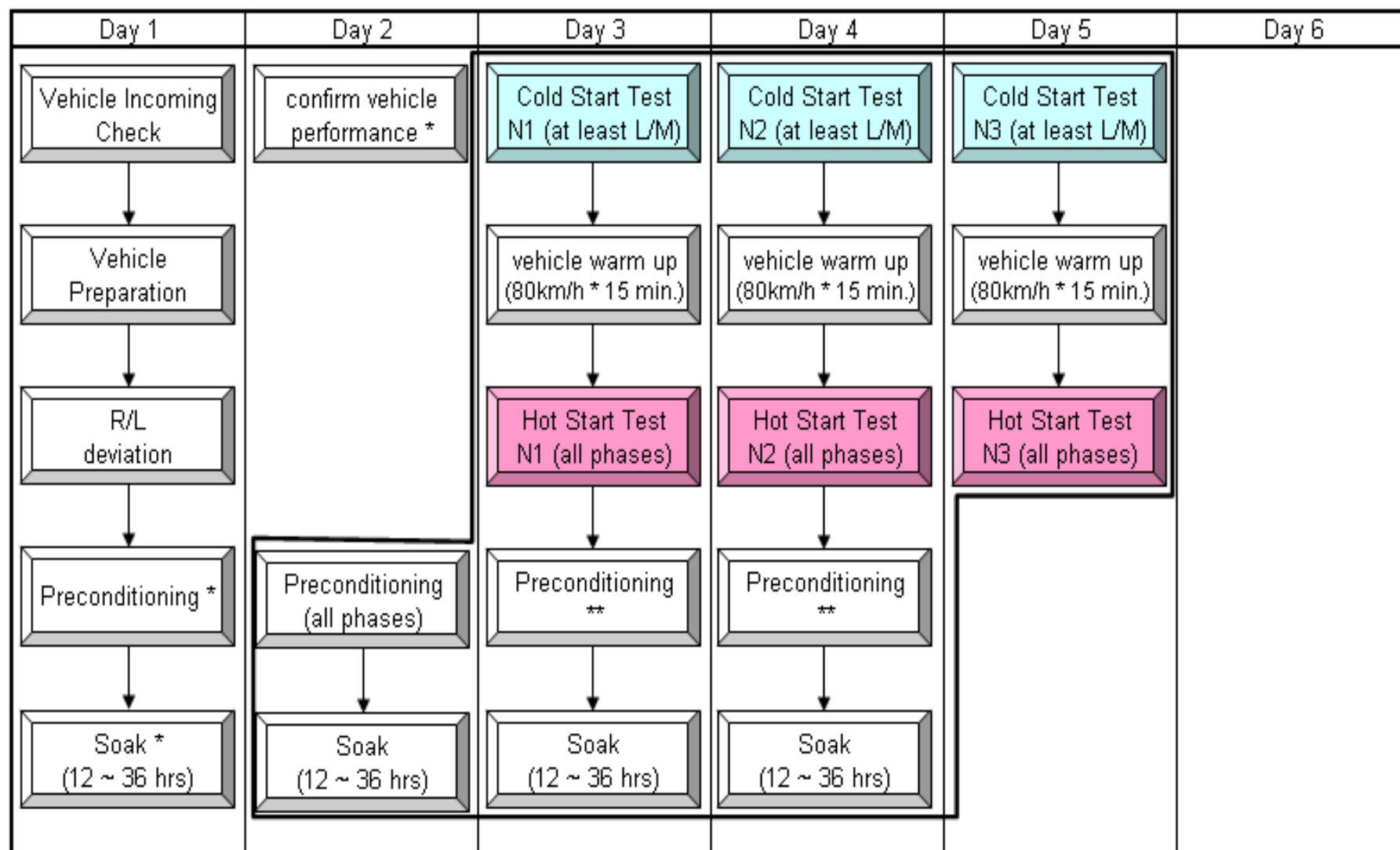


# **WLTP-DHC Validation Phase I**

## **Results and Recommendations by India**

DHC Subgroup 10<sup>th</sup> Meeting - VTF Meeting  
11 – 13<sup>th</sup> Oct 2011, Brussels

# Test Sequence as per WLTP-DHC-Validation1-01 Overview.ppt

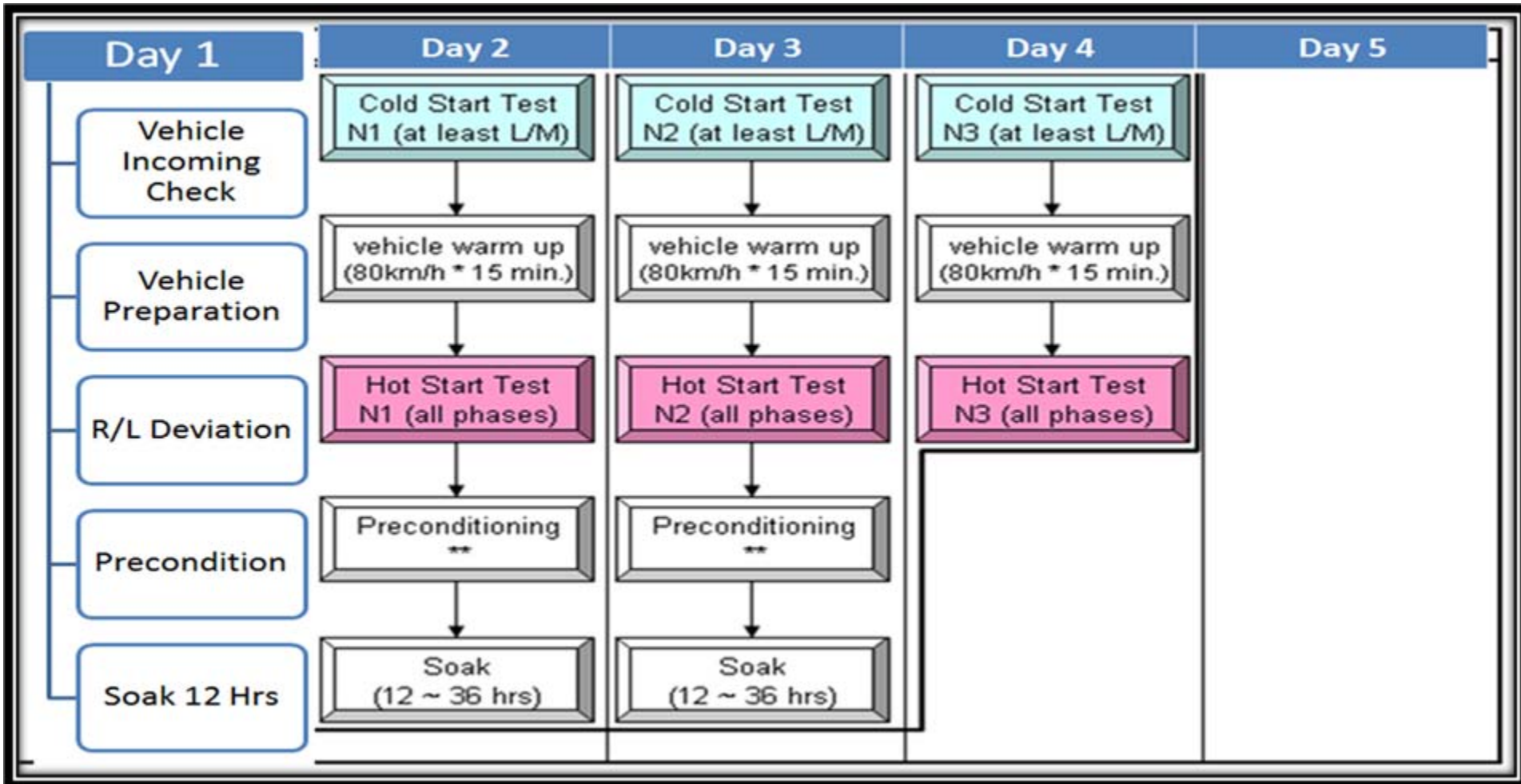


\*) recommended

run the current test procedure to confirm the proper vehicle operations

\*\*) can be skipped

# Test Sequence actually followed for Validation I



\*) Recommended  
run the current test procedure to confirm the proper vehicle operations

\*\* Can be skipped

**Vehicles < 20 kW - warm up at 50 kmph, 15 min**

# Details of Test Vehicles

Vehicle	1	2	3	4	5	6	7	8	9
Vehicle Category	LDCV	LDCV	PC	PC	PC	PC	PC	PC	PC
Model name	Ace	Ape Truck	Gio	Nano	Alto	Wagon R	EECO	Swift	i 20
Manufacturer	TML	Piaggio	M&M	TML	MSIL	MSIL	MSIL	MSIL	HMIL
Vmax, km/h	70	70	59	105	135	145	132	160	166
Fuel	Diesel	Diesel	Diesel	Petrol	Petrol	Petrol	CNG	Diesel	Petrol
Emission Norm	BS-III	BS-III	BS-III	BS-IV	BS-IV	BS-IV	BS-IV	BS-IV	BS-IV
Engine cc	702	1034	441	623	796	996	1196	1248	1197
Max. power (kW/@ rpm)	11.57 / 3200	19.5 / 3600	6.8/ 3600	28 / 5500	35 / 6200	50 / 6200	54.43 / 6000	55 / 4000	59 / 5200
Kerb wt (kg)	840	850	640	615	795	870		1080	1033
Transmission	4MT	5 MT	4MT	4MT	5 MT	5 MT	5 MT	5MT	5 MT
After treatment	DOC	DOC	DOC	TWC	TWC	TWC		DOC	TWC

