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Vp2 AP JRC Ispra

26 June-3 July 2015

12th WLTP
by C. Astorga

participants:

AVL
HORIBA
IONICON
LumaSense
Synspec
JRC

Experimental campaign: VELA lab Ispra

September 2015

Vehicle specifications

Features	FFV
Combustion type	Spark Ignition
Year of registration	2012
EU emission standard	Euro 5
After-treatment	TWC*
Fuel system	Direct Injection
Engine power (kW)	132
Engine displacement (cm ³)	1596
Odometer (km)	20010

*TWC (Three Way Catalyst)

Figure 1. WLTC speed profile

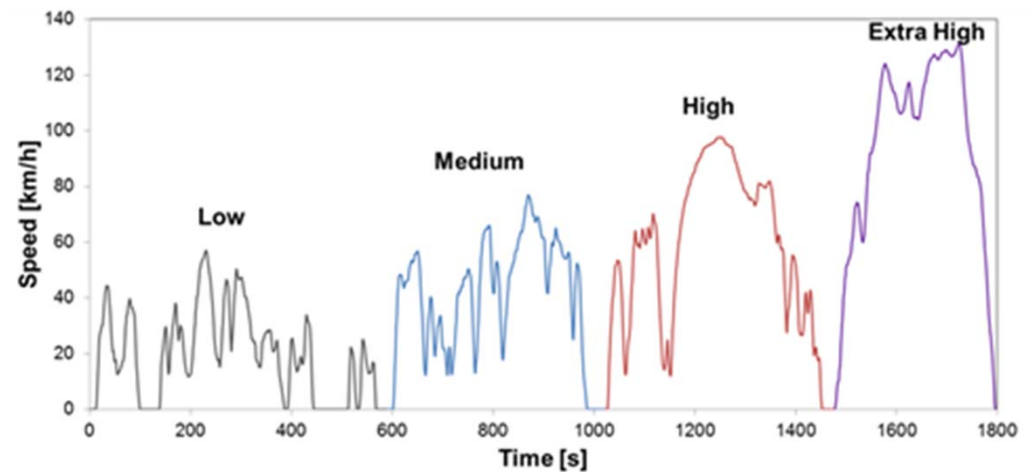


Table 2. Fuel specifications.

¹Research Octane Number; ²Motor Octane Number; ³Dry Vapor Pressure Equivalent

Parameter	Method	Unit	E85
RON ¹	ISO 5164	Index	107.3
MON ²	ISO 5163	Index	90.7
Density at 15 °C	EN ISO 3675-98	kg m ⁻³	782.3
DVPE ³ at 100 F	EN ISO 13016	mbar	464
Ethanol	EN ISO 13132	% v/v	84.1
Water	ASTM E 1064	% v/v	0.1
Sulphur (S)	EN ISO 20846	mg kg ⁻¹	<3.0
Carbon (C)	GC/calculated	mass %	57.0
Hydrogen (H)	GC/calculated	mass %	13.3
Oxygen (O)	GC/calculated	mass %	29.7

