HVAC Spec Updates

1.1 Heating, Ventilation & Air Conditioning (HVAC)

Drivers Cab HVAC & Demist

The heating and air conditioning for the bus shall keep the driver cab air completely separate to the passenger saloon air. This should be fed by exterior fresh air; there shall be no mixing or recirculation of the drivers air supply with saloon air by design intent. Evidence of this shall be provided as part of the Assessment Protocol detailed in Attachment 9.

The heating and air conditioning system for the driver's cab shall be fully controlled by the driver.

A cab screen demisting system shall be provided and shall be fully controlled by the driver. It shall operate independently from the saloon heating, upper deck cooling or cab air conditioning. This shall be fed by exterior fresh air; there shall be no mixing or recirculation with saloon air by design intent. The windscreen should demist effectively and equally on both sides of the driver assault screen partition.

In order to maintain safe CO_2 levels inside the cab, the cab ventilation system shall provide high standards of indoor air quality which will be provided by a demand controlled ventilation system that shall automatically keep CO_2 levels in the cab below 800 ppm at all times. Alternatively, a continuous fresh air feed of at least 10 litres per second may be supplied that cannot be disabled by the driver while the cab windows are closed.

Passenger Saloon HVAC

All buses shall be equipped with:

- A fully automatic heating, cooling and ventilation system with .
- Blown air heating and ventilation system to both lower and upper deck where appropriate. By preference heat should be supplied at floor level and cooling from above to ensure comfort and efficiency. Convection only systems are not acceptable.
- Fully automatic thermostatic control of the system. The thermostatic sensors should be positioned to reflect the interior, upper and/or lower deck temperature of the bus and be in a tamper proof location. By preference 3 sensors should be used per deck which are evenly distributed along it's length and the average value used for system control, with a maximum variation permissible of 2^{o}Heated or unheated air should be circulated throughout the bus dependant on interior bus temperature. It should not be necessary for the driver, maintenance teams or any other parties to adjust or set the heating or ventilation system during variations of temperature, such as during summer and winter periods.
- A continuous fresh air feed of 100 litres per second minimum shall be supplied at all times, including to both decks of double deck vehicles. This may be

provided via separate mechanical or static ventilation methods (spinning roof vent, ‘air scoop’ or similar) or via the main HVAC system. To promote energy efficiency and ensure high standards of air quality, this supply shall increase automatically dependant on the CO2 level in the passenger saloon or the number of passengers on board. This demand-controlled ventilation system shall automatically keep CO_2 levels below 1500 ppm at all times.

- The system should be adequately sized to provide 10L/second of fresh air for each passenger on a fully loaded vehicle.
- The system should provide a good circulation of air throughout the length of the bus interior and ensure an even temperature and fresh air distribution. A maximum air velocity of 5m/s is permissible at vent outlets.
- The air inlets to the HVAC system should be greater than 2m from ground level.
- Vehicles shall also be equipped with an air-cooling system as shown in Attachment 9. This system must be capable of reducing the internal saloon temperature by when subject to an interior saloon temperature of by inputting at variable fan speeds suitable quantities of conditioned and cooled air via saloon length ducting. Compliance with this requirement shall be demonstrated by means of a LBSL pull down test as defined in Attachment 9.
- If engine bay “maintenance only” shut off valves are required, they must utilise an independent hand tool and not be capable of being adjusted by lever or hand operation. The system should be designed to enable a full operational check of component functions and settings in the regular service routine.

Each of these systems shall be integrated into a fully automatic heating and ventilation system that avoids operational conflicts in accordance with Attachment 9.

The driver shall not be able to override the automatic heating / cooling systems for the passenger section of the bus. Any maintenance or testing function must be automatically reset to its full operational condition after every engine restart.

In addition, zero emission bus types must have a zero-emission heating solution (i.e. diesel heaters are not permitted).

A pre heat capability to soak upper and lower deck interior areas with forced heated air to warm up the side panels, hand poles and seating surfaces may be used.

Air Filtration

HVAC systems which use external air supplies only shall be fitted with air filtration which meets a minimum standard of ISO16890 Coarse 65%. This should include but is not limited to systems supplying the drivers cab.

HVAC systems which use recirculation of air within the saloon shall be fitted with air filtration which meets either;

a) A minimum efficiency standard of ISO16890 Coarse 65%, minimum anti-vral efficiency of 99.9% against ISO18184 and minimum anti-bacterial efficiency of 99.9% against ISO20743

b) A minimum efficiency standard of ISO16890 ePM1 whilst maintaining acceptable change interval frequencies

c) Another method which can be independently verified to provide equal or superior performance to a) and b)

Window Ventilation

Provision for passenger saloon ventilation should be provided by opening (hopper vent) side windows.On single deck buses such windows shall be provided at all full size bays.

On double deck buses such windows shall be provided:

- Lower deck
    - At all full size bays
- Upper deck
    - At foremost full size bay, nearside and offside
    - At rearmost full size bay, nearside and offside
    - At one other full size bay, nearside and offside

At least 11% of the total surface side glass area (excluding door glass and destination glass) should be of the open hopper type, providing an open area air gap of not less than 3.5% of total glass area.

A number of these opening windows must be capable of being fixed in a fully open position. The requirement minimum is;

- Lower deck
    - Foremost window
    - Rearmost window, nearside and offside
- Upper deck
    - Foremost window, nearside and offside
    - Rearmost window, nearside and offside