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HEEG Opinion on

An approach to identification of worst-case human exposure scenario for PT6

"This Opinion does not take into account any revisions (subsequent to 10 September 2012) of human factor values"

This document was prepared by CZ, FR and UK in cooperation with HEEG.

1. Background

At TM IV 2010 during discussions on the first PT6 substance, it was noted that this active substance (a.s.) would be present in a wide rage of products through its use as an in-can preservative. The range of products listed in Doc IIB were: waterborne coatings, polymer dispersions, filler dispersions, pigment slurries, solutions and dispersions of glues and thickeners, concrete additives, construction materials, detergents, cleaners, textile processing chemicals, paper and leather treatment agents and other aqueous formulations.

During the TM's discussions, it was acknowledged that it would be resource intensive to assess the exposures to the a.s. from use of all PT6 products it would be present in. It was recognised that an efficient way to assess the risks from uses of the a.s. as PT6 would be to try to determine from which uses exposure would be greatest, i.e. to try to determine which particular product – or small number of products – would give worst-case exposure assessments for the in-can preservatives use in PT6 products. If these worst-case assessments were acceptable, then it might be presumed the presence of the a.s. in other products would also be acceptable without having to carry out a specific exposure assessment for all the proposed products containing the a.s. as an in-can preservative.

In general, it is acknowledged that one product might give the worst-case primary exposure but that the worst-case secondary (indirect) exposure could apply to another product in the range of products containing the in-can preservative. For example, the worst-case **primary** exposure might be for application in a paint by brush but, the worst case for **secondary** exposure applies to the use of the in-can preservative in a detergent for washing of plates/cutlery etc.

Therefore, to assess an in-can preservative, we would need to: **(a)** select the product use which gives the worst-case **primary** exposure; and **(b)** select the product use which gives the worst-case **secondary** exposure. For proper worst case(s) of scenarios identification the following must be taken into account for all identified PT6 products:

Concentration of the PT6 substance in any concentrate made available for use (e.g. an additive for concrete)
Concentration of the PT6 substance in the in-use formulation (e.g. a ready-for-use paint)
Who is to be exposed by **primary** exposure (e.g. a professional, a non-professional or both)
Who is to be exposed by **secondary** exposure (e.g. a professional, a non-professional or both).

For primary and for secondary exposure, one would need to identify:
Routes of exposure – oral, dermal, by inhalation (a person could be exposed by one or more of these routes).
Duration and frequency of exposure via all the pertinent routes and will the exposure be acute/short-term, medium-term or long-term.
From the **recommended/usual/foreseeable** use of the product containing the PT6 substance, will potential exposure be reduced by protective clothing and/or engineering controls.
The absorption of the PT6 substance into the human body – via the identified potential routes - **from the in-use product**.

This paper provides generic guidance to Applicants and Member States on how to identify worst-case PT6 products and their uses, using as an example the case of an in-can preservative. The exposure and risks associated with these worst-case products/uses can then be addressed in detail using accepted models, e.g. those in the TNsG/User Guidance on Human Exposure to Biocidal Products, BEAT, ConsExpo etc. as up-dated by the Manual of Technical Agreements. Applicants and Member States wishing to propose other methods for assessment may do so as long as these other methods are substantiated, well documented and in line with the general principles of this HEEG guidance.

2. Proposal for the way forward for identification of the safe worst-case primary exposure scenario for PT6 treated products

2.1. Screening using RISKOFDERM calculator

To solve this complex issue experience is needed. For primary dermal exposure of professionals such experience is concentrated in RISKOFDERM program (Warren *et al*., 2006[1]).

The *RISKOFDERM* model was chosen as it draws on a large database of results collected between 2000 and 2004 when the project was carried out by a consortium of 15 partner institutes from 10 EU Member States. It contains more than 600 potential hand and body exposure samples from a wide range of industrial sectors. The information about exposure determining parameters obtained by questionnaires and the measured exposure data were used to develop a validated predictive model for estimating potential dermal exposure. Due to the large database from various exposure scenarios, the model is suitable for predicting exposure to biocides.

The RISKOFDERM project categorized exposure scenarios using a task-based approach into so-called dermal exposure operation units or DEOs. It defines 6 such DEOs.

1) Handling of (contaminated) objects (mixing filling)
2) Manual dispersion of products, (e.g. onto or over a surface by hand)
3) Dispersion of products with a hand-held tool (e.g. brushing, rolling)
4) Spray dispersion of a product (e.g. onto or over a surface)
5) Immersing of objects into a product
6) Mechanical treatment of solid objects (e.g. grinding, sawing)

2.2. Method

The detailed description of the approach followed is reported in Appendix I.

[1] Warren, ND, Marquart, H, Christopher, Y, Laitinen, J, van Hemmen, JJ (2006) Task-based dermal exposure models for regulatory risk assessment. *The Annals of Occupational Hygiene* 50(5), 491–503

2.3. Proposed step-by-step procedure

1) Among all the possible scenarios, those where the PT6 product is used undiluted in large amounts or/and where a whole shift exposure (i.e. 8 hours) can be assumed are candidates for the worst-case scenario and other scenarios should be excluded from further considerations at this step;

2) Calculate per shift dermal load using relevant DEOs; use 100% dermal absorption for calculation of systemic dose; use the 50th percentile of dermal load for long-term scenario and the 80th percentile or the highest realistic percentile for short-term scenario; use the lowest/usual efficacious concentration of the a.s. assumed from efficacy tests; no dilution should be used at any stage; where relevant add inhalation exposure. If the risk is acceptable for the identified worst case, no further refinement is needed. If not, proceed to step 3);

