

Study on cycle modification




~ Reflect validation test 1 result ~

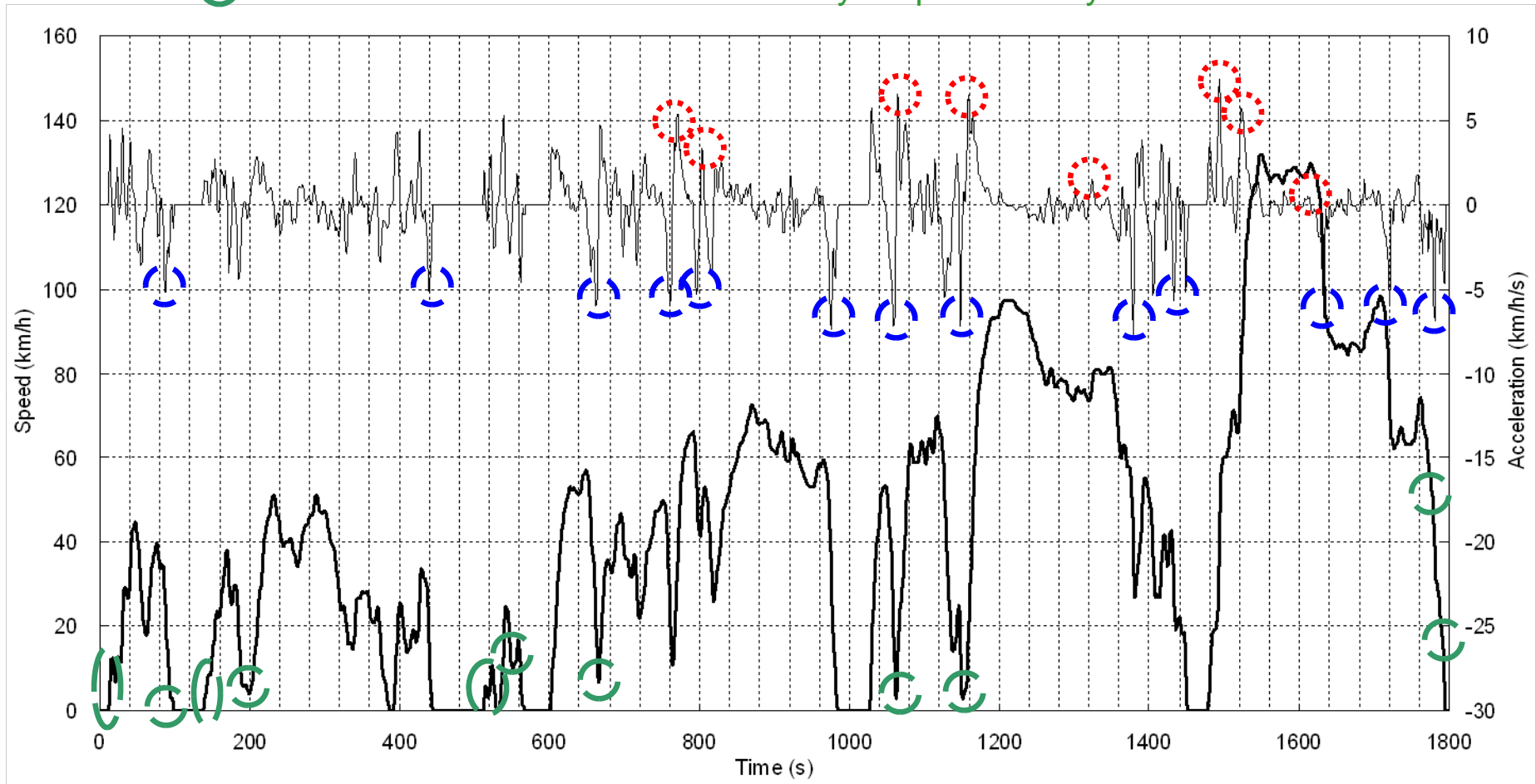
Prepared by Japan

10th DHC sub-group meeting
under GRPE/WLTP informal group
11-12 October 2011
Brussels, Belgium

1. Overview of Validation test 1 result
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3. Viewpoints of Modification
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 - 5.2. Review deceleration
 - 5.3. Review minimum speed

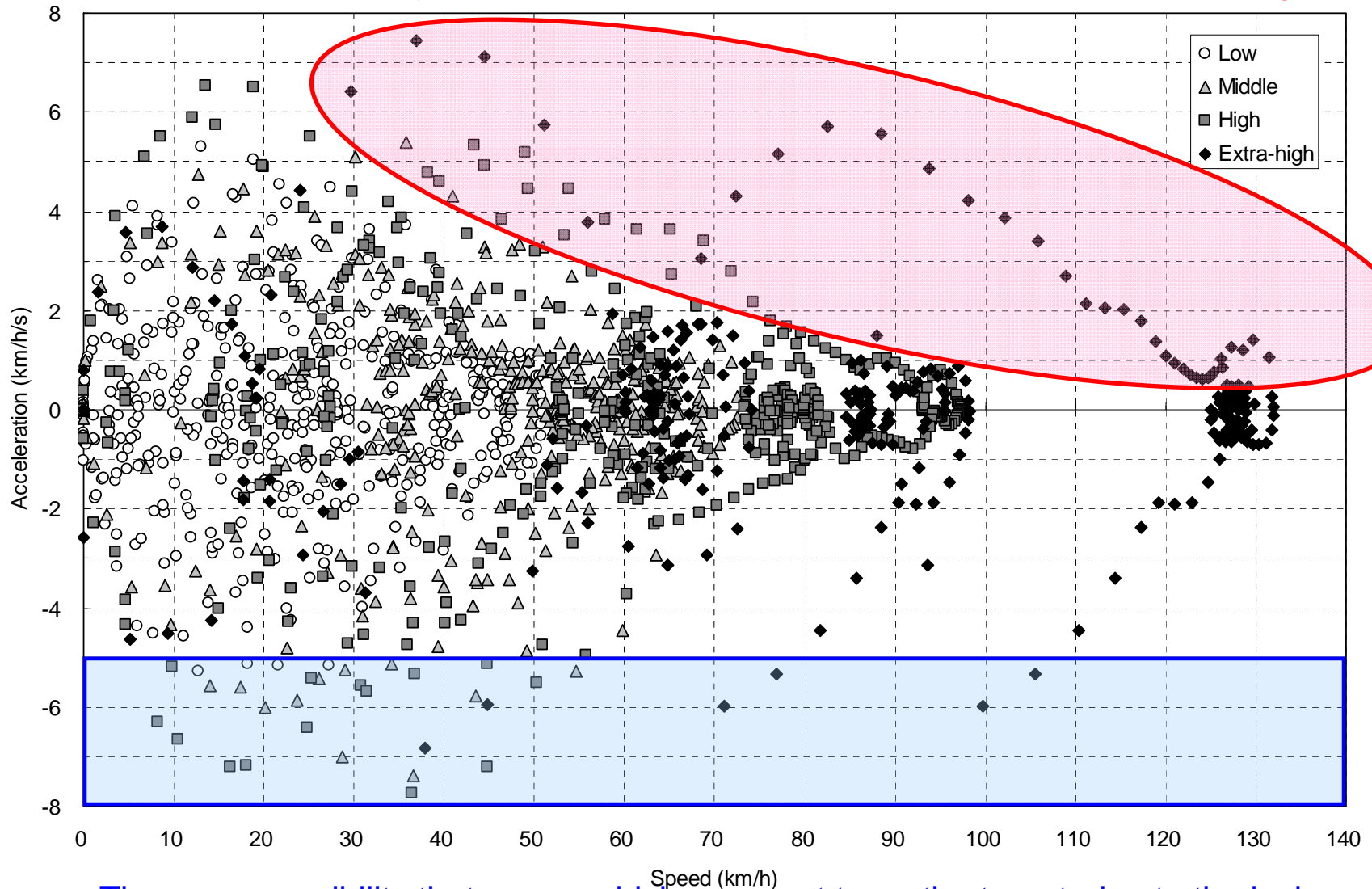
1.1. Overview of Validation test 1 result

-  can not follow the target speed during acceleration parts
-  can not trace the target speed during deceleration parts
-  have adverse influence on drivability / reproducibility



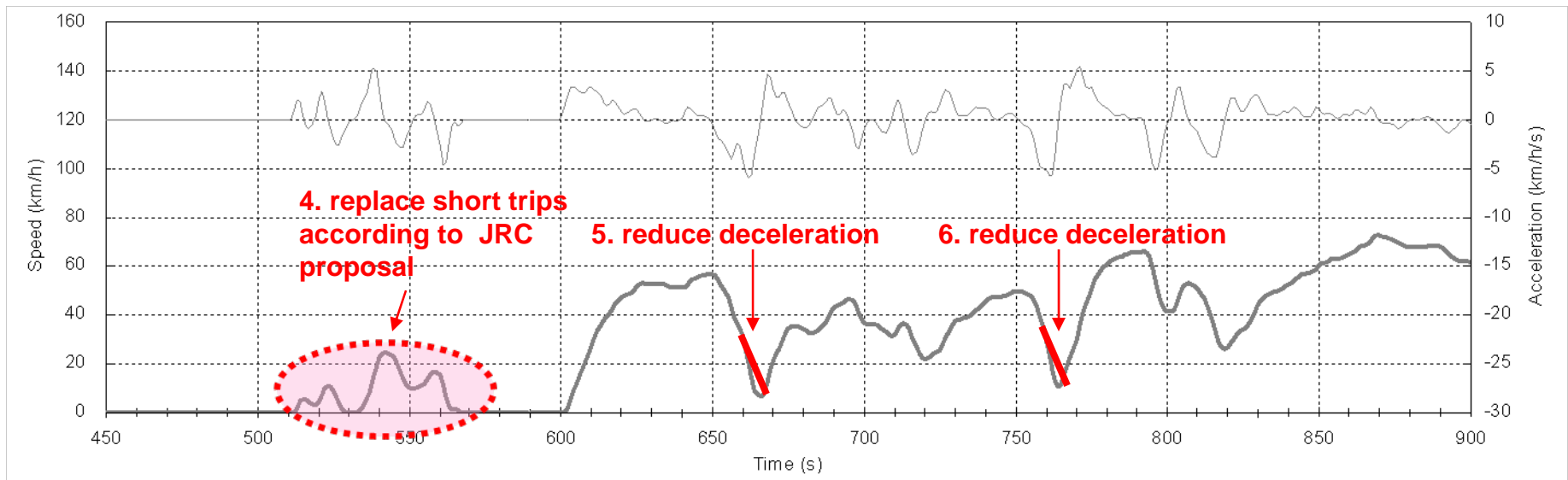
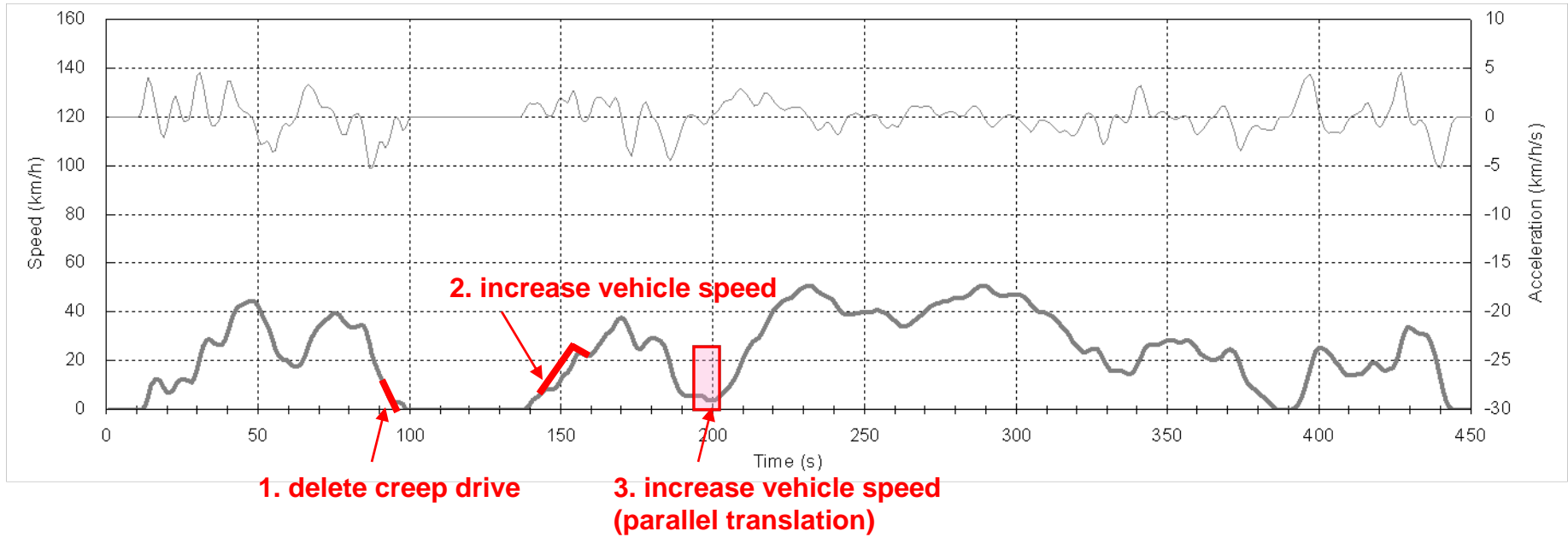
1.2. Potential area need to be modified

