CHAPTER 4717

DEPARTMENT OF HEALTH

ENVIRONMENTAL HEALTH

HEALTH RISK VALUES

4717.8000 PURPOSE AND SCOPE.

Subpart 1 **Purpose.** The purpose of parts 4717 8000 to 4717 8600 is to establish health risk values (HRVs) and multimedia health risk values (MHRVs) for chemicals or defined mixtures of chemicals emitted to the ambient air

Subp. 2. **Scope.** The HRVs and MHRVs established in parts 4717 8000 to 4717 8600 are intended for use by public agencies or private entities in Minnesota as one set of criteria in evaluating risks to human health by chemical emissions to the ambient air. The chemicals and defined mixtures of chemicals included in parts 4717.8000 to 4717 8600 do not include every toxic chemical emitted to air

The HRVs and MHRVs were not developed for evaluation of workplace exposures. The Occupational Safety and Health Administration, United States Department of Labor, is responsible for regulating workplace exposures

Statutory Authority: *MS s 144 12*
History: *26 SR 1229*

4717.8050 DEFINITIONS.

Subpart 1 **Scope.** For the purposes of parts 4717 8000 to 4717 8600, the terms in this part have the meanings given them

Subp. 2. **Acute health risk value or acute HRV.** "Acute health risk value" or "acute HRV" means the concentration of a chemical or defined mixture of chemicals in ambient air, at or below which the chemical or defined mixture of chemicals is unlikely to cause an adverse health effect to the general public when exposure occurs over a prescribed time. For implementation purposes, acute HRVs are compared to one-hour averaged concentrations of chemicals or defined mixtures of chemicals in air An acute HRV is expressed in units of micrograms of the chemical or defined mixture of chemicals per cubic meter of air ($\mu g/m^3$)

Subp 3 **Additional lifetime risk.** "Additional lifetime risk" means the probability that daily exposure to a carcinogen over a lifetime may induce cancer The Minnesota Department of Health uses an additional lifetime risk of 1E-5 (1 in 100,000) to set carcinogen exposure guidelines

Subp 4 **Benchmark concentration or BMC.** "Benchmark concentration" or "BMC" means the statistical lower limit on the concentration of the chemical or defined mixture of chemicals that produces a predetermined change in response rate of an adverse effect (called a benchmark response or BMR) compared to background The change in response rate over background of the BMR is usually in the range of

five to ten percent The benchmark concentration may be used instead of the NOAEL for noncancer endpoints and is expressed in units of milligrams of chemical or defined mixture of chemicals per cubic meter of air (mg/m³)

Subp 5. **Benchmark dose or BMD.** "Benchmark dose" or "BMD" means the the statistical lower limit on the dose of the chemical or defined mixture of chemicals that produces a predetermined change in response rate of an adverse effect (called a benchmark response or BMR) compared to background The change in response rate over background of the BMR is usually in the range of five to ten percent The benchmark dose may be used instead of the NOAEL for noncancer endpoints and is expressed in units of milligrams of chemical or defined mixture of chemicals per kilogram of body weight per day (mg/kg-day)

Subp 6. **Carcinogen.** "Carcinogen" means a chemical or defined mixture of chemicals

A listed as a human carcinogen or a probable human carcinogen according to "EPA Classification System for Categorizing Weight of Evidence for Carcinogenicity from Human and Animal Studies," The Risk Assessment Guidelines of 1986, United States Environmental Protection Agency, Office of Health and Environmental Assessment (August 1987) The classification system is incorporated by reference, is available through the Minitex interlibrary loan system, and is not subject to frequent change,

B listed as "carcinogenic to humans" or "likely to be carcinogenic to humans" according to Proposed Guidelines for Carcinogen Risk Assessment, United States Environmental Protection Agency, Office of Research and Development (July 1999) The guidelines are incorporated by reference, are available through the Mimtex interlibrary loan system, and are not subject to frequent change, or

C listed as a substance known to be a human carcinogen or reasonably anticipated to be a human carcinogen in the Report on Carcinogens, United States Department of Health and Human Services, Public Health Service, National Toxicology Program The report is incorporated by reference and is subject to frequent change The report is available on the Internet at http://ntp-server.niehs nih gov/newhomer-oc/aboutroc html

Subp 7 **Chemical abstracts service registry number or CAS RN.** "Chemical abstracts service registry number" or "CAS RN" means the number assigned to a chemical by the Chemical Abstracts Service, a division of the American Chemical Society, 2540 Olentangy River Road, Box 3012, Columbus, Ohio 43210 The chemical abstracts service registry numbers are published in Chemical Abstracts Service Registry Handbook - Number Section, American Chemical Society (1965) The handbook is incorporated by reference, is available through the Mmitex interlibrary loan system, and is subject to annual change

Subp 8 **Chronic health risk value or chronic HRV.** "Chronic health risk value" or "chronic HRV" means the concentration of a chemical or defined mixture of chemicals in ambient air, at or below which the chemical or defined mixture of chemicals is unlikely to cause an adverse health effect to the general public when exposure occurs daily throughout a person's lifetime For implementation purposes, chronic HRVs are compared to an annual average concentration of a chemical or defined mixture of chemicals in air. A chronic HRV is expressed in units of micrograms of the chemical or defined mixture of chemicals per cubic meter of air (µg/m³).

Subp 9. **Cumulative health risk value or cumulative HRV.** "Cumulative health risk value" or "cumulative HRV" is a HRV calculated by summing the hazard quotients of chemicals sharing a common endpoint A hazard quotient for a particular chemical is calculated by dividing the measured or modeled ambient air concentrations for a chemical by the HRV for that chemical The equation used to calculate a cumulative HRV or hazard index for noncarcinogenic effects of chemicals is found in part 4717 8600. The equation used to calculate a cumulative HRV or cancer index for carcinogens is found in part 4717.8550.

Subp 10 **Cumulative multimedia health risk value or cumulative MHRV.** "Cumulative multimedia health risk value" or "cumulative MHRV" is a MHRV calculated by summing the hazard quotients of chemicals sharing a common endpoint A hazard quotient for a particular chemical is calculated by dividing the measured or modeled ambient air concentrations for a chemical by the MHRV for that chemical. The equation used to calculate a cumulative MHRV or hazard index for noncarcinogenic effects of chemicals is found in part 4717 8600 The equation used to calculate a cumulative MHRV or cancer index for carcinogens is found in part 4717 8550

Subp. 11. **Defined mixture of chemicals.** "Defined mixture of chemicals" means a mixture of chemical compounds where the toxicity of that mixture of chemical compounds is quantified as a group, rather than individually, in an analytical procedure. Defined mixtures of chemicals include, but are not limited to, coke oven emissions, diesel particulate, and nickel refinery dust

Subp 12 **Endpoint of concern or endpoint.** "Endpoint of concern" or "endpoint" means an observable and measurable adverse biological event used as a scientifically defensible index of an effect of a low dose chemical exposure The designation of an endpoint of concern does not exclude other possible observable and measurable biological events

Subp. 13. **Extrarespiratory effect.** "Extrarespiratory effect" means a toxic effect produced at a site other than the respiratory system following inhalation of a chemical.

Subp 14 **Extrarespiratory regional dose deposition or RDD$_{ER}$.** "Extrarespiratory regional dose deposition" or "RDD$_{ER}$" is the estimated amount of inhaled chemical or defined mixture of chemicals that is transported to nonrespiratory tract tissues after absorption of the chemical has occurred. The default normalizing factor for extrarespiratory effects is body weight Until clearance and distribution parameters can be incorporated, it is assumed that 100 percent of a deposited dose to the entire respiratory system is available for uptake by the systemic circulation.

Subp. 15. **Extrarespiratory regional dose deposition ratio or RDDR$_{ER}$.** "Extrarespiratory regional dose deposition ratio" or "RDDR$_{ER}$" means the ratio of the extrarespiratory regional dose deposition calculated for an experimental animal to the calculated extrarespiratory regional dose deposition in a human.

Subp 16 **(H$_{b/g}$)$_A$.** "(H$_{b/g}$)$_A$" means the blood to gas (air) partition coefficient of a chemical in an experimental animal

Subp 17 **(H$_{b/g}$)$_H$.** "(H$_{b/g}$)$_H$" means the blood to gas (air) partition coefficient of a chemical in a human.