# Details of Test Vehicles



**Maruti Suzuki Swift**



**Hyundai i20**



**Mahindra GIO**



**Maruti Suzuki EECO CNG**



**Maruti Suzuki Alto**



**TATA ACE**



**Maruti Suzuki Wagon R**



**TATA Nano**



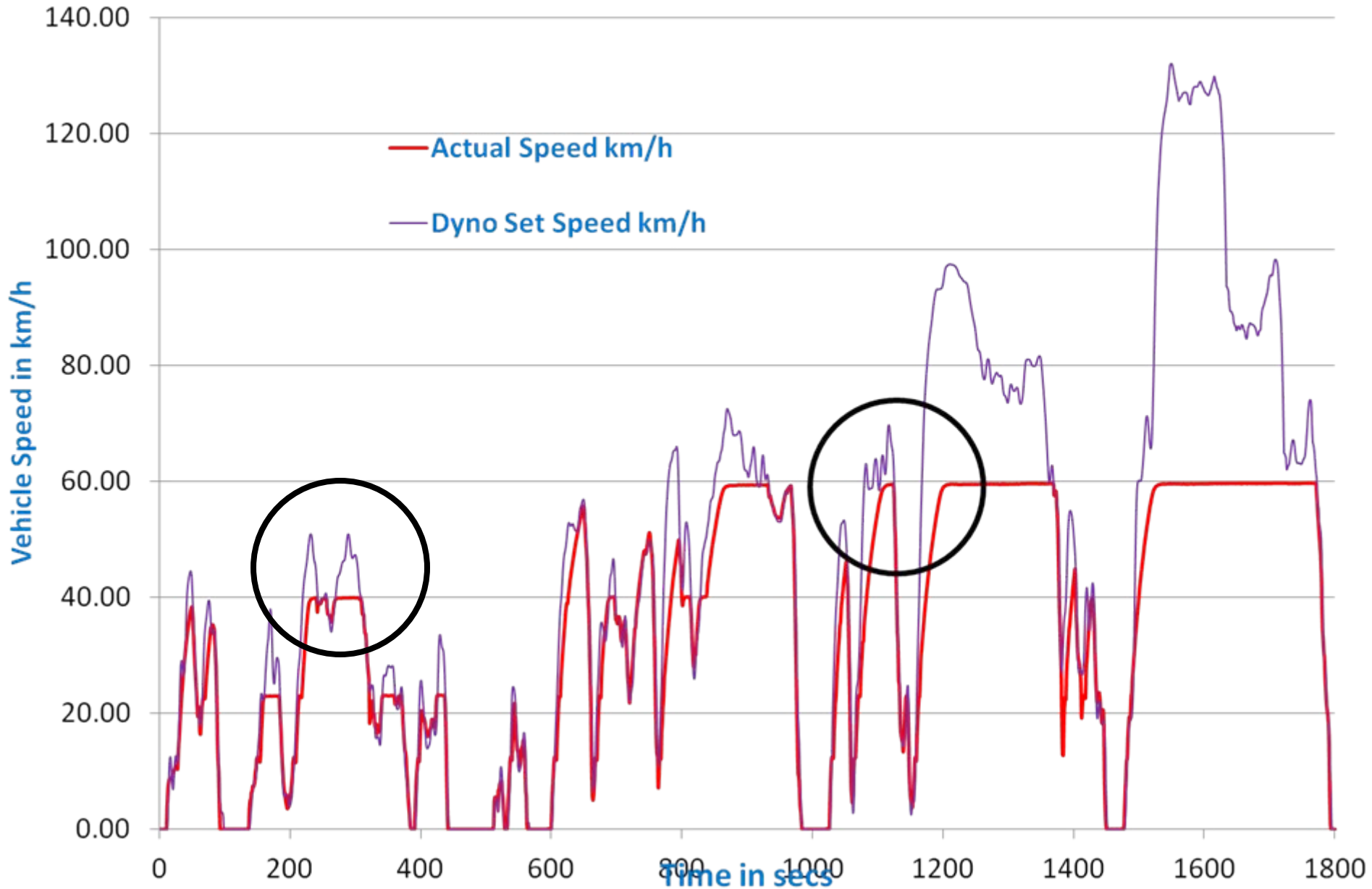
**Piaggio APE**

# Key Concerns

- ☐ **Drivability**
- ☐ **Max Speed**
- ☐ **Gear Shift Pattern**
- ☐ **Acceleration / Deceleration**

