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Chemical Management Plan 2 (CMP2) Scoping Project for Substance Information

Final Report on Phthalates

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Submitted By:

Cheminfo Services Inc.
30 Centurian Drive, Suite 205
Markham, Ontario L3R 8B8
Phone: (905) 944-1160
Fax: (905) 944-1175
E-mail: info@cheminfoservices.com

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1. Executive Summary

1.1 Introduction

The Chemicals Management Plan (CMP) is part of the Government of Canada's comprehensive environmental agenda and is managed jointly by Environment Canada and Health Canada. In October 2011, the Government of Canada announced the launch of the second phase of the CMP to continue its commitment to protecting the health and environment of Canadians. As part of the second phase of the CMP, approximately 500 substances in nine groups have been identified as priorities for action (i.e. the Substance Groupings Initiative). One of these groups of substances are phthalates.

Section 71 of the *Canadian Environmental Protection Act, 1999* (CEPA 1999) gives the authority to the Minister of the Environment to publish a notice requiring any person described therein to provide information to the Government for the purpose of assessing whether a substance is toxic or capable of becoming toxic. In order to facilitate stakeholder engagement and inform the design of the information gathering initiatives (i.e. section 71 survey notices), key information on the substances is needed to supplement information already identified in the target substance groupings profiles. Therefore the impetus of this project has been the collection of information on phthalates in order to better inform the development of this information collection mechanism.

1.2 Overview of Phthalates in General and CMP II Phthalates

There are few manufacturing facilities for phthalates located in Canada or the U.S. In Canada, there are only three plasticizer manufacturing facilities, specifically BASF (Cornwall, ON) and PolyOne (Orangeville, ON and St-Remi, QC). Without contacting each of these Canadian facilities, it is not possible to determine if they do in fact manufacture phthalates. However, PolyOne's only plasticizer manufacturing facilities in the U.S. or Canada are their two locations in Canada. Since PolyOne does manufacture phthalates, it is likely that one or both of these Canadian facilities manufacture phthalates (including some listed on CMP II). The BASF facility in Cornwall, ON is a specialty plasticizer plant and it is believed they also manufacture phthalates at this facility.

Research was conducted during the study to identify the North American manufacturers of the various phthalates contained in the Substance Groupings Initiative. As would be expected, there are only a handful of companies that are manufacturing the various phthalates. There are four phthalates listed under the Substance Groupings Initiative that based on research conducted during this study appear not be commercially produced.

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Table 1: North American Manufacturers of the Phthalates Listed Under the Substance Groupings Initiative

Phthalate	Common Name	Acronym	CAS	Manufacturers	Location	Product Name
1,2-Benzenedicarboxylic acid, dicyclohexyl ester	Dicyclohexyl Phthalate	DCHP	84-61-7	Unitex Chemical Corp. Vertellus Specialties, Inc	Greensboro, NC Greensboro, NC	Uniplex 250/Uniplex 250M Morflex®150
1,2-Benzenedicarboxylic acid, butyl cyclohexyl ester	Butyl Cyclohexyl Phthalate	BCHP	84-64-0	Unitex Chemical Corp. Dystar® Group	Greensboro, NC Reidsville, NC	BCHP Novaflex BCHP
1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester	Diisobutyl Phthalate	DIBP	84-69-5	Unitex Chemical Corp.	Greensboro, NC	Uniplex 155
1,2-Benzenedicarboxylic acid, dimethyl ester	Dimethyl Phthalate	DMP[1]	131-11-3	Unitex Chemical Corp.	Greensboro, NC	Uniplex 110
1,2-Benzenedicarboxylic acid, bis(phenylmethyl) ester	Dibenzyl Phthalate	DBenzP	523-31-9	---	---	---
1,2-Benzenedicarboxylic acid, diundecyl ester	Diundecyl Phthalate	DUP[2]	3648-20-2	ExxonMobil Chemical BASF PolyOne	Baton Rouge, LA Pasadena, TX and/or Cornwall, ON Orangeville, ON and/or St. Remi, QC	Jayflex™ L11P-E Palatinol® 111P-I Synplast® DUP-E
1,2-Benzenedicarboxylic acid, cyclohexyl 2-methylpropyl ester	Cyclohexyl Isobutyl Phthalate	CHIBP	5334-09-8	---	---	---
1,2-Benzenedicarboxylic acid, 2,2-dimethyl-1-(1-methylethyl)-3-(2-methyl-1-oxopropoxy)propyl phenylmethyl ester	Texanol® Benzyl Phthalate	B84P	16883-83-3	Ferro Corporation	Bridgeport, NJ	Santicizer® 278

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Phthalate	Common Name	Acronym	CAS	Manufacturers	Location	Product Name
1,2-Benzenedicarboxylic acid, diisodecyl ester	Diisodecyl Phthalate	DIDP[3]	26761-40-0	ExxonMobil Chemical PolyOne	Baton Rouge, LA Orangeville, ON or St. Remi, QC	Jayflex™ DIDP/Jayflex™ DIDP-E Synplast® DIDP-Electrical/Synplast® DIDP Normal
1,2-Benzenedicarboxylic acid, isooctyl phenylmethyl ester	Benzyl Isooctyl Phthalate	BIOP	27215-22-1	---	---	---
1,2-Benzenedicarboxylic acid, bis(methylcyclohexyl) ester	Dimethyl Cyclohexyl Phthalate	DMCHP	27987-25-3	Emery Oleochemicals	(potentially manufactures in North America, but likely in Asia)	Edenol® 344
1,2-Benzenedicarboxylic acid, diisononyl ester	Diisononyl Phthalate	DINP	28553-12-0	ExxonMobil Chemical BASF PolyOne	Baton Rouge, LA Pasadena, TX and/or Cornwall, ON Orangeville, ON and/or St. Remi, QC	Jayflex™ DINP Palatinol® N/Palatinol® N-I/Palatinol® N-E Synplast® DINP-N; Synplast® DINP-E; Synplast® Mixed Phthalate
1,2-Benzenedicarboxylic acid, benzyl C7-9-branched and linear alkyl esters	Benzyl Octyl Phthalate	B79P	68515-40-2	Ferro Corporation	Bridgeport, NJ	Santicizer® 261
1,2-Benzenedicarboxylic acid, di-C_{6-8}-branched alkyl esters, C_7-rich	Diisoheptyl Phthalate	DIHepP[4]	71888-89-6	---	---	---

[1] historical producers of DMP believed to include Eastman Chemical (Kingsport, TN) and Velsicol Chemical Corp (Chestertown, MD).
[2] historical producers of DUP believed to include Eastman Chemical (Kingsport, TN), Sterling Chemicals (Texas City, TX), Georgia Gulf Chemicals and Vinyls (Aberdeen, MS) and Teknor Apex (Brownsville, TX).
[3] historical producers of DIDP believed to include Hatco Corp (Fords, NJ) and Sunoco (Neville Island, PA).
[4] historical producers of DIHepP believed to include ExxonMobil Chemical (Baton Rouge, LA).
Source: Cheminfo Services

Outlined in the table below is a summary of the imports of phthalates into Canada for 2012. In total, there were 23,490 tonnes of imports of phthalates into Canada in 2012. The U.S. is, by far, the leading supplier of phthalates to the Canadian market, representing approximately 72% of the imports of phthalates into Canada in 2012. Asian countries are much smaller, but nevertheless important sources of phthalates for the Canadian market. For instance, combined China, Taiwan and South Korea represented 19.2% of the Canadian imports of phthalates in 2012. The other major origin point for Canadian imports of phthalates is Germany, which represented 6.5% of Canadian imports for 2012.

Table 2: Imports of Phthalates into Canada (2012)

(tonnes)

	Total	**Percentage of Total Phthalate Imports**
U.S.	16,832	71.7%
China	1,865	7.9%
Germany	1,523	6.5%
Taiwan	1,393	5.9%
South Korea	1,268	5.4%
Italy	270	1.1%
India	118	0.5%
Belgium	100	0.4%
Canada	75	0.3%
Poland	24	0.1%
Japan	11	<0.1
France	3	<0.1
Sri Lanka	3	<0.1
Chile	2	<0.1
Thailand	1	<0.1
Other	2	<0.1
Total	23,490	100%

Source: Statistics Canada, Canadian International Merchandise Trade Database.

Phthalates are the most commonly used plasticisers in the world and are primarily used in polyvinyl chloride (PVC) applications. For instance in Europe, approximately 93% of all phthalates are used to make PVC soft and flexible. They can be found in a range of everyday items including electrical cables, hoses, flooring, wallcoverings, coated textiles, tablecloths, stationery, luggage, sports equipment, roofing membranes, pool liners, footwear as well as medical devices such as tubing and blood bags and a range of automotive applications.

Although most phthalates make PVC flexible for a wide variety of uses, a few phthalates are, or have been, used in personal care products, such as perfumes, lotions, and nail polish. The level of phthalates in cosmetics and other similar products is quite small (2% or less of the product).[1] Other non-PVC end-uses for phthalates include: (i) paints and coatings manufacturing; (ii) adhesive and sealant manufacturing; (iii) printing ink manufacturing; and (iv) rubber product manufacturing.

The extent that the 14 CMP II phthalates are manufactured and consumed globally varies considerably. For some phthalates, we do not expect any section 71 submissions to be received by Environment Canada as they do not appear to be in commerce at present (e.g. DBenzP, CHIBP, BIOP and DIHepP). Alternatively, there are two phthalates (i.e. DINP, DIDP) under the Substance Groupings Initiative that are very high volume plasticizers and are likely among the top 2-3 phthalates consumed in Canada annually. Outlined in the table below is our initial assessment of the expected consumption of these fourteen phthalates in Canada as well as the number of expected section 71 responses that will be received by Environment Canada. Four qualitative categories have been used (high, medium, low, none). Please note that consultations with industry were unable to be conducted during the study and therefore our judgments below could only be based on available literature and the knowledge of the consultant.

Table 3: Summary of Fourteen Phthalates Contained in the Substance Groupings Initiative

Phthalate	CAS Number	Expected Number of Section 71 Responses and Consumption Range
Dicyclohexyl Phthalate	84-61-7	Low
Butyl Cyclohexyl Phthalate	84-64-0	Low
Diisobutyl Phthalate	84-69-5	Medium
Dimethyl Phthalate	131-11-3	Medium
Dibenzyl Phthalate	523-31-9	None
Diundecyl Phthalate	3648-20-2	Medium
Cyclohexyl Isobutyl Phthalate	5334-09-8	None
Texanol® Benzyl Phthalate	16883-83-3	Low
Diisodecyl Phthalate	26761-40-0	High
Benzyl Isooctyl Phthalate	27215-22-1	None
Dimethyl Cyclohexyl Phthalate	27987-25-3	Low
Diisononyl Phthalate	28553-12-0	High
Benzyl Octyl Phthalate	68515-40-2	Low
Diisoheptyl Phthalate	71888-89-6	None

Source: Cheminfo Services

[1] Accessed at the website of the Phthalate Esters Panel of the American Chemistry Council (http://phthalates.americanchemistry.com/).

1.3 Information Gaps

Chapter 5 contains a more detailed discussion of the information gaps that were determined during the course of the study. Only those information gaps that are considered of higher importance are discussed here in the Executive Summary.

There are four phthalates that no information could be located during the study (i.e. dibenzyl phthalate, cyclohexyl isobutyl phthalate, benzyl isooctyl phthalate and diisoheptyl phthalate) indicating that they are in fact currently commercial substances. It is believed that these four substances are not in commercial use at present. Therefore this may not be an information gap but simply a reality of the current market for phthalate plasticizers.

