

# WLTP Validation 2 Lot1

## Preliminary Evaluation on LabProcICE Issues ACEA Informal Document

Version DTP 11

based on analysis of VP2 Lot 1 Database by Heinz Steven (17 vehicles, 7 labs) and by Markus Bergmann and Konrad Kolesa (2 vehicles, 1 lab)

## Index for Discussion in Subgroup LabProcICE 4.-6.9.2012 Brussels (grey issues discussed at a later stage)

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# WLTP Procedure of Validation

Steps and documentation:

1. Objective for evaluation issue
2. How to measure
3. Results observed and documented
4. Current gtr proposal
5. Recommendation after data analysis of Validation Phase 2
6. Justification

# 6. Soak Temperature Tolerances

Objective: Feasibility of 2 K tolerance to be confirmed.

## Background:

- 3 phases of temperature monitoring (soak, start of test, test cell during cycle)
- Setpoint is 25° C, Target tolerance of temperature is +/- 2 K

## How to:

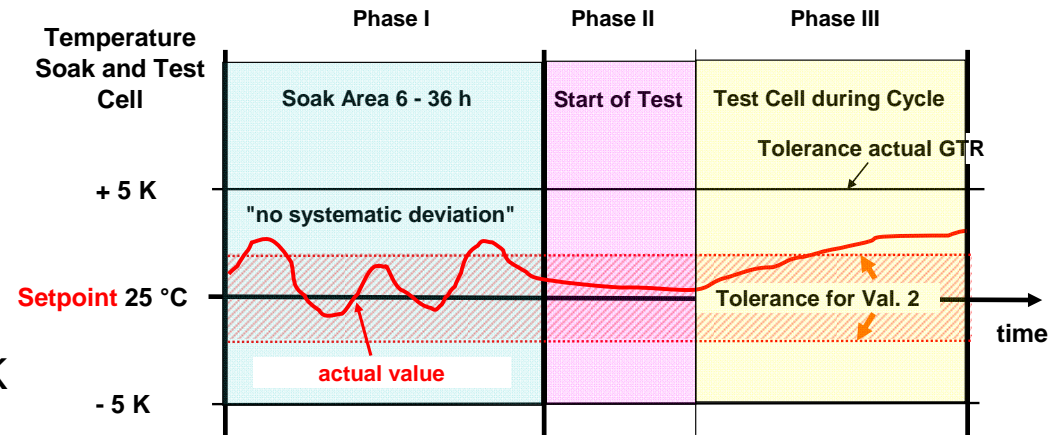
- Measurement of local temperatures in the soak area

## Measurement parameter:

- Modal air temperature in various locations, 1 Hz frequency, averaging over 5 min, ambient temperature for comparison

## Test equipment:

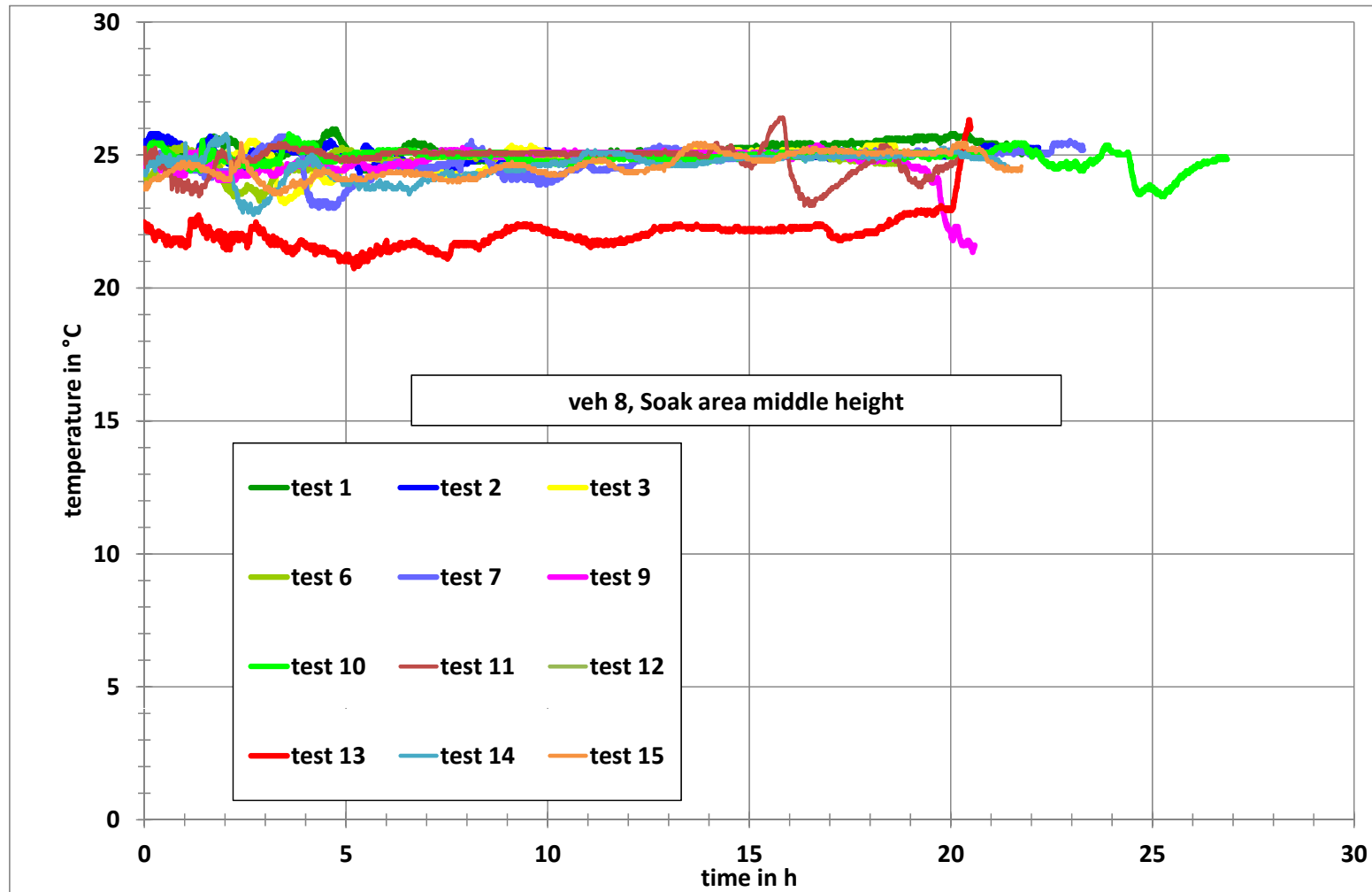
- Testbench, emission measurement, temperature monitoring system, RCB monitoring system



