

**Report No.** LM1810001-04\_V04  
**Project No.** LM1810001

## **FUEL CONSUMPTION TEST ACCORDING TO THE 2014 SORT PROCEDURE**

### **STANDARDISED ON-ROAD TESTS CYCLES**

Client's reference:

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Test period: 26<sup>th</sup> October 2018  
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This report contains 20 pages, including this cover and 2 annexes

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## 1. VEHICLE INFORMATION

### 1.1. Basic vehicle information

The table below shows the vehicle characteristics:



Manufacturer	BMC OTOMOTİV SANAYİ VE TİCARET A.Ş.	
Vehicle	12M PROCITY BUS	
Type	M3	
Reception date	17/09/2018	
Chassis n°	NMC285LKBLBC00001	
Engine	CUMMINS ISB6.7 E6C 300B Euro-6*	
Gearbox	ZF 6AP 1200B ECOLIFE Automatic	
Tyres	PIRELLI - 275/70 R22.5	
Initial / final mileage (km)	24.925	25.055

(\* Test specs shown in above table correspond to vehicle unit tested, which was equipped with engine "ISB6.7 E6C 300B". For "CUMMINS B6.7 E6D 300B EURO-6" engine configuration, please check Annex II.

## 2. TEST RESULTS

### 2.1. SORT fuel consumption and emissions results

The table below shows the averaged emissions and fuel consumption results for the SORT tests:

	Fuel consumption l/100km	Emissions			
		CO g/km	CO <sub>2</sub> g/km	THC g/km	NOx g/km
SORT 1	45,2	0,49	1.231,7	0,013	0,50
SORT 2	37,6	0,28	1.054,8	0,009	1,00
SORT 3	34,6	0,20	964,8	0,005	0,41

### 2.2. Vehicle test weights

The table below shows the vehicle weight for the SORT tests:

		SORT
Front axle	(kg)	4.876
Rear axle	(kg)	8.689
<b>Total weight</b>	<b>(kg)</b>	<b>13.565</b>

### 2.3. Test cycle SORT 1

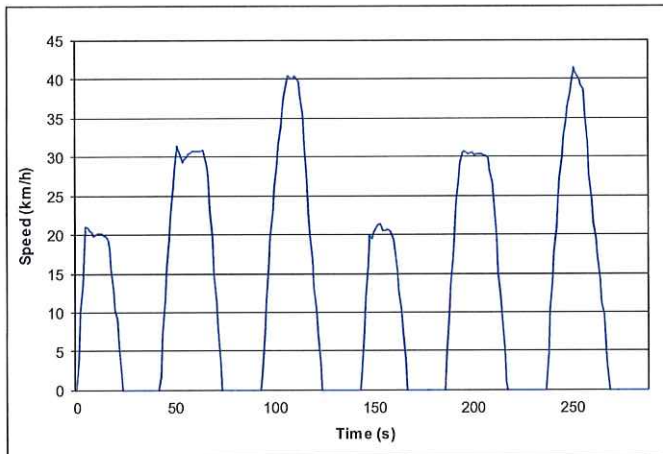
The tables below show the weather conditions and test characteristics in both directions for SORT1 cycles:

#### SORT 1 - Test 1

##### NORTH DIRECTION

##### Weather conditions

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 19:20	17,9	99,8	0,0	242,1	87,7

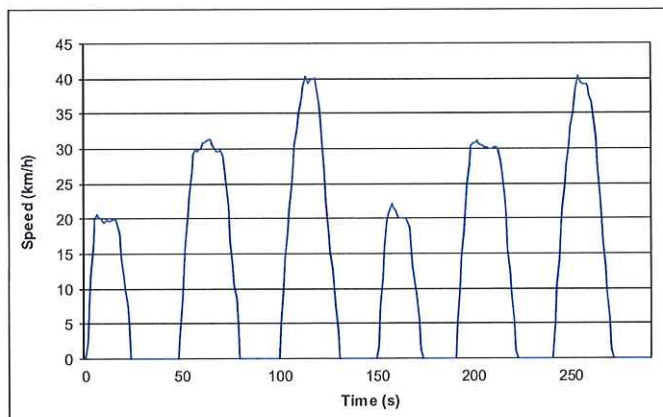


Total test distance (m)	1.042,7
Total test time (s)	288
Fuel consumption (l/100km)	44,8
Cycle speed (km/h)	13,0
CO emissions (g/km)	0,61
CO2 emissions (g/km)	1.232,5
HC emissions (g/km)	0,014
NOx emissions (g/km)	0,08

##### SOUTH DIRECTION

##### Weather conditions

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 19:10	18,0	99,8	0,6	244,6	87,9



Total test distance (m)	1.043,1
Total test time (s)	291
Fuel consumption (l/100km)	45,4
Cycle speed (km/h)	12,9
CO emissions (g/km)	0,62
CO2 emissions (g/km)	1.210,7
HC emissions (g/km)	0,013
NOx emissions (g/km)	0,36

