

Recommendation no. 4
of the BPC Ad hoc Working Group on Human Exposure

Cleaning of spray equipment in antifouling use
(PT21)

(Agreed at the Human Health Working Group IV on 17 September 2014)

1. Background

During a Technical Meeting discussion of a PT21 active substance dossier, the inclusion of the exposure scenario for cleaning of spray equipment for antifouling was examined.

The European Council of Paint, Printing Ink and Artists' Colours Industry (CEPE) was consulted for the explanation on the cleaning of spray equipment.

The evaluating Competent Authority for the PT21 active substance dossier received in May 2014 a paper from CEPE and Sea Europe on how cleaning of equipment for the professional spraying of antifouling paints is carried out (see Annex 1). CEPE also agreed with the proposed model to be used for exposure calculations. The proposed model for cleaning of spray equipment is from BEAT (based on the study by Delgado *et al*, 2004).

2. Aim of the recommendation

The aim of this recommendation is to evaluate the applicability for all antifouling substances of the proposed BEAT model (based on the study by Delgado *et al*, 2004) for cleaning of spray equipment.

3. Discussion

Data on exposure in cleaning of spray equipment is found in the study by Delgado *et al* (in BEAT) performed in car body repair shops (see Annex 2): "These tasks were measured in mainly SME. Cleaning the spray gun is carried out in many different ways depending on the car body repair shop. Usually, the spray gun is cleaned with water and later the parts that *still remain dirty are rubbed with paper, rag or brush, using water or any cleaning solution. The mean sampling time was 3.7 minutes. This scenario comprised several different activities. The main body regions exposed during the cleaning of the spray gun are the hands, though there might be splashes to other parts of the body.*"

Information on the duration of cleaning events is not available. Exposure values ranged from 0.44 to 213 $\mu\text{g paint}/\text{cm}^2/\text{min}$ with the arithmetic means of 1.09 $\mu\text{g paint}/\text{cm}^2/\text{min}$ for body and 37.2 $\mu\text{g paint}/\text{cm}^2/\text{min}$ for the hands. In BEAT, the indicative values (75th percentiles) are expressed as 19.28 $\mu\text{l paint}/\text{min}$ for body exposure and 35.87 $\mu\text{l paint}/\text{min}$ for hand exposure (see Annex 2). It is not considered necessary to refine the defaults for the cleaning process done solely with a solvent instead of water.

According to the information received from antifouling industry, the total time for cleaning process may be 15 to 20 minutes (see Annex 1). This includes cleaning the pump for paint, pumping thinner through the pump, and cleaning the nozzle. The thorough cleaning of spray equipment takes place at the end of the day. A quicker, less thorough cleaning, may take place before lunch break or if the type/colour of paint is changed. Gloves and coverall are used. The cleaning can be carried out by the mixer man (i.e. potman) or the sprayer.

When commenting on other PT21 active substances, it was proposed to use the default value of 210 mg for exposure calculation according to Marquart *et al* (Ann. Occup. Hyg., 2006, Vol. 50, No. 5 pp. 469-489, Table 5 (EU project RISKOFDERM)). The table from the referenced article is shown below:

Table 5 Default values for single datasets used in the derivation of default values; default values						
Activity	n	Reasonable worst case exposure		Typical case exposure		Remarks
		(mg)	(mg cm ⁻²)	(mg)	(mg cm ⁻²)	
DEO unit: Handling of objects						
Cleaning of spray guns	30	210	0.26	50	0.061	Three results out of 30 above 210 mg

It seems that this default value is also based on the Delgado study. It is focused on hand exposure and reasonable worst case is the 90th percentile of observed values.

The exposure values were compared between the BEAT model and the RISKOFDERM model and are shown in Table 1.

Table 1. Cleaning of spray equipment: exposure estimation to the antifouling paint with BEAT default values of 20 min for duration of the cleaning process and 1.6 g/cm³ for density of the paint.

