



SAE 2009 On-Board Diagnostics Symposium

Update on Light and Heavy Duty Vehicle

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GLOBAL OBD LEGISLATION UPDATE (WORLDWIDE REQUIREMENTS)

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OVERVIEW

- History of On-Board Diagnostics (OBD) Requirements
- California ARB, US EPA, and Europe
- Concerns about Worldwide OBD Requirements
- Status of Requirements for Other Regions / Countries*:
 - North America: Canada and Mexico
 - South America: Argentina, Brazil
 - Middle East: Israel
 - Asia: China, Hong Kong, India, Japan, S. Korea, Singapore, Thailand, Taiwan
 - Australia and New Zealand
- World Wide Harmonization

* Some second hand information has not been verified by presenter

HISTORY of OBD

- California required OBD I by 1991 model year
- California and US EPA required OBD II by 1996 model year
- European OBD (EOBD) phased-in 2000 – 2005
- Since 2000, many other countries have added OBD requirements

CALIFORNIA AIR RESOURCES BOARD (CARB)

- Light / Medium-duty (up to 14,000 lbs gross vehicle weight)
 - All emission control components, e.g.,
 - Catalyst, O2 sensor, EGR, AIR, fuel system, misfire, PCV, etc.
 - Stringent OBD thresholds, e.g., 1.5 times emission standards
 - Evap system integrity (must detect 0.040/0.020 inch leaks)
 - Electrical components: malfunctions that “affect” emissions
 - In Use monitor Performance Ratios (monitoring frequency)
 - Revisions adopted September, 2006
 - Permanent fault codes, fuel system cylinder imbalance, many requirements for Diesels
 - Revisions adopted May 28, 2009
 - Delayed primary O2 sensor asymmetric delay by one year
 - Monitor thermostat / cooling system for temperature drop


CALIFORNIA AIR RESOURCES BOARD (CARB)

- Heavy-duty (above 14,000 lbs gross vehicle weight)
 - Engine Mfr. Diagnostics required starting 2007 (very basic)
 - Stringent OBD required starting 2010 MY (similar to LD/MD)
 - In Use monitor Performance Ratios (monitoring frequency)
 - More stringent requirements & enforcement starting 2013 MY
 - Most recent revisions adopted May 28, 2009
- Service Information must be available on web site

US – EPA

- Light-duty
 - Required OBD since 1996 model year
 - Similar to California requirements
 - Will accept California OBD systems / approval
- Heavy-duty
 - Final rule published February 24, 2009
 - Similar to California requirements, but less stringent
 - Applies starting 2010 MY
 - More stringent requirements starting 2013 MY
 - Must demonstrate that California OBD system meets requirements
- Service Information must be available on web site

EUROPEAN OBD (EOBD) – Light-Duty Euro 4

- Similar to US EPA / California requirements, except:
 - Evap hardware requirements rather than evap system diagnostic (evap diagnostic meets requirement)
 - Require ISO Malfunction Indicator (engine symbol) – 
 - Fixed OBD thresholds on European Type I emission test
 - Minor electrical components need not be monitored unless exceed threshold (more cost effective than CARB OBD II)
 - Thresholds, etc., are revised with EU5/6 (see following slides)
- US EPA / CARB OBD systems are likely to meet EOBD requirements but are not automatically accepted

European OBD for Euro 5 and 6

OBD Implementation dates (M1/N1 light vehicles)

Euro 5: New types, September 1, 2009, All registrations **January 1, 2011**

Euro 5+: New types, September 1, 2011, All registrations **January 1, 2014**

Euro 6: New types, September 1, 2014, All registrations **September 1, 2015**

For voluntary certification of diesel engines according to Euro 6 in advance of its mandatory enforcement, “Euro 6-” shall be applied.

Gasoline engines shall only be type-approved to Euro 6 emission standards once new OBD thresholds have been introduced.

NOx Catalyst Monitor

NOx catalyst monitor is required beginning with Euro 5+

Rear Oxygen Sensor

Requirement to monitor all oxygen sensors which are used for catalyst diagnostics beginning with Euro 5. (makes requirement explicit)

SCR Exhaust Aftertreatment System

System to monitor incorrect reagent quality, reagent consumption, or alternatively have monitoring of NOx emissions

Failures to be stored as non-erasable PID for at least 800 days or 30 000 km of vehicle operation

Malfunctions in the reagent dosing system attributed to technical failures are also subject to OBD requirements.