There are possibility that low/middle powered vehicles can not follow the target

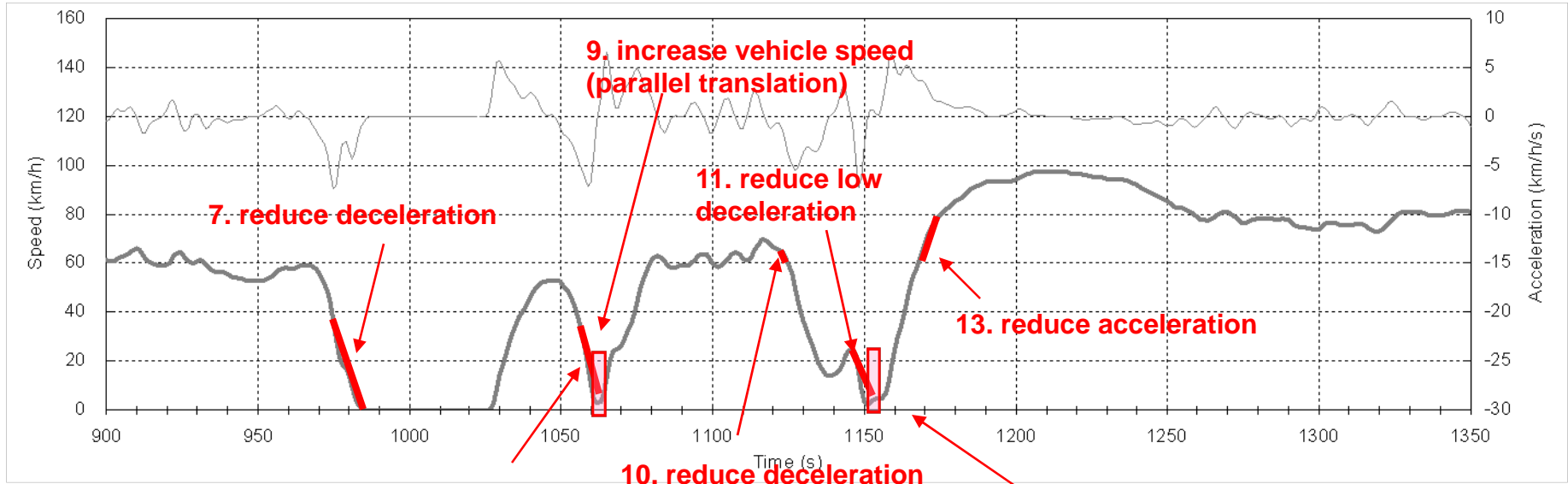


There are possibility that some vehicles can not trace the target, due to tire lock, shortage of brake power of rear wheel.

2.1. Proposal for modification parts

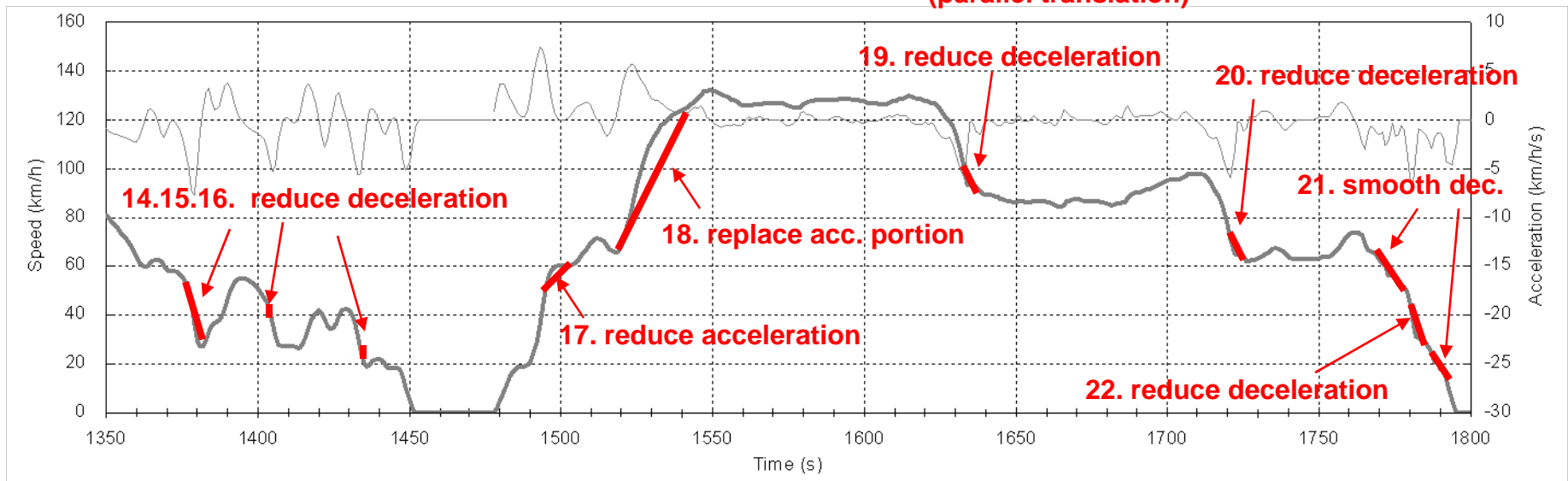


2.2. Proposal for modification parts



8. reduce deceleration

12. increase vehicle speed (parallel translation)



2.3. List of proposed modification parts

#	Time	Modification
1	90 – 99	delete creep portion
2	145 – 155	delete deceleration portion during low speed part
3	189 – 204	parallel translation to be minimum speed of 6.2 km/h
4	512 – 566	replaced ST4 and ST5 based on JRC
5	661 – 664	reduce deceleration
6	761 – 763	reduce deceleration
7	974 – 978	reduce deceleration
8	1057 – 1060	reduce deceleration
9	1061 – 1064	parallel translation to be minimum speed of 6.2 km/h
10	1127 -1128	reduce deceleration
11	1148 -1149	reduce deceleration
12	1150 -1156	parallel translation to be minimum speed of 6.2 km/h
13	1157 – 1171	reduce acceleration
14	1378 -1381	reduce deceleration
15	1405 – 1406	reduce deceleration
16	1433 – 1434	reduce deceleration
17	1493 – 1500	reduce acceleration
18	1520 – 1552	replace acceleration phase
19	1520 – 1552	reduce deceleration
20	1720 - 1722	reduce deceleration
21	1773, 1776	smooth deceleration
22	1780 - 1783	reduce deceleration

3. Viewpoints of Modification

➤ Acceleration

- Review acceleration portions based on comments from the participant laboratories
- Set maximum acceleration ratio 95 percentiles of cumulative frequency in each speed range
 - Ex-HIGH: replace high acceleration part (65 - 130km/h) by alternative acceleration part from in-use database which match the 95 percentiles

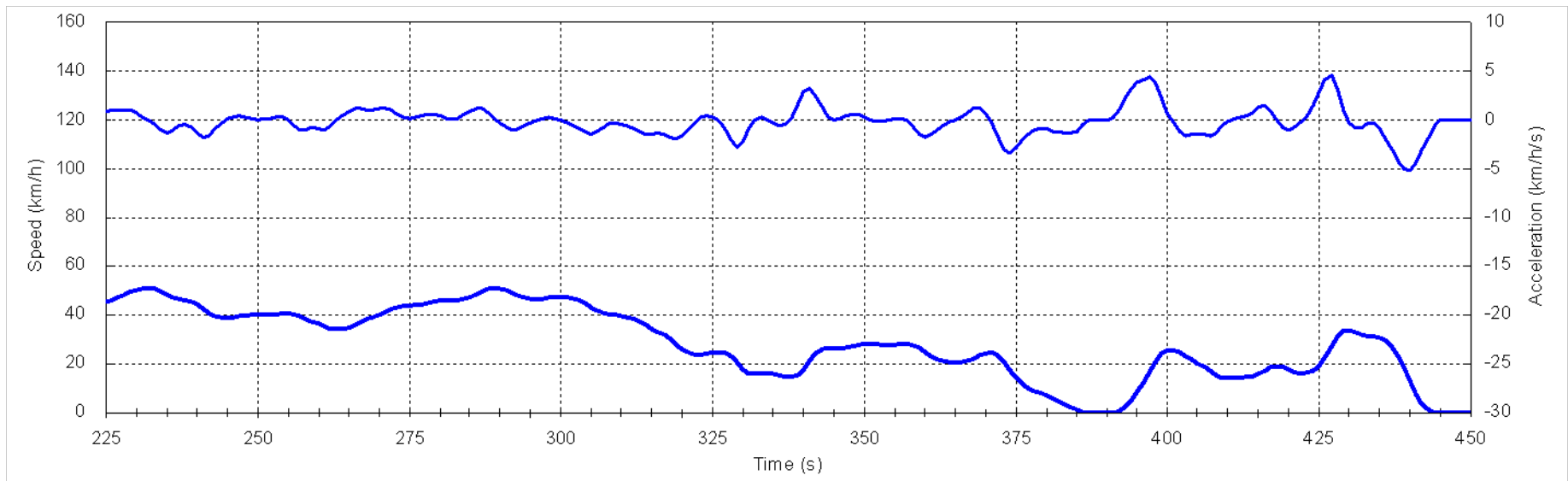
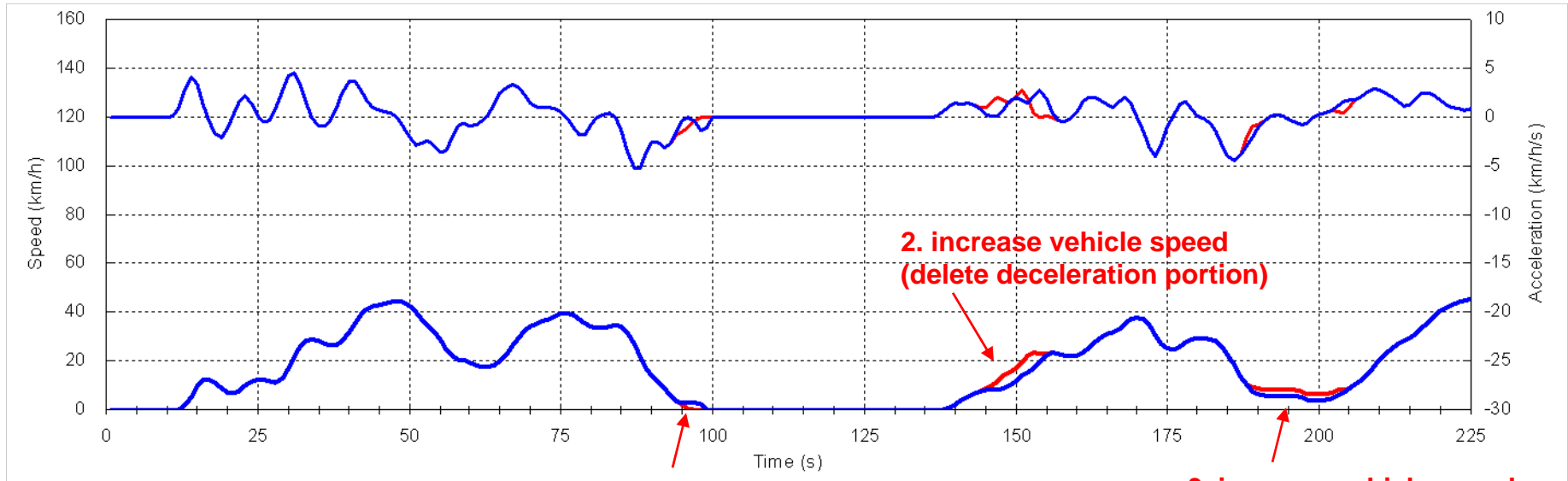
➤ Deceleration