There is limited information on the current distribution of phthalate plasticizers in Canada. The manufacturers are well known (at least in North America, Europe and to some extent Asia), however how these phthalates are distributed in Canada is unknown. This has important implications with respect to collecting relevant information through the section 71 notice to accurately define consumption in Canada as well as the end-use pattern. There are many different chemical distributors in Canada and without contacting each of the major phthalate manufacturers directly it is difficult to ascertain exactly whom they utilize as distributors in Canada. This is particularly important with respect to the Asian phthalate manufacturers that are supplying the Canadian market since they would likely rely to a greater extent on chemical distributors in Canada versus supplying their phthalates directly to end-users in Canada (as is often the case for North American manufacturers of various chemicals). Since China, South Korea and Taiwan represent almost 20% of the imports of phthalates into Canada, understanding who the distributors are of these phthalates is important to ensure that comprehensive information is obtained through the section 71 responses.

The vast majority of phthalates are consumed in the PVC sector, which is not that large in Canada. Many of the key companies in the PVC sector have been outlined in the main body of this report. However a greater uncertainty relates to the extent that these phthalates are consumed outside of the PVC sector. Gathering this information will be more difficult for Environment Canada because of the expected large number of potential end-users across a range of diverse sectors and the expected small volumes that are consumed by individual facilities. This issue is more problematic for certain phthalates that are primarily consumed outside of the PVC sector. For instance, DMP and DIBP are expected to have large percentages of their consumption potentially occurring outside of PVC. Gathering information on end-users within the PVC sector is more straightforward given that it is only one “sector” with not an exhaustive amount of potential end-users in

the key segments (e.g. wire and cable, flooring, etc.) and it is also represented by an active industry association (i.e. the Canadian Plastics Industry Association).

1.4 Potential Challenges for Collection of Data on Substances

Chapter 6 contains a more detailed discussion of the potential challenges for the collection of data on phthalates that were determined during the course of the study as well as our recommendation for addressing those challenges. Only those challenges that are considered of higher importance are discussed here in the Executive Summary.

The most challenging aspect of the process of informing relevant phthalate manufacturers/distributors of the section 71 notice is the supply of phthalates from Asian sources. Based on import data for phthalates, it appears that approximately 10-20% of the market for phthalates in Canada is supplied by Asian phthalate manufacturers. These manufacturers would typically rely to a greater extent on chemical distributors to sell their products versus supplying end-users directly themselves. In past studies, Cheminfo has identified relatively obscure Canadian chemical distributors that have aligned themselves with Chinese chemical manufacturers to supply plastic additives to the market in Canada. Therefore the challenge for Environment Canada is to ensure that the supply of these phthalates manufactured in Asia are being reported comprehensively through the section 71 notice. To reduce the risk that these Asian imports are unaccounted for through the section 71 responses, Environment Canada could undertake the following:

- Conduct research to identify the major manufacturers of phthalates in China, South Korea and Taiwan (some of which were identified in this report) and determine if/who they have established as their Canadian distributors;
- Contact the Canadian Border Services Agency to determine if Environment Canada could get access to information on the origin and destination company for imported phthalates from Asia;
- Based on the above two actions, communicate directly with the identified Canadian distributors (for Asian manufactured phthalates) informing them of the section 71 notice on phthalates; and
- Arrange for the Canadian Association of Chemical Distributors to inform their members of the phthalate section 71 notice.

The more challenging aspect of communicating with phthalate end-users will be the non-PVC end-users of phthalates in Canada. These non-PVC end-users are distributed across several sectors and include hundreds (potentially thousands) of potential end-users. The problem is exacerbated by the fact that usage of phthalates in these sectors is likely restricted to a small percentage of the companies and that these companies will generally consume small quantities of phthalates. To assist in maximizing responses from relevant

end-users in these non-PVC sectors, it is recommended that Environment Canada undertake the following:

- Arrange for the respective industry associations to inform their members of the phthalate section 71 notice and how to obtain it. These associations include the Canadian Cosmetic, Toiletry and Fragrance Association, Canadian Paints and Coatings Association, Rubber Association of Canada, Canadian Printing Ink Manufacturer's Association and the Adhesives and Sealants Manufacturers Association of Canada; and
- The contacts that Environment Canada established with the distributors of phthalates in Canada can also be beneficial in communicating with phthalate end-users. These distributors could be asked to communicate with their customers informing them of the phthalate section 71 notice and that they should review the notice to see if they meet the thresholds for submitting data to the federal government.

In terms of potential modifications to the current draft of the section 71 notice for phthalates, Cheminfo has recommended that Environment Canada:

- be as transparent as possible in the section 71 notice in terms of describing each of the fourteen phthalates. This would include multiple CAS numbers and multiple common names if relevant for specific substances as well as identifying the acronym that is likely the most commonly used identifier for the various phthalates.
- consider requiring all distributors of phthalates to respond to the section 71 notice with relevant information (irrespective of whether they import phthalates or not). Distributors are important links in the movement of phthalates from manufacturers to end-users and often are key to understanding the complete picture with respect to consumption of specific substances in Canada. Not all chemical distributors are importers and therefore they would not be subject to the current section 71 notice.
- consider requiring that the actual product or brand names be collected through the section 71 response. For instance, this would require importers and end-users to explicitly indicate that they are importing/using Jayflex™ DINP instead of just DINP. The current section 71 notice only requires that the "common or generic name…." of the substance be reported. It is unclear whether this means that "Jayflex® DINP" or just "DINP" would be reported. Attaching product/brand names to the manufacture, importation and end-use facilitates the tracking of the flow of phthalates from manufacture to end-use, since ExxonMobil's DINP product (Jayflex™ DINP) can be distinguished from BASF's DINP product (e.g. Palatinol® N) or PolyOne's DINP product (e.g. Synplast® DINP-N). If only DINP is reported by importers, distributors or end-users, it can be unclear which manufacturer produced the phthalate. Again this assists in understanding the flow of phthalates from manufacture to end-use.

2. Introduction

2.1 Background

The Government of Canada's Chemicals Management Plan (CMP) is part of the Government's comprehensive environmental agenda and is managed jointly by Environment Canada and Health Canada. In October 2011, the Government of Canada announced the launch of the second phase of the CMP to continue its commitment to protecting the health and environment of Canadians. As part of the second phase of the CMP, approximately 500 substances in nine groups have been identified as priorities for action (i.e. the Substance Groupings Initiative). These nine groups of substances will be further assessed and managed for potential risks to human health and the environment.

Table 4: Timing of the Issuance of Section 71 Survey Notices in Support of the Substance Groupings Initiative

Grouping	Initial Section 71 Launch
Aromatic azo and benzidine based substances	December 2011
Substituted diphenylamines	June 2012
Cobalt-containing substances	June 2012
MDI/MDAs	June 2012
Internationally classified substances	June 2012
Selenium-containing substances	December 2012
Certain organic flame retardants	December 2012
Phthalates	April 2013
Boron-containing substances	April 2013

Section 71 of the *Canadian Environmental Protection Act, 1999* (CEPA 1999) gives the authority to the Minister of the Environment to publish a notice requiring any person described therein to provide information to the Government for the purpose of assessing whether a substance is toxic or capable of becoming toxic. Information gathering, through the issuance of Section 71 survey notices in the *Canada Gazette* for these substance groupings was initiated in December 2011. As outlined in the table above, the section 71 survey notice for phthalates and boron-containing substances is scheduled to be published in April, 2013 (while the section 71 survey notice for selenium-containing substances has been delayed from its original scheduled date of December, 2012).

The other substance grouping that has had its section 71 survey notice scheduled towards the end of this process is the "certain organic flame retardants" grouping. However, Cheminfo already conducted a detailed study[2] for Environment Canada on all nine substances in this grouping, covering such issues as manufacture and import, use profile, international risk assessment and risk management measures and substitutes and alternatives. Therefore Environment Canada is now interested in collecting information on the other three substance groupings that have had their section 71 survey notice scheduled towards the end of the information collection process, specifically selenium-containing substances, boron-containing substances and phthalates.

In order to facilitate stakeholder engagement and inform the design of the information gathering initiatives (i.e. section 71 survey notices), key information on the substances is needed to supplement information already identified in the target substance groupings profiles. Therefore the impetus of this project has been the collection of information on the three substance groupings (i.e. selenium-containing substances, phthalates, boron-containing substances) that have not had their section 71 notice published in the *Canada Gazette* in order to better inform the development of this information collection mechanism. It is critical to understand these substance groupings such that informed decisions can be made on the design of survey instruments (e.g. section 71 survey notices), which consequently lead to the collection of the desired information to support the analyses of these substances and the eventual (potential) development of risk management instruments to mitigate their use/release. Therefore since five of the substance groupings have already had their section 71 notice issued, this project is focused on three substance groupings where Environment Canada may still have flexibility with respect to the design of upcoming information collection mechanisms from industry and other interested parties.

2.2 Project Objectives

Environment Canada now requires a summary of publicly available scientific literature and data on substances in upcoming grouping initiatives to better inform early stakeholder engagement and the development of information gathering approaches under the CMP. The target substance groupings for this information are: (i) selenium-containing substances; (ii) phthalates; and (iii) boron-containing substances.

Note that two other final reports have been submitted to Environment Canada in support of this project – one on selenium-containing substances and one on boron-containing substances.

[2] Cheminfo Services, *Use Profile Characterization for Certain Organic Flame Retardants Under the Chemicals Management Plan*, March, 2012.

The specific objectives of the study are to:

1. conduct a search of and compile data for the substances for each of the Target Substance Groupings.
2. complete an analysis of the information on substances that are regulated by other jurisdictions and compare to Canada's data needs.
3. identify any potential issues and concerns regarding data collection as well as identify information on human health and ecological concerns for substances in the target substance groupings.

2.3 Methodology

The information contained in this report was entirely developed based on literature sources. A wide range of literature sources and websites were utilized during the study. Among the most important sources of information were the websites of the major North American and European manufacturers of phthalates, which were all reviewed in order to identify the product range that they offer, end-use applications, manufacturing locations, etc.

In order to identify manufacturers of the various phthalates, the Hazardous Substances Data Bank and the U.S. Environmental Protection Agency's Inventory Update Rule websites were reviewed. The websites of various relevant industry associations, for instance the Phthalate Esters Panel of the American Chemistry Council and the European Council for Plasticisers and Intermediates (ECPI) were reviewed as well as websites that have been developed by the ECPI for specific phthalates.

There were two databases established by Canadian federal government departments that were utilized during the study, specifically the Canadian International Merchandise Trade Database (Statistics Canada) and the Canadian Importers Database (Industry Canada).

A range of environmental risk assessment documents on various phthalates that have been completed in the U.S., European Union, Japan and Australia were reviewed. In particular, the U.S. Consumer Product Safety Commission (CPSC) has recently completed several analyses of individual phthalates and all available documents from the CPSC on the phthalates of interest in this study were reviewed.

There have been various plastic additive handbooks that have been developed, including handbooks specifically on plasticizers. These industry references were reviewed during the study for relevant information.

Cheminfo has conducted previous work on plasticizers and phthalates and our previous reports, background information and files in general were reviewed for relevant information to support the objectives of this study.

Finally, a Google® search was conducted for phthalates in general as well as for the specific phthalates under consideration in this study. Several previously unknown information sources were identified using this research strategy.

2.4 Structure of the Final Report

There are five additional chapters in this report. Chapter 3 provides a broad overview of phthalates, covering such issues as the North American, European and global manufacturers of phthalates, estimated market demand for phthalates in general as well as for individual phthalates, end-use applications for phthalates, international trade in phthalates in Canada, initial perspective on end-users of phthalates in Canada and the range of organizations that would be most interested in future activities on phthalates at Environment Canada.

Chapter 4 contains individual profiles for all 14 phthalates that are included in the Substance Groupings Initiative. These profiles vary in detail depending upon the extent of the information that could be located on the individual phthalates. However in general, the profiles cover the manufacturing process, actual manufacturers, market demand and end-use applications for the various phthalates. Chapter 5 provides an analysis of the information gaps that after completing the study were determined to still exist. These information gaps were considered in context of Environment Canada's upcoming Section 71 notice on phthalates to be published in the *Canada Gazette*.

Chapter 6 provides conclusions and recommendations to assist Environment Canada in gathering information through their section 71 notice on phthalates. These recommendations and conclusions are generally related to ensuring that the relevant organizations are made aware of the upcoming Section 71 notice as well as industry and product-specific characteristics that should be taken into consideration when finalizing the section 71 notice. Chapter 7 contains the bibliography for the study, identifying those past literature sources that were referenced in the final report.