# Results of WLTP Validation Phase 2

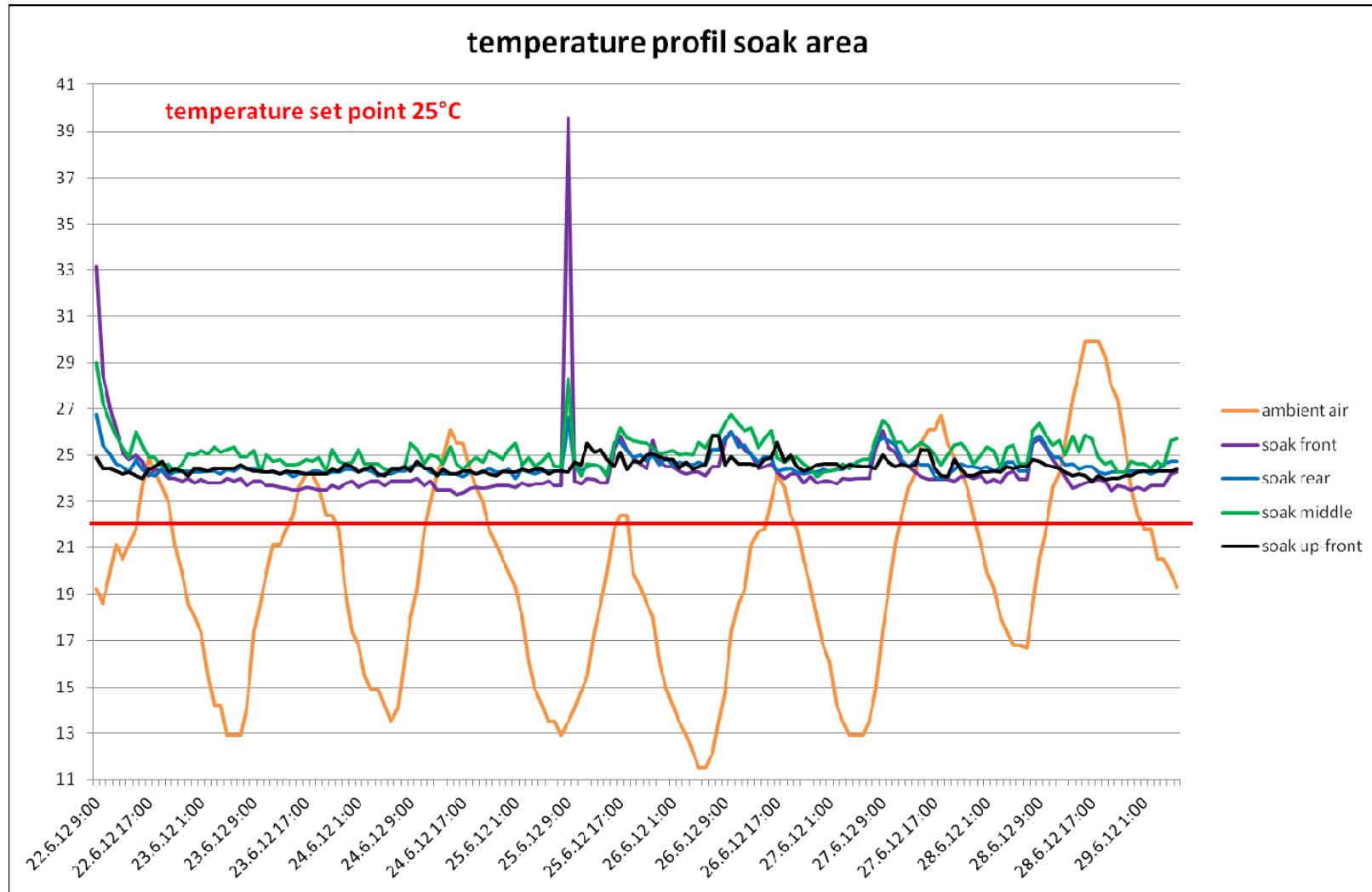
## Evaluation of soak temperatures

Example for soak temperature variation



# Results of WLTP Validation Phase 2

## Evaluation of temperatures in soak without fan cooling (1 week)



# Evaluation of Soak Temperature Tolerances

## Current Position in gtr annex 6:

### 1.2.2.2.2. Soak area

1.2.2.2.2.1. The soak area shall have a temperature setpoint of [298 K] and the tolerance of the actual value shall be within  $\pm 5$  K.

## Result of Evaluation of VP2:

The measured soak temperatures in various shows no systematic deviation from the setpoint. However some variation of soak temperature can be observed due to temporary heat input from other cars or forced cooling down events within the vicinity of the soaked vehicle.

## Current Position for DTP 11:

Stay with current proposal. The measuring tolerance of thermocouples in gtr (1,5 K) has to be considered to judge systematic deviations.

## Justification:

The structure of emission labs vary worldwide from small separate chambers to larger open areas where soak and dynos are combined. Even with the air temperature temporarily varying, the vehicle will be cooled down to the temperature setpoint.

## 8. Vehicle temperatures in soak during forced cooling down

Objective: 6 h forced cooling down improves lab efficiency. Feasibility of forced cooling down and equivalency to 12 -36 h soak time to be confirmed.

Background :

- Option of minimum soak time 6 h with forced cooling down and vehicle oil within 2 K of setpoint is setout in the gtr
- Location of temperature measurement of vehicle should be representative (engineering judgement)
- For example the temperature inside the compartment, water, oil...

How to:

- Measurement of representative vehicle temperatures during soak time with/without forced cooling down

Measurement parameter :

