253	Pick-up Truck with Crew Cab	Mazda B2500
43	WLJ5425	Pick-up Truck with Crew Cab	Isuzu Rodeo TFS 55HDRP
44	WXK3642	Pick-up Truck with Crew Cab	Nissan Frontier
45	WXK3673	Pick-up Truck	Nissan Navara
46	WXK3764	Pick-up Truck	Nissan Navara
47	WPM3004	Van	Kia Pregio
48	WRG4055	OKU Van	Weststar LDV Maxus 2.5
49	WKN7910	Tractor Shovel, Wheeled	TCM L20
50	WYC5958	Flatbottom Lorry 3 ton with Taillift	Nissan NU41T5

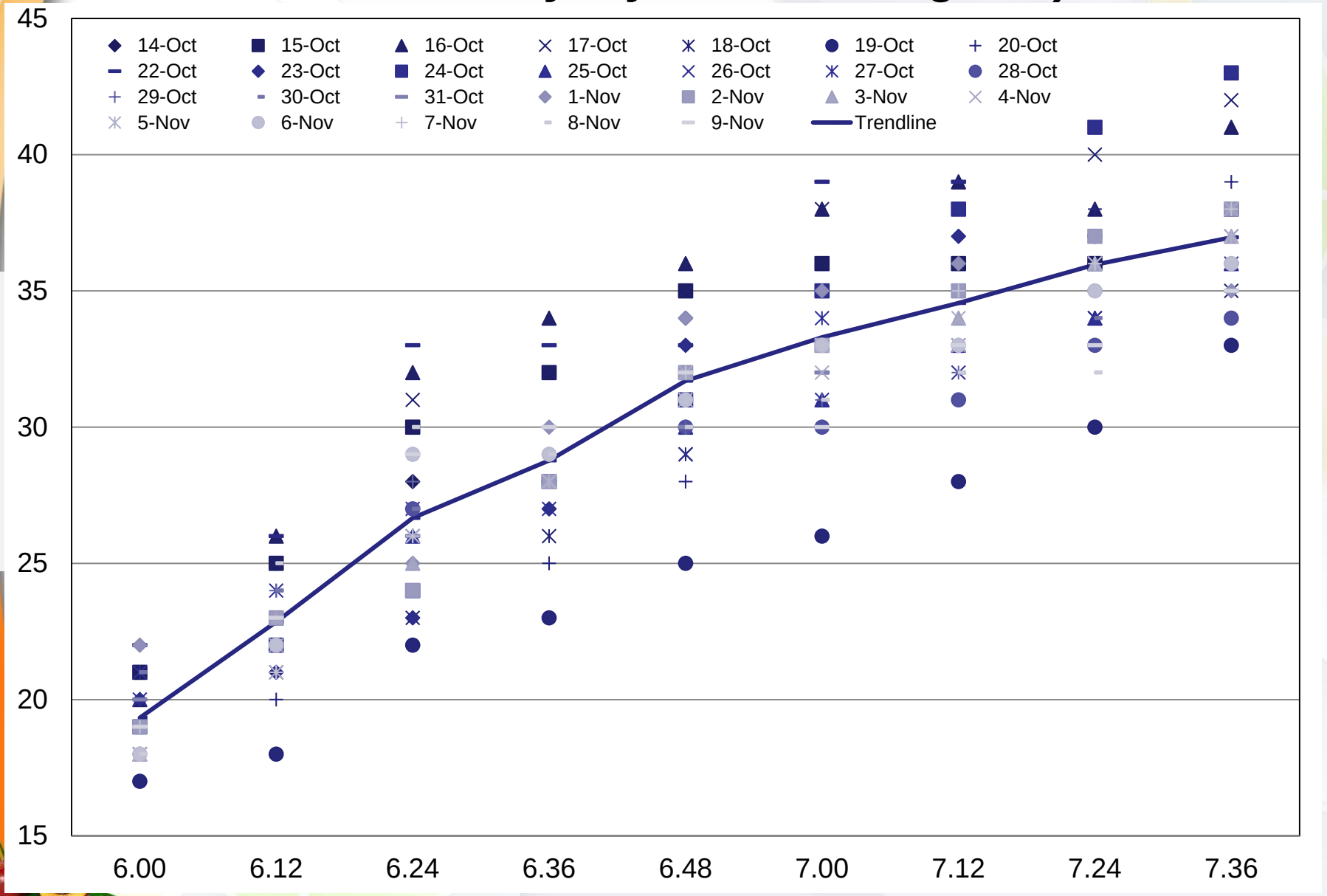
Vehicle idling and drivability test at Malaysia highlands using B10

