

# HEALTH HAZARDS FROM INHALING AND EXPOSURE TO SOLDERING FUMES

## **Health hazards from inhaling and exposure to soldering fumes.**

Manufacturers of flux usually point out that inhaling flux fumes, created when flux is heated to soldering temperatures, will cause irritation to nose, throat and respiratory organs. Health authorities also state that extended or repeated exposure to rosin flux may cause hypersensitivity and lead to occupational asthma.

The base product found in conventional flux is called **colophony**. Colophony is the translucent amber-colored rosin obtained when turpentine is distilled from the resin of pine trees. Colophony has been widely used in soldering processes for many years.

### **What is Colophony composed of?**

Colophony is a mixture of approximately 90% resin acid, mostly abietic acid with 10% neutral material such as stilbenederivatives, and different kinds of hydrocarbons. When flux is heated, airborne products are generated including aliphaticaldehydes such as formaldehyde. Most fluxes are also composed of organic amine hydrochloride, an activator helping to clean the soldering area. When heated, it releases hydrochloric acid and other gases containing benzene, toluene, styrene, phenol, chlorophenol and isopropyl alcohol.

### **What health hazards are related to flux gases?**

Studies have been made on workers in the electronic industry, mostly in the United States, and England. These studies show that at least 20% of the employees working in the soldering area show clinical symptoms of asthma caused by the work environment. These symptoms are characterized by coughing, shortness of breath, wheezing and chest pain. The conclusion of these studies is that colophony fumes are the main cause of the illness and employee turnover in occupations related to soldering.

Allergic hypersensitivity is common in soldering occupations. Hypersensitivity to flux fumes and their symptoms is usually developed from a period of a few months up to 16 years. The average period before the symptoms are developed is four years. Hypersensitivity of colophony is gradually indicated by wheezing and labored breathing. These symptoms are much more common by long duration of employment and they can even continue many years after the person has finished with this occupation. Eye and nose irritation is quite common, due to the fact that when flux is heated, the fumes from hydrochloric acid create a strong slime that causes irritation. Furthermore, there are reports showing that colophony may cause airborne contact skin diseases. This is attributed to many components in the flux, such as amino ethyl-ethanolamine and hydrazine that are harmful to the skin.

## **Colophony fumes are known to cause:**

- Occupational Asthma
- Chronic Bronchitis
- Chemical Hypersensitivity
- Chest Pain
- Headaches & Dizziness
- Eye and Nose Irritation
- Skin diseases

## **Health hazards by occupational lead exposure**

22 CCR 12805 is lead with a reproductive toxicant. It has an acceptable dose limit of 0.5 µg per day for a 154 lb (70 kg) person. Lead can cause a wide range of adverse health effects. These include fatigue, irritation and anemia along with other reproductive effects such as spontaneous abortion and sterility.

## **What is the result of these health hazards?**

INCREASE IN EMPLOYEE ABSENCE. Studies show that flux fumes are the main reason for employee absence in the soldering workforce. Regular visits to doctors are commonplace.

## **Workforce Turnover**

Work force turnover among soldering operators is mainly caused by flux fumes. Recruitment and training is an expensive cost for the industry.

## **Worker's Claims for Damages**

90% of all claims in the United States related to soldering occupations involving respiratory diseases are litigated. This is very expensive to the industry with increased health insurance premiums costing both employees and employers.

## **What can be done to minimize exposure of flux fumes?**

Most countries have limits for the exposure to pollutants. When the operator is exposed to 10% of the threshold level, action must be taken to reduce the dangerous substances created in the process.

A rule of thumb is to control and reduce the exposure to a level that most employees can be exposed to day after day during their working life without health risks. (In UK referred to as

COSHH)

Various solutions are:

### **1. CHANGE/REMOVAL OF SOURCE**

The source producing the toxicants can be removed or replaced. However, some processes require the use of certain chemicals to obtain the specified product quality and performance.

### **2. MOBILE SPOT SUCTION SYSTEMS AND AIR RECIRCULATING THROUGH FILTER SYSTEMS**

Spot suction systems prevent toxicants from reaching the respiratory organs. These must be placed as close to the source as possible without interfering with the process.

This method is the most common and it has many advantages:

- a. The polluted air is caught in a filter system and does not reach the external environment. The pollution of both the working area and products being manufactured are reduced. The working area gets less polluted and results in a better environment.
- b. The installation is easy and cost-effective. The investment is made only due to actual need. The filters can be adjusted to the specific process at the individual workbenches.
- c. Some of the spot suction systems have three or four-stage filters making it possible to capture both particles and gases. The filtrated air can therefore be re-circulated in to the working area. This saves energy and does not effect the existing ventilation.

### **3. SPOT SUCTION THROUGH THE VENTILATION SYSTEM OF THE BUILDING**

With this technique, large volumes of air can be removed from the operator's breathing zone.

This method is as effective as extraction with mobile systems but has several disadvantages:

- a. As this installation is extensive, the construction is often designed for bigger, future needs. This means that systems become more expensive both in installation and operation. Also, the flexibility at the working area is limited.
- b. It is quite complex to build filters which catch the wide spectrum of pollutants produced in the different processes at the working area. Instead it is common to exhaust the pollutants outdoors without any filtration.
- c. Costs for heating or cooling re-circulated air is high.

Threshold values for some of the VOC's that exist in soldering smoke fumes.

CAS-no	Name	Chemical no:	Threshold value Mg/m3*	Threshold value ppm*
25167-80-0	Chlorophenol	C <sub>6</sub> H <sub>5</sub> ClO	0,5	---
50-00-0	Formaldehyde	CH <sub>2</sub> O	0,6	0,5
111-30-8	Glutaraldehyde	C <sub>5</sub> H <sub>8</sub> O <sub>2</sub>	0,8**	0,2**
71-43-2	Benzene	C <sub>6</sub> H <sub>6</sub>	1,5	0,5
108-95-2	Phenol	C <sub>6</sub> H <sub>6</sub> O	4	1
141-43-5	Ethanolamine	C <sub>2</sub> H <sub>7</sub> NO	8	3
7647-01-0	Hydrochloric acid	ClH	8**	5**
75-07-0	Acetaldehyde	C <sub>2</sub> H <sub>4</sub> O	45	25
100-42-5	Styrene	C <sub>8</sub> H <sub>8</sub>	90	20
108-88-3	Toluene	C <sub>7</sub> H <sub>8</sub>	200	50
67-63-0	Isopropanol	C <sub>3</sub> H <sub>8</sub> O	350	150
67-34-1	Acetone	C <sub>3</sub> H <sub>6</sub> O	600	250

\* Average threshold value per day:

\*\* Maximum threshold value for 15 minutes

Source: AFS 2005:17 from Swedish Work Environment Authority

More information can be found at:

[www.cooperhandtools.com/weller](http://www.cooperhandtools.com/weller)

[www.agius.com](http://www.agius.com)

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Parts of this brochure have been made with the courtesy of Dr. Raymond Agius.