- Temperature, time,

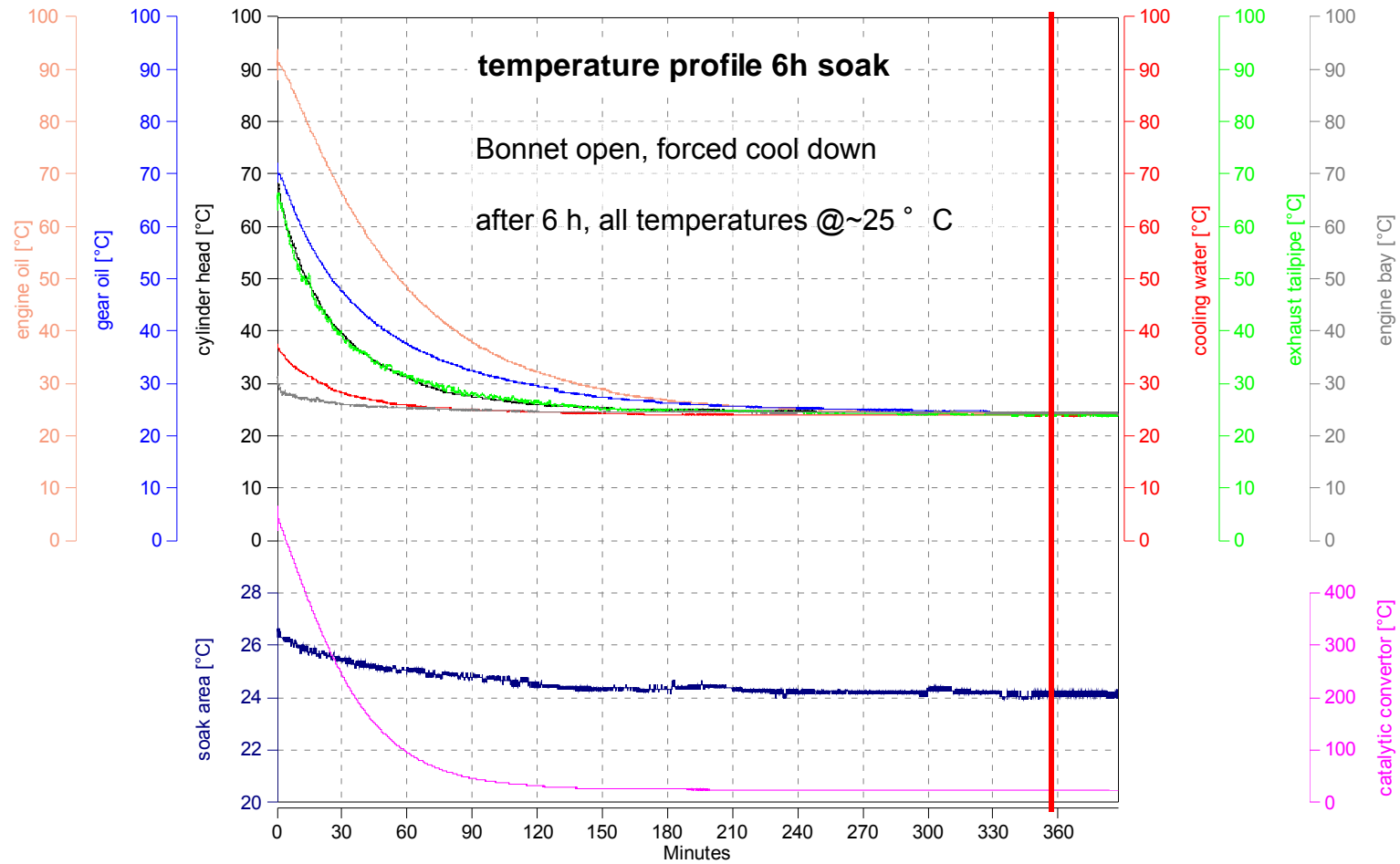
Test equipment:

- Temperature monitoring system



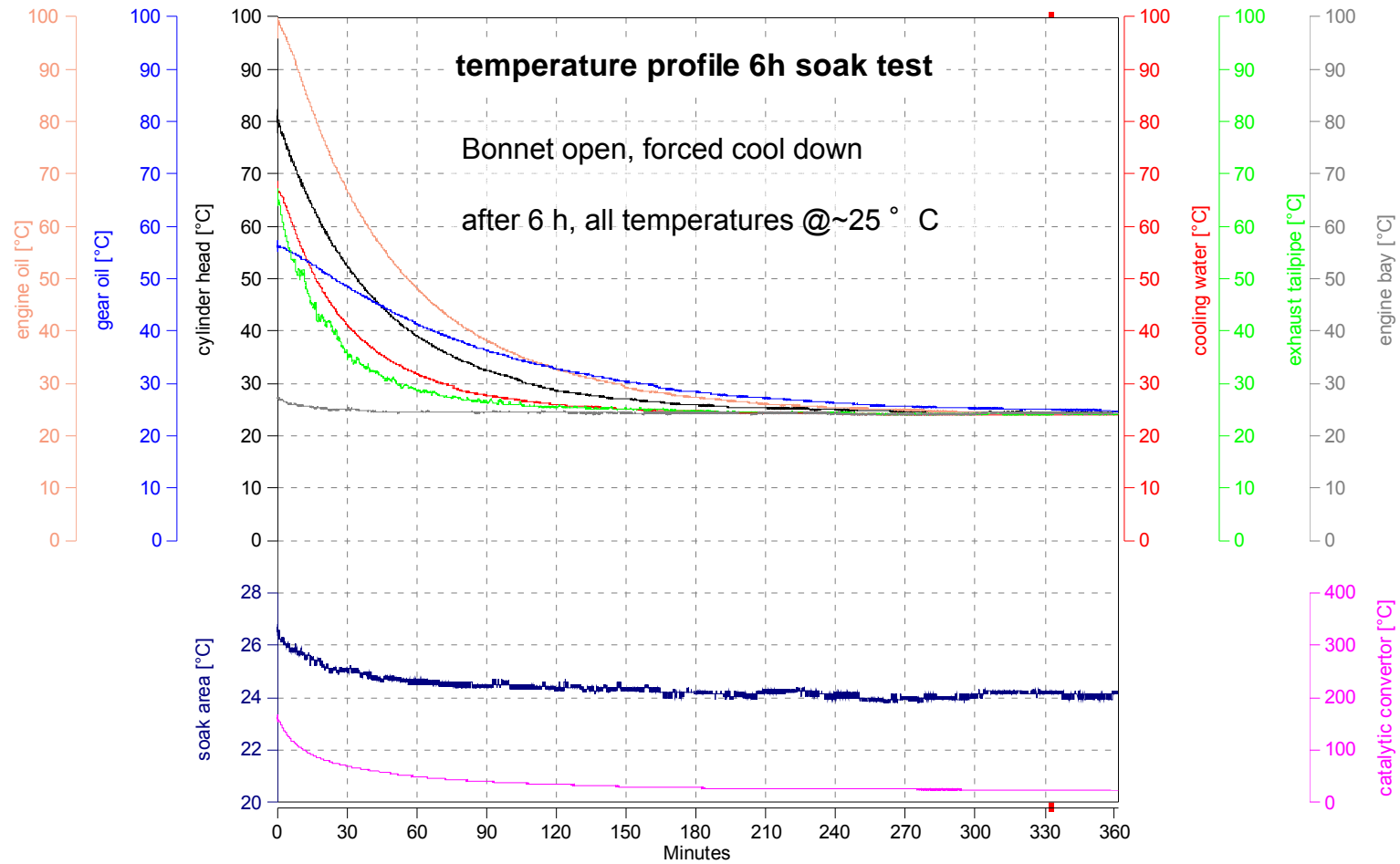
# Results of WLTP Validation Phase 2

Evaluation of vehicle temperatures in soak during forced cooling down  
WLTC\_TMH ( Veh class 3, test mass 4118lbs/F0=121)



