REFERENCES:

1. Bullerdiek, W. A., "Classification Information for Residential Flame-Fired Furnaces, Hot Water Heaters, Clothes Dryers and Ranges," Calspan Corp., September 1974.

2. Bullerdiek, W. A. and D. E. Adams, "Identification and Classification of Potential Hazards Associated With the Use of Residential Flame-Fired Furnaces, Hot Water Heaters, Clothes Dryers and Ranges," Calspan Corp., February 1975.

3. Bullerdiek, W. A. and D. E. Adams, "Investigation of Safety Standards for Flame-Fired Furnaces, Hot Water Heaters, Clothes Dryers and Ranges," Calspan Corp., July 1975.

4. Bullerdiek, W. A. and D. E. Adams, "Investigation of Safety Standards for Flame-Fired Space Heaters," Calspan Corp., February 1976.

5. Adams, D. E. and W. A. Bullerdiek, "Safety Investigation of Gas Appliance Energy Saving Devices and Automatic Vent Dampers for Oil Furnaces," Calspan Corp., October 1977.

6. Adams, D. E. and W. A. Bullerdiek, "Investigation of Safety Standards for Energy Saving Devices for Gas-Fired Appliances," Calspan Corp., March 1978.

7. Adams, D. E. and W. A. Bullerdiek, "Safety Devices for Gas-Fired Appliances," Calspan Advanced Technology Center, May 1980.

8. Kweller, Esher R. and William Cuthrell, "Testing of an Oxygen Depletion Detecting Device for Unvented Gas Fueled Heaters," National Bureau of Standards, January 1979.

9. Kweller, Esher R., "Unvented Heater Tests and Analysis of Standards for a Temperature Sensitive Limit Switch," National Bureau of Standards, November 1978.

10. Pierson, Ryan, "Low Cost Residential CO Detectors," National Bureau of Standards, January 1980.

Item 6: "Overview of Standards, Codes, and Regulations Relating to Gas Fired Appliances"

The most important organization involved in regulating the manufacture and installation of gas-fired appliances is the American National Standards Institute (ANSI), a voluntary standards writing organization that is familiar to most at the CPSC. Within ANSI, the committee involved with gas-fired appliances is the "Z21 American National Standards Committee on Performance and Installation of Gas Burning Appliances and Related Accessories." As its title suggests, the Z21 Committee writes standards not only for the appliances themselves but also for accessories such as automatic ignition devices, vent dampers and flexible connectors. The Z21 Committee is composed of representatives from the following organizations:

Air-Conditioning and Refrigeration Institute (ASHRAE)
American Gas Association (AGA)
American Insurance Association
American Petroleum Institute
American Public Gas Association
Association of Home Appliance Manufacturers
The Canadian Gas Association
Department of Health and Human Services
Factory Mutual System
Federal Housing Administration
Gas Appliance Manufacturers Association (GAMA)*
Federal Supply Service
International Association of Plumbing and Mechanical Officials
Mechanical Contractors Association of America
National Electrical Manufacturers Association
National Environmental Systems Contractors Association
National Fire Protection Association (NFPA)
National LP-Gas Association
National Solid Wastes Management Association
Naval Facilities Engineering Command
Underwriters Laboratories (UL)
Department of the Army
Individual member

The CPSC also has a membership on the Committee, but the representative has no vote. The Committee meets every Spring in Arlington, Virginia.

The Z21 Committee is composed of 17 subcommittees, where the standards are actually written. Most of these subcommittees are quite active and frequently discuss amendments to any of the 47 standards for which they are responsible. A listing of the subcommittees and the standards they maintain is attached.

*Members of GAMA are representatives, but GAMA itself is not.

In addition to ANSI, other important organizations are the American Gas Association (whose members are public utilities), the American Society of Mechanical Engineers, and the National Fire Protection Association. Among the work of these organizations is a combined effort known as the "National Fuel Gas Code" (ANSI Z223.1 and NFPA No. 54). This code sets standards for the installation of gas piping and gas equipment.

Underwriters Laboratories also has a limited number of standards relating to gas, principally involving recreational vehicles. As a general rule, UL standards deal with oil-fired equipment while ANSI standards deal with gas-fired equipment.

The American Gas Association acts as the secretariat for the ANSI Z 21 Committee. Most of the subcommittee meetings are held at the AGA Laboratories in Cleveland. AGA prints the minutes, keeps track of proposed amendments and votes, and mails materials. Within the Commission, both Engineering and OPM receive these materials, which provide a good source of information on current discussions, controversies and routine activity within the industry.

The AGA also certifies appliances as complying with ANSI standards in much the same way that UL lists products according to its own standards. Manufacturers make use of this AGA service in part because in many places there are state or local requirements that all gas appliances sold must be certified by the AGA. The AGA's Directory of Certified Appliances and Accessories lists literally many thousands of models of appliances and accessories.

Because of its public utility membership and consequent strong interest in safety, the AGA has frequently provided the Commission with an impartial source of high quality information. The AGA also has a research function that on at least one occasion has performed a section 15 assessment for the Commission.