	BEAT (Delgado <i>et al</i> (2004))	RISKOFDERM (Marquart <i>et al</i> (2010), Table 5)
	Indicative values for the paint: Body: 19.28 µl/min Hands: 35.87 µl/min	210 mg paint
Tier 1	Total exposure = 1103 µl → 1765 mg	
Tier 2 (gloves 10% penetration, impermeable coverall 5% penetration)	Total exposure = 91 µl → 145.6 mg	21.0 mg paint (only gloves)

Based on the same study, the two approaches give different results. This is due to the fact that values from Marquart's paper are based on a one time hand exposure observed in the Delgado study (mean duration 3.69 min) and BEAT gives values for body and hand exposure expressed in µl/min that can be adapted to the longer duration of 20 min proposed by industry. Therefore, the data from the Delgado study in BEAT are more flexible and more relevant to develop an exposure assessment.

Another option could have been to use directly the RISKOFDERM model. However, the data from the Delgado study are the only ones about cleaning of paint spray equipment in this model and are mixed with other tasks, like mixing and loading, to build the Dermal Exposure Operation unit handling of object (Marquart 2006). As a consequence, it seems more relevant to use the raw distributions of hand and body exposure from BEAT.

4. Proposal for harmonisation

In the absence of measured data on cleaning of antifouling spray equipment, it is proposed to use the data from the car repair study (Delgado *et al*, 2004) in BEAT. The potential indicative exposure values for the paint are 19.28 µl/min for body exposure and 35.87 µl/min for hand exposure (the density of the paint is used to convert µl to mg). The default value for duration of cleaning process is 20 min in a working day. No inhalation exposure is assumed during this scenario.

In this harmonized approach, the exposure from cleaning is to be added to the daily exposure of both the potman and the sprayer.

5. References

- CEPE and Sea Europe: "Description of the process for cleaning of airless spray equipment for professional application of antifouling paints". 15 May 2014 (See Annex 1)
- Delgado P., Porcel J., Abril I., Torres N., Teran A., Zugasti A. (2004) Potential Dermal Exposure during the Painting Process in Car Body Repair Shops. *Annals of Occupational Hygiene* (2004) 48 (3): 229-236
- Marquart H., Warren N.D., Laitinen J., Van Hemmen J. (2006) Default Values for Assessment of Potential Dermal Exposure of the Hands to Industrial Chemicals in the Scope of Regulatory Risk Assessments. *Annals of Occupational Hygiene* (2006) 50 (5): 469-489

6. Annexes

6.1 Annex 1: "Description of the process for cleaning of airless spray equipment for professional application of antifouling paints" (CEPE and Sea Europe, 15 May 2014)¹

1. What does spray equipment consist of?

The spray equipment items that come into contact with paint and need to be cleaned are:

- the airless spray pump
- mixer
- spray lines/hoses
- spray gun (with possible filter(s), fitting(s), etc.)
- spray nozzle (tip guard, zip/switch tip, tip filter)
- drum (empty 20 litre drum)

2. How are the different parts of the spray equipment cleaned?

Spray equipment is cleaned by replacing the paint in the hoses with solvent. Before solvent has been pumped all the way to the nozzle, the paint remaining in the pump and hoses will be sprayed back into the used paint container or an empty drum. When solvent starts coming out from the nozzle, it will be recycled back into the equipment via a container for the used solvent. The solvent that will be recirculated through the equipment will be the cleaning agent that was recommended on the paint container, normally xylene.

The gun itself, the nozzle and its parts, and the outside of pipes or hoses that have been in contact with paint will also be cleaned with a brush dipped in solvent.

3. Who does the cleaning?

The cleaning of the spray equipment will be carried out by the mixer man (pump/pot man) or jointly by the mixer man/men and the sprayer(s). Some sprayers prefer to clean their own spray gun with nozzle and possible filter(s).