There were two other deliverables submitted to Environment Canada in support of this project (outside of this final report). An Excel spreadsheet was developed that identifies the various common names, synonyms, CAS numbers, product names and other identifiers for the various phthalates. In addition, a compendium of exposure studies for phthalates and in particular the 14 phthalates under consideration was compiled and provided electronically to Environment Canada at the conclusion of the study.

3. Overview of the Manufacture and Use of Phthalates and Other Relevant Organizations

3.1 North American and Global Phthalate Manufacturers

Phthalates are manufactured by reacting phthalic anhydride with alcohol(s) which range from methanol and ethanol (C1/C2) up to tridecyl alcohol (C13), either as a straight chain or with some branching.[3]

There are few manufacturing facilities for phthalates located in Canada or the U.S. Outlined in the table below are the known phthalate manufacturing facilities in these two countries. In Canada, there are only three plasticizer manufacturing facilities, specifically BASF (Cornwall, ON) and PolyOne (Orangeville, ON and St-Remi, QC). Without contacting each of these Canadian facilities, it is not possible to determine if they do in fact manufacture phthalates. However, PolyOne's only plasticizer manufacturing facilities in the U.S. or Canada are their two locations in Canada. Since PolyOne does manufacture phthalates, it is likely that one or both of these Canadian facilities manufacture phthalates (including some listed on CMP II). The BASF facility in Cornwall, ON is a specialty plasticizer plant and it is believed they manufacture phthalate plasticizers at this facility since the facility reports releases of dioctyl phthalate (CAS 117-81-7) to the National Pollutant Release Inventory.

Table 5: Manufacturers of Phthalates in the U.S. and Canada

Company	Location
ExxonMobil Chemical	Baton Rouge, LA
BASF	Pasadena, TX; Cornwall, ON
Eastman Chemical	Kingsport, TN
Unitex Chemical Corporation	Greensboro, NC
Vertellus Specialties	Greensboro, NC
PolyOne	St Remi de Napierville, QC Orangeville, ON
Ferro Corporation	Bridgeport, NJ
Dystar® Group	Reidsville, NC

Source: Cheminfo Services

[3] Accessed at the website of the Plasticizers and Flexible PVC Information Centre (www.plasticizers.org).

In the U.S., ExxonMobil, BASF and Eastman Chemical are the largest producers of plasticizers and phthalates (ExxonMobil and BASF are believed to produce more phthalates than Eastman Chemical). Smaller phthalate manufacturers in the U.S. are Ferro Corporation, Unitex Chemical Corporation, Vertellus Specialties and Dystar® Group. There are other plasticizer manufacturing facilities in the U.S., however they are not producing phthalates, For instance, Eastman Chemical purchased the former Sterling Chemicals, Inc. operation (located in Texas City, Texas) in mid-2011, which is now exclusively producing non-phthalate plasticizers.

There may be other manufacturing locations for phthalates in the U.S. that are not listed in the table above (although all of the Canadian operations are accounted for). However the facilities outlined in the table above are expected to represent the vast majority (i.e. 90-100%) of phthalate production in the U.S. and Canada combined. As outlined in the exhibit below, ExxonMobil, Eastman Chemical and BASF are the three largest producers of plasticizers in the "Americas", with these same companies accounting for three of the top four positions in Europe, the Middle East and Africa (EMEA), with Evonik being the addition to the list for EMEA. Meanwhile it can be seen that Asia dominates all other regions of the world in terms of plasticizer production.[4] It has been estimated that Asia has 65% of the global plasticizer capacity.[5] As phthalates represent the vast majority of plasticizer production, each of these Asian companies is expected to produce large quantities of phthalates. For instance, manufacturers of DIDP and DINP outside of North America/Europe include Nan Ya and UPC.[6]

[4] ExxonMobil Chemical (July 16, 2009), *Plasticizers and the CPSIA*, presentation to the U.S. Consumer Product Safety Commission.
[5] BASF (July 10-13, 2011), *Plasticizer Market Update*, presented at the SPI Vinyl Products Division 22nd Annual Vinyl Compounding Conference.
[6] ExxonMobil Chemical (July 16, 2009), *Plasticizers and the CPSIA*, presentation to the U.S. Consumer Product Safety Commission.

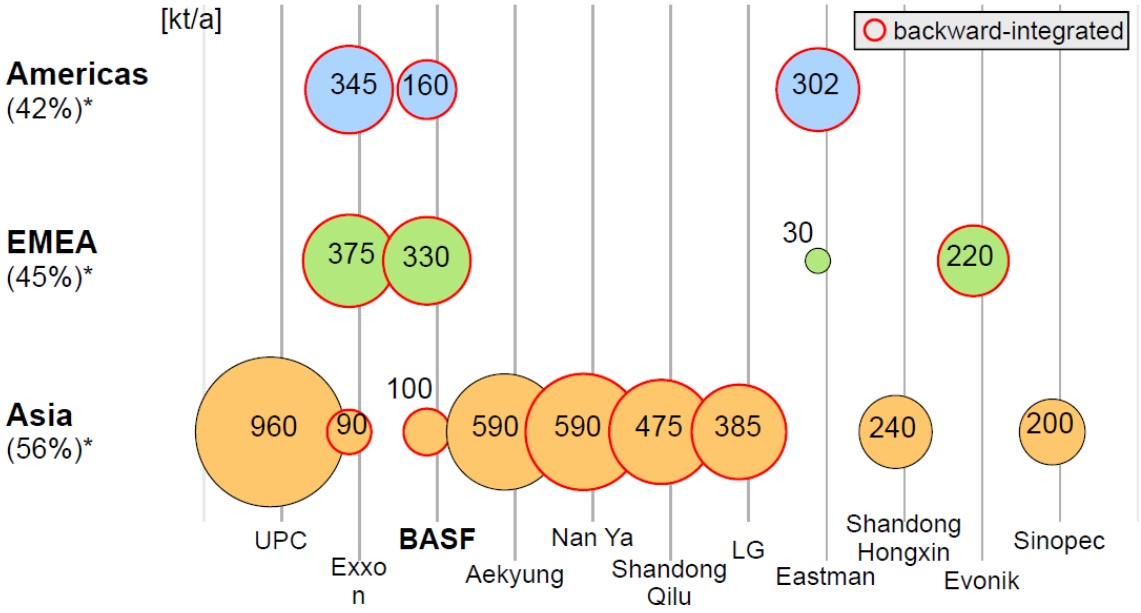

Figure 1: Major Global Producers of Plasticizers (2010)

Source: BASF (July 10-13, 2011), *Plasticizer Market Update*, presented at the SPI Vinyl Products Division 22nd Annual Vinyl Compounding Conference.

Market consolidations have been occurring in the North American plasticizer market, with the aforementioned purchase of Sterling Chemicals by Eastman Chemicals. In 2010, Eastman Chemical also acquired Genovique Specialties Corporation, which was a plasticizer manufacturer in Chestertown, Maryland. Genovique was previously known as Velsicol Chemical Corp. until it was re-branded as Genovique in 2008. Outlined in the table below is the most current information available on the production capacities for plasticizers in North America. Note that not all of this capacity is attributed to phthalates as non-phthalate plasticizers are continuously increasing their market share of the total plasticizer market.

Table 6: Estimated North American Plasticizer Production, by Company (2010)

(published ester capacities in kilotonnes)

Company	Annual Production Capacity
ExxonMobil	345
Eastman Chemical	302
BASF	160
Ferro	95
Teknor Apex	50
Others	180
Total	1,132

Source: adapted from BASF (July 10-13, 2011), *Plasticizer Market Update*, presented at the SPI Vinyl Products Division 22nd Annual Vinyl Compounding Conference.
Note: there is no information on Teknor Apex's website that indicates that they are still producing phthalate plasticizers. In addition, the Phthalate Esters Panel of the American Chemistry Council indicates that Teknor Apex is a user of phthalates and apparently no longer a manufacturer.

Research was conducted during the study to identify the North American manufacturers of the various phthalates contained in the Substance Groupings Initiative. As would be expected, there are only a handful of companies that are manufacturing the various phthalates, with the companies identified above quite prevalent on the list. It should be noted that there are four phthalates listed under the Substance Groupings Initiative that based on research conducted during this study appear not be commercially produced.

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Table 7: North American Manufacturers of the Phthalates Listed Under the Substance Groupings Initiative

Phthalate	Common Name	Acronym	CAS	Manufacturers	Location	Product Name
1,2-Benzenedicarboxylic acid, dicyclohexyl ester	Dicyclohexyl Phthalate	DCHP	84-61-7	Unitex Chemical Corp. Vertellus Specialties, Inc	Greensboro, NC Greensboro, NC	Uniplex 250/Uniplex 250M Morflex®150
1,2-Benzenedicarboxylic acid, butyl cyclohexyl ester	Butyl Cyclohexyl Phthalate	BCHP	84-64-0	Unitex Chemical Corp. Dystar® Group	Greensboro, NC Reidsville, NC	BCHP Novaflex BCHP
1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester	Diisobutyl Phthalate	DIBP	84-69-5	Unitex Chemical Corp.	Greensboro, NC	Uniplex 155
1,2-Benzenedicarboxylic acid, dimethyl ester	Dimethyl Phthalate	DMP[1]	131-11-3	Unitex Chemical Corp.	Greensboro, NC	Uniplex 110
1,2-Benzenedicarboxylic acid, bis(phenylmethyl) ester	Dibenzyl Phthalate	DBenzP	523-31-9	---	---	---
1,2-Benzenedicarboxylic acid, diundecyl ester	Diundecyl Phthalate	DUP[2]	3648-20-2	ExxonMobil Chemical BASF PolyOne	Baton Rouge, LA Pasadena, TX and/or Cornwall, ON Orangeville, ON and/or St. Remi, QC	Jayflex™ L11P-E Palatinol® 111P-I Synplast® DUP-E
1,2-Benzenedicarboxylic acid, cyclohexyl 2-methylpropyl ester	Cyclohexyl Isobutyl Phthalate	CHIBP	5334-09-8	---	---	---
1,2-Benzenedicarboxylic acid, 2,2-dimethyl-1-(1-methylethyl)-3-(2-methyl-1-oxopropoxy)propyl phenylmethyl ester	Texanol® Benzyl Phthalate	B84P	16883-83-3	Ferro Corporation	Bridgeport, NJ	Santicizer® 278

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Phthalate	Common Name	Acronym	CAS	Manufacturers	Location	Product Name
1,2-Benzenedicarboxylic acid, diisodecyl ester	Diisodecyl Phthalate	DIDP[3]	26761-40-0	ExxonMobil Chemical PolyOne	Baton Rouge, LA Orangeville, ON or St. Remi, QC	Jayflex™ DIDP/Jayflex™ DIDP-E Synplast® DIDP-Electrical/Synplast® DIDP Normal
1,2-Benzenedicarboxylic acid, isooctyl phenylmethyl ester	Benzyl Isooctyl Phthalate	BIOP	27215-22-1	---	---	---
1,2-Benzenedicarboxylic acid, bis(methylcyclohexyl) ester	Dimethyl Cyclohexyl Phthalate	DMCHP	27987-25-3	Emery Oleochemicals	(potentially manufactures in North America, but likely in Asia)	Edenol® 344
1,2-Benzenedicarboxylic acid, diisononyl ester	Diisononyl Phthalate	DINP	28553-12-0	ExxonMobil Chemical BASF PolyOne	Baton Rouge, LA Pasadena, TX and/or Cornwall, ON Orangeville, ON and/or St. Remi, QC	Jayflex™ DINP Palatinol® N/Palatinol® N-I/Palatinol® N-E Synplast® DINP-N; Synplast® DINP-E; Synplast® Mixed Phthalate
1,2-Benzenedicarboxylic acid, benzyl C7-9-branched and linear alkyl esters	Benzyl Octyl Phthalate	B79P	68515-40-2	Ferro Corporation	Bridgeport, NJ	Santicizer® 261
1,2-Benzenedicarboxylic acid, di-C_{6-8}-branched alkyl esters, C_7-rich	Diisoheptyl Phthalate	DIHepP[4]	71888-89-6	---	---	---