The Gas Appliance Manufacturers Association (GAMA) is a national trade association whose members manufacture over 90 percent of all residential, commercial and industrial gas appliances made in the U.S. as well as equipment used in the production, transmission and distribution of fuel gases. GAMA also represents manufacturers of appliances that use oil or electricity as their energy source.

GAMA is not a standards-writing organization and does not participate directly in the standards-writing process. However, its members participate in several organizations concerned with standards and practices such as ANSI, ASTM, NFPA and the American Society of Heating, Refrigeration and Air Conditioning Engineers. GAMA states that, through the technical committees of its 13 product divisions, it assists in the identification of areas where performance and safety standard revisions may become desirable to keep pace with improved technology.

AMERICAN NATIONAL STANDARDS COMMITTEES

SUBCOMMITTEES

SUPERVISED AMERICAN NATIONAL STANDARDS

Z21 STANDARDS COMMITTEE

Air Conditioning Subcommittee
Standard for Gas-Fired Absorption Summer Air Conditioning Appliances, Z21.40.1

Boiler Subcommittee
Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers, Z21.13

Camping Equipment Subcommittee
Standard for Portable Catalytic Heaters for Use With Propane Gas, Z21.62
Standard for Portable Camp Heaters of Other Than the Catalytic Type for Use With Liquefied Petroleum Gases, Z21.63

Central Furnace Subcommittee
Standard for Gas-Fired Central Furnaces (Except Direct Vent and Separated Combustion System Central Furnaces), Z21.47
Standard for Direct Vent Central Furnaces, Z21.64

Clothes Dryer Subcommittee
Standard for Gas Clothes Dryers, Volume I, Type 1 Clothes Dryers, Z21.5.1
Standard for Gas Clothes Dryers, Volume II, Type 2 Clothes Dryers, Z21.5.2

Connector Subcommittee
Standard for Metal Connectors for Gas Appliances, Z21.24
Standard for Flexible Connectors of Other Than All-Metal Construction for Gas Appliances, Z21.45
Standard for Gas Hose Connectors for Portable Indoor Gas-Fired Appliances, Z21.2
Standard for Gas Hose Connectors for Portable Outdoor Gas-Fired Appliances, Z21.54
Standard for Connectors for Movable Gas Appliances, Z21.69

Control Devices Subcommittee

Automatic Gas Valve Working Committee
Standard for Automatic Valves for Gas Appliances, Z21.21

Gas Appliance Pressure Regulator Working Committee
Standard for Gas Appliance Pressure Regulators, Z21.18

Gas Appliance Thermostat and Automatic Gas Ignition Systems Working Committee
Standard for Gas Appliance Thermostats, Z21.23
Standard for Automatic Gas Ignition Systems and Components, Z21.20

Gas Filter Working Committee
Standard for Gas Filters on Appliances, Z21.35

Manually Operated Gas Valve Working Committee
Standard for Manually Operated Gas Valves, Z21.15
Standard for Quick-Disconnect Devices for Use With Gas Fuel, Z21.41

Conversion Burner Subcommittee
Standard for Domestic Gas Conversion Burners, Z21.17
Standard for Installation of Domestic Gas Conversion Burners, Z21.8
Standard for Draft Hoods, Z21.12

Damper Subcommittee
Standard for Electrically Operated Automatic Vent Damper Devices for Use With Gas-Fired Appliances, Z21.66
Standard for Mechanically Actuated Automatic Vent Damper Devices for Use With

Food Service Equipment Subcommittee
Standard for Hotel and Restaurant Gas Ranges and Unit Broilers, Z83.11
Standard for Hotel and Restaurant Gas Deep Fat Fryers, Z83.13
Standard for Commercial Gas Baking and Roasting Ovens, Z83.12
Standard for Gas Counter Appliances, Z83.14
Standard for Gas-Fired Kettles, Steam Cookers and Steam Generators, Z83.15

Z223 STANDARDS COMMITTEE

Advisory Panel on Piping
Advisory Panel on Equipment Installation
Advisory Panel on Venting
Correlating Panel

National Fuel Gas Code, Z223.1

ID #
RP #
IRB #
CA# 81-2664

PRODUCT SAFETY ASSESSMENT (PSA)
TECHNICAL EVALUATION
REQUEST

DLN 7-14-81

PSA USE ONLY

REQUEST # 192

TIME/DATE RECEIVED: 10:00AM/7/6/81

RECEIVED BY:
NICK MARCHICA/PM
(Name/Title - Please Print)

DATE DUE: 7/24/81 : STATUS REPORT: 9/28/81 REV: 10/2/81 Compl: 10/6/81

REQUESTED BY:
Betty Fees/Compliance Officer
(Requestor's Name/Title - Please Print)

CACA (Org. Code) 6/30/81 (Date) PRIORITY: (Corrective Action Use Only)

TYPE OF EVALUATION REQUESTED (Please Print):
1. PLEASE REVIEW THE ATTACHED IN-depth REPORT AND DETERMINE, IF POSSIBLE, WHAT FACTORS MAY HAVE CONTRIBUTED TO OR WERE DIRECTLY RESPONSIBLE FOR THE FAILURE OF THE FLEXIBLE GAS CONNECTOR FOLLOWING THE MOVEMENT OF THE GAS APPLIANCE TO WHICH IT WAS ATTACHED. THE UNIT WAS RECEIVED FROM AN OKLAHOMA FIRE DEPT. ABSENT THE END COUPL.
(Use Back of this form if more space is needed)

PRODUCT IDENTIFICATION: [redacted] / (Sample Number - If Applicable)
(Manufacturer/Importer)

Flexible gas connector
(Other Descriptive Information - Brand Name/Model/Etc.)

