Supplemental Tables

**Table S1.** Draft NIOSH Tier 1 Banding Criteria: GHS Hazard Codes and Categories

|  |  |  |  |
| --- | --- | --- | --- |
| Endpoint | Endpoint Band | | |
| C | D | E |
| Acute Toxicity | H301, Cat. 3  H302, Cat. 4  H331, Cat. 3  H332, Cat. 4  H311, Cat. 3  H312, Cat. 4 | H300, Cat. 2 H330, Cat.2 H310, Cat.2 | H300, Cat. 1  H330, Cat. 1  H310, Cat. 1 |
| Skin Corrosion/Irritation | H315, Cat. 2 | none | H314, Cat. 1, 1A, 1B or 1C |
| Eye Damage/Irritation | H319, Cat. 2, 2A, or 2B | none | H318, Cat. 1 |
| Respiratory and Skin Sensitization | Skin: H317, Cat. 1B | Skin: H317, Cat. 1 or 1A Respiratory: H334, Cat. 1B | Skin: none Respiratory: H334, Cat. 1 or  1A |
| Germ Cell Mutagenicity | none | H341, Cat. 2 | H340, Cat. 1, 1A or 1B |
| Carcinogenicity | none | None | H350, Cat. 1, 1A or 1B H351, Cat. 2 |
| Reproductive Toxicity | H361 (excluding H361f, H361d, and H361fd), Cat. 2 | H360 (including H360f, H360d, and H360fd), Cat. 1B | H360 (including H360f, H360d, and H360 fd), Cat. 1 or 1A |
| Specific Target Organ Toxicity – Repeated Exposure | H371, Cat. 2  H373, Cat. 2 | None | H370, Cat. 1  H372, Cat. 1 |

**Cat:** Category; **GHS:** Globally Harmonized System of Classification and Labelling;

**Table S2**. Draft NIOSH Tier 2 Banding Criteria: Acute Toxicity

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Exposure/Dosing Route | Endpoint Band | | | | |
| A | B | C | D | E |
| Oral (LD50), mg/kg-bw | >2000 | >300 to ≤2000 | >50 to ≤300 | >5 to ≤50 | ≤5 |
| Dermal (LD50), mg/kg-bw | >2000 | >1000 to ≤2000 | >200 to ≤1000 | >50 to ≤200 | ≤50 |
| Inhalation, gases (LC50), ppmv/4 h | >20,000 | >2,500 to ≤20,000 | >500 to  ≤2,500 | >100 to ≤500 | ≤100 |
| Inhalation, vapors (LC50), mg/L/4 h | >20 | >10 to ≤20 | >2 to ≤10 | >0.5 to ≤2.0 | ≤0.5 |
| Inhalation, dusts and mists (LC50) | >5 | >1 to ≤5 | >0.5 to ≤1 | >0.05 to ≤0.5 | ≤0.05 |

**bw**: body weight; **LD50:** lethal dose 50%; **LC50:** lethal concentration 50%;

**Table S3.** Draft NIOSH Tier 2 Banding Criteria: Skin Corrosion/Irritation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Endpoint Band | | | |
|  | A | B | C | E |
| Skin Corrosion/Irritation Results | Non-irritating | Mild to moderate irritation | Moderate to severe irritation; reversible direct effects  OR | Skin corrosion; irreversible effects  pH ≤2 or >11.5 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  | Mixed results or irritant potential with unspecified severity |  |

**Table S4.** Draft NIOSH Tier 2 Banding Criteria: Eye Damage/Irritation

|  |  |  |  |
| --- | --- | --- | --- |
|  | Endpoint Band | | |
|  | A | C | E |
| Eye Damage/Irritation Results | Mild to moderate irritation | Severe irritation; moderate to severe irritation  OR  Irritant with unspecified severity, no conclusion, or mixed results | Irreversible eye damage |

**Table S5.** Draft NIOSH Tier 2 Banding Criteria: Respiratory Sensitization

|  |  |  |  |
| --- | --- | --- | --- |
|  | Endpoint Band | | |
|  | A | C | D |
| Respiratory Sensitization Results | No evidence | Mixed | Positive |

**Table S6.** Draft NIOSH Tier 2 Banding Criteria: Skin Sensitization

|  |  |  |  |
| --- | --- | --- | --- |
| Test Type | Endpoint Band | | |
| A | C | E |
| LLNA EC3 (%) | Non-skin sensitizer | >2.0 to ≤100  (weak to moderate skin sensitizer) | ≤2.0  (strong to extreme skin sensitizer) |
| GPMT | No positive response or low incidence | 30-60% of test animals respond at  >0.1% intradermal induction concentration  OR  ≥30% of test animals respond at >1% intradermal induction concentration | ≥30% of test animals respong at  ≤0.1% intradermal induction  concentration OR  ≥60% of test animals respond at  >0.1% to ≤1% intradermal induction  concentration |
| Buehler | No positive response or low incidence | ≥60% of test animals respond at >0.2 to  ≤20% topical induction concentration  OR  ≥15% of test animals respond at >20%  topical induction concentration | ≥15% of test animals respond at  ≤0.2% topical induction  concentration OR  ≥60% respond at any topical induction concentration |