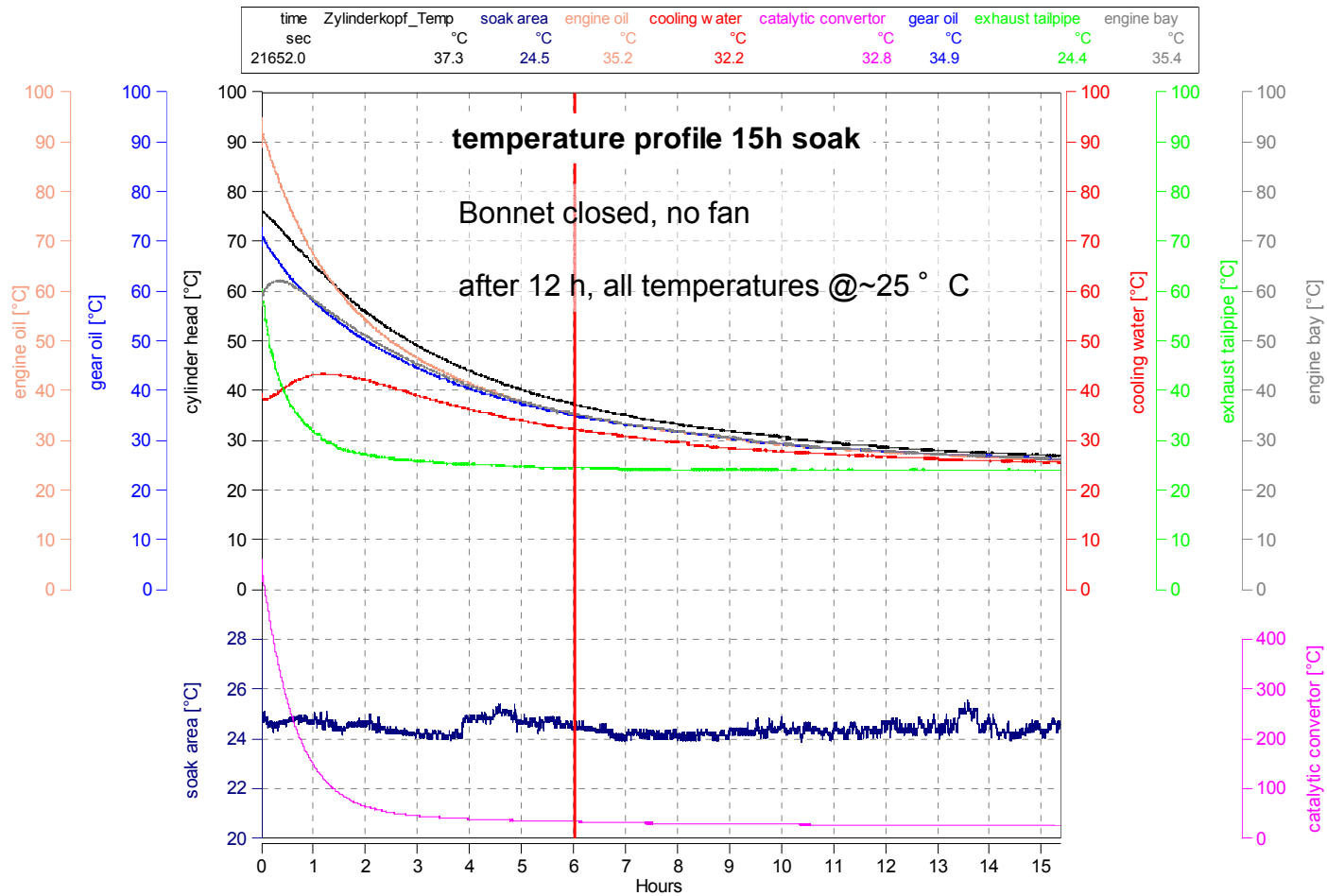
# Results of WLTP Validation Phase 2

Evaluation of vehicle temperatures in soak during forced cooling down  
WLTC\_TMH ( Veh. Class 3, test mass 4744lbs/F0=178)



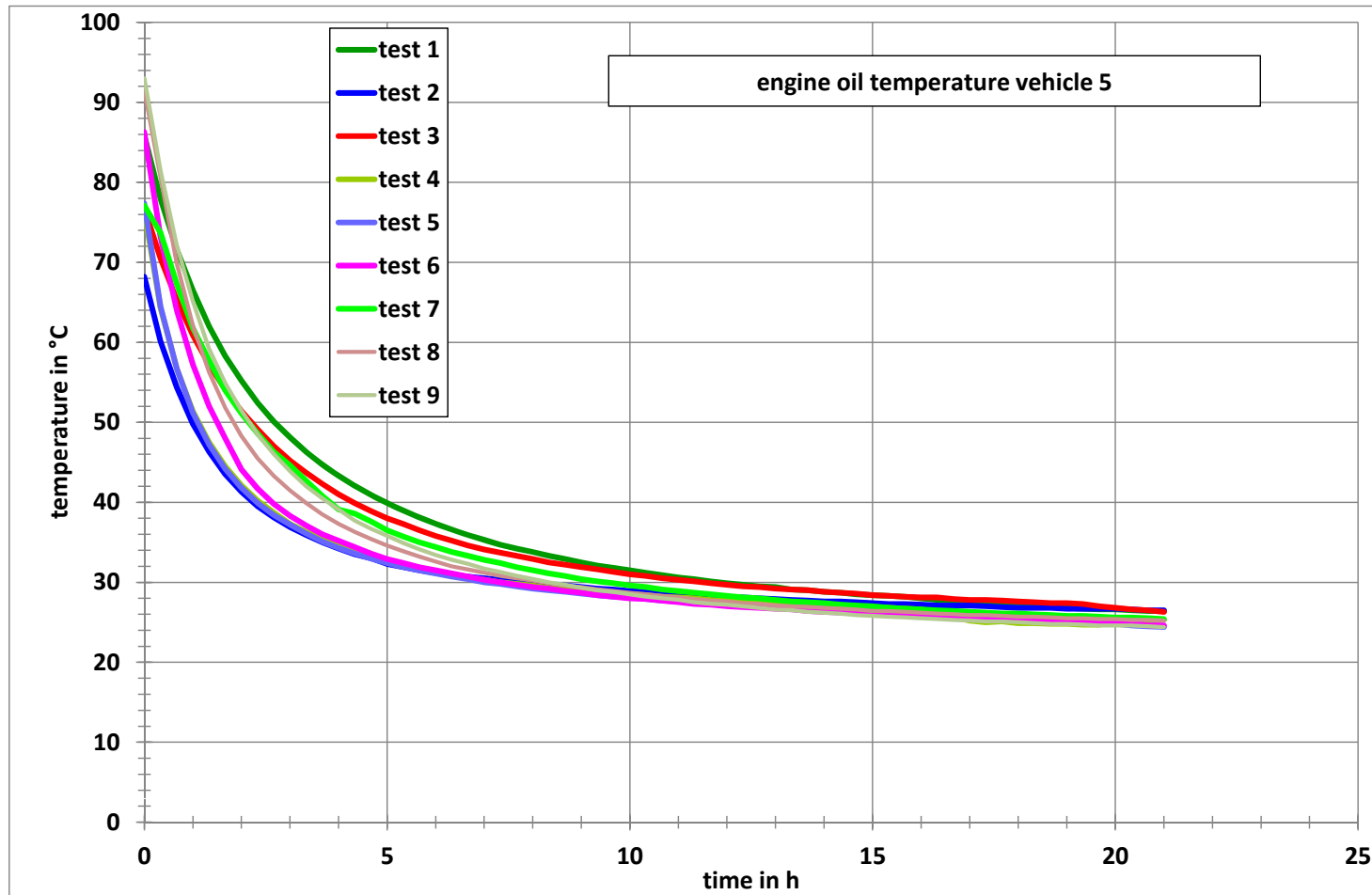
# Results of WLTP Validation Phase 2

## Evaluation of vehicle temperatures in soak without fan cooling



# Results of WLTP Validation Phase 2

## Vehicle cooling down in soak area



## Evaluation of soak temperatures during forced cooling down

### Current Position in gtr annex 6:

#### 1.2.7. Soak

1.2.7.1 After this preconditioning, and before testing, vehicles shall be kept in a room in which ambient conditions are described in 1.2.2.2.2. This conditioning shall be carried out according to the following options:

- (a) for at least six hours and until the engine oil temperature and coolant, if any, are within  $[298 \text{ K} \pm 2 \text{ K}]$ . At the request of the manufacturer, forced cooling down can be used with an open bonnet, or
- (b) for at least 12 hours and maximum 36 hours, with closed bonnet in soak area environment without using a cooling fan.