THIS BLOCK FOR PSA USE ONLY

ASSIGNED TO: FRANK BRAUER/ES
(Name/Organization Code)

DATE ASSIGNED:

ADDITIONAL INSTRUCTIONS:

2. File is in Rm 222
Can this be completed by 7/24/81?
• 7/21/81 Dennis McCoskrie to get T.O. assigned

557

TD #
RP #
HEB #
CA # 81-2-664

PRODUCT SAFETY ASSESSMENT (PSA)
TECHNICAL EVALUATION
REQUEST

DLN 7-24-81

PSA USE ONLY

REQUEST # 193

TIME/DATE RECEIVED: 11:30AM/7/2/81

RECEIVED BY:
DICK MARCHICA/PM
(Name/Title - Please Print)

DATE DUE: 7/24/81: STATUS REPORT: 9/28/81 REV: 10/5/81 Completed

REQUESTED BY:
Betty Fees/Compliance Officer
(Requestor's Name/Title - Please Print)

CA (Org. Code) 7/2/81 (Date) PRIORITY: (Corrective Action Use Only)

TYPE OF EVALUATION REQUESTED (Please Print):
1. Please review the attached in-depth report and determine, if possible, which specific may have contributed to or were directly responsible for the failure of the flexible gas connector following the movement of the gas appliance to which it was attached. (Use Back of this form if more space is needed)

PRODUCT IDENTIFICATION: [redacted]
(Manufacturer/Importer) (Sample Number - If Applicable)

FLEXIBLE GAS CONNECTOR
(Other Descriptive Information - Brand Name/Model/Etc.)

THIS BLOCK FOR PSA USE ONLY

ASSIGNED TO: FRANK BRAUER/ES
(Name/Organization Code)

DATE ASSIGNED:

ADDITIONAL INSTRUCTIONS:

358

1. File is in Rm 222
Can this be completed by 7/24/81?

. 7/2/81 Dennis McCoskrie to get T.O. assigned.

Z

UNITED STATES GOVERNMENT

Memorandum

U.S. CONSUMER PRODUCT
SAFETY COMMISSION
WASHINGTON, D.C. 20207

JUL 2 9 1981

TO: Richard A. Gross, Executive Director
THROUGH: Bert G. Simson, Director, OPM
THROUGH: Douglas L. Noble, Program Manager for Emerging Hazards, Office of Program Management

FROM: John Liskey, Program Manager, New Project Identification (NPI) Program, Office of Program Management

SUBJECT: Gas-Fired Appliances--Specific Issues

In early May, 1981 the NPI team prepared and transmitted to you a discussion paper on gas-fired appliances. This paper summarized available injury and economic information as well as presenting an overview of past and current activities within CPSC and other organizations to address safety hazards associated with these appliances. In late May, 1981, the paper was a topic of discussion at an Executive Management Team meeting. As a result of that discussion, you requested that specific issues be developed which could be used for focusing future CPSC activities on gas-fired appliances hazards.

Additionally, the EMT discussion centered on the possibility of a meeting between CPSC staff and the affected industry organizations in order to present our specific concerns and seek a cooperative approach in addressing those concerns. The suggestion of such a meeting derived from the staff's information that various industry and voluntary standards organizations already have extensive knowledge and existing standards on gas-fired appliances. The Fire and Thermal Burn program has an approved project in the FY 82 Operating Plan entitled "Gas-Fired Heating Systems" which would provide an initial start to such a cooperative effort. At the end of this memorandum several alternatives for addressing gas-fired appliances issues are presented for your consideration.

The attached document, (Tab A), prepared by Engineering Sciences (ES), provides information and recommendations for the following various types of gas-fired appliances:

- Carbon monoxide detectors
- Flexible connectors
- Combination controls
- Portable heaters
- Natural and LP gas detectors

Below are brief summaries of issues, discussed in more detail by ES, relating to the safety of these gas-fired appliances and accessories.

Carbon Monoxide Detectors

- Carbon monoxide poisonings are most commonly associated with furnaces and space heating equipment.

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° The most common causes of carbon monoxide (CO) poisoning appear to be improperly installed vents and lack of inspection and maintenance of the equipment on a regular basis.

° A possible information/education campaign which suggested that consumers have their heating equipment inspected and adjusted by a trained individual on a regular basis could be an effective action to reduce CO poisonings.

° The development of a low cost residential detector could lead to a reduction of CO poisonings. In 1979 the Commission asked the National Bureau of Standards (NBS) to examine the current technology of CO detection, prepare a feasibility study for developing a low cost residential CO detector, and prepare a sample development plan. Among the conclusions reached by NBS in January 1980 were that currently available CO detectors did not meet the requirements for a low cost residential detector. However, NBS noted that CO detector research and development was an active field, and the prospects for developing a low cost residential detector within a few years were good. NBS recommended that a continuous effort to monitor progress in the development of low cost residential CO detectors should be undertaken, and the feasibility should be re-evaluated on a yearly basis.

