



INTERPRETING
CHEMFORWARD
CHEMICAL HAZARD
RATINGS

v 2.0

Interpreting ChemFORWARD Chemical Hazard Ratings

The ChemFORWARD platform allows users to access information on chemical hazards in a tiered way to accommodate different levels of complexity and quantities of data:

1. At the highest level, **HAZARD BANDS** provide an overall chemical rating that allows for easy comparisons between chemicals. Hazard Bands indicate the overall level of severity associated with a chemical's inherent human health and environmental hazards*. Hazard bands provide the least granularity with respect to the details of toxicological or physical chemical data.
2. **HAZARD SUMMARY TABLES** present hazard classifications for each individual hazard endpoint associated with a chemical, along with a concise rationale for why each hazard was classified as such by a Licensed ChemFORWARD Assessor.
3. At the foundation of the information pyramid or "iceberg" (**Figure 1**), detailed data summaries, provided by Licensed Assessors, are stored in the ChemFORWARD platform. While they are not accessible to subscribers, they document results from literature reviews, toxicological testing, models, and other scientific data used to classify hazard endpoints for each chemical. As part of the research and documentation process, Assessors summarize these data summaries into rationales for classification that are viewable via the hazard summary tables.

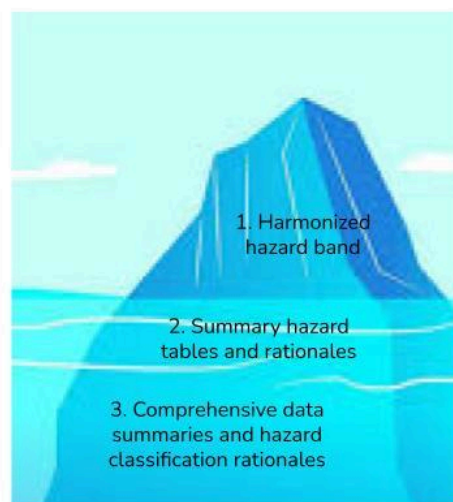


Figure 1. Tiered Levels of Information on Chemicals in ChemFORWARD

***Variation within Hazard Bands.** Two chemicals may share the same hazard band but have different inherent hazards. For example, one chemical may be assigned the C hazard band based on a Chemical Rating of x/c for skin corrosion, while another chemical may be assigned the C hazard band based on a Chemical Rating of x/c for moderate to high aquatic toxicity. The overall level of severity of the hazards are considered moderate to high even though the hazard endpoints driving the C Hazard Band are different.

Hazard Bands

Hazard Bands can indicate equivalency between different chemical hazard assessment (CHA) programs that use similar approaches to hazard classification as those that are used to inform ChemFORWARD Hazard Bands. For example, a chemical that is rated as GreenScreen Benchmark 3 is considered equivalent to a chemical assigned the B Hazard Band (**Figure 2**).

Equivalency does not mean that the CHA methodologies are identical. However, the equivalent programs are all aligned with respect to how they prioritize the elimination of high hazard chemicals that are of high risk in most scenarios. Additionally, they all prioritize the adoption of chemicals with low hazard, low risk based on intended and foreseeable uses, and good data quality and completeness.

Harmonized Hazard Band	Implications	Program Equivalency		
		Chemical Rating	US EPA SCIL	GreenScreen Benchmark
A	Low hazard and low risk	a	--	4
B	Some moderate hazards, low risk	b or c/b	green full circle	3 (3tp, 3dg)
C	Moderate hazard and moderate risk; or uncertainty that could result in moderate risk	x/c, x/c-CMR(Cat 2), grey/c, c/b-CRE	green half circle, yellow triangle	2 (2tp, 2dg)
D	Moderate to high hazard; emerging regulatory risk (may be chemical-class based with uncertain hazard)	x*	–	
F	High hazards and high risk in most scenarios	x-Reg, x/c-CMR(Cat 1), x/c-E, x-PBT, x-vPvB, x-vPT	grey square	1 (1tp), LT-1
U	CHA completed with excessive data gaps, rating is not possible	grey/c, grey	--	BM U
?	Request a CHA to inform a decision	No CHA	No CHA	No GS, , LT-UNK, LT-P1

Figure 2. Hazard Bands, Hazard Equivalency and CHA Program Equivalency

One purpose of adding the D Hazard Band is to better address the wide breadth of hazards associated with C Hazard Band chemicals, which is expected to highlight discrepancies between the new CF Hazard Band criteria and equivalent methodologies. Equivalent methodologies may be similarly limited in their ability to address the wide “moderate” hazard band in each classification framework (i.e. BM-2, Yellow Triangle). Prior to the addition of the D Hazard Band, two chemicals with vastly different hazard profiles may have both received a C Hazard band. For example, the following Hazard Summary Tables presented in **Figure 3a** and **Figure 3b** are for two chemicals which both evoked a ChemFORWARD C hazard band prior to this scoring revision:

Human Health										Environmental						Other						
	Carcinogenicity	Mutagenicity	Reproductive & Developmental Toxicity	Endocrine Activity / Disruption	Oral Toxicity	Dermal Toxicity	Inhalation Toxicity	Neurotoxicity	Skin, Eye, and Respiratory Corrosion/Irritation	Sensitization of Skin and Airways	Fish Toxicity	Daphnia Toxicity	Algae Toxicity	Terrestrial Toxicity	Persistence	Bioaccumulation	Climatic Relevance	Other (Human Health)	Organohalogenes	Toxic Metals	Other (Environmental Health)	
Oral	-	G	G	-	G	-	-	G	-	-	-	G	G	-	G	G	G	G	G	G	G	G
Dermal	G	G	-	-	-	G	-	G	G	R	-	G	G	-	G	G	G	G	G	G	G	G
Inhalation	-	G	-	-	-	-	-	-	G	-	-	G	G	-	G	G	G	G	G	G	G	G

Figure 3a. D Hazard Band Case Study - Irritant

Human Health										Environmental						Other						
	Carcinogenicity	Mutagenicity	Reproductive & Developmental Toxicity	Endocrine Activity / Disruption	Oral Toxicity	Dermal Toxicity	Inhalation Toxicity	Neurotoxicity	Skin, Eye, and Respiratory Corrosion/Irritation	Sensitization of Skin and Airways	Fish Toxicity	Daphnia Toxicity	Algae Toxicity	Terrestrial Toxicity	Persistence	Bioaccumulation	Climatic Relevance	Other (Human Health)	Organohalogenes	Toxic Metals	Other (Environmental Health)	
Oral	Y	G	R	Y	G	-	-	G	-	-	-	R	R	-	G	G	G	G	G	G	G	G
Dermal	Y	G	-	Y	-	G	-	G	G	G	-	R	R	-	G	G	G	G	G	G	G	G
Inhalation	Y	G	-	Y	-	-	G	G	G	G	-	R	R	-	G	G	G	G	G	G	G	G

Figure 3b. D Hazard Band Case Study - Potential EDC working via Repro/Dev MOA

Figure 3a provides the hazard profile of a skin irritant with no other documented hazard concerns, while **Figure 3b** provides the hazard profile of a high hazard reproductive/developmental toxicant with equivocal endocrine activity/disruption. The hazards of the former chemical can certainly be managed with proper industrial hygiene protocols and hazard labeling, where the latter chemical may pose an elevated risk of

adverse effects occurring following chronic, low-dose exposure. In this scenario, ChemFORWARD has determined that the chemical in **Figure 3b** would receive a D Hazard Band to indicate a higher hazard profile vs the chemical in **Figure 3a**. For more information about the differences between the C and D Hazard Bands, please review [ChemFORWARD Guidance: Chemical Hazard Rating Version 2.0](#).

Summary Hazard Tables

Summary hazard tables are useful to those who want more information about the specific hazards and/or data gaps associated with a chemical. ChemFORWARD was designed to present toxicological and physical/chemical hazard information using different CHA methods. Currently, the two methods built into ChemFORWARD are the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) and the Cradle to Cradle Certified (C2CC) Material Health Assessment Method (MHAM). Additional CHA methodology views will be made available in future updates. Users can toggle between the summary hazard tables generated from the two different systems, allowing for slightly different perspectives on the SAME data for the same hazard endpoints. The C2CC MHAM includes several hazard endpoints that are not found in GHS (e.g. endocrine disruption, environmental persistence, bioaccumulation, etc.). Summary hazard tables display the results by exposure route (oral, dermal, or inhalation) so users can see what is known, and not known, about hazards via different exposure routes.

The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) in ChemFORWARD

Most CHA methods are based on the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). GHS is an internationally agreed-upon standard managed by the United Nations that was set up to consolidate and replace the assortment of hazardous material classification and labeling schemes previously used around the world. It aims to ensure that information on physical hazards and toxicity from chemicals be available in order to enhance the protection of human health and the environment during the handling, transport, and use of these chemicals. GHS is updated every two years and ChemFORWARD assessments will be completed under the appropriate GHS version based on the CHA draft date.

GHS uses a system of chemical hazard endpoint classifications that result in different **Categories**, that describes the severity of observed effect. A Category 1 (Cat 1) hazard

is the most severe. Some hazard endpoints just have 1 or 2 Categories for classification, often with subcategories denoted by (a) and (b). Other endpoints, such as acute mammalian toxicity and acute aquatic toxicity have at least 4 Categories, with Category 4 being the least severe.

In the GHS Hazard Summary Table view, ChemFORWARD presents classifications as **Category levels** (e.g. Cat 1, Cat 2). If a hazard endpoint is **Not Classified**, then ChemFORWARD presents the hazard summary for that endpoint as NC in the hazard summary table cell. NC indicates that the chemical is LOW hazard for that hazard endpoint and therefore “not classified” as a hazardous substance under GHS methodology. Importantly, this does NOT mean that the hazard endpoint is missing information and therefore cannot be assigned a Category. If there are insufficient data for classification, then the hazard endpoint will read “CNP” which stands for **Classification Not Possible**:

Cat = Category (1, 1A, 2, 3, etc.)

