APPENDIX 4.

INTERIM GUIDANCE FOR SELECTING DEFAULT INHALATION RATES FOR CHILDREN AND ADULTS

DEPARTMENT OF PESTICIDE REGULATION MEMORANDUM

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MEMO NO. HSM-00010

DECEMBER 1, 2000

Department of Pesticide Regulation

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M E M O R A N D U M

TO: Worker Health and Safety Branch Staff
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HSM-00010

FROM: Chuck Andrews, Chief
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[Original signed by C Andrews and G Patterson]

DATE: December 1, 2000

SUBJECT: Interim Guidance for Selecting Default Inhalation Rates for Children and Adults

The Worker Health and Safety and Medical Toxicology Branch jointly developed the attached document entitled "Interim Guidance for Selecting Daily Inhalation Rates for Children and Adults." This document supercedes Branch policies regarding the selection of default inhalation rates for children and adults to estimate acute and chronic exposures. The default rates in the document should be used when estimating inhalation exposures in exposure assessment and risk characterization documents when actual data are unavailable. These inhalation rates should be used for any documents currently under development and any future documents to be developed. If a document has gone through Branch or DPR peer review, the author should discuss with his or her supervisor whether revisions should be made. Authors do not need to revise completed documents.

If you have any questions, please contact your supervisor.

Attachment

cc: Dr. Tobi Jones, Assistant Director

Interim Guidance for Selecting Default Inhalation Rates for Children and Adults

(December 1, 2000)

Purpose

This Guidance Document addresses the selection of default daily inhalation rates (in term of m^3/kg/day) for adults and children for both acute and chronic exposures. These values should be considered to calculate exposures, regulatory limits, and other values which require inhalation rate measurements and when actual data are not available. These rates are interim values until more detailed analyses are conducted to determine the appropriate rates for different age groups, gender, and duration of exposure (*i.e.,* acute and chronic exposures).

Background

Daily inhalation exposure is calculated from the air concentration (amount of chemical/m^3 of air) and inhalation rate (e.g., m^3/kg/day). Since inhalation rate is generally not measured in exposure or toxicity studies, default values have been adopted based on available data. Historically, the Medical Toxicology (MT) Branch and Worker Health and Safety (WH&S) Branch have used different default inhalation rates because of different application needs and the resources and references used. For adult daily inhalation rates, the values used by the Branches were similar. The MT Branch used 0.26 m^3/kg/day and the WH&S Branch used 0.28 m^3/kg/day. The default daily inhalation rates for children were significantly different. WH&S Branch used a value of 0.74 m^3/kg/day for a 6-year old child to represent all children. This value was based on an U.S. EPA 1985 analysis (U.S. EPA, 1997). MT Branch used a mean value of 0.46 m^3/kg/day for 1-10 year old children based on the analyses by the International Commission of Radiological Protection (ICRP) (Snyder *et al.,* 1975).

In 1997, U.S.EPA presented recommendations for short-term activity-based and long-term inhalation rates in the revised Exposure Factors Handbook (U.S. EPA, 1997; Table 5-23). These rates were based on more recent analyses of studies (Adams, 1993; Layton, 1993; Linn *et al.*, 1992 and 1993; Spier *et al.*, 1992) of California only residents (except Layton, 1993).

MT Branch and WH&S Branch discussed the U.S. EPA recommendation and available databases. To ensure consistency between the Branches, staff agreed to develop one set of default daily inhalation rates for adults and children. The recommended interim values are presented in this Document.

Recommendations

1. For adults and children, when the duration of activity and activity pattern are specified or known, use recommended short-term rates for the appropriate population in U.S. EPA Exposure Factors Handbook (Table 5-23 in U.S. EPA, 1997) (Attachment 1 and 2).

2. For children, when duration of activity and activity pattern are **not** specified, use the default value of **0.59 m^3/kg/day** for infants since infants have the highest value among all children group when body weight is considered (Attachment 1).