Flexible Connectors

° Flexible connectors are brass metal hoses used to transmit gas from a fixed position pipe to an appliance which may have to be moved from time to time for servicing.

° Leaks in these connectors occur in two principal ways: (1) Simple fatigue failure associated with repeated flexing of the metal connector back and forth as the appliance is serviced over a period of time, and (2) "Seasonal Cracking" - cracking occurs through the action of certain household cleaning chemicals (such as ammonia) on the brass connector.

° A possible solution to this leakage problem would appear to be the identification and use of more suitable materials that are not greatly subject to aging, fatigue failure, or chemical attack.

° Staff work is needed to demonstrate scientifically whether brass connectors can be made safer, whether protective coatings in current use are adequate, and whether more suitable coatings can be found. Once this work is completed, the appropriate American National Standards Institute (ANSI) Z21 subcommittee could be asked to address the problem.

Combination Controls for Gas Appliances

° Combination controls are single devices with which the user interacts in lighting the appliance and sometimes in operating it. (Example - Water Heater Control)

° Fire and explosions are the most common hazards attributed to this component of a gas appliance.

° Incidents frequently are associated with a failure of the pilot light safety shutoff system, followed by a user's misuse of the control. Rather than have the defect repaired, the user overrides the safety shutoff function to make the appliance work.

° The hazard may be minimized by a design that a user cannot override.

° Another hazard that may exist is gas leaks from controls, usually in the area of the gas cock and control knob.

° Additional staff work is needed to define clearly the extent and nature of these problems. Because the hazards (i.e. fire, explosions) are serious, combination controls may need to be addressed on a priority basis.

Portable Heaters

° There are two categories of portable, fueled heaters: (1) gas-fired heaters (cabinet heaters) and (2) kerosene heaters.

° The most significant potential hazard from both types is fire.

° Some individuals and organizations associated with the industry have made their concerns known to CPSC staff relating to the safety of cabinet heaters.

° The staff needs to investigate several areas of concern, monitor the proceedings of the organizations already involved in looking at possible hazards, and obtain further information from the states on their experience with portable heaters before any recommendations for Commission action can be developed. There are several areas of concern that have been raised for which the staff does not now have definitive answers:

(1) Does the use of liquid and gaseous fuels, in quantities sufficient to power portable heaters in a residence, pose an unacceptable hazard?

(2) Do the heaters pose an indoor air pollution problem?

(3) Are there controls over the size of the gas bottle used with cabinet heaters?

(4) What are the relative hazards of handling and using liquid and gaseous fuels in residences?

(5) What specific hazards do LP-gas bottles pose?

Gas Detectors

° Gas detectors may be an approach to detect directly any dangerous accumulations of gas in the areas in which gas-fired appliances are being used.

° Some devices are already on the market that can detect the presence of combustible gases and vapors; however, the effectiveness of these devices is not known.

° More work is needed to determine if such devices are feasible.

The five specific issues discussed above are of interest and concern to Commission staff and should be considered for future action. The procedure and priority in addressing these issues could follow several courses. Possible courses of action are recommended for your consideration:

(1) Direct the Fire & Thermal Burn (FTBH) Program to address one or more of the issues within their FY 82 Operating Plan project on gas-fired heating systems (Project Number 10497) The Project Manager for the FTBH program has prepared recommendations for action on hazards associated with gas fired appliances based on his review of the ES issues memorandum and current status of work on voluntary standards (Tab B).

(2) Select one or more issues for presentation to industry and voluntary standards organizations in order to seek cooperative approaches in addressing the problems. Such a meeting with these organizations could be arranged by the FTBH program or by other staff.

(3) Select one issue for priority attention by either the FTBH or NPI program. The purpose of establishing such a project would be to gather additional information in order to develop alternatives for Commission consideration.

I recommend that the above alternatives and possible additional ones be discussed at a future EMT meeting. If EMT discussion does take place, representatives from the FTBH program should be present.

Attachments

A

UNITED STATES GOVERNMENT

Memorandum

U.S. CONSUMER PRODUCT SAFETY COMMISSION

TO : Robert Northedge, ESNPI Team Representative

DATE: 19 JUN 1981

FROM : For John Liskey, Program Manager, NPI
Charles L. Willis, ESES

SUBJECT: Gas-Fired Appliances - Development of Issues

Introduction

This is in response to John Liskey's memorandum of May 27, 1981, in which he asked Engineering to provide information and recommendations to be used in developing work involving gas-fired appliances. To the extent that it could be accomplished in the time frame, this memorandum explores specific hazards of which we are aware, presents recommended approaches to solutions for various types of appliances and looks at methods for carrying out the solutions. Specific issues discussed relate to:

1. Carbon monoxide detectors
2. Flexible connectors
3. Combination Controls
4. Portable heaters
5. Natural and LP Gas detectors

One of John Liskey's requests was that we "Review the 1974 Calspan study and develop specific issues that need attention." A summary of the work done for the Commission by Calspan appears below, followed by the discussion of individual issues.

