



Mobile Air Conditioning System Refrigerant Emissions Measurement

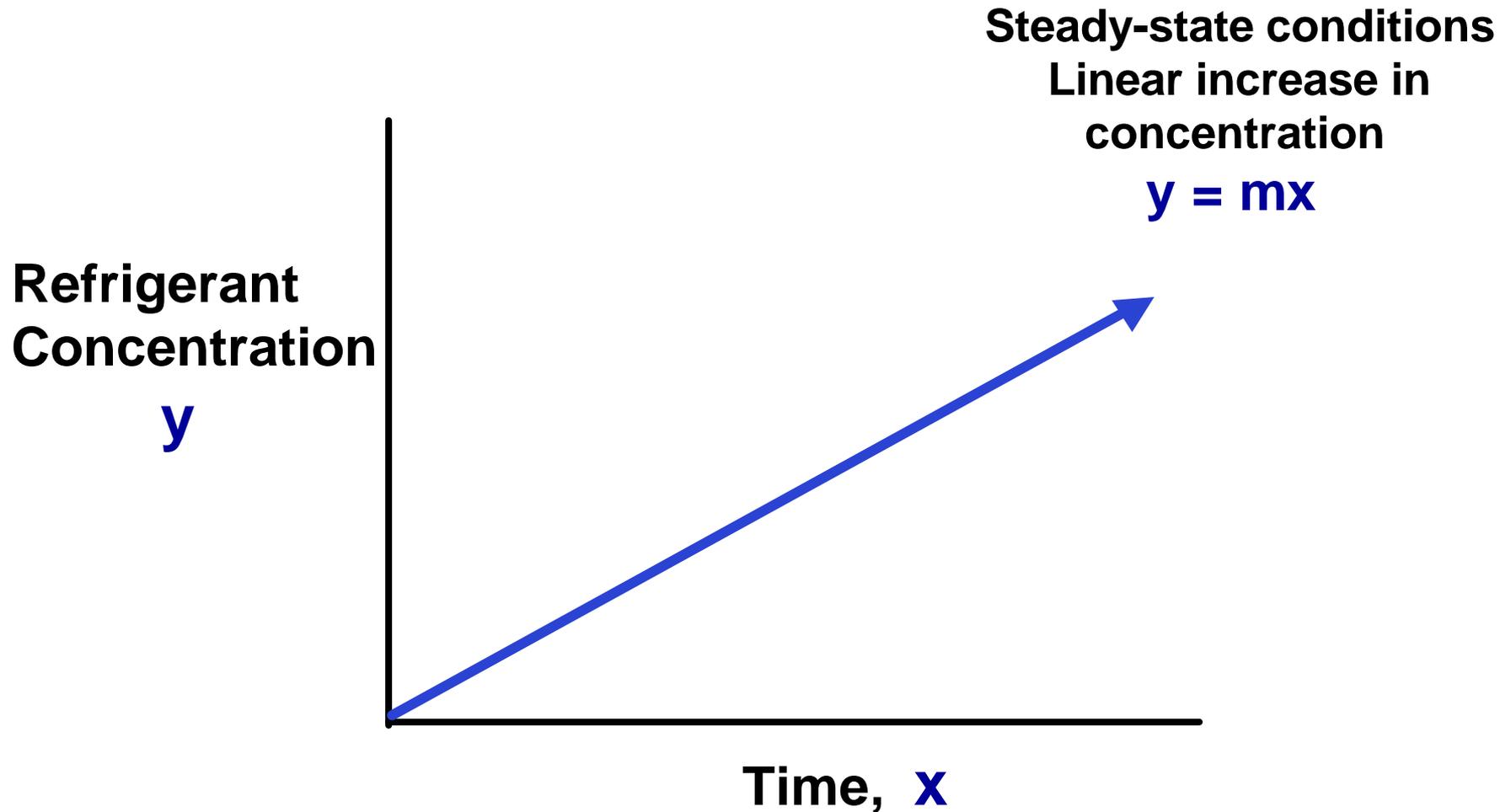
Mobile Air Conditioning Summit

March 16, 2005

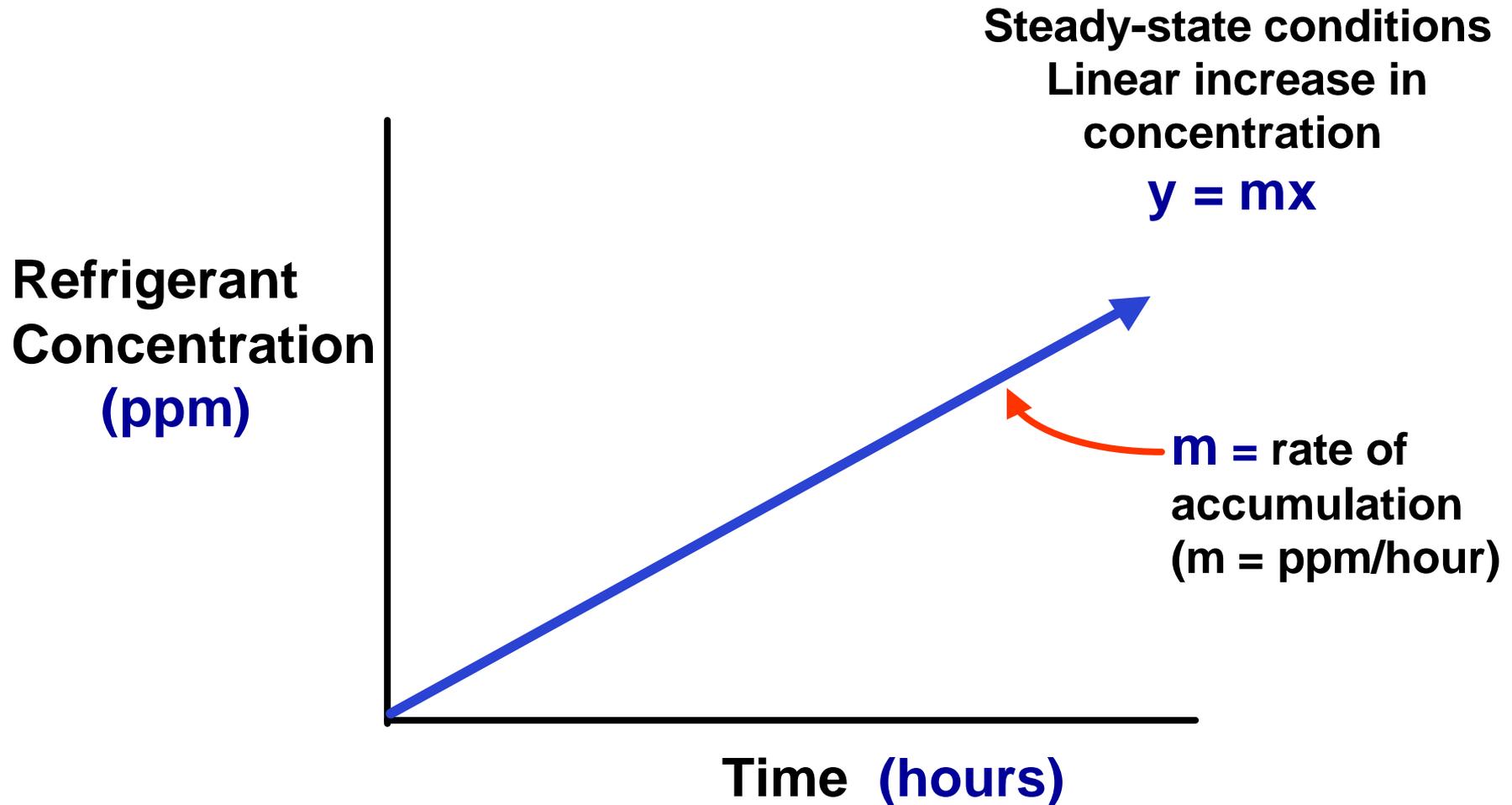
Sacramento, CA

James A. Baker

