



Brian R. Leahy  
Director

## MEMORANDUM

Edmund G. Brown Jr.  
Governor

TO: Shelley DuTeaux, PhD MPH  
Branch Chief  
Human Health Assessment Branch

VIA: Svetlana Koshlukova, PhD *[original signed by S. Koshlukova]*  
Senior Toxicologist  
Risk Assessment Section

FROM: Carolyn M. Lewis, MS, DABT *[original signed by C. Lewis]*  
Research Scientist III  
Risk Assessment Section

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SUBJECT: Update to the Worker Exposure Scenarios Evaluated in 2012 Chloropicrin Risk Characterization Document

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Workers are generally assumed to have an exposure duration of 8 hours/day for 5 days/week. The exposure durations for residential bystanders is assumed to be 24 hours/day for 7 days/week. However, in the final Risk Characterization Document (RCD) for chloropicrin dated November 14, 2012, adult human equivalent concentrations (HECs) and reference concentrations (RfCs) were calculated to evaluate seasonal and chronic exposure without distinguishing between the different exposure durations for workers and residential bystanders. As a result, workers should have had higher HECs and RfCs than bystanders since their exposure duration is shorter. Therefore, the subchronic and chronic HECs, RfCs and Margins of Exposure (MOEs) for workers have been revised as follows.

### **I. Revised Human Equivalent Concentrations and Reference Concentrations for Workers**

The 90-day inhalation study in rats was selected as the definitive study for evaluating seasonal inhalation exposure with a critical NOEL of 120 ppb (810  $\mu\text{g}/\text{m}^3$ ) based on the  $\text{BMCL}_{05}$  for rhinitis in females (Chun and Kintigh, 1993) (Table 1). The definitive study for evaluating seasonal exposure and the bystander HECs and RfCs have not changed from the 2012 RCD. However, the subchronic HEC for workers increased with the revised exposure duration of 8 hours/day, 5 days/week. An adult breathing rate of 0.28  $\text{m}^3/\text{kg}/\text{day}$  was assumed for workers. Therefore, for workers the subchronic HEC is 310 ppb (2.1  $\text{mg}/\text{m}^3$ ) and the subchronic RfC is 3.1 ppb (21  $\mu\text{g}/\text{m}^3$ ).

The 78-wk inhalation study in mice was selected as the definitive study for evaluating chronic inhalation exposure to chloropicrin with a critical NOEL of 49 ppb (329  $\mu\text{g}/\text{m}^3$ ) based on the  $\text{BMCL}_{2.5}$  for bronchiectasis in males and females (Burleigh-Flayer et al., 1995) (Table 1). The definitive study for evaluating chronic exposure and the bystanders HECs and RfCs have not changed from the 2012 RCD. However, the chronic HEC for workers has increased to 240 ppb



(1.6 mg/m<sup>3</sup>), assuming exposure was limited to 8 hours/day, 5 days/week. The chronic RfCs for workers also increased to 2.4 ppb (16 µg/m<sup>3</sup>).

**Table 1.** Revised Human Equivalent Concentrations and Reference Concentrations for Evaluating Seasonal and Chronic Exposure in Workers to Chloropicrin

| Exposure Scenario | Critical Endpoints                     | HEC <sup>a</sup>           |   | RfC  |   |
|-------------------|--|----------------------------|---|--|---|
|                   |  | Children                   | Adults  | Children   | Adults  |
| Seasonal          | Rhinitis in female rats                | <u>Bystander</u><br>35 ppb | <u>Bystander</u><br>73 ppb<br><u>Workers</u><br>310 ppb | <u>Bystander</u><br>0.35 ppb<br>UF <sup>b</sup> =100 | <u>Bystander</u><br>0.73 ppb<br><u>Workers</u><br>3.1 ppb<br>UF=100 |
| Chronic           | Bronchiectasis in male and female mice | <u>Bystander</u><br>27 ppb | <u>Bystander</u><br>56 ppb<br><u>Worker</u><br>240 ppb  | <u>Bystander</u><br>0.27 ppb<br>UF=100               | <u>Bystander</u><br>0.56 ppb<br><u>Workers</u><br>2.4 ppb<br>UF=100 |