- To avoid tire lock and/or shortage of brake power, set maximum deceleration to appropriate value (- 5.31 km/h/s)

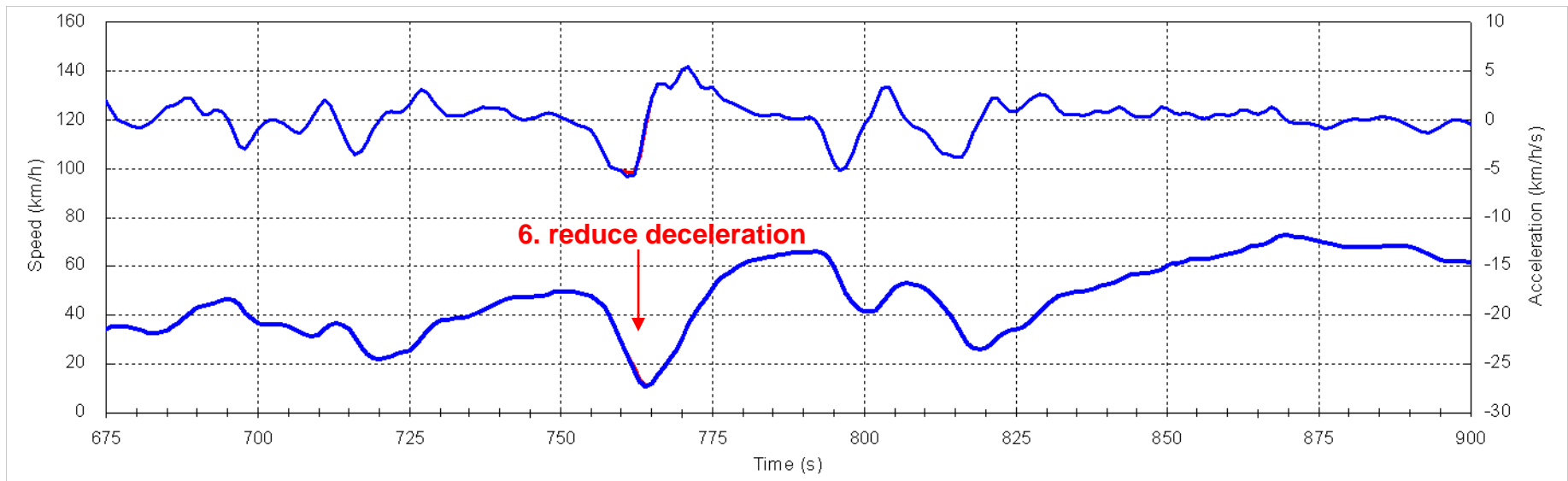
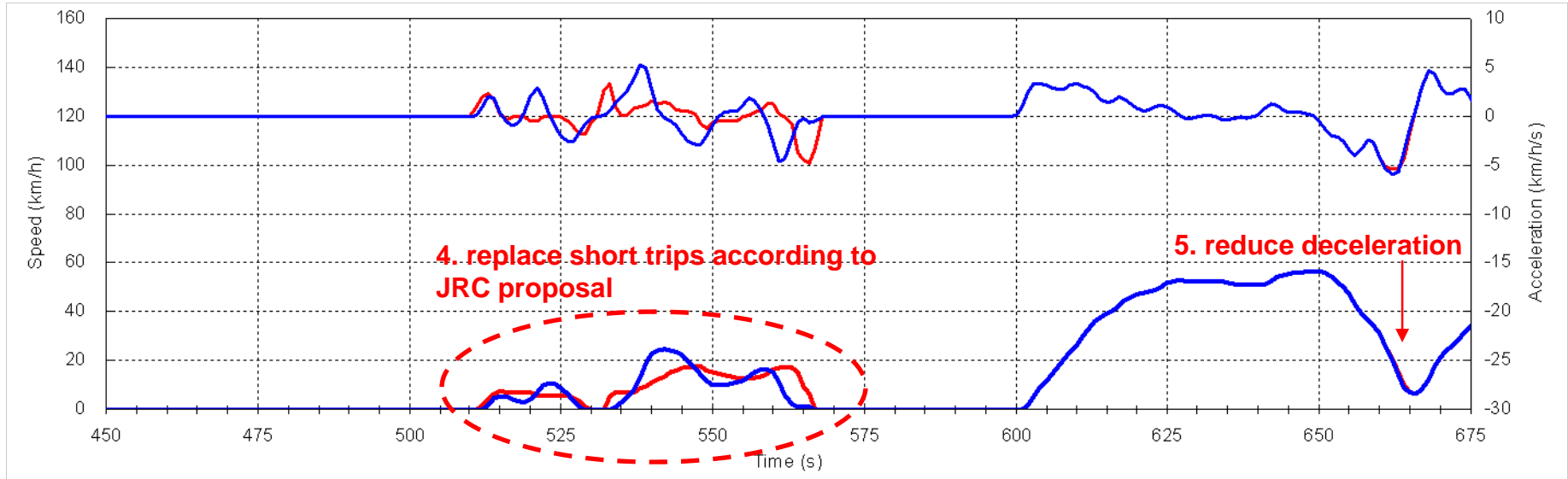
➤ Drivability / reproducibility

- Because Low speed portion (e.g. creep drive) have an adverse influence on drivability and reproducibility, minimum speed should be set to V_{idle} on 1st gear

