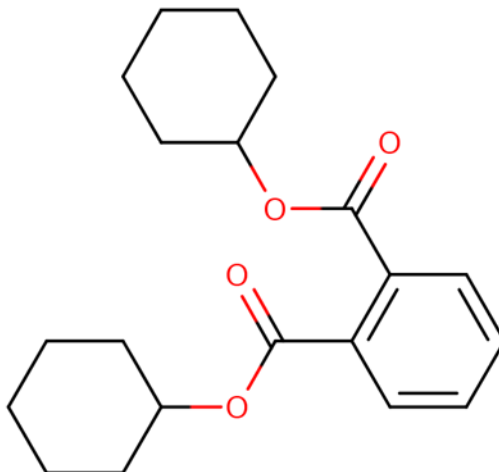




United States  
Environmental Protection Agency

**Draft Risk Evaluation for Dicyclohexyl Phthalate  
(DCHP)**

**CASRN 84-61-7**



*December 2024*

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267

### 268 **Docket**

269 Supporting information can be found in the public docket, Docket ID ([EPA-HQ-OPPT-2018-0504](#)).

270

### 271 **Disclaimer**

272 Reference herein to any specific commercial products, process, or service by trade name, trademark,  
273 manufacturer, or otherwise does not constitute or imply its endorsement, recommendation, or favoring  
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295 **This draft risk evaluation was reviewed and cleared for release by OPPT and OCSPP leadership.**

296 **EXECUTIVE SUMMARY**297 **Background**

298 EPA has evaluated the health and environmental risks of the chemical dicyclohexyl phthalate (DCHP)  
299 under the Toxic Substances Control Act (TSCA). **In this draft risk evaluation, EPA has preliminarily**  
300 **determined that DCHP presents an unreasonable risk of injury to human health under the**  
301 **conditions of use (COUs).** Of the 24 COUs that the Agency evaluated, 9 COUs have risk estimates that  
302 raise concerns for workers' exposure to DCHP; no COUs raise such concerns for consumers or the  
303 general population. In this draft evaluation, EPA's protective, screening-level approaches demonstrated  
304 that DCHP does not pose an unreasonable risk of injury to the environment. After this draft risk  
305 evaluation is informed by public comment and independent, expert peer review, EPA will issue a final  
306 risk evaluation that includes its determination as to whether DCHP presents unreasonable risk to human  
307 health or the environment under the TSCA COUs.

308  
309 DCHP is used primarily as a plasticizer in manufacturing adhesives, paints and coatings, plastic  
310 products, rubber products, and plastic resins. It is also used as a stabilizing agent in the manufacturing of  
311 adhesives, paint and coatings, plastic products, printing ink, rubber products, as well as plastic material  
312 and resin. Other uses of DCHP include industrial use in transportation equipment, computer, and  
313 electronic product manufacturing and commercial use in building/construction materials and laboratory  
314 chemicals—all of which are COUs. Workers may be exposed to DCHP when making these products or  
315 otherwise using DCHP in the workplace. When it is manufactured or used to make products, DCHP can  
316 be released into water, where because of its properties, most will end up in the sediment at the bottom of  
317 lakes and rivers. If released into the air, DCHP will attach to dust particles and be deposited on land or  
318 into water. Indoors, DCHP has the potential over time to be released from products and adhere to dust  
319 particles. If it does, people could inhale or ingest dust that contains DCHP.

320  
321 Laboratory animal studies have been conducted to study DCHP to determine whether it causes a range  
322 of non-cancer health effects on people. After reviewing the available studies, the Agency concludes that  
323 there is strong evidence that DCHP causes developmental toxicity (a non-cancer human health hazard).  
324 The most sensitive adverse developmental effects include effects on the developing male reproductive  
325 system consistent with a disruption of androgen action—what is known as *phthalate syndrome*, which  
326 results from decreased fetal testicular testosterone.

327  
328 EPA is including DCHP for cumulative risk assessment (CRA) along with five other phthalate  
329 chemicals that also cause effects on laboratory animals consistent with phthalate syndrome ([U.S. EPA,](#)  
330 [2023c](#)). Notably, assessments by Health Canada, U.S. Consumer Product Safety Commission (U.S.  
331 CPSC), European Chemicals Agency (ECHA), and the Australian National Industrial Chemicals  
332 Notification and Assessment Scheme (NICNAS) have reached similar conclusions regarding the  
333 developmental effects of DCHP. They have also conducted CRAs of phthalates based on these  
334 chemicals' shared ability to cause phthalate syndrome. Further, independent, expert peer reviewers  
335 endorsed EPA's proposal to conduct a CRA of phthalates under TSCA during the May 2023 meeting of  
336 the Science Advisory Committee on Chemicals (SACC) because doing so represents the best available  
337 science. In this draft risk evaluation, the Agency has evaluated cumulative exposure to phthalates for the  
338 U.S. civilian population using human biomonitoring data. Note that these phthalate exposures to the  
339 general civilian population cannot be attributed to specific TSCA COUs or other sources. This non-  
340 attributable cumulative exposure and risk, representing the national population, was taken into  
341 consideration by EPA in reaching its preliminary determination of unreasonable risk of injury of human  
342 health for DCHP. Had EPA not taken this into consideration, it could have understated the unreasonable  
343 risk of injury to human health for DCHP.

344

345 In December 2019, EPA designated DCHP as a high-priority substance for TSCA risk evaluation and in  
346 August 2020 released the final scope of the risk evaluation ([U.S. EPA, 2020b](#)). This draft risk evaluation  
347 assesses human health risk to workers, including occupational non-users (ONUs), consumers, and the  
348 general population exposed to environmental releases. It also assesses risk to the environment.  
349 Manufacturers report DCHP production volumes through the Chemical Data Reporting (CDR) rule  
350 under the associated CAS Registry Number (CASRN) 84-61-7. The production volume for DCHP was  
351 between 500,000 and 1,000,000 lb in 2019 based on the latest 2020 CDR data (EPA describes  
352 production volumes as a range to protect confidential business information). The Agency has evaluated  
353 DCHP across its TSCA COUs, ranging from manufacture to disposal.

354  
355 Past assessments of DCHP from other government agencies that addressed a broad range of uses, which  
356 may have included TSCA and non-TSCA uses, have concluded that DCHP does not pose risk to human  
357 health or the environment based on its concentration in products and the environment. Notably, both the  
358 U.S. CPSC's and Health Canada's risk assessments included consideration of exposure from children's  
359 products as well as from other sources such as personal care products, diet, consumer products, and the  
360 environment. However, these past assessments did not specifically consider exposure to workers. In this  
361 draft assessment, EPA comes to the same general conclusions of those assessments with regard to risk to  
362 consumers and the general population—with the exception of where it evaluated and has identified risks  
363 to workers with some manufacturing and processing uses of DCHP.

364  
365 In this draft risk evaluation, EPA evaluated risks resulting from exposure to DCHP from facilities that  
366 use, manufacture, or process DCHP under industrial and/or commercial COUs subject to TSCA and the  
367 products resulting from such manufacture and processing. Human or environmental exposure to DCHP  
368 through uses that are not subject to TSCA (*e.g.*, use in cosmetics, medical devices, food contact  
369 materials) were not specifically evaluated by the Agency in reaching its preliminary determination of  
370 unreasonable risk to injury of human health. This is because these uses are excluded from TSCA's  
371 definition of chemical substance. Thus, although EPA is preliminarily determining in this draft risk  
372 evaluation that nine specific TSCA COUs significantly contribute to its draft unreasonable risk finding  
373 for DCHP, this determination cannot be extrapolated to form conclusions about uses of DCHP that are  
374 not subject to TSCA and that EPA did not evaluate.

375

### 376 ***Determining Unreasonable Risk to Human Health***

377 EPA's TSCA existing chemical risk evaluations must determine whether a chemical substance does or  
378 does not present unreasonable risk to human health or the environment under its TSCA COUs. The  
379 unreasonable risk must be informed by the best available science. The Agency, in making the finding of  
380 *presents unreasonable risk to human health*, considers risk-related factors as described in its [risk](#)  
381 [evaluation framework rule](#). Risk-related factors beyond the levels of DCHP that can cause specific  
382 health effects include but are not limited to the type of health effect under consideration, the reversibility  
383 of the health effect being evaluated, exposure-related considerations (*e.g.*, duration, magnitude,  
384 frequency of exposure), population exposed (including any potentially exposed or susceptible  
385 subpopulations), and EPA's confidence in the information used to inform the hazard and exposure  
386 values. These considerations must be included as part of a pragmatic and holistic evaluation of hazard  
387 and exposure to DCHP. If an estimate of risk for a specific scenario exceeds the standard risk  
388 benchmarks, then the formal determination of whether those risks significantly contribute to the  
389 unreasonable risk of DCHP under TSCA must be both case-by-case and context-driven.

390

391 EPA evaluated the risks to people from being exposed to DCHP at work, indoors, and outdoors. In its  
392 human health evaluation, the Agency used a combination of screening-level and more refined  
393 approaches to assess how people might be exposed to DCHP through breathing or ingesting dust or

394 other particulates, as well as through skin contact. EPA has also authored a draft cumulative risk  
395 technical support document including DCHP and five other phthalate chemicals that all cause the same  
396 health effect—phthalate syndrome. The CRA takes into consideration differences in the ability of each  
397 phthalate to cause effects on the developing male reproductive system. Use of this “relative potency”  
398 across all the phthalates EPA is reviewing that cause phthalate syndrome provides a more robust risk  
399 assessment of DCHP as well as a common basis for adding risk across the six phthalates included in the  
400 cumulative assessment. Thus, risks are characterized for occupational and consumer exposures to  
401 DCHP, alone as well as in combination with the measured cumulative phthalate exposure that is  
402 experienced by the U.S. population and that cannot be attributed to a specific use.  
403

404 In determining whether DCHP presents an unreasonable risk of injury to human health, EPA considered  
405 the following potentially exposed and susceptible subpopulations (PESS) in its assessment: women of  
406 reproductive age, pregnant women, infants, children and adolescents, people who frequently use  
407 consumer products and/or articles containing high concentrations of DCHP, people exposed to DCHP in  
408 the workplace, people in proximity to releasing facilities, including fenceline communities, and Tribes  
409 and subsistence fishers whose diets include large amounts of fish. These subpopulations are PESS  
410 because some have greater exposure to DCHP per body weight (*e.g.*, infants, children, adolescents)  
411 while others may experience exposure from multiple sources or higher exposures than others. EPA’s  
412 robust screening analysis preliminarily finds that exposure of consumers and of the general population to  
413 DCHP does not contribute to unreasonable risk of injury to human health. However, the Agency  
414 preliminarily identified nine COUs where occupational exposure for workers significantly contributes to  
415 the unreasonable risk of injury to human health.  
416

#### 417 ***Summary, Considerations, and Next Steps***

418 EPA is preliminarily determining the following COUs, based on the DCHP individual analysis and the  
419 relative potency factor analysis, significantly contribute to the unreasonable risk to workers:

- 420 • Manufacturing – domestic manufacturing;
- 421 • Processing – incorporation into formulation, mixture, or reaction product – adhesive and sealant  
422 chemicals in adhesive manufacturing;
- 423 • Processing – incorporation into formulation, mixture, or reaction product – plasticizer (adhesive  
424 manufacturing; paint and coating manufacturing; and printing ink manufacturing);
- 425 • Processing – incorporation into formulation, mixture, or reaction product – stabilizing agent  
426 (adhesive manufacturing; asphalt paving, roofing, and coating materials manufacturing; and  
427 paints and coating manufacturing);
- 428 • Industrial use – finishing agent – cellulose film production;
- 429 • Industrial use – inks, toner, and colorant products (*e.g.*, screen printing ink);
- 430 • Industrial use – paints and coatings;
- 431 • Commercial use – inks, toner, and colorant products (*e.g.*, screen printing ink); and
- 432 • Commercial use – paints and coatings.

433 EPA is preliminarily determining that the following COUs do *not* significantly contribute to the  
434 unreasonable risk:

- 435 • Manufacturing – importing;
- 436 • Processing – incorporation into article – plasticizer in plastics product manufacturing and rubber  
437 product manufacturing;
- 438 • Processing – repackaging (*e.g.*, laboratory chemicals);
- 439 • Processing – recycling;
- 440 • Distribution in commerce;

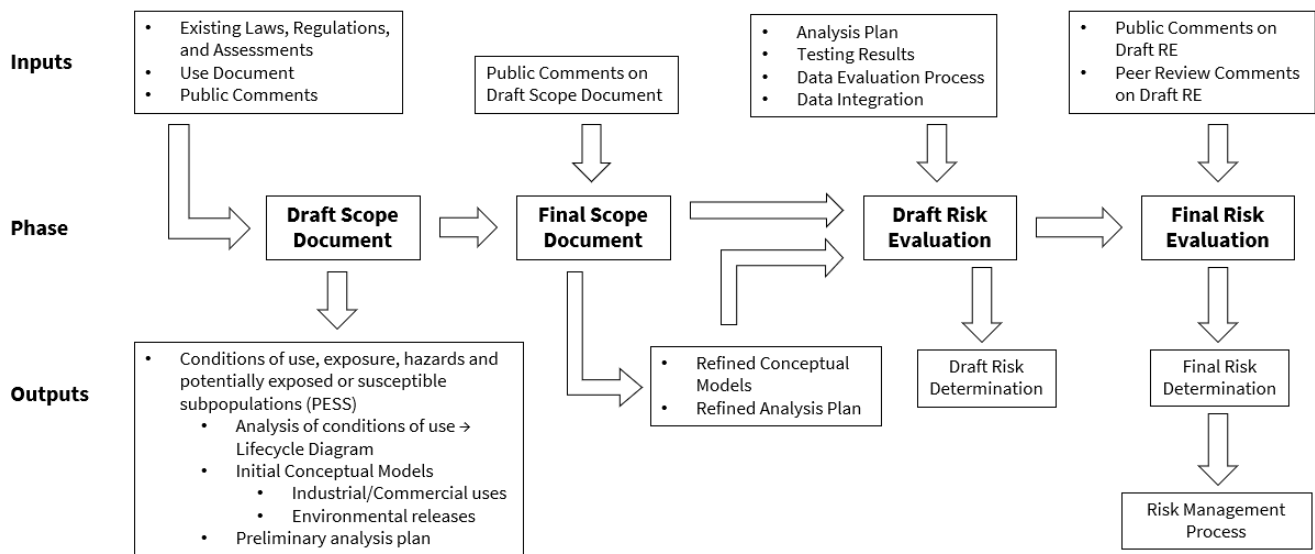
- 441 • Industrial use – adhesives and sealants (*e.g.*, computer and electronic product manufacturing;  
442 transportation equipment manufacturing);
- 443 • Industrial use – other articles with routine direct contact during normal use including rubber  
444 articles; plastic articles (hard) (*e.g.*, transportation equipment manufacturing);
- 445 • Commercial use – adhesives and sealants;
- 446 • Commercial use – building/construction materials not covered elsewhere;
- 447 • Commercial use – laboratory chemicals;
- 448 • Commercial use – other articles with routine direct contact during normal use including rubber  
449 articles; plastic articles (hard);
- 450 • Consumer use – adhesives and sealants;
- 451 • Consumer use – other articles with routine direct contact during normal use including rubber  
452 articles; plastic articles (hard);
- 453 • Consumer use – other consumer articles that contain dicyclohexyl phthalate from: inks, toner,  
454 and colorants; paints and coatings; adhesives and sealants (*e.g.*, paper products, textiles, products  
455 using cellulose film, etc.); and
- 456 • Disposal.

457 This risk evaluation has been released for public comment and will undergo independent, expert  
458 scientific peer review. EPA will issue a final DCHP risk evaluation after considering input from the  
459 public and peer reviewers. If in the final risk evaluation the Agency determines that DCHP presents  
460 unreasonable risk to human health or the environment, EPA will initiate regulatory action so that DCHP  
461 no longer presents such risk.

# 1 INTRODUCTION

EPA has evaluated dicyclohexyl phthalate (DCHP) under the Toxic Substances Control Act (TSCA) section 6(b). DCHP is primarily used as a plasticizer in polyvinyl chloride (PVC) in consumer, commercial, and industrial applications—although it is also used in adhesives, sealants, paints, coatings, rubbers, and non-PVC plastics as well as for other applications. Section 1.1 summarizes the scope of the draft DCHP risk evaluation and provides information on production volume, a life cycle diagram (LCD), conditions of use (COUs), and conceptual models used for DCHP. Section 1.2 presents the organization of this draft risk evaluation.

Figure 1-1 describes the major inputs, phases, and outputs/components of the [TSCA risk evaluation process](#), from scoping to releasing the final risk evaluation.



474  
475 **Figure 1-1. TSCA Existing Chemical Risk Evaluation Process**

## 1.1 Scope of the Risk Evaluation

EPA evaluated risk to humans and the environment for DCHP. Specifically for human populations, the Agency evaluated risk to workers and occupational non-users (ONUs) via inhalation routes; risk to workers via dermal routes; risk to ONUs via dermal routes for occupational exposure scenarios (OESs) in mists and dusts; risk to consumers via inhalation, dermal, and oral routes; and risk to bystanders via the inhalation route. Additionally, EPA considered the following potentially exposed and susceptible populations (PESS) in its assessment—women of reproductive age, pregnant women, infants, children and adolescents, people who frequently use consumer products and/or articles containing high-concentrations of DCHP, people exposed to DCHP in the workplace, and Tribes and subsistence fishers whose diets include large amounts of fish. As described further in Section 4.1.3, EPA assessed risks to the general population, including considerations for fenceline populations, from environmental releases using a screening-level analysis, which considered risk from exposure to DCHP via oral ingestion of surface water, drinking water, fish, and soil from air to soil deposition. For environmental populations, EPA evaluated risk to aquatic species via water, sediment, and air as well as risk to terrestrial species via air, soil, sediment, and water.

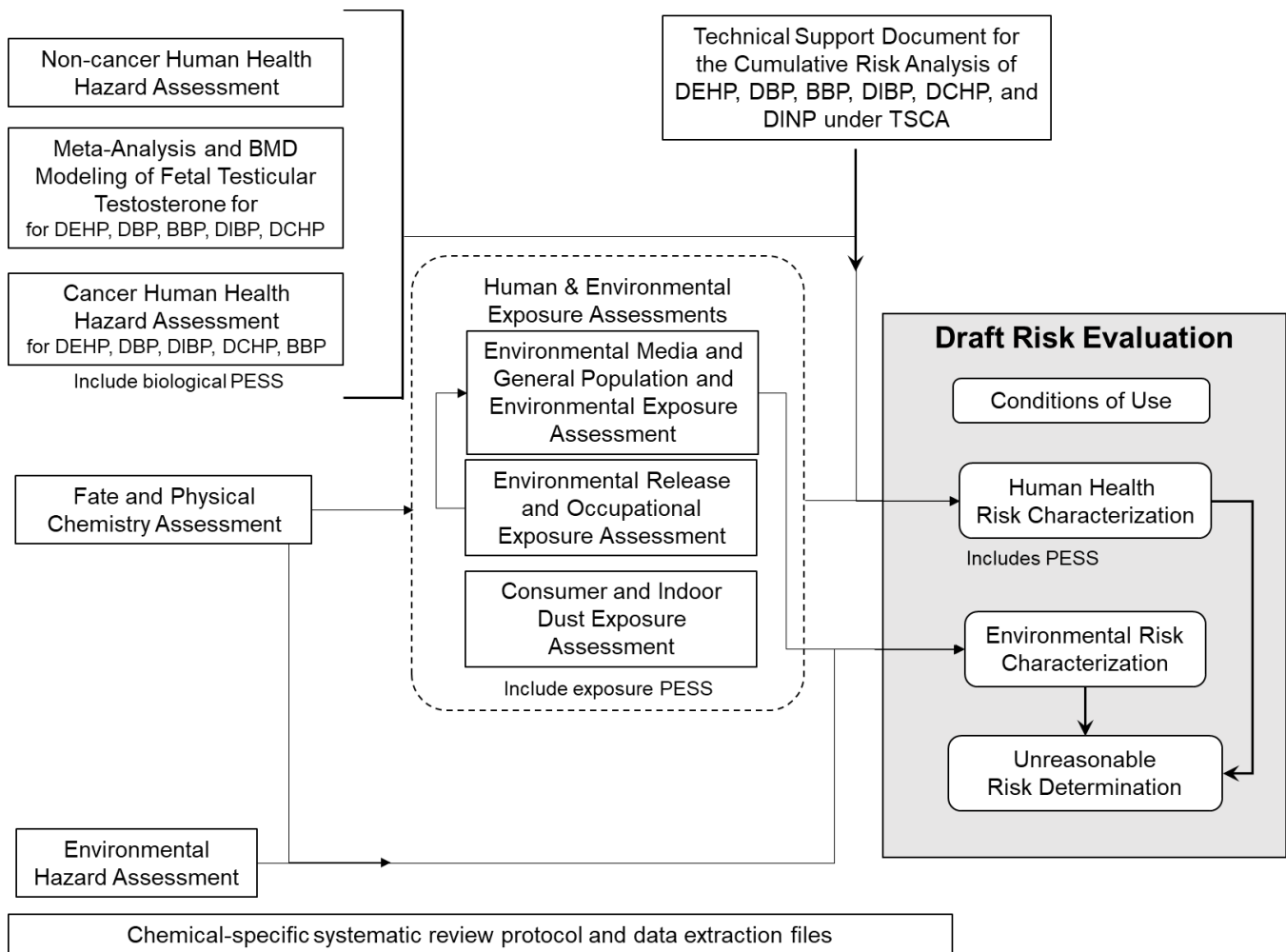
Consistent with EPA’s *Draft Proposed Approach for Cumulative Risk Assessment (CRA) of High-Priority Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances Control Act*

494 ([U.S. EPA, 2023c](#)), EPA has also authored a draft cumulative risk technical support document of DCHP  
495 and five other toxicologically similar phthalates (*i.e.*, diethylhexyl phthalate [DEHP], dibutyl phthalate  
496 [DBP], diisobutyl phthalate [DIBP], butyl benzyl phthalate [BBP], and diisononyl phthalate [DINP])  
497 that are also being evaluated under TSCA based on a common toxicological endpoint (*i.e.*, *phthalate*  
498 *syndrome*, which results from decreased fetal testicular testosterone). The cumulative analysis takes into  
499 consideration differences in phthalate potency to cause effects on the developing male reproductive  
500 system. Use of relative potency across the phthalates provides a more robust risk assessment of DCHP  
501 and a common basis for adding risk across the cumulative chemicals. Numerous other regulatory  
502 agencies—Health Canada, U.S. Consumer Product Safety Commission (U.S. CPSC), European  
503 Chemicals Agency (ECHA), and the Australian National Industrial Chemicals Notification and  
504 Assessment Scheme (NICNAS)—have assessed phthalates for cumulative risk, and EPA’s proposal to  
505 conduct a CRA of phthalates under TSCA was endorsed by the Science Advisory Committee on  
506 Chemicals (SACC) as the best available science. As described further in Sections 4.4.4 and 4.4.5,  
507 cumulative risk considerations focus on acute duration exposures to the most susceptible  
508 subpopulations: female workers and consumers of reproductive age (16–49 years of age) as well as male  
509 infants and male children (3–15 years of age) exposed to consumer products and articles.

510  
511 The draft DCHP risk evaluation includes a series of technical support documents (TSD). Each TSDI  
512 support document contains sub-assessments that inform adjacent, “downstream” technical support  
513 documents. A basic diagram showing the layout and relationship of these assessments is provided below  
514 in Figure 1-2. High-level summaries of each relevant technical support document are presented in this  
515 risk evaluation. Detailed information for each technical support document can be found in the  
516 corresponding documents. Appendix C includes a list and citations for all technical support documents  
517 and supplemental files included in the draft risk evaluation for DCHP.

518  
519 These technical support documents leveraged the data and information sources already identified in the  
520 *Final Scope of the Risk Evaluation for Dicyclohexyl Phthalate (1,2-Benzenedicarboxylic acid, 1,2-*  
521 *dicyclohexyl ester)*; CASRN 84-61-7 (also referred to as “final scope document”) ([U.S. EPA, 2020b](#)).  
522 OPPT conducted a comprehensive search for “reasonably available information” to identify relevant  
523 DCHP data for use in the draft risk evaluation. The approach used to identify specific relevant risk  
524 assessment information was discipline-specific and is detailed in *Draft Systematic Review Protocol for*  
525 *Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024ag](#)), or as otherwise noted in the relevant TSDs.

526



527

528 **Figure 1-2. Draft Risk Evaluation Document Summary Map**

529 **1.1.1 Life Cycle and Production Volume**

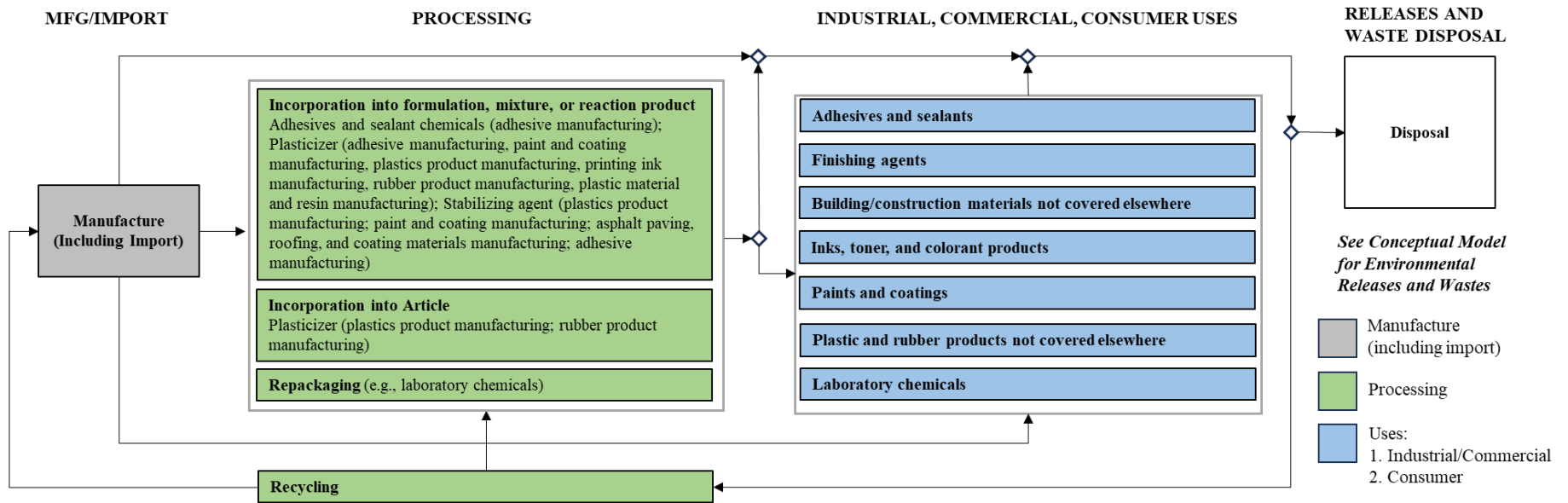
530 The LCD shown in Figure 1-3 depicts the COUs that are within the scope of the risk evaluation, during  
531 various life cycle stages, including manufacturing, processing, distribution, use (industrial, commercial,  
532 consumer), and disposal. The LCD has been updated since its inclusion in the final scope document,  
533 with consolidated and/or expanded processing and use steps. A complete list of updates and  
534 explanations of the updates made to COUs for DCHP from the final scope document to this draft risk  
535 evaluation is provided in Appendix D. The information in the LCD is grouped according to the  
536 Chemical Data Reporting (CDR) processing codes and use categories (including functional use codes  
537 for industrial uses and product categories for industrial and commercial uses). The CDR Rule under  
538 TSCA section 8(a) (see 40 CFR part 711) requires certain U.S. manufacturers (including importers) to  
539 provide EPA with information on the chemicals they manufacture or import into the United States. EPA  
540 collects CDR data approximately every four years with the latest collections occurring in 2006, 2012,  
541 2016, and 2020.

542

543 EPA included descriptions of the industrial, commercial, and consumer use categories identified from  
544 the 2020 CDR in the LCD (Figure 1-3) ([U.S. EPA, 2020a](#)). The descriptions provide a brief overview of  
545 the use category; the *Draft Environmental Release and Occupational Exposure Assessment for*  
546 *Dicyclohexyl Phthalate* ([U.S. EPA, 2024q](#)) contains more detailed descriptions (e.g., process

547 descriptions, worker activities, process flow diagrams, equipment illustrations) for each manufacturing,  
548 processing, use, and disposal category.

549



550

551

**Figure 1-3. DCHP Life Cycle Diagram**

552

553

See Table 1-1 for categories and subcategories of COUs. Activities related to distribution (*e.g.*, loading, unloading) will be considered throughout the DCHP life cycle, as well as qualitatively through a single distribution scenario.

554 The production volume for CASRN 84-61-7 in 2019 was between 500,000 and 1,000,000 pounds (lb) in  
555 2019 based on the latest 2020 CDR data. EPA describes production volumes as a range to protect  
556 production volume data claimed as confidential business information (CBI). For the 2020 CDR cycle,  
557 collected data included the company name, volume of each chemical manufactured/imported, the  
558 number of workers at each site, and information on whether the chemical was used in the commercial,  
559 industrial, and/or consumer sector(s).

560  
561 In the 2020 CDR, two sites reported production of DCHP. LANXESS reported a production volume of  
562 17,290 lb for the 2019 CDR reporting year. The remaining site, Vertellus LLC, reported their production  
563 volumes as CBI but also reported an export volume of 410,849 lb for 2019 and that 10 percent of their  
564 PV was used as a plasticizer in adhesive manufacturing. EPA assumed that this site had no uses of  
565 DCHP that are included under the reporting threshold and that 410,849 lb represented 90 percent of their  
566 total PV. Therefore, EPA calculated the total manufactured PV from the site as 456,499 lb ( $410,849 \div$   
567  $0.9 = 456,499$  lb or 207,064 kg). EPA was able to use this data and the number of reporting import sites  
568 to estimate an average import volume per site.

### 569 1.1.2 Conditions of Use Included in the Risk Evaluation

570 The final scope document ([U.S. EPA, 2020b](#)) identified and described the life cycle stages, categories,  
571 and subcategories that comprise TSCA COUs that EPA planned to consider in the risk evaluation. All  
572 COUs for DCHP included in this draft risk evaluation are reflected in the LCD (Figure 1-3) and  
573 conceptual models (Section 1.1.2.1). Table 1-1 below presents all COUs for DCHP.

574  
575 In this draft risk evaluation, EPA made updates to the COUs listed in the final scope document ([U.S.](#)  
576 [EPA, 2020b](#)). A complete list of updates and explanations of the updates made to COUs for DCHP from  
577 the final scope document to this draft risk evaluation is provided in Appendix D.

578  
579 **Table 1-1. Categories and Subcategories of Use and Corresponding Exposure Scenario in the**  
580 **Draft Risk Evaluation for DCHP**

Life Cycle Stage <sup>a</sup>	Category <sup>b</sup>	Subcategory <sup>c</sup>	Reference(s)
Manufacturing	Domestic manufacturing	Domestic manufacturing	<a href="#">(U.S. EPA, 2020a, 2019a)</a>
	Importing	Importing	<a href="#">(U.S. EPA, 2020a, 2019a)</a>
Processing	Processing – incorporation into formulation, mixture, or reaction product	Adhesive and sealant chemicals in: – Adhesive manufacturing	<a href="#">(U.S. EPA, 2019a)</a>
		Plasticizer in: – Adhesive manufacturing – Paint and coating manufacturing – Plastic material and resin manufacturing – Plastics product manufacturing – Printing ink manufacturing – Rubber product manufacturing	<a href="#">(U.S. EPA, 2020a; ACA, 2019; AIA, 2019; Carboline, 2019a, b; MEMA, 2019; U.S. EPA, 2019a, d)</a>
		Stabilizing agent in: – Adhesive manufacturing – Asphalt paving, roofing, and coating materials manufacturing – Paint and coating manufacturing – Plastics product manufacturing	<a href="#">(U.S. EPA, 2024aj; Nouryon Chemicals LLC, 2020; U.S. EPA, 2020a; AIA, 2019; U.S. EPA, 2019c)</a>

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December 2024

Life Cycle Stage <sup>a</sup>	Category <sup>b</sup>	Subcategory <sup>c</sup>	Reference(s)
	Processing – incorporation into article	Plasticizer in: – Plastics product manufacturing – Rubber product manufacturing	<a href="#">(AIA, 2019; MEMA, 2019; U.S. EPA, 2019a)</a>
	Repackaging	Repackaging ( <i>e.g.</i> , laboratory chemical)	<a href="#">(U.S. EPA, 2020d)</a>
	Recycling	Recycling	<a href="#">(U.S. CPSC, 2015)</a>
Distribution in Commerce	Distribution in commerce	Distribution in commerce	
Industrial Use	Adhesives and sealants	Adhesives and sealants ( <i>e.g.</i> , computer and electronic product manufacturing; transportation equipment manufacturing)	<a href="#">(Henkel, 2024; AIA, 2019; Henkel, 2019; MEMA, 2019; Henkel, 2017)</a>
	Finishing agent	Cellulose film production	<a href="#">(U.S. EPA, 2020c; Earthjustice, 2019)</a>
	Inks, toner, and colorant products	Inks, toner, and colorant products ( <i>e.g.</i> , screen printing ink)	<a href="#">(LANXESS, 2021; U.S. EPA, 2021c, 2019e; Gans Ink and Supply, 2018)</a>
	Paints and coatings	Paints and coatings	<a href="#">(Carboline, 2019a, b; U.S. EPA, 2019d)</a>
	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) ( <i>e.g.</i> , transportation equipment manufacturing)	<a href="#">(AIA, 2019; MEMA, 2019)</a>
Commercial Use	Adhesives and sealants	Adhesives and sealants	
	Building/construction materials not covered elsewhere	Building/construction materials not covered elsewhere	<a href="#">(LANXESS, 2021; U.S. EPA, 2019a)</a>
	Inks, toner, and colorant products	Inks, toner, and colorant products ( <i>e.g.</i> , screen printing ink)	<a href="#">(LANXESS, 2021; U.S. EPA, 2021c, 2019e; Gans Ink and Supply, 2018)</a>
	Laboratory chemicals	Laboratory chemicals	<a href="#">(Restek Corporation, 2024; Sigma-Aldrich, 2024a, b; NASA, 2020; U.S. EPA, 2020d; SPEX CertiPrep, 2019)</a>
Commercial Use	Paints and coatings	Paints and coatings	
	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	<a href="#">(U.S. EPA, 2020a; AIA, 2019; MEMA, 2019; U.S. EPA, 2019a)</a>
Consumer Use	Adhesives and sealants	Adhesives and sealants	<a href="#">(DeWalt, 2024a; ITW Permatex, 2024; Lord Corporation, 2024; Midwest Technology</a>

Life Cycle Stage <sup>a</sup>	Category <sup>b</sup>	Subcategory <sup>c</sup>	Reference(s)
			<a href="#">Products, 2024</a> ; <a href="#">MKT, 2024</a> ; <a href="#">ITW Permatex, 2021</a> ; <a href="#">DeWalt, 2020</a> ; <a href="#">MKT, 2018</a> ; <a href="#">Lord Corporation, 2017</a> )
	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	<a href="#">(U.S. EPA, 2020a</a> ; <a href="#">AIA, 2019</a> ; <a href="#">MEMA, 2019</a> ; <a href="#">U.S. EPA, 2019a</a> )
	Other	Other consumer articles that contain dicyclohexyl phthalate from: inks, toner, and colorants; paints and coatings; adhesives and sealants (e.g., paper products, textiles, products using cellulose film, etc.)	<a href="#">(Hydro-Gard, 2024</a> ; <a href="#">Hallstar, 2022</a> ; <a href="#">LANXESS, 2021</a> ; <a href="#">U.S. EPA, 2020c</a> ; <a href="#">Earthjustice, 2019</a> ; <a href="#">MEMA, 2019</a> ; <a href="#">U.S. EPA, 2019e</a> ; <a href="#">Gans Ink and Supply, 2018</a> ; <a href="#">Hydro-Gard, 2017a, b</a> ; <a href="#">U.S. CPSC, 2015</a> )
Disposal	Disposal	Disposal	

<sup>a</sup> Life Cycle Stage Use Definitions (40 CFR 711.3)

- “Industrial use” means use at a site at which one or more chemicals or mixtures are manufactured (including imported) or processed.
- “Commercial use” means the use of a chemical or a mixture containing a chemical (including as part of an article) in a commercial enterprise providing saleable goods or services.
- “Consumer use” means the use of a chemical or a mixture containing a chemical (including as part of an article, such as furniture or clothing) when sold to or made available to consumers for their use.
- Although EPA has identified both industrial and commercial uses here for purposes of distinguishing scenarios in this document, the Agency interprets the authority over “any manner or method of commercial use” under TSCA section 6(a)(5) to reach both.

<sup>b</sup> These categories of COUs appear in the LCD and broadly represent COUs of DCHP in industrial and/or commercial settings.

<sup>c</sup> These subcategories reflect more specific COUs of DCHP.

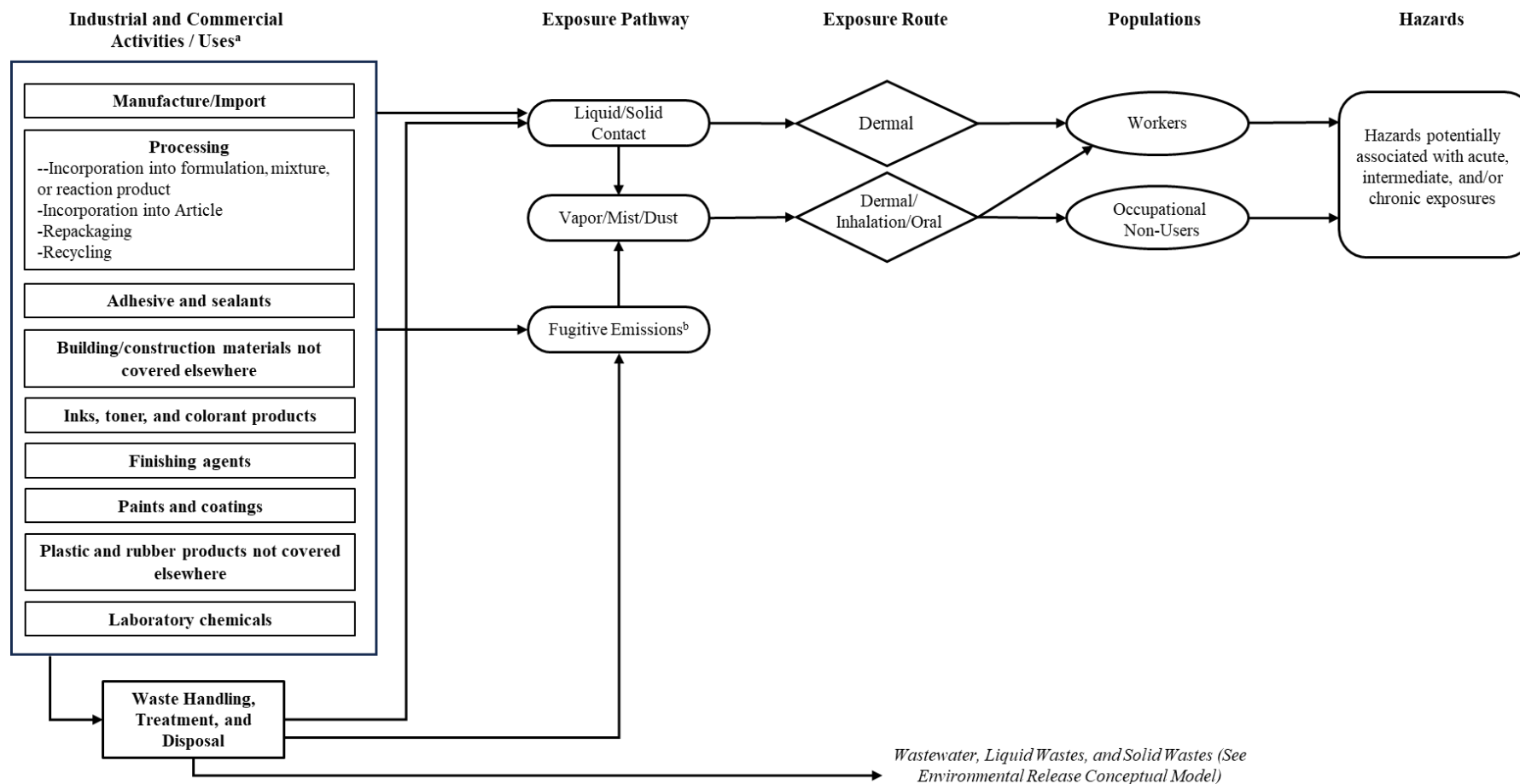
<sup>d</sup> The consumer COU of “Toys, playground, and sporting equipment” was removed and not included in DCHP’s final scoping document. The U.S. CPSC Chronic Hazard Advisory Panel (CHAP) report from 2014 ([U.S. CPSC, 2014](#)) that states, “DCHP is currently not found in children’s toys or child care articles, and it is not widely found in the environment” (page 117); the preamble of the 2017 CPSC final rule titled “Prohibition of Children’s Toys and Child Care Articles Containing Specified Phthalates,” which explains that “. . . the CPSC staff has not detected DCHP in toys and child care articles during routine compliance testing thus far. . .” ([U.S. CPSC, 2017](#)); As a result, EPA has no reasonably available information demonstrating that the consumer use of DCHP in toys is intended, known, or reasonably foreseen, and has not included it in the analysis for this draft risk evaluation of DCHP.

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### 1.1.2.1 Conceptual Models

The conceptual model in Figure 1-4 presents the exposure pathways, exposure routes, and hazards to human populations from industrial and commercial activities and uses of DCHP. There is potential for exposure to workers and/or ONUs via inhalation and via dermal contact. The conceptual model also includes potential ONU dermal exposure to DCHP in mists and dusts deposited on surfaces. EPA evaluated activities resulting in exposures associated with distribution in commerce (e.g., loading, unloading) throughout the various life cycle stages and COUs (e.g., manufacturing, processing, industrial use, commercial use, and disposal).

590 Figure 1-5 presents the conceptual model for consumer activities and uses, Figure 1-6 presents general  
591 population exposure pathways and hazards for environmental releases and wastes, and Figure 1-7  
592 presents the conceptual model for ecological exposures and hazards from environmental releases and  
593 wastes.

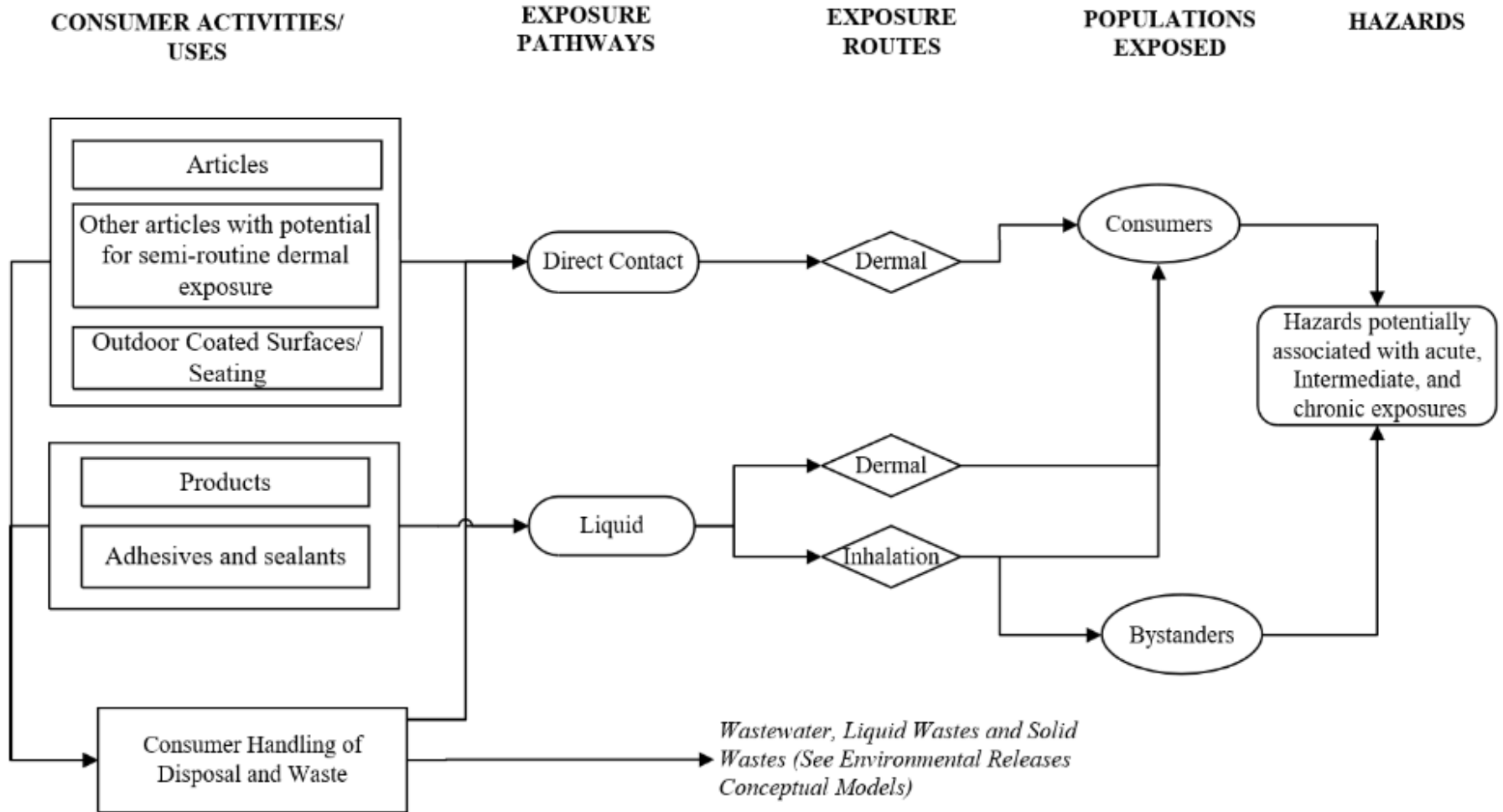


594

595 **Figure 1-4. DCHP Conceptual Model for Industrial and Commercial Activities and Uses: Potential Exposure and Hazards**

596 <sup>a</sup> Some products are used in both commercial and consumer applications. See Table 1-1 for categories and subcategories of COUs.

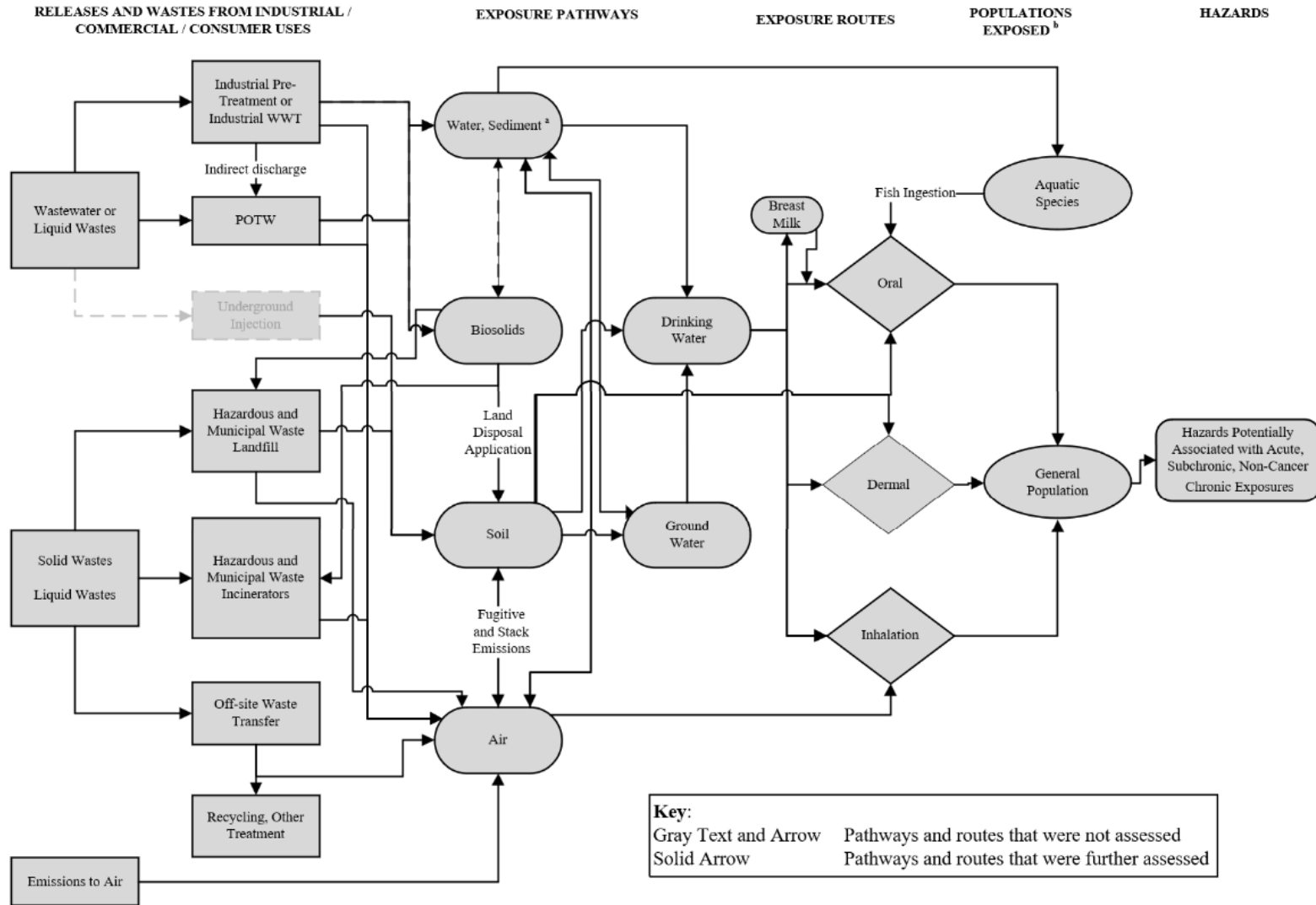
597 <sup>b</sup> Fugitive air emissions are emissions that are not routed through a stack and include fugitive equipment leaks from valves, pump seals, flanges,  
598 compressors, sampling connections and open-ended lines; evaporative losses from surface impoundment and spills; and releases from building ventilation  
599 systems.



600

601 **Figure 1-5. DCHP Conceptual Model for Consumer Activities and Uses: Potential Exposures and Hazards**

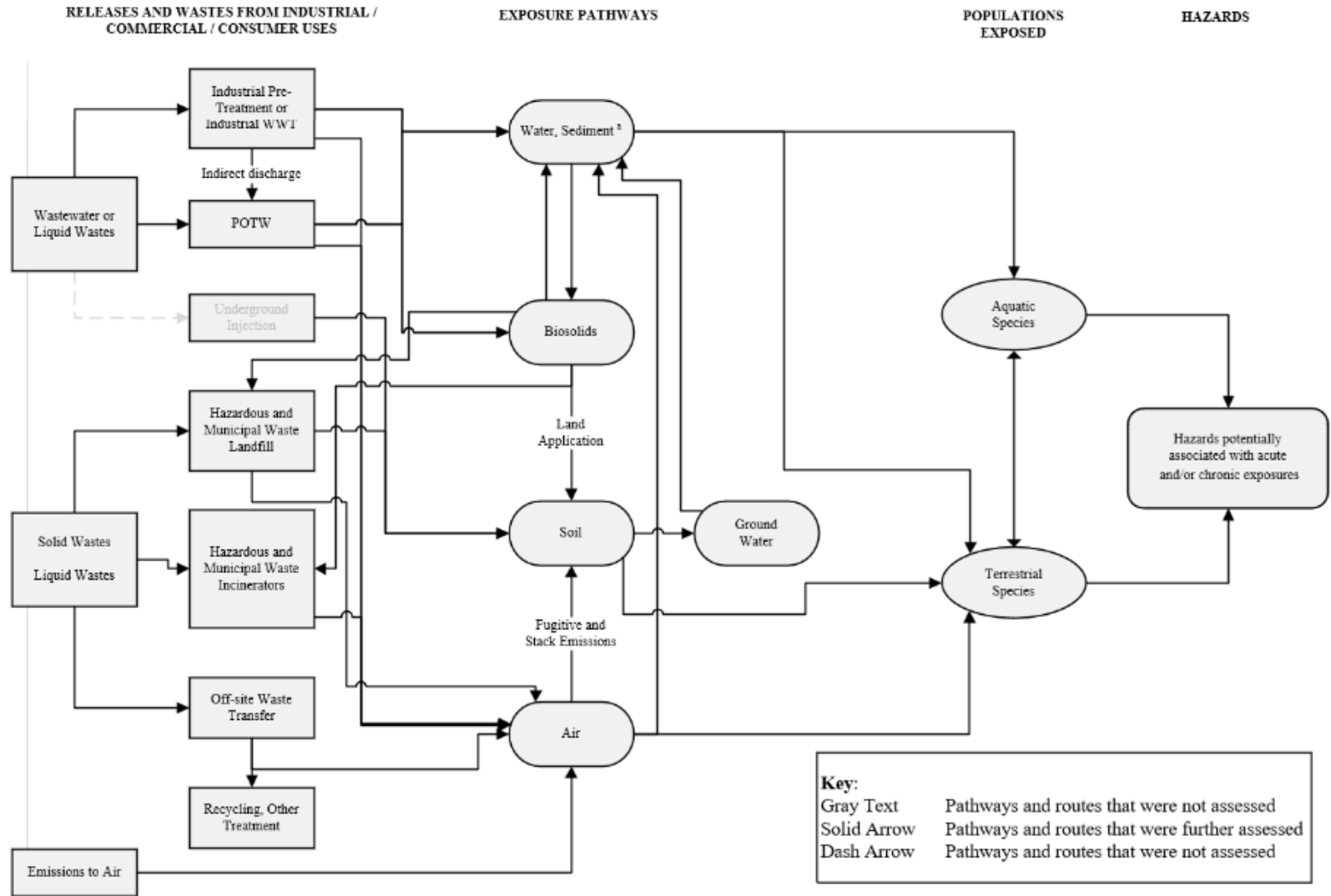
602 The conceptual model presents the exposure pathways, exposure routes, and hazards to human populations from consumer activities and uses of DCHP.



603

604 **Figure 1-6. DCHP Conceptual Model for Environmental Releases and Wastes: General Population Hazards**

605 The conceptual model presents the exposure pathways, exposure routes, and hazards to human populations from releases and wastes from industrial,  
 606 commercial, and/or consumer uses of DCHP. <sup>a</sup> Industrial wastewater or liquid wastes may be treated on-site and then released to surface water (direct  
 607 discharge), or pre-treated and released to publicly owned treatment works (POTWs) (indirect discharge). For consumer uses, such wastes may be released  
 608 directly to POTW. Drinking water will undergo further treatment in drinking water treatment plant. Groundwater may also be a source of drinking water.  
 609 Inhalation from drinking water may occur via showering. <sup>b</sup> Populations assessed include PESS.



610

611 **Figure 1-7. DCHP Conceptual Model for Environmental Releases and Wastes: Ecological Exposures and Hazards**

612 The conceptual model presents the exposure pathways, exposure routes, and hazards to human populations from releases and wastes from industrial,  
613 commercial, and/or consumer uses of DCHP. <sup>a</sup> Industrial wastewater or liquid wastes may be treated on-site and then released to surface water (direct  
614 discharge), or pre-treated and released to POTWs (indirect discharge). For consumer uses, such wastes may be released directly to POTW. Drinking water  
615 will undergo further treatment in drinking water treatment plant. Groundwater may also be a source of drinking water. Inhalation from drinking water may  
616 occur via showering.

617 **1.1.3 Populations and Durations of Exposure Assessed**

618 Based on the conceptual models presented in Section 1.1.2.1, EPA evaluated risk to humans and the  
619 environment. Environmental risks were evaluated for acute and chronic exposure scenarios for aquatic  
620 and terrestrial species, as appropriate. Human health risks associated with exposure to DCHP were  
621 evaluated for acute, intermediate, and chronic exposure scenarios, as applicable based on reasonably  
622 available exposure and hazard data as well as the relevant populations for each. Human populations  
623 assessed include the following:

- 624 • Workers, including average adults and women of reproductive age;
- 625 • ONUs, including average adults;
- 626 • Consumers, including infants (<1 year), toddlers (1–2 years), children (3–5 and 6–10 years),  
627 young teens (11–15 years), teenagers (16–20 years), and adults (21+ years);
- 628 • Bystanders, including infants (<1 year), toddlers (1–2 years), and children (3–5 and 6–10 years),  
629 young teens (11–15 years), teenagers (16–20 years), and adults (21+ years);
- 630 • General population, including infants (<1 year), toddlers (1–5 years), children (6–10 years),  
631 youth (11–15 and 16–20 years), and adults (21+ years).
- 632 • The age groups for consumers, bystanders, and general population are different because each life  
633 stage used unique exposure factors (e.g., mouthing, drinking water ingestion, fish consumption  
634 rates). These exposure factors are provided in EPA’s *Exposure Factors Handbook: 2011 Edition*  
635 ([U.S. EPA, 2011b](#)).

636 Consistent with its *Draft Proposed Approach for Cumulative Risk Assessment (CRA) of High-Priority*  
637 *Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances Control Act* ([U.S.](#)  
638 [EPA, 2023c](#)), EPA is focusing its relative potency factor (RPF) analysis and phthalate CRA on  
639 populations most relevant to the common hazard endpoint (i.e., reduced fetal testicular testosterone)—  
640 specifically women of reproductive age and male infants and male children. This approach emphasizes a  
641 common health effect for sensitive subpopulations; however, additional health endpoints are identified  
642 for broader populations and described in the individual non-cancer human health hazard assessments for  
643 DCHP ([U.S. EPA, 2024v](#)), DEHP ([U.S. EPA, 2024w](#)), DBP ([U.S. EPA, 2024u](#)), BBP ([U.S. EPA,](#)  
644 [2024t](#)), DIBP ([U.S. EPA, 2024x](#)), and DINP ([U.S. EPA, 2025b](#)). Additionally, EPA is focusing its RPF  
645 and CRA on acute duration exposures. This is because—as described further in the *Draft Technical*  
646 *Support Document for the CRA of DEHP, DBP, BBP, DIBP, DCHP, and DINP under TSCA* ([U.S. EPA,](#)  
647 [2024ah](#))—there is evidence that effects on the developing male reproductive system consistent with a  
648 disruption of androgen action can result from a single exposure during the critical window of  
649 development.

650 **1.1.3.1 Potentially Exposed and Susceptible Subpopulations**

651 TSCA section 6(b)(4)(A) requires that risk evaluations “determine whether a chemical substance  
652 presents an unreasonable risk of injury to health or the environment, without consideration of costs or  
653 other non-risk factors, including an unreasonable risk to a potentially exposed or susceptible  
654 subpopulation identified as relevant to the risk evaluation by the Administrator, under the conditions of  
655 use.” TSCA section 3(12) states that “the term ‘potentially exposed or susceptible subpopulation’  
656 [PESS] means a group of individuals within the general population identified by the Administrator who,  
657 due to either greater susceptibility or greater exposure, may be at greater risk than the general population  
658 of adverse health effects from exposure to a chemical substance or mixture, such as infants, children,  
659 pregnant women, workers, or the elderly.”

660  
661 This draft risk evaluation considers PESS throughout the human health risk assessment (Section 4),  
662 including throughout the exposure assessment, hazard identification, and dose-response analysis

663 supporting this assessment. EPA incorporated the following PESS into its assessment—women of  
664 reproductive age; pregnant women, infants, children and adolescents; people who frequently use  
665 consumer products and/or articles containing high-concentrations of DCHP; people exposed to DCHP in  
666 the workplace; and people who may be in proximity to releasing facilities, including fenceline  
667 communities, and people whose diets include large amounts of fish (*i.e.*, subsistence fisher and Tribal  
668 populations). These subpopulations are PESS because some have greater exposure to DCHP per body  
669 weight (*e.g.*, infants, children, adolescents), while some experience aggregate or sentinel exposures.  
670 EPA also evaluated non-attributable exposures and cumulative risk to phthalates (*i.e.*, DEHP, DBP,  
671 BBP, DIBP, and DINP) for the U.S. civilian population using NHANES biomonitoring data. This non-  
672 attributable cumulative risk from exposure to DEHP, DBP, BBP, DIBP, and DINP was taken into  
673 consideration as part of EPA’s cumulative risk calculations for DCHP, presented below in Sections 4.4.4  
674 and 4.4.5 and around exposures to DCHP from both occupational and consumer COUs/OES.

675  
676 Section 4.3.5 summarizes how PESS were incorporated into the risk evaluation through consideration of  
677 potentially increased exposures and/or potentially increased biological susceptibility and summarizes  
678 additional sources of uncertainty related to consideration of PESS.

## 679 **1.2 Organization of the Risk Evaluation**

680 This draft risk evaluation for DCHP includes five additional major sections, and several appendices, as  
681 listed below:

- 682 • Section 2 summarizes basic physical and chemical characteristics as well as the fate and  
683 transport of DCHP.
- 684 • Section 3 includes an overview of releases and concentrations of DCHP in the environment.
- 685 • Section 4 presents the human health risk assessment, including the exposure, hazard, and risk  
686 characterization based on the DCHP COUs. It includes a discussion of PESS based on both  
687 greater exposure and/or susceptibility as well as a description of aggregate and sentinel  
688 exposures. Section 4 also includes EPA’s CRA of DCHP, DEHP, DBP, BBP, DIBP, and DINP.
- 689 • Section 5 provides a discussion and analysis of the environmental risk assessment, including the  
690 environmental exposure, hazard, and risk characterization based on the COUs for DCHP. It also  
691 discusses assumptions and uncertainties and how they impact EPA’s overall confidence in risk  
692 estimates.
- 693 • Section 6 presents EPA’s proposed determination of whether the chemical presents an  
694 unreasonable risk to human health or the environment as a whole chemical approach and under  
695 the assessed COUs.
- 696 • Appendix A provides a list of key abbreviations and acronyms used throughout this draft risk  
697 evaluation.
- 698 • Appendix B provides a brief summary of the federal, state, and international regulatory history of  
699 DCHP.
- 700 • Appendix C includes a list and citations for all TSDs and supplemental files included in the draft  
701 risk evaluation for DCHP.
- 702 • Appendix D provides a summary of updates made to COUs for DCHP from the final scope  
703 document to this draft risk evaluation.
- 704 • Appendix E provides descriptions of the DCHP COUs evaluated by EPA.
- 705 • Appendix F provides the draft occupational exposure value for DCHP that was derived by EPA.

706 **2 CHEMISTRY AND FATE AND TRANSPORT OF DCHP**

707 Physical and chemical properties determine the behavior and characteristics of a chemical that inform its  
708 COUs, environmental fate and transport, potential toxicity, exposure pathways, routes, and hazards.  
709 Environmental fate and transport includes environmental partitioning, accumulation, degradation, and  
710 transformation processes. Environmental transport is the movement of the chemical within and between  
711 environmental media, such as air, water, soil, and sediment. Thus, understanding the environmental fate  
712 of DCHP informs the specific exposure pathways, and potential human and environmental exposed  
713 populations that EPA considered in this draft risk evaluation.

714  
715 Sections 2.1 and 2.2 summarize the physical and chemical properties, and environmental fate and  
716 transport of DCHP, respectively. EPA’s *Draft Physical Chemistry and Fate and Transport Assessment*  
717 *for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024z](#)) provides further details.

718 **2.1 Summary of Physical and Chemical Properties**

719 EPA gathered and evaluated physical and chemical property data and information according to the  
720 process described in the *Draft Systematic Review Protocol for Dicyclohexyl Phthalate (DCHP)* ([U.S.](#)  
721 [EPA, 2024ag](#)). During the evaluation of DCHP, EPA considered both measured and estimated physical  
722 and chemical property data/information summarized in Table 2-1, as applicable. Information on the full,  
723 extracted data set is available in the *Data Quality Evaluation and Data Extraction Information for*  
724 *Physical and Chemical Properties for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024j](#)).

725  
726 **Table 2-1. Physical and Chemical Properties of DCHP**

Property	Selected Value	Reference	Overall Quality Rating
Molecular Formula	C <sub>20</sub> H <sub>26</sub> O <sub>4</sub>		
Molecular Weight	330.43 g/mol		
Physical Form	Solid, prism	( <a href="#">Haynes, 2014</a> )	High
Physical Properties	White granular solid	( <a href="#">NLM, 2024</a> )	High
Melting Point	66 °C	( <a href="#">Haynes, 2014</a> )	High
Boiling Point	225 °C at 4 mm Hg	( <a href="#">Haynes, 2014</a> )	High
Density	1.383 g/cm <sup>3</sup>	( <a href="#">Haynes, 2014</a> )	High
Vapor Pressure	8.69 × 10 <sup>-7</sup> mmHg	( <a href="#">NLM, 2024</a> )	High
Vapor Density	No data		
Water Solubility	0.030–1.48 mg/L <sup>a</sup>	( <a href="#">U.S. EPA, 2017</a> )	Medium
Octanol:Water Partition coefficient (log K <sub>OW</sub> )	4.82	( <a href="#">EC/HC, 2017</a> )	High
Octanol:Air Partition Coefficient (log K <sub>OA</sub> )	10.23 <sup>a</sup>	( <a href="#">U.S. EPA, 2017</a> )	Medium
Henry’s Law Constant	9.446×10 <sup>-8</sup> atm·m <sup>3</sup> /mol at 25 °C <sup>a</sup>	( <a href="#">U.S. EPA, 2017</a> )	Medium
Flash Point	207 °C	( <a href="#">RSC, 2019</a> )	Medium
Auto-Flammability	No data		
Viscosity	Solid, N/A	( <a href="#">NLM, 2024</a> )	High

<sup>a</sup> Modeled value using EPI Suite™

## 2.2 Summary of Environmental Fate and Transport

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Reasonably available environmental fate data—including biotic and abiotic biodegradation rates, removal during wastewater treatment, volatilization from lakes and rivers, and organic carbon:water partition coefficient (log  $K_{OC}$ )—are the parameters used in this draft risk evaluation. In assessing the environmental fate and transport of DCHP, EPA considered the full range of results from the available data sources with medium and high data quality ratings collected through systematic review. Information on the full extracted data set is available in the *Data Quality Evaluation and Data Extraction Information for Physical and Chemical Properties for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024j](#)).

Other fate estimates were based on modeling results from EPI Suite™ ([U.S. EPA, 2012](#)), a predictive tool for physical and chemical properties and environmental fate estimation.

EPA evaluated the reasonably available information to characterize the physical and chemical properties and environmental fate and transport of DCHP. The key points are summarized below; DCHP

- Is a granular, crystalline solid under environmental conditions.
- Has a tendency to partition to soil, sediment, and particulate over water or air.
- Has limited solubility in water.
- Has low volatility in water or soil.

Given consistent results from numerous high-quality studies, there is robust evidence that when present in the environment, DCHP

- May degrade through hydrolysis, photolysis, aerobic or anaerobic biodegradation.
- May transport through the air and be deposited to soil or water.
- Will sorb to particulate in the atmosphere and in water.
- Is expected to be removed in wastewater treatment processes by sorbing to particulate, biosolids, and sludge.

As a result of limited studies identified, there is moderate confidence that DCHP

- Might be partially removed in conventional drinking water treatment.
- Might accumulate in individual fish and aquatic organisms, but is not expected to move up the food chain in aquatic environments.

The following bullets summarize the key points of the partitioning analysis; DCHP

- Will remain mostly in water but may sorb to sediment when released to aquatic environments.
- Will sorb to atmospheric particulate but may end up in small amounts in soil, water, and sediment when released to air.
- Will remain exclusively in soil when released to soil.
- Will sorb to particulate phases (soil, sediment, air particulate) with a small amount ending up in water when released to all three phases (air, water, and soil).

### 3 RELEASES AND CONCENTRATIONS OF DCHP IN THE ENVIRONMENT

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EPA estimated environmental releases and concentrations of DCHP. Section 3.1 describes the approach and methodology for estimating releases, Section 3.2 presents environmental release estimates, and Section 3.3 presents the approach and methodology for estimating environmental concentrations as well as a summary of concentrations of DCHP in the environment.

#### 3.1 Approach and Methodology

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At the time of this draft risk evaluation, releases of DCHP have not been reported to programmatic databases, including the Toxics Release Inventory (TRI), Discharge Monitoring Report (DMR), or National Emissions Inventory (NEI). Therefore, EPA utilized models to estimate environmental releases for each OES. This section provides an overview of the approach and methodology for assessing releases to the environment from industrial, commercial, and consumer uses. Specifically, Sections 3.1.1 through 3.1.3 describe the approach and methodology for estimating releases to the environment from industrial and commercial uses, and Section 3.1.4 describes the approach and methodology for assessing down-the-drain releases from consumer uses.

##### 3.1.1 Manufacturing, Processing, Industrial and Commercial Use

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This subsection describes the grouping of manufacturing, processing, industrial and commercial COUs into OESs, as well as the use of DCHP within each OES. Specifically, Section 3.1.1.1 provides a crosswalk of COUs to OESs and Section 3.1.1.2 provides descriptions for the use of DCHP within each OES.

##### 3.1.1.1 Crosswalk of Conditions of Use to Occupational Exposure Scenarios

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EPA categorized the COUs listed in Table 1-1 into OESs. Table 3-1 provides a crosswalk between the COUs and OESs. Each OES is developed based on a set of occupational activities and conditions such that similar occupational exposures and environmental releases are expected from the use(s) covered under that OES. For each OES, EPA provided occupational exposure and environmental release results, which are expected to be representative of the entire population of workers and sites for the given OES in the United States. In some cases, EPA defined only a single OES for multiple COUs, while in other cases the Agency developed multiple OESs for a single COU. EPA made this determination by considering variability in release and use conditions and whether the variability required discrete scenarios or could be captured as a distribution of exposures. The *Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024q](#)) provides further information on specific OESs.

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**Table 3-1. Crosswalk of Conditions of Use to Assessed Occupational Exposure Scenarios**

Life Cycle Stage	Category	Subcategory	OES
Manufacturing	Domestic manufacturing	Domestic manufacturing	Manufacturing
	Importing	Importing	Import and repackaging
Processing	Repackaging	Repackaging ( <i>e.g.</i> , laboratory chemicals)	Import and repackaging
	Processing – incorporation into formulation, mixture, or reaction product	Adhesive and sealant chemicals in: - Adhesive manufacturing	Incorporation into adhesives and sealants
		Plasticizer in: - Adhesive manufacturing - Paint and coating manufacturing - Plastics product manufacturing - Printing ink manufacturing - Rubber product manufacturing - Plastic material and resin manufacturing	Incorporation into adhesives and sealants; Incorporation into paints and coatings; PVC plastics compounding; non-PVC material compounding
		Stabilizing agent in: - Plastics product manufacturing - Paint and coating manufacturing - Asphalt paving, roofing, and coating materials manufacturing - Adhesive manufacturing	Incorporation into adhesives and sealants; Incorporation into paints and coatings; Incorporation into other formulations, mixtures, or reaction products; PVC plastics compounding; non-PVC material compounding
		Processing – incorporation into article	Plasticizer in: - Plastics product manufacturing - Rubber product manufacturing
	Recycling	Recycling	Recycling
Distribution	Distribution in commerce	Distribution in commerce	Distribution in commerce
Industrial Use	Adhesives and sealants	Adhesives and sealants in: - Transportation equipment manufacturing - Computer and electronic product manufacturing	Application of adhesives and sealants
	Finishing agent	Cellulose film production	Application of paints and coatings
	Inks, toner, and colorant products	Inks, toner, and colorant products ( <i>e.g.</i> , screen printing ink)	Application of paints and coatings
	Paints and coatings	Paints and coatings	Application of paints and coatings

Life Cycle Stage	Category	Subcategory	OES
	Plastic and rubber products not covered elsewhere	Plastic and rubber products not covered elsewhere in: - Transportation equipment manufacturing	Fabrication or use of final products or articles
Commercial Use	Adhesives and sealants	Adhesives and sealants	Application of adhesives and sealants
	Building/construction materials not covered elsewhere	Building/construction materials not covered elsewhere	Fabrication or use of final products or articles
	Inks, toner, and colorant products	Inks, toner, and colorant products (e.g., screen printing ink)	Application of paints and coatings
	Laboratory chemical	Laboratory chemical	Use of laboratory chemicals
	Paints and coatings	Paints and coatings	Application of paints and coatings
	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Fabrication or use of final products or articles
Disposal	Disposal	Disposal	Waste handling, treatment, and disposal

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### 3.1.1.2 Description of DCHP Use for Each OES

After EPA characterized the OESs for the occupational exposure assessment of DCHP, the occupational uses of DCHP for all OESs were summarized. Brief summaries of the uses of DCHP for all OESs are presented in Table 3-2.

**Table 3-2. Description of the Use of DCHP for Each OES**

OES	Use of DCHP
Manufacturing	DCHP is formed through the reaction of phthalic anhydride with cyclohexane ring alcohols (cyclohexanol).
Import and repackaging	DCHP is imported domestically for use and/or may be repackaged before shipment to formulation sites.
PVC plastics compounding	DCHP is used as an additive in PVC plastics to increase flexibility.
PVC plastics converting	
Incorporation into adhesives and sealants	DCHP is a plasticizer and stabilizing agent in adhesive and sealant products for industrial and commercial use.
Incorporation into paints and coatings	DCHP is a plasticizer and stabilizing agent in paint and coating products for industrial and commercial use.
Incorporation into other formulations, mixtures, or reaction products, not covered elsewhere	DCHP is incorporated into products, such as laboratory chemicals and asphalt paving, roofing, and coating materials.

OES	Use of DCHP
Non-PVC material compounding	DCHP is used as an additive in non-PVC polymers, such as rubber and cellulose, to increase flexibility.
Non-PVC material converting	
Application of adhesives and sealants	Industrial and commercial sites often apply DCHP in powdered form to serve as a hardener, thickener, or curing agent for adhesive and sealant materials. Liquid adhesive and sealant products containing DCHP are generally thick and paste-like, and these products are applied using roll or bead application methods. Products may also be applied using a syringe or caulk gun.
Application of paints and coatings	Industrial and commercial sites apply DCHP-containing paints and coatings using roll, brush, trowel, and spray application methods.
Use of laboratory chemicals	DCHP is a laboratory chemical used for laboratory analyses in solid and liquid forms.
Recycling	A fraction of PVC plastics that contain DCHP are recycled either in-house or at PVC recycling facilities for continuous compounding of new PVC material.
Fabrication or use of final products or articles	DCHP is found in a wide array of different final articles not found in other OES such as wall coverings or other solid plastic or rubber products.
Waste handling, treatment, and disposal	DCHP-containing products or residuals are managed as waste to be treated and/or disposed.

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**3.1.2 Estimating the Number of Release Days per Year for Facilities in Each OES**

Based on the limited data on the number of release days for the majority of the OESs, EPA developed generic estimates of the number of annual operating days (days/year) for facilities in each OES, as presented in Table 3-3. Generally, EPA does not have information on the number of operating days for facilities; however, the Agency used Generic Scenarios (GSs) or Emission Scenario Documents (ESDs) to assess the number of operating days for a given OES. EPA estimated average daily releases for facilities by assuming that the number of release days is equal to the number of operating days.

**Table 3-3. Generic Estimates of Number of Operating Days per Year for Each OES**

Occupational Exposure Scenario	Operating Days (days/yr)	Basis
Manufacturing	250	EPA assumed year-round site operation for 5 days each week, considering a 2-week downtime, totaling 250 days/year.
Import and repackaging	208–260	The 2022 Chemical Repackaging GS estimated the total number of operating days as one of three discrete values based on the typical shift lengths of operators over the course of a full year. Shift lengths include 8, 10, or 12 hour/day shifts, which resulted in operating day estimates of 174, 208, or 260 days/year. EPA assessed releases using Monte Carlo modeling (see <i>Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)</i> ( <a href="#">U.S. EPA, 2024q</a> )), which used a 50th to 95th percentile range of 208–260 days/year ( <a href="#">U.S. EPA, 2022a</a> ).

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Occupational Exposure Scenario	Operating Days (days/yr)	Basis
Incorporation into adhesives and sealants	250	EPA assumed year-round site operation for 5 days each week, considering a 2-week downtime, totaling 250 days/year.
Incorporation into paints and coatings	250	EPA assumed year-round site operation for 5 days each week, considering a 2-week downtime, totaling 250 days/year.
Incorporation into other formulations, mixtures, and reaction products not covered elsewhere	250	EPA assumed year-round site operation for 5 days each week, considering a 2-week downtime, totaling 250 days/year.
PVC plastics compounding	223–254	The 2021 <i>Revised Draft GS on the Use of Additives in Plastic Compounding</i> estimated the number of operating days as 148–264 days/year. Release estimates that EPA assessed using Monte Carlo modeling (see <i>Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)</i> ( <a href="#">U.S. EPA, 2024q</a> )) used a 50th to 95th percentile range of 223–254 days/year ( <a href="#">U.S. EPA, 2021d, 2014c</a> ).
PVC plastics converting	219–251	The 2021 <i>Revised Draft GS on the Use of Additives in the Thermoplastics Converting Industry</i> estimated the number of operating days as 138–253 days/year. Release estimates that EPA assessed using Monte Carlo modeling (see <i>Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)</i> ( <a href="#">U.S. EPA, 2024q</a> )) used a 50th to 95th percentile range of 219–251 days/year ( <a href="#">U.S. EPA, 2021e</a> ).
Non-PVC material compounding	234–280	The 2021 <i>Revised Draft GS on the Use of Additives in Plastic Compounding</i> and the 2020 <i>SpERC Factsheet on Rubber Production and Processing</i> estimated the total number of operating days as 148–300 days/year. Release estimates that EPA assessed using Monte Carlo modeling (see <i>Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)</i> ( <a href="#">U.S. EPA, 2024q</a> )) used a 50th to 95th percentile range of 234–280 days/year ( <a href="#">U.S. EPA, 2021d</a> ; <a href="#">ESIG, 2020b</a> ; <a href="#">U.S. EPA, 2014c</a> ).
Non-PVC material converting	219–251	The 2021 <i>Revised Draft GS on the Use of Additives in the Thermoplastics Converting Industry</i> estimated the number of operating days as 137–254 days/year. Release estimates that EPA assessed using Monte Carlo modeling (see <i>Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)</i> ( <a href="#">U.S. EPA, 2024q</a> )) used a 50th to 95th percentile range of 219–251 days/year ( <a href="#">U.S. EPA, 2021e</a> ).
Application of adhesives and sealants	232–325	Based on several end use products categories, the 2015 ESD on the Use of Adhesives estimated the total number of operating days as 50–365 days/year. Release estimates that EPA assessed using Monte Carlo modeling ( <i>Draft</i>

Occupational Exposure Scenario	Operating Days (days/yr)	Basis
		<i>Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)</i> ( <a href="#">U.S. EPA, 2024q</a> ) used a 50th to 95th percentile range of 232–325 days/year ( <a href="#">OECD, 2015b</a> ).
Application of paints and coatings	257–287	EPA assessed the total number of operating days based on the 2011 ESD on Radiation Curable Coatings, Inks and Adhesives, the 2011 ESD on Coating Application via Spray-Painting in the Automotive Finishing Industry, the 2004 GS on Spray Coatings in the Furniture Industry, and the <i>SpERC Factsheet for Industrial Application of Coatings and Inks by Spraying</i> . These sources estimated the total number of operating days as 225–300 days/year. Release estimates that EPA assessed using Monte Carlo modeling ( <i>Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)</i> ) ( <a href="#">U.S. EPA, 2024q</a> ) used a 50th to 95th percentile range of 257–287 days/year ( <a href="#">ESIG, 2020a</a> ; <a href="#">OECD, 2011a, b</a> ; <a href="#">U.S. EPA, 2004c</a> ).
Use of laboratory chemicals	Solid and Liquid: 235–258	The 2023 Use of Laboratory Chemicals GS estimated the total number of operating days with a discrete distribution based on the shift lengths of operators over the course of a full year. Shift lengths include 8, 10, or 12 hour/day shifts, which result in a range of 174–260 days/year for operating days. Release estimates that EPA assessed using Monte Carlo modeling ( <i>Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)</i> ) ( <a href="#">U.S. EPA, 2024q</a> ) used a 50th to 95th percentile range of 235–258 days/year ( <a href="#">U.S. EPA, 2023g</a> ).
Fabrication or use of final products or articles	250	EPA assumed year-round site operation for 5 days each week, considering a 2-week downtime, totaling 250 days/year. However, EPA was not able to perform a quantitative release assessment for this OES because the release parameters were unknown and unquantifiable.
Recycling	223–254	The 2021 Revised Draft GS on the Use of Additives in Plastic Compounding estimated the number of operating days as 148–264 days/year. Release estimates that EPA assessed using Monte Carlo modeling (see <i>Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)</i> ) ( <a href="#">U.S. EPA, 2024q</a> ) used a 50th to 95th percentile range of 223–254 days/year ( <a href="#">U.S. EPA, 2021d, 2014c</a> ).
Waste handling, treatment, and disposal	250	EPA assumed year-round site operation for 5 days each week, considering a 2-week downtime, totaling 250 days/year.

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### 3.1.3 Daily Release Estimation

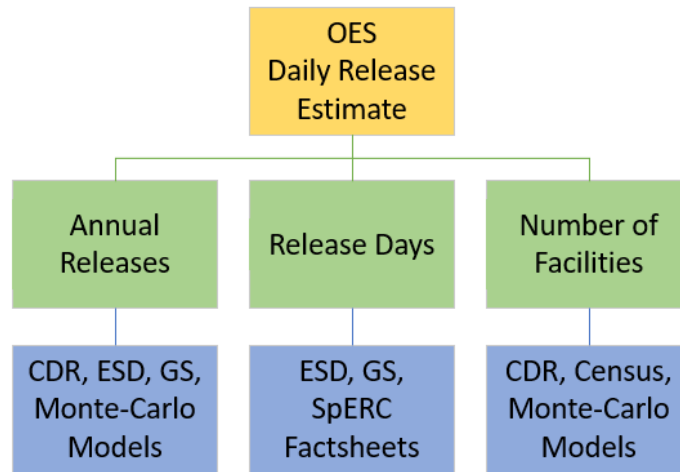
For each OES, EPA estimated releases to each medium of release using 2020 CDR data ([U.S. EPA, 2020a](#)), GSs and ESDs, and EPA published models as shown in Figure 3-1. Where available, EPA used GSs or ESDs to estimate number of release days, which EPA used to convert between annual release

817 estimates and daily release estimates. EPA used 2020 CDR, 2020 U.S. County Business Practices, and  
818 Monte Carlo modeling data to estimate the number of sites using DCHP within an OES. Generally,  
819 information for reporting sites in CDR was sufficient to accurately characterize each reporting site's  
820 OES. The *Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl*  
821 *Phthalate (DCHP)* (U.S. EPA, 2024q) describes EPA's approach and methodology for estimating daily  
822 releases and provides detailed facility level results for each OES.

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824 For each OES, EPA estimated DCHP releases per facility to each release medium applicable to that  
825 OES. For DCHP, EPA assessed releases to water, air, or land (*i.e.*, disposal to land).

