2. Number of flexible metal connectors in use - projected on a National basis:

	30,338,264
on Ranges	18,457,780
on other appliances	11,880,464

3. Number of flexible metal connectors replaced by reporting utilities due to failure: (estimated)

during 1971	8,119
1970	6,580
1969	5,811
1968	4,318
4 yr. total	24,728

4. Number of flexible metal connectors replaced due to failure - projected on a National basis:

during 1971	31,406
1970	25,453
1969	22,478
1968	16,703
4 yr. total	96,040

5. Average percentage of replacements:

Range connectors	78%
other	22%

6. Indicator that replacement was necessary:

odor complaint	89%
fire	4%
other	7%

7. Cause for replacement:

crack in corrugation	53%
crack at end	12%
bad flare	4%
proper adapter not used	15%
other	17%

It should be pointed out that most of the data shown is based on utility company estimates. The four year failure rate (Total 4 year failures ÷ by estimated number of connectors) of 0.3 percent is a minimum figure since several utilities indicated that commercial service organizations as well as the individual user replace an unknown number of connectors.

One utility (of 999,559 meters, with an estimated 483,000 connectors on their lines) forwarded statistical information from a controlled sampling effort covering a 30 day period; shown below are the results of this project.

Defective Range Connectors Received	43
Number of Work Days During Survey Period	30
Range Connectors Defective Per Day	1.43

Summary of Field Failure Reports

A total of 318 Field Failure Reports on Flexible Metal Connectors and 288 failed connectors were forwarded to the Laboratories by participating utilities. Shown below in Table II is the summarization of the data contained in these reports.

TABLE II

SUMMARY OF
FIELD FAILURE REPORT
FLEXIBLE METAL CONNECTORS

1. Reason for removal:
   a. crack in corrugation: 192
   b. crack or separation at end: 96
   c. bad flare: 8
   d. proper adapter not used: 21
2. Condition under which evidence of defect was noted:
   a. gas odor: 241
   b. broke when shifting appliance: 41
   c. utility turn on or leak check: 20
   d. fire: 16
3. Was connector properly installed:
   a. yes: 298
   b. no: 14
   c. not answered: 6
4. Was there evidence of physical abuse of connector:
   a. yes: 14
   b. no: 298
   c. not answered: 6

5. Did homeowner habitually move appliance with connector attached:

   a. yes: 30
   b. no: 282
   c. not answered: 6

6. Length of time connector was installed. (Note: Since this was not answered on many of the survey forms, actual date code information has been used.)

1972 date	= 2
1971 "	= 10
1970 "	= 8
1969 "	= 15
1968 "	= 16
1967 - 1965 "	= 14 per year avg.
1964 - 1960 "	= 5 per year avg.
1960 and older with no date code	= 195*

* A large number of this group are end fitting solder failures and separations.

Most reports indicated that the sample was forwarded as it was found in the field.

A previous field survey conducted in 1966 and discussed at the December 15, 1966 Connector Subcommittee meeting, indicated that connector failure from external corrosion was at that time a major problem. Results of the current survey would indicate that this is still true.

Metallurgical Examinations

Several of the failed samples were examined by Prof. Edward Trela, Associate Professor of Metallurgical Engineering at Cleveland State University. A report of his examination is attached. Prof. Trela also visually examined several batches of connectors with members of the Laboratories' staff in an effort to acquaint staff with visual appearance of failure mode characteristics.

In an effort to determine the major cause of failure on the samples received, Laboratories' staff examined each sample to classify failure modes.

Table III below details the results of their examination.

TABLE III

VISUAL EXAMINATION OF FAILED
CONNECTORS FOR FAILURE MODE

Failure Type	Number of Failures
Stress Corrosion (Many showed deposits of external chemical corrosion)	149
End Fitting Solder Failure	79
Mechanical Failure Due To Abuse	39
Bad Flare	8
Hole Due To Electrical Short	7
Visual Material Fault	6

Information received from other utilities, manufacturers, and the LPG industry follow in general the data shown above.

Conclusions

It can be concluded from the statistical information received, the results of the consultants metallurgical examination, and the sample examination that:

1. Connector field failure on a percentage basis is on the minimum estimated order of 0.3 percent, but in all probability not more than approximately 0.5 percent.

2. Most failures occur on connectors used with cooking appliances and appear to be the result of stress corrosion accelerated by external exposure to ammonia rather than physical abuse or repeated flexing. No geographic influence was noted for this failure mode.

3. Metallurgical examination indicates that the stresses induced by handling and installation after manufacture are of low magnitude compared to the yield stress of the material. Connectors examined showed signs of proper annealing during manufacture.

4. Conduct of the Season Cracking Test after the conduct of the Bending Test may not be the solution to the field stress corrosion problem as this test applies to stress levels beyond those thought to be typical.

5. Solder joint failure of multiple piece connectors is also a problem of definite concern.

6. End fitting solder joint failure or separation, proved a definite geographical failure mode. Seventy of the 79 failures of this type were from the west coast.

7. Connector age was not demonstrated to be a major factor in the stress corrosion failure problem.

8. Sporadic reports of holes due to electrical arcs were received.

Recommendations

Based on the above conclusions it is recommended that the standard be revised to require that:

1. All single wall flexible metal connectors of copper based alloy materials be provided with a non-metallic external coating and shall comply with Section 4.10 (Protectively Covered Connectors) of the current standard.

2. Single wall connectors of non-copper alloy materials shall also comply with the provisions of Section 4.10.

3. All flexible metal connectors be of one piece construction.

It is further recommended that the Season Cracking Test as currently specified in Section 4.5 be retained.

Adoption of the above revisions should minimize connector field failure by providing protection against external corrosive materials, limiting excessive flexure and torsion of the installed connector, and reducing the probability for damage by electrical arcs.

S. L. BLACHMAN

Attachment

October 2, 1972

REPORT

FAILURE ANALYSIS OF FLEXIBLE GAS CONNECTORS

(American Gas Association)

By

Edward Trela
Associate Professor of Metallurgical Engineering

Fenn College of Engineering
The Cleveland State University

This report has been prepared to summarize my findings concerning the failures of brass flexible gas connectors.

The following information and connectors were submitted for examination:

Utility	Connector No.	Make	Material *
A (Midwest)	4	T	70/30 Cartridge Brass
A (Midwest)	3	U	70/30 Cartridge Brass
B (Northeast)	30	V	70/30 Cartridge Brass
B (Northeast	9	U	70/30 Cartridge Brass
B (Northeast)	6	W	Admiralty Brass
B (Northeast)	8	V	Admiralty Brass
B (Northeast)	7	V	70/30 Cartridge Brass
C (West Coast)	28	X	70/30 Admiralty Brass
C (West Coast)	37	X	70/30 Cartridge Brass
C (West Coast)	99	Y	70/30 Cartridge Brass
C (West Coast)	31	X	70/30 Cartridge Brass
C (West Coast)	56	Z	70/30 Cartridge Brass

All of these connectors showed evidence of corrosion cracks.