Subp. 18. **Health effects assessment summary tables or HEAST.** "Health effects assessment summary tables" or "HEAST" means the health effects assessment summary tables prepared by the United States Environmental Protection Agency, Office of Research and Development (1991) The tables are incorporated by reference, are available through the Minitex interlibrary loan system, and are subject to quarter-annual changes

Subp 19. **Health risk value or HRV.** "Health risk value" or "HRV" means the concentration of a chemical or defined mixture of chemicals in ambient air, at or below which the chemical or defined mixture of chemicals is unlikely to cause an adverse health effect to the general public The HRV is expressed in units of micrograms of the chemical or defined mixture of chemicals per cubic meter of air ($\mu g/m^3$)

Subp. 20. **Human equivalent concentration or HEC.** "Human equivalent concentration" or "HEC" means the concentration of inhalation exposure for humans of an agent that is believed to induce the same magnitude of a toxic effect as associated with the experimental animal species exposure concentration HEC derivation may incorporate toxicokinetic information on the particular agent, if available, or use a default procedure, such as assuming that daily oral doses experienced for a lifetime are proportional to body weight raised to the 0.75 power.

Subp 21 **Integrated risk information system or IRIS.** "Integrated risk information system" or "IRIS" means the United States Environmental Protection Agency's electronic database for toxicologic information on chemicals The IRIS is updated monthly and is available on the Internet at the Web site of the United States Environmental Protection Agency (www epa.gov/iris/) The database is incorporated by reference and is subject to frequent change

Subp 22 **Lowest observed adverse effect level or LOAEL.** "Lowest observed adverse effect level" or "LOAEL" means the lowest exposure dose or concentration of a chemical or defined mixture of chemicals at which adverse effects have been observed in test animals or human test subjects and where the adverse effects are statistically different from background or a control group The LOAEL is expressed in units of either milligrams of a chemical or defined mixture of chemicals per cubic meter of air (mg/m^3) for inhalation exposures or units of milligrams of a chemical or defined mixture of chemicals per kilogram of body weight per day (mg/kg-day) for multimedia exposures

Subp 23 **Lowest observed adverse effect level adjusted or LOAEL$_{[ADJ]}$.** "Lowest observed adverse effect level adjusted" or "LOAEL$_{[ADJ]}$" means the lowest observed adverse effect level for a chemical or defined mixture of chemicals adjusted to a specific period of time For the chronic HRVs, the concentration in the scientific study is adjusted to a 24-hour per day, seven-day per week exposure period For acute HRVs, the adjustment may include either a time adjustment to a one-hour exposure period or an adjustment for concentration as indicated in part 4717 8500, subparts 3, 4, and 5.

Subp. 24 **μg/m^3.** "μg/m^3" means micrograms per cubic meter

Subp 25 **mg/m^3.** "mg/m^3" means milligrams per cubic meter

Subp 26. **Modifying factor.** "Modifying factor" means a factor used in the derivation of a reference dose or reference concentration The magnitude of the modifying factor reflects the scientific uncertainties of the study and database not explicitly treated with standard uncertainty factors (e g , the completeness of the overall database) A modifying factor is greater than zero and less than or equal to ten, and the default value for the modifying factor is one

Subp 27 **Multimedia health risk value or MHRV.** "Multimedia health risk value" or "MHRV" means the total daily dose of a chemical or defined mixture of chemicals that results from an emission to ambient air, at or below which is unlikely to cause an adverse health effect to the general public over a lifetime exposure Total daily dose is the sum of the exposure doses calculated from applicable inhalation or nonmhalation exposure pathways The MHRV is expressed in units of micrograms of the chemical or defined mixture of chemicals per kilogram of body weight per day (μg/kg-day)

Subp 28 **No observed adverse effect level or NOAEL.** "No observed adverse effect level" or "NOAEL" means the highest exposure level at which there are no statistically or biologically significant increases in the frequency or severity of adverse effect between the exposed population and its appropriate control Some effects may be produced at this level, but they are not considered adverse or precursors to adverse effects. The NOAEL is expressed in units of milligrams of chemical or defined mixture of chemicals per cubic meter of air (mg/m^3) or milligrams of chemical or defined mixture of chemicals per kilogram of body weight per day (mg/kg-day)

Subp. 29 **No observed adverse effect level adjusted or NOAEL$_{[ADJ]}$.** "No observed adverse effect level adjusted" or "NOAEL$_{[ADJ]}$" means the no observed adverse effect level for a chemical or defined mixture of chemicals adjusted to a specific period of time For the chronic HRVs, the concentration is adjusted to a 24-hour per day, seven-day per week exposure period For acute HRVs, the adjustment may include either a time adjustment to the scientific study data to a one-hour exposure period or an adjustment for concentration as indicated in part 4717 8500, subparts 3 and 4

Subp 30 **Potency slope or slope factor.** "Potency slope" or "slope factor" means an upper bound, approximating a 95 percent confidence limit, on the increased cancer risk from a lifetime exposure to a chemical or defined mixture of chemicals This

estimate, usually expressed in umts of proportion (of a population) affected per mg/kg/day, is generally reserved for use in the low-dose region of the dose-response relationship, that is, for exposures corresponding to risks less than one in 100 This number is derived from a mathematical extrapolation model that uses toxicologic data specific to each carcinogen The potency slope for a carcinogen by ingestion is expressed in units of the inverse of milligrams of the chemical or defmed mixture of chemicals per kilogram of body weight per day $(mg/kg\text{-}day)^{-1}$

Subp. 31. **Reference concentration or RfC.** "Reference concentration" or "RfC" means an estimate, with uncertainty spanning perhaps an order of magnitude, of a continuous inhalation exposure to the human population, including sensitive subgroups, that is likely to be without an appreciable risk or deleterious effects during a lifetime It can be derived from a NOAEL, LOAEL, or benchmark concentration, with uncertainty factors generally applied to reflect limitations on the scientific data available. The RfC is expressed in units of milligrams of the chemical or defined mixture of chemicals per cubic meter of air (mg/m^3)

Subp. 32. **Reference dose or RfD.** "Reference dose" or "RfD" means an estimate, with uncertainty spanning perhaps an order of magnitude, of a daily oral exposure to the human population, including sensitive subgroups, that is likely to be without an appreciable risk of deleterious effects during a lifetime It can be derived from a NOAEL, LOAEL, or benchmark dose, with uncertainty factors generally applied to reflect limitations of the scientific data available. The RfD is expressed in units of milligrams of the chemical or defmed mixture of chemicals per kilogram of body weight per day (mg/kg-day)

Subp 33 **Reference exposure level or REL.** "Reference exposure level" or "REL" means the concentration level of a chemical or defined mixture of chemicals at or below which no adverse health effects are anticipated for a specified exposure duration Reference exposure levels have been derived by the California Environmental Protection Agency, the Office of Environmental Health Hazard Assessment, under the Air Toxics "Hot Spots" Information and Assessment Act of 1987. The exposure levels are available on the Internet at the Web site of the Office of Environmental Health Hazard Assessment (www oehha org/air/acute_rels/acuterel html)

Subp. 34. **Regional deposited dose or RDD.** "Regional deposited dose" or "RDD" means the deposited dose of particles calculated for a respiratory tract region of mterest as related to an observed toxicity For respiratory effects of particles, the deposited dose is adjusted for ventilatory volumes and the surface area of the respiratory region affected and is expressed as milligrams per mmute per square centimeter (mg/mm-sq cm) For extrarespiratory effects of particles, the deposited dose in the total respiratory system is adjusted for ventilatory volumes and body weight and is expressed as milligrams per mmute per kilogram (mg/mm-kg).

Subp. 35. **Regional deposited dose ratio or RDDR.** "Regional deposited dose ratio" or "RDDR" means the ratio of the regional deposited dose calculated for a given exposure in the animal species of mterest (RDD_A) to the regional deposited dose of the same exposure in a human (RDD_H) This ratio is used to adjust the exposure effect level for interspecies dosimetric differences to derive a human equivalent concentration (HEC) for particles

Subp 36 **Regional gas dose or RGD.** "Regional gas dose" or "RGD" means the gas dose calculated for the respiratory system region of mterest as related to the observed effect for respiratory effects The deposited dose is adjusted for ventilatory volumes and the surface area of the respiratory region affected RGD is calculated per mmute expressed as milligrams per mmute per square centimeter (mg/mm-sq cm).