### Result of Evaluation of VP2:

Vehicle temperatures after 6h with forced cooling down show an equivalent level to 12 h soak without fan cooling.

### Current Position for DTP 11:

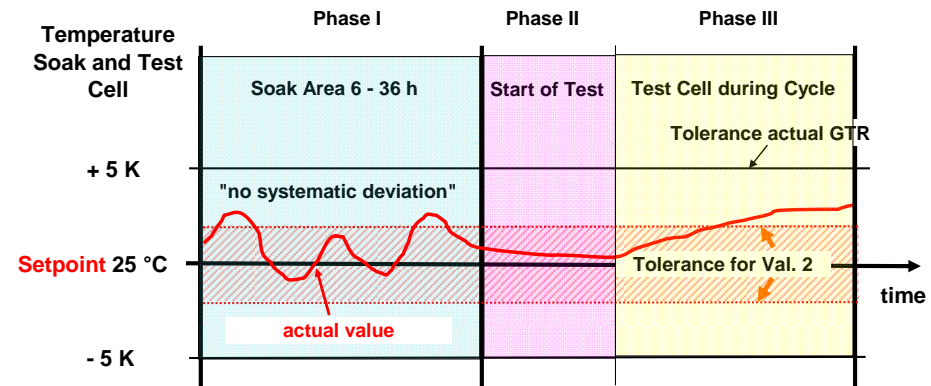
Stay with proposed options.

# 9. Test Cell Temperature Tolerances

Objective: Feasibility of tighter tolerance to be evaluated. Might request enhanced air condition infrastructure. Evaluate worst case conditions.

Background:

- 3 phases of temperature monitoring (soak, start of test, test cell during cycle)
- Setpoint is 25° C, target tolerance of temperature is +/- 2K



How to:

- Measurement of temperature between outlet of the fan and vehicle

Measurement parameter:

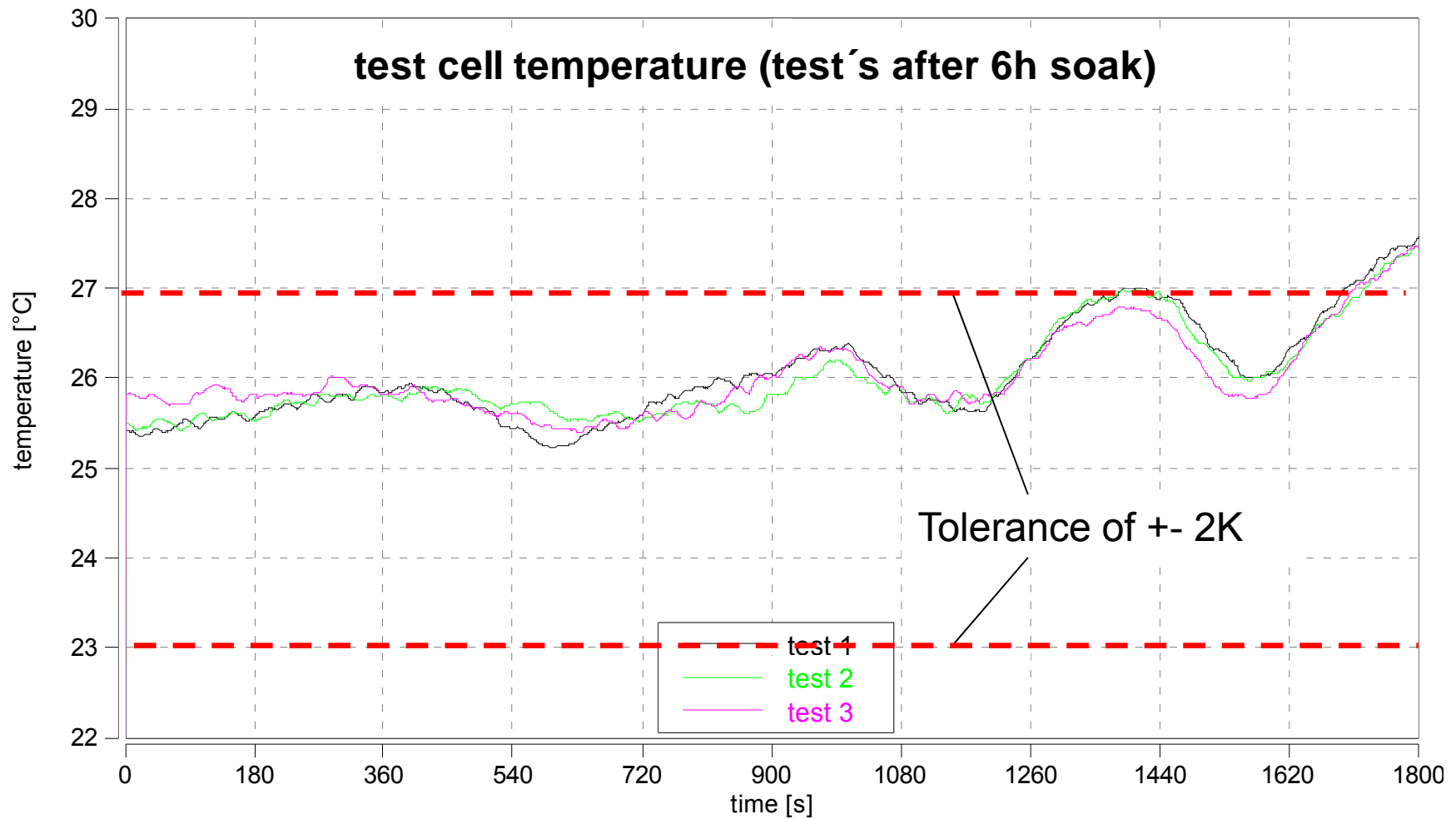
- Modal temperature, 1 Hz frequency, dynamic temperature behavior in phase II (before start of testing)

Test equipment:

- Temperature monitoring system

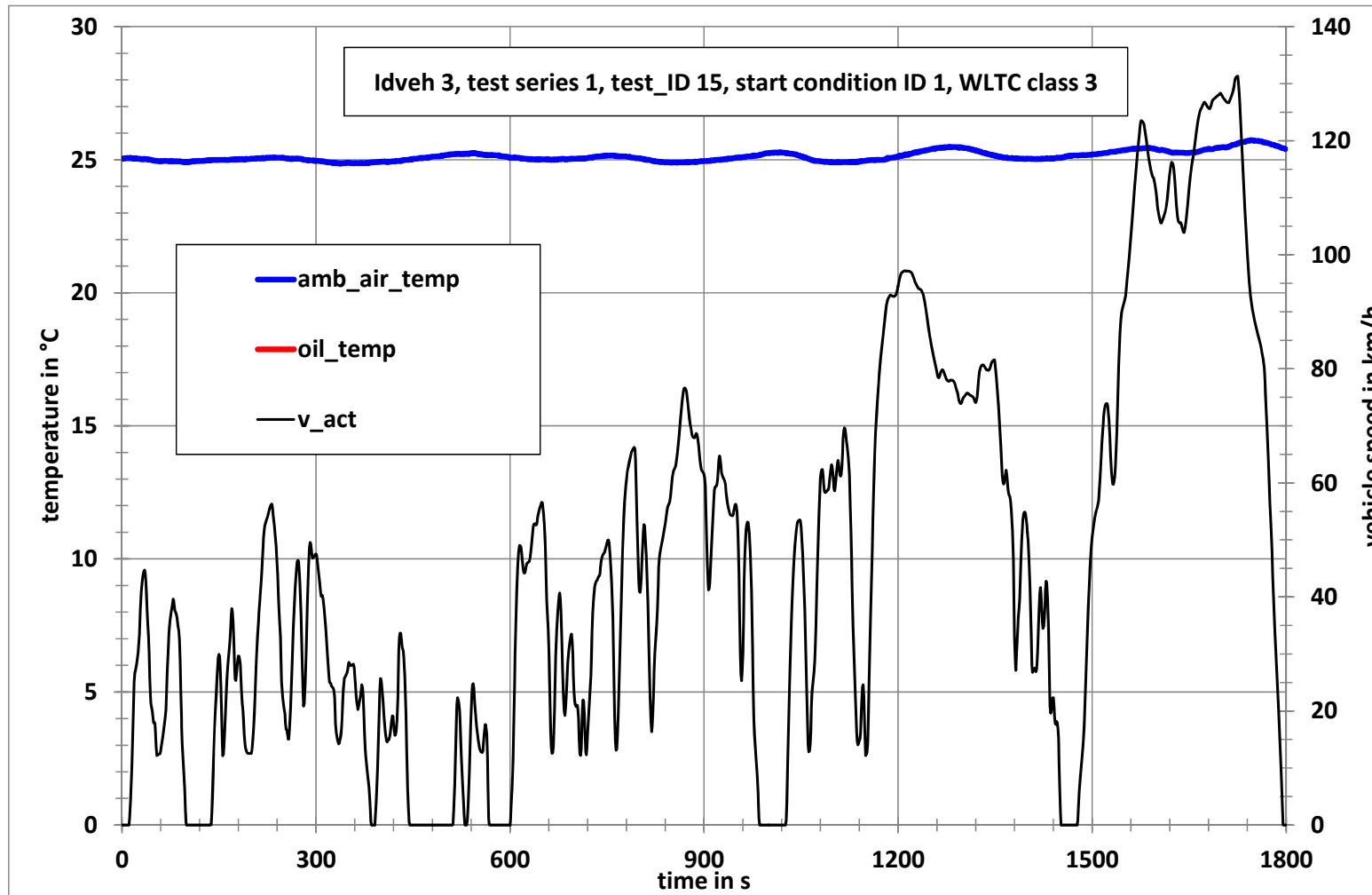
# Results of WLTP Validation Phase 2

## Example of soak temperature during one week VP2 testing



# Results of WLTP Validation Phase 2

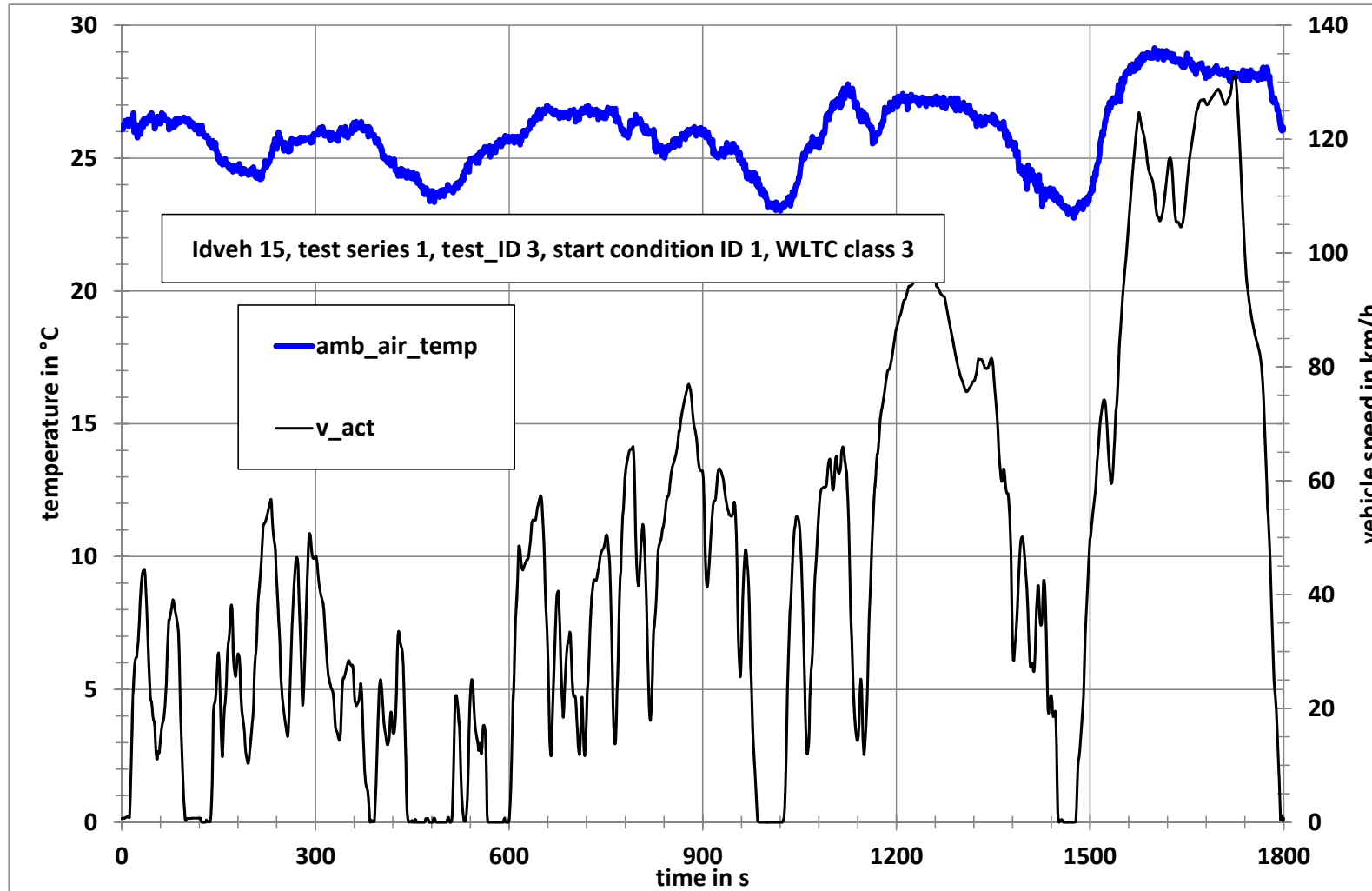
## Example of test cell temperature during WLTC - best case





# Results of WLTP Validation Phase 2

## Example of test cell temperature during WLTC - worst case



# Evaluation of test cell temperature during WLTC

## Current position in gtr annex 6:

1.2.2.2.1.1. The test cell with the chassis dynamometer and the gas sample collection device shall have a temperature setpoint of [298 K] . The tolerance of the actual value shall be within  $\pm 5$  K. The room temperature shall be measured continuously at the output of the cooling fan (1 Hz).