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828 **Figure 3-1. An Overview of How EPA Estimated Daily Releases for Each OES**

829 CDR = Chemical Data Reporting; ESD = Emission Scenario Document; GS =  
830 Generic Scenario; SpERC = Specific Environmental Release Category

### 831 **3.1.4 Consumer Down-the-Drain and Landfills**

832 EPA evaluated down-the-drain releases of DCHP for consumer COUs qualitatively. Although the  
833 Agency acknowledges that there may be DCHP releases to the environment via the cleaning and  
834 disposal of adhesives and sealants, the Agency did not quantitatively assess down-the-drain and disposal  
835 scenarios of consumer products due to limited information from monitoring data as well as limited  
836 availability of modeling tools that can adequately quantify disposal. EPA provides a qualitative  
837 assessment of down-the-drain releases of DCHP using physical and chemical properties in this section.  
838 See EPA's *Draft Consumer and Indoor Dust Exposure Assessment for Dicyclohexyl phthalate (DCHP)*  
839 (U.S. EPA, 2024c) for further details. For example, adhesives and sealants can be disposed down-the-  
840 drain when people using them wash their hands, brushes, sponges, and other product-applying tools.  
841 Very limited information is available on wastewater treatment and the removal of DCHP in drinking  
842 water treatment plants. As stated in the *Draft Physical Chemistry and Fate And Transport Assessment*  
843 *for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2024z), no data was identified by the EPA for DCHP in  
844 drinking water. Based on the low water solubility and log K<sub>ow</sub>, DCHP in water is expected to mainly  
845 partition to suspended solids present in water. The available information suggest that the use of  
846 flocculants and filtering media could potentially help remove DCHP during drinking water treatment by  
847 sorption into suspended organic matter, settling, and physical removal.

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849 In addition, adhesives and sealant products can be disposed of when users no longer have use for them  
850 or when the products have reached the product shelf life and are taken to landfills. All other solid  
851 products and articles listed in Table 4-6 can be removed and disposed of in landfills, or other waste  
852 handling locations that properly manage the disposal of products like adhesives and sealants. DCHP is

853 expected to be persistent as it leaches from consumer products disposed of in landfills. Due to low water  
854 solubility, DCHP is likely to be present in landfill leachate up to its aqueous limit of solubility (1.48  
855 mg/L). However, due to its affinity for organic carbon, DCHP is expected to be immobile in  
856 groundwater. Even in cases where landfill leachate containing DCHP were to migrate to groundwater,  
857 DCHP would likely partition from groundwater to organic carbon present in the subsurface ([U.S. EPA,  
858 2024p](#)).

## 859 **3.2 Summary of Environmental Releases**

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### 860 **3.2.1 Manufacturing, Processing, Industrial and Commercial**

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861 EPA combined its estimates for total production volume, release days, number of facilities, and hours of  
862 release per day to estimate a range of daily releases for each OES. Table 3-4 presents a summary of  
863 these ranges across facilities. See the *Draft Environmental Release and Occupational Exposure*  
864 *Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024q](#)) for additional detail on deriving the  
865 overall confidence score for each OES. EPA was not able to estimate site-specific releases for the  
866 fabrication or use of final products or articles OES. Disposal sites handling post-consumer, end-use  
867 DCHP were not quantifiable due to the wide and disperse use of DCHP in PVC and other products. Pre-  
868 consumer waste handling, treatment, and disposal are assumed to be captured in upstream OESs.

869 Table 3-4. Summary of EPA’s Daily Release Estimates for Each OES and EPA’s Overall Confidence in these Estimates

OES	Estimated Daily Release across Sites (kg/site-day)		Type of Discharge, <sup>a</sup> Air Emission, <sup>b</sup> or Transfer for Disposal <sup>c</sup>	Estimated Release Frequency across Sites (days) <sup>d</sup>		Number of Facilities <sup>e</sup>	Weight of Scientific Evidence Rating <sup>f</sup>	Sources
	Central Tendency	High-End		Central Tendency	High-End			
Manufacturing	9.4E-02	0.42	Stack Air	250		1 – LANXESS Corporation, Pittsburgh, PA	Moderate	CDR, Peer-reviewed literature (GS/ESD)
	0.12	0.55	Fugitive Air, Water, Incineration, or Landfill					
	0.94		Water, Incineration, or Landfill					
	0.15	0.57	Incineration or Landfill					
	2.5	11	Stack Air	250		1 – Vertellus LLC, Indianapolis, IN	Moderate	CDR, Peer-reviewed literature (GS/ESD)
	3.2	15	Fugitive Air, Water, Incineration, or Landfill					
	12		Water, Incineration, or Landfill					
	4.0	15	Incineration or Landfill					
Import and repackaging	1.5	9.3	Stack Air	208	260	2 – United Initiators, Inc., Elyria, OH; Nouryon Chemicals LLC, Chicago, IL	Moderate	CDR, Peer-reviewed literature (GS/ESD)
	1.9	12	Fugitive Air, Water, Incineration, or Landfill					
	4.0	8.2	Water, Incineration, or Landfill					
	2.4	13	Incineration or Landfill					

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OES	Estimated Daily Release across Sites (kg/site-day)		Type of Discharge, <sup>a</sup> Air Emission, <sup>b</sup> or Transfer for Disposal <sup>c</sup>	Estimated Release Frequency across Sites (days) <sup>d</sup>		Number of Facilities <sup>e</sup>	Weight of Scientific Evidence Rating <sup>f</sup>	Sources
	Central Tendency	High-End		Central Tendency	High-End			
Incorporation into adhesives and sealants	0.11	0.70	Stack Air	250		5–9 generic sites	Moderate	CDR, Peer-reviewed literature (GS/ESD)
	0.14	0.93	Fugitive Air, Water, Incineration, or Landfill					
	2.6	4.9	Water, Incineration, or Landfill					
	0.18	0.99	Incineration or Landfill					
Incorporation into paints and coatings	1.2E-02	0.10	Stack Air	250		20–34 generic sites	Moderate	CDR, Peer-reviewed literature (GS/ESD)
	1.6E-02	0.14	Fugitive Air, Water, Incineration, or Landfill					
	1.1	3.0	Water, Incineration, or Landfill					
	2.0E-02	0.15	Incineration or Landfill					
Incorporation into other formulations, mixtures, and reaction products	8.3E-02	0.78	Stack Air	250		11–22 generic sites	Moderate	CDR, Peer-reviewed literature (GS/ESD)
	0.11	1.0	Fugitive Air, Water, Incineration, or Landfill					
	0.13	1.2	Water, Incineration, or Landfill					
	0.13	1.2	Incineration or Landfill					

PUBLIC RELEASE DRAFT  
December 2024

OES	Estimated Daily Release across Sites (kg/site-day)		Type of Discharge, <sup>a</sup> Air Emission, <sup>b</sup> or Transfer for Disposal <sup>c</sup>	Estimated Release Frequency across Sites (days) <sup>d</sup>		Number of Facilities <sup>e</sup>	Weight of Scientific Evidence Rating <sup>f</sup>	Sources
	Central Tendency	High-End		Central Tendency	High-End			
PVC plastics compounding	0.12	4.1	Fugitive or Stack Air	223	254	5–9 generic sites	Moderate	CDR, Peer-reviewed literature (GS/ESD)
	0.83	7.9	Fugitive Air, Water, Incineration, or Landfill					
	3.5	18	Water, Incineration, or Landfill					
	1.1	6.1	Water					
	1.4	11	Incineration or Landfill					
PVC plastics converting	7.2E–03	0.19	Fugitive or Stack Air	219	251	42–67 generic sites	Moderate	CDR, Peer-reviewed literature (GS/ESD)
	4.7E–02	0.35	Fugitive Air, Water, Incineration, or Landfill					
	0.96	1.9	Water, Incineration, or Landfill					
	0.13	0.41	Water					
	0.43	1.4	Incineration or Landfill					
Non-PVC material compounding	3.1E–02	0.88	Fugitive or Stack Air	234	280	2–4 generic sites	Moderate	CDR, Peer-reviewed literature (GS/ESD)
	0.25	1.6	Fugitive Air, Water, Incineration, or Landfill					
	1.5	2.9	Water, Incineration, or Landfill					
	0.30	0.90	Water					
	0.41	2.1	Incineration or Landfill					

PUBLIC RELEASE DRAFT  
December 2024

OES	Estimated Daily Release across Sites (kg/site-day)		Type of Discharge, <sup>a</sup> Air Emission, <sup>b</sup> or Transfer for Disposal <sup>c</sup>	Estimated Release Frequency across Sites (days) <sup>d</sup>		Number of Facilities <sup>e</sup>	Weight of Scientific Evidence Rating <sup>f</sup>	Sources
	Central Tendency	High-End		Central Tendency	High-End			
Non-PVC material converting	2.0E-02	0.47	Fugitive or Stack Air	219	251	2-4 generic sites	Moderate	CDR, Peer-reviewed literature (GS/ESD)
	0.13	0.86	Fugitive Air, Water, Incineration, or Landfill					
	1.1	2.9	Water, Incineration, or Landfill					
	0.32	0.96	Water					
	1.1	3.3	Incineration or Landfill					
Application of paints and coatings with overspray controls (no overspray controls)	5.8E-09 [5.8E-09]	1.3E-08 [1.3E-08]	Fugitive Air	257	287	1-14 generic sites [1-14 generic sites]	Moderate	CDR, Peer-reviewed literature (GS/ESD)
	1.4 [7.4E-02]	5.1 [0.63]	Stack Air					
	9.4E-02 [13]	0.82 [47]	Fugitive Air, Water, Incineration, or Landfill					
	1.3 [1.3]	3.3 [3.3]	Water, Incineration, or Landfill					
	11 [0.12]	42 [0.88]	Incineration or Landfill					
Application of adhesives and sealants	5.7E-10	1.5E-09	Fugitive Air	232	325	6-80 generic sites	Moderate	CDR, Peer-reviewed literature (GS/ESD)
	4.2E-02	0.46	Stack Air					
	5.3E-02	0.61	Fugitive Air, Water, Incineration, or Landfill					
	0.33	1.6	Water, Incineration, or Landfill					
	0.67	3.6	Incineration or Landfill					

OES	Estimated Daily Release across Sites (kg/site-day)		Type of Discharge, <sup>a</sup> Air Emission, <sup>b</sup> or Transfer for Disposal <sup>c</sup>	Estimated Release Frequency across Sites (days) <sup>d</sup>		Number of Facilities <sup>e</sup>	Weight of Scientific Evidence Rating <sup>f</sup>	Sources
	Central Tendency	High-End		Central Tendency	High-End			
Use of laboratory chemicals – liquid	1.5E-12	2.6E-12	Fugitive or Stack Air	235	258	36,873 generic sites	Moderate	
	4.0E-03	5.0E-03	Water, Incineration, or Landfill					
Use of laboratory chemicals – solid	1.2E-04	1.0E-03	Stack Air	235	258	1,978–25,643 generic sites	Moderate	CDR, Peer-reviewed literature (GS/ESD)
	2.3E-04	2.0E-03	Unknown Media (Air, Water, Incineration, or Landfill)					
	6.6E-02	0.27	Water, Incineration, or Landfill					
	3.1E-04	3.0E-03	Incineration or Landfill					
Recycling	7.4E-04	4.3E-03	Stack Air	223	254	58 generic sites	Moderate	CDR, Peer-reviewed literature (GS/ESD)
	2.8E-03	9.2E-03	Fugitive Air, Water, Incineration, or Landfill					
	1.9E-03	3.9E-03	Water					
	1.3	1.8	Water, Incineration, or Landfill					

<sup>a</sup> Direct discharge to surface water; indirect discharge to non-POTWs; indirect discharge to POTWs

<sup>b</sup> Emissions via fugitive air or stack air, or treatment via incineration

<sup>c</sup> Transfer to surface impoundment, land application, or landfills

<sup>d</sup> Where available, EPA used industry provided information, ESDs, or GSs to estimate the number of release days for each COU.

<sup>e</sup> Where available, EPA used 2020 CDR ([U.S. EPA, 2020a](#)), 2020 U.S. County Business Practices ([U.S. Census Bureau, 2022](#)), and Monte Carlo models to estimate the number of sites that use DCHP for each COU.

<sup>f</sup> See Section 3.2.2 for details on EPA’s determination of the weight of scientific evidence rating.

### 3.2.2 Weight of Scientific Evidence Conclusions for Environmental Releases from Industrial and Commercial Sources

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For each OES, EPA considered the assessment approach, the quality of the data and models, and the uncertainties in the assessment results to determine a level of confidence for the environmental release estimates. Table 3-5 provides the Agency’s weight of scientific evidence rating for each OES.

EPA integrated numerous evidence streams across systematic review sources to develop environmental estimates for DCHP. The Agency made a judgment on the weight of scientific evidence supporting the release estimates based on the strengths, limitations, and uncertainties associated with the release estimates. EPA described this judgment using the following confidence descriptors: robust, moderate, slight, or indeterminate.

In determining the strength of the overall weight of scientific evidence, EPA considered factors that increase or decrease the strength of the evidence supporting the release estimate (whether measured or estimated)—including quality of the data/information, relevance of the data to the release scenario (including considerations of temporal and spatial relevance), and the use of surrogate data when appropriate. In general, higher rated studies (as determined through data evaluation) increase the weight of scientific evidence when compared to lower rated studies, and EPA gave preference to chemical- and scenario-specific data over surrogate data (*e.g.*, data from a similar chemical or scenario). For example, a conclusion of moderate weight of scientific evidence is appropriate where there is measured release data from a limited number of sources, such that there is a limited number of data points that may not cover most or all the sites within the OES. A conclusion of slight weight of scientific evidence is appropriate where there is limited information that does not sufficiently cover all sites within the COU, and the assumptions and uncertainties are not fully known or documented. See EPA’s *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for Chemical Substances, Version 1.0: A Generic TSCA Systematic Review Protocol with Chemical-Specific Methodologies* (also called “Draft Systematic Review Protocol”) ([U.S. EPA, 2021a](#)) for additional information on weight of scientific evidence conclusions.

Table 3-5 summarizes EPA’s overall weight of scientific evidence conclusions for its release estimates for each OES. In general, modeled data had data quality ratings of medium. As a result, for releases that used GSs/ESDs, the weight of scientific evidence conclusion was moderate, when used in tandem with Monte Carlo modeling.

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**Table 3-5. Summary of Overall Confidence in Environmental Release Estimates by Occupational Exposure Scenario**

OES	Weight of Scientific Evidence Conclusion in Release Estimates
Manufacturing	<p>EPA found limited chemical specific data for the manufacturing OES and assessed environmental releases using models and model parameters derived from CDR, the <i>2023 Methodology for Estimating Environmental Releases from Sampling Wastes</i> (<a href="#">U.S. EPA, 2023e</a>), and sources identified through systematic review (including surrogates DINP and DIDP industry-supplied data). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, with media of release assessed using assumptions from EPA/OPPT models and industry supplied data. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Additionally, Monte Carlo modeling uses a large number of data points (simulation runs) and considers the full distributions of input parameters. EPA used facility-specific DCHP manufacturing volumes for all facilities that reported this information to CDR and non-DCHP-specific operating parameters derived using data from a current U.S. manufacturing site for DIDP and DINP that is assumed to operate using similar operating parameters as DCHP manufacturing. This information was used to provide more accurate estimates than the generic values provided by the EPA/OPPT models. These strengths increase the weight of evidence.</p> <p>The primary limitation of EPA’s approach is the uncertainty in the representativeness of release estimates toward the true distribution of potential releases. In addition, one DCHP manufacturing site claimed their DCHP production volume as CBI for the purpose of CDR reporting; therefore, DCHP throughput estimates for this site are based on the site’s reported export volume and their reported PV percentage for industrial use. Additional limitations include uncertainties in the representativeness of the surrogate industry-provided operating parameters from DIDP and DINP and the generic EPA/OPPT models for DCHP manufacturing sites. These limitations decrease the weight of evidence.</p> <p>Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate, and the assessment provides a plausible estimate of releases considering the strengths and limitations of the reasonably available data.</p>
Import and repackaging	<p>EPA found limited chemical specific data for the import and repackaging OES and assessed releases to the environment using the assumptions and values from the Chemical Repackaging Generic Scenario (<a href="#">U.S. EPA, 2022a</a>), which the systematic review process rated high for data quality. EPA also referenced the <i>2023 Methodology for Estimating Environmental Releases from Sampling Wastes</i> (<a href="#">U.S. EPA, 2023e</a>). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment. EPA assessed the media of release using assumptions from the GS and EPA/OPPT models. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Additionally, Monte Carlo modeling uses a large number of data points (simulation runs) and the full distributions of input parameters. These strengths increase the weight of evidence.</p> <p>The primary limitation of EPA’s approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, because the default values in the GS are generic, there is uncertainty in the representativeness of these generic site estimates in characterizing actual releases from real-world sites that import and repackage DCHP. In addition, EPA lacks DCHP facility import volume data for all CDR-reporting import and repackaging sites due to claims of CBI; therefore, throughput estimates for these sites are based on the CDR reporting threshold of 25,000 lb and an annual DCHP national aggregate production volume range from CDR. These limitations decrease the weight of evidence.</p>

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	<p>Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate, and the assessment provides a plausible estimate of releases, considering the strengths and limitations of the reasonably available data.</p>
<p>Incorporation into adhesives and sealants</p>	<p>EPA found limited chemical specific data for the incorporation into adhesives and sealants OES and assessed releases to the environment using the ESD on the Formulation of Adhesives (<a href="#">OECD, 2009a</a>), which has a high data quality rating based on the systematic review process. EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment and assessed the media of release using assumptions from the ESD and EPA/OPPT models. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. Additionally, EPA used DCHP-specific data on concentrations in adhesive and sealant products in the analysis to provide more accurate estimates than the generic values provided by the ESD. The safety and product data sheets that EPA obtained these values from have high and medium data quality ratings based on the systematic review process. These strengths increase the weight of evidence.</p> <p>The primary limitation of EPA’s approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the default values in the ESD may not be representative of actual releases from real-world sites that incorporate DCHP into adhesives and sealants. In addition, EPA lacks data on DCHP-specific facility production volume and number of formulation sites, which are needed to estimate site throughput of DCHP. EPA based throughput on the CDR reporting threshold of 25,000 lb, an annual DCHP national aggregate production volume range, and ranges of downstream sites. These limitations decrease the weight of evidence.</p> <p>Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate, and the assessment provides a plausible estimate of releases, considering the strengths and limitations of the reasonably available data.</p>
<p>Incorporation into paints and coatings</p>	<p>EPA found limited chemical specific data for the incorporation into paints and coatings OES and assessed releases to the environment using the Draft GS for the Formulation of Waterborne Coatings (<a href="#">U.S. EPA, 2014a</a>), which has a medium data quality rating based on systematic review. EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment and assessed the media of release using assumptions from the GS and EPA/OPPT models. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. Additionally, EPA used DCHP-specific data on concentrations in paint and coating products to provide more accurate estimates of DCHP concentrations than the generic values provided by the GS. The safety and product data sheets that EPA obtained these values from have medium to high data quality ratings based on the systematic review process. These strengths increase the weight of evidence.</p> <p>The primary limitation of EPA’s approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values in the GS are specific to waterborne coatings and may not be representative of releases from real-world sites that incorporate DCHP into paints and coatings, particularly for</p>

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	<p>sites formulating other coating types (<i>e.g.</i>, solvent-borne coatings). In addition, EPA lacks data on DCHP-specific facility production volume and number of formulation sites; therefore, EPA based throughput and production volume estimates on CDR which has a reporting threshold of 25,000 lb, an annual DCHP production national aggregate production volume range, and ranges of downstream sites. These limitations decrease the weight of evidence.</p> <p>Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate, and the assessment provides a plausible estimate of releases, considering the strengths and limitations of the reasonably available data.</p>
Incorporation into other formulations, mixtures, and reaction products	<p>EPA found limited chemical specific data for the incorporation into other formulations, mixtures, and reaction products not covered elsewhere OES and assessed releases to the environment using the Draft GS for the Formulation of Waterborne Coatings (<a href="#">U.S. EPA, 2014a</a>), which has a medium data quality rating based on systematic review process. EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, and media of release using assumptions from the GS and EPA/OPPT models. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. Additionally, EPA used DCHP-specific data on concentrations in other formulation, mixture, and reaction products in the analysis to provide more accurate estimates than the generic values provided by the GS. The safety and product data sheets that EPA obtained these values from have high and medium data quality ratings based on the systematic review process. These strengths increase the weight of evidence.</p> <p>The primary limitation of EPA’s approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values in the GS are based on the formulation of paints and coatings and may not represent releases from real-world sites that incorporate DCHP into other formulations, mixtures, or reaction products. In addition, because no entries in CDR indicated a use relevant to this formulation OES, and there were no other sources to estimate the volume of DCHP used in this OES, EPA developed a high-end bounding estimate for production volume based on the CDR reporting threshold of 25,000 lb or 5% of total product volume for a given use, which by definition is expected to over-estimate the average release case. For DCHP facility throughputs, EPA used a range of generic default values in the GS. These limitations decrease the weight of evidence.</p> <p>Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate, and the assessment provides a plausible estimate of releases, considering the strengths and limitations of the reasonably available data.</p>
PVC plastics compounding	<p>EPA found limited chemical specific data for the plastics compounding OES and assessed releases to the environment using the Revised Draft GS for the Use of Additives in Plastic Compounding (<a href="#">U.S. EPA, 2021d</a>), which has a medium data quality rating based on systematic review. EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, and media of release using assumptions from the GS and EPA/OPPT models. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. These strengths increase the weight of evidence.</p>

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	<p>The primary limitation of EPA’s approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. The generic default concentration values in the GS consider all types of plastic compounding and may not represent releases from real-world sites that compound DCHP into specific types of plastic raw material. In addition, EPA lacks data on DCHP-specific facility production volume and number of compounding sites; therefore, EPA estimated throughput and production volume based on CDR which has a reporting threshold of 25,000 lb and an annual DCHP production national aggregate production volume range. These limitations decrease the weight of evidence.</p> <p>Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate, and the assessment provides a plausible estimate of releases, considering the strengths and limitations of the reasonably available data.</p>
PVC plastics converting	<p>EPA found limited chemical specific data for the plastics converting OES and assessed releases to the environment using the Revised Draft GS on the Use of Additives in the Thermoplastics Converting Industry, which has a medium data quality rating based on systematic review (<a href="#">U.S. EPA, 2021e</a>). EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, and media of release using assumptions from the GS and EPA/OPPT models. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo also considers a large number of data points (simulation runs) and the full distributions of input parameters. These strengths increase the weight of evidence.</p> <p>The primary limitation of EPA’s approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values in the ESD are based on all types of thermoplastics converting sites and processes and may not represent actual releases from real-world sites that convert DCHP-containing raw material into plastic articles using a variety of methods, such as extrusion or calendaring. In addition, EPA lacks data on DCHP-specific facility production volume and number of converting sites; therefore, EPA estimated throughput based on CDR which has a reporting threshold of 25,000 lb, an annual DCHP national aggregate production volume range, and ranges of downstream sites. These limitations decrease the weight of evidence.</p> <p>Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate, and the assessment provides a plausible estimate of releases, considering the strengths and limitations of the reasonably available data.</p>
Non-PVC material compounding	<p>EPA found limited chemical specific data for the non-PVC material compounding OES and assessed releases to the environment using the Revised Draft GS for the Use of Additives in Plastic Compounding and the ESD on Additives in the Rubber Industry (<a href="#">U.S. EPA, 2021d</a>; <a href="#">OECD, 2004</a>). Both sources have a medium data quality rating based on the systematic review process. EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, and media of release using assumptions from the GS, ESD, and EPA/OPPT models. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. These strengths increase the weight of evidence.</p>

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	<p>The primary limitation of EPA’s approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, there was a lack of concentration data for specific products that contained DCHP; EPA relied on the GS and ESD to generate concentration estimates. These values may not be representative of actual values from real-world sites that compound DCHP into non-PVC material. In addition, because no entries in CDR indicated a use relevant to compounding or converting non-PVC material, and there were no other sources to estimate the volume of DCHP used in this OES, EPA developed a high-end bounding estimate based on the CDR reporting threshold of 25,000 lb or 5% of total product volume for a given use, which by definition is expected to over-estimate the average release case. These limitations decrease the weight of evidence.</p> <p>Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate, and the assessment provides a plausible estimate of releases, considering the strengths and limitations of the reasonably available data.</p>
Non-PVC material converting	<p>EPA found limited chemical specific data for the non-PVC material converting OES and assessed releases to the environment using the Revised Draft GS on the Use of Additives in the Thermoplastics Converting Industry and the ESD on Additives in the Rubber Industry (<a href="#">U.S. EPA, 2021e</a>; <a href="#">OECD, 2004</a>). Both documents have a medium data quality rating based on systematic review. EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, and media of release using assumptions from the GS, ESD, and EPA/OPPT models. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. These strengths increase the weight of evidence.</p> <p>The primary limitation of EPA’s approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, there was a lack of concentration data for specific products that contained DCHP; EPA relied on the GS and ESD to generate concentration estimates. These values may not be representative of actual values from real-world sites that convert DCHP into non-PVC articles. In addition, because no entries in CDR indicated a use relevant to compounding or converting non-PVC material, and there were no other sources to estimate the volume of DCHP or number of sites used in this OES, EPA developed a range of high-end bounding estimates based on the CDR reporting thresholds, or 25,000 lb of 5% of total product volume for a given use, which by definition is expected to over-estimate the average release case. These limitations decrease the weight of evidence.</p> <p>Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate, and the assessment provides a plausible estimate of releases, considering the strengths and limitations of the reasonably available data.</p>
Application of adhesives and sealants	<p>EPA found limited chemical specific data for the application of adhesives and sealants OES and assessed releases to the environment using the <i>esd on the use of adhesives</i> (<a href="#">OECD, 2015a</a>), which has a medium data quality rating based on systematic review. EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, and media of release using assumptions from the ESD and EPA/OPPT models. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input</p>

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	<p>parameters. Additionally, EPA used DCHP-specific data on concentration and application methods for different DCHP-containing adhesives and sealant products in the analysis. These data provide more accurate estimates than the generic values provided by the ESD. The safety and product data sheets from which these values were obtained have high and medium data quality ratings from the systematic review process. These strengths increase the weight of evidence.</p> <p>The primary limitation of EPA’s approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values in the ESD may not represent releases from real-world sites that incorporate DCHP into adhesives and sealants. The overall production volume of DCHP for this OES was based on CDR data using the same assumptions as the Incorporation into adhesives and sealants OES. EPA lacks data on DCHP-specific facility use volume and number of use sites; therefore, EPA based facility throughput estimates and number of sites on industry-specific default facility throughputs from the ESD, DCHP product concentrations, and the overall production volume range from CDR data which has a reporting threshold of 25,000 lb. EPA also had minimal data for solid additives in adhesives, and had to base the DCHP concentration range for solid additives on the SDS for one product. These limitations decrease the weight of evidence.</p> <p>Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate, and the assessment provides a plausible estimate of releases, considering the strengths and limitations of reasonably available data.</p>
Application of paints and coatings	<p>EPA found limited chemical specific data for the application of paints and coatings OES and assessed releases to the environment using the ESD on the Application of Radiation Curable Coatings, Inks and Adhesives and the GS on Coating Application via Spray Painting in the Automotive Refinishing Industry (<a href="#">U.S. EPA, 2014b</a>; <a href="#">OECD, 2011b</a>). These documents have a medium data quality rating based on the systematic review process. EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment. EPA assessed media of release using assumptions from the ESD, GS, and EPA/OPPT models and a default assumption that all paints and coatings are applied via spray application. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. Additionally, EPA used DCHP-specific data on concentration for different DCHP-containing paints and coatings in the analysis. These data provide more accurate estimates than the generic values provided by the GS and ESD. The safety and product data sheets that EPA obtained these values from have high and medium data quality ratings based on the systematic review process. These strengths increase the weight of evidence.</p> <p>The primary limitation of EPA’s approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values in the GS and ESD may not represent releases from real-world sites that incorporate DCHP into paints and coatings. Additionally, EPA assumes spray applications of the coatings, which may not be representative of other coating application methods. In addition, EPA lacks data on DCHP-specific facility use volume and number of use sites; therefore, EPA based throughput estimates on values from ESD, GS, and CDR data which has a reporting threshold of 25,000 lb and an annual DCHP production volume range. EPA also lacked data for ready-to-apply coatings, and consequently assumed a concentration range for liquid coatings based on the SDS for one product. These limitations decrease the weight of evidence.</p>

OES	Weight of Scientific Evidence Conclusion in Release Estimates
	<p>Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate, and the assessment provides a plausible estimate of releases, considering the strengths and limitations of reasonably available data.</p>
Use of laboratory chemicals	<p>EPA found limited chemical specific data for the use of laboratory chemicals OES and assessed releases to the environment using the Draft GS on the Use of Laboratory Chemicals (<a href="#">U.S. EPA, 2023g</a>), which has a high data quality rating based on systematic review. EPA used EPA/OPPT models combined with Monte Carlo modeling to estimate releases to the environment, and media of release using assumptions from the GS and EPA/OPPT models for solid and liquid DCHP materials. EPA believes a strength of the Monte Carlo modeling approach is that variation in model input values allows for estimation of a range of potential release values that are more likely to capture actual releases than a discrete value. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. EPA used SDSs from identified laboratory DCHP products to inform product concentration and material states. These strengths increase the weight of evidence.</p> <p>EPA believes the primary limitation to be the uncertainty in the representativeness of values toward the true distribution of potential releases. In addition, EPA lacks data on DCHP-specific laboratory chemical throughput and number of laboratories; therefore, EPA based the number of laboratories and throughput estimates on stock solution throughputs from the GS on the Use of Laboratory Chemicals (U.S. EPA, 2023c) and on CDR reporting thresholds. Additionally, because no entries in CDR indicate a laboratory use and there were no other sources to estimate the volume of DCHP used in this OES, EPA developed a high-end bounding estimate based on the CDR reporting threshold of 25,000 lb or 5% of total product volume for a given use, which by definition is expected to over-estimate the average release case. These limitations decrease the weight of evidence.</p> <p>Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate, and the assessment provides a plausible estimate of releases, considering the strengths and limitations of reasonably available data.</p>
Fabrication or use of final products or articles	<p>No data were available to estimate releases for this OES and there were no suitable surrogate release data or models. This release is described qualitatively.</p>
Recycling	<p>EPA found limited chemical specific data for the recycling OES. EPA assessed releases to the environment from recycling activities using the Revised Draft GS for the Use of Additives in Plastic Compounding (<a href="#">U.S. EPA, 2021d</a>) as surrogate for the recycling process. The GS has a medium data quality rating based on systematic review. EPA/OPPT models were combined with Monte Carlo modeling to estimate releases to the environment. EPA believes the strength of the Monte Carlo modeling approach is that variation in model input values and a range of potential release values are more likely to capture actual releases than discrete values. Monte Carlo modeling also considers a large number of data points (simulation runs) and the full distributions of input parameters. EPA referenced the <i>Quantification and Evaluation of Plastic Waste in the United States</i>, which has a medium quality rating based on systematic review (<a href="#">Milbrandt et al., 2022</a>), to estimate the rate of PVC recycling in the United States. EPA estimated the DCHP PVC market share (based on the surrogate market shares from DINP and DIDP) to define an approximate recycling volume of PVC containing DCHP. These strengths increase the weight of evidence.</p>

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OES	Weight of Scientific Evidence Conclusion in Release Estimates
	<p>The primary limitation of EPA’s approach is the uncertainty in the representativeness of estimated release values toward the true distribution of potential releases at all sites in this OES. Specifically, the generic default values and release points in the GS represent all types of plastic compounding sites and may not represent sites that recycle PVC products containing DCHP. In addition, EPA lacks DCHP-specific PVC recycling rates and facility production volume data; therefore, EPA based throughput estimates on PVC plastics compounding data and U.S. PVC recycling rates, which are not specific to DCHP, and may not accurately reflect current U.S. recycling volume. DCHP may also be present in non-PVC plastics that are recycled; however, EPA was unable to identify information on these recycling practices. These limitations decrease the weight of evidence.</p> <p>Based on this information, EPA concluded that the weight of scientific evidence for this assessment is moderate, and the assessment provides a plausible estimate of releases, considering the strengths and limitations of the reasonably available data.</p>
Waste handling, treatment, and disposal	No data were available to estimate releases for this OES and there were no suitable surrogate release data or models. This release is described qualitatively.
Distribution in commerce	These releases are assessed as part of individual OESs where the relevant activities occur.

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### 3.2.3 Strengths, Limitations, Assumptions, and Key Sources of Uncertainty for the Environmental Release Assessment

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Manufacturers and importers of DCHP submit CDR data to EPA if they meet reporting threshold requirements. Sites are only required to load production data into CDR if their yearly production volume exceeds 25,000 lb. Sites can claim their production volume as CBI, further limiting the production volume information in CDR. As a result, some sites that produce or use DCHP may not be included in the CDR data set and the total production volume for a given OES may be under or overestimated. The extent to which sites that are not captured in the CDR reports release DCHP into the environment is unknown. The media of release for these sites is also unknown.

CDR information on the downstream use of DCHP at facilities is also limited; therefore, there is some uncertainty as to the production volume attributed to a given OES. For OES with limited CDR data, EPA developed potential production volume ranges given reported CDR data, known reporting thresholds, and the national aggregate production volume of 500,000 to less than 1,000,000 lb for DCHP in 2019. The Agency used the potential production volume ranges as uniform distributions in Monte Carlo modeling when assessing releases for each OES. Due to the wide range of potential production volumes attributable to certain OES, the overall releases may be over or underestimated. DCHP releases at each site may vary from day to day, such that on any given day the actual daily release rate may be higher or lower than the estimated average daily release rate.

The EPA has further identified the following additional uncertainties that contribute to the overall uncertainty in the environmental release assessment:

- **Use of Census Bureau data for Number of Facilities** – In some cases, EPA determined the maximum number of facilities for a given OES (for use in Monte Carlo modeling) from industry data from the U.S. Census Bureau, County and Business Patterns data set ([U.S. Census Bureau, 2022](#)).
- **Uncertainties Associated with Facility Throughputs** – EPA estimated facility throughputs of DCHP or DCHP-containing products using various methods, including using generic industry data presented in the relevant GS or ESD, or by calculation based on estimated number of facilities and overall production volume of DCHP from CDR for the given OES. In either case, the values used for facility throughputs may encompass a wide range of possible values. Due to these uncertainties, the facility throughputs may be under or overestimated.
- **Uncertainties Associated with Number of Release Days** – For most OESs, EPA estimated the number of release days using data from GSs, ESDs, or SpERC factsheets. In such cases, EPA used applicable sources to estimate a range of release days over the course of an operating year. Due to uncertainty in DCHP-specific facility operations, release days may be under or overestimated.
- **Uncertainties Associated with DCHP-Containing Product Concentrations** – In most cases, the number of identified products for a given OES were limited. In such cases, EPA estimated a range of possible DCHP concentrations for products in the OES. However, the extent to which these products represent all DCHP-containing products within the OES is uncertain. For OESs with little-to-no product data, EPA estimated DCHP concentrations from GSs or ESDs. Due to these uncertainties, the average product concentrations may be under or overestimated.

### 3.3 Summary of Concentrations of DCHP in the Environment

Based off the environmental release assessment summarized in Section 3.2 and detailed in EPA's *Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2024q), DCHP is expected to be released to the environment via air, water, biosolids, and disposal to landfills. Environmental media concentrations were quantified in ambient air, sediment, and surface water. Additional analysis of surface water used as drinking water was conducted for the Human Health Risk Assessment (see Section 4.1.3). EPA relied on its fate assessment to determine which environmental pathways to consider for its screening level analysis of environmental exposure and general population exposure to environmental releases. Details on the environmental partitioning and media assessment can be found in *Draft Physical Chemistry and Fate and Transport Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2024z). Briefly, based on DCHP's fate parameters (e.g., Henry's Law constant, log K<sub>oc</sub>, water solubility, fugacity modeling), EPA anticipated DCHP to be predominantly in water, soil, and sediment. Soil concentration of DCHP from land applications were not quantitatively assessed in the screening level analysis as DCHP was expected to have limited persistence potential and mobility in soils receiving biosolids.

Further detail on the screening-level assessment of each environmental pathway can be found in EPA's *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2024p). Because of limited environmental monitoring data and lack of location data for DCHP releases, EPA began its environmental and general population exposure assessment with a screening-level approach using the highest modeled environmental media concentrations for the environmental pathways expected to be of greatest concern. The highest environmental media concentrations were estimated using the release estimates for an OES associated with a COU that, paired with conservative assumption of environmental conditions, resulted in the greatest modeled concentration of DCHP in a given environmental medium type. Therefore, EPA did not estimate environmental concentrations of DCHP resulting from all OES presented in Table 3-1.

The OES resulting in the highest environmental concentration of DCHP varied by environmental media as shown in Table 3-6. PVC plastics compounding with or without consideration of wastewater treatment efficiency yielded the highest water concentrations using a 7Q10 flow,<sup>1</sup> 30Q5 flow,<sup>2</sup> and harmonic mean.<sup>3</sup> The Application of paints, coatings, adhesives, and sealants OES yielded the highest ambient air concentration. The summary table also indicates whether the high-end estimate was used for environmental or general population exposure assessment. For the screening-level analysis, if the high-end environmental media concentrations did not result in potential environmental or human health risk, no further OESs were assessed and no further refinements were pursued. For the surface water and ambient air pathways, only the OESs resulting in the highest estimated water column or ambient air concentrations were carried forward to the human health risk assessment (i.e., Plastic compounding for water and Application of paints, coatings, adhesives, and sealants for ambient air).

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<sup>1</sup> 7Q10 is defined as 7 consecutive days of lowest flow over a 10-year period. These flows are used to calculate estimates of chronic surface water concentrations to compare with the COCs for aquatic life (Versar, 2014).

<sup>2</sup> 30Q5 is defined as 30 consecutive days of lowest flow over a 5-year period. These flows are used to determine acute human exposures via drinking water (Versar, 2014).

<sup>3</sup> Harmonic mean is defined as the inverse mean of reciprocal daily arithmetic mean flow values. These flows represent a long-term average and are used to generate estimates of chronic human exposures via drinking water and fish ingestion.

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**Table 3-6. Summary of High-End DCHP Concentrations in Various Environmental Media from Environmental Releases**

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OES <sup>a</sup>	Release Media	Environmental Media	DCHP Concentration	Environmental or General Population
PVC plastics compounding without wastewater treatment	Water	Total water column (7Q10, <sup>b</sup> median flow)	165 µg/L	Environmental
		Total water column (7Q10, p75 flow)	5.56 µg/L	Environmental
		Total water column (7Q10, p90 flow)	0.57 µg/L	Environmental
		Median 7Q10 (benthic pore water)	95.3 µg/L	Not carried forward to environmental risk assessment <sup>c</sup>
		Median 7Q10 (benthic sediment)	112,000 µg/kg	Not carried forward to environmental risk assessment <sup>c</sup>
PVC plastics compounding without wastewater treatment	Water	Surface water (30Q5, <sup>d</sup> median flow)	126 µg/L	General population
		Surface water (harmonic mean, <sup>e</sup> median flow)	87.7 µg/L	General Population
PVC plastics compounding with wastewater treatment	Water	Surface water (30Q5, median flow)	39.6 µg/L	General population
		Surface water (harmonic mean, median flow)	27.5 µg/L	General population
Application of paints, and coatings	Fugitive air	Daily-averaged total (fugitive and stack, 100 m)	67.57 µg/m <sup>3</sup>	General population
		Annual-averaged total (fugitive and stack, 100 m)	46.28 µg/m <sup>3</sup>	General population

<sup>a</sup> Table 3-1 provides the crosswalk of OES to COUs.  
<sup>b</sup> 7Q10 is the 7 consecutive days of lowest flow over a 10-year period.  
<sup>c</sup> See Section 4.4 for further details.  
<sup>d</sup> 30Q5 is defined as 30 consecutive days of lowest flow over a 5-year period  
<sup>e</sup> Harmonic mean is defined as the inverse mean of reciprocal daily arithmetic mean flow values. These flows represent a long-term average.

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**3.3.1 Weight of Scientific Evidence Conclusions**

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Detailed discussion of the strengths, limitations, and sources of uncertainty for modeled environmental media concentration leading to a weight of scientific evidence conclusion can be found in EPA’s *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2024p). However, the weight of scientific evidence conclusion is summarized below for the modeled DCHP concentrations in surface water, sediment, and ambient air.

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**3.3.1.1 Surface Water**

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Due to the lack of release data for facilities discharging DCHP to surface water, releases to water were modeled as described in Section 3.2. The high-end estimate of releases to water for each COU was applied for surface water modeling as part of a conservative screening-level assessment. Additionally, due to a lack of site-specific release information, a generic distribution of hydrologic flows was developed from facilities which had been classified under relevant North American Industry Classification System (NAICS) codes, and which had National Pollutant Discharge Elimination System

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1003 (NPDES) permits. The flow rates were selected from the generated distributions and coupled with high-  
1004 end (95th percentile) release scenarios. EPA assumed higher releases are generally correlated with  
1005 higher receiving water body flows. *EPA generally has moderate confidence in the modeled*  
1006 *concentrations as being representative of actual releases, with greater confidence in the modeled*  
1007 *scenarios where high-end release amounts are paired with high-end flow rates. Additionally, EPA has*  
1008 *robust confidence that no surface water release scenarios exceed the high-end concentrations presented*  
1009 *in this evaluation, which have been applied as screening values.* Other model inputs were derived from  
1010 reasonably available literature collected and evaluated through EPA’s systematic review process for  
1011 TSCA risk evaluations. All monitoring and experimental data included in this analysis were from  
1012 articles rated “medium” or “high” quality from this process.

1013  
1014 The high-end modeled concentrations in the surface water and sediment identified through systematic  
1015 review exceeded the highest values available from monitoring studies by more than three orders of  
1016 magnitude. This confirms EPA’s expectation that modeled concentrations presented here are biased  
1017 toward overestimation, and thus appropriate to be applied as a screening-level evaluation in the  
1018 environmental and general population exposure to environmental releases assessment.

### 1019 **3.3.1.2 Ambient Air**

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1020 Similar to the surface water analysis, due to the lack of release data, releases to ambient air were  
1021 modeled using generic scenarios, and the high-end estimates of releases to ambient air for each COU  
1022 were applied for ambient air modeling. The uncertainties associated with the release data are detailed in  
1023 the *Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate*  
1024 *(DCHP)* ([U.S. EPA, 2024q](#)). However, EPA has robust confidence in using the IIOAC (Integrated  
1025 Indoor-Outdoor Air Calculator) modeling in the ambient air exposure assessment because its approach  
1026 and methodology were derived from peer-reviewed models and incorporate extensive feedback received  
1027 from the Science Advisory Committee on Chemicals. Due to the conservative assumptions made with  
1028 the use of high-end estimates, EPA has robust confidence that its modeled releases used for estimating  
1029 ambient air concentrations are appropriately conservative for a screening-level analysis.

## 4 HUMAN HEALTH RISK ASSESSMENT

### DCHP – Human Health Risk Assessment (Section 4): Key Points

EPA evaluated all reasonably available information to support human health risk characterization of DCHP for workers, ONUs, consumers, bystanders, and the general population, including PESS. Exposures to workers, ONUs, consumers, bystanders, and the general population are described in Section 4.1. Human health hazards are described in Section 4.2. Human health risk characterization is described in Section 4.3.

#### *Exposure Key Points*

- EPA assessed inhalation and dermal exposures for workers and ONUs, as appropriate, for each OES (Section 4.1.1). The primary route of exposure was inhalation.
- EPA assessed inhalation, dermal, and oral exposures for consumers and bystanders, as appropriate, for each TSCA COU (Section 4.1.2) in scenarios that represent a range of use patterns and behaviors. The primary route of exposure was dermal for most products, followed by inhalation.
- EPA assessed inhalation, oral, and dermal exposures for the general population via ambient air, surface water, drinking water, and fish ingestion for Tribal populations and determined that all exposures assessed for the general population were not of concern (Sections 4.1.3 and 4.3.4).
- EPA assessed non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP for the U.S. civilian population using NHANES urinary biomonitoring data and reverse dosimetry (Section 4.4.2).

#### *Hazard Key Points*

- EPA identified effects on the developing male reproductive system consistent with a disruption of androgen action, leading to phthalate syndrome, as the most sensitive and robust non-cancer hazard associated with oral exposure to DCHP in experimental animal models (Section 4.2).
- A non-cancer POD of 2.4 mg/kg-day was selected to characterize non-cancer risks for acute, intermediate, and chronic durations of exposure. A total uncertainty factor of 30 was selected for use as the benchmark margin of exposure.
- EPA derived draft relative potency factors (RPFs) based on a common hazard endpoint (*i.e.*, reduced fetal testicular testosterone). Draft RPFs were derived via meta-analysis and benchmark dose (BMD) modeling (Section 4.4.1). Given its limited toxicological data set, scaling by the RPF and application of the index chemical POD provides a more sensitive and robust dose-response assessment than the DCHP-specific POD.

#### *Risk Assessment Key Points*

- Dermal and ingestion exposures were not a risk driver for any duration of exposure or population.
- Inhalation exposures drive acute non-cancer risks to workers in occupational settings (Section 4.3.2).
- No potential non-cancer risk was identified for consumers (Section 4.3.3).
- No potential non-cancer risk was identified for the general population.
- EPA considered combined exposure across all routes of exposure for each individual occupational and consumer COU to calculate aggregate risks (Sections 4.3.2 and 4.3.3). No potential aggregate risk was identified for consumer COUs.
- EPA considered cumulative risk to workers and consumers through exposure to DCHP from individual COUs in combination with cumulative non-attributable national exposure to DEHP, DBP, BBP, DIBP, and DINP as estimated from NHANES biomonitoring data (Sections 4.4.4 and 4.4.5).
- EPA considered PESS throughout the exposure assessment, hazard identification, and dose-response analysis supporting this draft risk evaluation (Section 4.3.5).

### 4.1 Summary of Human Exposures

#### 1032 **4.1.1 Occupational Exposures**

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1033 The following subsections briefly describe EPA’s approach to assessing occupational exposures and  
1034 provide exposure assessment results for each OES. As stated in the final scope document ([U.S. EPA,  
1035 2020b](#)), the Agency evaluated exposures to workers and ONUs via the inhalation route—including  
1036 incidental ingestion of inhaled dust and exposures to workers via the dermal route from direct contact  
1037 with DCHP. Also, EPA accounted for dermal exposure to workers and ONUs from mist and dust  
1038 deposited on surfaces. The *Draft Environmental Release and Occupational Exposure Assessment for  
1039 Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024q](#)) provides additional details on the development of  
1040 approaches and the exposure assessment results.

##### 1041 **4.1.1.1 Approach and Methodology**

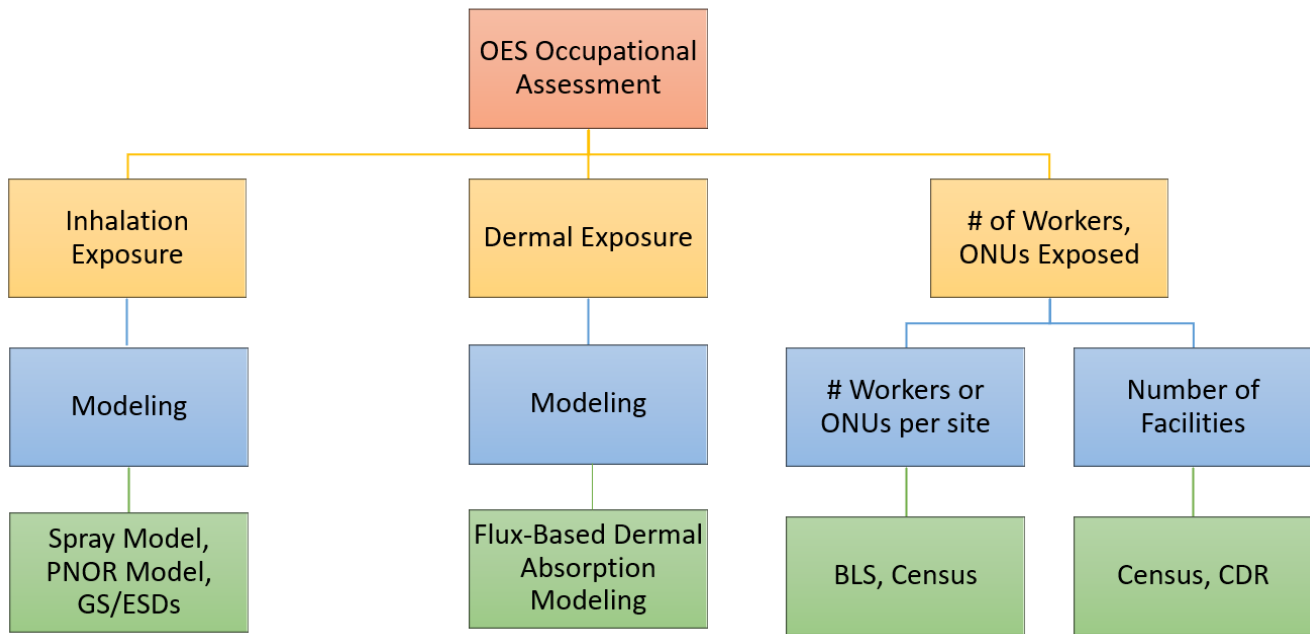
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1043 As described in the final scope document for DCHP (U.S. EPA, 2020b), EPA distinguished exposure  
1044 levels among potentially exposed employees for workers and ONUs. In general, the primary difference  
1045 between workers and ONUs is that workers may handle DCHP and have direct contact with DCHP,  
1046 while ONUs work in the general vicinity of DCHP but do not handle DCHP. Where possible, for each  
1047 COU, EPA identified job types and categories for workers and ONUs.

1049 As discussed in Section 3.1.1.1, EPA established OESs to assess the exposure scenarios within each  
1050 COU. Table 3-1 provides a crosswalk between COUs and OESs. EPA did not identify relevant  
1051 chemical-specific inhalation exposure monitoring data for the OESs. In the absence of inhalation  
1052 monitoring data, EPA used inhalation exposure models to estimate both central tendency and high-end  
1053 exposures. For inhalation exposure to dust in occupational settings, EPA used the data and approaches  
1054 from the *Generic Model for Central Tendency and High-End Inhalation Exposure to Total and  
1055 Respirable Particulates Not Otherwise Regulated (PNOR)* ([U.S. EPA, 2021b](#)). In all cases of  
1056 occupational dermal exposure to DCHP, EPA used a flux-limited dermal absorption model to estimate  
1057 high-end and central tendency dermal exposures for workers in each OES, as described in the *Draft  
1058 Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)*  
1059 ([U.S. EPA, 2024q](#)).

1061 EPA evaluated the quality of the models and data sources using the data quality review evaluation  
1062 metrics and the rating criteria described in the Draft Systematic Review Protocol ([U.S. EPA, 2021a](#)).  
1063 The Agency assigned an overall quality level of high, medium, or low to the relevant data. In addition,  
1064 EPA established an overall confidence level for the data when integrated into the occupational exposure  
1065 assessment. The Agency considered the assessment approach, the quality of the data and models, and  
1066 uncertainties in assessment results to assign an overall weight of scientific evidence rating of robust,  
1067 moderate, or slight.

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1070 **Figure 4-1. Approaches Used for Each Component of the Occupational Assessment for Each OES**

1071 CDR = Chemical Data Reporting; GS = Generic Scenario; ESD = Emission Scenario Document; BLS = Bureau  
1072 of Labor Statistics; PNOR = Particulates not Otherwise Regulated.

1073

1074 For inhalation and dermal exposure routes, EPA provides occupational exposure results representative  
1075 of both central tendency and high-end exposure conditions. The central tendency is expected to  
1076 represent occupational exposures in the center of the distribution for a given COU. For this risk  
1077 evaluation, EPA used the 50th percentile (median), mean (arithmetic or geometric), mode, or midpoint  
1078 value of a distribution to represent the central tendency scenario. Although the Agency preferred to  
1079 report the 50th percentile of the distribution, if the full distribution was unknown, EPA used either the  
1080 mean, mode, or midpoint of the distribution to represent the central tendency depending on the statistics  
1081 available for the distribution. The high-end exposure is expected to represent occupational exposures  
1082 that occur at probabilities above the 90th percentile, but below the highest exposure for any individual  
1083 (U.S. EPA, 1992). For this draft risk evaluation, EPA reported high-end results at the 95th percentile. If  
1084 the 95th percentile was not reasonably available, the Agency used a different percentile greater than or  
1085 equal to the 90th percentile but less than or equal to the 99th percentile—depending on the data that was  
1086 available for the distribution. If the full distribution is not known and the preferred statistics were not  
1087 reasonably available, EPA estimated a maximum or bounding estimate in lieu of the high-end. Table 4-1  
1088 provides a summary of the approach used to assess worker and ONU exposures and the Agency’s  
1089 weight of scientific evidence rating for the given exposure assessments.

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**Table 4-1. Summary of Exposure Monitoring and Modeling Data for Occupational Exposure Scenarios**

OES	Inhalation Exposure								Dermal Exposure				
	Monitoring					Modeling		Weight of Scientific Evidence Conclusion		Modeling		Weight of Scientific Evidence Conclusion	
	Worker	# Data Points	ONU	# Data Points	Data Quality Ratings	Worker	ONU	Worker	ONU	Worker	ONU	Worker	ONU
Manufacturing	x	N/A	x	N/A	N/A	✓	✓	Moderate	Moderate	✓	✓	Moderate	Moderate
Import and repackaging	x	N/A	x	N/A	N/A	✓	✓	Moderate	Moderate	✓	✓	Moderate	Moderate
Incorporation into adhesives and sealants	x	N/A	x	N/A	N/A	✓	✓	Moderate	Moderate	✓	✓	Moderate	Moderate
Incorporation into paints and coatings	x	N/A	x	N/A	N/A	✓	✓	Moderate	Moderate	✓	✓	Moderate	Moderate
Incorporation into other formulations, mixtures, and reaction products not covered elsewhere	x	N/A	x	N/A	N/A	✓	✓	Moderate	Moderate	✓	✓	Moderate	Moderate
PVC plastics compounding	x	N/A	x	N/A	N/A	✓	✓	Moderate	Moderate	✓	✓	Moderate	Moderate
PVC plastics converting	x	N/A	x	N/A	N/A	✓	✓	Moderate	Moderate	✓	✓	Moderate	Moderate
Non-PVC material compounding	x	N/A	x	N/A	N/A	✓	✓	Moderate	Moderate	✓	✓	Moderate	Moderate
Non-PVC material converting	x	N/A	x	N/A	N/A	✓	✓	Moderate	Moderate	✓	✓	Moderate	Moderate
Application of adhesives and sealants	x	N/A	x	N/A	N/A	✓	✓	Moderate	Moderate	✓	✓	Moderate	Moderate
Application of paints and coatings	x	N/A	x	N/A	N/A	✓	✓	Moderate	Moderate	✓	✓	Moderate	Moderate
Use of laboratory chemicals	x	N/A	x	N/A	N/A	✓	✓	Moderate	Moderate	✓	✓	Moderate	Moderate

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OES	Inhalation Exposure								Dermal Exposure					
	Monitoring					Modeling		Weight of Scientific Evidence Conclusion		Modeling		Weight of Scientific Evidence Conclusion		
	Worker	# Data Points	ONU	# Data Points	Data Quality Ratings	Worker	ONU	Worker	ONU	Worker	ONU	Worker	ONU	
Fabrication or use of final products or articles	✘	N/A	✘	N/A	N/A	✔	✔	Moderate	Moderate	✔	✔	Moderate	Moderate	
Recycling	✘	N/A	✘	N/A	N/A	✔	✔	Moderate	Moderate	✔	✔	Moderate	Moderate	
Waste handling, treatment, and disposal	✘	N/A	✘	N/A	N/A	✔	✔	Moderate	Moderate	✔	✔	Moderate	Moderate	
Distribution in Commerce <sup>a</sup>	✘	N/A	✘	N/A	N/A	✘	✘	N/A	N/A	✘	✘	N/A	N/A	

<sup>a</sup> Activities related to distribution (e.g., loading, unloading) are considered throughout the DCHP life cycle, as well as qualitatively through a single distribution scenario.

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**4.1.1.2 Summary of Number of Workers and ONUs**

The *Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024q](#)) provides a summary of the estimates of the number of exposed workers and ONUs for each OES. To prepare these estimates, EPA first identified relevant NAICS Codes for each OES. For these NAICS codes, the Standard Occupational Classification (SOC) codes from the Bureau of Labor Statistics (BLS) were used to classify SOC codes as either workers or ONUs. The Agency assumed that all other SOC codes represent occupations where exposure is unlikely. EPA also estimated the total number of facilities associated with the relevant NAICS Codes based on data from the U.S. Census Bureau. To estimate the average number of potentially exposed workers and ONUs per site, the total number of workers and ONUs were divided by the total number of facilities. The *Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024q](#)) provides additional details on the approach and methodology for estimating the number of facilities using DCHP as well as the number of potentially exposed workers and ONUs.

Table 4-2 summarizes the number of facilities and total number of exposed workers for all OESs. For scenarios in which the results are expressed as a range, the low end of the range is based on the 50th percentile estimate of the number of sites and the upper end of the range is based on the 95th percentile estimate of the number of sites.

**Table 4-2. Summary of Total Number of Workers and ONUs Potentially Exposed to DCHP for Each OES**

OES	Total Exposed Workers <sup>a b</sup>	Total Exposed ONUs <sup>a b</sup>	Number of Facilities <sup>a b</sup>	Notes
Manufacturing	77	36	2	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau, 2015</a> ).
Import and repackaging	40	18	2	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau, 2015</a> ). Averaged for two NAICS codes identified.
Incorporation into adhesives and sealants	90–162	35–126	5–9	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau, 2015</a> ).
Incorporation into paints and coatings	280–476	70–170	20–34	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau, 2015</a> ).
Incorporation into other formulations, mixtures, and reaction products not covered elsewhere	561–1,122	264–528	11–21	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau,</a>

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OES	Total Exposed Workers <sup>a b</sup>	Total Exposed ONUs <sup>a b</sup>	Number of Facilities <sup>a b</sup>	Notes
				<a href="#">2015</a> ). Averaged for two NAICS codes identified.
PVC plastics compounding	135–243	60–108	5–9	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau, 2015</a> ).
PVC plastics converting	756–1,206	210–335	42–67	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau, 2015</a> ).
Non-PVC material compounding	46–92	12–24	2–4	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau, 2015</a> ). Averaged for three NAICS codes identified.
Non-PVC material converting	46–92	12–24	2–4	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau, 2015</a> ). Averaged for three NAICS codes identified.
Application of adhesives and sealants	336–4,480	108–1,440	6–80	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau, 2015</a> ). Averaged for 18 NAICS codes identified.
Application of paints and coatings	12–168	6–84	1–14	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau, 2015</a> ). Averaged for 10 NAICS codes identified.
Use of laboratory chemicals (liquid)	36,873	331,857	36,873	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau, 2015</a> ). Averaged for two NAICS codes identified.
Use of laboratory chemicals (solid)	1,978–25,643	17,802–230,787	1,978–25,643	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau, 2015</a> ). Averaged for two NAICS codes identified.

OES	Total Exposed Workers <sup>a b</sup>	Total Exposed ONUs <sup>a b</sup>	Number of Facilities <sup>a b</sup>	Notes
Fabrication or use of final products or articles	N/A			Number of sites data was unavailable for this OES. Based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau, 2015</a> ), the average exposed workers per site was 9, and the average exposed ONUs per site was 3.
Recycling	754	432	58	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau, 2015</a> ). Averaged for three NAICS codes identified.
Waste handling, treatment, and disposal	754	432	58	Number of workers and ONU estimates based on the BLS and U.S. Census Bureau data ( <a href="#">U.S. BLS, 2016</a> ; <a href="#">U.S. Census Bureau, 2015</a> ). Averaged for three NAICS codes identified.
<sup>a</sup> EPA’s approach and methodology for estimating the number of facilities using DCHP and the number of workers and ONUs potentially exposed to DCHP can be found in the <i>Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)</i> ( <a href="#">U.S. EPA, 2024q</a> ). <sup>b</sup> When there is a range, the low end of the range is based on the 50th percentile estimate of the number of sites and the upper end is based on the 95th percentile estimate of the number of sites.				

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**4.1.1.3 Summary of Inhalation Exposure Assessment**

Table 4-3 presents a summary of inhalation exposure results based on exposure modeling for each OES. This tables provides a summary of the 8-hour time weighted average (8-hour TWA) inhalation exposure estimates for the average adult worker, as well as the Acute Dose (AD), the Intermediate Average Daily Dose (IADD), and the Chronic Average Daily Dose (ADD). The *Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024q](#)) provides exposure results specific to women of reproductive age and ONUs. The *Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* also provides additional details regarding AD, IADD, and ADD calculations along with EPA’s approach and methodology for estimating inhalation exposures.

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**Table 4-3. Summary of Average Adult Worker Inhalation Exposure Results for Each Occupational Exposure Scenario**

OES	Inhalation Estimates (Average Adult Worker)									
	Mist 8-h TWA (mg/m <sup>3</sup> )		PNOR 8-h TWA (mg/m <sup>3</sup> )		AD (mg/kg/day)		IADD (mg/kg/day)		ADD (mg/kg/day)	
	HE	CT	HE	CT	HE	CT	HE	CT	HE	CT
Manufacturing	N/A	N/A	5.0	0.48	0.63	6.0E-02	0.46	4.4E-02	0.43	4.1E-02
Import and repackaging	N/A	N/A	3.0	0.13	0.38	1.6E-02	0.28	1.2E-02	0.26	9.3E-03
Incorporation into adhesives and sealants	N/A	N/A	5.0	0.48	0.63	6.0E-02	0.46	4.4E-02	0.43	4.1E-02
Incorporation into paints and coatings	N/A	N/A	5.0	0.48	0.63	6.0E-02	0.46	4.4E-02	0.43	4.1E-02
Incorporation into other formulations, mixtures, or reaction products	N/A	N/A	5.0	0.48	0.63	6.0E-02	0.46	4.4E-02	0.43	4.1E-02
PVC plastics compounding	N/A	N/A	4.7	0.23	0.59	2.9E-02	0.43	2.1E-02	0.40	1.8E-02
PVC plastics converting	N/A	N/A	2.1	0.10	0.26	1.3E-02	0.19	9.5E-03	0.18	7.8E-03
Non-PVC materials compounding	N/A	N/A	2.8	0.14	0.35	1.7E-02	0.26	1.3E-02	0.24	1.1E-02
Non-PVC materials converting	N/A	N/A	0.94	4.6E-02	0.12	5.8E-03	8.6E-02	4.2E-03	8.0E-02	3.5E-03
Application of paints and coatings (liquids)	8.84	0.422	N/A	N/A	1.11	5.3E-02	0.81	3.9E-02	0.76	3.6E-02
Application of paints and coatings (solids)	N/A	N/A	4.9	0.28	0.61	3.5E-02	0.45	2.6E-02	0.42	2.4E-02
Application of adhesives and sealants (liquids)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Application of adhesives and sealants (solids)	N/A	N/A	2.7	0.15	0.34	1.9E-02	0.25	1.4E-02	0.23	1.2E-02
Use of laboratory chemicals (liquids)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Use of laboratory chemicals (solids)	N/A	N/A	2.7	0.19	0.34	2.4E-02	0.25	1.7E-02	0.23	1.5E-02
Recycling	N/A	N/A	1.6	0.11	0.20	1.4E-02	0.14	9.9E-03	0.13	8.2E-03
Fabrication or use of final products or articles	N/A	N/A	0.81	0.09	0.10	1.1E-02	7.4E-02	8.3E-03	6.9E-02	7.7E-03
Waste handling, treatment, and disposal	N/A	N/A	1.6	0.11	0.20	1.4E-02	0.14	9.9E-03	0.13	8.2E-03
Abbreviations: AD = acute dose; ADD = average daily dose; CT = central tendency; HE = high-end; IADD = intermediate average daily dose; PNOR = particulates not otherwise regulated; TWA = time-weighted average										

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**4.1.1.4 Summary of Dermal Exposure Assessment**

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Table 4-4 presents a summary of dermal exposure results for the average adult worker, which are based on both empirical dermal absorption data and dermal absorption modeling. The table includes the Acute Potential Dose Rate (APDR) for occupational dermal exposure estimates, as well as the AD, IADD, and Chronic ADD for the average adult worker. The *Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP) (U.S. EPA, 2024q)* provides exposure results for women of reproductive age and ONUs. The *Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* provides additional details regarding AD, IADD, and ADD calculations along with EPA’s approach and methodology for estimating dermal exposures.

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**Table 4-4. Summary of Average Adult Worker Dermal Exposure Results for Each OES**

OES	Dermal Estimates (Average Adult Worker)									
	Exposure Type		APDR (mg/day)		AD (mg/kg/day)		IADD (mg/kg/day)		ADD (mg/kg/day)	
	Liquid	Solid	HE	CT	HE	CT	HE	CT	HE	CT
Manufacturing; Incorporation into adhesives and sealants; Incorporation into paints and coatings; Incorporation into other formulations, mixtures, or reaction products; Application of paints and coatings (solids); Use of laboratory chemicals (solids); Fabrication or use of final products or articles		X	0.36	0.18	4.5E-03	2.3E-03	3.3E-03	1.7E-03	3.1E-03	1.5E-03
Import and repackaging		X	0.36	0.18	4.5E-03	2.3E-03	3.3E-03	1.7E-03	3.1E-03	1.3E-03
PVC plastics compounding; PVC plastics converting; non-PVC materials compounding; non-PVC materials converting; Application of adhesives and sealants (solids); Recycling; Waste handling, treatment, and disposal		X	0.36	0.18	4.5E-03	2.3E-03	3.3E-03	1.7E-03	3.1E-03	1.4E-03
Application of paints and coatings (liquids); Use of laboratory chemicals (liquids)	X		0.36	0.18	4.5E-03	2.3E-03	3.3E-03	1.7E-03	3.1E-03	1.5E-03
Application of adhesives and sealants (liquids)	X		0.36	0.18	4.5E-03	2.3E-03	3.3E-03	1.7E-03	3.1E-03	1.4E-03
Abbreviations: AD = acute dose; ADD = average daily dose; APDR = Acute Potential Dose Rate; CT = central tendency; HE = high-end; IADD = intermediate average daily dose										

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#### 4.1.1.5 Weight of Scientific Evidence Conclusions for Occupational Exposure

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Judgment on the weight of scientific evidence is based on the strengths, limitations, and uncertainties associated with the exposure estimates. The Agency considers factors that increase or decrease the strength of the evidence supporting the exposure estimate—including quality of the data/information, applicability of the exposure data to the COU (including considerations of temporal and locational relevance) and the representativeness of the estimate for the whole industry. The best professional judgment is summarized using the descriptors of robust, moderate, slight, or indeterminant, in accordance with the Draft Systematic Review Protocol ([U.S. EPA, 2021a](#)). For example, a conclusion of moderate is appropriate where exposure data is generated from a generic model with high quality data and some chemical-specific or industry-specific inputs, such that the exposure estimate is a reasonable representation of potential sites within the OES. A conclusion of slight weight of scientific evidence is appropriate where there is limited information that does not sufficiently cover all potential exposures within the COU, and the assumptions and uncertainties are not fully known or documented. See the Draft Systematic Review Protocol for additional information on weight of scientific evidence conclusions. Table 4-5 provides a summary of EPA’s overall confidence in its occupational exposure estimates for each of the OESs assessed.

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**Table 4-5. Summary of Assumptions, Uncertainty, and Overall Confidence in Exposure Estimates by OES**

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
Manufacturing	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the manufacturing OES. EPA utilized the PNOR Model (<a href="#">U.S. EPA, 2021b</a>) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (<a href="#">OSHA, 2020</a>). EPA used a subset of the respirable particulate data from the generic model identified with the Chemical Manufacturing NAICS code (NAICS code 325) to assess this OES, which EPA expects to be the most representative subset of the particulate data in the absence of chemical-specific data. EPA estimated the highest expected concentration of DCHP in particulates during manufacturing using DCHP concentration information from CDR reporters, which was also rated high for data quality in the systematic review process (<a href="#">U.S. EPA, 2020a</a>). These strengths increase the weight of scientific evidence.</p> <p>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DCHP is uncertain. Further, the model lacks metadata on worker activities. EPA also assumed eight exposure hours per day and 250 exposure days per year based on continuous DCHP exposure each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure when compared to particulate exposures. This is based on DCHP’s vapor pressure, and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.</p> <p>Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.</p>
Import and repackaging	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the import and repackaging OES. EPA utilized the PNOR Model (<a href="#">U.S. EPA, 2021b</a>) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (<a href="#">OSHA, 2020</a>). EPA used a subset of the respirable particulate data from the generic model identified with the Wholesale and Retail Trade NAICS codes (NAICS codes 42 through 45) to assess this OES, which EPA expects to be the most representative subset of the particulate data in the absence of chemical-specific data. EPA estimated the highest expected concentration of DCHP in particulates during import and repackaging using DCHP concentration information from CDR reporters, which was also rated high for data quality in the systematic review process (<a href="#">U.S. EPA, 2020a</a>). These strengths increase the weight of evidence.</p> <p>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DCHP is uncertain. Further, the model lacks metadata on worker activities. EPA also assumed eight exposure hours per day and 208 to 250 exposure days per year based on continuous DCHP exposure each working</p>

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	<p>day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP’s vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.</p> <p>Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.</p>
Incorporation into adhesives and sealants	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the incorporation into adhesives and sealants OES. EPA utilized the PNOR Model (<a href="#">U.S. EPA, 2021b</a>) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (<a href="#">OSHA, 2020</a>). EPA used a subset of the respirable particulate data from the generic model identified with the Chemical Manufacturing NAICS code (NAICS code 325) to assess this OES, which EPA expects to be the most representative subset of the particulate data for chemical product manufacturing in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during adhesive and sealant manufacturing using DCHP concentration information from CDR reporters, which was also rated high for data quality in the systematic review process (<a href="#">U.S. EPA, 2020a</a>). These strengths increase the weight of evidence.</p> <p>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DCHP is uncertain. Further, the model lacks metadata on worker activities. EPA also assumed eight exposure hours per day and 250 exposure days per year based on continuous DCHP particulate exposure while unpacking DCHP received on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP’s vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.</p> <p>Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.</p>
Incorporation into paints and coatings	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the incorporation into paints and coatings OES. EPA utilized the PNOR Model (<a href="#">U.S. EPA, 2021b</a>) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (<a href="#">OSHA, 2020</a>). EPA used a subset of the respirable particulate data from the generic model identified with the Chemical Manufacturing NAICS code (NAICS code 325) to assess this OES, which EPA expects to be the most representative subset of the particulate data for chemical product manufacturing in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during paint and coating manufacturing using DCHP</p>

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	<p>concentration information from CDR reporters, which was also rated high for data quality in the systematic review process (<a href="#">U.S. EPA, 2020a</a>). These strengths increase the weight of evidence.</p> <p>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DCHP is uncertain. Further, the model lacks metadata on worker activities. EPA also assumed eight exposure hours per day and 250 exposure days per year based on continuous DCHP particulate exposure while unpacking DCHP received on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP’s vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.</p> <p>Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.</p>
<p>Incorporation into other formulations, mixtures, and reaction products not covered elsewhere</p>	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the incorporation into other formulations, mixtures, and reaction products not covered elsewhere OES. EPA utilized the PNOR Model (<a href="#">U.S. EPA, 2021b</a>) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (<a href="#">OSHA, 2020</a>). EPA used a subset of the respirable particulate data from the generic model identified with the Chemical Manufacturing NAICS code (NAICS code 325) to assess this OES, which EPA expects to be the most representative subset of the particulate data for chemical product manufacturing in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during formulation, mixture or other chemical product manufacturing using DCHP concentration information from CDR reporters, which was also rated high for data quality in the systematic review process (<a href="#">U.S. EPA, 2020a</a>). These strengths increase the weight of evidence.</p> <p>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DCHP is uncertain. Further, the model lacks metadata on worker activities. EPA also assumed eight exposure hours per day and 250 exposure days per year based on continuous DCHP particulate exposure while unpacking DCHP received on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP’s vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.</p> <p>Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.</p>

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
PVC plastics compounding	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for PVC plastics compounding OES. EPA utilized the PNOR Model (<a href="#">U.S. EPA, 2021b</a>) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (<a href="#">OSHA, 2020</a>). EPA used a subset of the respirable particulate data from the generic model identified with the Plastics and Rubber Manufacturing NAICS code (NAICS code 326) to assess this OES, which EPA expects to be the most representative subset of the particulate data for PVC plastic manufacturing in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during PVC plastic compounding using DCHP concentration information from CDR reporters, which was also rated high for data quality in the systematic review process (<a href="#">U.S. EPA, 2020a</a>). These strengths increase the weight of evidence.</p> <p>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DCHP is uncertain. Further, the model lacks metadata on worker activities. EPA also assumed eight exposure hours per day based on continuous DCHP particulate exposure while unpacking DCHP received on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA set the number of exposure days based on Monte Carlo modeling of the operating days from the release assessment, with a maximum number of working days capped at 250 days per year based on EPA default assumptions. The high-end exposures are based on 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year. The central tendency exposures use 223 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP’s vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.</p> <p>Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.</p>
PVC plastics converting	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for PVC plastics converting OES. EPA utilized the PNOR Model (<a href="#">U.S. EPA, 2021b</a>) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (<a href="#">OSHA, 2020</a>). EPA used a subset of the respirable particulate data from the generic model identified with the Plastics and Rubber Manufacturing NAICS code (NAICS code 326) to assess this OES, which EPA expects to be the most representative subset of the particulate data for PVC plastics product manufacturing in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during PVC plastic converting using plasticizer additive concentration information from the Use of Additives in Plastic Converting Generic Scenario that was rated medium for data quality in the systematic review process (<a href="#">U.S. EPA, 2004a</a>). These strengths increase the weight of evidence.</p>

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	<p>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DCHP is uncertain. Further, the model lacks metadata on worker activities. EPA also assumed eight exposure hours per day based on continuous DCHP particulate exposure while handling DCHP-containing plastics on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA set the number of exposure days based on Monte Carlo modeling of the operating days from the release assessment, with a maximum number of working days capped at 250 days per year based on EPA default assumptions. The high-end exposures are based on 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year. The central tendency exposures use 219 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP’s vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.</p> <p>Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.</p>
Non-PVC material compounding	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for non-PVC material compounding OES. EPA utilized the PNOR Model (<a href="#">U.S. EPA, 2021b</a>) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (<a href="#">OSHA, 2020</a>). EPA used a subset of the respirable particulate data from the generic model identified with the Plastics and Rubber Manufacturing NAICS code (NAICS code 326) to assess this OES, which EPA expects to be the most representative subset of the particulate data for non-PVC plastic or rubber manufacturing in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during non-PVC material compounding using DCHP concentration information from CDR reporters, which was also rated high for data quality in the systematic review process (<a href="#">U.S. EPA, 2020a</a>). These strengths increase the weight of evidence.</p> <p>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DCHP is uncertain. Further, the model lacks metadata on worker activities. EPA also assumed eight exposure hours per day based on continuous DCHP particulate exposure while unpacking DCHP received on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA set the number of exposure days based on Monte Carlo modeling of the operating days from the release assessment, with a maximum number of working days capped at 250 days per year based on EPA default assumptions. The high-end exposures are based on 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year. The central tendency exposures use 227 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP’s vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.</p>

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	<p>Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.</p>
Non-PVC material converting	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for non-PVC material converting OES. EPA utilized the PNOR Model (<a href="#">U.S. EPA, 2021b</a>) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (<a href="#">OSHA, 2020</a>). EPA used a subset of the respirable particulate data from the generic model identified with the Plastics and Rubber Manufacturing NAICS code (NAICS code 326) to assess this OES, which EPA expects to be the most representative subset of the particulate data for non-PVC plastic and rubber product manufacturing in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during non-PVC material converting using rubber plasticizer concentration information from the Emission Scenario Document on Additives in Rubber Industry which has a medium rating for data quality in the systematic review process (<a href="#">OECD, 2004</a>). These strengths increase the weight of evidence.</p> <p>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DCHP is uncertain. Further, the model lacks metadata on worker activities. EPA also assumed eight exposure hours per day based on continuous DCHP particulate exposure while handling DCHP-containing plastics or rubbers on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA set the number of exposure days based on Monte Carlo modeling of the operating days from the release assessment, with a maximum number of working days capped at 250 days per year based on EPA default assumptions. The high-end exposures are based on 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year. The central tendency exposures use 219 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.</p> <p>Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.</p>
Application of adhesives and sealants	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the application of adhesives and sealants OES. EPA utilized the PNOR Model (<a href="#">U.S. EPA, 2021b</a>) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (<a href="#">OSHA, 2020</a>). EPA used the entire respirable particulate data set from the generic model to assess this OES, since adhesives and sealants containing DCHP may be used in a variety of end-use industries. EPA estimated the highest expected concentration of DCHP in particulates during application of adhesives and sealants using SDSs and product data sheets from identified DCHP-containing adhesives and sealant products in solid form. These strengths increase the weight of evidence.</p>

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	<p>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DCHP is uncertain. Further, the model lacks metadata on worker activities. EPA also assumed eight exposure hours per day based on continuous DCHP particulate exposure while handling DCHP-containing products on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA set the number of exposure days based on Monte Carlo modeling of the operating days from the release assessment, with a maximum number of working days capped at 250 days per year based on EPA default assumptions. The high-end exposures are based on 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year. The central tendency exposures use 232 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP’s vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.</p> <p>Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.</p>
Application of paints and coatings	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates. EPA used surrogate monitoring data from the ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry, which the systematic review process rated high for data quality, to estimate inhalation exposures to DCHP in the liquid form (<a href="#">OECD, 2011a</a>). EPA also used the PNOR Model (<a href="#">U.S. EPA, 2021b</a>) to estimate worker inhalation exposure to solid particulate, since DCHP may be received on site in solid form. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (<a href="#">OSHA, 2020</a>). EPA used the entire respirable particulate data set from the generic model to assess this OES, since paints and coatings containing DCHP may be used in a variety of end-use industries. EPA used SDSs and product data sheets from identified DCHP-containing products to identify product concentrations for the liquid spray and the solid particulate assessments. A strength of this approach is that both models (for solid particulate and for mist exposure) resulted in exposure estimates within an order of magnitude of each other. These strengths increase the weight of evidence.</p> <p>The primary limitation is the lack of DCHP-specific monitoring data. Specifically, the ESD serves as a surrogate source of monitoring data representing the level of exposure that could be expected at a typical work site for the given spray application method, and the generic model data represents particulate concentrations in air for solids handling exposures. EPA assumes spray applications of the coatings, so the estimates may not be representative of exposure during other coating application methods. Additionally, it is uncertain whether the substrates coated, and products used to generate the surrogate data are representative of those associated with DCHP-containing coatings. EPA only assessed mist or solid exposures to DCHP over a full 8-hour work shift to estimate the level of exposure, though other activities may result in exposures other than mist or solid particulate and application duration may be variable depending on the job site. EPA assessed 250 days of exposure per year based on workers applying coatings on every working day, however, application sites may use DCHP-containing coatings at much lower or variable frequencies. These limitations decrease the weight of evidence.</p>

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	<p>Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.</p>
Use of laboratory chemicals	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for use of laboratory chemicals OES. EPA utilized the PNOR Model (<a href="#">U.S. EPA, 2021b</a>) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (<a href="#">OSHA, 2020</a>). EPA used a subset of the respirable particulate data from the generic model identified with the Professional, Scientific, and Technical Services NAICS code (NAICS code 54) to assess this OES, which EPA expects to be the most representative subset of the particulate data for use of laboratory chemicals in the absence of DCHP-specific data. EPA estimated the highest expected concentration of DCHP in particulates during laboratory use using SDSs and product data sheets from identified lab-grade chemicals. These strengths increase the weight of evidence.</p> <p>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DCHP is uncertain. Further, the model lacks metadata on worker activities. EPA also assumed eight exposure hours per day based on continuous DCHP particulate exposure while handling DCHP-containing products on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA set the number of exposure days based on Monte Carlo modeling of the operating days from the release assessment, with a maximum number of working days capped at 250 days per year based on EPA default assumptions. The high-end exposures are based on 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year. The central tendency exposures use 232 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP's vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.</p> <p>Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.</p>
Fabrication or use of final products or articles	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the fabrication or use of final products or articles OES. EPA utilized the PNOR Model (<a href="#">U.S. EPA, 2021b</a>) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (<a href="#">OSHA, 2020</a>). EPA used a subset of the respirable particulate data from the generic model identified with the Furniture and Related Product Manufacturing NAICS code (NAICS code 337) to assess this OES, which EPA expects to be the most representative subset of the particulate data for this OES. EPA estimated the highest expected concentration of DCHP in particulates during product fabrication using plasticizer additive concentration information from the Use of Additives in Plastic Converting Generic Scenario that has a medium rating for data quality from the systematic review process (<a href="#">U.S. EPA, 2004a</a>). These strengths increase the weight of evidence.</p>

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	<p>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DCHP is uncertain. Further, the model lacks metadata on worker activities. EPA also assumed eight exposure hours per day based on continuous DCHP particulate exposure while handling DCHP-containing products on site each working day for a typical worker schedule; it is uncertain whether this captures actual worker schedules and exposures. EPA set the number of exposure days based on Monte Carlo modeling of the operating days from the release assessment, with a maximum number of working days capped at 250 days per year based on EPA default assumptions. The high-end exposures are based on 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year. The central tendency exposures use 232 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. EPA did not account for vapor inhalation exposures, but vapor exposures are not expected to significantly contribute to overall inhalation exposure compared to particulate exposures based on DCHP vapor pressure and the solid physical form assessed for this OES. These limitations decrease the weight of evidence.</p> <p>Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.</p>
Recycling	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the recycling OES. EPA utilized the PNOR Model (<a href="#">U.S. EPA, 2021b</a>) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (<a href="#">OSHA, 2020</a>). EPA used a subset of the respirable particulate data from the generic model identified with the Administrative and Support and Waste Management and Remediation Services NAICS code (NAICS code 56) to assess this OES, which EPA expects to be the most representative subset of the particulate data for this OES. EPA estimated the highest expected concentration of DCHP in plastic using plasticizer additive concentration information from the Use of Additives in Plastic Converting Generic Scenario that has a medium rating for data quality from the systematic review process (<a href="#">U.S. EPA, 2004a</a>). These strengths increase the weight of evidence.</p> <p>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DCHP is uncertain. Further, the model lacks metadata on worker activities. The high-end exposures use 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year, which is the expected maximum number of working days. The central tendency exposures use 223 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. Also, it was assumed that each worker is potentially exposed for 8 hours per workday; however, it is uncertain whether this captures actual worker schedules and exposures. These limitations decrease the weight of evidence.</p> <p>Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.</p>

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
Waste handling, treatment, and disposal	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the 8-hour TWA inhalation exposure estimates for the waste handling, treatment, and disposal OES. EPA utilized the PNOR Model (<a href="#">U.S. EPA, 2021b</a>) to estimate worker inhalation exposure to solid particulate. The respirable particulate concentrations used by the generic model were rated high for data quality from the systematic review process, and the model was built using OSHA CEHD data (<a href="#">OSHA, 2020</a>). EPA used a subset of the respirable particulate data from the generic model identified with the Administrative and Support and Waste Management and Remediation Services NAICS code (NAICS code 56) to assess this OES, which EPA expects to be the most representative subset of the particulate data for this OES. EPA estimated the highest expected concentration of DCHP in plastic using plasticizer additive concentration information from the Use of Additives in Plastic Converting Generic Scenario that has a medium rating for data quality from the systematic review process (<a href="#">U.S. EPA, 2004a</a>). These strengths increase the weight of evidence.</p> <p>The primary limitation is the uncertainty in the representativeness of values toward the true distribution of potential inhalation exposures. Specifically, EPA lacks facility-specific particulate concentrations in air, and the representativeness of the data set used in the model towards sites that actually handle DCHP is uncertain. Further, the model lacks metadata on worker activities. The high-end exposures use 250 days per year as the exposure frequency since the 95th percentile of operating days in the release assessment exceeded 250 days per year, which is the expected maximum number of working days. The central tendency exposures use 223 days per year as the exposure frequency based on the 50th percentile of operating days from the release assessment. Also, it was assumed that each worker is potentially exposed for 8 hours per workday; however, it is uncertain whether this captures actual worker schedules and exposures. These limitations decrease the weight of evidence.</p> <p>Based on these strengths and limitations, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of exposures.</p>
Distribution in commerce	These exposures are assessed as part of individual OESs where the relevant activities occur.
Dermal	<p>EPA considered the assessment approach, the quality of the data, and uncertainties in assessment results to determine a weight of scientific evidence conclusion for the dermal exposure estimates. EPA used dermal modeling of aqueous materials (<a href="#">U.S. EPA, 2023b, 2004b</a>) to estimate occupational dermal exposures of DCHP to workers and ONUs. The modeling approach for determining the aqueous permeability coefficient was within the range of applicability given the physical and chemical parameters of DCHP, and the modeling approach received a medium rating through EPA’s systematic review process. Additionally, the neat form of DCHP is a solid, the concentrated formulations are paste-like, and any liquid containing DCHP has very low concentrations; therefore, it is reasonable to assume that flux-limited absorption of aqueous DCHP serves as a reasonable upper bound for the dermal absorption of DCHP from occupational scenarios. Additionally, EPA assumed a standard 8-hour workday and that the chemical is contacted at least once per day. Because DCHP has low volatility and low absorption, it is possible that the chemical remains on the surface of the skin after a dermal contact until the skin is washed. Therefore, absorption of DCHP from occupational dermal contact with materials containing DCHP may extend up to 8 hours per day (<a href="#">U.S. EPA, 1991</a>). For average adult workers, the surface area of contact was assumed equal to the area of one hand (<i>i.e.</i>, 535 cm<sup>2</sup>) for central tendency, or two hands (<i>i.e.</i>, 1,070 cm<sup>2</sup>) for high-end</p>

OES	Weight of Scientific Evidence Conclusion in Exposure Estimates
	<p>exposures (<a href="#">U.S. EPA, 2011a</a>). The standard sources for exposure duration and area of contact received high ratings through EPA's systematic review process. These strengths increase the weight of evidence.</p> <p>EPA acknowledges that variations in chemical concentration and co-formulant components affect the rate of dermal absorption, and that these variations were not considered in the occupational dermal exposure assessment in favor of an upper bound dermal absorption estimate from flux-limited absorption of aqueous DCHP. Additionally, worker activity metadata used in the model, such as surface area of skin contact and exposure duration, are not facility or industry-specific and are meant to address generic dermal exposures in all OESs assessed. These limitations decrease the weight of evidence.</p> <p>The occupational dermal exposure assessment for contact with materials containing DCHP was based on dermal absorption modeling of aqueous DCHP, as well as standard occupational inputs for exposure duration and area of contact, as described above. Based on the strengths and limitations of these inputs, EPA has concluded that the weight of scientific evidence for this assessment is moderate and provides a plausible estimate of occupational dermal exposures.</p>

1155

1156 **4.1.1.5.1 Strengths, Limitations, Assumptions, and Key Sources of Uncertainty for**  
1157 **the Occupational Exposure Assessment**

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1158 EPA assigned overall confidence descriptions of high, medium, or low to the exposure assessments,  
1159 based on the strength of the underlying scientific evidence. When the assessment is supported by robust  
1160 evidence, the Agency's overall confidence in the exposure assessment is high; when supported by  
1161 moderate evidence, EPA's overall confidence is medium; when supported by slight evidence, the  
1162 Agency's overall confidence is low.