3) Instead of using 100% dermal absorption, use a single percentage value derived from available studies for the worst case identified in 1). Make sure that the used value covers all the dermal exposure scenarios envisaged. If the risk is acceptable, no further refinement is needed. If not, proceed to step 4) (steps 3) and 4) can be used interchangeably according to available information);

4) Use the worst-case dilution rate, if possible, that covers all the scenarios envisaged and thus should not change the identified worst-case scenario. If the risk is acceptable, no further refinement is needed. If not proceed to step 5);

5) Include PPE in your calculation. If the risk is acceptable, no further refinement is needed. If not proceed to step 6);

6) Use the dilution rate relevant for the individual scenarios. Be aware that it can change the identified worst-case scenario. If the risk is acceptable for the worst case, no further refinement is needed. If not, proceed to step 7);

7) If different from the dermal absorption rate used in 3), use the individual dermal absorption rate for the worst-case scenario. Again, this could lead to change in the worst-case scenario identified.

2.4. Conclusion

In many cases, the calculator will be sufficient for identifying the worst-case primary exposure scenario (in terms of internal dose), as it can often be reasonably argued that inhalation exposure will be negligible compared to dermal internal exposure. However, there may be cases where judging if the inhalation exposure, differences in dermal uptake for different PT6 treated products, and difference in PPE between different scenarios will be decisive factors. In some of such cases, inhalation exposure will have to be assessed, e.g. by the ART and added to the worst-case candidates. In other such cases the procedure will have to follow beyond point 3) above. Caution should be exercised when stating that the worst case for professional use covers also the non-professional one. It can be the case when PPE are not necessary to ensure internal exposure of professionals below AEL and/or where the amount of the product used up by professional is significantly (e.g. several fold) higher than that used up by the non-professional. It should also be borne in mind that non-professionals, unlike professionals, are often exposed only several times per year for short periods (e.g. brush-painting 4 times per year; US EPA 1996) and acute/short-term AEL is relevant for them. In light of these considerations, a case by case approach following this Opinion and expert judgement should be taken into account.

3. Proposal for the way forward for identification of the worst-case secondary exposure scenario

3.1. Looking for the worst-case scenario

The secondary/indirect exposure[2] will be determined by: the a.s. concentration in the in-use product; the amount of the a.s. deposited on to the item (e.g. wall etc.) treated with it; the likelihood of contact between consumer and the item; the intensity, frequency and duration of such contact (i.e. acute/short-term or chronic exposure); and for volatile substances, by assumed ventilation rate for indoor use.

As an example, a product for which the following uses where identified is used:

No	**Field of use envisaged**	**Likely concentration at which a.s. will be used**
1	<u>Paints and Coatings</u> – Used to control the growth of bacteria and fungi in water-based paints and coatings in storage containers before use.	7.5 to 30 ppm total a.s.
2	<u>Liquid Detergents</u> - Used to control the growth of bacteria and fungi in the preservation products such as liquid fabric softeners, dishwashing detergents, liquid laundry detergents, liquid soaps and hand cleaners, and the surfactants used in formulating such products.	6 to 15 ppm total a.s.
3	<u>Fuel Preservation</u> – Used to control the growth of fungi and bacteria in liquid hydrocarbon fuels and oils, and any associated water bottom phase, including crude oils, aviations fluids, kerosene, heating oils, residual fuel oils, coal slurries, liquefied petroleum gases, petrochemical feed stocks, and diesel fuels.	1.5 to 6 ppm total a.s.
4	<u>Textiles, Leathers and Inks</u> – Used to control the growth of fungi and bacteria in textile (woven and non-woven, natural and synthetic) processing chemicals, inks (lithographic, photographic, ink-jet fluids), and all chemicals used in the leather process industry.	6 to 30 ppm total a.s.
5	<u>Polymer Latex Preservation</u> - Used to control the growth of bacteria and fungi in the manufacture, storage, and transport of synthetic and natural polymer lattices and industrial biopolymers.	7.5 to 50 ppm total a.s.
6	<u>Adhesives and Sealants</u> - Used to control the growth of bacteria and fungi in water-soluble and water-dispersed adhesives and tacktifiers in storage containers before use.	7.5 to 30 ppm total a.s.

[2] Secondary/indirect exposure is defined as exposure of non-users (e.g. the general public) to residues of biocide from treated materials or articles, e.g. painted surfaces, textiles and surfaces washed/cleaned with detergents, food packaging.

7	Mineral Slurries - Used to control the growth of bacteria and fungi in aqueous-based inorganic/mineral slurries and inorganic pigments which are formulated into paints, coatings and paper.	10 to 30 ppm total a.s.
8	Electro-Deposition Coatings – Used to control the growth of bacteria and fungi in coatings applied by an electro-deposition process and associated rinse systems.	6 to 50 ppm total a.s.
9	Household (HH) and Industrial and Institutional (I&I) – Used to control the growth of bacteria and fungi in products used for car care, floor care, waxes, hard surface cleaners, pre-moistened sponges or mops, and the surfactants used in these types of products.	6 to 25 ppm total a.s.
10	Functional Fluids – Used to control the growth of bacteria and fungi in brake and hydraulic fluids, antifreeze, corrosion inhibitors, fuel additives, spinning fluid, and fountain solutions.	6 to 30 ppm total a.s.

Based on the above assumptions, it is possible to exclude from the worst-case candidates the following envisaged uses: *Fuel Preservation*, *Textiles, Leathers and Inks*, *Adhesives and Sealants*, *Mineral Slurries*, and *Functional Fluids*.

