MSBMA RECOMMENDED PRACTICE 002
MID-SIZE BUS AIR CONDITIONING SYSTEM PERFORMANCE TEST

S1. SCOPE. This standard establishes performance requirements for mid-size bus air conditioning systems.

S2. PURPOSE. The purpose of this recommended practice is to reduce the possibility of inadequate air conditioning performance in a mid-size bus.

S3. APPLICABILITY. This recommended practice applies to all mid-size buses.

S4. REQUIREMENTS. The air conditioning system shall perform as specified in either S4.1 or S4.2, under the conditions of S5. All measuring devices shall be accurate to 1% or better and temperature measuring devices to +/- 1 deg. F. Any circulating fans or other devices used in the test chamber must only be used to maintain the environmental requirements of the chamber during the test and may not in any way be used to enhance the performance of the test vehicle air conditioning system. This is a type certification, so any additional components that are installed or added to the primary air conditioning system to meet the performance criteria must also be added to production units built to comply with this recommended practice. Additionally, all standard components of the air conditioning system (including filters, ducts, vents, etc.) must be installed during the test.

S4.1 Northern Climate Minimum Performance
The air conditioning system shall lower the internal temperature of the vehicle at the thermocouple locations to a maximum, average temperature of 70°F DB in 30 minutes or less of the start from a minimum ambient starting temperature of 90°F DB. A minimum relative humidity level of 30% shall be maintained in the test chamber for the duration of the test. The independent temperature reading of each thermocouple probe inside the bus (test points 1 – 4) shall be within a range of +/- 3°F DB of the average temperature at the conclusion of the test.

S4.2 Southern Climate Minimum Performance
The air conditioning system shall lower the internal temperature of the vehicle at the thermocouple locations to a maximum, average temperature of 70°F DB in 30 minutes or less of the start from a minimum ambient starting temperature of 100°F DB. A minimum relative humidity level of 50% shall be maintained in the test chamber for the duration of the test. The independent temperature reading of each thermocouple probe inside the bus (test points 1 – 4) shall be within a range of +/- 3°F DB of the average temperature at the conclusion of the test.

S4.3 Test Equipment:

- Tachometer or other means of measuring engine RPM
- Stopwatch or other timing device
- Thermocouples or other suitable temperature measuring devices
- Voltmeter
- Hygrometer or other suitable humidity monitoring equipment

S5. TEST CONDITIONS.

S5.1 The vehicle shall have all occupant doors, windows, cabinet/compartment doors, hood, and exterior compartment doors open throughout the soak time conditions of S5.4.

S5.2 Engine high idle speed must be controlled to the engine/chassis manufacturer's recommended RPM setting for the duration of the test. If the engine control system is equipped with an automatic battery charge protection feature, this feature may be enabled for the duration of the test as an alternative to the requirements of S5.7.

S5.3 The test chamber must be capable of maintaining the minimum ambient starting temperature and relative humidity level specified in either S4.1 or 4.2 for the duration of the soak period and test. The test shall be considered invalid if the chamber temperature or relative humidity level drops below the minimum values during the procedure in S6.

S5.4 The vehicle shall soak in the test chamber at the minimum starting temperature for a minimum of 2 hrs., or longer, until such time as all thermocouples (both internal and external to the vehicle) measure the minimum starting temperature and the minimum relative humidity level is achieved.

S5.5 Testing shall not begin, until all doors, windows, hood, etc. from S5.1 are closed and the engine is started.

S5.6 The duration of the test shall be measured until the lesser of 30 minutes from engine startup occurs or until such time as the average temperature of all thermocouples is 70°F DB or less, with a maximum range of +/- 3°F DB of the average for all internal thermocouple temperatures.

S5.7 If an automatic battery charge protection feature is not enabled/available with the high idle operation of the engine during the test, a minimum battery voltage of 13.2V must be maintained for duration of test as measured at the vehicle's primary battery, and the test shall be considered invalid if the voltage level drops below 13.2V.

S5.8 <u>Thermocouple placement</u>

To monitor test chamber temperature, 2 exterior thermocouples are to be placed along the centerline of the vehicle, ½ way between the ground and the highest point of the vehicle (excluding bolt on items), 36 inches forward of the front extremity of the vehicle and 36 inches rear of the rear extremity.

4 thermocouples shall be placed in the interior of the vehicle:

- Test point 1 is located in the driver's area. With the seat in the rearmost position in the seat track, position the thermocouple at a height of 30 inches above the center of the seat cushion at a distance of 6 inches in front of the headrest/seatback to approximate the driver's head location;
- Test point 2 is located a distance of 4 feet rearward of the front windshield;
- Test point 3 is located at the midpoint of the body, and
- Test point 4 is located a distance of 4 feet forward of the rear wall.

Except for Test point 1, all thermocouples shall be located 4 feet above the floor at the longitudinal centerline of the bus.

S6. TEST PROCEDURE.

S6.1 With test chamber temperature stabilized at the minimum starting temperature, place vehicle in test chamber, turn off all power and soak the vehicle per requirements of S5.1 and S5.4. At a minimum, record each thermocouple temperature (both the test chamber test points and those in the interior of the bus) and the relative humidity level reading at the beginning of the soak period and at every 15 minutes for the duration of the soak period.

S6.2 Close all doors, windows, hood, etc. opened per S5.1 with the exception of the driver's door or other entrance door for access to the driver's compartment during start of test.

S6.3 With transmission in park or neutral and the parking brake applied, start engine and initiate high idle under conditions of S5.2.

S6.4 Set air conditioners in driver and passenger compartments to maximum cooling setting (maximum blower speed; coldest temperature setting; recirculating air). No one may be present inside the vehicle for duration of the test.

S6.5 At a minimum, record each thermocouple temperature, relative humidity level reading, engine RPM and battery voltage at the start of the test, after 10 minutes, 15 minutes, 20 minutes, 25 minutes and at 30 minutes. Interior Temperatures from Test points 1 – 4 are averaged, and the range is determined for each point as the difference from the average. Data may be recorded more frequently to determine a more specific point in time in which the conditions of S5.6 are met.