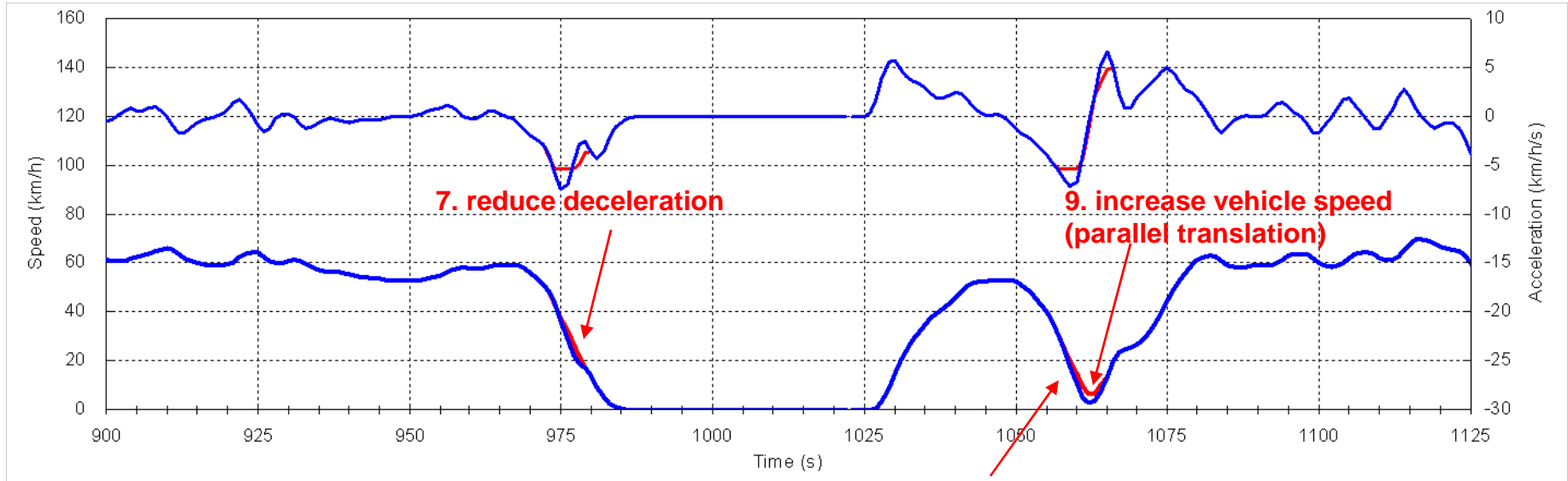
4.1. Proposal for modification



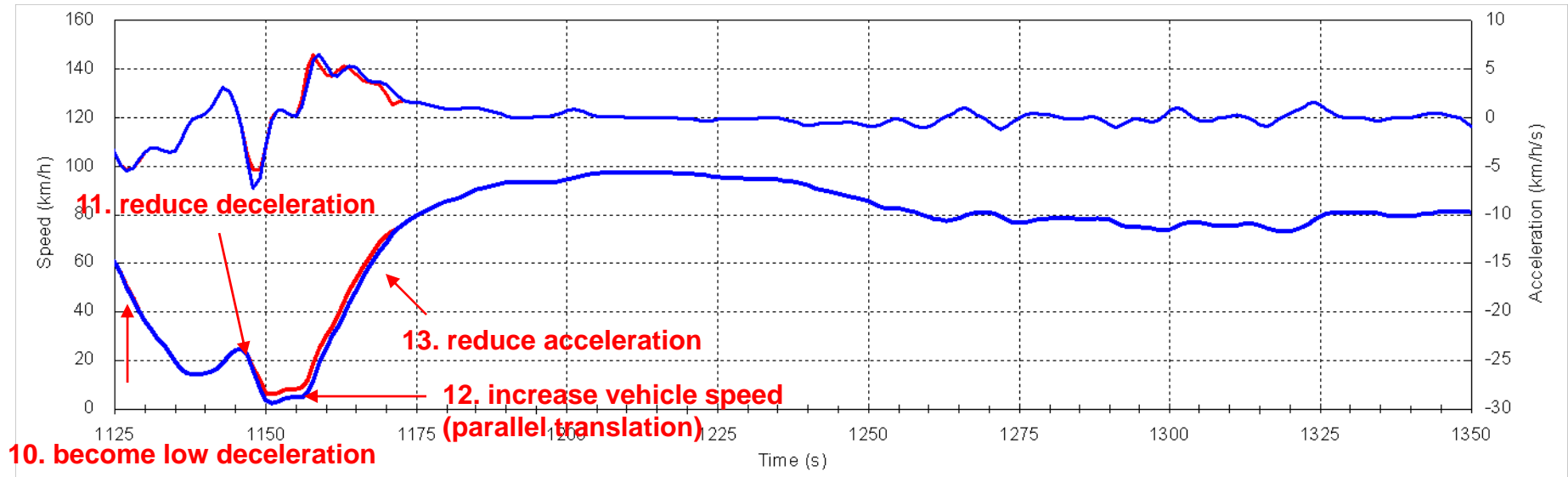
4.2. Proposal for modification



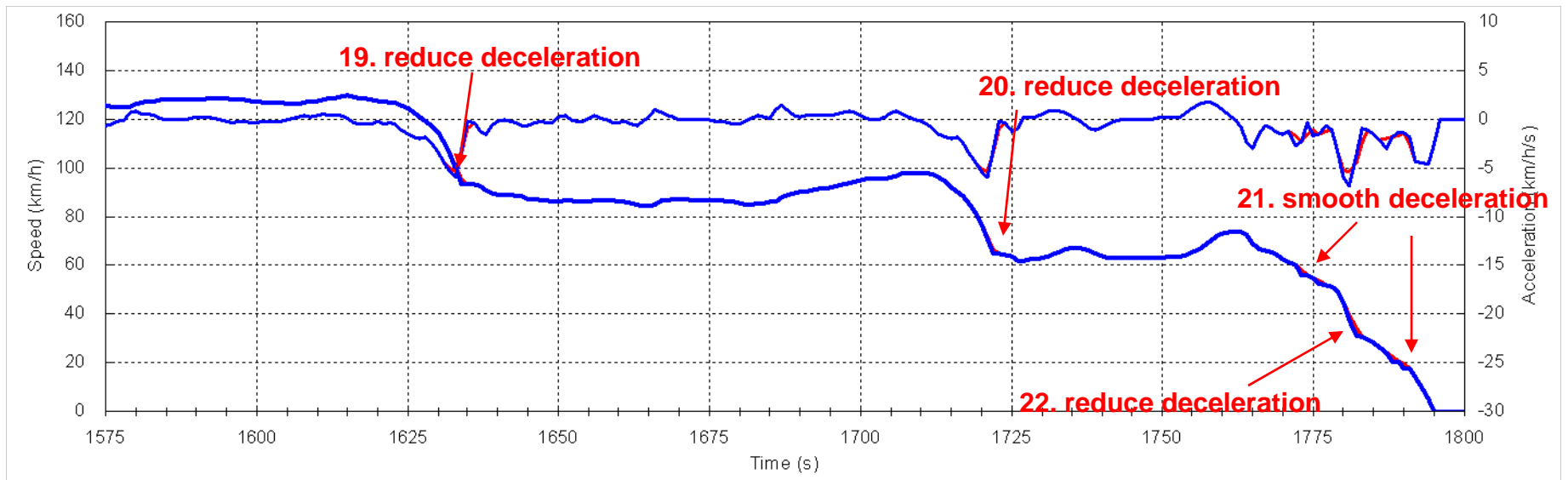
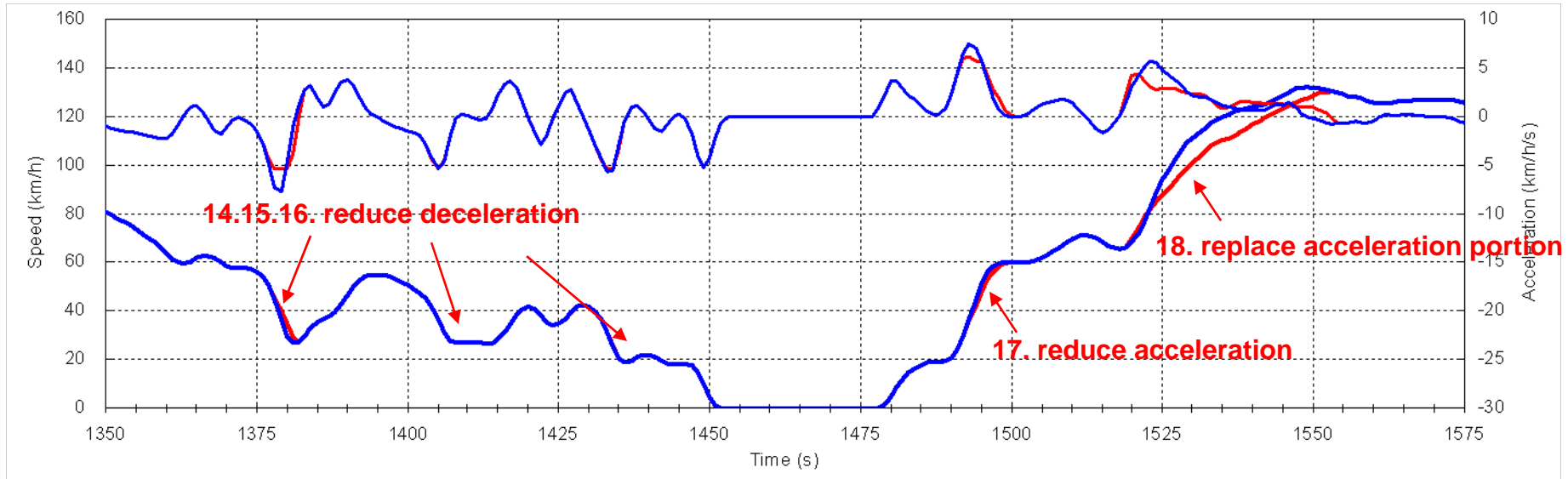
4.3. Proposal for modification



