

# Zero Emission Bus Certificate

<b>Customer:</b> Mellor		<b>DYNAMOMETER SETTINGS</b>			
<b>Customer Address:</b> Miall Street, Rochdale, Gt. Manchester, OL11 1H	<b>Telematics Capability</b>	Yes	<b>Test Weight</b>	5681	kg
<b>Test Purpose:</b> Zero Emission Bus Testing	<b>Maximum Speed (km/h)</b>	75 km/h	<b>F<sup>2</sup></b>	-164.54	N
<b>Vehicle Manufacturer:</b> Mellor	<b>Seated Capacity</b>	9	<b>F<sup>1</sup></b>	-0.1658	N/kmh
<b>Vehicle Model Name:</b> Sigma 7, SA9S1G07J21474001	<b>Passenger Capacity</b>	30	<b>F<sup>2</sup></b>	0.12896	N/kmh <sup>2</sup>
<b>Powertrain Technology:</b> Battery Electric	<b>Declared Unladen Weight (kg)</b>	5700	<b>F<sup>3</sup></b>	0.00000	N/kmh <sup>3</sup>
<b>Powertrain Configuration:</b> Direct Drive	<b>Gross Weight (kg)</b>	8000	<b>Equivalent test passengers</b>		7.5
<b>Zero Emission Heating:</b> PTC Heaters	<b>GVW Check</b>	OK	<b>Measured Unladen Weight (kg)</b>		5681
<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>	NMC	<b>Max Charge Capability (kW)</b>	Up to 100kW	<b>Fuel Cell Power Rating (kW)</b>	N/A
<b>Battery Installed Capacity (kWh)</b>	142	<b>Charger Compatibility</b>	DC	<b>Hydrogen Storage Capacity (kg)</b>	N/A
<b>Battery Usable Capacity (kWh)</b>	114	<b>Charge time from 20-80% SOC</b>	2- 4 hours	<b>Hydrogen Storage Pressure (bar)</b>	N/A

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

<b>Well-to-Tank Factor:</b> Electricity	80.92	g CO <sub>2e</sub> / MJ	<b>Fuel Provider</b>	UK market standard	<b>WTT evidence</b>	DBEIS Conversion 2021
<b>Well-to-Tank Factor:</b> Hydrogen	N/A	g CO <sub>2e</sub> / MJ	<b>Capacity of Tanker (kg)</b>	N/A	<b>Fuel Type / Pathway</b>	UK Grid Electricity
<b>Energy Density:</b> Hydrogen	120	MJ / kg	<b>Transport Distance of Hydrogen (km)</b>	N/A	<b>Hydrogen Production 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)*	Vehicle Energy Consumption (kWh)	Grid Electrical Energy Consumption (kWh/ 100km)
Outer Urban	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.02	67.59
Inner Urban	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.07	88.78
Rural	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.31	49.01
LBC Average	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.10	73.57
<b>UK BUS Average</b>	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9.41	62.55

## 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>	38.00	<b>Max ZE Range at 100% SOC (km)</b>	197
<b>Hydrogen Energy Over Test (kWh)</b>	N/A	<b>Measured grid energy during charging (kWh)</b>	41.00	<b>Max ZE Range at 80% SOC (km)</b>	157
<b>Hydrogen Delivered to Vehicle (kg)</b>	N/A	<b>Grid-to-Wheel efficiency (%)<sup>2</sup></b>	93%	<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, charger, drivetrain and the wheels of the bus.

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

Test Phase	Fuel Energy (MJ / km)	Fuel WTT*GHG Emissions (g CO <sub>2e</sub> / km)	Electrical Energy (MJ / km)	Electricity WTT* GHG Emissions (g CO <sub>2e</sub> / km)
Outer Urban	N/A	N/A	2.43	196.90
Inner Urban	N/A	N/A	3.20	258.63
Rural	N/A	N/A	1.76	142.77
LBC Average	N/A	N/A	2.65	214.30
<b>UK BUS Average</b>	N/A	N/A	2.25	182.21

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	
<b>GHG Well-to-Wheel</b>	182.2 g CO <sub>2e</sub> / km	<b>Average Diesel Equivalent</b>	763 g CO <sub>2e</sub> / km
<b>WTW CO<sub>2</sub> per passenger km (@ Max Pass Capacity)</b>	6.1 g CO <sub>2e</sub> /pass km	<b>WTW CO<sub>2</sub> per passenger km (@ Max Pass Capacity)</b>	25.4 g CO <sub>2e</sub> /pass km
Overall Zero Emission Bus Performance			
<b>WTW GHG saving</b>	580.4 g CO <sub>2e</sub> / km	<b>Maximum Theoretical Zero Emission Range (km)</b>	196.6
<b>% WTW GHG saving</b>	76% g CO <sub>2e</sub> / km	<b>Vehicle Energy Consumption (kWh/ km)</b>	0.6
<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

<b>COMMENTS:</b> Emission results marked in red are below detection levels. LBC = London Bus Cycle - Inner & Outer Urban phases of UKBC only.	<b>Cell</b>	Lower Saloon	Upper Saloon
	<b>Target Temperatures ±2 (°C) :</b>	10	17
	<b>Average Temperatures across testing (°C)</b>	10.00	21.68

**Test Numbers:** 20220315\_1222, 20220315\_1519, 20220315\_1714, 20220315\_2000

<b>Certificate approved by:</b> On behalf of Bus manufacturer	 John Randerson (May 10, 2022 11:55 GMT+1)	May 10, 2022	<b>Certificate Approved by:</b> On behalf of DfT / Zemo Partnership	 Dan Hayes	10.05.2022
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**Signature:**

**Email:**