MAC System Closed Chamber Testing Emissions Accumulation Method



MAC System Closed Chamber Testing Emissions Accumulation Method



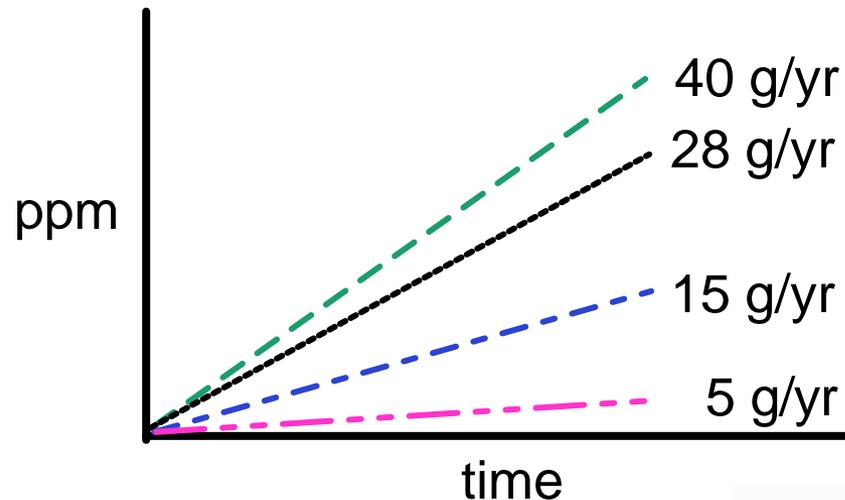
Testing Method: Photo-Acoustic Spectroscopic Analyzer Calibration with GE LS20 Leak Standard