For *Fuel Preservation, Polymer Latex Preservation, Electro-Deposition Coatings* and *Functional Fluids,* contact with the treated material by non-users, if any, shall be lower than potential worst-case candidates (e.g. contact with electro-coated item cannot be fully excluded, but the surface of the contact will probably be much lower than that of painted walls).

For *Adhesives and Sealants*, the surface available for contact shall be again limited, e.g. adhesives on wall paper, when compared to a painted wall.

Electro-Deposition Coatings can be dismissed as well as mineral slurries. The slurries are formulated to paints, thus the active substance will be dilute compared to the paint itself.

In light of these considerations, subgroups of *Paints and Coatings*, *Liquid Detergents*, *Household (HH) and Industrial and Institutional (I&I)* are worst-case candidates.

For *Paints and Coating*s, paints treated with PT6 product that are used undiluted can lead to significant secondary exposure, especially in children/infants due to their behaviour and high ratio between pulmonary ventilation rate. Contact with the a.s. is likely, and can be frequent and intense for freshly painted rooms, whereas it is expected to be less pronounced in rooms some time after painting.

Liquid Detergents and *Household (HH) and Industrial and Institutional (I&I) floor care products*, though used diluted, could be a source of the a.s., especially for children. Although dilution is assumed, unlike paints, these products are used repeatedly, if not on a daily basis. Contact with the a.s. is likely and can be frequent, but not very intense, due to dilution.

3.2. Evaluation of secondary exposure in various treated materials

The evaluation of indirect non-user exposure to the a.s. in the various treated materials was carried out by FR. The detailed calculation is provided in Appendix II.

3.3. Conclusion

The exercise described in Appendix II, which is a mere example, takes into account the in-use concentration of the product. In this example, the worst-case PT6 secondary exposure scenario has been identified as the short-term exposure of a child in a freshly painted room. The following steps can be considered:

1) if the short-term exposure value for a child in a freshly painted room is below the $AEL_{long\text{-}term}$ value, then no further evaluation is needed;
2) if this short-term exposure for the child is above the $AEL_{long\text{-}term}$, then long-term exposure of a child in a painted room must be calculated and compared to the $AEL_{long\text{-}term}$;
3) if the short-term exposure for the child is lower than the $AEL_{long\text{-}term}$ and the acute/short-term dose is lower than the $AEL_{short\text{-}term}$, then a worst case is identified as safe for all uses.

APPENDIX I

Proposal for the way forward for identification of the safe worst-case primary exposure scenario for PT6 treated products

1. Method

The DEOs defined in RISKOFDERM cover most (if not all) primary exposure scenarios for in-can preservatives when used by professional industrial users. Using parameters (mean values) determining the exposure given in Warren *et al.*, 2006 for individual DEOs, the following formulas can be compiled:

DEO 1:

Ln (PER) = **-** 1.12 + 0.93 (-0.74 for automation) x ln(V) + 3.4 (liquid) + 1 (little aerosol) + 2 (a lot of aerosol, dusty) **+** 1 (no ventilation) - 1.23 (infrequent contacts) **-** 1 (light contacts)

DEO 2:

Ln (PER) = + 6.7 + 0.38ln(V) + 3.5 (frequent contacts, not necessarily limited to hands) **-** 3.4 (no hand dipping) – 2.5 (infrequent contacts) - 1.5 (handle > 1 m)

DEO 3:

Ln (PER) = + 4.11 + 1.2xln(V) + 1.2 (handle < 30cm) + 1 (upwards) + 1 (oil) + 2.5 (body contact) **-** 1.2 (viscous liquid, brushing) **–** 1.2 (downward)

DEO 4:

Ln (PER) = +3.18 + 0.36xln(V) + 0.61 (volatile liquid, powder) + 1 (upwards) + 1.5 (also body) **-** 0.9 (ventilation, outside) **–** 1.5 (protective shield) – 1 (downward) – 1.46 (extension > 1 m)

DEO 5:

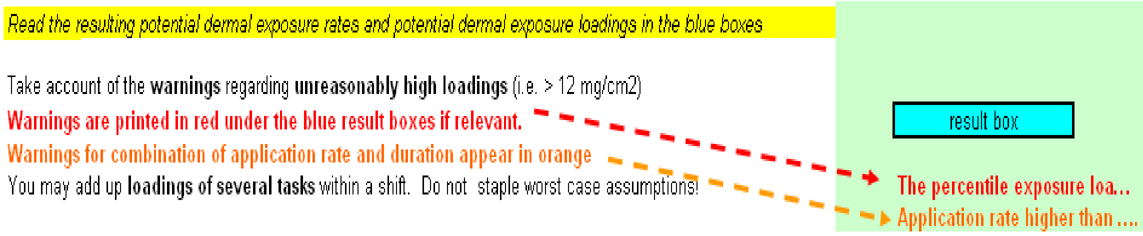
Ln (PER) = +2.04 +1.7 (handle < 30cm, big objects) + 2 (frequent hand dipping) - 1.4 (ventilation) **–** 1.6 (handle > 100cm or only small objects) – 2 (body)

For exposure calculations RISKOFDERM potential dermal exposure model version 2.1t(1).xls (hereafter referred to as the calculator) will be used. This calculator is validated using the above-mentioned formulas.

Validation of the calculations of the spreadsheet

Spreadsheet results were compared with calculations with the same input values using a pocket calculator and the equations taken directly from Warren et al. (2006). These comparisons (for two or three sets of inputs per DEO Unit) showed only very minor (rounding) differences at the last digits of some of the calculated percentiles It was concluded that the calculations were correct.

