

Zero Emission Bus Certificate

Customer: Mellor				DYNAMOMETER SETTINGS		
Customer Address:	Miall Street, Rochdale, Gt. Manchester, OL11 1HY	Telematics Capability	Yes	Test Weight	11314**	kg
Test Purpose:	Zero Emission Bus Testing	Maximum Speed (km/h)	70 km/h	F°	-244.10	N
Vehicle Manufacturer:	Mellor	Seated Capacity	31	F¹	-1.7867	N/kmh
Vehicle Model Name:	Sigma 9 (Based on Sigma 10 test)	Passenger Capacity	54	F²	0.16267	N/kmh ²
Powertrain Technology:	Battery Electric	Declared Unladen Weight (kg)	9368	F³	0.000000	N/kmh ³
Powertrain Configuration:	Direct Drive	Gross Weight (kg)	13500	Equivalent test passengers	15.5**	passengers
Zero Emission Heating:	PTC Heaters	GVW Check	OK	Measured Unladen Weight	10260*	kg
Battery Specification		Charging and Refuelling Capability		Hydrogen Specification		
Battery Manufacturer	CATL	Plug Type	DC	Fuel Cell Manufacturer	N/A	
Battery Chemistry	LFP	Max Charge Capability (kW)	Up to 100kW	Fuel Cell Power Rating (kW)	N/A	
Battery Installed Capacity (kWh)	241	Charger Compatibility	DC	Hydrogen Storage Capacity (kg)	N/A	
Battery Usable Capacity (kWh)*	193	Charge time from 20-80% SOC	2-6 hours	Hydrogen Storage Pressure (bar)	N/A	

* Recommended manufacturer guideline, subject to warranty

** Taken from Sigma 10 test

Declared fuel, properties and source plus carbon conversion factors

Well-to-Tank Factor: Electricity	80.92	g CO ₂ e / MJ	Fuel Provider	UK market standard	WTT evidence	DBEIS Conversion 2021
Well-to-Tank Factor: Hydrogen	N/A	g CO ₂ e / MJ	Capacity of Tanker (kg)	N/A	Fuel Type / Pathway	UK Grid Electricity
Energy Density: Hydrogen	120	MJ / kg	Transport Distance of Hydrogen (km)	N/A	Energy Source	UK Grid

Emissions and Energy consumption results from approved test facility - Average 4 tests

Test Phase	HC (g/km)	CO (g/km)	NOx (g/km)	PM (g/km)	CO ₂ (g/km)	CH ₄ (g/km)*	N ₂ O (g/km)*	Total Energy Consumption (kWh)	Vehicle Energy Consumption (kWh/km)	Grid Electrical Energy Consumption (kWh/ 100km)
Outer Urban	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.46	0.84	98.27
Inner Urban	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.83	1.12	130.80
Rural	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.98	0.54	63.10
LBC Average	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.28	0.92	107.40
UK BUS Average	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12.27	0.75	87.46

Zero Emissions (Z.E.) Range: Energy consumption and charging efficiency

Test Charger Used	22 kW	Total measured energy consumed on vehicle (kWh)¹	88.00	Max ZE Range at 100% SOC (km)	257
Hydrogen Energy Over Test (kWh)	N/A	Measured grid energy during charging (kWh)	103.00	Max ZE Range at 80% SOC (km)	205
Hydrogen Delivered to Vehicle (kg)	N/A	Grid-to-Wheel efficiency (%)²	85%	Test Distance Travelled (km)	66

¹ Total measured energy includes energy used during the 23 minute warmup, this is needed for charge efficiency calculation.

² Grid to Wheel efficiency represents the total energy losses between the grid and the wheels of the bus.

Calculated total Well-to-Wheel GHG CO₂ equivalent emissions over test

Test Phase	Fuel Energy (MJ / km)	Fuel WTT*GHG Emissions (g CO ₂ e / km)	Electrical Energy (MJ / km)	Electricity WTT* GHG Emissions (g CO ₂ e / km)
Outer Urban	N/A	N/A	3.54	286.27
Inner Urban	N/A	N/A	4.71	381.04
Rural	N/A	N/A	2.27	183.82
LBC Average	N/A	N/A	3.87	312.87
UK BUS Average	N/A	N/A	3.15	254.78

Data Generated by (On behalf of Test facility): _____ Date: _____

Data Approved by: _____ Date: _____

Zero Emission Bus Certificate Summary

Test Vehicle		Average Euro VI Diesel Equivalent			
Greenhouse Gas Emissions: Well-to-Wheel		254.8	g CO ₂ e / km	Average Diesel GHG Emissions Equivalent	989
WTW CO₂ per passenger km (@ Max Pass Capacity)		4.7	g CO ₂ e/pass km	WTW CO₂ per passenger km (@ Max Pass Capacity)	18.3
Overall Zero Emission Bus Performance					
WTW GHG saving		733.9	g CO ₂ e / km	Maximum Theoretical Zero Emission Range (km)	256.7
% WTW GHG saving		74%	g CO ₂ e / km	Vehicle Energy Consumption (kWh/ km)	0.75
Approved as Zero Emission Bus? (50% GHG saving or more)				YES	

* WTT : Well-to-Tank

** TTW : Tank-to-Wheel

*** WTW : Well-to Wheel

COMMENTS: LBC = London Bus Cycle - Inner & Outer Urban phases. Warm-up conducted prior to each set of 2xUKBC (15mins @ 35km/h steady state), energy consumed during the warm-up has been included in the total energy consumed. Driver manually controlled temperature in cabin to maintain interior temperature at approximately 17°C.
 This certificate covers both the Sigma 9 variant, using test results from the heavier Sigma 10

Test Numbers: 20220819_1511_2xUKBC, 20220819_1808_2xUKBC

 Certificate approved by: John Randerson
 On behalf of Bus manufacturer: John Randerson (Sep 20, 2022 14:54 GMT+1)

Sep 20, 2022

 Certificate Approved by: Dan Hayes
 On behalf of DfT / Zemo Partnership: Daniel Hayes 20.09.22

Heating Requirement	Cell	Lower Saloon	Upper Saloon
Target Temperatures ±2 (°C) :	10	17	n/a
Average Temperatures across testing (°C)	10.00	19.61	n/a










ZEB_Certificate_Mellor_Sigma9_EV_September_2022

Final Audit Report

2022-09-20

Created:	2022-09-20
By:	Zemo Partnership (admin@zemo.org.uk)
Status:	Signed
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