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MEETING LOG
DIRECTORATE FOR ENGINEERING SCIENCES

SUBJECT: Meeting between CPSC staff and Representatives from the Gas Furnace Industry to Discuss the CPSC Furnace Vent System Test Plan

PLACE: CPSC Headquarters, Room 410B/C

MEETING DATE: August 18, 1998

TIME: 9:30 am

LOG ENTRY SOURCE: Ronald A. Jordan RAJ

ENTRY DATE: August 19, 1998

COMMISSION ATTENDEES:

See attached sign-in sheet for Commission attendees.

NON-COMMISSION ATTENDEES:

See attached sign-in sheet for Non-Commission attendees.

MEETING SUMMARY:

CPSC staff and representatives from the gas furnace industry met to discuss CPSC staff's plan for testing the performance of gas furnaces during various levels of vent pipe blockage or separation. The tests will measure the emissions of carbon monoxide (CO) from furnaces during these vent system conditions. The meeting began at 9:30 a.m. Ron Jordan presented the CPSC test plan to the audience. The purpose and background were discussed in a brief introduction before the presentation shifted to the actual test plan. One of the representatives from the Gas Appliance Manufacturers Association (GAMA) stated that he wanted to ensure that it was understood that industry's presence at this meeting was not an indication that the furnace standard, ANSI Z21.47, was deficient. Following the presentation, a discussion was held. During the discussion, industry raised questions as to why CPSC staff was conducting such a project. CPSC staff responded they are conducting the testing for the following reasons:

- Concern about furnace performance when vent pipe is disconnected or partially blocked, based on In-Depth Investigations (IDI) and other reports.

- As a result of change in direction of the GRI work statement presented at the September 1997 Central Furnace Subcommittee meeting ; and

■Testing will strengthen staff's working knowledge of problem and could help support current or future recommendations.

Industry provided some technical input as to how to best accomplish certain aspects of the testing. CPSC staff stated it would carefully consider all of industry's input, and incorporate recommendations that staff agreed with.

The representative from International Approval Services stated they might be able to send one of their staff to the CPSC laboratory and train CPSC staff there on conducting certain furnace standards testing germane to the current test program. One of the attendees expressed the opinion that the one zone model cited in the test plan might not be appropriate for estimating room concentrations of CO when using a single chamber to operate the furnaces in and to measure emissions from. Furnace manufacturing representatives expressed concern that the furnaces would not be set up in accordance with furnace installation instructions and the National Fuel Gas Code (NFGC). They also expressed the concern that fans used to ensure good mixing of air within the chamber might have an adverse effect on furnace operation and resultant emissions of CO. One industry representative asked if CPSC staff could provide a more detailed schematic of the furnace test setup. CPSC staff took these comments into consideration and informed the audience that the furnaces would be installed in accordance with manufacturer's installation instructions and the NFGC to the extent possible, given the nature and purpose of the test program. CPSC staff also stated we would also consider going to a chamber-in-a-chamber test setup in order to address the concerns about emissions modeling and operation of the furnaces. CPSC staff also agreed to provide a more detailed schematic of the furnace test setup.

CPSC solicited further comments and technical input from the furnace industry representatives. One representative stated that it would be more beneficial if they could comment on a revised test plan that incorporated all concerns raised and changes made, including a more detailed furnace test setup schematic. Staff agreed to these requests and stated that it would send out a revised test plan and schematic as soon as possible. Staff also stated that it would need to receive input from industry 30 days from the date they received the revised test plan and schematic in order to move forward with testing. Industry agreed to this. The representatives from GAMA agreed to coordinate the revised test plan and industry comments between CPSC staff and the furnace industry.

The meeting adjourned at approximately 12:30 pm.

cc:

Office of the Secretary
Colin Church
ESEE Chronological File

Attachments

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FURNACE VENT SYSTEM TEST PLAN

Prepared by the U.S. Consumer Product Safety Commission Staff

OUTLINE

PURPOSE
BACKGROUND
EXPERIMENTAL SETUP
TEST DESCRIPTIONS
ANALYSIS OF TEST RESULTS

PURPOSE

To develop experimental data to determine:

- the effectiveness of Blocked Vent Safety Shutoff System (BVSSS);

- the effectiveness of a pressure switch and flame roll-out switch;

- the enclosure concentrations of CO as a result of spillage from units with various levels of vent system disconnection; and

- the enclosure concentrations of CO as a result of spillage from units with various levels of vent pipe blockage.

BACKGROUND

- Staff is concerned about furnace performance when vent pipe is disconnected or partially blocked.

- Staff is convinced of the need to conduct testing as a result of:

    (1) recent change in direction of the GRI work statement; and

    (2) reports of furnace BVSSS not providing adequate protection from partially blocked vents.

- Testing will strengthen staff's working knowledge of problem and could help support current or future recommendations.

TEST SETUP

Design Considerations

- Enclosure
- Circulation and Return Air Ducts
- Vent System

TEST SETUP

- Enclosure dimensions IAW manufacturer's installation instructions for "Confined Space"

- Approx. dimensions: 8ft.x8ft.x8ft.