1163  
1164 ***Strengths***

1165 The exposure scenarios and exposure factors underlying the inhalation and dermal assessment are  
1166 supported by moderate to robust evidence. Occupational inhalation exposure scenarios were informed  
1167 by moderate or robust sources of surrogate monitoring data or GSs/ESDs used to model the inhalation  
1168 exposure concentration. Exposure factors for occupational inhalation exposure include duration of  
1169 exposure, body weight, and breathing rate, which were informed by moderate to robust data sources.

1170  
1171 A strength of the modeling assessment includes the consideration of variable model input parameters as  
1172 opposed to using a single static value. Parameter variation increases the likelihood that the true  
1173 occupational inhalation exposures fall within the range of modeled estimates. An additional strength is  
1174 that all data that EPA used to inform the modeling parameter distributions have overall data quality  
1175 ratings of either high or medium from EPA's systematic review process. Strengths associated with  
1176 dermal exposure assessment are described in Table 4-5.

1177  
1178 ***Limitations***

1179 The principal limitation of the exposure assessments is uncertainty in the representativeness of the data  
1180 and models used, as there is no direct exposure monitoring data for DCHP in the literature from  
1181 systematic review. A limitation of the modeling methodologies is that most of the model input data from  
1182 GSs/ESDs, such as air speed or loss factors, are generic for the OESs and not specific to the use of  
1183 DCHP within the OESs. Additionally, the selected generic models and data may not be representative of  
1184 all chemical- or site-specific work practices and engineering controls. Limitations associated with  
1185 dermal exposure assessment are described in Table 4-5.

1186  
1187 ***Assumptions***

1188 When determining the appropriate model for assessing exposures to DCHP, EPA considered the  
1189 physical form of DCHP during different OESs. DCHP may be present in various physical forms such as  
1190 a powder, mist, paste, or in solution during the various OESs. EPA assessed each respective OES  
1191 assuming the physical form of DCHP based on available product data, CDR data, and information from  
1192 applicable GSs/ESDs. The physical form of DCHP can influence exposures substantially, so EPA  
1193 assumed DCHP is present in the physical form that is most prevalent and/or most protective for the  
1194 given OES when assessing the exposures.

1195  
1196 EPA calculated ADD values assuming workers and ONUs are regularly exposed during their entire  
1197 working lifetime, which likely results in an overestimate. Individuals may change jobs during the course  
1198 of their career such that they are no longer exposed to DCHP, and the actual ADD values become lower  
1199 than the estimates presented. Assumptions associated with dermal exposure assessment are described in  
1200 Table 4-5.

## 1202 **Uncertainties**

1203 EPA addressed variability in inhalation models by identifying key model parameters and applying  
1204 statistical distributions that mathematically define the parameter's variability. The Agency defined  
1205 statistical distributions for parameters using documented statistical variations where available. Where  
1206 the statistical variation was unknown, EPA made assumptions to estimate the parameter distribution  
1207 using available literature data, such as GSs and ESDs. However, there is uncertainty as to the  
1208 representativeness of the parameter distributions because these data are often not specific to sites that  
1209 use DCHP. In general, the effects of these uncertainties on the exposure estimates are unknown as the  
1210 uncertainties may result in either overestimation or underestimation of exposures depending on the  
1211 actual distributions of each of the model input parameters. Uncertainties associated with dermal  
1212 exposure assessment are described in Table 4-5.

1213  
1214 There are several uncertainties surrounding the estimated number of workers potentially exposed to  
1215 DCHP. First, BLS' OES employment data for each industry/occupation combination are only available  
1216 at the 3-, 4-, or 5-digit NAICS level, rather than the full 6-digit NAICS level. This lack of granularity  
1217 could result in an overestimate of the number of exposed workers if some 6-digit NAICS are included in  
1218 the less granular BLS estimates but are not likely to use DCHP for the assessed applications. EPA  
1219 addressed this issue by refining the OES estimates using total employment data from the U.S. Census'  
1220 Statistics of U.S. Businesses (SUSB). However, this approach assumes that the distribution of  
1221 occupation types (SOC codes) in each 6-digit NAICS is equal to the distribution of occupation types at  
1222 the parent 5-digit NAICS level. If the distribution of workers in occupations with DCHP exposure  
1223 differs from the overall distribution of workers in each NAICS, then this approach will result in  
1224 inaccuracy.

## 1225 **4.1.2 Consumer Exposures**

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1226 The following subsections briefly describe EPA's approach to assessing consumer exposures and  
1227 provide exposure assessment results for each COU. The *Draft Consumer and Indoor Dust Exposure*  
1228 *Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024c](#)) provides additional details on the  
1229 development of approaches and the exposure assessment results. The consumer exposure assessment  
1230 evaluated exposures from individual COUs while the indoor dust assessment uses a subset of consumer  
1231 articles with large surface area and presence in indoor environments to garner COU specific  
1232 contributions to the total exposures from dust.

### 1233 **4.1.2.1 Summary of Consumer and Indoor Dust Exposure Scenarios and Modeling** 1234 **Approach and Methodology**

---

1235 The main steps in performing a consumer exposure assessment are summarized below:

- 1236
- 1237 • Identification and mapping of product and article examples following the consumer COU table  
1238 (Table 1-1), product, and article identification.
- 1239 • Compilation of products and articles manufacturing use instructions to determine patterns of use.
- 1240 • Selection of exposure routes and exposed populations according to product/article use  
1241 descriptions.
- 1242 • Identification of data gaps and further search to fill gaps with studies, chemical surrogates or  
1243 product and article proxies, or professional judgement.
- 1244 • Selection of appropriate modeling tools based on available information and chemical properties.
- 1245 • Gathering of input parameters per exposure scenario.
- 1246 • Parameterization of selected modeling tools.

1247 Consumer products or articles containing DCHP were matched with the identified consumer COUs.  
1248 Table 4-6 summarizes the consumer exposure scenarios by COU for each product example(s), the  
1249 exposure routes, which scenarios are also used in the indoor dust assessment, and whether the analysis  
1250 was conducted qualitatively or quantitatively. The indoor dust assessment uses consumer products and  
1251 articles information for selected items with the goal of recreating the indoor environment. The subset of  
1252 consumer products and articles that can be used in the indoor dust assessment are selected for their  
1253 potential to have large surface area for dust collection, roughly larger than one square meter. Using these  
1254 criteria, EPA did not identify articles in the modeling exposure estimates to include in the indoor  
1255 assessment.

1256  
1257 When a quantitative analysis was conducted, exposure from the consumer COUs was estimated by  
1258 modeling. Exposure via inhalation and ingestion routes were modeled using EPA's Consumer Exposure  
1259 Model (CEM), Version 3.2 ([U.S. EPA, 2023b](#)). Dermal exposures were estimated using a computational  
1260 framework implemented within a spreadsheet environment. For each exposure route, EPA used the 10th  
1261 percentile, average, and 95th percentile value of an input parameter (*e.g.*, weight fraction, surface area)  
1262 where possible to characterize low, medium, and high exposure scenarios for a given COU. If only a  
1263 range was reported, EPA used the minimum and maximum of the range as the low and high values,  
1264 respectively. The average of the reported low and high values from the reported range was used for the  
1265 medium exposure scenario. See *Draft Consumer and Indoor Dust Exposure Assessment for*  
1266 *Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024c](#)) for details about the consumer modeling  
1267 approaches, sources of data, model parameterization, and assumptions.

1268  
1269 Exposure via the inhalation route occurs from inhalation of DCHP gas-phase emissions or when DCHP  
1270 partitions to suspended particulate from direct use or application of products. However, DCHP's low  
1271 volatility is expected to result in negligible gas-phase inhalation exposures. Sorption to suspended and  
1272 settled dust is likely to occur based on monitoring data (see indoor dust monitoring data in Section  
1273 4.1.2.1) and its affinity for organic matter which is typically present in household dust. Thus, inhalation  
1274 and ingestion of suspended and settled dust is considered in this assessment. Exposure via the dermal  
1275 route can occur from direct contact with products and articles. Exposure via ingestion depends on the  
1276 product or article use patterns. Exposure can occur via direct mouthing (*i.e.*, directly putting product in  
1277 mouth) in which the person can ingest settled dust with DCHP, or directly ingesting DCHP from  
1278 migration to saliva. Additionally, ingestion of suspended dust can occur when DCHP migrates from  
1279 product to dust or partitions from gas-phase to suspended dust.

1280  
1281 EPA labeled CEM lifestages to match those listed in the U.S. Centers for Disease Control and  
1282 Prevention (CDC) guidelines ([CDC, 2021](#)) and the Agency's *A Framework for Assessing Health Risks*  
1283 *of Exposures to Children* ([U.S. EPA, 2006](#)). CEM lifestages were re-labeled as follows:

- 1284 • Adult (21+ years) → Adult
- 1285 • Youth 2 (16–20 years) → Teenager
- 1286 • Youth 1 (11–15 years) → Young teen
- 1287 • Child 2 (6–10 years) → Middle childhood
- 1288 • Child 1 (3–5 years) → Preschooler
- 1289 • Infant 2 (1–2 years) → Toddler
- 1290 • Infant 1 (<1 year) → Infant

1291 EPA assessed acute, intermediate, and chronic exposures to DCHP from consumer COUs. For the acute  
1292 dose rate calculations, an averaging time of 1 day is used representing the maximum time-integrated  
1293 dose over a 24-hour period during the exposure event. The chronic dose rate is calculated iteratively at a  
1294 30-second interval during the first 24 hours and every hour after that for 60 days. Intermediate dose is

1295 the exposure to continuous or intermittent (depending on product) use during a 30-day period, which is  
1296 roughly a month. Professional judgment and product use descriptions were used to estimate events per  
1297 day and per month/year for the calculation of the intermediate/chronic dose.

1298

**Table 4-6. Summary of Consumer COUs, Exposure Scenarios, and Exposure Routes**

Consumer COU Category	Consumer COU Subcategory	Product/Article	Exposure Scenario and Route	Evaluated Routes					Qualitative / Quantitative <sup>d</sup>
				Suspended Dust & Vapor Inhalation	Dermal	Ingestion			
						Suspended Dust	Settled Dust	Mouthing	
Adhesives and sealants	Adhesives and sealants	Auto or construction bonding adhesive	Use of product in DIY <sup>a</sup> large-scale home repair activities. Direct contact during use; inhalation of emissions during use	✓	✓	✗	✗	✗	Quantitative
Adhesives and sealants	Adhesives and sealants	Adhesives for small repairs	Use of product in DIY <sup>a</sup> small-scale home repair activities. Direct contact during use	✗	✓	✗	✗	✗	Quantitative
Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Small articles with the potential for semi-routine contact: labels, nitrocellulose; ethylcellulose; chlorinated rubber; PVAc; PVC	Direct contact during use	✗ <sup>b</sup>	✓	✗	✗	✗	Quantitative
Other	Other consumer articles that contain dicyclohexyl phthalate from: inks, toner, and colorants; paints and coatings; adhesives and sealants (e.g., paper products, textiles, products using cellulose film, etc.)	Outdoor coated surfaces/seating	Direct contact during use	✗ <sup>c</sup>	✓	✗	✗	✗	Quantitative

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Consumer COU Category	Consumer COU Subcategory	Product/Article	Exposure Scenario and Route	Evaluated Routes					Qualitative / Quantitative <sup>d</sup>
				Suspended Dust & Vapor Inhalation	Dermal	Ingestion			
						Suspended Dust	Settled Dust	Mouthing	
Other	Other consumer articles that contain dicyclohexyl phthalate from: inks, toner, and colorants; paints and coatings; adhesives and sealants (e.g., paper products, textiles, products using cellulose film, etc.)	Small articles with the potential for semi-routine contact: labels, and packaging adhesives, foil and cellophane lacquers, and printing inks	Direct contact during use	✗ <sup>b</sup>	✓	✗	✗	✗	Quantitative
Other	Other consumer articles that contain dicyclohexyl phthalate from: inks, toner, and colorants; paints and coatings; adhesives and sealants (e.g., paper products, textiles, products using cellulose film, etc.)	Electronics containing dye adhesive	No exposures expected	✗	✗	✗	✗	✗	Qualitative
Disposal	Disposal	Down the drain products and articles	Down the drain and releases to environmental media	✗	✗	✗	✗	✗	Qualitative
Disposal	Disposal	Residential end-of-life disposal, product demolition for disposal	Product and article end-of-life disposal and product demolition for disposal	✗	✗	✗	✗	✗	Qualitative

DIY <sup>a</sup> – Do-it-Yourself  
 ✓ Scenario is considered either qualitatively or quantitatively in this assessment.  
 ✗ Scenario is deemed unlikely based on low volatility and small surface area, likely negligible gas and particle phase concentration for inhalation, low possibility of mouthing based on product use patterns and targeted population age groups, and/or low possibility of dust on surface due to barriers or low surface area for dust ingestion.  
 ✗<sup>b</sup> Scenario was deemed unlikely based on low volatility and small surface area and likely negligible gas and suspended particle phase concentration.  
 ✗<sup>c</sup> Outdoor use with significantly higher ventilation minimizes inhalation.  
<sup>d</sup> Quantitative applies to green check marks and qualitative applies to red “x” marks for the routes that were deemed unlikely.

1300 ***Inhalation and Ingestion Exposure Routes Modeling Approaches***

1301 Key parameters for articles modeled in CEM 3.2 are summarized in detail in Section 2 in the *Draft*  
1302 *Consumer and Indoor Dust Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA,](#)  
1303 [2024c](#)). Calculations, information and data sources, input parameters, and results are available in the  
1304 *Draft Consumer Exposure Analysis for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024d](#)). Generally,  
1305 and when possible, model parameters were determined based on specific articles identified in this  
1306 assessment and CEM defaults were only used where specific information was not available. A list of  
1307 some of the most sensitive input parameters for exposure from articles and products are listed below:

- 1308 • weight fraction (articles and products);
- 1309 • density (articles and products);
- 1310 • duration of use (products);
- 1311 • frequency of use for chronic, acute, and intermediate (products);
- 1312 • product mass used (products);
- 1313 • article surface area (articles);
- 1314 • chemical migration rate to saliva (articles);
- 1315 • area mouthed (articles); and
- 1316 • use environment volume (articles and products).

1317 Low, medium, and high intensity use exposure scenarios correspond to the use of reported statistics, or  
1318 single values. When different values are reported for low, medium, and high, the corresponding statistics  
1319 are the reported minimum for the low intensity use scenarios, calculated average from maximum and  
1320 minimum for the medium intensity use scenarios and reported maximum for the high intensity use  
1321 scenarios. Each input parameter listed above was parameterized according to the article-specific data  
1322 found via systematic review. If article-specific data were not available, CEM default parameters were  
1323 used., or an assumption based on article use descriptions by manufactures always leaning on the health  
1324 protective values. For example, for all scenarios, the near-field modeling option was selected to account  
1325 for a small personal breathing zone around the user during product use in which concentrations are  
1326 higher, rather than employing a single well-mixed room. A near-field volume of 1 m<sup>3</sup> was selected. See  
1327 Section 2.1 for weight fraction selection and Section 2.2.3 for parameterization details in the *Draft*  
1328 *Consumer and Indoor Dust Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA,](#)  
1329 [2024c](#)).

1330

1331 ***Dermal Exposure Routes Modeling Approaches***

1332 Dermal modeling was done outside of CEM. The use of the CEM model for dermal absorption, which  
1333 relies on total concentration rather than aqueous saturation concentration, would greatly overestimate  
1334 exposure to DCHP in liquid and solid products and articles. See ([U.S. EPA, 2024c](#)) for more details. The  
1335 dermal dose of DCHP associated with use of both liquid products and solid articles was calculated in a  
1336 spreadsheet outside of CEM. See the *Draft Consumer Exposure Analysis for Dicyclohexyl Phthalate*  
1337 *(DCHP)* ([U.S. EPA, 2024d](#)) for details. For each product or article, high, medium, and low exposure  
1338 scenarios were developed. Values for duration of dermal contact and area of exposed skin were  
1339 determined based on the reasonably expected use for each item. In addition, high, medium, and low  
1340 estimates for dermal exposures using a flux-limited approach were calculated and applied in the  
1341 corresponding exposure scenario. Key parameters for the dermal model are shown in Section 2.3 in  
1342 ([U.S. EPA, 2024c](#)).

1343 **4.1.2.2 Modeling Dose Results by COU for Consumer and Indoor Dust**

1344 This section summarizes the dose estimates from inhalation, ingestion, and dermal exposure to DCHP in  
1345 consumer products and articles. Detailed tables of the dose results for acute, intermediate, and chronic  
1346 exposures are available in *Draft Consumer Risk Calculator for Dicyclohexyl Phthalate (DCHP)* ([U.S.](#)

1347 [EPA, 2024e](#)). Modeling dose results for acute, intermediate, and chronic exposures and data patterns are  
1348 described in Section 3 in the *Draft Consumer and Indoor Dust Exposure Assessment for Dicyclohexyl*  
1349 *Phthalate (DCHP)* ([U.S. EPA, 2024c](#)). Generally, dermal exposures were overall highest followed by  
1350 inhalation across scenarios, COUs and lifestages. The range of inhalation doses for each scenario and  
1351 lifestage covered several orders of magnitude due to the wide range of DCHP content (weight fractions)  
1352 for adhesives, wide range of article exposure durations, and various skin contact surface area options for  
1353 the low, medium, and high scenarios. The dermal dose range was smaller for all scenarios driven  
1354 primarily by exposure durations and frequencies.

1355  
1356 The spread of values estimated for each product or article reflects the aggregate effects of variability and  
1357 uncertainty in key modeling parameters for each item; acute dose rate for some products and articles  
1358 covers a larger range than others primarily due to a wider distribution of DCHP weight fraction values  
1359 and behavioral factors such as duration of use or contact time and mass of product used as described in  
1360 Section 2 in ([U.S. EPA, 2024c](#)). Key differences in exposures among lifestages include designation as a  
1361 product user or bystander; behavioral differences such as hand to mouth contact times, and time spent on  
1362 the floor; and dermal contact expected from touching specific articles which may not be appropriate for  
1363 some lifestages.

#### 1364 **4.1.2.3 Weight of Scientific Evidence Conclusions for Consumer Exposure**

1365 Key sources of uncertainty for evaluating exposure to DCHP in consumer goods and strategies to  
1366 address those uncertainties are described in detail in Section 5.1 of *Draft Consumer and Indoor Dust*  
1367 *Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024c](#)). Generally, designation of  
1368 robust confidence suggests thorough understanding of the scientific evidence and uncertainties. The  
1369 supporting weight of scientific evidence outweighs the uncertainties to the point where it is unlikely that  
1370 the uncertainties could have a significant effect on the exposure estimate. The designation of moderate  
1371 confidence suggests some understanding of the scientific evidence and uncertainties. More specifically,  
1372 the supporting scientific evidence weighed against the uncertainties is reasonably adequate to  
1373 characterize exposure estimates. The designation of slight confidence is assigned when the weight of  
1374 scientific evidence may not be adequate to characterize the scenario, and when the assessor is making  
1375 the best scientific assessment possible in the absence of complete information and there are additional  
1376 uncertainties that may need to be considered. While the uncertainty for some of the scenarios and  
1377 parameters ranges from slight to robust the overall confidence to use the results for risk characterization  
1378 ranges from moderate to robust, depending on COU scenario. The basis for the moderate to robust  
1379 confidence in the overall exposure estimates is a balance between using parameters that will represent  
1380 various populations use patterns and lean on protective assumptions that are not excessive or  
1381 unreasonable.

##### 1382 **4.1.2.3.1 Strength, Limitations, Assumptions, and Key Sources of Uncertainty for** 1383 **the Consumer Exposure Assessment**

1384 The exposure assessment of chemicals from consumer products and articles has inherent challenges due  
1385 to many sources of uncertainty in the analysis, including variations in product formulation, patterns of  
1386 consumer use, frequency, duration, and application methods. Variability in environmental conditions  
1387 may also alter physical and/or chemical behavior of the product or article. Table 4-7 summarizes the  
1388 overall uncertainty per COU and provides a discussion of rationale used to assign the overall  
1389 uncertainty. The subsections ahead of the table describe sources of uncertainty for several parameters  
1390 used in consumer exposure modeling that apply across COUs and provide an in depth understanding of  
1391 sources of uncertainty and limitations and strengths within the analysis. The confidence to use the results  
1392 for risk characterization ranges from moderate to robust (Table 4-7).

1394 ***Product Formulation and Composition***

1395 Variability in the formulation of consumer products—including changes in ingredients, concentrations,  
1396 and chemical forms—can introduce uncertainty in exposure assessments. In addition, data were limited  
1397 for weight fractions of DCHP in consumer goods. EPA obtained DCHP weight fractions in various  
1398 products and articles from material safety sheets, databases, and existing literature. Where possible, the  
1399 Agency obtained multiple values for weight fractions for similar products or articles. The lowest value  
1400 was used in the low exposure scenario, the highest value in the high exposure scenario, and the average  
1401 of all values in the medium exposure scenario. EPA decreased uncertainty in exposure and subsequent  
1402 risk estimates in the high, medium, and low intensity use scenarios by capturing the weight fraction  
1403 variability and obtaining a better characterization of the products' and articles' varying composition  
1404 within one COU. Overall weight fraction confidence is *moderate* for products/articles with only one  
1405 source with descriptions on chemical testing, *robust* for products/articles with more than one source, and  
1406 *slight* for articles with only one source with unconfirmed content or little understanding on how the  
1407 information was produced. For example, when a source does not provide a description of the analysis or  
1408 the concentrations are derived from product production approaches rather than product testing.

1409  
1410 ***Product Use Patterns***

1411 Consumer use patterns like frequency of use, duration of use, and methods of application are expected to  
1412 differ. Where possible, high, medium, and low default values from CEM 3.2's prepopulated scenarios  
1413 were selected for mass of product used, duration of use, and frequency of use. In instances where no  
1414 prepopulated scenario was appropriate for a specific product, low, medium, and high values for each of  
1415 these parameters were estimated based on the manufacturers' product descriptions. EPA decreased  
1416 uncertainty by selecting use pattern inputs that represent product and article use descriptions and  
1417 furthermore capture the range of possible use patterns in the high to low intensity use scenarios.  
1418 Exposure and risk estimates are considered representative of product use patterns and well characterized.  
1419 Most use patterns' overall confidence is rated *robust*.

1420  
1421 ***Article Surface Area***

1422 The surface area of an article directly affects the potential for DCHP emissions to the environment. For  
1423 each article modeled for inhalation exposure, low, medium, and high estimates for surface area were  
1424 calculated (see Section 2 in ([U.S. EPA, 2024c](#))). Overall, confidence in surface area is *robust* for articles  
1425 because there is a good understanding of the dimensions of articles and their presence in indoor  
1426 environments.

1427  
1428 ***Human Behavior***

1429 CEM 3.2 has three different human activity patterns: stay-at-home, part-time out-of-the home (daycare,  
1430 school, or work), and full-time out-of-the-home. The activity patterns were developed based on the  
1431 Consolidated Human Activity Database (CHAD). For all products and articles modeled, the stay-at-  
1432 home activity pattern was selected as it is the most protective assumption.

1433  
1434 ***Modeling Tool***

1435 Confidence in the model used considers whether the model has been peer-reviewed, as well as whether  
1436 it is being applied in a manner appropriate to its design and objective. The model used, CEM 3.2, has  
1437 been peer-reviewed ([ERG, 2016](#)), is publicly available, and has been applied in the manner intended by  
1438 estimating exposures associated with uses of household products and/or articles. This also considers the  
1439 default values data source(s) such as building and room volumes, interzonal ventilation rates, and air  
1440 exchange rates. Overall confidence in the proper use of CEM and the consumer exposure estimates  
1441 results modeled is *robust*.

1442

**1443 Dermal Modeling for DCHP**

1444 Experimental dermal data was identified via the systematic review process to characterize consumer  
1445 dermal exposures to liquids or mixtures and formulations containing DCHP (see Section 2.3.1 in [\(U.S.  
1446 EPA, 2024c\)](#)). EPA has moderate understanding of the scientific evidence and the uncertainties. The  
1447 identification of uncertainties within the dermal approach is reasonably adequate to characterize  
1448 exposure estimates. The Agency has a *moderate* confidence in the dermal exposure to liquid and solid  
1449 products or articles modeling approach.

1450  
1451 A source of uncertainty regarding the dermal absorption of DCHP from products or formulations stems  
1452 from the varying concentrations and co-formulants that exist in products or formulations containing  
1453 DCHP. For purposes of this draft risk evaluation, EPA assumes that the absorptive flux of DCHP serves  
1454 as an upper bound of chemical into and through the skin for dermal contact with all liquid products or  
1455 formulations and solid products/articles. Dermal contact with products or formulations that have lower  
1456 concentrations of DCHP might exhibit lower rates of flux since there is less material available for  
1457 absorption. Conversely, co-formulants or materials within the products or formulations may lead to  
1458 enhanced dermal absorption, even at lower concentrations. Therefore, it is uncertain whether the  
1459 products or formulations containing DCHP would result in decreased or increased dermal absorption.  
1460 Based on the available dermal absorption data for DCHP, EPA has made assumptions that result in  
1461 exposure assessments that are the most human health protective in nature.

1462  
1463 Lastly, EPA notes that there is uncertainty with respect to the modeling of dermal absorption of DCHP  
1464 from solid matrices or articles and liquid products and formulations. Because there were no available  
1465 data related to the dermal absorption of DCHP from solid matrices or articles and liquid products, EPA  
1466 has assumed that dermal absorption of DCHP from solid objects would be limited by aqueous solubility  
1467 of DCHP. Therefore, to determine the maximum steady-state aqueous flux of DCHP, EPA utilized CEM  
1468 ([\(U.S. EPA, 2023b\)](#)) to first estimate the steady-state aqueous permeability coefficient of DCHP. The  
1469 estimation of the steady-state aqueous permeability coefficient within CEM ([\(U.S. EPA, 2023b\)](#)) is based  
1470 on a quantitative structure-activity relationship (QSAR) model presented by ten Berge ([2009](#)), which  
1471 considers chemicals with  $\log(K_{ow})$  ranging from  $-3.70$  to  $5.49$  and molecular weights ranging from 18 to  
1472  $584.6$ . The molecular weight of DCHP falls within the range suggested by ten Berge ([2009](#)), as does the  
1473  $\log(K_{ow})$  of DCHP. Therefore, there is a low to medium (due to assumptions used in migration of DCHP  
1474 from solid to aqueous media) uncertainty regarding the accuracy of the QSAR model used to predict the  
1475 steady-state aqueous permeability coefficient for DCHP.

**Table 4-7. Weight of Scientific Evidence Summary per Consumer Condition of Use**

Consumer COU Category and Subcategory	Weight of Scientific Evidence	Overall Confidence
Adhesives and sealants	<p>Two different scenarios were assessed under this COU for products with differing use patterns for which each scenario had a varying number of identified product examples (in parentheses): adhesives for small repairs (2) and automotive adhesives (3). The two scenarios and the products within capture the variability in product formulation and are represented in the high, medium, and low intensity use estimates. The overall confidence in this COU inhalation exposure estimate is robust because the CEM default parameters represent actual use patterns and location of use.</p> <p>For dermal exposure EPA used a dermal flux approach; moderate confidence was selected for this approach because uncertainty in the</p>	<p>Inhalation – Robust</p> <p>Dermal – Moderate</p>

Consumer COU Category and Subcategory	Weight of Scientific Evidence	Overall Confidence
	partitioning from product to skin and subsequent dermal absorption is not well characterized or confirmed with experimental results. However, other parameters like frequency and duration of use, and surface area in contact are well understood and representative, making the overall confidence in a health protective estimate moderate.	
Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	<p>One scenario was assessed under this COU. The scenario considered multiple articles and routine dermal contact with similar use patterns. The scenario for small articles of routine dermal contact was assessed for dermal exposures only because inhalation and ingestion would have low exposure potential due to the small surface area of the articles. The articles with routine contact scenario considered multiple input parameters used in the high, medium, and low intensity use scenarios.</p> <p>The dermal absorption estimate assumes that dermal absorption of DCHP from solid objects would be limited by the aqueous solubility of DCHP. EPA has slight confidence in the aspects of the exposure estimate for solid articles because of the high uncertainty in the assumption of partitioning from solid to liquid, and because subsequent dermal absorption is not well characterized. However, other parameters, such as frequency and duration of use as well as surface area in contact, are well understood and representative, resulting in an overall confidence of moderate in a health protective estimate.</p>	Dermal – Moderate
Other; Other consumer articles that contain dicyclohexyl phthalate from: inks, toner, and colorants; paints and coatings; adhesives and sealants (e.g., paper products, textiles, products using cellulose film, etc.)	Two different scenarios were assessed under this COU for articles with differing use patterns. The scenarios of outdoor seating (single article in use), and small articles with potential for routine contact (multiple articles) were evaluated. These two scenarios were assessed for dermal exposures. Dermal absorption estimates assumed that dermal absorption of DCHP from solid objects would be limited by the aqueous solubility of DCHP. EPA has slight confidence in the aspects of the exposure estimate for solid articles because of the high uncertainty in the assumption of partitioning from solid to liquid, and because subsequent dermal absorption is not well characterized. However, other parameters such as frequency and duration of use, and surface area in contact, are well understood and representative, resulting in an overall confidence of moderate in a health protective estimate.	Dermal – Moderate

**4.1.3 General Population Exposures to Environmental Releases**

General population exposures occur when DCHP is released into the environment and the environmental media are then a pathway for exposure. As described in the *Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2024g), releases of DCHP are expected in air, water, and disposal to landfills. Figure 4-2 provides a graphic representation of where and in which media DCHP is estimated to be found due to environmental releases and the corresponding route of exposure for the general population.

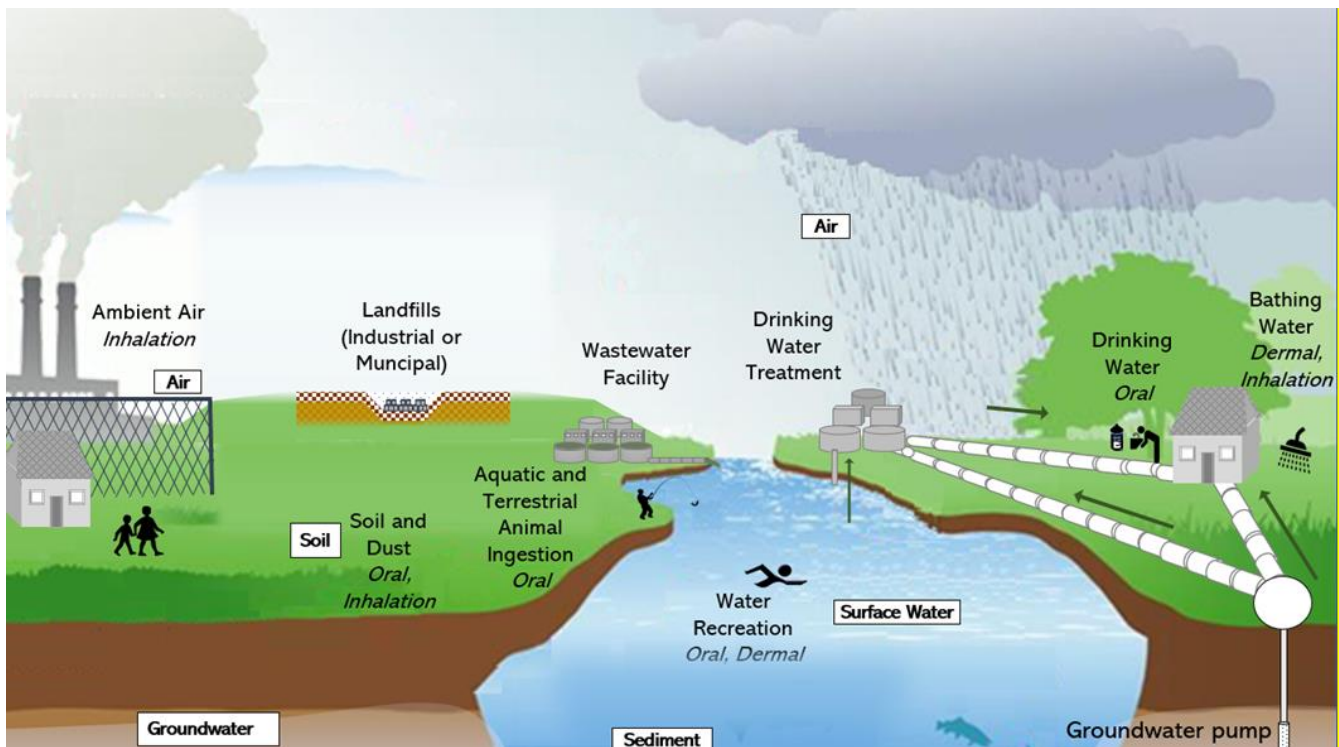
EPA took a screening-level approach to assess DCHP exposure to environmental releases for the general population. Screening level assessments are useful when there is little facility location- or scenario-specific information available. EPA began its DCHP general population exposure assessment using a screening-level approach because of limited environmental monitoring data for DCHP and lack of

1490 location data for DCHP releases. A screening-level analysis relies on conservative assumptions,  
1491 including default input parameters for modeling exposure, to assess exposures that would be expected to  
1492 be on the high end of the expected exposure distribution. Details on the use of screening-level analyses  
1493 in exposure assessment can be found in EPA's *Guidelines for Human Exposure Assessment* ([U.S. EPA,](#)  
1494 [2019b](#)).

1495  
1496 EPA considered fenceline populations in proximity to releasing facilities as part of the ambient air  
1497 exposure assessment by utilizing pre-screening methodology described in EPA's *Draft TSCA Screening*  
1498 *Level Approach for Assessing Ambient Air and Water Exposures to Fenceline Communities (Version*  
1499 *1.0)* ([U.S. EPA, 2022b](#)). For other exposure pathways, EPA's screening method assessing high-end  
1500 exposure scenarios used release data that reflect exposures expected to occur in proximity to releasing  
1501 facilities, which would include fenceline populations.

1502  
1503 EPA evaluated the reasonably available information for releases of DCHP from facilities that use,  
1504 manufacture, or process DCHP under industrial and/or commercial COUs subject to TSCA regulations  
1505 detailed in the *Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl*  
1506 *Phthalate (DCHP)* ([U.S. EPA, 2024q](#)). As described in Section 3.3, using the release data, EPA modeled  
1507 predicted concentrations of DCHP in surface water, sediment, drinking water, and ambient air in the  
1508 United States. Table 3-6 summarizes the high-end DCHP concentrations in environmental media from  
1509 environmental releases. The reason for assessing different pathways qualitatively or quantitatively is  
1510 discussed briefly in Section 3.3, and additional detail can be found in *Draft Environmental Media,*  
1511 *General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)*  
1512 ([U.S. EPA, 2024p](#)).

1513



1514

1515 **Figure 4-2. Potential Human Exposure Pathways to DCHP Environmental Releases for the**  
1516 **General Population**

1517 Potential routes of exposure are shown in italics under each potential pathway of exposure.

1518

1519 High-end estimates of DCHP concentration in the various environmental media presented in Table 3-6  
1520 and in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment*  
1521 *for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024p](#)) were used for screening-level purposes in the  
1522 general population exposure assessment. EPA’s *Guidelines for Human Exposure Assessment* ([U.S. EPA,](#)  
1523 [2019b](#)) defines high-end exposure estimates as a “plausible estimate of individual exposure for those  
1524 individuals at the upper end of an exposure distribution, the intent of which is to convey an estimate of  
1525 exposure in the upper range of the distribution while avoiding estimates that are beyond the true  
1526 distribution.” If risk is not found for these individuals with high-end exposure, no risk is anticipated for  
1527 central tendency exposures, which is defined as “an estimate of individuals in the middle of the  
1528 distribution.” Plainly, if there is no risk for an individual identified as having the potential for the highest  
1529 exposure associated with a COU for a given pathway of exposure, then that pathway was determined not  
1530 to be a pathway of concern and not pursued further. If any pathways were identified as a pathway of  
1531 concern for the general population, further exposure assessments for that pathway would be conducted  
1532 to include higher tiers of modeling when available, refinement of exposure estimates, and exposure  
1533 estimates for additional subpopulations and OES/COUs.

1534  
1535 Identifying individuals at the upper end of an exposure distribution included consideration of high-end  
1536 exposure scenarios defined as those associated with the industrial and commercial releases from a COU  
1537 and OES that resulted in the highest environmental media concentrations. As described in Section 3.3,  
1538 EPA focused on estimating high-end concentrations of DCHP from the largest estimated releases for the  
1539 purpose of its screening level assessment for environmental and general population exposures. This  
1540 means that the Agency considered the environmental concentration of DCHP in a given environmental  
1541 medium resulting from the OES that had the highest release compared to any other OES for the same  
1542 releasing media. Release estimates from OES resulting in lower environmental media concentrations  
1543 were not considered for this screening-level assessment. Additionally, individuals with the greatest  
1544 intake rate of DCHP per body weight were considered to be those at the upper end of the exposure.

1545  
1546 Table 4-8 summarizes the high-end exposure scenarios that were considered in the screening level  
1547 analysis, including the lifestage assessed as the most potentially exposed population based on intake rate  
1548 and body weight. It also indicates which pathways were evaluated quantitatively or qualitatively.  
1549 Exposure was assessed quantitatively only when environmental media concentrations were quantified  
1550 for the appropriate exposure scenario. For example, exposure from groundwater resulting from DCHP  
1551 release to the environment via biosolids or landfills was not quantitatively assessed because  
1552 environmental releases from biosolids and landfills were not quantified. Due to the high confidence in  
1553 the biodegradation rates and physical and chemical data, there is robust confidence that DCHP in soils  
1554 will not be mobile and will have low persistence potential. There is robust confidence that DCHP is  
1555 unlikely to be present in landfill leachates. However, exposure was still assessed qualitatively for  
1556 exposures potentially resulting from biosolids and landfills. Further details on the screening level  
1557 approach and exposure scenarios evaluated by EPA for the general population are provided in the *Draft*  
1558 *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl*  
1559 *Phthalate (DCHP)* ([U.S. EPA, 2024p](#)). Selected OESs represent those resulting in the highest modeled  
1560 environmental media concentrations for the purpose of a screening-level analysis. A crosswalk between  
1561 OESs and COUs is presented in Section 3.1.1.1.

1562

1563

**Table 4-8. Exposure Scenarios Assessed in General Population Screening Level Analysis**

OES	Exposure Pathway	Exposure Route	Exposure Scenario	Lifestage	Analysis (Quantitative or Qualitative) <sup>a</sup>
All	Biosolids	No specific exposure scenarios were assessed for qualitative assessments			Qualitative Section 3.1
All	Landfills	No specific exposure scenarios were assessed for qualitative assessments			Qualitative Section 3.2
PVC plastics compounding	Surface Water	Dermal	Dermal exposure to DCHP in surface water during swimming	Adults, youths, and children	Quantitative Section 5.1.1
		Oral	Incidental ingestion of DCHP in surface water during swimming	Adults, youths, and children	Quantitative Section 5.1.2
PVC plastics compounding	Drinking Water	Oral	Ingestion of drinking water	Adults, youths, and children	Quantitative Section 6
All	Fish Ingestion	Oral	Ingestion of fish for General Population	Adults and children	Quantitative Section 7.1
PVC plastics compounding			Ingestion of fish for subsistence fishers	Adult	Quantitative Section 7.2
PVC plastics compounding			Ingestion of fish for Tribal populations	Adult	Quantitative Section 7.3
Application of paints, coatings, adhesives, and sealants	Ambient Air	Inhalation	Inhalation of DCHP in ambient air resulting from industrial releases	All	Quantitative Section 9

<sup>a</sup>Note the references are to sections in *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024p](#)) and not this document.

1564

1565 EPA also considered urinary biomonitoring data, from CDC’s National Health and Nutrition  
 1566 Examination Survey (NHANES) (see Section 11 of EPA’s *Draft Environmental Media, General*  
 1567 *Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA,](#)  
 1568 [2024p](#)). The Agency analyzed urinary data for MCHP (mono-cyclohexyl phthalate, a metabolite of  
 1569 DCHP) measured in the 1999 to 2010 NHANES cycle. Low detection rates and limited variability in  
 1570 data precluded any meaningful statistical analyses. CDC stopped collecting urinary data for MCHP after  
 1571 2010. Furthermore, EPA’s systematic review process did not identify any suitable alternative sources of  
 1572 DCHP biomonitoring data fit for use in this risk evaluation Those studies were not considered because  
 1573 they used NHANES data, had very low (<30%) detection levels, evaluated very specific study  
 1574 populations (e.g., a cohort examining specific health concerns), or were not measured in the United  
 1575 States. Given the lack of recent urinary biomonitoring data, EPA did not conduct reverse dosimetry to  
 1576 calculate daily intake values for DCHP.

1577

**4.1.3.1 General Population Screening Level Exposure Assessment Results**

1578

***Land Pathway***

1579

1580 EPA evaluated general population exposures via the land pathway (i.e., application of biosolids,  
 1581 landfills) qualitatively. Due to low water solubility (1.48 mg/L) and affinity for sorption to soil and  
 1582 organic constituents in soil (log K<sub>oc</sub> = 4.47), DCHP is unlikely to migrate to groundwater via runoff  
 after land application of biosolids. Additionally, the half-life of 8.1 to 13.8 days in aerobic soils ([U.S.](#)

1583 [EPA, 2024z](#)) indicates that DCHP will have low persistence potential in the aerobic environments  
1584 associated with freshly applied biosolids. Because the physical and chemical properties of DCHP  
1585 indicate that it is unlikely to migrate from land applied biosolids to groundwater via runoff, EPA did not  
1586 model groundwater concentrations resulting from land application of biosolids.

1587

1588 Although there are no measured data on DCHP in landfill leachates, the potential to leach from landfills  
1589 into nearby groundwater or surface water systems is limited. Interpretation of the high-quality physical  
1590 and chemical property data indicates that DCHP is expected to have a high affinity to particulate (log  
1591  $K_{oc} = 4.47$ ) and organic media (log  $K_{ow} = 4.82$ ). This will cause significant retardation in groundwater  
1592 and limit leaching to groundwater. Because of its high hydrophobicity and high affinity for soil sorption,  
1593 it is unlikely that DCHP will migrate from landfills via groundwater infiltration or surface runoff.  
1594 Therefore, EPA concludes that further assessment of DCHP in landfill leachate is not needed.

1595

#### 1596 ***Surface Water Pathway – Incidental Ingestion and Dermal Contact from Swimming***

1597 EPA conducted modeling of releases to surface water at the point of release (*i.e.*, in the immediate water  
1598 body receiving the effluent) to estimate the resulting environmental media concentrations from TSCA  
1599 COUs. EPA conducted modeling with the U.S. EPA's Variable Volume Water Model with Point Source  
1600 Calculator tool (PSC) to estimate concentrations of DCHP within surface water and to estimate settled  
1601 sediment in the benthic region of streams. Releases associated with the PVC plastics compounding OES  
1602 resulted in the highest total water column concentrations, with 30Q5 water concentrations of 126  $\mu\text{g/L}$   
1603 without wastewater treatment and 39.6  $\mu\text{g/L}$  when run under an assumption of 68.6 percent wastewater  
1604 treatment removal efficiency (Table 4-9). Both treated and untreated scenarios were assessed due to  
1605 uncertainty about the prevalence of wastewater treatment from discharging facilities and to demonstrate  
1606 the hypothetical disparity in exposures between treated and untreated effluent in the generic release  
1607 scenarios. COUs mapped to this OES are shown in Table 3-1. These water column concentrations were  
1608 used to estimate the ADR from dermal exposure and incidental ingestion of DCHP while swimming for  
1609 adults (2+ years), youths (11–15 years), and children (6–10 years). Exposure scenarios leading to the  
1610 highest modeled ADR are shown in Table 4-9.

1611

#### 1612 ***Surface Water Pathway – Drinking Water***

1613 For the drinking water pathway, modeled surface water concentrations were used to estimate drinking  
1614 water exposures. For screening-level purposes, only the OES scenario resulting in the highest modeled  
1615 surface water concentrations, PVC plastics compounding, was included in the drinking water exposure  
1616 analysis. COUs mapped to this OES are shown in Table 3-1. EPA evaluated drinking water scenarios  
1617 that assumed a wastewater treatment removal efficiency of 68.6 percent and no further drinking water  
1618 treatment (Table 4-9). ADR and ADD values from drinking water exposure to DCHP were calculated  
1619 for various age groups but the most exposed lifestage, infants (birth to <1 year), is shown below.  
1620 Exposure scenarios leading to the highest ADR and ADD are shown in Table 4-9.

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1622  
1623

**Table 4-9. Summary of the Highest Doses in the General Population through Surface and Drinking Water Exposure**

OES <sup>a</sup>	Water Column Concentrations	Incidental Dermal Surface Water <sup>b</sup>	Incidental Ingestion <sup>c</sup>	Drinking Water <sup>d</sup>
	30Q5 Conc. (µg/L)	ADR <sub>POT</sub> (mg/kg-day)	ADR <sub>POT</sub> (mg/kg-day)	ADR <sub>POT</sub> (mg/kg-day)
PVC plastics compounding without wastewater treatment	126	1.1E-03	6.7E-04	1.8E-02
PVC plastics compounding With Wastewater Treatment	39.6	3.50E-04	2.1E-04	5.6E-03

<sup>a</sup> Only this OES was used in the screening assessment because it resulted in the highest surface water concentrations. Table 3-1 provides a crosswalk of industrial and commercial COUs to OES.  
<sup>b</sup> Most exposed age group: Adults (21+ years)  
<sup>c</sup> Most exposed age group: Youth (11–15 years)  
<sup>d</sup> Most exposed age group: Infant (birth to <1 year)

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**Fish Ingestion**

The key parameters to estimate human exposure to DCHP via fish ingestion are the surface water concentration, bioaccumulation factor (BAF), and fish ingestion rate. Surface water concentrations for DCHP associated with a particular COU were modeled using VVWM-PSC as described in Section 3.3.1.1. EPA used the PVC plastics compounding OES that resulted in the highest modeled DCHP concentrations in surface water, as well as various flow rates, in its screening-level analysis. The details on the BAF, which considers the animal’s uptake of a chemical from both diet and the water column, can be found in Section 8 of the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024p](#)).

EPA evaluated exposure to DCHP through fish ingestion for populations and age groups that had the highest fish ingestion rate per kg of body weight—including for adults and young toddlers in the general population, adult subsistence fishers, and adult Tribal populations. Only the fish ingestion rate changes for across the different populations; the surface water concentration and BAF remain the same. ADR and ADD values from fish ingestion exposure to DCHP were calculated for various populations and age groups and can be found in *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024p](#)), but Table 4-10 shows only the scenarios leading to the highest exposure.

1644

**Table 4-10. Summary of the Highest Doses for Fish Ingestion for Adults in Tribal Populations**

Calculation Method	Current Mean Ingestion Rate <sup>b</sup>	Heritage Ingestion Rate <sup>b</sup>
	ADR/ADD (mg/kg-day) <sup>a</sup>	ADR/ADD (mg/kg-day) <sup>a</sup>
Water solubility limit (1.48 mg/L)	2.68E-01	2.04
Modeled SWC for PVC plastics compounding, P50 flow (0.087 mg/L)	1.59E-02	1.21E-01
Modeled SWC for PVC plastics compounding, P75 flow (3.48E-03 mg/L)	6.30E-04	4.80E-03
Modeled SWC for PVC plastics compounding, P90 flow (2.4E-04 mg/L)	4.40E-05	3.35E-04
Highest monitored SWC (1.0E-05 mg/L)	2.53E-06	1.93E-05

SWC = surface water concentration  
<sup>a</sup> Current ingestion rate refers to the present-day consumption levels that are suppressed by contamination, degradation, or loss of access. Heritage rates existed prior to non-indigenous settlement on Tribal fisheries resources and changes to culture and lifeway.  
<sup>b</sup> The ADR and ADDs are identical because the inputs to estimating both exposure scenarios are identical.

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**Ambient Air Pathway**

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As part of the ambient air exposure assessment, EPA considered exposures to the general population in proximity to releasing facilities, including fenceline communities, by utilizing pre-screening methodology described in EPA’s *Draft TSCA Screening Level Approach for Assessing Ambient Air and Water Exposures to Fenceline Communities (Version 1.0)* (U.S. EPA, 2022b). EPA used the IIOAC to estimate ambient air concentrations using pre-run results from a suite of dispersion scenarios in a variety of meteorological and land-use settings within EPA’s American Meteorological Society/EPA Regulatory Model (AERMOD). The highest modeled 95th percentile annual ambient air concentration across all release scenarios was 67.57 µg/m<sup>3</sup> at 100 m from the releasing facility for the Application of paints and coatings OES (Table 3-6). COUs mapped to this OES are shown in Table 3-1. This OES was the only one assessed for the purpose of a screening-level assessment as it was associated with the highest ambient air concentration (see Section 13 of *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2024p) for more details).

**Table 4-11. General Population Ambient Air Exposure Summary**

OES <sup>a</sup>	Acute (Daily Average) <sup>b</sup>		Chronic (Annual Average) <sup>b</sup>	
	Air Concentration <sup>c</sup> (µg/m <sup>3</sup> )	AC (mg/kg-day)	Air Concentration <sup>c</sup> (µg/m <sup>3</sup> )	ADC (mg/kg-day)
Application of paints and coatings	67.57	67.57	46.28	46.28

AC = acute concentration; ADC = average daily concentration

<sup>a</sup> Table 3-1 provides a crosswalk of industrial and commercial COUs to OES.

<sup>b</sup> EPA assumes the general population is continuously exposed (*i.e.*, 24 hours per day, 365 days per year) to outdoor ambient air concentrations. Therefore, daily average modeled ambient air concentrations are equivalent to acute exposure concentrations, and annual average modeled ambient air concentrations are equivalent to chronic exposure concentrations.

<sup>c</sup> Air concentrations are reported for the high-end (95th percentile) modeled value at 100 m from the emitting facility and stack plus fugitive releases combined.

#### 4.1.3.1 Overall Confidence in General Population Screening Level Exposure Assessment

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The weight of scientific evidence supporting the general population exposure to environmental releases estimate is decided based on the strengths, limitations, and uncertainties associated with the exposure estimates, which are discussed in detail for ambient air, surface water, drinking water, and fish ingestion in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024p](#)). EPA summarized its weight of scientific evidence using confidence descriptors: robust, moderate, slight, or indeterminate. The Agency used general considerations (*i.e.*, relevance, data quality, representativeness, consistency, variability, uncertainties) as well as chemical-specific considerations for its weight of scientific evidence conclusions.

EPA determined robust confidence in its qualitative assessment of biosolids and landfills. For its quantitative assessment, the Agency modeled exposure due to various general population and environmental release exposure scenarios resulting from different pathways of exposure. Exposure estimates used high-end inputs for the purpose of risk screening. When available, monitoring data were compared to modeled estimates to evaluate overlap, magnitude, and trends. EPA has robust confidence that modeled releases used are appropriately conservative for a screening level-analysis. *Therefore, EPA has robust confidence that no exposure scenarios will lead to greater doses than presented in this draft risk evaluation. Despite slight and moderate confidence in the estimated values themselves, confidence in exposure estimates capturing high-end exposure scenarios was robust given that many of the modeled values exceeded those of monitored values.*

#### 4.1.4 Human Milk Exposures

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Infants are a potentially susceptible subpopulation because of their higher exposure per body weight, immature metabolic systems, and the potential for chemical toxicants to disrupt sensitive developmental processes—among other reasons. Reasonably available information from studies of experimental animal models also indicates that DCHP is a developmental toxicant ([U.S. EPA, 2024v](#)). EPA considered exposure and hazard information, as well as pharmacokinetic models, to determine the most scientifically supportable appropriate approach to evaluate infant exposure to DCHP from human milk ingestion ([U.S. EPA, 2024p](#)).

EPA identified two studies from Germany that measured DCHP concentrations in human milk. Neither of the studies characterized the possibility of occupational exposure to DCHP. No U.S. biomonitoring studies were identified. It is important to note that biomonitoring data do not distinguish between exposure routes or pathways and do not allow for source apportionment. In other words, biomonitoring data reflect total infant exposure through human milk ingestion and the contribution of specific TSCA COUs to overall exposure cannot be determined.

Furthermore, no human health studies have evaluated only lactational exposure from quantified levels of DCHP in milk. Uncertainties in the toxic moiety for DCHP and the limited half-life data of its metabolites in the human body that are both sensitive and specific also precluded modeling human milk concentrations by COUs. However, EPA has robust confidence that not modeling human milk concentrations is still protective of a nursing infant because multigenerational studies were evaluated to derive the hazard values. The multigenerational studies observed the effects on offspring across at least three generations resulting from maternal exposure during lactation, gestation, and other exposure periods. The hazard values are thus expected to protect a nursing infant's greater susceptibility during this unique lifestage whether due to sensitivity or greater exposure per body weight. Further discussion of the human milk pathway is provided in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024p](#)).

#### 4.1.5 Aggregate and Sentinel Exposure

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TSCA section 6(b)(4)(F)(ii) (15 U.S.C. 2605(b)(4)(F)(ii)) requires EPA, in conducting a risk evaluation, to describe whether aggregate and sentinel exposures under the COUs were considered and the basis for their consideration.

EPA defines aggregate exposure as “the combined exposures to an individual from a chemical substance across multiple routes and across multiple pathways (40 CFR 702.33).” For the draft DCHP risk evaluation, the Agency considered aggregate risk across all routes of exposure for each individual consumer and occupational COU evaluated for acute, intermediate, and chronic exposure durations. EPA did not consider aggregate exposure for the general population exposed to environmental releases. As described in Section 4.1.3, the Agency employed a risk screen approach for the general population exposure assessment. Based on results from the risk screen, no pathways of concern (*i.e.*, ambient air, surface water, drinking water, fish ingestion) to DCHP exposure were identified for the generation population.

EPA did not consider aggregate exposure scenarios across COUs because the Agency did not find any evidence to support such an aggregate analysis, such as statistics of populations using certain products represented across COUs or workers performing tasks across COUs. However, EPA considered combined exposure across all routes of exposure for each individual occupational and consumer COU to calculate aggregate risks (Sections 4.3.2 and 4.3.3).

EPA defines sentinel exposure as “the exposure to a chemical substance that represents the plausible upper bound of exposure relative to all other exposures within a broad category of similar or related exposures (40 CFR 702.33).” In terms of this draft risk evaluation, EPA considered sentinel exposures by considering risks to populations who may have upper bound exposures; for example, workers and ONUs who perform activities with higher exposure potential, or consumers who have higher exposure potential or certain physical factors like body weight or skin surface area exposed. The Agency characterized high-end exposures in evaluating exposure using both monitoring data and modeling approaches. Where statistical data are available, EPA typically uses the 95th percentile value of the available data set to characterize high-end exposure for a given COU. For general population and consumer exposures, the Agency occasionally characterized sentinel exposure through a “high-intensity use” category based on elevated consumption rates, breathing rates, or user-specific factors.

## 4.2 Summary of Human Health Hazards

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### 4.2.1 Background

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This section briefly summarizes the non-cancer and cancer human health hazards of DCHP (Section 4.2.2 and 4.2.3). Additional information on the non-cancer and cancer human health hazards of DCHP are provided in the *Draft Non-Cancer Human Health Hazard Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024v](#)) and *Draft Cancer Human Health Hazard Assessment for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2025a](#)).

### 4.2.2 Non-cancer Human Health Hazards of DCHP

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EPA identified effects on the developing male reproductive system as the most sensitive and robust non-cancer hazard associated with oral exposure to DCHP in experimental animal models. Existing assessments of DCHP—including ([U.S. CPSC, 2014, 2010](#)), ([ECCC/HC, 2020](#); [EC/HC, 2015](#)), ([ECHA, 2014](#)), and ([NICNAS, 2016, 2008](#))—also consistently identified effects on the developing male reproductive system as a sensitive and robust non-cancer effect following oral exposure to DCHP. EPA

1756 also considered epidemiologic evidence qualitatively as part of hazard identification and  
1757 characterization. However, epidemiologic evidence from the one DCHP study was not considered  
1758 further for dose-response analysis due to limitations and uncertainties in exposure characterization that  
1759 are discussed further in the *Draft Non-cancer Human Health Hazard Assessment for Dicyclohexyl*  
1760 *Phthalate (DCHP)* ([U.S. EPA, 2024v](#)). Use of epidemiologic evidence qualitatively is consistent with  
1761 phthalates assessments by Health Canada and U.S. CPSC.

1762  
1763 EPA is proposing a point of departure (POD) of 10 mg/kg-day (human equivalent dose [HED] of 2.4  
1764 mg/kg-day) based on phthalate syndrome-related effects on the developing male reproductive system  
1765 (decreased fetal testicular testosterone; decreased AGD; Leydig cell effects; decreased mRNA and/or  
1766 protein expression of steroidogenic genes; decreased protein expression of INSL3) to estimate non-  
1767 cancer risks from oral exposure to DCHP for acute, intermediate, and chronic durations of exposure in  
1768 the draft risk evaluation of DCHP. The proposed POD is the most sensitive no-observed-adverse-effect  
1769 level (NOAEL) and is further supported by one study reporting a NOAEL of 17 mg/kg-day ([Hoshino et](#)  
1770 [al., 2005](#)) and four other studies reporting effects on the developing male reproductive system consistent  
1771 with a disruption of androgen action and phthalate syndrome in rats at lowest-observed-adverse-effect  
1772 (LOAELs) ranging from 20 to 33 mg/kg-day ([Ahabab et al., 2017](#); [Ahabab and Barlas, 2015](#); [Furr et al.,](#)  
1773 [2014](#); [Ahabab and Barlas, 2013](#)). The Agency has performed  $\frac{3}{4}$  body weight scaling to yield the HED and  
1774 is applying the animal to human uncertainty factor (*i.e.*, interspecies uncertainty factor; UF<sub>A</sub>) of 3 and  
1775 the within human variability uncertainty factor an (*i.e.*, intraspecies uncertainty factor; UF<sub>H</sub>) of 10. Thus,  
1776 a total UF of 30 is applied for use as the benchmark MOE.

1777  
1778 Overall, based on the strengths, limitations, and uncertainties discussed in the *Draft Non-Cancer Human*  
1779 *Health Hazard Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024v](#)), EPA has robust  
1780 overall confidence in the proposed POD based on adverse effects on the developing male reproductive  
1781 system (*i.e.*, phthalate syndrome, which results from decreased fetal testicular testosterone). This POD  
1782 will be used to characterize risk from exposure to DCHP for acute, intermediate, and chronic exposure  
1783 scenarios.

1784  
1785 The applicability and relevance of this POD for all exposure durations (acute, intermediate, and chronic)  
1786 is described in the *Draft Non-Cancer Human Health Hazard Assessment for Dicyclohexyl Phthalate*  
1787 *(DCHP)* ([U.S. EPA, 2024v](#)). For purposes of assessing non-cancer risks, the selected POD is considered  
1788 most applicable to women of reproductive age, pregnant women, male infants, and male children. Use of  
1789 this POD to assess risk for other age groups (*e.g.*, adult males, and the elderly) is considered to be  
1790 conservative and appropriate for a screening-level assessment for these other age groups.

1791  
1792 No data are available for the dermal or inhalation routes that are suitable for deriving route-specific  
1793 PODs. Therefore, EPA is using the acute/intermediate/chronic oral POD to evaluate risks from dermal  
1794 exposure to DCHP. Differences between oral and dermal absorption are accounted for in dermal  
1795 exposure estimates in the draft risk evaluation for DCHP. For the inhalation route, EPA is extrapolating  
1796 the oral HED to an inhalation human equivalent concentration (HEC) per EPA's *Methods for Derivation*  
1797 *Of Inhalation Reference Concentrations and Application of Inhalation Dosimetry* ([U.S. EPA, 1994](#))  
1798 using the updated human body weight and breathing rate relevant to continuous exposure of an  
1799 individual at rest provided in EPA's *Exposure Factors Handbook: 2011 Edition* ([U.S. EPA, 2011b](#)). The  
1800 oral HED and inhalation HEC values selected by EPA to estimate non-cancer risk from  
1801 acute/intermediate/chronic exposure to DCHP in the draft risk evaluation of DCHP are summarized in  
1802 Table 4-12.

1804 **Table 4-12. Non-cancer HECs and HEDs Used to Estimate Risks**

Exposure Scenario	Target Organ System	Species	Duration	POD (mg/kg-day)	Effect at LOAEL	HED <sup>a</sup> (mg/kg-day)	HEC <sup>a</sup> (mg/m <sup>3</sup> ) [ppm]	Benchmark MOE <sup>b</sup>	Reference
Acute, intermed., chronic	Developing male reproductive system	Rat	10 days during gestation	NOAEL=10 <sup>c</sup>	Phthalate syndrome-related effects (e.g., ↓ fetal testicular testosterone; ↓ AGD; Leydig cell effects; ↓ mRNA and/or protein expression of steroidogenic genes; ↓INSL3)	2.4	13 [0.95]	UF <sub>A</sub> =3 UF <sub>H</sub> =10 Total UF=30	( <a href="#">Li et al., 2016</a> )

HEC = human equivalent concentration; HED = human equivalent dose; MOE = margin of exposure; NOAEL = no-observed-adverse-effect level; LOAEL = lowest-observed-adverse-effect level; POD = point of departure; UF = uncertainty factor

<sup>a</sup> HED and HEC values were calculated based on the most sensitive NOAEL of 10 mg/kg-day.

<sup>b</sup> EPA used allometric body weight scaling to the ¾ power to derive the HED. Consistent with EPA Guidance ([U.S. EPA, 2011c](#)), the interspecies uncertainty factor (UF<sub>A</sub>), was reduced from 10 to 3 to account remaining uncertainty associated with interspecies differences in toxicodynamics. The Agency used a default intraspecies (UF<sub>H</sub>) of 10 to account for variation in sensitivity within human populations.

<sup>c</sup> Statistically significant effects at 10 mg/kg-day are limited to fetal Leydig cell effects, decreased expression of genes and proteins involved in steroidogenesis, and decreased protein expression of INSL3 (all of which are not considered adverse in isolation). The remaining effects listed reached statistical significance at higher doses.

1805 **4.2.3 Cancer Human Health Hazards of DCHP**

1806 DCHP has not been evaluated for carcinogenicity in any 2-year cancer bioassays. EPA therefore  
1807 evaluated the relevance of read-across approaches to assess potential cancer hazards of DCHP based on  
1808 cancer bioassays and MOA information available for other phthalates being evaluated under TSCA (i.e.,  
1809 DEHP, DBP, BBP, DINP, DIDP) as discussed in the *Draft Cancer Human Health Hazard Assessment*  
1810 *for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP),*  
1811 *Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2025a](#)). (Note: EPA  
1812 plans to release the draft cancer assessment for peer review by the SACC and public comment in early  
1813 2025.)

1814  
1815 EPA used elements of the Rethinking Chronic Toxicity and Carcinogenicity Assessment for  
1816 Agrochemicals Project (ReCAAP) weight of evidence framework ([Hilton et al., 2022](#)) to determine the  
1817 need for carcinogenicity studies for DCHP. The framework takes into consideration multiple lines of  
1818 evidence to support decision-making for the chemical(s) of interest—including information pertaining to  
1819 nomenclature, physical and chemical properties; exposure and use patterns; absorption, distribution,  
1820 metabolism, and excretion (ADME) properties; and toxicological data (e.g., genetic toxicity, acute  
1821 toxicity, subchronic toxicity, hormone perturbation, immunotoxicity, and mode of action [MOA]). The  
1822 framework was developed by a workgroup comprising scientists from academia, government, non-  
1823 governmental organizations, and industry stakeholders. Recently, the Organisation for Economic Co-  
1824 operation and Development (OECD) developed several Integrated Approach to Testing and Assessment  
1825 (IATA) case studies demonstrating applicability of the weight of evidence framework ([OECD, 2024](#)).  
1826

1827 As part of this weight of evidence approach, human health hazard profiles for DCHP were evaluated and  
1828 compared to profiles for five read-across chemicals, including DEHP, DBP, BBP, DINP, and DIDP

1829 (also referred to as “read-across phthalates” in this document). Overall, based on the weight of scientific  
 1830 evidence, EPA has preliminarily concluded that the non-cancer POD for DCHP based on effects on the  
 1831 developing male reproductive system consistent with a disruption of androgen action and phthalate  
 1832 syndrome that was selected for characterizing risk from acute, intermediate, and chronic exposure to  
 1833 DCHP is appropriate for use in human health risk assessment and is protective of human health,  
 1834 including for PESS. Furthermore, *EPA preliminarily concludes that potential carcinogenicity of DCHP*  
 1835 *is not a significant remaining source of uncertainty in the quantitative and qualitative risk*  
 1836 *characterization, despite the lack of carcinogenicity bioassays for DCHP.* Further, these preliminary  
 1837 conclusions are based on several key weight of scientific evidence considerations.

1838  
 1839 First, DCHP is toxicologically similar to DEHP, DBP, BBP, DINP, and DIBP and can induce  
 1840 antiandrogenic effects and disrupt fetal testicular testosterone biosynthesis in rats leading to a spectrum  
 1841 of effects on the developing male reproductive system consistent with phthalate syndrome. Second, for  
 1842 the five read-across phthalates, effects on the developing male reproductive system consistent with  
 1843 phthalate syndrome was the most sensitive and robust endpoint for deriving PODs for use in  
 1844 characterizing risk for acute, intermediate, and chronic exposure scenarios. The only exception to this  
 1845 was for DINP, in which chronic non-cancer liver effects were identified as a more sensitive outcome  
 1846 than developmental toxicity for deriving a chronic POD. Finally, although cancer classifications for the  
 1847 five read-across phthalates vary, in no case was cancer found to be a risk driver.

### 1848 **4.3 Human Health Risk Characterization**

#### 1849 **4.3.1 Risk Assessment Approach**

1850 The exposure scenarios, populations of interest, and toxicological endpoints used for evaluating risks  
 1851 from acute, short-term/intermediate, and chronic/lifetime exposures are summarized in Table 4-13.

1852 **Table 4-13. Exposure Scenarios, Populations of Interest, and Hazard Values**

<b>Population of Interest and Exposure Scenario</b>	<b>Workers</b> Male and female adolescents and adults (16+ years) and women of reproductive age directly working with DCHP under light activity (breathing rate of 1.25 m <sup>3</sup> /h) (for further details see <a href="#">(U.S. EPA, 2024q)</a> ) <u>Exposure Durations</u> <ul style="list-style-type: none"> <li>• <i>Acute</i> – 8 hours for a single workday</li> <li>• <i>Intermediate</i> – 8 hours per workday for 22 days per 30-day period</li> <li>• <i>Chronic</i> – 8 hours per workday for 250 days per year for 31 or 40 working years</li> </ul> <u>Exposure Routes</u> <ul style="list-style-type: none"> <li>• Inhalation and dermal</li> </ul>
	<b>Occupational Non-users</b> Male and female adolescents and adults (16+ years old) indirectly exposed to DCHP within the same work area as workers (breathing rate of 1.25 m <sup>3</sup> /h) (for further details see <a href="#">(U.S. EPA, 2024q)</a> ) <u>Exposure Durations</u> <ul style="list-style-type: none"> <li>• <i>Acute, Intermediate, and Chronic</i> – same as workers</li> </ul> <u>Exposure Routes</u> <ul style="list-style-type: none"> <li>• Inhalation, dermal (mist and dust deposited on surfaces)</li> </ul>
	<b>Consumers</b> Male and female infants (<1 year), toddlers (1–2 years), children (3–5 years and 6–10 years), young teens (11–15 years), teenagers (16–20 years) and adults (21+ years) exposed to DCHP through product or article use (for further details see <a href="#">(U.S. EPA, 2024c)</a> ) <u>Exposure Durations</u> <ul style="list-style-type: none"> <li>• <i>Acute</i> – 1 day exposure</li> <li>• <i>Intermediate</i> – 30 days per year</li> </ul>

<p><b>Population of Interest and Exposure Scenario</b></p>	<ul style="list-style-type: none"> <li>• <i>Chronic</i> – 365 days per year</li> </ul> <p><u>Exposure Routes</u></p> <ul style="list-style-type: none"> <li>• Inhalation, dermal, and oral</li> </ul>
	<p><b>Bystanders</b> Male and female infants (&lt;1 year), toddlers (1–2 years), and children (3–5 years and 6–10 years) incidentally exposed to DCHP through product use (for further details see (<a href="#">U.S. EPA, 2024c</a>))</p> <p><u>Exposure Durations</u></p> <ul style="list-style-type: none"> <li>• <i>Acute</i> – 1 day exposure</li> <li>• <i>Intermediate</i> – 30 days per year</li> <li>• <i>Chronic</i> – 365 days per year</li> </ul> <p><u>Exposure Routes</u></p> <ul style="list-style-type: none"> <li>• Inhalation</li> </ul>
	<p><b>General Population</b> Male and female infants, children, youth, and adults exposed to DCHP through drinking water, surface water, ambient air, and fish ingestion (for further details see (<a href="#">U.S. EPA, 2024p</a>))</p> <p><u>Exposure Durations</u></p> <ul style="list-style-type: none"> <li>• <i>Acute</i> – Exposed to DCHP continuously for a 24-hour period</li> <li>• <i>Chronic</i> – Exposed to DCHP continuously for up to 78 years</li> </ul> <p><u>Exposure Routes</u></p> <ul style="list-style-type: none"> <li>• Inhalation, dermal, and oral (depending on exposure scenario)</li> </ul>
	<p><b>National Population</b> Children aged 3–5, 6–11 years, and 11 to &lt;16 years; male and female adults 16+ years; and women of reproductive age (16–49 years of age) exposed to DEHP, DBP, BBP, DIBP, and DINP through all exposure pathways and routes as measured through urinary biomonitoring (<i>i.e.</i>, NHANES) (for further details see (<a href="#">U.S. EPA, 2024ah</a>))</p> <p><u>Exposure Durations</u></p> <ul style="list-style-type: none"> <li>• Durations not easily characterized in urinary biomonitoring studies</li> <li>• Likely between acute and intermediate as phthalates have elimination half-lives on the order of several hours and are quickly excreted from the body in urine. Spot urine samples, as collected through NHANES, are representative of relatively recent exposures.</li> </ul> <p><u>Exposure Routes</u></p> <ul style="list-style-type: none"> <li>• NHANES urinary biomonitoring data provides an estimate of aggregate exposure (<i>i.e.</i>, exposure through oral, inhalation, and dermal routes)</li> </ul>
<p><b>Health Effects, Concentration and Time Duration</b></p>	<p><b>Non-cancer Acute/Intermediate/Chronic Value</b> Sensitive health effect: Developmental toxicity (<i>i.e.</i>, effects on the developing male reproductive system including decreased fetal testicular testosterone; decreased AGD; Leydig cell effects; decreased mRNA and/or protein expression of steroidogenic genes; decreased protein expression of INSL3) (for further details see (<a href="#">U.S. EPA, 2024v</a>)) HEC Daily, continuous = 13 mg/m<sup>3</sup> (0.95 ppm) HED Daily = 2.4 mg/kg-day; dermal and oral Total UF (benchmark MOE) = 30 (UF<sub>A</sub> = 3; UF<sub>H</sub> = 10)</p> <p><b>Hazard Relative Potency</b> Relative potency factors for DEHP, DBP, BBP, DIBP, DCHP, and DINP were derived based on reduced fetal testicular testosterone. DBP was selected as the index chemical (for further details see (<a href="#">U.S. EPA, 2024ah</a>)). RPF<sub>DEHP</sub> = 0.84 RPF<sub>DBP</sub> = 1 (index chemical) RPF<sub>BBP</sub> = 0.52 RPF<sub>DIBP</sub> = 0.53 RPF<sub>DCHP</sub> = 1.66 RPF<sub>DINP</sub> = 0.21 Index chemical (DBP) POD = HED Daily = 2.1 mg/kg-day Total UF (benchmark MOE) = 30 (UF<sub>A</sub> = 3; UF<sub>H</sub> = 10)</p>

#### 4.3.1.1 Estimation of Non-cancer Risks from Exposure to DCHP

EPA used a margin of exposure (MOE) approach to identify potential non-cancer risks for individual exposure routes (*i.e.*, oral, dermal, inhalation). The MOE is the ratio of the non-cancer POD divided by a human exposure dose. Acute, short-term, and chronic MOEs for non-cancer inhalation and dermal risks were calculated using Equation 4-1.

##### Equation 4-1. Margin of Exposure Calculation

$$MOE = \frac{\text{Non-cancer Hazard Value (POD)}}{\text{Human Exposure}}$$

Where:

<i>MOE</i>	=	Margin of exposure for acute, intermediate, or chronic risk comparison (unitless)
<i>Non-cancer Hazard Value (POD)</i>	=	HEC (mg/m <sup>3</sup> ) or HED (mg/kg-day)
<i>Human Exposure</i>	=	Exposure estimate (mg/m <sup>3</sup> or mg/kg-day)

MOE risk estimates may be interpreted in relation to benchmark MOEs. Benchmark MOEs are typically the total UF for each non-cancer POD. The MOE estimate is interpreted as a human health risk of concern if the MOE estimate is less than the benchmark MOE (*i.e.*, the total UF). On the other hand, if the MOE estimate is equal to or exceeds the benchmark MOE, the risk is not considered to be of concern and mitigation is not needed. Typically, the larger the MOE, the more unlikely it is that a non-cancer adverse effect occurs relative to the benchmark. When determining whether a chemical substance presents unreasonable risk to human health or the environment, calculated risk estimates are not “bright-line” indicators of unreasonable risk, and EPA has the discretion to consider other risk-related factors in addition to risks identified in the risk characterization.

#### 4.3.1.2 Estimation of Non-cancer Aggregate Risks from Exposure to DCHP

As described in Section 4.1.5, EPA considered aggregate risk from exposure to DCHP across all routes of exposure for each individual consumer and occupational COU evaluated for acute, intermediate, and chronic exposure durations. To identify potential non-cancer risks for aggregate exposure scenarios for workers (Section 4.3.2) and consumers (Section 4.3.3), EPA used the total MOE approach ([U.S. EPA, 2001](#)). For the total MOE approach, MOEs for each exposure route of interest in the aggregate scenario must first be calculated. The total MOE for the aggregate scenario can then be calculated using Equation 4-2.

##### Equation 4-2. Total Margin of Exposure Calculation

$$\text{Total MOE} = \frac{1}{\frac{1}{MOE_{Oral}} + \frac{1}{MOE_{Dermal}} + \frac{1}{MOE_{Inhalation}} \dots}$$

Where:

<i>Total MOE</i>	=	Margin of exposure for aggregate scenario (unitless)
<i>MOE<sub>Oral</sub></i>	=	Margin of exposure for oral route (unitless)
<i>MOE<sub>Dermal</sub></i>	=	Margin of exposure for dermal route (unitless)
<i>MOE<sub>Inhalation</sub></i>	=	Margin of exposure for inhalation route (unitless)

1898 Total MOE risk estimates may be interpreted in relation to benchmark MOEs, as described in Section  
1899 4.3.1.1.

### 1900 **4.3.2 Risk Estimates for Workers**

---

1901 This section summarizes risk estimates for workers from inhalation and dermal exposures, as well as  
1902 aggregated exposures to DCHP from individual DCHP COUs across routes. In this section, risks are  
1903 calculated for all exposed workers based on the DCHP-derived PODs described in Section 4.2.2.  
1904 Subsequently in Section 4.4.4, those same risks for female workers of reproductive age exposed to  
1905 DCHP at the highest levels (acute durations) are calculated using the more robust RPFs described in  
1906 Section 4.4.1 and added to estimates of national non-attributable exposure of five toxicologically similar  
1907 phthalates for an estimate of cumulative risk.

1908  
1909 Risk estimates for workers from inhalation and dermal exposures, as well as aggregated exposures, are  
1910 shown in Table 4-14. This section provides discussion and characterization of risk estimates for workers,  
1911 including women of reproductive age and ONUs, for the various OESs and COUs.

#### 1912 ***Manufacturing***

1913  
1914 For the manufacture of DCHP, inhalation exposure from dust generation is expected to be the dominant  
1915 route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from  
1916 3.5 to 5.6 for average adult workers and women of reproductive age, while high-end dermal MOEs for  
1917 the same populations and exposure scenarios ranged from 532 to 845 (Benchmark = 30). The central  
1918 tendency MOEs for the same populations and exposure scenarios ranged from 36 to 58 for inhalation  
1919 exposure and 1,064 to 1,689 for dermal exposure (Benchmark = 30). Aggregation of inhalation and  
1920 dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation  
1921 exposure alone. The variations between the central tendency and high-end estimates of worker  
1922 inhalation exposures are described below.

1923  
1924 EPA estimated worker inhalation exposures using the *Generic Model for Central Tendency and High-  
1925 End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* for  
1926 dust exposures ([U.S. EPA, 2021b](#)). For inhalation exposure to PNOR, EPA determined the 50th and  
1927 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS Codes starting  
1928 with 325 (Chemical Manufacturing). EPA multiplied these dust concentrations by the industry provided  
1929 maximum DCHP concentration manufactured (*i.e.*, 100%) to estimate DCHP particulate concentrations  
1930 in the air. Therefore, the differences in the central tendency and high-end dust concentrations led to  
1931 significant differences between the central tendency and high-end risk estimates.

1932  
1933 Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a  
1934 worker may experience in the chemicals industry, the composition of workplace dust is uncertain. The  
1935 exposure and risk estimates are based on the assumption that the concentration of DCHP in workplace  
1936 dust is the same as the concentration of DCHP manufactured. However, it is likely that workplace dust  
1937 contains a variety of constituents that do not contain any DCHP in addition to particles from  
1938 manufactured DCHP. The constituents that do not contain DCHP would dilute the overall concentration  
1939 of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the  
1940 concentration of DCHP in the final product. Due to this uncertainty in DCHP concentration in  
1941 workplace dust, central tendency values of exposure are expected to be most reflective of worker  
1942 exposures within the COUs covered under the “Manufacturing” OES (*i.e.*, Manufacturing COU:  
1943 Domestic manufacturing).

1944

**1945 *Import and Repackaging***

1946 For the import of DCHP, inhalation exposure from dust generation is expected to be the dominant route  
1947 of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 5.8 to  
1948 9.3 for average adult workers and women of reproductive age, while high-end dermal MOEs for the  
1949 same populations and exposure scenarios ranged from 532 to 845 (Benchmark = 30). The central  
1950 tendency MOEs for the same populations and exposure scenarios ranged from 134 to 259 for inhalation  
1951 exposure and 1,064 to 2,031 for dermal exposure (Benchmark = 30). Aggregation of inhalation and  
1952 dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation  
1953 exposure alone. The large variations between the central tendency and high-end estimates of worker  
1954 inhalation exposures are described below.