- Conducted one month B10 test at Cameron Highlands in Oct 2016
- Vehicle used was Peugeot 508 GT with a 2.2L Euro5 specification
- Everyday 6 am, vehicle started and driven for 50km around Cameron Highland. Once completed, vehicle will be parked at designated outdoor parking overnight
- For every 10 km travelled, B10 fuel sample will be taken at fuel line before the fuel filter. Fuel temperature will be measured
- Vehicle overnight idling test for 3 days were also conducted

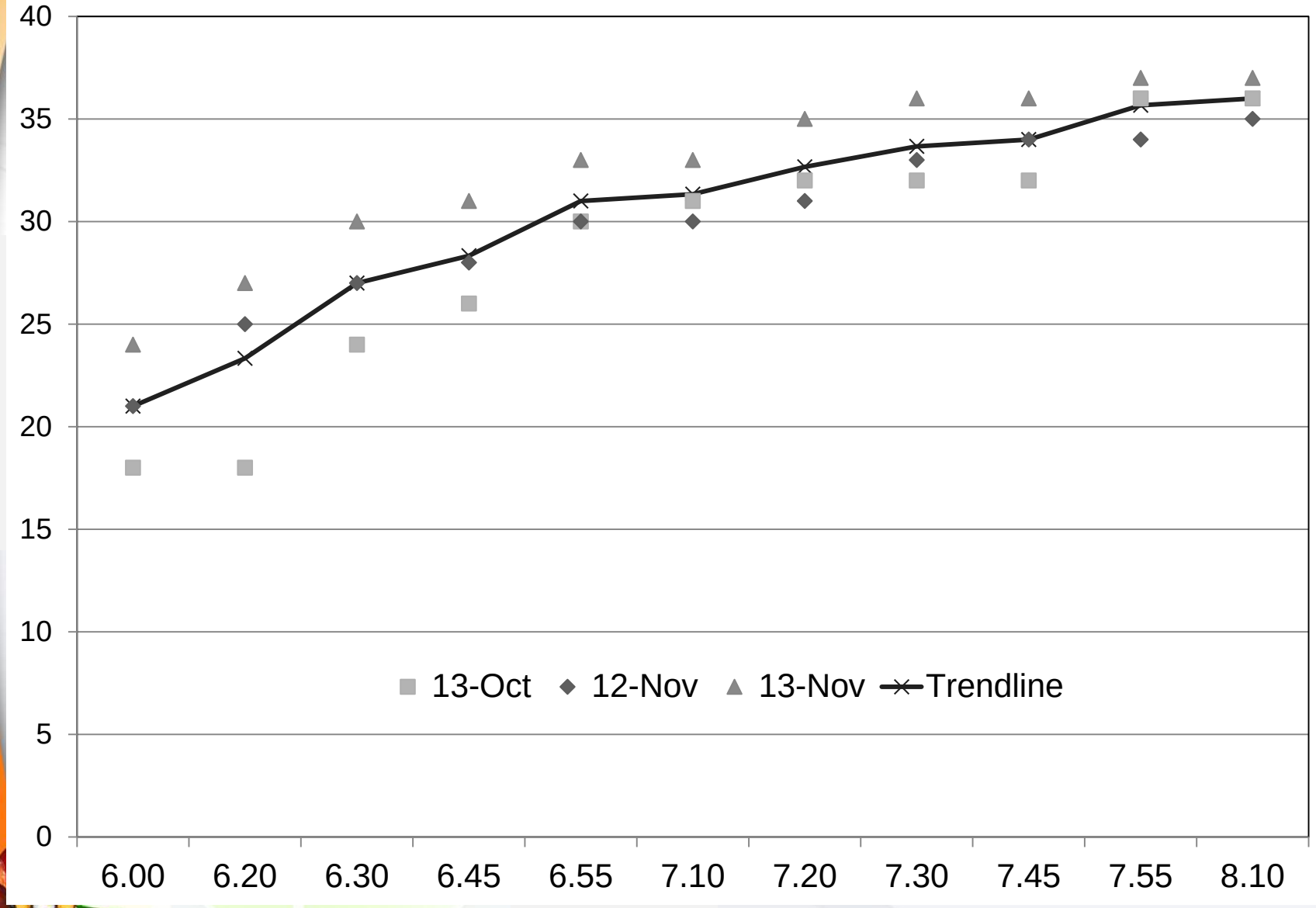
Ambient Temperature at Cameron Highlands