Speed average (km/h)	13,0
Fuel consumption average (l/100km)	45,1

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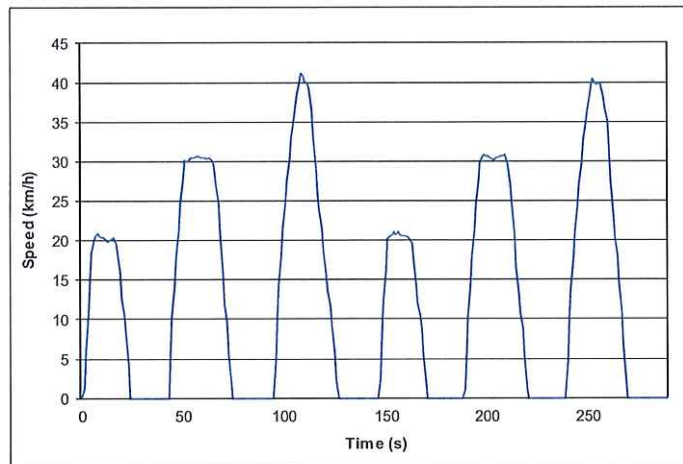
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**SORT 1 - Test 2**

**NORTH DIRECTION**

**Weather conditions**

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 19:40	17,6	99,8	0,3	290,4	89,4

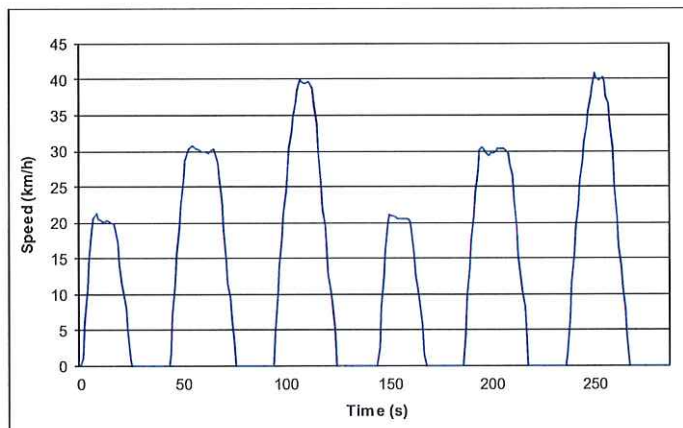


Total test distance	(m)	1.040,6
Total test time	(s)	289
Fuel consumption	(l/100km)	45,3
Cycle speed	(km/h)	13,0
CO emissions	(g/km)	0,54
CO2 emissions	(g/km)	1.234,4
HC emissions	(g/km)	0,013
NOx emissions	(g/km)	0,67

**SOUTH DIRECTION**

**Weather conditions**

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 19:30	17,7	99,8	0,2	214,9	88,6



Total test distance	(m)	1.043,5
Total test time	(s)	286
Fuel consumption	(l/100km)	45,5
Cycle speed	(km/h)	13,1
CO emissions	(g/km)	0,46
CO2 emissions	(g/km)	1.247,6
HC emissions	(g/km)	0,014
NOx emissions	(g/km)	0,96

Speed average	(km/h)	13,0
Fuel consumption average	(l/100km)	45,4

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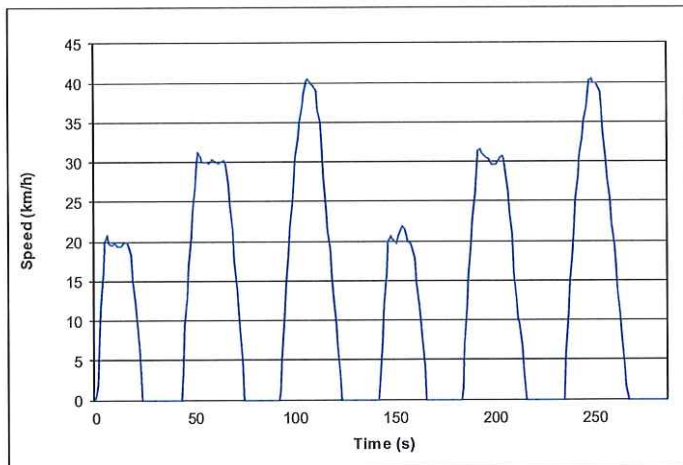
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**SORT 1 - Test 3**

**NORTH DIRECTION**

**Weather conditions**

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 20:00	17,4	99,8	0,3	282,2	90,3