Subp 37 **Regional gas dose ratio or RGDR.** "Regional gas dose ratio" or "RGDR" means the ratio of the regional gas dose calculated for a given exposure in the animal species of mterest (RGD_A) to the regional gas dose of the same exposure in humans (RGD_H). This ratio is used to adjust the exposure effect level for interspecies dosimetric differences to derive a human equivalent concentration (HEC) for gases with respiratory effects

Subp 38. **Respiratory effect.** "Respiratory effect" means a toxic effect produced in the respiratory system. Respiratory effects are divided into the categories of upper respiratory effects and lower respiratory effects Effects in the upper respiratory system consist of effects primarily in the extrathoracic (ET) region, consisting of the nose, mouth, nasopharynx, oropharynx, laryngopharynx, and larynx, and in the upper tracheo-bronchial (TB) region consisting of the trachea, bronchi, and bronchioles

The lower respiratory system effects consist of effects primarily in the pulmonary (PU) region, consisting of the respiratory bronchioles, alveolar ducts, alveolar sacs, and alveoli, and effects in the lower tracheobronchial (TB) region, consisting of the trachea and bronchioles to the terminal bronchioles

Subp. 39. **Respiratory system.** "Respiratory system" means the nose, mouth, nasopharynx, oropharynx, larynx, trachea, bronchi, bronchioles, and the alveolar ducts, alveolar sacs, and alveoli of the lung

Subp. 40 **Statistical significance.** "Statistical significance" means the probability that a result is likely to be due to chance alone By convention, a difference between two groups is usually considered statistically significant if chance could explain it only five percent of the time or less Study design considerations may influence the *a priori* choice of a different statistical significance level.

Subp. 41. **Subchronic health risk value or subchronic HRV.** "Subchronic health risk value" or "subchronic HRV" means the concentration of a chemical or defined mixture of chemicals in ambient air at or below which the chemical or defined mixture of chemicals is unlikely to cause an adverse health effect to the general public when exposure occurs on a continuous basis over a less than lifetime exposure For implementation purposes, subchronic HRVs are compared to a 13-week averaged concentration of a chemical or defined mixture of chemicals in ambient air A subchronic HRV is expressed in units of micrograms of the chemical or defined mixture of chemicals per cubic meter of air ($\mu g/m^3$)

Subp 42. **Uncertainty factor.** "Uncertainty factor" means the numerical factors used to account for the variation in sensitivity among members of the human population, the uncertainty in extrapolating laboratory animal data to humans, the uncertainty in extrapolating from data obtained in a study that involves less than lifetime exposure to lifetime exposure, the uncertainty in using LOAEL data due to the absence of NOAEL data, and the inability of any single study to adequately address all possible adverse outcomes in humans

Subp 43. **Unit risk.** "Unit risk" means the upper bound excess cancer risk from a continuous lifetime exposure to a chemical or defined mixture of chemical concentration at one microgram per cubic meter ($1 \mu g/m^3$) in air

Statutory Authority: *MS s 144 12*

History: *26 SR 1229, 26 SR 1395*

4717.8100 TABLE OF CHRONIC HRVs.

The heading for each item contains the chemical name and, in parenthesis, the CAS RN Each item lists the chronic HRV, the equation used to develop the chronic HRV, and the variables necessary for the equation The equations used to develop the chronic HRV are designated as follows. "A" means calculating the NOAEL$_{[HEC]}$ or LOAEL$_{[HEC]}$ or BMC$_{[HEC]}$ under part 4717 8300, subpart 3, and applying the general equation under part 4717 8300, subpart 2, "B" means calculating the NOAEL$_{[HEC]}$ or LOAEL$_{[HEC]}$ or BMC$_{[HEC]}$ under part 4717 8300, subpart 4, and applying the general equation under part 4717.8300, subpart 2, "C" means calculating the NOAEL$_{[HEC]}$ or LOAEL$_{[HEC]}$ or BMC$_{[HEC]}$ under part 4717 8300, subpart 5, and applying the general equation under part 4717 8300, subpart 2, "D" means calculating the NOAEL$_{[HEC]}$ or LOAEL$_{[HEC]}$ or BMC$_{[HEC]}$ under part 4717 8300, subpart 6, and applying the general equation under part 4717 8300, subpart 2, and "E" means applying the equation under part 4717 8400, subpart 2. The endpoint of concern is listed for use in determining a

cancer index under part 4717.8550 or a hazard index under part 4717 8600 The unit risk for carcinogens is expressed as risk per ($\mu g/m^3$).

TABLE OF CHRONIC HRVs

A. Acetaldehyde (75-07-0)

Chronic HRV ($\mu g/m^3$)	**5**
Endpoint of concern	Cancer
Equation	E
Unit risk	2 2E-6

B. Acetonitrile (75-05-8)

Chronic HRV ($\mu g/m^3$)	**60**
Endpoint of concern	Mortality
Equation	D
$NOAEL_{[HEC]}$ (mg/m^3)	6E1
Uncertainty factor	1,000

C. Acrylomtrile (107-13-1)

Chronic HRV ($\mu g/m^3$)	**0.1**
Endpoint of concern	Cancer
Equation	E
Umt risk	6 8E-5

D Ammonia (7664-41-7)

Chronic HRV ($\mu g/m^3$)	**80**
Endpoint of concern	Upper and lower respiratory system
Equation	C
$NOAEL_{[HEC]}$ (mg/m^3)	2 3
Uncertainty factor	30

E Antimony trioxide (1309-64-4)

Chronic HRV ($\mu g/m^3$)	**0.2**
Endpoint of concern	Lower respiratory system
Equation	A
$BMC_{[HEC]}$ (mg/m^3)	7 4E-2
Uncertainty factor	300

F Arsenic (7440-38-2)

Chromc HRV ($\mu g/m^3$)	**0.002**
Endpoint of concern	Cancer
Equation	E
Umt risk	4 3E-3

G. Benzene (71-43-2)

Chronic HRV ($\mu g/m^3$)	**1.3 - 4.5**
Endpomt of concern	Cancer
Equation	E
Umt risk	2 2E-6 to 7.8E-6

H Benzidine (92-87-5)

Chronic HRV ($\mu g/m^3$)	**0.0002**
Endpoint of concern	Cancer
Equation	E
Unit risk	6.7E-2

I. Beryllium (7440-41-7)

Chronic HRV ($\mu g/m^3$)	**0.004**
Endpoint of concern	Cancer
Equation	E
Unit risk	2.4E-3

J Bis(chloromethyl)ether (542-88-1)

Chronic HRV ($\mu g/m^3$)	**0.0002**
Endpoint of concern	Cancer
Equation	E
Unit risk	6 2E-2

K Bromomethane (74-83-9)

Chronic HRV ($\mu g/m^3$)	**5**
Endpomt of concern	Upper respiratory system
Equation	C
$LOAEL_{[HEC]}$ (mg/m^3)	4 8E-1
Uncertainty factor	100

L. 1,3-Butadiene (106-99-0)

Chronic HRV ($\mu g/m^3$)	**0.04**
Endpoint of concern	Cancer
Equation	E
Unit risk	2 8E-4

M. Cadmium (7440-43-9)

Chronic HRV ($\mu g/m^3$)	**0.006**
Endpomt of concern	Cancer
Equation	E
Unit risk	1 8E-3

N. Carbon disulfide (75-15-0)

Chronic HRV ($\mu g/m^3$)	**700**
Endpomt of concern	Nervous system
Equation	D
$BMC_{[HEC]}$ (mg/m^3)	1.97E1
Uncertainty factor	30

O 2-Chloroacetophenone (532-27-4)

Chronic HRV ($\mu g/m^3$)	**0.03**
Endpomt of concern	Upper and lower respiratory system
Equation	C
$LOAEL_{[HEC]}$ (mg/m^3)	3E-2
Uncertainty factor	1,000

P. Chromium VI (18540-29-9)

Chronic HRV (μg/m^3)	**0.0008**
Endpoint of concern	Cancer
Equation	E
Unit risk	1.2E-2

Q Coke oven emissions (8007-45-2)

Chronic HRV (μg/m^3)	**0.02**
Endpoint of concern	Cancer
Equation	E
Unit risk	6 2E-4

R 1,2-Dibromoethane (106-93-4)

Chronic HRV (μg/m^3)	**0.05**
Endpoint of concern	Cancer
Equation	E
Unit risk	2 2E-4

S Dichloromethane (75-09-2)

Chronic HRV (μg/m^3)	**20**
Endpoint of concern	Cancer
Equation	E
Umt risk	4.7E-7

T 1,3-Dichloropropene (542-75-6)

Chronic HRV (μg/m^3)	**20**
Endpoint of concern	Upper respiratory system
BMC$_{[HEC]}$ (mg/m^3)	7.2E-1
Equation	C
Uncertainty factor	30

U. Dichlorvos (62-73-7)

Chronic HRV (μg/m^3)	**0.5**
Endpoint of concern	Nervous system
Equation	D
NOAEL$_{[HEC]}$ (mg/m^3)	5E-2
Uncertainty factor	100

V Diesel particulates (*)

Chronic HRV (μg/m^3)	**5**
Endpoint of concern	Lower respiratory system
Equation	A
NOAEL$_{[HEC]}$ (mg/m^3)	1 55E-1
Uncertainty factor	30

W N,N-dimethylformamide (68-12-2)

Chronic HRV (μg/m^3)	**30**
Endpoint of concern	Gastrointestinal system and hepatic system
Equation	D
LOAEL$_{[HEC]}$ (mg/m^3)	7 9
Uncertainty factor	300

