Chemical Testing of Flight Attendant Uniforms – March 2017

In Feb. 2017, the Association of Flight Attendants-CWA, AFL-CIO requested chemical testing on 14 Flight Attendant uniform garments in circulation at Envoy Air, PSA Airlines, and Piedmont Airlines. These are the same garments being worn by mainline American Airlines Flight Attendants. Key findings are listed in Table 1.

Table 1: Summary of chemical testing of 14 TwinHill uniform garments

(Bold font indicates amount of chemical that exceeded limits in Oeko-Tex 100 Standard)

Garment	Chemicals found
All-weather coat	Lining fabric: nickel; Padding material: NP(EO)[1], OP(EO)[2]
Apron	chlordane, formaldehyde, nickel
Shirt, white (cotton)	chlordane
Suiting, dress (wool blend)	Woven fabric: chromium, nickel
Suiting, pants (wool blend)	Lining: NP[3]
Suiting, skirt (polyester-alt.)	Pocket lining: dichlorophenol, nickel, **pentachlorophenol tetrachlorophenol**, trichlorophenol,
Suiting, skirt (wrap, wool-blend)	Pocket lining: nickel, **tetrachlorophenol**, dichlorophenol, trichlorophenol, pentachlorophenol; Woven fabric: NP; Lining: NP
Suiting, vest (wool blend)	Woven fabric: NP, NP(EO)

Table 2 summarizes which of the chemical compounds listed in Table 1 are sensitizers, irritants, endocrine disruptors, and carcinogens. Links to references sources are posted at http://www.afanet.org/uniforms

Table 2: Chemicals found in 1+ fabrics with description of key health impacts

Chemical	Sensitizer?	Irritant?	Known/suspected Endocrine disruptor?	Carcinogen?
Chlordane	No	Yes	Yes	Probable human carcinogen
Chromium	Yes	Yes	Insufficient data	Depends; hexavalent chromium is a human carcinogen; trivalent chromium is not
Dichlorophenol	No	Yes	Yes	No
Formaldehyde	Yes	Yes	Yes	Known human carcinogen
Nickel	Yes	Yes	Yes	Probable human carcinogen
NP	No	Yes	Yes	No data
NP(EO)	Yes	Yes	No data	No data
OP(EO)	No	Yes	No data	No data
Pentachlorophenol	No	Yes	Yes	Likely human carcinogen
Tetrachlorophenol	No	Yes	Yes	Possible animal carcinogen
Trichlorophenol	No	Yes	Yes	Probable human carcinogen

[1] NP(EO) = nonylphenolethoxylates; listed if ≥ 15 mg/kg (below Oeko-Tex 100 standard limit)
[2] OP(EO) = octylphenolethoxylates; listed if ≥ 15 mg/kg (below Oeko-Tex 100 standard limit)
[3] NP = nonylphenol (NP); listed if ≥ 5 mg/kg (below Oeko-Tex 100 standard limit)

Table 3 describes how these chemicals can be used in the textile industry, followed by answers to some frequently asked questions.

Table 3: Description of how the measured chemicals can be used in textile production

Chemical	How used in textiles
Chlordane	Chlordane is a chlorinated insecticide. In the US, industry cancelled its use in 1988. Its role in textile production/assembly is unclear.
Chromium, nickel	Metals in fabrics (including, but not limited to chromium and nickel) are most often sourced to dyes. Metals can also be used in buttons and zippers.
Formaldehyde	Formaldehyde can be added to fabrics to prevent shrinkage and make fabrics color-fast and wrinkle-resistant.
NP, NP(EO), OP(EO)	These compounds can be used in textile production as detergents, coating agents, waterproofing agents, adhesives, and in printing/dyeing operations.
Penta/tetra/tri/dichlorophenols	Pentachlorophenol and tetrachlorophenol are used in making pesticides and fungicides. Pentachlorophenol is best known for its use as a wood preservative. Trichlorophenol is used to control mildew and insects. Dichlorophenol can be used in the production of herbicides and disinfectants.

- **Which garments were tested?**

In Feb. 2017, AFA sent 14 TwinHill uniform garments to a specialty fabrics lab to have them tested for the presence of chemical compounds that have previously been associated with reports of clothing-related outbreaks of symptoms. The 14 tested garments came from some of the batches of uniforms being worn by our members at PSA, Piedmont, and Envoy, as well as mainline AA Flight Attendants, since September 2016.