a HEC = BMDL x BR<sub>a</sub>/BR<sub>h</sub> x exposure<sub>a</sub>/exposure<sub>h</sub>. BR<sub>a</sub> = 0.96 and 1.8 m<sup>3</sup>/k/day for rats and mice, respectively. BR<sub>h</sub> = 0.59 and 0.28 m<sup>3</sup>/kg/day for children and adults, respectively. Exposure<sub>a</sub> = 6 hrs/day, 5 days/wk for rats and mice. Exposure<sub>h</sub> = 24 hrs/day, 7 days/wk for bystanders and 8 hrs/day, 5 days/wk for workers.

b UF = Uncertainty factor used to derive RfC.

## II. Revised Margins of Exposure for Workers

### II.A. Soil Fumigation

The revised seasonal margins of exposure (MOEs) for workers involved in soil fumigation are summarized in Table 2. The revised subchronic HEC of 310 ppb for workers<sup>1</sup> was used to calculate the MOEs. All of the seasonal MOEs for soil fumigation are greater than one (> 1). The lowest seasonal MOEs range from 6 – 8 were for driver, co-pilot, tarp splitters and removers with broadcast, tarped application when chloropicrin was used as one of the active ingredients. When chloropicrin was the sole active ingredient, all of the workers involved in broadcast, tarped application had MOEs less than 100. With other application methods, the driver, co-pilot or applicator also had MOEs less than 100. The only worker scenarios with MOEs greater than 100 were soil sealers or shapers with broadcast, non-tarped application, tarp punchers with bedded, tarped application, pipe-layers with bedded, non-tarped application, tarp punchers with drip irrigation, and applicators with hand-wand application of Pic-Brom 25. When chloropicrin was used as a warning agent at either 10.5% or less than 2%, the seasonal MOEs were generally

<sup>1</sup> Based on rhinitis in female rats and the seasonal exposure estimates found in Table 23, Chloropicrin Risk Characterization Document, Department of Pesticide Toxicology, November 14, 2012. Available at [http://www.cdpr.ca.gov/docs/risk/rcd/chloropicrinrisk\\_2012.pdf](http://www.cdpr.ca.gov/docs/risk/rcd/chloropicrinrisk_2012.pdf)

greater than 100. The exception was with broadcast, tarped application where the driver, co-pilot, tarp splitter, and tarp remover had MOEs less than 100.

**Table 2.** Revised Seasonal Margins of Exposure for Workers Involved in Soil Fumigation with Chloropicrin<sup>a</sup>

| Exposure Scenarios                     | Margin of Exposure     |                     |                   |
|--|------------------------|---------------------|-------------------|
|  | Active Ingredient >15% | Warning Agent 10.5% | Warning Agent <2% |
| Broadcast, tarped <sup>b</sup>         |                        |                     |                   |
| Driver                                 | 8                      | 72                  | 380               |
| Copilot                                | 6                      | 57                  | 300               |
| Shoveler                               | 17                     | 160                 | 860               |
| Tarp splitter                          | 6                      | 59                  | 310               |
| Tarp remover                           | 6                      | 59                  | 310               |
| Soil shaper                            | 54                     | 510                 | 2,700             |
| Soil shaper - Tri-Form 40/60           | 89                     | NA <sup>b</sup>     | NA                |
| Soil shaper - Tri-Con 33/67            | 80                     | NA                  | NA                |
| Broadcast, non-tarped                  |                        |                     |                   |
| Driver                                 | 16                     | 150                 | 780               |
| Soil sealer                            | 36                     | 340                 | 1,800             |
| Soil shaper - shallow                  | 120                    | NA                  | NA                |
| Soil shaper – shallow (Tri-Form 40/60) | 200                    | NA                  | NA                |
| Soil shaper - deep                     | 190                    | 1800                | 9,400             |
| Soil shaper - deep (Tri-Form 40/60)    | 310                    | NA                  | NA                |
| Soil shaper - deep (Tri-Con 33/67)     | 280                    | NA                  | NA                |
| Bedded, tarped                         |                        |                     |                   |
| Driver                                 | 63                     | 600                 | 3,100             |
| Copilot                                | 50                     | 470                 | 2,500             |
| Shoveler                               | 87                     | 830                 | 4,300             |
| Tarp puncher                           | 620                    | 5,900               | 16,000            |
| Bedded, non-tarped                     |                        |                     |                   |
| Driver                                 | 13                     | NA                  | NA                |
| Pipe layer                             | 260                    | NA                  | NA                |
| Pipe layer - Tri-Con 33/67             | 360                    | NA                  | NA                |
| Drip irrigation                        |                        |                     |                   |
| Applicator - tarped                    | 50                     | 470                 | 2,500             |
| Tarp puncher                           | 170                    | 1,600               | 8,300             |
| Applicator - non-tarped                | 37                     | NA                  | NA                |
| Handwand replant                       |                        |                     |                   |
| Applicator                             | 32                     | 300                 | 1,600             |
| Applicator - Telone C-35               | 92                     | NA                  | NA                |
| Applicator - Pic-Brom 25               | 130                    | NA                  | NA                |
| Potting soil                           |                        |                     |                   |
| Tarp remover                           | NA                     | 59                  | 310               |