## Result of Evaluation of VP2:

The tolerance of  $\pm 5$  K was not exceeded during VP2 testing, however the tighter tolerance of  $\pm 2$  K in some labs could not be kept with heavier vehicles. At the end of the driving cycle the heat input by the vehicle exceeded the ability of the air conditioning systems.

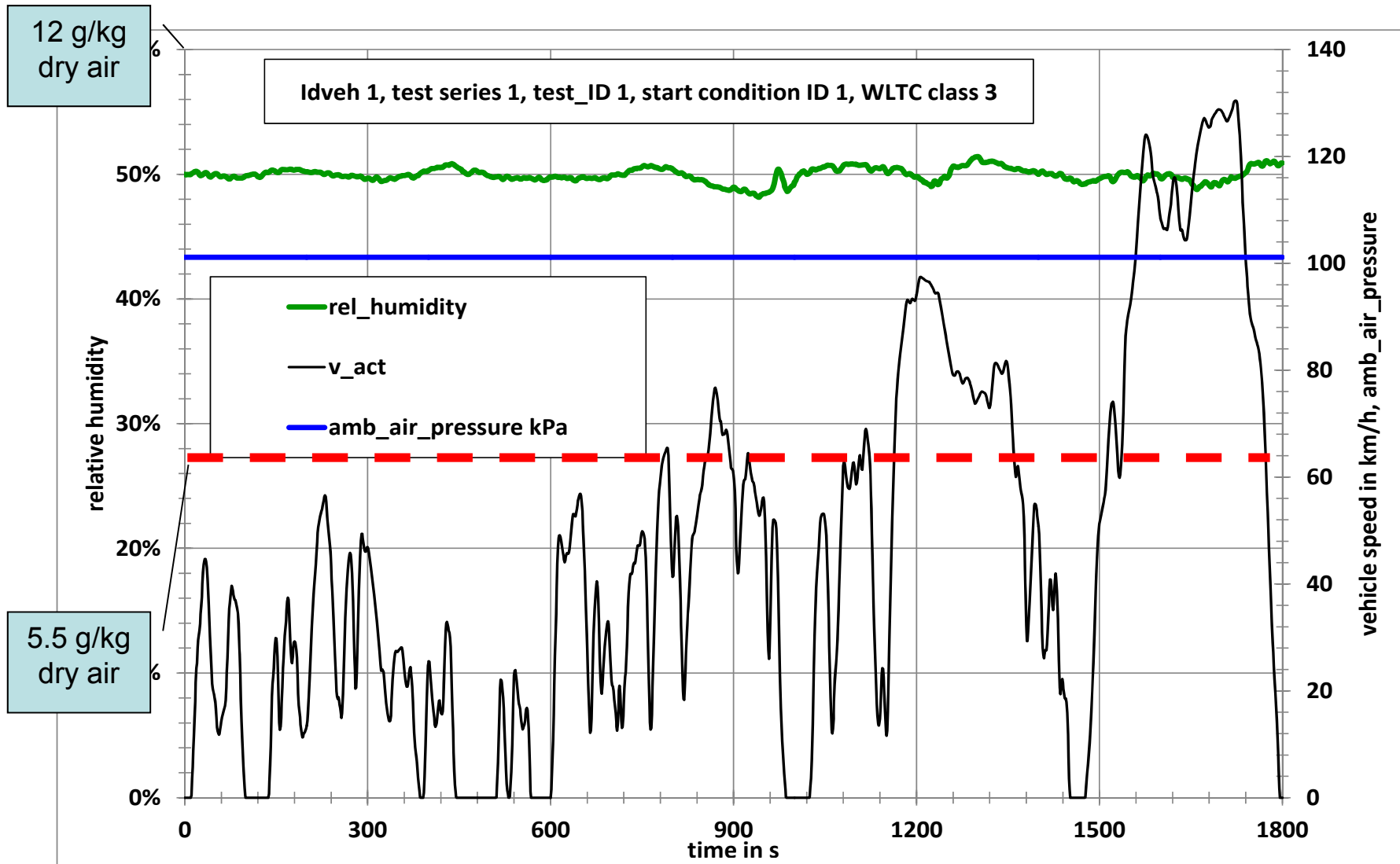
## Current Position for DTP 11:

Stay with the setpoint of 298 K for the test cell temperature, but allow a  $\pm 5$ K tolerance after start of the engine for technical reasons (similar to US provisions)

