車輛排放測試
趨勢及要求

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捐助機構
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IVE

Member of VTC Group
VTC 機構成員

為什麼我們需要進行車輛排廢測試

- 排廢控制有助改善空氣質素
- 新車輛登記的要求
- 進口車輛登記的要求
- 年檢要求
- 按要求的專項檢查

如何測試車輛排放

- 使用底盤式功率機 (俗稱跑步機)
- 廢氣採樣系統
- 排廢分析儀
- 車輛在指定的駕駛測試週期運行

功率測試機

- 發動機功率測試機

功率測試機

- 底盤功率測試機

採樣系統

- SIGNAL CVS system for the Euro V or VI emission testing

CVS - Constant Volume Sampler

採樣系統

- EFM系統

化學分析儀

SIGNAL化學分析儀

- 總碳氫化合物(THC)
- 氮氧化物(NOx)
- 二氧化碳(CO_2)
- 甲烷(CH_4)
- 一氧化碳(CO)
- 氧氣(O_2)

化學分析儀

PEMS

排廢測試週期

汽車排放測量大致分為以下兩大類:

1. 私家車及輕型貨車-

於車輛行駛特定的測試週期時使用設有採樣系統和化學分析儀的底盤功率測試機以收集及量度車輛排放情況

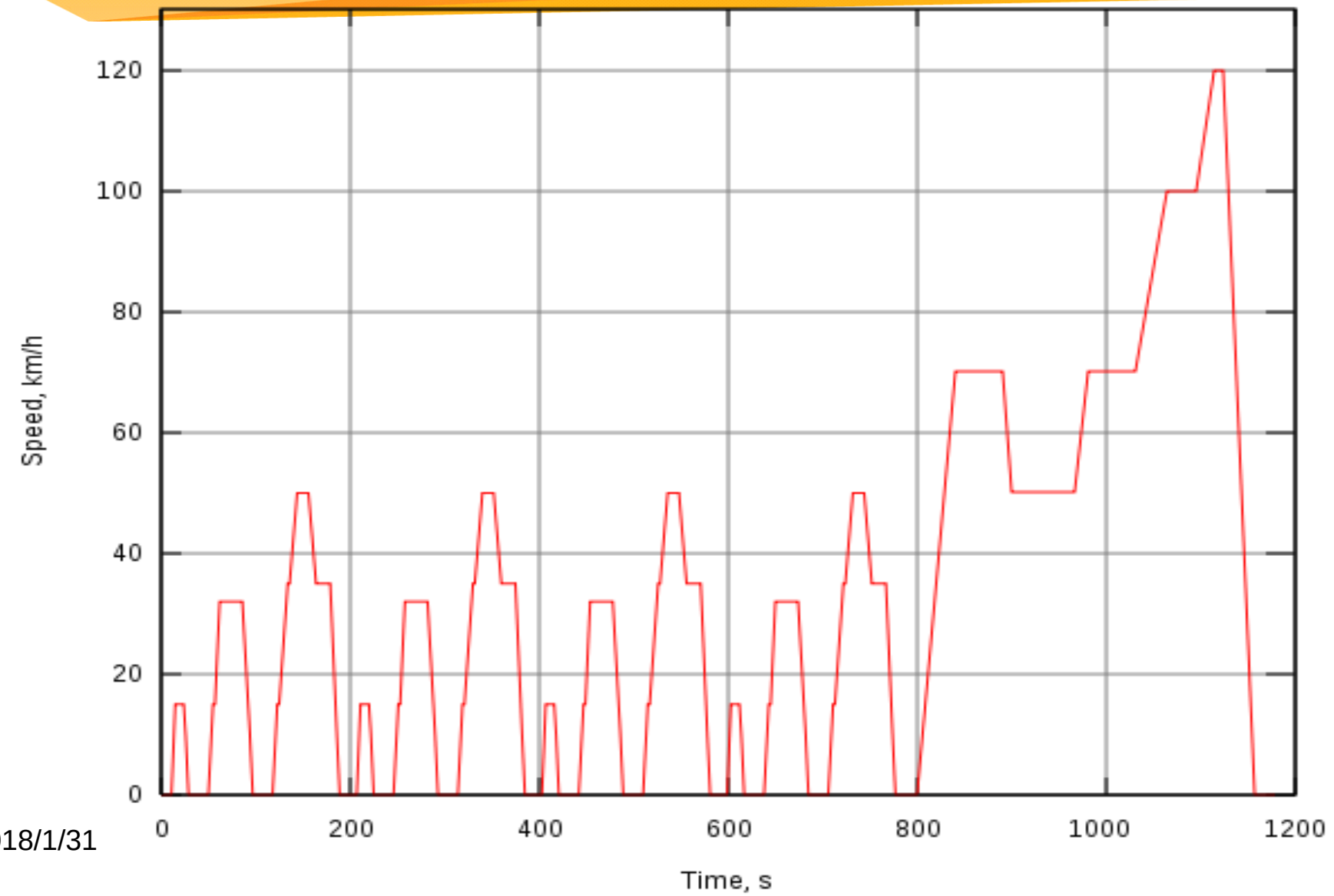
2. 中型貨車及重型貨車-

主要使用發動機功率測試機及動態底盤功率測試機

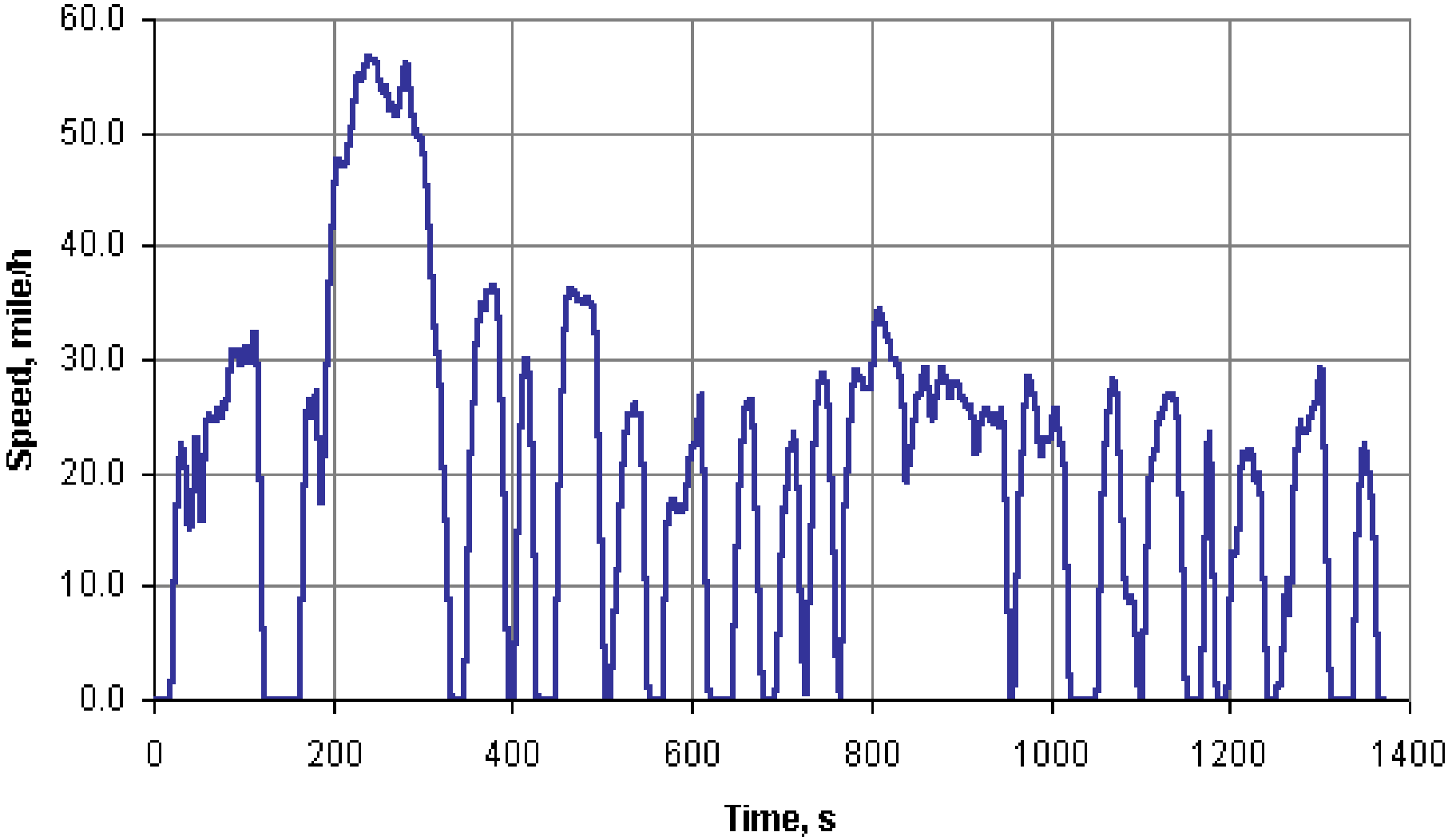
私家車及輕型貨車測試週期

- 新歐盟駕駛週期(NEDC)
- 聯邦測試程序(FTP or FTP75)
- 日本測試程序(JC08)
- 世界輕型測試程序 (2015)
- 香港動態排廢測試(HKTET)