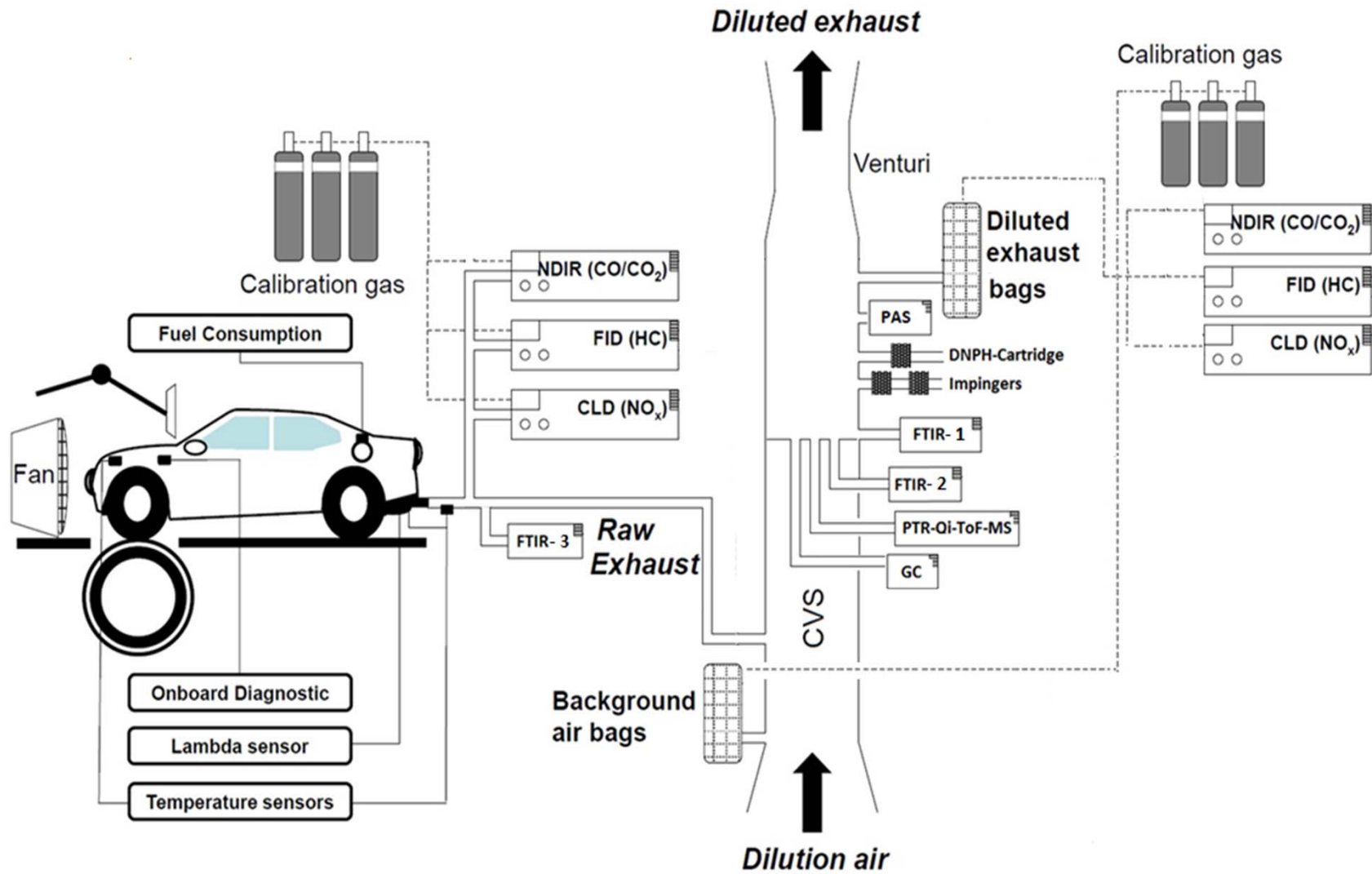


Table 4. Regulated emissions (mg/km); (*g/km).
Errors refer to the standard deviation of the three performed tests.

	THC	NMHC	CO	NO_x	CO₂*
Phase 1	172±17	127±11	588±154	52±3	258.2±0.9
Phase 2	4±1	2.1±0.4	117±82	14±2	186.9±0.4
Phase 3	1.8±0.5	1.0±0.2	110±35	9±1	170.3±0.3
Phase 4	18±1	7.8±0.6	931±226	23.1±0.6	210±1
WLTC	31±2	20±1	466±36	20.8±0.6	199.5±0.5



		Analysis					
	Technique	Sampling flow (l/min)	Frequency and Response	Sampling Temp (°C)	Cell/chamber Temp (°C)	Additional Pollutant measured	
AVL SESAM i60 FT SII	FTIR-1	8	5 Hz	50	50	EtOH, HCHO & CH ₃ CHO	
HORIBA MEXA-FT	FTIR-2	5	1 Hz	r.t.	53	EtOH, HCHO & CH ₃ CHO	
IONICON	PTR-Qi-ToF-MS	0.067	1 Hz	80	80	EtOH, HCHO & CH ₃ CHO	
LumaSense	PAS	0.2	≤ 60 s*	r.t.	~ 40°C	EtOH	
Synspec	GC	1.1**	5 min	r.t.	-	EtOH & CH ₃ CHO	
JRC MKS	FTIR-3	10	5 Hz	190	190	EtOH, HCHO & CH ₃ CHO	
CARB Method 1001	Impinger/ GC-FID	4	Off-line	50	-	EtOH	
CARB Method 1004	Cartridge/ HPLC-UV	1	Off-line	50	-	HCHO & CH ₃ CHO	

*PAS measured from a bag once the test was finished; ** 5.5 l sampled every 5 minutes.



