



## Assembly and Packaging

# Solder Fumes: Stopping the Pollution

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With new environmental regulation such as the European RoHS (Restriction of Hazardous Substances) and REACH (Research, Evaluation, Authorization of Chemicals) in the headlines, it is difficult not to notice that everyone is “searching for a safe society” to work and play in.

In addition, more and more countries (China, South Korea, Norway and even states in the U.S.A., such as California), are administering or considering similar types of legislation that require that the processes as well as the products being manufactured, meet a higher standard of environmental safety.

It is extremely urgent in today’s world that the products that our workers and our families come into contact with become safer than the products of previous years. In 2007, there was widespread news of and acknowledgement of simple products such as toys that were being produced with high percentages of lead in the paints — products that our families were dealing with on a daily basis. It is this type of public concern that generates the need for tighter controls in general for our society.

The same holds true for the type of environment where most workers spend the majority of their time.

Manufacturing companies worldwide spend hundreds of millions of dollars each year on health care. Safety in the workplace is at the top of the list for maintaining a healthy workforce, even when safety comes in forms that are not readily visible or apparent. The air that we breathe is one area that is not only difficult to see and measure, but even more difficult to dictate.

### Harmful Substances

Manufacturing processes of all types can produce harmful substances that the average worker is exposed to on a daily basis.

Virtually any material that is being changed or altered can release harmful substances into the airstream. For many years, common cigarette smoke was not considered harmful in most environments, especially the workplace, but even the use of cigarettes has been banned by corporate policies and government legislative bodies in an effort to eliminate the poisonous effects of second-hand smoke.

Common conditions that are caused by direct contact, continuous breathing or inhalation of harmful chemicals would include:

- Allergic Reactions: lacrymation (runny eyes) —



*Fume extraction wand attached to soldering iron.*

acute irritation of the eyes caused by high exposure to fumes; rhinorrhoea (runny nose) — acute irritation of the nose caused by high exposure to fumes; colophony — a contact allergy caused by contact with coniferous tree rosins/resins and acids.

- Occupational asthma — respiratory disease associated with the workplace.
- Bronchitis — acute bronchitis caused typically by virus or bacteria and chronic bronchitis caused by tobacco smoke or infectious agents.
- Physical irritations — such as reactions to isocyanate solvents, dyes, fiberglass, etc.

There is typically a latent period between the first exposure and the onset of symptoms of occupational asthma. Under certain severe conditions, less than several months of exposure to a sensitizing agent may be long enough for the appearance of OA symptoms to occur. It can also take as long as 20 years for the symptoms to occur. However, the average time for the OA symptoms to be recognized is approximately 4 years.

This may in part be contributed to whether the exposure is over a long period of time with low levels of exposure to the sensitizing agent or to a single exposure at very high concentrations. Some of the chemicals, materials or processes that may cause concern for workers and their employers include:

- Soldering fluxes used in hand soldering — including rosin/resin based fluxes.
- Solder paste/fluxes in semi-automated processes. These can include V.O.C. (volatile organic compounds) in solder compositions, and halides.
- Greases, oils and other lubricants.
- Corrosion inhibitors.
- Printing inks.
- Solvents.
- Cutting fluids.
- Abietic acids.
- Abietic/abietyl/methyl abietate alcohols.
- Certain brands of pipe joint compounds.
- Hydrochloric and primaric acids.
- Carbon monoxide.
- Machining, de-burring, cutting, polishing or grinding of metals. In electronics as well as general manufacturing processes, many different types of harmful chemicals or materials can be introduced back into the atmosphere. The safest and most efficient means of dealing with hazardous substances is to provide the proper equipment for purifying the quality of the air in the workplace.

### Filtration Also Needed

For the environment to be properly controlled, more than just a means of moving the air away from the workers is required. The best method is to provide a source for cleansing the air through efficient filtration. HEPA (High Efficiency Particulate Air) filtration is one means of controlling the air that is recycled back into the workplace. HEPA filtration provides air quality levels in the 99.5 to 99.975 percent range, making the air that is purified, perhaps cleaner than its original state — by also removing pollens, smoke, and unhealthy gases — and even irritating odors, when active carbon is incorporated as part of the filtration. Soldering applications

can present the most challenges for companies who are contemplating the conversion to fume extraction. Most customers are of the belief that converting to “Lead Free” applications sidesteps the need to provide fume extraction to the workplace. The reality is that the opposite is true: lead-free generates even more noxious fumes.



*Benchtop fume extraction system for hand soldering tools.*

Weller has devoted several years to testing of different flux cored solder alloys. This has typically consisted of soldering iron tip life testing that provided data on the quality and longevity of the iron plating of Weller soldering tips. As a byproduct of the tip life test, Weller fume extraction equipment was employed to protect the working environment during the test phase of the project. The collection of fine metal particles as well as fine air particulates, has offered a great deal of important data.

Weller teamed with several European test agencies to monitor the types and levels of solder contaminants found during the collection process.

### Fine Metal Particles

What was uniquely determined by the collection of the contaminants is that the distribution of fine metal particles into the air during hand soldering was virtually non-existent. The European Standards Association has established a Maximum Allowable Threshold of Fine Metal Particles at 2 Milligrams per Cubic Meter (2 mg/m<sup>3</sup>).

Of three different Solder alloys tested during the initial phase of the experiment, only two of the three came even remotely close to 1/10 of the maximum allowable concentration of fine metal particles. This indicates that fine metal particles are not generally re-distributed into the environment.

When using fume extraction equipment that incorporates HEPA filtration, the before-and-after results were reduced even further. Applications that involve metal working may, however, provide significantly differing results.

The most interesting conclusion from the solder alloy testing is that the distribution of fine air particulates into the environment during hand soldering exceeds the maximum allowable threshold established by the European Standards Association. A limit

was set for fine air particulates to not exceed 3 Milligrams per Cubic Meter (3 mg/m<sup>3</sup>).

Of the three different Solder alloys tested, all exceeded the maximum allowable threshold. This indicates that fine air particulates are re-distributed into the environment and should be a concern for workers in hand soldering applications. However, when using fume extraction equipment, the measurable levels were considerably reduced and after HEPA filtration, the levels were virtually non-existent.

The most significant point derived from these data is to ensure that the selected solder manufacturer's technical data sheet and the material safety data sheets are reviewed to define which solder/flux combinations either recommend or require the use of fume extraction. Solder manufacturers' Technical data sheets will provide detailed information as to the safety and health concerns when using their products. The manufacturer may indicate one or more of these recommended levels of ventilation:

- Use in a well-ventilated area.

- Soldering processes will generate product fumes, which should be vented.
- Soldering fumes must be exhausted or vented for operator safety. In addition, all chemical manufacturer's application notes, process notes or material safety data sheets will be the primary indicator of whether normal ventilation is adequate or whether fume extraction should be applied in the workplace.

A couple of operational notes are important: before using external ventilation type systems, consult your local Fire Department regarding collection of flammable materials inside piping systems and your local Environmental Agency for emissions regulations. Also consult your insurance carrier for information pertaining to openings in the walls or ceilings of a facility.

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