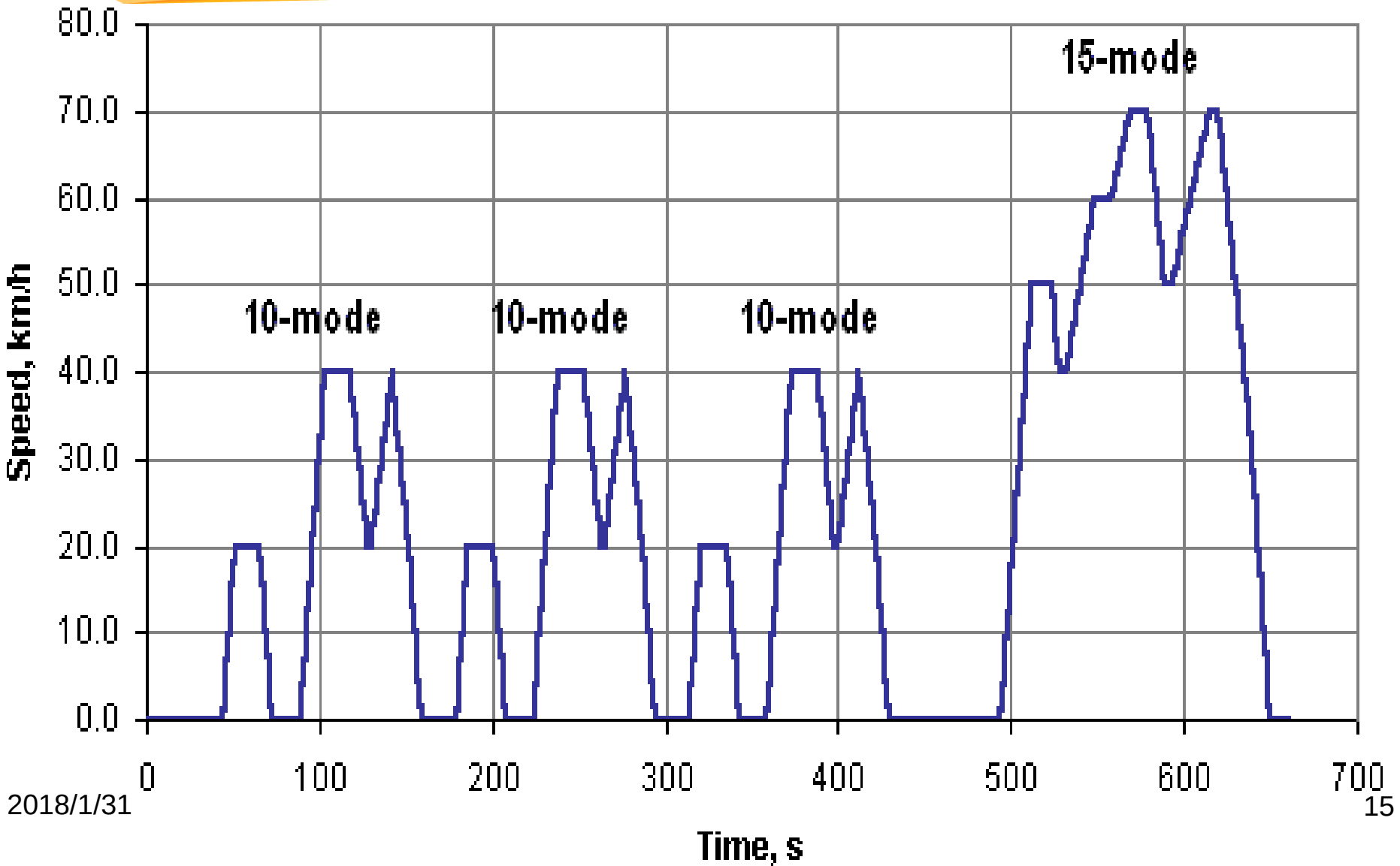
EUDC



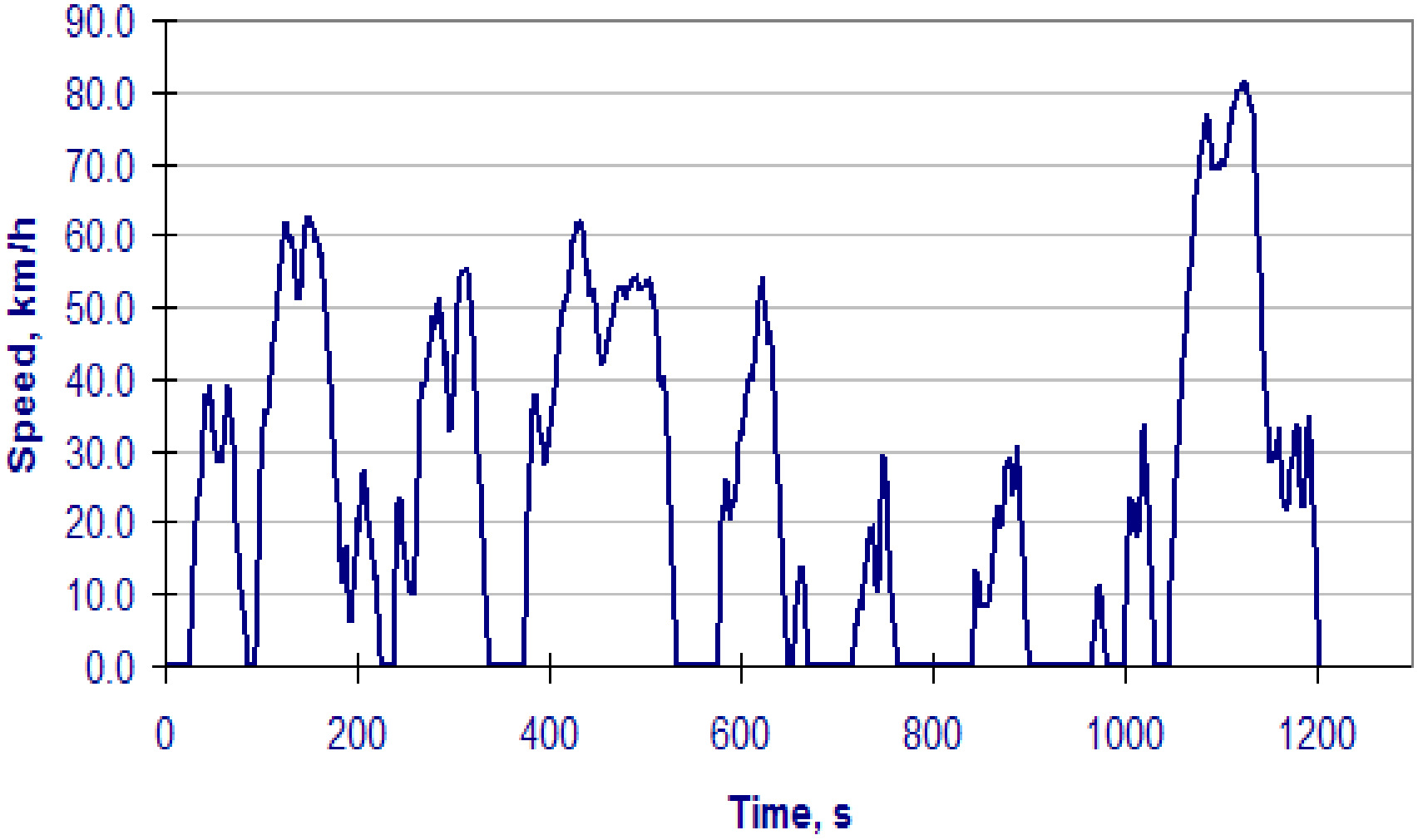
FTP75


60.0
50.0
40.0
30.0
20.0
10.0
0.0
Speed, mile/h
0
200
400
600
800
1000
1200
1400
Time, s

Japan 10-15


80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Speed, km/h