The Calspan work was considered in developing the issues, and it constitutes a valuable information base. In addition, the discussion of individual issues builds upon the ES workaday experience, including numerous Product Safety Assessment analyses, frequent contacts with outside parties, and other sources of information. Therefore, the recommendations section is based upon the total ES experience and not the Calspan reports considered in a vacuum.

The Calspan Work

Over the past seven years, the CPSC has contracted with Calspan Corporation on a number of occasions to study issues related to

flame-fired equipment. Most of the effort has centered on gas-fired equipment and accessories. This series of contracts has resulted in seven reports, abstracted below.

Not only have these reports served to form a basis of knowledge on which the staff has built some of its subsequent efforts, they also have been widely disseminated and considered within the industry. For example, the most recent report (number seven, below) was copied by ANSI and included in its mailings to members of various subcommittees of the Z21 Committee on Performance and Installation of Gas Burning Appliances and Related Accessories. The Subcommittee for Gas-Fired Steam and Hot Water Boilers requested that the Gas Appliance Manufacturers Association (GAMA) review the report for recommendations and return any recommendations to the appropriate Z21 appliance subcommittees.

In July 1974 the CPSC contracted with Calspan Corp. for an investigation of safety standards for flame-fired ranges, furnaces, water heaters, and dryers. At the time, these appliances were ranked 17th, 38th, 39th, and 122nd, respectively, on the Consumer Product Hazard Index. The first four documents listed below comprise the results of that contract.

1. "Classification Information for Residential Flame-Fired Furnaces, Hot Water Heaters, Clothes Dryers and Ranges, September 1974.

This report classifies the appliances named in its title according to type, size, fuel, installation and other pertinent factors. Also included are a glossary of terms in common use in the industry, a list of manufacturers and private labelers of the appliances listed in the report, and marketing statistics for the years 1963-1972. As a preliminary report, it draws no conclusions.

2. "Identification and Classification of Potential Hazards Associated with the Use of Residential Flame-Fired Furnaces, Hot Water Heaters, Clothes Dryers and Ranges," February 1975.

Using accident and injury information supplied by the Commission, Calspan identified hazards associated with each individual type of appliance and listed the probable failure modes that cause the appliance to present the particular hazards. Typical failure modes identified involved such things as inadequate design, use of improper fuel, inadequate installation, improper operation, deterioration with age, and poor maintenance practices.

3. "Investigation of Safety Standards for Flame-Fired Furnaces, Hot Water Heaters, Clothes Dryers and Ranges," July 1975.

This report was intended to conclude the study. It is a study determining the existence, applicability, adequacy, and effectiveness of safety standards covering the design, construction, installation, operation

and maintenance of the appliance. The report included recommendations for improvement. A number of shortcomings were identified, but none was so serious that Calspan felt that a specific standard could be considered to be without merit. Key recommendations related to flammable vapor ignition, carbon monoxide development, surface temperature limitations, primary operating and safety control functioning, and quality assurance. Recommendations for further work involved determining the economic impact of implementing some of the recommendations, development of a program addressing the quality assurance shortcomings, and additional study of requirements relating to surface temperature and combustion performance.

4. "Investigation of Safety Standards for Flame-Fired Space Heaters," February 1976.

In August 1975 the contract that produced the three reports listed above was modified to include residential space heating equipment. This report results from that modification and supplements the other three reports, which did not deal with residential space heating equipment. In many respects, the presentation and findings of this report tracked those of the first three. Key hazards identified were burns from direct exposure to flame, or from intermediate ignition of such items as fabric, structure or flammable liquids, burns from contact wih hot surfaces, and exposure to carbon monoxide. The type and degree of hazard associated with space heating equipment was found to depend greatly on the design of the particular heater and the type of fuel used. The most pervasive weaknesses in the standards examined were said to be lack of effective limitations on surface temperatures and insufficient consideration of quality assurance.

The following reports are the products of separate studies that Calspan conducted for the Commission after completion of the 1974 contract. Each report represents a separate study.

5. "Safety Investigation of Gas Appliance Energy Saving Devices and Automatic Vent Dampers for Oil Furnaces," October 1977.

This report deals with analytic and experimental investigations Calspan conducted of the safety of various specific energy saving devices for use with gas-fired appliances. The specific energy saving devices studies were automatic vent dampers, flue gas heat extractors, an extended draft hood, a commercial dryer exhaust recirculator, residential dryer exhaust diverters, a water heater insulation kit, and alternative ignition systems. Because of the interest in automatic vent dampers, the study also included vent dampers intended for use with oil-fired furnaces. Devices from 25 manufacturers were investigated; some manufacturers supplied more than one model. Only safety was specifically investigated, not energy-saving potential or reliability problems unrelated to safety. Although some of the devices were found to meet criteria of reasonable levels of safety, Calspan found that a number of devices ". . . were found to have safety deficiencies at various levels ranging up to those indicating imminent risk of life to the user."

6. "Investigation of Safety Standards for Energy Saving Devices for Gas-Fired Appliances," March 1978.

Report number 5, above, investigated energy saving devices. This report dealt with proposed standards relating to the devices.