Basis for default value: This rate is based on the inhalation rates (m^3/day) and body weights determined by Layton (1993). These rates were estimated from the food-energy intakes of individuals sampled in the 1977-1978 National Food Consumption Survey data. The rationale is that energy expenditures associated with basic metabolic requirements and physical activities equals food energy intake. Therefore, the energy content of a person's diet can be used to estimate his or her energy expenditures and related respiratory requirements.

The U.S. EPA adopted these as recommended long-term inhalation rates (m^3/day) for children in the Exposure Factors Handbook (U.S. EPA, 1997). When these rates are expressed in terms of body weights, the infants have the highest daily inhalation rate (0.59 m^3/kg/day for 4.5 m^3/day and 7.6 kg body weight). Therefore, DPR is selecting the infant inhalation rate as the default value to represent all children.

3. For adults, when the duration of activity and activity pattern are **not** specified, use the default value of **0.28 m^3/kg/day** for both genders.

   Basis for default value: These default inhalation rates are based on the activity pattern, inhalation rate per activity, and default body weights (Attachment 2). The activity pattern was based on specific activities reported for persons 18 years old and older in a survey conducted by the California Air Resources Board (Table 4.1; Wiley *et al., 1991*). The time spent in the activity categories were: 8.5 hours rest, 13.2 hours light, 1.4 hours moderate, and 0.27 hours of heavy activity (Attachment 3). The inhalation rates per activity were the mean of rates determined by Adams (1993) and Layton (1993). These rates were recommended in the U.S. EPA Exposure Factor Handbook for age's 19-65 years (U.S. EPA, 1997). These rates were: 0.4 m^3/hr (rest), 1.0 m^3/hr (light), 1.6 m^3/hr (moderate), and 3.2 m^3/hr (heavy). The default body weight was 71.8 kg as the mean body weight for ages 18<75 (Table 7-2 in U.S. EPA, 1997).

   The recommended long-term rates for adults, based on the analysis of the 1977-1978 NFCS data by Layton (1993), were not selected as default values. The rates of 12-17 m^3/day are lower than the 20 m^3/day default commonly used by regulatory agencies, including the U.S. EPA. Also, the direct measurement of activity patterns and inhalation rates are available for adults (*i.e.* Wiley et al., 1991 and Adams, 1993).

4. For both children and adult exposures, inhalation rates for specific age groups should be considered whenever it is appropriate. For example, a specific age group may be selected in an aggregate exposure assessment to ensure an age-correspondence across multiple routes or pathways.

5. When the long-term inhalation rates are used to estimate acute exposure, it should be explicitly stated in the risk characterization document that they contribute toward an under-estimation of exposure. Short-term high-end inhalation rates are likely to be higher than the amortized average value for long-term exposure.

6. In the future, the MT and WH&S Branches will conduct a more detailed analysis of the database using distributional methodology. This will require time and commitment from the staff of both Branches. Building a reliable database not only will lend support to a default point estimate of inhalation rate, but also facilitate a distributional analysis in the future.

7. Staff should consult their respective Branch Chief on the implementation of these recommended values. This Guidance Document is subject to revisions for the incorporation of new data and approaches.

References

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Linn, W.S., C.E. Spier, and J.D. Hackney, 1993. Activity patterns in ozone-exposed construction workers. J. Occup. and Med. Tox. 2(1):1-14.

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Wiley, J.A., J. P. Robinson, T. Piazza, K. Garrett, K. Cirksena, Y.T. Cheng, and G. Martin, 1991. Activity patterns of California residents. Contract No. A6-177-33. Final Report. Air Resources Board, Research Division, California Environmental Protection Agency, Sacramento, CA.

U.S. EPA, 1997. Exposure Factors Handbook Volume 1- General Factors. EPA/600/P-95/002Fa, August, 1997. Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C.

Attachment 1: Daily Inhalation Rates for Children.