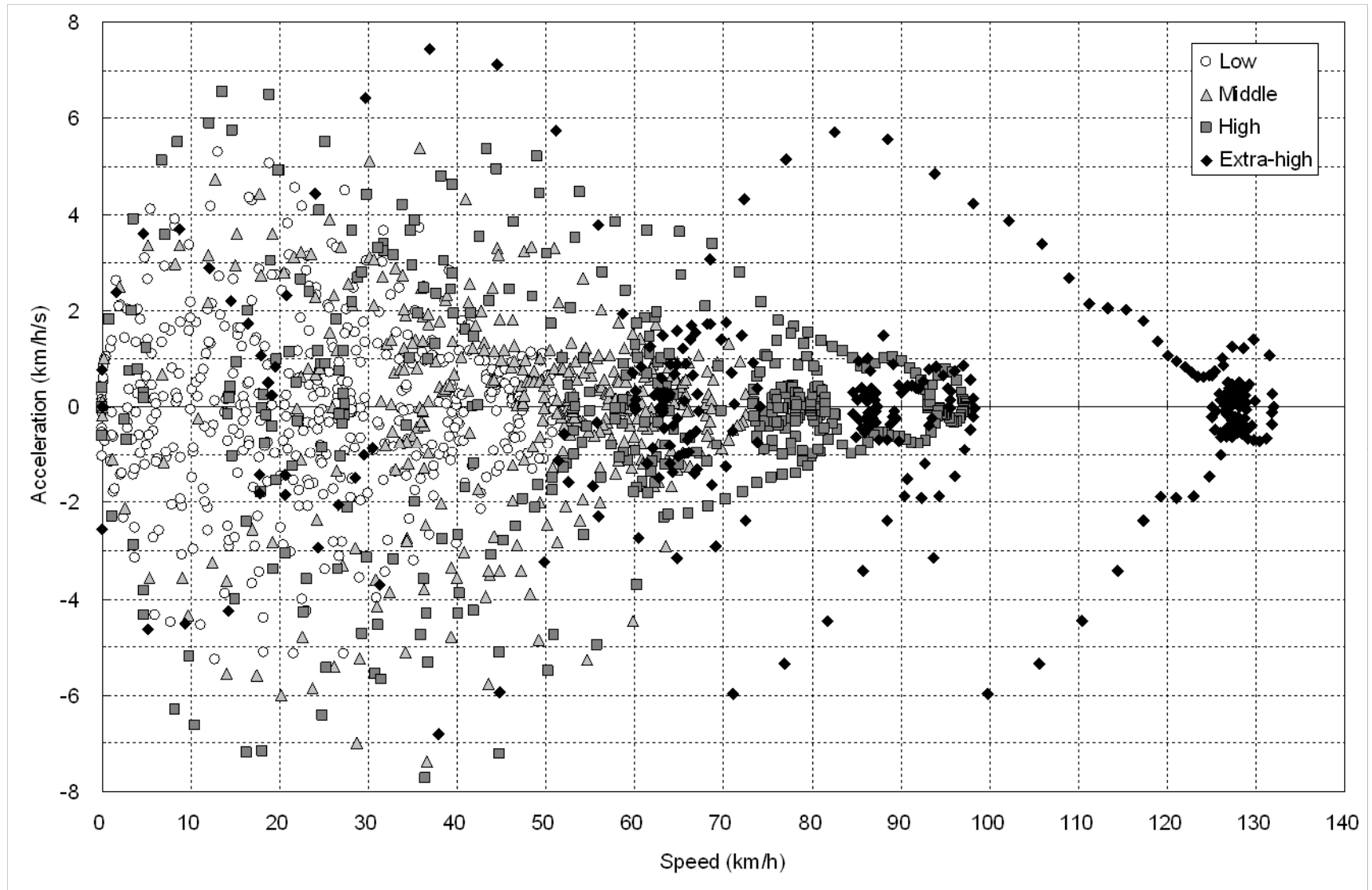
8. reduce deceleration



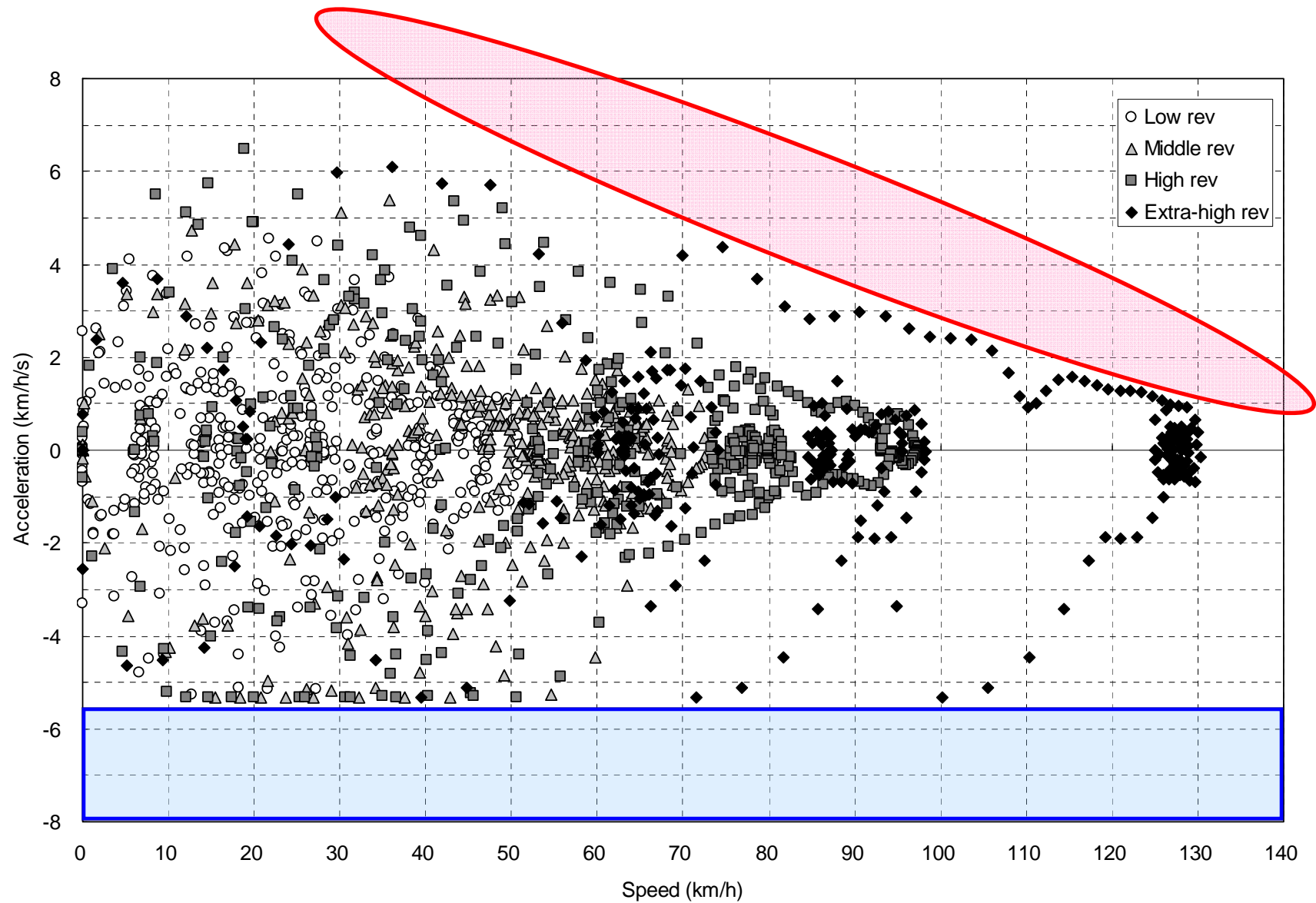
4.4. Proposal for modification



4.5. VA distribution of WLTC v2



4.6. VA distribution of WLTC v2 rev.



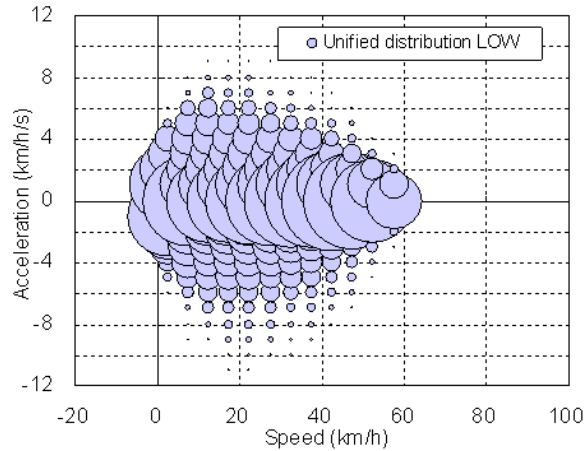
5.1. Influence for X² value

Phase	Cycle	Cycle duration	Driving distance	Average speed	Max. speed	Max. acceleration	Max. Deceleration	RPA	Acceleration ratio	Deceleration ratio	Cruise ratio	Idling ratio	Chi-squared value
-	-	s	km	km/h	km/h	km/h/s	km/h/s	m/s ²	%	%	%	%	-
Low	Unified	-	-	19.8	60.0	-	-	0.192	27.5	25.4	22.7	24.5	-
	WLTC v2	589	3.0	18.2	50.9	5.3	-5.3	0.165	26.1	27.8	19.7	26.3	0.248
	WLTC v2 rev.	589	3.0	18.4	50.9	4.5	-5.3	0.158	26.0	26.5	22.6	25.0	0.295
Mid	Unified	-	-	38.4	80.0	-	-	0.188	31.4	27.5	28.8	12.2	-
	WLTC v2	433	5.0	41.6	72.5	5.4	-7.4	0.155	37.0	24.2	27.7	11.1	0.640
	WLTC v2 rev.	433	5.0	41.7	72.5	5.4	-5.3	0.155	37.0	24.5	27.5	11.1	0.668
High	Unified	-	-	58.0	110.0	-	-	0.156	31.3	27.2	35.5	6.0	-
	WLTC v2	455	7.0	55.5	97.4	6.5	-7.7	0.144	29.0	28.8	35.2	7.0	0.963
	WLTC v2 rev.	455	7.1	55.8	97.4	6.5	-5.3	0.143	28.8	28.8	36.0	6.4	0.883
Ex-high	Unified	-	-	86.8	194.7	-	-	0.108	25.7	23.4	48.9	2.0	-
	WLTC v2	323	7.7	86.0	132.0	7.4	-6.8	0.127	25.4	25.4	47.7	1.5	5.259
	WLTC v2 rev.	323	7.7	85.4	130.4	6.1	-5.3	0.126	26.9	25.7	45.8	1.5	4.413

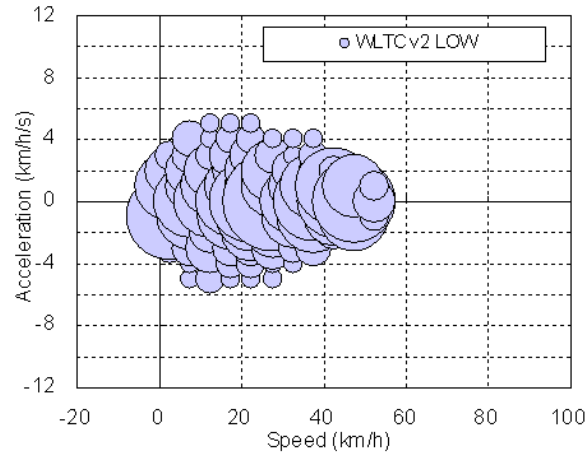
In HIGH and Ex-high phase, When the cycle was modified, X² value become smaller and then test cycle have more representativeness

5.2. Comparison of VA distribution – LOW & MIDDLE

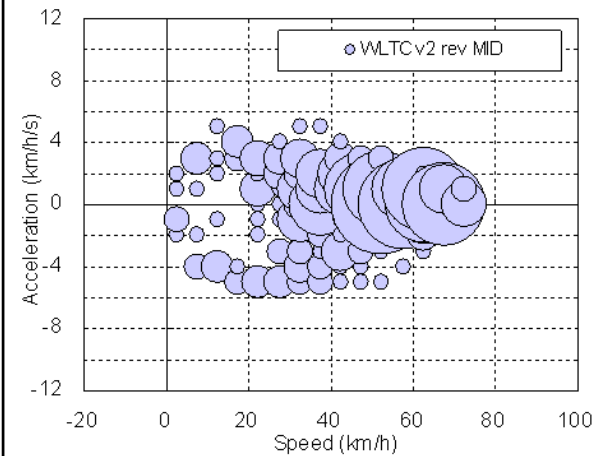
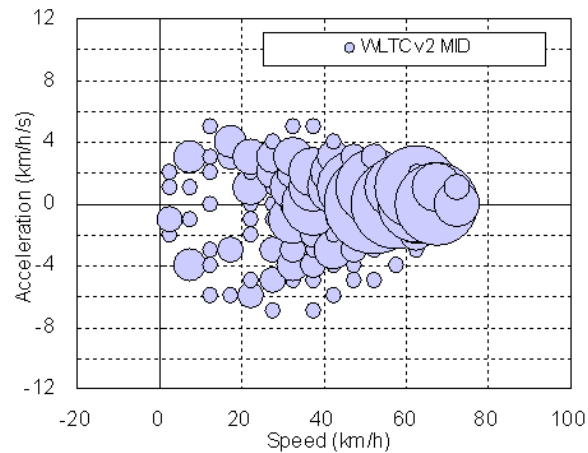
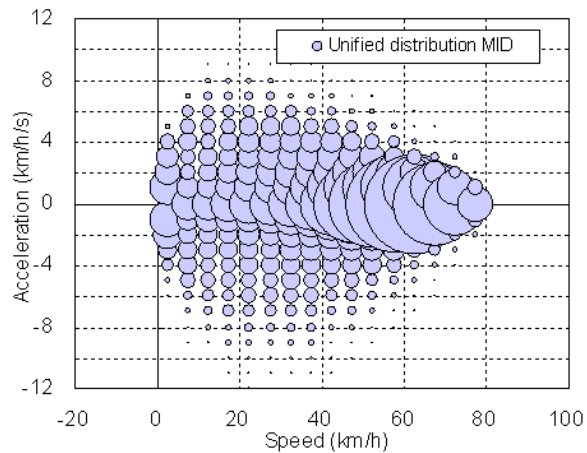
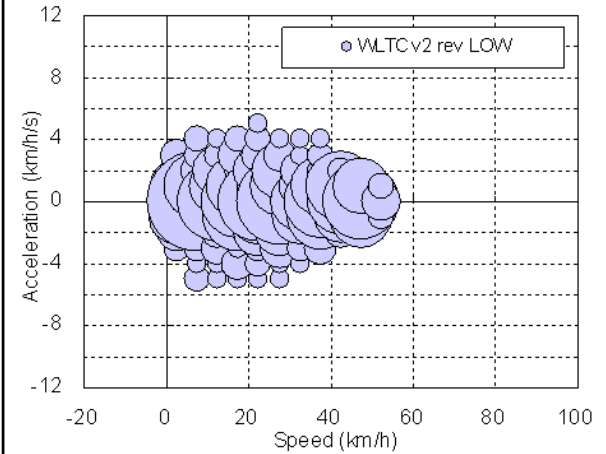
[Unified distribution]



[WLTC v2]

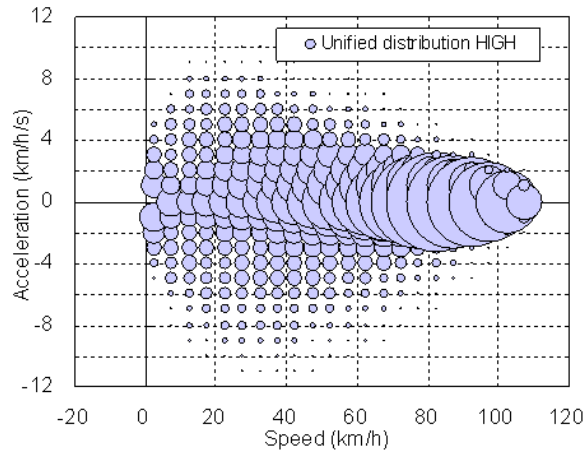


[WLTC v2 rev]

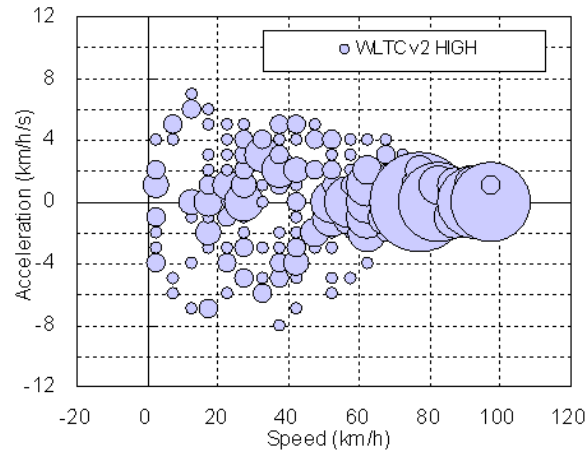


5.3. Comparison of VA distribution – HIGH & Ex-HIGH

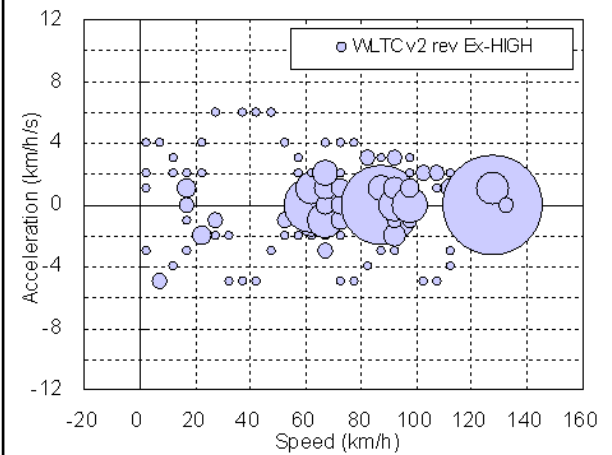
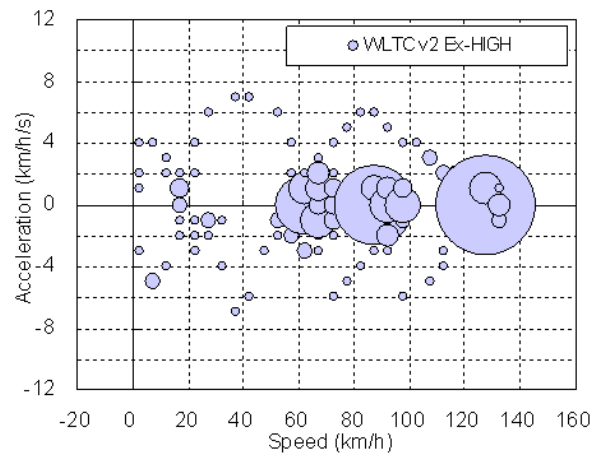
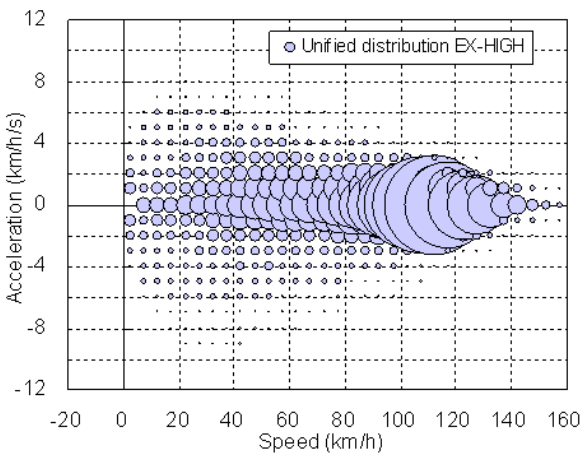
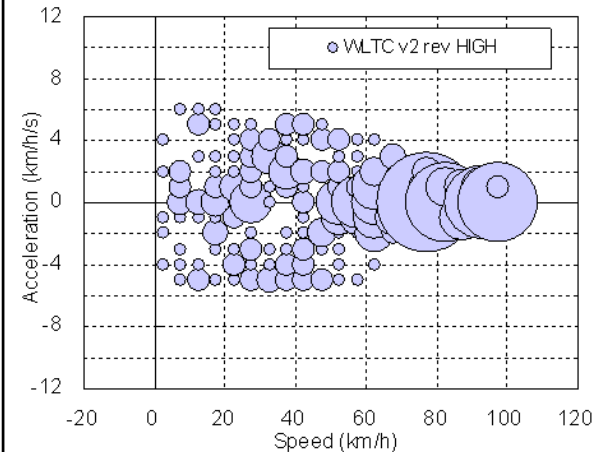
[Unified distribution]