1955

1956 EPA estimated worker inhalation exposures using the *Generic Model for Central Tendency and High-*  
1957 *End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* for  
1958 dust exposures ([U.S. EPA, 2021b](#)). For inhalation exposure to PNOR, EPA determined the 50th and  
1959 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS Codes starting  
1960 with 45 (Wholesale and Retail Trade). EPA multiplied these dust concentrations by the industry  
1961 provided maximum DCHP concentration imported (*i.e.*, 100%) to estimate DCHP particulate  
1962 concentrations in the air. Therefore, the differences in the central tendency and high-end dust  
1963 concentrations led to significant differences between the central tendency and high-end risk estimates.

1964

1965 Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a  
1966 worker may experience in the wholesale and retail trade industry, the composition of workplace dust is  
1967 uncertain. The exposure and risk estimates are based on the assumption that the concentration of DCHP  
1968 in workplace dust is the same as the concentration of imported DCHP. However, it is likely that  
1969 workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles  
1970 from imported DCHP. The constituents that do not contain DCHP would dilute the overall concentration  
1971 of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the  
1972 concentration of DCHP in the imported product. Due to this uncertainty in DCHP concentration in  
1973 workplace dust, central tendency values of exposure are expected to be most reflective of worker  
1974 exposures within the COUs covered under the “Import and repackaging” OES (*i.e.*, Manufacture COU:  
1975 Importing; Processing COU: Repackaging [*e.g.*, laboratory chemicals]).

1976

**1977 *Incorporation into Adhesives and Sealants***

1978 For the incorporation of DCHP into adhesives and sealants, inhalation exposure from dust generation is  
1979 expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic  
1980 inhalation exposure ranged from 3.5 to 5.6 for average adult workers and women of reproductive age,  
1981 while high-end dermal MOEs for the same populations and exposure scenarios ranged from 532 to 845  
1982 (Benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged  
1983 from 36 to 58 for inhalation exposure and 1,064 to 1,689 for dermal exposure (Benchmark = 30).

1984 Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to  
1985 risk estimates from inhalation exposure alone. The variations between the central tendency and high-end  
1986 estimates of worker inhalation exposures are described below.

1987

1988 EPA estimated worker inhalation exposures using the *Generic Model for Central Tendency and High-*  
1989 *End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* for  
1990 dust exposures ([U.S. EPA, 2021b](#)). For inhalation exposure to PNOR, EPA determined the 50th and  
1991 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS Ccodes starting  
1992 with 325 (Chemical Manufacturing). EPA multiplied these dust concentrations by the industry provided  
1993 maximum potential DCHP concentration in the raw material (*i.e.*, 100%) to estimate DCHP particulate

1994 concentrations in the air. Therefore, the differences in the central tendency and high-end dust  
1995 concentrations led to significant differences between the central tendency and high-end risk estimates.  
1996

1997 Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a  
1998 worker may experience in the chemical manufacturing industry, the composition of workplace dust is  
1999 uncertain. The exposure and risk estimates are based on the assumption that the concentration of DCHP  
2000 in workplace dust is the same as the concentration of DCHP in the raw material. However, it is likely  
2001 that workplace dust contains a variety of constituents that do not contain any DCHP in addition to  
2002 particles from DCHP-containing raw materials. The constituents that do not contain DCHP would dilute  
2003 the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is  
2004 likely less than the concentration of DCHP in the raw material. Due to this uncertainty in DCHP  
2005 concentration in workplace dust, central tendency values of exposure are expected to be most reflective  
2006 of worker exposures within the COUs covered under the “Incorporation into adhesives and sealants”  
2007 OES (*i.e.*, Processing COUs: Plasticizer in adhesive manufacturing; Adhesive and sealant chemicals in  
2008 adhesive manufacturing; Stabilizing agent in adhesive manufacturing).  
2009

### 2010 ***Incorporation into Paints and Coatings***

2011 For the incorporation of DCHP into paints and coatings, inhalation exposure from dust generation is  
2012 expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic  
2013 inhalation exposure ranged from 3.5 to 5.6 for average adult workers and women of reproductive age,  
2014 while high-end dermal MOEs for the same populations and exposure scenarios ranged from 532 to 845  
2015 (Benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged  
2016 from 36 to 58 for inhalation exposure and 1,064 to 1,689 for dermal exposure (Benchmark = 30).  
2017 Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to  
2018 risk estimates from inhalation exposure alone. The variations between the central tendency and high-end  
2019 estimates of worker inhalation exposures are described below.  
2020

2021 EPA estimated worker inhalation exposures using the *Generic Model for Central Tendency and High-*  
2022 *End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* for  
2023 dust exposures ([U.S. EPA, 2021b](#)). For inhalation exposure to PNOR, EPA determined the 50th and  
2024 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS Codes starting  
2025 with 325 (Chemical Manufacturing). EPA multiplied these dust concentrations by the industry provided  
2026 maximum potential DCHP concentration in the raw material (*i.e.*, 100%) to estimate DCHP particulate  
2027 concentrations in the air. Therefore, the differences in the central tendency and high-end dust  
2028 concentrations led to significant differences between the central tendency and high-end risk estimates.  
2029

2030 Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a  
2031 worker may experience in the chemical manufacturing industry, the composition of workplace dust is  
2032 uncertain. The exposure and risk estimates are based on the assumption that the concentration of DCHP  
2033 in workplace dust is the same as the concentration of DCHP in the raw material. However, it is likely  
2034 that workplace dust contains a variety of constituents that do not contain any DCHP in addition to  
2035 particles from DCHP-containing raw materials. The constituents that do not contain DCHP would dilute  
2036 the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is  
2037 likely less than the concentration of DCHP in the raw material. Due to this uncertainty in DCHP  
2038 concentration in workplace dust, central tendency values of exposure are expected to be most reflective  
2039 of worker exposures within the COUs covered under the “Incorporation into paints and coatings” OES  
2040 (*i.e.*, Processing COUs: Plasticizer in paint and coating manufacturing; Stabilizing agent in paint and  
2041 coating manufacturing).  
2042

***Incorporation into Other Formulations, Mixtures, or Reaction Products Not Otherwise Specified***

For the incorporation of DCHP into other formulations, mixtures, or reaction products not otherwise specified, inhalation exposure from dust generation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 3.5 to 5.6 for average adult workers and women of reproductive age, while high-end dermal MOEs for the same populations and exposure scenarios ranged from 532 to 845 (Benchmark = 30). The central tendency MOEs for the same populations and exposure scenarios ranged from 36 to 58 for inhalation exposure and 1,064 to 1,689 for dermal exposure (Benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The variations between the central tendency and high-end estimates of worker inhalation exposures are described below.

EPA estimated worker inhalation exposures using the *Generic Model for Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* for dust exposures ([U.S. EPA, 2021b](#)). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS codes starting with 325 (Chemical Manufacturing). EPA multiplied these dust concentrations by the industry provided maximum potential DCHP concentration in the raw material (*i.e.*, 100%) to estimate DCHP particulate concentrations in the air. Therefore, the differences in the central tendency and high-end dust concentrations led to significant differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the chemical manufacturing industry, the composition of workplace dust is uncertain. The exposure and risk estimates are based on the assumption that the concentration of DCHP in workplace dust is the same as the concentration of DCHP in the raw material. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from DCHP-containing raw materials. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in the raw material. Due to this uncertainty in DCHP concentration in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the “Incorporation into other formulations, mixtures, or reaction products not Covered Elsewhere” OES (*i.e.*, Processing COU: Stabilizing agent in asphalt paving, roofing, and coating materials manufacturing).

***PVC Plastics Compounding***

For PVC plastics compounding, inhalation exposure from dust generation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 3.7 to 6.0 for average adult workers and women of reproductive age, while high-end dermal MOEs ranged from 532 to 845 (Benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 76 to 137 for inhalation exposure and 1,064 to 1,894 for dermal exposures (Benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The reason for the variation between high-end and central tendency estimates of worker inhalation exposures is described below.

EPA estimated worker inhalation exposures using the *Generic Model for Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* for dust exposures ([U.S. EPA, 2021b](#)). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS Codes starting

2092 with 326 (Plastics and Rubber Manufacturing). EPA multiplied these dust concentrations by the industry  
2093 provided maximum potential DCHP concentration in the raw additive material (*i.e.*, 100%) to estimate  
2094 DCHP particulate concentrations in the air. Therefore, the differences in the central tendency and high-  
2095 end dust concentrations led to significant differences between the central tendency and high-end risk  
2096 estimates.

2097  
2098 Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a  
2099 worker may experience in the compounding industry, the composition of workplace dust is uncertain.  
2100 The exposure and risk estimates assume that the concentration of DCHP in workplace dust is the same  
2101 as the concentration of DCHP in the raw material. However, it is likely that workplace dust contains a  
2102 variety of constituents that do not contain any DCHP in addition to particles from DCHP-containing raw  
2103 materials. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in  
2104 the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP  
2105 in the raw material. Due to the uncertainty of DCHP concentrations in workplace dust, central tendency  
2106 values of exposure are expected to be most reflective of worker exposures within the COUs covered  
2107 under the “PVC plastics compounding” OES (*i.e.*, Processing COUs: Plasticizer in plastic material and  
2108 resin manufacturing; Plastics product manufacturing; Stabilizing agent in plastics product  
2109 manufacturing).

#### 2110 ***Non-PVC Material Compounding***

2111 For non-PVC material compounding, inhalation exposure from dust generation is expected to be the  
2112 dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure  
2113 ranged from 6.2 to 9.9 for average adult workers and women of reproductive age, while high-end dermal  
2114 MOEs ranged from 532 to 845 (Benchmark = 30). For central tendency, MOEs for the same population  
2115 and exposure scenarios ranged from 126 to 217 for inhalation exposure and 1,064 to 1,805 for dermal  
2116 exposures (Benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible  
2117 differences in risk when compared to risk estimates from inhalation exposure alone. The reason for the  
2118 variation between high-end and central tendency estimates of worker inhalation exposures is described  
2119 below.  
2120

2121  
2122 EPA estimated worker inhalation exposures using the *Generic Model for Central Tendency and High-  
2123 End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* for  
2124 dust exposures ([U.S. EPA, 2021b](#)). For inhalation exposure to PNOR, EPA determined the 50th and  
2125 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS Codes starting  
2126 with 326 (Plastics and Rubber Manufacturing). EPA multiplied these dust concentrations by the industry  
2127 provided maximum potential DCHP concentration in the raw additive material (*i.e.*, 60%) to estimate  
2128 DCHP particulate concentrations in the air. Therefore, the differences in the central tendency and high-  
2129 end dust concentrations led to significant differences between the central tendency and high-end risk  
2130 estimates.

2131  
2132 Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a  
2133 worker may experience in the compounding industry, the composition of workplace dust is uncertain.  
2134 The exposure and risk estimates assume that the concentration of DCHP in workplace dust is the same  
2135 as the concentration of DCHP in the raw material. However, it is likely that workplace dust contains a  
2136 variety of constituents that do not contain any DCHP in addition to particles from DCHP-containing raw  
2137 materials. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in  
2138 the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP  
2139 in the raw material. Due to the uncertainty of DCHP concentrations in workplace dust, central tendency  
2140 values of exposure are expected to be most reflective of worker exposures within the COUs covered

2141 under the “Non-PVC Material Compounding” OES (*i.e.*, Processing COUs: Plasticizer in plastic  
2142 material and resin manufacturing; Plastics product manufacturing; Rubber product manufacturing;  
2143 Stabilizing agent in plastics product manufacturing).

#### 2144 ***PVC Plastics Converting***

2145 For PVC plastics converting, inhalation exposure from dust generation is expected to be the dominant  
2146 route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from  
2147 8.2 to 13 for average adult workers and women of reproductive age, while high-end dermal MOEs  
2148 ranged from 532 to 845 (Benchmark = 30). For central tendency, MOEs for the same population and  
2149 exposure scenarios ranged from 168 to 309 for inhalation exposure and 1,064 to 1,929 for dermal  
2150 exposures (Benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible  
2151 differences in risk when compared to risk estimates from inhalation exposure alone. The reason for the  
2152 variation between high-end and central tendency estimates of worker inhalation exposures is described  
2153 below.  
2154

2155 EPA estimated worker inhalation exposures using the *Generic Model for Central Tendency and High-  
2156 End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* for  
2157 dust exposures ([U.S. EPA, 2021b](#)). For inhalation exposure to PNOR, EPA determined the 50th and  
2158 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS Codes starting  
2159 with 326 (Plastics and Rubber Manufacturing). EPA multiplied these dust concentrations by the industry  
2160 provided maximum potential DCHP concentration in PVC plastic (*i.e.*, 45%) to estimate DCHP  
2161 particulate concentrations in the air. Therefore, the differences in the central tendency and high-end dust  
2162 concentrations led to differences between the central tendency and high-end risk estimates.  
2163  
2164

2165 Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a  
2166 worker may experience in the converting industry, the composition of workplace dust is uncertain. The  
2167 exposure and risk estimates assume that the concentration of DCHP in workplace dust is the same as the  
2168 concentration of DCHP in the PVC plastic. However, it is likely that workplace dust contains a variety  
2169 of constituents that do not contain any DCHP in addition to particles from DCHP-containing PVC  
2170 plastics. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in  
2171 the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP  
2172 in the PVC plastic. Due to the uncertainty of DCHP concentrations in workplace dust, central tendency  
2173 values of exposure are expected to be most reflective of worker exposures within the COUs covered  
2174 under the “PVC plastics converting” OES (*i.e.*, Processing COU: Plasticizer in plastics product  
2175 manufacturing).  
2176

#### 2177 ***Non-PVC Material Converting***

2178 For non-PVC material converting, inhalation exposure from dust generation is expected to be the  
2179 dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure  
2180 ranged from 18 to 30 for average adult workers and women of reproductive age, while high-end dermal  
2181 MOEs ranged from 532 to 845 (Benchmark = 30). For central tendency, MOEs for the same population  
2182 and exposure scenarios ranged from 378 to 696 for inhalation exposure and 1,064 to 1,929 for dermal  
2183 exposures (Benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible  
2184 differences in risk when compared to risk estimates from inhalation exposure alone. The reason for the  
2185 variation between high-end and central tendency estimates of worker inhalation exposures is described  
2186 below.  
2187

2188 EPA estimated worker inhalation exposures using the *Generic Model for Central Tendency and High-  
2189 End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* for

2190 dust exposures ([U.S. EPA, 2021b](#)). For inhalation exposure to PNOR, EPA determined the 50th and  
2191 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS Codes starting  
2192 with 326 (Plastics and Rubber Manufacturing). EPA multiplied these dust concentrations by the industry  
2193 provided maximum potential DCHP concentration in non-PVC material (*i.e.*, 20%) to estimate DCHP  
2194 particulate concentrations in the air. Therefore, the differences in the central tendency and high-end dust  
2195 concentrations led to differences between the central tendency and high-end risk estimates.  
2196

2197 Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a  
2198 worker may experience in the converting industry, the composition of workplace dust is uncertain. The  
2199 exposure and risk estimates assume that the concentration of DCHP in workplace dust is the same as the  
2200 concentration of DCHP in the non-PVC material. However, it is likely that workplace dust contains a  
2201 variety of constituents that do not contain any DCHP in addition to particles from DCHP-containing  
2202 non-PVC materials. The constituents that do not contain DCHP would dilute the overall concentration of  
2203 DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration  
2204 of DCHP in the non-PVC material. Due to the uncertainty of DCHP concentrations in workplace dust,  
2205 central tendency values of exposure are expected to be most reflective of worker exposures within the  
2206 COUs covered under the “Non-PVC Material Converting” OES (*i.e.*, Processing COUs: Plasticizer in  
2207 plastics product manufacturing; Rubber product manufacturing).  
2208

### 2209 *Application of Adhesives and Sealants*

2210 The applications of adhesives and sealants were assessed for solid and liquid products containing  
2211 DCHP. The majority of DCHP-containing adhesive and sealant products identified exist in solid form  
2212 and inhalation exposure from dust generation is expected to be the dominant route of exposure for solid  
2213 adhesive and sealant products, though dermal exposures to solid adhesive and sealant products  
2214 containing DCHP were also considered. There were a few liquid adhesive and sealant products  
2215 containing DCHP identified; however, liquid adhesive and sealant products containing DCHP are  
2216 extremely viscous and are better classified as “paste-like” materials. The literature and product data do  
2217 not indicate the potential for spray coating of DCHP-containing adhesive and sealant products;  
2218 therefore, inhalation exposures from the use of liquid adhesive and sealant chemicals containing DCHP  
2219 are expected to be *de minimis* since there are no mists generated during use, and the vapor pressure of  
2220 DCHP is very low. Consequently, EPA assumed negligible inhalation exposure from the use of liquid  
2221 adhesive and sealant products containing DCHP and only assessed dermal exposures for liquid adhesive  
2222 and sealant use. Risk values associated with the use of liquid adhesive and sealant products containing  
2223 DCHP are covered under the “Application of adhesives and sealants – liquids” OES (*i.e.*, Industrial  
2224 COUs: Adhesives and sealants (transportation equipment manufacturing; computer and electronic  
2225 product manufacturing) and Commercial COUs: Adhesives and sealants). See Appendix F of the *Draft*  
2226 *Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate (DCHP)*  
2227 ([U.S. EPA, 2024g](#)) for product details.  
2228

2229 MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 6.4 to 10 for  
2230 average adult workers and women of reproductive age, while high-end dermal MOEs ranged from 532  
2231 to 845 (Benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios  
2232 ranged from 116 to 201 for inhalation exposure and 1,064 to 1,821 for dermal exposures (Benchmark =  
2233 30). For dust exposure from solid products, the aggregation of inhalation and dermal exposures led to  
2234 negligible differences in risk when compared to risk estimates from inhalation exposure alone. The use  
2235 of liquid adhesive and sealant products is not expected to produce an inhalation exposure and therefore  
2236 dermal exposure to the liquid is expected to be the dominant route of exposure. For liquid adhesive and  
2237 sealant products, the high-end and central tendency dermal MOEs ranged from 532 to 845 and 1,064 to  
2238 1,821, respectively (Benchmark = 30). The reason for the variation between high-end and central

2239 tendency estimates of inhalation exposure to dust and the rationale for not assessing inhalation data for  
2240 liquids is described below.

2241  
2242 EPA estimated worker inhalation exposures to dust from solid products using the *Generic Model for*  
2243 *Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not*  
2244 *Otherwise Regulated (PNOR)* for dust exposures ([U.S. EPA, 2021b](#)). The application of adhesives and  
2245 sealants does not fall under a specific NAICS Code; therefore, EPA used the entire PNOR model data  
2246 set to estimate DCHP particulate concentrations in the air during the use of solid DCHP-containing  
2247 adhesive and sealant products. EPA determined the 50th and 95th percentiles of the surrogate dust  
2248 monitoring data and multiplied these dust concentrations by the maximum potential DCHP  
2249 concentration in solid adhesive and sealant products (*i.e.*, 55%) to estimate DCHP particulate  
2250 concentrations in the air. Therefore, the differences in the central tendency and high-end dust  
2251 concentrations led to differences between the central tendency and high-end risk estimates.

2252  
2253 Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a  
2254 worker may experience in a variety of industries, the composition of workplace dust is uncertain. The  
2255 exposure and risk estimates assume that the concentration of DCHP in workplace dust is the same as the  
2256 concentration of DCHP in the adhesive or sealant material. However, it is likely that workplace dust  
2257 contains a variety of constituents that do not contain any DCHP in addition to particles from solid  
2258 DCHP-containing adhesive and sealant products. The constituents that do not contain DCHP would  
2259 dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust  
2260 is likely less than the concentration of DCHP in solid adhesive and sealant products. Due to the  
2261 uncertainty of DCHP concentrations in workplace dust, central tendency values of exposure are  
2262 expected to be most reflective of worker exposures within the COUs covered under the “Application of  
2263 adhesives and sealants – solids” OES (*i.e.*, Industrial COUs: Adhesives and sealants (Transportation  
2264 equipment manufacturing; Computer and electronic product manufacturing) and Commercial COUs:  
2265 Adhesives and sealants).

### 2266 2267 ***Application of Paints and Coatings***

2268 The applications of paints and coatings were assessed for solid and liquid products containing DCHP.  
2269 For the liquid and solid paint and coating products containing DCHP, inhalation exposure is expected to  
2270 be the dominant route of exposure. For liquids, inhalation exposure is expected to occur primarily from  
2271 mist during spray application of the product, and for solids, inhalation exposure is expected to primarily  
2272 occur from dust release of the solid product prior to mixing with other components. Therefore, EPA  
2273 distinguished exposure estimates between *liquid spray* and *solid dust* exposure from the application of  
2274 paint and coating products containing DCHP. MOEs for high-end acute, intermediate, and chronic  
2275 inhalation exposure from the *liquid spray application scenario* ranged from 2.0 to 3.2 for average adult  
2276 workers and women of reproductive age, while high-end dermal MOEs ranged from 532 to 845  
2277 (Benchmark = 30). For central tendency of the *liquid spray application scenario*, MOEs for the same  
2278 populations and exposure scenarios ranged from 41 to 66 for inhalation exposures and 1,064 to 1,689 for  
2279 dermal exposures (Benchmark = 30). MOEs for high-end acute, intermediate, and chronic inhalation  
2280 exposure from the *solid dust scenario* ranged from 3.5 to 5.7 for average adult workers and women of  
2281 reproductive age, while high-end dermal MOEs ranged from 532 to 845 (Benchmark = 30). For central  
2282 tendency of the *solid dust scenario*, MOEs for the same populations and exposure scenarios ranged from  
2283 62 to 100 for inhalation exposure and 1,064 to 1,689 for dermal exposure (Benchmark = 30).  
2284 Aggregation of inhalation and dermal exposures led to small differences in MOEs when compared to  
2285 MOE estimates from dominant exposure route alone.

2287 For the “Application of paint and coatings – liquids” exposure scenario, EPA relied on mist monitoring  
2288 data from the ESD on Coating Application via Spray-Painting in the Automotive Refinishing Industry  
2289 (OECD, 2011a), which showed that the central tendency (*i.e.*, 50th percentile) of mist concentrations  
2290 from automotive refinishing was 3.38 mg/m<sup>3</sup> and the high-end (*i.e.*, 95th percentile) was 22.1 mg/m<sup>3</sup>.  
2291 These mist concentration data were derived from a variety of industrial and commercial automotive  
2292 refinishing scenarios (*e.g.*, different gun types and booth configurations), but all scenarios considered in  
2293 the ESD commonly used the spray application of auto refinishing coatings. While the tasks evaluated for  
2294 mist concentrations varied in time, with the 95th percentile of spray times among tasks being 141  
2295 minutes, EPA assumed that these mist concentrations may be persistent in an environment where  
2296 spraying occurs throughout all or most of the workday. The more highly pressurized spray guns  
2297 generally lead to higher inhalation exposure levels, and less pressurized spray guns generally lead to  
2298 lower inhalation exposure levels. The same trend is expected for dermal exposure. Specifically, high-  
2299 pressure spray applications are more likely to lead to higher levels of dermal exposure, and low-pressure  
2300 spray guns are more likely to lead to lower levels of dermal exposure. However, there are a variety of  
2301 factors other than spray equipment type that affect exposure levels, such as spray booth ventilation  
2302 configuration, product concentration, and spray duration. High-end levels of exposure represent  
2303 scenarios where one or more factors are contributing to unusually elevated exposure levels, whereas  
2304 central tendency levels of exposure represent more typical levels of exposure for scenarios where there  
2305 are few factors contributing to increased exposure. There is uncertainty regarding the particular  
2306 combination of factors that would lead to high-end levels of exposure.

2307  
2308 The range of exposure estimates shown in Table 4-14 for “Application of paints and coatings – liquids”  
2309 are potentially reflective of industrial or commercial operations where paints and coatings are applied  
2310 using spray methods (*i.e.*, Industrial COU: Paints and coatings; and Commercial COU: Paints and  
2311 coatings). As described in the section above, EPA assumed that task-based mist concentrations may be  
2312 persistent throughout the entirety of a workday, which is realistic but on the conservative end of  
2313 expected exposure duration for spray coating scenarios. The central tendency estimates of the spray  
2314 application scenario represent the midpoint of available product concentrations and the mist  
2315 concentration from the 50th percentile of the data presented in the ESD on Coating Application via  
2316 Spray-Painting in the Automotive Refinishing Industry ([OECD, 2011a](#)), and these levels of exposure are  
2317 expected to be typical for standard working conditions where workers are spray applying paint and  
2318 coating products containing DCHP for up to 8 hours per day. However, it is noted that there are several  
2319 factors that affect exposure levels related to the spray application of paint and coating chemicals  
2320 including spray equipment type, spray booth ventilation configuration, product concentration, and spray  
2321 duration.

2322  
2323 High-end levels of exposure may occur if one or more of these factors contribute to elevated levels of  
2324 exposure; however, there is uncertainty regarding the conditions associated with high-end exposures.  
2325 Because the high-end risk estimates are based on high-end mist concentration levels, high-end product  
2326 concentration, and high-end exposure duration, the high-end risk values presented in Table 4-14 for  
2327 “Application of paints and coatings – liquids” may overestimate exposures for typical working  
2328 conditions. However, EPA does expect high-pressure spray application of paint and coating products  
2329 containing DCHP based on the available product information. Specifically, EPA identified one product  
2330 ([Carboline, 2019b](#)) that is intended for high-pressure spray application and the concentration of DCHP  
2331 in the product is listed as up to 2.5 percent. For an 8-hour workday spent spraying with a paint/coating  
2332 product containing 2.5 percent DCHP, mist levels exceeding 12.8 mg/m<sup>3</sup> (*i.e.*, 91st percentile of the  
2333 distribution of mist monitoring data) would result in risk values below the benchmark MOE. Although  
2334 most worker exposures to DCHP through spray application of paints and coatings are expected to be  
2335 closer to the central tendency exposure values for this COU, a confluence of a subset of variables (*e.g.*,

low ventilation, high-pressure spray, *etc.*) would result in risk below the benchmark. While most workers are not expected to experience elevated exposures (*i.e.*, greater than 90th percentile of mist concentration data for an 8-hour period) on a daily basis, it is considered plausible and expected for such exposures to occur in an acute one-day scenario.

For any liquid paint and coating products that are applied using non-spray methods (*i.e.*, Industrial COUs: Inks, toner, and colorant products [*e.g.*, screen printing ink]; Cellulose film production; Paints and coatings; and Commercial COUs: Inks, toner, and colorant products [*e.g.*, screen printing ink]; Paints and coatings), inhalation exposures are expected to be *de minimis* because mists or dusts are not generated during application and the vapor pressure of DCHP is extremely low at room temperature. However, workers may be exposed through the dermal route under non-spray application scenarios. Therefore, exposures associated with the non-spray application of liquid paint and coating products containing DCHP are characterized by the range of dermal risk values only, which are shown in Table 4-16 for “Application of paints and coatings – liquids.”

For the “Application of paints and coatings – solids” exposure scenario, EPA estimated worker inhalation exposures to dust from solid products using the *Generic Model for Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* for dust exposures ([U.S. EPA, 2021b](#)). The application of paints and coatings does not fall under a specific NAICS Code; therefore, EPA used the entire PNOR model data set to estimate DCHP particulate concentrations in the air during the use of solid DCHP-containing paint and coating products. EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data and multiplied these dust concentrations by the maximum potential DCHP concentration in the solid paint and coating component (*i.e.*, 100%) to estimate DCHP particulate concentrations in the air. Therefore, the differences in the central tendency and high-end dust concentrations led to differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in a variety of industries, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DCHP in workplace dust is the same as the concentration of DCHP in the solid paint and coating component. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from solid DCHP-containing paint and coating products. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in solid paint and coating products. Due to the uncertainty of DCHP concentrations in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the “Application of paints and coatings – solids” OES (*i.e.*, Industrial COUs: Inks, toner, and colorant products [*e.g.*, screen printing ink]; Cellulose film production; Paints and coatings; and Commercial COUs: Inks, toner, and colorant products [*e.g.*, screen printing ink]; Paints and coatings).

### ***Use of Laboratory Chemicals***

The use of laboratory chemicals was assessed for solid and liquid products containing DCHP. Inhalation exposure from dust generation is expected to be the dominant route of exposure for solid laboratory chemicals. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 6.4 to 10 for average adult workers and women of reproductive age, while high-end dermal MOEs ranged from 532 to 845 (Benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 91 to 157 for inhalation exposure and 1,064 to 1,797 for dermal exposures (Benchmark = 30). For dust exposure, the aggregation of inhalation and dermal exposures led to

negligible differences in risk when compared to risk estimates from inhalation exposure alone. The use of liquid laboratory chemicals is not expected to produce an inhalation exposure and therefore dermal exposure to the liquid is expected to be the dominant route of exposure. For liquid laboratory chemicals, the high-end and central tendency dermal MOEs ranged from 532 to 845 and 1,064 to 1,797, respectively (Benchmark = 30). The reason for the variation between high-end and central tendency estimates of worker inhalation exposure to dust and the rationale for not assessing inhalation data for liquids is described below.

EPA assessed worker inhalation exposures to dust from solid laboratory chemicals. The literature and product data do not indicate the potential for the generation of mists during the use of liquid lab chemicals. Therefore, inhalation exposures from the use of liquid DCHP-containing lab chemicals containing DCHP are expected to be *de minimis* because there are no mists generated during use and the vapor pressure of DCHP is very low. Consequently, EPA assumed negligible inhalation exposure from the use of liquid lab chemicals and only assessed dermal exposures for liquid laboratory chemical use.

EPA estimated worker inhalation exposures to dust from solid laboratory chemicals using the *Generic Model for Central Tendency and High-End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* for dust exposures ([U.S. EPA, 2021b](#)). For inhalation exposure to PNOR, EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS Codes starting with 54 (Professional, Scientific, and Technical Services). EPA determined the 50th and 95th percentiles of the surrogate dust monitoring data and multiplied these dust concentrations by the industry provided maximum potential DCHP concentration in lab chemicals (*i.e.*, 100%) to estimate DCHP particulate concentrations in the air. Therefore, the differences in the central tendency and high-end dust concentrations led to differences between the central tendency and high-end risk estimates.

Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a worker may experience in the laboratory services industry, the composition of workplace dust is uncertain. The exposure and risk estimates assume that the concentration of DCHP in workplace dust is the same as the concentration of DCHP in the laboratory chemicals. However, it is likely that workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles from solid DCHP-containing laboratory chemicals. The constituents that do not contain DCHP would dilute the overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in the solid laboratory chemicals. Due to the uncertainty of DCHP concentrations in workplace dust, central tendency values of exposure are expected to be most reflective of worker exposures within the COUs covered under the “Use of lab chemicals” OES (*i.e.*, Commercial COU: Laboratory chemical).

#### ***Fabrication or Use of Final Products or Articles***

For fabrication or use of final products or articles, inhalation exposure from dust generation is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic inhalation exposure ranged from 21 to 35 for average adult workers and women of reproductive age, whereas high-end dermal MOEs for the same populations and exposure scenarios ranged from 532 to 845 (Benchmark = 30). For central tendency, MOEs for the same population and exposure scenarios ranged from 193 to 311 for inhalation exposure and 1,064 to 1,689 for dermal exposures (Benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible differences in risk when compared to risk estimates from inhalation exposure alone. The variations between the central tendency and high-end estimates of worker inhalation exposures are described below.

2434 EPA estimated worker inhalation exposures using the *Generic Model for Central Tendency and High-*  
2435 *End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* for  
2436 dust exposures ([U.S. EPA, 2021b](#)). For inhalation exposure to PNOR, EPA determined the 50th and  
2437 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS Codes starting  
2438 with 337 (Furniture and Related Product Manufacturing). EPA multiplied these dust concentrations by  
2439 the maximum DCHP concentration in PVC (*i.e.*, 45%) to estimate DCHP particulate concentrations in  
2440 the air. Therefore, the differences in the central tendency and high-end dust concentrations led to  
2441 significant differences between the central tendency and high-end risk estimates.  
2442

2443 Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a  
2444 worker may experience in the end use and fabrication industries, the composition of workplace dust is  
2445 uncertain. The exposure and risk estimates assume that the concentration of DCHP in workplace dust is  
2446 the same as the concentration of DCHP in the PVC material. However, it is likely that workplace dust  
2447 contains a variety of constituents that do not contain any DCHP in addition to particles from DCHP-  
2448 containing products or articles. The constituents that do not contain DCHP would dilute the overall  
2449 concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely less than  
2450 the concentration of DCHP in final products and articles. Due to the uncertainty of DCHP  
2451 concentrations in workplace dust, central tendency values of exposure are expected to be most reflective  
2452 of worker exposures within the COUs covered under the “Fabrication or use of final products or  
2453 articles” OES (*i.e.*, Industrial COU: Plastic and rubber products not covered elsewhere in transportation  
2454 equipment manufacturing; and Commercial COUs: Building/construction materials not covered  
2455 elsewhere; Other articles with routine direct contact during normal use including rubber articles; Plastic  
2456 articles [hard]).  
2457

### 2458 ***Recycling and Waste Handling, Treatment, and Disposal***

2459 The approaches for the Recycling OES and the Waste handling, treatment and disposal OES are  
2460 identical and therefore consolidated here. For both OESs, the inhalation exposure from dust generation  
2461 is expected to be the dominant route of exposure. MOEs for high-end acute, intermediate, and chronic  
2462 inhalation exposure ranged from 11 to 18 for average adult workers and women of reproductive age,  
2463 while high-end dermal MOEs for the same populations and exposure scenarios ranged from 532 to 845  
2464 (Benchmark = 30) for both OESs. The central tendency MOEs for the same populations and exposure  
2465 scenarios ranged from 161 to 291 for inhalation exposure and 1,064 to 1,894 for dermal exposure for  
2466 both OES (Benchmark = 30). Aggregation of inhalation and dermal exposures led to negligible  
2467 differences in risk when compared to risk estimates from inhalation exposure alone. The variations  
2468 between the central tendency and high-end estimates of worker inhalation exposures are described  
2469 below.  
2470

2471 EPA estimated worker inhalation exposures using the *Generic Model for Central Tendency and High-*  
2472 *End Inhalation Exposure to Total and Respirable Particulates Not Otherwise Regulated (PNOR)* for  
2473 dust exposures ([U.S. EPA, 2021b](#)). For inhalation exposure to PNOR, EPA determined the 50th and  
2474 95th percentiles of the surrogate dust monitoring data taken from facilities with NAICS Codes starting  
2475 with 56 (Administrative and Support and Waste Management and Remediation Services). EPA  
2476 multiplied these dust concentrations by the industry provided maximum DCHP concentration in PVC  
2477 (*i.e.*, 45%) to estimate DCHP particulate concentrations in the air. PVC concentration was used for this  
2478 estimate because it is expected to be the predominant type of waste containing DCHP that is recycled or  
2479 disposed of. Therefore, the differences in the central tendency and high-end dust concentrations led to  
2480 significant differences between the central tendency and high-end risk estimates.  
2481

2482 Although the PNOR (*i.e.*, dust) concentration data provides a reliable range of dust concentrations that a

2483 worker may experience in the recycling and disposal industry, the composition of workplace dust is  
2484 uncertain. The exposure and risk estimates are based on the assumption that the concentration of DCHP  
2485 in workplace dust is the same as the concentration of DCHP in PVC plastics. However, it is likely that  
2486 workplace dust contains a variety of constituents that do not contain any DCHP in addition to particles  
2487 from DCHP-containing products or articles. The constituents that do not contain DCHP would dilute the  
2488 overall concentration of DCHP in the dust, and the concentration of DCHP in workplace dust is likely  
2489 less than the concentration of DCHP in recycled or disposed products or articles. Therefore, central  
2490 tendency values of exposure are expected to be more reflective of worker exposures within the COUs  
2491 covered under the “Recycling” and the “Disposal” OESs (*i.e.*, Processing COU: Recycling; and Disposal  
2492 COU: Disposal).  
2493

#### 2494 ***Distribution in Commerce***

2495 Distribution in commerce includes transporting DCHP or DCHP-containing products between work  
2496 sites or to final use sites as well as loading and unloading from transport vehicles. Individuals in  
2497 occupations that transport DCHP-containing products (*e.g.*, truck drivers) or workers who load and  
2498 unload transport trucks may encounter DCHP or DCHP-containing products.  
2499

2500 Although some worker activities (*e.g.*, loading or unloading) associated with distribution in commerce  
2501 are similar to COUs such as manufacturing or import, it is expected that workers involved in distribution  
2502 in commerce spend less time exposed to DCHP than workers in manufacturing or import facilities since  
2503 only part of the workday is spent in an area with potential exposure. Therefore, occupational exposures  
2504 associated with the distribution in commerce COU are expected to be less than other COUs with similar  
2505 worker activities (*i.e.*, manufacturing and import).

#### 2506 **4.3.2.1 Overall Confidence in Worker Risk Estimates for Individual DCHP COUs**

2507 As described in Section 4.1.1.5, EPA has moderate confidence in the assessed occupational inhalation  
2508 and dermal exposures (Table 4-5) and robust confidence in the non-cancer POD selected to characterize  
2509 risk from acute, intermediate, and chronic duration exposures to DCHP (Section 4.2). Overall, the  
2510 Agency has moderate confidence in the risk estimates calculated for worker and ONU inhalation and  
2511 dermal exposure scenarios. Sources of uncertainty associated with the occupational COUs are discussed  
2512 above in Section 4.3.2.

2513 Table 4-14. Occupational Aggregate Risk Summary Table for DCHP

Life Cycle Stage/ Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
					Acute	Intermed.	Chronic	Acute	Intermed.	Chronic	Acute	Intermed.	Chronic
Manufacturing – Domestic Manufacturing	Domestic manufacturing	Manufacturing	Average Adult Worker	High-End	3.8	5.2	5.6	532	725	776	3.8	5.2	5.6
				Central Tendency	40	55	58	1,064	1,451	1,553	39	53	56
			Women of Reproductive Age	High-End	3.5 <sup>a</sup>	4.7	5.1	579 <sup>a</sup>	789	845	3.5 <sup>a</sup>	4.7	5.0
				Central Tendency	36 <sup>a</sup>	49	53	1,157 <sup>a</sup>	1,578	1,689	35 <sup>a</sup>	48	51
			ONU	High-End	40	55	58	1,064	1,451	1,553	39	53	56
				Central Tendency	40	55	58	1,064	1,451	1,553	39	53	56
Manufacturing – Importing	Importing	Import and repackaging	Average Adult Worker	High-End	6.4	8.7	9.3	532	725	776	6.3	8.6	9.2
				Central Tendency	148	201	259	1,064	1,451	1,867	130	177	228
			Women of Reproductive Age	High-End	5.8 <sup>a</sup>	7.9	8.5	579 <sup>a</sup>	789	845	5.7 <sup>a</sup>	7.8	8.4
Central Tendency	134 <sup>a</sup>			182	235	1,157 <sup>a</sup>	1,578	2,031	120 <sup>a</sup>	163	210		
Processing – Repackaging	Repackaging (e.g., laboratory chemicals)		ONU	High-End	148	201	216	1,064	1,451	1,553	130	177	189
				Central Tendency	148	201	259	1,064	1,451	1,867	130	177	228

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Life Cycle Stage/ Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
					Acute	Intermed.	Chronic	Acute	Intermed.	Chronic	Acute	Intermed.	Chronic
Processing – Processing – incorporation into formulation, mixture, or reaction product	Plasticizer in: – adhesive manufacturing	Incorporation into adhesives and sealants	Average Adult Worker	High-End	3.8	5.2	5.6	532	725	776	3.8	5.2	5.6
	Central Tendency			40	55	58	1,064	1,451	1,553	39	53	56	
	Stabilizing agent in: – adhesive manufacturing		Women of Reproductive Age	High-End	3.5 <sup>a</sup>	4.7	5.1	579 <sup>a</sup>	789	845	3.5 <sup>a</sup>	4.7	5.0
				Central Tendency	36 <sup>a</sup>	49	53	1,157 <sup>a</sup>	1,578	1,689	35 <sup>a</sup>	48	51
	ONU		ONU	High-End	40	55	58	1,064	1,451	1,553	39	53	56
				Central Tendency	40	55	58	1,064	1,451	1,553	39	53	56
Processing – Processing – incorporation into formulation, mixture, or reaction product	Plasticizer in: – paint and coating manufacturing – printing ink manufacturing	Incorporation into paints and coatings	Average Adult Worker	High-End	3.8	5.2	5.6	532	725	776	3.8	5.2	5.6
	Central Tendency			40	55	58	1,064	1,451	1,553	39	53	56	
	Stabilizing agent in: – Paint and coating manufacturing		Women of Reproductive Age	High-End	3.5 <sup>a</sup>	4.7	5.1	579 <sup>a</sup>	789	845	3.5 <sup>a</sup>	4.7	5.0
				Central Tendency	36 <sup>a</sup>	49	53	1,157 <sup>a</sup>	1,578	1,689	35 <sup>a</sup>	48	51
	ONU		ONU	High-End	40	55	58	1,064	1,451	1,553	39	53	56
				Central Tendency	40	55	58	1,064	1,451	1,553	39	53	56

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Life Cycle Stage/ Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
					Acute	Intermed.	Chronic	Acute	Intermed.	Chronic	Acute	Intermed.	Chronic
Processing – Processing – incorporation into formulation, mixture, or reaction product	Stabilizing agent in: – asphalt paving, roofing, and coating materials manufacturing	Incorporation into other formulations, mixtures, and reaction products not covered elsewhere	Average Adult Worker	High-End	3.8	5.2	5.6	532	725	776	3.8	5.2	5.6
				Central Tendency	40	55	58	1,064	1,451	1,553	39	53	56
			Women of Reproductive Age	High-End	3.5 <sup>a</sup>	4.7	5.1	579 <sup>a</sup>	789	845	3.5 <sup>a</sup>	4.7	5.0
				Central Tendency	36 <sup>a</sup>	49	53	1,157 <sup>a</sup>	1,578	1,689	35 <sup>a</sup>	48	51
			ONU	High-End	40	55	58	1,064	1,451	1,553	39	53	56
				Central Tendency	40	55	58	1,064	1,451	1,553	39	53	56
Processing – Processing – incorporation into formulation, mixture, or reaction product	Plasticizer in: – plastic material and resin manufacturing – plastics product manufacturing	PVC plastics compounding	Average Adult Worker	High-End	4.1	5.6	6.0	532	725	776	4.1	5.5	5.9
				Central Tendency	83	114	137	1,064	1,451	1,741	77	106	127
			Women of Reproductive Age	High-End	3.7 <sup>a</sup>	5.0	5.4	579 <sup>a</sup>	789	845	3.7 <sup>a</sup>	5.0	5.4
	Central Tendency			76 <sup>a</sup>	103	124	1,157 <sup>a</sup>	1,578	1,894	71 <sup>a</sup>	97	116	
	ONU		High-End	83	114	122	1,064	1,451	1,553	77	106	113	
			Central Tendency	83	114	137	1,064	1,451	1,741	77	106	127	

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Life Cycle Stage/ Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
					Acute	Intermed.	Chronic	Acute	Intermed.	Chronic	Acute	Intermed.	Chronic
Processing – Processing – incorporation into article	Plasticizer in: – Plastics product manufacturing	PVC plastics converting	Average Adult Worker	High-End	9.1	12	13	532	725	776	8.9	12	13
				Central Tendency	186	253	309	1,064	1,451	1,773	158	215	263
			Women of Reproductive Age	High-End	8.2 <sup>a</sup>	11	12	579 <sup>a</sup>	789	845	8.1 <sup>a</sup>	11	12
				Central Tendency	168 <sup>a</sup>	229	280	1,157 <sup>a</sup>	1,578	1,929	147 <sup>a</sup>	200	244
			ONU	High-End	186	253	271	1,064	1,451	1,553	158	215	231
				Central Tendency	186	253	309	1,064	1,451	1,773	158	215	263
Processing – Processing – incorporation into formulation, mixture, or reaction product	Plasticizer in: – plastics product manufacturing – rubber product manufacturing – plastic material and resin manufacturing	Non-PVC material compounding	Average Adult Worker	High-End	6.8	9.3	9.9	532	725	776	6.7	9.2	9.8
				Central Tendency	139	190	217	1,064	1,451	1,659	123	168	192
			Women of Reproductive Age	High-End	6.2 <sup>a</sup>	8.4	9.0	579 <sup>a</sup>	789	845	6.1 <sup>a</sup>	8.3	8.9
				Central Tendency	126 <sup>a</sup>	172	196	1,157 <sup>a</sup>	1,578	1,805	114 <sup>a</sup>	155	177
	ONU		High-End	139	190	203	1,064	1,451	1,553	123	168	180	
			Central Tendency	139	190	217	1,064	1,451	1,659	123	168	198	
	Stabilizing agent in: – Plastics product manufacturing		ONU	High-End	139	190	203	1,064	1,451	1,553	123	168	180
				Central Tendency	139	190	217	1,064	1,451	1,659	123	168	198

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Life Cycle Stage/ Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
					Acute	Intermed.	Chronic	Acute	Intermed.	Chronic	Acute	Intermed.	Chronic
Processing – Processing – incorporation into article	Plasticizer in: – plastics product manufacturing – rubber product manufacturing	Non-PVC material converting	Average Adult Worker	High-End	20	28	30	532	725	776	20	27	29
				Central Tendency	417	569	696	1,064	1,451	1,773	300	409	500
			Women of Reproductive Age	High-End	18 <sup>a</sup>	25	27	579 <sup>a</sup>	789	845	18 <sup>a</sup>	24	26
				Central Tendency	378 <sup>a</sup>	515	630	1,157 <sup>a</sup>	1,578	1,929	285 <sup>a</sup>	388	475
			ONU	High-End	417	569	609	1,064	1,451	1,553	300	409	438
				Central Tendency	417	569	696	1,064	1,451	1,773	300	409	500
Industrial Use – Finishing agent	Cellulose film production	Application of paints and coatings – liquids	Average Adult Worker	High-End	2.2	3.0	3.2	532	725	776	2.2	2.9	3.2
Industrial Use – Inks, toner, and colorant products	Inks, toner, and colorant products (e.g., screen printing ink)			Central Tendency	45	62	66	1,064	1,451	1,553	44	59	64
Commercial Use – Inks, toner, and colorant products	Inks, toner, and colorant products (e.g., screen printing ink)		Women of Reproductive Age	High-End	2.0 <sup>a</sup>	2.7	2.9	579 <sup>a</sup>	789	845	2.0 <sup>a</sup>	2.7	2.9
				Central Tendency	41 <sup>a</sup>	56	60	1,157 <sup>a</sup>	1,578	1,689	40 <sup>a</sup>	54	58
Industrial Use – Paints and coatings	Paints and coatings		ONU	High-End	45	62	66	1,064	1,451	1,553	44	59	64
				Central Tendency	45	62	66	1,064	1,451	1,553	44	59	64
Commercial Use – Paints and coatings	Paints and coatings												

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Life Cycle Stage/ Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
					Acute	Intermed.	Chronic	Acute	Intermed.	Chronic	Acute	Intermed.	Chronic
Industrial Use – Finishing agent	Cellulose film production	Application of paints and coatings – solids	Average Adult Worker	High-End	3.9	5.3	5.7	532	725	776	3.9	5.3	5.7
Industrial Use – Inks, toner, and colorant products	Inks, toner, and colorant products (e.g., screen printing ink)			Central Tendency	69	94	100	1,064	1,451	1,553	64	88	94
Commercial Use – Inks, toner, and colorant products	Inks, toner, and colorant products (e.g., screen printing ink)		Women of Reproductive Age	High-End	3.5 <sup>a</sup>	4.8	5.2	579 <sup>a</sup>	789	845	3.5 <sup>a</sup>	4.8	5.1
				Central Tendency	62 <sup>a</sup>	85	91	1,157 <sup>a</sup>	1,578	1,689	59 <sup>a</sup>	80	86
Industrial Use – Paints and coatings	Paints and coatings		ONU	High-End	69	94	100	1,064	1,451	1,553	64	88	94
Commercial Use – Paints and coatings	Paints and coatings	Central Tendency		69	94	100	1,064	1,451	1,553	64	88	94	
Industrial Uses – Adhesives and sealants	Adhesives and sealants (e.g., computer and electronic product manufact.; transportation equipment manufact.)	Application of adhesives and sealants – liquids	Average Adult Worker	High-End	N/A	N/A	N/A	532	725	776	532	725	776
				Central Tendency	N/A	N/A	N/A	1,064	1,451	1,674	1,064	1,451	1,674
Women of Reproductive Age	High-End		N/A	N/A	N/A	579 <sup>a</sup>	789	845	579 <sup>a</sup>	789	845		
	Central Tendency		N/A	N/A	N/A	1,157 <sup>a</sup>	1,578	1,821	1,157 <sup>a</sup>	1,578	1,821		
Commercial uses – Adhesives and sealants	Adhesives and sealants		ONU	High-End	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Central Tendency		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

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Life Cycle Stage/ Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
					Acute	Intermed.	Chronic	Acute	Intermed.	Chronic	Acute	Intermed.	Chronic
Industrial Uses – Adhesives and sealants	Adhesives and sealants in – computer and electronic product manufact.; transportation equipment manufact.	Application of adhesives and sealants – solids	Average Adult Worker	High-End	7.1	9.7	10	532	725	776	7.0	9.6	10
				Central Tendency	128	175	201	1,064	1,451	1,674	114	156	180
			Women of Reproductive Age	High-End	6.4 <sup>a</sup>	8.8	9.4	579 <sup>a</sup>	789	845	6.4 <sup>a</sup>	8.7	9.3
				Central Tendency	116 <sup>a</sup>	158	182	1,157 <sup>a</sup>	1,578	1,821	105 <sup>a</sup>	144	166
Commercial Uses – Adhesives and sealants	Adhesives and sealants		ONU	High-End	128	175	187	1,064	1,451	1,553	114	156	167
				Central Tendency	128	175	201	1,064	1,451	1,674	114	156	180
Commercial Use – Laboratory chemicals	Laboratory chemicals	Use of laboratory chemicals – liquid	Average Adult Worker	High-End	N/A	N/A	N/A	532	725	776	532	725	776
				Central Tendency	N/A	N/A	N/A	1,064	1,451	1,652	1,064	1,451	1,652
			Women of Reproductive Age	High-End	N/A	N/A	N/A	579 <sup>a</sup>	789	845	579 <sup>a</sup>	789	845
				Central Tendency	N/A	N/A	N/A	1,157 <sup>a</sup>	1,578	1,797	1,157 <sup>a</sup>	1,578	1,797
			ONU	High-End	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
				Central Tendency	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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Life Cycle Stage/ Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
					Acute	Intermed.	Chronic	Acute	Intermed.	Chronic	Acute	Intermed.	Chronic
Commercial Use – Laboratory chemicals	Laboratory chemicals	Use of laboratory chemicals – solid	Average Adult Worker	High-End	7.1	9.7	10	532	725	776	7.0	9.6	10
				Central Tendency	101	138	157	1,064	1,451	1,652	92	126	143
			Women of Reproductive Age	High-End	6.4 <sup>a</sup>	8.8	9.4	579 <sup>a</sup>	789	845	6.4 <sup>a</sup>	8.7	9.3
				Central Tendency	91 <sup>a</sup>	125	142	1,157 <sup>a</sup>	1,578	1,797	85 <sup>a</sup>	116	132
			ONU	High-End	101	138	148	1,064	1,451	1,553	92	126	135
				Central Tendency	101	138	157	1,064	1,451	1,652	92	126	143
Industrial Use – Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) (e.g., transportation equipment manufact.)	Fabrication or use of final products or articles	Average Adult Worker	High-End	24	32	35	532	725	776	23	31	33
				Central Tendency	213	291	311	1,064	1,451	1,553	178	242	259
			Women of Reproductive Age	High-End	21 <sup>a</sup>	29	31	579 <sup>a</sup>	789	845	21 <sup>a</sup>	28	30
Central Tendency	193 <sup>a</sup>	263		282	1,157 <sup>a</sup>	1,578	1,689	166 <sup>a</sup>	226	242			
Commercial Use – Building/ construction materials not covered elsewhere	Building/ construction materials not covered elsewhere	Fabrication or use of final products or articles	ONU	High-End	213	291	311	1,064	1,451	1,553	178	242	259
Commercial Use – Other articles with routine direct contact during normal use including rubber articles	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)			Central Tendency	213	291	311	1,064	1,451	1,553	178	242	259

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Life Cycle Stage/ Category	Subcategory	OES	Worker Population	Exposure Level	Inhalation Risk Estimates (Benchmark MOE = 30)			Dermal Risk Estimates (Benchmark MOE = 30)			Aggregate Risk Estimates (Benchmark MOE = 30)		
					Acute	Intermed.	Chronic	Acute	Intermed.	Chronic	Acute	Intermed.	Chronic
Processing – Recycling	Recycling	Recycling	Average Adult Worker	High-End	12	17	18	532	725	776	12	16	17
				Central Tendency	178	242	291	1,064	1,451	1,741	152	208	249
			Women of Reproductive Age	High-End	<i>11<sup>a</sup></i>	15	16	<i>579<sup>a</sup></i>	789	845	<i>11<sup>a</sup></i>	15	16
				Central Tendency	<i>161<sup>a</sup></i>	219	263	<i>1,157<sup>a</sup></i>	1,578	1,894	<i>141<sup>a</sup></i>	193	231
			ONU	High-End	178	242	260	1,064	1,451	1,553	152	208	222
				Central Tendency	178	242	291	1,064	1,451	1,741	152	208	249
Disposal – Disposal	Disposal	Waste handling, treatment and disposal	Average Adult Worker	High-End	12	17	18	532	725	776	12	16	17
				Central Tendency	178	242	291	1,064	1,451	1,741	152	208	249
			Women of Reproductive Age	High-End	<i>11<sup>a</sup></i>	15	16	<i>579<sup>a</sup></i>	789	845	<i>11<sup>a</sup></i>	15	16
				Central Tendency	<i>161<sup>a</sup></i>	219	263	<i>1,157<sup>a</sup></i>	1,578	1,894	<i>141<sup>a</sup></i>	193	231
			ONU	High-End	178	242	260	1,064	1,451	1,553	152	208	222
				Central Tendency	178	242	291	1,064	1,451	1,741	152	208	249

<sup>a</sup> Scaling by the RPF and application of the index chemical POD provides a more sensitive and robust hazard assessment than the DCHP-specific POD, given its more limited toxicological data set. Please see Table 4-22 for the RPF analysis values.

2514

### 4.3.3 Risk Estimates for Consumers

This section summarizes risk estimates for consumers from inhalation, ingestion, and dermal exposures, as well as aggregated exposures, to DCHP from individual DCHP COUs across routes. In this section, risks are calculated for all exposed populations based on the DCHP-derived PODs described in Section 4.2.2. Subsequently in Section 4.4.5, those same risks for consumers that are adults of reproductive age, infants, children, and teenagers exposed to DCHP at the highest levels (acute durations) are calculated using the more robust RPFs described in Section 4.4.1 and added to estimates of national non-attributable exposure of five toxicologically similar phthalates for an estimate of cumulative risk. Table 4-15 summarizes the dermal, inhalation, ingestion, and aggregate MOEs used to characterize non-cancer risk for acute, intermediate, and chronic exposure to DCHP and presents these values for all lifestages for each COU. A screening-level assessment for consumers considers high-intensity exposure scenarios which rely on conservative assumptions to assess exposures that would be expected to be on the high end of the expected exposure distribution. The corresponding high-intensity exposure scenario risk estimates are used as a conservative and health protective screening approach. MOEs for high-intensity exposure scenarios are shown for all consumer COUs, while MOEs for medium-intensity exposure scenarios are shown only for COUs with high-intensity MOEs close to the benchmark of 30 (no scenarios were in exceedance or within 20% of the benchmark). Exposure risk estimates were calculated considering product and article user and bystander. Bystanders are people that are not in direct use or application of a product but can be exposed to DCHP by proximity to the use of the product via inhalation of gas-phase emissions or suspended dust. Some product scenarios were assessed for children under 10 years as bystanders and children older than 11 years as users, because the products were not targeted for direct use by young children (<10 years). In instances where a lifestage could reasonably be either a product user or bystander, the inputs for a user were selected because that scenario would result in larger exposure doses.

Of note, the risk summary below is based on the most sensitive non-cancer endpoint for all relevant duration scenarios (*i.e.*, developmental toxicity for acute, intermediate, and chronic durations). MOEs for all high-, medium- and low-intensity exposure scenarios for all COUs are provided in the *Draft Consumer Risk Calculator for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024e](#)).

#### ***COUs with MOEs for High-Intensity Exposure Scenarios Ranging from 740 to 950,000***

All consumer COUs product and article examples resulted in MOEs for high-intensity exposure scenarios ranging from 740 for acute duration dermal exposure to DCHP from outdoor seating for infants (less than one year old) to 950,000 for intermediate duration inhalation of suspended dust from automotive adhesives for adults (21+ years) (Table 4-15). Variability in MOEs for these high-intensity exposure scenarios results from use of different exposure factors for each COU and product or article example that led to different estimates of exposure to DCHP. As described in the *Draft Consumer and Indoor Dust Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024c](#)) and *Draft Non-Cancer Human Health Hazard Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024v](#)), EPA has moderate to robust confidence in the exposure estimates and robust confidence in the non-cancer hazard value used to estimate non-cancer risk for these COUs.

#### ***Adhesives and Sealants***

Two different scenarios were assessed under this COU for products with differing use patterns for example, adhesives for small repairs (2 products) and automotive adhesives (2 products). The two scenarios capture the variability in product formulation and use patterns in the high, medium, and low intensity use estimates. The small repairs products are used in small amounts and have very short working times (<5 minutes), which limits the potential for inhalation exposure. However, if dermal

2563 exposure occurs during use it is possible that the product may not be washed off immediately, resulting  
2564 in exposure. As such, both products were modeled for dermal exposure only. The automotive adhesives  
2565 products may be used for large repairs to vehicle bodies and were assessed for both inhalation and  
2566 dermal exposure. The overall confidence in the inhalation exposure estimates for this COU is robust  
2567 because the CEM default parameters are representative and plausible use patterns and location of use.  
2568 For dermal exposure, EPA used a dermal flux approach. The Agency has moderate confidence in dermal  
2569 estimates because of the moderate uncertainty in the partitioning from product to skin. In addition,  
2570 subsequent dermal absorption is not well characterized or confirmed with experimental results.  
2571 However, other parameters such as frequency and duration of use, and surface area in contact, are well  
2572 understood and representative, resulting in an overall confidence of moderate in a health protective  
2573 estimate. Additionally, EPA has robust overall confidence in the underlying chronic POD based on  
2574 developmental toxicity (Section 4.2).

2575  
2576 Aggregate risk from dermal, ingestion, and inhalation exposures to DCHP for the two scenarios was also  
2577 considered. All three exposure routes are essentially negligible in their overall contribution to the  
2578 aggregate since the individual MOE values were significantly higher than the benchmark of 30.

2579  
2580 ***Other Articles with Routine Direct Contact During Normal Use Including Rubber Articles; Plastic***  
2581 ***Articles (Hard)***

2582 One scenario was assessed under this COU. It considered multiple articles and routine dermal contact  
2583 with similar use patterns. The scenario for small articles of routine dermal contact was assessed for  
2584 dermal exposures only because inhalation and ingestion would have low exposure potential due to the  
2585 small surface area of the articles and limited time spent in an indoor environment before disposal and  
2586 mouthing was not an expected behavior based on the generic article examples identified.

2587  
2588 The small articles with the potential for semi-routine contact scenario considers some generic example  
2589 descriptions but not specific products, for example labels, nitrocellulose; ethylcellulose; chlorinated  
2590 rubber; PVAc; PVC. These examples are expected to be used in smaller items and the primary exposure  
2591 route is through dermal contact when handling the goods. Although DCHP content was not reported or  
2592 measured in specific products, this scenario was included for dermal exposure calculations, which does  
2593 not use weight fractions. Dermal contact events are likely short and/or infrequent, but an individual  
2594 could have appreciable daily contact with multiple items. All acute and chronic MOE values were well  
2595 above the benchmark of 30. The MOE values increase with increasing age due to changes in inhalation  
2596 rate to body weight ratios, thus leading to decreasing exposure with increasing age.

2597  
2598 Dermal absorption estimates are based on the assumption that dermal absorption of DCHP from solid  
2599 objects would be limited by aqueous solubility of DCHP. EPA has slight confidence for solid objects  
2600 because the high uncertainty in the assumption of partitioning from solid to liquid and subsequent  
2601 dermal absorption is not well characterized. However, other parameters such as frequency and duration  
2602 of use, and surface area in contact, are well understood and representative, resulting in an overall  
2603 confidence of moderate in a health protective estimate. Additionally, EPA has robust overall confidence  
2604 in the underlying chronic POD based on developmental toxicity (Section 4.2).

2605  
2606 ***Other; Consumer Articles that Contain Dicyclohexyl Phthalate from: Inks, Toner, and Colorant,***  
2607 ***Paints and Coatings, Adhesives, and Sealants (e.g., Paper Products, Textiles, Products Using***  
2608 ***Cellulose Film, etc.)***

2609 Three different scenarios were assessed under this COU for articles with differing use patterns: Outdoor  
2610 seating, small articles with potential for routine contact (multiple non-specific articles), and electronics  
2611 containing dye adhesive (qualitative discussion). The outdoor seating and small articles scenarios were

2612 assessed for dermal exposures only. For the outside seating scenario, based on DCHP's waterproofing  
2613 and weather resistant properties and the expected use case for outdoor seating, EPA anticipated use of  
2614 this article occurs outdoors where air exchange rates are large; thus, inhalation exposure is expected to  
2615 be negligible. Dermal exposures were modeled for a scenario where consumers sit on coated surfaces  
2616 (e.g., on seats at a sporting event or directly on a terrace). The small articles with the potential for semi-  
2617 routine contact scenario considers generic examples but no specific items were identified (like labels for  
2618 cleaning products or arts and crafts materials); instead, EPA used article descriptors like labels and  
2619 packaging adhesives, foil and cellophane lacquers, and printing inks. These articles are expected to be  
2620 used in small quantities and the primary exposure route is through dermal contact when handling the  
2621 goods. Although DCHP content was not reported or measured in specific articles, this scenario was  
2622 included for dermal exposure calculations that do not use weight fractions. Dermal contact events are  
2623 likely short and/or infrequent, but an individual could have appreciable daily contact with multiple  
2624 items. The items are not expected to be mouthed and the likelihood of inhalation exposure is minimal  
2625 due to their small surface area and limited time spent in an indoor environment before disposal. The  
2626 electronics containing dye adhesive was qualitatively assessed because it is used in small quantities and  
2627 contained within the electronic articles; thus, no exposures are expected during potential use of these  
2628 items. An aggregate analysis for this COU was not performed because all scenarios were assessed for  
2629 dermal exposures only.

2630  
2631 EPA has slight confidence in some aspects of the exposure estimate for solid articles because of the high  
2632 uncertainty in the assumption of partitioning from solid to liquid and because subsequent dermal  
2633 absorption is not well characterized. However, other parameters such as frequency and duration of use  
2634 and surface area in contact are well understood and representative, resulting in an overall confidence of  
2635 moderate in a health protective estimate. Additionally, EPA has robust overall confidence in the  
2636 underlying chronic POD based on developmental toxicity (Section 4.2).

#### 2637 **4.3.3.1 Overall Confidence in Consumer Risks**

2638 As described in Section 4.1.2.3 and in more detail in the *Draft Consumer and Indoor Dust Exposure*  
2639 *Assessment Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024c](#)), EPA has moderate and robust  
2640 confidence in the assessed inhalation, ingestion, and dermal consumer exposure scenarios, and robust  
2641 confidence in the acute, intermediate and chronic non-cancer PODs selected to characterize risk from  
2642 acute, intermediate, and chronic duration exposures to DCHP (see Section 4.2 and ([U.S. EPA, 2024c](#))).  
2643 The exposure doses used to estimate risk relied on conservative, health protective inputs and parameters  
2644 that are considered representative of a wide selection of use patterns. Sources of uncertainty associated  
2645 with all consumer COUs are discussed above in Section 4.3.3.

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**Table 4-15. Consumer Risk Summary Table**

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) <sup>a</sup>	Lifestage (years) (Benchmark MOE = 30)							
					Infant (<1 year)	Toddler (1–2 years)	Preschooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adult (21+ years)	
Consumer Uses: Adhesives and sealants: Adhesives and sealants	Adhesives for small repairs	Acute <sup>c</sup>	Dermal	H	–	–	–	–	16,000	17,000	16,000	
			Ingestion	H	–	–	–	–	–	–	–	
			Inhalation	H	–	–	–	–	–	–	–	
			Aggregate	H	–	–	–	–	16,000	17,000	16,000	
		Intermed.	–	–	–	–	–	–	–	–	–	
		Chronic	Dermal	H	–	–	–	–	–	110,000	120,000	110,000
			Ingestion	H	–	–	–	–	–	–	–	–
			Inhalation	H	–	–	–	–	–	–	–	–
Aggregate	H		–	–	–	–	–	110,000	120,000	110,000		
Consumer Uses: Adhesives and sealants: Adhesives and sealants	Automotive adhesives  ( <sup>b</sup> = MOE for bystander scenario)	Acute <sup>c</sup>	Dermal	H	–	–	–	–	11,000	12,000	11,000	
			Ingestion	H	–	–	–	–	–	–	–	
			Inhalation	H	20,000 <sup>b</sup>	21,000 <sup>b</sup>	26,000 <sup>b</sup>	37,000 <sup>b</sup>	43,000	52,000	63,000	
			Aggregate	H	20,000 <sup>b</sup>	21,000 <sup>b</sup>	26,000 <sup>b</sup>	37,000 <sup>b</sup>	8,800	9,800	9,600	
		Intermed.	Dermal	H	–	–	–	–	–	170,000	180,000	170,000
			Ingestion	H	–	–	–	–	–	–	–	–
			Inhalation	H	300,000 <sup>b</sup>	310,000 <sup>b</sup>	390,000 <sup>b</sup>	560,000 <sup>b</sup>	650,000	780,000	950,000	
			Aggregate	H	300,000 <sup>b</sup>	310,000 <sup>b</sup>	390,000 <sup>b</sup>	560,000 <sup>b</sup>	130,000	150,000	140,000	
		Chronic	–	–	–	–	–	–	–	–	–	
		Consumer Uses: Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Small articles with potential for semi-routine contact: labels, nitrocellulose; ethylcellulose; chlorinated rubber; PVAc; PVC	Acute <sup>c</sup>	Dermal	H	2,100	2,400	2,800	3,500	4,400	4,900
Ingestion	H				–	–	–	–	–	–	–	
Inhalation	H				–	–	–	–	–	–	–	
Aggregate	H				2,100	2,400	2,800	3,500	4,400	4,900	4,500	
Intermed.	–			–	–	–	–	–	–	–	–	
Chronic	Dermal			H	2,100	2,400	2,800	3,500	4,400	4,900	4,500	
	Ingestion			H	–	–	–	–	–	–	–	
	Inhalation			H	–	–	–	–	–	–	–	
	Aggregate	H	2,100	2,400	2,800	3,500	4,400	4,900	4,500			

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Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Route	Exposure Scenario (H, M, L) <sup>a</sup>	Lifestage (years) (Benchmark MOE = 30)						
					Infant (<1 year)	Toddler (1–2 years)	Preschooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenagers (16–20 years)	Adult (21+ years)
Consumer Uses: Consumer articles that contain dicyclohexyl phthalate from: Inks, toner, and colorants; Paints and coatings; Adhesives and sealants (e.g., paper products, textiles, products using cellulose film, etc.)	Outdoor seating	Acute <sup>c</sup>	Dermal	H	740	870	1,000	1,200	1,600	1,700	1,600
			Ingestion	H	–	–	–	–	–	–	–
			Inhalation	H	–	–	–	–	–	–	–
			Aggregate	H	740	870	1,000	1,200	1,600	1,700	1,600
		Intermed.	–	–	–	–	–	–	–	–	–
		Chronic	Dermal	H	5,200	6,100	7,000	8,700	11,000	12,000	11,000
			Ingestion	H	–	–	–	–	–	–	–
			Inhalation	H	–	–	–	–	–	–	–
			Aggregate	H	5,200	6,100	7,000	8,700	11,000	12,000	11,000
		Consumer Uses: Consumer articles that contain dicyclohexyl phthalate from: Inks, toner, and colorants; Paints and coatings; Adhesives and sealants (e.g., paper products, textiles, products using cellulose film, etc.)	Small articles with the potential for semi-routine contact: labels, and packaging adhesives, foil and cellophane lacquers, and printing inks	Acute <sup>c</sup>	Dermal	H	2,100	2,400	2,800	3,500	4,400
Ingestion	H				–	–	–	–	–	–	–
Inhalation	H				–	–	–	–	–	–	–
Aggregate	H				2,100	2,400	2,800	3,500	4,400	4,900	4,500
Intermed.	–			–	–	–	–	–	–	–	–
Chronic	Dermal			H	2,100	2,400	2,800	3,500	4,400	4,900	4,500
	Ingestion			H	–	–	–	–	–	–	–
	Inhalation			H	–	–	–	–	–	–	–
	Aggregate			H	2,100	2,400	2,800	3,500	4,400	4,900	4,500
Consumer Uses: Consumer articles that contain dicyclohexyl phthalate from: Inks, toner, and colorants; Paints and coatings; Adhesives and sealants (e.g., paper products, textiles, products using cellulose film, etc.)	Electronics containing dye adhesive			Exposures not expected. Identified in dye attach adhesive used in wirebond packaging for semiconductor devices or in automotive cameras. As the adhesive is used in small quantities and contained within the electronic articles, no exposures are expected during potential use of these items							

<sup>a</sup> Exposure scenario intensities include high (H), medium (M), and low (L).

<sup>b</sup> Bystander scenarios

<sup>c</sup> Scaling by the RPF and application of the index chemical POD provides a more sensitive and robust hazard assessment than the DCHP-specific POD, given its more limited toxicological data set. Please see Table 4-23 for the RPF analysis values.

#### 4.3.4 Risk Estimates for General Population Exposed to DCHP through Environmental Releases

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As described in the *Draft Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* (U.S. EPA, 2024p) and Section 4.1.3, EPA used a screening-level approach for general population exposures for DCHP releases associated with TSCA COUs. Fenceline communities were considered as part of the general population in proximity to releasing facilities as part of the ambient air exposure assessment by utilizing pre-screening methodology described in EPA's *Draft TSCA Screening Level Approach for Assessing Ambient Air and Water Exposures to Fenceline Communities (Version 1.0)* (U.S. EPA, 2022b). For other exposure pathways, the Agency's screening method assessing high-end exposure scenarios used release data that reflect exposures expected to occur in proximity to releasing facilities, which would include fenceline communities.

EPA evaluated surface water, drinking water, fish ingestion, and ambient air pathways quantitatively, in addition to the land pathway (*i.e.*, landfills and application of biosolids) qualitatively. For pathways assessed quantitatively, high-end estimates of DCHP concentration in the various environmental media were used for screening-level purposes. EPA used an MOE approach using high-end exposure estimates to determine whether an exposure pathway had potential non-cancer risks. High-end exposure estimates were defined as those associated with the industrial and commercial releases from a COU and OES that resulted in the highest environmental media concentrations. If there is no risk for an individual identified as having the potential for the highest exposure associated with a COU for a given pathway of exposure, then that pathway was determined to not be a pathway of concern and not pursued further. If any pathways were identified as a pathway of concern for the general population, further exposure assessments for that pathway would be conducted to include higher tiers of modeling when available and exposure estimates developed for additional subpopulations and COUs. Using a screening-level approach described in Section 4.1.3, *no pathways of exposure were identified to be of concern for the general population exposed to environmental releases.*

##### ***Land Pathway***

DCHP has a low water solubility and high affinity for sorption to particulate and organic media. This indicates that it is unlikely to migrate from land-applied biosolids to groundwater via runoff. DCHP's potential to leach from landfills into nearby groundwater or surface water systems is also limited. Therefore, EPA evaluated general population exposures via the land pathway (*i.e.*, application of biosolids, landfills) qualitatively (Section 4.1.3.1).

##### ***Surface Water Pathway***

MOEs for general population exposure through incidental ingestion and dermal contact during swimming ranged from 2,171 to 6,310 for scenarios assuming no wastewater treatment and from 5,521 to 20,000 for scenarios assuming 68.6 percent wastewater treatment removal efficiency (Table 4-16). Therefore, *based on a screening-level assessment, risk for non-cancer health effects is not expected for the surface water pathway, and the pathway is not considered to be a pathway of concern for the general population.*

Acute MOEs through drinking water ingestion were 135 and 430 without and with wastewater treatment, respectively, for the lifestage (*i.e.*, infants) with the highest exposure (Table 4-16). *Based on the screening-level analysis, risk for non-cancer health effects is not expected for the drinking water pathway, and the drinking water pathway is not considered to be a pathway of concern for the general population.*

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**Table 4-16. Summary of the Highest Doses for General Population through Surface and Drinking Water Exposure**

OES <sup>a</sup>	Water Column Concen.	Incidental Dermal Surface Water <sup>b</sup>		Incidental Ingestion Surface Water <sup>c</sup>		Drinking Water <sup>d</sup>	
	30Q5 Conc. (µg/L)	ADR <sub>POT</sub> (mg/kg-day)	Acute MOE (Benchmark MOE = 30)	ADR <sub>POT</sub> (mg/kg-day)	Acute MOE (Benchmark MOE = 30)	ADR <sub>POT</sub> (mg/kg-day)	Acute MOE (Benchmark MOE = 30)
PVC plastics compounding <i>without</i> wastewater treatment	126	1.1E-03	2,171	6.7E-04	3,559	1.8E-02	135
PVC plastics compounding <i>with</i> wastewater treatment	39.6	3.50E-04	6,913	2.1E-04	11,000	5.6E-03	430

N/A = not applicable  
<sup>a</sup> Table 3-1 provides a crosswalk of industrial and commercial COUs to OES.  
<sup>b</sup> Most exposed age group: Adults (21+ years)  
<sup>c</sup> Most exposed age group: Youth (11–15 years)  
<sup>d</sup> Most exposed age group: Infant (birth to <1 year)

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**Fish Ingestion**

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EPA evaluated potential exposure and subsequent risks to DCHP through fish ingestion for populations and age groups that had the highest fish ingestion rate per kg of body weight—including adults and young toddlers in the general population, adult subsistence fishers, and adult Tribal populations. Risks were estimated for various populations and age groups; however, Table 4-17 show only results for the Tribal populations because it led to the highest exposure.

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For the screening-level analysis, EPA started with the water solubility limit as an upper limit of DCHP concentration in surface water for the general population, subsistence fisher, and Tribal populations. Screening-level risk estimates were above the benchmark for the general population based on conservative exposure estimates. Refinements were needed for the subsistence fisher and Tribal populations because screening-level risk estimates using the water solubility limit were below the benchmark (see Section 8 of (U.S. EPA, 2024p)). Refinements included use of estimated water releases by OES, as well as incorporation of various hydrologic flow data for each OES, to model the surface water concentrations. Briefly, hydrologic flow data were categorized into median flow (P50), 75th percentile flow (P75), and 90th percentile flow (P90). EPA expects high-end releases to discharge to surface waters with higher flow conditions (e.g., P75 and P90).

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The PVC plastics compounding OES resulted in the highest surface water concentrations. Surface water concentrations calculated based on the median flow rate led to risk estimates below benchmark for only Tribal populations ingesting fish at the heritage rate. Heritage rates are not suppressed by contamination, degradation, or loss of access and existed prior to non-indigenous settlement on Tribal fisheries resources (U.S. EPA, 2016a). As high-end releases are not expected to discharge to water bodies with low flow conditions like P50, EPA incorporated higher flow rates and treatment efficiency into its analysis for Tribal populations. When treatment is considered, risk estimates were above benchmark even at the P50 condition for all scenarios. Lastly, DCHP is expected to have low potential for bioaccumulation, biomagnification, and uptake by aquatic organisms because of its low water solubility and high hydrophobicity as described in Section 4.4. *Therefore, fish ingestion is not a pathway of concern for DCHP for Tribal members, subsistence fishers, or the general population.*

2728 **Table 4-17. Fish Ingestion for Adults in Tribal Populations Summary**

Calculation Method	Current Mean Ingestion Rate <sup>b</sup> (Benchmark MOE = 30)		Heritage Ingestion Rate <sup>b</sup> (Benchmark MOE = 30)	
	ADR/ADD (mg/kg-day)	Chronic and Acute MOE <sup>a</sup>	ADR/ADD (mg/kg-day)	Chronic and Acute MOE <sup>a</sup>
Water solubility limit (1.48 mg/L)	2.68E-01	9	2.04	1
Modeled SWC for PVC plastics compounding, P50 flow (0.087 mg/L)	1.59E-02	151	1.21E-01	20
Modeled SWC for PVC plastics compounding, P75 flow (3.48E-03 mg/L)	6.30E-04	3,812	4.80E-03	500
Modeled SWC for PVC plastics compounding, P90 flow (2.4E-04 mg/L)	4.40E-05	54,597	3.35E-04	7,163
Modeled SWC for PVC plastics compounding, P50 flow, Treated (2.7E-02 mg/L)	4.97E-03	482	3.79E-02	63
Highest monitored SWC (1.0E-05 mg/L)	2.53E-06	947,643	1.93E-05	124,326

SWC = surface water concentration  
<sup>a</sup> The acute and chronic MOEs are identical because the exposure estimates and the POD do not change between acute and chronic.  
<sup>b</sup> Current ingestion rate refers to the present-day consumption levels that are suppressed by contamination, degradation, or loss of access. Heritage rates existed prior to non-indigenous settlement on Tribal fishers resources and changes to culture and lifeway.

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**Ambient Air Pathway**

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2731 As part of the ambient air exposure assessment, EPA considered exposures to the general population in  
 2732 proximity to releasing facilities, including fenceline communities, by utilizing pre-screening  
 2733 methodology described in EPA’s *Draft TSCA Screening Level Approach for Assessing Ambient Air and*  
 2734 *Water Exposures to Fenceline Communities (Version 1.0)* ([U.S. EPA, 2022b](#)). Using the highest  
 2735 modeled 95th percentile air concentration, MOEs for general population exposure through inhalation are  
 2736 192 for acute and 281 for chronic (Table 4-18) (compared to a benchmark of 30).

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2738 *Based on risk screening results, risk for non-cancer health effects is not expected for the ambient air*  
 2739 *pathway; therefore, the ambient air pathway is not considered to be a pathway of concern to DCHP for*  
 2740 *the general population, including fenceline communities.*

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**Table 4-18. General Population Ambient Air Exposure Summary**

OES <sup>a</sup>	Acute (Daily Average)			Chronic (Annual Average)		
	Air Concentration <sup>b</sup> (µg/m <sup>3</sup> )	AC (mg/kg-day)	MOE	Air Concentration <sup>b</sup> (µg/m <sup>3</sup> )	ADC (mg/kg-day)	MOE
Application of paints and coatings	67.57	67.57	192	46.28	46.28	281

AC = acute concentration; ADC = average daily concentration; MOE = margin of exposure; OES = occupation exposure scenario  
<sup>a</sup> Table 1-1 provides a crosswalk of industrial and commercial COUs to OES.  
<sup>b</sup> Air concentrations are reported for the high-end (95th percentile) modeled value at 100 m from the emitting facility and stack plus fugitive releases combined.

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2745 **Urinary Biomonitoring Data – NHANES**

2746 CDC stopped collected urinary data for MCHP after 2010. EPA analyzed biomonitoring data from the  
2747 1999–2010 NHANES cycle but the low detection rates and limited data variability precluded any  
2748 meaningful statistical analyses. Furthermore, EPA’s systematic review process did not identify any  
2749 suitable alternative sources of DCHP biomonitoring data. Therefore, EPA did not conduct reverse  
2750 dosimetry to calculate daily intake values for DCHP (Section 4.1.3.1).

2751 **4.3.4.1 Overall Confidence in General Population Screening Level Exposure**  
2752 **Assessment**

2753 The weight of scientific evidence supporting the general population exposure estimate is decided based  
2754 on the strengths, limitations, and uncertainties associated with the exposure estimates, which are  
2755 discussed in detail for ambient air, surface water, drinking water, and fish ingestion in the *Draft*  
2756 *Environmental Media, General Population, and Environmental Exposure Assessment for Dicyclohexyl*  
2757 *Phthalate (DCHP)* ([U.S. EPA, 2024p](#)). EPA summarized its weight of scientific evidence using  
2758 confidence descriptors: robust, moderate, slight, or indeterminate. EPA used general considerations (*i.e.*,  
2759 relevance, data quality, representativeness, consistency, variability, uncertainties) as well as chemical-  
2760 specific considerations for its weight of scientific evidence conclusions.

2761 EPA determined robust confidence in its qualitative assessment of biosolids and landfills. For its  
2762 quantitative assessment, EPA modeled exposure due to various general population exposure scenarios  
2763 resulting from different pathways of exposure. Exposure estimates used high-end inputs for the purpose  
2764 of risk screening. When available, monitoring data was compared to modeled estimates to evaluate  
2765 overlap, magnitude, and trends. EPA has robust confidence that modeled releases used are appropriately  
2766 conservative for a screening level analysis. Therefore, EPA has robust confidence that no exposure  
2767 scenarios will lead to greater doses than presented in this evaluation. Despite slight and moderate  
2768 confidence in the estimated values themselves, confidence in exposure estimates capturing high-end  
2769 exposure scenarios was robust given that many of the modeled values exceeded those of monitored  
2770 values.  
2771

2772 **4.3.5 Risk Estimates for Potentially Exposed or Susceptible Subpopulations**

2774 EPA considered PESS throughout the exposure assessment and throughout the hazard identification and  
2775 dose-response analysis supporting the draft DCHP risk evaluation.  
2776

2777 Some population group lifestages may be more susceptible to the health effects of DCHP exposure. As  
2778 discussed in Section 4.2 and in EPA’s *Draft Non-cancer Human Health Hazard Assessment for*  
2779 *Dicyclohexyl Phthalate* ([U.S. EPA, 2024v](#)) and *Draft Technical Support Document for the Cumulative*  
2780 *Risk Analysis of DEHP, DBP, BBP, DIBP, DCHP, and DINP Under TSCA* ([U.S. EPA, 2024ah](#)),  
2781 exposure to DCHP causes adverse effects on the developing male reproductive system consistent with a  
2782 disruption of androgen action and phthalate syndrome in experimental animal models. Therefore,  
2783 women of reproductive age, pregnant women, male infants, male children, and male adolescents are  
2784 considered to be susceptible subpopulations. These susceptible lifestages were considered throughout  
2785 the draft risk evaluation. For example, women of reproductive age were evaluated for occupational  
2786 exposures to DCHP for each COU (Section 4.3.2). Additionally, infants (<1 year), toddlers (1–2 years),  
2787 preschoolers (3–5 years), middle school children (6–10 years), young teens (11–15 years), and teenagers  
2788 (16–20 years) were evaluated for exposure to DCHP through consumer products and articles (Section  
2789 4.3.3). EPA also considered cumulative phthalate exposure and risk for female workers of reproductive  
2790 age, as well as male children and female consumers of reproductive age. Additionally, the Agency used  
2791 a value of 10 for the UF<sub>H</sub> to account for human variability. The Risk Assessment Forum, in *A Review of*  
2792 *the Reference Dose and Reference Concentration Processes*, discusses some of the evidence for

2793 choosing the default factor of 10 when data are lacking—including toxicokinetic and toxicodynamic  
2794 factors as well as greater susceptibility of children and elderly populations ([U.S. EPA, 2002b](#)).  
2795

2796 The available data suggest that some groups or lifestages have greater exposure to DCHP. This includes  
2797 people exposed to DCHP at work, those who frequently use consumer products and/or articles  
2798 containing high concentrations of DCHP, those who may have greater intake of DCHP per body weight  
2799 (*e.g.*, infants, children, adolescents) leading to greater exposure. EPA accounted for these populations  
2800 with greater exposure in the draft DCHP risk evaluation as follows:

- 2801 • EPA evaluated a range of OESs for workers and ONUs, including high-end exposure scenarios  
2802 for women of reproductive age (a susceptible subpopulation) and average adult workers.
- 2803 • EPA evaluated a range of consumer exposure scenarios, including high-intensity exposure  
2804 scenarios for infants and children (susceptible subpopulations). These populations had greater  
2805 intake per body weight.
- 2806 • EPA evaluated a range of general population exposure scenarios, including high-end exposure  
2807 scenarios for infants and children (susceptible subpopulations). These populations had greater  
2808 intake per body weight.
- 2809 • EPA evaluated exposure to DCHP through fish ingestion for subsistence fishers and Tribal  
2810 populations.
- 2811 • EPA aggregated occupational inhalation and dermal exposures for each COU for women of  
2812 reproductive age (a susceptible subpopulation) and average adult workers.
- 2813 • EPA aggregated consumer inhalation, dermal, and oral exposures for each COU for infants and  
2814 children (susceptible subpopulations).
- 2815 • EPA evaluated cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP for the U.S. civilian  
2816 population using NHANES urinary biomonitoring data and reverse dosimetry for women of  
2817 reproductive age (16–49 years) and male children (3–5, 6–11, and 12–15 years of age).
- 2818 • For women of reproductive age, black non-Hispanic women had higher, albeit not statistically  
2819 significantly higher, 95th percentile cumulative exposures to DEHP, DBP, BBP, DIBP, and  
2820 DINP compared to women of other races (*e.g.*, white non-Hispanic, Mexican America). The 95th  
2821 percentile cumulative exposure estimate for black non-Hispanic women served as the non-  
2822 attributable national cumulative exposure estimate used by EPA to evaluate cumulative risk to  
2823 workers and consumers.

