

PREVENTING CARBON MONOXIDE AT A SOURCE

U.S. Consumer Product Safety Commission
Ronald A. Jordan

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HAZARD: CARBON MONOXIDE POISONING

- Carbon monoxide (CO) is colorless, odorless, and poisonous.
- CO displaces oxygen from blood and bonds with hemoglobin, causing asphyxiation.
- Gas heating systems were associated with 67 (48%) of the average estimated 141 CO poisoning deaths reported to CPSC (1999-2002).¹

¹“Non-Fire Carbon Monoxide Deaths Associated with the Use of Consumer Products: 2002 Annual Estimates” Directorate for Epidemiology, U.S. Consumer Product Safety Commission, July 2005.

STRATEGIES TO REDUCE THE RISK

- Alert consumers to the risk.
- Warn consumers when CO enters the home.
- Prevent CO from entering home.

VENTED GAS APPLIANCE CO SENSORS PROJECT

OBJECTIVES

- To demonstrate the technical feasibility of using sensor technology in vented gas heating appliances.
- Adoption of voluntary standards requirements that vented gas heating appliances shut down or exhibit other preemptive response to dangerous levels of CO within the appliance.

VENTED GAS APPLIANCE CO SENSORS PROJECT

Goal

To reduce the number of CO poisoning deaths associated with vented gas heating systems.

Strategy

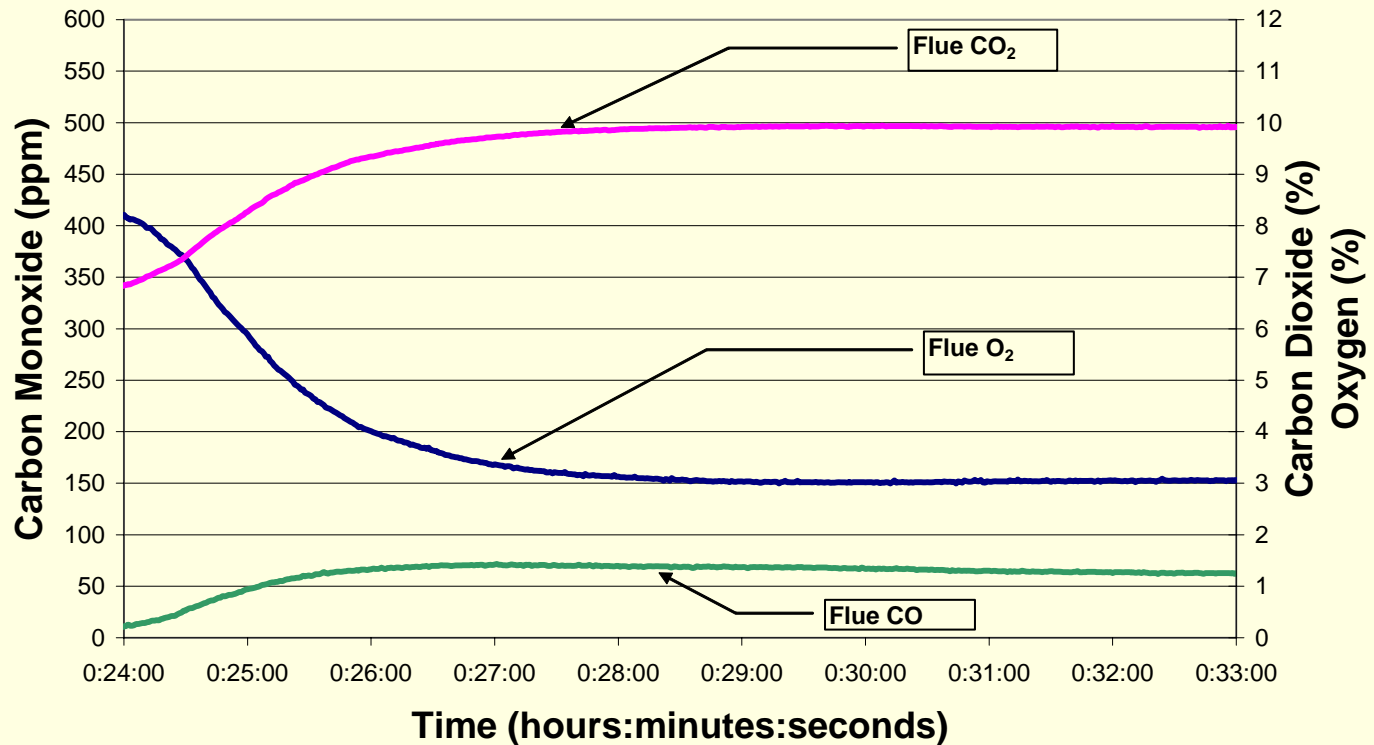
Prevent CO from entering home.

