

Zero Emission Bus Certificate

Customer: Volvo Bus Corporation				DYNAMOMETER SETTINGS	
Customer Address:	Dept 86100, ARAK3 S, SE-405 08, Gothenburg	Telematics Capability	Yes	Test Weight	15796 kg
Test Purpose:	Zero Emission Bus Testing	Maximum Speed (km/h)	80 km/h	F ^o	789.20 N
Vehicle Manufacturer:	Volvo Bus Corporation	Seated Capacity	43	F ¹	6.4041 N/kmh
Vehicle Model Name:	BZL Single Deck	Passenger Capacity	86	F ²	0.1303 N/kmh ²
Powertrain Technology:	Battery Electric	Declared Unladen Weight (kg)	13098	F ³	0.000000 N/kmh ³
Powertrain Configuration:	Direct Drive	Gross Weight (kg)	19500	Equivalent test passengers	
Zero Emission Heating:	CO2 Heat Pump & PTC Heaters	GVW Check	OK	Measured Unladen Weight (kg)	
				21.75	
				13167	
Battery Specification		Charging and Refuelling Capability		Hydrogen Specification	
Battery Manufacturer	-	Plug Type	CCS 2 & OppCharge	Fuel Cell Manufacturer	N/A
Battery Chemistry	NCA	Max Charge Capability (kW)	Up to 150kW /300kW	Fuel Cell Power Rating (kW)	N/A
Battery Installed Capacity (kWh)	376	Charger Compatibility	DC / OppCharge	Hydrogen Storage Capacity (kg)	N/A
Battery Usable Capacity (kWh)	300	Charge time from 20-80% SOC	2 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 ₂ 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	7.93	143.54
Inner Urban	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.79	131.00
Rural	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.88	109.19
LBC Average	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10.71	140.01
UK BUS Average	N/A	N/A	N/A	N/A	N/A	N/A	N/A	17.59	126.10

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

Test Charger Used	22 kW	Total measured energy consumed on vehicle (kWh)¹	105.55	Max ZE Range at 100% SOC (km)	278
Hydrogen Energy Over Test (kWh)	N/A	Measured grid energy during charging (kWh)	123.48	Max ZE Range at 80% SOC (km)	223
Hydrogen Delivered to Vehicle (kg)	N/A	Grid-to-Wheel efficiency (%)²	85%	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 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	5.17	418.15
Inner Urban	N/A	N/A	4.72	381.61
Rural	N/A	N/A	3.93	318.09
LBC Average	N/A	N/A	5.04	407.87
UK BUS Average	N/A	N/A	4.54	367.34

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	367.3 g CO ₂ e / km	Average Diesel Equivalent	1290 g CO ₂ e / km
WTW CO₂ per passenger km (@ Max Pass Capacity)	4.3 g CO ₂ e/pass km	WTW CO₂ per passenger km (@ Max Pass Capacity)	15.0 g CO ₂ e/pass km
Overall Zero Emission Bus Performance			
WTW GHG saving	922.8 g CO ₂ e / km	Maximum Theoretical Zero Emission Range (km)	278.3
% WTW GHG saving	72% g CO ₂ e / km	Vehicle Energy Consumption (kWh/ km)	1.3
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.

Certification based on previous 7900E test results, with updated weight and battery capacity

Test Numbers: ML02018887 (10-Oct-19), ML02018888 (10-Oct-19), ML02018889 (10-Oct-19), ML02018890 (10-Oct-19), ML02018891 (10-Oct-19), ML02018892 (10-Oct-19).

Certificate approved by:

On behalf of Bus manufacturer

Certificate Approved by:

On behalf of DIT / Zemo Partnership

Daniel Hayes

07.04.2022

Cell	Lower Saloon	Upper Saloon
Target Temperatures ±2 (°C) :	10	N/A
Average Temperatures across testing (°C)	9.41	16.05