Mobile Climate Control
On Road

HVAC Specification Guidelines

Detailed instructions for your AC system

MCC Customer Care

1. HVAC Capacity and Performance

General configuration

The HVAC climate control system shall be capable of controlling the temperature and maintaining the humidity levels of the interior of the bus as defined in the following paragraphs.

The HVAC unit may either be roof or rear-mounted. Note that a rear-mounted unit will preclude a rear window and that the term "roof-mounted unit" includes units mounted on top of or beneath the roof surface.

For Electric AC high-voltage electric driven A/C system with semi-hermetic or equivalent AC compressor, low or high-voltage driven condenser fan & evaporator blower motors and optional brushless AC generator.

HVAC Capacity Requirements

With the bus running at the design operating profile with corresponding door opening cycle, and carrying a number of passengers equal to 150 percent of the seated load, the HVAC system shall control the average passenger compartment temperature within a range between 65 and 80°F, while maintaining the relative humidity to a value of 50 percent or less. The system shall maintain these conditions while subjected to any outside ambient temperatures within a range of 10 to 95°F and at any ambient relative humidity levels between 5 and 50 percent. Passenger loads to be calculated as per APTA's *Recommended Practice* "Transit Bus HVAC System Instrumentation and Performance Testing".

When the bus is operated in outside ambient temperatures of 95 to 115°F, the interior temperature of the bus shall be permitted to rise 0.5°F for each degree of exterior temperature in excess of 95°F.

When the bus is operated in outside ambient temperatures in the range of –10 to 10°F, the interior temperature of the bus shall not fall below 55°F. The heating system will have a sufficient capacity to maintain an average inside temperature of 65°F + or –3°F throughout the interior of the bus with an outside ambient temperature of 20°F, when the system is provided with 160°F coolant temperature at 8 GPM. This temperature will be held on the bus with the engine at normal operating temperature. The temperature difference between the area six inches from the ceiling and six inches from the floor of the bus will not vary by more than 12°F with floor heat or 18°F without.

System capacity testing, including pull-down/warm-up, stabilization and profile, shall be conducted in accordance to APTA's Recommended Practice "Transit Bus HVAC System Instrumentation and Performance Testing".

NOTE: The recommended locations of temperature probes are only guidelines and may require slight modifications to address actual bus design. Care must be taken in the placement of sensing devices. In general, the locations are intended to accurately represent the interior passenger area.

Testing shall be performed as necessary to ensure compliance to performance requirements stated herein.

Air Conditioning Performance Requirements

The air-conditioning portion of the HVAC system shall be capable of reducing the passenger compartment temperature from 110 to 90°F in less than 20 minutes after engine start-up. Engine temperature shall be within the normal operating range at the time of start-up of the cool-down test, and the engine speed shall be limited to fast idle, which may be activated by a driver-controlled device. During the cool-down period, the refrigerant pressure shall not exceed safe high-side pressures, and the condenser discharge air temperature, measured 6 in. from the surface of the coil, shall be less than 45°F above the condenser inlet air temperature. Pretest soak bus until floor mass reaches 110°F.

The appropriate solar load as recommended in the APTA "Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning Systems", representing 4 p.m. on August 21, shall be used. There shall be no passengers on board, and the doors and windows shall be closed.

2. HVAC Controls and Temperature Uniformity

Climate Control System

The HVAC system excluding the driver's heater/defroster shall be centrally controlled with an advanced electronic/diagnostic control system with provisions for extracting/reading data. The system shall be compliant with J1939 Communication Protocol for receiving and broadcasting of data.

Hot engine coolant water shall be delivered to the HVAC system driver's defroster/heater and other heater cores by means of an auxiliary coolant pump, sized for the required flow.

The climate control system shall be fully automatic and control the return air temperature to within ±2°F of specified temperature control setpoint.

Dual-Temperature Control Set Point, the temperature control setpoint for the system shall be 72°F in the cooling mode and 68°F in the heating mode.

Temperature Uniformity

The interior temperatures, measured at the same height above the floor, shall not vary more than ±5°F from the front to the rear from the average temperature determined in accordance with APTA's "Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning System." Variations of greater than ±5°F will be allowed for limited, localized areas provided that the majority of the measured temperatures fall within the specified requirement.