- Circulation air duct, return air duct, and vent system IAW manufacturer's installation instructions

- Circulation air ducted to the outdoors

- Return air ducted from out doors

- Vent system terminates at exhaust hood in test area at CPSC's engineering laboratory

TEST SETUP

Data to Measure

Oxygen (O_2) level in the enclosure (% or ppm)
O_2 consumption rate (-cc/kJ)
Carbon dioxide (CO_2) emissions rate (cc/kJ)
Carbon monoxide (CO) emissions rate (cc/kJ)
Fuel consumption rate (kJ/hr)
Air changes per hour (ACH)
Temperature (T) at draft hood
Temperature (T) at heat exchanger inlet
Inducer fan pressure (P)
Time-to-main burner shutoff (t)
Total test duration (t)
Background O_2, CO, and CO_2 enclosure concentrations

BLOCKED VENT SAFETY SHUTOFF SYSTEM (BVSSS) EFFECTIVENESS TEST

Four (4) conditions:

- One hundred (100) percent vent blockage
- Seventy (70) percent vent blockage
- Thirty (30) percent vent blockage
- Zero (0) percent vent blockage

BLOCKED VENT SAFETY SHUTOFF SYSTEM (BVSSS) EFFECTIVENESS TEST

Basic approach:

- Block vent pipe incrementally using an Iris Diaphragm

- Measure enclosure CO, CO_2, O_2 levels

- Measure temperature of flue products at the draft hood and in enclosure

- Operate until BVSSS shuts unit off, stop test

- If unit does not shut off, run test until equilibrium CO levels reached, stop test

- If unit did not shut off, repeat with vent pipe blocked 10 % more

BLOCKED VENT SAFETY SHUTOFF SYSTEM (BVSSS) EFFECTIVENESS TEST

Location of Sensors

- 5 CO, CO_2, and O_2 sensors throughout enclosure
- 5 thermocouples throughout enclosure
- 1 thermocouple adjacent to BVSSS at draft hood

PRESSURE SWITCH & FLAME ROLLOUT SWITCH EFFECTIVENESS TEST

■ Same conditions as BVSSS test

■ Same basic approach as BVSSS test

■ Same sensor locations

■ Replace testing of BVSSS function with:
*pressure switch
*flame rollout switch

■ Measure temperature of flue products at heat exchanger inlet opening (locate thermocouple adjacent to flame rollout switch)

■ Pressure tap of the pressure switch

DISCONNECTED VENT SPILLAGE TEST

Four (4) conditions:

- Complete separation
- Two inch gap
- Hairline gap
- No disconnect (baseline)

DISCONNECTED VENT SPILLAGE TEST

Basic approach:

- Disconnect vent pipe incrementally
- Measure enclosure CO, CO_2, O_2 levels and temperature
- Measure temperature of flue products at the vent disconnect
- Run test until equilibrium CO levels reached

DISCONNECTED VENT SPILLAGE TEST

Location of Sensors

- 5 CO, CO_2, and O_2 sensors throughout enclosure

- 5 thermocouples throughout enclosure

- 1 thermocouple at the point of vent pipe separation

DRAFT HOOD-EQUIPPED AND INDUCED DRAFT FURNACE TEST MATRIX

FURNACE NO.	**NO. 1**	**NO. 2**	**NO. 3**	**NO. 4**	**NO. 5**	**NO. 6**
BVSSS EFFECTIVENESS TEST ***(for draft hood-equipped units only)***						
0%	2	2	2	----	----	----
30%	2	2	2	----	----	----
70%	2	2	2	----	----	----
100%	2	2	2	----	----	----
PRESSURE SWITCH & FLAME ROLLOUT SWITCH EFFECTIVENESS TEST ***(for induced draft furnaces only)***						
0%	----	----	----	2	2	2
30%	----	----	----	2	2	2
70%	----	----	----	2	2	2
100%	----	----	----	2	2	2
DISCONNECTED VENT SPILLAGE TEST						
0%	2	2	2	2	2	2
Hairline	2	2	2	2	2	2
Two-Inches	2	2	2	2	2	2
100%	2	2	2	2	2	2
Total Number of Tests						**96**

ANALYSIS OF TEST RESULTS

Estimates of indoor carbon monoxide, carbon dioxide, and oxygen levels that would be present in typical residences are to be determined using the One-Zone Mass Balance Model.

One -Zone Mass Balance Model:

$$C_t = \frac{\frac{E \cdot Q}{V}\left(1 - e^{-t(A+K)}\right) + A \cdot C_{out}}{A + K} \qquad (1)$$

where:

C_t is the concentration (of CO, NO_2, CO_2, or O_2) at time t, cc/m3 or parts-per-million (ppm)
t is the time, hours
E is the emission rate, cc/kJ
Q is the fuel consumption rate, kJ/h
V is the compartment volume, m^3
A is the air infiltration rate, air changes per hour or h^{-1}
K is the reactive decay rate, h^{-1}
C_{out} is the outdoor concentration, ppm

ANALYSIS OF TEST RESULTS

The equilibrium concentration (C_{eq}) is given by:

$$C_{eq} = \frac{\frac{E \cdot Q}{V} + A \cdot C_{out}}{A + K} \qquad (2)$$