4. What protective wear and other personal protective equipment (PPE) are used?

Typical clothing for mixer men and the sprayers is disposable coverall with hoods on top of a normal overall. Whilst sprayers will have air fed masks, this is worn only occasionally by mixer men. Normally the mixer men will use a filter mask with a filter that absorbs spray dust and solvent fumes. Mixer men may use the same type of full face visors as the sprayers or they may use protective goggles. Hands will be protected by protective gloves (chemically resistant).

¹ This description was prepared by CEPE and Sea Europe with consultancy from the application companies Muehlhan and Pyeroy in April and May 2014.

5. How long does it take each time?

The typical process for a thorough cleaning at the end of the day is as follows:

- a) When the spraying operation is completed the drum of paint will be replaced with a drum containing thinner. The remaining paint in the spray line will be sprayed until the thinner is nearly through to the gun. When the pressure builds up just before the solvent is coming through, the pump pressure will be reduced and the spray gun will be directed to a waste container until thinner runs through the gun. The nozzle tip may also be reversed.
- b) The tip will be removed and the gun will be cleaned by recirculating thinner. The tip will then be put back into the nozzle and thinner will continue to be sprayed into the used solvent container at low pressure. The recirculation of thinner may go on for approximately 5 minutes.
- c) After the flow of thinner has been closed, a clean brush will be used to clean the outside of the gun and nozzle. This may be done whilst the gun is still connected to the spray line. The brush cleaning may take from 2.5 to 5 minutes.
- d) When the gun has been removed from the hose, the end of the spray line will be put into the drum of thinner. Then the machine (pump) will be turned back on and solvent will be left to circulate for approximately 5 minutes if attended (or longer if left on during a break).
- e) Finally the pump will be turned off, the suction pipe will be lifted out of the drum with used solvent, and the end of the suction pipe/hose will be cleaned with a brush dipped in solvent for approximately 2-3 minutes.

There will be one mixer man per pump. The total cleaning time of the airless unit at the end of the day will be approximately 15-20 minutes. This includes cleaning the pump for paint, pumping thinner through the pump, and cleaning the nozzle. This is normally done without any skin contact with the antifouling paint since mixer men (and sprayers) wear protective and chemically-resistant gloves and other PPE.

An extended cleaning will take place at irregular intervals depending on how frequent the spray equipment has been used. This will take place subsequent to the thorough cleaning at the end of the day described above. The extended cleaning does not involve the circulation of solvents. The paint removed in this process will be completely cured, so called scaling. During the extended cleaning the operator strips down the pump, opens the bottom clack/valve, cleans individual parts, and cleans or replaces filters. The extended cleaning may take approximately 45 minutes subsequent to the thorough cleaning. Therefore, in these cases it may take up to one hour to complete the entire cleaning process.

6. When is it cleaned?

The thorough cleaning takes place at the end of the day. A cleaning procedure based on the same principle, but quicker and less thorough may take place before a lunch break or if the type or colour of paint to be sprayed is changed, or for other reasons of a brake in the application.

Blockages due to particles in the paint are normally opened by reversing the nozzle tip and do generally not require cleaning.

7. How frequent is it cleaned?

The thorough cleaning of spray equipment that has been used for antifouling coatings will take place at the end of the day. If, within one day, the spray equipment was also used to spray anti-corrosive paint after the application of antifouling paint was completed, a quick less thorough brief cleaning (see below) is normally sufficient before the change of paint type. In these cases there will not be residues of antifouling paint in the spray equipment at the end of the day.

8. Is the cleaning between different paints different from the cleaning before a lunch break or the cleaning at the end of the day?

The quicker less thorough brief cleaning will take place in between different antifouling products or colours or in between different coating types. Since antifouling paints will not cure rapidly inside the hoses and pumps (contrary to 2-pack type paints), the cleaning before the lunch break or before other reasons for significantly pausing the spraying will be brief or simply be to immerse the spray gun in solvent. Therefore, a thorough cleaning twice a day will be a worst case scenario with respect to the exposure to antifouling also for the cases where a quicker less thorough brief intermediate cleaning should take place more than once.