[1] Inject known refrigerant leak rate into chamber (all components in place) and measure ppm vs. time

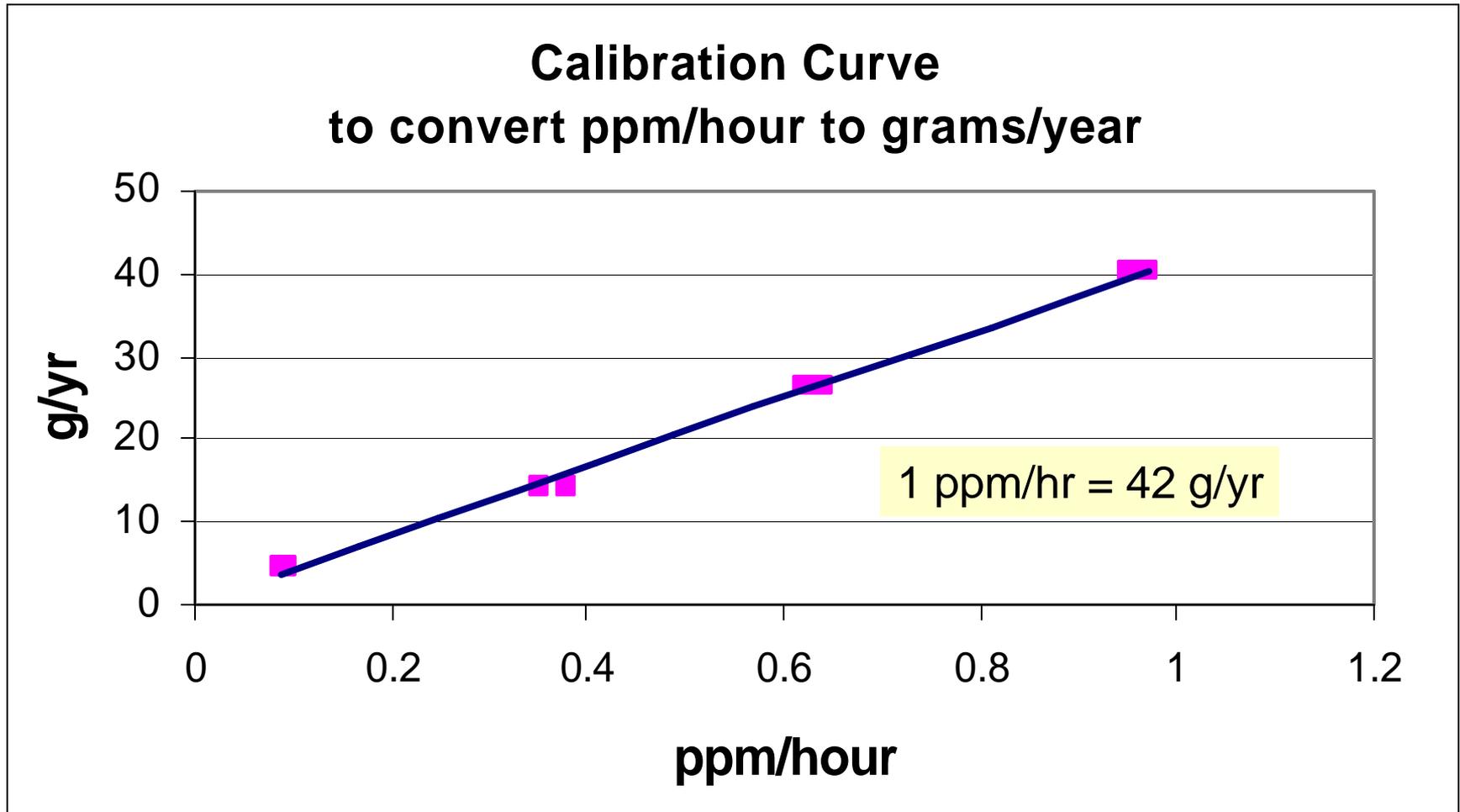


[2] Measure ppm vs. time for a series of **different** known leak rates.

