Zemo Partnership | **Zero Emission Bus Certification ID:** | **ZEB-MELLOR-SIGMA10-2022** | Approved Test facility | UTAC

Zero Emission Bus Certificate

Customer:	**Mellor**			**DYNAMOMETER SETTINGS**		
Customer Address:	**Miall Street, Rochdale, Gt. Manchester, OL11 1HY**	*Telematics Capability*	Yes	Test Weight	11450	kg
Test Purpose:	**Zero Emission Bus Testing**	*Maximum Speed (km/h)*	70 km/h	F°	-156.82	N
Vehicle Manufacturer:	**Mellor**	*Seated Capacity*	31	F¹	-4.1830	N/kmh
Vehicle Model Name:	**Sigma 10, MX22 LFY**	*Passenger Capacity*	54	F²	0.20797	N/kmh ²
Powertrain Technology	**Battery Electric**	*Declared Unladen Weight (kg)*	10500	F³	0.000000	N/kmh ³
Powetrain Configuration	**Direct Drive**	*Gross Weight (kg)*	16500	*Equivalent test passengers*	15.5	passengers
Zero Emission Heating	**PTC Heaters**	*GVW Check*	**OK**	*Measured Unladen Weight*	10276	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)	**260**	**Charger Compatibility**	**DC**	**Hydrogen Storage Capacity (kg)**	**N/A**
Battery Usable Capacity (kWh)*	**210**	**Charge time from 20-80% SOC**	**2-6 hours**	**Hydrogen Storage Pressure (bar)**	**N/A**

* Recommended manufacturer guideline, subject to warranty

Declared fuel, properties and source plus carbon conversion factors

Well-to-Tank Factor:	***Electricity***	**80.92**	**g CO2e / MJ**	*Fuel Provider*	**UK market standard**	*WTT evidence*	**DBEIS Conversion 2021**
Well-to-Tank Factor:	***Hydrogen***	**N/A**	**g CO2e / 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_2O (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)**	**281**
Hydrogen Energy Over Test (kWh)	**N/A**	**Measured grid energy during charging (kWh)**	**103.00**	**Max ZE Range at 80% SOC (km)**	**224**
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 CO_2 equvialent emissions over test

Test Phase	Fuel Energy (MJ /km)	Fuel WTT*GHG Emissions (g CO_2e / km)	Electrical Energy (MJ / km)	Electricity WTT* GHG Emissions (g CO_2e / km)
Outer Urban	N/A	N/A	3.54	286.26
Inner Urban	N/A	N/A	4.71	381.02
Rural	N/A	N/A	2.27	183.82
LBC Average	N/A	N/A	3.87	312.88
UK BUS Average	N/A	N/A	3.15	254.79

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 CO2e / km**	**Average Diesel GHG Emissions Equivalent**	**989**	**g CO2e / km**
WTW CO2 per passenger km (@ Max Pass Capacity)	**4.7**	**g CO2e/pass km**	**WTW CO2 per passenger km (@ Max Pass Capacity)**	**18.3**	**g CO2e/pass km**

Overall Zero Emission Bus Performance

WTW GHG saving	**733.9**	**g CO2e / km**	**Maximum Theoretical Zero Emission Range (km)**	**281.0**
% WTW GHG saving	**74%**	**g CO2e / 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: Emission results marked in red are below detection levels. LBC = London Bus Cycle - Inner & Outer Urban phases of UKBC only. **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.**

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

Test Numbers: 20220819_1511_2xUKBC, 20220819_1808_2xUKBC

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

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

ZEB_Certificate_Mellor_Sigma10_EV_September_2022

Final Audit Report 2022-09-20

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