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Table 5. Formaldehyde (HCHO), acetaldehyde (CH₃CHO) and ethanol (EtOH) emission factors (mg/km) over the WLTC

	Sampling*	EtOH	CH ₃ CHO	HCHO
FTIR-1	CVS	17±4	5.4±0.4	1.1±0.1
FTIR-2	CVS	16±2	5.2±0.3	0.8±0.2
PTR-Qi-ToF-MS	CVS	17±3	5.4±0.2	1.0±0.1
PAS¹	CVS	16±1	-	-
GC²	CVS	14±2	5±1 [°]	-
FTIR-3	TP	17±2	5.3±0.6	1.1±0.1
Cartridges + HPLC-UV (CARB 1004)	CVS	-	4.6±0.3 [□]	1.2±0.1
Impingers + GC-FID (CARB 1001)	CVS	16±2	-	-
Assigned value (mg/km)		16.2	5.2	1.0
Repeatability (%)		14	12	13
Reproducibility (%)		14	12	19

The errors refer to the standard deviation of the three repetitions.

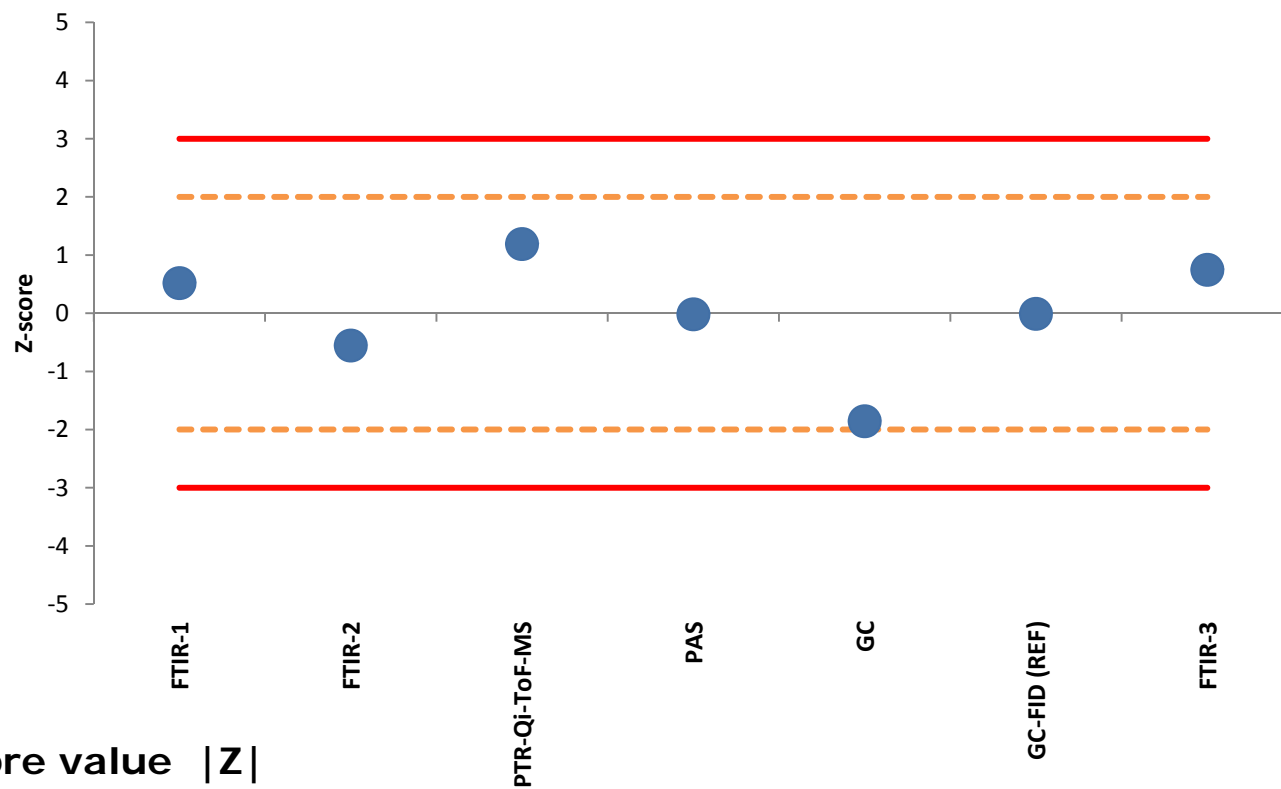
*Sampling points: CVS dilution tunnel; TP tailpipe; ¹ photoacoustic spectroscopy; ² double GC system. Statistical analysis: [°] variance straggler (Cochran's test with 5% critical value), [□] average straggler (Grubbs' test with 5% critical value).