THE PROBLEM

- Improper fuel-air mixture or reduced flame temperature can result in incomplete combustion of fuel, leading to the production of dangerous levels of CO in appliance exhaust.
- If a leakage path (e.g, blocked or disconnected vent) of appliance exhaust to living space is present, then a CO exposure hazard is created.

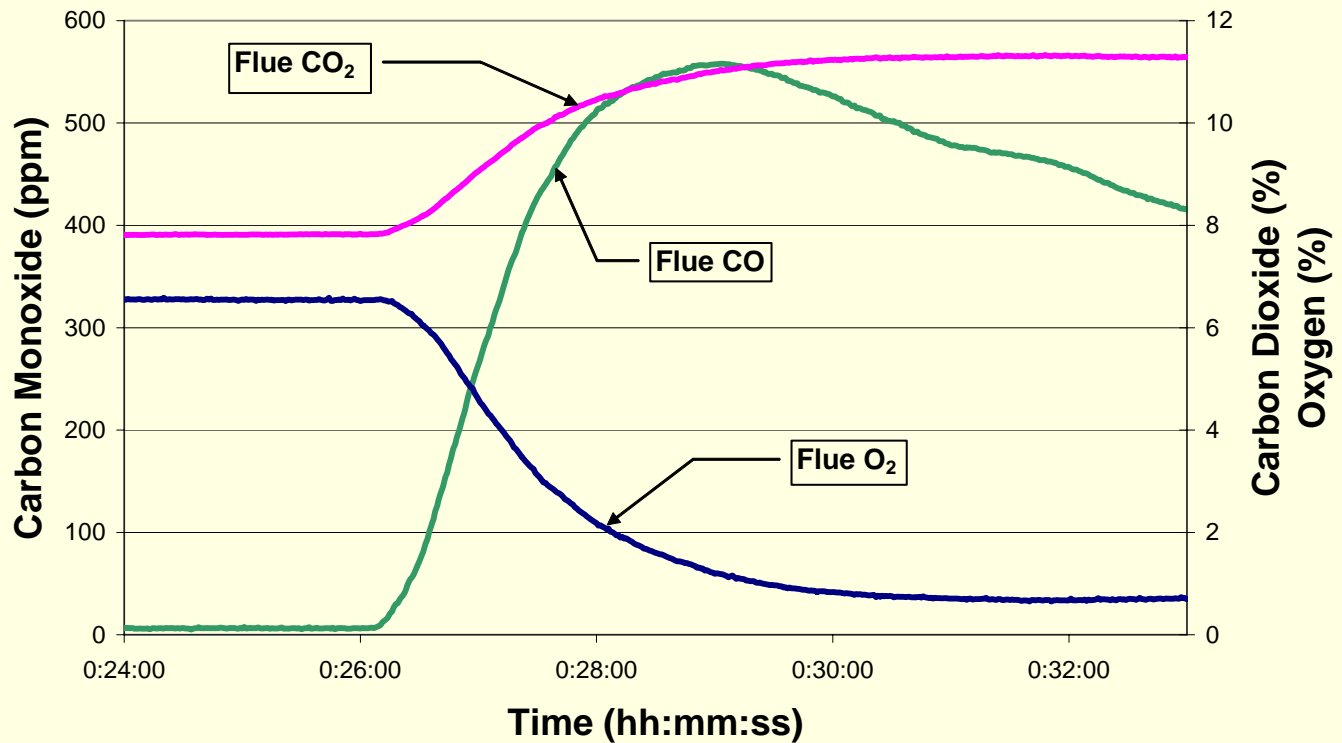
FLUE GAS CONCENTRATIONS- NORMAL FIRING RATE

Flue Gas Profile Test
Blocked Vent & $P_{\text{manifold}} @ 3.5 \text{ in. w.c.}$