*Material type based on chemical analysis performed by Cleveland State University.

The following investigative procedures were undertaken:

(1) Chemical analysis to identify alloy

(2) Macroscopic and microscopic examination of subject part to classify type of failure

(3) X-Ray diffraction analysis of corrodents

(4) Evaluation of findings and recommendations:

TABLE I

Sample No.	Grain Size, mm.	Corrosion Product (Ammonia)
3	0.100/.110	Trace
4	0.045	Trace
6	0.045/.050	Trace
9	0.035/.040	Trace
30	0.090/.100	Trace
56	0.100/.110	Trace
8	0.045	Trace
28	0.090	Trace
99	0.110/.120	None (High Sulfates)
31	0.075	Trace
7	0.090	None
37	0.150	Trace

X-Ray diffraction studies of the greenish corrosion product identified:

Cu $(NH_3)_4 \cdot CO_3$ and 4 Z_{NO} $CO_2 \cdot 4H_{20}$ with some complex sulphates.

The microscopic examination of the fracture indicated intergranular failure. Sections through various tubings exhibited a clean uncorroded inside surface, indicating that the corrosion environment was exterior.

The micro section conducted on samples 3, 4, 5a, 5, and 9 exhibited classic examples of stress corrosion cracking. The shape of the matrix grains indicate that the material was originally in the annealed condition.

Briefly the evidence so far indicates that the corrodent in all cases is most assuredly ammonia and the stress arises from what the flexible tube is subject to during installation and use. The corroded areas appear to be the result of splashing or spilling of possibly household cleaners containing large amounts of ammonia.

Discussion:

Stress corrosion failure which is typical of 70/30 brasses is caused by the simultaneous presence of tensile stresses and specific corrodent or environment - ammonia - air - carbon dioxide. The stresses have to be tensile, compressive stress rarely incubate stress corrosion failure. The standard method of Mercurous Nitrate test is an accelerated test for the purpose of detecting the presence of residual (internal) stresses that might bring about failure of the material. However, this test really applies to high stress levels and the stresses that are causing the connector failures may be as low as about 10% of the yield stress.

The ammonia is generally considered to be the specific corrodent causing stress corrosion. Water vapor must be present - oxygen and carbon dioxide accelerate the cracking in brass exposed to amines in moist air.

The X-Ray diffraction results seemed to indicate the following reaction:

$$4\ Cu + 8\ NH_3 + O_2 + 2H_2 = 4\ Cu(NH_3) + 4OH$$

$$2\ Cu + NH_3 + O_2 + 2H_{20} = 2\ Cu\ (NH_3)_4 + 4OH$$

In order to eliminate the failure problem:

(1) Alloy could be changed to a red brass, namely 80 Cu, 20 zinc with low limits of phosphorus, arsenic and antimony.

(2) An electrolytic deposited tin would act as a barrier to amonnia agents.

(3) Non-metallic coatings would act as a protective coating and reduce the "kinking" which is the principal source of stress. Phenol lacquers have been used successfully as well as the new cross-linked polyethylene tubing.

Respectfully submitted,

Edward Trela

Edward Trela

UNITED STATES GOVERNMENT

Memorandum

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

TO : Ron Medford, Project Manager, OPM
Through: William W. Walton, AED, ES
Through: William H. King, Division Director, ESES

DATE: OCT 26 1983

FROM : Sidney H. Greenfeld, Technical Assistant, AED, ES

SUBJECT: Status Report on Flexible Connectors

Attached is a copy of the Status Report on Flexible Connectors as of September 30, 1983. I recommend that Epidemiology look at the NFIRS, NEISS and IDI accident information on flexible connectors and report prior to June, 1984, to provide an independent input of information to supplement that which AGA will provide.

Attachment

cc: W. Walton
W. King
J. Fandey
T. Cooper
D. Switzer

6(b) CLEARED: 6-28-84

✓ No Mfrs Identified

____ Excepted _____

____ Mfrs Notified

Comments Processed

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Gas Heating Systems Project

10497

Status Report on Flexible Metal Connectors for Gas Appliances

Sidney H. Greenfeld

Directorate for Engineering Sciences

October 1983

Executive Summary

There are over 130 million flexible metal connectors for gas appliances in use in the United States. These fail on occasion, mostly through small leaks, sometimes catastrophically. Because of a rash of failures resulting from stress corrosion (when exposed to ammonia vapors present occasionally in households) and end-fitting solder failures, the ANSI Z21.24 standard for these connectors was modified in 1973. Stress corrosion tests were introduced and the use of phosphorus in the solder components was prohibited.

Over the years since this modification, there have continued to be failures. However, the existing documentation is sparse and does not define the magnitude of the problem. Consequently, an activity was started with AGA to obtain information from its member companies as a basis for determining the nature and magnitude of the problem, if, indeed, one exists. Preliminary information from AGA indicates that most of the failures are in connectors made prior to 1973,* but some failures occur in the newer connectors. Additional information will be provided to the staff by AGA in April 1984, to form the basis for planning any actions that might be necessary.

* ANSI Standard Z21.24, Metal Connectors for Gas Appliances, was revised in 1973 to correct certain deficiences established by a survey in 1972.

Flexible Metal Connectors for Gas Appliances

Definition:

Because the term "flexible connector" is not what its name implies, a definition is provided, as follows: A flexible metal connector for gas appliances is defined as ". . . an appliance connector constructed entirely of new, unused parts and materials, consisting of corrugated tubing, depending on all-metal construction for gastightness, --- having fittings at both ends with taper pipe threads for connection to gas appliances and house piping." ANSI standard Z21.24-1981 covers connectors up to a nominal length of six feet. The connectors are used to connect appliances with house piping without the necessity for perfect alignment of the pipes to be connected, but are not meant for continual flexing, movement or vibrations. The ANSI Standard requires that the instructions provided with each conector mention that the connectors are ". . . not designed for movement after installation. . ."

Purpose:

Flexible metal connectors for gas appliances have been involved in a number of accidents, resulting in explosions and fires. The causes were traced to failures of soldered or brazed end-fittings and stress corrosion of the brass bodies of the connectors. Prior to 1973, end fittings frequently were brazed or soldered to connector bodies with either butted or lapped surfaces. Particularly with the butted surfaces, but to a lesser degree with the lapped surfaces, corrosion occurred in the joint and leaks developed. In production, brass tubing is deformed to provide a degree of flexibility to the tubing. The deformed tubing is normally annealed to relieve the residual stresses.