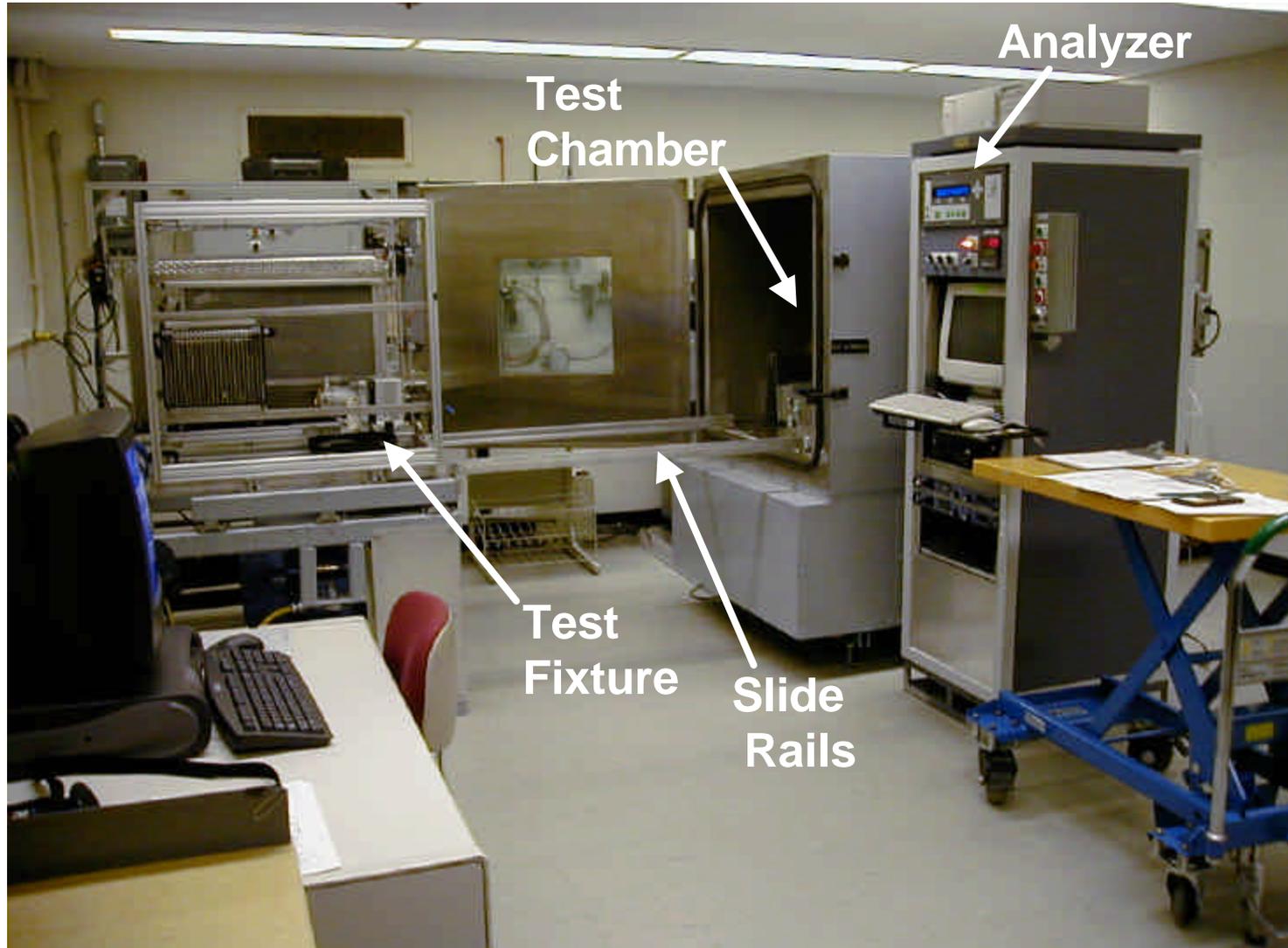
**Slope for each
leak rate
correlates to the
mass leak rate**