10-mode
10-mode
10-mode
15-mode
0
100
200
300
400
500
600
700
Time, s

Japan JC08

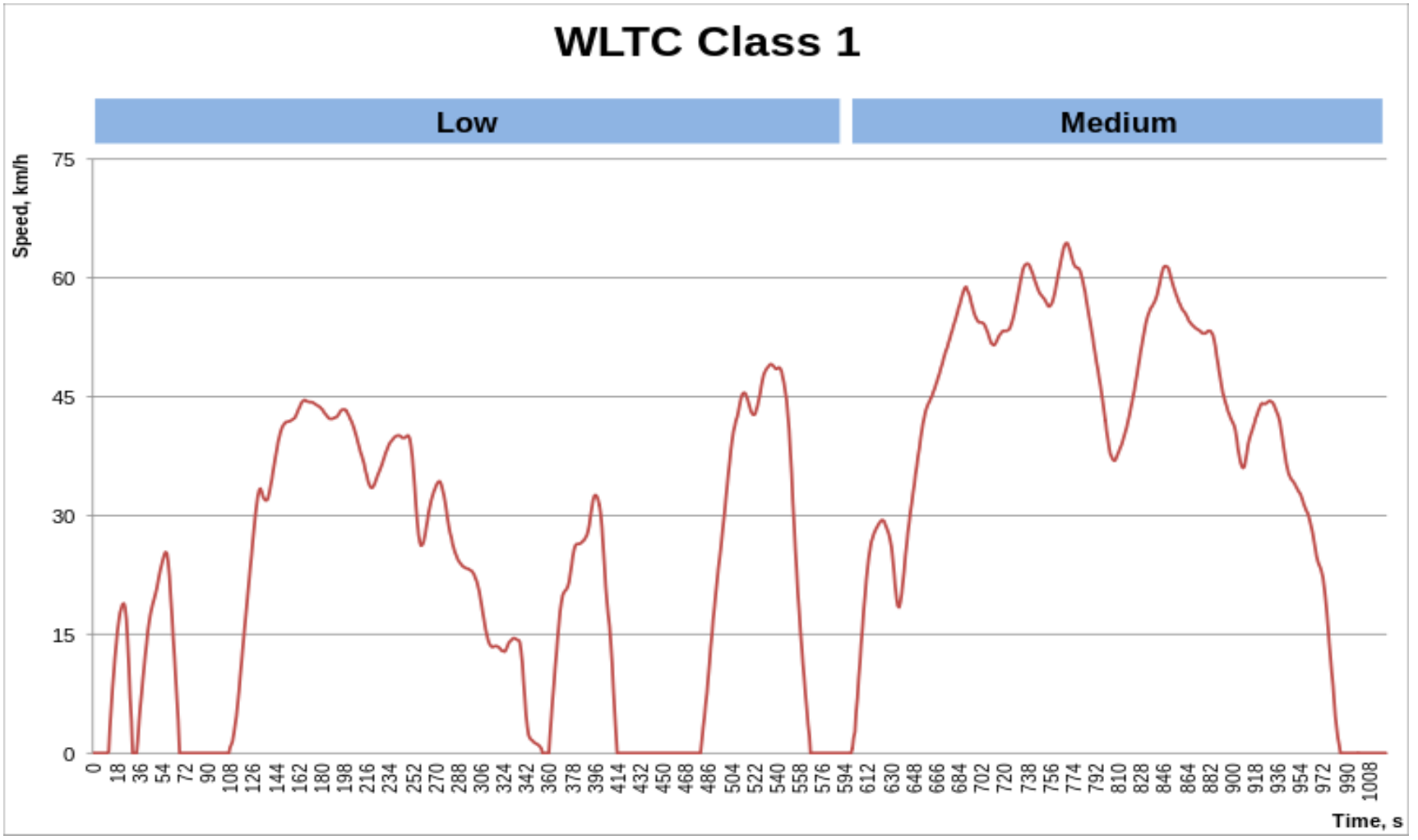

90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Speed, km/h
0
200
400
600
800
1000
1200
Time, s