X Epichlorohydrin (106-89-8)

Chronic HRV (μg/m^3)	**8**
Endpoint of concern	Cancer
Equation	E
Unit risk	1 2E-6

Y 1,2-Epoxybutane (106-88-7)

Chronic HRV (μg/m^3)	**20**
Endpomt of concern	Upper respiratory system
Equation	C
LOAEL$_{[HEC]}$ (mg/m^3)	4 8
Uncertainty factor	300

Z Ethylene glycol monobutyl ether (111-76-2)

Chronic HRV (μg/m^3)	**13,000**
Endpoint of concern	Hematologic system
Equation	D
BMC$_{[HEC]}$ (mg/m^3)	3 8E2
Uncertainty factor	30

AA Formaldehyde (50-00-0)

Chronic HRV (μg/m^3)	**0.8****
Endpoint of concern	Cancer
Equation	E
Unit risk	1 3E-5

BB. 1,6-Hexamethylene diisocyanate (822-06-0)

Chronic HRV (μg/m^3)	**0.01****
Endpoint of concern	Upper and lower respiratory system
Equation	C
NOAEL$_{[HEC]}$ (mg/m^3)	1E-3
Uncertainty factor	100

CC. n-Hexane (110-54-3)

Chronic HRV (μg/m^3)	**2,000**
Endpoint of concern	Nervous system and upper respiratory system
Equation	D
LOAEL$_{[HEC]}$ (mg/m^3)	7 3E1
Uncertainty factor	30

DD Hydrazıne/Hydrazıne sulfate (302-01-2)

Chronıc HRV (μg/m^3)	**0.002**
Endpoınt of concern	Cancer
Equatıon	E
Unıt rısk	4 9E-3

EE Hydrogen chlorıde (7647-01-0)

Chronıc HRV (μg/m^3)	**20**
Endpoınt of concern	Upper respıratory system
Equatıon	C
LOAEL$_{[HEC]}$ (mg/m^3)	6 1
Uncertaınty factor	300

FF Hydrogen cyanıde (74-90-8)

Chronıc HRV (μg/m^3)	**3**
Endpoınt of concern	Endocrıne system and nervous system
Equatıon	D
LOAEL$_{[HEC]}$ (mg/m^3)	2 5
Uncertaınty factor	1,000

GG Manganese (7439-96-5)

Chronıc HRV (μg/m^3)	**0.2**
Endpoınt of concern	Nervous system
Equatıon	B
BMC$_{[HEC]}$ (mg/m^3)	1 9E-2
Uncertaınty factor	100

HH. Methyl methacrylate (80-62-6)

Chronıc HRV (μg/m^3)	**700****
Endpoınt of concern	Upper and lower respıratory system
Equatıon	C
BMC$_{[HEC]}$ (mg/m^3)	7 2
Uncertaınty factor	10

II Methylene dıphenyl dıısocyanate (MDI) and polymerıc MDI (101-68-8 and 9016-87-9)

Chronıc HRV (μg/m^3)	**0.6****
Endpoınt of concern	Upper and lower respıratory system
Equatıon	A
BMC$_{[HEC]}$ (mg/m^3)	6E-2
Uncertaınty factor	100

JJ Nıckel refınery dust (*)

Chronıc HRV (μg/m^3)	**0.04**
Endpoınt of concern	Cancer
Equatıon	E
Unıt rısk	2 4E-4

KK. Nickel subsulfide (12035-72-2)

Chronic HRV (μg/m^3)	**0.02**
Endpoint of concern	Cancer
Equation	E
Unit risk	4.8E-4

LL. 2-Nitropropane (79-46-9)

Chronic HRV (μg/m^3)	**20**
Endpoint of concern	Hepatic system
Equation	D
LOAEL$_{[HEC]}$ (mg/m^3)	1 6E1
Uncertainty factor	1,000

MM. Propylene oxide (75-56-9)

Chronic HRV (μg/m^3)	**3**
Endpoint of concern	Cancer
Equation	E
Unit risk	3 7E-6

NN Styrene (100-42-5)

Chronic HRV (μg/m^3)	**1000**
Endpoint of concern	Nervous system
Equation	D
NOAEL$_{[HEC]}$ (mg/m^3)	3 4E1
Uncertainty factor	30

OO. Toluene (108-88-3)

Chronic HRV (μg/m^3)	**400**
Endpoint of concern	Nervous system and upper respiratory system
Equation	D
LOAEL$_{[HEC]}$ (mg/m^3)	1 19E2
Uncertainty factor	300

PP 2,4-/2,6-Toluene diisocyanate (26471-62-5)

Chronic HRV (μg/m^3)	**0.08****
Endpoint of concern	Lower respiratory system
Equation	D
NOAEL$_{[HEC]}$ (mg/m^3)	2.3E-3
Uncertainty factor	30

QQ Vinyl acetate (108-05-4)

Chronic HRV (μg/m^3)	**200**
Endpoint of concern	Upper respiratory system
Equation	C
NOAEL$_{[HEC]}$ (mg/m^3)	5
Uncertainty factor	30

RR Vinyl chloride (75-01-4)

Chronic HRV (μg/m^3)	1
Endpoint of concern	Cancer
Equation	E
Unit risk	8 8E-6

* This HRV is for a chemical mixture which, therefore, does not have a chemical-specific number assigned by the Chemical Abstracts Service

** This HRV may not provide protection for individuals who have been previously sensitized to this chemical

Statutory Authority: *MS s 144.12*

History: *26 SR 1229; 26 SR 1395*

4717.8150 TABLE OF SUBCHRONIC HRVs.

The heading for each item contains the chemical name and, in parenthesis, the CAS RN Each item lists the subchronic HRV, the equation used to develop the subchronic HRV, and the variables necessary for the equation. The equations used to develop the subchronic HRV are designated as follows "A" means calculating the NOAEL$_{[HEC]}$ or LOAEL$_{[HEC]}$ or BMC$_{[HEC]}$ under part 4717.8300, subpart 3, and applying the general equation under part 4717 8300, subpart 2, "B" means calculating the NOAEL$_{[HEC]}$ or LOAEL$_{[HEC]}$ or BMC$_{[HEC]}$ under part 4717 8300, subpart 4, and applying the general equation under part 4717 8300, subpart 2; "C" means calculating the NOAEL$_{[HEC]}$ or LOAEL$_{[HEC]}$ or BMC$_{[HEC]}$ under part 4717 8300, subpart 5, and applying the general equation under part 4717 8300, subpart 2, and "D" means calculating the NOAEL$_{[HEC]}$ or LOAEL$_{[HEC]}$ or BMC $_{[HEC]}$ under part 4717.8300, subpart 6, and applying the general equation under part 4717 8300, subpart 2. The endpoint of concern is listed for use in determining a hazard index under part 4717 8600.

TABLE OF SUBCHRONIC HRVs

A Acrolein (107-02-8)

Subchronic HRV (μg/m^3)	**0.2**
Endpoint of concern	Upper respiratory system
Equation	C
LOAEL$_{[HEC]}$ (mg/m^3)	2E-2
Uncertainty factor	100

B Acrylic acid (79-10-7)

Subchronic HRV (μg/m^3)	**3**
Endpoint of concern	Upper respiratory system
Equation	C
LOAEL$_{[HEC]}$ (mg/m^3)	3 3E-1
Uncertainty factor	100

C Allyl chloride (107-05-1)

Subchronic HRV (μg/m^3)	**10**
Endpoint of concern	Nervous system
Equation	D
NOAEL$_{[HEC]}$ (mg/m^3)	3 6
Uncertainty factor	300

D. Arsine (7784-42-1)

Subchronic HRV (μg/m^3)	**0.1**
Endpoint of concern	Hematologic system
Equation	D
NOAEL$_{[HEC]}$ (mg/m^3)	1 4E-2
Uncertainty factor	100

E. Chlordane (12789-03-6)

Subchronic HRV (μg/m^3)	**7**
Endpoint of concern	Hepatic system
Equation	B
NOAEL$_{[HEC]}$ (mg/m^3)	6 5E-1
Uncertainty factor	100

F. Chlorine dioxide (10049-04-4)

Subchronic HRV (μg/m^3)	**0.6**
Endpoint of concern	Lower respiratory system
Equation	C
LOAEL$_{[HEC]}$ (mg/m^3)	6 4E-1
Uncertainty factor	1,000

G. Chromic acid mists and dissolved Cr (VI) aerosols (18540-29-9)

Subchronic HRV (μg/m^3)	**0.02**
Endpoint of concern	Upper and lower respiratory system
Equation	C
LOAEL$_{[ADJ]}$ (mg/m^3)	7.1E-4
Uncertainty factor	30