The calculator calculates a potential dermal exposure rate distribution from the given input values. It is proposed that for determination of the worst-case scenario the 50th percentile[3] is used for long-term scenarios. This is primarily due to the fact that often higher percentiles have not even been measured and are thus considered as unrealistic. The calculator uses messages to warn against using unrealistic input values:



2. Professional exposure: looking for the worst-case scenario

It can be argued that the best candidates for the worst-case scenario are those where the product treated with PT6 are used undiluted and the whole shift exposure can be assumed. The ranges of measured data in the RISKOFDERM project can be used as a guide and are summarized in the following table lifted from the calculator:

Validity ranges of the model

The model is valid for the situations fitting with the situations covered in the underlying data sets. Outside of these situations the validity is not sure.

In the next table the boundaries of the measured data for use rate and duration are presented per process.

	Use rate (L/min or kg/min)		Duration (minutes)		
Process	Solids	Liquids	Solids	Liquids	Remarks
Filling, mixing and loading	0,56 - 225	0,008 - 257	1 - 20	0,33 - 125	
Wiping	---	0,0017 - 1,18	---	5 - 35	There is also a boundary to the combination of use rate and duration
Dispersion hand-held tools	---	0,0001 - 1,1	---	1 - 445	There is also a boundary to the combination of use rate and duration
Spraying	0,02 - 0,12	0,04 - 50,4	4 - 90	3 - 600	Combination of high use rate and high duration was very rare
Immersion	---	---	---	4 - 483	
Mechanical treatment	---	---	18 - 154	47 - 214	

Changes compared to version 2.0 of the model

Version 2.1 contains the improvements made after the evaluation of the correct flow of the model and the correctness of the texts in the model.

Several changes were made, generally to correct (textual) errors. Example: in the input sheet on Immersion, one of the questions mentioned "spraying" instead of "immersion".

More relevant changes are:

The whole shift condition is approximately fulfilled for the scenarios 1), 2) and 3). However, high dilution rate of the PT6 treated product is assumed for immersion and hence only brush painting and spraying are candidates for the worst-case scenario.

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[3] 50th percentile is not to be used for other models such as BEAT etc. Nor is this 50th percentile to be used for regular risk assessments.

Dispersion hand-held tools	Dispersion with hand-held tools refers to:	dispersion of products or substances by using a brush, comb, rake, roller or other tool with a handle; the purpose is to spread the product over a surface.
Spraying	Spraying refers to:	spray application of products such as paints, glues, cleaning agents hosing down with water using a normal water line under normal pressure is <u>not</u> included.
Immersion	Immersion refers to:	Immersing objects in chemicals, where the exposure is to the chemicals in which the product is immersed and not to substances coming from the object.

Thus brush painting and spraying is to be compared. For the comparison it is essential to <u>use realistic input values</u> and parameters determining exposure (e.g., handle length, application direction etc):

Brush painting: application rate 79 ml/min (i.e. derived from 38 L = 95th percentile - used up in 480 min; US EPA 1996, as cited in the TNsG Human Exposure, Pt. 2, p. 69), major application direction: level and overhead, handle < 30 cm, duration: 480 min: dermal exposure 11774 (50th percentile) exposure hands: 4574 mg (50th percentile), exposure body 7200 mg (50th percentile).

Spraying (airless): 118 ml/min (57 L used per surface area of 260 m^2 higher percentile based on judgment OPPHED - Office of Pollution Prevention, Health Effects Division), major application direction: level, indoors, 480 min. potential dermal exposure: 7786 mg; hands 2170 mg (80th percentile); body 5616 mg (80th percentile).

Inputs		Warnings
Where is the spray application done?	Indoors	
Is spraying done overhead, level or downward?	Level	Back
What is the direction of airflow that comes from the source?	Away from the worker	Print
Is the worker segregated from the source?	No	
How far is the source from the worker	Up to 1 meter	
What is the volatility of the carrier liquid?	Not highly volatile	
Is the product sprayed a liquid or a solid?	Liquid	
Application rate of product (L/min or kg/min)	0.118	
Cumulative duration of scenario per shift (min)	480	

See the guidance for some remarks on different criteria for the performance of the model

Results - percentiles	Hands (820 cm^2)		Body (18720 cm^2)		
	Hands rate (mL/min)	Hands loading (mg)	Body rate (mL/min)	Body loading (mg)	
10.00%	0	218	1	565	
20.00%	1	480	3	1243	
30.00%	2	848	5	2195	
40.00%	3	1378	7	3567	
50.00%	5	2170	12	5616	
60.00%	7	3416	18	8842	
70.00%	12	5552	30	14371	
80.00%	20	9801	53	25371	
90.00%	45	*21559*	116	55804	May be unrealistic
95.00%	86	*41336*	223	106997	May be unrealistic
99.00%	292	*140162*	756	362808	May be unrealistic

Assuming dermal uptake of 100% and using the lowest efficacious concentration of the a.s. of 0.1% (w/w) determined in efficacy tests, the systemic doses of the active substance are calculated as follows:

Brushing: 11774 x 0.001/60 = 0.196 mg/kg bw/day

Spraying: 7786 x 0.001/60 =0.129 mg/kg bw/day

Both doses exceed the AEL of 0.07 mg/kg bw/day. Therefore, a refinement of the exposure estimate of this scenario is required, taking into account, for example, dermal absorption value and PPE.