The flexible connectors can also be overstressed during installation or movement of the appliance to which they are connected in service. Residual stresses from either of these causes can result in accelerated corrosion in the presence of ammonia vapors, which vapors in the home are a consequence of the use of such common household products as floor waxes, floor cleaners, window cleaners and oven cleaners. Changes were made in the ANSI standard in 1973 to remedy these deficiencies. This activity is to determine how well the revisions served to correct the deficiencies and whether currently produced brass flexible connectors are still a significant safety problem. If the deficiencies have not been corrected, the ANSI standard will be modified further. If a serious problem still exists in connectors sold prior to the revision in the standard, a strategy will be developed to inform those consumers with the older connectors how to use them safely.

Discussion:

The Commission's interest in flexible metal connectors can be traced back to 1974, when it requested NBS to analyze a failed flexible brass connector. 1/ A chronology of the Commission's involvement with these connectors was included in a "Discussion Paper on Flexible Gas Connectors" issued in June 1982. 2/ This paper discussed, among other things, a recall of connectors that had been involved in accidents, which recall was accomplished through close cooperation with The Department of Housing and Urban Development, The American Gas Association and its member companies. These connectors failed at the brazed joint. The flexible connector issue was transferred from the Corrective Action Division to the Emerging Hazards Program in June, 1982, following this discussion paper, to assess the situation and

recommend what action should be taken.

The possible hazards associated with flexible metal connectors were assessed by the NPI team and the advisability of replacing them on a regular basis, such as every five years, was explored. 3/ Discussions were held with members of the gas industry. It was concluded in a memorandum to the Files on December 29, 1982, 4/ that there was "insufficient information or evidence of a hazard for NPI to recommend that a priority project --" be established. The subject was referred to the Fire/Burn Team, which, in turn, placed it in the Gas Heating Systems Project.

Under the Gas Heating Systems Project, it was decided to request additional information from AGA on the involvement of flexible metal connectors in accidents, with particular emphasis on connectors complying with the 1973 or later versions of the ANSI Z21.24 standard.

In response to a letter from the Executive Director to the President of AGA on May 17, 1983, 5/ certain general information was provided to the Commission on August 30, 1983. 6/ Because this information was insufficient to satisfy the staff's needs, a second request was sent to AGA. 7/ AGA will obtain the additional information through their Customer Service and Utilization Committee and report back to the Commission in April 1984.

The staff plans to continue to work with AGA to obtain the additional information required to determine the magnitudes of the problems with pre- and post- 1973 flexible metal connectors and whether any action is required by the Commission. A final report with recommendations will be made in June, 1984.

References:

1/ NBS Report - NBS R 75-669
Failure of Flexible Brass Appliance Connectors, February, 1975

2/ Discussion Paper on Flexible Gas Connectors, Product Safety Assessment Team, June 10, 1982

3/ NPI Product Review-Flexible Metal Connectors for Gas Appliances, December 29, 1982

4/ Metal Connectors for Gas Appliances, Z21.24

5/ Letter, Edgar Morgan, CPSC to George H. Lawrence, AGA, May 17, 1983

6/ Letter, Louis A. Sarkas, AGA to Edgar Morgan, CSPC, August 30, 1983

7/ Letter Sidney H. Greenfeld, CPSC, to Stanley L. Blachman, AGAL, September, 1983.

LOG OF MEETING

DIRECTORATE FOR ENGINEERING SCIENCES

SUBJECT: Visit to AGA Research House & Gas Connector Meetings

DATE OF MEETING: April 23-25, 1984 PLACE: Cleveland, Ohio

LOG ENTRY SOURCE: Sidney H. Greenfeld, ES SHG

DATE OF ENTRY: April 27, 1984

COMMISSION ATTENDEES: Sidney H. Greenfeld, ES

NON-COMMISSION ATTENDEES:

Members of ANSI Subcommittee on Connectors for Gas Appliances and Guests

6(b) CLEARED: 6-28-88
✓ No Mfrs Identified
Excepted
Mfrs Notified
Comments Processed

SUMMARY OF MEETING:

Research House

In connection with the Connector Subcommittee meetings on April 24 and 25, arrangements had been made to visit the AGA Research House on April 23. The Chairman and her Special Assistant, Allen Dunn, also visited the Research House. This House is a specially constructed, unique facility for studying the performance of gas appliances under real-life use conditions. Heat losses and air infiltration rates can be carefully controlled over wide ranges and the entire facility is intensively instrumented. This House is completely furnished to permit families of various sizes to live in it during the studies. This House will be dedicated on May 2, 1984.

Connector Subcommittee Meetings

The Connector Subcommittee members were informed that all substantive changes and modifications to standards, as well as new standards, will require rationale statements developed by the appropriate subcommittees and approved by a two thirds vote of the main Committee Z21.

The following standards were discussed and proposed revisions approved:

° Metal Connectors for Gas Appliances - Z21.24.

1.7a and 3.81a - add words --- "and the connector must not be concealed within or run through any wall, floor or partition".

1.7h, 1.8.1d, 3.8.1.h and 3.9.1h - Standard must be identified as ANSI Z21.24 either in the instructions or on the ring.

5.3e - add "e. Impact tests on fittings provided with both internal and external threads".

° Flexible Connectors of other than All-Metal Construction - Z21.45.

All the revisions to be made in the Standard for Metal Connectors were voted to be made in this standard.

The AGA staff will attempt to combine Z21.24 and Z21.45 for consideration of the Subcommittee and will include the wording from Z21.24 to limit the stress corrosion testing to copper base alloys.

° Connectors for Movable Gas Appliances Z21.69

2.11.2 - Deleted because it has been deleted in the other connector standards.

2.8 - Voted to reference "2.2 Test Procedure for Leakage" whenever leakage measurements are required in Z21.69.

1.4.5 - Voted to require a centering, or retention skirt, extending 18 inch into or over the tube whenever an end fitting is welded or brazed onto the tube and to restrict the phosphorus content of the welding or brazing to 0.05%.

1.7.2a - Voted to require that these connectors not be in or go through walls, floors or partitions.

1.7.2 and 1.8.1d - Voted to require a marking to identify this standard on connectors or in the instructions as Z21.69.

3.3e - Voted to include an impact test on end fittings with internal and external threads.

° Connectors for Portable Indoor Equipment - Z21.2

Voted to make the same changes in Z21.2 as made in the previously considered connector standards, where appropriate.