H Cr(VI) particulates (18540-29-9)

Subchronic HRV (μg/m^3)	**1**
Endpoint of concern	Lower respiratory system
Equation	A
BMC$_{[HEC]}$ (mg/m^3)	3.5E-2
Uncertainty factor	30

I Cumene (98-82-8)

Subchronic HRV (μg/m^3)	**4,000**
Endpoint of concern	Renal system and endocrine system
Equation	D
NOAEL$_{[HEC]}$ (mg/m^3)	4 35E2
Uncertainty factor	100

J 1,2-Dibromo-3-chloropropane (96-12-8)

Subchronic HRV (μg/m^3)	**2**
Endpoint of concern	Male reproductive system
Equation	D
NOAEL$_{[HEC]}$ (mg/m^3)	1 7E-1
Uncertainty factor	100

K 1,4-Dichlorobenzene (106-46-7)

   Subchronic HRV (μg/m^3)   **800**
   Endpoint of concern   Hepatic system
   Equation   D
   NOAEL$_{[HEC]}$ (mg/m^3)   7.5E1
   Uncertainty factor   100

L 1,2-Dichloropropane (78-87-5)

   Subchronic HRV (μg/m^3)   **10**
   Endpoint of concern   Upper respiratory system
   Equation   C
   LOAEL$_{[HEC]}$ (mg/m^3)   1 3
   Uncertainty factor   100

M Dicyclopentadiene (77-73-6)

   Subchronic HRV (μg/m^3)   **3**
   Endpoint of concern   Renal system
   Equation   D
   LOAEL$_{[HEC]}$ (mg/m^3)   9.6E-1
   Uncertainty factor   300

N 2-Dimethylamino ethanol (101-01-0)

   Subchronic HRV (μg/m^3)   **70**
   Endpoint of concern   Upper respiratory system
   Equation   C
   NOAEL$_{[HEC]}$ (mg/m^3)   1 96
   Uncertainty factor   30

O Ethylene glycol monomethyl ether(EGME) or 2-methoxyethanol (109-86-4)

   Subchronic HRV (μg/m^3)   **60**
   Endpoint of concern   Male reproductive and
                                          hematologic systems
   Equation   D
   NOAEL$_{[HEC]}$(mg/m^3)   1 7E1
   Uncertainty factor   300

P Hydrogen sulfide (7783-06-4)

   Subchronic HRV (μg/m^3)   **10**
   Endpoint of concern   Upper respiratory system
   Equation   C
   NOAEL$_{[HEC]}$ (mg/m^3)   1 01
   Uncertainty factor   100

Q Phosphine (7803-51-2)

Subchronic HRV (μg/m^3)	**3**
Endpoint of concern	Decreased body weight
Equation	D
NOAEL$_{[HEC]}$ (mg/m^3)	2.5E-1
Uncertainty factor	100

R. Propylene glycol monomethyl ether (107-98-2)

Subchronic HRV (μg/m^3)	**20,000**
Endpoint of concern	Nervous system
Equation	D
NOAEL$_{[HEC]}$ (mg/m^3)	6 58E2
Uncertainty factor	30

S Triethylamine (121-44-8)

Subchronic HRV (μg/m^3)	**70**
Endpoint of concern	Upper respiratory system
Equation	C
NOAEL$_{[HEC]}$ (mg/m^3)	1 95E1
Uncertainty factor	300

Statutory Authority: *MS s 144 12*
History: *26 SR 1229, 26 SR 1395*

4717.8200 TABLE OF ACUTE HRVs.

The heading for each item contains the chemical name and, in parenthesis, the CAS RN Each item lists the acute HRV, the equation used to develop the acute HRV, and the variables necessary for the equation The equations used to develop the acute HRV are designated as follows "A" means calculating the NOAEL or LOAEL or BMC$_{[ADJ]}$ under part 4717 8500, subpart 3, and applying the general equation under part 4717 8500, subpart 2, "B" means calculating the NOAEL$_{[ADJ]}$ or LOAEL$_{[ADJ]}$ or BMC $_{[ADJ]}$ under part 4717 8500, subpart 4, and applying the general equation under part 4717 8500, subpart 2, "C" means calculating the BMC or BMC$_{[ADJ]}$ under part 4717.8500, and "D" means applying the equation under part 4717 8500, subpart 5. The endpoint of concern is listed for use in determining a hazard index under part 4717.8600.

<center>TABLE OF ACUTE HRVs</center>

A Ammonia (7664-41-7)

Acute HRV (μg/m^3)	**3,200**
Endpoint of concern	Irritant - eye, respiratory system
Equation	C
BMC (mg/m^3)	9.5
Uncertainty factor	3

B. Arsine (7784-42-1)

Acute HRV (μg/m^3)	**200**
Endpoint of concern	Hematologic*
Equation	A
NOAEL$_{[ADJ]}$ (mg/m^3)	1 6E1
Uncertainty factor	100

C. Benzene (71-43-2)

Acute HRV (μg/m^3)	**1,000**
Endpoint of concern	Reproductive/ developmental
Equation	D
NOAEL (mg/m^3)	1.3E2
Uncertainty factor	100

D. Carbon disulfide (75-15-0)

Acute HRV (μg/m^3)	**6,000**
Endpoint of concern	Reproductive/ developmental
Equation	D
NOAEL (mg/m^3)	6 2E2
Uncertainty factor	100

E. Chlorine (7882-50-5)

Acute HRV (μg/m^3)	**290**
Endpoint of concern	Irritant - respiratory system
Equation	A
NOAEL (mg/m^3)	2 9
Uncertainty factor	10

F. Chloroform (67-66-3)

Acute HRV (μg/m^3)	**150**
Endpoint of concern	Reproductive/ developmental
Equation	D
LOAEL (mg/m^3)	1 5E2
Uncertainty factor	1,000

G. Dichloromethane (75-09-2)

Acute HRV (μg/m^3)	**10,000**
Endpoint of concern	Nervous system
Equation	A
NOAEL$_{[ADJ]}$ (mg/m^3)	6 8E2
Uncertainty factor	60

H 1,4-Dioxane (123-91-1)

Acute HRV (μg/m^3)	**3,000**
Endpoint of concern	Irritant - eye and nasal
Equation	A
LOAEL$_{[ADJ]}$ (mg/m^3)	1 8E2
Uncertainty factor	60

I Ethyl benzene (100-41-4)

Acute HRV ($\mu g/m^3$)	**10,000**
Endpoint of concern	Reproductive/ developmental
Equation	D
NOAEL (mg/m^3)	4.3E2
Uncertainty factor	30

J Ethyl chloride (75-00-3)

Acute HRV ($\mu g/m^3$)	**100,000**
Endpoint of concern	Reproductive/ developmental
Equation	D
NOAEL (mg/m^3)	4E3
Uncertainty factor	30

K Ethylene glycol monoethyl ether (110-80-5)

Acute HRV ($\mu g/m^3$)	**400**
Endpoint of concern	Reproductive/ developmental
Equation	D
NOAEL (mg/m^3)	3 7E1
Uncertainty factor	100

L Ethylene glycol monoethyl ether acetate (111-15-9)

Acute HRV ($\mu g/m^3$)	**100**
Endpoint of concern	Reproductive/ developmental
Equation	D
LOAEL (mg/m^3)	1 4E2
Uncertainty factor	1,000

M. Ethylene glycol monomethyl ether (EGME)(109-86-4) or 2-methoxyethanol

Acute HRV ($\mu g/m^3$)	**90**
Endpoint of concern	Reproductive/ developmental
Equation	D
NOAEL (mg/m^3)	9.3
Uncertainty factor	100

N Formaldehyde (50-00-0)

Acute HRV ($\mu g/m^3$)	**94**
Endpomt of concern	Irritant - eye and respiratory system
Equation	C
BMC (mg/m^3)	9 4E-1
Uncertainty factor	10

O   Hydrogen chloride (7647-01-1)

Acute HRV (μg/m³)	**2,700**
Endpoint of concern	Irritant - eye and respiratory system
Equation	A
NOAEL (mg/m³)	2.7
Uncertainty factor	1

P. Hydrogen cyanide (74-90-8)

Acute HRV (μg/m³)	**700**
Endpoint of concern	Nervous system*
Equation	A
NOAEL (mg/m³)	6.8E1
Uncertainty factor	100

Q   Hydrogen fluoride (7664-39-3)

Acute HRV (μg/m³)	**240**
Endpoint of concern	Irritant - respiratory system
Equation	A
NOAEL$_{[ADJ]}$ (mg/m³)	2.4
Uncertainty factor	10

R. Methanol (67-56-1)

Acute HRV (μg/m³)	**25,000**
Endpoint of concern	Nervous system
Equation	A
NOAEL$_{[ADJ]}$ (mg/m³)	2.5E2
Uncertainty factor	10