#### 2824 **4.4 Human Health Cumulative Risk Assessment and Characterization**

2825 EPA developed a *Draft Technical Support Document for the Cumulative Risk Analysis of DEHP, DBP,*  
2826 *BBP, DIBP, DCHP, and DINP Under TSCA* ([U.S. EPA, 2024ah](#)) (draft CRA TSD) for the CRA of six  
2827 toxicologically similar phthalates being evaluated under Section 6 of the Toxic Substances Control Act  
2828 (TSCA): di(2-ethylhexyl) phthalate (DEHP), butyl benzyl phthalate (BBP), dibutyl phthalate (DBP),  
2829 dicyclohexyl phthalate (DCHP), diisobutyl phthalate (DIBP), and diisononyl phthalate (DINP). EPA  
2830 previously issued a *Draft Proposed Approach for Cumulative Risk Assessment of High-Priority*  
2831 *Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances Control Act* (draft  
2832 2023 approach), which outlined an approach for this assessment ([U.S. EPA, 2023c](#)). EPA’s proposal  
2833 was subsequently peer-reviewed by the Science Advisory Committee on Chemicals (SACC) in May  
2834 2023 ([U.S. EPA, 2023f](#)). In the 2023 draft approach, EPA identified a cumulative chemical group and  
2835 PESS [15 U.S.C. section 2605(b)(4)]. Based on toxicological similarity and induced effects on the  
2836 developing male reproductive system consistent with a disruption of androgen action and phthalate  
2837 syndrome, EPA proposed a cumulative chemical group of DEHP, BBP, DBP, DCHP, DIBP, and DINP,  
2838 but not diisodecyl phthalate (DIDP). This approach emphasizes a uniform measure of hazard for  
2839 sensitive subpopulations, namely women of reproductive age and/or male infants and children, however

2840 additional health endpoints are known for broader populations and described in the individual non-  
2841 cancer human health hazard assessments for DEHP ([U.S. EPA, 2024w](#)), DBP ([U.S. EPA, 2024u](#)), DIBP  
2842 ([U.S. EPA, 2024x](#)), BBP ([U.S. EPA, 2024t](#)), DCHP ([U.S. EPA, 2024v](#)), and DINP ([U.S. EPA, 2025b](#)),  
2843 including hepatic, kidney, and other developmental and reproductive toxicity.

2844  
2845 EPA's approach for assessing cumulative risk is described in detail in the draft CRA TSD ([U.S. EPA,](#)  
2846 [2024ah](#)) and incorporates feedback from the SACC ([U.S. EPA, 2023f](#)) on EPA's 2023 draft proposal  
2847 ([U.S. EPA, 2023c](#)). EPA is focusing its CRA on acute duration exposures of women of reproductive  
2848 age, male infants, and male children to six toxicologically similar phthalates (*i.e.*, DEHP, DBP, BBP,  
2849 DIBP, DCHP, DINP) that induce effects on the developing male reproductive system consistent with a  
2850 disruption of androgen action and phthalate syndrome. The Agency is further focusing its CRA on acute  
2851 duration exposures because there is evidence that effects on the developing male reproductive system  
2852 consistent with a disruption of androgen action can result from a single exposure during the critical  
2853 window of development (see Section 1.5 of ([U.S. EPA, 2024ah](#)) for further details). To evaluate  
2854 cumulative risk, EPA is using a relative potency factor (RPF) approach. RPFs for DEHP, DBP, BBP,  
2855 DIBP, DCHP, and DINP were developed using a meta-analysis and benchmark dose (BMD) modeling  
2856 approach based on a uniform measure (*i.e.*, reduced fetal testicular testosterone). EPA is also using  
2857 NHANES data to supplement, not substitute, evaluations for exposure scenarios for TSCA COUs to  
2858 provide non-attributable, total exposure for addition to the relevant scenarios presented in the individual  
2859 risk evaluations.

2860  
2861 The analogy of a "risk cup" is used throughout this document to describe cumulative exposure estimates.  
2862 The risk cup term is used to help conceptualize the contribution of various phthalate exposure routes and  
2863 pathways to overall cumulative risk estimates and serves primarily as a communication tool. The term/  
2864 concept describes exposure estimates where the full cup represents the total exposure that leads to risk  
2865 (cumulative MOE) and each chemical contributes a specific amount of exposure that adds a finite  
2866 amount of risk to the cup. A full risk cup indicates that the cumulative MOE has dropped below the  
2867 benchmark MOE (*i.e.*, total UF), whereas cumulative MOEs above the benchmark indicate that only a  
2868 percentage of the risk cup is full.

2869  
2870 The remainder of the human health CRA is organized as follows:

- 2871 • Section 4.4.1 – Describes the approach used by EPA to derive draft relative potency factors for  
2872 DEHP, DBP, BBP, DIBP, DCHP, and DINP based on reduced fetal testicular testosterone,  
2873 which are used by EPA as part of the current CRA and to assess exposures to individual  
2874 phthalates by scaling to an index chemical (RPF analysis). Section 2 of EPA's draft CRA TSD  
2875 ([U.S. EPA, 2024ah](#)) provides more details.
- 2876 • Section 4.4.2 – Briefly describes the approach used by EPA to calculate cumulative non-  
2877 attributable phthalate exposure for the U.S. population using NHANES urinary biomonitoring  
2878 and reverse dosimetry. Section 4 of EPA's draft CRA TSD ([U.S. EPA, 2024ah](#)) provides  
2879 additional details.
- 2880 • Section 4.4.3 – Describes how EPA combined exposures to DCHP from individual consumer  
2881 and occupational COUs/OES with cumulative non-attributable phthalate exposures from  
2882 NHANES to estimate cumulative risk. An empirical example is also provided. Section 5 of  
2883 EPA's draft CRA TSD ([U.S. EPA, 2024ah](#)) provides additional details.

2884 For additional details regarding EPA's draft CRA, readers are directed to the following TSDs:

- 2885 • *Draft Technical Support Document for the Cumulative Risk Analysis of Di(2-ethylhexyl)*  
2886 *Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl*

2887 *Phthalate (DIBP), Dicyclohexyl Phthalate (DCHP), and Diisononyl Phthalate (DINP) Under the*  
2888 *Toxic Substances Control Act (TSCA) (U.S. EPA, 2024ah);*

- 2889 • *Draft Meta-Analysis and Benchmark Dose Modeling of Fetal Testicular Testosterone for Di(2-*  
2890 *ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP),*  
2891 *Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP) (U.S. EPA, 2024s);*
- 2892 • *Draft Proposed Approach for Cumulative Risk Assessment of High-Priority Phthalates and a*  
2893 *Manufacturer-Requested Phthalate under the Toxic Substances Control Act (U.S. EPA, 2023c);*
- 2894 • *Draft Proposed Principles of Cumulative Risk Assessment under the Toxic Substances Control*  
2895 *Act (U.S. EPA, 2023d); and*
- 2896 • *Science Advisory Committee on Chemicals meeting minutes and final report, No. 2023-01 - A set*  
2897 *of scientific issues being considered by the Environmental Protection Agency regarding: Draft*  
2898 *Proposed Principles of Cumulative Risk Assessment (CRA) under the Toxic Substances Control*  
2899 *Act and a Draft Proposed Approach for CRA of High-Priority Phthalates and a Manufacturer-*  
2900 *Requested Phthalate (U.S. EPA, 2023f).*

#### 2901 **4.4.1 Hazard Relative Potency**

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2902 This section briefly summarizes the RPF approach used by EPA to evaluate phthalates for cumulative  
2903 risk. Section 4.4.1.1 provides a brief overview and background for the RPF approach methodology,  
2904 while Section 4.4.1.2 provides a brief overview of the draft RPFs derived by EPA for DEHP, DBP,  
2905 BBP, DIBP, DCHP, and DINP based on decreased fetal testicular testosterone. Further details regarding  
2906 the draft relative potency analysis conducted by EPA are provided in the following two TSDs:

- 2907 • *Draft Technical Support Document for the Cumulative Risk Analysis of Di(2-ethylhexyl)*  
2908 *Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl*  
2909 *Phthalate (DIBP), Dicyclohexyl Phthalate (DCHP), and Diisononyl Phthalate (DINP) Under the*  
2910 *Toxic Substances Control Act (TSCA) (U.S. EPA, 2024ah); and*
- 2911 • *Draft Meta-Analysis and Benchmark Dose Modeling of Fetal Testicular Testosterone for Di(2-*  
2912 *ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP),*  
2913 *Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP) (U.S. EPA, 2024s).*

##### 2914 **4.4.1.1 Relative Potency Factor Approach Overview**

---

2915 For the RPF approach, chemicals being evaluated require data that support toxicologic similarity (e.g.,  
2916 components of a mixture share a known or suspected common MOA or share a common apical  
2917 endpoint/effect) and have dose-response data for the effect of concern over similar exposure ranges  
2918 (U.S. EPA, 2023a, 2000, 1986). RPF values account for potency differences among chemicals in a  
2919 mixture and scale the dose of one chemical to an equitoxic dose of another chemical (i.e., the index  
2920 chemical). The chemical selected as the index chemical is often among the best characterized  
2921 toxicologically and considered to be representative of the type of toxicity elicited by other components  
2922 of the mixture. Implementing an RPF approach requires a quantitative dose-response assessment for the  
2923 index chemical and pertinent data that allow the potency of the mixture components to be meaningfully  
2924 compared to that of the index chemical. In the RPF approach, RPFs are calculated as the ratio of the  
2925 potency of the individual component to that of the index chemical using either (1) the response at a fixed  
2926 dose, or (2) the dose at a fixed response (Equation 4-3).

#### 2927 **Equation 4-3. Calculating RPFs**

$$2928 \quad RPF_i = \frac{BMD_{R-IC}}{BMD_{R-i}}$$

2930 Where:  
2931  $BMD$  = Benchmark dose (mg/kg/day)  
2932  $R$  = Magnitude of response (*i.e.*, benchmark response)  
2933  $I$  =  $i^{\text{th}}$  chemical  
2934  $IC$  = Index chemical

2935 After scaling the chemical component doses to the potency of the index chemical, the scaled doses are  
2936 summed and expressed as index chemical equivalents for the mixture (Equation 4-4).

2937  
2938 **Equation 4-4. Calculating Index Chemical Equivalents**

2939 
$$\text{Index Chemical Equivalents}_{MIX} = \sum_{i=1}^n d_i \times RPF_i$$

2940 Where:  
2941  $\text{Index chemical equivalents}$  = Dose of the mixture in index chemical equivalents  
2942 (mg/kg/day)  
2943  $d_i$  = Dose of the  $i^{\text{th}}$  chemical in the mixture (mg/kg/day)  
2944  $RPF_i$  = Relative potency factor of the  $i^{\text{th}}$  chemical in the mixture  
2945 (unitless)

2946 Non-cancer risk associated with exposure to an individual chemical or the mixture can then be assessed  
2947 by calculating an MOE, which in this case is the ratio of the index chemical's non-cancer hazard value  
2948 (*e.g.*, the BMDL) to an estimate of exposure expressed in terms of index chemical equivalents. The  
2949 MOE is then compared to the benchmark MOE (*i.e.*, the total uncertainty factor associated with the  
2950 assessment) to characterize risk.

2951 **4.4.1.2 Relative Potency Factors**

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2952  
2953  
2954 ***Derivation of Draft RPFs***

2955 To derive RPFs for DEHP, DBP, BBP, DIBP, DCHP, and DINP, EPA utilized a meta-analysis and  
2956 BMD modeling approach similar to that used by NASEM (2017) to model decreased fetal testicular  
2957 testosterone. As described further in EPA's *Draft Meta-Analysis and Benchmark Dose Modeling of*  
2958 *Fetal Testicular Testosterone for DEHP, DBP, BBP, DIBP, and DCHP* (U.S. EPA, 2024s), the Agency  
2959 evaluated benchmark responses (BMRs) of 5, 10, and 40 percent. For input into the CRA of phthalates,  
2960 EPA has derived draft RPFs using BMD<sub>40</sub> estimates (Table 4-19). For further details regarding RPFs  
2961 derivation, see Section 2 of EPA's *Draft Technical Support Document for the Cumulative Risk Analysis*  
2962 *of DEHP, DBP, BBP, DIBP, DCHP, and DINP Under TSCA* (U.S. EPA, 2024ah).

2963  
2964 ***Selection of the Index Chemical***

2965 Of the six phthalates being evaluated for cumulative risk under TSCA (*i.e.*, DEHP, DBP, BBP, DIBP,  
2966 DCHP, and DINP), EPA has preliminarily selected DBP as the index chemical.

2967  
2968 As described further in Section 2 of EPA's *Draft Technical Support Document for the Cumulative Risk*  
2969 *Analysis of DEHP, DBP, BBP, DIBP, DCHP, and DINP under TSCA* (U.S. EPA, 2024ah), EPA selected  
2970 DBP as the index chemical DBP has a high-quality toxicological database of studies demonstrating  
2971 effects on the developing male reproductive system consistent with a disruption of androgen action and  
2972 phthalate syndrome. Furthermore, studies of DBP demonstrate toxicity representative of all phthalates in  
2973 the cumulative chemical group and DBP is well characterized for the MOA associated with phthalate  
2974 syndrome. Finally, compared to other phthalates, including well-studied phthalates such as DEHP, DBP

2975 has the most dose-response data available in the low-end range of the dose-response curve where the  
 2976 BMD<sub>5</sub> and BMDL<sub>5</sub> are derived, which provides a robust and scientifically sound foundation of BMD  
 2977 and BMDL estimates on which the RPF approach is based.

2979 **Table 4-19. Draft Relative Potency Factors Based on**  
 2980 **Decreased Fetal Testicular Testosterone**

Phthalate	BMD <sub>40</sub> (mg/kg-day)	RPF Based on BMD <sub>40</sub>
DBP (Index chemical)	149	<b>1</b>
DEHP	178	<b>0.84</b>
DIBP	279	<b>0.53</b>
BBP	284	<b>0.52</b>
DCHP	90	<b>1.66</b>
DINP	699	<b>0.21</b>

2981 ***Index Chemical POD***

2982 As with any risk assessment that relies on BMD analysis, the POD is the lower confidence limit used to  
 2983 mark the beginning of extrapolation to determine risk associated with human exposures. As described  
 2984 further in the non-cancer human health hazards of DEHP ([U.S. EPA, 2024w](#)), DBP ([U.S. EPA, 2024u](#)),  
 2985 BBP ([U.S. EPA, 2024t](#)), DIBP ([U.S. EPA, 2024x](#)), DCHP ([U.S. EPA, 2024v](#)), and DINP ([U.S. EPA,](#)  
 2986 [2025b](#)) (see Appendices titled “Considerations for Benchmark Response (BMR) Selection for Reduced  
 2987 Fetal Testicular Testosterone” in each hazard assessment), EPA has reached the conclusion that a BMR  
 2988 of 5 percent is the most appropriate and health protective response level for evaluating decreased fetal  
 2989 testicular testosterone. For the index chemical, DBP, the BMDL<sub>5</sub> for the best fitting linear-quadratic  
 2990 model is 9 mg/kg-day for reduced fetal testicular. Using allometric body weight scaling to the three-  
 2991 quarters power ([U.S. EPA, 2011c](#)), EPA extrapolated an HED of 2.1 mg/kg-day to use as the POD for  
 2992 the index chemical in the CRA.

2993 ***Selection of the Benchmark MOE***

2994 Consistent with Agency guidance ([U.S. EPA, 2022c](#), [2002b](#)), EPA selected an intraspecies uncertainty  
 2995 factor (UF<sub>H</sub>) of 10, which accounts for variation in susceptibility across the human population and the  
 2996 possibility that the available data might not be representative of individuals who are most susceptible to  
 2997 the effect. EPA used allometric body weight scaling to the three-quarters power to derive an HED of 2.1  
 2998 mg/kg-day DBP, which accounts for species differences in toxicokinetics. Consistent with EPA  
 2999 Guidance ([U.S. EPA, 2011c](#)), the interspecies uncertainty factor (UF<sub>A</sub>), was reduced from 10 to 3 to  
 3000 account remaining uncertainty associated with interspecies differences in toxicodynamics. *Overall, a*  
 3001 *total uncertainty factor of 30 was selected for use as the benchmark margin of exposure for the CRA*  
 3002 *(based on a interspecies uncertainty factor [UF<sub>A</sub>] of 3 and a intraspecies uncertainty factor [UF<sub>H</sub>] of 10).*

3003 ***Weight of Scientific Evidence***

3004 EPA has preliminary selected an HED of 2.1 mg/kg-day (BMDL<sub>5</sub> of 9 mg/kg-day) as the index chemical  
 3005 (DBP) POD. This POD is based on a meta-analysis and BMD modeling of decreased fetal testicular  
 3006 testosterone from eight studies of rats gestationally exposed to DBP. The Agency EPA has also derived  
 3007 draft RPFs of 1, 0.84, 0.53, 0.52, 1.66, and 0.21 for DBP (index chemical), DEHP, DIBP, BBP, DCHP,  
 3008 and DINP, respectively, based on a common toxicological outcome (*i.e.*, reduced fetal testicular  
 3009 testosterone). EPA has *robust overall confidence in the proposed POD for the index chemical (i.e.,*  
 3010 *DBP) and the derived draft RPFs.*

3014  
3015 Application of RPF provides a more robust basis for assessing the dose-response to the common hazard  
3016 endpoint across all assessed phthalates. For DCHP and a subset of the phthalates with a more limited  
3017 toxicological data set, scaling by the RPF and application of the index chemical POD provides a more  
3018 sensitive and robust hazard assessment than the chemical-specific POD. Readers are directed to the  
3019 *Draft Technical Support Document for the Cumulative Risk Analysis of DEHP, DBP, BBP, DIBP,*  
3020 *DCHP, and DINP Under TSCA* ([U.S. EPA, 2024ah](#)) for a discussion of the weight of evidence  
3021 supporting EPA’s preliminary conclusions.

#### 3022 **4.4.2 Cumulative Phthalate Exposure: Non-attributable Cumulative Exposure to DEHP,** 3023 **DBP, BBP, DIBP, and DINP Using NHANES Urinary Biomonitoring and Reverse** 3024 **Dosimetry**

---

3025 This section briefly summarizes EPA’s approach and results for estimating non-attributable cumulative  
3026 exposure to phthalates using NHANES urinary biomonitoring data and reverse dosimetry. Readers are  
3027 directed to Section 4 of EPA’s *Draft Technical Support Document for the Cumulative Risk Analysis of*  
3028 *DEHP, DBP, BBP, DIBP, DCHP, and DINP Under TSCA* ([U.S. EPA, 2024ah](#)) for additional details.  
3029

3030 NHANES is an ongoing exposure assessment of the U.S. population’s exposure to environmental  
3031 chemicals using biomonitoring. The NHANES biomonitoring data set is a national, statistical  
3032 representation of the general, non-institutionalized, civilian U.S. population. CDC’s NHANES data set  
3033 provides an estimate of average aggregate exposure to individual phthalates for the U.S. population.  
3034 However, exposures measured via NHANES cannot be attributed to specific sources, such as TSCA  
3035 COUs or other sources. Given the short half-lives of phthalates, neither can NHANES capture acute, low  
3036 frequency exposures. Instead, as concluded by the SACC review of the draft 2023 approach, NHANES  
3037 provides a “snapshot” or estimate of total, non-attributable phthalate exposure for the U.S. population  
3038 and relevant subpopulations ([U.S. EPA, 2023f](#)). These estimates of total non-attributable exposure can  
3039 supplement assessments of scenario-specific acute risk in individual risk evaluations.  
3040 Monoester metabolites of BBP, DBP, DEHP, DIBP, and DINP in human urine are regularly measured  
3041 as part of the NHANES biomonitoring program and are generally detectable in human urine at a high  
3042 frequency, including during the most recent NHANES survey period (*i.e.*, 2017–2018). One urinary  
3043 metabolite (*i.e.*, monocyclohexyl phthalate [MCHP]) of DCHP was included in NHANES from 1999  
3044 through 2010, but was excluded from NHANES after 2010 due to low detection levels and a low  
3045 frequency of detection in human urine (detected in <10% of samples in 2009–2010 NHANES survey)  
3046 ([CDC, 2013](#)). Therefore, EPA did not use NHANES urinary biomonitoring data to estimate a daily  
3047 aggregate intake value for DCHP through reverse dosimetry.  
3048

3049 EPA used urinary phthalate metabolite concentrations for DEHP, DBP, BBP, DIBP, and DINP  
3050 measured in the most recently available NHANES survey (2017–2018) to estimate the average daily  
3051 aggregate intake of each phthalate through reverse dosimetry for

- 3052 • Women of reproductive age (16–49 years);
- 3053 • Male children (4 to <6 years, used as a proxy for male infants and toddlers);
- 3054 • Male children (6–11 years); and
- 3055 • Male children (12 to <16 years).

3056 Since NHANES does not include urinary biomonitoring for infants or toddlers, and other national data  
3057 sets are not available, EPA used biomonitoring data from male children 3 to less than 6 years of age as a  
3058 proxy for male infants (<1 year) and male toddlers (1–2 years). See Section 4 of ([U.S. EPA, 2024ah](#)) for  
3059 further details regarding the reverse dosimetry approach. Aggregate daily intake estimates for these

3060 populations are presented in Table 4-20.<sup>4</sup> Aggregate daily intake values were also calculated for women  
3061 of reproductive age stratified by race and socioeconomic status (Table 4-21). A similar analysis by race  
3062 was not done for male children because the NHANES sample size is smaller for this population.  
3063

3064 Aggregate daily intake values for each phthalate were then scaled by relative potency using the RPFs in  
3065 Table 4-19, expressed in terms of index chemical (DBP) equivalents, and summed to estimate  
3066 cumulative daily intake in terms of index chemical (DBP) equivalents using the approach outlined in  
3067 Sections 4.4.1 and 4.4.3.  
3068

3069 Since EPA is focusing its CRA on acute exposure durations, EPA selected 95th percentile exposure  
3070 estimates from NHANES to serve as the non-attributable nationally representative exposure estimate for  
3071 use in its CRA. For women of reproductive age, EPA's analysis indicates that black, non-Hispanic  
3072 women have slightly higher 95th percentile cumulative phthalate exposure compared to other racial  
3073 groups; thus, 95th percentile cumulative exposure estimates for black non-Hispanic women of  
3074 reproductive age was selected for use in the CRA of DCHP (Table 4-20).  
3075

3076 The 95th percentile of national cumulative exposure serves as the estimate of non-attributable phthalate  
3077 exposure for its CRA of DCHP as follows:

- 3078 • Women of reproductive age (16–49 years, black Non-Hispanic): 5.16 µg/kg-day index chemical  
3079 (DBP) equivalents. This serves as the non-attributable contribution to worker and consumer  
3080 women of reproductive age in Section 4.4.4 and Section 4.4.5.
- 3081 • Males (3–5 years): 10.8 µg/kg-day index chemical (DBP) equivalents. This serves as the non-  
3082 attributable contribution to consumer male infants (<1 year), toddlers (1–2 years), and  
3083 preschoolers (3–5 years) in Section 4.4.5. Since NHANES does not include urinary  
3084 biomonitoring for infants (<1 year) or toddlers (1–2 years), and other national data sets are not  
3085 available, EPA used biomonitoring data from male children (3 to <6 years) as a proxy for male  
3086 infants and toddlers.
- 3087 • Males (6–11 years): 7.35 µg/kg-day index chemical (DBP) equivalents This serves as the non-  
3088 attributable contribution to consumer male children (6–10 years) in Section 4.4.5.
- 3089 • Males (12–15 years): 4.36 µg/kg-day index chemical (DBP) equivalents. This serves as the non-  
3090 attributable contribution to consumer male teenagers (11–15 years) in Section 4.4.5.

#### 3091 **4.4.2.1.1 Weight of Scientific Evidence: Non-attributable Cumulative Exposure to** 3092 **Phthalates**

3093 *Overall, EPA has robust confidence in the derived estimates of non-attributable cumulative exposure*  
3094 *from NHANES urinary biomonitoring using reverse dosimetry.* The Agency EPA used urinary  
3095 biomonitoring data from the CDC's national NHANES dataset, which provides a statistical  
3096 representation of the general, non-institutionalized, civilian U.S. population. To estimate daily intake  
3097 values from urinary biomonitoring for each phthalate, EPA used reverse dosimetry. The reverse  
3098 dosimetry approach used by EPA has been used extensively in the literature and has been used by CPSC  
3099 ([2014](#)) and Health Canada ([ECCC/HC, 2020](#)) to estimate phthalate daily intake values from urinary  
3100 biomonitoring data. However, given the short half-lives of phthalates, NHANES biomonitoring data is  
3101 not expected to capture low frequency exposures and may be an underestimate of acute phthalate  
3102 exposure.

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<sup>4</sup> EPA defines *aggregate exposure* as the “combined exposures to an individual from a single chemical substance across multiple routes and across multiple pathways” ([40 CFR section 702.33](#)).

3103  
3104

**Table 4-20. Cumulative Phthalate Daily Intake ( $\mu\text{g}/\text{kg}\text{-day}$ ) Estimates for Women of Reproductive Age, Male Children, and Male Teenagers from the 2017–2018 NHANES Cycle**

Population	Percentile	Phthalate	Aggregate Daily Intake ( $\mu\text{g}/\text{kg}\text{-day}$ )	RPF	Aggregate Daily Intake in DBP Equivalents ( $\mu\text{g}/\text{kg}\text{-day}$ )	% Contribution to Cumulative Exposure	Cumulative Daily Intake (DBP Equivalents, $\mu\text{g}/\text{kg}\text{-day}$ )	Cumulative MOE (POD = 2,100 $\mu\text{g}/\text{kg}\text{-day}$ )	% Contribution to Risk Cup (Benchmark = 30) <sup>a</sup>
Females (16–49 years; n = 1,620)	50	DBP	0.21	1	0.210	22.1	0.950	2,211	1.4%
		DEHP	0.53	0.84	0.445	46.9			
		BBP	0.08	0.52	0.042	4.38			
		DIBP	0.2	0.53	0.106	11.2			
		DINP	0.7	0.21	0.147	15.5			
	95	DBP	0.61	1	0.610	17.2	3.55	592	5.1%
		DEHP	1.48	0.84	1.24	35.0			
		BBP	0.42	0.52	0.218	6.15			
		DIBP	0.57	0.53	0.302	8.51			
		DINP	5.6	0.21	1.18	33.1			
Males (3–5 years; n = 267)	50	DBP	0.56	1	0.560	18.4	3.04	690	4.3%
		DEHP	2.11	0.84	1.77	58.2			
		BBP	0.22	0.52	0.114	3.76			
		DIBP	0.57	0.53	0.302	9.93			
		DINP	1.4	0.21	0.294	9.66			
	95	DBP	2.02	1	2.02	18.6	10.8	194	15.5%
		DEHP	6.44	0.84	5.41	49.9			
		BBP	2.46	0.52	1.28	11.8			
		DIBP	2.12	0.53	1.12	10.4			
		DINP	4.8	0.21	1.01	9.30			

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Population	Percentile	Phthalate	Aggregate Daily Intake (µg/kg-day)	RPF	Aggregate Daily Intake in DBP Equivalents (µg/kg-day)	% Contribution to Cumulative Exposure	Cumulative Daily Intake (DBP Equivalents, µg/kg-day)	Cumulative MOE (POD = 2,100 µg/kg-day)	% Contribution to Risk Cup (Benchmark = 30) <sup>a</sup>
Males (6–11 years; n = 553)	50	DBP	0.38	1	0.380	20.1	1.89	1,111	2.7%
		DEHP	1.24	0.84	1.04	55.1			
		BBP	0.16	0.52	0.083	4.40			
		DIBP	0.33	0.53	0.175	9.26			
		DINP	1	0.21	0.210	11.1			
	95	DBP	1.41	1	1.41	19.2	7.35	286	10.5%
		DEHP	4.68	0.84	3.93	53.5			
		BBP	0.84	0.52	0.437	5.94			
		DIBP	1.62	0.53	0.859	11.7			
		DINP	3.4	0.21	0.714	9.71			
Males (12–15 years; n = 308)	50	DBP	0.33	1	0.330	27.6	1.19	1,758	1.7%
		DEHP	0.66	0.84	0.554	46.4			
		BBP	0.14	0.52	0.073	6.09			
		DIBP	0.21	0.53	0.111	9.32			
		DINP	0.6	0.21	0.126	10.5			
	95	DBP	0.62	1	0.620	14.2	4.36	482	6.2%
		DEHP	2.51	0.84	2.11	48.3			
		BBP	0.64	0.52	0.333	7.63			
		DIBP	0.59	0.53	0.313	7.17			
		DINP	4.7	0.21	0.987	22.6			

<sup>a</sup> A cumulative exposure of 70 µg DBP equivalents/kg-day would result in a cumulative MOE of 30 (i.e., 2,100 µg DBP-equivalents/kg-day ÷ 70 µg DBP equivalents/kg-day = 30), which is equivalent to the benchmark of 30, indicating that the exposure is at the threshold for risk. Therefore, to estimate the percent contribution to the risk cup, the cumulative exposure expressed in DBP equivalents is divided by 70 µg DBP equivalents/kg-day to estimate percent contribution to the risk cup.

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3107  
3108

**Table 4-21. Cumulative Phthalate Daily Intake ( $\mu\text{g}/\text{kg}\text{-day}$ ) Estimates for Women of Reproductive Age (16–49 years old) by Race and Socioeconomic Status from the 2017–2018 NHANES Cycle**

Race/ Socioeconomic Status (SES)	Percentile	Phthalate	Aggregate Daily Intake ( $\mu\text{g}/\text{kg}\text{-day}$ )	RPF	Aggregate Daily Intake in DBP Equivalents ( $\mu\text{g}/\text{kg}\text{-day}$ )	% Contribution to Cumulative Exposure	Cumulative Daily Intake (DBP Equivalents, $\mu\text{g}/\text{kg}\text{-day}$ )	Cumulative MOE (POD = 2,100 $\mu\text{g}/\text{kg}\text{-day}$ )	% Contribution to Risk Cup (Benchmark = 30) <sup>a</sup>
Race: white non- Hispanic (n = 494)	50	DBP	0.22	1	0.22	21.6	1.02	2,058	1.5%
		DEHP	0.59	0.84	0.50	48.6			
		BBP	0.10	0.52	0.05	5.1			
		DIBP	0.20	0.53	0.11	10.4			
		DINP	0.70	0.21	0.15	14.4			
	95	DBP	0.58	1	0.58	17.6	3.30	636	4.7%
		DEHP	1.44	0.84	1.21	36.6			
		BBP	0.29	0.52	0.15	4.6			
		DIBP	0.55	0.53	0.29	8.8			
		DINP	5.10	0.21	1.07	32.4			
Race: black non- Hispanic (n = 371)	50	DBP	0.10	1	0.10	15.0	0.667	3,151	1.0%
		DEHP	0.38	0.84	0.32	47.9			
		BBP	0.04	0.52	0.02	3.1			
		DIBP	0.15	0.53	0.08	11.9			
		DINP	0.70	0.21	0.15	22.1			
	95	DBP	0.48	1	0.48	9.3	5.16	407	7.4%
		DEHP	4.28	0.84	3.60	69.7			
		BBP	0.30	0.52	0.16	3.0			
		DIBP	0.40	0.53	0.21	4.1			
		DINP	3.40	0.21	0.71	13.8			

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Race/ Socioeconomic Status (SES)	Percentile	Phthalate	Aggregate Daily Intake (µg/kg-day)	RPF	Aggregate Daily Intake in DBP Equivalents (µg/kg-day)	% Contribution to Cumulative Exposure	Cumulative Daily Intake (DBP Equivalents, µg/kg-day)	Cumulative MOE (POD = 2,100 µg/kg-day)	% Contribution to Risk Cup (Benchmark = 30) <sup>a</sup>
Race: Mexican American (n = 259)	50	DBP	0.19	1	0.19	22.4	0.849	2,474	1.2%
		DEHP	0.49	0.84	0.41	48.5			
		BBP	0.06	0.52	0.03	3.7			
		DIBP	0.17	0.53	0.09	10.6			
		DINP	0.60	0.21	0.13	14.8			
	95	DBP	0.42	1	0.42	11.6	3.61	582	5.2%
		DEHP	1.24	0.84	1.04	28.9			
		BBP	0.39	0.52	0.20	5.6			
		DIBP	0.46	0.53	0.24	6.8			
		DINP	8.10	0.21	1.70	47.1			
Race: Other (n = 496)	50	DBP	0.26	1	0.26	25.3	1.03	2041	1.5%
		DEHP	0.64	0.84	0.54	52.2			
		BBP	0.07	0.52	0.04	3.5			
		DIBP	0.15	0.46	0.07	6.7			
		DINP	0.60	0.21	0.13	12.2			
	95	DBP	0.84	1	0.84	20.7	4.06	517	5.8%
		DEHP	1.37	0.84	1.15	28.3			
		BBP	0.41	0.52	0.21	5.2			
		DIBP	0.46	0.53	0.24	6.0			
		DINP	7.70	0.21	1.62	39.8			

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Race/ Socioeconomic Status (SES)	Percentile	Phthalate	Aggregate Daily Intake (µg/kg-day)	RPF	Aggregate Daily Intake in DBP Equivalents (µg/kg-day)	% Contribution to Cumulative Exposure	Cumulative Daily Intake (DBP Equivalents, µg/kg-day)	Cumulative MOE (POD = 2,100 µg/kg-day)	% Contribution to Risk Cup (Benchmark = 30) <sup>a</sup>
SES: Below poverty level (n = 1,056)	50	DBP	0.21	1	0.21	22.0	0.955	2,199	1.4%
		DEHP	0.53	0.84	0.45	46.6			
		BBP	0.09	0.52	0.05	4.9			
		DIBP	0.20	0.53	0.11	11.1			
		DINP	0.70	0.21	0.15	15.4			
	95	DBP	0.82	1	0.82	18.2	4.50	467	6.4%
		DEHP	1.75	0.84	1.47	32.7			
		BBP	0.34	0.52	0.18	3.9			
		DIBP	0.51	0.53	0.27	6.0			
		DINP	8.40	0.21	1.76	39.2			
SES: At or above poverty level (n = 354)	50	DBP	0.20	1.00	0.20	27.9	0.718	2,924	1.0%
		DEHP	0.31	0.84	0.26	36.3			
		BBP	0.06	0.52	0.03	4.3			
		DIBP	0.15	0.53	0.08	11.1			
		DINP	0.70	0.21	0.15	20.5			
	95	DBP	0.48	1.00	0.48	16.3	2.94	713	4.2%
		DEHP	1.07	0.84	0.90	30.5			
		BBP	0.45	0.52	0.23	7.9			
		DIBP	0.65	0.53	0.34	11.7			
		DINP	4.70	0.21	0.99	33.5			

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Race/ Socioeconomic Status (SES)	Percentile	Phthalate	Aggregate Daily Intake (µg/kg-day)	RPF	Aggregate Daily Intake in DBP Equivalents (µg/kg-day)	% Contribution to Cumulative Exposure	Cumulative Daily Intake (DBP Equivalents, µg/kg-day)	Cumulative MOE (POD = 2,100 µg/kg-day)	% Contribution to Risk Cup (Benchmark = 30) <sup>a</sup>
SES: Unknown (n = 210)	50	DBP	0.26	1.00	0.26	23.2	1.12	1,870	1.6%
		DEHP	0.67	0.84	0.56	50.1			
		BBP	0.06	0.52	0.03	2.8			
		DIBP	0.23	0.53	0.12	10.9			
		DINP	0.70	0.21	0.15	13.1			
	95	DBP	0.60	1.00	0.60	25.5	2.35	893	3.4%
		DEHP	0.86	0.84	0.72	30.7			
		BBP	0.21	0.52	0.11	4.6			
		DIBP	0.35	0.53	0.19	7.9			
		DINP	3.50	0.21	0.74	31.2			

<sup>a</sup> A cumulative exposure of 70 µg DBP equivalents/kg-day would result in a cumulative MOE of 30 (*i.e.*, 2,100 µg DBP-equivalents/kg-day ÷ 70 µg DBP equivalents/kg-day = 30), which is equivalent to the benchmark of 30, indicating that the exposure is at the threshold for risk. Therefore, to estimate the percent contribution to the risk cup, the cumulative exposure expressed in DBP equivalents is divided by 70 µg DBP equivalents/kg-day to estimate percent contribution to the risk cup.

3109

#### 4.4.3 Estimation of Risk Based on Relative Potency

As described in the *Draft Technical Support Document for the Cumulative Risk Analysis of DEHP, DBP, BBP, DIBP, DCHP, and DINP under TSCA* ([U.S. EPA, 2024ah](#)), EPA is focusing its exposure assessment for the CRA for DCHP on evaluation of exposures through individual TSCA consumer and occupational DCHP COUs as well as non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP using NHANES urinary biomonitoring data and reverse dosimetry. To estimate cumulative risk, EPA first scaled all phthalate exposures by relative potency using the RPFs presented in Table 4-19 to express phthalate exposure in terms of index chemical (DBP) equivalents. Exposures from individual DCHP consumer or worker COUs/OES were then combined to estimate cumulative risk. Cumulative risk was estimated using the four-step process outlined below, along with one empirical example of how EPA calculated cumulative risk for one occupational OES for DCHP (*i.e.*, Application of paints and coatings [solids]).

##### **Step 1: Convert DCHP Exposure Estimates from Each Individual Consumer and Occupational COU to Index Chemical Equivalents (*i.e.*, Occupational and Consumer Exposure from Sections 4.1.1 and 4.1.2, Respectively)**

In this step, DCHP acute duration exposure estimates from each consumer and occupational COU/OES are scaled by relative potency and expressed in terms of index chemical (DBP) equivalents using Equation 4-5. This step is repeated for all individual exposure estimates for each route of exposure being assessed for each COU (*i.e.*, inhalation and dermal exposures for occupational COUs; inhalation, ingestion, and dermal exposure for consumer COUs).

##### **Equation 4-5. Scaling DCHP Exposures by Relative Potency**

$$DCHP \text{ Exposure (in DBP equivalents)} = AD_{Route\ 1} \times RPF_{DCHP}$$

Where:

DCHP exposure	=	Acute exposure for a given route of exposure from a single occupational or consumer COU expressed in terms of $\mu\text{g}/\text{kg}$ index chemical (DBP) equivalents
$AD_{Route\ 1}$	=	Acute dose in $\mu\text{g}/\text{kg}$ from a given route of exposure from a single occupational or consumer COU/OES
$RPF_{DCHP}$	=	The relative potency factor (unitless) for DCHP, which is 1.66 (Table 4-19).

*Example:* 50th percentile inhalation and dermal DCHP exposures for female workers of reproductive age are 38.7 and 2.07  $\mu\text{g}/\text{kg}$  for the Application of paints and coatings (solids) OES ([U.S. EPA, 2024ab](#)). Using Equation 4-5, inhalation, dermal, and aggregate DCHP exposures for this OES can be scaled by relative potency to 64.2, 3.44, and 67.68  $\mu\text{g}/\text{kg}$  DBP equivalents, respectively.

$$DCHP_{Inhalation-COU} = 64.2 \mu\text{g}/\text{kg DBP equivalents} = 38.7 \mu\text{g}/\text{kg DCHP} \times 1.66$$

$$DCHP_{Dermal-COU} = 3.44 \mu\text{g}/\text{kg DBP equivalents} = 2.07 \mu\text{g}/\text{kg DCHP} \times 1.66$$

$$DCHP_{Aggregate-COU} = 67.68 \mu\text{g}/\text{kg DBP equivalents} \\ = (2.07 \mu\text{g}/\text{kg DCHP} + 38.7 \mu\text{g}/\text{kg DCHP}) \times 1.66$$

3158 **Step 2: Estimate Non-attributable Cumulative Exposure to DEHP, DBP, BBP, DIBP, and DINP**  
 3159 **Using NHANES Urinary Biomonitoring Data and Reverse Dosimetry (see Section 4.4.2 for Further**  
 3160 **Details)**

3161 Non-attributable exposure for a national population to DEHP, DBP, BBP, DIBP, and DINP was  
 3162 estimated using Equation 4-6, where individual phthalate daily intake values estimated from NHANES  
 3163 biomonitoring data and reverse dosimetry were scaled by relative potency, expressed in terms of index  
 3164 chemical (DBP) equivalents, and summed to estimate non-attributable cumulative exposure in terms of  
 3165 DBP equivalents. Equation 4-6 was used to calculate the cumulative exposure estimates provided in  
 3166 Table 4-20 and Table 4-21.

3167

3168 **Equation 4-6. Estimating Non-attributable Cumulative Exposure to DEHP, DBP, BBP, DIBP, and**  
 3169 **DINP**

3170

$$\begin{aligned} \text{Cumulative Exposure (Non - attributable)} \\ &= (DI_{DEHP} \times RPF_{DEHP}) + (DI_{DBP} \times RPF_{DBP}) + (DI_{BBP} \times RPF_{BBP}) \\ &+ (DI_{DIBP} \times RPF_{DIBP}) + (DI_{DINP} \times RPF_{DINP}) \end{aligned}$$

3173 Where:

3174 *Cumulative exposure (non-attributable)* is expressed in index chemical (DBP) equivalents  
 3175 ( $\mu\text{g}/\text{kg}\text{-day}$ ).

3176 *DI* is The daily intake value ( $\mu\text{g}/\text{kg}\text{-day}$ ) for each phthalate that was calculated using NHANES  
 3177 urinary biomonitoring data and reverse dosimetry (DI) values for each phthalate for each  
 3178 assessed population are provided in Table 4-20 and Table 4-21).

3179 *RPF* is the relative potency factor (unitless) for each phthalate from Table 4-19.

3180

3181 *Example:* The 95th percentile cumulative exposure estimate of 5.16  $\mu\text{g}/\text{kg}\text{-day}$  DBP equivalents for  
 3182 black, non-Hispanic women of reproductive age (Table 4-21) is calculated using Equation 4-6 as  
 3183 follows:

3184

$$\begin{aligned} 5.16 \mu\text{g}/\text{kg DBP equivalents} \\ &= (4.28 \mu\text{g}/\text{kg DEHP} \times 0.84) + (0.48 \mu\text{g}/\text{kg DBP} \times 1) + (0.30 \mu\text{g}/\text{kg BBP} \times 0.52) \\ &+ (0.40 \mu\text{g}/\text{kg DIBP} \times 0.53) + (3.40 \mu\text{g}/\text{kg DINP} \times 0.21) \end{aligned}$$

3185

3186 **Step 3: Calculate MOEs for DCHP Exposures and for Each Phthalate Exposure Included in the**  
 3187 **Cumulative Scenario**

3188 Next, MOEs are calculated for each exposure of interest that is included in the cumulative scenario  
 3189 using Equation 4-7. For example, this step involves calculating MOEs for inhalation and dermal DCHP  
 3190 exposures expressed in index chemical equivalents for each individual COU/OES in Step 1, and an  
 3191 MOE for non-attributable cumulative phthalate exposure from Step 2 above.

3192

3193 **Equation 4-7. Calculating MOEs for Exposures of Interest for Use in the RPF and Cumulative**  
 3194 **Approaches**

$$MOE_1 = \frac{\text{Index Chemical (DBP) POD}}{\text{Exposure}_1 \text{ in DBP Equivalents}}$$

3195 Where:

3196  $MOE_1$  (unitless) = The MOE calculated for each exposure of interest included  
 3197 in the cumulative scenario.

3198 *Index chemical (DBP) POD* = The POD selected for the index chemical, DBP. The index  
 3199 chemical POD is 2,100  $\mu\text{g}/\text{kg}$  (Section 4.4.1).

3200  $Exposure_1$  = The exposure estimate in DBP equivalents for the pathway

3201

of interest (*i.e.*, from Step 1 or 2 above).

*Example:* Using Equation 4-7, the MOEs for inhalation and dermal DCHP exposure estimates for the Application of paints and coatings (solids) OES in DBP equivalents from Step 1 and the MOE for the non-attributable cumulative exposure estimate in DBP equivalents from sSep 2 are 33, 610, and 407, respectively.

$$MOE_{Cumulative\ Non-attributable} = 407 = \frac{2,100\ \mu g/kg}{5.16\ \mu g/kg}$$

$$MOE_{COU-Inhalation} = 32.7 = \frac{2,100\ \mu g/kg}{64.2\ \mu g/kg}$$

$$MOE_{COU-Dermal} = 610 = \frac{2,100\ \mu g/kg}{3.44\ \mu g/kg}$$

#### Step 4: Calculate the Cumulative MOE

For the cumulative MOE approach, MOEs for each exposure of interest in the cumulative scenario are first calculated (Step 3). The cumulative MOE for the cumulative scenario can then be calculated using Equation 4-8, which shows the addition of MOEs for the inhalation and dermal exposures routes from an individual DCHP COU as well as the MOE for non-attributable cumulative exposure to phthalates from NHANES urinary biomonitoring and reverse dosimetry. Additional MOEs can be added to the equation as necessary (*e.g.*, for the ingestion route for consumer scenarios).

#### Equation 4-8. Cumulative Margin of Exposure Calculation

$$Cumulative\ MOE = \frac{1}{\frac{1}{MOE_{COU-Inhalation}} + \frac{1}{MOE_{COU-Dermal}} + \frac{1}{MOE_{Cumulative-Non-attributable}} \dots}$$

*Example:* The cumulative MOE for the Application of paints and coatings (solids) OES is 28.9 and is calculated by summing the MOEs for each exposure of interest from Step 3 as follows:

$$Cumulative\ MOE = 28.9 = \frac{1}{\frac{1}{32.7} + \frac{1}{610} + \frac{1}{407}}$$

#### 4.4.4 Risk Estimates for Workers Based on Relative Potency

This section summarizes RPF analysis risk estimates for female workers of reproductive age from acute duration exposures to DCHP. In the RPF analysis, EPA focused its occupational risk assessment on this population and exposure duration because as described in Section 4.4 and ([U.S. EPA, 2024ah](#)), this population and exposure duration is considered most directly applicable to the common hazard outcome that serves as the basis for the RPF analysis (*i.e.*, reduced fetal testicular testosterone).

To evaluate cumulative risk to female workers of reproductive age, EPA combined inhalation and dermal exposures to DCHP from each individual occupational COU/OES with non-attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP (estimated from NHANES urinary biomonitoring using reverse dosimetry). As described in Section 4.4.3, for each individual phthalate exposures were scaled by relative potency per chemical, expressed in terms of index chemical (DBP) equivalents, and summed to estimate cumulative exposure and cumulative risk for each COU. MOEs in

Table 4-22 are shown both with (cumulative MOE) and without (MOEs for individual DCHP COU derived using the RPF analysis) the addition of non-attributable cumulative exposure (estimated from NHANES using reverse dosimetry) so that MOEs scaled by relative potency can be compared.

Table 4-22 summarizes the acute duration central tendency and high-end MOEs for female workers of reproductive age used to characterize cumulative risk from exposure to DCHP, DEHP, DBP, BBP, DIBP, and DINP, as well as DCHP MOEs scaled by relative potency without non-attributable cumulative exposure (*i.e.*, NHANES) included. MOE calculations are also provided in the *Draft Occupational and Consumer Cumulative Risk Calculator for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024y](#)). As discussed in Section 4.3.2, high-end acute MOEs for female workers of reproductive age were below the benchmark of 30 for all DCHP COUs/OES evaluated as part of the individual chemical assessment. Addition of non-attributable cumulative national exposure (from NHANES) would have no influence on high-end risk conclusions. Therefore, EPA focused its cumulative risk characterization on central tendency MOEs (none of which were <30 in the individual DCHP assessment in Section 4.3.2). For all COUs, the Agency presents MOEs for each individual exposure route. That is, MOEs resulting from inhalation and dermal DCHP exposures for each COU/OES scaled to index chemical (DBP) equivalents (*i.e.*, the RPF analysis) as well as cumulative occupational exposure (*i.e.*, aggregate exposure to DCHP from a single COU [in index chemical equivalents] combined with cumulative national exposure [in index chemical equivalents]), so that the contribution of each exposure to the cumulative MOE can be discerned.

#### ***COUs/OES with Cumulative MOEs Ranging from 34 to 244***

As can be seen from Table 4-22, cumulative acute central tendency MOEs ranged from 34 to 244 for COUs covered under 12 of the OESs evaluated for DCHP, including the following:

- Import and repackaging (cumulative MOE = 55);
- PVC plastics compounding (cumulative MOE = 34);
- PVC plastics converting (cumulative MOE = 65);
- Non-PVC materials compounding (cumulative MOE = 52);
- Non-PVC materials converting (cumulative MOE = 110);
- Application of adhesives and sealants (liquids) (cumulative MOE = 244);
- Application of adhesives and sealants (solids) (cumulative MOE = 49);
- Use of laboratory chemicals (liquids) (cumulative MOE = 244);
- Use of laboratory chemicals (solids) (cumulative MOE = 40);
- Recycling (cumulative MOE = 63);
- Fabrication or use of final products and articles (cumulative MOE = 72); and
- Waste handling, treatment, and disposal (cumulative MOE = 63).

#### ***COUs/OES with Cumulative MOEs Ranging from 18 to 29***

As can be seen from Table 4-22, cumulative acute central tendency MOEs ranged from 18 to 29 for COUs covered under six OES, including:

- Manufacturing (cumulative MOE = 18);
- Incorporation into other formulations, mixtures, or reaction products (cumulative MOE = 18);
- Incorporation into adhesives and sealants (cumulative MOE = 18);
- Incorporation into paints and coatings (cumulative MOE = 18);
- Application of paints and coatings – liquids (cumulative MOE = 20); and
- Application of paints and coatings – solids (cumulative MOE = 29).

3291 EPA characterizes these preceding six OESs as part of the individual chemical assessment in Section  
3292 4.3.2. The central tendency acute aggregate MOE from exposure to DCHP alone for female workers of  
3293 reproductive age is 35 for four of the six OESs showing cumulative risk (*i.e.*, Manufacturing;  
3294 Incorporation into other formulations, mixtures, or reaction products; Incorporation into adhesives and  
3295 sealants; and Incorporation into paints and coatings) (Table 4-14), while the cumulative MOE for these  
3296 four OES is 18 (Table 4-22). For one OES (Application of paints and coatings – liquids), the central  
3297 tendency acute aggregate MOE from exposure to DCHP alone for female workers of reproductive age is  
3298 40 (Table 4-14), while the cumulative MOE for this OES is 20 (Table 4-22). For the sixth OES  
3299 (Application of paints and coatings – solids), the central tendency acute aggregate MOE from exposure  
3300 to DCHP alone for female workers of reproductive age is 60 (Table 4-14), while the cumulative MOE  
3301 for this OES is 29 (Table 4-22).

3302  
3303 For all of the evaluated OESs, including these six OESs, three factors contribute to the lower cumulative  
3304 MOEs compared to the acute aggregate central tendency MOE for female workers of reproductive age:

3305 *Scaling by Relative Potency:* DCHP inhalation and dermal exposures for the six OESs were scaled by  
3306 relative potency to the index chemical. The RPF for DCHP is 1.66, which means DCHP exposures when  
3307 multiplied by the RPF and expressed in terms of index chemical (DBP) equivalents, increased by 66  
3308 percent. *This 66 percent increase in exposure expressed in terms of index chemical equivalents is the*  
3309 *primary factor leading to lower cumulative MOEs.* RPFs used to scale for relative potency were  
3310 calculated based on a common hazard endpoint (*i.e.*, reduced fetal testicular testosterone) from data  
3311 from multiple studies evaluating effects of phthalates on fetal testicular testosterone using a meta-  
3312 analysis and BMD modeling approach for each of the six phthalates included in the cumulative chemical  
3313 group (see [\(U.S. EPA, 2024ah\)](#) for further details). This analysis provides a robust basis for assessing  
3314 the dose-response for the common hazard endpoint (*i.e.*, reduced fetal testicular testosterone) across the  
3315 six toxicologically similar phthalates included in the cumulative assessment. For example, use of meta-  
3316 analysis and BMD modeling allowed EPA to utilize more fetal testicular testosterone data in the low-  
3317 end range of the dose-response curve to gain a better understanding of the hazards of DCHP at the low-  
3318 end range of the dose-response curve compared to the index chemical, DBP. Overall, EPA has robust  
3319 confidence in the draft RPFs used in this CRA (Section 4.4.4.1).

3320  
3321 *Index Chemical POD:* As described previously in Sections 4.4.1 and 4.4.3, cumulative MOEs are  
3322 calculated by dividing the cumulative exposure estimate expressed in terms of index chemical (DBP)  
3323 equivalents by the index chemical POD. The POD for the index chemical (DBP) used to calculate  
3324 cumulative risk is 2.1 mg/kg (based on a BMDL<sub>5</sub> for reduced fetal testicular testosterone).  
3325 Comparatively, the DCHP POD used to calculate MOEs for individual DCHP COUs in Section 4.3.2 is  
3326 2.4 mg/kg (based on a NOAEL for phthalate syndrome-related effects). *The index chemical (DBP) POD*  
3327 *is 12.5 percent lower (i.e., more sensitive) than the individual DCHP POD, which contributes to the*  
3328 *lower cumulative MOEs.* Overall, EPA has robust confidence in the index chemical (DBP) POD used in  
3329 this CRA. This is because the POD is based on fetal testicular testosterone data from eight publications  
3330 that was integrated via meta-analysis and BMD modeling. Notably, several of the available studies  
3331 evaluated effects on fetal testicular testosterone at dose levels in the low-end range of the dose response  
3332 curve (*i.e.*, 1, 10, 33, and 50 mg/kg-day) where the BMD<sub>5</sub> (14 mg/kg-day) and BMDL<sub>5</sub> (9 mg/kg-day)  
3333 were derived (see [\(U.S. EPA, 2024ah\)](#) for further details).

3334  
3335 *Addition of Non-attributable Cumulative Exposure:* As part of its CRA, EPA calculated non-attributable  
3336 cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP using NHANES urinary biomonitoring  
3337 data from the 2017 to 2018 survey (most recent data set available) and reverse dosimetry (see Section  
3338 4.4.2 and [\(U.S. EPA, 2024ah\)](#) for further details), representing exposure to a national population. DCHP  
3339 was not included as part of the cumulative non-attributable national exposure estimate because DCHP

3340 has not been included in NHANES analyses since 2011 due to low frequencies of detection and low  
3341 detection levels in urine (Section 4.4.2). Non-attributable cumulative exposure estimates were scaled by  
3342 relative potency and expressed in index chemical (DBP) equivalents. Non-attributable cumulative  
3343 exposure was then combined with acute inhalation and dermal DCHP exposures for each individual  
3344 COU/OES scaled by relative potency. For female workers of reproductive age, EPA added a non-  
3345 attributable cumulative exposure of 5.16 µg/kg index chemical (DBP) equivalents to calculate the  
3346 cumulative MOE. This non-attributable cumulative exposure estimate is the 95th percentile estimate for  
3347 black non-Hispanic women of reproductive age (16 to 49 years). *This non-attributable cumulative*  
3348 *exposure contributes approximately 7.4 percent to the risk cup with a benchmark MOE of 30.*  
3349

3350 Overall, EPA has robust confidence in the non-attributable cumulative exposure estimate since it was  
3351 calculated from CDC's NHANES biomonitoring data set, which provides a statistically representative  
3352 sampling of the U.S. civilian population. Furthermore, the Agency used a well-established reverse  
3353 dosimetry approach to calculate phthalate daily intake values from urinary biomonitoring data.  
3354 For five out of the six OESs showing cumulative risk (*i.e.*, Manufacturing; Incorporation into other  
3355 formulations, mixtures, or reaction products; Incorporation into adhesives and sealants; Incorporation  
3356 into paints and coatings; and Application of paints and coatings – liquids), scaling acute inhalation  
3357 exposures by relative potency alone led to acute inhalation MOEs below 30, ranging from 19 to 22,  
3358 whereas the acute cumulative MOE (DCHP OES + cumulative non-attributable) ranged from 18 to 20.  
3359 For one OES showing cumulative risk (*i.e.*, Application of paints and coatings – solids), the acute  
3360 aggregate MOE based on exposure to DCHP expressed in index chemical equivalents was 31 and  
3361 adding non-attributable cumulative exposure resulted in a cumulative MOE of 29.

#### 3362 **4.4.4.1 Overall Confidence in Cumulative Worker Risk Estimates**

3363 EPA has robust confidence in the RPFs and index chemical POD used to calculate the RPF analysis and  
3364 cumulative MOEs. To derive RPFs and the index chemical POD, the Agency integrated data from  
3365 multiple studies evaluating fetal testicular testosterone using a meta-analysis approach and conducted  
3366 BMD modeling. This meta-analysis and BMD modeling approach represents a refinement of the  
3367 NOAEL/LOAEL approach used in the individual DCHP assessment and therefore increases EPA's  
3368 confidence in risk estimates. Finally, the Agency has robust confidence in the non-attributable  
3369 cumulative exposure estimates for DEHP, DBP, BBP, DIBP, and DINP derived from NHANES urinary  
3370 biomonitoring data using reverse dosimetry.

3371

**Table 4-22. Risk Summary Table for Female Workers of Reproductive Age Using the RPF Analysis**

Life Cycle Stage/ Category	Subcategory	OES	Exposure Level	Acute MOEs for Female Workers of Reproductive Age (Benchmark = 30)			
				Inhalation MOE (DCHP COU; Exposure in DBP Equivalents)	Dermal MOE (DCHP COU; Exposure in DBP Equivalents)	Aggregate MOE (DCHP COU; Exposure in DBP Equivalents)	Cumulative MOE (Aggregate DCHP MOE + Cumulative Non- attributable) <sup>a</sup>
Manufacturing – Domestic manufacturing	Domestic manufacturing	Manufacturing	CT	19.1	610	18.5	17.7
			HE	1.8	305	1.8	1.8
Manufacturing – Importing	Importing	Import and Repackaging	CT	70	610	63	55
Processing – Repackaging	Repackaging ( <i>e.g.</i> , laboratory chemicals)		HE	3.1	305	3.0	3.0
Processing – Processing – incorporation into formulation, mixture, or reaction product	Plasticizer in: – Adhesive manufacturing	Incorporation into adhesives and sealants	CT	19.1	610	18.5	17.7
	Adhesive and sealant chemicals in: – Adhesive manufacturing		HE	1.8	305	1.8	1.8
	Stabilizing Agent in: – Adhesive manufacturing						
Processing – Processing – incorporation into formulation, mixture, or reaction product	Plasticizer in: – Paint and coating manufacturing – Printing ink manufacturing	Incorporation into paints and coatings	CT	19.1	610	18.5	17.7
	Stabilizing agent in: – Paint and coating manufacturing		HE	1.8	305	1.8	1.8
Processing – Processing – incorporation into formulation, mixture, or reaction product	Stabilizing agent in: Asphalt paving, roofing, and coating materials manufacturing	Incorporation into other formulations, mixtures, and reaction products not covered elsewhere	CT	19.1	610	18.5	17.7
			HE	1.8	305	1.8	1.8

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Life Cycle Stage/ Category	Subcategory	OES	Exposure Level	Acute MOEs for Female Workers of Reproductive Age (Benchmark = 30)			
				Inhalation MOE (DCHP COU; Exposure in DBP Equivalents)	Dermal MOE (DCHP COU; Exposure in DBP Equivalents)	Aggregate MOE (DCHP COU; Exposure in DBP Equivalents)	Cumulative MOE (Aggregate DCHP MOE + Cumulative Non- attributable) <sup>a</sup>
Processing – Processing – incorporation into formulation, mixture, or reaction product	Plasticizer in: – Plastic material and resin manufacturing – Plastics product manufacturing	PVC plastics compounding	CT	40	610	37	34
			HE	1.9	305	1.9	1.9
	Stabilizing agent in: –Plastics product manufacturing						
Processing – Processing – incorporation into article	Plasticizer in: – Plastics product manufacturing	PVC plastics converting	CT	89	610	77	65
			HE	4.3	305	4.3	4.2
Processing – Processing – incorporation into formulation, mixture, or reaction product	Plasticizer in: – Plastics product manufacturing – Rubber product manufacturing – Plastic material and resin manufacturing	Non-PVC material compounding	CT	66	610	60	52
			HE	3.2	305	3.2	3.2
	Stabilizing agent in: –Plastics product manufacturing						
Processing – Processing – incorporation into article	Plasticizer in: – Plastics product manufacturing – Rubber product manufacturing	Non-PVC material converting	CT	199	610	150	110
			HE	9.7	305	9.4	9.2

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Life Cycle Stage/ Category	Subcategory	OES	Exposure Level	Acute MOEs for Female Workers of Reproductive Age (Benchmark = 30)			
				Inhalation MOE (DCHP COU; Exposure in DBP Equivalents)	Dermal MOE (DCHP COU; Exposure in DBP Equivalents)	Aggregate MOE (DCHP COU; Exposure in DBP Equivalents)	Cumulative MOE (Aggregate DCHP MOE + Cumulative Non- attributable) <sup>a</sup>
Industrial Use – Finishing agent	Cellulose film production	Application of paints and coatings – liquids	CT	21.7	610	21.0	19.9
Industrial Use – Inks, toner, and colorant products	Inks, toner, and colorant products (e.g., screen printing ink)		HE	1.0	305	1.0	1.0
Commercial Use – Inks, toner, and colorant products	Inks, toner, and colorant products (e.g., screen printing ink)						
Industrial Use – Paints and coatings	Paints and coatings						
Commercial Use – Paints and coatings	Paints and coatings						
Industrial Use – Finishing agent	Cellulose film production	Application of paints and coatings – solids	CT	32.7	610	31.1	28.9
Industrial Use – Inks, toner, and colorant products	Inks, toner, and colorant products (e.g., screen printing ink)		HE	1.9	305	1.9	1.8
Commercial Use – Inks, toner, and colorant products	Inks, toner, and colorant products (e.g., screen printing ink)						
Industrial Use – Paints and coatings	Paints and coatings						
Commercial Use – Paints and coatings	Paints and coatings						

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Life Cycle Stage/ Category	Subcategory	OES	Exposure Level	Acute MOEs for Female Workers of Reproductive Age (Benchmark = 30)			
				Inhalation MOE (DCHP COU; Exposure in DBP Equivalents)	Dermal MOE (DCHP COU; Exposure in DBP Equivalents)	Aggregate MOE (DCHP COU; Exposure in DBP Equivalents)	Cumulative MOE (Aggregate DCHP MOE + Cumulative Non- attributable) <sup>a</sup>
Industrial Uses – Adhesives and sealants	Adhesives and sealants ( <i>e.g.</i> , computer and electronic product manufacturing; transportation equipment manufacturing)	Application of adhesives and sealants – liquids	CT	–	610	–	244
			HE	–	305	–	174.3
Commercial Uses – Adhesives and sealants	Adhesives and sealants						
Industrial Uses – Adhesives and sealants	Adhesives and sealants in ( <i>e.g.</i> , computer and electronic product manufacturing; transportation equipment manufacturing)	Application of adhesives and sealants – solids	CT	61	610	56	49
			HE	3.4	305	3.4	3.3
Commercial Use – Laboratory chemicals	Laboratory chemicals	Use of laboratory chemicals – liquid	CT	–	610	–	244
			HE	–	305	–	174.3
Commercial Use – Laboratory chemicals	Laboratory chemicals	Use of laboratory chemicals – solid	CT	48	610	45	40
			HE	3.4	305	3.4	3.3

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Life Cycle Stage/ Category	Subcategory	OES	Exposure Level	Acute MOEs for Female Workers of Reproductive Age (Benchmark = 30)			
				Inhalation MOE (DCHP COU; Exposure in DBP Equivalents)	Dermal MOE (DCHP COU; Exposure in DBP Equivalents)	Aggregate MOE (DCHP COU; Exposure in DBP Equivalents)	Cumulative MOE (Aggregate DCHP MOE + Cumulative Non- attributable) <sup>a</sup>
Industrial Use – Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) (e.g., transportation equipment manufacturing)	Fabrication or use of final products or articles	CT	102	610	87	72
Commercial Use – Building/construction materials not covered elsewhere	Building/construction materials not covered elsewhere		HE	11.3	305	10.9	10.6
Commercial Use – Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)						
Processing – Recycling	Recycling	Recycling	CT	85	610	74	63
			HE	5.8	305	5.7	5.6
Disposal – Disposal	Disposal	Waste handling, treatment and disposal	CT	85	610	74	63
			HE	5.8	305	5.7	5.6

<sup>a</sup> The acute cumulative MOE is derived by summing inhalation exposure from each individual DCHP COU with dermal exposure from the same DCHP COU and the cumulative non-attributable exposure to DEHP, DBP, BBP, DIBP, and DINP. Non-attributable cumulative exposure was estimated from NHANES urinary biomonitoring data using reverse dosimetry. All exposure estimates were (1) scaled by relative potency, (2) expressed in index chemical equivalents (i.e., DBP equivalents), (3) summed to calculate cumulative exposure in index chemical equivalents, and then (4) compared to the index chemical POD (i.e., HED of 2.1 mg/kg-day) to calculate the cumulative MOE.

#### 4.4.5 Risk Estimates for Consumers Based on Relative Potency

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This section summarizes cumulative risk estimates for consumers from acute duration exposures to DCHP. EPA focused its CRA on women of reproductive age and male infants and children. EPA focused its consumer CRA on these populations for the acute exposure duration because, as described in Section 4.2 and (U.S. EPA, 2024ah), these populations and exposure duration are considered most directly applicable to the common hazard outcome that serves as the basis for the cumulative assessment (*i.e.*, reduced fetal testicular testosterone). For consumers, EPA did not specifically evaluate women of reproductive age or male infants and children; however, consumer exposures of teenagers (16–20 years) and adults (21+ years) were considered a proxy for women of reproductive age, while infants (<1 year), toddlers (1–2 years), children (3–5 and 6–10 years), and young teens (11–15 years) were considered a proxy for male infants and children.

After scaling high-intensity DCHP acute exposure estimates from individual COUs by relative potency and adding non-attributable cumulative exposure (calculated from NHANES) from DEHP, DBP, BBP, DIBP, and DINP, *all high-intensity consumer COUs product and article examples had cumulative MOEs above the benchmark of 30*, ranging from 130 for acute infant exposure through outdoor seating to 455 for acute exposure to adhesives for small repairs for young teens (11–15 years) (Table 4-23).

##### 4.4.5.1 Overall Confidence in Cumulative Consumer Risks

---

As discussed in Section 4.3.3, EPA has moderate to robust confidence in all of the exposure estimates for the evaluated consumer product scenarios. The Agency has robust confidence in the RPFs and index chemical POD used to calculate the cumulative MOEs. To derive RPFs and the index chemical POD, EPA integrated data from multiple studies evaluating fetal testicular testosterone using a meta-analysis approach and conducted BMD modeling. This meta-analysis and BMD modeling approach represents a refinement of the NOAEL/LOAEL approach used in the individual DCHP assessment and therefore increases EPA's confidence in risk estimates. Finally, EPA has robust confidence in the non-attributable cumulative exposure estimates for DEHP, DBP, BBP, DIBP, and DINP derived from NHANES urinary biomonitoring data using reverse dosimetry.

3400 **Table 4-23. Consumer Cumulative Risk Summary Table**

Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Scenario (H, M, L) <sup>a</sup>	Exposure Scenario	Lifestage (Years) MOE (Based on All Exposures in Index Chemical Equivalents) (Benchmark MOE = 30)						
					Infant (<1 Year)	Toddler (1–2 Years)	Preschooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenager (16–20 years)	Adult (21+ years)
Consumer Uses: Adhesives and sealants: Adhesives and sealants	Adhesives for small repairs	Acute	H	Cumulative (Aggregate DCHP COU + Cumulative Non-attributable)	–	–	–	–	455	389	388
Consumer Uses: Adhesives and sealants: Adhesives and sealants	Automotive adhesives	Acute	H	Cumulative (Aggregate DCHP COU + Cumulative Non-attributable)	191	191	192	282	437	377	377
Consumer Uses: Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Small articles with potential for semi-routine contact: labels, nitrocellulose; ethylcellulose; chlorinated rubber; PVAc; PVC	Acute	H	Cumulative (Aggregate DCHP COU + Cumulative Non-attributable)	165	169	172	248	400	351	348
Consumer Uses: Consumer articles that contain dicyclohexyl phthalate from: Inks, toner, and colorants; Paints and coatings; Adhesives and sealants (e.g., paper products, textiles, products using cellulose film, etc.)	Outdoor seating	Acute	H	Cumulative (Aggregate DCHP COU + Cumulative Non-attributable)	130	136	142	199	305	281	275
Consumer Uses: Consumer articles that contain dicyclohexyl phthalate from: Inks, toner, and colorants; Paints and coatings; Adhesives and sealants (e.g., paper products, textiles, products using cellulose film, etc.)	Small articles with the potential for semi-routine contact: labels, and packaging adhesives, foil and cellophane lacquers, and printing inks	Acute	H	Cumulative (Aggregate DCHP COU + Cumulative Non-attributable)	165	169	172	248	400	351	348
Consumer Uses: Consumer articles that contain dicyclohexyl phthalate from: Inks, toner, and colorants; Paints and coatings; Adhesives and sealants (e.g., paper	Electronics containing dye adhesive	Exposures not expected. Identified in dye attach adhesive used in wirebond packaging for semiconductor devices or in automotive cameras. As the adhesive is used in small quantities and contained within the electronic articles, no exposures are expected during potential use of these items.									

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Life Cycle Stage: COU: Subcategory	Product or Article	Duration	Exposure Scenario (H, M, L) <sup>a</sup>	Exposure Scenario	Lifestage (Years) MOE (Based on All Exposures in Index Chemical Equivalents) (Benchmark MOE = 30)							
					Infant (<1 Year)	Toddler (1–2 Years)	Preschooler (3–5 years)	Middle Childhood (6–10 years)	Young Teen (11–15 years)	Teenager (16–20 years)	Adult (21+ years)	
products, textiles, products using cellulose film, etc.)												
<sup>a</sup> Exposure scenario intensities include high (H), medium (M), and low (L). <sup>b</sup> Bystander scenarios <sup>c</sup> Indoor scenario												

3401

#### 4.4.6 Cumulative Risk Estimates for the General Population

For DCHP, EPA did not evaluate cumulative risk for the general population from environmental releases. As discussed in Section 4.1.3, the Agency employed a screening-level approach to assess risk from exposure to DCHP for the general population from environmental releases. Using this conservative screening-level approach, EPA did not identify any pathways of concern, indicating that refinement was not necessary.

### 4.5 Comparison of Single Chemical and Cumulative Risk Assessments

In support of the developed CRA, EPA has relied substantially on existing CRA-related work by the Agency's Risk Assessment Forum (RAF), EPA Office of Pesticide Programs (OPP), the Organisation for Economic Co-operation and Development (OECD), the European Commission, and the World Health Organization (WHO) and International Programme on Chemical Safety (IPCS), including

- *Guidelines for the Health Risk Assessment of Chemical Mixtures* ([U.S. EPA, 1986](#));
- *Guidance for Identifying Pesticide Chemicals and Other Substances that Have a Common Mechanism of Toxicity* ([U.S. EPA, 1999](#));
- *Supplementary Guidance for Conducting Health Risk Assessment of Chemical Mixtures* ([U.S. EPA, 2000](#));
- *General Principles for Performing Aggregate Exposure and Risk Assessments* ([U.S. EPA, 2001](#));
- *Guidance on Cumulative Risk Assessment of Pesticide Chemicals that Have a Common Mechanism of Toxicity* ([U.S. EPA, 2002a](#));
- *Framework for Cumulative Risk Assessment* ([U.S. EPA, 2003](#));
- *Concepts, Methods and Data Sources for Cumulative Health Risk Assessment of Multiple Chemicals, Exposures, and Effects: A Resource Document* ([U.S. EPA, 2007](#));
- *Pesticide Cumulative Risk Assessment: Framework for Screening Analysis Purpose* ([U.S. EPA, 2016b](#));
- *Advances in Dose Addition For Chemical Mixtures: A White Paper* ([U.S. EPA, 2023a](#)).
- *Phthalates and Cumulative Risk Assessment: The Tasks Ahead* ([NRC, 2008](#));
- *State of the Art Report on Mixture Toxicity* ([European Commission, 2009](#));
- *Risk Assessment of Combined Exposure to Multiple Chemicals: A WHO/IPCS Framework* ([Meek et al., 2011](#)); and
- *Considerations for Assessing the Risks of Combined Exposure to Multiple Chemicals* ([OECD, 2018](#)).

Herein, EPA has evaluated risks for workers (Section 4.3.2), consumers (Section 4.3.3), and the general population (Section 4.3.4) from exposure to DCHP alone, as well as cumulative risks for workers (Section 4.4.4) and consumers (Section 4.4.5) that take into account differences in relative potency and cumulative non-attributable exposure to DEHP, DBP, BBP, DIBP, and DINP from NHANES biomonitoring and reverse dosimetry.

There are several notable differences between the individual DCHP assessment (Section 4.3) and the CRA (Section 4.4). As part of the individual DCHP assessment (Section 4.3), EPA considered all human health hazards of DCHP and selected a POD based on a NOAEL for phthalate syndrome-related effects to characterize risk from exposure to DCHP. As part of its exposure assessment in the individual DCHP assessment, EPA considered acute, intermediate, and chronic exposures durations for a broad range of populations—including female workers of reproductive age, average adult workers, ONUs, the general population, and consumers of various lifestages (e.g., infants, toddlers, children, adults). Furthermore, in the individual DCHP assessment, EPA evaluated inhalation and dermal exposures to workers, as well as

3447 consumer exposure to DCHP via the inhalation, dermal, and ingestion exposure routes. In contrast, the  
3448 CRA is more focused in scope (Section 4.4). First, the CRA is based on a uniform measure of hazard  
3449 (*i.e.*, reduced fetal testicular testosterone) that serves as the basis for deriving RPFs and the index  
3450 chemical (DBP) POD, which were derived via meta-analysis and BMD modeling (Section 4.4.1).  
3451 Second, the CRA is focused on acute duration exposures and the most sensitive populations (*i.e.*, women  
3452 of reproductive age, male infants, male children) (Section 4.4). Finally, for the CRA, DCHP exposures  
3453 from individual consumer and worker COUs were (1) scaled by relative potency; (2) expressed in index  
3454 chemical (DBP) equivalents; and (3) combined with non-attributable cumulative exposure to DEHP,  
3455 DBP, BBP, DIBP, and DINP from NHANES.

3456  
3457 Both the individual DCHP assessment (Section 4.3) and the CRA (Section 4.4) led to similar  
3458 conclusions regarding risk estimates for consumers. As discussed in Section 4.3.3, high-intensity MOEs  
3459 for consumer scenarios ranged from 740 to 950,000 in the individual DCHP assessment (Benchmark =  
3460 30), while cumulative consumer MOEs ranged from 130 to 455 (cumulative Benchmark = 30) (Section  
3461 4.4.5).

3462  
3463 For workers, cumulative acute central tendency MOEs ranged from 18 to 29 for COUs covered under  
3464 six OESs (Section 4.4.5). Comparatively, these same six OESs had aggregate acute MOEs that ranged  
3465 from 35 to 60 in the individual DCHP assessment (Section 4.3.2). Overall, there are three primary  
3466 factors that influenced differences in risk estimates between the individual DCHP assessment (Section  
3467 4.3) and the RPF analysis (Section 4.4), which are described below:

- 3468 • **Scaling by Relative Potency.** DCHP inhalation, dermal, and ingestion exposures from individual  
3469 COUs/OES were scaled by relative potency to the index chemical. The RPF for DCHP is 1.66,  
3470 which means DCHP exposures when multiplied by the RPF and expressed in terms of index  
3471 chemical (DBP) equivalents, increased by 66 percent. This increase in exposure expressed in  
3472 terms of index chemical equivalents is the primary factor leading to lower cumulative MOEs.
- 3473 • **Index Chemical POD.** Cumulative MOEs are calculated by dividing the index chemical POD by  
3474 a cumulative exposure estimate expressed in terms of index chemical (DBP) equivalents. The  
3475 POD for the index chemical (DBP) used to calculate cumulative risk is 2.1 mg/kg (based on a  
3476 BMDL<sub>5</sub> for reduced fetal testicular testosterone). Comparatively, the DCHP POD used to  
3477 calculate MOEs for individual DCHP COUs is 2.4 mg/kg (based on a NOAEL for phthalate  
3478 syndrome-related effects). The index chemical (DBP) POD is 12.5 percent lower (*i.e.*, more  
3479 sensitive) than the individual DCHP POD, which contributes to the lower cumulative MOEs.
- 3480 • **Addition of Non-attributable Cumulative Exposure.** As part of its CRA, EPA calculated non-  
3481 attributable cumulative exposure to DEHP, DBP, BBP, DIBP, and DINP using NHANES urinary  
3482 biomonitoring data from the 2017 to 2018 survey reverse dosimetry (Section 4.4.2), representing  
3483 exposure to a national population. *Overall, this non-attributable cumulative exposure contributes*  
3484 *approximately 7.4 to 15.5 percent to the risk cup, depending on the population and age group.*

3485 Ultimately, the impact of scaling by relative potency has a significant impact on the risk estimates for  
3486 exposure to DCHP alone. There is little additional cumulative risk by adding the simultaneous exposure  
3487 of other phthalates to the single chemical risk estimates for DCHP (*i.e.*, non-attributable cumulative  
3488 exposure from NAHNES adds 7.4–15.5% to the risk cup).

3489  
3490 EPA has robust confidence in its CRA and moderate to robust confidence in its individual assessment of  
3491 DCHP for workers (Section 4.3.2.1), consumers (Section 4.3.3.1), and the general population (Section  
3492 4.3.4.1). RPFs used to scale for relative potency were calculated based on a common hazard endpoint  
3493 (*i.e.*, reduced fetal testicular testosterone) from data from multiple studies evaluating effects of

3494 phthalates on fetal testicular testosterone using a meta-analysis and BMD modeling approach for each of  
3495 the six phthalates included in the cumulative chemical group ([U.S. EPA, 2024ah](#)). This analysis provides  
3496 a robust basis for assessing the dose-response for the common hazard endpoint (*i.e.*, reduced fetal  
3497 testicular testosterone) across the six toxicologically similar phthalates included in the CRA. For  
3498 example, use of meta-analysis and BMD modeling allowed EPA to utilize more fetal testicular  
3499 testosterone data in the low-end range of the dose-response curve to gain a better understanding of the  
3500 hazards of DCHP at the low-end range of the dose-response curve compared to the index chemical,  
3501 DBP.

3502 **5 ENVIRONMENTAL RISK ASSESSMENT**

3503

**DCHP - Environmental Risk Assessment (Section 5):  
Key Points**

EPA evaluated the reasonably available information to support the environmental risk assessment of DCHP. The key points of the environmental risk assessment are summarized below:

- DCHP is expected to be released to the environment via air, water, biosolids, and disposal to landfills. Based on DCHP's fate parameters, concentrations of DCHP in soil and groundwater resulting from releases to the landfill or via biosolids were not quantified but discussed qualitatively because DCHP is not expected to be persistent or be mobile in soils (Section 2).
- High-end concentrations of DCHP in surface water were estimated for the purpose of risk assessment for environmental exposure. The only two OESs with estimated water releases were Plastic compounding and Recycling, with Plastic compounding being the highest release and subsequent environmental concentrations in surface water (Section 3 and ([U.S. EPA, 2024p](#))).
- The physical and chemical properties of DCHP indicate that it has low bioaccumulation potential and is unlikely to biomagnify. Therefore, EPA did not analyze the trophic transfer of DCHP through dietary exposures to aquatic organisms ([U.S. EPA, 2024p](#)).
- EPA derived a concentration of concern (COC) for reproductive effects of chronic DCHP water exposure of 32 µg/L DCHP to an aquatic invertebrate, *Daphnia magna* ([U.S. EPA, 2024o](#)). Empirical toxicity data for laboratory rats were used to estimate a terrestrial mammal hazard threshold of 179.3 mg/kg bw/d DCHP ([U.S. EPA, 2024o](#)).
- EPA found no reasonably available definitive environmental hazard data for DCHP exposures to birds, reptiles, sediment-dwelling animals, terrestrial invertebrates, or plants ([U.S. EPA, 2024o](#)). Therefore, DCHP hazards to these organisms were not assessed.
- Based on qualitative risk characterization, EPA does not expect risk for any assessed pathways for exposure of DCHP to terrestrial organisms. Risk is not expected because exposure to terrestrial organisms in water, soil, air, and diet is expected to be low (Section 2) and no evidence of DCHP hazard to wild terrestrial organisms was reasonably available (Section 5.2). EPA considered DCHP hazard to laboratory rodents in lieu of reasonably available wild mammal hazard resulting in conservative dietary mammal exposures being at least an order of magnitude lower than the hazard threshold (Section 5.3). The Agency has robust confidence in the preliminary determination of no risk to terrestrial organisms.
- Based on qualitative risk characterization, EPA does not expect risk for acute durations of DCHP exposure to aquatic organisms because reasonably available data found no acute hazard effects up to and above the estimated upper bound of the range of probable water solubility limits (1,480 µg/L) (Section 5.3).
- Based on qualitative risk characterization, EPA does not expect risk of chronic DCHP exposure to aquatic animals. Considerable uncertainties exist about the limit of water solubility, water release estimates, and low flow surface water modeling estimates. No risk was indicated under scenarios of lower limits of water solubility, lower release estimates, more rapid stream flow, and available measured DCHP water concentrations from the literature.