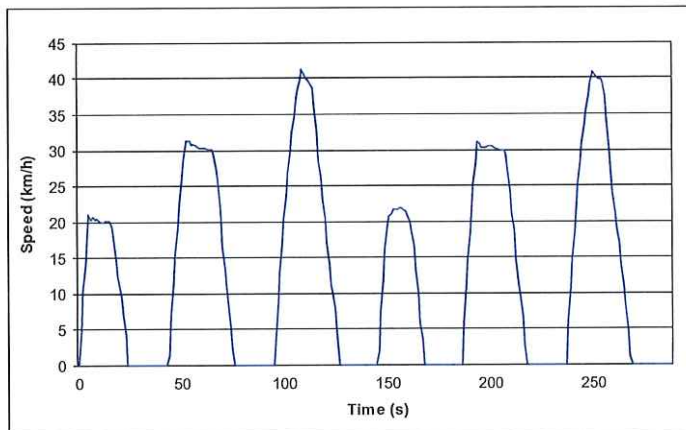


Total test distance	(m)	1.042,4
Total test time	(s)	286
Fuel consumption	(l/100km)	44,9
Cycle speed	(km/h)	13,1
CO emissions	(g/km)	0,30
CO2 emissions	(g/km)	1.215,5
HC emissions	(g/km)	0,012
NOx emissions	(g/km)	0,35

**SOUTH DIRECTION**

**Weather conditions**

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 19:50	17,5	99,8	0,6	282,1	89,7



Total test distance	(m)	1.046,5
Total test time	(s)	288
Fuel consumption	(l/100km)	45,3
Cycle speed	(km/h)	13,1
CO emissions	(g/km)	0,41
CO2 emissions	(g/km)	1.249,7
HC emissions	(g/km)	0,013
NOx emissions	(g/km)	0,59

Speed average	(km/h)	13,1
Fuel consumption average	(l/100km)	45,1

Fuel consumption average SORT1 (l/100km)	45,2
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## 2.4. Test cycle SORT 2

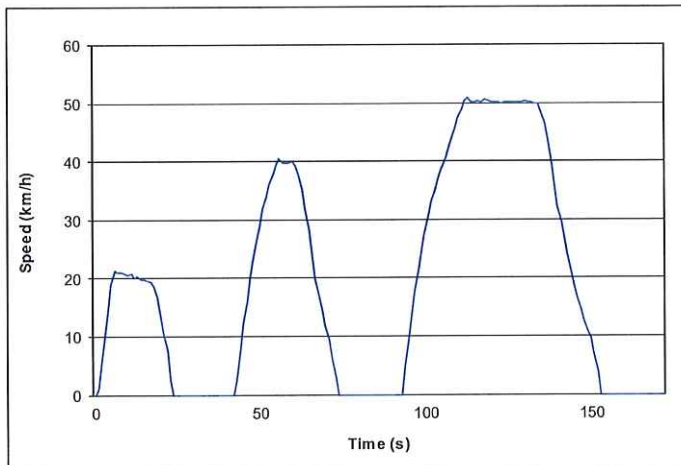
The tables below show the weather conditions and test characteristics in both directions for SORT2 cycles:

### SORT 2 - Test 1

#### NORTH DIRECTION

##### Weather conditions

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 20:30	17,3	99,8	0,7	295,6	91,9

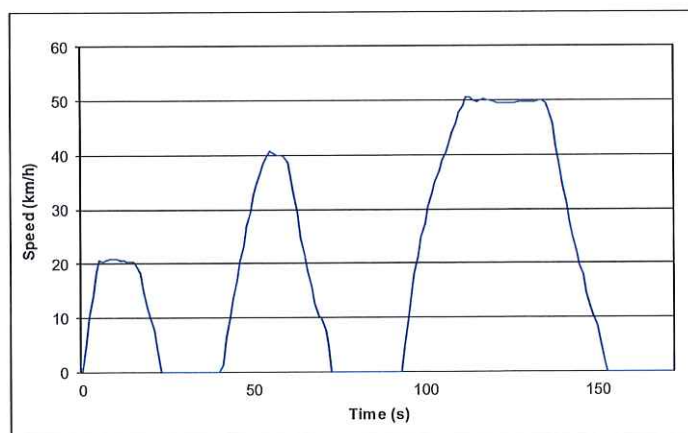


Total test distance	(m)	921,8
Total test time	(s)	172
Fuel consumption	(l/100km)	37,4
Cycle speed	(km/h)	19,3
CO emissions	(g/km)	0,29
CO2 emissions	(g/km)	1.041,2
HC emissions	(g/km)	0,009
NOx emissions	(g/km)	0,88

#### SOUTH DIRECTION

##### Weather conditions

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 20:20	17,2	99,8	0,8	290,2	91,9



Total test distance	(m)	915,3
Total test time	(s)	172
Fuel consumption	(l/100km)	37,7
Cycle speed	(km/h)	19,2
CO emissions	(g/km)	0,39
CO2 emissions	(g/km)	1.064,1
HC emissions	(g/km)	0,007
NOx emissions	(g/km)	0,85