European OBD for Euro 5 and 6

Particulate emissions:

Particulate fault thresholds apply to direct injection gasoline vehicles beginning with Euro 5.

-> If manufacturer shows that the 50 mg/km level is not reached no monitoring is required

EGR:

EGR flow monitoring required for Diesels beginning with Euro 5.

In-use monitoring rate counters (performance ratios):

Requirement to introduce rate counters beginning with Euro 5+ (wide range of monitors?)

Ratio requirement 0,100 for Euro 5+ and Euro 6-

Full ratio requirements apply from Euro 6

Generic Scan Tool communication:

CAN communication required for Euro 6 vehicles.

-> Same requirements as for CARB OBDII

European OBD for Euro 5 and 6

Fuel requirements

EOBD-regulation applies also to bi-fuel and flex-fuel vehicles from Euro 5.

-Type approval test to be performed on gasoline (E5)/natural gas, gasoline/hydrogen, gasoline/LPG, gasoline/E85 as applicable

-The fuel type is also part of the engine family designation, which means that flex-fuel vehicles can not be type approved in the same family as a gasoline-only vehicle.

-Allowed monitoring disablement after switching of fuel: Bi-fuel 5 s, flex-fuel 1 minute. There is also a provision that allows for extended times if the manufacturer can argue for the need.

Access to Vehicle Repair Information

-Vehicle manufacturers shall make available repair **and** maintenance information through their own web-sites.

-This information shall include all diagnostic tool functions and all the links to repair information and troubleshooting instructions.

-The access to this information may be subject to the payment of a reasonable fee.

Euro 5 OBD Thresholds

		Reference mass (RW) (kg)	Mass of carbon monoxide		Mass of non-methane hydrocarbons		Mass of oxides of nitrogen		Mass of particulates	
			(CO) (mg/km)		(NMHC) (mg/km)		(NOx) (mg/km)		(PM) (mg/km)	
Category	Class		PI	CI	PI	CI	PI	CI	PI ⁽¹⁾	CI ⁽²⁾
M	---	All	1900	1900	250	320	300	540	50	50
N ₁ ⁽³⁾	I	RW ≤ 1305	1900	1900	250	320	300	540	50	50
	II	1305 < RW ≤ 1760	3400	2400	330	360	375	405	50	50
	III	1760 < RW	4300	2800	400	400	410	840	50	50
N ₂	-	All	4300	2800	400	400	410	840	50	50

Key: PI = Positive Ignition, CI = Compression Ignition

(1) Positive ignition particulate mass standards apply only to vehicles with direct injection engines

(2) Until the dates set out in Article 17 a PM threshold limit of 80 mg/km shall apply to vehicles of categories M and N with a reference mass greater than 1760 kg

(3) Includes M1 vehicles that meet the 'special social needs' definition of Regulation (EC) No 715/2007

Euro 6 interim OBD thresholds, diesel only

For tax incentive purposes, it will be possible to certify diesel engines according to Euro 6 standards before the mandatory dates using these interim thresholds. Gasoline engines shall only be type-approved to Euro 6 emission standards once new OBD thresholds have been introduced.

		Reference mass (RW) (kg)	Mass of carbon monoxide (CO) (mg/km)	Mass of non-methane hydrocarbons (NMHC) (mg/km)	Mass of oxides of nitrogen (NOx) (mg/km)	Mass of particulates (PM) (mg/km)
Category	Class		CI	CI	CI	CI
M	---	All	1900	320	240	50
N ₁	I	$RW \leq 1305$	1900	320	240	50
	II	$1305 < RW \leq 1760$	2400	360	315	50
	III	$1760 < RW$	2800	400	375	50
N ₂	-	All	2800	400	375	50

Key: CI = Compression Ignition

Euro 6 thresholds

A first concept for Euro 6 OBD thresholds was issued July 19, 2008, and is intended to be reviewed before September 1, 2010.

