City and County of San Francisco

Department of Public Health

San Francisco General Hospital
Medical Center

Occupational Health Clinic
Bldg. 9, Rm. 109
25 June 1984

Peter L. Trask
735 Bishop St., #408
Honolulu, HA 96813

Dear Mr. Trask:

Thank you for your letter of April 30 regarding the work you are doing with flight attendants. Thank you also for the copy of your excellent article.

Our program at the Occupational Health Clinic is up to this time only supported financially by the Flight Attendant unions. The article in the IUFA newsletter gave the impression that we were associated with CAL-OSHA, which is unfortunately not the case. We are currently working with several groups of flight attendants on projects initiated and largely performed by their members:

(1) Flight attendant health survey, performed by the Association of Professional Flight Attendants to identify problems associated with potential cabin contaminants on DC-10's (Interim Report enclosed).

(2) Flight Attendant respiratory function study, performed by the IUFA, involving questionnaires and pre-flight, during flight, and post-flight breathing measurements. This study is nearing completion of the first phase.

We would be happy to support your efforts to form an organization to further the publicizing of the health problems associated with flight. Let us know how we can help you in this endeavor.

Sincerely yours,

James E. Cone, MD, MPH
Chief, Occupational Health Clinic

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Public Health

San Francisco General Hospital
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September 6, 1983

INTERIM REPORT #1
Association of Professional Flight Attendants

I. Introduction/Background

On June 28, 1983 the Occupational Health Clinic was contacted by Connie Stevens, Safety and Health Regional Chairperson, Association of Professional Flight Attendants representing flight attendants at American Airlines. She requested technical assistance with evaluating a problem experienced by flight attendants working the American Airlines flights between San Francisco and Honolulu, over the past year, who reported symptoms including decreased appetite, respiratory distress, nosebleeds, sinus congestion, pain in nostrils, and blockage of eustacian tubes to ears, beginning during these flights and lasting up to three weeks.

Flight attendants reportedly smelled fumes with a foul smell at various times during the flights, described at "musty" or "like dirty socks." Initial reports were limited to DC10-10's with occasional reports from flight attendants flying on DC10-30's and 747 aircraft. These reports had been made to the company through the flight log, and the initial hypothesis of the possible cause of this problem was an engine oil, Mobil Jet II. The company subsequently indicated that they would replace the engine oil with a new oil (RM 254, from Mobil). However, reports of continued odors and persistent and recurrent symptoms have come to the attention of the APFA, and flight attendants have expressed concern over continued possible exposures and long-term health effects.

II. Actions Taken To Date

On June 28, 1983, Buck Cameron, Industrial Hygienist for the Occupational Health Clinic, met with Connie Stevens, APFA, to discuss the problem. Buck Cameron agreed to obtain further information regarding the exact nature of the oils and other possible exposures by obtaining Material Safety Data Sheets from the manufacturer.

On August 9, Buck Cameron, Industrial Hygienist and James E. Cone, Chief, Occupational Health Clinic, met with Connie Stevens, APFS, to further discuss the problem. Further details on process description were obtained from Connie Stevens, and a preliminary draft of a questionnaire which the APFA planned to send to a group of its members was reviewed. A revised questionnaire was drafted, and planned to be distributed to all flight attendants on the SFO-HNL flights, to cover a total of 5 flights each. An additional group of Flight Attendants flying a similar route from Los Angeles was selected to be surveyed to determine if they were experiencing similar problems with unusual odors or symptoms. The identical questionnaire was to be distributed to the LA flight attendants.

Questionnaires were to be sent to the Occupational Health Clinic for coding (after personal identifiers were removed by APFA), and analyzed.

In addition, several flight attendants requested to be seen at the Occupational Health Clinic to further evaluate their symptoms and possible health problems as a result of this exposure.

Further data on the exact process involved in the ventilation system and possible airline cabin contaminants was to be obtained by Buck Cameron.

III. Results to Date

A. Environmental

1. Hazard Recognition

Four flight attendants assigned to the SFO-HNL-SFO route were interviewed separately by Buck Cameron at the Occupational Health Clinic. The purpose of these interviews was to determine if the symptoms described in Section B (below) correlated with the "dirty socks" odor and/or with particular aircraft, locations within aircraft, and/or phases of flight.

The flight attendants' perceptions of the conditions and areas associated with their symptoms are very consistent, with differences seemingly related to variations in work locations within the aircraft.

Factors identified included:

a. The "dirty socks" smell is strongly associated with the reported symptoms. Symptoms are reported most frequently, and are most pronounced, during or following flights where the odor is strong. Symptoms are reported, however, even when odors are slight or not noticeable.