Speed average	(km/h)	19,2
Fuel consumption average	(l/100km)	37,6

*Signature*

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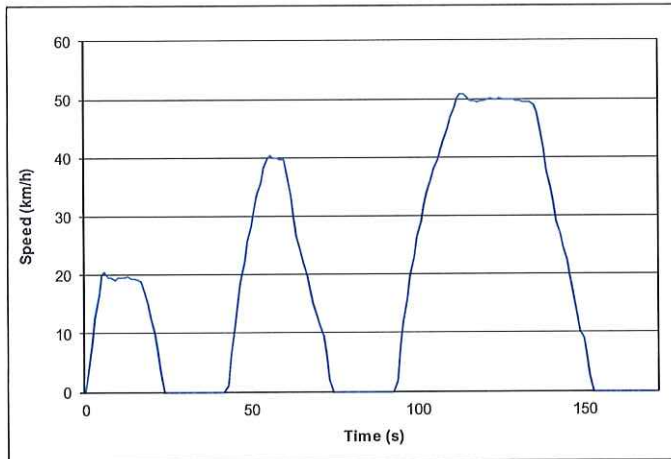
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**SORT 2 - Test 2**

**NORTH DIRECTION**

**Weather conditions**

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 20:50	16,8	99,8	0,8	273	93,3

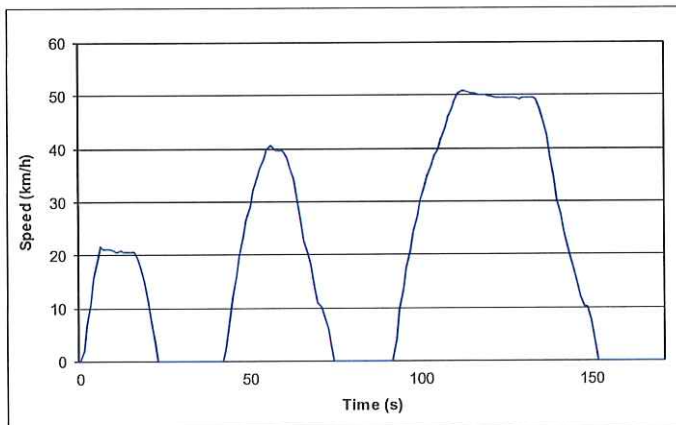


Total test distance	(m)	922,5
Total test time	(s)	172
Fuel consumption	(l/100km)	37,6
Cycle speed	(km/h)	19,3
CO emissions	(g/km)	0,25
CO2 emissions	(g/km)	1.066,6
HC emissions	(g/km)	0,009
NOx emissions	(g/km)	0,95

**SOUTH DIRECTION**

**Weather conditions**

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 20:40	17,1	99,8	0,8	282,8	92,0



Total test distance	(m)	923,2
Total test time	(s)	171
Fuel consumption	(l/100km)	37,8
Cycle speed	(km/h)	19,4
CO emissions	(g/km)	0,25
CO2 emissions	(g/km)	1.056,8
HC emissions	(g/km)	0,009
NOx emissions	(g/km)	0,88

Speed average	(km/h)	19,4
Fuel consumption average	(l/100km)	37,7

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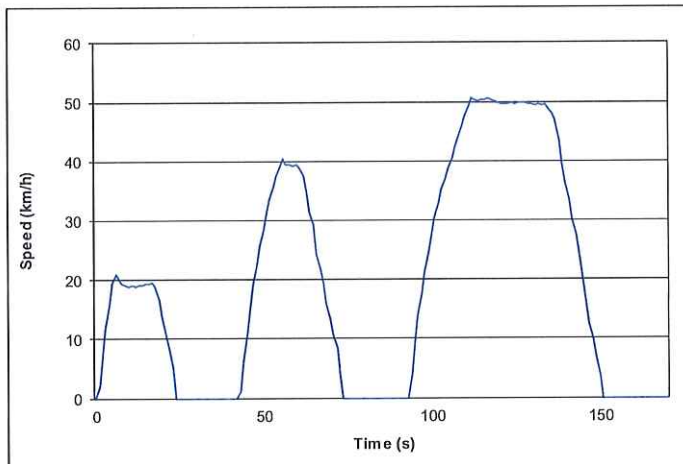


**SORT 2 - Test 3**

**NORTH DIRECTION**

**Weather conditions**

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 21:10	16,5	99,8	0,5	243,4	96,4