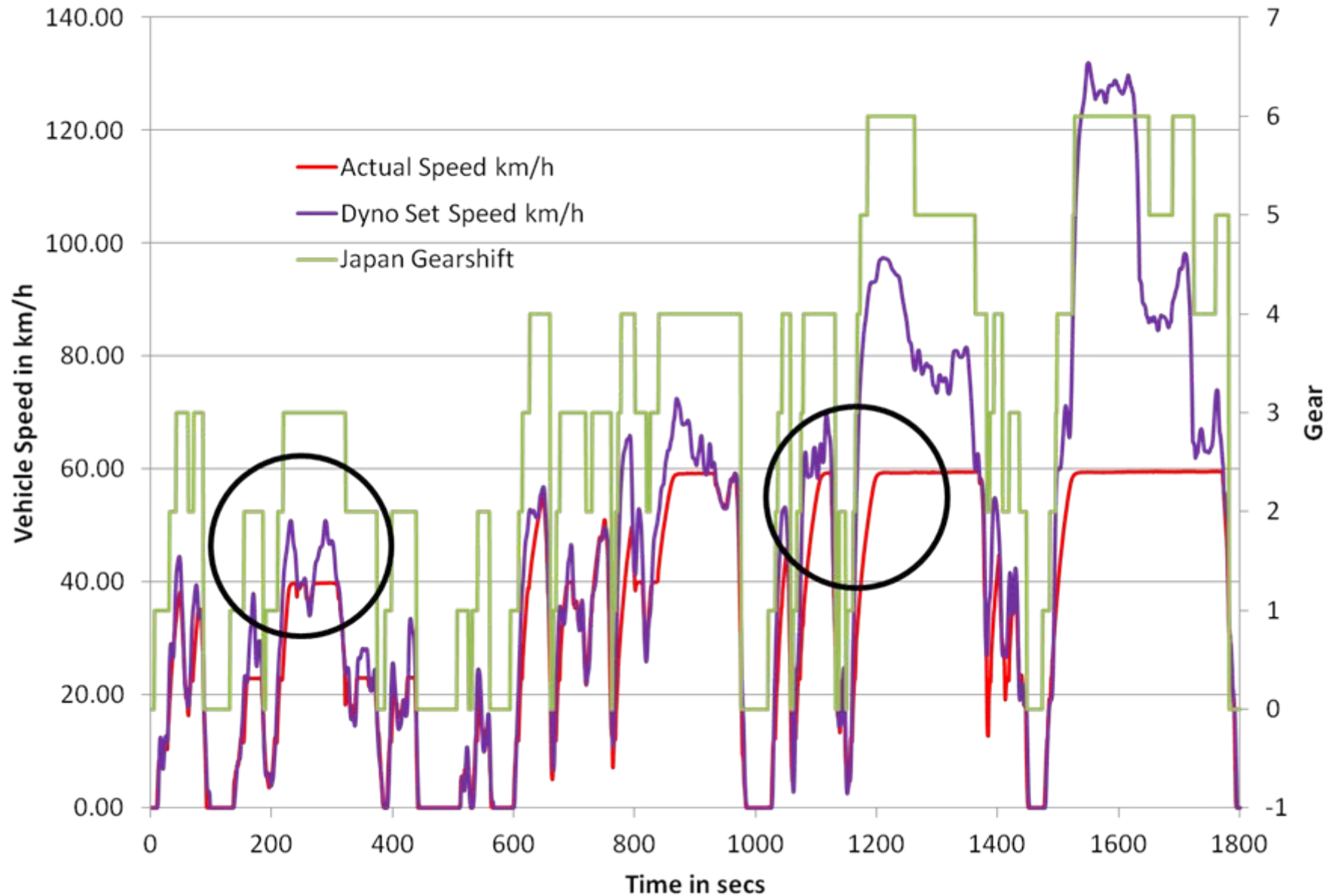
**Drivability**

# Japan Gear Shifting: GIO \_Cold Start

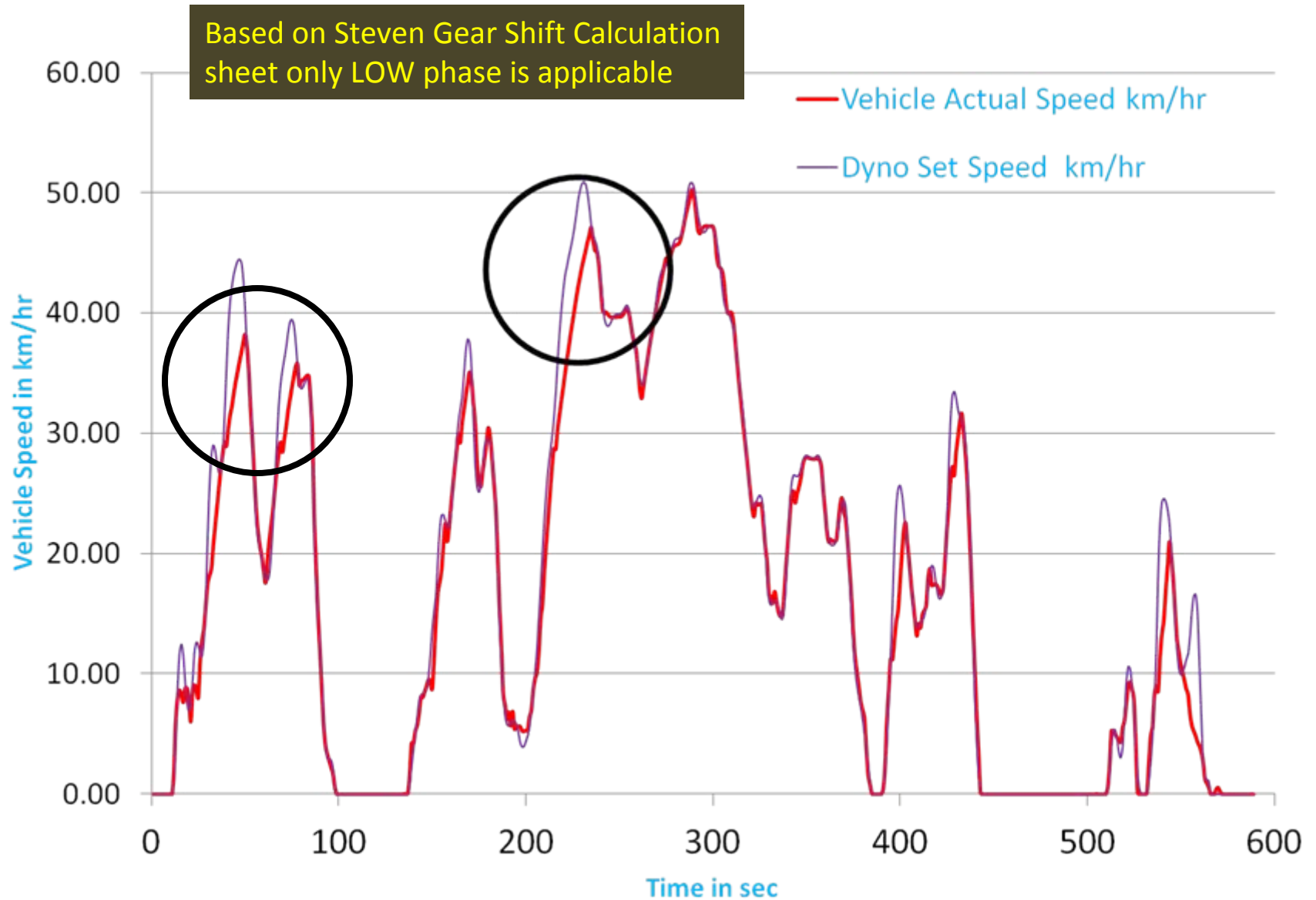




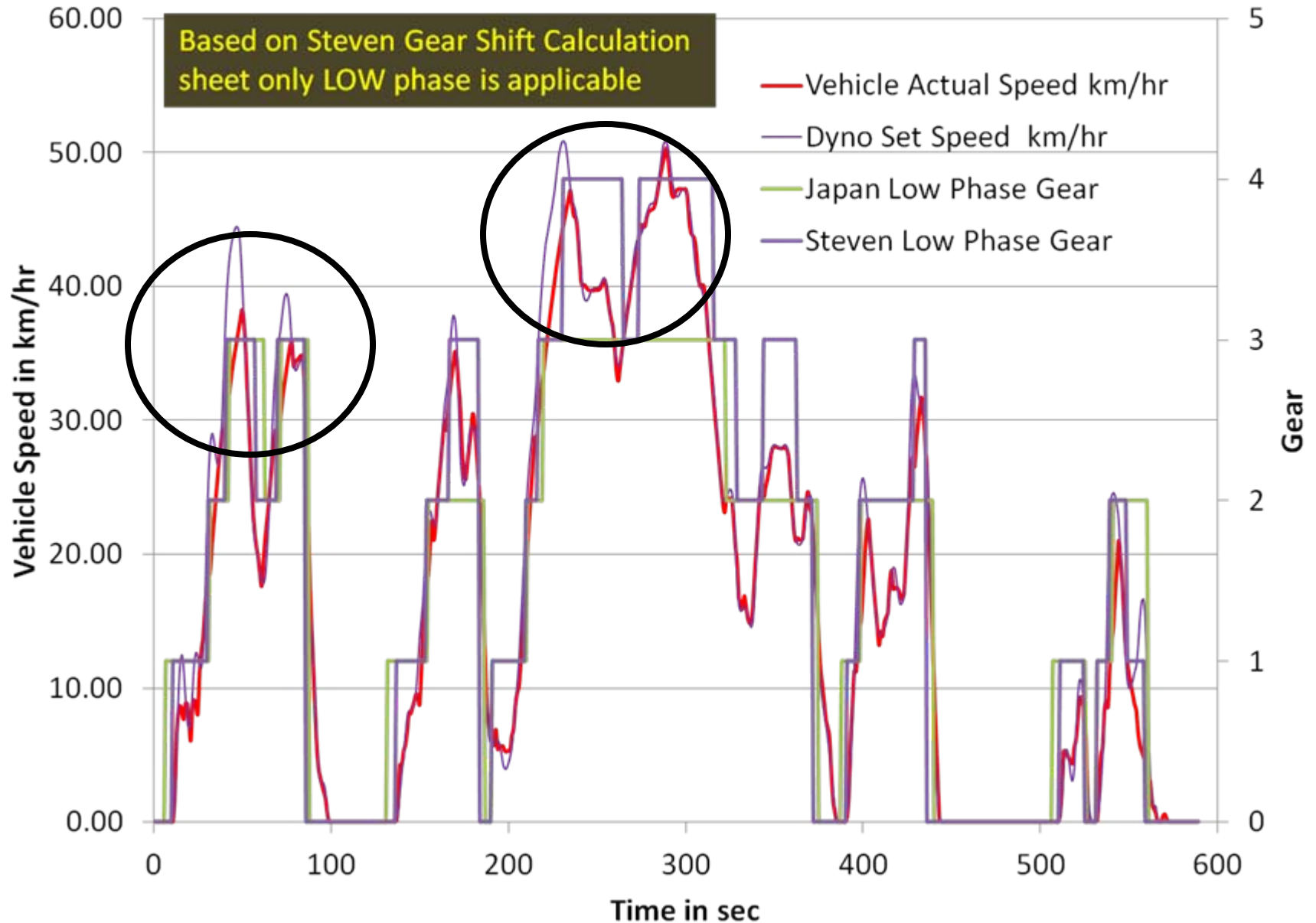
# Japan Gear Shifting: GIO\_Cold Start



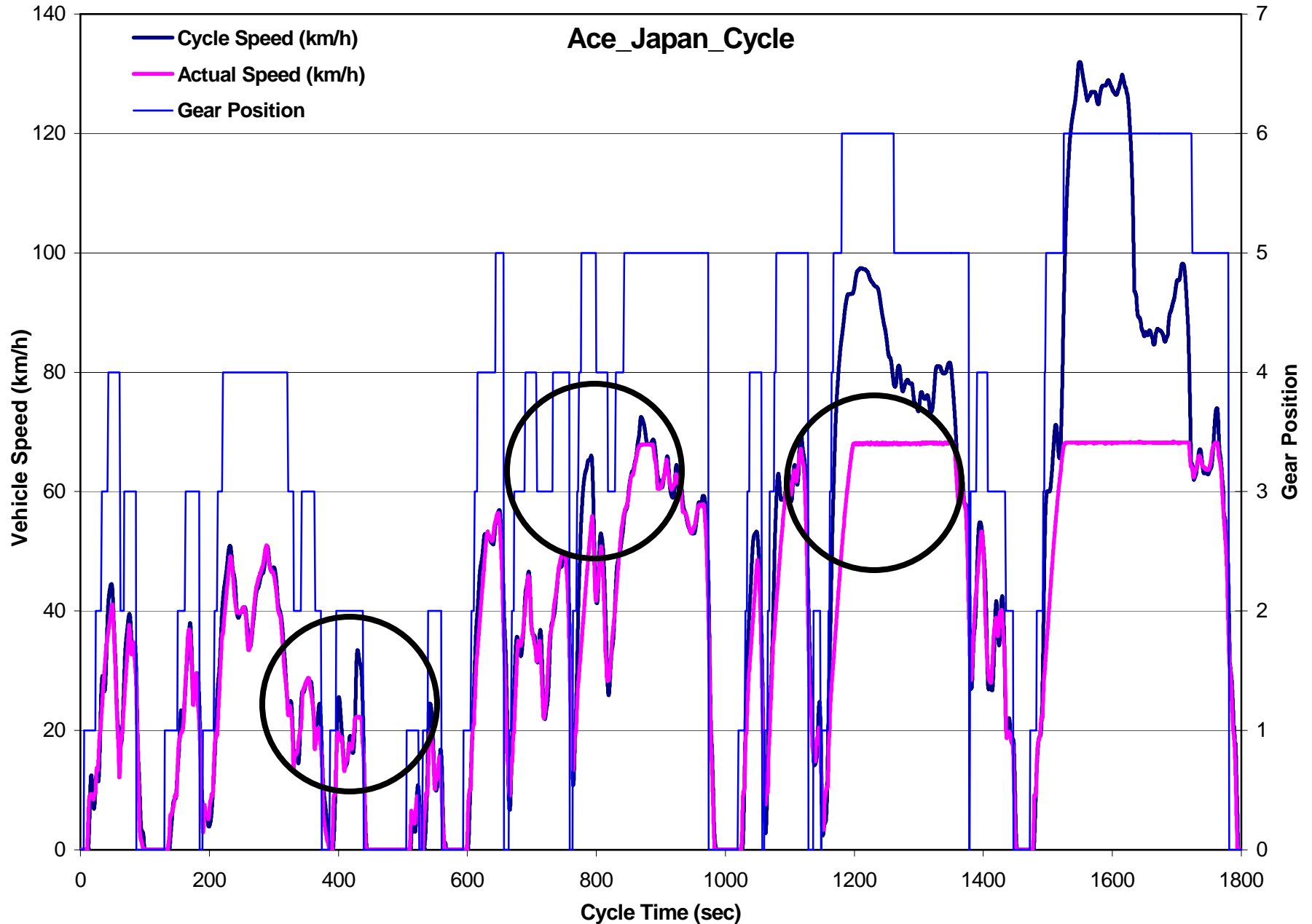
# Steven Gear Shifting\_GIO\_Cold Start



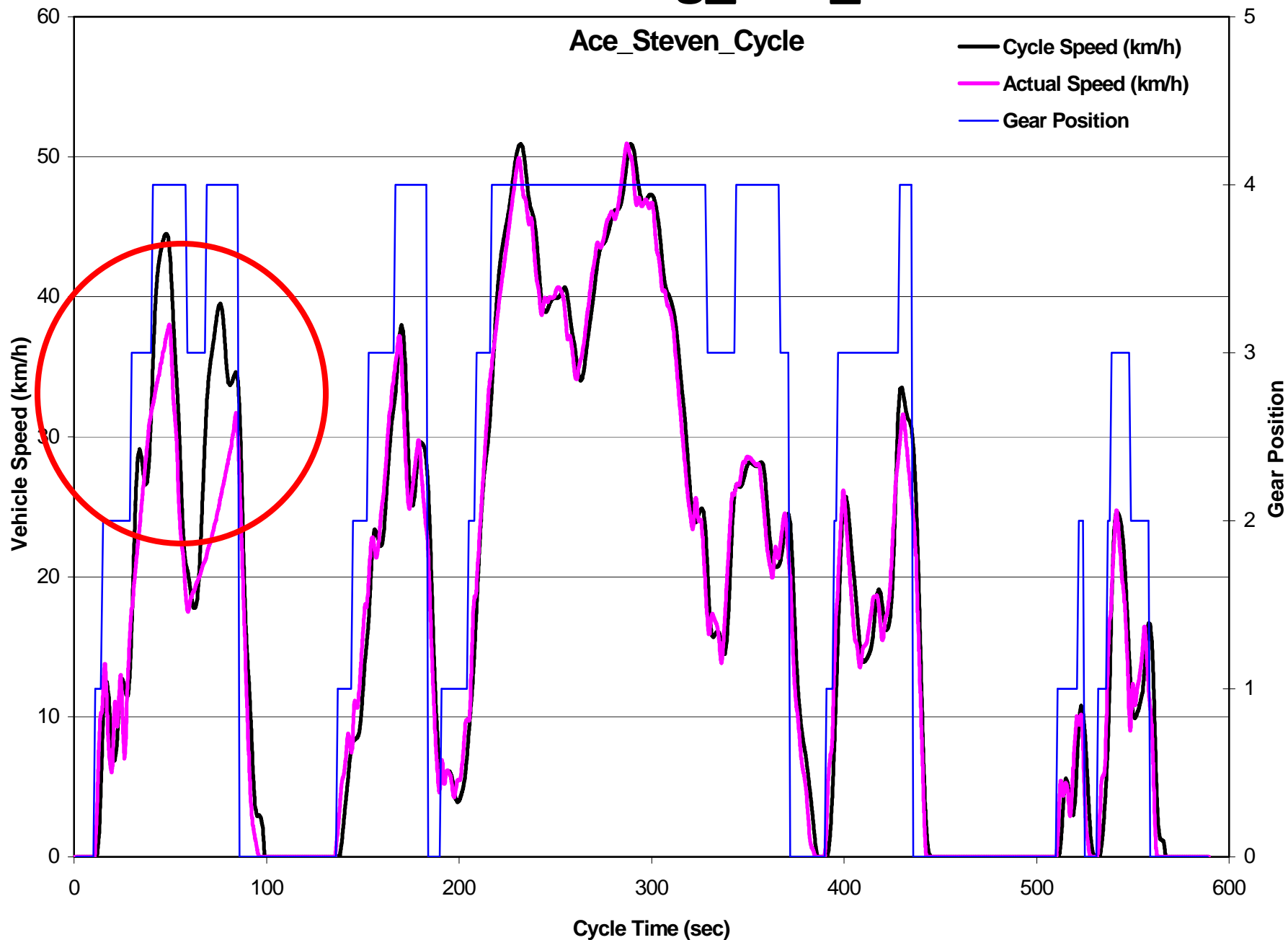
# Steven Gear Shifting\_GIO\_Cold Start



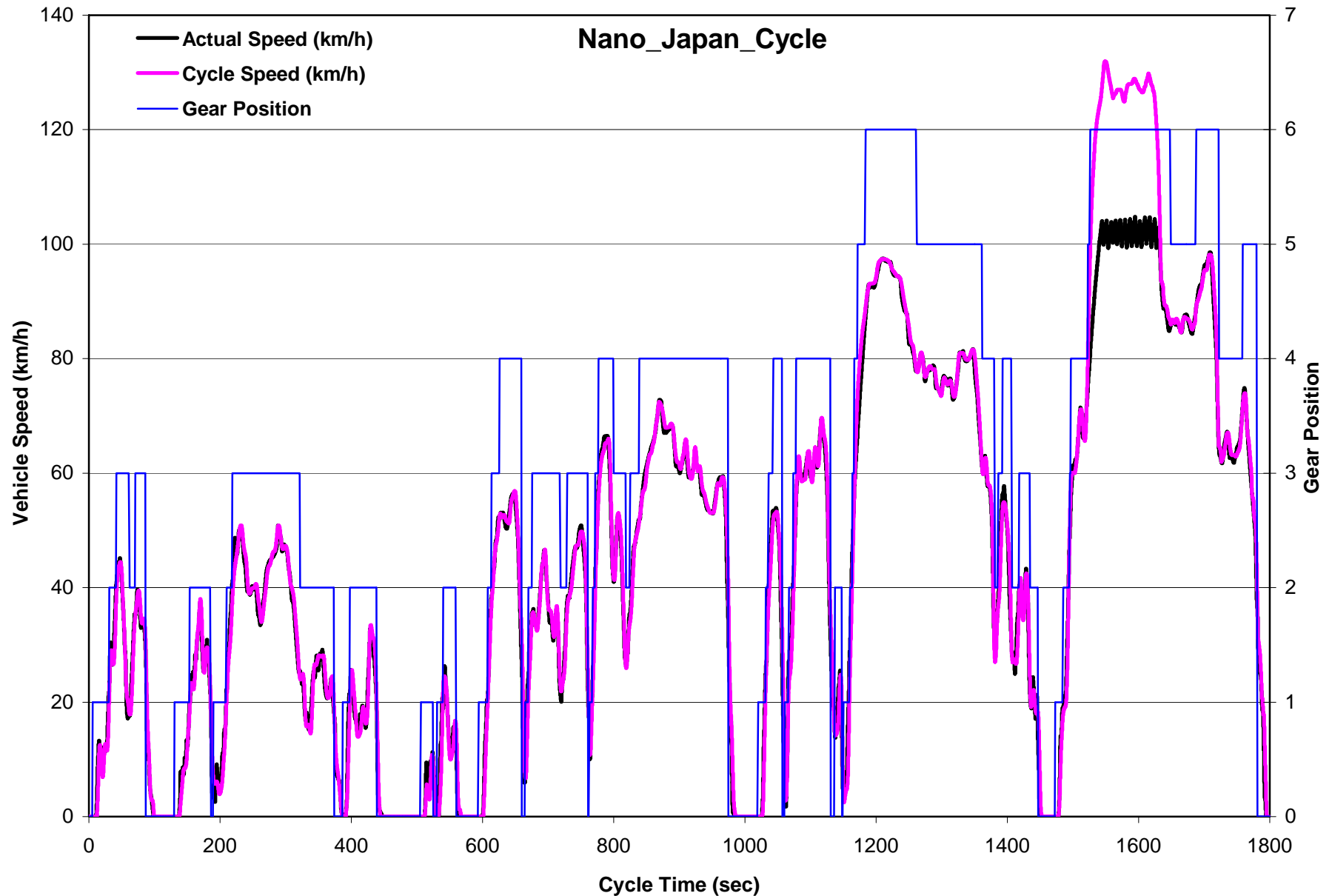