(1) Realistic dermal uptake is to be factored in. Dermal absorption determined in the *in vitro* study was 10%. However the dose per cm^2 used in the study was 120 $\mu l/cm^2$, whereas the dose per cm^2 during exposure is much lower (e.g. 2170 mg/ $840cm^2$ =2.6 mg/ cm^2 = 2.6 $\mu l/cm^2$ (assuming density of $1g/cm^3$ for the sake of the argument). Extrapolation using dermal penetration coefficient determined in the study showed that 60% dermal absorption can be used to cover all the exposure scenarios (based on the physico-chemical properties of the substance it is assumed that dermal uptake from aqueous solutions shall cover all other solution- types).

In light of these considerations, the doses are now:

Brushing: 0.6 x 11774 x 0.001/60 = 0.118 mg/kg bw/day

Spraying: 0.6 x 7786 x 0.001/60 =0.078 mg/kg bw/day

Both doses still exceed AEL of 0.07 mg/kg bw/day.

(2) As both doses still exceed the AEL value, commonly used coveralls are to be factored in. Coveralls will stop, for example, 50% of the product getting to the body skin.

In light of these considerations, the doses are now:

Brushing: 0.6 x 0.001(4574 + 7200 x 0.5)/60 =0.082 mg/kg bw/day

Spraying: 0.6 x 0.001 (2170 + 5616 x 0.5)/60 = 0.049 mg/kg bw/day

Spraying no longer leads to the dose exceeding AEL, while brushing still exceeds AEL.

Conclusion: As the second worst case (i.e. spraying) does not lead to dose exceeding the AEL value (without including exposure on inhalation) at step **(2)** the task of identifying the worst case can be considered finished, concluding that brushing with undiluted PT6 treated product is the worst case. The fact that PPE (e.g. gloves) or dilution needs to be applied for brushing to make it a safe use will not change the outcome as all other uses (except spraying) might be safe without PPE or dilution **(2)**.

3. Non-professional exposure: comparison with professional exposure

For comparison non- professional exposure is given below:

80^{th} percentile is used for non-professionals as only short-term exposure scenario is assumed (e.g. brush-painting 4 times per year; US EPA 1996). Non-professional exposure is compared with the $AEL_{short\text{-}term}$ value of 0.2 mg/kg bw/day.

Brush Painting: Non-professional application rate 16 ml/min application rate 7.6 L = 90^{th} percentile used up in 480 minutes US EPA 1996 major application direction: level and overhead, handle < 30 cm, duration: 480 min: dermal exposure 8038 – hand 5280 (80^{th} percentile), body 2758 (80^{th} percentile).

Spraying (airless) : 118 ml/min (39 L used per surface area of 260 m^2 higher percentile based on judgment OPPHED - Office of Pollution Prevention, Health Effects Division), major application direction: level, indoors, 480 min. potential dermal exposure: 35172 mg; hands 9801 mg (80^{th} percentile); body 25371 mg (80^{th} percentile).

The doses are now:

Brushing: 0.6 x 8038 x 0.001/60 = 0.08 mg/kg bw/day

Spraying: 0.6 x 35172 x 0.001/60 =0.35 mg/kg bw/day

For non-professionals, spraying is the worst case, but is regarded as unsafe for use without protection afforded by clothing. As the second worst case, i.e. brushing (without protection afforded by clothing), does not exceed $AEL_{short\text{-}term}$ of 0.2 mg/kg bw/day, there is no need for further steps. It can be assumed that exposure via inhalation is insignificant for painting with brush and will not result in exposure exceeding the AEL. Spraying with the undiluted product is not a safe use for non-professionals even without factoring in exposure via inhalation.

APPENDIX II

Evaluation of indirect exposure as a result of use of the active substance in the preserved products

1. Paint and coatings

Inhalation exposure – WPEM

Indirect inhalation concentrations exposures to child and adult residents of homes and/or offices painted with paint containing a.s. were estimated using the Wall Paint Exposure Model or WPEM (USEPA, 2001).

The 3 modelled WPEM exposure scenarios were as follows:

“RESADULT” = Adult resident in a house being painted

“RESCHILD” = Child resident in a house being painted

“OFFADULT” = Adult resident in an office being painted

The above populations were selected because the WPEM model contains default parameters for each of these use scenarios as summarized in Table 1.1.

The vapour pressure, molecular weight and weight fraction of the substance in the paint were entered into the model. All other parameters required for the model were obtained from the default scenario files in WPEM, with the exception that body weights for adults and children were set at 60 kg and 15 kg respectively, rather than the WPEM defaults of 71.8 kg and 20.3 kg, respectively. This change was made in order for the body weights to be consistent with the values used for other exposure scenarios in this assessment and in typical biocidal risk assessments in general.

Table 1.1 *Summary of inputs for WPEM default scenarios for indirect inhalation exposure to paint containing 30 ppm.*