S. Methyl bromide (74-83-9)

Acute HRV (μg/m³)	**2,000**
Endpoint of concern	Nervous system*
Equation	A
LOAEL$_{[ADJ]}$ (mg/m³)	1.4E2
Uncertainty factor	60

T   Methyl ethyl ketone (78-93-3)

Acute HRV (μg/m³)	**10,000**
Endpoint of concern	Irritant - eye and respiratory system
Equation	A
LOAEL$_{[ADJ]}$ (mg/m³)	8E2
Uncertainty factor	60

U   Nickel and nickel compounds (**)

Acute HRV (μg/m³)	**11**
Endpoint of concern	Irritant - respiratory system
Equation	A
LOAEL (mg/m³)	6.7E-2
Uncertainty factor	6

V Nitric acid (7697-37-2)

Acute HRV ($\mu g/m^3$)	**130**
Endpoint of concern	Irritant - respiratory system
Equation	A
NOAEL (mg/m^3)	1 29E-1
Uncertainty factor	1

W. Phenol (108-95-2)

Acute HRV ($\mu g/m^3$)	**5,800**
Endpoint of concern	Irritant - eye and respiratory system
Equation	B
NOAEL$_{[ADJ]}$ (mg/m^3)	5 8E1
Uncertainty factor	10

X. Phosgene (75-44-5)

Acute HRV ($\mu g/m^3$)	**4**
Endpomt of concern	Irritant - respiratory system*
Equation	A
NOAEL$_{[ADJ]}$ (mg/m^3)	4E-1
Uncertainty factor	100

Y. Sodium hydroxide (1310-93-2)

Acute HRV ($\mu g/m^3$)	**8**
Endpomt of concern	Irritant - eye, skin, and respiratory system
Equation	A
LOAEL$_{[ADJ]}$ (mg/m^3)	5E-1
Uncertainty factor	60

Z Styrene (100-42-5)

Acute HRV ($\mu g/m^3$)	**21,000**
Endpoint of concern	Irritant - eye and respiratory system
Equation	A
NOAEL$_{[ADJ]}$ (mg/m^3)	2 1E2
Uncertainty factor	10

AA Tetrachloroethylene or perchlorethylene (127-18-4)

Acute HRV ($\mu g/m^3$)	**20,000**
Endpomt of concern	Irritant - eye and respiratory and nervous systems
Equation	B
LOAEL$_{[ADJ]}$ (mg/m^3)	1.2E3
Uncertainty factor	60

BB Toluene (108-88-3)

Acute HRV (μg/m^3)	**37,000**
Endpoint of concern	Irritant - eye and respiratory and nervous systems
Equation	B
NOAEL$_{[ADJ]}$ (mg/m^3)	3 7E2
Uncertainty factor	10

CC. 1,1,1-Trichloroethane or methyl chloroform (71-55-6)

Acute HRV (μg/m^3)	**140,000**
Endpoint of concern	Nervous system
Equation	A
NOAEL (mg/m^3)	1 37E3
Uncertainty factor	10

DD. Trichloroethylene (79-01-6)

Acute HRV (μg/m^3)	**2,000**
Endpoint of concern	Reproductive/ developmental
Equation	D
LOAEL (mg/m^3)	5 4E2
Uncertainty factor	300

EE. Triethylamine (121-44-8)

Acute HRV (μg/m^3)	**2,800**
Endpoint of concern	Irritant - eye, transient corneal edema
Equation	B
NOAEL$_{[ADJ]}$ (mg/m^3)	2 8E1
Uncertainty factor	10

FF. Vanadium pentoxide (1314-62-1)

Acute HRV (μg/m^3)	**30**
Endpoint of concern	Irritant - respiratory system
Equation	B
LOAEL$_{[ADJ]}$ (mg/m^3)	3E-1
Uncertainty factor	10

GG Xylenes (1330-20-7)

Acute HRV (μg/m^3)	**43,000**
Endpoint of concern	Irritant - eye and respiratory and nervous systems
Equation	A
NOAEL (mg/m^3)	4.3E2
Uncertainty factor	10

* This HRV is for a chemical where there is little magnitude difference between the level where mild irritancy occurs and levels where more severe adverse health effects occur.

** This HRV is for a chemical mixture which, therefore, does not have a chemical-specific number assigned by the Chemical Abstracts Service

Statutory Authority: *MS s 144 12*

History: *26 SR 1229; 26 SR 1395*

4717.8250 TABLE OF MHRVs FOR MULTIMEDIA EXPOSURE TO AIR TOXICS.

The heading for each item contains the chemical name and, in parenthesis, the CAS RN Each item lists the MHRV and the variables necessary for the equation The equations used to develop the MHRV are designated as follows "A" means applying the equation under part 4717.8350 for noncarcinogenic effects of toxicants and "B" means applying the equation under part 4717 8450 for carcinogens The endpoint of concern is listed for use in determining a cancer index under part 4717 8550 or a hazard index under part 4717 8600.

TABLE OF MHRVs

A. Antimony (7440-36-0)

MHRV (μg/kg-day)	**0.4**
Endpoint of concern	Hematologic system
Equation	A
LOAEL (mg/kg-day)	3 5E-1
Uncertainty factor	1,000

B. Arsenic (7440-38-2)

MHRV (μg/kg-day)	**0.007**
Endpoint of concern	Cancer
Equation	B
Potency slope [mg/kg-day]$^{-1}$	1 5

C. Benzo[a]pyrene (50-32-8)

MHRV (μg/kg-day)	**0.001**
Endpoint of concern	Cancer
Equation	B
Potency slope [mg/kg-day]$^{-1}$	7 3

D Cadmium (7440-43-9)

MHRV (μg/kg-day)	**0.5**
Endpoint of concern	Renal system
Equation	A
NOAEL (mg/kg-day)	5E-3
Uncertainty factor	10

E Manganese (7439-96-5)

MHRV (μg/kg-day)	**140**
Endpoint of concern	Nervous system
Equation	A
NOAEL (mg/kg-day)	1 4E-1
Uncertainty factor	1

F. Methylmercury (22967-92-6)

MHRV (μg/kg-day)	**0.1**
Endpoint of concern	Nervous system and developmental
Equation	A
BMD (mg/kg-day)	1E-3
Uncertainty factor	10

G. Nickel (7440-02-0)

MHRV (μg/kg-day)	**20**
Endpoint of concern	Decreased body and organ weights
Equation	A
NOAEL (mg/kg-day)	5
Uncertainty factor	300

H Polychlorinated biphenyls (PCB) (1336-36-3)

MHRV (μg/kg-day)	**0.05**
Endpoint of return	Developmental
Equation	A
LOAEL (mg/kg-day)	5E-4
Uncertainty factor	10

Statutory Authority: *MS s 144 12*
History: *26 SR 1229*

4717.8300 EQUATIONS FOR CALCULATION OF HRVs FOR NONCARCINOGEN-IC EFFECTS OF TOXICANTS.

Subpart 1 **Scope.** This part establishes the method for determining the health risk values (HRVs) for noncarcinogenic effects of toxicants.

Subp. 2 **General equation; calculating HRV for noncarcinogenic effect of toxicant.** The equation for calculating an HRV for a noncarcinogenic effect of a toxicant is

$$\text{HRV} = \frac{\text{NOAEL}_{[ADJ]} \text{ or LOAEL}_{[ADJ]} \text{ or BMC}_{[ADJ]} \times 1{,}000}{(\text{Uncertainty factor})(\text{Modifying factor})}$$

or

$$\text{HRV} = \frac{\text{NOAEL}_{[HEC]} \text{ or LOAEL}_{[HEC]} \text{ or BMC}_{[HEC]} \times 1{,}000}{(\text{Uncertainty factor})(\text{Modifying factor})}$$

Where:

A HRV is expressed in units of micrograms per cubic meter ($\mu g/m^3$) of air,

B. $\text{NOAEL}_{[ADJ] \text{ or } [HEC]}$, $\text{LOAEL}_{[ADJ] \text{ or } [HEC]}$, or $\text{BMC}_{[ADJ] \text{ or } [HEC]}$ is expressed in units of milligrams per cubic meter (mg/m^3) of air,

C uncertainty factor and modifying factor are unitless,

D the default value for modifying factor is one unless otherwise specified in part 4717.8100 or 4717.8150; and

E. 1,000 is a factor to convert milligrams to micrograms

Subp 3. **Equation for NOAEL$_{[HEC]}$, LOAEL$_{[HEC]}$, or BMC$_{[HEC]}$; particles with respiratory effect.** The equation for calculating a NOAEL$_{[HEC]}$, LOAEL$_{[HEC]}$, or BMC$_{[HEC]}$ for a particle having a respiratory effect is

NOAEL$_{[HEC]}$ or LOAEL$_{[HEC]}$ or BMC$_{[HEC]}$ =
NOAEL$_{[ADJ]}$ or LOAEL$_{[ADJ]}$ or BMC$_{[ADJ]}$ $\times$ RDDR

Where.