# Japan Gear Shifting\_Ace\_Cold Start



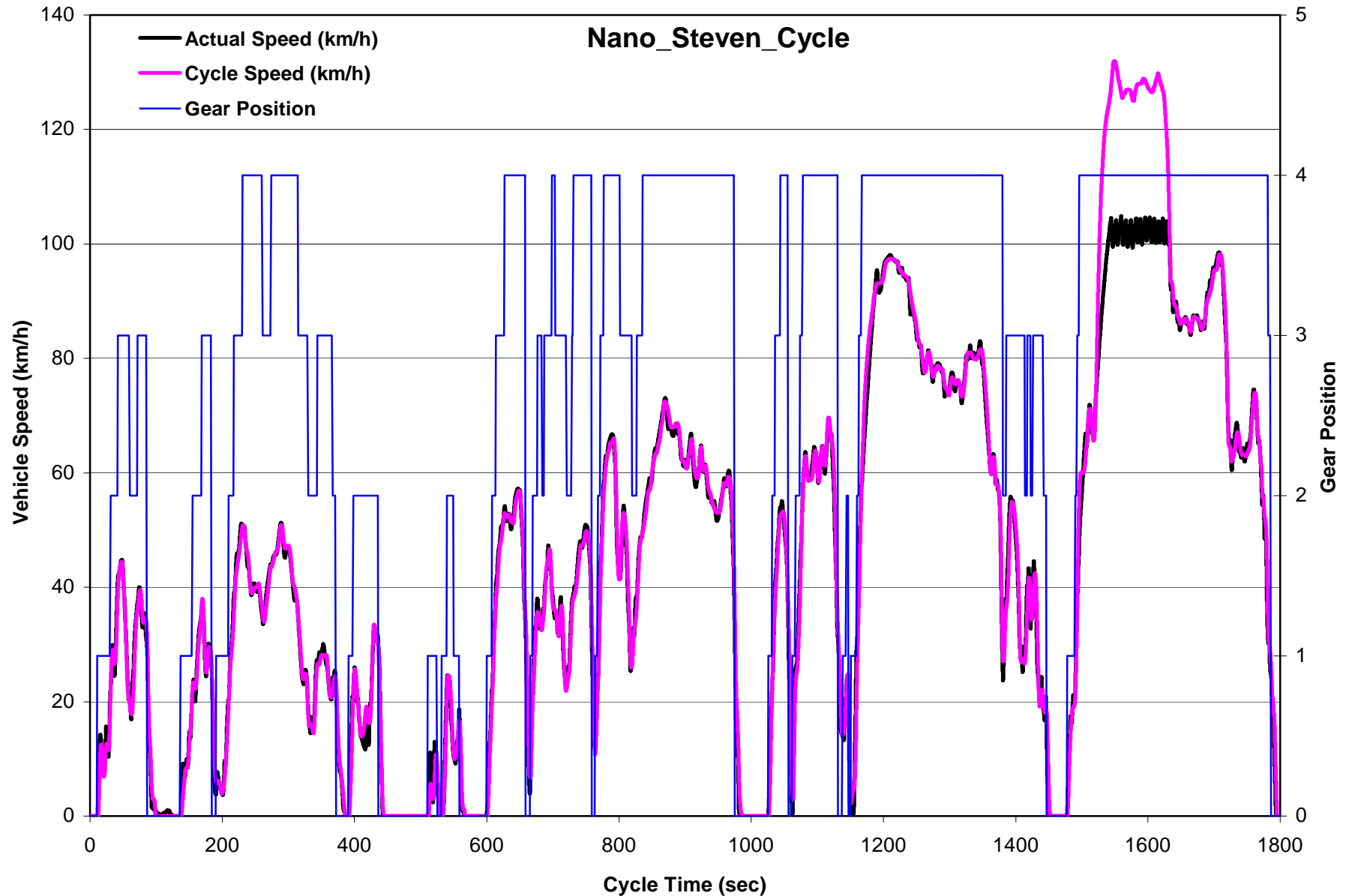
# Steven Gear Shifting\_Ace\_Cold Start



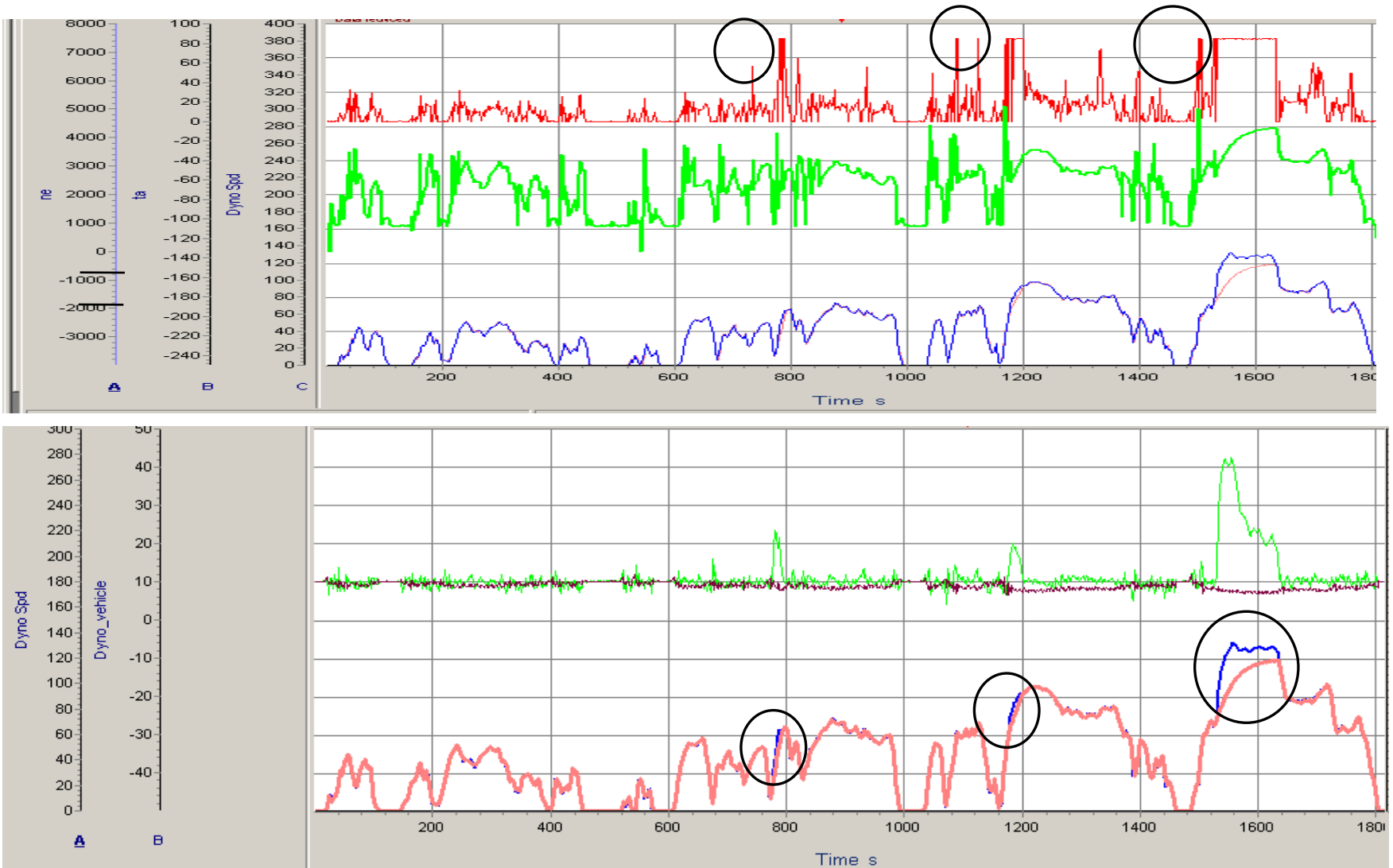
# Japan Gear Shifting\_Nano\_Cold Start



# Steven Gear Shifting\_Nano\_Cold Start



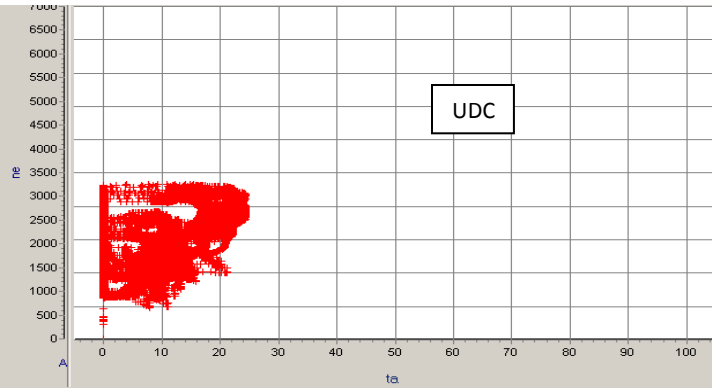
# Japan Gear Shift \_ Alto



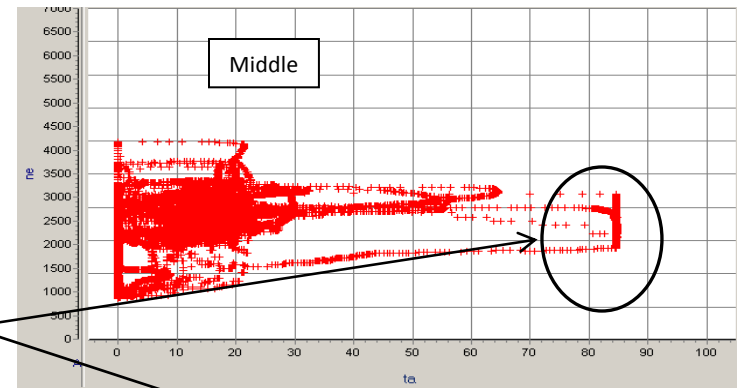