[1] historical producers of DMP believed to include Eastman Chemical (Kingsport, TN) and Velsicol Chemical Corp (Chestertown, MD).
[2] historical producers of DUP believed to include Eastman Chemical (Kingsport, TN), Sterling Chemicals (Texas City, TX), Georgia Gulf Chemicals and Vinyls (Aberdeen, MS) and Teknor Apex (Brownsville, TX).
[3] historical producers of DIDP believed to include Hatco Corp (Fords, NJ) and Sunoco (Neville Island, PA).
[4] historical producers of DIHepP believed to include ExxonMobil Chemical (Baton Rouge, LA).
Source: Cheminfo Services

3.2 Market for Plasticizers and Phthalates

The estimated world consumption of plasticizers in 2011 was 6.4 million tonnes, with an estimated 95% of plasticizers used in flexible PVC. Phthalates represent 87% of this volume, with non-phthalates representing 13%. In Asia, Di(2-ethylhexyl)phthalate (DEHP) remains the largest product, but diisononyl phthalate (DINP) demand is increasing quickly. There is also significant and rapid growth in demand for non-phthalates for exported articles from Asia (due to restrictions on phthalate usage in Europe and North America). The overall trend in the world market for plasticizers is that there is steady global growth driven by emerging economies.[7]

Table 8: Global Demand for Plasticizers (2011)

(million tonnes)

Region	Plasticizer Consumption
North America	0.8
Europe	1.0
Asia Pacific	3.5
Latin America	0.3
Rest of World	0.8
Total	6.4

Source: Eastman Chemical (July, 2012), *Global Plasticizer Update*, presented at the SPI Flexible Vinyl Products Conference.

The North American plasticizer market is dominated by the U.S., which represents an estimated 87% of North American sales. As Canada represents an estimated 7% of annual North American sales, this would equate to an annual market for plasticizers in Canada of approximately 56,000 tonnes. As noted above, phthalates represent 87% of total global plasticizer consumption. If this percentage also applies to Canada, then annual phthalate consumption in Canada could be estimated to be approximately 49,000 tonnes.

[7] Eastman Chemical (July, 2012), *Global Plasticizer Update*, presented at the SPI Flexible Vinyl Products Conference.

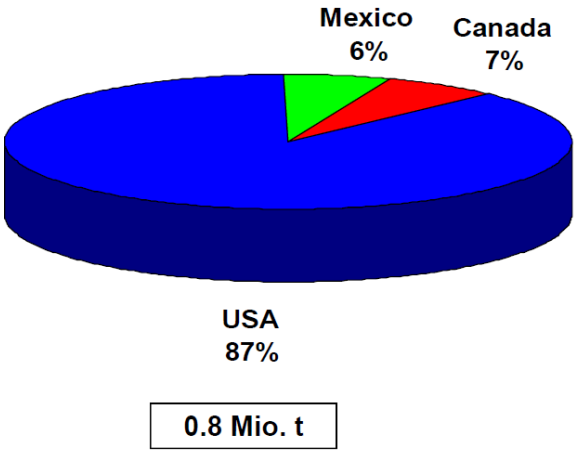

Figure 2: Distribution of the North American Plasticizer Market

Source: BASF (July 10-13, 2011), *Plasticizer Market Update*, presented at the SPI Vinyl Products Division 22nd Annual Vinyl Compounding Conference.

3.2.1 Categories of Phthalate Plasticizers

Today about 80 PVC plasticizers are available in the U.S., of which approximately 20 are phthalates.[8] For phthalate esters, the plasticizer range extends from esters prepared from C1 alcohols to C13 alcohols.[9] Phthalates can be segmented into high molecular weight phthalates and low molecular weight phthalates,[10] based on the number of carbons in their alcohol chain. High molecular weight phthalates include those with more than six carbons in their backbone (i.e. those with 7-13 carbon atoms in their chemical backbone), which gives them increased permanency and durability. Low molecular weight phthalates are those with only 3-6 carbon atoms in their chemical backbone.[11] C1 to C3 phthalate esters are solvents, not generally PVC plasticizers. Because of high volatility, C4-C6 phthalate esters are no longer used as PVC plasticizers in most countries. C4 phthalates (i.e. Di-n-butyl phthalate - DBP) find some specialty uses as solvents, but its use is declining.[12]

[8] Godwin, Allen. (August 24, 2011), *Uses of Phthalates and Other Plasticizers*, presentation at the U.S. EPA's DfE Kickoff Meeting Phthalates Alternatives Assessment.
[9] Ibid.
[10] ExxonMobil (July 16, 2009), *Plasticizers and the CPSIA*, presented to the U.S. Consumer Product Safety Commission.
[11] Accessed at the website of the Plasticizers and Flexible PVC Information Centre (www.plasticizers.org).
[12] Godwin, Allen. (August 24, 2011), *Uses of Phthalates and Other Plasticizers*, presentation at the U.S. EPA's DfE Kickoff Meeting Phthalates Alternatives Assessment.

Table 9: Examples of Phthalate Esters: Alkyl Group Carbon Chain Length

Carbon Chain Length	Acronym	Common Name
C1	DMP	Dimethyl Phthalate
C2	DEP	Diethyl Phthalate
C3	DMeOEP	Dimethoxyethyl Phthalate
C4	DBP DIBP BBP	Di-n-butyl phthalate Diisobutyl phthalate Butyl benzyl phthalate
C5	DPP	Di-n-propyl phthalate
C6	DHP	Diisohexyl phthalate
C7	DIHP	Diisoheptyl phthalate
C8	DEHP	Di(2-ethylhexyl) phthalate
C9	DINP	Diisononyl phthalate
C10	DIDP DPHP	Diisodecyl phthalate Di(2-Propyl Heptyl) phthalate
C11	DUP	Diundecyl phthalate
C13	DTDP	Ditridecyl phthalate

Source: Eastman Chemical (July, 2012), *Global Plasticizer Update*, presented at the SPI Flexible Vinyl Products Conference.

Note:

C1-C2 phthalates – typically used in non-PVC applications. Their high volatility make them unsuitable for flexible PVC applications.

C3-C6 phthalates – used in applications where high solvating plasticizers and stain resistance are required for example, foamed leather cloth and flooring.

C7-C10 phthalates – most widely used general purpose plasticizers employed in applications such as wire and cable, geomembranes, roofing membranes, truck tarpaulins, coated fabrics, wall covering and flooring.

C11-C13 phthalates – used where high temperature performance or low fogging is required, for instance in car interiors or in automotive cables. [13]

In Europe, high molecular weight phthalates (e.g. DINP, DIDP, DPHP, diisoundecyl phthalate - DIUP and DTDP) represent just over 80% of all the phthalates currently being produced. Meanwhile low molecular weight phthalates (e.g. DBP, DIBP and BBP) represent about 15% of the European market. Three of these low molecular weight phthalates (i.e. DBP, BBP and DEHP) were included in Annex XIV of the REACH regulation in February, 2011 and will be phased out in the European Union by February

[13] Accessed at the website of the Plasticizers and Flexible PVC Information Centre (www.plasticizers.org).

2015 unless an application for authorisation is made before July, 2013 and an authorisation granted (DIBP is still on the REACH Candidate List for Authorisation).[14]

Plasticizers can also be divided into general purpose plasticizers and specialty plasticizers. General purpose plasticizers: (i) offer the optimized balance of performance and costs; (ii) offer flexibility at the lowest cost; (iii) provide good low temperature properties and acceptable volatility; (iv) can be used with a variety of processing techniques; and (v) are usable in almost every market segment. Meanwhile specialty plasticizers: (i) impart one or more special properties but may offer compromised properties in other areas; (ii) are unavailable in sufficient quantities or at competitive pricing to supply a large portion of the flexible PVC market; and (iii) cannot be used in all or most flexible PVC processing techniques because of its physical form.[15]

3.2.2 Identification of High-Volume Phthalates

Only a subset of the above-noted 20 phthalates achieve general plasticizer status and therefore are consumed in high volumes. As outlined in the exhibit below, the largest consumed phthalates are DINP, DIDP, DPHP, DEHP (also known as DOP), dioctyl terephthalate (DOTP) and BBP.[16] Of these, two are listed under the federal government's Substance Groupings Initiative, specifically DINP and DIDP.

[14] Ibid.
[15] Godwin, Allen. (August 24, 2011), *Uses of Phthalates and Other Plasticizers*, presentation at the U.S. EPA's DfE Kickoff Meeting Phthalates Alternatives Assessment.
[16] Ibid.

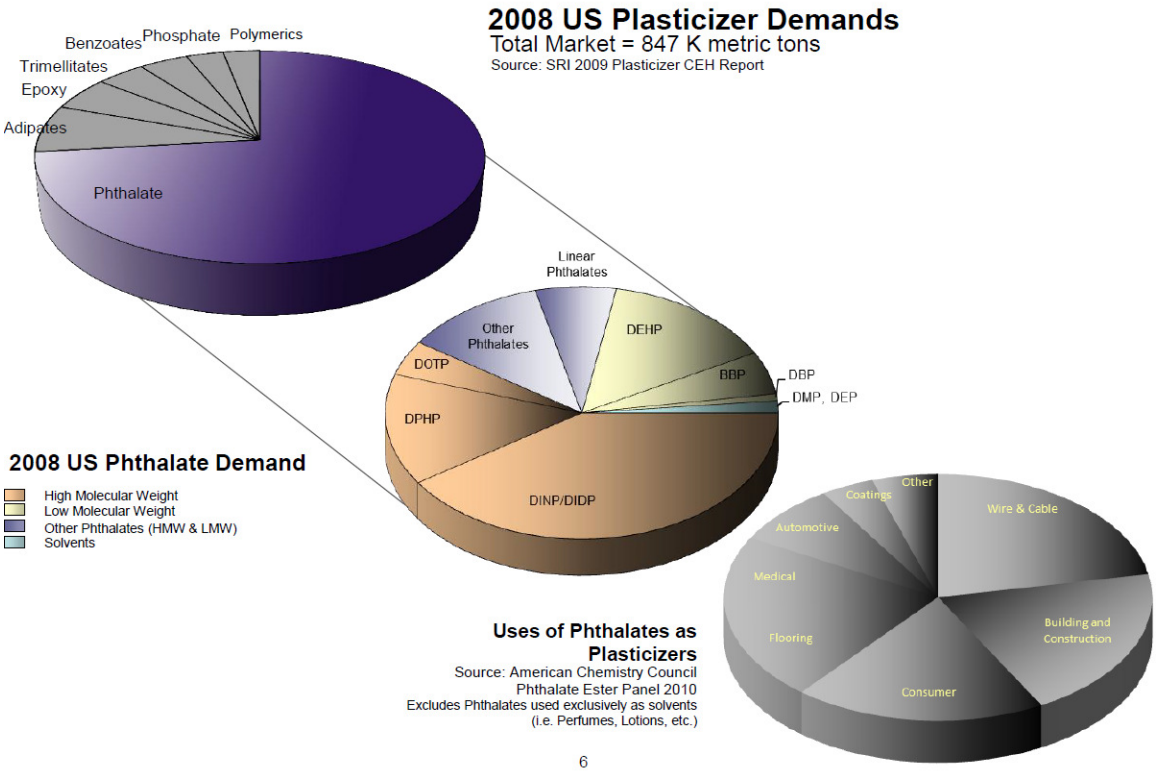

Figure 3: 2008 Plasticizer Demand in the U.S.

Source: Godwin, Allen. (August 24, 2011), *Uses of Phthalates and Other Plasticizers*, presentation at the U.S. EPA's DfE Kickoff Meeting Phthalates Alternatives Assessment.