WLTP2015

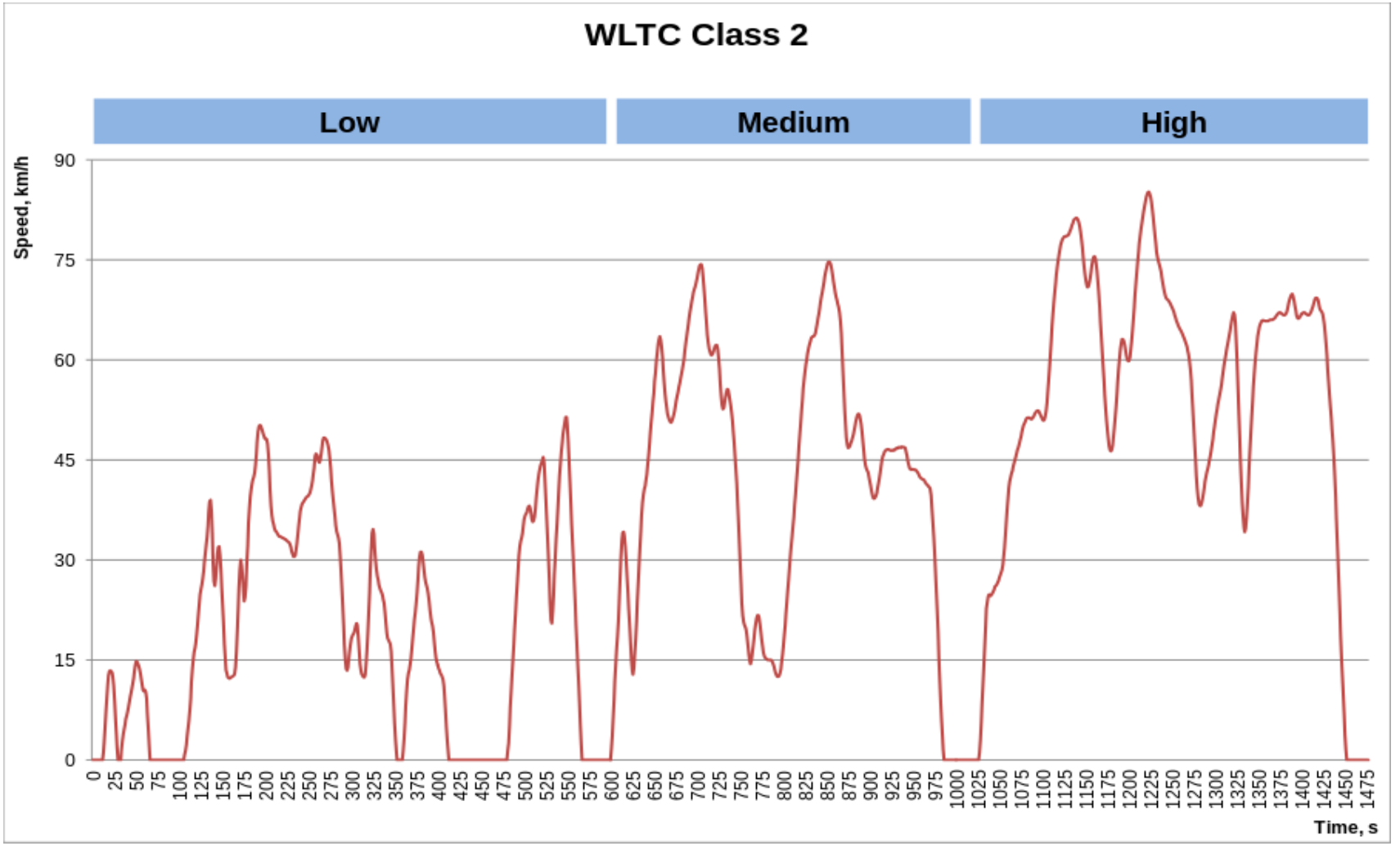
運用三種不同的WLTC測試週期, 視乎車輛類別而定-defined by power-weight ratio PWr in kW/Tonne (rated engine power / kerb weight):

- 第1類 – 低馬力車輛 PWr <= 22;
- 第2類 - 車輛界乎 22 < PWr <= 34;
- 第3類 – 高馬力車輛 PWr > 34.