FLUE GAS CONCENTRATIONS- OVERFIRED

Flue Gas Profile Test
Blocked Vent & $P_{\text{manifold}} @ 4.3 \text{ in. w.c.}$



PREVENT CO FROM ENTERING THE HOME

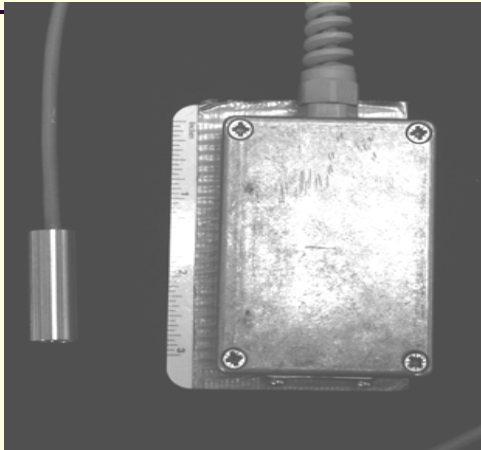
HOW:

Require appliance to shut down/preempt when dangerous levels of CO are generated.

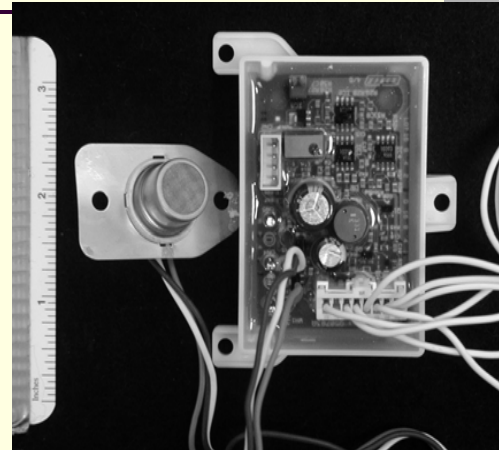
BENEFITS:

- Assures efficient appliance operation.
- Stops CO at the source.
- Prevents CO poisoning deaths and injuries from vented gas appliances.