Proposed revisions to the National Fuel Gas Code (ANSI Z223.1, NFPA No. 54) were examined, including procedures for a safety inspection of an existing appliance installation prior to modification, for field derating, for area reduction of a vent connector, and for installing electrically operated automatic vent damper devices. Calspan found that a major deficiency of this standard was the lack of adequate assurance that the installer is qualified to perform the modification. (This was said to arise from the fact that there is no nationally recognized method by which competence of installers can be judged: no national certification program, no nationally recognized training courses, and no national accrediting agency.) Also lacking were procedures for determining adequate venting capability, particularly in respect to the effects of changes in outside temperature and wind conditions.

The automatic vent damper standards were found to be deficient in several respects. First was the lack of quality assurance provisions that provide an adequate statistical foundation for sampling and testing, and lack of a requirement for a failure modes and effects analysis. In addition, the standards allowed the manufacturer to require the installer to supply separately certain auxiliary components necessary for a safe installation. The standards also were found to lack requirements for accommodating the rather wide range of vent temperatures that may be experienced in the field.

The standard covering alternative ignition systems was found to be deficient primarily because the general level of quality of ignition equipment then on the market was thought to be substantially higher than was required by the standard. Therefore, some upgrading of the standard was indicated. Also, some tests were inadequately specified, so that there would not be sufficient assurance that the test results would in fact reflect the stated intent of the test.

7. "Safety Devices for Gas-Fired Appliances," May 1980.

The purpose of this study was to determine the feasibility of additional safety devices for home heating systems to reduce or eliminate the carbon monoxide hazard. The possible presence of energy conservation devices was considered. Calspan was to identify possible devices that would detect the failure of flue gases to vent properly and would shut down the appliance. The devices were to be evaluated as to their safety improvement potential, practicability, and the potential problems that would be encountered in use.

The study was confined to acute carbon monoxide hazards. Primary emphasis was on methods that were available at relatively low cost or could be projected to be of low cost if implemented on a wide scale.

The study concluded that techniques exist that would appear to meet tests of reasonableness of cost and effectiveness. At the time of the study, thermal "spill" switches were said to be the most likely candidates. (These are devices that detect elevated temperatures carried by flue products leaving the draft hood through the relief opening into the surroundings of the appliance.) Other techniques were promising for the future.

Individual Issues

Below are brief discussions of individual issues relating to the safety of gas-fired appliances and accessories. Because significant staff resources would be needed for the issues to be fully developed, in many cases that task has not been accomplished. It is anticipated that such issue-development would be among the first accomplishments within each particular topic approved for further work. Issue development would proceed through working level meetings within the Commission and with appropriate outside parties. That would be followed by engineering hazard analysis.

It is emphasized that the list of issues presented below is not a definitive list of topics that may need the attention of the Commission. It is common for unanticipated items to arise during the course of a typical year. However, the items presented, each for its own reason, are thought to be among the reasonable ones on which to concentrate Commission resources in the area of gas-fired appliances.

Carbon Monoxide

Carbon monoxide poisoning is one of the most pervasive injuries associated with gas-fired equipment. It is most commonly associated with furnaces and space heating equipment. In many cases, the responsibility for avoiding carbon monoxide poisoning rests primarily on someone other than the manufacturer of the appliance. Among the most common causes of carbon monoxide poisoning appear to be improperly installed vents and lack of inspection and maintenance of the equipment on a regular basis.

A major I&E campaign with one thought at its focus--that consumers should have their heating equipment inspected and adjusted by a trained individual on a regular basis (preferably annually)--should be one of the more effective actions the Commission can take to reduce CO poisonings. A reading of the in-depth investigations and similar material from the CO files will convince one that an unduly large proportion of CO poisonings involve people who simply do not comprehend the danger of poor installation and maintenance practices or who may never have thought to have their equipment inspected and serviced.

Apart from consumer information and education, the Commission can proceed with hardware-related solutions in a proper case. An example is the mandatory standard for gas-fired space heaters, which will require the use of an oxygen depletion safety shut-off sensor on unvented gas-fired space heaters.

Another example of Commission interest in hardware-related solutions was a study conducted in 1979 for the Commission at the National Bureau of Standards (NBS). Being aware of the frequency with which CO poisoning occurs, the Commission asked NBS to examine the current technology of CO detection, prepare a feasibility study for developing a low cost residential CO detector, and prepare a sample development plan. Development of such a low cost residential CO detector would provide protection from CO poisoning roughly equilavent to the protection from fire currently provided by smoke detectors. Among the conclusions reached by NBS in January 1980 were that currently available CO detectors did not meet the requirements for a low cost residential detector. However, NBS also noted that CO detector research and development was an active field, and the prospects for developing a low cost residential detector within a few years were good. NBS recommended that a continuous effort to monitor progress in the development of low cost residential CO detectors should be undertaken, and the feasibility should be re-evaluated on a yearly basis. Because of the then-lack of feasibility, the remainder of the project was not completed.

As of this writing, the enhancement level of the FY '82 budget contains a project that would repeat the NBS work of 1979 and, if early results are encouraging, to continue the work to completion.

Beyond this initial study, the role of the CPSC is undefined. The Commission could tell industry that it will encourage the development of low cost residential CO detectors if the technology proves out. What form the encouragement would take is not clear. It is suggested that merely proving that the development of such a device is feasible may be a sufficient contribution.