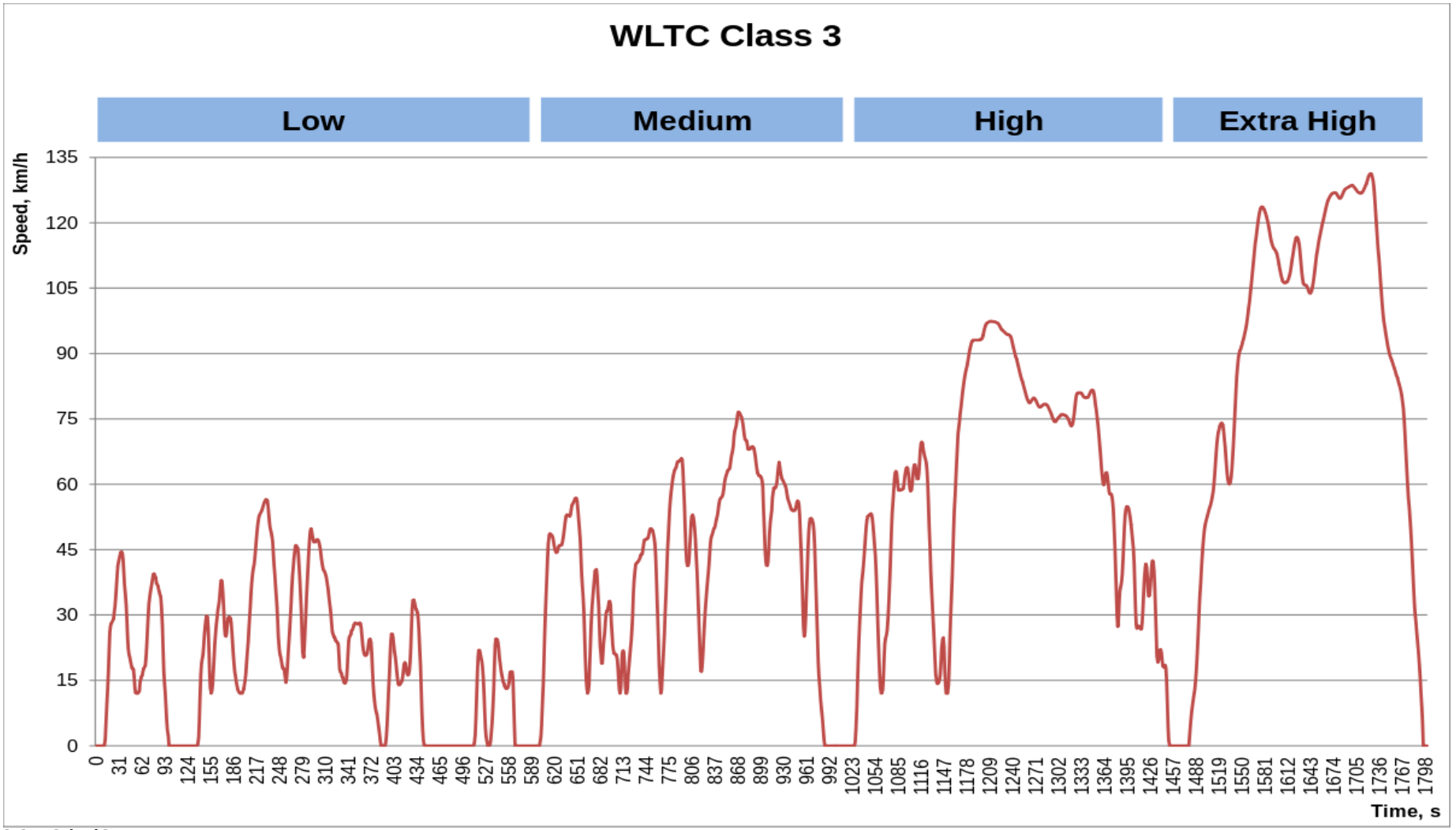
WLTP2015

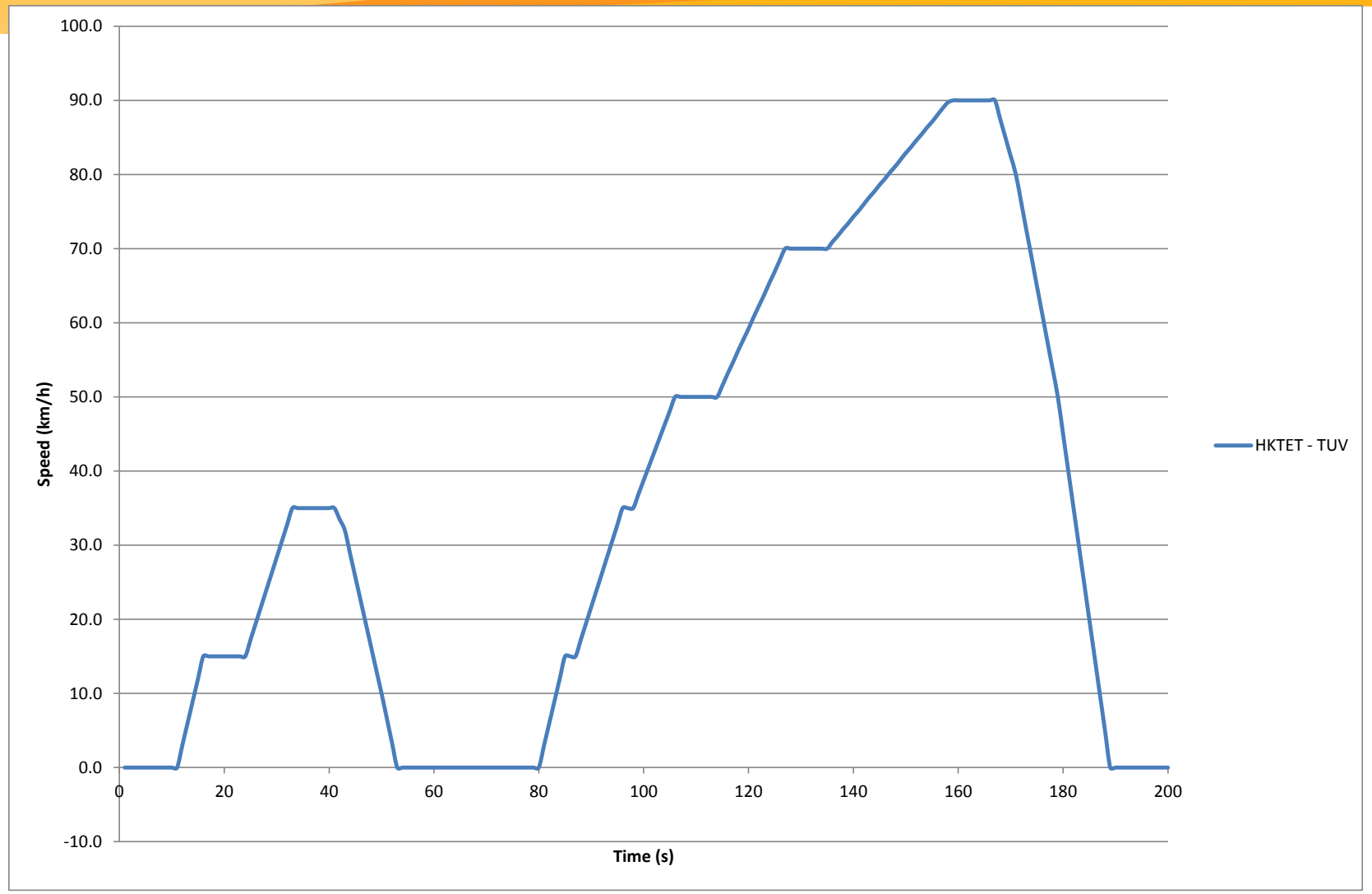

WLTC Class 1
Low
Medium
Speed, km/h
75
60
45
30
15
0
0 18 36 54 72 90 108 126 144 162 180 198 216 234 252 270 288 306 324 342 360 378 396 414 432 450 468 486 504 522 540 558 576 594 612 630 648 666 684 702 720 738 756 774 792 810 828 846 864 882 900 918 936 954 972 990 1008
Time, s

WLTP2015


WLTC Class 2
Low
Medium
High
Speed, km/h
0
15
30
45
60
75
90
0 25 50 75 100 125 150 175 200 225 250 275 300 325 350 375 400 425 450 475 500 525 550 575 600 625 650 675 700 725 750 775 800 825 850 875 900 925 950 975 1000 1025 1050 1075 1100 1125 1150 1175 1200 1225 1250 1275 1300 1325 1350 1375 1400 1425 1450 1475
Time, s

WLTP2015


WLTC Class 3
Low
Medium
High
Extra High
Speed, km/h
135
120
105
90
75
60
45
30
15
0
0
31
62
93
124
155
186
217
248
279
310
341
372
403
434
465
496
527
558
589
620
651
682
713
744
775
806
837
868
899
930
961
992
1023
1054
1085
1116
1147
1178
1209
1240
1271
1302
1333
1364
1395
1426
1457
1488
1519
1550
1581
1612
1643
1674
1705
1736
1767
1798
Time, s