° Connectors for Portable Outdoor Gas Fired Appliances Z21.54

Voted as in Z21.2

° Outdoor Connectors For Manufactured (Mobile) Homes

Voted to modify the language throughout the proposed standard to be consistent with the Housing and Urban Development Standard on Manufactured Homes.

A large number of editorial changes were voted to be made in the proposed standard, primarily for clarification and for consistency with other standards.

° Marking for Removable Fittings

Because of the high probability of distorting the unions used on flexible connectors when stamping additional markings on them by the connector manufacturer, the subcommittee voted to require only the fitting manufacturer's markings, and these only on the central part of the three-part unions.

° Caution Against the Use of Metal Connectors with Gases Containing More Than 0.3 grams/100ft^3 of Hydrogen Sulfide.

No action was taken because this is a requirement of the National Fuel Gas Code, NFPA 54/ANSI Z223.1.

° Deletion of Semi-rigid Connectors from the Canadian Standard.

This type of connector is usually made of metal tubing on the job and none has been submitted for certification for many years. This type of connector will probably no longer be specified when Z21.24 and Z21.45 are combined.

° Electric Arcing with Coated Metal Connectors

Instances of electric arcing at coated metal connector connections were observed in several instance in which the flare was coated along with the outer walls of the connector when electric appliances were accidentally grounded to heating systems. It was decided that this is a quality control problem. Every manufacturer present agreed to tighten up on his quality control procedures and remove coatings on the flare ends. If this does not correct the situation, the subcommittee will consider developing a requirement.

° Mandrel Diameter for Ammonia Test.

The Committee voted to keep the requirement in the standards as is. A coiled connector was circulated as obtained in commerce with a 7/8" diameter bend in it (2½" in standard).

This deformation, occurring after the stress corrosion test, can produce residual stresses and make the connector susceptible to stress corrosion. The manufacturers present stated that they ship connectors in batches that are packaged straight, with no bends. Packaging concerns purchase these, coil them and pack connectors individually for sale. The manufacturers agreed to notify all their packaging customers to avoid making bends sharper than the 2½" mandrel used in the tests.

° Brazed Connectors

The only connectors with brazed end fittings being made are imported stainless steel connectors. Brazed or soldered brass connectors have not been produced for many years.

° Ban of Corrugated Metal Connectors

Massachusetts is considering banning brass corrugated connectors for gas appliances. Public hearings are scheduled for May 2.

cc: OS
R. Medford, OPM
B. Fees, CACA
T. Cooper, ESIS

UNITED STATES GOVERNMENT

Memorandum

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

TO: Ron Medford, Project Manager, EX-[illegible] 84

THRU: David Schmeltzer, AED CACA

THRU: David Thome, Director, CACA

FROM: Betty Fees, Senior Compliance Officer
Corrective Actions Divisions

DATE: 11 JUL 1984

SUBJECT: Flexible Gas Connectors

6(b) CLEARED: 6/29/84 RESTRICTED
X No Mfrs Identified
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____ Mfrs Notified
Comments Processed
MFR. ID Removed

RESTRICTION REMOVED
Available for Public Release
By: [illegible] Date 6-26-85

Background

This follows the meeting held in your office on 5/7/84 and your request that the writer provide a summary of the information collected in CACA on the above referenced product.

CACA has continued to monitor complaints and in-depth investigations, describing hazards, accruing to the use of flexible gas connectors for the purpose of identifing any defects which may be subject to possible Section 15 action. While there has not been any Section 15 cases, as a result of this monitoring largely due to the lack of information on the connectors as often they are no longer available or can not be identified, there is indisputable information that the hazard, though a subtle one, may result in fires and explosion incurring personal injury, death or property damage.

As related in our earlier referral of this product by memorandum dated 5/19/82 to Emerging Hazards, in March, 1982 CACA was engaged in the investigation of a report from Lt. Dan Couturier of the Fire Department for the city of Saginaw, Michigan, concerning 24 fire and 9 non fire incidents associated with faulty gas connectors for the years 1980 to 1981. Although there were no injury reports about occupants of the dwellings, there were unspecified injury reports involving fire fighters, a property loss of $78,219.92 and contents loss of $22,695.00. The age of the connectors were reported to vary from 5-16 years. The failure mode was described as a fracture of the corrugated ends of the connectors at the soldered joints and there were signs of corrosion from inside out. Eight (8) of the unidentified incident connectors were later examined by the staff who observed that the failure mode was a recognized problem exhibited by an earlier faulty connector identified as the [redacted] All but 2 of the 33 incident connectors were attached to gas ranges (2 - clothes dryers). It was estimated by Lt. Couturier that three quarters of the ruptures occurred at the gas line connections. This is a significant finding and may serve to dispel some of the common belief within the industry that failures generally occur when the appliance is moved by the user.

In December, 1983, the Dallas Regional Office alerted CACA of an impending In-Depth Investigation (ID No. 831129HCC3054) involving a non-injury fire incident in Denver related to a faulty flexible connector. Dallas was requested to expand this investigation with a follow up to the Denver Fire Department concerning other possible experiences associated with the use of flexible connectors.

The Denver Resident Post performed this investigation and in doing so accessed records in the records department, investigation department, and the fire prevention section in the Denver Fire Department. Records were examined for the years 1980 through 1983 which disclosed the following

incident data for leaking gas or fires related to the use and operation of flexible gas connectors:

YEAR	INCIDENTS
1980	138
1981	82
1982	99
1983	102 (1/2/83 - 12/25/83)
Total	421
Average	105 Annually

An examination of the 1983 Denver Fire Department field incident reports revealed:

1 Death - gas explosion
2 Severe Personal injuries (2 events - 1 explosion)
17 Property Damage Incidents

CPSC In-Depth Investigations extraneously gathered include:

1. IDI 80072BEP0002 - 1 Death - Fire and Explosion - Connector failed in the weld - Arizona

2. IDI 82122CEP3037 - 2 Deaths - Fire and Explosion - Colorado

3. IDI 821008BEP3006 - 1 Death - Fire and Explosion - Fire began where connector attaches to service gasoline - Oklahoma

4. IDI 831129HB62007 - 13 year old severly burned, house totally destroyed - [redacted] - Iowa

5. IDI 830907DAL5121 - Explosion - Extensive property damage - Connector broke at gas supply line - Texas

6. IDI 831209CBC3047 - Explosion - Property Damage - Believed that it failed near gas line - Montana

7. IDI 840402CBC3142 - Minor Burns - Adult - Extensive property damage - Mobile Home - Tennessee

8. IDI 830713CCC1257 - Explosion - Mobile Home destroyed - Gas Dryer Connector had small holes - Georgia

9. IDI 820811CAI0670 - Explosion - Gas Dryer - (4 year old) Connector manufactured by [redacted] Division of [redacted] a manufacturer of connectors, was referenced in the Doug Noble memo of 8/18/80 as a firm reported by James Shumaker, Public Service Co. (PSC), Colorado as 1 of 9 firms in a recent survey conducted by PSC considered to be

manufacturing potential defective connectors due to a common constructive feature with Cobra or having a tendency to corrode at an accelerated rate) - Illinois

Three (3) of the nine (9) incidents suggest failure of the connector at the gas supply line

10. FOIA Request No. S201011 - Severe Burns to Family - House Fire - Minnesota

Discussion and Recommendation

While we are enthusiastic that there are specifications pertaining to the construction and installation of flexible gas connectors contained in ANSI 221.24-1973, ANSI 221.24a - 1976 and ANSI 221.24b - 1979 published by the American Gas Association, CACA feels that this is not the sole remedy to the problem.