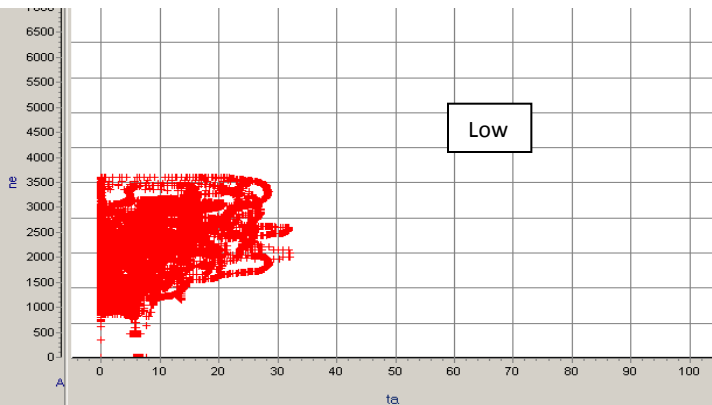
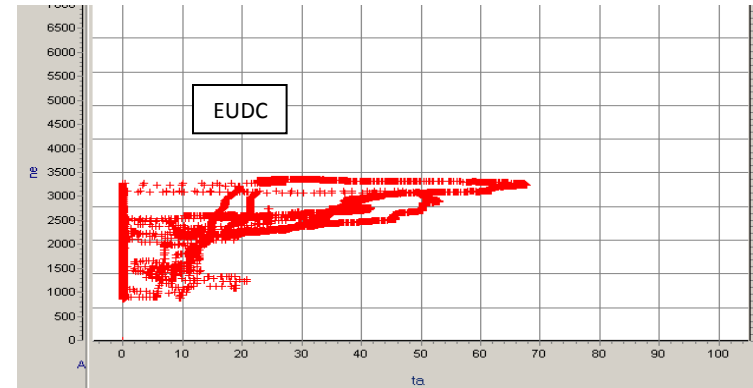
***It is difficult to meet target speed. Error is more than 10km/h in M and H Phases, even after driving vehicle in WOT.***



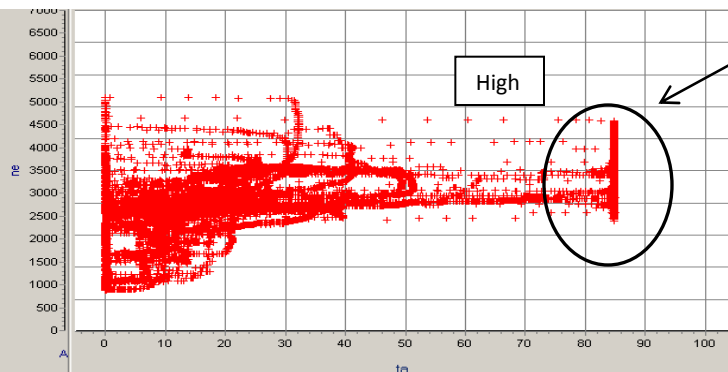
# Effect of Driving Cycle on Engine Operation\_Alto



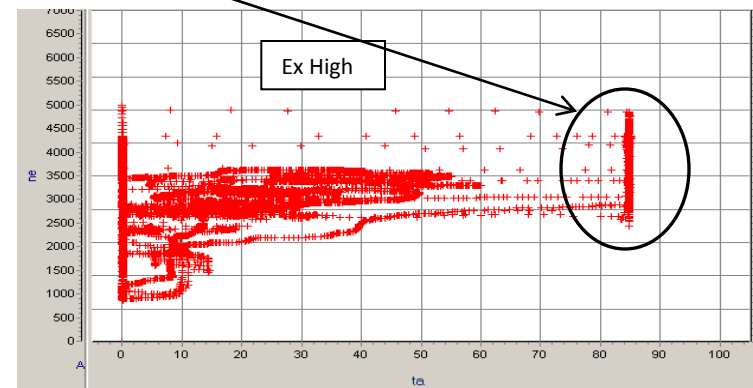
RPM / Pedal  
position Scatter  
for Alto Petrol