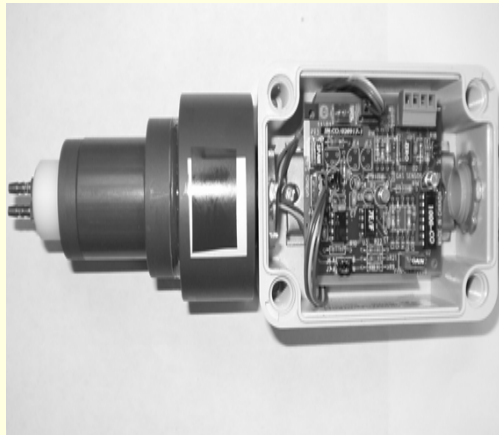
SENSOR TECHNOLOGIES TESTED



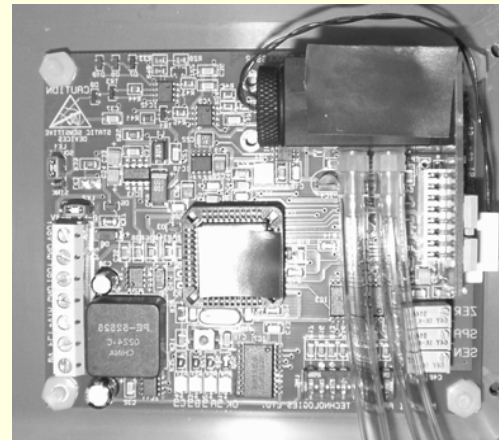
MMOS



Catalytic

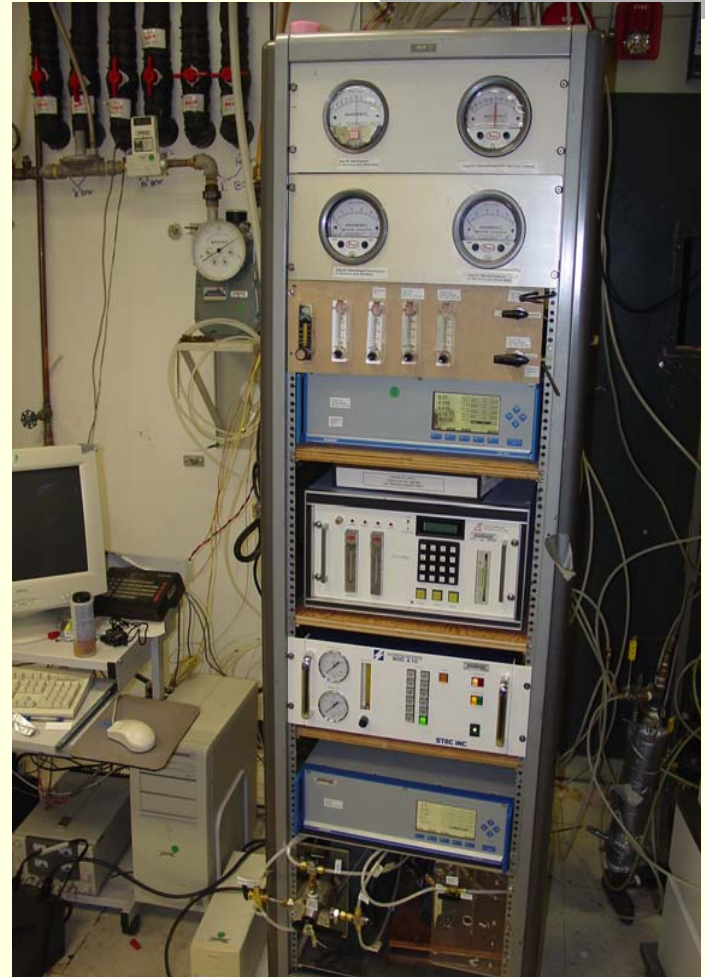
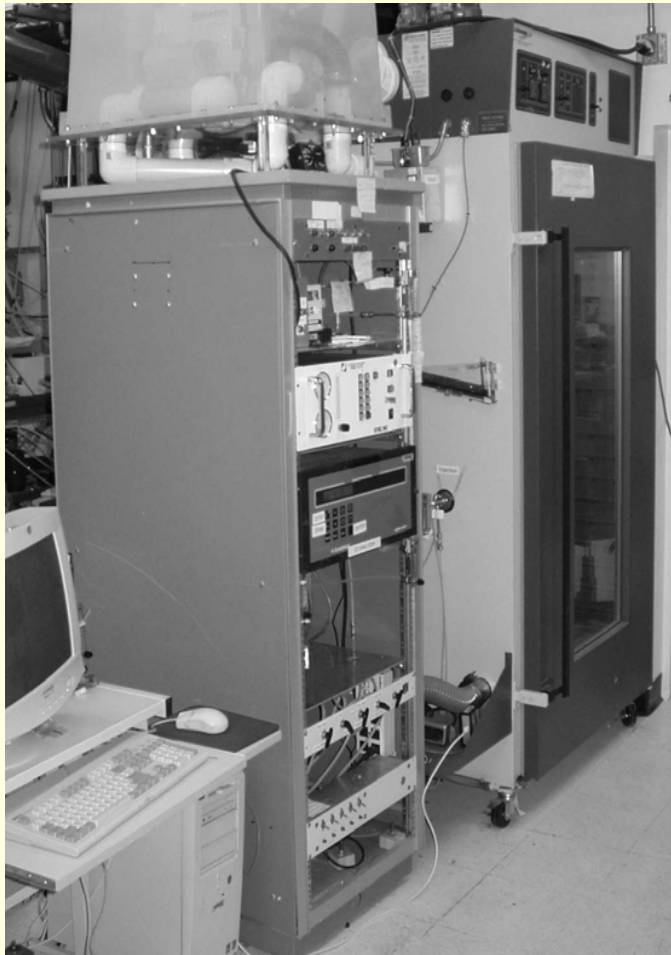