6.2 Annex 2: Delgado *et al* (2004) study from BEAT

Potential dermal exposure during cleaning of spray equipment

Scenario:

For potential dermal exposure to the body the following exposure scenarios are considered informative

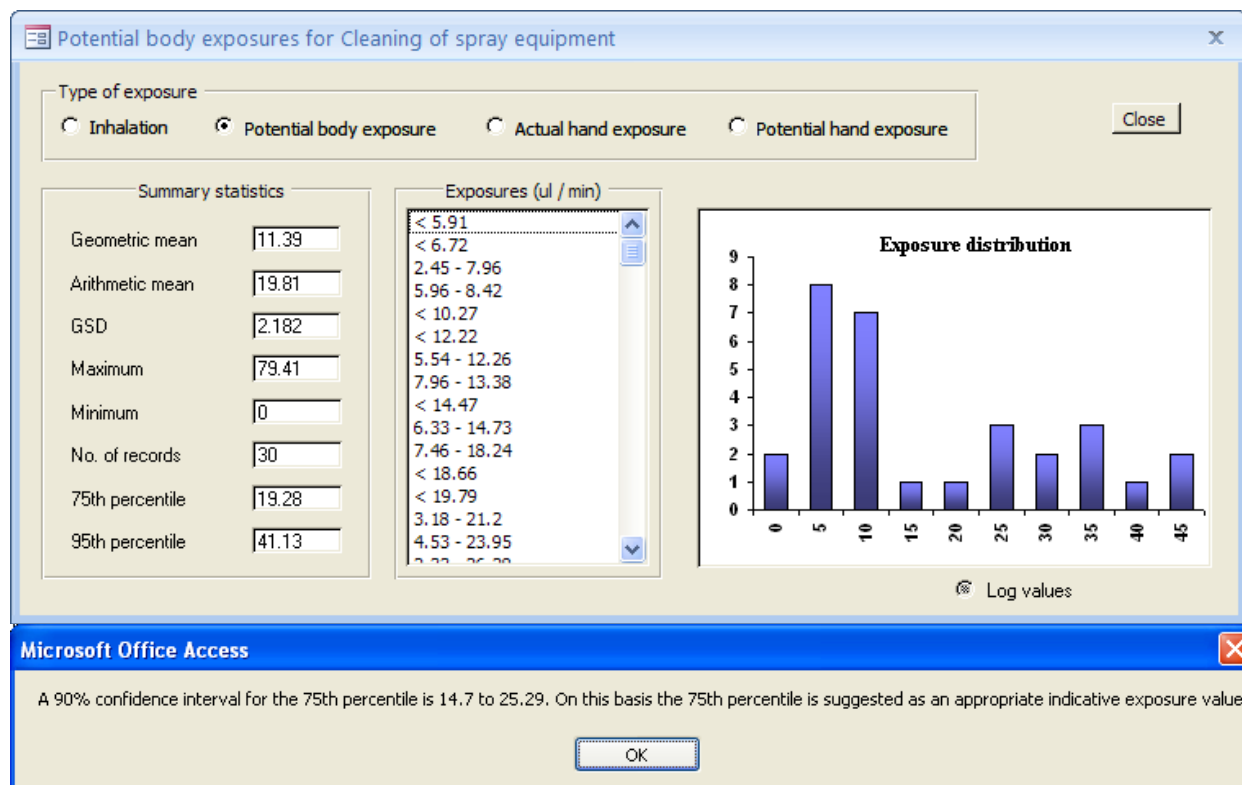
Cleaning of spray equipment:

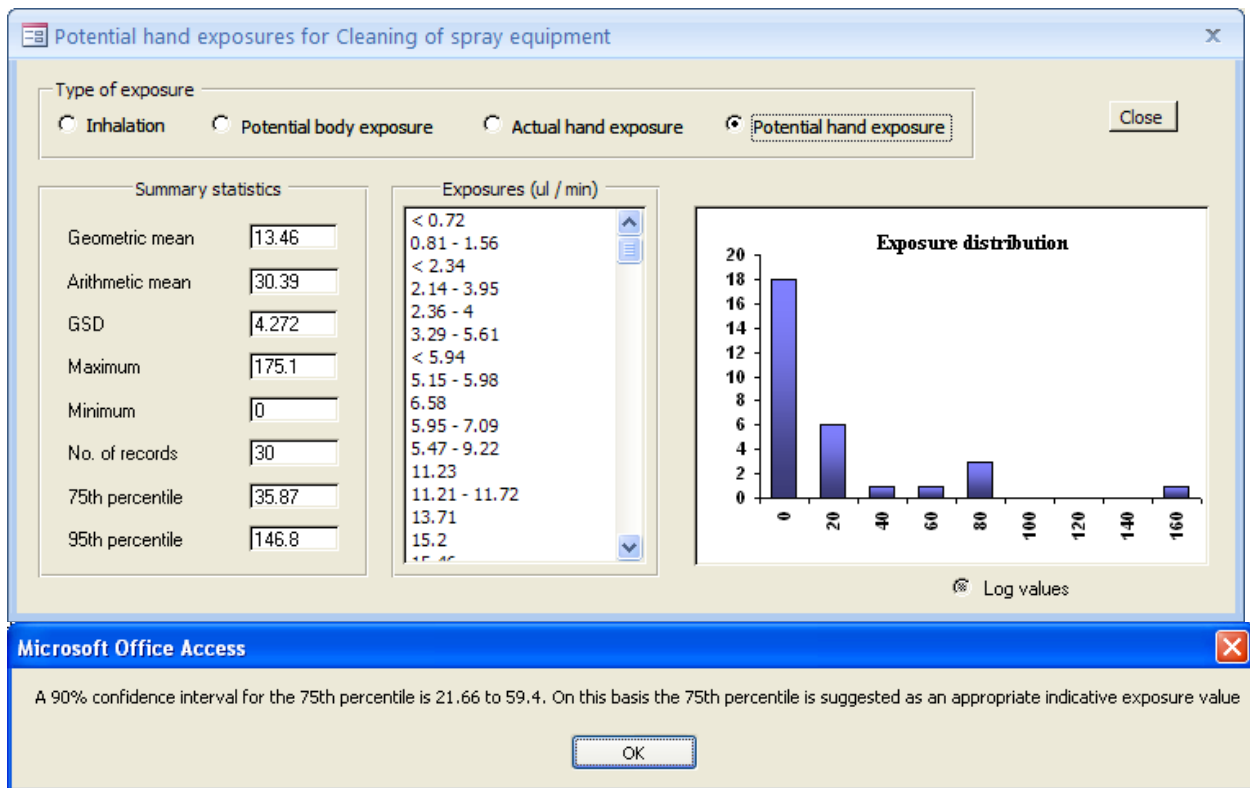
This task was measured in mainly SME. Cleaning the spray gun is carried out in many different ways depending on the car body repair shop. Usually, the spray gun is cleaned with water and later the parts that still remain dirty are rubbed with paper, rag or brush, using water or any cleaning solution. The mean sampling time was 3.7 minutes. This scenario comprised several different activities. The main body regions exposed during the cleaning of the spray gun are the hands, though there might be splashes to other parts of the body. (INSHT)

Uncertainty factor: 1.0

Number of exposure: 30

Reference: Delgado P., Porcel J., Abril I., Torres N., Teran A., Zugasti A. (2004) Potential Dermal Exposure during the Painting Process in Car Body Repair Shops. Annals of Occupational Hygiene (48) 229-236.





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