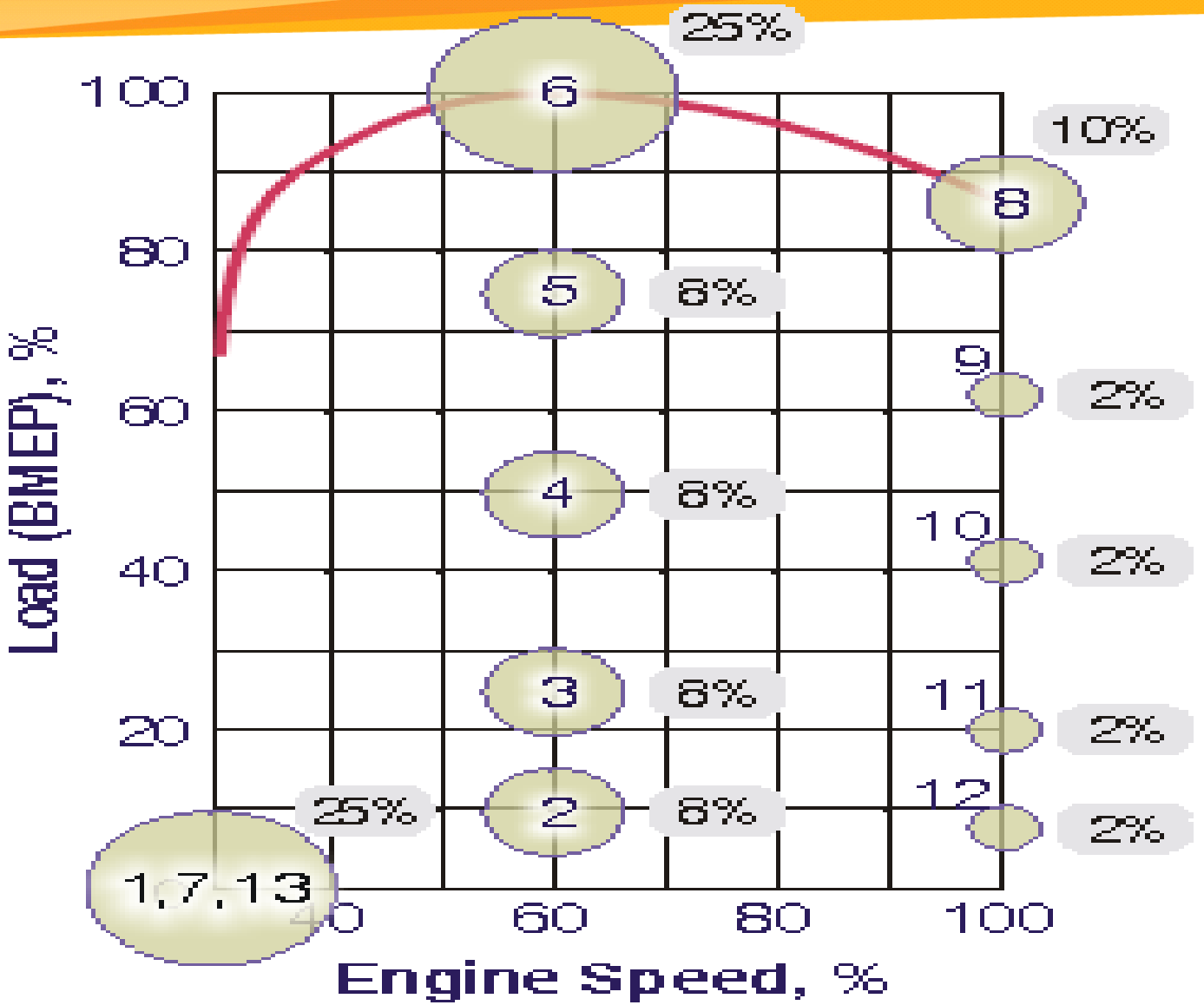

100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
Speed (km/h)
0
20
40
60
80
100
120
140
160
180
200
Time (s)
HKTET - TUV

Test cycles for MGV, HGV and Buses

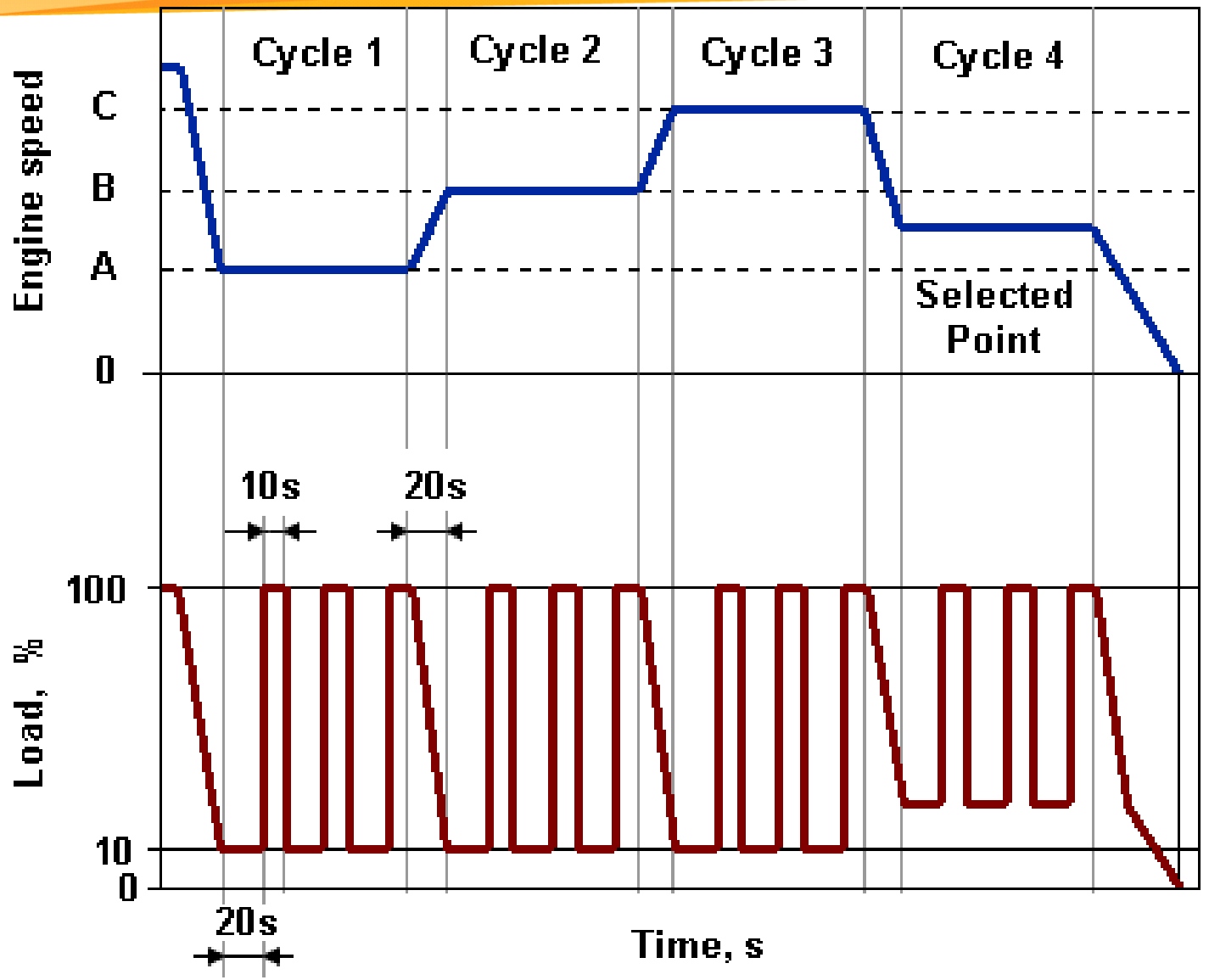
EU Emission Standards for HD Diesel Engines, g/kWh (smoke in m^{-1})