Electrochemical



NDIR

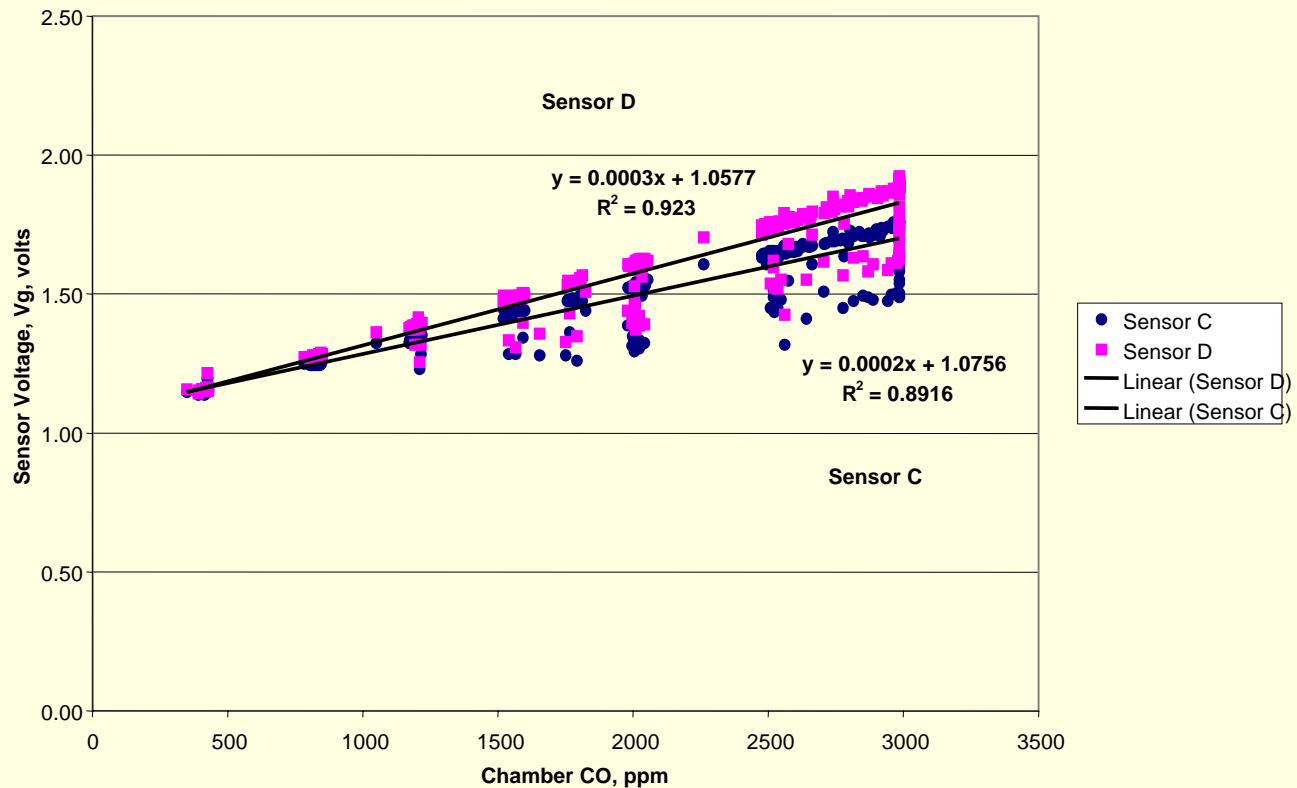
ENVIRONMENTAL CHAMBER TESTING



Test Outcomes---

Catalytic CO Sensor in a Chamber

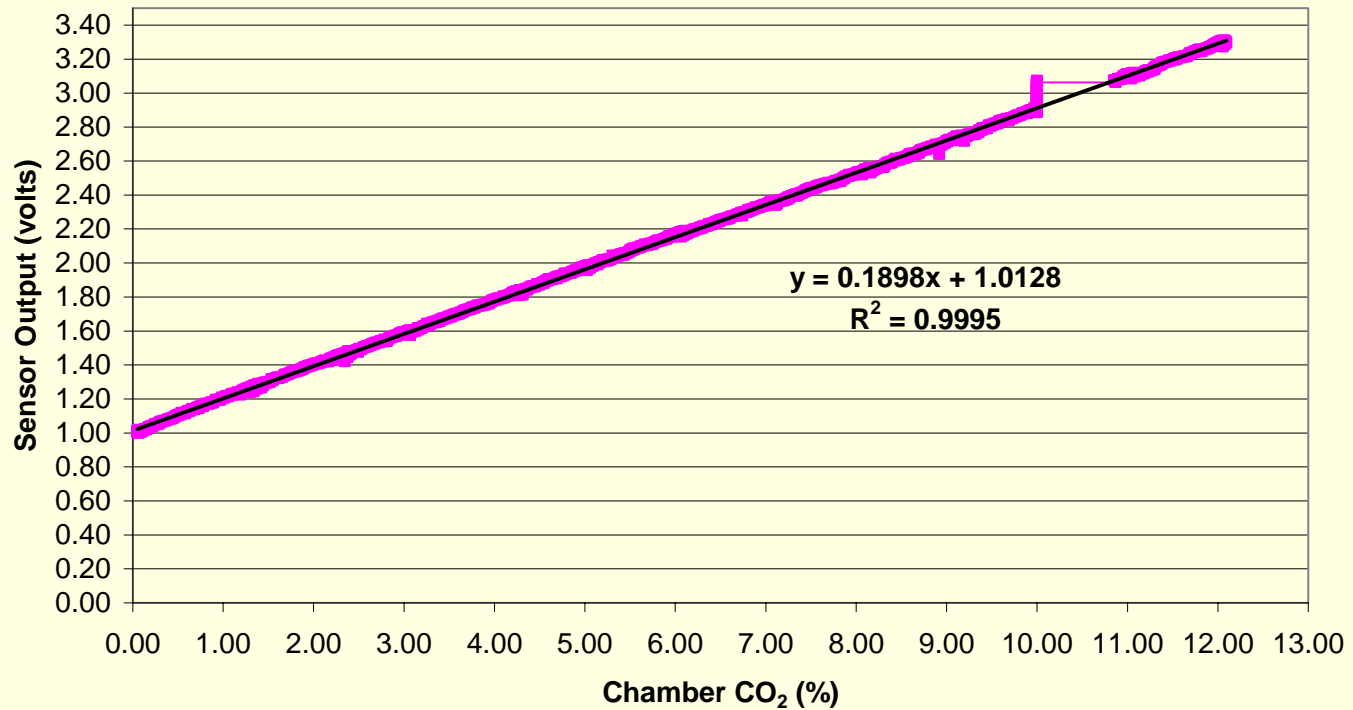