The fourteen phthalates commonly in domestic use today include: (i) DMP; (ii) DEP; (iii) DBP; (iv) DIBP; (v) BBP; (vi) DIHP; (vii) DEHP; (viii) diisooctyl phthalate (DIOP); (ix) DINP; (x) DIDP; (xi) DUP and DIUP; (xii) DTDP; (xiii) DPHP; and (xiv) various linear phthalates. Of those fourteen phthalates, all except DMP, DEP, and DBP are primarily used to plasticize PVC without sacrificing its durability. These fourteen phthalates account for 98% of the phthalates used domestically today in the U.S. About 70% of that phthalate market is comprised of DINP, DIDP, DPHP and DEHP.[17] Of these fourteen phthalates, DMP, DIBP, DINP, DIDP and DUP are contained on the list of phthalates under the Substance Groupings Initiative.

Of the phthalate plasticizers consumed globally, DEHP represents approximately 54%, DINP 27%, DPHP and DIDP were 11% and all others represented the remainder.

[17] American Chemistry Council (January 12, 2009), *Section 108 of the Consumer Product Safety Improvement Act: Phthalates in Children's Products; Request for Comments and Information*, submitted to the Consumer Product Safety Commission.

Identified trends are the replacement of DEHP (DOP) with C9/C10 phthalates.[18] Another identified trend is that plasticizer market growth (in North America) is below GDP due to increases in finished good imports. Also European Union REACH regulations are impacting DEHP, BBP and DBP consumption.[19]

Table 10: Regional Demand for Phthalate and Non-Phthalate Plasticizers (2009)

	U.S.	Western Europe	Asia
DEHP (DOP)	19%	16%	60%
C9/C10 Phthalates[1]	33%	63%	21%
Linears/Other Phthalates	19%	6%	9%
Non-Phthalates	28%	16%	10%
Total	100%	100%	100%

[1] includes DINP, DPHP, DIDP.
Source: BASF (July 10-13, 2011), *Plasticizer Market Update*, presented at the SPI Vinyl Products Division 22nd Annual Vinyl Compounding Conference.

3.3 Canadian International Trade in Phthalates

Utilizing the most recent Customs Tariff from the Canadian Border Services Agency, there are three (six-digit) HS codes that cover the entire international trade in phthalates, specifically:

- 291732 – Dioctyl Orthophthalates
    - 2917320020 – Di(2-ethylhexyl) o-phthalate
    - 2917320090 - Other
- 291733 – Dinonyl or Didecyl Orthophthalates
    - 2917330010 – Diisononyl Orthophthalate
    - 2917330090 - Other
- 291734 – Other Esters of Orthophthalic Acid

The 10-digit HS codes specified above provide additional details on specific phthalate plasticizers, in this case DEHP and DINP. As DINP is a CMP II substance, Environment

[18] BASF (July 10-13, 2011), *Plasticizer Market Update*, presented at the SPI Vinyl Products Division 22nd Annual Vinyl Compounding Conference.
[19] ExxonMobil (July 16, 2009), *Plasticizers and the CPSIA*, presented to the U.S. Consumer Product Safety Commission.

Canada may want to purchase the DINP import data from Statistics Canada in order to compare that quantity to what is obtained through any future section 71 information requirement.

Canada operates at a significant trade deficit with respect to phthalates. In 2012, Canada exported just over 8,000 tonnes of phthalates while they imported approximately 23,500 tonnes. This resulted in a trade deficit of approximately 15,400 tonnes.

Table 11: Canadian Trade Balance in Phthalates (2012)

(tonnes)

International Trade	Quantity
Exports	8,087
Imports	23,490
Trade Deficit	(15,403)

Source: Statistics Canada, Canadian International Merchandise Trade Database.

3.3.1 Exports of Phthalates

As outlined in the table on the following page, the vast majority (i.e. 96.4%) of Canadian exports of phthalates are to the U.S. Hong Kong is the second largest destination for Canadian phthalates, representing just over 3% of exports in 2012.

Table 12: Exports of Phthalates From Canada (2012)

(tonnes)

	HS Code 291734 Other Esters of Orthophthalic Acid	HS Code 291733 Dinonyl or Didecyl Orthophthalates	HS Code 291732 Dioctyl Orthophthalates	Total	Percentage of Total Phthalate Exports
U.S.	6,472	1,235	87	7,794	96.4%
Hong Kong	258			258	3.2%
Germany		19		19	0.2%
Venezuela	13			13	0.2%
France	3			3	<0.1
China	1			1	<0.1
Taiwan		<1		<1	<0.1
Total	6,746	1,254	87	8,087	100%

Source: Statistics Canada, Canadian International Merchandise Trade Database.

3.3.2 Imports of Phthalates

Outlined in the table on the following page is a summary of the imports of phthalates into Canada for 2012, across the three relevant (six-digit) HS codes. In total, there were 23,490 tonnes of imports of phthalates into Canada in 2012. The U.S. is, by far, the leading supplier of phthalates to the Canadian market, representing approximately 72% of the imports of phthalates into Canada in 2012. Asian countries are much smaller, but nevertheless important sources of phthalates for the Canadian market. For instance, combined China, Taiwan and South Korea represented 19.2% of the Canadian imports of phthalates in 2012. The other major origin point for Canadian imports of phthalates is Germany, which represented 6.5% of Canadian imports for 2012.

As with exports, the most significant category for imports is the "catch all" HS code of 291734, which captures all phthalates that are not covered by the other two HS codes.

It is important to note that starting in 2012, the list of phthalates was consolidated under the above noted three (six-digit) HS codes. Prior to 2012, there was significantly more detailed import (and export) data available on individual phthalates, including one additional phthalate listed under the Substance Groupings Initiative (e.g. DIDP). Therefore Environment Canada may want to consider obtaining this historical import data on DIDP in order to compare it to what is obtained through any future section 71 responses. To summarize, individual phthalate import data appears to be available for two CMP II phthalates, specifically DINP and DIDP (only from 2011-backwards).

Table 13: Imports of Phthalates into Canada (2012)

(tonnes)

	HS Code 291734 Other Esters of Orthophthalic Acid	HS Code 291733 Dinonyl or Didecyl Orthophthalates	HS Code 291732 Dioctyl Orthophthalates	Total	Percentage of Total Phthalate Imports
U.S.	15,258	1,163	411	16,832	71.7%
China	582	1,255	28	1,865	7.9%
Germany	1,461	61	1	1,523	6.5%
Taiwan	316	1,077		1,393	5.9%
South Korea	441	86	741	1,268	5.4%
Italy		268	2	270	1.1%
India	74	44		118	0.5%
Belgium			100	100	0.4%
Canada	1	49	25	75	0.3%
Poland	24			24	0.1%
Japan	11	<1		11	<0.1
France	3			3	<0.1
Sri Lanka			3	3	<0.1
Chile			2	2	<0.1
Thailand			1	1	<0.1
Other	<1		2	2	<0.1
Total	18,171	4,004	1,315	23,490	100%

Source: Statistics Canada, Canadian International Merchandise Trade Database.

Outlined in the table below are the major Canadian importers of two of the three relevant phthalate (six-digit) HS codes. One HS code (i.e. HS Code 291733 - Dinonyl or Didecyl Orthophthalates) did not have any publicly available information in the Canadian Importers Database. As expected, major phthalate manufacturers are represented on the list of major Canadian importers (i.e. BASF Canada, Eastman Chemical Canada, PolyOne Canada, Evonik Degussa). There are several chemical distributors represented on this list as well (i.e. LV Lomas Ltd., Quadra Chemicals Ltd., Univar Canada).

Table 14: Largest Importers of Phthalates in Canada (2011)

HS Code 291734 Other Esters of Orthophthalic Acid	**HS Code 291732 Dioctyl Orthophthalates**
BASF Canada (Mississauga, ON)	BASF Canada (Mississauga, ON)
Canroof Corporation (Toronto, ON)	Eastman Chemical Canada (Kingsport, TN)
Evonik Degussa Canada (Burlington, ON)	LV Lomas Ltd. (Brampton, ON)
I.G. Machine & Fibers (Brampton, ON)	Morgan Foods (Richmond, BC)
RPM Canada (Toronto, ON)	PolyOne Canada (Orangeville, ON)
	Quadra Chemicals Ltd. (Vaudreuil-Dorion, QC)
	Resin Technology LLC (Groton, MA)
	Rocket Leasing (Taber, AB)
	Univar Canada (Edmonton, AB)

Note: HS Code 291734 Other Esters of Orthophthalic Acid - top five importers represent 77.89% of the cumulative value of imports for 2011.
HS Code 291732 Dioctyl Orthophthalates - top nine importers represent 79.38% of the cumulative value of imports for 2011.
Source: Industry Canada, Canadian Importers Database.

In terms of end-users, Canroof Corporation is a roofing shingle manufacturer, RPM Canada manufacturers adhesives, sealants, coatings and other related products and I.G. Machine & Fibers produces roofing accessories. It is unknown why Morgan Foods and Rocket Leasing would appear on the list of major importers of phthalates.

It should be noted that phthalates will also enter Canada already incorporated in PVC compound (as well as finished products). It is impossible to ascertain from publicly available information what particular phthalates are contained in plasticized PVC compound (or finished products) that is entering Canada.

3.4 End-use Applications for Phthalates

Phthalates are the most commonly used plasticisers in the world and are primarily used in PVC applications. For instance in Europe, approximately 93% of all phthalates are used to make PVC soft and flexible. They can be found in a range of everyday items including electrical cables, hoses, flooring, wallcoverings, coated textiles, tablecloths, stationery, luggage, sports equipment, roofing membranes, pool liners, footwear as well as medical devices such as tubing and blood bags and a range of automotive applications.

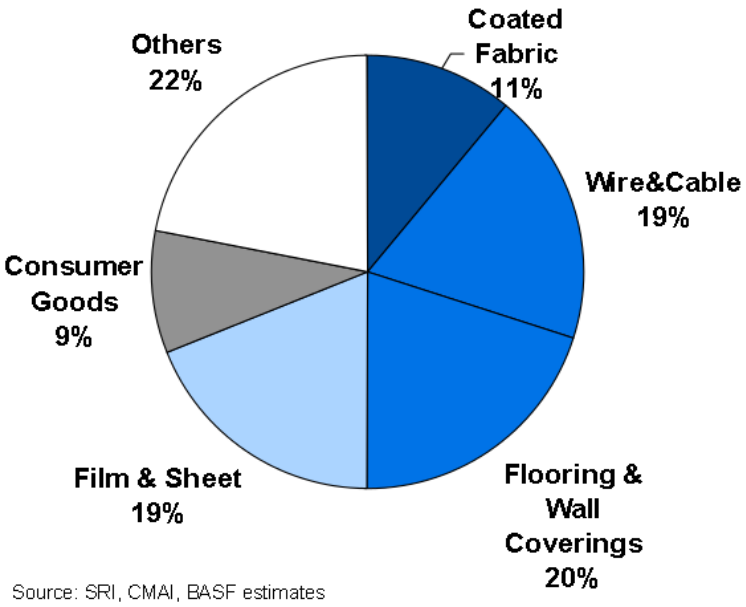

Figure 4: Plasticizer End Use Applications (2010)

Source: BASF (July 10-13, 2011), *Plasticizer Market Update*, presented at the SPI Vinyl Products Division 22nd Annual Vinyl Compounding Conference.

3.4.1 PVC Applications for Phthalates

A brief description of the use of phthalates within their major end-use applications in PVC is as follows:[20]

- Automotive - the average car has more than 1,000 plastic components and roughly 12% of them are made of soft PVC in such application as underbody coatings and sealants, wire harnesses, passenger compartment parts and small exterior trims and fittings.

[20] Accessed at the website of the Plasticizers and Flexible PVC Information Centre (www.plasticizers.org).