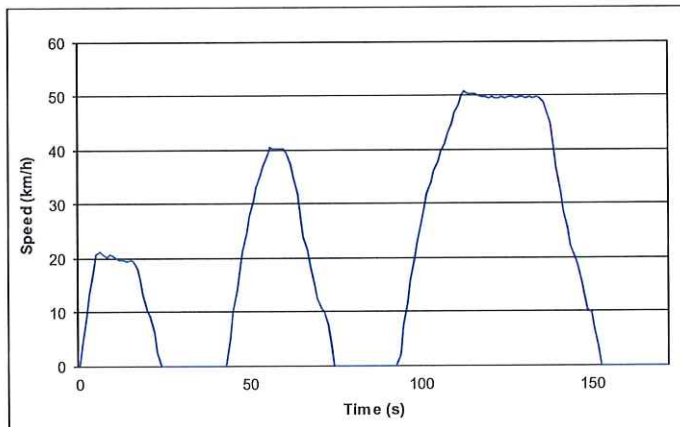


Total test distance	(m)	921,7
Total test time	(s)	170
Fuel consumption	(l/100km)	<b>37,3</b>
Cycle speed	(km/h)	19,5
CO emissions	(g/km)	0,24
CO2 emissions	(g/km)	1.045,6
HC emissions	(g/km)	0,009
NOx emissions	(g/km)	1,24

**SOUTH DIRECTION**

**Weather conditions**

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 21:00	16,6	99,8	0,5	194,2	94,7



Total test distance	(m)	923,8
Total test time	(s)	172
Fuel consumption	(l/100km)	<b>38,1</b>
Cycle speed	(km/h)	19,3
CO emissions	(g/km)	0,25
CO2 emissions	(g/km)	1.054,7
HC emissions	(g/km)	0,009
NOx emissions	(g/km)	1,19

Speed average	(km/h)	<b>19,4</b>
Fuel consumption average	(l/100km)	<b>37,7</b>

Fuel consumption average SORT2 (l/100km)	<b>37,6</b>
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## 2.5. Test cycle SORT 3

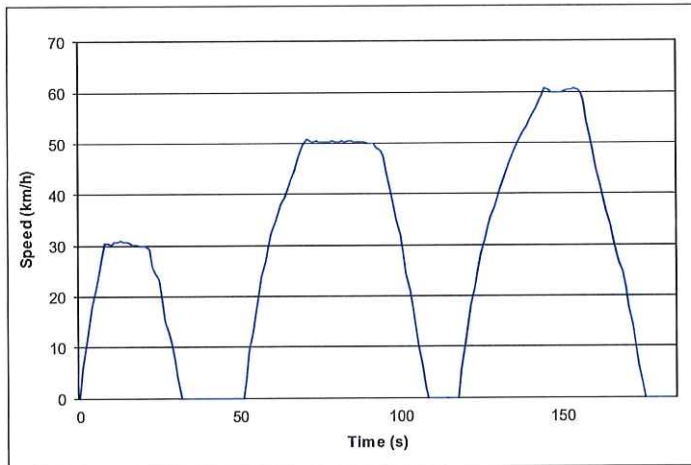
The tables below show the weather conditions and test characteristics in both directions for SORT3 cycles:

### SORT 3 - Test 1

#### NORTH DIRECTION

##### Weather conditions

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 21:30	16,5	99,8	0,3	186,8	95,9

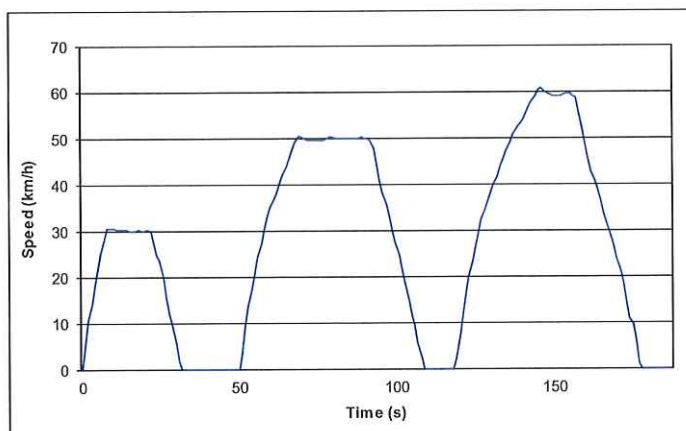


Total test distance	(m)	1.450,2
Total test time	(s)	185
Fuel consumption	(l/100km)	34,3
Cycle speed	(km/h)	28,2
CO emissions	(g/km)	0,15
CO2 emissions	(g/km)	968,0
HC emissions	(g/km)	0,006
NOx emissions	(g/km)	0,26

#### SOUTH DIRECTION

##### Weather conditions

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 21:20	16,6	99,8	0,5	285	97,0



Total test distance	(m)	1.451,3
Total test time	(s)	187
Fuel consumption	(l/100km)	34,7
Cycle speed	(km/h)	27,9
CO emissions	(g/km)	0,22
CO2 emissions	(g/km)	965,3
HC emissions	(g/km)	0,006
NOx emissions	(g/km)	0,27