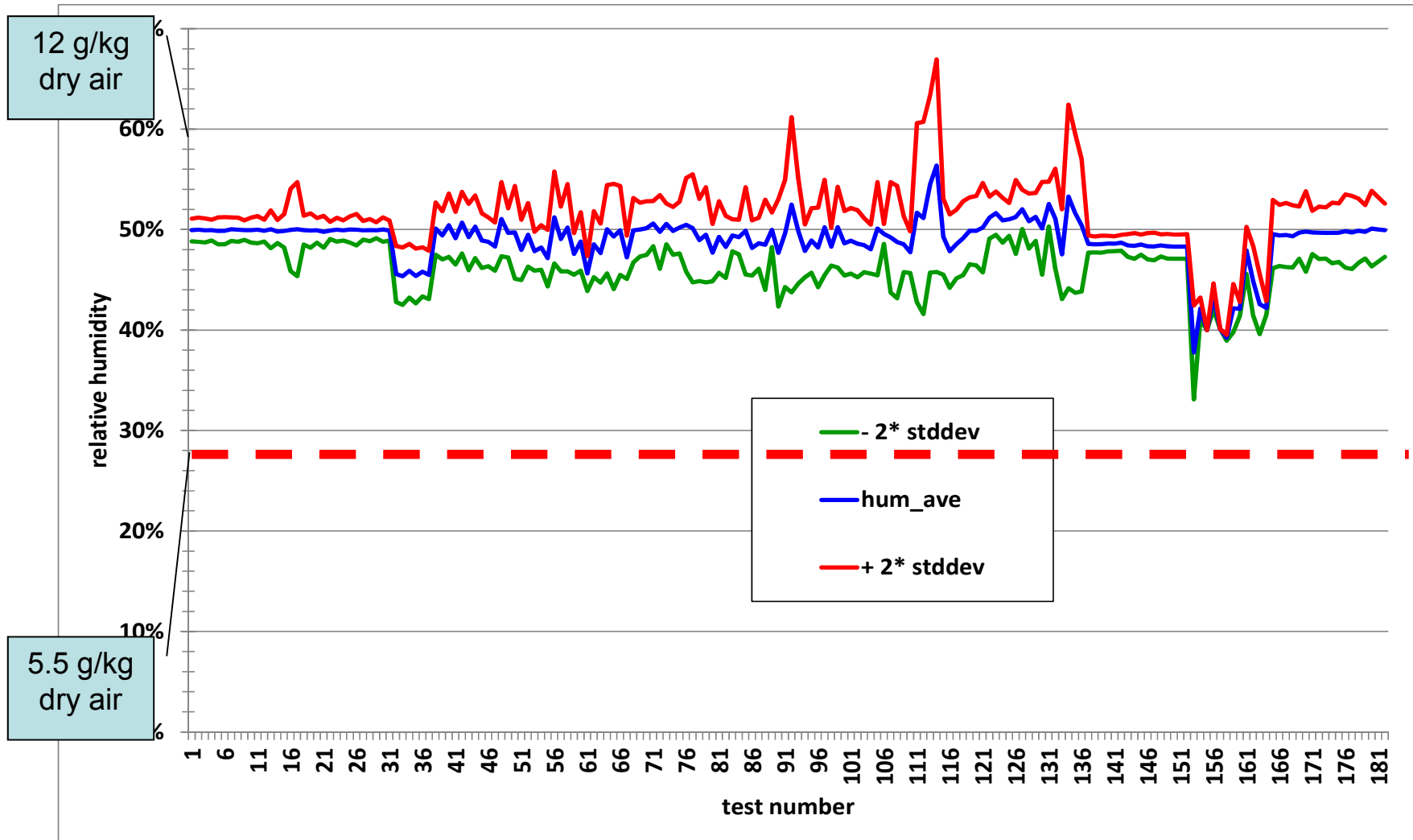
## Justification:

The influence of marginal higher air temperature on the measured results of emissions is negligible once the warming up of the vehicle has passed. A more powerful air condition is expensive and requires in most cases huge structural measures in lab equipment.

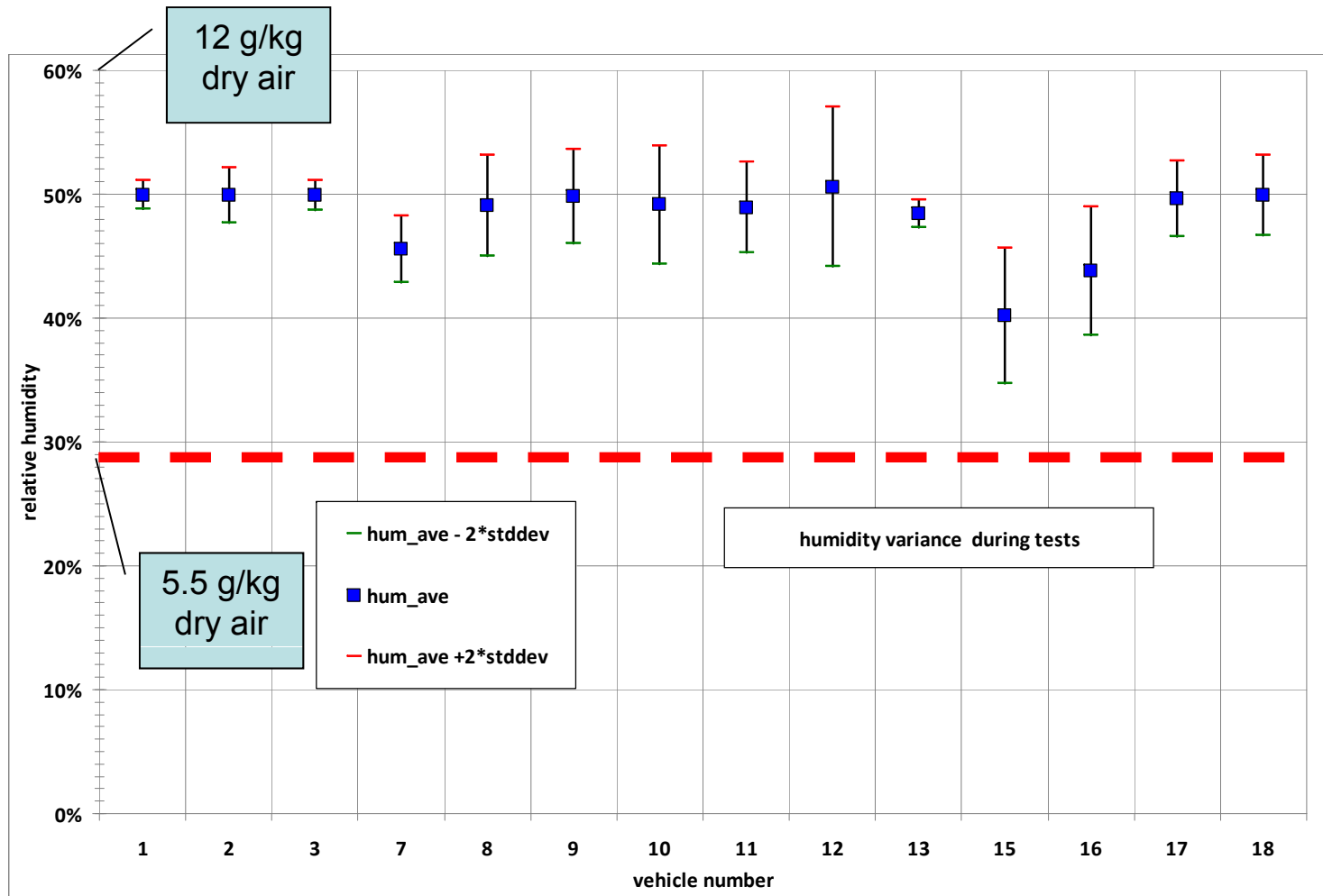
# Evaluation of Humidity in the Test Cell during the WLTC Test



# Evaluation of Humidity in the Test Cell during the WLTC Test



# Evaluation of Humidity in the Test Cell during the WLTC Test



# Evaluation of Humidity in the Test Cell during the Test

## Current Position in gtr annex 6:

1.2.2.2.1.2. The absolute humidity ( $H_a$ ) of either the air in the test cell or the intake air of the engine shall be such that:

$$5.5 \leq H_a \leq 12.2 \text{ (g H}_2\text{O/kg dry air)}$$

1.2.2.2.1.2. Humidity shall be measured continuously (1 Hz).

## Result of Evaluation of VP2:

Vehicle tests in different labs shows variation of humidity within the tolerance

## Current Position for DTP 11:

Stay with actual tolerance in gtr

## Justification:

Humidity variation influences  $\text{NO}_x$  emission measurement. Within the given tolerance the effect is compensated with a correction factor dependent on actual values of humidity. A tighter tolerance would not enhance the data quality but increase system costs of the test cell air condition significantly.