Converting Chamber Emissions to MAC System Emissions



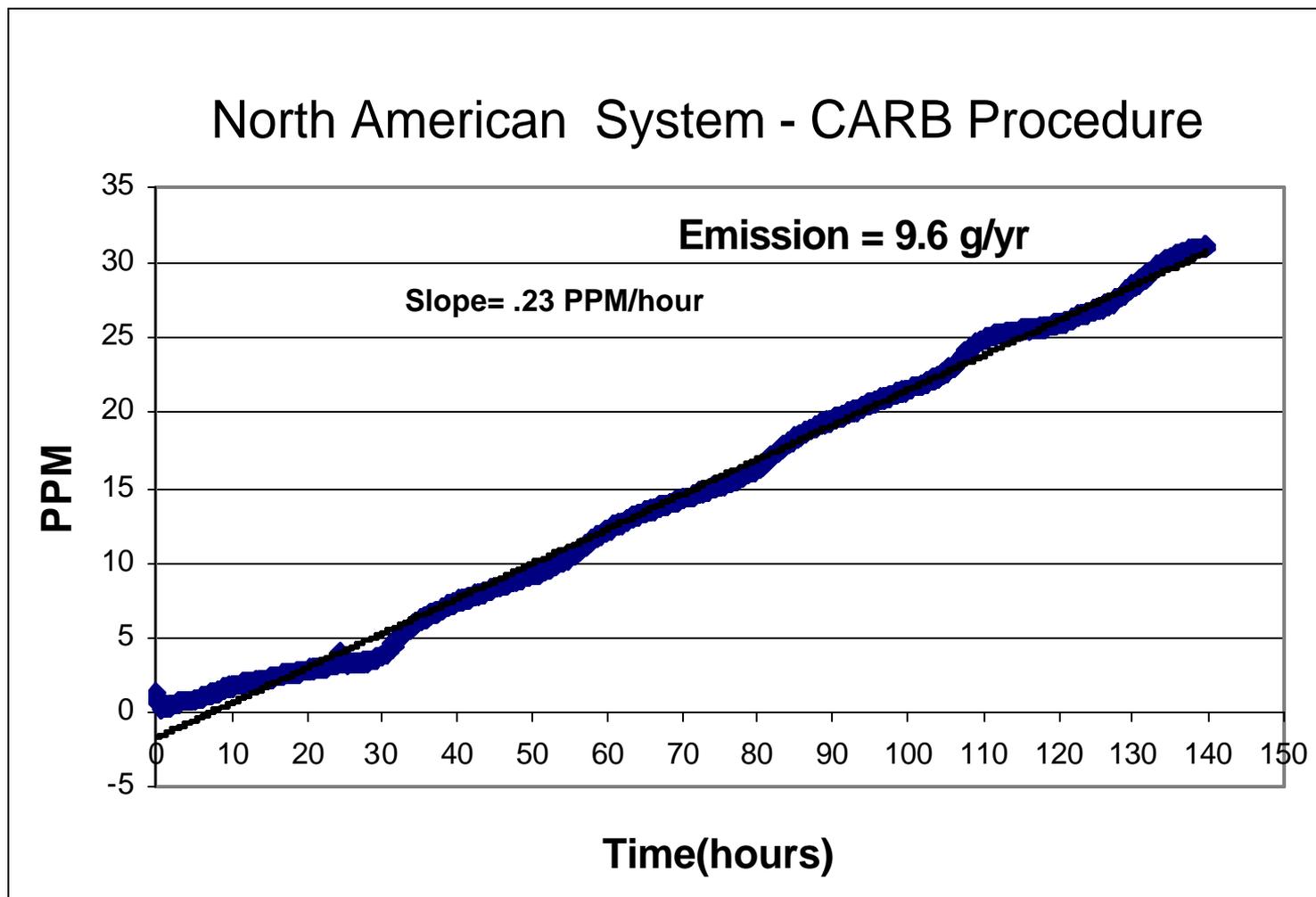
Refrigerant Emissions Analysis Lab (REAL Room)