WOT Conditions

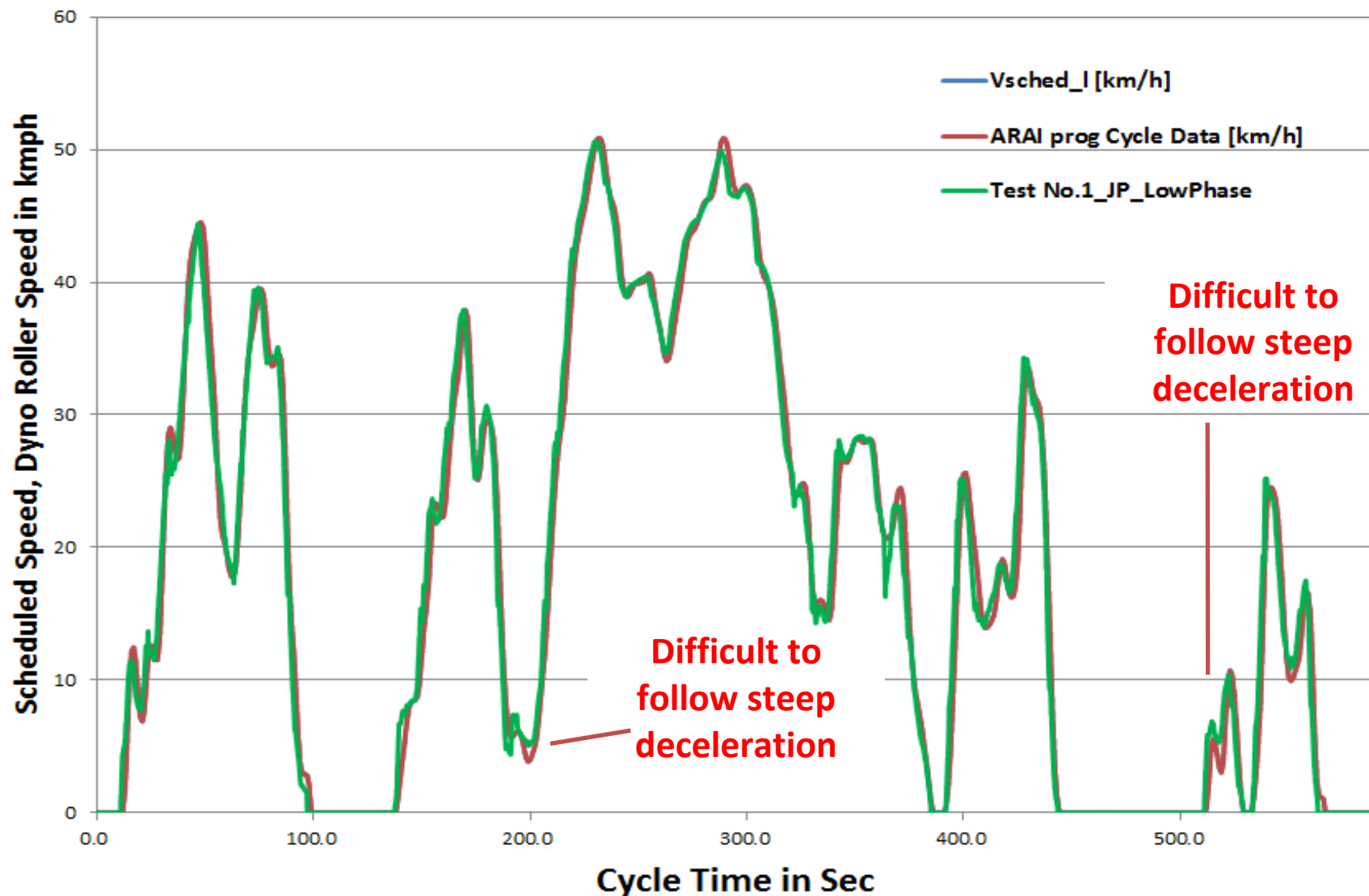


*Stringency of the  
new cycle is high on  
Small Cars esp. in M  
/ H Phases*



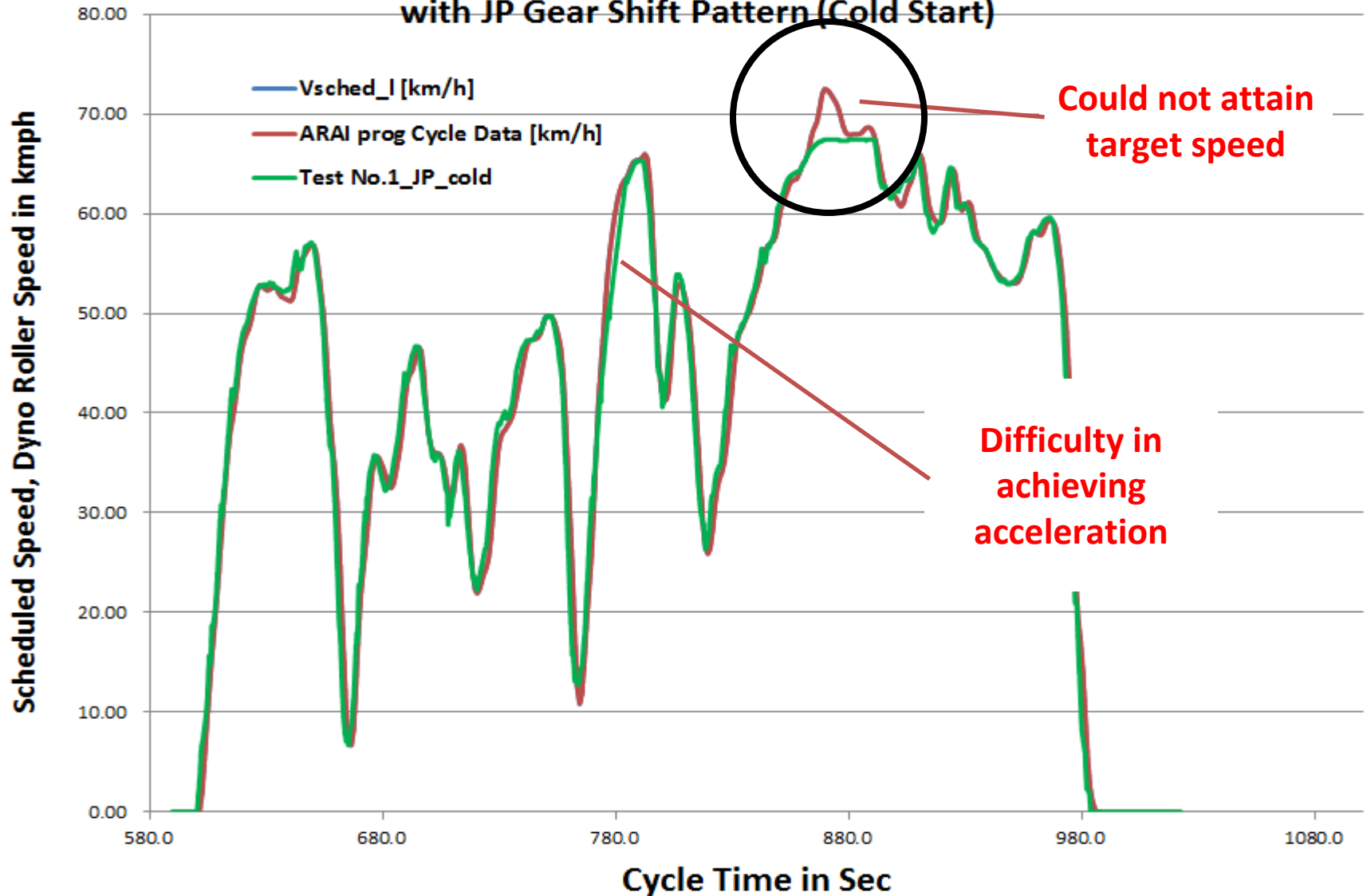
# Japan Gear Shift – Ape\_Low Phase

WLTP Validation Phase-1: Test No.1 with JP Gear Shift Pattern (Cold)

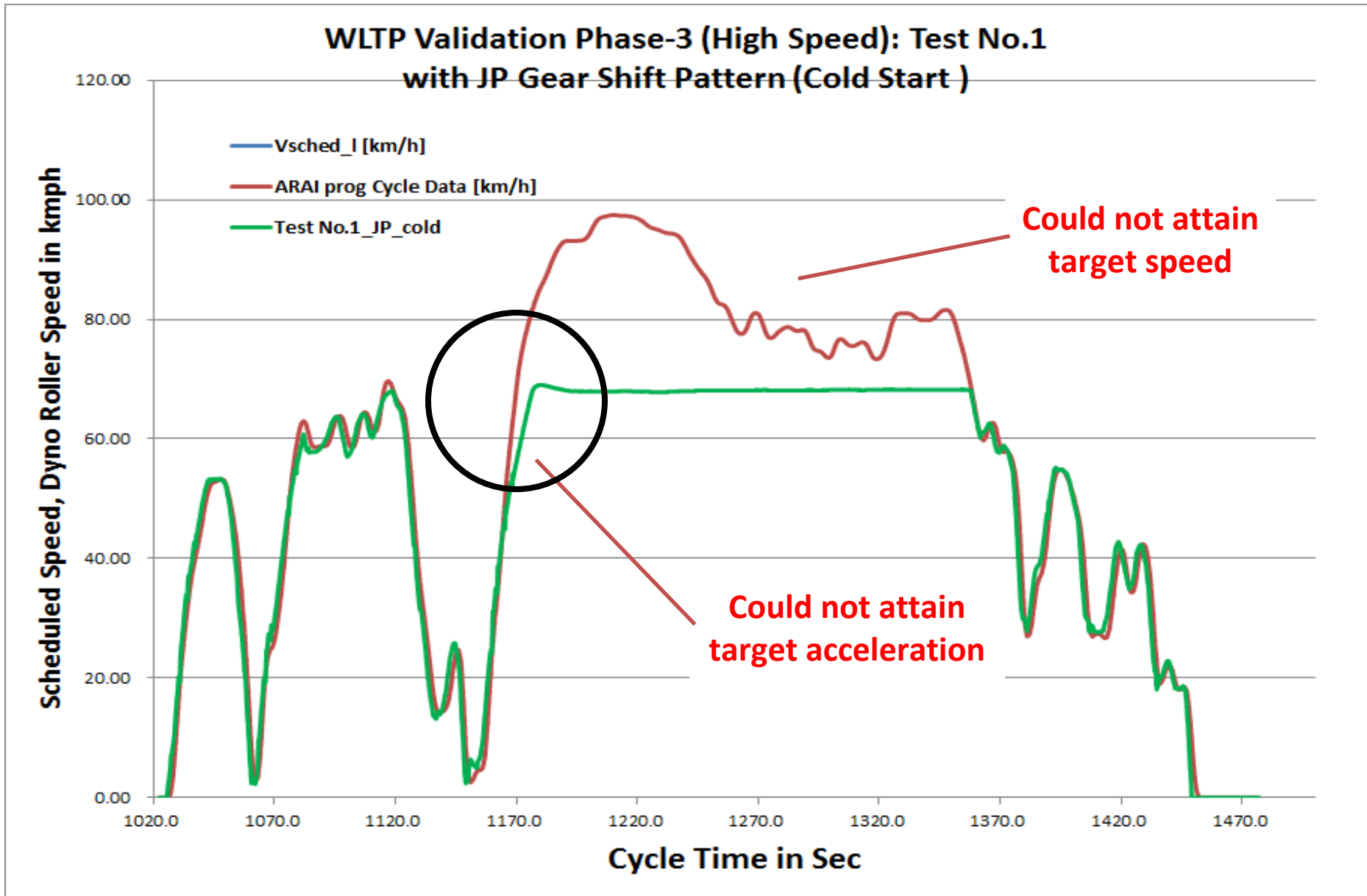


# Japan Gear Shift – Ape\_Middle Phase

WLTP Validation Phase2 (Mid Speed) : Test No.1  
with JP Gear Shift Pattern (Cold Start)