- Building and Construction - PVC is the most widely used polymer in building and construction applications and examples of applications containing phthalates (generally high molecular weight phthalates) include cladding and roofing membranes as well as cables, flooring and wall coverings (see below).
- Cables & Wires - plasticised PVC is the most widely used electrical insulation material, not only for protecting wires in thousands of everyday machines and appliances but also as the preferred insulation and sheathing for data transmission cables and fibreoptics. Examples of applications include the use of general purpose high molecular weight phthalates for energy cables used in buildings and for power distribution wiring buried underground which must remain flexible even at low temperatures.
- Flooring - PVC floors can last for up to 20 years of intensive use. Over this period, phthalates guarantee the application's flexibility despite frequent temperature changes.
- Wall Coverings - the success of PVC for wall coverings depends on plasticizers which not only allow the polymer to be soft and flexible but also facilitate key aesthetic, design and hygiene qualities. Vinyl wall coverings are particularly used in heavy traffic areas such as businesses, schools, hotels and hospitals.
- Toys – there are restrictions on the use of phthalates in toys and childcare items (that can be placed in the mouth) on such high molecular weight phthalates as DINP, DIDP and DNOP, although they can still be used in certain applications. Alternatively, low molecular weight phthalates (including DEHP, DBP and BBP) are no longer allowed in any kind of toys and childcare articles.

3.4.2 Non-PVC Applications for Phthalates

Although most phthalates make PVC flexible for a wide variety of uses, a few phthalates are, or have been, used in personal care products, such as perfumes, lotions, and nail polish. The level of phthalates in cosmetics and other similar products is quite small (2% or less of the product). DEP is the most common of the phthalates used in personal care products. It is the lightest in weight of the commonly used phthalates, and is sometimes used in cosmetics, air fresheners, and other products to make fragrances last longer. DBP has been used in nail polish to make it both flexible and resistant to chipping. Restrictions on its use in nail polish and other cosmetics in Europe have caused most manufacturers to eliminate the use of DBP in nail products.[21]

In the European Union, some low molecular weight phthalates (e.g. DBP, DIBP) are no longer able to be used for manufacturing of personal care products (e.g. cosmetics) due to provisions of the European Cosmetics legislation. In North America, low molecular weight phthalates are still permitted, although some companies have voluntarily stopped

[21] Accessed at the website of the Phthalate Esters Panel of the American Chemistry Council (http://phthalates.americanchemistry.com/).

using them. Today, only DMP and DEP are used in cosmetics in the European Union and are used in North America as well.[22]

High molecular weight phthalates are not used in cosmetics simply because their technical properties and molecular structure do not make them suitable for these applications.[23]

Besides cosmetics and personal care products, other non-PVC applications of phthalates include such applications as coatings, rubber products, inks, adhesives and sealants.[24]

3.4.3 U.S. Restrictions on the Use of Phthalates in Specific Applications

In the U.S., the *Consumer Product Safety Improvement Act* (CPSIA), places restrictions on six phthalates in toys and children's products. These restrictions became effective February 10, 2009 and are summarized as follows:[25]

- DEHP, DBP and BBP - there were permanent restrictions, effective February 10, 2009, on the sale of children's toys and childcare articles with concentrations of more than 0.1% of DEHP, DBP or BBP.
- DINP, DIDP and DnOP - CPSIA placed temporary (interim) restrictions, effective February 10, 2009, on the sale of children's toys that can be placed in a child's mouth, and on child care articles that contain more than 0.1% of DINP, DIDP or DnOP. Toys that can be put in the mouth are defined to include toys or parts smaller than five centimeters in one dimension. Toys that cannot be put in the mouth, but can be licked, are not included.

In October 2007, California passed legislation banning the manufacture and sale of toys and child care products that contain levels of six specific phthalates of more than 0.1%. The law went into effect on January 1, 2009. In Washington, a regulation has been established to limit the use of phthalates to 1,000 parts-per-million in toys, cosmetics and jewelry for children under the age of 12, and car seats that are made and sold in the state, effective July 1, 2009.[26]

[22] Accessed at the website of the Plasticizers and Flexible PVC Information Centre (www.plasticizers.org).
[23] Ibid.
[24] Ibid.
[25] Accessed at the website of the Phthalate Esters Panel of the American Chemistry Council (http://phthalates.americanchemistry.com/).
[26] Ibid.

3.4.4 Canadian End-Users for Phthalates

The major Canadian end-users of phthalates will be within the PVC industry in Canada, specifically manufacturers of PVC compound and finished flexible PVC products. Examples of these products include merchant PVC compound, wire and cable, flooring, miscellaneous plastisols, coated fabrics, sheet and a range of other miscellaneous applications. Not all companies within these segments of the PVC industry in Canada will consume phthalates, as there are non-phthalate plasticizers available. In addition, some of these companies will not compound their own PVC and therefore will not import or purchase phthalates, but instead will purchase PVC compound containing the phthalates. Therefore these companies appear not to be consuming phthalates (since they do not purchase pure phthalates), but they in fact are consumers of these plasticizers (contained in the PVC compound).

3.4.4.1 Merchant PVC Compound

PVC resin requires a number of additives to facilitate its processing (in extruders and other plastic processing equipment), and to improve its performance during use. Additives include plasticizers, fillers (e.g., calcium carbonate), heat stabilizers, flame retardants, antioxidants, and pigments. The mixing of these and other ingredients with the solid PVC resin is carried out in blenders and the process is referred to as compounding. Compounding can be carried out internally by PVC plastic processors (referred to as captive PVC compounding) or companies can make PVC compounds for a variety of applications and customers (i.e. these companies do not manufacture finished PVC products). This latter group is referred to as merchant compounders. Compounding (internal or merchant) may involve the use of plasticizers depending on the flexibility desired in the final product. There are only two merchant PVC compounders in Canada, as outlined in the table below.

Table 15: Merchant PVC Compounders in Canada

Company	Location
PolyOne	Orangeville, ON
Reinier Plastics	Marieville, Quebec

Source: Cheminfo interviews.

3.4.4.2 Wire and Cable

PVC resin has suitable dielectric properties for use as wire and cable insulation. Generally, the level of plasticizer is in the 20% range but can vary significantly depending

on whether there are fillers included in the formulation. Major markets for PVC wire and cable include new home construction and telecommunications. There are likely under 30 PVC wire and cable producers in Canada. The smaller ones tend to purchase PVC compounds (e.g. from the merchant compounders), while the larger producers are more likely to make their own PVC compound.

Table 16: PVC Wire and Cable Manufacturers in Canada

Company	Location
General Cable	St. Jerome, QC La Malbaie, QC Moose Jaw, SK
Deca Cables	Trenton, ON
Belden Canada	Cobourg, ON
Cables PTI Cables	Pointe Claire, QC
M.I. Cable Technologies	Calgary, AB
Prysmiam Cables	Prescott, ON St. Jean sur Richelieu, QC
Domtech	Trenton, ON
Electrical Components International	Tillsonburg, ON
Anamet Canada Inc.	Colborne, ON
DSG-Canusa Canada	Huntsville, ON Toronto, ON
Eastern Wire & Conduit	Richmond Hill, ON
Electro Cables Inc.	Trenton, ON
Industrial Thermo Polymers Ltd.	Brampton, ON
Leoni Elocab Limited.	Kitchener, ON
Nexans Canada Inc.	Fergus, ON Montreal, QC Vanier, QC Weyburn, SK
Northern Cables Inc.	Brockville, ON
Shawflex	Rexdale, ON
Southwire Company	Stouffeville, ON
Superior Flexible Conduits Inc.	Colborne, ON
Times Fiber Canada	Renfrew, ON

Source: Cheminfo Services Inc.

3.4.4.3 Flooring

PVC flooring includes homogeneous vinyl tile, fibre-reinforced vinyl composition tiles, vinyl carpetbacking and roll goods. The latter is sheeting that may or may not contain a foam interlayer. There are less than half a dozen producers of PVC flooring in Canada.

Table 17: Major Canadian Producers of PVC Flooring

Company	Location
Armstrong World Industries	Montreal, QC
Domco Torkett Inc.	Farnham, QC
Flextile Ltd.	Etobicoke, ON
Interface	Belleville, ON
American Biltrite	Sherbrooke, QC

Source: Cheminfo Services

3.4.4.4 Miscellaneous Plastisols

PVC can be used in plastisol formulations for dip molding and spraying applications. Products include gloves, wallpaper and other wall coverings, automobile parts coatings, artificial leather, anti-corrosive sealants, wire racks, and other protective coatings. Tank and industrial parts can be coated with PVC plastisols to provide chemical resistance that is required in the chemicals and plating industries. There are dozens of companies that can used vinyl plastisols. Often the quantities of plastisol involved are low.

Table 18: Major Vinyl Plastisol Product Processors in Canada

Company	Location
Best Glove Manufacturing.	Coaticook, QC
Blue Mountain Wall Coverings Ltd.	Mississauga, ON

Source: Cheminfo Services

3.4.4.5 Coated Fabrics

There are few manufacturers of PVC coated fabrics in Canada. The largest known manufacturers in Canada are outlined in the table below.

Table 19: Manufacturers of PVC Coated Fabrics in Canada

Company	Location
Morbern	Cornwall, ON
Naizil Inc.	Bolton, ON
Vintex	Mount Forest, ON
Stedfast	Granby, QC

Source: Cheminfo Services

3.4.4.6 PVC Sheet

There are few companies in Canada making flexible PVC sheet. Canadian General Tower in Cambridge, ON is likely the largest processor in Canada. The calendering process is used for production of flexible sheets used in automotive applications, upholstery, shower curtains, etc. Flexible sheet can also be made using vinyl plastisols solutions that are cured to form the sheet.

3.4.4.7 Non-PVC End-Users

As noted in this report, the vast majority of phthalates are used within the PVC sector. However there are small amounts of phthalates used in the following sectors as well: (i) cosmetic and personal care product manufacturing; (ii) paints and coatings manufacturing; (iii) adhesive and sealant manufacturing; (iv) printing ink manufacturing; and (v) rubber product manufacturing. There are likely other, even smaller end-users of phthalates outside of those sectors listed above. Combined there are hundreds of manufacturers of these products in Canada, any number of which could be consuming phthalates (likely in small quantities). It is expected that the vast majority of companies in these sectors are not consuming any phthalates.

3.5 Other Relevant Interested Organizations

Besides phthalate manufacturers and end-users that were discussed above, there are other interested organizations with respect to the use of phthalates in Canada and any potential restrictions implemented by the federal government. The two most relevant groups (outside of manufacturers and end-users) will be phthalate distributors in Canada as well as industry associations representing the interests of phthalate manufacturers, distributors and end-users. In terms of associations, the table below identifies the most important associations related to the manufacturing, distribution and end-use of phthalates in Canada.

Table 20: Key Industry Associations with an Interest in Phthalates

Stage in Lifecycle	Industry Association	Location	Notes
Manufacture	American Chemistry Council Phthalate Esters Panel	Washington D.C.	• Composed of all major manufacturers and some users of the primary phthalate esters in commerce in the U.S. • Panel members include BASF Corporation, Eastman Chemical Company, ExxonMobil Chemical Company, and Ferro Corporation.
	European Council for Plasticisers and Intermediates	Brussels, Belgium	• Represents the interests of European manufacturers of plasticisers. • Eight member companies include Arkema, DEZA, ExxonMobil, Perstorp Oxo, BASF, Evonik Oxeno, Oxochemie and ZAK Spolka Akcyjna.
Distribution	Canadian Association of Chemical Distributors	Oakville, ON	• Represents the interests of chemical distributors in Canada. • Has a total of 46 member companies.
Use	Canadian Plastics Industry Association	Mississauga, ON	• Represents the PVC manufacturing and processing sectors in Canada which will be the largest consumers of phthalates in Canada.
	Canadian Cosmetic, Toiletry and Fragrance Association	Mississauga, ON	• Represents the personal care products industry in Canada. • Has over 175 members.

There are other Canadian industry associations representing consumers of smaller quantities of phthalates, specifically in the coatings (i.e. Canadian Paint and Coatings Association – Ottawa, ON), rubber products (Rubber Association of Canada – Mississauga, ON), inks (Canadian Printing Ink Manufacturers' Association – Greater Toronto Area) and adhesives and sealants (Adhesives and Sealants Manufactures Association of Canada – Thornhill, ON) sectors.