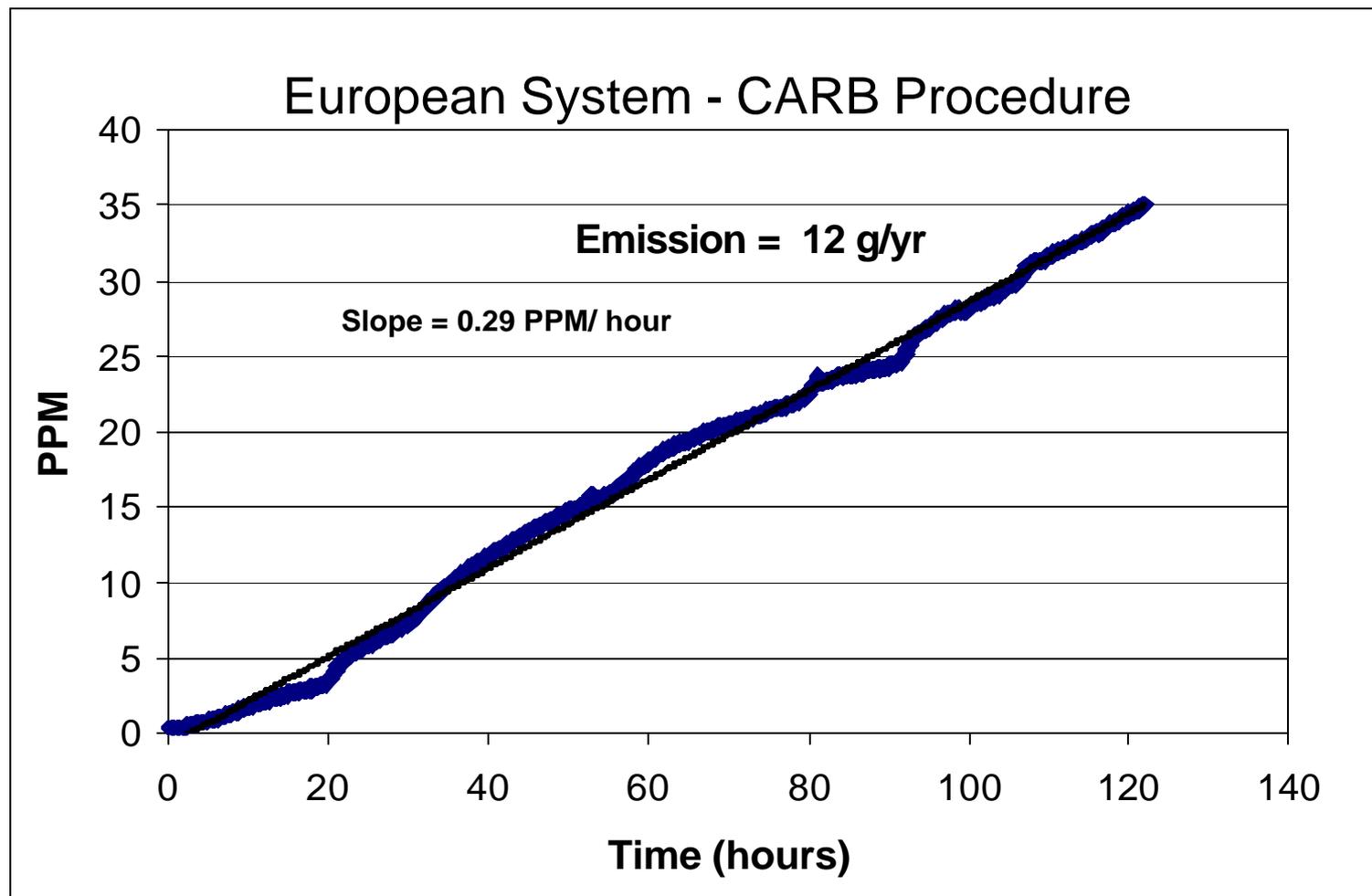
Static Testing – California Air Resources Board Procedure

- **REAL System Procedure**
 - **System Level - Emission measured using CARB procedure**
 - » **Chamber open, fan on, run A/C system for 30 minutes at 200 psig, 2000 rpm**
 - » **Shut system down**
 - » **Within 2 minutes, slide A/C system into chamber, close door and seal**
 - » **Soak components at 80°F for 60 minutes (record time, temperature, and refrigerant ppm)**
 - » **Cycle temperature in 12 hour intervals from 72°F to 96°F for for total 48 hrs.**
 - » **Record the entire accumulation over 49 hours total time, and determine the leak rate**