3504 **5.1 Summary of Environmental Exposures**

3505 EPA assessed environmental concentrations of dicyclohexyl phthalate (DCHP) in air, water, and land  
3506 (soil, biosolids, and groundwater) for use in environmental exposure. The environmental exposures are  
3507 described in the *Draft Physical Chemistry and Fate and Transport Assessment for Dicyclohexyl*

3508 *Phthalate (DCHP)* ([U.S. EPA, 2024z](#)) and the *Draft Environmental Media, General Population, and*  
3509 *Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024p](#)). DCHP  
3510 will preferentially sorb into sediments, soils, particulate matter in air, and in wastewater solids during  
3511 wastewater treatment. High-quality studies of DCHP biodegradation rates and physical and chemical  
3512 properties indicate that DCHP will have limited persistence and mobility in soils receiving biosolids  
3513 ([U.S. EPA, 2024z](#)). Surface water, pore water, and sediment concentrations of DCHP were modeled  
3514 using VVWM-PSC. The PVC plastics compounding COU resulted in the highest estimated release to  
3515 water, followed by Recycling. DCHP concentrations in receiving waters were estimated for these COUs  
3516 and ranged from 0.057 µg/L to 165 µg/L DCHP in the water column in low flow (7Q10) conditions. For  
3517 the land pathways, there are uncertainties in the relevance of limited monitoring data for biosolids and  
3518 landfill leachate to the COUs considered. However, based on high-quality physical and chemical  
3519 property data, EPA determined that DCHP will have low persistence potential and mobility in soils.  
3520 Therefore, groundwater concentrations resulting from releases to the landfill or to agricultural lands via  
3521 biosolids applications were not quantified but were discussed qualitatively.

3522  
3523 Limited measured data were reasonably available from the scientific literature on DCHP concentrations  
3524 in soils, biosolids, soils receiving biosolids, and landfills. No monitoring data of DCHP in these  
3525 environments were reasonably available. Limited reasonably available information was available related  
3526 to the uptake and bioavailability of DCHP soils. Based on the range of estimates of water solubility (30–  
3527 1,480 µg/L) and hydrophobicity (log Kow = 4.82; log Koc = 4.47), DCHP is expected to have low  
3528 bioavailability in soil. DCHP has not readily measured or monitored in aquatic or terrestrial organisms  
3529 and has low bioaccumulation and biomagnification potential. Therefore, DCHP has low potential for  
3530 trophic transfer through food webs. DCHP is expected to have minimal air to soil deposition.

## 3531 **5.2 Summary of Environmental Hazards**

3532 EPA evaluated the reasonably available information for environmental hazard endpoints associated with  
3533 DCHP exposure to ecological receptors in aquatic and terrestrial ecosystems. The Agency reviewed two  
3534 references from the peer-reviewed literature and four studies reported by the Japanese Ministry of the  
3535 Environment that were subsequently summarized by EU ECHA. EPA determined all references had  
3536 high or medium data quality. These hazards are described in the *Draft Environmental Hazard*  
3537 *Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024o](#)).

3538  
3539 EPA found limited definitive environmental hazard data for DCHP. The reasonably available studies  
3540 found all acute exposure hazards to fish, invertebrates, and algae to be higher than the upper bound of  
3541 the range of probable water solubility limits of 1,480 µg/L DCHP. However, DCHP caused chronic  
3542 reproductive effects to an aquatic invertebrate (*Daphnia magna*) and a fish species (*Danio rerio*) at  
3543 concentrations below the water solubility limit. EPA derived a concentration of concern (COC) for  
3544 reproductive effects of chronic DCHP water exposure of 32 µg/L DCHP.

3545  
3546 In terrestrial habitats, the available data suggest that DCHP might cause hazard to terrestrial mammals  
3547 through dietary exposures. A hazard effects threshold was estimated based on laboratory rodent  
3548 experiments because wild organism hazard studies were not reasonable available. EPA determined a  
3549 terrestrial mammal hazard threshold leading to reduced body weight over two generations of dietary  
3550 exposure to 179.3 mg/kg bw/d DCHP.

3551  
3552 No hazard data were reasonably available for birds, reptiles, terrestrial invertebrates, and plants.  
3553 Therefore, these taxa were not assessed.

## 5.3 Environmental Risk Characterization

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### 5.3.1 Risk Assessment Approach

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The environmental risk characterization of DCHP was conducted to evaluate whether the potential releases and resultant exposures of DCHP in water, air, or soil will exceed the DCHP concentrations observed to result in hazardous effects to aquatic or terrestrial organisms. In evaluating the DCHP exposure concentrations, monitored and modeled DCHP concentrations in surface water were used quantitatively. Concentrations of DCHP in soil (biosolids, landfills, air deposition) and air is limited or is not expected to be bioavailable and were used qualitatively. In evaluating the environmental hazard of DCHP, a weight of evidence approach was used to select hazard threshold concentrations for the derivation of risk quotients for aquatic organisms. A weight of evidence approach was also used to select hazard threshold concentrations for a description of risk for terrestrial organisms.

Environmental risk was characterized by calculating risk quotients or RQs ([U.S. EPA, 1998](#); [Barnthouse et al., 1982](#)). The RQ is defined in Equation 5-1 below.

#### Equation 5-1. Calculating the Risk Quotient

$$RQ = \frac{\text{Predicted Environmental Concentration}}{\text{Hazard Threshold}}$$

For aquatic organisms, the “effect level” is a derived COC based on a hazard effects concentration. The COC used to calculate RQs for aquatic organisms was derived from hazard values resulting from chronic exposures to DCHP. An RQ equal to 1 indicates that the exposures are the same as the concentration that causes effects. If the RQ exceeds 1, the exposure is greater than the effect concentration and risk is indicated. If the RQ is less than 1, the exposure is less than the effect concentration and risk is not indicated. In this assessment, an initial RQ value was determined only for surface water exposure to aquatic organisms where the worst-case scenario of release, flow, water solubility and chronic invertebrate hazard were considered. After further consideration of realistic conditions and hazards, risk was assessed qualitatively for surface water exposures and all other pathways.

In addition to modeling, environmental monitoring and biomonitoring data were reviewed and screened to assess wildlife exposure to DCHP ([U.S. EPA, 2024p](#)). EPA qualitatively assessed the trophic transfer of DCHP through food webs to wildlife using a worst-case scenario and physical and chemical properties. DCHP is not expected to be persistent in the environment as it is expected to degrade rapidly under most environmental conditions with delayed biodegradation in low-oxygen media and DCHP’s bioavailability is expected to be limited ([U.S. EPA, 2024z](#)). Estimates of the DCHP limit of water solubility range from 30 to 1,480 µg/l, leading to uncertainty about DCHP dissolved in surface water. DCHP is expected to have low bioaccumulation potential, biomagnification potential, and low potential for uptake based on a log BCF (bioconcentration factor) of 2.85 and a log BAF (bioaccumulation factor) of 1.83 ([U.S. EPA, 2024p, z](#)).

### 5.3.2 Risk Estimates for Aquatic and Terrestrial Species

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For DCHP, surface water exposure was the only scenario where modeled concentrations could be compared with a hazard threshold or a COC. Thus, EPA calculated an initial RQ for surface water DCHP concentration but did not calculate RQs for other scenarios of exposure to organisms. Instead, because either exposure or hazard effects estimates were not reasonably available for other scenarios,

3599 environmental risk of DCHP to other organisms was characterized by a qualitative description of risk  
3600 (Table 5-1).  
3601

3602 **Table 5-1. Relevant Exposure Pathway to Receptors and Corresponding Risk Assessment for the**  
3603 **DCHP Environmental Risk Characterization**

Exposure Pathway	Receptor	Risk Assessment
Surface water	Chronic exposure to aquatic species (reduced <i>Daphnia magna</i> reproduction >21 days)	Qualitative; No risk
	Acute exposure: no hazard up to and above 2,000 µg/L DCHP to fish ( <i>Oryzias latipes</i> ), <i>D. magna</i> , and algae ( <i>Raphidocelis subcapitata</i> )	Qualitative; No risk
Trophic transfer	Terrestrial mammal	Qualitative; No risk
Biosolids	Terrestrial mammal	Qualitative; No risk
Landfills	Terrestrial mammal	Qualitative; No risk

3604  
3605 **Surface Water**

3606 The COC was derived from a study of the hazard effects due to chronic (21-day) aqueous exposures to  
3607 the freshwater invertebrate, *Daphnia magna* (NITE, 2000) and determined to be 32 µg/L DCHP. The  
3608 reasonably available studies on Japanese medaka (*Oryzias latipes*), *D. magna*, and the freshwater algae  
3609 (*Raphidocelis subcapitata*) found no aquatic acute exposure hazards up to and above the water solubility  
3610 limit of 1,480 µg/L DCHP (U.S. EPA, 2024o).  
3611

3612 EPA found no evidence from monitoring reports or the scientific literature that DCHP occurs in surface  
3613 water at the COC of 32 µg/L. However, EPA modeled surface water release under the most conservative  
3614 and least likely scenario from the PVC plastics compounding COU. This conservative model included  
3615 (1) the highest modeled release estimate, (2) the lowest 7-day average flow over 10 years from a generic  
3616 stream, and (3) the highest modeled estimate of the limit of DCHP water solubility (1,480 µg/L). These  
3617 conditions are unlikely for at least two reasons. First, it combined the highest release from a facility into  
3618 a low flow scenario indicative of a small stream. Without site-specific data, EPA does not have evidence  
3619 that a high release, small stream combination exists in the United States. Second, experimental evidence  
3620 suggests that the functional limit of DCHP water solubility may be near the lower EPA estimated range  
3621 of 30 µg/L rather than the upper bound of the estimated range of 1,480 µg/L. Specifically, two studies  
3622 that attempted to find hazard thresholds of DCHP to aquatic organisms report their inability to keep  
3623 DCHP in solution above 30 to 50 µg/L even with the aid of cosolvents (Swedish Chemicals Agency,  
3624 2023; Mathieu-Denoncourt et al., 2016). The VMM-PSC modeled concentrations were 165 µg/L DCHP  
3625 in surface water and 95 µg/L in porewater over 21 days, which are below the upper bound estimate of  
3626 the limit of water solubility of 1,480 µg/L (U.S. EPA, 2024aa), but over 3 times greater than the lower  
3627 bound estimate of the limit of water solubility (30 µg/L) and the water solubility limit (30 µg/L)  
3628 proposed by the Swedish Chemicals Agency (Swedish Chemicals Agency, 2023).  
3629

3630 A first-tier screen computed RQs using the upper bound estimate of water solubility (1,480 µg/L), the  
3631 highest release, and median low flow (7Q10) and the COC (32 µg/L) over 21 days resulting in a RQ  
3632 greater than 1. However, RQs were less than 1 under all other scenarios that considered one or more of  
3633 the following surface water scenarios, higher flow rates (e.g., 75th percentile 7Q10), modeled central  
3634 tendency release estimates (e.g., 1.11 kg/day), or limits of water solubility at the lower bounded estimate  
3635 (30 µg/L). Additional uncertainty about the first-tier screen RQ is due to the DCHP COC being derived

3636 from a *Daphnia* study that found a 12.9 percent reduction in offspring reproduction after two to three  
3637 generations of exposure to 572 µg/L DCHP ([NITE, 2000](#)). The exposure concentrations in this  
3638 experiment were enhanced by the use of dimethylformamide as a cosolvent, which resulted in DCHP  
3639 concentrations well above the lower bound estimate of water solubility (30 µg/L) ([NITE, 2000](#)).  
3640 Therefore, EPA determined a low likelihood of DCHP persisting in surface waters for a long enough  
3641 duration (21 days) to cause chronic hazard in aquatic invertebrates, and thus a preliminary indication of  
3642 no risk.

3643  
3644 In one available study, DCHP concentrations measured in the water column did not exceed 0.014 µg/L  
3645 ([Keil et al., 2011](#)). Monitoring by the Washington State Department of Ecology resulted in no DCHP  
3646 detection above the detection limit (0.05 µg/L) ([WA DOE, 2022](#)). No information is available on the  
3647 potential continuous or persistent nature of DCHP in the water column of natural systems or from  
3648 specific release sites. Modeled concentrations from the Processing/ PVC plastics compounding  
3649 COU/OES release scenarios coupled with low flow conditions predict unlikely conditions for exposure  
3650 to exceed COCs. Risk of chronic DCHP exposure to aquatic invertebrates requires surface water  
3651 concentrations to be three orders of magnitude greater than those reported in the literature as background  
3652 concentration or at a point source ([Keil et al., 2011](#)). Modeled DCHP water concentrations from  
3653 recycling release scenarios did not indicate risk even in similar low flow conditions.

#### 3654 ***Sediment and Pore Water***

3655 DCHP is expected to partition primarily to soil and sediment, regardless of the compartment of  
3656 environmental release ([U.S. EPA, 2024ai](#)). DCHP is not expected to undergo long-range transport and is  
3657 expected to be found predominantly in sediments near point sources, with a decreasing trend in sediment  
3658 concentrations downstream due to DCHP's strong affinity and sorption potential for organic carbon in  
3659 sediment. EPA's maximum modeled concentrations under low flow conditions of 112 mg/kg/d ([U.S.  
3660 EPA, 2024p](#)) reflect the physical and chemical properties of DCHP and its predicted affinity for  
3661 sediment ([U.S. EPA, 2024z](#)), but may be overestimated due to conservative parameters and the Variable  
3662 Volume Water Model – Point Source Calculator (VVM-PSC) three compartment model. Also, DCHP is  
3663 not expected to be persistent in the environment as it is expected to degrade rapidly under most  
3664 environmental conditions with delayed biodegradation in low-oxygen media ([U.S. EPA, 2024z](#)).

3665  
3666 EPA found no evidence from monitoring reports or the scientific literature that DCHP occurs in pore  
3667 water at the COC of 32 µg/L. Porewater DCHP concentrations from VVM-PSC modeling resulted in a  
3668 maximum of 93 µg/L, which exceeded the DCHP limit of solubility (30 µg/L). EPA found no  
3669 reasonably available studies on the hazard effects of DCHP sediment exposures to aquatic organisms  
3670 ([U.S. EPA, 2024o](#)). Despite this, the Agency considered the COC of DCHP to *Daphnia* (32 µg/L) to  
3671 indicate chronic exposure hazard effects to sediment dwelling animals. Because of the water solubility  
3672 uncertainties described for surface risk to aquatic invertebrates, EPA determined a low likelihood of  
3673 DCHP persisting in sediment and pore waters for a long enough duration (21 days) to cause chronic  
3674 hazard in aquatic invertebrates, and thus a preliminary indication of no risk.

#### 3675 ***Air***

3676 No studies on the hazardous effects of DCHP inhalation were reasonably available for EPA to review.  
3677 Only a few studies that monitored ambient DCHP air concentrations were reasonably available for the  
3678 Agency to review. DCHP in particulates averaged 0.01 ng/m<sup>3</sup> in one study ([Lee et al., 2019](#)). Low to  
3679 negligible air concentrations are expected from TSCA COUs and air to soil modeling was not  
3680 conducted. Thus, EPA qualitatively assessed risk using low exposures via air pathways and a  
3681 preliminary indication of no risk.

3685 **Landfill**

3686 EPA qualitatively assessed risk of landfill to groundwater and soil DCHP exposure to aquatic and  
3687 terrestrial organisms. No hazard data were reasonably available for groundwater-dwelling or soil-  
3688 dwelling animals or plants. EPA considered the COC of DCHP to *Daphnia* (32 µg/L) to indicate chronic  
3689 exposure hazard effects to groundwater dwelling animals. Empirical toxicity data for rats and mice were  
3690 used to estimate a hazard threshold value for terrestrial mammals that may ingest soils at 179.3 mg/kg-  
3691 bw/day ([U.S. EPA, 2024o](#)).

3692  
3693 DCHP may be deposited into landfills through various waste streams, including consumer waste,  
3694 residential waste, and industrial waste, as well as through municipal waste like dewatered wastewater  
3695 biosolids. No studies were identified which reported the concentration of DCHP in landfills or in the  
3696 surrounding land. There is limited information regarding DCHP in dewatered biosolids, which may be  
3697 sent to landfills for disposal. DCHP is not expected to be persistent in the environment as it is expected  
3698 to degrade rapidly under most environmental conditions with delayed biodegradation in low-oxygen  
3699 media. DCHP is slightly soluble in water (range from 0.03–1,480 mg/L) and has limited potential to  
3700 leach from landfills into nearby groundwater or surface water systems. However, DCHP is expected to  
3701 have a high affinity to particulate (log K<sub>oc</sub> = 4.47) and organic media (log K<sub>ow</sub> = 4.82), which would  
3702 cause significant retardation in groundwater and limit leaching to groundwater. Because of its high  
3703 hydrophobicity and high affinity for soil sorption, it is not expected to be bioavailable for uptake. As a  
3704 result, the available evidence indicates that migration from landfills to surface water and sediment is  
3705 limited, and EPA did not model DCHP leaching from landfills to groundwater or surface water systems.  
3706 EPA determined a low likelihood of DCHP persisting in and being bioavailable in groundwater from  
3707 landfills for a long enough duration to cause chronic hazard in animals, and thus a preliminary indication  
3708 of no risk.

3709  
3710 There is limited reasonably available information related to the uptake and bioavailability of DCHP in  
3711 soils. DCHPs solubility and sorption coefficients suggest that bioaccumulation and biomagnification  
3712 will not be of significant concern for soil-dwelling organisms adjacent to landfills. The combination of  
3713 factors such as biodegradation ([U.S. EPA, 2024z](#)) and the weight of evidence supporting a lack of  
3714 bioaccumulation and lack of biomagnification supports this qualitative assessment that potential DCHP  
3715 concentrations in landfills do not present concentrations greater than the hazard thresholds to terrestrial  
3716 organisms. EPA determined a low likelihood of DCHP persisting and being bioavailable to solid-  
3717 dwelling animals, plants, or in the diets of mammals for a long enough duration to cause chronic hazard,  
3718 and thus a preliminary indication of no risk.

3719  
3720 **Biosolids**

3721 EPA qualitatively assessed risk of biosolids to soil DCHP exposure to terrestrial organisms. No hazard  
3722 data were reasonably available for soil-dwelling animals or plants. Empirical toxicity data for rats and  
3723 mice were used to estimate a hazard threshold value for terrestrial mammals at 179.3 mg/kg-bw/day  
3724 ([U.S. EPA, 2024o](#)). DCHP may be introduced to biosolids by the absorption or adsorption of DCHP to  
3725 particulate or organic material during wastewater treatment. Wastewater treatment is expected to remove  
3726 up to 98 percent of DCHP during wastewater treatment via sorption of DCHP to biosolids ([Wu et al.,  
3727 2019](#)). Modeling of DCHP removal in wastewater treatment predicts sorption to account for a total of  
3728 71.2 percent removal of DCHP with 70.6 percent overall removal attributed to biosolid sorption and the  
3729 remaining 0.6 percent removal attributed to biological treatment ([U.S. EPA, 2017](#)). There are currently  
3730 no reasonably available U.S.-based studies reporting DCHP concentration in biosolids or in soil  
3731 following land application.

3732

3733 High-end release scenarios were considered not to be applicable to the evaluation of land application of  
3734 biosolids. More specifically, high-end releases of DCHP from industrial facilities are unlikely to be  
3735 discharged directly to municipal wastewater treatment plants without pre-treatment, and biosolids from  
3736 industrial facilities are unlikely to be directly land applied following on-site treatment.  
3737

3738 There is limited measured data on concentrations of DCHP in biosolids or soils receiving biosolids and  
3739 there is uncertainty that concentrations used in this analysis are representative of all types of  
3740 environmental releases. However, the high-quality biodegradation rates and physical and chemical  
3741 properties show that DCHP will have limited persistence potential and mobility in soils receiving  
3742 biosolids ([U.S. EPA, 2024z](#)). The combination of factors such as biodegradation and the weight of  
3743 evidence supporting a lack of bioaccumulation and lack of biomagnification supports this qualitative  
3744 assessment that potential DCHP concentrations in biosolids do not present concentrations greater than  
3745 hazard threshold values to terrestrial organisms. Therefore, EPA determined a low likelihood of DCHP  
3746 persisting and being bioavailable to soil-dwelling animals, plants, or in the diets of mammals for a long  
3747 enough duration to cause chronic hazard, and thus a preliminary indication of no risk.  
3748

### 3749 ***Trophic Transfer***

3750 EPA did not conduct a quantitative modeling analysis of the trophic transfer of DCHP through food  
3751 webs because of the chemical properties and fate of DCHP indicate low potential for bioaccumulation or  
3752 biomagnification. Specifically, the Agency does not expect DCHP to persist in surface water,  
3753 groundwater, or air. DCHP is not expected to be persistent in the environment as it is expected to  
3754 degrade rapidly under most environmental conditions with delayed biodegradation in low-oxygen  
3755 media, and DCHP's bioavailability is expected to be limited ([U.S. EPA, 2024z](#)). Estimates of the DCHP  
3756 limit of water solubility range from 30 to 1,480 µg/L, leading to uncertainty about DCHP dissolved in  
3757 surface water. DCHP is expected to have low bioaccumulation potential, biomagnification potential, and  
3758 low potential for uptake based on a log BCF of 2.85 and a log BAF of 1.83 ([U.S. EPA, 2024p, z](#)). For  
3759 example, a worst-case scenario screening that uses the upper bound of water solubility as the water  
3760 concentration (1,480 µg/L DCHP) and BAF of 67, results in 99 mg/kg-bw DCHP in fish. A similar  
3761 calculation results in 11 mg/kg-bw DCHP in fish if the highest modeled concentration from EPA's  
3762 VVM-PSC (164 µg/L) is used. These values are less than the terrestrial mammal threshold value of  
3763 179.3 mg/kg-bw/day over 70 days. These values would only be lower in simulations that incorporate  
3764 other release and exposure scenarios in a trophic transfer model. Finally, EPA also did not find  
3765 reasonably available data sources that report the aquatic bioconcentration, aquatic bioaccumulation,  
3766 aquatic food web magnification, terrestrial biota-sediment accumulation, or terrestrial bioconcentration  
3767 of DCHP. Therefore, EPA determined a low likelihood of DCHP transferring through food webs to  
3768 reach the terrestrial mammal threshold value of 179.3 mg/kg-bw/day and thus a preliminary indication  
3769 of no risk.  
3770

### 3771 ***Distribution in Commerce***

3772 EPA evaluated activities resulting in exposures associated with distribution in commerce (*e.g.*, loading,  
3773 unloading) throughout the various life cycle stages and COUs (*e.g.*, manufacturing, processing,  
3774 industrial use, commercial use, disposal) rather than a single distribution scenario. The Agency lacks  
3775 data to assess risks to the environment from environmental releases and exposures related to distribution  
3776 of DCHP in commerce as a single OES. However, most of the releases from this COU/OES are  
3777 expected to be captured within the releases of other COU/OES because most of the activities (loading,  
3778 unloading) generating releases from distribution of commerce are release points of other COU/OESs.

### 5.3.3 Overall Confidence and Remaining Uncertainties Confidence in Environmental Risk Characterization

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The environmental risk characterization of DCHP evaluated confidence from environmental exposures and environmental hazards. Exposure confidence is detailed within [U.S. EPA \(2024p\)](#), the TSD *Draft Environmental Media and General Population and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)*, represented by modeled and monitored data. Hazard confidence was represented by evidence as reported previously in the *Draft Environmental Hazard Assessment for Dicyclohexyl Phthalate (DCHP)* [U.S. EPA \(2024o\)](#).

The overall confidence in the preliminary risk characterization for the aquatic assessment is robust. EPA has indicated no risk to aquatic organisms under most realistic release, flow, and solubility scenarios except in a scenario with the most conservative assumptions. The Agency has robust confidence that the conservative scenario with worst-case assumptions is unlikely for several reasons. First, EPA has determined DCHP water releases to be low due to its chemical properties and predicted fate ([U.S. EPA, 2024z](#)), making modeled exposure predictions greater than COCs unlikely. Also, DCHP is a solid at room temperature with considerable variation in the estimates of water solubility that ranges from 30 µg/L to 1,480 µg/L. Under EPA's release of DCHP to water generic scenarios, the amount of DCHP that may be released to surface water as a solid and the amount that is dissolved in water critically depends on the functional or environmentally relevant solubility of DCHP in water bodies. Evidence from the only available U.S. monitoring study reported the maximum DCHP at 0.014 µg/L ([Keil et al., 2011](#)), plus two toxicity studies that reported DCHP leaving solution above 30 µg/L ([Swedish Chemicals Agency, 2023](#); [Mathieu-Denoncourt et al., 2016](#)) suggest that EPA's modeled high-end release and low stream flow scenario resulting 165 µg/L DCHP is unlikely to occur in aquatic ecosystems. Thus, no reasonably available evidence reports dissolved water concentrations as high as 165 µg/L and the weight of evidence points to a low likelihood of DCHP concentrations reaching 165 µg/L.

The environmental hazard to aquatic organisms is also not clear because only two peer-reviewed studies and a handful of reports are reasonably available for EPA to review. These studies have high data quality evaluation ratings, but corroborating results from additional studies would improve the accuracy and precision of the Agency's COC for chronic exposure while increasing the confidence for indications of low likelihood of risk. All but two of these studies did not find acute exposure effects at concentrations up to 2,000 µg/L, indicating that short exposure durations pose little risk to aquatic organisms. Chronic exposure effects on reproductive endpoints were documented for an invertebrate and a fish at approximately 30 µg/L DCHP concentrations. All these studies used solvent carriers to keep DCHP in solution. Taken together, it remains unclear whether high concentrations of DCHP in the water column occur in ecosystems and whether these exposure concentrations can persist long enough to incur reproductive effects on aquatic organisms. Thus, the weight of evidence summarized in this document leads to the preliminary characterization of no risk to aquatic receptors.

The overall confidence in the preliminary risk characterization for the terrestrial assessment is robust. EPA has robust confidence that DCHP is not likely to present environmental risk through most scenarios that may expose DCHP to terrestrial organisms. This confidence is due to the relatively low volumes of release across COUs, the physical and chemical properties of DCHP, and the low number of studies that document DCHP in the environment. These result in low to negligible exposure concentrations in air, landfills, biosolids and soils. Trophic transfer of DCHP through food webs is also unlikely due to DCHP's chemical and fate properties that indicate that it has low potential to bioaccumulate or biomagnify in food webs. This weight of evidence of low potential for DCHP exposures in terrestrial ecosystems—coupled with no reasonably available studies of DCHP hazard effects to wildlife and a relatively high surrogate mammal hazard threshold from laboratory rodent data—indicate exposure

3828 above the hazard threshold is an unlikely risk to terrestrial organisms. Although the lack of reasonably  
3829 available studies on the hazardous effects of DCHP on wildlife does not rule out hazard and subsequent  
3830 risk, the weight of evidence summarized in this document leads to the preliminary indication that risk to  
3831 terrestrial receptors is not expected.

## 6 UNREASONABLE RISK DETERMINATION

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TSCA section 6(b)(4) requires EPA to conduct a risk evaluation to determine whether a chemical substance presents an unreasonable risk of injury to health or the environment, without consideration of costs or other non-risk factors, including an unreasonable risk to a PESS identified by EPA as relevant to the risk evaluation, under the TSCA COUs.

EPA is preliminarily determining that DCHP presents an unreasonable risk of injury to human health under the COUs. *The Agency is preliminarily determining that DCHP does not present unreasonable risk of injury to the environment.* This draft unreasonable risk determination is based on the information in previous sections of this draft risk evaluation, the appendices, and the TSDs of this draft risk evaluation in accordance with TSCA section 6(b). It is also based on (1) the best available science (TSCA section 26(h)); (2) weight of scientific evidence standards (TSCA section 26(i)); and (3) relevant implementing regulations in 40 CFR part 702, including, to the extent practicable, the amendments to the procedures for chemical risk evaluations under TSCA finalized in May 2024 (89 FR 37028; May 3, 2024).

If, in the final TSCA risk evaluation for DCHP, EPA determines that DCHP presents an unreasonable risk of injury to health or the environment under the COUs, the Agency will initiate risk management for DCHP by applying one or more of the requirements under TSCA section 6(a) to the extent necessary so that DCHP no longer presents such risk. The risk management requirements will likely focus on the COUs significantly contributing to the unreasonable risk. However, under TSCA section 6(a), EPA is not limited to regulating the specific COUs found to significantly contribute to the unreasonable risk and may select from among a suite of risk management options related to manufacture, processing, distribution in commerce, commercial use, and disposal to address the unreasonable risk. For instance, EPA may regulate “upstream” COUs (*e.g.*, processing, distribution in commerce) to address “downstream” COUs that significantly contribute to unreasonable risk (*e.g.*, use)—even if the upstream activities are not significantly contributing to the unreasonable risk. The Agency would also consider whether such risk may be prevented or reduced to a sufficient extent by action taken under another federal law, such as referral to another agency under TSCA section 9(a) or use of another EPA-administered authority to protect against such risk pursuant to TSCA section 9(b), as appropriate.

As noted in the EXECUTIVE SUMMARY, DCHP is used primarily as a plasticizer to make flexible PVC. It is also used to make building and construction materials; automotive care and fuel products; and other commercial and consumer products including adhesives and sealants, paints and coatings, electrical and electronic products. Workers may be exposed to DCHP when making these products or otherwise using DCHP in the workplace. When it is manufactured or used to make products, DCHP can be released into the water, where because of its properties, most of it will end up in the sediment at the bottom of lakes and rivers. If it is released into the air, DCHP will attach to dust particles and then be deposited onto land or into water. Indoors, DCHP has the potential over time to be come out of products and adhere to dust particles. If it does, people could inhale or ingest dust that contains DCHP. In addition to DCHP, workers and consumers can be exposed to other phthalates that have the same toxicological endpoint (*i.e.*, decreased fetal testicular testosterone). EPA has authored a draft cumulative risk technical support document of DCHP and five other toxicologically similar phthalates (*i.e.*, DEHP, DBP, DIBP, BBP, and DINP) that are also being evaluated under TSCA. This TSD will allow EPA to assess the combined risk to health from multiple chemicals with similar effects simultaneously, recognizing that human exposure to phthalates is widespread and that multiple phthalates can disrupt development of the male reproductive system. The use of EPA’s cumulative risk assessment (CRA) in the preliminary risk determination is discussed in more detail in Section 6.1.3 as well as the worker (Section 6.1.4) and consumer (Section 6.1.5) sections.

3881 The COUs evaluated for DCHP are listed in Table 1-1. EPA is preliminarily determining the following  
3882 COUs based on the DCHP individual analysis and the relative potency factor (RPF) analysis,  
3883 significantly contribute to the unreasonable risk to workers:

- 3884 • Manufacturing – domestic manufacturing;
- 3885 • Processing – incorporation into formulation, mixture, or reaction product – adhesive and sealant  
3886 chemicals in adhesive manufacturing;
- 3887 • Processing – incorporation into formulation, mixture, or reaction product – plasticizer (adhesive  
3888 manufacturing; paint and coating manufacturing; and printing ink manufacturing);
- 3889 • Processing – incorporation into formulation, mixture, or reaction product – stabilizing agent  
3890 (adhesive manufacturing; asphalt paving, roofing, and coating materials manufacturing; and  
3891 paints and coating manufacturing)
- 3892 • Industrial use – finishing agent – cellulose film production;
- 3893 • Industrial use – inks, toner, and colorant products (*e.g.*, screen printing ink);
- 3894 • Industrial use – Paints and coatings;
- 3895 • Commercial use – inks, toner, and colorant products (*e.g.*, screen printing ink); and
- 3896 • Commercial use – paints and coatings.

3897 EPA is preliminarily determining that the following COUs do *not* significantly contribute to the  
3898 unreasonable risk:

- 3899 • Manufacturing – importing;
- 3900 • Processing – incorporation into article – plasticizer (plastics product manufacturing and rubber  
3901 product manufacturing);
- 3902 • Processing – repackaging (*e.g.*, laboratory chemicals);
- 3903 • Processing – recycling;
- 3904 • Distribution in commerce;
- 3905 • Industrial use – adhesives and sealants (*e.g.*, computer and electronic product manufacturing;  
3906 transportation equipment manufacturing);
- 3907 • Industrial use – other articles with routine direct contact during normal use including rubber  
3908 articles; plastic articles (hard) (*e.g.*, transportation equipment manufacturing);
- 3909 • Commercial use – adhesives and sealants;
- 3910 • Commercial use – building/construction materials not covered elsewhere;
- 3911 • Commercial use – laboratory chemicals;
- 3912 • Commercial use – other articles with routine direct contact during normal use including rubber  
3913 articles; plastic articles (hard);
- 3914 • Consumer use – adhesives and sealants;
- 3915 • Consumer use – other articles with routine direct contact during normal use including rubber  
3916 articles; plastic articles (hard);
- 3917 • Consumer use – other consumer articles that contain dicyclohexyl phthalate from: inks, toner,  
3918 and colorants; paints and coatings; adhesives and sealants (*e.g.*, paper products, textiles, products  
3919 using cellulose film, etc.); and
- 3920 • Disposal.

3921 Whether EPA makes a determination of unreasonable risk for a particular chemical substance under  
3922 TSCA depends upon risk-related factors beyond exceedance of benchmarks, such as the endpoint under  
3923 consideration, the reversibility of effect, exposure-related considerations (*e.g.*, duration, magnitude,  
3924 frequency of exposure, population exposed), how PESS groups were considered in the assessment, and  
3925 the confidence in the information used to inform the hazard and exposure values. For COUs evaluated  
3926 quantitatively, EPA also considers how central tendency or high-end risk estimates represented the risk

3927 related factors, and the Agency based the risk determination on the risk estimates that best represented  
3928 the COUs. Additionally, in this draft risk evaluation, EPA describes the strength of the scientific  
3929 evidence supporting the human health and environmental assessments as robust, moderate, or slight.  
3930 Robust confidence suggests thorough understanding of the scientific evidence and uncertainties, as well  
3931 as the supporting weight of scientific evidence, outweighs the uncertainties to the point where it is  
3932 unlikely that the uncertainties could have a significant effect on the risk. Moderate confidence suggests  
3933 some understanding of the scientific evidence and uncertainties, and the supporting scientific evidence  
3934 weighed against the uncertainties is reasonably adequate to characterize the risk. Slight confidence is  
3935 assigned when the weight of scientific evidence may not be adequate to characterize the risk, and when  
3936 the Agency is making the best scientific assessment possible in the absence of complete information.

3937  
3938 This draft risk evaluation discusses important assumptions and key sources of uncertainty in the risk  
3939 characterization, and these are described in more detail in the respective weight of scientific evidence  
3940 conclusions sections for fate and transport, environmental release, environmental exposures,  
3941 environmental hazards, and human health hazards, respectively. It also includes overall confidence and  
3942 remaining uncertainties sections for human health and environmental risk characterizations.

3943  
3944 Additionally, EPA considered, where relevant, the Agency's analyses on aggregate exposures and  
3945 cumulative risk. Aggregate exposure analyses consider effects on populations that are exposed to DCHP  
3946 via multiple routes (e.g., dermal contact, ingestion, and inhalation). Cumulative risk refers to human  
3947 health risks related to exposures to multiple chemicals—in this case the six phthalates considered in the  
3948 CRA TSD. EPA has applied the methods and principles of CRA outlined in EPA's *Draft Proposed*  
3949 *Approach for Cumulative Risk Assessment (CRA) of High-Priority Phthalates and a Manufacturer-*  
3950 *Requested Phthalate under the Toxic Substances Control Act* ([U.S. EPA, 2023c](#)) and EPA's *Draft*  
3951 *Technical Support Document for the Cumulative Risk Analysis of Di(2-ethylhexyl) Phthalate (DEHP),*  
3952 *Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), Dicyclohexyl*  
3953 *Phthalate (DCHP), and Diisononyl Phthalate (DINP) Under the Toxic Substances Control Act (TSCA)*  
3954 ([U.S. EPA, 2024ah](#)), to derive non-cancer risk estimates for occupational and consumer exposures.  
3955 These cumulative, non-cancer risk estimates are considered in addition to the individual risk estimates  
3956 for DCHP. Notably, other authoritative and regulatory agencies (i.e., CPSC, Health Canada, ECHA,  
3957 NICNAS, EFSA) have evaluated phthalates, including DCHP, for cumulative risk. Further, independent,  
3958 expert peer reviewers on the SACC endorsed EPA's proposal to conduct a CRA of phthalates under  
3959 TSCA because it represents the best available science. The Agency's approach for assessing cumulative  
3960 risk, which is described in detail in the draft CRA TSD ([U.S. EPA, 2024ah](#)), incorporates feedback from  
3961 the SACC ([U.S. EPA, 2023f](#)) who peer reviewed EPA's draft proposed approach in May 2023 ([U.S.](#)  
3962 [EPA, 2023f](#)).

## 3963 **6.1 Human Health**

3964 Calculated non-cancer risk estimates (MOEs) can provide a risk profile of DCHP by presenting a range  
3965 of estimates for different health effects for different COUs. When characterizing the risk to human  
3966 health from occupational exposures during risk evaluation under TSCA, EPA conducts baseline  
3967 assessments of risk and makes its determination of unreasonable risk from a baseline scenario that does  
3968 not assume use of respiratory protection or other personal protective equipment (PPE).<sup>5</sup> A calculated  
3969 MOE that is less than the benchmark MOE is a starting point for informing a determination of

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<sup>5</sup> It should be noted that, in some cases, baseline conditions may reflect certain mitigation measures, such as engineering controls, in instances where exposure estimates are based on monitoring data at facilities that have engineering controls in place.

3970 unreasonable risk of injury to health, based on non-cancer effects. It is important to emphasize that these  
3971 calculated risk estimates alone are not bright-line indicators of unreasonable risk.

### 3972 **6.1.1 Populations and Exposures EPA Assessed for Human Health**

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3973 EPA has evaluated risk to adolescent and adult workers (including ONUs and female workers of  
3974 reproductive age) 16 years of age and older; consumer users and bystanders, including infants and  
3975 children; and the general population, including infants and children and people who consume fish. The  
3976 Agency evaluated these risks using reasonably available monitoring and modeling data for inhalation  
3977 and dermal exposures, as applicable. EPA has evaluated risk from inhalation and dermal exposure of  
3978 DCHP to workers, including ONUs, as appropriate for each exposure scenario, but the primary route of  
3979 exposure was inhalation. The Agency evaluated risk from inhalation, dermal, and oral-exposure to  
3980 consumer users and inhalation exposures to bystanders. Finally, EPA also evaluated risk from exposures  
3981 from surface water, drinking water, fish ingestion, ambient air, and land pathways (*i.e.*, landfills and  
3982 application of biosolids) to the general population.

3983 Descriptions of the data used for human health exposure and human health hazards are provided in  
3984 Sections 4.1 and 4.2, respectively, in this draft risk evaluation. Uncertainties for overall exposures and  
3985 hazards are presented in this draft risk evaluation, the *Draft Consumer and Indoor Dust Exposure*  
3986 *Assessment for Dicyclohexyl phthalate (DCHP)* ([U.S. EPA, 2024c](#)), the *Draft Environmental Media and*  
3987 *General Population and Environmental Exposure Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S.](#)  
3988 [EPA, 2024p](#)), the *Draft Environmental Release and Occupational Exposure Assessment for*  
3989 *Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024q](#)), and the *Draft Non-Cancer Human Health Hazard*  
3990 *Assessment for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024v](#)) and are considered in this  
3991 preliminary unreasonable risk determination.  
3992

### 3993 **6.1.2 Summary of Human Health Effects**

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3994 EPA is preliminarily determining that the unreasonable risk presented by DCHP is due to

- 3995 • non-cancer effects in workers from inhalation exposures;
- 3996 • non-cancer effects in workers from aggregate exposures (*i.e.*, inhalation + dermal); and
- 3997 • non-cancer effects in workers from cumulative exposures (*i.e.*, DCHP + other phthalates).

3998 With respect to health endpoints upon which EPA is basing this preliminary unreasonable risk  
3999 determination, the Agency has robust overall confidence in the proposed POD based on the developing  
4000 male reproductive system for use in characterizing risk from exposure to DCHP for acute, intermediate,  
4001 and chronic exposure scenarios. In addition, overall, EPA has robust confidence in the draft factors used  
4002 in the RPF analysis and cumulative risk analysis. See Section 4.4 and EPA's *Draft Technical Support*  
4003 *Document for the Cumulative Risk Analysis of Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate*  
4004 *(DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), Dicyclohexyl Phthalate (DCHP),*  
4005 *and Diisononyl Phthalate (DINP) Under the Toxic Substances Control Act (TSCA)* ([U.S. EPA, 2024ah](#)),  
4006 for further description of the RPF analysis.  
4007

4008 DCHP has not been evaluated for carcinogenicity in any two-year cancer bioassays. EPA therefore  
4009 evaluated the relevance of read-across approaches to assess potential cancer hazards of DCHP based on  
4010 cancer bioassays and MOA information available for other phthalates being evaluated under TSCA (*i.e.*,  
4011 DEHP, DBP, BBP, DINP, DIDP) as discussed in the *Draft Cancer Human Health Hazard Assessment*  
4012 *for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP),*  
4013 *Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2025a](#)). Overall, based  
4014 on the weight of scientific evidence, EPA preliminarily concludes that potential carcinogenicity of

4015 DCHP is not a significant remaining source of uncertainty in the quantitative and qualitative risk  
4016 characterization, despite the lack of DCHP carcinogenicity bioassays.

4017  
4018 EPA's exposure and overall risk characterization PODs and MOEs are summarized in Section 4.3, with  
4019 specific health risk estimates for workers (including ONUs), consumers, bystanders, and the general  
4020 population presented in Section 4.3.2 (workers), Section 4.3.3 (consumers and bystanders), Section 4.3.4  
4021 (general population), and Section 4.3.5 (PESS). Again, these MOEs and benchmarks are not bright-  
4022 lines, and EPA has discretion to consider other risk-related factors when determining if a COU  
4023 significantly contributes to the unreasonable risk determination of the chemical substance.

### 4024 **6.1.3 Basis for Unreasonable Risk to Human Health**

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4025 In developing the exposure and hazard assessments for DCHP, EPA analyzed reasonably available  
4026 information to ascertain whether some human populations may have greater exposure and/or  
4027 susceptibility than the general population to the hazard posed by DCHP. For this DCHP draft risk  
4028 evaluation, EPA has accounted for the following PESS groups: people who are expected to have greater  
4029 exposure to DCHP, such as people exposed to DCHP at work; women of reproductive age; infants and  
4030 children who frequently have contact with consumer products and/or articles containing high  
4031 concentrations of DCHP; those who may have greater intake of DCHP per body weight (*e.g.*, infants,  
4032 children, adolescents); those exposed to DCHP through certain age-specific behaviors (*e.g.*, mouthing by  
4033 infants and children); and Tribes and subsistence fishers whose diets include large amounts of fish.  
4034 Additionally, EPA identified population group lifestages that may have greater susceptibility to the  
4035 health effects of DCHP as PESS, including women of reproductive age, pregnant women, infants,  
4036 children, and adolescents. A full PESS analysis is provided in Section 4.3.5 of this draft risk evaluation.

4037  
4038 Risk estimates based on high-end exposure levels (*e.g.*, 95th percentile, or high intensity scenarios) are  
4039 generally intended to cover individuals with sentinel exposures, whereas risk estimates at the central  
4040 tendency exposure are generally estimates of average or typical exposures. For DCHP, EPA was able to  
4041 calculate risk estimates for PESS groups in this assessment (*e.g.*, female workers of reproductive age,  
4042 infants and children). In addition, the non-cancer PODs are based on susceptible populations. The  
4043 POD—which is used for acute, intermediate, and chronic exposure durations—is based on effects  
4044 observed during pregnancy whereas the intermediate and chronic PODs are based on reproductive  
4045 effects observed in adolescent males. The use of either central tendency or high-end risk estimates for  
4046 female workers of reproductive age to make a determination of unreasonable risk was based on  
4047 assumptions about the COU using reasonably available information about a typical scenario and process  
4048 within the COU. In determining whether a COU significantly contributes to the unreasonable risk to  
4049 DCHP, EPA considered the central tendency for most of the occupational estimates. Central tendency  
4050 values of exposure are often expected to be the most reflective of worker exposures within the DCHP  
4051 COUs, as explained further in Section 6.1.3.

4052  
4053 To make an unreasonable risk determination for consumers, EPA considered risk estimates for  
4054 consumers (*e.g.*, infants and children) representing high-intensity *exposure* levels, which are distinct  
4055 from the occupational central-tendency or high-end risk estimates that represent a point within the  
4056 modeled distribution. For example, high-intensity consumer indoor dust exposure scenarios assumed  
4057 that people are in their homes for longer periods than the medium- or lower- intensity scenarios. Health  
4058 parameters were also adjusted for each population, such as inhalation rates used per lifestage.

4059  
4060 EPA has also aggregated exposures across certain routes for workers, including ONUs, and consumers  
4061 for COUs with quantitative risk estimates. For most occupational COUs, aggregation of inhalation and  
4062 dermal exposures led to negligible differences in risk estimates when compared with risk estimates from

4063 inhalation alone, because inhalation is the predominant route of exposure. For consumers, dermal, oral,  
4064 and inhalation routes were aggregated, which did not result in any risk estimates below the benchmark  
4065 MOE, similar to the consumer risks from individual exposure routes. The UF of 10 for human variability  
4066 that EPA applied to MOEs accounts for increased susceptibility of populations such as children and  
4067 elderly populations. Detailed information on how EPA characterized sentinel and aggregate risks is  
4068 provided in Section 4.1.5.

4069  
4070 In addition to the analysis done for DCHP alone (referred to as “individual analysis”), EPA applied both  
4071 the methods and principles of CRA (*Draft Proposed Approach for Cumulative Risk Assessment (CRA)*  
4072 *of High-Priority Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances*  
4073 *Control Act* ([U.S. EPA, 2023c](#)), as well as the *Draft Technical Support Document for the Cumulative*  
4074 *Risk Analysis of Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate*  
4075 *(BBP), Diisobutyl Phthalate (DIBP), Dicyclohexyl Phthalate (DCHP), and Diisononyl Phthalate*  
4076 *(DINP) Under the Toxic Substances Control Act (TSCA)* ([U.S. EPA, 2024ah](#))), to derive non-cancer risk  
4077 estimates for occupational and consumer exposures. EPA’s draft CRA includes cumulative exposure to  
4078 other toxicologically similar phthalates being evaluated under TSCA (*i.e.*, DEHP, DBP, BBP, DIBP, and  
4079 DINP) and uses an “RPF analysis” to characterize risk. Using a meta-analysis and BMD modeling  
4080 approach to model decreased fetal testicular testosterone, EPA derived an RPF for DCHP of 1.66 based  
4081 on BMD<sub>40</sub>. This means DCHP exposures, when multiplied by the relative potency factor and expressed  
4082 in terms of index chemical (*i.e.*, DBP) equivalents, increased by 66 percent.

4083  
4084 The above approach accounts for potency differences among chemicals in a mixture and scales the dose  
4085 of one chemical to an equitoxic dose of another chemical (*i.e.*, the index chemical). The chemical  
4086 selected as the index chemical (*i.e.*, DBP) is the best characterized toxicologically and considered to be  
4087 representative of the type of toxicity elicited by other components of the mixture, which allows EPA to  
4088 utilize more fetal testicular testosterone data in the low-end range of the dose-response curve to gain a  
4089 better understanding of the hazards of DCHP at the low-end range of the dose-response curve.  
4090 Additionally, the index chemical (*i.e.*, DBP) POD is 12.5 percent lower (*i.e.*, more sensitive) than the  
4091 individual DCHP POD, which also contributes to the lower RPF analysis MOEs as compared with the  
4092 individual non-scaled DCHP risk estimates. Non-cancer risk associated with exposure to an individual  
4093 phthalate or a mixture can then be assessed by calculating an MOE, which is then compared with the  
4094 benchmark MOE. EPA has robust confidence in the proposed POD for the index chemical (*i.e.*, DBP)  
4095 and the EPA-derived RPF for DCHP used to calculate the RPF analysis and cumulative MOEs.

4096  
4097 The draft CRA TSD also includes the addition of a non-attributable cumulative exposure to DEHP,  
4098 DBP, BBP, DIBP, and DINP as estimated from NHANES urinary biomonitoring data using reverse  
4099 dosimetry. The NHANES exposure is non-attributable—meaning it cannot be attributed to specific  
4100 COUs or other sources, but likely includes exposures attributable to both TSCA COUs and other sources  
4101 (*e.g.*, diet, food packaging cosmetics). However, as discussed in more detail below, DCHP’s toxicity  
4102 reflected in the previously discussed 66 percent increase in exposure expressed in terms of index  
4103 chemical equivalents is the primary factor leading to lower RPF analysis MOEs and indications of  
4104 unreasonable risk. Adding in the non-attributable cumulative exposure to other phthalates contributes  
4105 approximately 7.1 percent to the risk cup for female workers of reproductive age, assuming a benchmark  
4106 MOE of 30 (see Section 4.4.4 for the cumulative worker risk estimates). EPA has robust confidence in  
4107 the estimates of non-attributable cumulative exposure derived from NHANES urinary biomonitoring  
4108 data using reverse dosimetry. Note that this draft risk evaluation has been released for public comment  
4109 and will undergo independent, expert scientific peer review by the SACC. EPA will issue a final DCHP  
4110 risk evaluation after considering input from the public and peer reviewers, which will include peer  
4111 review of EPA’s draft RPF analysis.

#### 6.1.4 Workers

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EPA took into consideration both the individual analysis and the draft RPF analysis; based on the occupational and cumulative risk estimates and related risk factors from the individual and draft RPF analyses, the Agency is preliminarily determining that the non-cancer effects from worker inhalation exposure to DCHP and worker aggregate exposures to DCHP from manufacturing and eight processing, industrial, and commercial COUs significantly contribute to the unreasonable risk.

Nearly all occupational COUs were quantitatively assessed in the individual analysis. EPA analyzed vapor/mist and/or particulate concentration inhalation exposure in the occupational scenarios, and separate estimates of central tendency and high-end exposures were made for adolescent and adult (16+ years) workers, female workers of reproductive age, and ONUs. Dermal exposure in the OESs in the individual analysis was analyzed using the acute potential dose rate. For the COUs assessed, dermal exposure for ONUs was evaluated using the central tendency estimates for workers because the risk to ONUs are assumed to be equal to or less than risk to workers who handle materials containing DCHP as a part of their job. Risk was not indicated to workers, including ONUs, for any COU at the high-end or central tendency for dermal exposure estimates. More information on occupational risk estimates is in Section 4.3.2 of this risk evaluation.

Within the individual analysis, non-cancer risk estimates were calculated from acute, intermediate, and chronic inhalation and dermal exposures. However, the draft RPF analysis focused on non-cancer risk estimates from acute exposure as there is evidence that effects on the developing male reproductive system can result from a single exposure during the critical window of development. Additionally, because relative potency factors are based on reduced fetal testicular testosterone, EPA considers the most directly applicable populations for the draft RPF analysis to be pregnant women, women of reproductive age, and male infants and male children. More information on the draft RPF analysis is provided in Section 4.4 of this risk evaluation.

In the absence of inhalation monitoring data, EPA used inhalation exposure models to estimate central tendency and high-end worker (including ONU) inhalation exposures using the Particulates Not Otherwise Regulated (PNOR) Model. In the individual analysis, there were multiple COUs where the exposure and risk estimates are based on the assumption that the concentration of DCHP in workplace dust is the same as the maximum concentration of DCHP manufactured or in the product. It is likely that workplace dusts contain a variety of constituents besides the final product, so the concentration of DCHP in workplace dust is likely less than the concentration of DCHP in the final product. Therefore, in those cases, central tendency values of exposure are expected to be the most reflective of worker exposures within the DCHP COUs, and EPA is relying on central tendency when considering estimates from the PNOR model (*i.e.*, dust) in this preliminary unreasonable risk determination.

There are notable differences in the risk estimates from the individual analysis and the RPF analysis for four OESs represented by four COUs: Domestic manufacturing; Processing – incorporation into formulation, mixture, or reaction product – adhesive and sealant chemicals in (adhesive manufacturing); Processing – incorporation into formulation, mixture, or reaction product – plasticizer in (adhesive manufacturing, paint and coating manufacturing, and printing ink manufacturing); and Processing – incorporation into formulation, mixture, or reaction product – stabilizing agent in (adhesive manufacturing, paint and coating manufacturing, and asphalt paving, roofing and coating materials manufacturing). All four COUs have the same risk estimates. At the central tendency in the individual analysis, these COUs have acute inhalation and acute aggregate risk estimates for female workers of reproductive age that initially do not appear to significantly contribute to unreasonable risk because they are slightly above the benchmark of 30 (*i.e.*, MOEs of 36 for acute inhalation and 35 for acute aggregate

4161 exposure). However, at the central tendency using the draft RPF analysis, those same four COUs have  
 4162 acute inhalation and acute aggregate risk estimates for DCHP exposure expressed in index chemical  
 4163 equivalents that are well below the benchmark for female workers of reproductive age (*i.e.*, MOEs of  
 4164 19.1 for acute inhalation and 18.5 for aggregate exposure). Adding in the non-attributable cumulative  
 4165 phthalate exposure (*i.e.*, NHANES) to the aggregate exposure lowers the MOE only slightly from 18.5  
 4166 to 17.7. A COU example of the risk estimates is presented in Table 6-1.  
 4167

**Table 6-1. Example of Occupational Risk Estimates for OES Manufacturing (Female Workers of Reproductive Age and Benchmark MOE = 30)**

Life Cycle Stage/ Category	Subcategory	OES	Exposure Level	Individual Analysis		RPF Analysis		
				Acute Inhalation Risk Estimates	Acute Aggregate Risk Estimates	Acute Inhalation Risk Estimates	Acute Aggregate Risk Estimates	Cumulative (Acute Aggregate + Cumulative Non-attributable)
Manufacturing – Domestic manufacturing	Domestic manufacturing	Manufacturing	High-End	3.5	3.5	1.8	1.8	1.8
			Central Tendency	36	35	19.1	18.5	17.7

4170 Note that for DCHP, as explained in Section 6.1.3, most of the difference between the MOEs calculated  
 4171 using the individual analysis and the MOEs calculated using the draft RPF analysis is due to scaling  
 4172 DCHP to the index chemical and not to the additional, non-attributable cumulative risk from NHANES.  
 4173 As previously noted, the phthalate selected as the index chemical (*i.e.*, DBP) is the best characterized  
 4174 toxicologically and considered to be representative of the type of toxicity elicited by other components  
 4175 of the mixture. This allows EPA to utilize more fetal testicular testosterone data in the low-end range of  
 4176 the dose-response curve to gain a better understanding of the hazards of DCHP at the low-end range of  
 4177 the dose-response curve. This analysis provides a more robust basis for assessing the dose-response for  
 4178 the common hazard endpoint (*i.e.*, reduced fetal testicular testosterone) across the six toxicologically  
 4179 similar phthalates included in the CRA, including DCHP.  
 4180

4181 Additionally, there are two COUs associated with PVC plastics compounding, PVC plastics converting,  
 4182 non-PVC material compounding, and non-PVC material converting (*i.e.*, Processing – incorporation into  
 4183 formulation, mixture, or reaction product – plasticizer and Processing – incorporation into formulation,  
 4184 mixture, or reaction product – stabilizing agent) that do not indicate risk in either the individual or the  
 4185 RPF analysis. These OESs have acute inhalation and acute aggregate risk estimates for female workers  
 4186 of reproductive age above the benchmark MOE of 30 in the individual analysis (*i.e.*, MOEs range from  
 4187 76–378 for acute inhalation and 71–285 for acute aggregate exposure) and for risk estimates based on  
 4188 the RPF analysis (*i.e.*, MOEs range from 40–199 for acute inhalation and 37–150 for acute aggregate  
 4189 DCHP exposure expressed in index chemical equivalents). The acute aggregate MOEs in the RPF  
 4190 analysis range from 34 to 110 when including non-attributable cumulative risk from NHANES.  
 4191

4192 As a result, EPA is preliminarily determining that those four COUs, with the exception of the activities  
 4193 associated with plastic and rubber manufacturing discussed in the previous paragraph, significantly  
 4194 contribute to the unreasonable risk to human health. This determination is based on the central tendency  
 4195 acute inhalation and aggregate (*i.e.*, inhalation plus dermal) exposure estimates for female workers of  
 4196 reproductive age from the individual analysis, and it takes into consideration the RPF analysis acute  
 4197 inhalation, aggregate and non-attributable cumulative (from NHANES) risk estimates. It is also  
 4198 important to note that while EPA is relying on the central tendency, as it is expected to be the most  
 4199 reflective of worker exposures, the high-end risk estimates for acute inhalation and aggregate risk  
 4200 estimates for female workers of reproductive age for these four COUs are also well below the MOE  
 4201

4202 benchmark of 30 (*i.e.*, MOEs of 3.5 for acute inhalation and 3.5 for acute aggregate exposure in the  
4203 individual analysis).

- 4204 • Manufacturing – domestic manufacturing;
- 4205 • Processing – incorporation into formulation, mixture, or reaction product – adhesive and sealant  
4206 chemicals in adhesive manufacturing;
- 4207 • Processing – incorporation into formulation, mixture, or reaction product – plasticizer in  
4208 adhesive manufacturing; paint and coating manufacturing; and printing ink manufacturing; and
- 4209 • Processing – incorporation into formulation, mixture, or reaction product – stabilizing agent in  
4210 adhesive manufacturing; asphalt paving, roofing, and coating materials manufacturing; and  
4211 paints and coating manufacturing.

4212 At the central tendency in the individual analysis, there are five other COUs (represented by two OESs  
4213 that were assessed as paints and coatings both as liquids and solids) that have acute inhalation and  
4214 aggregate risk estimates for female workers of reproductive age that are above the benchmark MOE of  
4215 30 (*i.e.*, MOEs of 41 for acute inhalation and 40 for aggregate exposure for liquids/spray application and  
4216 MOEs of 62 for acute inhalation and 59 for aggregate exposure for solids) and risk estimates that are  
4217 below the benchmark at the high-end estimates (*i.e.*, MOEs of 2 for acute inhalation and 2 for aggregate  
4218 exposure for liquids/spray application and MOEs of 3.5 for acute inhalation and 3.5 for aggregate  
4219 exposure for solids). As explained above, the central tendency values of exposure are expected to be the  
4220 most reflective of worker exposures within the DCHP COUs when utilizing the PNOR model, such as  
4221 for applications of paints and coatings *solids*—because the high-end assumption about the concentration  
4222 of DCHP in workplace dust is extremely conservative and highly unlikely in actual workplaces. For  
4223 paints and coatings *liquids*, in general, central tendency represents the typical exposure of most workers  
4224 to DCHP through spray application; however, a confluence of a subset of variables (*e.g.*, low ventilation,  
4225 high-pressure spray, *etc.*) would result in risk below the benchmark (of which EPA assessed a DCHP  
4226 product that resulted in such an example). While most workers are not expected to experience elevated  
4227 exposures (*i.e.*, greater than 90th percentile of mist concentration data for an 8-hour period) on a daily  
4228 basis, it is considered plausible and expected for such exposures to occur in an acute 1-day scenario.  
4229 Therefore, for these COUs, EPA’s preliminary risk determination is based on the estimates associated  
4230 with the high-end scenario. This is consistent with EPA’s approach to liquid spray applications in other  
4231 phthalate risk evaluations.

4232  
4233 Additionally, at the high-end in the draft RPF analysis, those same five COUs, which are listed below,  
4234 have acute inhalation and aggregate risk estimates that are well below the benchmark for female workers  
4235 of reproductive age for liquids (*i.e.*, MOEs of 1 for acute inhalation and 1 for aggregate exposure for  
4236 liquid application for high end). Adding in the non-attributable cumulative phthalate exposure (*i.e.*,  
4237 NHANES) to the aggregate exposure does not impact the high-end estimates at all. A COU example of  
4238 the risk estimates for both liquids and solids is represented in

4239 Table 6-2; all five COUs (Industrial use of a finishing agent in cellulose film production, Industrial and  
4240 commercial use of paints and coatings, and Industrial and commercial use of inks, toner, and colorant  
4241 products [*e.g.*, screen printing ink]) have the same risk estimates for each scenario of liquids vs. solids.

4242  
4243 Because risk estimates for liquids in the individual analysis, as well as the draft RPF analysis, are well  
4244 below the benchmark MOE, EPA is preliminarily determining that those five COUs significantly  
4245 contribute to the unreasonable risk of injury to human health based on the high-end acute inhalation and  
4246 aggregate exposure estimates for female workers of reproductive age. The Agency also considered the  
4247 RPF analysis acute inhalation, aggregate, and non-attributable cumulative (from NHANES) risk  
4248 estimates.

- Industrial use – finishing agent – cellulose film production;
- Industrial use – inks, toner, and colorant products (*e.g.*, screen printing ink);
- Industrial use – paints and coatings;
- Commercial use – inks, toner, and colorant products (*e.g.*, screen printing ink); and
- Commercial use – paints and coatings.

**Table 6-2. Example of Occupational Risk Estimates for OES Applications of Paints and Coatings (Female Workers of Reproductive Age and Benchmark MOE = 30)**

Life Cycle Stage/ Category	Subcategory	OES	Exposure Level	Individual Analysis		RPF Analysis		
				Acute Inhalation Risk Estimates	Acute Aggregate Risk Estimates	Acute Inhalation Risk Estimates	Acute Aggregate Risk Estimates	Cumulative (Acute Aggregate + Cumulative Non-attributable)
Industrial Use – Finishing agent	Cellulose film production	Application of paints and coatings – liquids	High-End	2.0	2.0	1.0	1.0	1.0
			Central Tendency	41	40	21.7	21.0	19.9
Industrial Use – Finishing agent	Cellulose film production	Application of paints and coatings – solids	High-End	3.5	3.5	1.9	1.9	1.8
			Central Tendency	62	59	32.7	31.1	28.9

One COU, Distribution in commerce, did not have quantitative risk estimates for workers. For the purposes of the unreasonable risk determination and the individual analysis, distribution in commerce of DCHP includes transporting DCHP or DCHP-containing products between work sites or to final use sites, as well as loading and unloading from transport vehicles. Individuals in occupations that transport DCHP-containing products (*e.g.*, truck drivers) or workers who load and unload transport trucks may encounter DCHP or DCHP-containing products. EPA did not calculate risk estimates for the specific Distribution in commerce COU. The Agency evaluated activities resulting in exposures associated with distribution in commerce (*e.g.*, loading, unloading) throughout the various life cycle stages and COUs (*e.g.*, manufacturing, processing, industrial use, commercial use, disposal) rather than a single distribution scenario. Although some worker activities associated with distribution in commerce are similar to COUs such as manufacturing or import, it is expected that workers involved in distribution in commerce spend less time exposed to DCHP than workers in manufacturing or import facilities because only part of the workday is spent in an area with potential exposure. Therefore, occupational exposures associated with the distribution in commerce COU are expected to be less than other COUs with similar worker activities and the Agency preliminarily determines that distribution in commerce does not significantly contribute to DCHP’s unreasonable risk to human health.

In the overall occupational assessment for the individual analysis, EPA has moderate confidence in the assessed occupational inhalation and dermal exposure scenarios (Table 4-5) and robust confidence in the non-cancer POD selected to characterize risk from acute, intermediate, and chronic duration exposures to DCHP. The Agency has moderate confidence in the risk estimates calculated for worker and ONU inhalation and dermal exposure scenarios. More information on EPA’s confidence in these risk estimates and the uncertainties associated with them can be found in Section 4.3.2.

For the draft RPF analysis, EPA has robust confidence in the relative potency factors and index chemical POD used to calculate the MOEs. To derive RPFs and the index chemical POD, EPA integrated data from multiple studies evaluating fetal testicular testosterone using a meta-analysis

4285 approach and conducted BMD modeling. This meta-analysis and BMD modeling approach represents a  
4286 refinement of the NOAEL/LOAEL approach used in the individual DCHP assessment and therefore  
4287 increases EPA's confidence in the risk estimates (for further information, see Section 4.4). Finally, EPA  
4288 has robust confidence in the non-attributable cumulative exposure estimates for DEHP, DBP, BBP,  
4289 DIBP, and DINP derived from NHANES urinary biomonitoring data using reverse dosimetry. Given the  
4290 fast elimination kinetics of phthalates, NHANES biomonitoring data is not expected to capture low-  
4291 frequency, high-intensity exposures and therefore is not intended to be an estimate of acute cumulative  
4292 phthalate exposure. Overall, EPA has moderate confidence in the dermal and inhalation exposure  
4293 assessments for all nine of the COUs showing risk at the central tendency in the RPF analysis.

### 4294 **6.1.5 Consumers**

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4295 Based on the consumer risk estimates and related risk factors, EPA's preliminary determination is that  
4296 consumer uses do not significantly contribute to the unreasonable risk of DCHP. The consumer and  
4297 bystander exposure scenarios described in this draft risk evaluation represent a wide selection of  
4298 consumer use patterns. EPA did not find MOEs that were below the benchmark for any consumer COU.  
4299

4300 For DCHP, EPA assessed consumer risk from inhalation, ingestion, and dermal exposures, as well as  
4301 aggregated exposure across consumer COUs. Consumer and bystander populations assessed were infant  
4302 (<1 year), toddler (1–2 years), preschooler (3–5 years), middle childhood (6–10 years), young teen (11–  
4303 15 years), teenager (16–20), and adult (21+ years). A screening-level assessment for consumers was  
4304 conducted considering high-intensity exposure scenario risk estimates, which relies on conservative  
4305 assumptions to assess exposures that would be expected to be on the high-end of the expected exposure  
4306 distribution. All high-end MOEs were above the benchmark MOE for all consumer COUs. MOEs for  
4307 high-intensity exposure scenarios ranged from 56 to 17,000,000. In addition, the highest levels (acute  
4308 durations) were calculated using the more sensitive and robust relative potency factor analysis described  
4309 in Section 4.4.5 and added to estimates of national non-attributable cumulative exposure of five  
4310 toxicologically similar phthalates (*i.e.*, DEHP, DBP, BBP, DIBP, and DINP) so that an estimate of  
4311 cumulative risk could be considered. The cumulative risk estimates, listed in Table 4-23, also did not  
4312 indicate risk to consumers and all MOEs were well above the benchmark for all COUs.  
4313

4314 EPA has moderate and robust confidence in the assessed inhalation, ingestion, and dermal consumer  
4315 exposure scenarios, and robust confidence in the acute, intermediate, and chronic non-cancer PODs  
4316 selected to characterize risk from acute, intermediate, and chronic duration exposures to DCHP. No  
4317 intermediate duration was assessed for any consumer use outside of automobile adhesives. The exposure  
4318 doses used to estimate risk relied on conservative, health-protective inputs and parameters that are  
4319 considered representative of a wide selection of use patterns. In addition, EPA has robust confidence in  
4320 the RPFs and index chemical POD used to calculate the RPF analysis and cumulative MOEs as well as  
4321 in the derived estimates of non-attributable cumulative exposure from NHANES urinary biomonitoring  
4322 using reverse dosimetry. More information on the Agency's confidence in these risk estimates and the  
4323 uncertainties associated with them can be found in this draft risk evaluation and the *Draft Consumer and*  
4324 *Indoor Dust Exposure Assessment Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024c](#)).

### 4325 **6.1.6 General Population**

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4326 EPA employed a screening-level approach for general population exposures for DCHP because of  
4327 limited environmental monitoring data for DCHP and lack of location data for DCHP releases. If risks  
4328 were not indicated for an individual (adult, infant, etc.) identified as having the potential for the highest  
4329 exposure associated with a COU for a given pathway of exposure (*i.e.*, at high-end or the 95th  
4330 percentile), then that pathway was determined not to significantly contribute to the risk and was not  
4331 further analyzed. Also, as a part of EPA's screening-level approach, the Agency considered the

4332 environmental concentration of DCHP in a given environmental medium resulting from the OES (*e.g.*,  
4333 PVC plastics compounding) that had the highest release compared with any other OES for the same  
4334 releasing media. Release estimates from OESs resulting in lower environmental media concentrations  
4335 were not considered for this screening-level assessment. For DCHP, EPA did not evaluate cumulative  
4336 risk for the general population from environmental releases because after using the previously described  
4337 conservative screening-level approach, the Agency did not identify any pathways of concern, indicating  
4338 that refinement and further evaluation were not necessary. EPA evaluated surface water, sediment,  
4339 drinking water, fish ingestion, and ambient air pathways quantitatively, and land pathways (*i.e.*, landfills  
4340 and application of biosolids) qualitatively (see Section 4.1.3).

4341  
4342 EPA is preliminarily determining that the COUs do not significantly contribute to the unreasonable risk  
4343 of DCHP to the general population from the ambient air—including people living or working near  
4344 facilities (fenceline populations)—based on analysis of non-cancer risk. Although EPA is preliminarily  
4345 determining that nine COUs significantly contribute to unreasonable risk of DCHP due to occupational  
4346 exposures (*e.g.*, through dust that a worker may experience in the chemicals industry; see also Section  
4347 6.1.4), the general population exposures from DCHP COUs, including those, are minimal and do not  
4348 indicate unreasonable risk. This is due in part to the physical and chemical properties of DCHP; for  
4349 example, it has low bioaccumulation potential, low water solubility (1.48 mg/L), low affinity for  
4350 sorption to soil, and is unlikely to migrate. EPA's preliminary determination for each pathway (*e.g.*,  
4351 land, surface water, fish ingestion) is discussed below in more detail.

#### 4352 ***Land Pathway***

4353  
4354 Due to DCHP's low water solubility (1.48 mg/L) and low persistence under most conditions, DCHP is  
4355 unlikely to migrate from land-applied biosolids to groundwater via runoff and is unlikely to be present in  
4356 landfill leachate or be mobile in soils. For these reasons, biosolids and landfill were evaluated  
4357 qualitatively. As such, EPA does not expect general population exposure to DCHP to occur via the land  
4358 pathway. Therefore, the Agency is preliminarily determining that the land pathway does not  
4359 significantly contribute to the unreasonable risk for DCHP. For further information, see Section 4.3.4.

#### 4360 ***Drinking Water and Incidental Surface Water Ingestion and Dermal Contact***

4361  
4362 EPA used the highest possible DCHP concentration in surface water due to facility release (*i.e.*, in the  
4363 immediate water body receiving the effluent) to quantitatively evaluate the risk to the general population  
4364 from exposure to DCHP from drinking water or incidental ingestion and dermal contact during  
4365 recreational swimming. The Agency took the high-end exposure estimates associated with the COU with  
4366 the highest total water column concentration to calculate an MOE. Releases associated with the PVC  
4367 plastics compounding OES (*i.e.*, plasticizer in plastic material and resin manufacturing and plastics  
4368 product manufacturing and stabilizing agent in plastics product manufacturing) resulted in the highest  
4369 total water column concentrations, with the lowest 30-day average flow that occurs once every 5 years  
4370 (*i.e.*, 30Q5 water concentration) of 126 µg/L without wastewater treatment and 39.6 µg/L when run  
4371 under an assumption of 68.6 percent wastewater treatment removal efficiency. These water column  
4372 concentrations were used to estimate dermal exposure and incidental ingestion of DCHP while  
4373 swimming for adults (21+ years), youths (11–15 years), and children (6–10 years). MOEs for general  
4374 population exposure through incidental ingestion and dermal contact during swimming were well above  
4375 the benchmark MOE of 30 and ranged from 2,171 to 6,310 for scenarios assuming no wastewater  
4376 treatment and from 5,521 to 20,000 for scenarios assuming 68.6 percent wastewater treatment removal  
4377 efficiency (Table 4-16).

4378  
4379 Based on this screening level assessment, risk for non-cancer health effects is not expected for the  
4380 surface water pathway. For the drinking water pathway, modeled surface water concentrations were

used to estimate drinking water exposures. Drinking water exposure to DCHP was calculated for various age groups—but even at the most susceptible lifestage, infants (birth to <1 year), risk is not expected. Acute MOEs through drinking water ingestion were 135 and 430 without and with wastewater treatment, respectively, for the lifestage (*i.e.*, infants) with the highest exposure (Table 4-16). Therefore, the drinking water pathway is not considered to be a pathway of concern for DCHP exposure for the general population and EPA is preliminarily determining that the drinking water and surface water pathway do not significantly contribute to the unreasonable risk for DCHP for the general population. For further information, see Section 4.3.4.

### ***Fish Ingestion***

EPA evaluated potential risk from exposure to DCHP through fish ingestion using a screening-level analysis based on conservative exposure estimates for adults in the general population, adult subsistence fishers, and adult Tribal populations. The Agency started with the water solubility limit as an upper limit of DCHP concentration in surface water and determined refinements were needed because the screening-level risk estimates were below the benchmark MOE of 30. Refinements using modeled concentrations at the 50th percentile (or P50 flow rate) were needed for the adult subsistence fisher and adult Tribal populations because the water solubility limit resulted in risk estimates below the benchmark. Because the P50 modeled concentrations still resulted in risk estimates below benchmarks for Tribal populations, EPA further refined its analysis by incorporating higher flow rates and treatment efficiency. Hydrologic flow data were categorized into median flow (P50), 75th percentile flow (P75), and 90th percentile flow (P90). The Agency expects high-end releases to discharge to surface waters with higher flow conditions (*e.g.*, P75 and P90). Exposure estimates based on the P50 flow rate resulted in risk estimates below the benchmark. Risk estimates for fish ingestion generated at concentrations of DCHP at the water solubility limit or at highest measured concentrations in surface water did not indicate risk to Tribal populations. MOEs based on conservative values, such as surface water concentration from a stormwater catchment area, still resulted in risk estimates that are above their benchmarks. Therefore, EPA is preliminarily determining that fish ingestion does not significantly contribute to the unreasonable risk for DCHP for Tribal members, subsistence fishers, and the general population. For further information, see Section 4.3.4.

### ***Inhalation***

EPA estimated ambient air concentrations using results from dispersion scenarios. The highest modeled 95th percentile annual ambient air concentration across all release scenarios was 67.57  $\mu\text{g}/\text{m}^3$  at 100 m from the releasing facility for the Application of paints and coatings OES. This OES was the only one assessed for the purpose of a screening-level assessment as it was associated with the highest ambient air concentration. MOEs for general population exposure through inhalation were both well above the benchmark MOE of 30 (*i.e.*, 192 for acute and 281 for chronic; see also Table 4-18). Therefore, based on this screening-level analysis, risk for non-cancer health effects is not expected for the ambient air pathway and EPA is preliminarily determining that the ambient air pathway does not significantly contribute to the unreasonable risk for DCHP for the general population. For further information, see Section 4.3.4.

EPA expects that general population inhalation exposures from distribution in commerce would be even lower than those for workers. Therefore, the Agency is preliminarily determining that distribution in commerce does not significantly contribute to the unreasonable risk of DCHP.

## **6.2 Environment**

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EPA is preliminarily determining that DCHP does not present unreasonable risk of injury to the environment. DCHP is expected to be released to the environment via air, water, biosolids, and disposal

4429 to landfills. The physical and chemical properties of DCHP indicate that it is not expected to be  
4430 persistent or be mobile in soils and that it has low bioaccumulation potential. Given these characteristics  
4431 and the data available, the environmental risk characterization for DCHP involved qualitative analysis of  
4432 risk to aquatic and terrestrial organisms via exposure pathways of surface water, trophic transfer,  
4433 biosolids, and landfills. EPA has robust confidence in its preliminary determination that all assessed  
4434 pathways of exposure to terrestrial animals do not significantly contribute to the unreasonable risk of  
4435 DCHP. The Agency also has robust confidence in its preliminary determination that there is no risk for  
4436 acute durations of DCHP exposure to aquatic organisms because reasonably available data found no  
4437 acute hazard effects up to and above the estimated upper bound of water solubility. EPA has  
4438 preliminarily determined that chronic exposure to aquatic animals does not significantly contribute to  
4439 the unreasonable risk of DCHP. Considerable uncertainties exist about the limit of water solubility,  
4440 water release estimates, and low-flow surface water modeling estimates. However, EPA has robust  
4441 confidence in this preliminary unreasonable risk determination because no risk was indicated under  
4442 realistic scenarios of lower water solubility, lower release estimates, more rapid stream flow, and  
4443 available measured DCHP water concentrations from the literature.

### 4444 **6.2.1 Populations and Exposures EPA Assessed for the Environment**

---

4445 EPA assessed environmental concentrations of DCHP in air, water, and land (soil, biosolids, and  
4446 groundwater) for use in environmental exposure. DCHP will preferentially sorb into sediments, soils,  
4447 particulate matter in air, and in wastewater solids during wastewater treatment. High-quality studies of  
4448 DCHP biodegradation rates and physical and chemical properties indicate that DCHP will have limited  
4449 persistence and mobility in soils receiving biosolids ([U.S. EPA, 2024z](#)) and low bioavailability in soil.  
4450 DCHP is not readily found in aquatic or terrestrial organisms and has low bioaccumulation and  
4451 biomagnification potential. Therefore, DCHP has low potential for trophic transfer through food webs  
4452 and DCHP is expected to have minimal air to soil deposition.

4453  
4454 Surface water exposure was the only scenario where modeled concentrations could be compared with a  
4455 COC. The reasonably available studies found all acute exposure hazards to fish, invertebrates, and algae  
4456 to be higher than the water solubility limit of DCHP, so no unreasonable risk for acute exposures to  
4457 DCHP in surface water was indicated. For chronic exposures, EPA derived a COC for reproductive  
4458 effects of chronic DCHP water exposure to an aquatic invertebrate (*Daphnia magna*) ([NITE, 2000](#)). The  
4459 Agency EPA found no evidence that DCHP occurs in surface water at the COC of 32 µg/L. EPA  
4460 modeled surface water concentrations and under the most conservative and least likely scenario,  
4461 estimated a high-end concentration of 165 µg/L DCHP and a RQ greater than 1. However, all other  
4462 scenarios with more realistic release values, stream flow rates, or DCHP water solubility had RQs less  
4463 than 1. Therefore, EPA determined a low likelihood of DCHP persisting in surface waters for a long  
4464 enough duration (21 days) to cause chronic hazard in aquatic invertebrates, and thus a preliminary  
4465 determination that chronic exposure to aquatic animals does not significantly contribute to the  
4466 unreasonable risk of DCHP.

### 4467 **6.2.2 Summary of Environmental Effects**

---

4468 EPA qualitatively assessed risk via release to surface water and subsequent deposition to sediment as  
4469 well as the ambient air exposure pathway for its limited contribution via deposition to soil, water, and  
4470 sediment and is preliminarily identifying

- 4471 • No adverse effects to aquatic organisms;
- 4472 • No adverse effects to aquatic dependent mammals; and
- 4473 • No adverse effects to terrestrial mammals.

4474 EPA did not conduct a quantitative modeling analysis of the trophic transfer of DCHP through food  
4475 webs because the chemical properties and fate of DCHP indicate low potential for bioaccumulation or  
4476 biomagnification. Specifically, the Agency does not expect DCHP to persist in surface water,  
4477 groundwater, or air. DCHP may persist in sediment, soil, biosolids, or landfills after release to these  
4478 environments, but DCHP's bioavailability is expected to be limited. Finally, EPA also did not find  
4479 reasonably available data sources that report the aquatic bioconcentration, aquatic bioaccumulation,  
4480 aquatic food web magnification, terrestrial biota-sediment accumulation, or terrestrial bioconcentration  
4481 of DCHP. Therefore, the Agency determined a low likelihood of DCHP transferring through food webs  
4482 thus a preliminary indication of no risk.

4483  
4484 As explained in Section 5.3.1, EPA used a screening level approach in this draft risk evaluation using  
4485 conservative environmental release estimates for occupational COUs with the highest releases to  
4486 determine whether there is risk to the environment and the general population. The Agency first  
4487 characterized risk based upon the COU with the highest estimated concentrations for a given pathway,  
4488 based on the OES and the associated environmental media assessed in the draft risk evaluation. If this  
4489 exposure concentration did not exceed the hazard thresholds harmful to organisms, EPA based the draft  
4490 risk determination on this maximum exposure scenario to be most inclusive and protective by  
4491 encompassing the exposures from other COUs within the OES. The Agency determined that the hazard  
4492 data for fish, aquatic invertebrates, sediment-dwelling organisms, algae, terrestrial invertebrates, and  
4493 terrestrial mammals indicated no adverse effects from exposures up to and exceeding the limit of water  
4494 solubility.

4495  
4496 EPA expects that environmental releases from distribution in commerce will be similar or less than the  
4497 exposure estimates from the COUs evaluated qualitatively, which did not exceed hazard to ecological  
4498 receptors. Therefore, the Agency has preliminarily determined that distribution in commerce also would  
4499 not result in exposures that significantly contribute to the unreasonable risk of DCHP.

4500  
4501 EPA evaluated down-the-drain releases of DCHP for consumer COUs qualitatively. Although the  
4502 Agency acknowledges that there may be DCHP releases to the environment via the cleaning and  
4503 disposal of adhesives, sealants, paints, and coatings, EPA did not quantitatively assess down-the drain  
4504 and disposal scenarios of consumer products due to limited information from monitoring data and  
4505 limited availability of modeling tools. However, modeling tools and consideration of the physical and  
4506 chemical properties of DCHP allows the Agency to conduct a qualitative assessment. DCHP is expected  
4507 to be persistent as it leaches from consumer products disposed of in landfills. Due to low water  
4508 solubility, DCHP is likely to be present in landfill leachate up to its aqueous limit of solubility.  
4509 However, due to its affinity for organic carbon, DCHP is expected to be immobile in groundwater, and  
4510 even in cases where landfill leachate containing DCHP were to migrate to groundwater, DCHP would  
4511 likely partition from groundwater to organic carbon present in the subsurface. Therefore, EPA is  
4512 preliminarily determining that the consumer COUs do not significantly contribute to the unreasonable  
4513 risk of DCHP due to down-the-drain releases.

### 4514 **6.2.3 Basis for No Unreasonable Risk of Injury to the Environment**

4515 Based on the draft risk evaluation for DCHP—including the risk estimates, the environmental effects of  
4516 DCHP, the exposures, physical and chemical properties of DCHP, and consideration of uncertainties—  
4517 EPA did not identify risk of injury to the environment that would significantly contribute to the  
4518 unreasonable risk determination for DCHP. For aquatic organisms, surface water was determined to be  
4519 the driver of exposure, but the Agency does not expect this pathway to significantly contribute to  
4520 unreasonable risk to the environment. EPA does not expect exposure to DCHP via water, land, or

4521 dietary pathways to significantly contribute to unreasonable risk to the environment. The overall  
4522 confidence in the preliminary risk characterizations for aquatic and terrestrial assessments is robust.

### 4523 **6.3 Additional Information Regarding the Basis for Unreasonable Risk**

4524 Table 6-3 summarizes the basis for this unreasonable risk determination of injury to human health  
4525 presented in this draft DCHP risk evaluation. In these tables, a checkmark (✓) indicates how the COU  
4526 significantly contributes to the unreasonable risk by identifying the type of effect (*e.g.*, non-cancer for  
4527 human health) and the exposure route to the population that results in such significant contribution. As  
4528 explained in Section 6.1, for this draft unreasonable risk determination, EPA has considered the effects  
4529 of DCHP to human health at the central tendency and high-end, as well as effects of DCHP to human  
4530 health and the environment from the exposures associated with the COU, risk estimates, and  
4531 uncertainties in the analysis. In addition, certain exposure routes for some COUs were not assessed  
4532 because it was determined that there was no viable exposure pathway. These COUs and their respective  
4533 exposure routes are grayed-out in Table 6-3. Checkmarks in Table 6-3 represent risk at the high-end and  
4534 central tendency exposure level as discussed in Section 6.1. See Sections 4.3 and 5.3 for a summary of  
4535 risk estimates.