In terms of distribution, without contacting the major global phthalate manufacturers it is difficult to discern how they distribute their products in Canada. Our experience in the past on similar projects is that these manufacturers will use a mixture of distribution channels for their products. For large volume accounts, the phthalate manufacturers will distribute their products directly to the end-user site. In these instances, the distribution

arms of PolyOne Canada, ExxonMobil, BASF, etc. will be the major distributors of these phthalates in Canada.

For smaller volume accounts, phthalate manufacturers will utilize the services of chemical distribution companies in Canada. There are many chemical distribution companies in Canada, with some of the larger distributors being Canada Colors and Chemicals, Univar, Brenntag, LV Lomas, Chemroy, Quadra Chemicals and Unipex. As was noted earlier, Univar, LV Lomas and Quadra Chemicals are known to be importing and distributing phthalates in Canada. Since upwards of 20% of the Canadian imports of phthalates are supplied by Asian manufacturers, these Canadian distributors likely play an important role in distributing these products to various end-users in Canada.

4. Profiles of Individual Phthalates

4.1 Summary

This chapter contains profiles for all fourteen phthalates that are contained within the Substance Groupings Initiative. The extent that these phthalates are manufactured and consumed globally varies considerably. For some phthalates, we do not expect any section 71 submissions to be received by Environment Canada as they do not appear to be in commerce at present (e.g. DBenzP, CHIBP, BIOP and DIHepP). Alternatively, there are two phthalates (i.e. DINP, DIDP) under the Substance Groupings Initiative that are very high volume plasticizers and are likely among the top 2-3 phthalates consumed in Canada annually. Outlined in the table below is our initial assessment of the expected consumption of these fourteen phthalates in Canada as well as the number of expected section 71 responses that will be received by Environment Canada. Four qualitative categories have been used (high, medium, low, none). Please note that consultations with industry were unable to be conducted during the study and therefore our judgments below could only be based on available literature and the knowledge of the consultant.

Table 21: Summary of Fourteen Phthalates Contained in the Substance Groupings Initiative

Phthalate	CAS Number	Expected Number of Section 71 Responses and Consumption Range
Dicyclohexyl Phthalate	84-61-7	Low
Butyl Cyclohexyl Phthalate	84-64-0	Low
Diisobutyl Phthalate	84-69-5	Medium
Dimethyl Phthalate	131-11-3	Medium
Dibenzyl Phthalate	523-31-9	None
Diundecyl Phthalate	3648-20-2	Medium
Cyclohexyl Isobutyl Phthalate	5334-09-8	None
Texanol® Benzyl Phthalate	16883-83-3	Low
Diisodecyl Phthalate	26761-40-0	High
Benzyl Isooctyl Phthalate	27215-22-1	None
Dimethyl Cyclohexyl Phthalate	27987-25-3	Low
Diisononyl Phthalate	28553-12-0	High
Benzyl Octyl Phthalate	68515-40-2	Low
Diisoheptyl Phthalate	71888-89-6	None

Source: Cheminfo Services

4.2 Dicyclohexyl Phthalate (DCHP) (CAS 84-61-7)

In general, DCHP is manufactured commercially in a closed system by catalytically esterifying phthalic anhydride with cyclohexane ring alcohols (cyclohexanol). As with other phthalates, the unreacted alcohols are recovered and reused, and the DCHP mixture is purified by vacuum distillation or activated charcoal. The purity of DCHP can achieve 99% or greater using current manufacturing processes. The remaining fraction of DCHP may contain a maximum of 0.1% water and 0.15% phthalic acid.[27] DCHP belongs to a group of transitional phthalates defined as those produced from alcohols with straight-chain carbon backbones of C4-6.[28]

Table 22: Identification of the Substance - DCHP

Relevant CAS Numbers	84-61-7; 169741-16-6; 55819-02-8
Chemical Name	1, 2-Benzenedicarboxylic acid, dicyclohexyl ester
Identified Product Names	Morflex® 150; Uniplex 250; Unimoll® 66

The most recent production data available on DCHP under the U.S. Environmental Protection Agency's Inventory Update Rule indicates that less than 227 tonnes of DCHP were manufactured in the U.S. in 2006.[29] This confirms information in the literature that U.S. production of DCHP is low.[30] Information from Japan indicates that in 1998, 276 tonnes of DCHP was imported[31], while in 2001 a total of approximately 100 tonnes of DCHP was produced.[32]

Available information indicates that there are two manufacturers of DCHP in the U.S. (and none in Canada), specifically Vertellus Specialties Inc. (Morflex® 150) and Unitex Chemical Corporation (Uniplex 150). Meanwhile there is one identified manufacturer of DCHP in Europe, specifically Lanxess (Unimoll® 66). It should be noted that Lanxess purchased Unitex Chemical Corporation in October, 2011.

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[27] Versar Inc. and SRC Inc. (June, 2011), *Toxicity Review for Dicyclohexyl Phthalate (DCHP, CASRN 84-61-7)*, prepared for U.S. Consumer Product Safety Commission.
[28] Australian Government Department of Health and Ageing NICNAS (June, 2008), *Existing Chemical Hazard Assessment Report – Dicyclohexyl Phthalate*.
[29] Accessed at the website of the U.S. Environmental Protection Agency's Inventory Update Rule (http://www.epa.gov/oppt/iur/).
[30] Versar Inc. and SRC Inc. (June, 2011), *Toxicity Review for Dicyclohexyl Phthalate (DCHP, CASRN 84-61-7)*, prepared for U.S. Consumer Product Safety Commission.
[31] Japan Ministry of Economy, Trade and Industry, *Hazard Assessment of Dicyclohexyl Phthalate - [Dicyclohexyl phthalate, CAS No. 84-61-7].*
[32] Japan Government, *Summary of Initial Risk Assessment Report Dicyclohexyl Phthalate CAS No : 84-61-7.*

According to Vertellus, Morflex® 150 is a solid at ambient conditions and is used as a plasticizer in heat-sealable films and as a co-plasticizer in PVC. Solidification from the liquid state is time dependent, thus making it useful in thermo sensitive adhesives as well.[33] Meanwhile, Unitex Chemical Corporation describes their Uniplex 250 as a heat-activated plasticizer used in heat seal applications such as food wrappers, food labels, pharmaceutical labels and other applications where a delayed heat activated adhesive is required. In addition, Uniplex 250 is used in printing ink formulations to improve adhesion and water resistance when applied to paper, vinyl, textile and other substrates.[34]

Table 23: Identified North American and European Manufacturers of DCHP

Manufacturer	Location	Product Name
Unitex Chemical Corporation	Greensboro, NC	Uniplex 250 Uniplex 250M
Vertellus Specialties Inc.	Greensboro, NC	Morflex® 150
Lanxess	Germany	Unimoll®66 Unimoll®66M

According to Lanxess, Unimoll®66 (and Unimoll®66M) is used as a plasticizer in PVC, acrylate, cellulose acetate and ethylene vinyl acetate adhesives and coatings. Lanxess indicates that Unimoll® 66 M is frequently used as an additive in heat-activatable adhesives (for example it is incorporated into an acrylate dispersion). Unimoll® 66 is also used as a retardant agent (to prevent oxidation) in organic peroxides. Organic peroxides are reactive, thermally unstable compounds, which, through their decomposition, can cause the crosslinking of elastomers and polymers. They are used, for example, to cure coatings and resins. Improved safety during storage, transport and handling can be achieved through the retardation of peroxides. This involves the addition of substances to the peroxide which are inert towards the peroxide concerned, such as Unimoll®66.[35] Additional information indicates that Unimoll®66/66M is used to improve the storage stability and fusing characteristics of vinyl plastisols.[36]

[33] Vertellus™ (January, 2007), *Morflex® 150 – Dicyclohexyl Phthalate Technical Data Sheet.*
[34] Unitex Chemical Corporation (June, 2009), *Uniplex 250 - Dicyclohexyl Phthalate CAS NO. 84-61-7.*
[35] Lanxess (2004), *Plastic Additives – Plasticizers.*
[36] Versar Inc. and SRC Inc. (June, 2011), *Toxicity Review for Dicyclohexyl Phthalate (DCHP, CASRN 84-61-7)*, prepared for U.S. Consumer Product Safety Commission.

The U.S. Environmental Protection Agency's Inventory Update Rule indicates that DCHP is used in adhesives manufacturing for use in paper products (with the final concentration of the DCHP in adhesives ranging from 1-30%).[37]

The general literature indicates that DCHP is a minor use plasticizer found in a variety of consumer products.[38] Identified end-use applications for DCHP in the general literature are as follows:

- DCHP is generally used as a plasticizer for cellulose nitrate, benzyl cellulose, ethyl cellulose, chlorinated rubber, polyvinyl acetate, polyvinyl butyral, PVC, polystyrene and acrylic plastics when products are intended for food or drink contact, and other polymers. DCHP is also used as a heat sealer for cellulose and in paper finishes (i.e. imparts water resistance to printers ink in such items as food wrappers/labels, pharmaceutical labels, price labels). It has been reported in Australia that DCHP is imported for adhesive manufacture (i.e. hot melt adhesives, sometimes as high as 60% by volume; underfloor sealing compounds) and for use in screen printing inks for paper, vinyl, textiles, and other substrates.[39/40/41/42]
- the U.S. FDA has approved DCHP for use: (i) in the manufacture of cellophane from food packaging alone, or in combination with other phthalates where total phthalates do not exceed 5%; (ii) as a component in coated or uncoated food-contact surface of paper and paperboard used for all aspects of handling aqueous or fatty foods; (iii) as a component of adhesives for food contact articles; (iv) in polymeric substances used in all aspects of food handling; (v) and in plastic film (at concentrations of <10% total phthalates) prepared from polyvinylacetate, polyvinyl chloride, and vinyl chloride copolymers.[43]

[37] Accessed at the website of the U.S. Environmental Protection Agency's Inventory Update Rule (http://www.epa.gov/oppt/iur/).
[38] Versar Inc. and SRC Inc. (June, 2011), *Toxicity Review for Dicyclohexyl Phthalate (DCHP, CASRN 84-61-7)*, prepared for U.S. Consumer Product Safety Commission.
[39] Ibid.
[40] Australian Government Department of Health and Ageing NICNAS (June, 2008), *Phthalates Hazard Compendium - A Summary of Physicochemical and Human Health Hazard Data for 24 ortho-phthalate Chemicals*.
[41] Australian Government Department of Health and Ageing NICNAS (June, 2008), *Existing Chemical Hazard Assessment Report – Dicyclohexyl Phthalate*.
[42] Japan Ministry of Economy, Trade and Industry, *Hazard Assessment of Dicyclohexyl Phthalate - [Dicyclohexyl phthalate, CAS No. 84-61-7]*.
[43] Versar Inc. and SRC Inc. (June, 2011), *Toxicity Review for Dicyclohexyl Phthalate (DCHP, CASRN 84-61-7)*, prepared for U.S. Consumer Product Safety Commission.

- used to stabilize some rubbers, resins, and polymers, including nitrocellulose, polyvinyl acetate, and polyvinyl chloride.[44]
- within Japan, end-use applications identified for DCHP include as a plasticizer for nitrocellulose, ethyl cellulose, vinyl acetate and vinyl chloride resins. In addition, DCHP was identified as a plasticizers for moisture-proof cellophane, acrylic lacquers, and heat sensitive adhesives, anti-blocking agents for plastic surfaces.[45/46]

4.3 Butyl Cyclohexyl Phthalate (BCHP) (CAS 84-64-0)

BCHP is a very low volume plasticizer that based on available information is not produced by any of the large phthalate manufacturers in North America. Its production and use appear to be declining and only two commercial products could be located for BCHP. It is expected that there will be very low volumes of BCHP reported imported into Canada and it is unlikely that any of the three plasticizer manufacturing facilities in Canada are producing BCHP (since a review of the PolyOne and BASF websites indicated that they were not manufacturing BCHP).