   Visible haze or smoke is occasionally, but not usually, seen when the odor is strong.

b. Both the odor and symptoms are most frequently associated with DC10-10 aircraft. Similar reports have been made, however, concerning DC10-30 and 747 aircraft.

c. The odor and symptoms are stronger on certain aircraft. Complaints have been made concerning aircraft numbers 117, 118, 124, 126, 128, 132, 134.

d. The odor is strongest at particular aircraft locations. The over-wing section and galley service area have been identified as high odor areas. The odor has also been reported in the cockpit.

e. The odor is most pronounced on taxi, take off and landing; least pronounced during cruise.

f. The odor, and symptoms, are more pronounced when Mobil Jet II turbine oil is used.

g. The odor is reduced when the water separator bags are changed. This is most noticeable when bags are serviced at Honolulu.

h. Aircraft ventilation systems are not apparently effective.

i. Cigarette smoke is an additional irritant but is not directly associated with the principle complaint.

j. Typical cruising altitude is 38,000 feet. This is lower than altitudes normally associated with high ozone exposure.

2. Review of American Airlines Correspondence

In response to flight attendant reports of odor and irritation, American Airlines has theorized that the problems may be associated with one or more of the following:

a. The chemical composition of the turbine oil being used (Mobil Jet II)

b. Contamination of the APU door or inlet duct by oil from the #2 engine.

c. Contamination of heat exchangers.

d. Insufficient cabin ventilation.

3. Possible Chemical Agents

a. Turbine oils

Mobil Jet II is a synthetic oil which contains Tri-cresyl phosphates (known eye, skin and mucous membrane irritants.)

Mobil RM 254 is similar in composition to Mobil Jet II but is claimed by the manufacturer to be more highly refined.

The composition of Exxon 2380 has not been determined.

b. Hydraulic fluids

Aircraft hydraulic fluids also contain phosphate esters.

c. Other possible agents

Include sulphur dioxide, oxides of nitrogen, ozone, cigarette smoke, formaldehyde, and pyrolysis products of oil, jet fuel and hydraulic fluids.

4. Controls

Actions taken by American Airlines to improve cabin air quality have not led to a complete or consistent removal of air contaminants. These actions have included:

a. More frequent changing of water bags.

b. Burning out of contaminants from the air conditioning system.

c. Cleaning the APU door and inlet duct.

d. Changing to Exxon 2380 turbine oil.

e. Increasing the airflow capability of the air conditioning system.

B. Medical Results to Date

1. Clinical Evaluation

Four flight attendants have been seen to this date at the Occupational Health Clinic. Symptoms reported since May 1982 included nasal burning, increased tearing, headache, increased rhinorrhea, sneezing, sore throat, hoarseness, cough with brown phlegm, and hearing difficulties noted after beginning to fly the SFO-HNL flights, particularly on DC10 aircrafts #118, #135, and in particular areas of the planes (3L and Zone B). Symptoms were noted immediately after entering a plane with a peculiar odor described as similar to "dirty socks", and continued for 1-3 days in one flight attendant, 4-5 days in another. Several stated that they had consulted other physicians, and had been removed from exposure for various lengths of time over the past year. Physical findings included signs of mucous membrane irritation in one flight attendant, and serous otitis in one flight attendant.

Further evaluation of these symptoms is planned, including respiratory function evaluation and hearing/ENT evaluation where clinically indicated.

2. Questionnaire Results

An initial total of 58 questinnaires were received from flight attendants who flew "turn-around" flights from SFO-HNL 8/15-8/17/83. Participation rate was 100% of those surveyed.

Ages of flight attendants ranged from 35-44 with a mean of 37 years. All 58 respondents were female, and 17 indicated they were smokers, and 41 were non-smokers. Forty-two reported a history of prior allergies. Aircrafts included #128, 116, and 134.

Unusual odors were reported by 14 of 20 flight attendants working on aircraft #128 on 8/17/83, and 12 of 20 flight attendants on aircraft #116 on 8/16/83. No such odor was reported by any flight attendant on 8/15/83. The odor was described as "dirty socks", "musty", or "resembling petroleum burning". The odor was detected only during taxi out by one flight attendant, on descent only by 14, and landing only by 3, and during multiple portions of the flights by 5.

Symptom prevalence is shown in Table 1.

Symptoms were reported more frequently during flights on 8/16 and 8/17 with a smaller number reporting symptoms on the 8/15 flights, with the exception of eye redness alone and dryness alone reported more frequently on 8/15.