a Margin of Exposure (MOE) = NOEL or HEC / Exposure Dosage. NOEL= No-Observed-Effect Level. HEC = Human Equivalent Concentration. Subchronic HEC = 310 ppb for workers. Exposure estimates from Table 23 in 2012 RCD. Values rounded to two significant figures.

b NA = Not applicable

The annual exposures to chloropicrin for workers involved in soil fumigation were reevaluated using the revised chronic HEC of 240 ppb for workers.<sup>2</sup> The revised annual MOEs for these workers are summarized in Table 3. The annual MOEs were slightly larger than the seasonal MOEs. However, the same scenarios that had MOEs less than 100 with seasonal exposure also had MOEs less than 100 for annual exposure. As with seasonal exposure, the annual MOEs were lowest for drivers, co-pilots, tarp-splitters, and tarp removers with broadcast, tarped fumigation when chloropicrin was the active ingredient (MOE range = 11-14). When chloropicrin was used as a warning agent, either at 10.5% or less than 2%, the annual MOEs were all greater than 100.

### II.B. Structural Fumigation

The revised MOEs for workers involved in structural fumigation are summarized in Table 4. The seasonal MOEs were estimated using the subchronic HEC of 310 ppb for workers.<sup>3</sup> The seasonal MOEs ranged from 5 (for fumigators) to 20 (for tarp removers). The annual MOEs were calculated using the chronic HEC of 240 ppb for workers. The annual MOEs were similar to the seasonal MOEs ranging from 7 to 30.

**Table 3.** Revised Annual Margins of Exposure for Workers Involved in Soil Fumigation with Chloropicrin<sup>a</sup>

| Exposure Scenarios                     | Margin of Exposure        |                        |                      |
|--|---------------------------|------------------------|----------------------|
|  | Active Ingredient<br>>15% | Warning Agent<br>10.5% | Warning Agent<br><2% |
| Broadcast, tarped <sup>b</sup>         |                           |                        |                      |
| Driver                                 | 14                        | 130                    | 690                  |
| Copilot                                | 11                        | 100                    | 550                  |
| Shoveler                               | 32                        | 300                    | 1,600                |
| Tarp splitter                          | 11                        | 110                    | 570                  |
| Tarp remover                           | 11                        | 110                    | 570                  |
| Soil shaper                            | 98                        | 940                    | 4,900                |
| Soil shaper - Tri-Form 40/60           | 160                       | NA <sup>b</sup>        | NA                   |
| Soil shaper - Tri-Con 33/67            | 150                       | NA                     | NA                   |
| Broadcast, non-tarped                  |                           |                        |                      |
| Driver                                 | 29                        | 270                    | 1,400                |
| Soil sealer                            | 66                        | 620                    | 3,300                |
| Soil shaper - shallow                  | 220                       | NA                     | NA                   |
| Soil shaper – shallow (Tri-Form 40/60) | 360                       | NA                     | NA                   |
| Soil shaper - deep                     | 350                       | 3,300                  | 17,000               |
| Soil shaper - deep (Tri-Form 40/60)    | 580                       | NA                     | NA                   |
| Soil shaper - deep (Tri-Con 33/67)     | 520                       | NA                     | NA                   |