		Reference mass (RW) (kg)	Mass of carbon monoxide		Mass of non-methane hydrocarbons		Mass of oxides of nitrogen		Mass of particulates		Number of particulates	
			(CO) (mg/km)		(NMHC) (mg/km)		(NOx) (mg/km)		(PM) (mg/km)		(P) (#/km)	
Category	Class		PI	CI	PI	CI	PI	CI	PI ⁽¹⁾	CI	PI ⁽²⁾	CI
M	---	All	1500	750	100	140	90	140	9	9		1.2 X 10 ¹²
N ₁	I	RW ≤ 1305	1500	750	100	140	90	140	9	9		1.2 X 10 ¹²
	II	1305 < RW ≤ 1760	2700	940	130	140	110	180	9	9		1.2 X 10 ¹²
	III	1760 < RW	3400	1100	160	140	120	220	9	9		1.2 X 10 ¹²
N ₂	-	All	3400	1100	160	140	120	220	9	9		1.2 X 10 ¹²

Key: PI = Positive Ignition, CI = Compression Ignition

- (1) Positive ignition particulate mass standards apply only to vehicles with direct injection engines
- (2) X 2 threshold to be considered once emission limit is set

EUROPEAN OBD (EOBD) – Heavy-Duty

- Stage 1:
 - Applies to diesel
 - Starting 01OCT2005 new types / 01OCT2006 all types (Euro IV)
 - Monitor for major functional failure (no emission thresholds)
 - Catalyst, deNOx system, DPF, or combinations of these
- Stage 1 with NOx Control:
 - Applies to diesel
 - Starting 01OCT2006 new types / 01OCT2007 all types (Euro IV)
 - Add emission thresholds for deNOx and EGR systems
 - Requires NOx sensor or equivalent technology
 - Torque limiters required for defined deNOx system failures

EUROPEAN OBD (EOBD) – Heavy-Duty (continued)

- Stage 2:
 - Applies to diesel and gas
 - Starting 01OCT2008 new types / 01OCT2009 all types (Euro V)
 - Specified emission thresholds
 - Requires NOx sensor or equivalent technology
 - Torque limiters required for defined deNOx system failures
- Proposal for World Wide Harmonized HD OBD:
 - Likely to apply to Diesel for Euro VI
 - Regulation 595/2009 requires Euro VI starting 31DEC2012 for new types / 31DEC2013 for all types?
 - Aim to bring WWH-OBD into Euro VI (finalized mid-2010?)

CONCERNS ABOUT WORLDWIDE OBD REQUIREMENTS

- OBD systems are extremely complex and difficult to make reliable
 - Thousands of lines of code and calibration values per configuration
- System complexity and proliferation
 - Unique OBD requirements for different countries would have no air quality benefit and would cause unmanageable system complexity and proliferation of vehicle configurations, service procedures, etc., resulting in exorbitant cost
 - Excessively stringent requirements could result in false MILs and consumer rejection of OBD
- Worldwide OBD requirements should be as consistent as possible, to avoid unmanageable complexity, proliferation, and cost
 - All countries should accept US or European OBD systems & approval
 - European OBD systems are most cost effective

CANADA

- US OBD required starting from 1998 model year for light-duty
 - Both CARB OBD and US EPA OBD approval are automatically accepted with no additional testing or paperwork

MEXICO

- For light-duty vehicles, OBD was required from 2006 model year
 - US EPA, CARB, and EOBD will be accepted
- For heavy-duty, OBD will be required from 2011 model year
 - US EPA, CARB, and EOBD will be accepted

ARGENTINA

- EOBD will be required for light-duty:
 - Domestic new models starting January 1, 2008
 - All models including imports starting January 1, 2009
- US EPA / CARB OBD systems are likely to meet EOBD requirements but are not automatically accepted

BRAZIL

- Basic OBD (OBDBr-1) only for passenger cars starting 01JAN2007:
 - Phase-in 40 / 70 / 100 %
 - Need not monitor misfire or catalyst
 - Either US CARB or EOBD will be accepted (ISO symbol required)
- Enhanced OBD (OBDBr-2) required starting 01JAN2010:
 - Phase-in 60 / 100 %
 - Combination of EOBD requirements (Euro 4) and US FTP cycle
 - Unique emission thresholds (Brazil cycle NBR 6601 = FTP 75)
 - Complications due to fuel / OBD demonstration on E22 / E100
 - Evap leak monitor not required, same as EOBD
 - Accept CARB or EOBD for imports up to 1,000 units/6 mo.
 - OBD not required for diesel vehicles
- Proposal: OBD requirements for Heavy-duty starting 01JAN2012
 - Equivalent to 2005/55/EC Directive (Euro V)

ISRAEL

- EOBD was required starting from 2003 model year for light-duty
 - US EPA / CARB OBD certification approval is also accepted

CHINA (PRC) – Light-duty

- Requires EOBD
 - High mileage vehicles are required for OBD testing
- For light-duty gasoline vehicles:
 - Beijing: Dec. 30, 2005 all registrations
 - Country: July 1, 2008 new types, July 1, 2009 all registrations
 - GVW>2500kg: July 1, 2010 new types, July 1, 2011 all registrations
- For light-duty diesel vehicles:
 - Beijing: ?Light-duty diesel vehicles may be banned?
 - Country: July 1, 2010 new types, July 1, 2011 all registrations
- Must submit documentation and perform OBD testing for approval
 - US CARB or EOBD systems are not automatically accepted
 - Waivers for small volume applications are in discussion
 - Allow US FTP for preconditioning?