GRAPH 5. RESPONSE CURVE FOR CATALYTIC SENSORS
CO vs. Vg



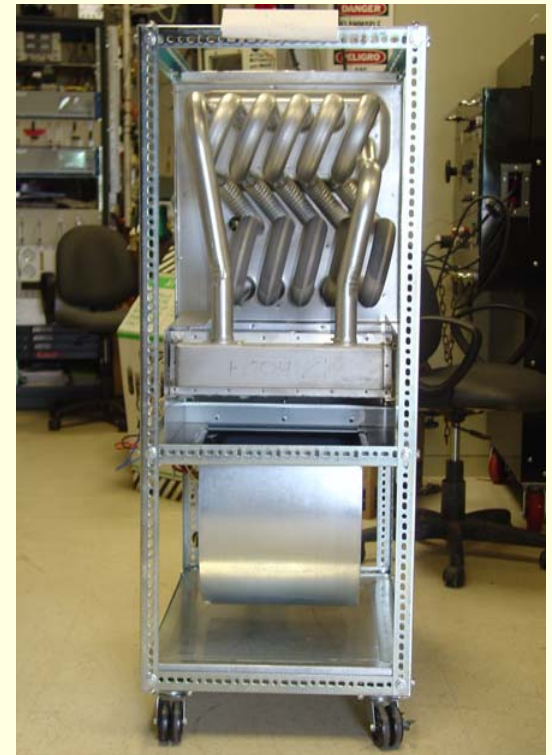
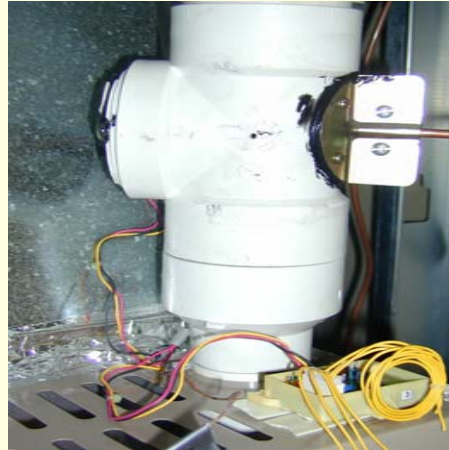
Test Outcomes---