Tier	Date	Test
Euro I	1992 (< 85 kW)	R-49
	1992 (> 85 kW)	
Euro II	October 1996	
	October 1998	
Euro III	*October 1999 (EEVs only)*	*ESC* & *ELR*
	October 2000	
Euro IV	October 2005	ESC & ELR
Euro V	October 2008	
Euro VI	January 2013	WHSC

R49


25%
6
10%
8
5
8%
9
2%
4
8%
10
2%
3
8%
11
2%
25%
2
8%
12
2%
1,7,13
100
80
60
40
20
0
60
80
100
Load (BMEP), %
Engine Speed, %

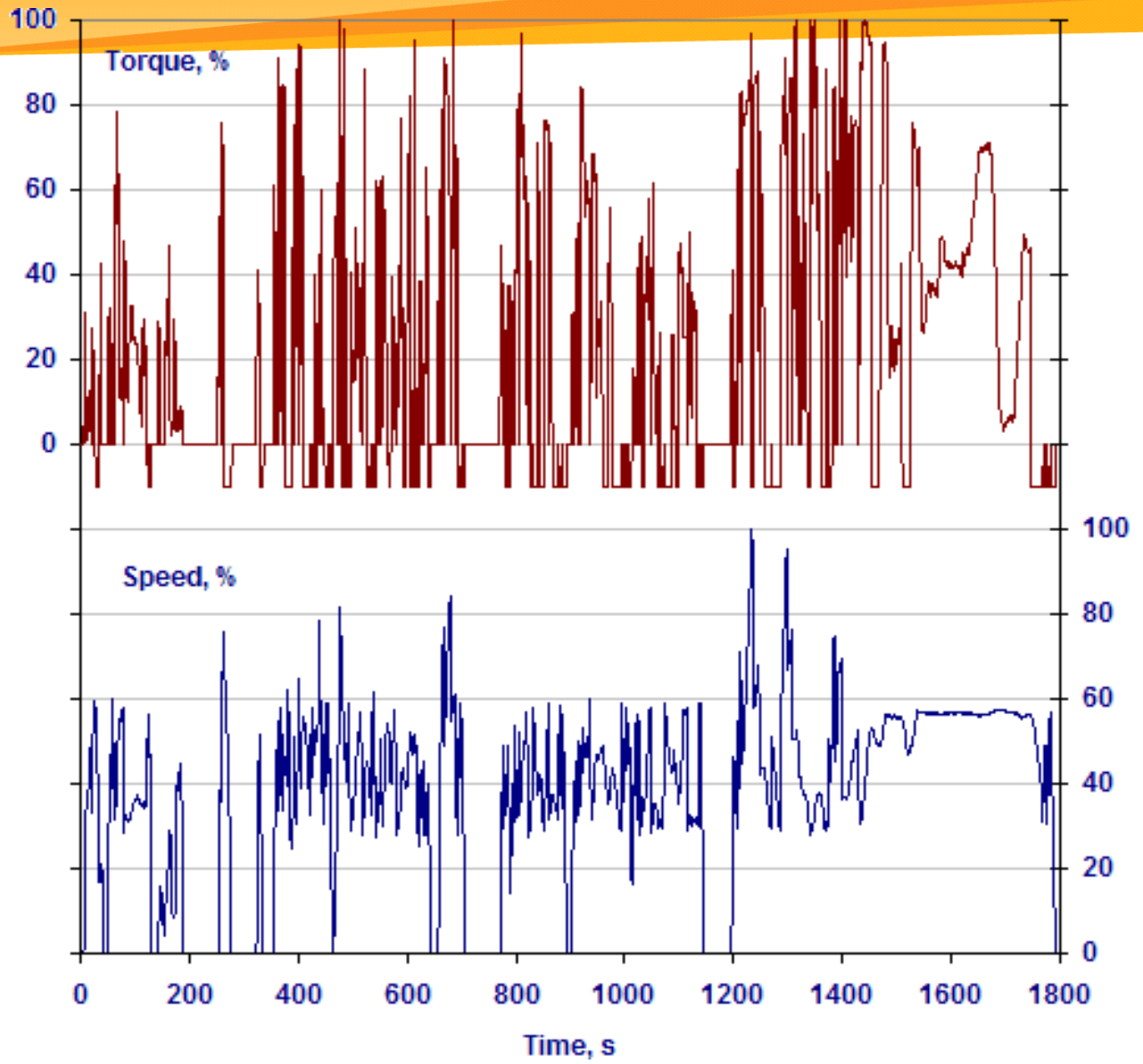
ESC/ELR


Cycle 1
Cycle 2
Cycle 3
Cycle 4
Engine speed
C
B
A
0
Selected Point
10s
20s
100
10
0
Load, %
20s
Time, s

WHSC

World Harmonized Stationary Cycle (WHSC)				
Mode	**Speed**	**Load**	**Weighting Factor**	**Mode Length†**
-	%	%	-	s
0	Motoring	-	0.24	-
1	0	0	0.17/2	210
2	55	100	0.02	50
3	55	25	0.10	250
4	55	70	0.03	75
5	35	100	0.02	50
6	25	25	0.08	200
7	45	70	0.03	75
8	45	25	0.06	150
9	55	50	0.05	125
10	75	100	0.02	50
11	35	50	0.08	200
12	35	25	0.10	250
13	0	0	0.17/2	210
Total			1	1895
† Including 20 s ramp				

WHTC


Torque, %
100
80
60
40
20
0
Speed, %
100
80
60
40
20
0
0
200
400
600
800
1000
1200
1400
1600
1800
Time, s

Euro 5 Vs Euro 6

Pollutant	Euro 5 Light-Duty		Euro 6 Light-Duty	
	Gasoline	Diesel	Gasoline	Diesel
CO	1.0	0.5	1.0	0.5
HC	0.1[a]		0.1[e]	
$HC+NO_x$		0.23		0.17
NO_x	0.06	0.18	0.06	0.08
PM	0.005[c]	0.005	0.005[c]	0.005
PN (#/km)		6.0×10^{11}	6.0×10^{11} [d]	6.0×10^{11}

[a] and 0.068 g/km for NMHC; [c] applicable only to DI engines, 0.0045 g/km using the PMP measurement procedure; [d] applicable only to DI engines, 6 x 1012 #/km within the first three years of Euro 6 effective dates.