4536

**Table 6-3. Supporting Basis for the Draft Unreasonable Risk Determination for Human Health<sup>a</sup> (Occupational COUs)**

Life Cycle Stage	Category	Subcategory	Population	Exposure Route <sup>b</sup>	Acute	Life Cycle Stage	Category
Manufacturing	Domestic manufacturing	Domestic manufacturing	Average Adult Worker	Dermal			
				Inhalation			
				Aggregate			
			Female Worker of Reproductive Age <sup>c</sup>	Dermal			
				Inhalation	✓		
				Aggregate	✓		
	ONU	Dermal					
		Inhalation					
	Importing	Importing	Average Adult Worker	Dermal			
				Inhalation			
				Aggregate			
			Female Worker of Reproductive Age	Dermal			
Inhalation							
Aggregate							
ONU	Dermal						
	Inhalation						
Processing – incorporation into formulation, mixture, or reaction product		Adhesive and sealant chemicals in: – Adhesive Manufacturing	Average Adult Worker	Dermal			
				Inhalation			
				Aggregate			
			Female Worker of Reproductive Age	Dermal			
				Inhalation	✓		
				Aggregate	✓		
		ONU	Dermal				
			Inhalation				
		Plasticizer in: – Adhesive manufacturing – Paint and coating manufacturing – Printing ink manufacturing	Average Adult Worker	Dermal			
				Inhalation			
				Aggregate			

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Life Cycle Stage	Category	Subcategory	Population	Exposure Route <sup>b</sup>	Acute	Life Cycle Stage	Category
Processing	Processing – incorporation into formulation, mixture, or reaction product	Plasticizer in: – Adhesive manufacturing – Paint and coating manufacturing – Printing ink manufacturing	Female Worker of Reproductive Age	Dermal			
				Inhalation	✓		
				Aggregate	✓		
			ONU	Dermal			
				Inhalation			
				Aggregate			
		Plasticizer in: – Plastic material and resin manufacturing – Plastics product manufacturing – Rubber product manufacturing	Average Adult Worker	Dermal			
				Inhalation			
				Aggregate			
			Female Worker of Reproductive Age	Dermal			
				Inhalation			
				Aggregate			
		ONU	Dermal				
			Inhalation				
			Aggregate				
		Stabilizing agent in: – Adhesive manufacturing – Asphalt paving, roofing, and coating materials manufacturing – Paint and coating manufacturing	Average Adult Worker	Dermal			
				Inhalation			
				Aggregate			
			Female Worker of Reproductive Age	Dermal			
				Inhalation	✓		
				Aggregate	✓		
		ONU	Dermal				
			Inhalation				
			Aggregate				
Stabilizing agent in: – Plastics product manufacturing	Average Adult Worker	Dermal					
		Inhalation					
		Aggregate					
	Female Worker of Reproductive Age	Dermal					
		Inhalation					
		Aggregate					

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Life Cycle Stage	Category	Subcategory	Population	Exposure Route <sup>b</sup>	Acute	Life Cycle Stage	Category		
Processing	Processing – incorporation into article	Plasticizer in: – Plastics product manufacturing – Rubber product manufacturing	ONU	Dermal					
				Inhalation					
			Average Adult Worker	Dermal					
				Inhalation					
				Aggregate					
			Female Worker of Reproductive Age	Dermal					
				Inhalation					
				Aggregate					
			ONU	Dermal					
				Inhalation					
			Repackaging	Repackaging (e.g., laboratory chemical)	Average Adult Worker	Dermal			
						Inhalation			
	Aggregate								
	Female Worker of Reproductive Age	Dermal							
		Inhalation							
		Aggregate							
	ONU	Dermal							
		Inhalation							
	Recycling	Recycling			Average Adult Worker	Dermal			
						Inhalation			
						Aggregate			
Female Worker of Reproductive Age					Dermal				
			Inhalation						
			Aggregate						
ONU			Dermal						
			Inhalation						

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Life Cycle Stage	Category	Subcategory	Population	Exposure Route <sup>b</sup>	Acute	Life Cycle Stage	Category		
Distribution in Commerce	Distribution in Commerce	Distribution in commerce	Worker	Dermal					
				Inhalation					
			ONU	Dermal					
				Inhalation					
Industrial Use	Adhesive and sealants	Adhesives and sealants (e.g., computer and electronic product manufacturing; transportation equipment manufacturing)	Average Adult Worker	Dermal					
				Inhalation					
				Aggregate					
			Female Worker of Reproductive Age	Dermal					
				Inhalation					
				Aggregate					
			ONU	Dermal					
				Inhalation					
			Finishing agent	Cellulose film production	Average Adult Worker	Dermal			
						Inhalation			
						Aggregate			
					Female Worker of Reproductive Age	Dermal			
	Inhalation	✓							
	Aggregate	✓							
	ONU	Dermal							
		Inhalation							
	Inks, toner, and colorant products	Inks, toner, and colorant products (e.g., screen printing ink)			Average Adult Worker	Dermal			
						Inhalation			
						Aggregate			
					Female Worker of Reproductive Age	Dermal			
			Inhalation	✓					
			Aggregate	✓					
			ONU	Dermal					

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Life Cycle Stage	Category	Subcategory	Population	Exposure Route <sup>b</sup>	Acute	Life Cycle Stage	Category	
Industrial Use	Paints and coatings	Paints and coatings	Average Adult Worker	Inhalation				
				Dermal				
				Inhalation				
			Female Worker of Reproductive Age	Aggregate				
				Dermal				
				Inhalation	✓			
			ONU	Aggregate	✓			
				Dermal				
				Inhalation				
	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Average Adult Worker	Dermal				
				Inhalation				
				Aggregate				
			Female Worker of Reproductive Age	Dermal				
				Inhalation				
				Aggregate				
ONU			Dermal					
			Inhalation					
Commercial Use	Adhesives and sealants	Adhesives and sealants	Average Adult Worker	Dermal				
				Inhalation				
				Aggregate				
			Female Worker of Reproductive Age	Dermal				
				Inhalation				
				Aggregate				
	ONU	Dermal						
		Inhalation						
		Building/construction materials not covered elsewhere		Average Adult Worker	Dermal			
					Inhalation			

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Life Cycle Stage	Category	Subcategory	Population	Exposure Route <sup>b</sup>	Acute	Life Cycle Stage	Category	
Commercial Use	Building/constructi on materials not covered elsewhere		Female Worker of Reproductive Age	Aggregate				
				Dermal				
				Inhalation				
			ONU	Aggregate				
				Dermal				
				Inhalation				
	Inks, toner, and colorant products	Inks, toner, and colorant products (e.g., screen printing ink)	Average Adult Worker	Dermal				
				Inhalation				
				Aggregate				
			Female Worker of Reproductive Age	Dermal				
				Inhalation	✓			
				Aggregate	✓			
	ONU	Dermal						
		Inhalation						
	Laboratory chemicals	Laboratory chemicals	Average Adult Worker	Dermal				
				Inhalation				
				Aggregate				
			Female Worker of Reproductive Age	Dermal				
Inhalation								
Aggregate								
ONU			Dermal					
			Inhalation					
Paints and coatings			Paints and coatings	Average Adult Worker	Dermal			
					Inhalation			
					Aggregate			
				Female Worker of Reproductive Age	Dermal			
	Inhalation	✓						

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Life Cycle Stage	Category	Subcategory	Population	Exposure Route <sup>b</sup>	Acute	Life Cycle Stage	Category
Commercial Use	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)	ONU	Aggregate	✓		
				Dermal			
				Inhalation			
			Average Adult Worker	Dermal			
				Inhalation			
				Aggregate			
	Female Worker of Reproductive Age	Dermal					
		Inhalation					
		Aggregate					
	ONU	Dermal					
		Inhalation					
	Disposal	Disposal	Disposal	Average Adult Worker	Dermal		
Inhalation							
Aggregate							
Female Worker of Reproductive Age				Dermal			
				Inhalation			
				Aggregate			
ONU				Dermal			
				Inhalation			

<sup>a</sup> Grayed-out boxes indicate certain exposure routes that were not assessed because it was determined that there was no viable exposure pathway.

<sup>b</sup> Inhalation, dermal, and aggregate risk estimates were generated for each COU for workers (average adult and women of reproductive age) and ONUs if it was determined that there was a viable exposure pathway.

<sup>c</sup> EPA analyzed and presented risk for female workers of reproductive age, which are a subset of the average adult worker population, separately due to the greater susceptibility of developing fetuses to adverse health effects from phthalate exposure.

4538 **REFERENCES**

- 4539 [ACA. \(2019\)](#). Comment submitted by Raleigh Davis, Assistant Director and Riaz Zaman, Counsel,  
4540 Government Affairs, American Coatings Association (ACA). Dicyclohexyl phthalate; TSCA  
4541 Review: Docket EPA-HQ-OPPT-2018-0504-0006. July 3, 2019.  
4542 <https://www.regulations.gov/document?D=EPA-HQ-OPPT-2018-0504-0003>
- 4543 [Ahabab, MA; Barlas, N. \(2013\)](#). Developmental effects of prenatal di-n-hexyl phthalate and dicyclohexyl  
4544 phthalate exposure on reproductive tract of male rats: Postnatal outcomes. Food Chem Toxicol  
4545 51: 123-136. <http://dx.doi.org/10.1016/j.fct.2012.09.010>
- 4546 [Ahabab, MA; Barlas, N. \(2015\)](#). Influence of in utero di-n-hexyl phthalate and dicyclohexyl phthalate on  
4547 fetal testicular development in rats. Toxicol Lett 233: 125-137.  
4548 <http://dx.doi.org/10.1016/j.toxlet.2015.01.015>
- 4549 [Ahabab, MA; Güven, C; Koçkaya, EA; Barlas, N. \(2017\)](#). Comparative developmental toxicity  
4550 evaluation of di- n-hexyl phthalate and dicyclohexyl phthalate in rats. Toxicol Ind Health 33:  
4551 696-716. <http://dx.doi.org/10.1177/0748233717711868>
- 4552 [AIA. \(2019\)](#). Comment submitted by David Hyde, Director, Environmental Policy, Aerospace Industries  
4553 Association (AIA). Dicyclohexyl phthalate; TSCA Review: Docket EPA-HQ-OPPT-2018-0504-  
4554 0006. August 2, 2019. [https://www.regulations.gov/document?D=EPA-HQ-OPPT-2018-0504-  
4555 0006](https://www.regulations.gov/document?D=EPA-HQ-OPPT-2018-0504-0006)
- 4556 [Barnhouse, LW; DeAngelis, DL; Gardner, RH; O'Neill, RV; Suter, GW; Vaughan, DS. \(1982\)](#).  
4557 Methodology for Environmental Risk Analysis. (ORNL/TM-8167). Oak Ridge, TN: Oak Ridge  
4558 National Laboratory.
- 4559 [Carboline. \(2019a\)](#). Product Data Sheet (PDS): Thermaline 4900. St. Louis, MO.  
4560 <https://www.carboline.com/products/product-details/?prod=4901&global=true>
- 4561 [Carboline. \(2019b\)](#). Safety Data Sheet (SDS): Thermaline 4900. St. Louis, MO.  
4562 <https://www.carboline.com/products/product-details/?prod=4901&global=true>
- 4563 [CDC. \(2013\)](#). Fourth national report on human exposure to environmental chemicals, updated tables,  
4564 September 2013. (CS244702-A). Atlanta, GA.  
4565 [http://www.cdc.gov/exposurereport/pdf/FourthReport\\_UpdatedTables\\_Sep2013.pdf](http://www.cdc.gov/exposurereport/pdf/FourthReport_UpdatedTables_Sep2013.pdf)
- 4566 [CDC. \(2021\)](#). Child development: Positive parenting tips [Website].  
4567 <https://www.cdc.gov/ncbddd/childdevelopment/positiveparenting/index.html>
- 4568 [CETCO. \(2018a\)](#). Safety Data Sheet (SDS): Cetguard Catalyst Powder. Hoffman Estates, IL.  
4569 [CETCO. \(2018b\)](#). Technical Data Sheet (TDS): Cetguard Catalyst Powder. Hoffman Estates, IL.  
4570 [https://www.mineralstech.com/docs/default-source/performance-materials-  
documents/cetco/building-materials/technical-data-  
sheets/tds\\_cetguard\\_catalyst\\_powder\\_am\\_en\\_201803\\_v2.pdf](https://www.mineralstech.com/docs/default-source/performance-materials-<br/>4571 documents/cetco/building-materials/technical-data-<br/>4572 sheets/tds_cetguard_catalyst_powder_am_en_201803_v2.pdf)
- 4573 [CETCO. \(2018c\)](#). Technical Data Sheet (TDS): Cetguard SG. Hoffman Estates, IL.  
4574 [CETCO. \(2024\)](#). CETGUARD High-Performance Waterproofing [Website].  
4575 [https://www.mineralstech.com/business-segments/performance-materials/cetco/building-  
materials/products/waterproofing/cetguard](https://www.mineralstech.com/business-segments/performance-materials/cetco/building-<br/>4576 materials/products/waterproofing/cetguard)
- 4577 [ChemMasters. \(2017a\)](#). Safety Data Sheet (SDS): Durapatch™ mMa Methyl Metharylate Concrete  
4578 Repair Mortar. Madison, OH.
- 4579 [ChemMasters. \(2017b\)](#). Safety Data Sheet (SDS): mMa Grout. Madison, OH.  
4580 [ChemMasters. \(2018\)](#). Product Data Sheet (PDS): Polytops MMA Grout. Madison, OH.  
4581 [ChemMasters. \(2024\)](#). Polytops™ mMa Grout [Website].  
4582 <https://www.chemmasters.net/PolytopsMMA.php>
- 4583 [DeWalt. \(2020\)](#). Safety Data Sheet (SDS): Hammer capsule. Toewson, MD.  
4584 [DeWalt. \(2022\)](#). General information: Hammer capsule. Toewson, MD.

- 4585 [DeWalt. \(2024a\)](#). DeWALT Hammer Capsule, Tanner bolt: Online listing. Toewson, MD.  
4586 [https://www.tannerbolt.com/pow-06704-5-8-powers-hammer-capsule-drive-in-type-capsule-](https://www.tannerbolt.com/pow-06704-5-8-powers-hammer-capsule-drive-in-type-capsule-adhesives)  
4587 [adhesives](#)
- 4588 [DeWalt. \(2024b\)](#). DeWALT Hammer Capsule: Online listing. Toewson, MD.  
4589 [https://anchors.dewalt.com/anchors/products/chemical-anchors/glass-capsule-chemical-](https://anchors.dewalt.com/anchors/products/chemical-anchors/glass-capsule-chemical-anchors/hammer-capsule.php#productspecs)  
4590 [anchors/hammer-capsule.php#productspecs](#)
- 4591 [Earthjustice. \(2019\)](#). Comment submitted by Eve C. Gartner, Staff Attorney, Earthjustice: 84-61-7  
4592 DCHP Technical Report Final 11-20. Dicyclohexyl phthalate; TSCA Review: Docket EPA-HQ-  
4593 OPPT-2018-0504-0011. December 3, 2019. [https://www.regulations.gov/document?D=EPA-](https://www.regulations.gov/document?D=EPA-HQ-OPPT-2018-0504-0011)  
4594 [HQ-OPPT-2018-0504-0011](#)
- 4595 [EC/HC. \(2015\)](#). State of the science report: Phthalate substance grouping: Medium-chain phthalate  
4596 esters: Chemical Abstracts Service Registry Numbers: 84-61-7; 84-64-0; 84-69-5; 523-31-9;  
4597 5334-09-8;16883-83-3; 27215-22-1; 27987-25-3; 68515-40-2; 71888-89-6. Gatineau, Quebec:  
4598 Environment Canada, Health Canada. [https://www.ec.gc.ca/ese-ees/4D845198-761D-428B-](https://www.ec.gc.ca/ese-ees/4D845198-761D-428B-A519-75481B25B3E5/SoS_Phthalates%20%28Medium-chain%29_EN.pdf)  
4599 [A519-75481B25B3E5/SoS\\_Phthalates%20%28Medium-chain%29\\_EN.pdf](#)
- 4600 [EC/HC. \(2017\)](#). Draft screening assessment: Phthalate substance grouping. Ottawa, Ontario:  
4601 Government of Canada, Environment Canada, Health Canada. [http://www.ec.gc.ca/ese-](http://www.ec.gc.ca/ese-ees/default.asp?lang=En&n=516A504A-1)  
4602 [ees/default.asp?lang=En&n=516A504A-1](#)
- 4603 [ECCC/HC. \(2020\)](#). Screening assessment - Phthalate substance grouping. (En14-393/2019E-PDF).  
4604 Environment and Climate Change Canada, Health Canada.  
4605 [https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-](https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/screening-assessment-phthalate-substance-grouping.html)  
4606 [substances/screening-assessment-phthalate-substance-grouping.html](#)
- 4607 [ECHA. \(2014\)](#). Committee for Risk Assessment RAC Opinion proposing harmonised classification and  
4608 labelling at EU level of Dicyclohexyl phthalate, EC number: 201-545-9, CAS number: 84-61-7.  
4609 [https://heronet.epa.gov/heronet/index.cfm/reference/download/reference\\_id/10328890](https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/10328890)
- 4610 [ENF Plastic. \(2024\)](#). Plastic recycling plants in the United States [Website].  
4611 [https://www.enfplastic.com/directory/plant/United-States?plastic\\_materials=pl\\_PVC](https://www.enfplastic.com/directory/plant/United-States?plastic_materials=pl_PVC)
- 4612 [ERG. \(2016\)](#). Peer review of EPA's Consumer Exposure Model and draft user guide (final peer review  
4613 report). Washington, DC: U.S. Environmental Protection Agency.
- 4614 [ESIG. \(2020a\)](#). SpERC fact sheet: Industrial application of coatings by spraying. Brussels, Belgium.  
4615 [https://echa.europa.eu/documents/10162/8718351/cepe\\_sperc\\_4.1\\_5.1\\_5.2\\_factsheet\\_Dec2020](https://echa.europa.eu/documents/10162/8718351/cepe_sperc_4.1_5.1_5.2_factsheet_Dec2020_en.pdf/b52857d5-1d76-bf5a-a5fb-8f05cdc84d99?t=1610988863215)  
4616 [en.pdf/b52857d5-1d76-bf5a-a5fb-8f05cdc84d99?t=1610988863215](#)
- 4617 [ESIG. \(2020b\)](#). SPERC Factsheet – Use in rubber production and processing. Brussels, Belgium.  
4618 [https://www.esig.org/wp-content/uploads/2020/05/19\\_industrial\\_rubber-](https://www.esig.org/wp-content/uploads/2020/05/19_industrial_rubber-production_processing.pdf)  
4619 [production\\_processing.pdf](#)
- 4620 [Euclid Chemical Company. \(2018\)](#). Safety Data Sheet (SDS): Dural MMA Initiator. Cleveland, OH.  
4621 [Euclid Chemical Company. \(2019a\)](#). Technical Data Sheet (TDS): Dural MMA Healer/Sealer.  
4622 Cleveland, OH.
- 4623 [Euclid Chemical Company. \(2019b\)](#). Technical Data Sheet (TDS): Dural MMA Initiator. Cleveland,  
4624 OH.
- 4625 [European Commission. \(2009\)](#). State of the art report on mixture toxicity - Final report. Brussels,  
4626 Belgium: European Commission.  
4627 [https://ec.europa.eu/environment/chemicals/effects/pdf/report\\_mixture\\_toxicity.pdf](https://ec.europa.eu/environment/chemicals/effects/pdf/report_mixture_toxicity.pdf)
- 4628 [Ford Motor Company. \(2015\)](#). Safety Data Sheet (SDS): Metal bonding adhesive. Dearborn, Michigan.  
4629 [http://sds.fmpco.com/images/fmp\\_msds/TA1B.pdf](http://sds.fmpco.com/images/fmp_msds/TA1B.pdf)
- 4630 [Furr, JR; Lambright, CS; Wilson, VS; Foster, PM; Gray, LE, Jr. \(2014\)](#). A short-term in vivo screen  
4631 using fetal testosterone production, a key event in the phthalate adverse outcome pathway, to  
4632 predict disruption of sexual differentiation. Toxicol Sci 140: 403-424.  
4633 <http://dx.doi.org/10.1093/toxsci/kfu081>

4634 [Gans Ink and Supply. \(2018\)](#). X102452, X102822, X102839, X102840, L-3049. Gans Ink and Supply.  
4635 <https://www.gansink.com/wp-content/uploads/2018/11/SDS-642-SDS-Version-11-9-18.pdf>  
4636 [Hallstar. \(2022\)](#). Safety Data Sheet (SDS): UNIPLEX™ 250. Chigaco, IL.  
4637 <https://www.hallstarindustrial.com/product/uniplex-250/>  
4638 [Haynes, WM. \(2014\)](#). CRC handbook of chemistry and physics  
4639 Dicyclohexyl phthalate (95 ed., pp. 3-170). Boca Raton, FL: CRC Press.  
4640 [Henkel. \(2017\)](#). Materials for automotive cameras: Bonding, connecting, protecting and thermal  
4641 solutions. Rocky Hill, CT.  
4642 [Henkel. \(2019\)](#). Safety Data Sheet (SDS): LOCTITE ABLESTIK 2035SC known as Ablebond 2035SC.  
4643 Rocky Hill, CT.  
4644 [Henkel. \(2024\)](#). Technical Data Sheet (TDS): LOCTITE® ABLESTIK 2035SC. Rocky Hill, CT.  
4645 [Hilton, GM; Adcock, C; Akerman, G; Baldassari, J; Battalora, M; Casey, W; Clippinger, AJ; Cope, R;  
4646 Goetz, A; Hayes, AW; Papineni, S; Peffer, RC; Ramsingh, D; Williamson Riffle, B; Sanches da  
4647 Rocha, M; Ryan, N; Scollon, E; Visconti, N; Wolf, DC; Yan, Z; Lowit, A. \(2022\)](#). Rethinking  
4648 chronic toxicity and carcinogenicity assessment for agrochemicals project (ReCAAP): A  
4649 reporting framework to support a weight of evidence safety assessment without long-term rodent  
4650 bioassays. Regul Toxicol Pharmacol 131: 105160. <http://dx.doi.org/10.1016/j.yrtph.2022.105160>  
4651 [Hoshino, N; Iwai, M; Okazaki, Y. \(2005\)](#). A two-generation reproductive toxicity study of dicyclohexyl  
4652 phthalate in rats. J Toxicol Sci 30: 79-96. <http://dx.doi.org/10.2131/jts.30.s79>  
4653 [Hydro-Gard. \(2012a\)](#). Section 071800 - Vehicular traffic coating. Yorba Linda, CA.  
4654 [Hydro-Gard. \(2012b\)](#). Section 071813 - Pedestrian traffic coating for thin set tile. Yorba Linda, CA.  
4655 [Hydro-Gard. \(2017a\)](#). Safety Data Sheet (SDS): Gard-Deck® Hardener (BPO). Yorba Linda, CA.  
4656 [Hydro-Gard. \(2017b\)](#). Technical Data Sheet (TDS): Gard-Deck® Hardener (BPO). Yorba Linda, CA.  
4657 [Hydro-Gard. \(2024\)](#). HYDRO-GARD Gard-Deck System [Website]. [https://www.hydro-](https://www.hydro-gard.com/index.php/gard-deck/)  
4658 [gard.com/index.php/gard-deck/](https://www.hydro-gard.com/index.php/gard-deck/)  
4659 [ITW Permatex. \(2021\)](#). Safety Data Sheet (SDS): Duco cement. Solon, OH.  
4660 [https://archpdfs.lps.org/Chemicals/Duco\\_Cement.pdf](https://archpdfs.lps.org/Chemicals/Duco_Cement.pdf)  
4661 [ITW Permatex. \(2024\)](#). Amazon listing: Duco Cement Multi-Purpose Household Glue - 1 fl oz  
4662 [Website]. [https://www.amazon.com/Duco-Cement-Multi-Purpose-Household-](https://www.amazon.com/Duco-Cement-Multi-Purpose-Household-Glue/dp/B0000A605H/ref=sr_1_1?crd=U00IFPFGUTEE&dib=eyJ2IjoiMSJ9.KzpHc3863oh7YHdqKmXtdl4zuHqoyUYEVGEWizlHkvGjHj071QN20LucGBJIEps.sBJgmuEJPN8RvG711ZDI6kdz3ZgbgQxulbuajEVYWHc&dib_tag=se&keywords=duco+cement&qid=1727379759&s=hpc&sprefix=duco+cement%2Chpc%2C51&sr=1-1)  
4663 [Glue/dp/B0000A605H/ref=sr\\_1\\_1?crd=U00IFPFGUTEE&dib=eyJ2IjoiMSJ9.KzpHc3863oh7](https://www.amazon.com/Duco-Cement-Multi-Purpose-Household-Glue/dp/B0000A605H/ref=sr_1_1?crd=U00IFPFGUTEE&dib=eyJ2IjoiMSJ9.KzpHc3863oh7YHdqKmXtdl4zuHqoyUYEVGEWizlHkvGjHj071QN20LucGBJIEps.sBJgmuEJPN8RvG711ZDI6kdz3ZgbgQxulbuajEVYWHc&dib_tag=se&keywords=duco+cement&qid=1727379759&s=hpc&sprefix=duco+cement%2Chpc%2C51&sr=1-1)  
4664 [YHdqKmXtdl4zuHqoyUYEVGEWizlHkvGjHj071QN20LucGBJIEps.sBJgmuEJPN8RvG711Z](https://www.amazon.com/Duco-Cement-Multi-Purpose-Household-Glue/dp/B0000A605H/ref=sr_1_1?crd=U00IFPFGUTEE&dib=eyJ2IjoiMSJ9.KzpHc3863oh7YHdqKmXtdl4zuHqoyUYEVGEWizlHkvGjHj071QN20LucGBJIEps.sBJgmuEJPN8RvG711ZDI6kdz3ZgbgQxulbuajEVYWHc&dib_tag=se&keywords=duco+cement&qid=1727379759&s=hpc&sprefix=duco+cement%2Chpc%2C51&sr=1-1)  
4665 [DI6kdz3ZgbgQxulbuajEVYWHc&dib\\_tag=se&keywords=duco+cement&qid=1727379759&s=](https://www.amazon.com/Duco-Cement-Multi-Purpose-Household-Glue/dp/B0000A605H/ref=sr_1_1?crd=U00IFPFGUTEE&dib=eyJ2IjoiMSJ9.KzpHc3863oh7YHdqKmXtdl4zuHqoyUYEVGEWizlHkvGjHj071QN20LucGBJIEps.sBJgmuEJPN8RvG711ZDI6kdz3ZgbgQxulbuajEVYWHc&dib_tag=se&keywords=duco+cement&qid=1727379759&s=hpc&sprefix=duco+cement%2Chpc%2C51&sr=1-1)  
4666 [hpc&sprefix=duco+cement%2Chpc%2C51&sr=1-1](https://www.amazon.com/Duco-Cement-Multi-Purpose-Household-Glue/dp/B0000A605H/ref=sr_1_1?crd=U00IFPFGUTEE&dib=eyJ2IjoiMSJ9.KzpHc3863oh7YHdqKmXtdl4zuHqoyUYEVGEWizlHkvGjHj071QN20LucGBJIEps.sBJgmuEJPN8RvG711ZDI6kdz3ZgbgQxulbuajEVYWHc&dib_tag=se&keywords=duco+cement&qid=1727379759&s=hpc&sprefix=duco+cement%2Chpc%2C51&sr=1-1)  
4667 [Keil, R; Salemme, K; Forrest, B; Neibauer, J; Logsdon, M. \(2011\)](#). Differential presence of  
4668 anthropogenic compounds dissolved in the marine waters of Puget Sound, WA and Barkley  
4669 Sound, BC. Mar Pollut Bull 62: 2404-2411. <http://dx.doi.org/10.1016/j.marpolbul.2011.08.029>  
4670 [LANXESS. \(2021\)](#). 2021 LANXESS Product Information Spreadsheet. Cologne: LANXESS Solutions  
4671 US Inc.  
4672 [Lee, YM; Lee, JE; Choe, W; Kim, T; Lee, JY; Kho, Y; Choi, K; Zoh, KD. \(2019\)](#). Distribution of  
4673 phthalate esters in air, water, sediments, and fish in the Asan Lake of Korea. Environ Int 126:  
4674 635-643. <http://dx.doi.org/10.1016/j.envint.2019.02.059>  
4675 [Li, X; Chen, X; Hu, G; Li, L; Su, H; Wang, Y; Chen, D; Zhu, Q; Li, C; Li, J; Wang, M; Lian, Q; Ge, R.  
4676 \(2016\)](#). Effects of in utero exposure to dicyclohexyl phthalate on rat fetal leydig cells. Int J  
4677 Environ Res Public Health 13: 1. <http://dx.doi.org/10.3390/ijerph13030246>  
4678 [Lord Corporation. \(2017\)](#). Safety Data Sheet (SDS): Fusor 108B, 109B Metal Bonding ADH PT B.  
4679 Cary, NC. [https://www.parker.com/content/dam/Parker-com/Literature/Assembly---Protection-](https://www.parker.com/content/dam/Parker-com/Literature/Assembly---Protection-Solutions-Division/Safety-Datasheets/SDS-MSDS-Safety-Data-Sheet---FUSOR-108B--109B-METAL-BONDING-ADH-PT-B.pdf)  
4680 [Solutions-Division/Safety-Datasheets/SDS-MSDS-Safety-Data-Sheet---FUSOR-108B--109B-](https://www.parker.com/content/dam/Parker-com/Literature/Assembly---Protection-Solutions-Division/Safety-Datasheets/SDS-MSDS-Safety-Data-Sheet---FUSOR-108B--109B-METAL-BONDING-ADH-PT-B.pdf)  
4681 [METAL-BONDING-ADH-PT-B.pdf](https://www.parker.com/content/dam/Parker-com/Literature/Assembly---Protection-Solutions-Division/Safety-Datasheets/SDS-MSDS-Safety-Data-Sheet---FUSOR-108B--109B-METAL-BONDING-ADH-PT-B.pdf)

- 4682 [Lord Corporation. \(2020\)](#). Technical Data Sheet (TDS): Fusor® 108B/109B Metal Bonding Adhesive  
4683 (Medium). Cary, NC.
- 4684 [Lord Corporation. \(2021\)](#). Fusor® repair adhesives: Adhesives, sealers & sound control for collision  
4685 repair. Cary, NC.
- 4686 [Lord Corporation. \(2024\)](#). Lord Fusor Metal Adhesive Medium 7.6 OZ [Website].  
4687 <https://www.amazon.com/Lord-Fusor-ADHESIVE-MEDIUM-FUS-108B/dp/B002CMR8WM>
- 4688 [Mathieu-Denoncourt, J; Martyniuk, CJ; Loughery, JR; Yargeau, V; de Solla, SR; Langlois, VS.](#) (2016).  
4689 Lethal and sublethal effects of phthalate diesters in *Silurana tropicalis* larvae. *Environ Toxicol*  
4690 *Chem* 35: 2511–2522. <http://dx.doi.org/10.1002/etc.3413>
- 4691 [Meek, ME; Boobis, AR; Crofton, KM; Heinemeyer, G; Raaij, MV; Vickers, C.](#) (2011). Risk assessment  
4692 of combined exposure to multiple chemicals: A WHO/IPCS framework. *Regul Toxicol*  
4693 *Pharmacol* 60. <http://dx.doi.org/10.1016/j.yrtph.2011.03.010>
- 4694 [MEMA. \(2019\)](#). Comment submitted by Catherine M. Wilmarth, Attorney, Alliance of Automobile  
4695 Manufacturers and Laurie Holmes, Senior Director, Environmental Policy, Motor & Equipment  
4696 Manufacturers Association (MEMA). (EPA-HQ-OPPT-2019-0131-0022). Alliance of  
4697 Automobile Manufacturers and Motor & Equipment Manufacturers Association.  
4698 <https://www.regulations.gov/document?D=EPA-HQ-OPPT-2019-0131-0022>
- 4699 [Midwest Technology Products. \(2024\)](#). Midwest Technology Products: Permatex Duco Cement  
4700 [Website]. <https://www.midwesttechnology.com/duco-cement/>
- 4701 [Milbrandt, A; Coney, K; Badgett, A; Beckham, GT.](#) (2022). Quantification and evaluation of plastic  
4702 waste in the United States. *Resour Conservat Recycl* 183: 106363.  
4703 <http://dx.doi.org/10.1016/j.resconrec.2022.106363>
- 4704 [MKT. \(2018\)](#). Safety Data Sheet (SDS): Liquid Roc 300 Twin Tube. Lonoke, AR.  
4705 [https://www.mktfastening.com/sites/default/files/content/downloadable-](https://www.mktfastening.com/sites/default/files/content/downloadable-files/lr300_twin_tube_sds_0.pdf)  
4706 [files/lr300 twin tube sds 0.pdf](https://www.mktfastening.com/sites/default/files/content/downloadable-files/lr300_twin_tube_sds_0.pdf)
- 4707 [MKT. \(2023a\)](#). General information: Adhesive anchoring systems. Lonoke, AR.  
4708 [https://www.mktfastening.com/sites/default/files/content/downloadable-](https://www.mktfastening.com/sites/default/files/content/downloadable-files/mkt_general_information_adhesive_anchoring_systems.pdf)  
4709 [files/mkt general information adhesive anchoring systems.pdf](https://www.mktfastening.com/sites/default/files/content/downloadable-files/mkt_general_information_adhesive_anchoring_systems.pdf)
- 4710 [MKT. \(2023b\)](#). Product Data Sheet (PDS): Liquid Roc® 300 Twin Tube. Lonoke, AR.  
4711 [https://www.mktfastening.com/sites/default/files/content/downloadable-](https://www.mktfastening.com/sites/default/files/content/downloadable-files/mkt_liquid_roc_300_twin_tube.pdf)  
4712 [files/mkt liquid roc 300 twin tube.pdf](https://www.mktfastening.com/sites/default/files/content/downloadable-files/mkt_liquid_roc_300_twin_tube.pdf)
- 4713 [MKT. \(2024\)](#). Amazon listing: MKT Polyester Liquid ROC 300 Chemical Anchor, 5.5 oz Pouch  
4714 [Website]. [https://www.amazon.com/MKT-Polyester-Liquid-Chemical-](https://www.amazon.com/MKT-Polyester-Liquid-Chemical-Anchor/dp/B00D8JEHMW)  
4715 [Anchor/dp/B00D8JEHMW](https://www.amazon.com/MKT-Polyester-Liquid-Chemical-Anchor/dp/B00D8JEHMW)
- 4716 [NASA. \(2020\)](#). Comment submitted by Denise Thaller, Director, Environmental Management Division,  
4717 National Aeronautics and Space Administration (NASA) regarding draft scopes of the risk  
4718 evaluations of DEHP and DBP. (EPA-HQ-OPPT-2018-0501-0043). Washington, DC.  
4719 <https://www.regulations.gov/comment/EPA-HQ-OPPT-2018-0501-0043>
- 4720 [NASEM. \(2017\)](#). Application of systematic review methods in an overall strategy for evaluating low-  
4721 dose toxicity from endocrine active chemicals. In Consensus Study Report. Washington, D.C.:  
4722 The National Academies Press. <http://dx.doi.org/10.17226/24758>
- 4723 [NICNAS. \(2008\)](#). Phthalates hazard compendium: A summary of physicochemical and human health  
4724 hazard data for 24 ortho-phthalate chemicals. Sydney, Australia: Australian Department of  
4725 Health and Ageing, National Industrial Chemicals Notification and Assessment Scheme.  
4726 <https://www.regulations.gov/document/EPA-HQ-OPPT-2010-0573-0008>
- 4727 [NICNAS. \(2016\)](#). C4-6 side chain transitional phthalates: Human health tier II assessment. Sydney,  
4728 Australia: Australian Department of Health, National Industrial Chemicals Notification and  
4729 Assessment Scheme. <https://www.industrialchemicals.gov.au/sites/default/files/C4->

- 4730 [6%20side%20chain%20transitional%20phthalates\\_Human%20health%20tier%20II%20assessm](#)  
4731 [ent.pdf](#)
- 4732 [NITE. \(2000\).](#) [Dicyclohexyl phthalate: Reproduction inhibition test for Daphnia magna]. (9B481G).  
4733 Tokyo, Japan: Japanese Ministry of the Environment.
- 4734 [https://chem.echa.europa.eu/100.001.405/dossier-view/4742a866-2c9d-40f3-b353-](https://chem.echa.europa.eu/100.001.405/dossier-view/4742a866-2c9d-40f3-b353-f6d166324c0d/IUC5-3939cf10-8ed5-4e34-9e0b-878b94344d49_e15fb14e-d558-465c-ba63-11a1b792aa74)  
4735 [f6d166324c0d/IUC5-3939cf10-8ed5-4e34-9e0b-878b94344d49\\_e15fb14e-d558-465c-ba63-](https://chem.echa.europa.eu/100.001.405/dossier-view/4742a866-2c9d-40f3-b353-f6d166324c0d/IUC5-3939cf10-8ed5-4e34-9e0b-878b94344d49_e15fb14e-d558-465c-ba63-11a1b792aa74)  
4736 [11a1b792aa74](https://chem.echa.europa.eu/100.001.405/dossier-view/4742a866-2c9d-40f3-b353-f6d166324c0d/IUC5-3939cf10-8ed5-4e34-9e0b-878b94344d49_e15fb14e-d558-465c-ba63-11a1b792aa74)
- 4737 [NLM. \(2024\).](#) PubChem: Hazardous Substance Data Bank: Dicyclohexyl phthalate, 84-61-7 [Website].  
4738 <https://pubchem.ncbi.nlm.nih.gov/compound/6777#source=HSDB>
- 4739 [Nouryon Chemicals LLC. \(2020\).](#) Comment submitted by Robert van de Graaf, Sales Director,  
4740 Americas, Polymer Catalysts, Nouryon Chemicals LLC. Dicyclohexyl phthalate; TSCA Review:  
4741 Docket EPA-HQ-OPPT-2018-0504-0015. January 2, 2020. Nouryon Chemicals LLC.  
4742 <https://www.regulations.gov/document?D=EPA-HQ-OPPT-2018-0504-0015>
- 4743 [Nouryon Chemicals LLC. \(2024\).](#) Nouryon's response to EPA's question concerning the listed  
4744 subcategory "hardener" for DCHP. Chicago, IL.
- 4745 [NRC. \(2008\).](#) Phthalates and cumulative risk assessment: The task ahead. Washington, DC: National  
4746 Academies Press. <http://dx.doi.org/10.17226/12528>
- 4747 [OECD. \(2004\).](#) Emission scenario document on additives in rubber industry.  
4748 (ENV/JM/MONO(2004)11). Paris, France.  
4749 [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono\(2004\)11](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2004)11&doclanguage=en)  
4750 [&doclanguage=en](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2004)11&doclanguage=en)
- 4751 [OECD. \(2009a\).](#) Emission scenario document on adhesive formulation. (ENV/JM/MONO(2009)3;  
4752 JT03263583). Paris, France.  
4753 [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono\(2009\)3&](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2009)3&doclanguage=en)  
4754 [doclanguage=en](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2009)3&doclanguage=en)
- 4755 [OECD. \(2009b\).](#) Emission scenario documents on coating industry (paints, lacquers and varnishes).  
4756 (JT03267833). Paris, France.  
4757 [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env%20/jm/mono\(200](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env%20/jm/mono(2009)24&doclanguage=en)  
4758 [9\)24&doclanguage=en](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env%20/jm/mono(2009)24&doclanguage=en)
- 4759 [OECD. \(2011a\).](#) Emission scenario document on coating application via spray-painting in the  
4760 automotive refinishing industry. In OECD Series on Emission Scenario Documents No 11.  
4761 (ENV/JM/MONO(2004)22/REV1). Paris, France: Organization for Economic Co-operation and  
4762 Development.  
4763 [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono\(2004\)22/](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2004)22/rev1&doclanguage=en)  
4764 [rev1&doclanguage=en](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2004)22/rev1&doclanguage=en)
- 4765 [OECD. \(2011b\).](#) Emission Scenario Document on the application of radiation curable coatings, inks, and  
4766 adhesives via spray, vacuum, roll, and curtain coating.
- 4767 [OECD. \(2015a\).](#) Emission scenario document on the use of adhesives. In Series on Emission Scenario  
4768 Documents No 34. (JT03373626). Paris, France.  
4769 [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/JM/MONO\(2015](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/JM/MONO(2015)4&doclanguage=en)  
4770 [\)4&doclanguage=en](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/JM/MONO(2015)4&doclanguage=en)
- 4771 [OECD. \(2015b\).](#) Emission scenario document on use of adhesives. In Series on Emission Scenario  
4772 Documents No 34. (Number 34). Paris, France.  
4773 [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/JM/MONO\(2015](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/JM/MONO(2015)4&doclanguage=en)  
4774 [\)4&doclanguage=en](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/JM/MONO(2015)4&doclanguage=en)
- 4775 [OECD. \(2018\).](#) Considerations for assessing the risks of combined exposure to multiple chemicals (No.  
4776 296). In Series on Testing and Assessment No 296. Paris, France.  
4777 <http://dx.doi.org/10.1787/ceca15a9-en>

4778 [OECD. \(2024\)](#). Case study on the use of Integrated Approaches for Testing and Assessment (IATA) for  
4779 chronic toxicity and carcinogenicity of agrichemicals with exemplar case studies - ninth review  
4780 cycle (2023). In Series on Testing and Assessment No 402. Paris, France: OECD Publishing.  
4781 <http://dx.doi.org/10.1787/c3b9ac37-en>

4782 [OSHA. \(2020\)](#). Chemical Exposure Health Data (CEHD). Washington, DC. Retrieved from  
4783 <https://www.osha.gov/opengov/healthsamples.html>

4784 [Restek Corporation. \(2024\)](#). EPA Method 8061A Phthalate Esters Mixture, 1000 µg/mL in  
4785 Hexane:Acetone (80:20), 1 mL/ampul [Website]. <https://www.restek.com/p/33227>

4786 [RSC. \(2019\)](#). ChemSpider: Dicyclohexyl phthalate [Website]. [http://www.chemspider.com/Chemical-  
4787 Structure.6519.html?rid=1d301c57-7330-4894-8613-c99aa064387d](http://www.chemspider.com/Chemical-Structure.6519.html?rid=1d301c57-7330-4894-8613-c99aa064387d)

4788 [Sauereisen. \(2022\)](#). Product Data Sheet (PDS): Vinyl Ester - Silica Filled Mortar No. 400. Pittsburgh,  
4789 PA. <https://www.sauereisen.com/wp-content/uploads/400-Vinyl-Ester-Mortar.pdf>

4790 [Sauereisen. \(2024\)](#). Vinyl ester – Silica Filled Mortar 400 [Website].  
4791 <https://www.sauereisen.com/product/no-400vinyl-ester-silica-filled-mortar/>

4792 [Sigma-Aldrich. \(2024a\)](#). Safety Data Sheet (SDS): Benzoyl peroxide blend with dicyclohexyl phthalate.  
4793 St. Louis, MO. <https://www.sigmaaldrich.com/US/en/sds/SIGMA/B5907>

4794 [Sigma-Aldrich. \(2024b\)](#). Safety Data Sheet (SDS): Dicyclohexyl phthalate. St. Louis, MO.  
4795 <https://www.sigmaaldrich.com/US/en/sds/ALDRICH/306150>

4796 [SPEX CertiPrep. \(2019\)](#). Safety Data Sheet (SDS): Phthalate esters mix. Metuchen, NJ: SPEX CertiPrep  
4797 LLC. <https://www.spex.com/MSDS/8061-X.pdf>

4798 [Swedish Chemicals Agency. \(2023\)](#). Substance evaluation conclusion as required by REACH article 48  
4799 and evaluation report for dicyclohexyl phthalate. (EC No 201-545-9). Sundbyberg, Sweden.

4800 [Ted Pella. \(2017\)](#). Safety Data Sheet (SDS): Product No. 18025 JB-4 Catalyst, Component of JB-4 Kit  
4801 18020. Redding, CA. [https://www.tedpella.com/SDS\\_html/18020\\_JB-  
4802 4\\_Catalyst\(18025\)\\_sds.pdf](https://www.tedpella.com/SDS_html/18020_JB-4_Catalyst(18025)_sds.pdf)

4803 [Ted Pella. \(2024\)](#). Embedding kits: Embedding chemicals for electron microscopy and light microscopy  
4804 [Website]. [https://www.tedpella.com/chemical\\_html/chem2.aspx](https://www.tedpella.com/chemical_html/chem2.aspx)

4805 [ten Berge, W. \(2009\)](#). A simple dermal absorption model: Derivation and application. *Chemosphere* 75:  
4806 1440-1445. <http://dx.doi.org/10.1016/j.chemosphere.2009.02.043>

4807 [Tomer, A; Kane, J. \(2015\)](#). The great port mismatch. U.S. goods trade and international transportation.  
4808 The Global Cities Initiative. A joint project of Brookings and JPMorgan Chase.  
4809 <https://www.brookings.edu/wp-content/uploads/2015/06/brgkssrvygcifreightnetworks.pdf>

4810 [U.S. BLS. \(2016\)](#). May 2016 Occupational Employment and Wage Estimates: National Industry-  
4811 Specific Estimates [Website]. <http://www.bls.gov/oes/tables.htm>

4812 [U.S. Census Bureau. \(2015\)](#). Statistics of U.S. Businesses (SUSB).  
4813 <https://www.census.gov/data/tables/2015/econ/susb/2015-susb-annual.html>

4814 [U.S. Census Bureau. \(2022\)](#). County Business Patterns: 2020. Suitland, MD.  
4815 <https://www.census.gov/data/datasets/2020/econ/cbp/2020-cbp.html>

4816 [U.S. CPSC. \(2010\)](#). Toxicity review of dicyclohexyl phthalate (DCHP). Bethesda, MD: U.S. Consumer  
4817 Product Safety Commission, Directorate for Hazard Identification and Reduction.  
4818 [https://web.archive.org/web/20190320060432/https://www.cpsc.gov/s3fs-  
4819 public/ToxicityReviewOfDCHP.pdf](https://web.archive.org/web/20190320060432/https://www.cpsc.gov/s3fs-public/ToxicityReviewOfDCHP.pdf)

4820 [U.S. CPSC. \(2014\)](#). Chronic Hazard Advisory Panel on Phthalates and Phthalate Alternatives (with  
4821 appendices). Bethesda, MD: U.S. Consumer Product Safety Commission, Directorate for Health  
4822 Sciences. <https://www.cpsc.gov/s3fs-public/CHAP-REPORT-With-Appendices.pdf>

4823 [U.S. CPSC. \(2015\)](#). Exposure assessment: Composition, production, and use of phthalates. Cincinnati,  
4824 OH: Prepared by: Toxicology Excellence for Risk Assessment Center at the University of  
4825 Cincinnati. [https://web.archive.org/web/20190320060357/https://www.cpsc.gov/s3fs-  
4826 public/pdfs/TERAReportPhthalates.pdf](https://web.archive.org/web/20190320060357/https://www.cpsc.gov/s3fs-public/pdfs/TERAReportPhthalates.pdf)

- 4827 [U.S. CPSC. \(2017\)](#). Prohibition of children's toys and child care articles containing specified phthalates.  
4828 Final rule. Fed Reg 82: 49938-49982.
- 4829 [U.S. EPA. \(1986\)](#). Guidelines for the health risk assessment of chemical mixtures. Fed Reg 51: 34014-  
4830 34025.
- 4831 [U.S. EPA. \(1991\)](#). Chemical engineering branch manual for the preparation of engineering assessments.  
4832 (68-D8-0112). Cincinnati, OH: US Environmental Protection Agency, Office of Toxic  
4833 Substances.  
4834 <https://nepis.epa.gov/Exe/ZyNET.exe/P10000VS.txt?ZyActionD=ZyDocument&Client=EPA&Index=1991%20Thru%201994&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&UseQField=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5CZYFILES%5CINDEX%20DATA%5C91THRU94%5CTXT%5C00000019%5CP10000VS.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=233&ZyEntry=1>
- 4840  
4841  
4842
- 4843 [U.S. EPA. \(1992\)](#). Guidelines for exposure assessment. Federal Register 57(104):22888-22938 [EPA  
4844 Report]. (EPA/600/Z-92/001). Washington, DC.  
4845 <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=15263>
- 4846 [U.S. EPA. \(1994\)](#). Methods for derivation of inhalation reference concentrations and application of  
4847 inhalation dosimetry [EPA Report]. (EPA600890066F). Research Triangle Park, NC.  
4848 <https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=71993&CFID=51174829&CFTOKEN=25006317>  
4849
- 4850 [U.S. EPA. \(1998\)](#). Guidelines for ecological risk assessment [EPA Report]. (EPA/630/R-95/002F).  
4851 Washington, DC: U.S. Environmental Protection Agency, Risk Assessment Forum.  
4852 <https://www.epa.gov/risk/guidelines-ecological-risk-assessment>
- 4853 [U.S. EPA. \(1999\)](#). Guidance for identifying pesticide chemicals and other substances that have a  
4854 common mechanism of toxicity. Washington, DC. [https://www.epa.gov/sites/default/files/2015-07/documents/guide-2-identify-pest-chem\\_0.pdf](https://www.epa.gov/sites/default/files/2015-07/documents/guide-2-identify-pest-chem_0.pdf)  
4855
- 4856 [U.S. EPA. \(2000\)](#). Supplementary guidance for conducting health risk assessment of chemical mixtures  
4857 (pp. 1-209). (EPA/630/R-00/002). Washington, DC: U.S. Environmental Protection Agency,  
4858 Risk Assessment Forum. <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=20533>
- 4859 [U.S. EPA. \(2001\)](#). General principles for performing aggregate exposure and risk assessments [EPA  
4860 Report]. Washington, DC. <https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/general-principles-performing-aggregate-exposure>  
4861
- 4862 [U.S. EPA. \(2002a\)](#). Guidance on cumulative risk assessment of pesticide chemicals that have a common  
4863 mechanism of toxicity [EPA Report]. Washington, D.C.
- 4864 [U.S. EPA. \(2002b\)](#). A review of the reference dose and reference concentration processes.  
4865 (EPA630P02002F). Washington, DC. <https://www.epa.gov/sites/production/files/2014-12/documents/rfd-final.pdf>  
4866
- 4867 [U.S. EPA. \(2003\)](#). Framework for cumulative risk assessment [EPA Report]. (EPA/630/P-02/001F).  
4868 Washington, DC. [https://www.epa.gov/sites/production/files/2014-11/documents/frmwrk\\_cum\\_risk\\_assmnt.pdf](https://www.epa.gov/sites/production/files/2014-11/documents/frmwrk_cum_risk_assmnt.pdf)  
4869
- 4870 [U.S. EPA. \(2004a\)](#). Additives in plastics processing (converting into finished products) -generic scenario  
4871 for estimating occupational exposures and environmental releases. Draft. Washington, DC.
- 4872 [U.S. EPA. \(2004b\)](#). Risk Assessment Guidance for Superfund (RAGS), volume I: Human health  
4873 evaluation manual, (part E: Supplemental guidance for dermal risk assessment).  
4874 (EPA/540/R/99/005). Washington, DC: U.S. Environmental Protection Agency, Risk  
4875 Assessment Forum. <https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e>

- 4876 [U.S. EPA. \(2004c\)](#). Spray coatings in the furniture industry - generic scenario for estimating  
4877 occupational exposures and environmental releases.
- 4878 [U.S. EPA. \(2004d\)](#). Spray coatings in the furniture industry - generic scenario for estimating  
4879 occupational exposures and environmental releases: Draft. Washington, DC.  
4880 [https://www.epa.gov/tsca-screening-tools/using-predictive-methods-assess-exposure-and-fate-  
4881 under-tsca](https://www.epa.gov/tsca-screening-tools/using-predictive-methods-assess-exposure-and-fate-under-tsca)
- 4882 [U.S. EPA. \(2006\)](#). A framework for assessing health risk of environmental exposures to children.  
4883 (EPA/600/R-05/093F). Washington, DC: U.S. Environmental Protection Agency, Office of  
4884 Research and Development, National Center for Environmental Assessment.  
4885 <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=158363>
- 4886 [U.S. EPA. \(2007\)](#). Concepts, methods, and data sources for cumulative health risk assessment of  
4887 multiple chemicals, exposures, and effects: A resource document [EPA Report]. (EPA/600/R-  
4888 06/013F). Cincinnati, OH. <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=190187>
- 4889 [U.S. EPA. \(2010\)](#). Manufacture and use of printing inks - generic scenario for estimating occupational  
4890 exposures and environmental releases: Draft. Washington, DC. [https://www.epa.gov/tsca-  
4891 screening-tools/chemsteer-chemical-screening-tool-exposures-and-environmental-  
4892 releases#genericscenarios](https://www.epa.gov/tsca-screening-tools/chemsteer-chemical-screening-tool-exposures-and-environmental-releases#genericscenarios)
- 4893 [U.S. EPA. \(2011a\)](#). Exposure factors handbook: 2011 edition [EPA Report]. (EPA/600/R-090/052F).  
4894 Washington, DC: U.S. Environmental Protection Agency, Office of Research and Development,  
4895 National Center for Environmental Assessment.  
4896 <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100F2OS.txt>
- 4897 [U.S. EPA. \(2011b\)](#). Exposure factors handbook: 2011 edition (final) (EPA/600/R-090/052F).  
4898 Washington, DC. <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=236252>
- 4899 [U.S. EPA. \(2011c\)](#). Recommended use of body weight 3/4 as the default method in derivation of the oral  
4900 reference dose. (EPA100R110001). Washington, DC.  
4901 <https://www.epa.gov/sites/production/files/2013-09/documents/recommended-use-of-bw34.pdf>
- 4902 [U.S. EPA. \(2012\)](#). Estimation Programs Interface Suite™ for Microsoft® Windows, v 4.11 [Computer  
4903 Program]. Washington, DC. Retrieved from [https://www.epa.gov/tsca-screening-tools/epi-  
4904 suitetm-estimation-program-interface](https://www.epa.gov/tsca-screening-tools/epi-suitetm-estimation-program-interface)
- 4905 [U.S. EPA. \(2014a\)](#). Formulation of waterborne coatings - Generic scenario for estimating occupational  
4906 exposures and environmental releases -Draft. Washington, DC. [https://www.epa.gov/tsca-  
4907 screening-tools/using-predictive-methods-assess-exposure-and-fate-under-tsca](https://www.epa.gov/tsca-screening-tools/using-predictive-methods-assess-exposure-and-fate-under-tsca)
- 4908 [U.S. EPA. \(2014b\)](#). Generic scenario on coating application via spray painting in the automotive  
4909 refinishing industry.
- 4910 [U.S. EPA. \(2014c\)](#). Use of additive in plastic compounding - generic scenario for estimating  
4911 occupational exposures and environmental releases: Draft. Washington, DC.  
4912 [https://www.epa.gov/tsca-screening-tools/using-predictive-methods-assess-exposure-and-fate-  
4913 under-tsca](https://www.epa.gov/tsca-screening-tools/using-predictive-methods-assess-exposure-and-fate-under-tsca)
- 4914 [U.S. EPA. \(2016a\)](#). Guidance for conducting fish consumption surveys. (823B16002).  
4915 [https://www.epa.gov/sites/production/files/2017-01/documents/fc\\_survey\\_guidance.pdf](https://www.epa.gov/sites/production/files/2017-01/documents/fc_survey_guidance.pdf)
- 4916 [U.S. EPA. \(2016b\)](#). Pesticide cumulative risk assessment: Framework for screening analysis.  
4917 Washington, DC: Office of Pesticide Programs. [https://www.epa.gov/pesticide-science-and-  
4918 assessing-pesticide-risks/pesticide-cumulative-risk-assessment-framework](https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/pesticide-cumulative-risk-assessment-framework)
- 4919 [U.S. EPA. \(2017\)](#). Estimation Programs Interface Suite™ v.4.11. Washington, DC: U.S. Environmental  
4920 Protection Agency, Office of Pollution Prevention Toxics. Retrieved from  
4921 [https://www.epa.gov/tsca-screening-tools/download-epi-suitetm-estimation-program-interface-  
4922 v411](https://www.epa.gov/tsca-screening-tools/download-epi-suitetm-estimation-program-interface-v411)

- 4923 [U.S. EPA. \(2019a\)](#). Chemical data reporting (2012 and 2016 public CDR database). Washington, DC:  
4924 U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics. Retrieved  
4925 from <https://www.epa.gov/chemical-data-reporting>
- 4926 [U.S. EPA. \(2019b\)](#). Guidelines for human exposure assessment [EPA Report]. (EPA/100/B-19/001).  
4927 Washington, DC: Risk Assessment Forum. [https://www.epa.gov/sites/production/files/2020-01/documents/guidelines\\_for\\_human\\_exposure\\_assessment\\_final2019.pdf](https://www.epa.gov/sites/production/files/2020-01/documents/guidelines_for_human_exposure_assessment_final2019.pdf)
- 4928 [U.S. EPA. \(2019c\)](#). Meeting summary with Nouryon and EPA to discuss conditions of use for  
4929 dicyclohexyl phthalate. Washington, DC. [https://www.regulations.gov/document/EPA-HQ-  
4930 OPPT-2018-0504-0017](https://www.regulations.gov/document/EPA-HQ-OPPT-2018-0504-0017)
- 4931 [U.S. EPA. \(2019d\)](#). Meeting with Carboline and EPA to discuss conditions of use for dicyclohexyl  
4932 phthalate. Washington, DC. [https://www.regulations.gov/document/EPA-HQ-OPPT-2018-0504-  
4933 0018](https://www.regulations.gov/document/EPA-HQ-OPPT-2018-0504-0018)
- 4934 [U.S. EPA. \(2019e\)](#). Meeting with Vertellus and EPA to discuss conditions of use for dicyclohexyl  
4935 phthalate. Washington, DC. [https://www.regulations.gov/document/EPA-HQ-OPPT-2018-0504-  
4936 0021](https://www.regulations.gov/document/EPA-HQ-OPPT-2018-0504-0021)
- 4937 [U.S. EPA. \(2020a\)](#). 2020 CDR data [Database]. Washington, DC: U.S. Environmental Protection  
4938 Agency, Office of Pollution Prevention and Toxics. Retrieved from  
4939 <https://www.epa.gov/chemical-data-reporting/access-cdr-data>
- 4940 [U.S. EPA. \(2020b\)](#). Final scope of the risk evaluation for dicyclohexyl phthalate (1,2-  
4941 benzenedicarboxylic acid, 1,2-dicyclohexyl ester); CASRN 84-61-7 [EPA Report]. (EPA-740-R-  
4942 20-019). Washington, DC: Office of Chemical Safety and Pollution Prevention.  
4943 [https://www.epa.gov/sites/default/files/2020-09/documents/casrn\\_84-61-  
4944 7\\_dicyclohexyl\\_phthalate\\_final\\_scope.pdf](https://www.epa.gov/sites/default/files/2020-09/documents/casrn_84-61-7_dicyclohexyl_phthalate_final_scope.pdf)
- 4945 [U.S. EPA. \(2020c\)](#). Meeting with EPA and Futamura USA to discuss conditions of use for dicyclohexyl  
4946 phthalate. Washington, DC. [https://www.regulations.gov/comment/EPA-HQ-OPPT-2018-0504-  
4947 0045](https://www.regulations.gov/comment/EPA-HQ-OPPT-2018-0504-0045)
- 4948 [U.S. EPA. \(2020d\)](#). Phone call with Sigma-Aldrich: 1/6/20 [Personal Communication].  
4949 <https://www.regulations.gov/comment/EPA-HQ-OPPT-2018-0504-0019>
- 4950 [U.S. EPA. \(2021a\)](#). Draft systematic review protocol supporting TSCA risk evaluations for chemical  
4951 substances, Version 1.0: A generic TSCA systematic review protocol with chemical-specific  
4952 methodologies. (EPA Document #EPA-D-20-031). Washington, DC: Office of Chemical Safety  
4953 and Pollution Prevention. [https://www.regulations.gov/document/EPA-HQ-OPPT-2021-0414-  
4954 0005](https://www.regulations.gov/document/EPA-HQ-OPPT-2021-0414-0005)
- 4955 [U.S. EPA. \(2021b\)](#). Generic model for central tendency and high-end inhalation exposure to total and  
4956 respirable Particulates Not Otherwise Regulated (PNOR). Washington, DC: Office of Pollution  
4957 Prevention and Toxics, Chemical Engineering Branch.
- 4958 [U.S. EPA. \(2021c\)](#). Meeting summary with LANXESS 09-20-2021: Di-isobutyl Phthalate (DIBP)  
4959 Consortium representatives and EPA to discuss uses of di-isobutyl phthalate and dicyclohexyl  
4960 phthalate. Washington, DC. [https://www.regulations.gov/document/EPA-HQ-OPPT-2018-0434-  
4961 0053](https://www.regulations.gov/document/EPA-HQ-OPPT-2018-0434-0053)
- 4962 [U.S. EPA. \(2021d\)](#). Use of additives in plastic compounding – Generic scenario for estimating  
4963 occupational exposures and environmental releases (Revised draft) [EPA Report]. Washington,  
4964 DC: Office of Pollution Prevention and Toxics, Risk Assessment Division.
- 4965 [U.S. EPA. \(2021e\)](#). Use of additives in plastics converting – Generic scenario for estimating  
4966 occupational exposures and environmental releases (revised draft). Washington, DC: Office of  
4967 Pollution Prevention and Toxics.
- 4968 [U.S. EPA. \(2022a\)](#). Chemical repackaging - Generic scenario for estimating occupational exposures and  
4969 environmental releases (revised draft) [EPA Report]. Washington, DC.  
4970

- 4971 [U.S. EPA. \(2022b\)](#). Draft TSCA screening level approach for assessing ambient air and water exposures  
4972 to fenceline communities (version 1.0) [EPA Report]. (EPA-744-D-22-001). Washington, DC:  
4973 Office of Chemical Safety and Pollution Prevention, U.S. Environmental Protection Agency.  
4974 [https://heronet.epa.gov/heronet/index.cfm/reference/download/reference\\_id/10555664](https://heronet.epa.gov/heronet/index.cfm/reference/download/reference_id/10555664)
- 4975 [U.S. EPA. \(2022c\)](#). ORD staff handbook for developing IRIS assessments [EPA Report]. (EPA 600/R-  
4976 22/268). Washington, DC: U.S. Environmental Protection Agency, Office of Research and  
4977 Development, Center for Public Health and Environmental Assessment.  
4978 [https://cfpub.epa.gov/ncea/iris\\_drafts/recordisplay.cfm?deid=356370](https://cfpub.epa.gov/ncea/iris_drafts/recordisplay.cfm?deid=356370)
- 4979 [U.S. EPA. \(2023a\)](#). Advances in dose addition for chemical mixtures: A white paper. (EPA/100/R-  
4980 23/001). Washington, DC. <https://assessments.epa.gov/risk/document/&deid=359745>
- 4981 [U.S. EPA. \(2023b\)](#). Consumer Exposure Model (CEM) Version 3.2 User's Guide. Washington, DC.  
4982 [https://www.epa.gov/tsca-screening-tools/consumer-exposure-model-cem-version-32-users-  
4983 guide](https://www.epa.gov/tsca-screening-tools/consumer-exposure-model-cem-version-32-users-guide)
- 4984 [U.S. EPA. \(2023c\)](#). Draft Proposed Approach for Cumulative Risk Assessment of High-Priority  
4985 Phthalates and a Manufacturer-Requested Phthalate under the Toxic Substances Control Act.  
4986 (EPA-740-P-23-002). Washington, DC: U.S. Environmental Protection Agency, Office of  
4987 Chemical Safety and Pollution Prevention. [https://www.regulations.gov/document/EPA-HQ-  
4988 OPPT-2022-0918-0009](https://www.regulations.gov/document/EPA-HQ-OPPT-2022-0918-0009)
- 4989 [U.S. EPA. \(2023d\)](#). Draft Proposed Principles of Cumulative Risk Assessment under the Toxic  
4990 Substances Control Act. (EPA-740-P-23-001). Washington, DC: U.S. Environmental Protection  
4991 Agency, Office of Chemical Safety and Pollution Prevention.  
4992 <https://www.regulations.gov/document/EPA-HQ-OPPT-2022-0918-0008>
- 4993 [U.S. EPA. \(2023e\)](#). Methodology for estimating environmental releases from sampling waste (revised  
4994 draft). Washington, DC: Office of Pollution Prevention and Toxics, Chemical Engineering  
4995 Branch.
- 4996 [U.S. EPA. \(2023f\)](#). Science Advisory Committee on Chemicals meeting minutes and final report, No.  
4997 2023-01 - A set of scientific issues being considered by the Environmental Protection Agency  
4998 regarding: Draft Proposed Principles of Cumulative Risk Assessment (CRA) under the Toxic  
4999 Substances Control Act and a Draft Proposed Approach for CRA of High-Priority Phthalates and  
5000 a Manufacturer-Requested Phthalate. (EPA-HQ-OPPT-2022-0918). Washington, DC: U.S.  
5001 Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention.  
5002 <https://www.regulations.gov/document/EPA-HQ-OPPT-2022-0918-0067>
- 5003 [U.S. EPA. \(2023g\)](#). Use of laboratory chemicals - Generic scenario for estimating occupational  
5004 exposures and environmental releases (Revised draft generic scenario) [EPA Report].  
5005 Washington, DC: U.S. Environmental Protection Agency, Office of Pollution Prevention and  
5006 Toxics, Existing Chemicals Risk Assessment Division.
- 5007 [U.S. EPA. \(2024a\)](#). Draft Ambient Air Exposure Assessment for Dicyclohexyl Phthalate (DCHP).  
5008 Washington, DC: Office of Pollution Prevention and Toxics.
- 5009 [U.S. EPA. \(2024b\)](#). Draft Cancer Human Health Hazard Assessment for Di(2-ethylhexyl) Phthalate  
5010 (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP),  
5011 and Dicyclohexyl Phthalate (DCHP). Washington, DC: Office of Pollution Prevention and  
5012 Toxics.
- 5013 [U.S. EPA. \(2024c\)](#). Draft Consumer and Indoor Dust Exposure Assessment for Dicyclohexyl Phthalate  
5014 (DCHP). Washington, DC: Office of Pollution Prevention and Toxics.
- 5015 [U.S. EPA. \(2024d\)](#). Draft Consumer Exposure Analysis for Dicyclohexyl Phthalate (DCHP).  
5016 Washington, DC: Office of Pollution Prevention and Toxics.
- 5017 [U.S. EPA. \(2024e\)](#). Draft Consumer Risk Calculator for Dicyclohexyl Phthalate (DCHP). Washington,  
5018 DC: Office of Pollution Prevention and Toxics.

- 5019 [U.S. EPA. \(2024f\)](#). Draft Data Extraction Information for Environmental Hazard and Human Health  
5020 Hazard Animal Toxicology and Epidemiology for Dicyclohexyl Phthalate (DCHP). Washington,  
5021 DC: Office of Pollution Prevention and Toxics.
- 5022 [U.S. EPA. \(2024g\)](#). Draft Data Extraction Information for General Population, Consumer, and  
5023 Environmental Exposure for Dicyclohexyl Phthalate (DCHP). Washington, DC: Office of  
5024 Pollution Prevention and Toxics.
- 5025 [U.S. EPA. \(2024h\)](#). Draft Data Quality Evaluation and Data Extraction Information for Environmental  
5026 Fate and Transport for Dicyclohexyl Phthalate (DCHP). Washington, DC: Office of Pollution  
5027 Prevention and Toxics.
- 5028 [U.S. EPA. \(2024i\)](#). Draft Data Quality Evaluation and Data Extraction Information for Environmental  
5029 Release and Occupational Exposure for Dicyclohexyl Phthalate (DCHP). Washington, DC:  
5030 Office of Pollution Prevention and Toxics.
- 5031 [U.S. EPA. \(2024j\)](#). Draft Data Quality Evaluation and Data Extraction Information for Physical and  
5032 Chemical Properties for Dicyclohexyl Phthalate (DCHP). Washington, DC: Office of Pollution  
5033 Prevention and Toxics.
- 5034 [U.S. EPA. \(2024k\)](#). Draft Data Quality Evaluation Information for Environmental Hazard for  
5035 Dicyclohexyl Phthalate (DCHP). Washington, DC: Office of Pollution Prevention and Toxics.
- 5036 [U.S. EPA. \(2024l\)](#). Draft Data Quality Evaluation Information for General Population, Consumer, and  
5037 Environmental Exposure for Dicyclohexyl Phthalate (DCHP). Washington, DC: Office of  
5038 Pollution Prevention and Toxics.
- 5039 [U.S. EPA. \(2024m\)](#). Draft Data Quality Evaluation Information for Human Health Hazard Animal  
5040 Toxicology for Dicyclohexyl Phthalate (DCHP). Washington, DC: Office of Pollution  
5041 Prevention and Toxics.
- 5042 [U.S. EPA. \(2024n\)](#). Draft Data Quality Evaluation Information for Human Health Hazard Epidemiology  
5043 for Dicyclohexyl Phthalate (DCHP). Washington, DC: Office of Pollution Prevention and  
5044 Toxics.
- 5045 [U.S. EPA. \(2024o\)](#). Draft Environmental Hazard Assessment for Dicyclohexyl Phthalate (DCHP).  
5046 Washington, DC: Office of Pollution Prevention and Toxics.
- 5047 [U.S. EPA. \(2024p\)](#). Draft Environmental Media and General Population and Environmental Exposure  
5048 for Dicyclohexyl Phthalate (DCHP). Washington, DC: Office of Pollution Prevention and  
5049 Toxics.
- 5050 [U.S. EPA. \(2024q\)](#). Draft Environmental Release and Occupational Exposure Assessment for  
5051 Dicyclohexyl Phthalate (DCHP). Washington, DC: Office of Pollution Prevention and Toxics.
- 5052 [U.S. EPA. \(2024r\)](#). Draft Fish Ingestion Risk Calculator for Dicyclohexyl Phthalate (DCHP).  
5053 Washington, DC: Office of Pollution Prevention and Toxics.
- 5054 [U.S. EPA. \(2024s\)](#). Draft Meta-Analysis and Benchmark Dose Modeling of Fetal Testicular  
5055 Testosterone for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl  
5056 Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP).  
5057 Washington, DC: Office of Pollution Prevention and Toxics.
- 5058 [U.S. EPA. \(2024t\)](#). Draft Non-cancer Human Health Hazard Assessment for Butyl benzyl phthalate  
5059 (BBP). Washington, DC: Office of Pollution Prevention and Toxics.
- 5060 [U.S. EPA. \(2024u\)](#). Draft Non-cancer Human Health Hazard Assessment for Dibutyl Phthalate (DBP).  
5061 Washington, DC: Office of Pollution Prevention and Toxics.
- 5062 [U.S. EPA. \(2024v\)](#). Draft Non-Cancer Human Health Hazard Assessment for Dicyclohexyl Phthalate  
5063 (DCHP). Washington, DC: Office of Pollution Prevention and Toxics.
- 5064 [U.S. EPA. \(2024w\)](#). Draft Non-cancer Human Health Hazard Assessment for Diethylhexyl Phthalate  
5065 (DEHP). Washington, DC: Office of Pollution Prevention and Toxics.
- 5066 [U.S. EPA. \(2024x\)](#). Draft Non-cancer Human Health Hazard Assessment for Diisobutyl phthalate  
5067 (DIBP). Washington, DC: Office of Pollution Prevention and Toxics.

- 5068 [U.S. EPA. \(2024y\)](#). Draft Occupational and Consumer Cumulative Risk Calculator for Dicyclohexyl  
5069 Phthalate (DCHP). Washington, DC: Office of Pollution Prevention and Toxics.
- 5070 [U.S. EPA. \(2024z\)](#). Draft physical chemistry and fate and transport assessment for dicyclohexyl  
5071 phthalate (DCHP). Washington, DC: Office of Pollution Prevention and Toxics.
- 5072 [U.S. EPA. \(2024aa\)](#). Draft Physical Chemistry Assessment for Dicyclohexyl Phthalate (DCHP).  
5073 Washington, DC: Office of Pollution Prevention and Toxics.
- 5074 [U.S. EPA. \(2024ab\)](#). Draft Risk Calculator for Occupational Exposures for Dicyclohexyl Phthalate  
5075 (DCHP). Washington, DC: Office of Pollution Prevention and Toxics.
- 5076 [U.S. EPA. \(2024ac\)](#). Draft Summary of Facility Release Data for Di(2-ethylhexyl) Phthalate (DEHP),  
5077 Dibutyl Phthalate (DBP), and Butyl Benzyl Phthalate (BBP). Washington, DC: Office of  
5078 Pollution Prevention and Toxics.
- 5079 [U.S. EPA. \(2024ad\)](#). Draft Surface Water Human Exposure Risk Calculator for Dicyclohexyl Phthalate  
5080 (DCHP) for P50 Flow Rates. Washington, DC: Office of Pollution Prevention and Toxics.
- 5081 [U.S. EPA. \(2024ae\)](#). Draft Surface Water Human Exposure Risk Calculator for Dicyclohexyl Phthalate  
5082 (DCHP) for P75 Flow Rates. Washington, DC: Office of Pollution Prevention and Toxics.
- 5083 [U.S. EPA. \(2024af\)](#). Draft Surface Water Human Exposure Risk Calculator for Dicyclohexyl Phthalate  
5084 (DCHP) for P90 Flow Rates. Washington, DC: Office of Pollution Prevention and Toxics.
- 5085 [U.S. EPA. \(2024ag\)](#). Draft Systematic Review Protocol for Dicyclohexyl Phthalate (DCHP).  
5086 Washington, DC: Office of Pollution Prevention and Toxics.
- 5087 [U.S. EPA. \(2024ah\)](#). Draft Technical Support Document for the Cumulative Risk Analysis of Di(2-  
5088 ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP),  
5089 Diisobutyl Phthalate (DIBP), Dicyclohexyl Phthalate (DCHP), and Diisononyl Phthalate (DINP)  
5090 Under the Toxic Substances Control Act (TSCA). Washington, DC: Office of Chemical Safety  
5091 and Pollution Prevention.
- 5092 [U.S. EPA. \(2024ai\)](#). Environmental Media and General Population Screening for Diisononyl Phthalate  
5093 (DINP). Washington, DC: Office of Pollution Prevention and Toxics.  
5094 <https://www.regulations.gov/docket/EPA-HQ-OPPT-2018-0436>
- 5095 [U.S. EPA. \(2024aj\)](#). Meeting summary with Nouryon and EPA to discuss conditions of use for  
5096 dicyclohexyl phthalate. Washington, DC.
- 5097 [U.S. EPA. \(2025a\)](#). Draft Cancer Human Health Hazard Assessment for Di(2-ethylhexyl) Phthalate  
5098 (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP),  
5099 and Dicyclohexyl Phthalate (DCHP). Washington, DC: Office of Pollution Prevention and  
5100 Toxics.
- 5101 [U.S. EPA. \(2025b\)](#). Non-Cancer Human Health Hazard Assessment for Diisononyl Phthalate (DINP)  
5102 Washington, DC: Office of Pollution Prevention and Toxics.
- 5103 [Versar. \(2014\)](#). Exposure and Fate Assessment Screening Tool (E-FAST 2014) - Documentation  
5104 manual. Washington, DC: U.S. Environmental Protection Agency. [https://www.epa.gov/tsc-](https://www.epa.gov/tsc-screening-tools/e-fast-exposure-and-fate-assessment-screening-tool-version-2014)  
5105 [screening-tools/e-fast-exposure-and-fate-assessment-screening-tool-version-2014](https://www.epa.gov/tsc-screening-tools/e-fast-exposure-and-fate-assessment-screening-tool-version-2014)
- 5106 [Vertellus LLC. \(2020\)](#). Comment submitted by Misty L. Bogle, Global Director, Regulatory  
5107 Management, Vertellus LLC regarding the Draft Scope of the Risk Evaluation for Dicyclohexyl  
5108 Phthalate (1,2Benzenedicarboxylic acid, 1,2-dicyclohexyl ester). Indianapolis, IN: Vertellus  
5109 LLC. <https://www.regulations.gov/comment/EPA-HQ-OPPT-2018-0504-0043>
- 5110 [WA DOE. \(2022\)](#). Survey of phthalates in Washington State waterbodies, 2021. (Publication 22-03-  
5111 027). Olympia, WA. <https://apps.ecology.wa.gov/publications/documents/2203027.pdf>
- 5112 [Wu, J; Ma, T; Zhou, Z; Yu, Na; He, Z; Li, B; Shi, Y; Ma, D. \(2019\)](#). Occurrence and fate of phthalate  
5113 esters in wastewater treatment plants in Qingdao, China. Hum Ecol Risk Assess 25: 1547-1563.  
5114 <http://dx.doi.org/10.1080/10807039.2018.1471341>  
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5116 **APPENDICES**

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5118 **Appendix A KEY ABBREVIATIONS AND ACRONYMS**

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5119	ADD	Average daily dose
5120	ADC	Average daily concentration
5121	BBP	Butyl benzyl phthalate
5122	BLS	Bureau of Labor Statistics
5123	CASRN	Chemical Abstracts Service Registry Number
5124	CBI	Confidential business information
5125	CDR	Chemical Data Reporting
5126	CEHD	Chemical Exposure Health Data
5127	CEM	Consumer Exposure Model
5128	CFR	Code of Federal Regulations
5129	COC	Concentration of concern
5130	CPSC	Consumer Product Safety Commission
5131	CRA	Cumulative risk assessment
5132	DBP	Dibutyl phthalate
5133	DCHP	Dicyclohexyl phthalate
5134	DEHP	Diethylhexyl phthalate
5135	DIBP	Diisobutyl phthalate
5136	DIDP	Diisodecyl phthalate
5137	DINP	Dicyclohexyl phthalate
5138	DIY	Do-it-yourself
5139	EPA	Environmental Protection Agency
5140	ESD	Emission scenario document
5141	EU	European Union
5142	FDA	Food and Drug Administration
5143	GS	Generic scenario
5144	K <sub>oc</sub>	Soil organic carbon: water partitioning coefficient
5145	K <sub>ow</sub>	Octanol: water partition coefficient
5146	HEC	Human equivalent concentration
5147	HED	Human equivalent dose
5148	IADD	Intermediate average daily dose
5149	IR	Ingestion rate
5150	LCD	Life cycle diagram
5151	LOAEL	Lowest-observed-adverse-effect level
5152	Log K <sub>oc</sub>	Logarithmic organic carbon: water partition coefficient
5153	Log K <sub>ow</sub>	Logarithmic octanol: water partition coefficient
5154	MOA	Mode of action
5155	MOE	Margin of exposure
5156	NAICS	North American Industry Classification System
5157	NHANES	National Health and Nutrition Examination Survey
5158	NICNAS	National Industrial Chemicals Notification and Assessment Scheme
5159	NOAEL	No-observed-adverse-effect level
5160	NPDES	National Pollutant Discharge Elimination System
5161	OCSPP	Office of Chemical Safety and Pollution Prevention
5162	OECD	Organisation for Economic Co-operation and Development
5163	OES	Occupational exposure scenario

5164	OEV	Occupational exposure value
5165	ONU	Occupational non-user
5166	OPPT	Office of Pollution Prevention and Toxics
5167	OSHA	Occupational Safety and Health Administration
5168	PBZ	Personal breathing zone
5169	PESS	Potentially exposed or susceptible subpopulations
5170	PND	Postnatal day
5171	PNOR	Particulates not otherwise regulated
5172	POD	Point of departure
5173	PV	Production volume
5174	PVC	Polyvinyl chloride
5175	RPF	Relative potency factor
5176	RQ	Risk quotient
5177	SACC	Science Advisory Committee on Chemicals
5178	SDS	Safety data sheet
5179	SOC	Standard occupational classification
5180	SpERC	Specific emission release category
5181	TRI	Toxic Release Inventory
5182	TRV	Toxicity reference value
5183	TSCA	Toxic Substances Control Act
5184	TSD	Technical support document
5185	TWA	Time-weighted average
5186	UF	Uncertainty factor
5187	U.S.	United States
5188	WWTP	Wastewater treatment plant
5189	7Q10	The lowest 7-day average flow that occurs (on average) once every 10 years
5190	30Q5	The lowest 30-day average flow that occurs (on average) once every 5 years

5191 **Appendix B REGULATORY AND ASSESSMENT HISTORY**

5192 **B.1 Federal Laws and Regulations**

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**Table\_Apx B-1. Federal Laws and Regulations**

Statutes/Regulations	Description of Authority/Regulation	Description of Regulation
EPA statutes/regulations		
Toxic Substances Control Act (TSCA) – section 6(b)	EPA is directed to identify high-priority chemical substances for risk evaluation; and conduct risk evaluations on at least 20 high priority substances no later than 3.5 years after the date of enactment of the Frank R. Lautenberg Chemical Safety for the 21st Century Act.	DCHP is one of the 20 chemicals EPA designated as a high-priority substance for risk evaluation under TSCA ( <a href="#">84 FR 71924</a> , December 30, 2019). Designation of DCHP as high-priority substance constitutes the initiation of the risk evaluation on the chemical.
Toxic Substances Control Act (TSCA) – section 8(a)	The TSCA section 8(a) CDR Rule requires manufacturers (including importers) to give EPA basic exposure-related information on the types, quantities, and uses of chemical substances produced domestically and imported into the United States.	DCHP manufacturing (including importing), processing and use information is reported under the CDR rule ( <a href="#">85 FR 20122</a> , April 9, 2020).
Toxic Substances Control Act (TSCA) – section 8(b)	EPA must compile, keep current and publish a list (the TSCA Inventory) of each chemical substance manufactured (including imported) or processed in the United States.	DCHP was on the initial TSCA Inventory and therefore was not subject to EPA’s new chemicals review process under TSCA Section 5 ( <a href="#">60 FR 16309</a> , March 29, 1995).
Clean Water Act (CWA) – sections 301, 304, 306, 307, and 402	Clean Water Act section 307(a) established a list of toxic pollutants or combination of pollutants under the CWA. The statute specifies a list of families of toxic pollutants also listed in the Code of Federal Regulations at 40 CFR part 401.15. The “priority pollutants” specified by those families are listed in 40 CFR part 423 Appendix A. These are pollutants for which best available technology effluent limitations must be established on either a national basis through rules (sections 301(b), 304(b), 307(b), 306) or on a case-by-case best professional judgement basis in NPDES permits, see section 402(a)(1)(B). EPA identifies the best available technology that is economically achievable for that industry after considering statutorily prescribed factors and sets regulatory requirements based on the performance of that technology.	As a phthalate ester, DCHP is designated as a toxic pollutant under section 307(a)(1) of the CWA, and as such is subject to effluent limitations ( <a href="#">40 CFR 401.15</a> ).
Other federal statutes/regulations		

Statutes/Regulations	Description of Authority/Regulation	Description of Regulation
Federal Food, Drug, and Cosmetic Act (FFDCA)	Provides the Food and Drug Administration (FDA) with authority to oversee the safety of food, drugs, and cosmetics, except residues of pesticides in food are regulated by EPA under FFDCA section 408 (discussed above where applicable).	DCHP is listed as an optional substance to be used in: adhesives to be used as components of articles intended for use, in accordance with prescribed conditions, in packaging, transporting, or holding food ( <a href="#">21 CFR section 175.105</a> ); the base sheet and coating of cellophane ( <a href="#">21 CFR section 177.1200</a> ); plasticizers in polymeric substances ( <a href="#">21 CFR section 178.3740</a> ).
Consumer Product Safety Improvement Act of 2008 (CPSIA)	Under section 108 of the Consumer Product Safety Improvement Act of 2008 (CPSIA), CPSC prohibits the manufacture for sale, offer for sale, distribution in commerce or importation of eight phthalates in toys and childcare articles at concentrations >0.1%: DEHP, DBP, BBP, DINP, DIBP, DPENP, DHEXP and DCHP.	The use of DCHP at concentrations >0.1% is banned in toys and childcare articles ( <a href="#">16 CFR part 1307</a> ).