The flexible connector is an integral part of the over all gas hook up and assembly to gas appliances found in homes, mobile homes and apartments (connectors are also used in restaurants and other gas serviced facilities). The general public is essentially unaware of the employment of this device in their home. Further, they are unaware of the need for replacement of the connector which by the nature of the product has the capacity to fail through the aging process. The aging process can be accelerated by moving the appliance or through corrosion resulting from exposure to ammonia atmospheres.

CACA therefore recommends that there be a consumer awareness program which would include the participation of all gas servicing and supply systems in the country. Owners of all gas serviced dwellings should be informed of the need for periodic replacement of the connectors (5 years suggested) as well as the need for replacement when appliances are moved for servicing. Simultaneously, consumers could be warned against moving appliances for cleaning. For replacement purposes, connectors could easily display a manufacturer's logo and production date on the AGA ring which encircles the connector.

The Commission may coordinate activities with HUD by sharing information on mobile home incidents to seek cooperation by mobile home park operators for a programmed plan for replacement of connectors as mobile homes are moved in and out of the park site. Where local codes exist for connectors, have the local gas servicing facility inspect for assurance of safe hook up and disconnection.

Our data indicates that there still appears to be some percentage of Cobra connectors remaining in homes, apartments and mobile homes. Another Service Bulletin by AGA to all delegates of AGA member companies may be helpful citing some of the CPSC hazard data as a basis for their appeal for cooperation in locating the [redacted] or similarly constructed connectors which are simply accidents waiting to happen (IDI #8L0811CAC0670).

Connectors appear to have a long shelf life, therefore, it is not unlikely that many of the early designed connectors such as the [redacted] are still available in the chain of distribution and should be considered for voluntary recall by the manufacturer to assure themselves that only those complying connectors with the ANSI standard remain in the market place (this should also include the early uncoated units).

It seems advisable that restaurants and/or other related businesses might also be considered for survey by gas servicing suppliers to determine if they have a proper connector since gas appliances such as ranges are routinely moved for cleaning purposes.

Finally, as recommended earlier we would encourage industry and AGA to continue in their efforts to up grade the connectors considering alternate materials such as stainless steel as a substitute for brass.

In the past, the Commission has maintained a low profile in addressing this product, largely due to the absence of hazard data. Even though our data now appears somewhat limited the experiences as related by only 2 city fire departments in the country seems sufficient for us to realize that the connectors are going to come to an end of life cycle, and when this occurs, depending on the circumstances, may result in the most grave consquences.

Dan Cooper

U.S. CONSUMER PRODUCT SAFETY COMMISSION

WASHINGTON, D.C. 20207

22 SEP 1983

Mr. Stanley Blachman, Manager Advanced Technology
American Gas Association Laboratories
8501 E. Pleasant Valley Road
Cleveland, Ohio 44131

Dear Stan:

The Commission recently received a letter from Lou Sarkas summarizing the information he received in response to questions raised on Ed Morgan's letter of May 17, 1983 to George Lawrence. The information tended to be general in nature, as we expected, and indicated that flexible connectors made to the revised ANSI standard were performing reasonably well. However, the information provided demonstrated that we needed to probe more deeply.

Prior to receiving Lou's letter, he and I had discussed the nature of the replies coming in from the various gas companies and agreed that additional information would be needed. He suggested that I work directly with you to develop this information and keep him informed of our progress.

I have developed a series of questions which I feel might provide the detailed information needed to determine the magnitude of the problem. Let's discuss them after you have had time to look them over.

The first two questions relate to Lou's letter of August 26, 1983, and have to do with the basis for the answers in that letter:

- How many companies responded to your inquiry?
- Approximately how many flexible connectors in use do they represent?

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Comments Processed

The following questions relate to the experience of individual companies:

- How many flexible brass gas connectors do you estimate are in use within your jurisdiction?
- On what basis have you made your estimate?
- What proportion of connector failures do you estimate your company gets notified of? Do you get reports from plumbers who replace failed connectors?
- Do you have a policy of inspecting flexible connectors, such as when an appliance is replaced or when you are called in for service on other gas appliances or accessories?
- By what criteria is "the failed connector" determination made?
- Do you automatically replace flexible connectors that have not failed if they are obviously deformed or damaged?
- Do you encounter stainless steel as well as brass flexible connectors in residences?

- Please answer the following questions for each connector failure:

(a) What is the age of the connector at failure?

(b) What is the connector made of: brass, stainless steel, coated brass, lined brass, brass with soldered or brazed ends?

(c) What is the type of failure encountered?

(d) What circumstances resulted in the failure?

(e) What are the consequences of the failure?

(f) What is done with the failed connector?

- Under what circumstances do you recommend coated or lined connectors?

  (a) How well, in your estimation, does the coating or lining perform its function?

  (b) What type of failures do you encounter in lined connectors?

  (c) What type of failures do you encounter in coated connectors?

(d) In your opinion, does a cracked or perforated coating aggravate connector failures? Are the failures concentrated in the breaks in the coating?

(e) Is there evidence of adhesion failures of the coating?

(f) What is the age of each connector you have replaced?

(g) Have you retained the connectors that were replaced?

- What fraction of the failed connectors you have replaced was manufactured to the 1973 Amended ANSI Z21.24 standard?

- Are you encountering different types of failures in the post-73 connectors than in the earlier ones? If so, what are the differences?

- Do you encounter many leaks in rigid connections to gas appliances?

- Are modifications of the ANSI Z21.24 standard needed to make flexible connectors safer? If so, what should be done and why?

Sincerely,

Sidney H. Greenfeld

Sidney H. Greenfeld
Directorate for Engineering Sciences

cc: Ron Medford
Lou Sarkas
Larry Ingels

American Gas Association Laboratories

August 6, 1984

Mr. Sidney H. Greenfeld
U.S. Consumer Product Safety Commission
Washington D.C. 20207

Dear Sid:

Attached is a report on Appliance Connector Field Service History which summarizes the information received when I contacted representatives of the A.G.A. Customer Service and Utilization Committee seeking responses to a list of questions relative to appliance connectors which you and other members of CPSC Staff developed.