When activity pattern is specified:			
Activity	Inhalation rate (m^3/ hour)[a]	Daily inhalation rate (m^3/kg/day)	
Rest	0.3	Depends on body weights and activity pattern selected for the age group of interest	
Sedentary	0.4		
Light	1.0		
Moderate	1.2		
Heavy	1.9		
When activity pattern is not specified:			
Age years	Mean body weight (kg)[b]	Inhalation rate (m^3/day)[b]	Daily Inhalation rate (m^3/kg/day)
Infants male/female	7.6	4.5	**0.59**
1-2 male/female	13	6.8	0.52
3-5 male/female	18	8.3	0.46
6-8 male/female	26	10	0.38
9-11 male 9-11 female	36 36	14 13	0.39 0.36
12-14 male 12-14 female	50 49	15 12	0.30 0.24
15-18 male 15-18 female	66 56	17 12	0.26 0.21

a/ Data from U.S. EPA (1997, Table 5-23) for short-term exposures and were based on analyses by Spier *et al*., 1992; Layton, 1993; Linn *et al*., 1992, and Adam, 1993.

b/ Data from Layton, 1993 (Tables 3 and 5) and recommended by U.S. EPA (1997) for long-term exposures.

Attachment 2: Daily Inhalation Rates for Adults.[a]

When activity pattern is specified:		
Activity	Inhalation rate (m^3/ hour)[a]	Daily inhalation rate (m^3/kg/day)
Rest	0.4	Depends on body weights and activity pattern selected for the age group of interest
Sedentary	0.5	
Light	1.0	
Moderate	1.6	
Heavy	3.2	

When activity pattern is not specified:			
Activity	Hours/day[b]	Inhalation rate (m^3/ hour)[a]	Inhalation rate (m^3/day)
Rest	8.5	0.4	20 m^3/day
Light	13.2	1.0	
Moderate	1.4	1.6	
Heavy	0.27	3.2	

Age years	Mean Body weight (kg)[c]	Inhalation rate (m^3/day)	Daily Inhalation rate (m^3/kg/day)
Both	71.8	20	**0.28**

a/ Data from U.S. EPA (1997, Table 5-23) for short-term exposures and were based on analyses by Layton, 1993 and Adam, 1993.
b/ Data from Wily *et al.,* (1991) and categorization of activities from OEHHA (2000).
c/ Mean body weight for ages 18<75 for both genders (Table 7-2 (U.S. EPA, 1997).

Attachment 3: Categorization of Specific Activities[a]

Rest (8.5 hours)	Light (13.2 hours)		Moderate (1.4 hours)	Heavy (0.27 hours)
Breaks	Main job	travel during work	cleaning house	active sports
night sleep	Travel to/from work	eating	outdoor cleaning	outdoor
naps/day	Food preparation	meal cleanup	car repair/	walking or
sleep	Clothes care	plant care	maintenance	hiking
think, relax	Animal care	other household work	other repairs	
	Helping/teaching	talking/reading	baby care	
	Other child care	at dry cleaners	child care	
	Travel, child care	personal services	indoor playing	
	Medical appointments	govt./financial services	outdoor playing	
	car repair services	other repair services	everyday shopping	
	other services	errands	durable/house shop	
	travel, goods/services	washing	music/drama/dance	
	medical care	help and care		
	meals at home	meals out		
	dressing	N.A. activities		
	travel, personal care	students' classes		
	other classes	homework		
	other education	travel, education		
	volunteer/helping	religious group		
	religious practice	child/youth/family		
	other organizations	travel, organizations		
	sports events	entertainment, events		
	movies	theatre		
	museums	visiting		
	parties	bars/lounges		
	other social activities	travel, events/social		
	hobbies	domestic crafts		
	games	computer use		
	travel, recreation	radio		
	TV	records/tapes		
	Read books	reading magazine/other		
	Reading newspaper	conversations		
	Writing	travel, communication		

a/ Based on activity (minutes/day) analyses of Wiley *et al.,* (1991) and categorization of activities of OEHHA (2000).