Onset of symptoms occurred predominatly during the later portion of each flight, with 18 reporting symptoms during cruise, descent, and landing/taxi in, and 16 noting symptoms throughout the flight.

Odor and symptoms were reported from flight attendants assigned to all parts of aircraft.

IV. Discussion - Preliminary Investigation Indices

A. Environmental

Flight attendant interviews and a review of company correspondence indicate that the symptoms reported are caused by one or more air contaminants. At least one of these contaminants is the probable cause of the "dirty socks" odor.

The concentrations of these contaminants seem to vary with the aircraft, location within the aircraft, and with phases of flight. Although the contaminant(s) associated with the odor appears to be the primary cause of irritation, other contaminants may also contribute to the scope or severity of symptoms.

Although Mobil Jet II has been implicated as a causative agent this relationship has not been proven. It can not be assumed that removing this oil will completely eliminate the problems of odor and irritation.

B. Medical

The results of the medical evaluations and questionnaires among flight attendants on American Airlines flights from SFO-HNL indicates that for approximately the past year, flight attendants have been reporting unusual odors and symptoms which are associated in time with these odors, primarily of mucous membrane irritation and upper airway irritation. Several have had significant time lost from work as a result, and several have now

developed chronic symptoms similar to those previously only noted during and shortly after each flight. These type of symptoms may be seen with many airborne substances, including but not limited to sulfur dioxide, nitrogen oxides, formaldehyde, ozone, low humidity, smoke particulates, and oil pyroloysis products. The temporal relationship of the symptoms and unusual odor suggested a cause and effect relation. The increased frequency of eye redness and dryness noted on the flight without unusual odor reported suggests that the eye symptoms may not be related as directly to the unusual odor, but may be due to other factors such as heavy cigarette smoke contamination (noted by one flight attendant on that flight).

V. Recommendations

A. Environmental

1. Identify all likely cabin air contaminants.

2. Evaluate cabin air concentrations of each contaminant by sampling several locations in several aircraft during each phase of flight. Sampling results should be compared to medical questionnaire results to determine which contaminants best correlate with symptoms.

3. Eliminate possible causes of exposure to prevent chronic health effects and acute symptoms among flight attendants and passengers who may be at risk of respiratory difficulty. Control may be achieved by eliminating the causative agent, improving maintenance procedures and/or by making engineering changes to the aircraft. Until air concentrations of irritants are reduced to a safe level any flight attendant experiencing irritation should be provided with a respirator capable of removing organic vapors and gases.

B. Medical

1. Continued medical surveillance of flight logs to detect future reports of unusual odors/symptoms among flight attendants, passengers, or pilots. Prompt investigation and correction of situations with suspected contamination of airline air.

2. Analysis of further questionnaires from other bases to determine extent of problem over the next few weeks.

Report prepared by:

Buck Cameron, MS, Industrial Hygienist

James E. Cone, MD, MPH, Chief, Occupational Health Clinic

Table 1
Symptoms reported
American Airlines Flight Attendants Survey

Symptom	# reporting			Total #	%(of total)
	8/15	8/16	8/17		
Eye: Irritation	1	1	3	5	9
Dry	5	0	2	7	12
Watery	0	0	1	1	2
Red	3	0	1	4	7
Burning	0	4	4	8	13
Multiple Sxs	3	4	6	13	22
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Any symptom	12	9	17	38	66
Nasal: Irritation	0	1	1	2	3
Drainage	4	4	2	10	17
Dryness	5	0	9	14	24
Multiple Sxs	0	5	4	9	15
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Any Symptom	9	10	16	35	60
Sinus: Burning	0	2	1	3	5
Congestion	0	2	0	2	3
Multiple Sxs	0	6	3	9	16
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Any Symptom	0	10	4	14	24
Ear: Irritation	0	0	1	1	2
Blockage	1	0	1	2	3
Congestion	0	2	2	4	7
Multiple Sxs	0	1	2	4	7
----------	-	-	-	-	-
Any Symptom	1	3	6	11	19
CNS: Headache	0	3	2	5	9
Dizziness	0	1	0	1	2
Lightheadednes	0	1	1	2	3
Multiple Sxs	0	2	0	2	3
----------	-	-	-	-	-
Any Symptom	0	7	3	10	17
Chest: Irritation	0	0	1	1	2
Cough	2	0	0	2	3
Burning	0	2	0	2	3
Difficulty breathing	2	1	0	3	5
Multiple Sxs	0	3	1	4	7
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Any Symptom	4	6	2	12	21