CHINA (PRC) – Heavy-Duty

- Similar to EOBD from the European Union (EU)
- Stage 1:
 - Unlike EOBD, no Stage 1 option exists in China
- Stage 1 with NOx Control:
 - Beijing: Starting 01OCT2008 for all types
 - Nationwide: Starting JAN2010 new types / JAN2011 for all types
- Stage 2:
 - Beijing: Starting JAN2012 for new types / JAN2013 for all types
 - Nationwide: Starting JAN2012 new types / JAN2013 for all types

CHINA (PRC) – Future Requirements

- Chinese draft standards on OBD: HJ/T-XXXX-200X
 - 10JUL2009 draft waiting for government approval
- Standard expected to be required by government (20XX?)
- Proposal based on EOBD, but with significant changes:
 - Comprehensive components – monitor if below threshold
 - Monitor fuel system
 - End of line (COP) test requirements (full testing on audit basis)
 - OBD to be used in I/M roadside check

HONG KONG

- Gasoline vehicles require EOBD, US OBD, or Japan OBD
 - Passenger car (GVW \leq 2500kg) starting 01JAN2006
 - Passenger car (2500kg<GVW<3500kg) starting 01JAN2007
- Diesel vehicles require US OBD or EOBD
 - Passenger car starting 01JAN2006
 - Commercial vehicle starting 01JAN2007
- Will accept EOBD, US /CARB OBD, or Japan OBD approval certificate

INDIA (proposal)

- India OBD I – Vehicles manufactured from April 1, 2010
 - Applies to category M1, M2, and N1 (less than 3,500 kg)
 - Gasoline: O2, AIR, EGR, comprehensive components, distance since MIL on
 - Diesel: fuel injection system, EGR, comprehensive components, distance since MIL on
- India OBD II – Vehicles manufactured from April 1, 2013
 - Applies to all vehicles (including LPG, CNG, **above 3,500 kg**)
 - Requirements similar to EOBD (Euro 4)
 - Gasoline: add catalyst, misfire, fuel system, and evap system
 - Diesel: add catalyst, PM trap, fuel system
 - US and EOBD systems not automatically accepted

JAPAN

- Basic OBD required starting 2002 (accept US / CARB or EOBD)
 - Applies to gasoline and diesel vehicles
 - Require ISO 2575 Malfunction Indicator (engine symbol)
- Advanced J-OBDII system
 - Domestic new light-duty model vehicles October 1, 2008
 - All light-duty vehicles including imports September 1, 2010
 - Applies to gasoline vehicles with GVW≤3500kg
 - Unique requirements and new JC08 emission test mode
 - Will accept CARB and EOBD approvals
- Basic OBD continues to apply to:
 - Gasoline vehicles with GVW>3500kg
 - All Diesel vehicles (regardless of weight – includes Heavy-duty)

SOUTH KOREA

- Gasoline: K-OBD similar to prior (1997) version of CARB OBD II
 - Except requires 0.040 inch evap monitor (rather than 0.020)
- Diesel: European OBD (EOBD Euro 4) requirements
- Phase-in schedule:
 - Gasoline small-sized: 10/30/100% in 2005/06/07
 - < 10,000 units/yr: 10/30/50/75/100% in 2005/06/07/08/09
 - < 1,001 units/yr: 100% in 2009
 - Gasoline mid-sized: 2006 Homologation, 2007 Registration
 - Diesel small-sized: 2006 Homologation, 2007 Registration
 - Diesel mid-sized: 2007 Homologation, 2008 Registration
 - All large-sized: 2009 Homologation, 2010 Registration
- July 2008, no longer need OBD witness testing for Korean approval
 - Will accept manufacturer test data, if facility has been approved

SOUTH KOREA – Future requirements:

- Gasoline: similar to prior versions (2002 & 2007) of CARB OBD II
 - Applies to New Types 01/01/2013, All Types 01/01/2015
 - NOx Catalyst Monitor
 - Cold Start Monitoring (from 2007 CARB regulation)
 - Air Conditioning Monitor (from 2002 CARB regulation)
 - Primary O2 sensor
 - Secondary O2 sensor (POPD)
 - Fuel System (feedback from secondary O2 sensor – SFTD)
 - Thermostat / Engine Cooling System Performance
 - VVT Monitoring (including Mode \$06)
 - Permanent Fault Codes
 - (did not include O2 asymmetric delay or air fuel imbalance AIFM)
 - In-Use Performance Ratios (IUPR)
 - 0.1 ratio applies for first three years

SOUTH KOREA – Future requirements:

- LPG: Current (2006) version of KOBD
 - Except no evaporative system monitoring requirements
- Applies to New Types 01/01/2012, All Types 01/01/2014

- Diesel: Euro 5 OBD requirements
 - Emission Thresholds, IUPM, EGR, NOx Reduction Device
- Applies to New Types 01/01/2012, All Types 01/01/2014

SINGAPORE

- Gasoline:
 - Vehicles with Euro III emissions must have EOBD
- Diesels:
 - Vehicles with Euro IV emissions must have EOBD
- US EPA / CARB OBD systems are likely to meet EOBD requirements but are not automatically accepted

THAILAND

- OBD is to be required with Euro 4
 - Starting 2012 for new models and 2013 for all models
 - Industry is asking for delay for CNG vehicles due to fuel quality

TAIWAN

- OBD is required starting 2008 model year
 - Both US / CARB OBD and EOBD will be accepted
 - Demo test not needed, if CARB or EOBD approved
 - COP testing is required

AUSTRALIA

- Requires EOBD for light duty
 - Gasoline: new models 01JAN2005, all models 01JAN2006
 - Diesel: new models 01JAN2006, all models 01JAN2007
- US EPA / CARB OBD systems are likely to meet EOBD requirements but are not automatically accepted

NEW ZEALAND

- Requires OBD for vehicles manufactured after 01JAN2006
 - Must comply with US / CARB, EOBD, or Japan OBD
 - Accepts certification approval from other countries

2011 MY LD/MD Worldwide OBD Requirements

Country	OBD Required	Certification	Demo Testing	PVE/COP Test
Argentina	EOBD	Required	No	No
Australia	EOBD	Required	Accept other	No
Brazil	BR2/US/EOBD	Required	BR2 – in Brazil	COP, on request
Canada	US / CARB	Accept US	No	No
China (PRC)	EOBD	Required	Yes – in China	COP
Europe	EOBD – Euro 5	Required	Yes – witness	Yes – ratio testing
Hong Kong	J1/US/EOBD	Accept other	No	No
India Proposal	India – OBD I	Required	Yes	No
Israel	EOBD	Accept other	No	No
Japan	J2/US/EOBD	Accept other	No	No
Korea	KOBD	Required	Yes (no witness)	COP, on request

