Zemo Partnership | **Zero Emission Bus Certification ID:** | **ZEB-YUTONG-E12-2022** | Approved Test facility | UTAC CERAM MILLBROOK

Zero Emission Bus Certificate

Customer:	**Pelican Bus and Coach**			**DYNAMOMETER SETTINGS**		
Customer Address:	**Wakefield Europort, Alofts Lane, Wakefield**	*Telematics Capability*	Yes	Test Weight	15110	kg
Test Purpose:	**Zero Emission Bus Testing**	*Maximum Speed (km/h)*	80 km/h	F^0	-335.26	N
Vehicle Manufacturer:	**Yutong**	*Seated Capacity*	37	F^1	-2.5310	N/kmh
Vehicle Model Name:	**E12**	*Passenger Capacity*	70	F^2	0.15277	N/kmh ^{2}
Powertrain Technology	**Battery Electric**	*Declared Unladen Weight (kg)*	13750	F^3	0.000000	N/kmh ^{3}
Powetrain Configuration	**Direct Drive**	*Gross Weight (kg)*	19500	*Equivalent test passengers*		18.5
Zero Emission Heating	**PTC Heaters**	*GVW Check*	**OK**	*Measured Unladen Weight (kg)*		13852

Battery Specification		**Charging and Refuelling Capability**		**Hydrogen Specification**	
Battery Manufacturer	**CATL**	**Plug Type**	**DC CCS 2 (x2)**	**Fuel Cell Manufacturer**	**N/A**
Battery Chemistry	**LFP**	**Max Charge Capability (kW)**	**Up to 240kW**	**Fuel Cell Power Rating (kW)**	**N/A**
Battery Installed Capacity (kWh)	**422**	**Charger Compatibility**	**DC**	**Hydrogen Storage Capacity (kg)**	**N/A**
Battery Usable Capacity (kWh)*	**371**	**Charge time from 20-80% SOC**	**1.5 - 4 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**	*Hydrogen Production 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)*	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	5.86	99.11
Inner Urban	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.54	110.37
Rural	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.26	77.54
LBC Average	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.40	102.26
UK BUS Average	N/A	N/A	N/A	N/A	N/A	N/A	N/A	13.65	**91.07**

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

Test Charger Used	**22 kW**	**Total measured energy consumed on vehicle (kWh)[1]**	**55.00**	**Max ZE Range at 100% SOC (km)**	**443**
Hydrogen Energy Over Test (kWh)	**N/A**	**Measured grid energy during charging (kWh)**	**60.00**	**Max ZE Range at 80% SOC (km)**	**355**
Hydrogen Delivered to Vehicle (kg)	**N/A**	**Grid-to-Wheel efficiency (%)[2]**	**92%**	**Test Distance Travelled (km)**	**65**

[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	3.57	288.72
Inner Urban	N/A	N/A	3.97	321.52
Rural	N/A	N/A	2.79	225.88
LBC Average	N/A	N/A	3.68	297.90
UK BUS Average	N/A	N/A	3.28	265.31

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*		
GHG Well-to-Wheel	**265.3**	**g CO2e / km**	**Average Diesel Equivalent**	**1139**	**g CO2e / km**
WTW CO2 per passenger km (@ Max Pass Capacity)	**3.8**	**g CO2e/pass km**	**WTW CO2 per passenger km (@ Max Pass Capacity)**	**16.3**	**g CO2e/pass km**

Overall Zero Emission Bus Performance

WTW GHG saving	**874.1 g CO2e / km**	**Maximum Theoretical Zero Emission Range (km)**	**443.2**
% WTW GHG saving	**77% g CO2e / km**	**Vehicle Energy Consumption (kWh/ km)**	**0.9**
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.

	Cell	Lower Saloon	Upper Saloon
Target Temperatures ±2 (°C) :	**10**	**17**	**N/A**
Average Temperatures across testing (°C)	9.98	19.67	N/A

Test Numbers: 20220311_1522, 20220311_1655, 20220311_1812, 20220311_1921

Certificate approved by:
On behalf of Bus manufacturer

Certificate Approved by:
On behalf of DfT / Zemo Partnership

Daniel Hayes
7.04.2022

Dan Hayes

Partnership | Zero Emission Bus Certification ID: ZEB-YUTONG-E12-2022 | Approved Test facility

Zero Emission Bus Certificate

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Certificate approved by: On behalf of Bus manufacturer IAN DOWNIE 7-4-2022

Certificate Approved by: of DfT / Zemo Partnership Daniel Hayes 7.04.2022 *On behalf* Dan Hayes