Model Input	**“RESADULT”**	**“RESCHILD”**	**“OFFADULT”**
Type of Building	House	House	Low-rise office
Percent Painted	One bedroom (10%)	One bedroom (10%)	Entire floor (50%)
Painted Surface	Walls only	Walls only	Walls only
Painted Area	452 ft^2 (ca. 42 m^2)	452 ft^2 (ca. 42 m^2)	20,000 ft^2 (ca. 198 m^2)
Air exchange rate	0.45 /hr	0.45 /hr	1.0 /hr
Number of Coats	1 primer/1 paint	1 primer/1 paint	1 primer/1 paint
Paint Coverage	200/400 ft^2/gal (primer/paint) (ca. 4.9/9.8 m^2/L)	200/400 ft^2/gal (primer/paint) (ca. 4.9/9.8 m^2/L)	200/400 ft^2/gal (primer/paint) (ca. 4.9/9.8 m^2/L)
Number of Painters	1 professional	1 professional	10 professional
Application Rate/ Painter	0.85 gal/hr (3.22 L/h)	0.85 gal/hr (3.22 L/h)	0.85 gal/hr (3.22 L/h)
Priming vs. Painting	Paint same day	Paint same day	Paint same day
Total Duration	3.99 hr	3.99 hr	17.65 hr
Type of Paint	Latex flat	Latex flat	Latex flat
Chemical			
Weight Fraction active substance	0.00003 primer 0.00003 paint	0.00003 primer 0.00003 paint	0.00003 primer 0.00003 paint
Exposed Individual	Adult occupant	Child occupant	Adult occupant
Gender	Non-specific	Non-specific	Non-specific
Location During Painting	In building, not in painted area	In building, not in painted area	Not in building
Total Exposure Events in Lifetime	50	10	10
Years in Lifetime	75	10	75
Body Weight	60 kg	15 kg	60 kg
Length of Model Run	20 days	20 days	20 days

The model estimated inhalation exposures for the 3 default scenarios and the results are summarized in Table 1.2.

The ADD (average daily dose) is estimated over the entire period of exposure (i.e., 75 years for adults or 10 years for children).

The APDR (acute/short-term potential dose rate) is the highest 24-hour dose rate for an exposed individual.

The highest 15-minutes and 8-hr airborne predicted concentrations (C15-min and C8-hour) and Average Daily Concentration (ADC) of a.s. are also reported (mg/m^3).

Table 1.2 *Summary of indirect inhalation exposures estimated using default scenarios in WPEM for paint and primer containing 30 ppm active substance*

	"RESADULT"	**"RESCHILD"**	**"OFFADULT"**
Short-Term APDR (mg/kg/day)	1.29×10^{-3}	5.38×10^{-3}	9.71×10^{-4}
Long-Term ADD (mg/kg/day)	1.48×10^{-5}	5.84×10^{-5}	2.42×10^{-6}
$C_{15\text{-min}}$ (mg/m^3)	1.13×10^{-2}	1.13×10^{-2}	1.00×10^{-2}
$C_{8\text{-hour}}$ (mg/m^3)	9.42×10^{-3}	9.65×10^{-3}	9.71×10^{-3}
ADC (mg/m^3)	7.17×10^{-5}	8.52×10^{-5}	8.06×10^{-6}

Inhalation exposure – Conclusion

The WPEM estimated concentrations for the three scenarios above which were modelled assuming 0.45 ACH to 1.0 ACH (Air Changes per Hour), and 208 m^3 to 4500 m^3 room volume.

The highest C8-hour (mg/m^3) of 9.71×10^{-3} mg/m^3 has been considered for the long-term exposure assessment for adult and children.

Other assumptions are taken from the Chronic Reference scenarios (scenario 2) from the User Guidance page 52:

- Inhalation rate for an adult in a moderately ventilated room: 18.5 m^3 air/18h, i.e. 24.7 m^3 air/24 h day;

- Inhalation rate for a child in a moderately ventilated room: 4 m^3 air/18h, i.e. 5.3 m^3 air/24 h day

So calculated systemic doses for medium-term exposure are: 0.00971 x 24.7 / 60 = 4.00 $\times 10^{-3}$ mg/kg bw/day for adults and 0.00971 x 5.3 / 15 = 3.43 $\times 10^{-3}$ mg/kg bw/day for children.

The final estimates for short-, and long-term, using the results from the monitoring study, are reported in Table 1.3.

Table 1.3 *Indirect exposure via inhalation to occupants of painted room*

	Inhaled concentration [mg a.s./m^3]	Systemic dose to Adults [mg a.s. / kg bw / day]	Systemic dose to Children [mg a.s. / kg bw / day]
Long-term	9.71×10^{-3}	4.00×10^{-3}	3.43×10^{-3}

RMS considers that the long-term exposure estimates is the most relevant for the risk assessment, and will be reported later.

Dermal exposure from contact with active substance in wet and dry paint

An additional source of potential indirect exposure to a.s. in paint is post-application dermal contact of a freshly painted wet surface by a child. This sort of post-application indirect exposure is considered short-term.

According to the TNsG (Part 3, page 37), a child may contact 200 cm^2 of wet paint, and 50% of the paint on the coated surface may be dislodged and adhere to the skin.

The paint layer is assumed to be 0.1 cm thick with a typical density of 1.2 g/cm^3, equivalent to 0.036 mg a.s./cm^3 paint (containing 30 ppm a.s).

The dermal penetration of the a.s. through skin is assumed to be 77.5%.

The reasonable worst-case short-term exposure for a 15 kg child with 200 cm^2 of hand surface area touching the paint containing 30 ppm a.s. is calculated as:

Hand deposit concentration = 30 ppm a.s.

Systemic dose (dermal) = 0.1 cm x 0.036 mg as/cm3 x 50% dislodged x 200 cm2 x 77.5% / 15 kg bw = 1.86 x10-2 mg/kg bw/day

For long-term indirect dermal exposure to a.s. in paint and coatings from a dry coated surface containing a.s., the same assumptions as for the short-term scenario above are used, with the exception that 3% of the available a.s. is assumed to be dislodged from the dry coated surface[4], and a larger contacted surface area of 1,000 cm^2 is assumed[5] to consider repeated contacts (10 contacts per day). The calculated reasonable worst-case indirect chronic exposure for this scenario is as follows:

[4] 3% transfer efficiency reported in TNsG v.1 part2 p.203 for painted wood.