[WLTC v2]

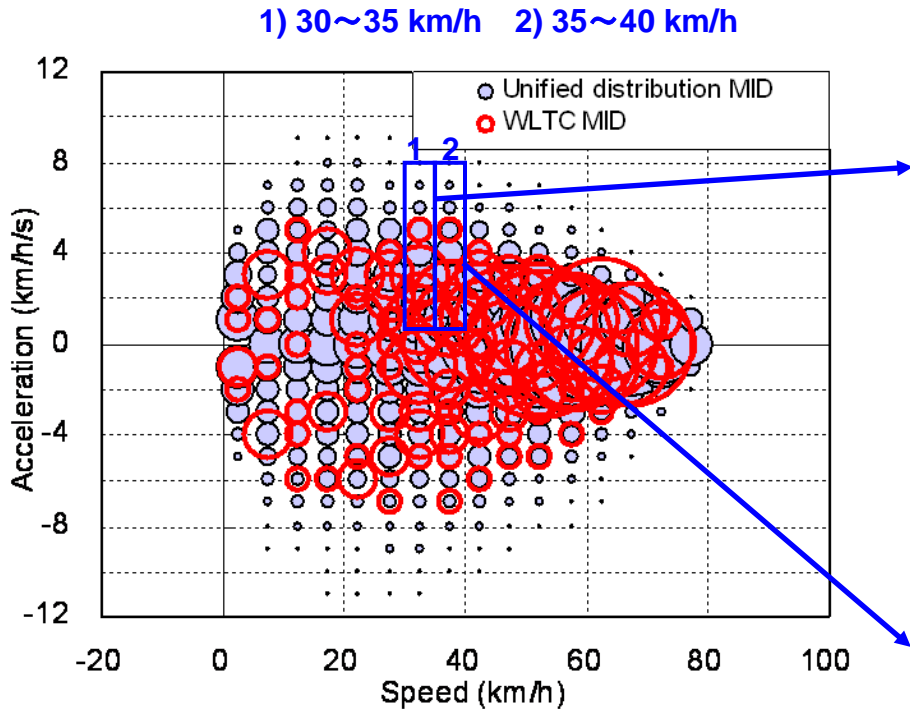


[WLTC v2 rev]



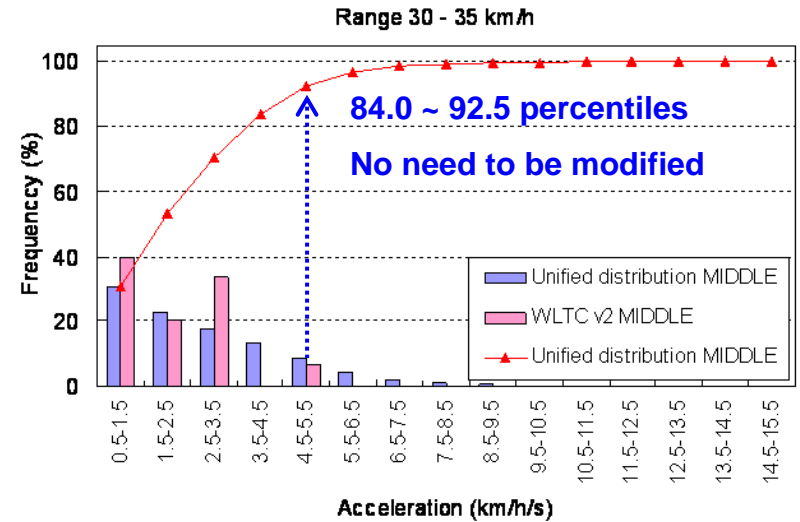
6.1.1. Review acceleration for MIDDLE phase

[MIDDLE phase]

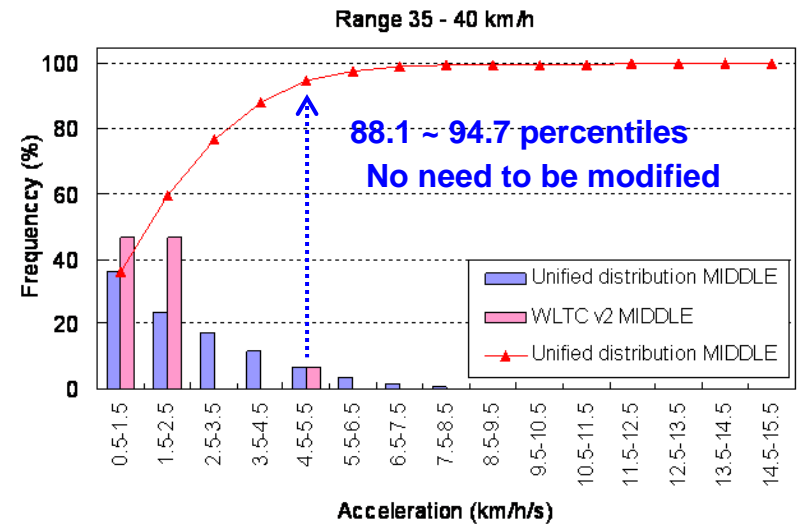


Because acceleration in middle phase keep in 95percentiles, it is not necessary to modify the acceleration parts in middle phase

1) 30~35 km/h

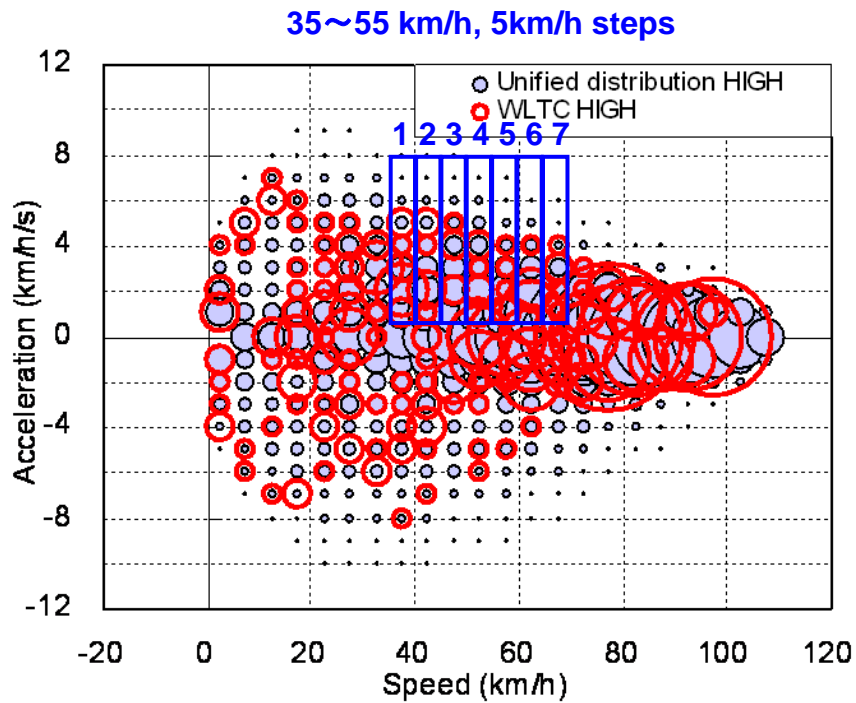


2) 35~40 km/h

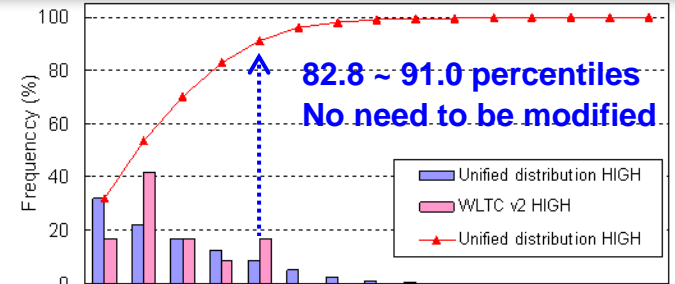


6.1.2. Review acceleration for HIGH phase - 1

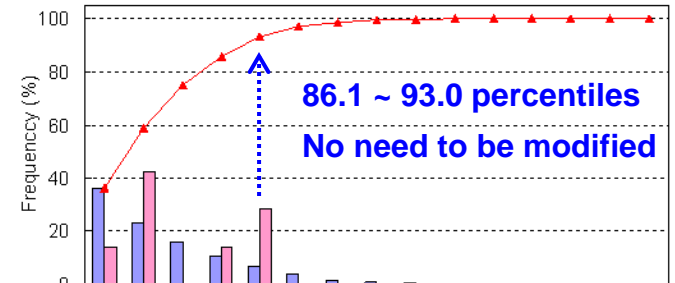
[HIGH phase]