3. HVAC SYSTEM – General Construction and Installation Requirements

The system shall be equipped with brushless motors with auto variable fan speed fan.

The air from the heating system will be distributed evenly on both sides of the bus and dispersed the full length of the side windows.

A/C refrigerant type will be R134A, R407c, or equivalent.

The HVAC return air grill area will have a minimum of 80% free area as compared to the evaporator coil(s) face area.

The heating and ventilation system shall be capable of introducing approximately ninety (90) percent recirculated air and ten (10) percent outside air. All outside air entering the passenger compartment will be filtered. These filters shall be the serviceable type and be located for convenient access for maintenance.

The control switches for the heating system will be located in the driver's compartment. The driver will have the option of heat mode, ventilation mode (fan only), air conditioning mode, automatic mode or off.

All motors will be located for easy replacement. Anti-seize compound must be applied to the shaft of the motors to allow for ease of removal of the fan assembly.

The water circulating pump will be of a brushless motor design requiring infrequent bearing and no motor brush replacement and will be readily accessible for service and inspection. The pump will have a magnetically driven impeller to allow removal of the pump motor without the need to remove the entire pump. The water circulating pump and motor bearing surfaces shall be coated with a special coating designed to prevent the bearing from seizing. The pump will have a minimum installed capacity of fifteen (15) gallons per minute. This is sized for a 40' bus, more flow will be required for a 60' bus depending on the heating requirement. Circuit protection will be by fuse or manually resettable circuit breaker only.

To improve the performance of both the heating and air-conditioning system, it is imperative that excellent insulation be installed throughout the bus. The cool air will be evenly distributed throughout the bus including the driver's compartment. Additional cool air will be provided to the driver by means of a booster fan located in the air conditioning duct. The driver will control this fan by means of a toggle switch located on the side instrument console.

Recirculation and Fresh air filters to have MERV 4 filtration efficiency.

The air conditioning system will be equipped with a replaceable drier of sufficient size for the proposed air conditioning system. To facilitate servicing and testing of the air conditioning system, two back seated valves will be pro-

vided; one on each side of the drier. The air conditioning system will be equipped with Schrader or approved equal valves. It is preferred that the air conditioning evaporator and condenser be located on either the roof of the bus or the rear above the engine compartment and must be designed for ease of maintenance of the expansion valve, return air filter and electrical controls. The filter for the air conditioning system shall have a serviceable element.

The liquid receiver tank will be equipped with a dual upper and lower sight glass to inspect the refrigerant level. A pressure relief valve, or rupture disc, will be installed in the top of the receiver as a safety device in the case of high discharge pressure. Refrigerant type moisture indicator to be provided.

The condenser will be mounted away from any heat generating component so as to prevent warm air from being ingested by the condenser.

Two back seated valves will be provided at the air conditioning compressor to allow the compressor to be isolated from the air conditioning system.

The clutch and compressor must be so designed as to allow its engagement at any speed without damage to either component or other components on the bus.
A compressor capacity unloading system will be provided to minimize the use of reheat.

The belt powering the air conditioning compressor must be shielded with an approved belt guard to prevent injuries to service personnel. A decal will also be provided warning maintenance personnel to keep fingers clear of belts. A belt tensioning system will be provided to minimize vibration and to allow for belt removal and re-tensioning without moving or realigning the compressor. Circuit protection will be by fuse or manually resettable circuit breaker only.

4. Ventilation System (optional)

The ventilation system will be designed so that it can be used as a power ventilation system during the summer months. In the ventilation mode the non-conditioned air will be circulated through the bus.

5. Driver's Heater and Windshield Defroster

An independently controlled front heater and defroster will be located under the front dash to provide heat for the driver and heated air to defrost the windshield.

Air for the front defroster will come either from the interior of the bus or from the outside environment. All air will be filtered before passing through the front heater core. All controls will be within easy reach of the driver. The front defroster will have a minimum of three fan speeds.

Distribution air ducts shall be designed to minimize air side pressure drop and provide even air distribution over the windshield.

Defrosting system to be compliant with SAE J381