[5] Assumption proposed by the Applicant and thought realistic by RMS, equivalent to 10 contacts of the palms (100 cm^3) with the wall. No reference value can be found for this scenario.

Hand deposit concentration = 30 ppm a.s.

Systemic dose = 0.1 cm x 3% dislodged a.s. x 0.036 mg a.s./cm3 x 1,000 cm2 x 77.5% / 15 kg bw

=

5.58 x 10-3 mg/kg bw/day

Dermal exposure following contacts with painted walls is not assessed for adults as the contact frequency is much lower.

<u>Ingestion of paint by child</u>

In theory, a small child could intentionally ingest paint chips or coated surfaces containing dried paint with in the coating.

For the purposes of a worst-case exposure scenario, a child with "pica" - the habitual practice of eating non-food objects (such as soil and paint) - is assumed to ingest as much as 10 grams of paint per day[6].

It is also assumed that 100% of the ingested a.s. is absorbed[7] into the body of the 15 kg child.

Assuming the active substance is concentrated by a factor of 2 as the paint dries[8] (i.e., 60 ppm w/w in the dried paint), the systemic exposure in this scenario is calculated as follows:

0.0060% x 10g/day x 100% / 15 kg = 4 x10^{-5} mg/kg/day

This scenario relates short-term exposure and covers conservatively the potential hand-to-mouth transfer of paint, which is not estimated separately.

Table 1.4 *Exposure estimates for child in a fresh painted room (Short-term exposure)*

	Systemic dose (mg a.s./kg bw/d)
Child occupying a painted room (inhalation)	3.43 x 10^{-3}
Child in contact with a freshly painted surface (dermal)	1.86 x 10^{-2}
Child ingesting paint chips (oral)	4 x 10^{-5}
Total systemic exposure (mg a.s./kg bw/day)	2.21 x 10^{-2}

[6] EPA's Child-Specific Exposure Factors Handbook, section 5.4
[7] Oral absorption determined in Document IIA rounded to 100% in the calculations.
[8] A typical latex paint contains about 50% solids, according to ConsExpo Paint products fact sheet.

__Table 1.5__ Exposure estimates for child in a dry painted room (Chronic exposure)

	Systemic dose (mg a.s./kg bw/d)
Child occupying a painted room (inhalation)	3.43×10^{-3}
Child in contact with a dry painted surface (dermal)	5.58×10^{-3}
Total systemic exposure (mg a.s./kg bw/day)	9.01×10^{-3}

__Table1.6__ Paint and coating uses indirect exposure summary

Tier	**Inhalation exposure**		**Dermal exposure**		**Oral exposure**	**Total exposure**
PPE	External concentration	Systemic dose	Deposit on skin (hands)	Systemic dose	Systemic dose	Systemic dose
	mg a.s. / m^3 air (8-hrs TWA)	mg a.s. / kg bw /day	ppm a.s.	mg a.s. / kg bw /day	mg a.s. / kg bw /day	mg a.s. / kg bw /day
Task – time frame:	**Adult occupying a painted room – Chronic inhalation exposure**					
Tier 1: Without PPE	2.91×10^{-2}	4.00×10^{-3}	Not relevant	Not relevant	Not relevant	4.00×10^{-3}
Task – time frame:	**Child occupying a painted room – Chronic inhalation exposure**					
Tier 1: Without PPE	2.91×10^{-2}	3.43×10^{-3}	Not relevant	Not relevant	Not relevant	3.41×10^{-3}
Task – time frame:	**Child in contact with a freshly painted wet surface – Short-term dermal exposure**					
Tier 1: Without PPE	Not relevant	Not relevant	30	1.86×10^{-2}	Not relevant	1.86×10^{-2}
Task – time frame	**Child in contact with a freshly painted dry surface – Chronic dermal exposure**					
Tier 1: Without PPE	Not relevant	Not relevant	30	5.58×10^{-3}	Not relevant	5.58×10^{-3}
Task – time frame:	**Child ingesting paint chips – Short-term oral exposure**					
Tier 1: Without PPE	Not relevant	Not relevant	Not relevant	Not relevant	4×10^{-5}	4×10^{-5}
Task – time frame:	**Total combined exposure – Child short-term exposure**					
Tier 1: Without PPE	2.91×10^{-2}	3.43×10^{-3}	Not relevant*	1.86×10^{-2}	4×10^{-5}	2.21×10^{-2}
Task – time frame:	**Total combined exposure – Child Chronic exposure**					
Tier 1: Without PPE	2.91×10^{-2}	3.41×10^{-3}	Not relevant*	5.58×10^{-3}	Not relevant	9.01×10^{-3}

*As for local dermal effect it is the concentration of the active substance during the event of contact that is relevant, combined exposure has only been assessed for systemic exposure.

2. Liquid detergents

<u>Dermal exposure from wearing clothes</u>

Residues of components of laundry detergents may remain on textiles after washing and could come in contact with the skin via migration from textile to skin. The quantity of residues migrated to skin can be estimated by ConsExpo, using method and parameters from the Cleaning Product Fact Sheet.