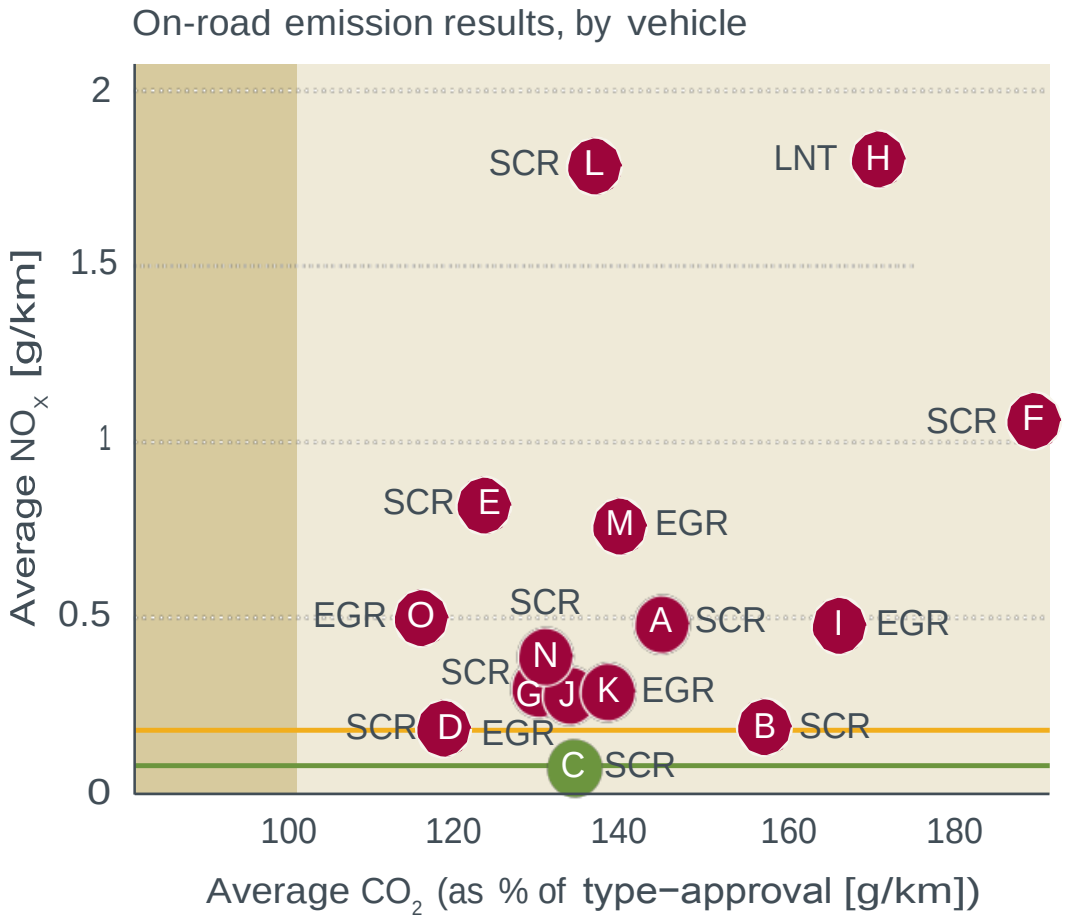
使用中的排放控制裝置之耐用性

- 第715/2007號條例
- 每5年及每10萬公里,製造商需檢查服務中的車輛
- 排放控制裝置的耐用性須達到至少16萬公里
- 排放控制系統可獲得50%以上的OBD信息

排廢控制策略

	Euro 5	Euro 6
Gasoline	• Combustion improvements over Euro 4 • Faster oxygen sensors • Catalyst improvements- oxygen storage capacity and better coatings	• No changes required for port fuel-injected gasoline engines • Improvements to fuel injection timing or addition of a gasoline particle filter for gasoline direct injection (GDI) engines
Diesel	• Combustion improvements over Euro 4 • Variable fuel injection timing for DPF regeneration • DOC + DPF • Some engines use lean NO_x traps	• Increased fuel injection pressure • Smaller and medium-size engines (<2 liters) tend to use DOC+DPF and primarily LNT for NO_x control • Larger cars (>2L) use DOC+DPF+SCR • Some manufacturers offer EGR-onlv NO_x control (with no aftertreatment control), and DOC+DPF on medium and larger cars

世界性的廢氣排放



Above type-approval
Below or equal to type-approval
Above Euro 5 limit
Above Euro 6, below Euro 5 limit
Below Euro 6 limit
Euro 5 limit
Euro 6 limit

15 test vehicles in total (6 manufacturers), with diferent NO_x control technologies:

- 10 selective catalytic reduction (SCR)
- 4 exhaust gas recirculation (EGR)
- 1 lean NO_x trap (LNT)

Average Euro 6 NO_x conformity factors (ratio of on-road emissions to legal limits):

- all cars: 7.1
- best performer (Vehicle C, SCR): 1.0
- bad performer (Vehicle H, LNT): 24.3
- worst performer (Vehicle L, SCR): 25.4

歐盟六期重型汽車

	Euro V Heavy-Duty		Euro VI Heavy-Duty	
	Euro V SS[a]	Euro V T[b]	Euro VI SS[a]	Euro VI T[b]
Emission limits (g/km)				
CO	1.5	4.0	1.5	4.0
HC	0.46	0.55	0.13	0.16[d]
CH_4[c]		1.1		0.5
NO_x	2.0	2.0	0.4	0.46
PM	0.02	0.03	0.01	0.01
PN (#/km)			8.0×10^{11}	6.0×10^{11}
Smoke (1/m)	0.5			
Ammonia (ppm)[12]			0.01	0.01
Fuel Sulfur Limit (ppm)	10	10	10	10
Test Cycle	ESC & ELR	ETC	WHSC	WHTC

[a] Steady-state testing; [b] Transient testing; [c] For Euro V for Natural Gas only, for Euro VI, NG and LPG; [d] Total HC for diesel engines, non-methane HC for others

重型汽車之排廢控制

- 更高的注射壓力
- 可變燃油噴射時間和數量
- 重新設計燃燒室
- 基於SCR系統控制NOx
- E6 PM和PN減少所需的DPF
- 只適用於較小卡車的EGR

多謝!

問答環節!