Speed average	(km/h)	28,1
Fuel consumption average	(l/100km)	34,5

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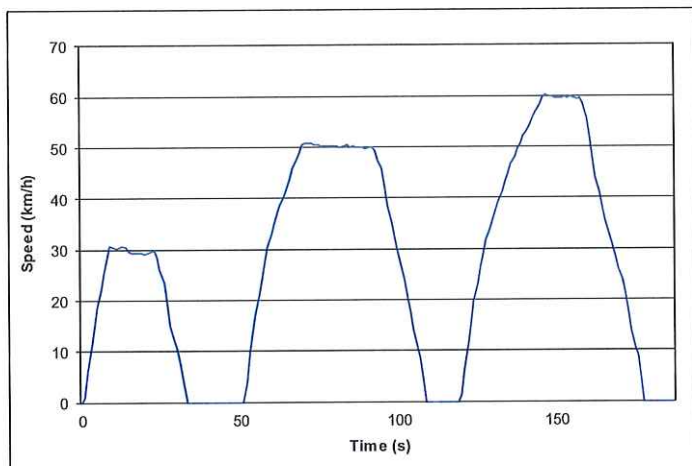
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**SORT 3 - Test 2**

**NORTH DIRECTION**

**Weather conditions**

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 21:50	16,6	99,7	0,4	315,7	97,3

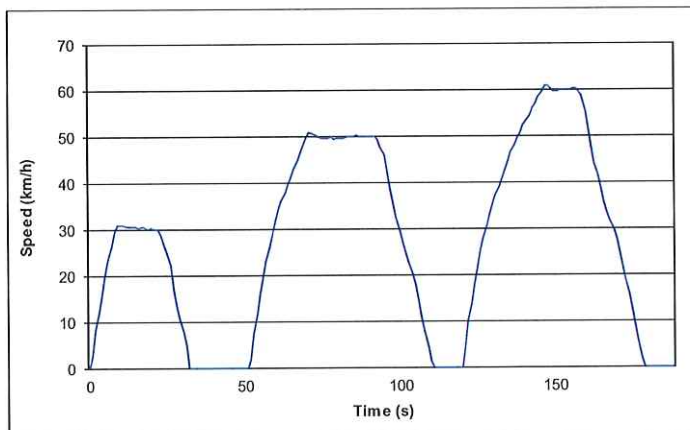


Total test distance	(m)	1.450,1
Total test time	(s)	187
Fuel consumption	(l/100km)	34,4
Cycle speed	(km/h)	27,9
CO emissions	(g/km)	0,20
CO2 emissions	(g/km)	957,6
HC emissions	(g/km)	0,005
NOx emissions	(g/km)	0,20

**SOUTH DIRECTION**

**Weather conditions**

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 21:40	16,4	99,8	0,4	174,3	96,8



Total test distance	(m)	1.451,7
Total test time	(s)	188
Fuel consumption	(l/100km)	34,9
Cycle speed	(km/h)	27,8
CO emissions	(g/km)	0,22
CO2 emissions	(g/km)	971,6
HC emissions	(g/km)	0,006
NOx emissions	(g/km)	0,37

Speed average	(km/h)	27,9
Fuel consumption average	(l/100km)	34,7

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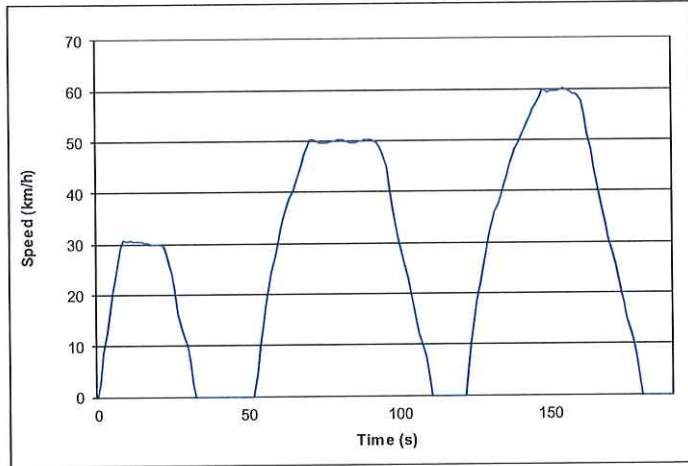
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**SORT 3 - Test 3**

**NORTH DIRECTION**

**Weather conditions**

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 22:10	16,4	99,7	0,1	112,3	96,3