For this exposure estimate the terms are defined with the following values for the calculation:

A: Product (textile) amount worn per day	1000 g
F1: Weight fraction of substance in product	15 $x10^{-6}$ (ppm)
M: Amount of undiluted product used	115 g (laundry detergent)
F3: Percentage of detergent deposited on the fabric	20%
w: total weight of fabric	5 kg
F2: Percent weight fraction transferred from medium to skin	50%

Fraction of active ingredient in the textile (FL) = M x F1 x F3 / w

Substance migrated to skin = FL x F2

Substituting these values into the equation yields:

Fraction of active ingredient in the textile = 115 g x 15 ppm x 1000 x 20% / 5 kg = 0.069 mg a.s./kg textile

Substance migrated to skin = 0.069 x 50% = 0.0345 mg a.s.

Thus, assuming dermal penetration of the a.s. through the skin to be 77.5%, the estimated indirect dermal exposure for an adult with body weight 60 kg is :

Fraction of active substance in the textile: 0.069 mg a.s./kg

Systemic dose: 0.0345 x 77.5% / 60 = 4.46 $x10^{-4}$ mg a.s./kg bw/day

The same calculations can be done for a child with body weight 15 kg.

Fraction of active ingredient in the textile: 0.069 mg a.s./kg

Systemic dose: 0.0345 x 77.5% / 15 = 1.78 x 10-3 mg a.s./kg bw/day

Exposure to residual a.s. may be possible due to indirect or secondary exposure from clothes cleaning with detergents containing it. However, it is likely that due to its high water solubility, substance is not bound to textile but stays in the water phase, and that any trace residues present in wet textile will quickly degrade or evaporate during drying and ironing processes.

Oral exposure

Secondary exposure to PT 6 may occur when the general public use liquid detergent products containing the a.s.. Oral exposure may be possible form eating with utensils and dishware that have been washed with PT 6 preserved dishwashing detergents.

In addition, PT 6 biocides may be used in the preservation of several industrial and consumer products, which are used as raw materials for the manufacturing of food contact materials, including polymer lattices and mineral slurries. Therefore, the migration from the packaging material into food consumed by humans may occur. The assessment of the above-mentioned scenarios will not be taken into account in the present document, as it is being developed in the ongoing guidance document (Guidance on Estimating Transfer of Biocidal Active Substances into Foods) from DRAWG (Dietary Risk Assessment Working Group).

3. *Household (HH), and Industrial and Institutional (I&I)*

Inhalation exposure from a.s. evaporating from cleaned surfaces

The indirect inhalation exposure to active substance off gassed or evaporated from cleaned surfaces is considered insignificant due to the low end-use concentration (about 1 ppm or less) in diluted solutions, and the relatively small surface areas (in comparison to a painted room) cleaned with a detergent product.

Any potential inhalation exposure to the substance from cleaned surfaces would be many times less than that estimated from the indirect paint exposure scenarios which assumes an adult or child living in a room 24 hrs a day that has had the walls and ceiling coated with a paint containing 15 ppm a.s..

Dermal and oral exposure following contact with cleaned surfaces

Children are exposed to residues of preserved liquid detergents on cleaned surfaces, while crawling on these surfaces and ingesting by hand-mouth transfer.

Assuming that :

- the detergent product (containing 25 ppm a.s.) is diluted by factor 20[9] in the bucket (i.e. 250 ml in 5 litres), thus the applied solution contains 1.25 ppm (1.25 mg/L at density 1 or 1.25 x 10-3 mg/cm^3) of a.s.,

- the solution is applied on surface with a film thickness of 0.1 mm (0.01 cm), thus the surface concentration is 1.25 x 10^{-3} mg/cm^3 x 0.01 cm = 1.25 x 10^{-5} mg/cm^2,

[9] Default value from ConsExpo Cleaning Products Fact Sheet

- a 15 kg child contacts 6000 cm^2 of cleaned surface area with their bare skin and 30% of the a.s. dislodges to the skin[10],

- of the amount of a.s. contacting the skin, 77.5% is dermally absorbed, and 10% is ingested after transfer hand-mouth[11] and then absorbed with a rate of 100%,

the dermal and oral indirect exposure to children following use of preserved surface cleaners is :

Hand deposit concentration = 1.25 ppm a.s.

Dermal systemic dose = 1.25 x 10-3 mg a.s./cm3 x 0.01 x 30% x 6,000 cm2 x 77.5% / 15 kg =

1.16 x10-3 mg a.s./kg bw/day

Oral systemic dose = 1.25 x 10-3 mg ai/cm3 x 0.01 x 30% x 6,000 cm2 x 10% x 100% / 15 kg =

1.50 x 10-4 mg a.s./kg bw/day

As the surfaces are not cleaned every day, and the substance on surface is rapidly wiped off (e.g. by shoes) this exposure is considered to be medium-term.

Table 3.1 *Household (HH), and Industrial and Institutional (I&I) uses indirect exposure summary (medium-term exposure)*

Tier	**Inhalation exposure**		**Dermal exposure**		**Oral exposure**	**Total exposure**
PPE	External concentration	Systemic dose	Deposit on skin (hands)	Systemic dose	Systemic dose	Systemic dose
	mg a.s. / m^3 air (8-hrs TWA)	mg a.s. / kg bw /day	ppm a.s.	mg a.s. / kg bw /day	mg a.s. / kg bw /day	mg a.s. / kg bw /day
Task – time frame:	**Infant crawling on surface cleaned with treated detergents**					
Tier 1: Without PPE	Not relevant	Not relevant	1.25 ppm a.s.	1.16×10^{-3}	1.50×10^{-4}	1.31×10^{-3}

[10] Default value from ConsExpo Pesticide Products Fact Sheet, p.28.
[11] From ConsExpo: The hands form about 20% of the uncovered skin and 50% of the product on the hands is transferred to mouth.