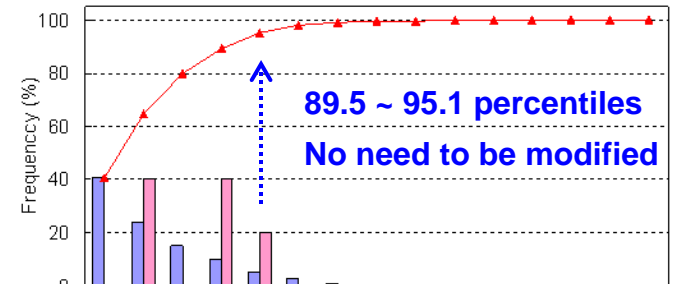
(1) 35 – 40 km/h



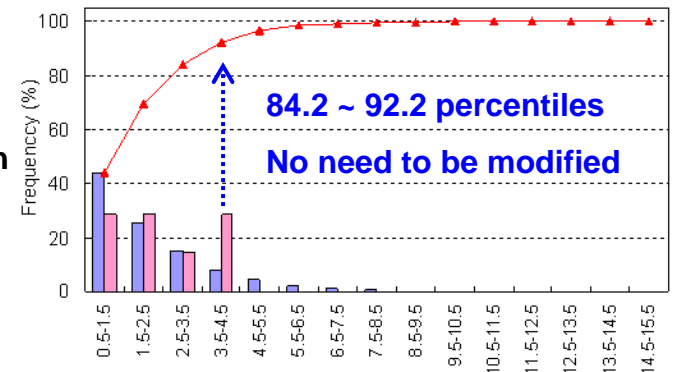
(2) 40 – 45 km/h



(3) 45 – 50 km/h

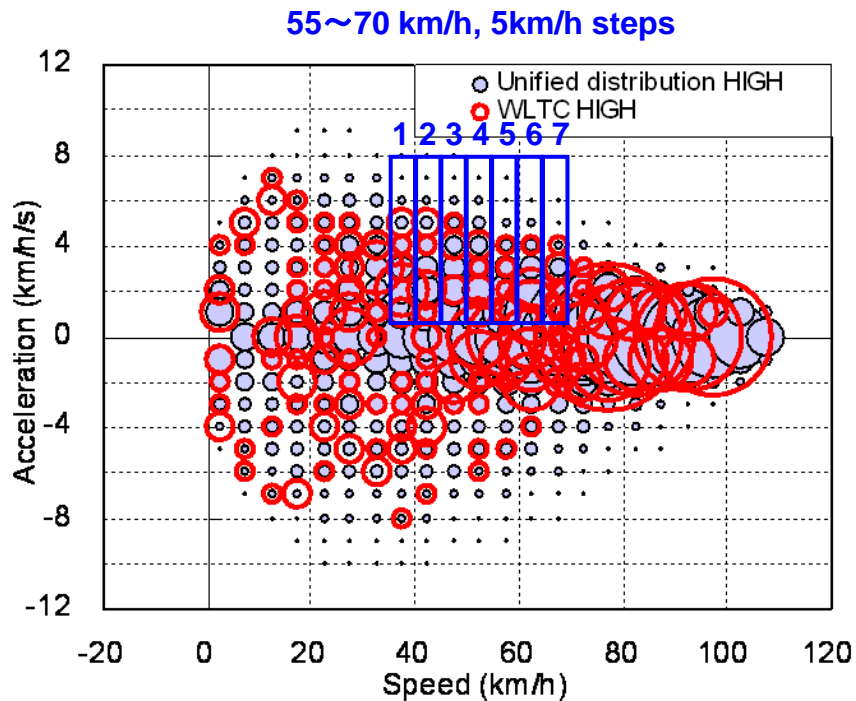


(4) 50 – 55 km/h



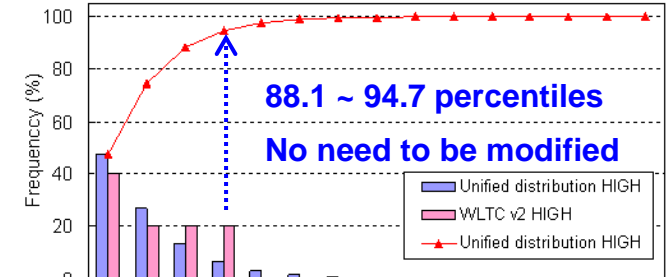
6.1.3. Review acceleration for HIGH phase - 2

[HIGH phase]

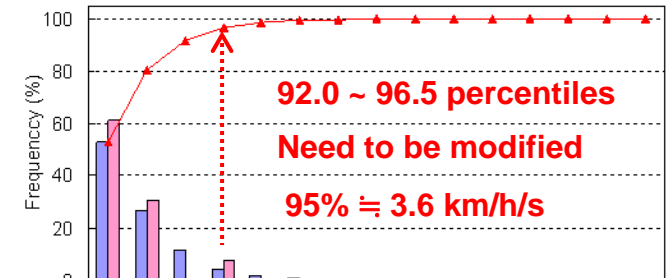


In HIGH phase, acceleration exceed 95 percentiles in the range of 60 to 70 km/h, Therefore it is necessary to reduce acceleration

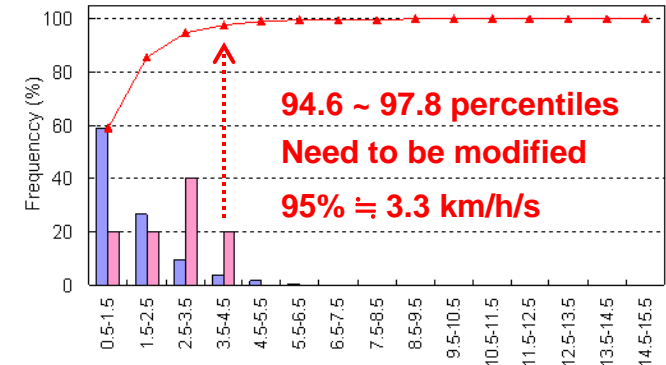
(5) 55 – 60 km/h



(6) 60 – 65 km/h

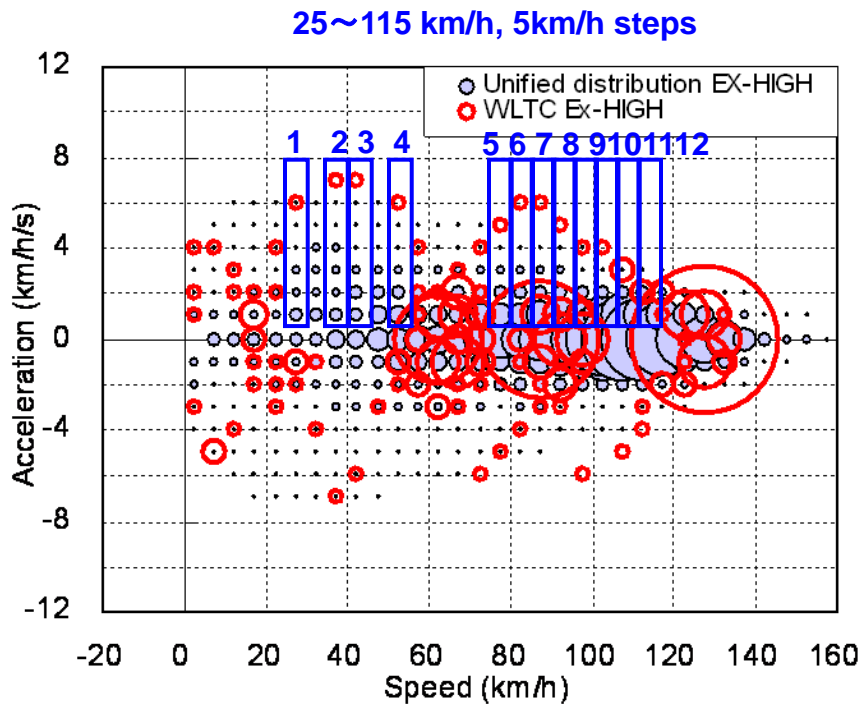


(7) 65 – 70 km/h

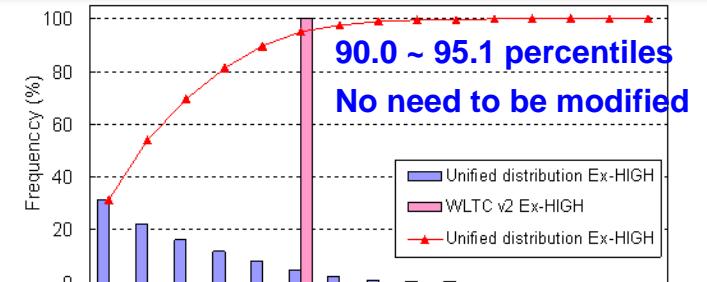


6.1.4. Review acceleration for Ex-HIGH phase-1

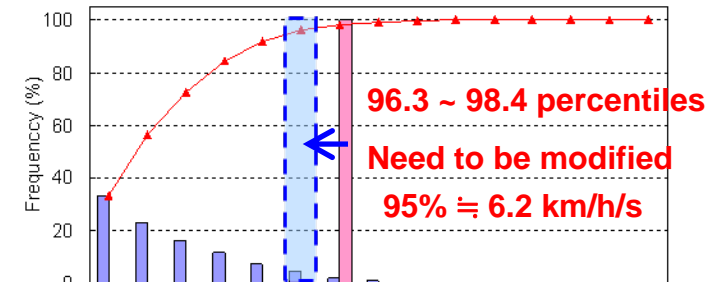
[Ex-HIGH phase]



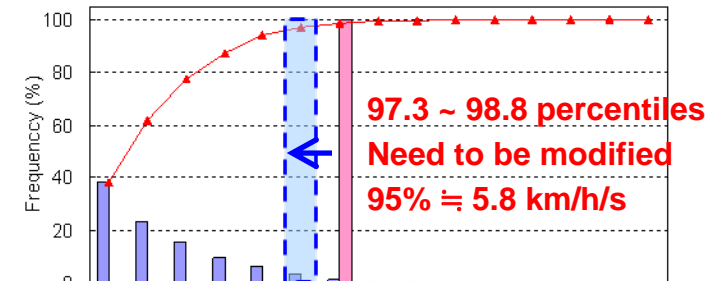
(1) 25 – 30 km/h



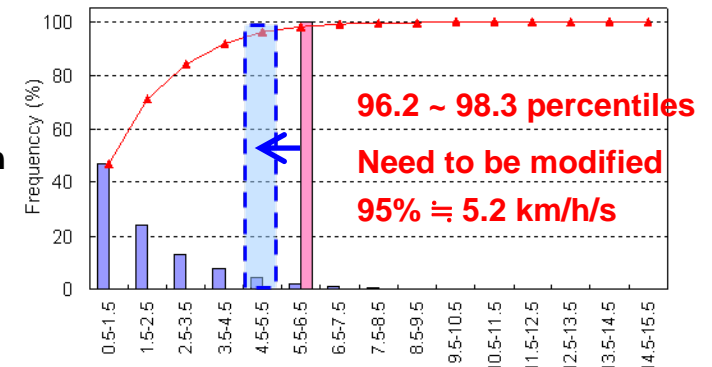
(2) 35 – 40 km/h



(3) 40 – 45 km/h

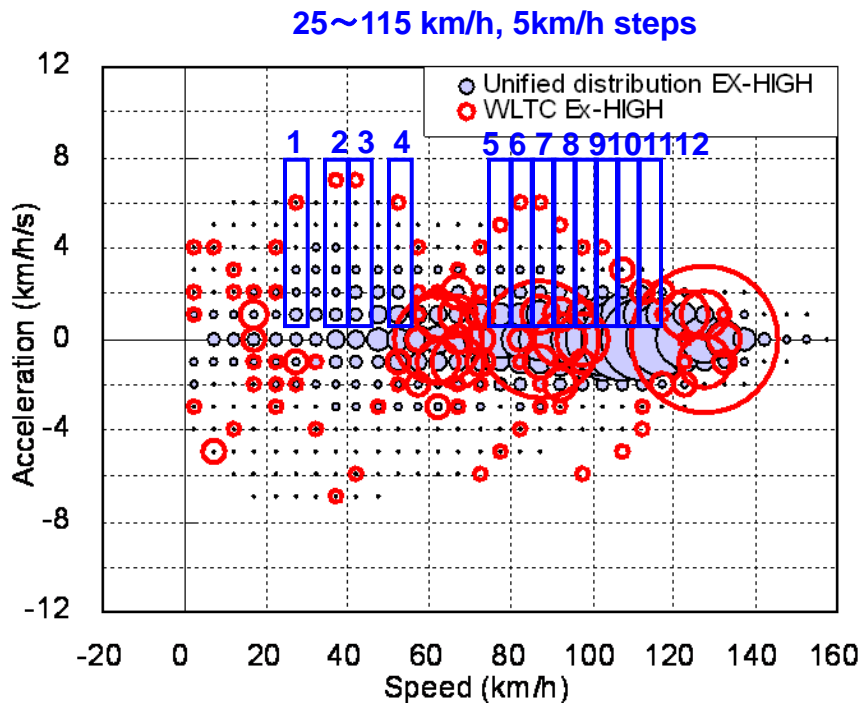


(4) 50 – 55 km/h

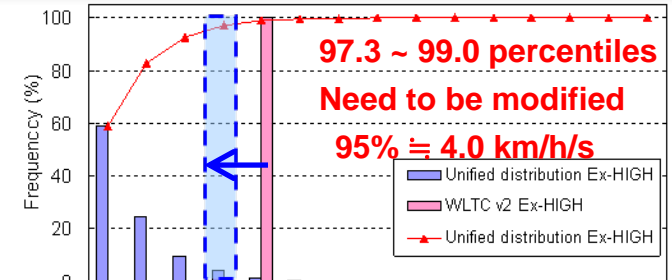


6.1.5. Review acceleration for Ex-HIGH phase-2

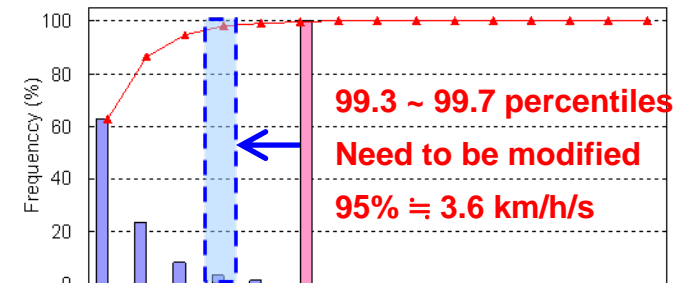
[Ex-HIGH phase]