In all, about 28,000 flight attendants are wearing these garments which have been (and are being) assembled in batches at factories located in at least five countries (Bangladesh, China, Indonesia, Sri Lanka, and Vietnam) with fabrics sourced to unknown locations and where production line practices may vary over time, between factories, and between batches of the same garments. So, the chemical contents in the apron, for example, may vary over time or even between batches from the same factory.

- **How did AFA decide which chemicals to ask the lab to look for in those garments?**

The chemical tests performed on these fabrics represent our “best guess” as to what chemicals could be in the uniforms and could be causing the reported skin, eye, and respiratory symptoms. We focused on chemicals that can be measured in fabrics and for which there is at least one published fabric standard, so that we could have some context for understanding the test results.

Testing on these uniform garments prior to March 2017 confirms that additional chemical compounds have been found in these fabrics. Those data matter because they highlight the “chemical soup” nature of these fabrics. However, it is hard to interpret the health impact of exposure to long lists of chemicals where there are no standards for comparison, so we limited our testing to specific compounds.

- **If the amount of a chemical in a garment is below a published limit, is it safe?**

Published limits for chemicals in fabrics are helpful because they provide some context for what a given amount of a chemical in a fabric means. However, they do not necessarily represent an assurance of safety. One of the million dollar questions is that, if a chemical (like nickel) is measured in a fabric, but is below the maximum allowed amount for nickel in fabrics, does it matter? The short answer is that it's complicated, but it certainly could matter, and especially for sensitizers. It is helpful to understand that fabric limits are set one chemical at a time which does not address the impact of contact with a complex mixture of chemicals in a fabric. Obviously, contact with fabric that contains one irritant at "low levels" is not the same as contact with a fabric that contains 20 irritants, each at "low levels."

And aside from the complication of having contact with a mixture of chemicals, some chemical limits for fabrics are based on the sensitivity of the laboratory equipment that will be used to measure that chemical in fabric. Of course, you can't set a chemical limit below what your equipment can measure, but the basis for a particular published limit must be clearly defined, and some limits may need to be revised downward when technology improves.

Even when the published limit for a given chemical in clothes is grounded in protecting the wearer from developing symptoms, chances are good that the basis is preventing irritant symptoms, because it's generally accepted that there is some "no effect" concentration for most people who have contact with a single chemical on intact skin. However, it is more complex to define a "no effect" level for sensitizers because (as the name suggests) some people will develop a sensitization response when exposed to one or more sensitizer chemicals. Sensitization involves an immune-mediated response (called the "sensitization phase") which is "clinically quiet" (meaning no symptoms). When a sensitized person is exposed again, they will exhibit symptoms, and the amount of the chemical that triggers their symptoms can be less than both the dose that caused their immune system to get involved and the dose required to cause irritant effects in non-sensitized people. So, there is a lot of variability between people in terms of "what's safe." For these reasons, if a person is sensitized to a given chemical, then a "no effects" limit for irritant effects is unlikely to be protective. Also, continued exposure to chemical allergens can result in worsening of symptoms and a poorer prognosis. Other factors that influence how much of an exposure is needed to cause symptoms include whether the skin is intact or broken/irritated, the duration of the exposure (cumulative dose), and whether or not the person is exposed to a mixture of compounds that may interact with each other.

- **The sweaters and blouses/shirts are not included in Table 2. Does that mean they tested clean?**

We invited AFA members who reported uniform reactions to identify which garments they associated with symptoms. The top five answers were the pants (67% of respondents), one of the shirts (63%), buttoned cardigan (56%), one of the blazers (52%), and the dress (46%). So, shirts were #2 and a sweater was #3. Thus the March 2017 data do not answer all of the questions about the chemical contents of these clothes. A Feb. 2017 report on some chemical testing of 68 Flight Attendant uniform garments worn at these same airlines identified the presence of 15 sensitizer compounds: antimony, arsenic salts, benzophenone, benzyl benzoate, 4-biphenyl ester benzoic acid, chromium, cobalt, Disperse Red 60, Disperse Orange 30, 9,10-dimethylanthracene, 4,4'-diphenylmethane diisocyanate, ethylbenzaldehyde, formaldehyde, mercaptobenzothiazole, and 2-(methylthio)-benzothiazole. There is only some overlap between the findings of the Feb. 2017 and March 2017 reports.