NC = Not Classified (equivalent to LOW hazard using GHS criteria)

CNP = Classification Not Possible (no data or insufficient data available for classification)

In the GHS hazard summary table, cells are color coded to help with interpretation. If the cell is:

GREY: Classification is not possible (CNP)

RED: Category is accompanied by GHS signal word “Danger”

ORANGE: Category is accompanied by GHS signal word “Warning”

YELLOW: Category is accompanied by no GHS signal word

GREEN: Not Classified

Figure 4 provides an example GHS Summary Hazard Table for a chemical in ChemFORWARD. Click on any cell in the table to generate a popup window that displays the Rationale behind the classification such as the rationale for Mutagenicity displayed here.

	Carcinogenicity	Mutagenicity	Reproductive Toxicity	Developmental Toxicity	Acute Toxicity	STOT-Single	STOT-Repeated	STOT- Neurotoxicity-Single	STOT- Neurotoxicity-Repeated	Skin Sensitizer	Respiratory Sensitizer	Skin Corrosion/Irritation	Serious Eye Damage/Eye Irritation	Acute Aquatic Toxicity	Chronic Aquatic Toxicity	Ozone Depletion
Oral	NC	(NC)	(NC)	(NC)	NC	CNP	NC	(NC)	(NC)					(NC)	(Cat 2)	NC
Dermal	CNP		CNP	CNP	CNP	CNP	CNP	(NC)	(NC)	(NC)		(NC)	Cat 2B			
Inhalation	CNP		CNP	CNP	CNP	CNP	CNP	(NC)	(NC)		(NC)					

Rationale ✕

Chromosomal aberration assay on dibutyl sebacate and bacterial mutation studies on analogs provide sufficient information to indicate dibutyl sebacate has low concern for inducing genotoxicity. Lower confidence due to use of analogs.

Figure 4. Example GHS Hazard Summary Table with Rationale for Mutagenicity

The Cradle to Cradle Material Health Assessment Methodology

The Cradle to Cradle Material Health Assessment Methodology assigns hazard ratings to 24 individual human and environmental health endpoints. The system is largely based on GHS with the addition of hazard endpoints including but not limited to Persistence, Bioaccumulation Potential and Endocrine Activity/Disruption. Similar to the GHS hazard summary table, hazard classifications are broken out by exposure route so that users will know what is known and not known about the hazards associated with a chemical based on its intended use and likely exposure route. See **Figure 5** to review the C2CC Summary Hazard Table. ChemFORWARD assessments will be completed under the appropriate C2CC MHAM version based on the CHA draft date. The Cradle to Cradle endpoint hazard rating uses colors to indicate the following:

- GREEN:** No/Low hazard identified for the endpoint
- YELLOW:** Borderline/equivocal hazard identified for the endpoint
- RED:** Considered hazardous for the endpoint
- PURPLE:** Highest hazard (for persistence- and bioaccumulation potential only)
- GREY:** Insufficient data available to determine hazard level for the endpoint

Human Health											Environmental							Other			
	Carcinogenicity	Mutagenicity	Reproductive & Developmental Toxicity	Endocrine Activity / Disruption	Oral Toxicity	Dermal Toxicity	Inhalation Toxicity	Neurotoxicity	Skin, Eye, and Respiratory Corrosion/Irritation	Sensitization of Skin and Airways	Fish Toxicity	Daphnia Toxicity	Algae Toxicity	Terrestrial Toxicity	Persistence	Bioaccumulation	Climatic Relevance	Other (Human Health)	Organohalogen	Toxic Metals	Other (Environmental Health)
Oral	G	G	G	(G)	G	(G)	(G)	G	(G)	(G)	R	G	R	G	G	G	G	G	G	G	G
Dermal	(G)	G	(G)	(G)	(G)	(G)	(G)	G	Y	G	R	G	R	G	G	G	G	G	G	G	G
Inhalation	(G)	G	(G)	(G)	(G)	(G)	(G)	G	(G)	(G)	R	G	R	G	G	G	G	G	G	G	G

Figure 5. Example C2CC MHAM Hazard Summary Table

Confidence

For all hazard views, the summary hazard tables also include indicators of the Assessor's confidence in the data supporting the classifications:

Classifications in **bold** text indicate that the Assessor has high confidence in the classification.

Classifications in *(italic text in parentheses)* indicate low confidence in the classification.

Confidence levels are not assigned to CNP, thus CNP is written in plain text.

Additional information regarding Chemical Ratings, Hazard Bands, Equivalency, and more is available in the ChemFORWARD subscriber platform.

For questions regarding ChemFORWARD Hazard Ratings, please contact: info@chemforward.org.