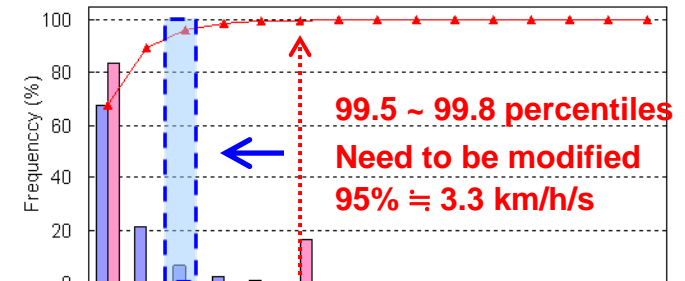
(5) 75 – 80 km/h



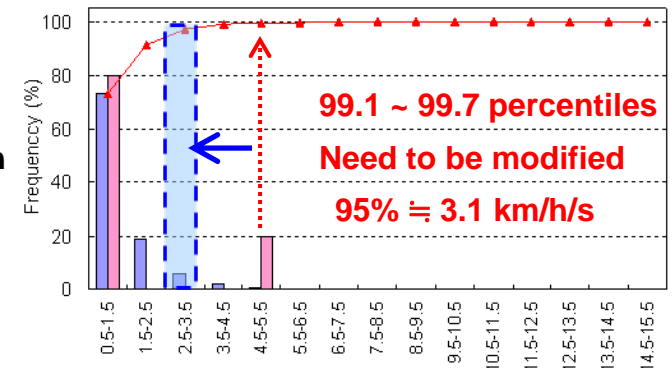
(6) 80 – 85 km/h



(7) 85 – 90 km/h

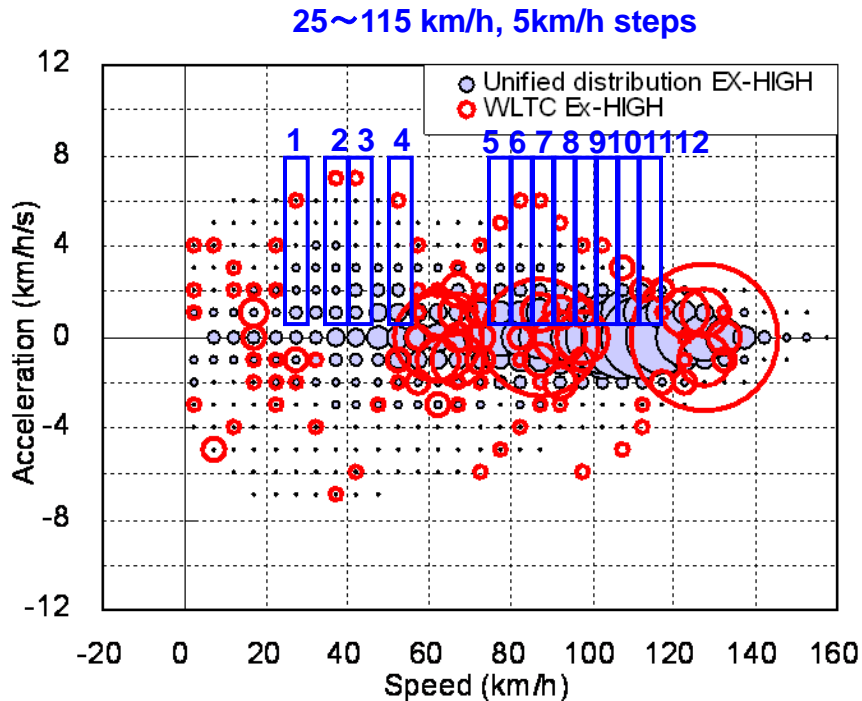


(8) 90 – 95 km/h



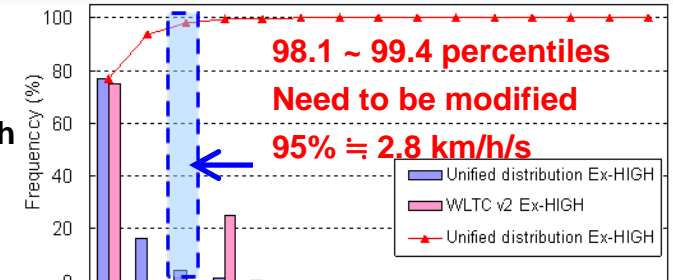
6.1.6. Review acceleration for Ex-HIGH phase-3

[Ex-HIGH phase]

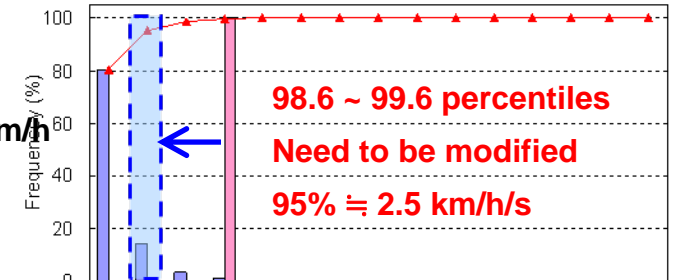


In Ex-HIGH phase, acceleration exceed 95 percentiles in the range of 35 to 55 km/h and 75 to 115 km/h. Therefore it is necessary to reduce acceleration

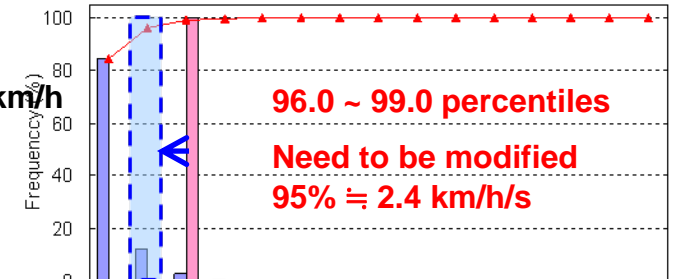
(9) 95 – 100 km/h



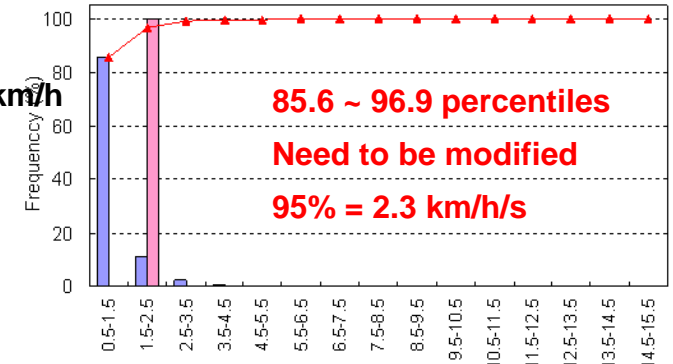
(10) 100 – 105 km/h



(11) 105 – 110 km/h



(12) 110 – 115 km/h



6.2.1. Acceleration portion for Ex-HIGH

- The 95% of cumulative frequency in each speed range are as follows;

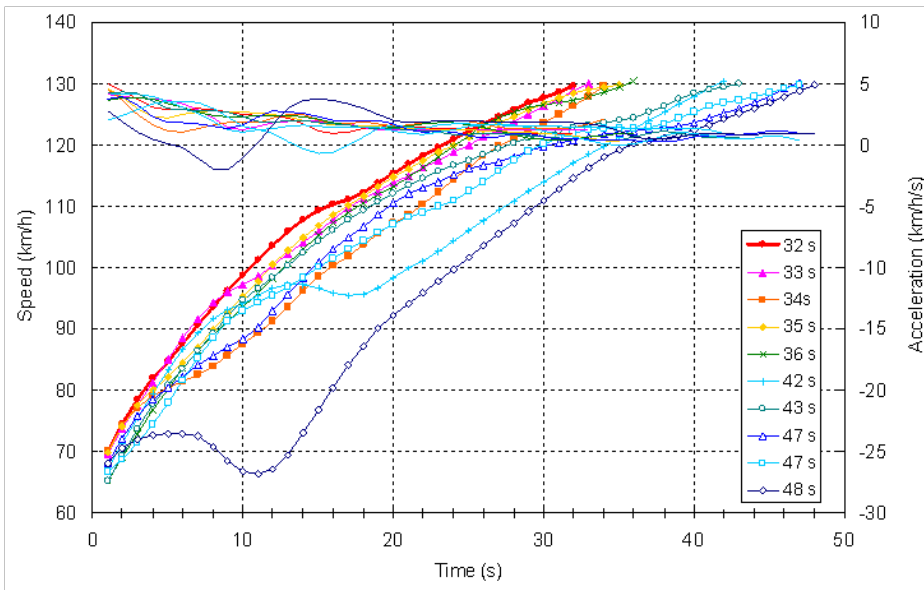
Ex-HIGH	95 percentiles
75 – 85	3.5 – 4.5 km/h/s
85 - 100	2.5 – 3.5 km/h/s
100 - 115	1.5 – 2.5 km/h/s

- Search acceleration portion which meet the above criteria from in-use database
- Select the shortest / highest acceleration one

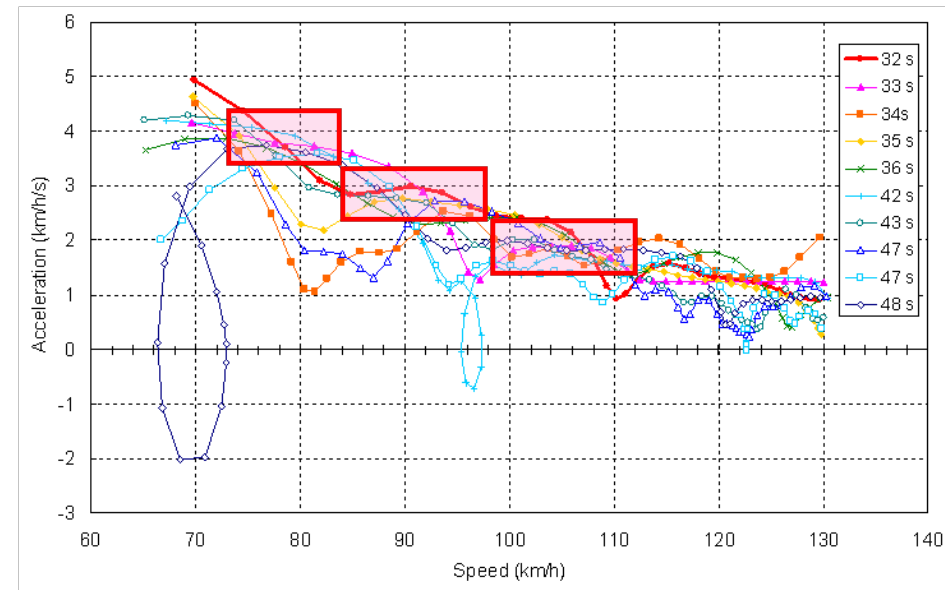
6.2.2. Ex-HIGH (65-130 km/h)

65-130km/hまでの区間を32秒で到達する加速データを選択

[Time series 60 – 130 km/h]



[Speed vs. Acceleration]



6.3. maximum deceleration

- For light duty truck and/or FR (front engine – rear drive) vehicle, maximum deceleration should be reviewed. Maximum deceleration of current test cycle for certification is as follows;

	NEDC	UDDS	JC08
Maximum deceleration	-5.00 km/h/s (-1.389 m/s ²)	-5.31 km/h/s (-1.475 m/s²)	-4.05 km/h/s (-1.125 m/s ²)

- It's preferable to be the maximum deceleration of -5.31 km/h/s

6.4. Minimum speed of short trip (Vidle of 1st gear)

Minimum vehicle speed should be 6.2km/h

(Unit: km/h)

Gear	Average of V_{1000}	Average of V_{idle}
1	7.5	6.2
2	15.0	12.4
3	22.5	18.6
4	29.9	24.8
5	37.6	31.0
6	46.7	37.7

(*) Vidle: Vehicle speed @ idling engine speed

*) Calculated based on vehicle specification of submitted in-use driving data)