## B.2 State Laws and Regulations

**Table\_Apx B-2. State Laws and Regulations**

State Actions	Description of Action
Chemicals of High Concern to Children	Several states have adopted reporting laws for chemicals in children’s products containing DCHP, including Maine ( <a href="#">38 MRSA Chapter 16-D</a> ) and Washington State ( <a href="#">Wash. Admin. Code 173-334-130</a> ).
Other	DCHP is listed as a Candidate Chemical under California’s Safer Consumer Products Program established under Health and Safety Code section 25252 and 25253 (California, <a href="#">Candidate Chemical List</a> . Accessed April 16, 2019). California lists DCHP as a designated priority chemical for biomonitoring under criteria established by California SB 1379 ( <a href="#">Biomonitoring California, Priority Chemicals</a> , February 2019). Oregon lists DCHP as a toxic air contaminant ( <a href="#">OAR 340-245-8020 Table 2</a> ).

## B.3 International Laws and Regulations

**Table\_Apx B-3. International Laws and Regulations**

Country/ Organization	Requirements and Restrictions
European Union	On June 27, 2018, DCHP was listed on the <a href="#">Candidate List</a> as a Substance of Very High Concern (SVHC) under regulation (EC) No 1907/2006 - REACH (Registration, Evaluation, Authorization and Restriction of Chemicals because it is toxic for reproduction (Article 57(c) and has endocrine disrupting properties (Article 57(f) - human health). DCHP was evaluated under the 2017 Community rolling action plan (CoRAP) under regulation (European Commission [EC]) No1907/2006 - REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) ( <a href="#">European Chemicals Agency (ECHA) database</a> . Accessed April 16, 2019).

Country/ Organization	Requirements and Restrictions
Australia	DCHP was assessed under Human Health Tier II of the Inventory Multi-Tiered Assessment and Prioritization (IMAP) as part of the C4-6 side chain transitional phthalates. Uses reported include in adhesives and printing inks (NICNAS, 2016, Human Health Tier II assessment for C4-6 side chain transitional phthalates). In addition, DCHP was assessed under Environment Tier II of IMAP as part of the phthalate esters. In 2015, DCHP was also assessed as a Priority Existing Chemical (Assessment Report No. 40) (National Industrial Chemicals Notification and Assessment Scheme (NICNAS). <a href="#">Chemical inventory</a> . Database accessed April 3, 2019).
Japan	DCHP is regulated in Japan under the following legislation: <ul style="list-style-type: none"> <li>• Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc. (Chemical Substances Control Law; CSCL)</li> <li>• Act on Confirmation, etc. of Release Amounts of Specific Chemical Substances in the Environment and Promotion of Improvements to the Management Thereof. (<a href="#">National Institute of Technology and Evaluation [NITE] Chemical Risk Information Platform [CHRIP]</a>. Accessed April 16, 2019).</li> </ul>
Austria, Denmark, Ireland, New Zealand, United Kingdom	Occupational exposure limits for DCHP ( <a href="#">GESTIS International limit values for chemical agents (Occupational exposure limits, OELs) database</a> . Accessed April 18, 2017). Austria, Ireland, New Zealand and the United Kingdom have an eight-hours limit of 5 mg/m <sup>3</sup> . Denmark has an eight-hours limit of 3 mg/m <sup>3</sup> and a short-term limit of 6 mg/m <sup>3</sup> .

## B.4 Assessment History

**Table\_Apx B-4. Assessment History of DCHP**

Authoring Organization	Publication
U.S. EPA publications	
–	–
Other U.S.-based organizations	
U.S. Consumer Product Safety Commission (CPSC)	Chronic Hazard Panel on Phthalates and Phthalate Alternatives Final Report (with Appendices) ( <a href="#">U.S. CPSC, 2014</a> )  Toxicity Review of DCHP ( <a href="#">U.S. CPSC, 2010</a> )
International	
European Union, European Chemicals Agency (ECHA)	Committee for Risk Assessment RAC Opinion proposing harmonised classification and labelling at EU level of DCHP, EC number: 201-545-9, CAS number: 84-61-7 ( <a href="#">ECHA, 2014</a> )
Government of Canada, Environment Canada, Health Canada	Screening Assessment: Phthalate Substance Grouping ( <a href="#">ECCC/HC, 2020</a> )  State of the science report: Phthalate substance grouping: Medium-chain phthalate esters: Chemical Abstracts Service Registry Numbers: 84-61-7; 84-64-0; 84-69-5; 523-31-9; 5334-09-8; 16883-83-3; 27215-22-1; 27987-25-3; 68515-40-2; 71888-89-6 ( <a href="#">EC/HC, 2015</a> )

Authoring Organization	Publication
National Industrial Chemicals Notification and Assessment Scheme (NICNAS), Australian Government	<p>C4-6 side chain transitional phthalates: Human health tier II assessment (<a href="#">NICNAS, 2016</a>)</p> <p>Phthalates hazard compendium: A summary of physicochemical and human health hazard data for 24 ortho-phthalate chemicals (<a href="#">NICNAS, 2008</a>)</p>

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## 5205 **Appendix C LIST OF TECHNICAL SUPPORT DOCUMENTS**

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5206 Appendix C includes a list and citations for all supplemental documents included in the Draft Risk  
5207 Evaluation for DCHP.

5208  
5209 Associated **Systematic Review Protocol and Data Quality Evaluation and Data Extraction**

5210 Documents – Provide additional detail and information on systematic review methodologies used as  
5211 well as the data quality evaluations and extractions criteria and results.

5212  
5213 *Draft Systematic Review Protocol for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024ag](#)) – In lieu  
5214 of an update to the *Draft Systematic Review Protocol Supporting TSCA Risk Evaluations for*  
5215 *Chemical Substances*, also referred to as the “2021 Draft Systematic Review Protocol” ([U.S. EPA,](#)  
5216 [2021a](#)), this systematic review protocol for the Draft Risk Evaluation for DCHP describes some  
5217 clarifications and different approaches that were implemented than those described in the 2021 Draft  
5218 Systematic Review Protocol in response to (1) SACC comments, (2) public comments, or (3) to  
5219 reflect chemical-specific risk evaluation needs. This supplemental file may also be referred to as the  
5220 “DCHP Systematic Review Protocol.”

5221  
5222 *Draft Data Quality Evaluation and Data Extraction Information for Physical and Chemical*  
5223 *Properties for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024j](#)) – Provides a compilation of tables  
5224 for the data extraction and data quality evaluation information for DCHP. Each table shows the data  
5225 point, set, or information element that was extracted and evaluated from a data source that has  
5226 information relevant for the evaluation of physical and chemical properties. This supplemental file  
5227 may also be referred to as the “DCHP Data Quality Evaluation and Data Extraction Information for  
5228 Physical and Chemical Properties.”

5229  
5230 *Draft Data Quality Evaluation and Data Extraction Information for Environmental Fate and*  
5231 *Transport for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024h](#)) – Provides a compilation of tables  
5232 for the data extraction and data quality evaluation information for DCHP. Each table shows the data  
5233 point, set, or information element that was extracted and evaluated from a data source that has  
5234 information relevant for the evaluation for Environmental Fate and Transport. This supplemental file  
5235 may also be referred to as the “DCHP Data Quality Evaluation and Data Extraction Information for  
5236 Environmental Fate and Transport.”

5237  
5238 *Draft Data Quality Evaluation and Data Extraction Information for Environmental Release and*  
5239 *Occupational Exposure for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024i](#)) – Provides a  
5240 compilation of tables for the data extraction and data quality evaluation information for DCHP. Each  
5241 table shows the data point, set, or information element that was extracted and evaluated from a data  
5242 source that has information relevant for the evaluation of environmental release and occupational  
5243 exposure. This supplemental file may also be referred to as the “DCHP Data Quality Evaluation and  
5244 Data Extraction Information for Environmental Release and Occupational Exposure.”

5245  
5246 *Draft Data Quality Evaluation Information for General Population, Consumer, and Environmental*  
5247 *Exposure for Dicyclohexyl Phthalate (DCHP)* ([U.S. EPA, 2024l](#)) – Provides a compilation of tables  
5248 for the data quality evaluation information for DCHP. Each table shows the data point, set, or  
5249 information element that was evaluated from a data source that has information relevant for the  
5250 evaluation of general population, consumer, and environmental exposure. This supplemental file  
5251 may also be referred to as the “DCHP Data Quality Evaluation Information for General Population,  
5252 Consumer, and Environmental Exposure.”

5253

5254 *Draft Data Extraction Information for General Population, Consumer, and Environmental Exposure*  
5255 *for Dicyclohexyl Phthalate (DCHP) (U.S. EPA, 2024g)* – Provides a compilation of tables for the  
5256 data extraction for DCHP. Each table shows the data point, set, or information element that was  
5257 extracted from a data source that has information relevant for the evaluation of general population,  
5258 consumer, and environmental exposure. This supplemental file may also be referred to as the  
5259 “DCHP Data Extraction Information for General Population, Consumer, and Environmental  
5260 Exposure.”

5261  
5262 *Draft Data Quality Evaluation Information for Human Health Hazard Epidemiology for*  
5263 *Dicyclohexyl Phthalate (DCHP) (U.S. EPA, 2024n)* – Provides a compilation of tables for the data  
5264 quality evaluation information for DCHP. Each table shows the data point, set, or information  
5265 element that was evaluated from a data source that has information relevant for the evaluation of  
5266 epidemiological information. This supplemental file may also be referred to as the “DCHP Data  
5267 Quality Evaluation Information for Human Health Hazard Epidemiology.”

5268  
5269 *Draft Data Quality Evaluation Information for Human Health Hazard Animal Toxicology for*  
5270 *Dicyclohexyl Phthalate (DCHP) (U.S. EPA, 2024m)* – Provides a compilation of tables for the data  
5271 quality evaluation information for DCHP. Each table shows the data point, set, or information  
5272 element that was evaluated from a data source that has information relevant for the evaluation of  
5273 human health hazard animal toxicity information. This supplemental file may also be referred to as  
5274 the “DCHP Data Quality Evaluation Information for Human Health Hazard Animal Toxicology.”

5275  
5276 *Draft Data Quality Evaluation Information for Environmental Hazard for Dicyclohexyl Phthalate*  
5277 *(DCHP) (U.S. EPA, 2024k)* – Provides a compilation of tables for the data quality evaluation  
5278 information for DCHP. Each table shows the data point, set, or information element that was  
5279 evaluated from a data source that has information relevant for the evaluation of environmental  
5280 hazard toxicity information. This supplemental file may also be referred to as the “DCHP Data  
5281 Quality Evaluation Information for Environmental Hazard.”

5282  
5283 *Draft Data Extraction Information for Environmental Hazard and Human Health Hazard Animal*  
5284 *Toxicology and Epidemiology for Dicyclohexyl Phthalate (DCHP) (U.S. EPA, 2024f)* – Provides a  
5285 compilation of tables for the data extraction for DCHP. Each table shows the data point, set, or  
5286 information element that was extracted from a data source that has information relevant for the  
5287 evaluation of environmental hazard and human health hazard animal toxicology and epidemiology  
5288 information. This supplemental file may also be referred to as the “DCHP Data Extraction  
5289 Information for Environmental Hazard and Human Health Hazard Animal Toxicology and  
5290 Epidemiology.”

5291  
5292 **Associated Technical Support Documents (TSDs)** – Provide additional details and information on  
5293 exposure, hazard, and risk assessments.

5294  
5295 *Draft Physical Chemistry and Fate and Transport Assessment for Dicyclohexyl Phthalate (DCHP)*  
5296 *(DCHP) (U.S. EPA, 2024z).*

5297  
5298 *Draft Environmental Release and Occupational Exposure Assessment for Dicyclohexyl Phthalate*  
5299 *(DCHP) (U.S. EPA, 2024q).*

5300  
5301 *Draft Consumer and Indoor Dust Exposure Assessment for Dicyclohexyl Phthalate (DCHP) (U.S.*  
5302 *EPA, 2024c).*

5303 *Draft Environmental Media and General Population and Environmental Exposure Assessment for*  
5304 *Dicyclohexyl Phthalate (DCHP) ([U.S. EPA, 2024p](#)).*

5305  
5306 *Draft Environmental Hazard Assessment for Dicyclohexyl Phthalate (DCHP) ([U.S. EPA, 2024o](#)).*  
5307

5308 *Draft Non-Cancer Human Health Hazard Assessment for Dicyclohexyl Phthalate (DCHP) ([U.S.](#)*  
5309 *[EPA, 2024v](#)).*

5310  
5311 *Draft Cancer Human Health Hazard Assessment for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl*  
5312 *Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP), and Dicyclohexyl*  
5313 *Phthalate (DCHP) ([U.S. EPA, 2024b](#)).*

5314  
5315 *Draft Consumer Risk Calculator for Dicyclohexyl Phthalate (DCHP) ([U.S. EPA, 2024e](#)).*  
5316

5317 *Draft Consumer Exposure Analysis for Dicyclohexyl Phthalate (DCHP) ([U.S. EPA, 2024d](#)).*  
5318

5319 *Draft Risk Calculator for Occupational Exposures for Dicyclohexyl Phthalate (DCHP) ([U.S. EPA,](#)*  
5320 *[2024ab](#)).*

5321  
5322 *Draft Fish Ingestion Risk Calculator for Dicyclohexyl Phthalate (DCHP) ([U.S. EPA, 2024r](#)).*  
5323

5324 *Draft Surface Water Human Exposure Risk Calculator for Dicyclohexyl Phthalate (DCHP) for P50*  
5325 *Flow Rates ([U.S. EPA, 2024ad](#)).*

5326  
5327 *Draft Surface Water Human Exposure Risk Calculator for Dicyclohexyl Phthalate (DCHP) for P75*  
5328 *Flow Rates ([U.S. EPA, 2024ae](#)).*

5329  
5330 *Draft Surface Water Human Exposure Risk Calculator for Dicyclohexyl Phthalate (DCHP) for P90*  
5331 *Flow Rates ([U.S. EPA, 2024af](#)).*

5332  
5333 *Draft Ambient Air Exposure Assessment for Dicyclohexyl Phthalate (DCHP) ([U.S. EPA, 2024a](#)).*  
5334

5335 *Draft Occupational and Consumer Cumulative Risk Calculator for Dicyclohexyl Phthalate (DCHP)*  
5336 *([U.S. EPA, 2024y](#)).*

5337  
5338 *Draft Meta-Analysis and Benchmark Dose Modeling of Fetal Testicular Testosterone for Di(2-*  
5339 *ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl*  
5340 *Phthalate (DIBP), and Dicyclohexyl Phthalate (DCHP) ([U.S. EPA, 2024s](#)).*

5341  
5342 *Draft Technical Support Document for the Cumulative Risk Analysis of Di(2-ethylhexyl) Phthalate*  
5343 *(DEHP), Dibutyl Phthalate (DBP), Butyl Benzyl Phthalate (BBP), Diisobutyl Phthalate (DIBP),*  
5344 *Dicyclohexyl Phthalate (DCHP), and Diisononyl Phthalate (DINP) Under the Toxic Substances*  
5345 *Control Act (TSCA) ([U.S. EPA, 2024ah](#)).*

5346  
5347 *Draft Summary of Facility Release Data for Di(2-ethylhexyl) Phthalate (DEHP), Dibutyl Phthalate*  
5348 *(DBP), and Butyl Benzyl Phthalate (BBP) ([U.S. EPA, 2024ac](#)).*  
5349

5350 **Appendix D UPDATES TO THE DCHP CONDITIONS OF USE**  
5351 **TABLE**

5352 After the final scope document ([U.S. EPA, 2020b](#)), EPA received updated submissions under the 2020  
5353 CDR reported data. In addition to new submissions received under the 2020 CDR, the reporting name  
5354 codes changed for the 2020 CDR reporting cycle. Therefore, the Agency is amending the description of  
5355 certain DCHP COUs based on those new submissions and new reporting name codes. Also, EPA  
5356 received information from stakeholders on specific uses of DCHP. Table\_Apx D-1 summarizes the  
5357 changes to the COUs based on the new reporting codes in the 2020 CDR and any other new information  
5358 since the publication of the final scope.  
5359

5360 **Table\_Apx D-1. Additions and Name Changes to Categories and Subcategories of Conditions of**  
5361 **Use Based on CDR Reporting and Stakeholder Engagement**

Life Cycle Stage and Category	Original Subcategory in the Final Scope Document	Occurred Change	Revised Subcategory in the 2024 Draft Risk Evaluation
Processing, Processing as a reactant	Processing aids not otherwise listed in: – Miscellaneous manufacturing	Consolidated into a category and associated subcategory under “processing, incorporation into formulation, mixture, or reaction product, stabilizing agent” based on further consultations with the submitters of the CDR data, review of their 2020 CDR cycle submissions, and given EPA’s refined understanding of how DCHP is used ( <a href="#">U.S. EPA, 2024aj, 2020a</a> ).	Processing – Incorporation in formulation, mixture, or reaction product – Stabilizing agent (plastics product manufacturing)
Processing, Processing as a reactant	Process regulator in: – Paint and coating manufacturing – Plastic material and resin manufacturing – Plastics product manufacturing – Rubber product manufacturing	Consolidated category and associated subcategories under “processing, incorporation into formulation, mixture, or reaction products” based on further consultations with the submitters of the CDR data, review of their 2020 CDR cycle submissions, and given EPA’s refined understanding of how DCHP is used ( <a href="#">U.S. EPA, 2024aj, 2020a</a> ).	Processing – Incorporation in formulation, mixture, or reaction product – Plasticizer (plastic material and resin manufacturing; rubber product manufacturing)  And  Processing – Incorporation in formulation, mixture, or reaction product – Stabilizing agent (paint and coating manufacturing; plastics product manufacturing)
Processing, Incorporation into formulation, mixture, or reaction product	Filler in: – Rubber product manufacturing	Removed COU based on further consultations with the submitters of the CDR data and review of their 2020 CDR cycle submissions ( <a href="#">U.S. EPA, 2024aj, 2020a</a> ). DCHP is not used as a hardener, or the previously reported CDR code of “filler” ( <a href="#">Nouryon Chemicals LLC, 2024</a> ).	N/A
Processing, Incorporation into formulation,	Laboratory chemical	Consolidated category and associated subcategory under “repackaging” as an example based	Processing – Repackaging – Repackaging (e.g., laboratory chemical)

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Life Cycle Stage and Category	Original Subcategory in the Final Scope Document	Occurred Change	Revised Subcategory in the 2024 Draft Risk Evaluation
mixture, or reaction product		on further review of the COUs. DCHP is not being reformulated or used in laboratory manufacturing, rather it is being used as a technical standard or reference reagent ( <a href="#">U.S. EPA, 2020d</a> ).	
Processing, Incorporation into formulation, mixture, or reaction product	Paint additives and coating additives not described by other codes: – Printing ink manufacturing	Consolidated category and associated subcategory under a COU that was reported in a more recent CDR cycle.	Processing – Incorporation in formulation, mixture, or reaction product – Plasticizer (printing ink manufacturing)
Processing, Incorporation into formulation, mixture, or reaction product	N/A	Updated the subcategory to reflect the 2020 CDR cycle.	Processing – Incorporation in formulation, mixture, or reaction product – Plasticizer (plastic material and resin manufacturing)
Processing, Incorporation into formulation, mixture, or reaction product	Processing aids not otherwise listed: – Services – Paint and coating manufacturing – Asphalt paving, roofing, and coating materials manufacturing – Adhesive manufacturing	Consolidated category and associated subcategories as a “stabilizing agent” based on further consultations with the submitters of the CDR data and review of their 2020 CDR cycle submissions ( <a href="#">U.S. EPA, 2024aj</a> ; <a href="#">Nouryon Chemicals LLC, 2020</a> ; <a href="#">U.S. EPA, 2020a, 2019c</a> ).	Processing – Incorporation in formulation, mixture, or reaction product – Stabilizing agent (adhesive manufacturing; asphalt paving, roofing, and coating materials manufacturing; paint and coating manufacturing)
Processing, Incorporation into formulation, mixture, or reaction product	Process regulator in: – Adhesive manufacturing	Consolidated category and associated subcategory under a COU that was both reported in a more recent CDR cycle and more appropriate given EPA’s understanding of how DCHP is used.	Processing – Incorporation in formulation, mixture, or reaction product – Stabilizing agent (adhesive manufacturing)
Processing; Incorporation into formulation, mixture, or reaction product	N/A	Updated the subcategory to reflect the 2020 CDR cycle.	Processing – Incorporation in formulation, mixture, or reaction product – Stabilizing agent (paints and coating manufacturing)
Processing, Incorporation into formulation, mixture, or reaction product	N/A	Updated the subcategory to reflect the 2020 CDR cycle.	Processing – Incorporation in formulation, mixture, or reaction product – Stabilizing agent (plastics product manufacturing)
Industrial Use, Adhesives and sealants	Adhesives and sealants in: – Transportation equipment manufacturing – Computer and electronic product manufacturing	Updated the category and subcategory to add “computer and electronic product manufacturing” and “transportation equipment manufacturing” as examples to not preclude other industrial sectors.	Industrial Use – Adhesives and sealants (e.g., computer and electronic product manufacturing; transportation equipment manufacturing)

PUBLIC RELEASE DRAFT  
December 2024

Life Cycle Stage and Category	Original Subcategory in the Final Scope Document	Occurred Change	Revised Subcategory in the 2024 Draft Risk Evaluation
Industrial Use	N/A	Added the COU “paints and coatings” to the new life cycle stage of “industrial use” based on a new understanding of information from an SDS that explained the use could take place on an industrial scale ( <a href="#">Carboline, 2019b</a> ).	Industrial Use – Paints and coatings
Industrial Use, Plastic and rubber products not covered elsewhere	Plastic and rubber products not covered elsewhere in: – Transportation equipment manufacturing	Updated the category and subcategory to better reflect 2020 CDR reporting codes and to add “transportation equipment manufacturing” as an example to not preclude other industrial sectors.	Industrial Use – Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard) (e.g., transportation equipment manufacturing)
Commercial Use, Plastic and rubber products not covered elsewhere	Plastic and rubber products not covered elsewhere	Updated the category and subcategory to reflect the 2020 CDR cycle.	Commercial Use – Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)
Consumer Use, Arts, crafts, and hobby materials	Arts, crafts, and hobby materials (e.g., modeling clay)	Removed this COU upon further review, concluding it was no longer reasonably foreseen.	N/A
Consumer Use, Plastic and rubber products not covered elsewhere	Plastic and rubber products not covered elsewhere	Updated the category and subcategory to reflect the 2020 CDR cycle.	Consumer Use – Other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)

5362

5363 As indicated in Table\_Apx D-1, the changes are based on close examination of the CDR reports,  
5364 including the 2020 CDR reports that were received after the scope was completed, additional research  
5365 on the COUs, additional comments from stakeholders, and overall systematic review of the use  
5366 information.

5367

5368 When developing this draft risk evaluation, EPA concluded that some subcategories of the COUs listed  
5369 in the final scope document ([U.S. EPA, 2020b](#)) were redundant and consolidation was needed to avoid  
5370 evaluation of the same COU multiple times. The Agency further concluded that there were some  
5371 instances where subcategory information on the processing and uses of DCHP was misreported by CDR  
5372 reporters based on outreach with stakeholders. For these instances, EPA recategorized the activity  
5373 described in the COU listed in the scope to fit the description of the COU included in this draft risk  
5374 evaluation.

5375

5376 In addition, EPA did further analysis of the following COUs, which resulted in the changes presented on  
5377 the table that warrant further explanation because these COUs were changed significantly between the  
5378 final scope and this draft risk evaluation:

5379

- 5380 • Processing, Processing as a reactant, “processing aids not otherwise listed in miscellaneous  
5381 manufacturing; process regulator in paint and coating manufacturing, plastic material and resin  
5382 manufacturing, plastics product manufacturing, and rubber product manufacturing” were all  
removed from the COUs as it was determined (due in part to a refined understanding of how

5383 DCHP is used and stakeholder outreach) that DCHP is not used as a reactant and it is more  
5384 appropriately characterized as “Processing – incorporated into a formula, mixture or reaction  
5385 product.” These uses are better captured under other processing COUs that more accurately  
5386 reflect EPA’s understanding of how DCHP is used.

5387 EPA has also included further information about any other COUs (reported in the 2020 CDR cycle ([U.S.](#)  
5388 [EPA, 2020a](#)) or otherwise) that are not included in the draft DCHP risk evaluation:

- 5389 • Processing, Processing as a reactant, “plasticizer in plastics product manufacturing; intermediate  
5390 in all other basic organic chemical manufacturing; stabilizing agent in paint and coating  
5391 manufacturing and plastics product manufacturing; and processing aids not otherwise specified  
5392 in plastics product manufacturing” were reported in the 2020 CDR cycle and were not included  
5393 in the draft risk determination analysis as it was determined that DCHP is not used as a reactant  
5394 and it is more appropriately characterized as “Processing – incorporated into a formula, mixture  
5395 or reaction product.” These uses are better captured under other processing COUs that more  
5396 accurately reflect EPA’s understanding of how DCHP is used.
- 5397 • Processing, Processing as a reactant, “hardener in paint and coating manufacturing; and plastics  
5398 product manufacturing” were reported in the 2020 CDR cycle and were not included in the draft  
5399 risk determination analysis as it was determined that DCHP is not used as a reactant and is more  
5400 appropriately characterized as “Processing – incorporated into a formula, mixture or reaction  
5401 product.” Additionally, based on Agency research and communication with stakeholders it is  
5402 EPA’s understanding that the use of “hardener” is better captured as a “stabilizing agent” for the  
5403 draft DCHP risk evaluation ([U.S. EPA, 2024aj](#)). Ultimately, these uses are better captured under  
5404 other processing COUs that more accurately reflect EPA’s understanding of how DCHP is used.
- 5405 • Processing, Processing incorporation into formulation, mixture, or reaction product, “processing  
5406 aids not otherwise specified in plastics product manufacturing” was reported in the 2020 CDR  
5407 cycle and was not included in the draft risk determination analysis after additional research and  
5408 communication with stakeholders ([U.S. EPA, 2024aj](#)). It is EPA’s understanding that this COU  
5409 is more appropriately consolidated into Processing, Processing incorporation into formulation,  
5410 mixture, or reaction product, “stabilizing agent.”
- 5411 • Note that in the final scope document for DCHP ([U.S. EPA, 2020b](#)), EPA removed the consumer  
5412 use of dicyclohexyl phthalate in toys, playground, and sporting equipment as a COU for  
5413 numerous reasons, which include: a public comment received on the draft DCHP scoping  
5414 document ([Vertellus LLC, 2020](#)); the Consumer Product Safety Commission’s (CPSC) Chronic  
5415 Hazard Advisory Panel (CHAP) report from 2014 ([U.S. CPSC, 2014](#)) that states, “DCHP is  
5416 currently not found in children’s toys or child care articles, and it is not widely found in the  
5417 environment” (page 117); the preamble of the 2017 CPSC final rule titled “Prohibition of  
5418 Children's Toys and Child Care Articles Containing Specified Phthalates,” which explains that “.  
5419 . . the CPSC staff has not detected DCHP in toys and child care articles during routine  
5420 compliance testing thus far. . .” ([U.S. CPSC, 2017](#)); and CPSC’s final rule, which prohibits  
5421 manufacture for sale, offer for sale, distribution in commerce, and importation into the United  
5422 States of any children’s toy or child care article that contains more than 0.1 percent of  
5423 dicyclohexyl phthalate as it “would prevent [DCHP’s] use as a substitute for other banned  
5424 phthalates” (82 FR 49982 (2017); 16 CFR 1307.3). As a result, EPA has no reasonably available  
5425 information demonstrating that the consumer use of dicyclohexyl phthalate in toys, playground,  
5426 and sporting equipment is intended, known, or reasonably foreseen, and therefore removed this  
5427 COU from the final scope and has not included it in the analysis for this draft risk evaluation of  
5428 DCHP.

5429 **Appendix E CONDITIONS OF USE DESCRIPTIONS**

---

5430 The following descriptions are intended to include examples of uses, so as not to exclude other activities  
5431 that may also be included in the COUs of the chemical substance. To better describe the COU, EPA  
5432 considered CDR submissions from previous CDR cycles for DCHP (CASRN 84-61-7), and the COU  
5433 descriptions reflect what the Agency identified as the best fit for those submissions. Examples of  
5434 articles, products, or activities are included in the following descriptions to help describe the COU but  
5435 are not exhaustive. EPA uses the terms “articles” and “products” or product mixtures in the following  
5436 descriptions and is generally referring to articles and products as defined by 40 CFR part 751. There  
5437 may be instances where the terms are used interchangeably by a company or commenters, or by EPA in  
5438 reference to a code from CDR reports that are referenced (*e.g.*, “plastics products manufacturing,” or  
5439 “fabric, textile, and leather products”), EPA will clarify as needed when these references are included  
5440 throughout the COU descriptions below.

5441 **5.1 Manufacturing – Domestic Manufacturing**

---

5442 Domestic manufacture means to manufacture or produce DCHP within the United States. For purposes  
5443 of the DCHP risk evaluation, this includes the extraction of DCHP from a previously existing chemical  
5444 substance or complex combination of chemical substances and loading and repackaging (but not  
5445 transport) associated with the manufacturing or production of DCHP.

5446  
5447 DCHP is typically manufactured in a closed system through catalytic esterification of phthalic anhydride  
5448 and cyclohexanol in solvent at elevated temperatures (130 °C) ([U.S. CPSC, 2010](#)). After the reaction,  
5449 excess alcohol is recovered and DCHP is purified through vacuum distillation or activated charcoal  
5450 ([U.S. EPA, 2020b](#)). Based on manufacturing operations for similar phthalates, activities may also  
5451 include filtrations and quality control sampling of the DCHP product. Additionally, manufacturing  
5452 operations include equipment cleaning/reconditioning and product transport to other areas of the  
5453 manufacturing facility or offsite shipment for downstream processing or use. Current manufacturing  
5454 processes can achieve a DCHP purity of 99 percent or greater, with some impurities of water and  
5455 phthalic acid ([U.S. CPSC, 2010](#)). This COU includes the typical manufacturing process and any other  
5456 similar production of DCHP.

5457  
5458 ***Examples of CDR Submissions.***

5459 In the 2016 CDR cycle, one company reported domestic manufacturing of DCHP (CASRN 84-61-7) as  
5460 large crystal pellets.

5461  
5462 In the 2020 CDR cycle, two companies reported domestic manufacturing of DCHP (CASRN 84-61-7).  
5463 One CDR company reported domestic manufacturing of DCHP as pellets or large crystals, while the  
5464 second company reported domestic manufacturing of DCHP as a dry powder.

5465 **E.2 Manufacturing – Importing**

---

5466 Import refers to the import of DCHP into the customs territory of the United States. In general,  
5467 chemicals may be imported into the United States in bulk via water, air, land, and intermodal shipments,  
5468 and loading and repackaging (but not transport) associated with the import of DCHP ([Tomer and Kane,  
5469 2015](#)). These shipments take the form of oceangoing chemical tankers, railcars, tank trucks, and  
5470 intermodal tank containers ([U.S. EPA, 2020b](#)).

5471  
5472 Imported DCHP is shipped in either dry powder, liquid, water or solvent wet solid form ([U.S. EPA,  
5473 2020a](#)). Import sites unload the import containers and transfer DCHP into smaller containers (bags or  
5474 supersacks) for downstream processing, use within the facility, or offsite use. Operations may include

5475 quality control sampling of DCHP product and equipment cleaning. No changes to chemical  
5476 composition occur during importation of this COU ([U.S. EPA, 2022a](#)).

5477  
5478 ***Examples of CDR Submissions.***

5479 In the 2016 CDR cycle, one company reported importation of DCHP (CASRN 84-61-7) in a solid form.

5480  
5481 In the 2020 CDR cycle, two companies reported importation of DCHP (CASRN 84-61-7).

5482 One CDR company reported importation of DCHP as dry powder, liquid, while the second company  
5483 reported importation of DCHP as water or a solvent wet solid.

5484 **E.3 Processing – Incorporation into Formulation, Mixture, or Reaction**  
5485 **Product – Adhesive and Sealant Chemicals in Adhesive**  
5486 **Manufacturing**

---

5487 This COU refers to the preparation of a product; that is, the incorporation of DCHP into formulation,  
5488 mixture, or a reaction product that occurs when a chemical substance is added to a product (or product  
5489 mixture), after its manufacture, for distribution in commerce. In this case, processing of DCHP into an  
5490 adhesive and sealant in adhesive manufacturing.

5491  
5492 Based on the 2009 Emission Scenario Document (ESD) on the Manufacture of Adhesives, a typical  
5493 adhesive incorporation site receives and unloads DCHP into adhesive and sealant formulations in  
5494 industrial mixing vessels as a batch blending or mixing process, with no reactions or chemical changes  
5495 occurring to the plasticizer (*i.e.*, DCHP) during the mixing process ([OECD, 2009a](#)). Process operations  
5496 may also include quality control sampling. EPA expects that sites will load DCHP-containing adhesive  
5497 and sealant products into bottles, small containers, or drums depending on the product type. ([OECD,](#)  
5498 [2009a](#)).

5499  
5500 ***Examples of CDR Submissions.***

5501 In the 2016 cycle, one company reported the use of DCHP (CASRN 84-61-7) as adhesive and sealant  
5502 chemicals in adhesive manufacturing.

5503 **E.4 Processing – Incorporation into Formulation, Mixture, or Reaction**  
5504 **Product – Plasticizer (Adhesive Manufacturing; Paint and Coating**  
5505 **Manufacturing; Plastic Material and Resin Manufacturing; Plastics**  
5506 **Product Manufacturing; Printing Ink Manufacturing; and Rubber**  
5507 **Product Manufacturing)**

---

5508 This COU refers to the preparation of a product; that is, the incorporation of DCHP into formulation,  
5509 mixture, or a reaction product that occurs when a chemical substance is added to a product (or product  
5510 mixture) after its manufacture, for distribution in commerce—in this case as a plasticizer in various  
5511 industrial sectors and uses, specifically as an adhesive, paint and coating, plastic material and resin,  
5512 plastic product, printing or PVC plastisol ink and as a rubber product.

5513  
5514 The American Coatings Association explained that DCHP is a plasticizer, additive and impurity in  
5515 adhesives in amounts less than 1 percent ([ACA, 2019](#)) and according to information provided to EPA,  
5516 DCHP is also used within products or formulations for the manufacture, operation and maintenance of  
5517 aerospace products ([AIA, 2019](#)). More specifically, the Aerospace Industries Association explained that  
5518 DCHP can be used as a plasticizer for nitrocellulose, chlorinated rubber polyvinyl chloride and other  
5519 polymers and adhesives.

5520 In manufacturing of plastic material and resin through non-PVC and PVC compounding, DCHP is  
5521 blended into polymers. Compounding involves the mixing of the polymer with the plasticizer and other  
5522 chemical such as fillers and heat stabilizers. The plasticizer needs to be absorbed into the particle to  
5523 impart flexibility to the polymer. For PVC compounding, compounding occurs through mixing of  
5524 ingredients to produce a powder (dry blending) or a liquid (plastisol blending). The most common  
5525 process for dry blending involves heating the ingredients in a high intensity mixer and transfer to a cold  
5526 mixer. The plastisol blending is done at ambient temperature using specific mixers that allow for the  
5527 breakdown of the PVC agglomerates and the absorption of the plasticizer into the resin particle. EPA is  
5528 also aware that DCHP may be incorporated into PVC plastisol inks and inks for screen printing  
5529 ([Hallstar, 2022](#); [LANXESS, 2021](#); [Gans Ink and Supply, 2018](#); [U.S. CPSC, 2015](#)).

#### 5530 *Examples of CDR Submissions*

5531 In the 2016 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as a plasticizer in  
5532 plastics product manufacturing and one CDR company reported the use of DCHP as a plasticizer in  
5533 printing ink manufacturing.

5534 In the 2020 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as a plasticizer in  
5535 plastics material and resin manufacturing and one CDR company reported the use of DCHP as a  
5536 plasticizer in adhesive manufacturing.

### 5537 **E.5 Processing – Incorporation into Formulation, Mixture, or Reaction 5538 Product – Stabilizing Agent (Adhesive Manufacturing; Asphalt 5539 Paving, Roofing, and Coating Materials Manufacturing; Paints and 5540 Coating Manufacturing; and Plastics Product Manufacturing)**

5541 This COU refers to the preparation of a product; that is, the incorporation of DCHP into formulation,  
5542 mixture, or a reaction product that occurs when a chemical substance is added to a product (or product  
5543 mixture), after its manufacture, for distribution in commerce. In this case DCHP is used as a stabilizing  
5544 agent, specifically as a phlegmatizer (a compound that minimizes the explosive tendency of another  
5545 compound or material) for dibenzoyl peroxide (BPO) and peroxide-based formulations to improve the  
5546 safety and handling properties and to prevent explosions ([U.S. EPA, 2024aj](#); [AIA, 2019](#)). These BPO  
5547 mixtures (in which DCHP is present) are then used as a curing agent for unsaturated polyesters or  
5548 methyl methacrylate (MMA) systems, which is used in various industrial sectors and uses including  
5549 asphalt, roofing, and flooring systems, coatings, adhesives, and within the aerospace industry ([U.S.  
5550 EPA, 2024aj](#); [Nouryon Chemicals LLC, 2020](#); [AIA, 2019](#); [U.S. EPA, 2019c](#)). EPA has confirmed that  
5551 this COU has recently been discontinued with the CDR submitter. However, the use of DCHP as a  
5552 stabilizing agent was only recently ceased (*i.e.*, in 2021) and the available information regarding DCHP  
5553 suggests that this COU could occur. Therefore, it is included in EPA’s evaluation.

#### 5554 *Examples of CDR Submissions*

5555 In the 2016 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as a process  
5556 regulator in paints and coating manufacturing, which has been recategorized in the COU table to  
5557 “stabilizing agent” after discussions with the company that purchased the previous 2016 reporting  
5558 company ([U.S. EPA, 2024aj, 2019c](#)). See Appendix D for more information on the changes from the  
5559 COU from the *Final Scope of the Risk Evaluation for Dicyclohexyl Phthalate (DCHP); CASRN 84-61-7*  
5560 ([U.S. EPA, 2020b](#)).

5561 In the 2020 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as a stabilizing agent  
5562 in paints and coating manufacturing.

## **E.6 Processing – Incorporation into Articles – Plasticizer (Plastics Product Manufacturing and Rubber Product Manufacturing)**

---

This COU refers to the preparation of an article; that is, the incorporation of DCHP into articles, meaning DCHP becomes an integral component of the article, after its manufacture, for distribution in commerce. In this case, DCHP is present in a raw material such as rubber or plastic that contains a mixture of plasticizers and other additives, and this COU refers to the manufacturing of PVC and non-PVC articles including rubber, plastic, and miscellaneous articles using those raw materials. According to information provided to EPA, DCHP is used as a plasticizer in plastic and rubber articles used in the aerospace industry ([AIA, 2019](#)), and a variety of articles in transportation equipment such as automotive vehicles ([MEMA, 2019](#)). Simple and complex plastic and rubber articles containing DCHP are also assumed to be used in electronics ([U.S. CPSC, 2015](#)), as well as a variety of other industrial and commercial end uses. DCHP is also assumed to be used as a plasticizer in a variety of other simple and complex articles such those found in building and construction materials ([LANXESS, 2021](#)).

### ***Examples of CDR Submissions***

In the 2016 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as a plasticizer in plastics products manufacturing, one company reported the commercial and consumer use of DCHP in plastic and rubber products not covered elsewhere.

In the 2020 CDR cycle, one company reported the commercial and consumer use of DCHP (CASRN 84-61-7) as a plasticizer in other articles with routine direct contact during normal use including rubber articles; plastic articles (hard), which is a further refined description compared with the 2016 CDR cycle code of “plastic and rubber products not covered elsewhere.”

## **E.7 Processing – Repackaging (e.g., Laboratory Chemical)**

---

Repackaging refers to the preparation of DCHP for distribution in commerce in a different form, state, or quantity than originally received or stored by various industrial sectors, including chemical product and preparation manufacturing, wholesale and retail trade, and laboratory chemicals manufacturing. This COU includes the transferring of DCHP from a bulk container into smaller containers. One company explained that DCHP and phthalates more generally are domestically repackaged for laboratory use ([U.S. EPA, 2020d](#)). This COU would not apply to the relabeling or redistribution of a chemical substance without removing the chemical substance from the original container it was supplied in. No changes to chemical composition occur during repackaging of this COU ([U.S. EPA, 2022a](#)).

This COU was not reported in the 2016 or 2020 CDR cycles.

## **E.8 Processing – Recycling**

---

This COU refers to the process of treating generated waste streams (*i.e.*, which would otherwise be disposed of as waste) containing DCHP that are collected, either on-site or at a third-party site, for commercial purpose. DCHP is primarily recycled industrially in the form of DCHP-containing PVC/plastic waste streams. New PVC can be manufactured from recycled and virgin materials at the same facility. Some ([ENF Plastic, 2024](#)) estimate a total of 228 plastics recyclers operating in the United States of which 58 accept PVC wastes for recycling. It is unclear if the total number of sites includes some or all circular recycling sites—facilities where new PVC can be manufactured from recycled and virgin materials on the same site. Articles containing DCHP from inks, coatings, etc., may also be recycled ([U.S. EPA, 2020b](#)). EPA notes that although DCHP was not reported for recycling in the 2016 or 2020 CDR reporting periods, EPA is assuming that recycling waste streams could contain DCHP.

## 5612 **E.9 Distribution in Commerce**

---

5613 For purposes of assessment in this draft risk evaluation, distribution in commerce consists of the  
5614 transportation associated with the moving of DCHP or DCHP-containing products between sites  
5615 manufacturing, processing or recycling DCHP or DCHP-containing products, or to final use sites, or for  
5616 final disposal of DCHP or DCHP-containing products. More broadly under TSCA, “distribution in  
5617 commerce” and “distribute in commerce” are defined under TSCA section 3(5). No changes to chemical  
5618 composition occur during transportation of DCHP ([U.S. EPA, 2022a](#)).

## 5619 **E.10 Industrial Use – Adhesive and Sealants (e.g., Computer and Electronic 5620 Product Manufacturing; Transportation Equipment Manufacturing)**

---

5621 This COU refers to DCHP as it is used in various industrial sectors as a component of adhesive or  
5622 sealant mixtures. Meaning the use of DCHP after it has already been incorporated into an adhesive  
5623 and/or sealant product or mixture, as opposed to when it is used upstream (e.g., when DCHP is  
5624 processed into the adhesive and sealant formulation). The American Coatings Association explained that  
5625 DCHP is a plasticizer, additive, and impurity in adhesives in amounts less than 1 percent ([ACA, 2019](#)).

5626  
5627 According to information provided to EPA, DCHP is used as an adhesive within the aerospace industry  
5628 ([AIA, 2019](#)) and as an adhesive sealant for body panel assemblies and parts by automobile  
5629 manufacturers applications ([MEMA, 2019](#)). EPA has also identified several examples of specific  
5630 products for this COU, such as a nonconductive die attach adhesive containing DCHP at concentrations  
5631 of 0.1 to 1 percent. This adhesive has been formulated for use in high throughput die attach applications  
5632 within the semi-conductor industry within various types of electronics (e.g., automotive cameras)  
5633 ([Henkel, 2024, 2019, 2017](#)).

### 5634 **Examples of CDR Submissions**

5635 In the 2016 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as adhesive and  
5636 sealant chemicals in adhesive manufacturing.

5637  
5638 In the 2020 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as a plasticizer in  
5639 adhesive manufacturing.  
5640

## 5641 **E.11 Industrial Use – Finishing Agent – Cellulose Film Production**

---

5642 This COU refers to the use of DCHP as a component of the finishing agent used in cellulose film  
5643 production. Meaning the use of DCHP after it has already been incorporated into the finishing agent  
5644 itself, as opposed to when it is used upstream (e.g., when DCHP is processed into the finishing agent or  
5645 paint and coating formulation).

5646  
5647 CDR described a “finishing agent” as a chemical substance used to impart such functions as softening,  
5648 static-proofing, wrinkle resistance, and water repellence. Substances may be applied to textiles, paper,  
5649 and leather. In this case DCHP is used during the cellulose film production to bathe or coat the film,  
5650 giving it barrier properties as well as promoting heat seal. This cellulose film is then used in a variety of  
5651 labeling, and packaging end uses ([U.S. EPA, 2020c](#); [Earthjustice, 2019](#)).

5652  
5653 This COU was not reported in the 2016 or 2020 CDR reporting cycles.

## 5654 **E.12 Industrial Use – Inks, Toner, and Colorant Products**

---

5655 This COU refers to the use of DCHP in various industrial sectors as a component in ink, toner, and  
5656 colorant products. Meaning the use of DCHP after it has already been incorporated into ink, toner,

5657 and/or colorant products, or while it is being applied to various articles, as opposed to when it is used  
5658 upstream (e.g., when DCHP is processed into the ink, toner, and colorant product formulation).  
5659

5660 According to information provided to EPA in 2021, DCHP (referred to in this case as Uniplex 250) has  
5661 been used as an element of PVC inks/PVC plastisol formulations ([Hallstar, 2022](#); [LANXESS, 2021](#);  
5662 [U.S. EPA, 2021c, 2019e](#)). Uniplex 250 is also marketed as being used as a polymer additive in labels  
5663 and printing ink formulations ([Hallstar, 2022](#)) and DCHP has been used as part of the screen-printing  
5664 process for textiles ([Gans Ink and Supply, 2018](#)). Printing inks are composed of colorants (e.g.,  
5665 pigments, dyes and toners) dispersed in a formulation to form a paste, liquid or solid, which can be  
5666 applied to a substrate surface and dried ([U.S. EPA, 2010](#)). Screen printing requires a mesh screen to  
5667 transfer the ink to a substrate, whereas digital printing allows for the transfer of a digital image directly  
5668 onto a substrate. Inkjet printing is the most common form of digital printing. It involves the application  
5669 of small drops of ink onto a substrate, with direct contact between the ink nozzle and the substrate ([U.S.  
5670 EPA, 2010](#)).

#### 5671 *Examples of CDR Submissions*

5672 In the 2016 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as a plasticizer in  
5673 printing ink manufacturing.  
5674

### 5675 **E.13 Industrial Use – Paints and Coatings**

5676 This COU refers to the use of DCHP in various industrial sectors as a component in paints and coating  
5677 mixtures. This is a use of DCHP after it has already been incorporated into paint and coating or BPO  
5678 mixtures, or while it is being applied to various articles, as opposed to when it is used upstream (e.g.,  
5679 when DCHP is processed into adhesive, sealant or BPO formulation).  
5680

5681 EPA has identified an example of an industrial paint and coating product for this COU; a single-  
5682 component silicone acrylic finish that air dries and is suitable for high temperature exposures up to  
5683 500 °F with DCHP concentrations of 2.5 to less than 10 percent. This paint and coating is applied via  
5684 pressurized or conventional spray and can be used to protect various elements, equipment, etc. in an  
5685 industrial or manufacturing setting ([Carboline, 2019a, b](#); [U.S. EPA, 2019d](#)).  
5686

5687 EPA expects that products under this COU would be applied in the industrial sector; however, note that  
5688 it is possible for these products to be purchased by commercial users and applied in the commercial  
5689 sector as well.  
5690

#### 5691 *Examples of CDR Submissions*

5692 In the 2016 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as a process  
5693 regulator in paints and coating manufacturing, which has been recategorized in the COU table to  
5694 “stabilizing agent” after discussions with the company that purchased the previous 2016 reporting  
5695 company ([U.S. EPA, 2024aj](#)). See Appendix D for more information on the changes from the COUs  
5696 from the *Final Scope of the Risk Evaluation for Dicyclohexyl Phthalate (DCHP) CASRN 84-61-7* ([U.S.  
5697 EPA, 2020b](#)).

5698 In the 2020 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as a stabilizing agent  
5699 in paints and coating manufacturing.  
5700  
5701

## **E.14 Industrial Use – Other Articles with Routine Direct Contact During Normal Use Including Rubber Articles; Plastic Articles (Hard) (e.g., Transportation Equipment Manufacturing)**

---

This COU refers to the use of DCHP in rubber and plastic products in various industrial sectors, such as transportation equipment manufacturing. Meaning the use of DCHP after it has already been incorporated into a plastic or rubber product, as opposed to when it is used upstream (e.g., when DCHP is processed into the plastic/rubber product).

According to information provided to EPA, DCHP is used as a plasticizer in plastic and rubber products used in the aerospace industry ([AIA, 2019](#)) and a variety of transportation equipment such as both vehicles production parts and replacement parts ([MEMA, 2019](#)). The Alliance of Automobile Manufacturers and the Motor & Equipment Manufacturers Association did explain that “[t]he average scope of the relative mass of DCHP in the parts from the Alliance’s data collection is 0.24 gram. Excluding body/exterior parts, that average drops below 0.01 gram” ([MEMA, 2019](#)).

As such, workers would be expected to handle or touch products covered by this COU with their hands and be exposed to DCHP through dermal contact.

### ***Examples of CDR Submissions***

In the 2016 CDR cycle, one company reported the commercial use of DCHP (CASRN 84-61-7) in plastic and rubber products not covered elsewhere.

In the 2020 CDR cycle, the same company reported the commercial use of DCHP (CASRN 84-61-7) as a plasticizer in other articles with routine direct contact during normal use including rubber articles; plastic articles (hard), which is a further refined description compared to the 2016 CDR cycle code of “plastic and rubber products not covered elsewhere”.

## **E.15 Commercial Use – Adhesives and Sealants**

---

This COU is referring to the commercial use of DCHP in adhesives and sealants. Meaning the use of DCHP-containing adhesives and sealants in a commercial setting, such as a business or at a job site, as opposed to upstream use of DCHP (e.g., when DCHP is processed into the adhesive and sealant formulation) or use in an industrial setting.

Workers in a commercial setting generally apply adhesives and sealants that already have DCHP incorporated as a plasticizer or combine two-part adhesives where DCHP acts as a phlegmatizer with BPO in unsaturated polyesters or MMA systems ([U.S. EPA, 2024aj](#)). The American Coatings Association explained that DCHP is a plasticizer, additive and impurity in adhesives in amounts less than one percent ([ACA, 2019](#)). According to information provided to EPA, DCHP is used as an adhesive within the aerospace industry ([AIA, 2019](#)), and an adhesive sealant for body panel assemblies and parts by automobile manufacturers applications ([MEMA, 2019](#)).

Commercial adhesives and sealants that are used to fasten other materials together or to prevent the passage of liquid or gas are captured under this COU. For example, products under this COU can be two-part adhesives, glues or caulks, which are stored in separate parts, generally a base and an activator or a resin and a hardener that may undergo a reaction or cure once combined. EPA expects that some commercial applications of adhesives and sealants containing DCHP may occur using non-pressurized methods, but that most commonly, the products containing DCHP are more likely applied via a syringe or caulk gun. More specifically, EPA has identified several examples of products for this COU, such as

5749 a metal bonding adhesive used in variety of automotive care applications (e.g., panel bonding, weld and  
5750 rivet bonding of quarter panels, rear body panels, roof panels, door skins, van side panels and outer truck  
5751 bed panels) that contain DCHP concentrations of one to five percent ([Lord Corporation, 2021](#), [2020](#),  
5752 [2017](#)) as well as a similar metal bonding product with DCHP concentrations from three to less than five  
5753 percent ([Ford Motor Company, 2015](#)). EPA also identified various two-part adhesive anchoring systems,  
5754 such as a two-part hammer-capsule system designed for use in the installation of a threaded rod into  
5755 solid concrete and masonry materials that contained DCHP concentrations of 1 to 2.5 percent ([DeWalt,](#)  
5756 [2024b](#), [2022](#), [2020](#)), as well as another two-part polyester liquid system to be used once again in  
5757 construction and building environments ([MKT, 2023a](#), [b](#), [2018](#)).

5758  
5759 EPA expects that the use of these types of products would occur in commercial applications; however,  
5760 EPA notes that these products are likely to be sourced by DIY consumers through various online  
5761 vendors as well ([DeWalt, 2024a](#); [Lord Corporation, 2024](#); [MKT, 2024](#)).

#### 5762 *Examples of CDR Submissions*

5763 In the 2016 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as adhesive and  
5764 sealant chemicals in adhesive manufacturing.

5765  
5766  
5767 In the 2020 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as a plasticizer in  
5768 adhesive manufacturing.

### 5769 **E.16 Commercial Use – Building/Construction Materials Not Covered** 5770 **Elsewhere**

---

5771 This COU is referring to the commercial use of DCHP in building/construction materials not covered  
5772 elsewhere. Meaning the use of DCHP-containing building/construction materials in a commercial  
5773 setting, such as at a business or at a job site, as opposed to upstream use of DCHP (e.g., when DCHP is  
5774 processed into articles).

5775  
5776 According to information provided to EPA in 2021, DCHP (referred to in this case as Uniplex 250) has  
5777 been used as an article in a “range of construction products-boards” ([LANXESS, 2021](#)). These boards  
5778 are presumed to be used in a variety of commercial applications and settings.

#### 5779 *Examples of CDR Submissions*

5780 In the 2012 CDR cycle, one company reported the commercial use of DCHP (CASRN 84-61-7) as  
5781 building/construction materials not covered elsewhere.

### 5782 **E.17 Commercial Use – Ink, Toner, and Colorant Products**

---

5783 This COU refers to the commercial use of DCHP in ink, toner, and colorant products. Meaning the use  
5784 of DCHP-containing ink, toner, and/or colorant products in a commercial setting, such as a business or  
5785 at a job site, as opposed to upstream use of DCHP (e.g., when DCHP is processed into the ink, toner,  
5786 and colorant product formulation) or use in an industrial setting.

5787  
5788  
5789 According to information provided to EPA in 2021, DCHP (referred to in this case as Uniplex 250) has  
5790 been used as an element of PVC inks/PVC plastisol formulations ([LANXESS, 2021](#); [U.S. EPA, 2021c](#),  
5791 [2019e](#)). Uniplex 250 is also marketed as being used as a polymer additive in labels and printing ink  
5792 formulations ([Hallstar, 2022](#)) and has been used as part of the screen-printing process for textiles ([Gans](#)  
5793 [Ink and Supply, 2018](#)). The expected users of these products would be specific to the printing

5794 community and these inks would likely be applied through mechanical methods or as part of the screen-  
5795 printing process.

5796

### 5797 ***Examples of CDR Submissions***

5798 In the 2016 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as a plasticizer in  
5799 printing ink manufacturing.

## 5800 **E.18 Commercial Use – Laboratory Chemicals**

5801 This COU is referring to the commercial use of DCHP in laboratory chemicals. DCHP can be used as a  
5802 laboratory chemical, such as a chemical standard or reference material during analyses. Some laboratory  
5803 chemical manufacturers identify use of DCHP as a certified reference material and research chemical  
5804 ([Restek Corporation, 2024](#); [Sigma-Aldrich, 2024a, b](#); [U.S. EPA, 2020d](#); [SPEX CertiPrep, 2019](#)). Users  
5805 of the products under this category would be expected to apply these products through general  
5806 laboratory use applications. According to information provided to EPA by NASA, the Agency indicated  
5807 that DCHP is used as a laboratory chemical in applications such as analytical standards, research,  
5808 equipment calibration and sample preparation ([NASA, 2020](#)).

5809

5810 DCHP has also been used as the powder in a two-part laboratory acrylic mounting system for laboratory  
5811 specimens that are sensitive to high pressures and temperatures, as well as an embedding polymer resin  
5812 kit intended for preparation for samples for high resolution light microscopy ([Ted Pella, 2024, 2017](#)).  
5813 DCHP in this case is used as part of a BPO catalyst.

5814

5815 This use was not reported to EPA in the 2016 or 2020 CDR cycles.

## 5816 **E.19 Commercial Use – Paints and Coatings**

5817 This COU is referring to the commercial use of DCHP as a plasticizer and stabilizer (*i.e.*, phlegmatizer)  
5818 in paints and coating systems. Meaning the use of DCHP-containing paints and coatings in a commercial  
5819 setting, such as at a business or at a job site, as opposed to upstream use of DCHP (*e.g.*, when DCHP is  
5820 processed into the paint, coating, or BPO formulation) or use in an industrial setting.

5821

5822 Workers in a commercial setting generally apply paints and coatings that already have DCHP  
5823 incorporated as a plasticizer or combine two (or even sometimes three) part paints and coatings where  
5824 DCHP acts as a phlegmatizer with BPO in unsaturated polyesters or MMA systems ([U.S. EPA, 2024aj](#)).  
5825 The solid DCHP/BPO product often acts as a catalyst or curing agent when mixed with a second, often  
5826 liquid, component by workers at the end use site before application. This mixing begins the  
5827 polymerization reaction or process. Workers are expected to be potentially exposed when mixing  
5828 components to form a liquid paint/coating, when transferring the liquid mixture to the application  
5829 equipment if necessary, and/or when applying the coating or system itself to the substrate ([U.S. EPA,](#)  
5830 [2014b](#); [OECD, 2009b](#); [U.S. EPA, 2004d](#)). End use sites may also receive liquid paint and coating  
5831 formulations already containing DCHP as a single component, making the need to mix two components  
5832 obsolete. Application methods for DCHP-containing paints and coatings may include spray, brush,  
5833 and/or trowel coating.

5834

5835 Various paints and coatings that utilize DCHP are applied in commercial settings such as in roofing,  
5836 construction, and in cement/protection for high traffic areas, etc. often to provide waterproofing, UV  
5837 protection and/or chemical resistance. More specifically, EPA has identified several examples of  
5838 products for this COU, such as a single-component silicone acrylic finish that air dries and is suitable for  
5839 high temperature exposures up to 500 °F with DCHP concentrations of 2.5 to less than 10 percent. This  
5840 paint and coating is applied via pressurized spray and can be used to protect various elements,

5841 equipment, and so on, in an industrial or manufacturing setting ([Carboline, 2019a, b](#); [U.S. EPA, 2019d](#)).  
5842 EPA also identified various two or even multi-part paints and coatings systems including: a vinyl ester  
5843 silicone filled mortar; a three component, MMA-based grout; a poly methyl-methacrylate (PMMA) resin  
5844 used in roofing and waterproofing applications; a polyurethane modified methyl methacrylate  
5845 (PUMMA) vehicular and pedestrian traffic coating system; and a MMA resin used as a penetrating  
5846 crack healer/sealer or to fortify extremely porous concrete substrates.

5847  
5848 The vinyl ester silicone filled mortar contained concentrations of DCHP at less than 0.005 percent and  
5849 when used with chemical-resistant masonry units and the proper membrane, it will protect concrete and  
5850 steel substrates from chemical attack and physical abuse. The mortar is a two-part system including a  
5851 liquid and the powder (which contains DCHP), which must be mixed together (3.25 parts powder to 1  
5852 part liquid) prior to trowel based application of an average one-eighth inch thick bed directly on top of  
5853 membrane or preceding course of brickwork. According to the company, this product is used in the  
5854 construction of floors, sumps, trenches, tanks, vessels and bleach towers in chemical processing; food  
5855 and beverage plants; dairies; laboratories; and textile, steel and pulp and paper mills ([Sauereisen, 2024,](#)  
5856 [2022](#)).

5857  
5858 The three component MMA based grout is flowable, non-shrink, durable polymer grout that according  
5859 to the company's website, can be used as the grouting of bearing plates on bridges and trestles,  
5860 rehabilitation of bridge decks, airport runways, expansion joints and column grouting. DCHP can be  
5861 found in the catalyst or Part B in concentrations of 50 to 51 percent. Seven to 14 fluid ounces (oz)  
5862 (depending on the ambient air temperature) of the catalyst/Part B, is mixed with 1 gallon of Part A resin,  
5863 and 70 lb of Part C grout aggregate. Once mixed, the company directs workers to distribute the blended  
5864 resin over the surface and brush in or prepare a form and pour the material into place ([ChemMasters,](#)  
5865 [2024, 2018, 2017a, b](#)).

5866  
5867 The PMMA resin is used in roofing and waterproofing applications through a two-part plus  
5868 fleece/membrane self-flashing and self-adhering system, which according to the company is used in  
5869 structural below-grade concrete surfaces, and protected roof and split-slab decks ([CETCO, 2024, 2018a,](#)  
5870 [b, c](#)). DCHP has been identified in the catalyst powder at 50 percent which is then mixed with the resin  
5871 at various ratios ranging from 2 to 6 percent depending on the weight of the resin used and temperature.

5872  
5873 The polyurethane modified methyl methacrylate (PUMMA) vehicular and pedestrian traffic coating  
5874 system, is specifically designed for use in parking structures, balconies, stadium seating, walkways,  
5875 plaza decks, etc. ([Hydro-Gard, 2012a, b](#)). This is a multi-component system, which uses a catalyst that  
5876 contains DCHP in concentrations of 40 to 55 percent combined with a resin and a flashing or polyester  
5877 fleece to create a liquid applied waterproofing membrane/coating ([Hydro-Gard, 2024, 2017a, b](#)).

5878  
5879 Finally, the last product example for commercial paints and coatings is an MMA resin that is used as a  
5880 penetrating crack healer/sealer or to fortify extremely porous concrete substrates, such as parking and  
5881 bridge decks, loading docks and warehouses. DCHP can be found in the initiator component in  
5882 concentrations of 50 to less than 100 percent. To begin the hardening process the workers must add  
5883 roughly 0.5 oz to a gallon of resin at around 32 to 39 degrees, increasing up to 2 oz at 90 to 105 degrees  
5884 Fahrenheit. The product is then recommended to be spread evenly on the surface as a flood coat with a  
5885 squeegee or rollers and allowed to absorb completely into the concrete substrate ([Euclid Chemical](#)  
5886 [Company, 2019a, b, 2018](#)).

5887  
5888 Note these listed examples are not all inclusive of every product under this COU, and that EPA expects  
5889 that these types of products would be purchased by commercial operations and applied by professional

contractors in various commercial settings. The Agency also expects that some of these products are likely to be used for industrial applications; however, they would be available and used in smaller scale commercial settings for similar purposes (e.g., protection on structural components, construction).

#### ***Examples of CDR Submissions***

In the 2016 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as a process regulator in paints and coating manufacturing, which has been recategorized in the COU table to “stabilizing agent” after discussions with the company that purchased the previous 2016 reporting company ([U.S. EPA, 2024aj](#)). See Appendix D for more information on the changes from the COUs from the *Final Scope of the Risk Evaluation for Dicyclohexyl Phthalate (DCHP); CASRN 84-61-7* ([U.S. EPA, 2020b](#)).

In the 2020 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as a stabilizing agent in paints and coating manufacturing.

### **E.20 Commercial Use – Other Articles with Routine Direct Contact During Normal Use Including Rubber Articles; Plastic Articles (Hard)**

This COU is referring to the commercial use of DCHP in various rubber and plastic articles that are intended for routine direct contact. The 2020 CDR reporting category “other articles with routine direct contact during normal use including rubber articles; plastic articles (hard)” is intended to capture items such as gloves, boots, clothing, rubber handles, gear levers, steering wheels, handles, pencils, and handheld device casing. Given the use of DCHP as a general-purpose plasticizer for PVC and non-PVC applications, EPA expects that this use of DCHP has been identified in previous CDR reports as “plastic and rubber products not covered elsewhere.”

According to information provided to EPA, DCHP is used as a plasticizer in plastic and rubber products used in the aerospace industry ([AIA, 2019](#)) and a variety of transportation equipment such as both vehicles production parts and replacement parts (e.g., brake calipers, fender shim, disc brake assembly) ([MEMA, 2019](#)). The Alliance of Automobile Manufacturers and the Motor & Equipment Manufacturers Association did explain that “[t]he average scope of the relative mass of DCHP in the parts from the Alliance’s data collection is 0.24 gram. Excluding body/exterior parts, that average drops below 0.01 gram” ([MEMA, 2019](#)).

As such, workers would be expected to handle or touch products covered by this COU with their hands and be exposed to DCHP through dermal contact.

#### ***Examples of CDR Submissions***

In 2016 one CDR company reported the commercial use of DCHP (CASRN 84-61-7) in plastic and rubber products not covered elsewhere.

In 2020 the same CDR company reported the commercial use of DCHP (CASRN 84-61-7) as a plasticizer in other articles with routine direct contact during normal use including rubber articles; plastic articles (hard), which is a further refined description compared to the 2016 CDR cycle code of “plastic and rubber products not covered elsewhere.”

### **E.21 Consumer Use – Adhesives and Sealants**

This COU is referring to the consumer use of DCHP in adhesives and sealants. According to information provided to EPA, the American Coatings Association explained that DCHP is a plasticizer,

5936 additive, and impurity in adhesives in amounts less than 1 percent ([ACA, 2019](#)). EPA has identified  
5937 DCHP in a multi-purpose nitrocellulose household glue at one to five percent with suggested  
5938 applications of china, vases, plastic, wood, metal, and crafts ([ITW Permatex, 2024](#); [Midwest  
5939 Technology Products, 2024](#); [ITW Permatex, 2021](#)) as well as adhesives and sealants meant for the  
5940 industrial and commercial automotive industry that are also available to consumer customers ([Lord  
5941 Corporation, 2021, 2020, 2017](#)). For example, the two-part metal bonding adhesive is meant for use in  
5942 various elements of an automotive (e.g., panel bonding, weld and rivet bonding of quarter panels, rear  
5943 body panels, roof panels, door skins, van side panels and outer truck bed panels) and has a DCHP  
5944 concentration of one to five percent ([Lord Corporation, 2017](#)). EPA has also identified various two-part  
5945 adhesive anchoring systems, such as a two-part hammer-capsule system designed for use in the  
5946 installation of a threaded rod into solid concrete and masonry materials that contained DCHP  
5947 concentrations of 1 to 2.5 percent ([DeWalt, 2024b, 2022, 2020](#)), as well as another two-part polyester  
5948 liquid system to be used once again in construction and building environments ([MKT, 2023a, b, 2018](#)).  
5949

5950 Aside from the household glue, EPA expects that the primary use of several of these products is meant  
5951 to occur in industrial/commercial applications only; however, the Agency notes that several of these  
5952 products can be sourced by DIY consumers through various online vendors ([DeWalt, 2024a](#); [Lord  
5953 Corporation, 2024](#); [MKT, 2024](#)).  
5954

5955 This COU was not reported in the 2016 or 2020 CDR cycles.

## 5956 **E.22 Consumer Use – Other Articles with Routine Direct Contact During** 5957 **Normal Use Including Rubber Articles; Plastic Articles (Hard)**

5958 This COU is referring to the consumer use of DCHP in various rubber and plastic articles that are  
5959 intended for consumer use through routine direct contact. The 2020 CDR reporting category “other  
5960 articles with routine direct contact during normal use including rubber articles; plastic articles (hard)” is  
5961 intended to capture items such as gloves, boots, clothing, rubber handles, gear levers, steering wheels,  
5962 handles, pencils, and handheld device casing. Given the use of DCHP as a general-purpose plasticizer  
5963 for PVC and non-PVC applications, EPA expects that this use of DCHP has been identified in previous  
5964 CDR reports as “plastic and rubber products not covered elsewhere.”  
5965

5966 According to information provided to EPA, DCHP is used as a plasticizer in plastic and rubber products  
5967 used in the aerospace industry ([AIA, 2019](#)) as well as a variety of transportation equipment such as both  
5968 vehicles production parts and replacement parts ([MEMA, 2019](#)). The Alliance of Automobile  
5969 Manufacturers and the Motor & Equipment Manufacturers Association did explain that “[t]he average  
5970 scope of the relative mass of DCHP in the parts from the Alliance’s data collection is 0.24 gram.  
5971 Excluding body/exterior parts, that average drops below 0.01 gram” ([MEMA, 2019](#)).  
5972

5973 According to additional information provided to EPA in 2021, DCHP (referred to in this case as Uniplex  
5974 250) has been used as an article in a “range of construction products-boards” ([LANXESS, 2021](#)). These  
5975 boards are presumed to be used in a variety of commercial applications and settings; however, could still  
5976 be a source of exposure for consumers.  
5977

5978 As such, consumers would be expected to handle or touch products covered by this COU with their  
5979 hands and be exposed to DCHP through dermal contact.  
5980

### 5981 **Examples of CDR Submissions**

5982 In the 2016 CDR cycle, one company reported the consumer use of DCHP (CASRN 84-61-7) in plastic  
5983 and rubber products not covered elsewhere.

5984 In the 2020 CDR cycle, the same company reported the consumer use of DCHP (CASRN 84-61-7) as a  
5985 plasticizer in other articles with routine direct contact during normal use including rubber articles;  
5986 plastic articles (hard), which is a further refined description compared to the 2016 CDR cycle code of  
5987 “plastic and rubber products not covered elsewhere.”

### 5988 **E.23 Consumer Use – Other Consumer Articles that Contain DCHP from:** 5989 **Inks, Toner, and Colorants; Paints and Coatings; and Adhesives and** 5990 **Sealants**

5991 This COU is referring to the consumer use of articles that contain DCHP from inks, toner, and colorants,  
5992 paints and coatings and adhesives and sealants.

5993  
5994 According to information provided to EPA in 2021, DCHP (referred to in this case as Uniplex 250) has  
5995 been used as an element of PVC inks/PVC plastisol formulations ([LANXESS, 2021](#); [U.S. EPA, 2019e](#)).  
5996 Uniplex 250 is also marketed as being used as a polymer additive in labels and printing ink formulations  
5997 (Hallstar Website) and has been used as part of the screen-printing process for textiles ([Gans Ink and](#)  
5998 [Supply, 2018](#)). EPA expects consumers to be exposed to DCHP through various products, such as textiles,  
5999 labels, packaging, etc.

6000  
6001 The Agency has also identified several examples of commercial paints and coatings that already have  
6002 DCHP incorporated as a plasticizer or combine two (or even multiple) components where DCHP acts as  
6003 a phlegmatizer with BPO in unsaturated polyesters or MMA systems ([U.S. EPA, 2024aj](#)). These paints  
6004 and coatings that utilize DCHP, are often applied in commercial settings such as in roofing,  
6005 construction, and in cement/protection for high traffic areas (etc.)—often to provide waterproofing, UV  
6006 protection and/or chemical resistance. In particular, EPA identified a product that is used as a vehicular  
6007 and pedestrian traffic coating system, specifically designed for use in parking structures, balconies,  
6008 stadium seating, walkways, plaza decks, etc. ([Hydro-Gard, 2024, 2017a, b, 2012a, b](#)). EPA expects  
6009 consumers to be exposed to DCHP through this coating in areas where consumer access is presumed,  
6010 such as balconies and stadium seating.

6011  
6012 Additionally, DCHP is used during the cellulose film production to bathe or coat the film, giving it  
6013 barrier properties as well as promoting heat seal. This cellulose film is then used in a variety of labeling,  
6014 and packaging end uses ([U.S. EPA, 2020c](#); [Earthjustice, 2019](#)). Any packaging or cellulose film end  
6015 uses that are not subject to the U.S. Food and Drug Administration (FDA) regulations, would be  
6016 captured under this COU. EPA would expect dermal exposure to DCHP through handling cellulose film.  
6017

6018 Finally, EPA has identified commercial or industrial adhesives and sealants that already have DCHP  
6019 incorporated as a plasticizer or combine a two-part adhesive where DCHP acts as a phlegmatizer in  
6020 unsaturated polyesters or MMA systems ([U.S. EPA, 2024aj](#)). The American Coatings Association  
6021 explained that DCHP is a plasticizer, additive, and impurity in adhesives in amounts less than one  
6022 percent ([ACA, 2019](#)). According to information provided to EPA, DCHP is used as an adhesive within  
6023 the aerospace industry ([AIA, 2019](#)), and an adhesive sealant for body panel assemblies and parts by  
6024 automobile manufacturers applications ([MEMA, 2019](#)). EPA has also identified various industrial and  
6025 commercial applications of adhesives and sealants in the construction industry, electronics etc. As a  
6026 result, the Agency expects consumer to be exposed to DCHP through various complex articles that used  
6027 an adhesive and sealant that contained DCHP, such as electronics, cars, airplanes, and  
6028 building/construction materials.  
6029

6030 ***Examples of CDR Submissions***

6031 In the 2016 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as a plasticizer in  
6032 printing ink manufacturing. One company reported the use of DCHP as a process regulator in paints and  
6033 coating manufacturing, which has been recategorized in the COU table to “stabilizing agent” after  
6034 discussions with the company that purchased the previous 2016 reporting company ([U.S. EPA, 2024aj](#)).  
6035 Another company reported the use of DCHP as an adhesive and sealant chemicals in adhesive  
6036 manufacturing.

6037  
6038 In the 2020 CDR cycle, one company reported the use of DCHP (CASRN 84-61-7) as a stabilizing agent  
6039 in paints and coating manufacturing and one company reported the use of DCHP as a plasticizer in  
6040 adhesive manufacturing.

6041 **E.24 Disposal**

6042 Each of the COUs of DCHP may generate waste streams of the chemical. For purposes of the DCHP  
6043 risk evaluation, this COU refers to the DCHP in a waste stream that is collected from facilities and  
6044 households and are unloaded at and treated or disposed at third-party sites. This COU also encompasses  
6045 DCHP contained in wastewater discharged by consumers or occupational users to a POTW or other,  
6046 non-POTW for treatment, as well as other wastes.

6047  
6048 DCHP is expected to be released to other environmental media, such as introductions of biosolids to soil  
6049 or migration to water sources, through waste disposal (*e.g.*, disposal of formulations containing DCHP,  
6050 plastic and rubber products, and transport containers). Disposal may also include destruction and  
6051 removal by incineration. Recycling of DCHP and DCHP containing products is considered a different  
6052 COU. Environmental releases from industrial sites are assessed in each COU.

## Appendix F DRAFT OCCUPATIONAL EXPOSURE VALUE DERIVATION

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EPA has calculated a draft 8-hour existing chemical occupational exposure value to summarize the occupational exposure scenario and sensitive health endpoints into a single value. This calculated draft value may be used to support risk management efforts for DCHP under TSCA section 6(a), 15 U.S.C. section 2605. EPA calculated the draft value rounded to 0.63 mg/m<sup>3</sup> for inhalation exposures to DCHP as an 8-hour time-weighted average (TWA) and for consideration in workplace settings (see Appendix F.1) based on the acute, non-cancer human equivalent concentration (HEC) for developmental toxicity (*i.e.*, phthalate syndrome-related effects on the developing male reproductive system).

TSCA requires risk evaluations to be conducted without consideration of costs and other non-risk factors, and thus this draft occupational exposure value represents a risk-only number. If risk management for DCHP follows the finalized risk evaluation, EPA may consider costs and other non-risk factors, such as technological feasibility, the availability of alternatives, and the potential for critical or essential uses. Any existing chemical exposure limit used for occupational safety risk management purposes could differ from the draft occupational exposure value presented in this appendix based on additional consideration of exposures and non-risk factors consistent with TSCA section 6(c).

This calculated draft value for DCHP represents the exposure concentration below which exposed workers and ONUs are not expected to exhibit any appreciable risk of adverse toxicological outcomes, accounting for PESS. It is derived based on the most sensitive human health effect (*i.e.*, effects on the developing male reproductive system) and exposure duration (*i.e.*, acute) relative to benchmarks and a standard occupational scenario assumption of an 8-hour workday.

EPA expects that at the draft occupational exposure value of 0.047 ppm (0.63 mg/m<sup>3</sup>), a worker or ONU also would be protected against developmental toxicity from intermediate and chronic duration occupational exposures if ambient exposures are kept below this draft occupational exposure value. The Agency has not separately calculated a draft short-term (*i.e.*, 15-minute) occupational exposure value because EPA did not identify hazards for DCHP associated with this very short duration.

EPA did not identify a government-validated method for analyzing DCHP in air.

The Occupational Safety and Health Administration (OSHA) has not set a permissible exposure limit (PEL) as an [8-hour TWA for DCHP](#). EPA located several occupational exposure limits for DCHP (CASRN 84-61-7) in other countries (<https://ilv.ifa.dguv.de/limitvalues/20258>). Identified 8-hour TWA values range from 3 mg/m<sup>3</sup> in Denmark to 5 mg/m<sup>3</sup> in Austria, Ireland, New Zealand, South Africa, and the United Kingdom. Additionally, EPA found that [New Zealand](#) and the [United Kingdom](#) have an established occupational exposure limit of 5 mg/m<sup>3</sup> (8-hour TWA) in each country's code of regulation that is enforced by each country's worker safety and health agency.

### F.1 Draft Occupational Exposure Value Calculations

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This appendix presents the calculations used to estimate draft occupational exposure values using inputs derived in this draft risk evaluation. Multiple values are presented below for hazard endpoints based on different exposure durations. For DCHP, the most sensitive occupational exposure value is based on non-cancer developmental effects and the resulting 8-hour TWA is rounded to 0.63 mg/m<sup>3</sup>.

6098 **Draft Acute Non-cancer Occupational Exposure Value**

6099 The draft acute occupational exposure value ( $EV_{acute}$ ) was calculated as the concentration at which the  
 6100 acute MOE would equal the benchmark MOE for acute occupational exposures using Equation\_Apx  
 6101 F-1:

6102  
 6103 **Equation\_Apx F-1.**  
 6104

$$6105 \quad EV_{acute} = \frac{HEC_{acute}}{Benchmark\ MOE_{acute}} * \frac{AT_{HEC_{acute}}}{ED} * \frac{IR_{resting}}{IR_{workers}} =$$

$$6106$$

$$6107 \quad \frac{0.95\ ppm}{30} * \frac{\frac{24h}{d}}{\frac{8h}{d}} * \frac{0.6125 \frac{m^3}{hr}}{1.25 \frac{m^3}{hr}} = 0.047\ ppm$$

$$6108$$

$$6109 \quad EV_{acute} \left( \frac{mg}{m^3} \right) = \frac{EV\ ppm * MW}{Molar\ Volume} = \frac{0.047\ ppm * 330.4 \frac{g}{mol}}{24.45 \frac{L}{mol}} = 0.63 \frac{mg}{m^3}$$

6110  
 6111 **Draft Intermediate Non-cancer Occupational Exposure Value**

6112 The draft intermediate occupational exposure value ( $EV_{intermediate}$ ) was calculated as the concentration at  
 6113 which the intermediate MOE would equal the benchmark MOE for intermediate occupational exposures  
 6114 using Equation\_Apx F-2:

6115  
 6116 **Equation\_Apx F-2.**  
 6117

$$6118 \quad EV_{intermediate} = \frac{HEC_{intermediate}}{Benchmark\ MOE_{intermediate}} * \frac{AT_{HEC\ intermediate}}{ED * EF} * \frac{IR_{resting}}{IR_{workers}}$$

$$6119$$

$$6120 \quad = \frac{0.95\ ppm}{30} * \frac{\frac{24h}{d} * 30d}{\frac{8h}{d} * 22d} * \frac{0.6125 \frac{m^3}{hr}}{1.25 \frac{m^3}{hr}} = 0.063\ ppm = 0.86 \frac{mg}{m^3}$$

6121  
 6122 **Draft Chronic Non-cancer Exposure Value**

6123 The draft chronic occupational exposure value ( $EV_{chronic}$ ) was calculated as the concentration at which  
 6124 the chronic MOE would equal the benchmark MOE for chronic occupational exposures using  
 6125 Equation\_Apx F-3:

6126  
 6127 **Equation\_Apx F-3.**  
 6128

$$6129 \quad EV_{chronic} = \frac{HEC_{chronic}}{Benchmark\ MOE_{chronic}} * \frac{AT_{HEC\ chronic}}{ED * EF * WY} * \frac{IR_{resting}}{IR_{workers}}$$

$$6130$$

$$6131 \quad = \frac{0.95\ ppm}{30} * \frac{\frac{24h}{d} * \frac{365d}{y} * 40\ y * 0.6125 \frac{m^3}{hr}}{\frac{8h}{d} * \frac{250d}{y} * 40\ y * 1.25 \frac{m^3}{hr}} = 0.068\ ppm = 0.92 \frac{mg}{m^3}$$

6132 Where:

6133  $AT_{hecate}$  = Averaging time for the POD/HEC used for evaluating non-cancer

6134		acute occupational risk based on study conditions and HEC
6135		adjustments (24 h/day).
6136	$AT_{HEC_{intermediate}}$	= Averaging time for the POD/HEC used for evaluating non-cancer
6137		intermediate occupational risk based on study conditions and/or
6138		any HEC adjustments (24 h/day for 30 days).
6139	$AT_{HEC_{chronic}}$	= Averaging time for the POD/HEC used for evaluating non-cancer
6140		chronic occupational risk based on study conditions and/or HEC
6141		adjustments (24 h/day for 365 days/year) and assuming the
6142		same number of years as the high-end working years (WY, 40
6143		years) for a worker.
6144	$Benchmark\ MOE_{acute}$	= Acute non-cancer benchmark margin of exposure, based on the
6145		total uncertainty factor of 30
6146	$Benchmark\ MOE_{intermediate}$	= Intermediate non-cancer benchmark margin of exposure, based on
6147		the total uncertainty factor of 30
6148	$Benchmark\ MOE_{chronic}$	= Chronic non-cancer benchmark margin of exposure, based on the
6149		total uncertainty factor of 30
6150	$EV_{acute}$	= Acute occupational exposure value
6151	$EV_{intermediate}$	= Intermediate occupational exposure value
6152	$EV_{chronic}$	= Chronic occupational exposure value
6153	$ED$	= Exposure duration (8 h/day)
6154	$EF$	= Exposure frequency (1 day for acute, 22 days for intermediate, and
6155		250 days/year for chronic and lifetime)
6156	$HEC$	= Human equivalent concentration for acute, intermediate, or chronic
6157		non-cancer occupational exposure scenarios
6158	$IR$	= Inhalation rate (default is 1.25 m <sup>3</sup> /h for workers and 0.6125 m <sup>3</sup> /h
6159		assumed from “resting” animals from toxicity studies)
6160	$Molar\ Volume$	= 24.45 L/mol, the volume of a mole of gas at 1 atm and 25 °C
6161	$MW$	= Molecular weight of DCHP (330.4 g/mole)
6162	$WY$	= Working years per lifetime at the 95th percentile (40 years).
6163		
6164	<i>Unit conversion:</i>	
6165	1 ppm = 13.51 mg/m <sup>3</sup> (see equation associated with the $EV_{acute}$ calculation)	