Flexible Connectors

Flexible connectors are used to connect gas-fired appliances with the building gas supply. Used principally with kitchen appliances, they proved a boon to installers and servicers who previously had to make a difficult hard-pipe-to-hard-pipe connection in relatively inaccessible spaces such as that behind a stove. Flexible connectors allow the servicer to connect the stove while it is away from the wall. After checking the connection for leaks the servicer can then push the stove back against the wall.

Flexible connectors are made of solid corrugated brass. It is known that they have a potential for cracking and leaking. Because such leaks occur in the gas supply to the appliance itself, they can be large and therefore quite hazardous.

The potential for leaks occurs in two principal ways. The first involves simple fatigue failure associated with repeated flexing of the

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metal connector back and forth as the appliance is serviced over a period of time. In the worst case, the final bending--the one that causes the crack--can occur after the appliance is serviced as it is being pushed back into its usual position. In such a case the leak might readily go undetected by the servicer.

The second principal way in which a serious leak can occur in a flexible connector involves what commonly is called "season cracking." A crack in a connector can occur through season cracking without the connector's having been flexed during the life of the appliance. Season cracking occurs through the action of certain household chemicals (such as ammonia) on the brass connector. Wherever the connector has been bent since its manufacture, there will remain residual stresses. Because of the existence of these stresses, the stressed portions of the connector are vulnerable to chemical attack and subsequent corrosion.

One attempted solution has been to coat flexible connectors with a plastic-like paint to protect them from chemical attack. Not only will this not protect against fatigue cracking through ordinary bending, but it also may not be effective against season cracking. The staff has possession of a coated flexible connector that was involved in an explosion. This connector has a large crack that appears to have evolved through season cracking.

The ideal solution would appear to be the identification and use of more suitable materials that are not greatly subject to aging, fatigue failure, or chemical attack.

Staff has discussed these problems with NBS and has identified an approach to the initial part of an investigation: the engineering hazard analysis designed to demonstrate scientifically whether brass connectors can be made safer, whether coatings in current use are adequate, and whether more suitable coatings can be found.

If the above analysis were conducted, and it demonstrated that new materials are needed, the ANSI Z21 Subcommittee on Standards for Connectors for Gas Appliances could be approached. Because this Subcommittee has the reputation of being intransigent, it is believed that a persuasive case must be developed during an engineering hazard analysis in order to persuade the Subcommittee and others to search for alternative materials or alternative solutions.

Recommendation: Conduct an engineering hazard analysis in-house and at NBS. Depending upon the result of the analysis, the appropriate ANSI Z21 subcommittee can be asked to address the problem.

Combination Controls for Gas Appliances

A combination control for a gas-fired appliance is a single "box" and is the device with which the user interacts in lighting the appliance

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and sometimes in operating it. Combination controls serve a number of functions. For example, in the case of a water heater a typical combination control will contain the following devices and functions:

- knob for pilot, off and on settings
- gas cock
- thermostat
- main gas valve controlled by thermostat
- pressure regulator
- temperature control
- pilot safety shutoff device (also called a power unit)
- pilot gas filter
- high temperature safety shutoff switch

The Commission has seen many cases of fires and explosions in which combination controls were implicated. Several investigations have been conducted of such devices in connection with the Product Safety Assessment function, among them the [redacted] cases.

Because the Commission has not had to litigate any cases with respect to combination controls, it has not been necessary to prove the nature of the defects with these units. However, circumstantial evidence is strong that the incidents frequently are associated with a failure of the pilot safety shutoff system, followed by a user's misuse of the control. Rather than have the defect repaired, the user overrides a safety function to make the appliance work. Some combination controls cannot be defeated in this manner; in such cases the user must have a repair made before the control may be used. Other controls appear to be easy to defeat. Therefore, the Commission knows of at least some ways in which the hazard that has appeared in the past may be minimized by adopting a design that a user cannot override.

It is not certain whether the failure of the pilot safety shutoff system that seems to initiate the incidents in question is a failure that can eventually be expected in every control or whether such failure are caused by isolated defects. The evidence is that such failures can be expected in most units. If that is true, it appears that some consumers handle the situation well by obtaining simple repair work. Others react by trying to use the control as it was not intended to be used and create hazardous situations. The point to be made in these cases is that the failure of the pilot safety shutoff device (power unit) may be foreseeable and, in such a case, the design of certain of the combination controls contributes to the hazard by allowing the user to engage in a foreseeable and dangerous practice.

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In addition to hazards that result directly or indirectly from failure of the pilot safety shut-off system, the Commission has seen evidence of gas leaks from controls, usually in the area of the gas cock and control knob. According to the Division of Corrective Action, there have been rumors of additional leaks. Whether such leaks are common is not known at this time.

One possible approach to diminishing hazards associated with combination controls would involve generally educating consumers about the hazards that can result from using the controls in ways they are not intended to be used. Because only a careless consumer is likely to misuse his control in the ways that the Commission has seen, information and education may not be a practical approach in this case.