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PERFORMANCE INDICATOR – Z-SCORE

Ethanol (n = 7)



Evaluation of
performance

Z-score value |Z|

Satisfactory

≤ 2

Questionable

> 2 but ≤ 3

Unsatisfactory

> 3

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Figure 8 a. Z-scores obtained for the instruments capable of monitoring acetaldehyde

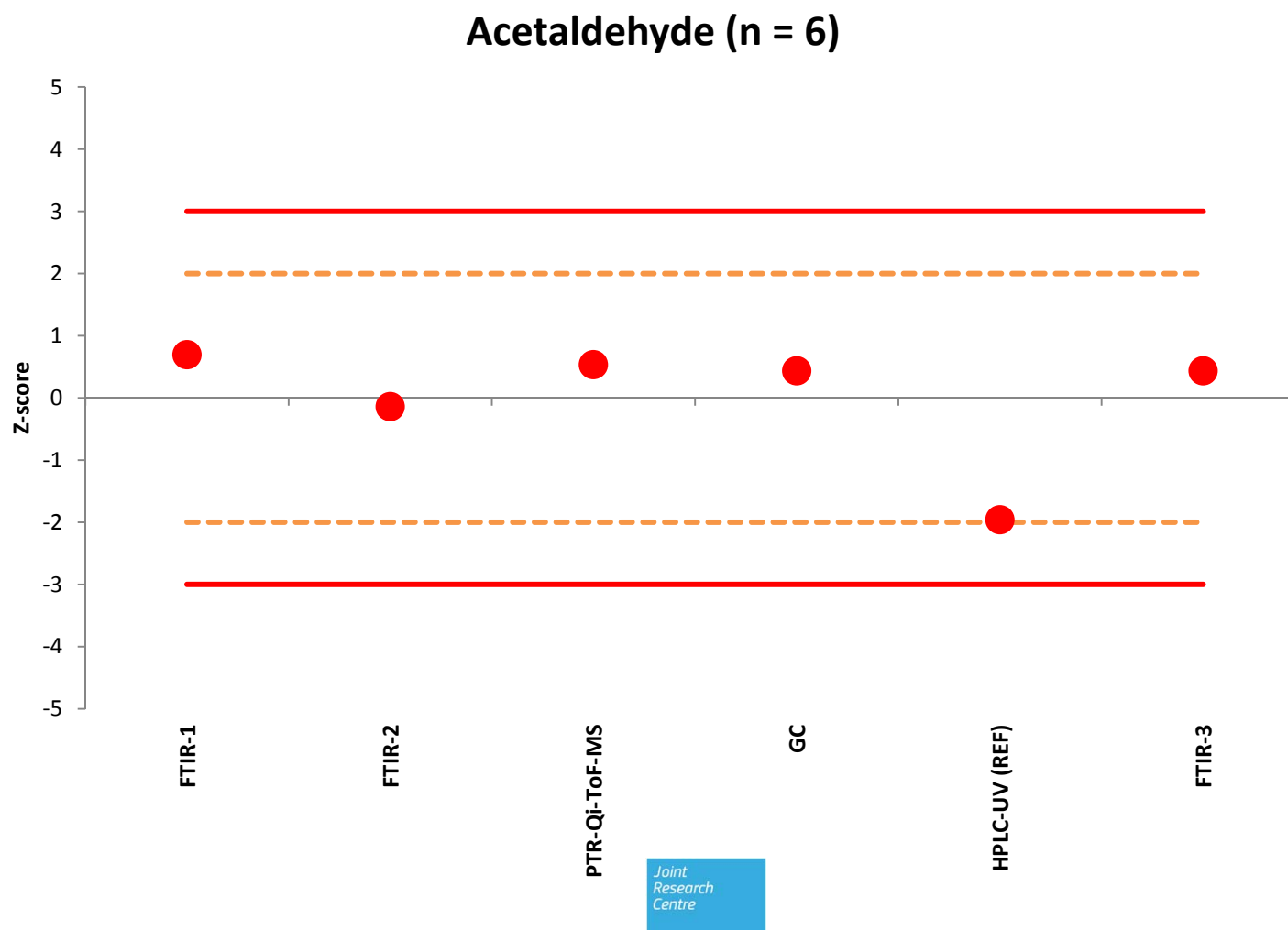
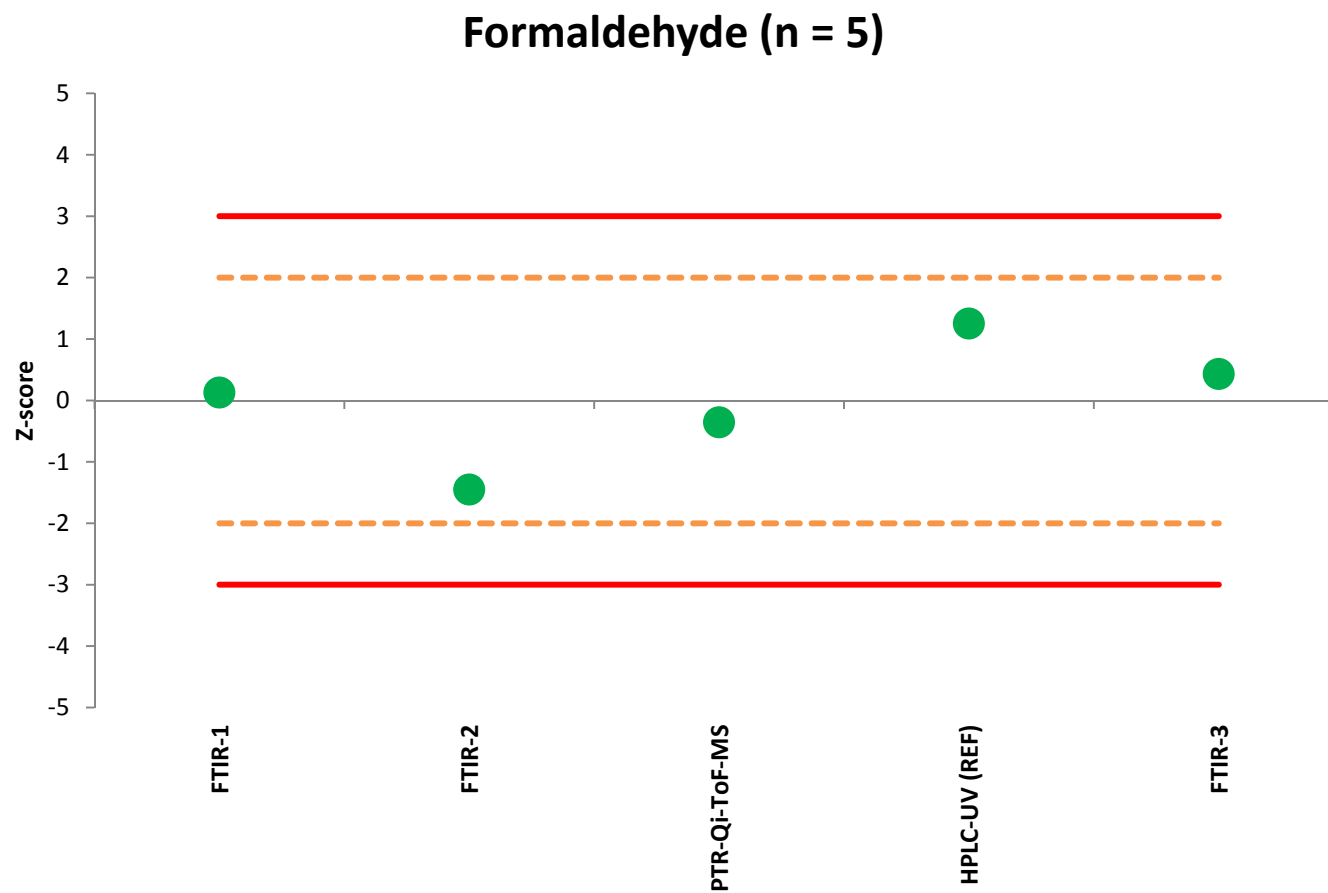


Figure 8 b. Z-scores obtained for the instruments capable of monitoring formaldehyde



Conclusions

During the exercise there were found *in situ* and also online analytical instrumentation capable of measuring the three additional pollutants (EtOH, HCHO and CH₃CHO) from the diluted exhaust (sampled at the CVS) with good repeatability and reproducibility.

All tested instruments resulted to be in good agreement.

The intercomparison of all analytical instrumentation measuring at the CVS was very satisfactory.



**This presentation will be extended
and presented during the next
12th WLTP meeting.**

**All data are taken from the Report*
prepared by JRC staff after the
validation phase.**

Dr Suarez Bertoa

Dr Clairotte

Dr Astorga

*** Contributions from all participants
in the Validation phase in Ispra
have been collected for the
elaboration of the report**