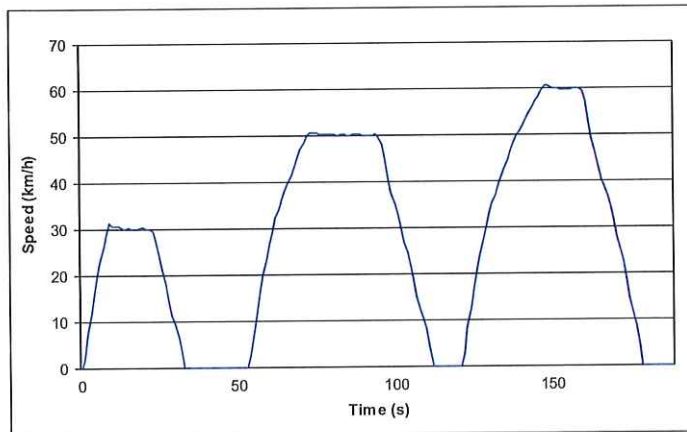


Total test distance	(m)	1.449,8
Total test time	(s)	190
Fuel consumption	(l/100km)	34,4
Cycle speed	(km/h)	27,5
CO emissions	(g/km)	0,21
CO2 emissions	(g/km)	960,8
HC emissions	(g/km)	0,005
NOx emissions	(g/km)	0,78

**SOUTH DIRECTION**

**Weather conditions**

Date	Temperature (°C)	Pressure (KPa)	Wind speed (m/s)	Wind direction (°)	Humidity (%)
26/10/2018 22:00	16,7	99,7	0,4	244,7	95,9



Total test distance	(m)	1.451,2
Total test time	(s)	188
Fuel consumption	(l/100km)	35,0
Cycle speed	(km/h)	27,8
CO emissions	(g/km)	0,17
CO2 emissions	(g/km)	965,1
HC emissions	(g/km)	0,005
NOx emissions	(g/km)	0,57

Speed average	(km/h)	27,6
Fuel consumption average	(l/100km)	34,7

Fuel consumption average SORT3	(l/100km)	34,6
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### 3. VEHICLE INSTRUMENTATION

The vehicle instrumentation used during the test was as follows:

Equipment	Brand	Model	Serial Number
Speed sensor	Racelogic	Vbox2SX10	121832
Fuel flowmeter	AIC	6004	164918
PEMS equipment GA	Horiba	OBS-One	161336
PEMS equipment THC	Horiba	OBS-One	GLV85FS9
Weather station	Campbell Scientific	CR1000	E2744


  
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## *Annex I: Sheet 3 Test protocol*

This annex contains 4 pages.

  
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## Test protocol

For tests to be repeatable, it is necessary to definition with accuracy the vehicle actually tested, especially because a certain level of margin is left to manufacturers.  
The test must consequently be documented with accuracy in a test protocol describing the most relevant elements, so that in case of later confirmation tests, the tested bus is clearly defined and cannot give rise to dispute or misinterpretation.

Date of test	26/10/2018
Time of test begin	18:00
Time of test end	00:00
Place of test	IDIADA HQ – Dynamic platform A

### A. Test external conditions (for information)

#### 1. Street conditions

N°	Item	Value	Unit
1.1	State of track surface	Dry	
1.2	Max. longitudinal gradient	+/- 0,0	%
1.3	Track altitude	125	m
1.4	Min. radius	--	m
1.5	Track length	1.900	m

#### 2. Weather conditions

N°	Item	Value		Unit
		SORT		
		Initial	Final	
2.1	Wind speed	0,6	0,1	m/s
2.2	Temperature	18,0	16,4	°C
2.3	Humidity	87,9	96,3	%
2.4	Atmospheric pressure	99,8	99,7	kPa

### B. Vehicle set-up

#### 1.1. Type et dimension:

N°	Item	Value	Unit
1.1.1	Vehicle type	M3	
1.1.2	Length	12,0	m
1.1.3	Width	2,535	m
1.1.4	Height	3,110	m
1.1.5	Empty weight	10.712	kg
1.1.6	Mileage	24.925	km

#### 1.2. Engine

N°	Item	Value	Unit	At (rpm)
1.2.1	Manufacturer and type	CUMMINS ISB6.7 E6C 300B Euro-6		
1.2.2	Engine capacity	6.700	cc	
1.2.3	Maximum power	220	kW	2.100
1.2.4	Maximum torque	1.182	Nm	1.150 – 1.400
1.2.5	Driving mode of engine ventilator	Hydrostatic		

### 1.3. Gearbox

N°	Item	Value
1.3.1	Manufacturer and type	ZF 6AP 1200B ECOLIFE Automatic
1.3.2	Programme used	6070205732_AL0_04_CI_03

### 1.4. Tyres

N°	Item	Value	Unit
1.4.1	Manufacturer and type	PIRELLI MC:01	
1.4.2	Dimensions	275/70 R22.5	
1.4.3	Front axle nominal pressure	130	Psi
1.4.4	Rear axle nominal pressure	130	Psi
1.4.5	Pattern depth of new tyres	--	mm
1.4.6	Actual pattern depth measured (min-max)	--	mm