A. NOAEL$_{[HEC]}$, LOAEL$_{[HEC]}$, or BMC$_{[HEC]}$ is expressed in units of milligrams per cubic meter (mg/m^3) of air;

B NOAEL$_{[ADJ]}$, LOAEL$_{[ADJ]}$, or BMC$_{[ADJ]}$ is expressed in units of milligrams per cubic meter (mg/m^3) of air; and

C RDDR is the regional deposited dose ratio and is unitless.

Subp 4 **Equation for NOAEL$_{[HEC]}$, LOAEL$_{[HEC]}$, or BMC$_{[HEC]}$; particles with extrarespiratory effect.** The equation for calculating a NOAEL$_{[HEC]}$, LOAEL$_{[HEC]}$, or BMC$_{[HEC]}$ for particles with an extrarespiratory effect is

NOAEL$_{[HEC]}$ or LOAEL$_{[HEC]}$ or BMC$_{[HEC]}$ =
NOAEL$_{[ADJ]}$ or LOAEL$_{[ADJ]}$ or BMC$_{[ADJ]}$ $\times$ RDDR$_{ER}$

Where·

A. NOAEL$_{[HEC]}$, LOAEL$_{[HEC]}$, or BMC$_{[HEC]}$ is expressed in units of milligrams per cubic meter (mg/m^3) of air,

B NOAEL$_{[ADJ]}$, LOAEL$_{[ADJ]}$, or BMC$_{[ADJ]}$ is expressed in units of milligrams per cubic meter (mg/m^3) of air, and

C. RDDR$_{ER}$ is the regional deposited dose ratio for extrarespiratory effects and is unitless.

Subp. 5. **Equation for NOAEL$_{[HEC]}$, LOAEL$_{[HEC]}$, or BMC$_{[HEC]}$; gas with respiratory effect.** The equation for calculating the NOAEL$_{[HEC]}$, LOAEL$_{[HEC]}$, or BMC$_{[HEC]}$ for a gas having a respiratory effect is:

NOAEL$_{[HEC]}$ or LOAEL$_{[HEC]}$ or BMC$_{[HEC]}$ =
NOAEL$_{[ADJ]}$ or LOAEL$_{[ADJ]}$ or BMC$_{[ADJ]}$ $\times$ RGDR

Where

A. NOAEL$_{[HEC]}$, LOAEL$_{[HEC]}$, or BMC$_{[HEC]}$ is expressed in units of milligrams per cubic meter (mg/m^3) of air,

B. NOAEL$_{[ADJ]}$, LOAEL$_{[ADJ]}$, or BMC$_{[ADJ]}$ is expressed in units of milligrams per cubic meter (mg/m^3) of air; and

C. RGDR is the regional gas dose ratio in the specific region of the respiratory tract and is unitless.

Subp. 6 **Equation for NOAEL$_{[HEC]}$, LOAEL$_{[HEC]}$, or BMC$_{[HEC]}$; gas with extrarespiratory effect.** The equation for calculating the NOAEL$_{[HEC]}$, LOAEL$_{[HEC]}$, or BMC$_{[HEC]}$ for a gas having an extrarespiratory effect is.

$$NOAEL_{[HEC]} = NOAEL_{[ADJ]} \times \frac{(H_{b/g})_A}{(H_{b/g})_H}$$

or

$$LOAEL_{[HEC]} = LOAEL_{[ADJ]} \times \frac{(H_{b/g})_A}{(H_{b/g})_H}$$

'or

$$BMC_{[HEC]} = BMC_{[ADJ]} \times \frac{(H_{b/g})_A}{(H_{b/g})_H}$$

Where

A NOAEL$_{[HEC]}$, LOAEL$_{[HEC]}$, or BMC$_{[HEC]}$ is expressed in units of milligrams per cubic meter (mg/m^3) of air,

B NOAEL$_{[ADJ]}$, LOAEL$_{[ADJ]}$, or BMC$_{[ADJ]}$ is expressed in units of milligrams per cubic meter (mg/m^3) of air, and

C $(H_{b/g})_A/(H_{b/g})_H$ is the ratio of the blood gas (air)partition coefficient of the chemical in the experimental animal to the blood gas (air) partition coefficient of the chemical in a human, the ratio is unitless If $(H_{b/g})_A > (H_{b/g})_H$ or if the partition coefficient values are unknown, $(H_{b/g})_A/(H_{b/g})_H = 1 0$

Statutory Authority: *MS s 144 12*

History: *26 SR 1229 26 SR 1395*

4717.8350 EQUATION FOR CALCULATION OF MHRV FOR NONCARCINOGENIC EFFECTS OF TOXICANTS.

Subpart 1 **Scope.** This part establishes the method for determining the multimedia health risk value (MHRV) for a noncarcinogenic effect of a toxicant emitted to the air.

Subp 2 **Equation for MHRV for noncarcinogenic effect of toxicant.** The equation for calculating a MHRV for a noncarcinogenic effect of a toxicant is

$$MHRV = \frac{NOAEL \text{ or } LOAEL \text{ or } BMD}{(Uncertainty\ factor)\ (Modifying\ factor)} \times 1{,}000$$

Where·

A MHRV is expressed in units of micrograms of chemical or defined mixture of chemicals per kilogram of body weight per day (μg/kg-day);

B NOAEL, LOAEL, or BMD is expressed in units of milligrams of chemical or defined mixture of chemicals per kilogram body weight per day (mg/kg-day),

C. uncertainty factor and modifying factor are unitless;

D. the default value for modifying factor is one unless otherwise specified in part 4717 8250; and

E. 1,000 is a factor to convert milligrams to micrograms.

Statutory Authority: *MS s 144.12*

History: *26 SR 1229, 26 SR 1395*

4717.8400 EQUATION FOR CALCULATION OF HRVs FOR CARCINOGENS.

Subpart 1. **Scope.** This part establishes the method for determining the health risk values (HRVs) for a carcinogen.

Subp. 2 **Equation for carcinogens.** The equation for determining the HRV for a carcinogen is.

$$HRV = \frac{Additional\ lifetime\ risk}{Unit\ risk}$$

Where:

A HRV is expressed in units of micrograms per cubic meter (μg/m^3) of air,

B umt risk is expressed in units of micrograms of the chemical or defined mixture of chemicals per cubic meter of air; and

C. additional lifetime risk is unitless.

Statutory Authority: *MS s 144 12*

History: *26 SR 1229*

4717.8450 EQUATION FOR CALCULATION OF MHRV FOR CARCINOGENS.

Subpart 1. **Scope.** This part establishes the methods for determining the multimedia health risk values (MHRVs) for carcinogens emitted to the air

Subp 2. **General equation for calculating MHRVs for carcinogens.** The general equation for calculating MHRVs for carcinogens is

$$\text{MHRV} = \frac{\text{Additional lifetime risk}}{\text{Potency slope}} \times 1{,}000$$

Where.

A MHRV is expressed in units of micrograms per kilogram of body weight per day (μg/kg-day),

B. potency slope is expressed in units of the inverse of milligrams per kilogram of body weight per day $(\text{mg/kg-day})^{-1}$,

C additional lifetime risk is unitless; and

D 1,000 is a factor to convert milligrams to micrograms

Statutory Authority: *MS s 144 12*

History: *26 SR 1229*

4717.8500 EQUATIONS FOR CALCULATION OF HRVs FOR ACUTE TOXICITY.

Subpart 1 **Scope.** This part establishes the method for determining the health risk value (HRV) for toxicants having acute toxicity effects.