You will note that the last section of this report includes a number of suggestions for revisions to the appliance connector standard made by respondents from utility companies. These suggestions will be presented to the Subcommittee at their next meeting. Some of them I am sure you will recognize have either previously been considered, have been addressed, have been rejected, or are in process of implementation.

Although I sent copies of my April 3, 1984 letter in which the specific questions were included to members of the connector subcommittee, I have received no response other than from those utilities who are also on the Customer Service and Utilization Committee from that mailing.

If you have any questions, please feel free to contact me.

Best regards,

S. L. BLACHMAN
Manager
Advanced Technology

cc: R. Medford
F. G. Hammaker

Attch.

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REPORT OF APPLIANCE CONNECTOR FIELD SERVICE HISTORY

During April, 1984, individuals serving on the A.G.A. Customer Service and Utilization Committee as representatives of forty gas utility companies were requested to respond to a list of questions prepared by Sid Greenfeld of CPSC pertaining to flexible connector usage and service history. Of the 29 companies which responded, 24 were able to provide information, however, as expected, very little documented evidence exists, and the answers received are primarily opinions based upon experience.

The reporting utility companies represent approximately 16 million residential gas customers with an estimated 23 million flexible appliance connectors in use.

The information received suggests the following general conclusions:

- Most connector failures are reported to the gas company by customers who detect the odor of gas.

- Plumbers and other service agents almost never report leaky connectors to the gas company.

- Half of the reporting utilities have a policy of inspecting all connectors in a residence when making an entry call.

- The criteria for determining if a connector has failed is leakage or obvious physical damage.

- The large majority of failed connectors are uncoated brass types, many having soldered-on end pieces. (Three utilities indicated that failures of dual wall connectors also are encountered and four mentioned problems with coated types.)

- The typical age of a failed connector is 10-20 years.

- Most utilities either replace or advice replacement of a damaged connector, even if it is not leaking.

- The percentage of stainless connectors in residences is minimal (three companies reportedly now use them exclusively for replacement, however.)

- The predominant type of connector failure is stress corrosion cracking of the convuluted tubing, followed by corrosion of soldered ends. Other reported problems include the following:

  * mechanical failure of tubing caused by abuse such as kinking, twisting or stretching

  * cracking of tube flare, flare nut or end fitting, apparently due to overtightening

  * failure to use pipe adaptor (attaching flare nut directly to pipe thread)

  * loose flare connections

- Failures usually occur as appliances are being moved and the connector is subjected to bending, twisting or stretching. This has resulted in gas leaks and occasional fires.

- Failure to use proper pipe adaptors at the connections continues to be a problem which results in gas leaks (four of the reporting companies listed this as a problem).

- In nearly all instances, defective connectors are scrapped. (One utility representing about 400,000 customers and perhaps 200,000 connectors in use, retained 87 failed connectors as part of a study of such failures. According to the data submitted, the results of that study correlate with the conclusions of this survey.)

- The performance of coated brass connectors appears to be substantially better than uncoated brass types. They apparently experience the same types of failures as plain brass connectors, but to a lesser extent.

- Experience with lined connector designs is minimal and inconclusive.

- There is some indication that cracked coating can cause concentrated failures in the area of the breaks (Six companies stated this is a problem.)

- There have been some problems with lack of coating adhesion, especially with earlier coated connectors. (Six companies, including one of those mentioned in the preceeding paragraph, indicated this defect.)

- Connectors certified to the 1973 or later edition of Z21.24 appear to be subject to the same type of failures as earlier designs, but to a lesser extent. (Seven utilities reported "fewer cracks" or "less corrosion" in the post 1973 designs.)

Note: Three utilities indicated that they believe most recent connector failures involved those designed to the 1973 or later standard. The remaining 21 companies had no records or opinions on this point.

- Experience with leaks in rigid appliance piping and connections appears to be minimal with unions being the primary source of problems in this category.

Participating utility companies suggest the following revisions to ANSI Z21.24:

- Prohibit brass construction (1 utility)

- Prohibit brased or soldered construction (2 utilities)

- Require a shut-off valve as part of the connector (1 utility)

- Standardize flare connection design to prevent mismatch with pipe threads or with an improper adaptor (3 utilities)

- Add vibration tests (1 utility)

- Increase the severity of the strenth test for fittings (1 utility)

- Develop coverage for specific connector applications, such as mobile homes, commercial ranges, residential ranges, etc., since "many failures are a result of misapplication" (2 utilities)

- Change name to "alignment connector" since the term "flexible" suggests that frequent movement is permissable (1 utility)

UNITED STATES GOVERNMENT

Memorandum

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

TO : Ron Medford, OPM
Through: William H. King, Jr., Director, ESES

DATE: 22 AUG 1984

FROM : Sidney H. Greenfeld, ES

SUBJECT: Status Report on Flexible Metal Connectors for Gas Appliances for FY '84

Attached is a copy of the Status Report on Flexible Metal Connectors for Gas Appliances for FY '84.

Attachment

cc: William Walton, ES
Tom Cooper, ESES
Don Switzer, ESES
Betty Fees, CACA

6(b) CLEARED: 6-28-88
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Gas Heating Systems Project

10497

Status Report on Flexible Metal Connectors for Gas Appliances

Sidney H. Greenfeld

Directorate for Engineering Sciences

August 1984

Executive Summary

There are over 130 million flexible metal connectors for gas appliances in use in the United States. These fail on occasion, mostly through small leaks, sometimes catastrophically. Because of a rash of failures resulting from stress corrosion (when exposed to ammonia vapors present occasionally in households) and end-fitting solder failures, the ANSI Z21.24 standard for these connectors was modified in 1973. Stress corrosion tests were introduced and the use of phosphorus in the solder components was prohibited.

Over the years since this modification, there have continued to be failures. However, the existing documentation is sparse and does not define the magnitude of the problem. Consequently, AGA was requested to obtain information for CPSC to be used as a basis for determining the nature and magnitude of the problem, if, indeed, one exists. Preliminary information from AGA indicates that most of the failures are in connectors made prior to 1973,* but some failures occur in the newer connectors (correspondence attached). The failures are at the same type, but to a lesser extent; however, since most of the failures occur in connectors 10 to 20 years old, it is still too early to determine the effectiveness of the 1973 revisions to the standard.

CPSC is also involved in a program through the Flexible Connector Subcommittee to test flexible connectors that are being sold in a tightly coiled form to determine if sufficient stress is introduced by the coiling process to make them susceptible to stress corrosion.