A voluntary standards approach may be especially fruitful in this situation. The two major manufacturers of controls for water heaters have instituted design changes that make it difficult or impossible for a consumer to defeat the safety function. (One of these modifications is known to accomplish this result; the other probably does also). Building upon this beginning, it may be possible to persuade any remaining manufacturers of inadequate controls to join in a collective effort to improve the designs and the standard requirements.

Recommendation: That the CPSC define and implement a plan of engineering hazard analysis to define clearly the extent and nature of the problem. Then, either working level meetings could be held with industry or the appropriate ANSI subcommittees could be approached. Because of the serious nature of the hazard posed, combination controls might prove to be a candidate for a mandatory standard if the voluntary approach fails, and if the engineering hazard analysis supports the need.

Portable Heaters

Historically, portable space heaters have not enjoyed a large market in the United States. This may be due in part to state and local fire codes, which frequently permit their use outside of residential situations but not in residences. Nevertheless, as a practical matter the states cannot control the use of a portable heater after it is sold.

There has been growing evidence that the market for portable unvented gas-fired and unvented kerosene heaters may be increasing. They have been in evidence in trade shows, and television advertising has shown portable heaters being used in the home. The number of inquiries at the Commission seems to have increased noticeably.

In considering portable heaters, it would seem that the Commission should deal both with the gas-fired heaters (called cabinet heaters) and the portable kerosene heaters since consumers may not differentiate

between them, and both appear to share at least one significant potential hazard, namely fire hazard. In addition it may not be equitable to the manufacturers of one kind of heater to deal with hazards posed by the product and fail to deal with the hazards of the competition when both products may present a potential for injury or death.1/

Some individuals and organizations with connections to the industry have raised concerns relating to the safety of cabinet heaters. The American Gas Association (AGA) is concerned that both cabinet and kerosene types may present hazards, each type having its own special problems. AGA is pressing its concern with Commission staff.

The National LP-GAS Association has established a task force to study the European experience with these heaters and to identify any problems that they may feel must be solved before the heaters could be safely used in residences in this country. Represented on this task force are the National Fire Protection Association, the American Gas Association, Underwriters Laboratories, the Gas Appliance Manufacturers Association and other interested parties.

In anticipation that the use of portable heaters would become an issue for some level of Commission consideration, Engineering has written letters to the organizations named in the paragraph above soliciting information on the safety aspects of using cabinet heaters in residences.

Among the issues that have been raised and for which the staff does not now have definitive answers are:

1. Use of liquid and gaseous fuels in a residence in quantities sufficient to power portable heaters may constitute an unacceptable hazard from the mere presence of the fuel.

2. One or both types of heater may contribute significantly to indoor air pollution. In particular, it has been claimed that sulphrous fumes from kerosene heaters may lead to the production of acid mists in the home.

3. It appears that the low sulfur fuel that should be used in kerosene heaters may not be readily available in most parts of the country.

4. There appears to be a lack of control over the size of the gas bottle that can be used with cabinet heaters. Although most of these heaters have a space inside the cabinet to accept a bottle of gas, there may be nothing to prevent the user from using a hose to connect a very large external bottle to the cabinet.

1/ There is a class of non-portable kerosene heater that also is known as a cabinet heater. Although such heaters are not within the scope of the title "portable heaters," if this project is accomplished some consideration should be given to whether the kerosene cabinet heaters should be included.

5. There is a general question concerning the relative hazards of handling and using liquid and gaseous fuels in residences.

6. It has been alleged that an unvented kerosene heater presents the same hazard from carbon monoxide poisoning that is presented by an unvented gas-fired heater. Others have said that such is not the case due to kerosene's tendency to self-extinguish as oxygen concentrations drop.

7. If an LP-gas bottle is refilled outdoors during the winter months and brought indoors, there may be a hazard that, when the bottle warms up, gas will escape through a pressure relief device and pool in the residence.

Recommendation: It is recommended that the staff investigate these questions and others that may arise, monitor the proceedings of the task force sponsored by the National LP-Gas Association, and gather available information from the states on their experience with portable heaters. Recommendations for further Commission action would be made at a later date and would be governed by the results of the investigation. However, in the interim certain specific suggestions may be made to voluntary standards groups as the need for changes may become evident.

Gas Detectors

Risks from fire and explosion may be addressed through improvements in gas-handling hardware, such as that suggested above by the work involving combination controls. An additional approach might be to detect directly any accumulations of gas in the areas in which gas-fired appliances are being used. This approach might be taken either in conjunction with hardware improvements or as an alternative to a hardware-based approach.

A low cost residential gas detector could help to minimize the dangers from accumulation of gas. Today, some devices are known that can detect the presence of combustible gases and vapors. However, many of them also react to other household compounds such as ammonia.2/

A project similar to the one described above for carbon monoxide detectors could be undertaken for detection devices for natural and LP gas. In a manner paralleling the CO detector investigation, NBS could investigate the technology of such detectors and make recommendations to the Commission.

This Gas Detectors project could be conducted in combination with the CO Detectors project or as a separate item.

2/ It is worth noting that, because of the tendency of LP gas to settle and pool, it presents a more serious fire and explosion hazard than does natural gas. This tendency should make it easier to detect by providing a higher concentration than one would find with natural gas, which tends to disperse.

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