Static Emissions Measurement via CARB Test Procedure



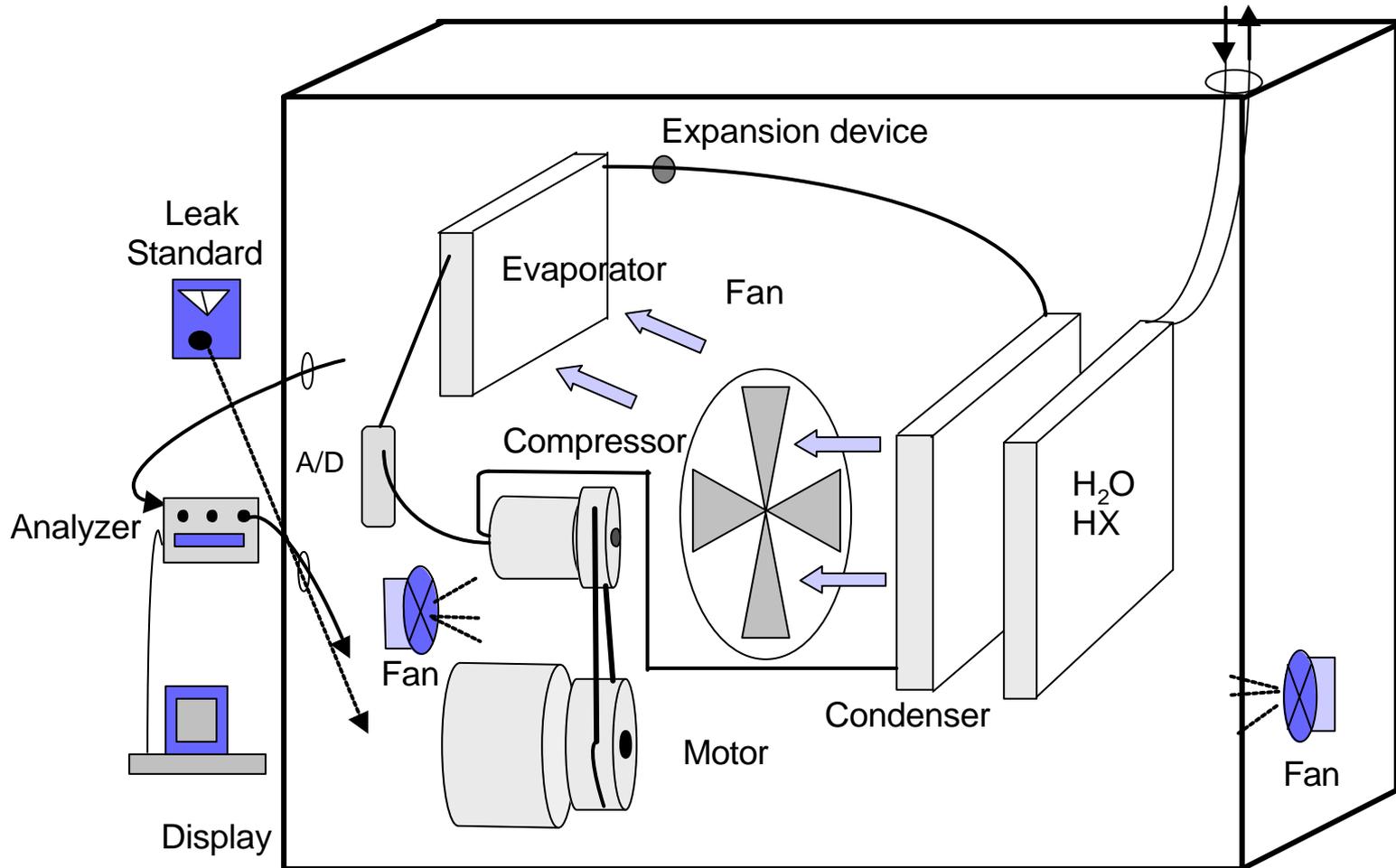
Static Emissions Measurement via CARB Test Procedure