<sup>2</sup> Based on bronchiectasis in male and female mice and the annual exposure estimates found in Table 24, Chloropicrin Risk Characterization Document, Department of Pesticide Toxicology, November 14, 2012. Available at [http://www.cdpr.ca.gov/docs/risk/red/chloropicrinrisk\\_2012.pdf](http://www.cdpr.ca.gov/docs/risk/red/chloropicrinrisk_2012.pdf)

<sup>3</sup> Based on rhinitis in female rats and the seasonal exposure estimates from Table 26 of the 2012 RCD, *ibid*.

| Exposure Scenarios, <i>continued</i>   | Margin of Exposure        |                        |                      |
|--|---------------------------|------------------------|----------------------|
|  | Active Ingredient<br>>15% | Warning Agent<br>10.5% | Warning Agent<br><2% |
| Bedded, tarped   |                           |                        |                      |
| Driver   | 110                       | 1,100                  | 5,800                |
| Copilot  | 91                        | 870                    | 4,600                |
| Shoveler   | 160                       | 1,500                  | 8,000                |
| Tarp puncher   | 1,100                     | 11,000                 | 29,000               |
| Bedded, non-tarped   |                           |                        |                      |
| Driver   | 25                        | NA                     | NA                   |
| Pipe layer   | 480                       | NA                     | NA                   |
| Pipe layer - Tri-Con 33/67   | 670                       | NA                     | NA                   |
| Drip irrigation  |                           |                        |                      |
| Applicator - tarped  | 91                        | 870                    | 4,600                |
| Tarp puncher   | 310                       | 2,900                  | 15,200               |
| Applicator - non-tarped  | 68                        | NA                     | NA                   |
| Handwand replant   |                           |                        |                      |
| Applicator   | 98                        | 930                    | 4,900                |
| Applicator - Telone C-35   | 280                       | NA                     | NA                   |
| Applicator - Pic-Brom 25   | 390                       | NA                     | NA                   |
| Potting soil   |                           |                        |                      |
| Tarp remover   | NA                        | 130                    | 710                  |
| a Margin of Exposure (MOE) = NOEL or HEC / Exposure Dosage. NOEL= No-Observed-Effect Level. HEC = Human Equivalent Concentration. Chronic HEC = 240 ppb for workers. Exposure estimates from Table 24 in 2012 RCD. Values rounded to two significant figures.<br>b NA = Not applicable |                           |                        |                      |

**Table 4.** Revised Seasonal and Chronic Margins of Exposure for Workers Involved in Structural Fumigation with Chloropicrin

| Exposure Scenario  | Margins of Exposure   |                     |
|--|-----------------------|---------------------|
|  | Seasonal <sup>a</sup> | Annual <sup>b</sup> |
| Applicator   | NA <sup>c</sup>       | NA                  |
| Tarp Remover   | 20                    | 30                  |
| Aerator  | NA                    | NA                  |
| Fumigator  | 5                     | 7                   |
| Reentry  | 9                     | 13                  |
| a Margin of Exposure (MOE) = NOEL or HEC / Exposure Dosage. NOEL= No-Observed-Effect Level. HEC = Human Equivalent Concentration. Subchronic HEC = 310 ppb for workers. Exposure estimates from Table 26 in 2012 RCD. Values rounded to two significant figures.<br>b Margin of Exposure (MOE) = NOEL or HEC / Exposure Dosage. NOEL= No-Observed-Effect Level. HEC = Human Equivalent Concentration. Chronic HEC = 240 ppb for workers. Exposure estimates from Table 26 in n 2012 RCD. Values rounded to two significant figures.<br>c NA = Not applicable |                       |                     |