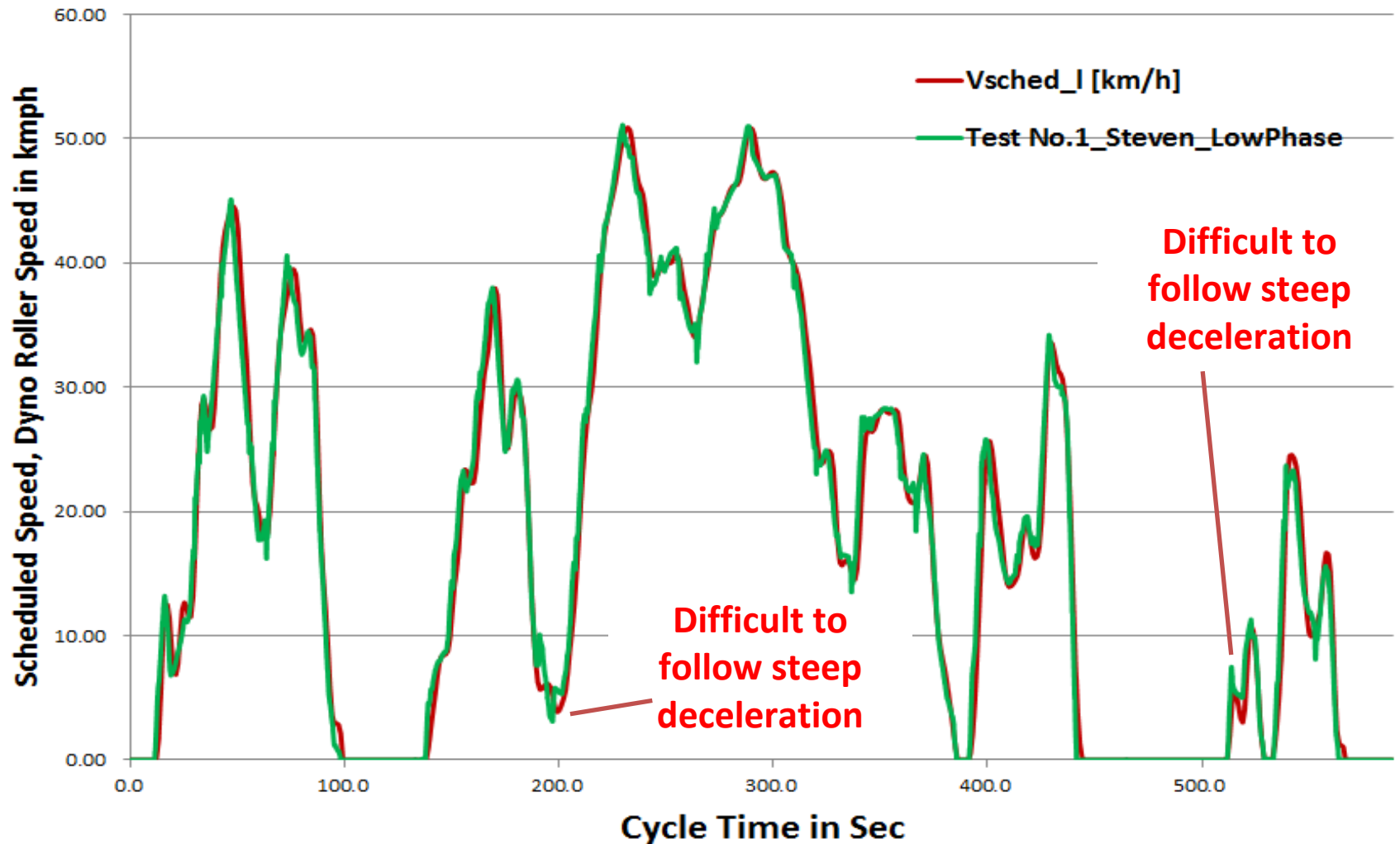


# Japan Gear Shift – Ape\_High Phase



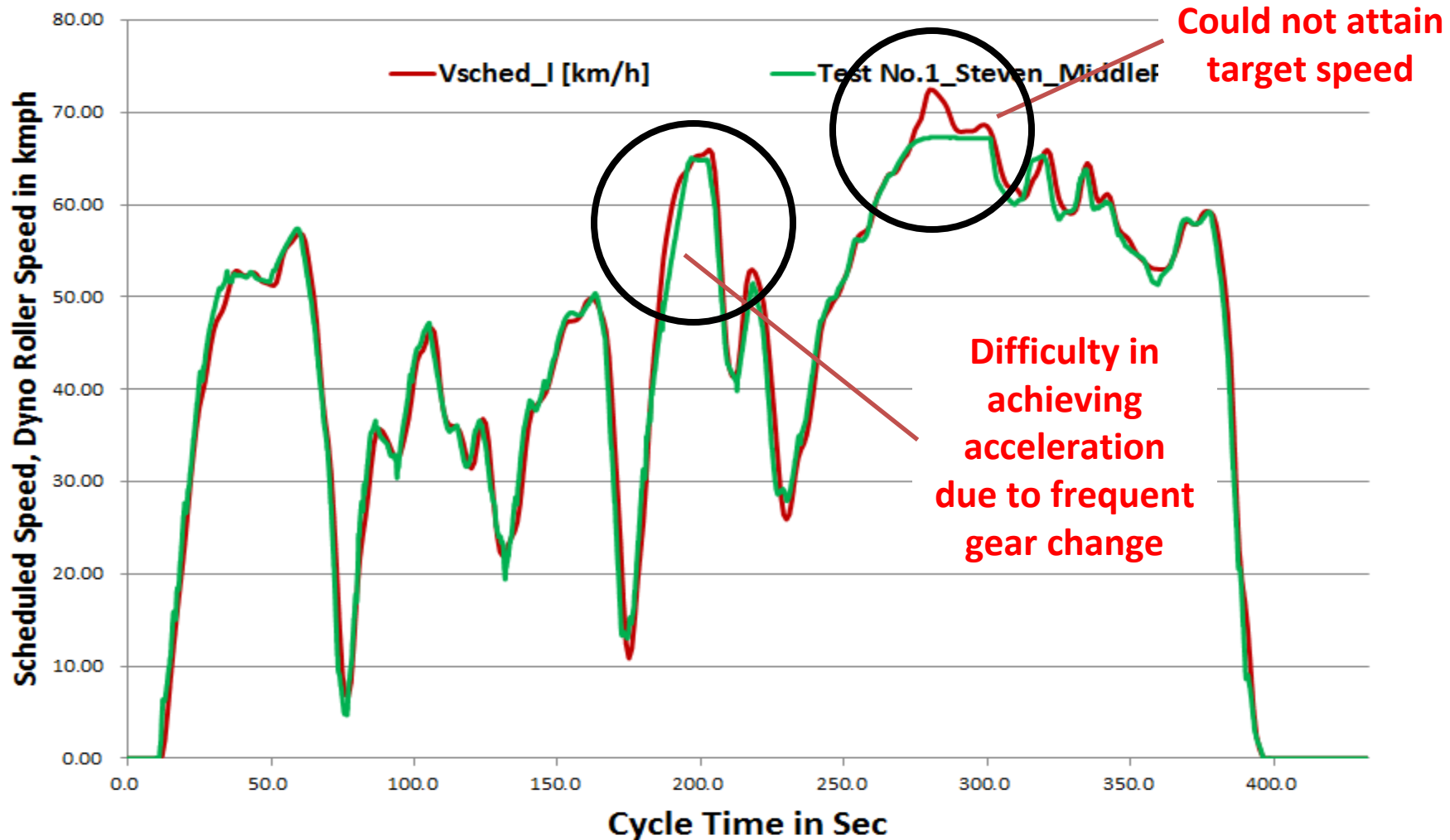
# Steven Gear Shift – Ape\_Low Phase

WLTP Validation Phase-1: Test No.1 with steven Gear Shift Pattern  
(Cold Start - Low Speed Phase)



# Steven Gear Shift – Ape\_Middle Phase

WLTP Validation Phase-1: Test No.1 with steven Gear Shift Pattern  
(Cold Start - Middle Speed Phase)



**Max Speed**

# Driving Cycle Max Speed (kmph)

- ❑ WLTP Max Speeds are higher than current MIDC, NEDC, FTP & JP.
- ❑ Higher Max Speed and higher acceleration in WLTP, result in drivability issues in compact vehicles, esp. in which engine will be operating at full load and max engine speed.