### 1.5. Rear Axle

N°	Item	Value
1.5.1	Manufacturer and type	ZF AV 133 / 87°
1.5.2	Reduction ratio	6.20:1

### 1.6. Engine lubricant

N°	Item	Value
1.6.1	Type	--
1.6.2	SAE Grade	--
1.6.3	Other features	--

### 1.7. Gearbox lubricant


N°	Item	Value
1.7.1	Type	--
1.7.2	SAE Grade	--
1.7.3	Other features	--

### 1.8. Batteries

N°	Item	Value	Unit
1.8.1	Type	240	Ah
1.8.2	Number	2	
1.8.3	Nominal unit voltage	12	V
1.8.4	Unit weight	2x60	Kg

### 1.9. Miscellaneous equipment

N°	Item	Value
1.9.1	Number of doors	3
1.9.2	ABS/ASR	--
1.9.3	Retarder	ZF 6AP 1200B
1.9.4	Air conditioning	--
1.9.5	Other	--

  
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### 1.10. Calculation of the load characteristics CL of the tested vehicle.

N°	Item	Value		
1.10.1	Load factor CL (load)	$CL = 116.19 \times (L - 1.20) \times W$	3.181	kg
CL	Lump load			

### 1.11. Optional equipment

N°	Item	Weight to deduct from lump load	Unit
1.11.1	Air-conditioning	150	kg
1.11.2	Ramp for wheelchair users	10	kg
1.11.3	Ticketing equipment (excluding pay desk)	--	kg
1.11.4	Automatic vehicle monitoring system (AVM)	5	kg
1.11.5	Information equipment	5	kg
1.11.6	Video camera equipment	5	kg
1.11.7	Security driver cabin	70	kg
1.11.8	Double glazing	--	kg
1.11.9	Exhaust filters	--	kg
1.11.10	Lubrimatic equipment	--	kg
1.11.11	Other equipment (heater, oil pan, rear tow hook and extingtor)	--	kg
<b>(1)</b>	<b>Total weight to be deducted from lump load</b>	<b>245</b>	<b>kg</b>

### 1.12. Other factors to take into account

N°	Item	Actual weight (A)	Reference weight (B)	Difference (A-B)	Unit
1.12.1	External destination displays	--	--	--	kg
1.12.2	Seats (number: 26x10)	260	290	-30	kg
1.12.3	Fuel tank capacity (210x0,84)	210	166	44	kg
1.12.4	Urea tank capacity	30	5	25	
1.12.5	On board persons (number Y) (excluding driver)	--	--	--	kg
1.12.6	Fuel measuring equipment	40	--	40	kg
<b>(2)</b>	<b>Total weight to be deducted from lump load</b>			<b>79</b>	<b>kg</b>

### 1.13. Final value of lump load to apply


N°	Item	Value		
1.13.1	Empty weight	10.712		kg
1.13.2	Lump load	3.181		kg
1.13.3	Optional equipment (1)	245		kg
1.13.4	Other factors (2)	79		kg
1.13.5	= 3.181 - (1) - (2)	2.857		kg
1.13.6	Empty weight + load	Calculated	13.569	kg
		Measured	13.565	kg

## 2. Fuel

N°	Item		
2.1	EC standard	98 / 70 EC	
2.2	Sulphur rate	10	ppm
2.3	Fuel temperature at test start	45,5	°C
2.4	Fuel temperature at test end	50,5	°C
2.5	Adblue©	--	L
	Quantity at the beginning of the test	--	L
	Quantity at the end of the test	--	L
	Difference	--	L

## ***Annex II: Considerations for Cummins Stage-D Emission Level Engine B6.7 E6D***

This annex contains 1 page.

  
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## Considerations for Cummins Stage-D Emission Level Engine B6.7 E6D

Based on below listed documentation, there are no relevant differences regarding fuel consumption results according to SORT Protocol tests. This report covers engine configurations below:


- CUMMINS ISB6.7 E6C 300B EURO-6 Stage C
- CUMMINS B6.7 E6D 300B EURO-6 Stage D

The following information and documentation was provided by Cummins Engine Limited on 27<sup>th</sup> of June 2019:

- *“Euro VI Phase D Impact Presentation\_rev3.1\_November 2018”*;
  - o Cummins documentation about main changes on their engine platforms moving from Stage-C to Stage-D.
- *“e5 595 2009 627 2014C 1007 00 6\_7”*;
  - o Engine ISB6.7E6C type approval documentation for Stage-C.
- *“e5-595-2009-2018-932D-0018-00 6\_7”*;
  - o Engine B6.7E6D type approval documentation for Stage-D.

The following report was issued by IDIADA upon request of BMC:

- *“LM1810064\_07\_12m”*;
  - o Report with comparative SORT tests regarding fuel consumption and emissions on a single BMC bus unit with both Stage-C and Stage-D emission level engine configurations.

  
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