*ANSI Standard Z21.24, Metal Connectors for Gas Appliances, was revised in 1973 to correct deficiencies established by a survey in 1972.

Flexible Metal Connectors for Gas Appliances

Definition:

Because the term "flexible connector"* is not what its name implies, a definition is provided, as follows: A flexible metal connector for gas appliances is defined as "... an appliance connector constructed entirely of new, unused parts and materials, consisting of corrugated tubing, depending on all-metal construction for gastightness, --- having fittings at both ends with taper pipe threads for connection to gas appliances and house piping." ANSI standard Z21.24-1981 covers connectors up to a nominal length of six feet. The connectors are used to connect appliances with house piping without the necessity for perfect alignment of the pipes to be connected, but are not meant for continual flexing, movement or vibrations. The ANSI Standard requires that the instructions provided with each connector mention that the connectors are "... not designed for movement after installation. . ."

Background and Purpose:

Flexible metal connectors for gas appliances have been involved in a number of accidents, resulting in explosions and fires. The causes were traced to failures of soldered or brazed end-fittings and stress corrosion of the brass bodies of the connectors. Prior to 1973, end-fittings frequently were brazed or soldered to connector bodies with

* AN effort is underway to change the name to "alignment connector."

either butted or lapped surfaces. Particularly with the butted surfaces, but to a lesser degree with the lapped surfaces, corrosion occurred in the joint and leaks developed. In production, brass tubing is deformed to provide a degree of flexibility to the tubing. The deformed tubing is normally annealed to relieve any residual stresses.

Flexible connectors can also be overstressed during installation or movement of the appliance to which they are connected in service. Residual stresses from either of these causes can result in accelerated corrosion in the presence of ammonia vapors, which may be present in the home as a result of the use of such common household products as floor waxes, floor cleaners, window cleaners and oven cleaners. Changes were made in the ANSI Standard in 1973* that were designed to remedy the problems of stress corrosion and brazed end-fitting failures. This activity is to determine how well the revisions served to correct these deficiencies and whether currently produced brass flexible connectors are still a significant safety problem. If the deficiencies have not been corrected, the ANSI standard will be modified further. If a serious problem exists in connectors sold prior to the revision in the standard, a strategy will be developed to inform those consumers with the older connectors of the potential hazard how to use them safely or to replace them.

*The changes included the introduction of a stress corrosion test and the prohibition of the use of solder or brazing materials with phosphorus in them.

Discussion:

The Commission's interest in flexible metal connectors can be traced back to 1974, when it requested NBS to analyze a failed flexible brass connector. 1/ A chronology of the Commission's involvement with these connectors was included in a "Discussion Paper on Flexible Gas Connectors" issued in June 1982. 2/ This paper discussed, among other things, a recall of connectors that had been involved in accidents. This recall was accomplished through close cooperation with The Department of Housing and Urban Development, The American Gas Association and its member companies. These connectors failed at the brazed joint. Following this discussion paper, the flexible connector issue was transferred from the Corrective Action Division to the Emerging Hazards Program in June, 1982, to assess the situation and recommend what action should be taken.

The possible hazards associated with flexible metal connectors were assessed by the New Product Identification (NPI) team and the advisability of replacing them on a regular basis, such as every five years, was explored. 3/ Discussions were held with members of the gas industry. It was concluded in a memorandum to the Files on December 29, 1982, 4/ that there was "insufficient information or evidence of a hazard for NPI to recommend that a priority project --" be established. The subject was referred to the Fire/Burn Team, which, in turn, placed it in the Gas Heating Systems Project.

Under the Gas Heating Systems Project, it was decided to request additional information from AGA on the involvement of flexible metal

connectors in accidents, with particular emphasis on connectors complying with the 1973 or later versions of the ANSI Z21.24 standard.

In response to a letter from the Executive Director to the President of AGA on May 17, 1983, 5/ certain general information was provided to the Commission on August 30, 1983. 6/ Because this information was insufficient to satisfy the staff's needs, a second request was sent to AGA. 7/ AGA planned to obtain the additional information through its Customer Service and Utilization Committee and an official request was made in April 1984.

The information was slow coming in and a follow up request had to be made by AGA. On August 6, 1984, a brief status report was sent to the Commission. Both the request to the members of the Customer Service and Utilization Committee membership and the status report are attached. 8/ Those reporting provided little documented information, but provided opinions based on many years of service.

Several of the preliminary generalizations in the report deserve emphasis:

"- The large majority of failed connectors are uncoated brass, many having soldered-on end pieces.

- The typical age of a failed connector is 10-20 years.

- Half of the reporting utilities have a policy of inspecting all connectors in a residence when making an entry call.

- Most utilities either replace or advise replacement of a damaged connector, even if it is not leaking.

- The predominant type of connector failure is stress corrosion cracking of the convoluted tubing, followed by corrosion of soldered ends.
- The performance of coated connectors appears to be substantially better than uncoated brass types. They apparently experience the same types of failure, but to a lesser extent.
- There is some indication that cracked coating can cause concentrated failures in the areas of breaks.
- Connectors certified to the 1973, or later, editions of Z21.24 appear to be subject to the same type of failures as earlier designs, but to a lesser extent.
- Experience with leaks in rigid appliance piping and connections appears to be minimal, with unions being the primary source of problems in this category."

A few other types of connector failure were experienced and a few suggestions for remedying the recurrent problems were made. From these preliminary generalizations, it would seem that most of the failures still involve the pre-1973 Standard connectors, and require 10-20 years to occur. Thus, the period of jeopardy of the post 1973 connectors is just being entered. Since the connectors manufactured to the revised ANSI Standard seem to be failing in the same failure modes as the earlier connectors, even though to a smaller extent, it would seem that additional requirements may have to be explored and developed.

Another report will be issued when replies have been received from more companies and the results can be analyzed in more detail. Information is also being collected by NLPGA from its member companies for the final report.

During the April 1984 meeting of the Flexible Connectors Subcommittee, it was reported that some packagers, not manufacturers, were tightly coiling connectors and packaging them in individual plastic envelopes for sale to individuals. The inner coil involved a bend radius significantly smaller than that required in the ammonia stress corrosion test in the ANSI Standard and this might introduce permanent stresses greater than those induced in that test. It was agreed that individual manufacturers would collect specimens of their connectors marketed in this manner and test them. The Commission staff is also collecting some connectors on the open market.

A suggested protocol was sent to the AGAL 9/ on June 18, 1984. This material was sent to the manufacturers of connectors by AGAL on June 28, 1984. 10/ A request to procure a number of connectors was sent to the Field on August 3, 1984. It is anticipated that the connectors will be purchased by the end of September and testing done during the first quarter of FY1985.