Ultimate Goal

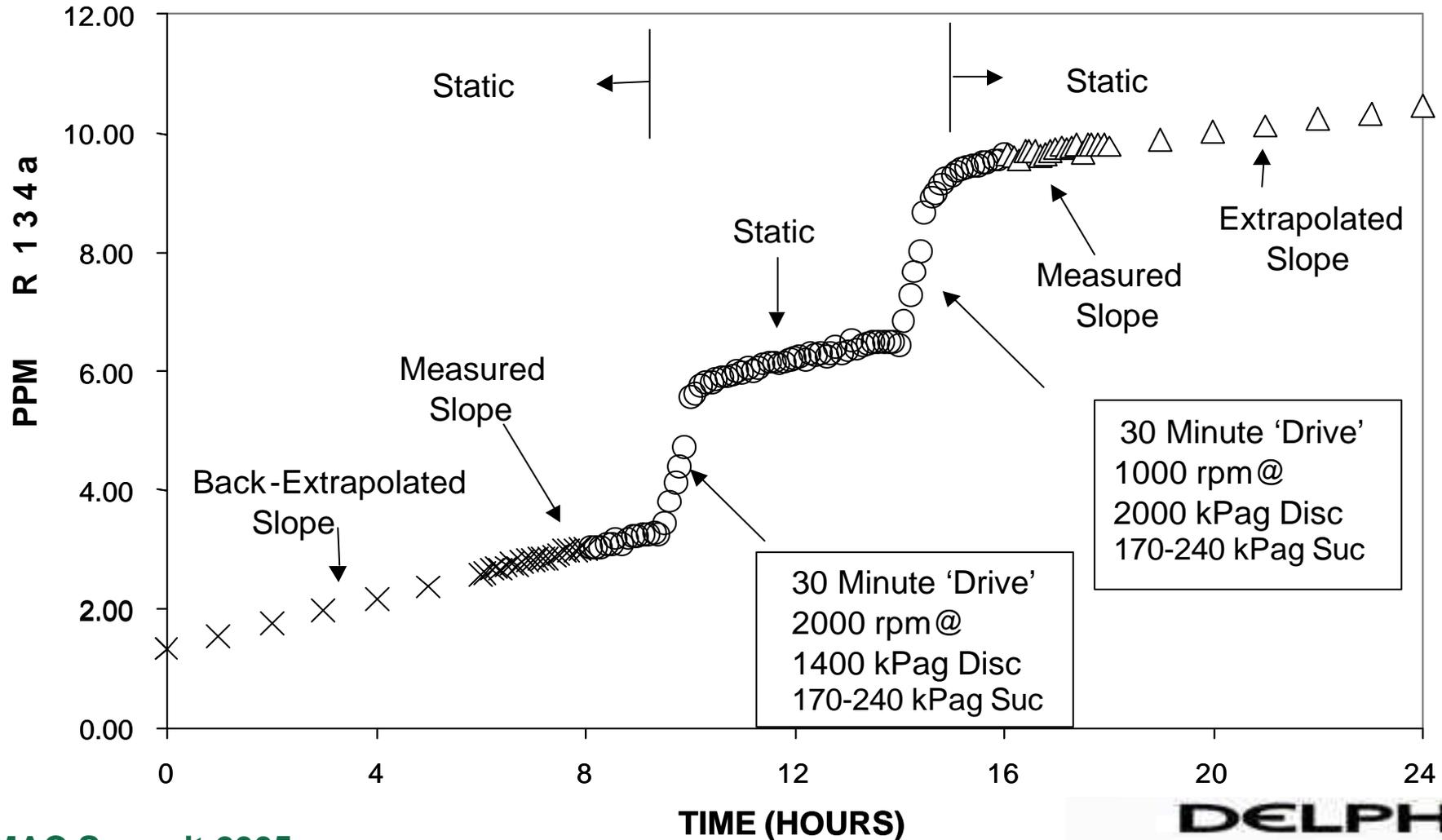
**Static & Dynamic Emissions Measurement
During Simulated Customer Drive Cycle**

Refrigerant Emissions Test Chamber



Static & Dynamic Driving Cycle Emissions Measurement

Emissions Over a 24 Hour Period
Ultimately Expressed as Annual Emissions



Path Forward

□ Delphi

- **Continue to Develop Emissions Measurement Capability**
- **Assist MAC Industry in Developing Test Standards**

□ Mobile Air Conditioning Industry

- **Collaborate within SAE to Develop Industry Standards for Refrigerant Emissions Testing**
 - **Draft Standard Test Method Provided to SAE Interior Climate Control Standards Committee**
- **Coordinate Efforts with Industry Groups (JAMA, VDA, etc.)**
- **Coordinate Efforts with Regulatory Authorities**