**GPMT:** guinea pig maximization test; **LLNA EC3:** local lymph node assay effective concentration required to produce a three-fold increase in the stimulation index compared to vehicle-treated controls

**Table S7.** Draft NIOSH Tier 2 Banding Criteria: Genotoxicity

|  |  |  |  |
| --- | --- | --- | --- |
|  | Endpoint Band | | |
|  | A | C | D |
| Genotoxicity Results | Negative | Mixed | Positive |

**Table S8.** Draft NIOSH Tier 2 Banding Criteria: Carcinogenicity

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Quantitative** | Endpoint Band | | | |
| Potency Factor | A | C | D | E |
| Slope Factor, (mg/kg-day)-1 | NA | <0.01 | ≥0.01 to <10 | ≥10 |
| Inhalation risk unit, (µg/m3)-1 | NA | <3x10-6 | ≥3x10-6 to <0.01 | ≥0.01 |
| TD05, mg/kg-day | NA | >5 | >0.005 to ≤5 | ≤0.005 |
| TC05 (µg/m3) | NA | >16,700 | >5 to 16,700 | ≤5 |
| **Qualitative** |  |  |  |  |
| NTP Report on Carcinogens | NA | NA | NA | 1. Known to be a human carcinogen 2. Reasonably anticipated to be a human carcinogen |
| EPA IRISA | 1. Group E (evidence of non-carcinogenicity for humans) 2. Not likely to be carcinogenic to humans | NA | 1. Group C 2. Suggestive evidence of carcinogenic potential | 1. Group A 2. Carcinogenic to humans 3. Group B1 4. Group B2 5. Likely to be carcinogenic to humans |
| IARCB | Group 4 | NA | NA | 1. Group 1 2. Group 2A 3. Group 2B |
| State of California OEHHA | NA | NA | NA | Type of toxicity=cancer |

**Group 1**: carcinogenic to humans; **Group 2A:** probably carcinogenic to humans; **Group A:** human carcinogen; **Group 2B:** possibly carcinogenic to humans; **Group 4:** probably not carcinogenic to humans; **Group B1:** probable human carcinogen; **Group B2:** probable human carcinogen; **Group C:** possible human carcinogen; **IARC:** International Agency for Research on Cancer; **NA:** not applicable; **NTP:** National Toxicology Program; **OEHHA:** Office of Environmental Health Hazard Assessment; **TD:** tumorigenic dose

AGroup D (not classifiable as to human carcinogenicity) and category “data are inadequate for an assessment of carcinogenic potential”, no band assigned.

BGroup 3 (no classifiable as to its carcinogenicity to humans), no band assigned.

**Table S9.** Draft NIOSH Tier 2 Banding Criteria: Reproductive Toxicity

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Exposure/Dosing Route | Endpoint Band | | | | |
| A | B | C | D | E |
| Oral, Dermal, mg/kg-day | >300 | >30 to ≤300 | >3 to ≤30 | >0.3 to ≤3 | ≤0.3 |
| Inhalation, gases and vapors, ppm | >10,000 | >1,000 to ≤10,000 | >100 to ≤,1000 | >10 to ≤100 | ≤10 |
| Inhalation, dusts and mists,  µg/m3 | >10,000 | >1,000 to ≤10,000 | >100 to ≤1,000 | >10 to ≤100 | ≤10 |

**Table S10.** Draft NIOSH Tier 2 Banding Criteria: Specific Target Organ Toxicity-Repeated Exposure

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Exposure/Dosing Route | Endpoint Band | | | | |
| A | B | C | D | E |
| Oral, Dermal, mg/kg-day | >1,000 | >100 to ≤1,000 | >10 to ≤100 | >1 to ≤10 | ≤1 |
| Inhalation, gases and vapors, ppm | >30,000 | >3,000 to ≤30,000 | >300 to ≤3,000 | >30 to ≤300 | ≤30 |
| Inhalation, dusts and mists,  µg/m3 | >30,000 | >3,000 to ≤30,000 | >300 to ≤3,000 | >30 to ≤300 | ≤30 |

**Table S11.** Endpoint Determinant Scores (EDS) Associated with Health Effect Endpoints under Draft NIOSH Tier 2

|  |  |
| --- | --- |
| Endpoint | EDS if Adequate Data AvailableA |
| Acute Toxicity | 5 |
| Skin Corrosion/Irritation | 5 |
| Eye Damage/Irritation | 5 |
| Respiratory Sensitization | 10 |
| Skin Sensitization | 5 |
| Genotoxicity | 5 |
| Carcinogenicity Quantitative Qualitative | 30  20 or 30B |
| Reproductive Toxicity | 30 |
| Specific Target Organ Toxicity – Repeated Exposure | 30 |

AIf adequate data are not available, endpoint determinant score is 0.

BSee Table 3-7 in: National Institute for Occupational Safety and Health (NIOSH): The NIOSH Occupational Exposure Banding Process: Guidance for the Evaluation of Chemical Hazards, External Review Draft. March 8, 2017. Available at: https://[www.regulations.gov/document?D=CDC-2017-0028-0002](http://www.regulations.gov/document?D=CDC-2017-0028-0002) (accessed 17 Aug 2018).