NDIR CO₂ Sensor in a Chamber

Chamber CO₂ vs. IR CO₂ Sensor Output
(130°F, 50% RH)



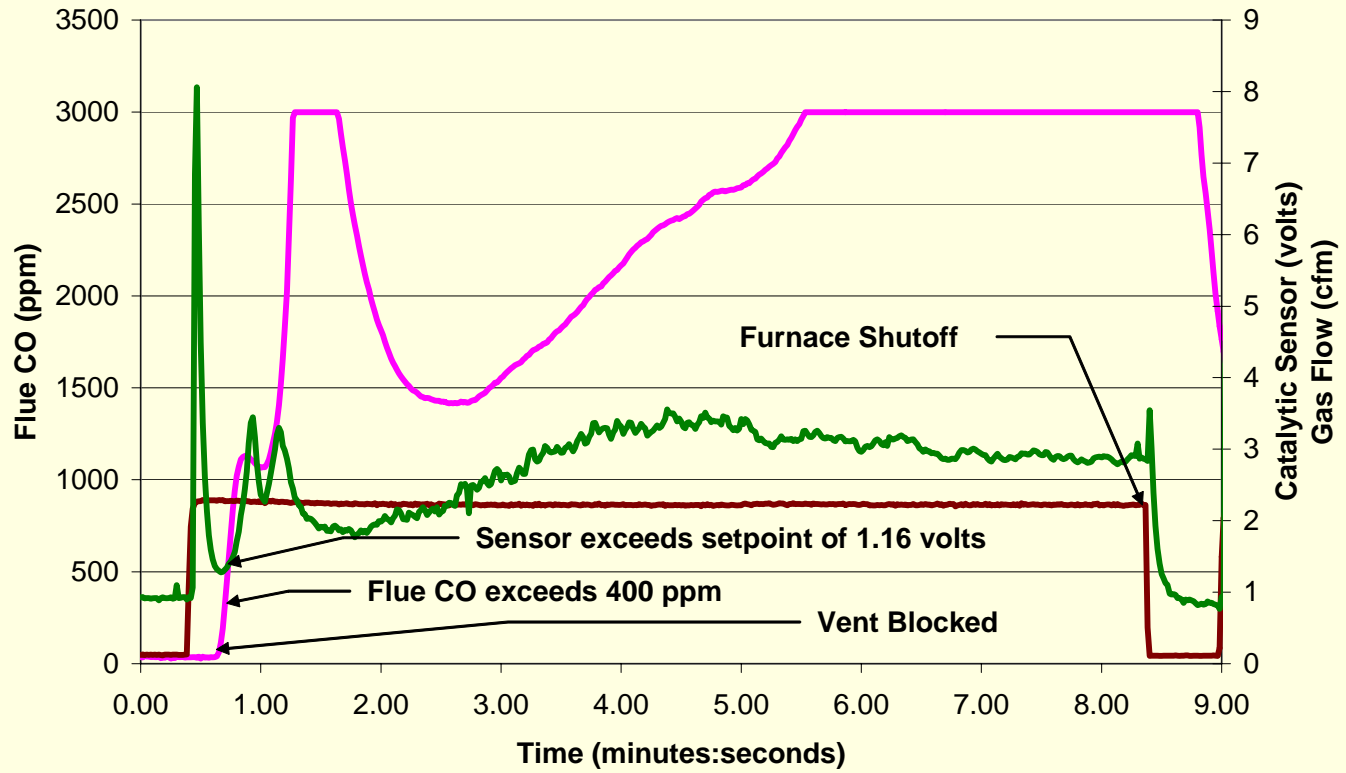
IN FURNACE TESTING



Test Outcomes---

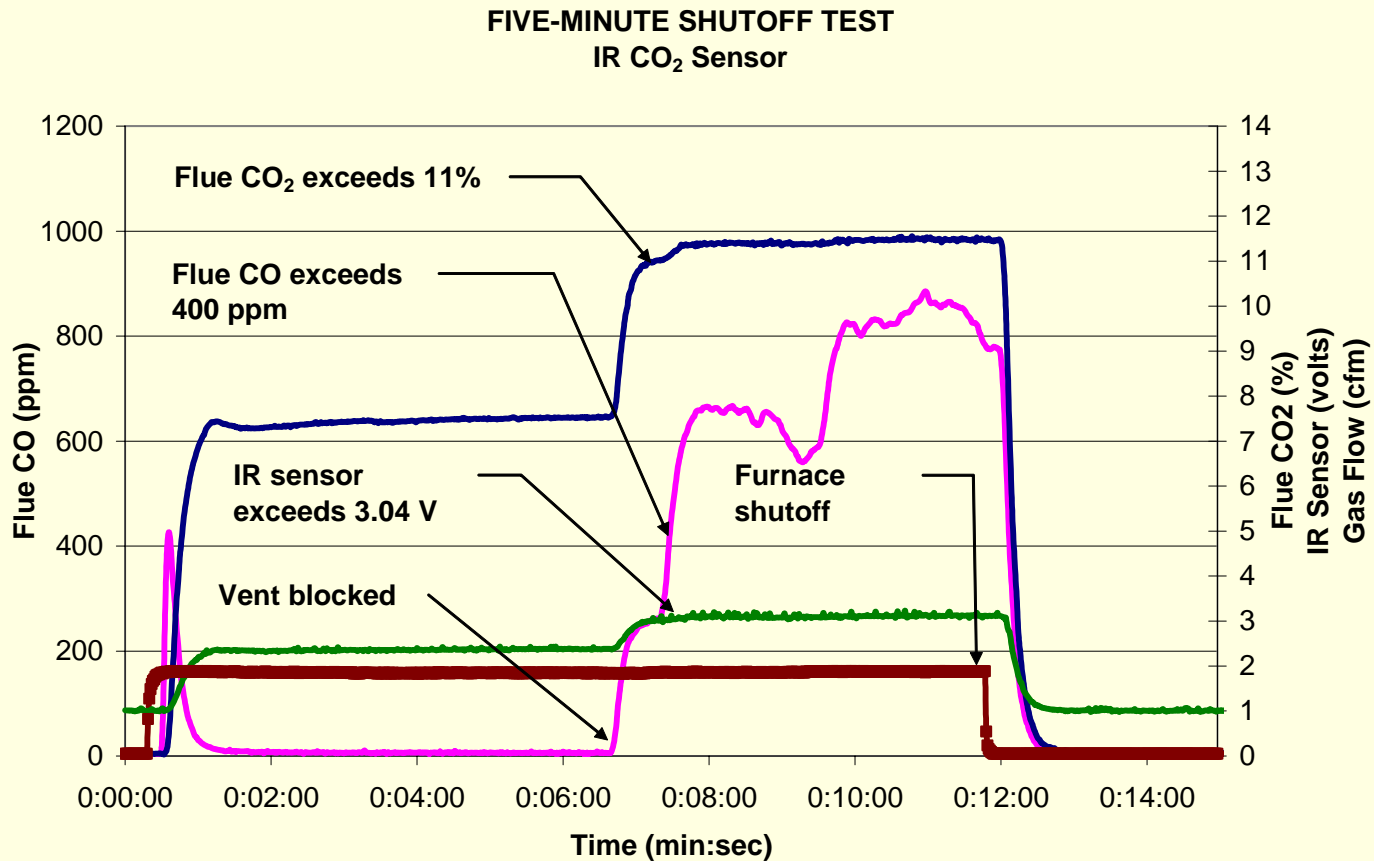
Catalytic CO Sensor in a furnace

Eight-Minute Shutoff Test
Catalytic CO Sensor



Test Outcomes---

NDIR CO₂ Sensor in a furnace



CHALLENGES

To demonstrate technical feasibility, must address:

- Durability
- Reliability
- Long Life

WHAT'S NEXT?

- Demonstrate durability, reliability, and longevity of promising technologies that are currently available.
- Evaluate promising technologies on the horizon.

CONCLUSION

- The concept of using appliance-based CO sensors has been demonstrated.
- Durability and longevity need to be demonstrated to gain acceptance by gas appliance manufacturers.
- Consumers can be protected before CO enters the living space.

CPSC PROJECT CONTACTS

- **Project:** Vented Gas Appliance CO Sensors

- **Project Manager:** Ronald A. Jordan
Mechanical Engineer
O (301) 504-7575
Email: rjordan@cpsc.gov