Subp 2. **General equation for calculating an HRV for an acute irritant.** The equation for calculating an HRV for an acute irritant is.

$$\text{HRV} = \frac{\text{NOAEL or NOAEL}_{[ADJ]}}{(\text{Uncertainty factor})(\text{Modifying factor})} \times 1{,}000$$

or

$$\text{HRV} = \frac{\text{LOAEL or LOAEL}_{[ADJ]}}{(\text{Uncertainty factor})(\text{Modifying factor})} \times 1{,}000$$

or

$$\text{HRV} = \frac{\text{BMC or BMC}_{[ADJ]}}{(\text{Uncertainty factor})(\text{Modifying factor})} \times 1{,}000$$

Where:

A. HRV is expressed in units of micrograms per cubic meter (μg/m^3) of air,

B NOAEL, NOAEL$_{[ADJ]}$, LOAEL, LOAEL$_{[ADJ]}$, BMC, or BMC$_{[ADJ]}$ is expressed in units of milligrams per cubic meter (mg/m^3) of air;

C uncertainty factors and modifying factor are unitless;

D. the default value for modifying factor is one unless otherwise specified in part 4717 8200, and

E 1,000 is a factor to convert milligrams to micrograms

Subp. 3 **Methods of calculation for acute irritant; study exposure time from 30 minutes to two hours.**

For acute irritants where the study time is 30 minutes to two hours, the study NOAEL or LOAEL will be used without adjustment. For studies where the exposure time is 30 minutes to two hours and a BMC approach is used, a time adjustment may be necessary When a BMC approach is used, the equation for calculating a $BMC_{[ADJ]}$ is.

$$BMC_{[ADJ]} \times 60 \text{ minutes} = BMC_{(study)} \times \text{exposure duration}$$

Where:

A $BMC_{(study)}$ is expressed in units of milligrams of a chemical or defined mixture of chemicals per cubic meter (mg/m^3) of air used in the study as the exposure concentration, and

B. $BMC_{[ADJ]}$ is expressed in units of milligrams per cubic meter (mg/m^3) of air

Subp. 4. **Equation for acute irritant; study exposure time from two to eight hours.** The equation for calculating a $NOAEL_{[ADJ]}$, $LOAEL_{[ADJ]}$, or $BMC_{[ADJ]}$ for an acute irritant based on data from a study where the exposure time or adverse health effect onset time is greater than two hours but less than or equal to eight hours is

$$(NOAEL_{(study)}{}^n \text{ or } LOAEL_{(study)}{}^n \text{ or } BMC_{(study)}{}^n) (\text{exposure duration or onset of critical effect}) = NOAEL_{[ADJ]} \text{ or } LOAEL_{[ADJ]} \text{ or } BMC_{[ADJ]}$$

Where

A. $NOAEL_{(study)}$, $LOAEL_{(study)}$, or $BMC_{(study)}$ is expressed in units of milligrams of a chemical or defined mixture of chemicals per cubic meter (mg/m^3) of air used in the study as the exposure concentration,

B the default value for n is 2 unless noted otherwise,

C the exposure duration represents the time at which the critical effect occurred. This most often is the exposure duration, but in some instances the critical effect may differ from the exposure duration, depending on the critical endpoint being observed, and

D. $NOAEL_{[ADJ]}$, $LOAEL_{[ADJ]}$, or $BMC_{[ADJ]}$ is expressed in units of milligrams per cubic meter (mg/m^3) of air.

Subp. 5. **Calculation of HRV for chemical causing reproductive/developmental toxicity.** The equation for calculating an HRV for a chemical or defined mixture of chemicals causing reproductive/developmental toxicity is

$$HRV = \frac{NOAEL \text{ or } LOAEL \text{ or } BMC}{(\text{Uncertainty factor}) (\text{Modifying factor})} \times 1,000$$

Where.

A HRV is expressed in units of micrograms per cubic meter ($\mu g/m^3$) of air,

B NOAEL, LOAEL, or BMC is expressed in units of milligrams per cubic meter (mg/m^3) of air,

C uncertainty factor and modifying factor are unitless;

D. the default value for modifying factor is one unless otherwise specified in part 4717.8200, and

E 1,000 is a factor to convert milligrams to micrograms

Statutory Authority: *MS s 144 12*

History: *26 SR 1229; 26 SR 1395*

CANCER INDEX AND HAZARD INDEX

4717.8550 PROCEDURE FOR DETERMINING CANCER INDEX FOR SIMULTANEOUS EXPOSURE TO MULTIPLE CARCINOGENS.

Subpart 1 **Cancer index.** To evaluate simultaneous exposure for multiple carcinogens, a cancer index must be calculated using the procedure in this part

Subp 2. **Carcinogenic HRVs.** For health risk values (HRVs) that have cancer endpoints, items A to C apply

A. A cancer index is determined for chemicals or defined mixtures of chemicals with an inhalation endpoint of cancer using the following equation.

$$\text{Cancer Index} = \frac{E_{C1}}{HRV_{C1}} + \frac{E_{C2}}{HRV_{C2}} + \quad + \frac{E_{Cn}}{HRV_{Cn}}$$

Where:

(1) E_{Cn} represents the measured or modeled ambient air concentration as expressed in units of micrograms per cubic meter ($\mu g/m^3$) of the first, second, through the nth carcinogen; and

(2) HRV_{Cn} represents the chronic HRV of the first, second, through n^{th} carcinogen as expressed in units of micrograms per cubic meter ($\mu g/m^3$)

B A cancer index of one is equivalent to a cumulative HRV A cancer index greater than one exceeds the cumulative HRV

Subp 3 **Carcinogenic MHRVs.** For mixtures of multimedia health risk values (MHRVs) that have cancer endpoints, items A to C apply.

A. A cancer index is determined for chemicals or defined mixtures of chemicals with an endpoint of cancer using the following equation

$$\text{Cancer Index} = \frac{D_{C1}}{MHRV_{C1}} + \frac{D_{C2}}{MHRV_{C2}} + \quad + \frac{D_{Cn}}{MHRV_{Cn}}$$

Where

(1) D_{Cn} represents the calculated lifetime averaged daily dose of the first, second, through the nth carcinogen as expressed in units of micrograms per kilogram of body weight per day ($\mu g/kg\text{-}d$), and

(2) $MHRV_{Cn}$ represents the MHRV of the first, second, through the nth carcinogen as expressed in units of micrograms per kilogram of body weight per day ($\mu g/kg\text{-}d$).

B A cancer index of one is equivalent to a cumulative MHRV. A cancer index greater than one exceeds the cumulative MHRV

Statutory Authority: *MS s 144 12*

History: *26 SR 1229*

4717.8600 PROCEDURE FOR DETERMINING HAZARD INDEX FOR ASSESSING SIMULTANEOUS EXPOSURE TO MULTIPLE TOXICANTS WITH NON-CARCINOGENIC EFFECTS.

Subpart 1. **Hazard index.** When simultaneous exposure is evaluated for multiple toxicants with noncarcinogenic effects, a hazard index must be calculated using the procedure in this part.

Subp. 2 **HRVs for toxicants with noncarcinogenic effects.** For health risk values (HRVs) that have endpoints other than cancer, items A to D apply.

A The chemicals or defined mixtures of chemicals detected in the air must be first grouped by endpoint of concern and by HRV type (acute, subchronic, chronic)

B A separate hazard index is then calculated for each same endpomt of concern group within the chronic, subchronic, and acute categories.

C When two or more chemicals or defined mixtures of chemicals have the same endpoint, a hazard index must be determined using the following equation.

$$\text{Hazard Index} = \frac{E_{ST1}}{HRV_{ST1}} + \frac{E_{ST2}}{HRV_{ST2}} + \quad + \frac{E_{STn}}{HRV_{STn}}$$

Where

(1) E_{STn} represents the measured or modeled ambient air concentration of the first, second, through the nth toxicant with noncarcmogenic effects in air as expressed in units of micrograms per cubic meter ($\mu g/m^3$), and

(2) HRV_{STn} represents the HRV of the first, second, through the nth toxicant with noncarcinogemc effects as expressed in units of micrograms per cubic meter ($\mu g/m^3$)

D. A hazard index of one or less indicates a combined concentration of chemicals unlikely to cause an adverse health effect to the general pubhc

E. A hazard index of one equals the cumulative HRV.

Subp 3 **MHRVs for toxicants with noncarcinogenic effects.** For multimedia health risk values (MHRVs) that have endpoints other than cancer, items A to C apply

A. The chemicals or defmed mixtures of chemicals measured or modeled in ambient air must first be grouped by endpomt of concern.

B When two or more chemicals or defmed mixtures of chemicals have the same endpomt, a hazard index must be determined using the following equation·

$$\text{Hazard Index} = \frac{D_{ST1}}{MHRV_{ST1}} + \frac{D_{ST2}}{MHRV_{ST2}} + \quad + \frac{D_{STn}}{MHRV_{STn}}$$

Where:

(1) D_{STn} represents the calculated dose of the first, second, through the nth toxicant with noncarcinogenic effects as expressed m micrograms per kilogram of body weight per day ($\mu g/kg\text{-}d$), and

(2) $MHRV_{STn}$ represents the MHRV of the first, second, through the nth toxicant with noncarcinogenic effects as expressed in micrograms per kilogram of body weight per day ($\mu g/kg\text{-}d$)

C. A hazard index of one or less indicates a combined concentration of chemicals unlikely to cause an adverse health effect to the general public

D A hazard index of one equals the cumulative MHRV

Statutory Authority: *MS s 144 12*
History: *26 SR 1229; 26 SR 1395*