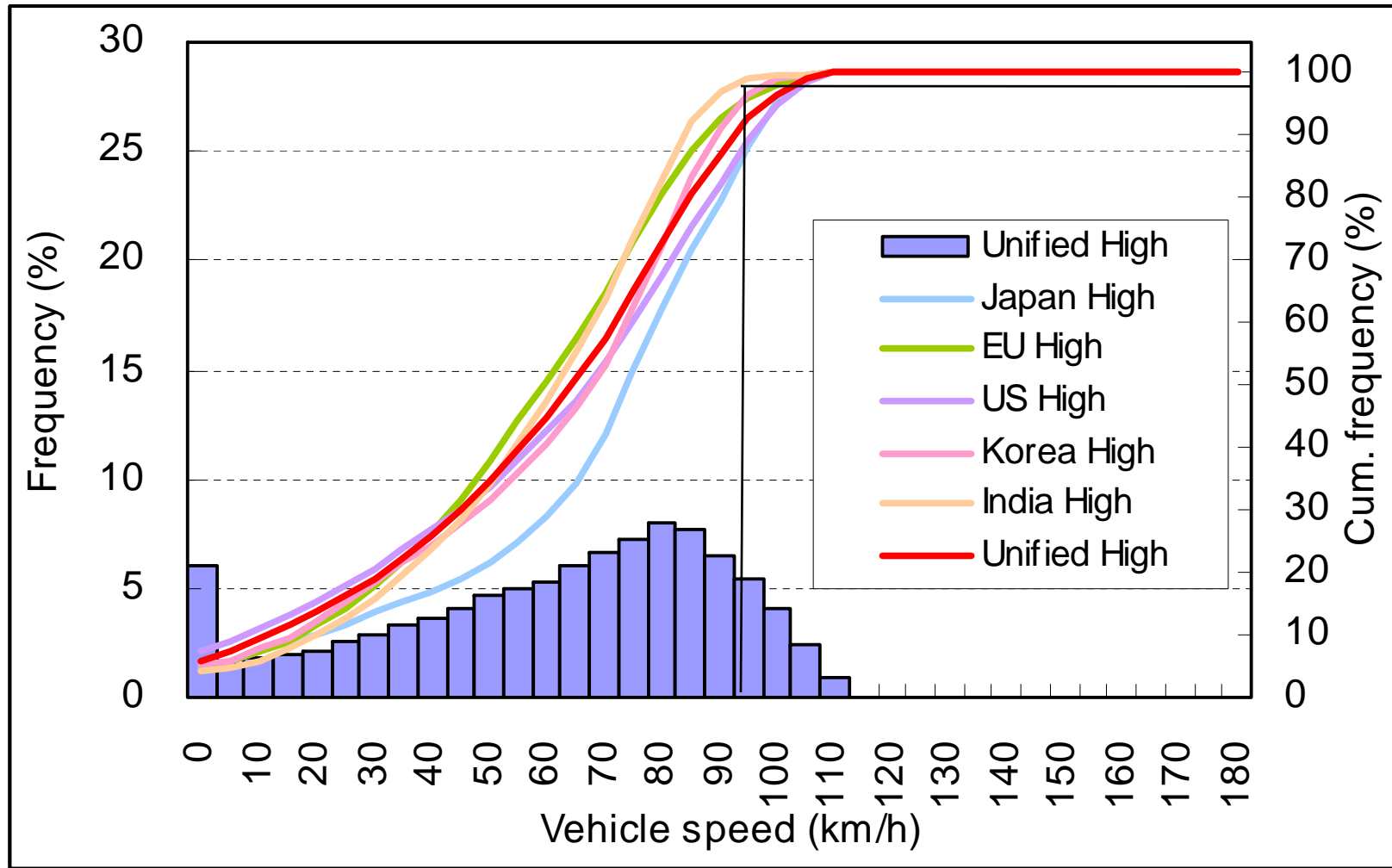
	Part1	Part2	Max. cycle
MIDC, India	50.0	90.0	90.0
NEDC, Europe	50.0	120.0	120.0
US FTP	91.2		91.2
Japan JC 08	81.6		81.6

	Low	Middle	High	Ex-High	Harmonized Cycle	Optional WLTP cycle
WLTC Ver2.0	50.9	72.5	97.4	132	90	120

***Based on Road Load Data submitted by CPs -  
Rationale of having the proposed Max Speed needs to be discussed.***

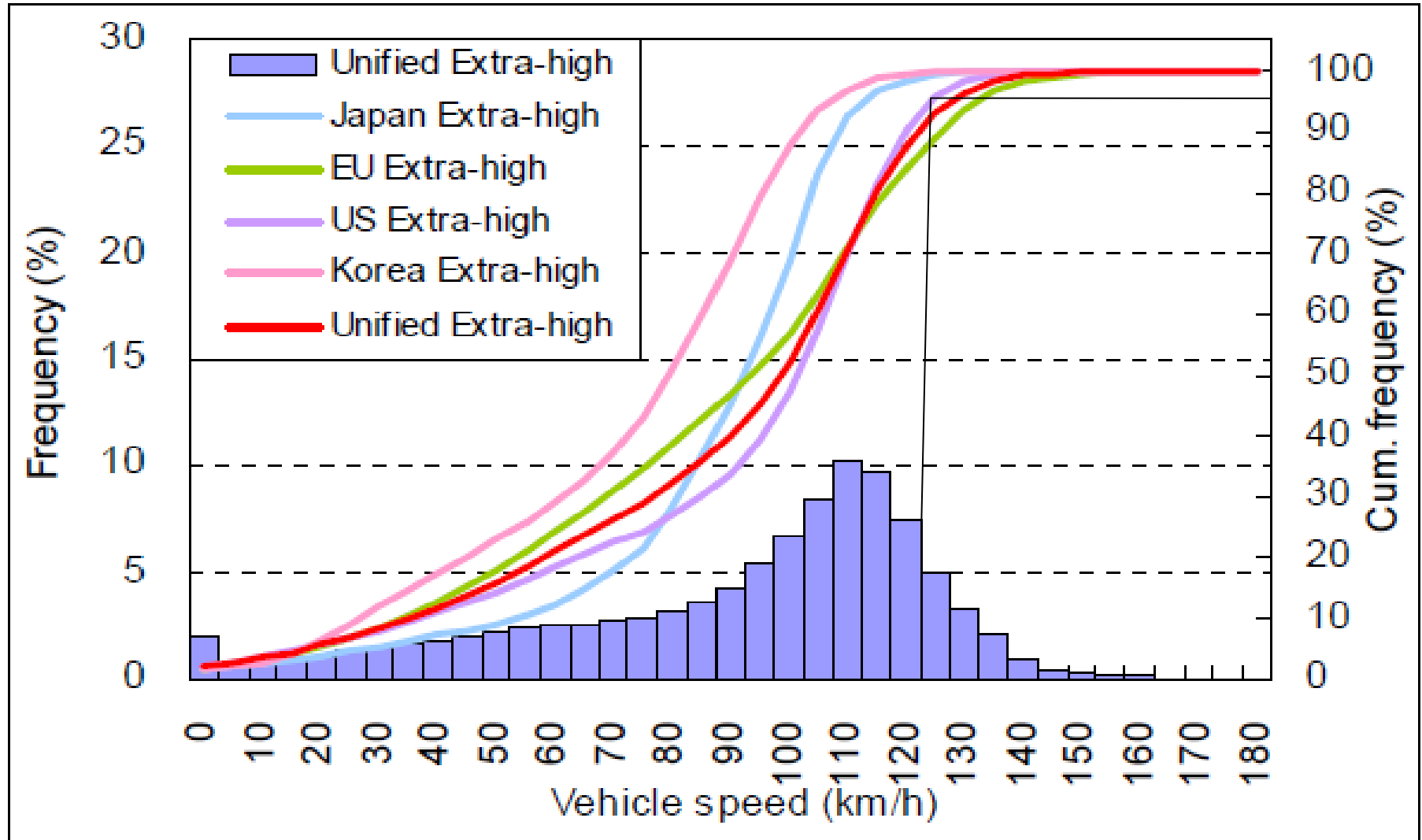


# WLTP Data: Speed Distribution (High Phase)



*Analyzing the unified High Phase distribution, hardly 3% of the Indian driving Data exceeds 90km/h. For other regions this varies from 5% to 10%. There exists a strong rationale of lowering the max speed of the High Phase to 90km/h.*

# WLTP Data: Speed Distribution (Extra-High Phase)



Analyzing the unified Extra-High Phase distribution, hardly 4% of the Driving Data exceeds 120km/h. There exists a strong rationale of lowering the max speed of the Extra High Phase to 120km/h.

# **Gear Shift Pattern**

# Gear Shift Pattern

- ❑ 3 different Gear Shift Patterns have been suggested:
  - ✓ PC (Fixed Gear Shifts) (Japan)
  - ✓ LDCV (For Commercial Vehicles) (Japan)
  - ✓ Stevens Gear Shift (Vehicle Dependent)
  
- ❑ Observations on Steven's proposal: Multiplicity of Test Patterns as it is dependent on vehicle parameters
  - ✓ Power to Weight Ratio
  - ✓ Gear Ratios
  - ✓ Idle RPM / Max RPM.
  - ✓ Calculation restricts the modes in WLTP cycle
  
- ❑ This point needs to be discussed.

# India Views & Recommendations

# India's Views and Recommendations

Item	Concern	Recommendation
Acceleration	<ol style="list-style-type: none"><li>1. Acceleration is Too High in Low Middle and High Phases. Even with WOT condition, not able to meet the drive cycle<ol style="list-style-type: none"><li>a. L&amp; M Phase for &lt;20kW Engines</li><li>b. H &amp; ExH for &lt;60kW Engines</li></ol></li><li>2. Abrupt change in Acceleration and Deceleration</li></ol>	<ol style="list-style-type: none"><li>1. Moderate Accelerations for all phases so as not to penalize the small capacity engine vehicles. Accelerations should be around <math>1.1 \text{ m/s}^2</math> in line with the Road Data collected</li><li>2. Smoothening of drive cycle is necessary</li></ol>
Max Speed	<ol style="list-style-type: none"><li>1. Speed in all phases are high.</li><li>2. Not possible for vehicles to meet the max speed.</li><li>3. Not in line with the Road Data collected.</li></ol>	<ol style="list-style-type: none"><li>1. High Phase should be limited to 90 km/h</li><li>2. For EX H should be limited to 120 km/h as per current NEDC</li></ol>

# India's Views and Recommendations

Item	Concern	Recommendation
Gear Shifting & Tolerance on Driving Trace	<ol style="list-style-type: none"><li>1. Number of gear shift points throughout WLTP cycle are too high (i.e. for PC =80, LDCV =84) - Driver fatigue.</li><li>2. Harmonisation of gear change points – Comparison of vehicles on same pattern not possible.</li></ol>	<ol style="list-style-type: none"><li>1. To Reduce it similar to NEDC cycle (i.e. ~ 23 for both PC &amp; LDVC</li><li>2. Uniform Gear Shift Pattern to be evolved for PC and LDCV to avoid multiplicity of tests</li><li>3. Driving trace tolerance of 3 % shall be changed to <math>\pm 3</math> km/h at all speeds considering the dynamic nature of proposed WLTP driving cycle.</li></ol>

- The present Harmonized Driving Cycle is
  - Very stringent on Compact Vehicles and <20kW Engine Capacity Vehicles.
  - Will result in a shift to vehicles with bigger engines just to meet Driving Cycle, compromising on CO<sub>2</sub> emissions and Fuel Consumption from Fleet.

# India's Views and Recommendations - Summary

Parameters	India MIDC	Europe NEDC	Japan JC08	USA FTP75	India's Proposal	
					World Harmonized Cycle	Optional WLTP Cycle
Time in s	1180	1180	1204	1877	1477	1800
Distance, km	10.6	11.0	8.2	17.9	15	22.7
Max Speed, km/h	90	120	81.6	91.2	90	120
No. of Phases	2	2	1	3	3	4



**Thank You**