

## Zero Emission Bus Certificate

<b>Customer:</b> Mellor				<b>DYNAMOMETER SETTINGS</b>		
<b>Customer Address:</b>	Miall Street, Rochdale, Gt. Manchester, OL11 1HY	<b>Telematics Capability</b>	Yes	Test Weight	11314**	kg
<b>Test Purpose:</b>	Zero Emission Bus Testing	<b>Maximum Speed (km/h)</b>	70 km/h	F <sup>0</sup>	-244.10	N
<b>Vehicle Manufacturer:</b>	Mellor	<b>Seated Capacity</b>	27	F <sup>1</sup>	-1.7867	N/kmh
<b>Vehicle Model Name:</b>	Sigma 8 (Based on Sigma 10 test)	<b>Passenger Capacity</b>	54	F <sup>2</sup>	0.16267	N/kmh <sup>2</sup>
<b>Powertrain Technology:</b>	Battery Electric	<b>Declared Unladen Weight (kg)</b>	8720	F <sup>3</sup>	0.000000	N/kmh <sup>3</sup>
<b>Powertrain Configuration:</b>	Direct Drive	<b>Gross Weight (kg)</b>	13500	<b>Equivalent test passengers</b>	15.5**	passengers
<b>Zero Emission Heating:</b>	PTC Heaters	<b>GVW Check</b>	OK	<b>Measured Unladen Weight</b>	10260*	kg
<b>Battery Specification</b>		<b>Charging and Refuelling Capability</b>		<b>Hydrogen Specification</b>		
<b>Battery Manufacturer</b>	CATL	<b>Plug Type</b>	DC	<b>Fuel Cell Manufacturer</b>	N/A	
<b>Battery Chemistry</b>	LFP	<b>Max Charge Capability (kW)</b>	Up to 100kW	<b>Fuel Cell Power Rating (kW)</b>	N/A	
<b>Battery Installed Capacity (kWh)</b>	241	<b>Charger Compatibility</b>	DC	<b>Hydrogen Storage Capacity (kg)</b>	N/A	
<b>Battery Usable Capacity (kWh)*</b>	193	<b>Charge time from 20-80% SOC</b>	2-6 hours	<b>Hydrogen Storage Pressure (bar)</b>	N/A	

\* Recommended manufacturer guideline, subject to warranty

\*\* Taken from Sigma 10 test

### Declared fuel, properties and source plus carbon conversion factors

<b>Well-to-Tank Factor: Electricity</b>	80.92	g CO <sub>2</sub> e / MJ	<b>Fuel Provider</b>	UK market standard	<b>WTT evidence</b>	DBEIS Conversion 2021
<b>Well-to-Tank Factor: Hydrogen</b>	N/A	g CO <sub>2</sub> e / MJ	<b>Capacity of Tanker (kg)</b>	N/A	<b>Fuel Type / Pathway</b>	UK Grid Electricity
<b>Energy Density: Hydrogen</b>	120	MJ / kg	<b>Transport Distance of Hydrogen (km)</b>	N/A	<b>Energy Source</b>	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 <sub>2</sub> (g/km)	CH <sub>4</sub> (g/km)*	N <sub>2</sub> 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
<b>UK BUS Average</b>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12.27	0.75	<b>87.46</b>

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

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

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

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

### Calculated total Well-to-Wheel GHG CO<sub>2</sub> equivalent emissions over test

Test Phase	Fuel Energy (MJ / km)	Fuel WTT*GHG Emissions (g CO <sub>2</sub> e / km)	Electrical Energy (MJ / km)	Electricity WTT* GHG Emissions (g CO <sub>2</sub> 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
<b>UK BUS Average</b>	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

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

\* WTT : Well-to-Tank

\*\* TTW : Tank-to-Wheel

\*\*\* WTW : Well-to Wheel

**COMMENTS:** LBC = London Bus Cycle - Inner & Outer Urban phases of UKBC only. Warm-up conducted prior to each set of 2xUKBC Heating Requirement (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 8 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 16:24 GMT+1)

Sep 20, 2022

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

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










# ZEB\_Certificate\_Mellor\_Sigma8\_EV\_September\_2022

Final Audit Report

2022-09-20

Created:	2022-09-20
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