The staff plans to continue to work with AGA to obtain the additional information required to determine the magnitude of the problems with pre- and post- 1973 flexible metal connectors and whether any action is required by the Commission. A final report with recommendations will be made in the second quarter of FY1985.

References

1/ NBS Report - NBS R 75-669
Failure of Flexible Brass Appliance Connectors, February, 1975

2/ Discussion Paper on Flexible Gas Connectors, Product Safety Assessment Team, June 10, 1982

3/ NPI Product Review-Flexible Metal Connectors for Gas Appliances, December 29, 1982

4/ Metal Connectors for Gas Appliances, Z21.24

5/ Letter, Edgar Morgan, CPSC to George H. Lawrence, AGA, May 17, 1983

6/ Letter, Louis A. Sarkas, AGA to Edgar Morgan, CPSC, August 30, 1983

7/ Letter, Sidney H. Greenfeld, CPSC, to Stanley L. Blachman, AGAL, September, 1983

8/ Letter, Stanley Blachman, AGAL to individual members of the Customer Service and Utilization Committee, June 4, 1984, and Letter, Stanley Blachman, AGAL, to Sidney Greenfeld August 6, 1984 (Attached)

9/ Letter, Sidney Greenfeld to Stanley Blachman, June 18, 1984

10/ Letter, Stanley Blachman to manufacturers of appliance connectors of Corrugated Metal Tubing and Fittings, June 28, 1984

Present

UNITED STATES GOVERNMENT

Memorandum

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

TO : All Regional Offices
Through: Otto Hall, AED, Field Operations

DATE: DEC 12 1984

FROM : Arthur K. McDonald, Director, EPDS

SUBJECT: Field Data Collection Program for Flexible Gas Line Connectors

(b) CLEARED: 6-28-85
✓ No Mfrs Identified
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Background

The gas heating systems project has been selected as an FY 85 priority by the Commission. As part of this project, the household structures team has identified flexible gas line connectors as a hazard which needs to be studied further. Preliminary injury data analysis indicated that there were 36 in-depth investigations, 6 consumer complaints, and 107 fire service reports in CPSC files. This information and an analysis and summary of the data were included in an October 23, 1984 memo to OPM from EPHA (Attachment A). This information was subsequently included in a briefing package, sent to the Commission on December 3, 1984.

Attachment B to this memo provides additional background information, in the form of a summary of data provided by Saginaw, Michigan.

Discussions with the gas industry have resulted in a meeting being scheduled for January to consider revising the existing voluntary standard. In support of this activity, and in order to better define the scope and nature of the problem, the household structures team has determined that at least 75 new cases from several widely separated geographical locations, are needed for further analysis.

Resources

The Office of Program Management has approved the use of a total of 2.5 professional staff months of field time (0.5 per regional office) from the gas heating systems project, for the start up and liaison necessary to support this project. The MIS code for this activity is 10497.

Time spent conducting the investigations should be charged to the separate code for investigations. MIS-91165.

Cases selected for on-site investigation should be charged to category ID - BUNN311985.

Sources of Data

Each Regional Office should contact fire departments and gas utilities within its region to identify at least two communities which meet the following criteria:

1. Enough fires with flexible gas connectors that the Regional Office can get at least 15 cases from all of its participating sources between January 1, 1985 and May 31, 1985.

2. Willingness to call the Regional Office, when flexible connector-related incidents occur.

Description of Data Collection Activities

Regional Offices, using either existing relationships, new contacts or both, will contact fire departments and gas utilities within their regions. They will then select at least two communities which report fairly frequent incidents of gas leaks and/or fires attributed to flexible gas line connectors, and which are willing to participate in the activity. Participation will consist of notifying the Regional Office of incidents involving flexible gas connectors as they happen, so the Regional Office can select cases for on-site investigation.

The Regional Office will provide EPDS a list of all fire departments and gas utilities contacted. This list is described in the "Summary of Deliverables" section, Item #1.

In the process of establishing contact and discussing the activity with fire departments or gas utilities, ask if they have any computerized or tabulated incidents involving flexible gas connectors (See Attachment B). If so, please request them and send them to George Rutherford, EPDS. If they have copies of actual incident reports, that they are willing to send, request these also. We are not asking that the Regional Offices go through the records to extract cases, only that they be requested if the department or utility has them easily available. If there is a fee for providing this information, check in with EPDS, there may be some funds available to buy data.

Regional Offices should keep a record of all cases reported to them by the fire departments and gas utilities, and provide this list to EPDS (See "Summary of Deliverables" Item #2.)

From the cases reported to them, the regional offices will select cases for on-site investigations. A copy of the latest draft of the guideline for flexible gas connector investigations is at Attachment C to this memo.

In order to properly analyze the variables being considered, the Division of Hazard Analysis (EPHA) needs to receive a minimum of 75 completed on-site investigations (15 per Regional Office). At least half of these cases should be of actual fires, rather than incidents involving only a gas leak.

EPHA has already received extensive information from Saginaw, Michigan and Denver, Colorado. EPHA requests that no more than 5 investigations be selected from either of these cities.

Within these limitations, cases should be selected for follow-up as randomly as possible. Factors such as severity of the occurence or travel time involved can be considered, but please take care not to select cases based on things like material of the connector, age of the connector, and similar variables. These product-related variables will be analyzed quantitatively, and if cases are intentionally selected, e.g. because the connector was new, it would bias the data for the analysis.

Whenever possible, samples of failed connectors should be obtained and sent to the sample custodian, attention Bernard Schwartz, Engineering Laboratory.

Summary of Deliverables

1. List of all fire departments and gas utilities contacted, including:

   a. Size of each fire department or gas utility, expressed in either number of fires annually, for fire departments, or number of gas customers, for gas utilities.

   b. The source's estimate of how many flexible connector-related incidents they see annually.

   c. An indication of which of the sources contacted agreed to participate by reporting cases involving flexible gas line connectors when they happen.

2. A list of all cases reported to the Regional Office by the sources, including any product or incident information provided. This list should indicate which of the reported cases have been selected for on-site investigation.

3. Any retrospective tabulations (e.g. See Attachment B) or hard copies of actual reports, which the sources are willing to provide.

4. At least 15 on-site investigations, with as many samples as possible.

Minutes of Meeting

of

SUBCOMMITTEE ON STANDARDS FOR
CONNECTORS FOR GAS APPLIANCES

January 29, 1985

6(b) CLEARED: 6-28-88

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(Minutes of January 29, 1985 Meeting of Subcommittee on Standards for Connectors for Gas Appliances)

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