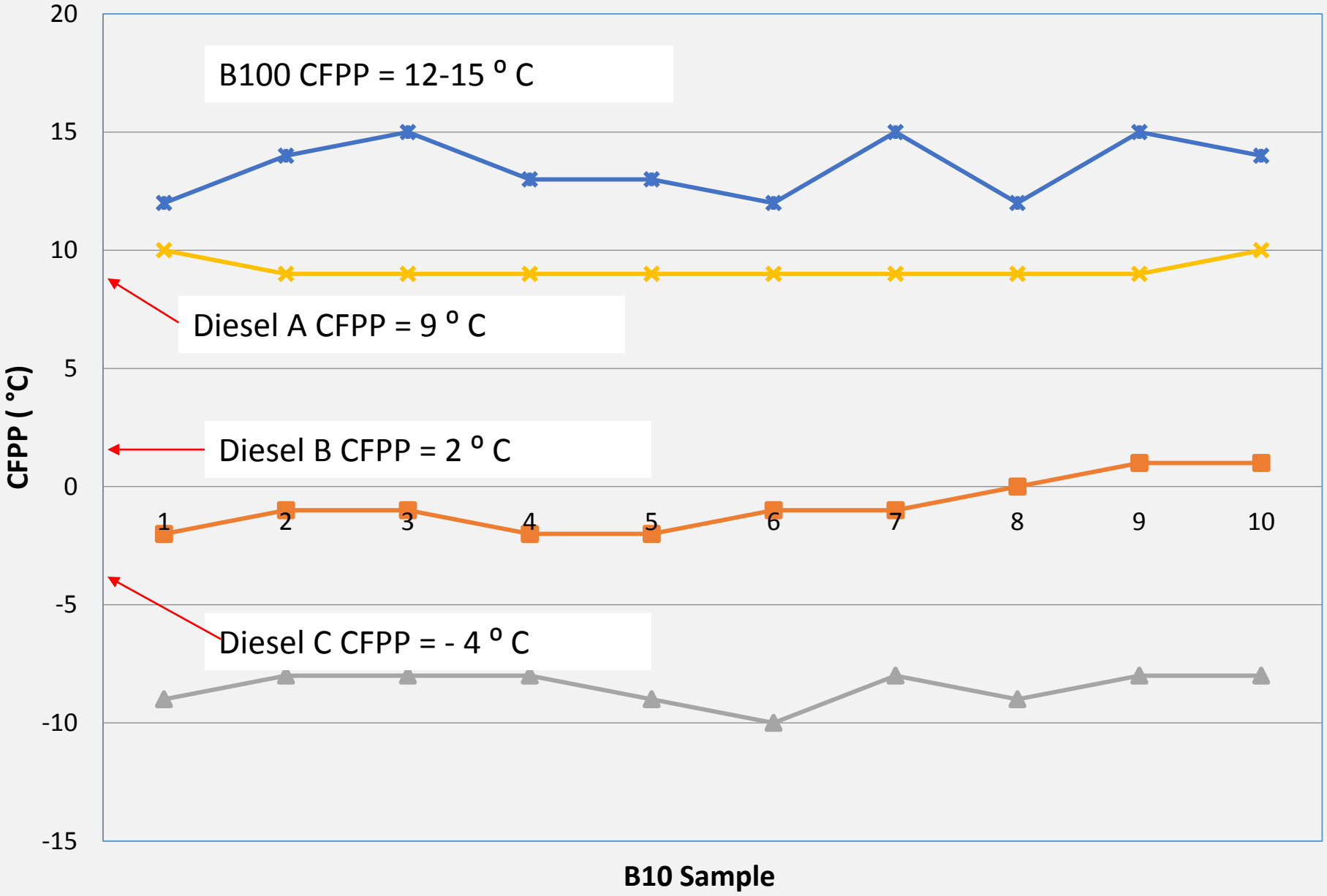
B10 Fuel Temperature vs Time (Soaking overnight and everyday 50km driving test)



B10 Fuel Tempeture vs Time (Overnight Vehicle Idling Test – 2 hours engine operation)



Effect on CFPP of blended fuel vs diesel



Findings

- The vehicle had no problem starting throughout the whole duration of the test
- The lowest ambient temperature recorded was 16°C (6am)
- The lowest fuel temperature recorded was 17°C
- Fuel temperature increased by 2°C after driving for 10 minutes (4 – 7km)
- The highest fuel temperature recorded after driving 50km was 43°C
- The highest ambient temperature recorded was 26°C (2 – 3pm)
- CFPP of diesel should be a good indicator for determining cold temperature operability of biodiesel blended fuel up to B10

Conclusion

- Malaysian government is committed to implement high blend of biodiesel as greener fuel in the future.
- Short term goal is to implement B15 in 2020 as stipulated in the 11th Malaysian Plan.
- Joint research with JAMA and local universities using high biodiesel blends are in progress.

Thank you

Email: harrison@mpob.gov.my