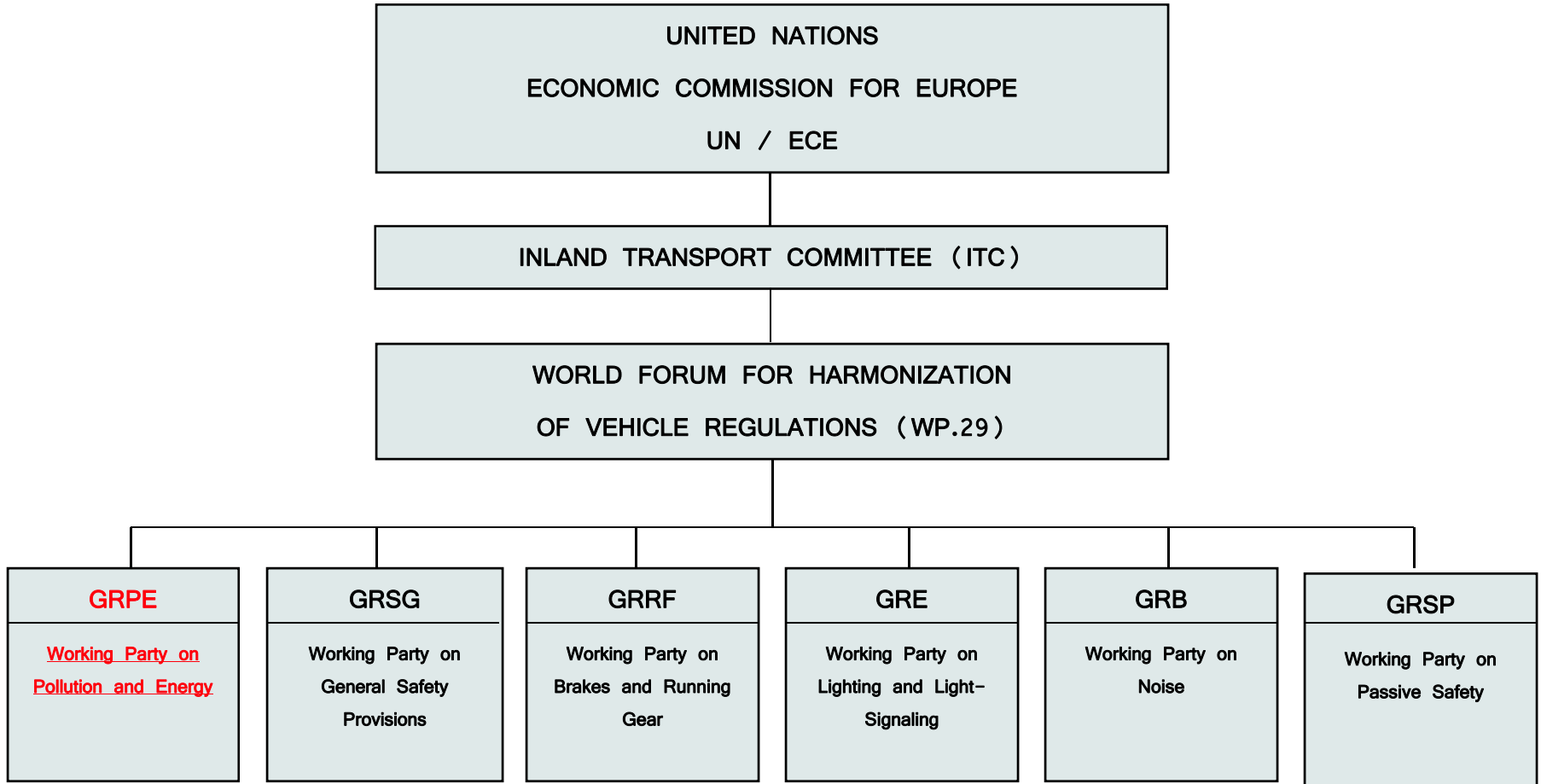
2011 MY LD/MD Worldwide OBD Requirements

Country	OBD Required	Certification	Demo Testing	PVE/COP Test
Mexico	US / EOBD	Accepts other	No	No
New Zealand	J1/US/EOBD	Accepts other	No	No
Singapore	EOBD	Required	No	No
Taiwan	US/EOBD	Accepts other	No	COP, on request
US	US / CARB	Required	Yes	Yes – PVE testing

WORLD WIDE HARMONIZATION

- The 1958 Agreement established a process under the United Nations Economic Commission for Europe (UNECE) to facilitate the adoption of uniform conditions of approval and the reciprocal recognition of approval for motor vehicle equipment and parts (focused in Europe). WP29 was appointed the administrative body of the agreement.
- With the 1998 agreement, a process was agreed upon by Europe, Japan and the U.S. to allow for global harmonization of vehicle regulations, i.e., Global Technical Regulation (GTR).

UN ECE WP29 Organization



WORLD WIDE HARMONIZATION

- First GRPE project area:
 - World Wide Harmonized Heavy Duty OBD (WWH-OBD)
 - Focus: On-Road Heavy-Duty Diesel Exhaust Emissions
- Current status / expected timing WWH-OBD GTR:
 - GTR was adopted by WP29 November 15, 2006 (GTR No.5)
<http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29registry/gtr5.html>
 - Likely to be applied by EU starting 31DEC2012 (other countries?)
- World Light-duty [Test] Procedure (WLTP) proposal submitted by Japan:
 - July 2007, Reference: ECE/TRANS/WP.29/2007/98;
 - Will include:
 - Common test cycle reflecting real world driving conditions;
 - Many different technical tests, perhaps eventually including OBD;
 - June 2009: WP29/AC3 agreed to start work on WLTP gtr;
 - US, Japan & EU – sponsors of WLTP gtr;
 - First meeting, September 07-08, 2009
 - Immediate focus on test cycle and measurement procedures.

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