FLORIDA DEPARTMENT OF TRANSPORTATION

AIR CONDITIONING PULL-DOWN TEST PROCEDURE

(VERSION 2)

OVERVIEW

This test will be performed on all air-conditioning systems installed in vehicles procured from TRIPS vehicle contracts in support of both performance standards and quality star ratings. Testing conditions will replicate severe duty transit operations. FDOT will test one or more buses (systems) from each contract within the first award year. If a system fails the test, FDOT reserves the right to suspend vehicle orders utilizing this system, or terminate the contract associated with the failed system. FDOT reserves the right to randomly test new buses at any time during the contract period to ensure compliance.

TEST CONDITIONS / EQUIPMENT

The test will be performed on an asphalt parking lot in direct sunlight. The vehicle will be surrounded by a wall five (5) feet high, fifteen (15) feet wide and the length adjusted to the length of the bus. The minimum testing conditions require an ambient temperature of 94 degrees Fahrenheit (F) (+- 3 degrees) with 60% relative humidity.

All temperature measurements will be recorded in degrees of F and be captured using the Measurement Computing Data Acquisition capturing device. This device is configured with the manufacturer's latest edition of the TracerDAQ software. Calibration of the device is conducted prior to the test using the manufacturer's InstaCal Software.

Pressure readings are captured using the Yellow Jacket 686800 Manifold gauge set.

Voltage readings are captured using the Fluke model 78 automotive multi-meter.

Amperage readings are captured using the Fluke model 336 True RMS Clamp Meter.

TEST SET-UP

1. Perform a complete ultrasonic leak detection test of the air conditioning system. If the system fails the leak detection test, do not proceed

2. Ensure all windows and doors are closed properly, with no gaps or leaks. Ensure interior engine cover is sealed properly

3. Connect all test equipment:

    a. C0 Lead: An Omega Engineering J-Type 5 position Fine Wire Thermocouple will be placed outside of the vehicle, away from mechanical and radiant heat sources, to capture ambient temperature

b. C1 Lead: An Omega Engineering J-Type 5 position Fine Wire Thermocouple will be placed 48 inches to 52 inches from the rear wall and four feet above the floor surface to capture bus interior temperature

c. C2 Lead: An Omega Engineering J-Type 5 position Fine Wire Thermocouple will be placed at the center line of the bus interior, four feet above the floor surface, to capture bus interior temperature

d. C3 Lead: An Omega Engineering J-Type 5 position Fine Wire Thermocouple will be placed at the first row of seats, four feet above the floor surface, to capture bus interior temperature

e. C4 Lead: An Omega Engineering J-Type ICSS Thermocouple will be placed near the center of the evaporator core to capture rear evaporator core temperature

f. C5 Lead: An Omega Engineering J-Type 5 position Fine Wire Thermocouple will be placed above the engine, near the fire wall, to capture the bus engine compartment temperature

g. C6 Lead: An Omega Engineering J-Type ICSS Thermocouple will be placed near the center at the air-in side of the condenser to capture the condenser core temperature

h. C7 Lead: An Omega Engineering J-Type 5 position Fine Wire Thermocouple will be placed near the center of the air-out side of the condenser to capture the condenser air temperature

i. Connect the manifold gauge set to the add-on A/C system

j. Connect the multi-meter to the battery (s)

k. Connect the ammeter to the battery cable

TEST PROCEDURE

1. Heat-soak the bus under test conditions for a minimum of two hours. Record the date, time of day, vehicle identification number, and location.
2. With the vehicle in park and all doors and windows closed, start the engine.
3. Turn on the air conditioning system, set the a/c system to maximum cooling position, and turn on all interior and exterior lights.
4. Let vehicle run with the high idle on (approximately 1200 RPM on diesel engines and approximately 1500 RPM on gasoline engines). If the high idle is designed to automatically turn off after the first 15 minutes, the driver's door will be opened and the high idle immediately turned back on to complete the test. This action will not invalidate the test

5. Record all temperature readings (seven leads) in 15 second increments
6. Record pressure readings at the service ports of the add-on / second stage A/C system at the beginning of the test and at ten (10) minute increments thereafter
7. Record battery voltage readings at the battery (s) at the beginning of the test and at ten (10) minute increments thereafter
8. Record amperage readings at the positive cable coming off the battery (s) at the beginning of the test and at ten (10) minute increments thereafter
9. At the end of the 30 minute A/C pull down test there will be a 30 minute heat-gain test performed to determine the efficiency of the insulation in the bus using the same measurement equipment used for the A/C pull down test. Record all temperature readings (seven leads) in 15 second increments to determine fastest rise and total rise in bus interior temperature

SYSTEM TEST RESULTS

During the test, the interior temperature of the bus should lower uniformly throughout and should lower the interior temperature within the prescribed time.

The system will **fail** the test if:

a) The temperature difference between C1, C2, and C3 varies more than two degrees during each 15 second reading during the last 15 minutes of the test

b) The system fails to lower the interior temperature to a minimum of 70 degrees F (+ or - 2 degrees) measured at C1 by the end of the 30 minute test (conditions must reflect an ambient temperature of 94 degrees F (+ or – 3 degrees) measured at C0, with a minimum of 60% relative humidity)

c) The voltage readings at the batteries fall below 12.9 volts at any time during the test

Additional data will be captured to allow the TRIPS program to analyze and compare system attributes and configurations:

i. Fastest time to achieve 70 degrees with the lowest amperage draw
ii. Fastest overall time to achieve 70 degrees
iii. Lowest temperature retained during the 30 minute heat-gain test
iv. Lowest head pressure reading captured during step 6 of the test
v. Highest voltage output captured during step 7 of the test
vi. Lowest amperage draw captured during step 8 of the test