Table 24: Identification of the Substance - BCHP

Relevant CAS Numbers	84-64-0
Chemical Name	1,2-Benzenedicarboxylic acid, butyl cyclohexyl ester
Identified Product Names	BCHP; Novaflex BCHP

The U.S. Environmental Protection Agency's Inventory Update Rule requirements for 2006 were that manufacturers and importers producing (or importing) 25,000 pounds (i.e. 11.4 tonnes) or more of a reportable chemical substance reported the identity of the chemical substance and basic manufacturing information. There was no information on production or importation of BCHP in the U.S. for 2006 reporting under the Inventory Update Rule, while for 2002 production was reported at under 227 tonnes. Therefore it appears that production and use of BCHP is declining and under 11.4 tonnes of BCHP was manufactured in the U.S. in 2006.[47] Unitex Chemical Corporation was the only listed company reporting BCHP in 1998 and 2002 under the Inventory Update Rule. Unitex

[44] Centres for Disease Control and Prevention, *National Biomonitoring Program - Biomonitoring Summary – Phthalates Overview*.
[45] Japan Ministry of Economy, Trade and Industry, *Hazard Assessment of Dicyclohexyl Phthalate - [Dicyclohexyl phthalate, CAS No. 84-61-7]*.
[46] Japan Government, *Summary of Initial Risk Assessment Report Dicyclohexyl phthalate CAS No : 84-61-7.*
[47] Accessed at the website of the U.S. Environmental Protection Agency's Inventory Update Rule (http://www.epa.gov/oppt/iur/).

Chemical Corporation was also one of two companies independently identified as manufacturing BCHP in the U.S. It should be noted that the DyStar® Group advertises themselves as a toll manufacturer of Novaflex BCHP and therefore potentially only manufacture it when they have received an order.

Table 25: Identified North American and European Manufacturers of BCHP

Manufacturer	Location	Product Name
Unitex Chemical Corporation	Greensboro, NC	BCHP
DyStar® Group	Reidsville, NC	Novaflex BCHP

The end-use applications listed for a previously manufactured BCHP product (i.e. Velsicol 6938) was as a plasticizer for PVC applications providing good low temperature properties and the offering of fast fusion in plastisols for coating and spray applications.[48] Velsicol Chemical Corporation was re-branded in 2008 as Genovique Specialties Corporation and subsequently purchased by Eastman Corporation. A review of Eastman Chemical's current plasticizer offerings did not identify BCHP.

There is a scarcity of available literature on BCHP, again indicating that it a very low volume manufactured phthalate. Available literature indicates that BCHP is used as a plasticizer for polymers and elastomers and in nitrocellulose lacquers.[49] Additional information indicates it is used as a plasticizer in PVC, other vinyls, cellulosics and polystyrene.[50] DCHP was found in only 1 out of 36 perfume samples at a concentration of 3 mg/kg.[51]

4.4 Diisobutyl Phthalate (DIBP) (CAS 84-69-5)

In general, DIBP is manufactured commercially in a closed system by catalytically esterifying phthalic anhydride with n-butyl alcohols (isobutanol). As with other phthalates, the unreacted alcohols are recovered and reused, and the DIBP mixture is purified by vacuum distillation or activated charcoal. The purity of DIBP can achieve 99% or greater using current manufacturing processes. The remaining fraction of DIBP

[48] Ash, Michael & Ash, Irene (2004), *Handbook of Green Chemicals – 2nd Edition*.
[49] PubChem Compound, *Butyl Cyclohexyl Phthalate - Compound Summary*, accessed at http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?cid=6779.
[50] Gooch, Jan W., *Encyclopedia Dictionary of Polymers, 2nd Edition*.
[51] European Commission, Scientific Committee on Consumer Products – SCCP (March, 2007), *Opinion on Phthalates in Consumer Products*.

may contain a maximum of 0.1% water. DIBP is considered a low molecular weight phthalate with a carbon backbone of C3.[52]

Table 26: Identification of the Substance - DIBP

Relevant CAS Numbers	84-69-5
Chemical Name	1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester
Identified Product Names	Uniplex 155; Oxoplast® IB

Within the U.S. in 2011, DIBP was manufactured by Eastman Chemical Company (Kingsport, TN) and Unitex Chemical Company (Greensboro, NC). However it was reported that Eastman Chemical was to discontinue producing dibutyl phthalate (DBP) (and presumably DIBP) in December of 2011.[53] A search of Eastman Chemical's website did not reveal any mention of DIBP and therefore they are likely no longer a manufacturer of this phthalate. U.S. production of DIBP has been suggested to be low.[54] The U.S. production range for DIDP in 2006 was between 227-455 tonnes, with Unitex Chemical Corporation being the only identified manufacturer in the U.S. in 2006.[55] Marketing data suggest that U.S. consumption of DIBP has been slightly higher than production, meaning that DIBP produced in the U.S. is probably utilized locally and also that a small amount of DIBP may be imported.[56]

Table 27: Identified North American and European Manufacturers of DIBP

Manufacturer	Location	Product Name
Unitex Chemical Corporation	Greensboro, NC	Uniplex 155
Grupa Azoty	Poland	Oxoplast® IB

Existing literature indicates that at present there is at least one European producer of DIBP.[57] Independent research during the study also identified one European manufacturer of DIDP, located in Poland.

[52] Versar Inc. & SRC Inc. (July, 2011), *Toxicity Review for Diisobutyl Phthalate (DiBP, CASRN 84-69-5*).
[53] Ibid.
[54] Ibid.
[55] Accessed at the website of the U.S. Environmental Protection Agency's Inventory Update Rule (http://www.epa.gov/oppt/iur/).
[56] Versar Inc. & SRC Inc. (July, 2011), *Toxicity Review for Diisobutyl Phthalate (DiBP, CASRN 84-69-5*).
[57] European Chemicals Agency (December, 2010), *Background Document for Diisobutyl Phthalate (DIBP*).

The global production of both DBP and DIBP combined was estimated at 450,000 tons/year. In an authorized IUCLID data sheet (from 2000) the quantity of DIBP manufactured and/or used in Europe is indicated to be in the range of 10,000 to 50,000 tons/year.[58] It has also been estimated that in 2009-2010, 20,000 tonnes of DIBP/BBP/DBP were produced or imported in the European Union and that 13,000 tonnes of these three plasticizers were produced or imported for the manufacture of articles in the European Union. DIBP appears to contribute more to these volumes than the other two plasticizers.[59] Finally an estimate for 2007 is that the tonnage of DIBP contained in end-products marketed in the European Union was 10,750 tonnes.[60]

With respect to identified DIBP products, Uniplex 155 is a general purpose plasticizer that is widely compatible with both thermoplastic and thermosetting resins. Uniplex 155 is suggested to be used as a solvent/plasticizer in cellophane, resin coated sand for foundry castings and organic peroxides.[61] Meanwhile information on Oxoplast® IB indicates that it is mostly used as a softening agent for PVC. It is used for the production of flexible lining, paints and lacquers, adhesives, curing agents for polyester resins, dispersions of polyvinyl acetate and nitrocellulose products.[62]

The general literature on DIBP indicates that it is a specialist plasticizer and is used in combination with other high molecular weight phthalates. It is a fast fusing plasticizer, which by itself it is too volatile for PVC applications (and is therefore used in combination with other phthalates). It is frequently used as a gelling aid in combination with other plasticizers. It is used as a plasticizer for nitrocellulose (lowest cost plasticizer for cellulose nitrate), cellulose ether, and polyacrylate and polyacetate dispersions.[63] These are used in paints, lacquers, varnishes, paper, pulp and boards, as adhesives, binding agents, softeners and viscosity adjusters. DIBP is also used in coatings (e.g. antislip coatings) and in epoxy repair mortars. As a plasticizer in dispersion glues and printing inks DIBP is applied in paper and packaging for food (e.g. rice, baking mixtures, cheese, bread, nuts) and bottled water. DIBP has been detected in many consumer products frequently used by children like crayons, bar ends of run bikes, erasers and school bags. In a Chinese study DIBP has been identified in consumer products such as suckers, plastic spoons and forks, boxes for microwave ovens, milk package bags, disposable cups, plates and bowls. DIBP was found in 20/36 perfumes with

[58] Versar Inc. & SRC Inc. (July, 2011), *Toxicity Review for Diisobutyl Phthalate (DiBP, CASRN 84-69-5*).
[59] Danish Environmental Protection Agency (August, 2011), *Annex XV Restriction Report – Proposal for a Restriction – Substance Name: Bis(2-Ethylhexyl)Phthalate (DEHP), Benzy Butyl Phthalate (BBP), Dibutyl Phthalate (DBP), Diisobutyl Phthalate (DIBP).*
[60] European Chemicals Agency, *Committee for Risk Assessment (RAC), Committee for Socio-economic Analysis (SEAC) (July, 2012), Background Document to the Opinion on the Annex XV Dossier Proposing Restrictions for Four Phthalates.*
[61] Unitex Chemical Corporation (June, 2009), *Uniplex 155 - Di-Isobutyl Phthalate CAS NO. 84-69-5***.**
[62] Accessed at the Grupa Azoty website (http://grupaazoty.com/).
[63] Accessed at the DIBP Information Center (www.dibp-facts.com).

concentrations ranging from 0.2 - 38 mg/kg. As DIBP is contained in a wide range of products, the use of DIBP is considered widespread and dispersive.[64/65]

Other end-use applications where DIBP has been used include nail polish, cosmetics, lubricants, floor carpets, tapestry, clothing treatments, rubber dentistry settings, as a fuel stabilizer, in leather varnishes and lacquers, as a concrete additive, as an adjusting agent for lead chromate paint pigments, explosive material, lacquer manufacturing, and methyl methacrylate applications. DIBP is also used in printing inks for paper and packaging.[66] In Australia, DIBP is imported for use a plasticizer in the manufacture of PVC and rubber and as a component of industrial adhesives and catalyst systems for polypropylene and fiberglass manufacture.[67]

DIBP has very similar application properties to DBP and may therefore be used to substitute for DBP in most, if not all, of its applications. These range from the plasticization of PVC to the production of paints, printing inks and adhesives.[68]

While DIBP is not used extensively in PVC, it nevertheless has been identified in a range of PVC products. Available information from studies in Europe indicate the following presence of DIBP in PVC products:[69/70/71]

- PVC Flooring Products – In one study from Denmark, the measured DIBP concentration ranged from 0.65% (PVC with foam backing) to 5.71% (cushioned PVC). These percentages were based on data from 2005. As total plasticizer concentrations generally are in the range of 10-30% in PVC flooring, it is likely that DIBP is used in conjunction with other plasticizers. Additional research in 2010 analyzed eight separate PVC flooring samples, with only 1 containing DIBP at a concentration greater than 1%. The one PVC flooring sample had a DIBP concentration of 7.4%. Furthermore, an analysis of 25 separate PVC flooring products in Germany indicated that most products contained a mixture of phthalates with the total concentration of phthalates in the products ranging from approximately 6.3% to 36.5%. The average content of DIBP was ≤6.9% and it was present in 4 products.

[64] European Chemicals Agency (December, 2010), *Background Document for Diisobutyl Phthalate (DIBP)*.
[65] Versar Inc. & SRC Inc. (July, 2011), *Toxicity Review for Diisobutyl Phthalate (DiBP, CASRN 84-69-5)*.
[66] Ibid.
[67] Ibid.
[68] Accessed at the DIBP Information Center (www.dibp-facts.com).
[69] European Chemicals Agency, *Committee for Risk Assessment (RAC), Committee for Socio-economic Analysis (SEAC) (July, 2012), Background Document to the Opinion on the Annex XV Dossier Proposing Restrictions for Four Phthalates*.
[70] Danish Environmental Protection Agency (August, 2011), *Annex XV Restriction Report – Proposal for a Restriction – Substance Name: Bis(2-Ethylhexyl)Phthalate (DEHP), Benzy Butyl Phthalate (BBP), Dibutyl Phthalate (DBP), Diisobutyl Phthalate (DIBP)*.
[71] Danish Environmental Protection Agency (2011), *Background Data for Annex XV Dossier - DEHP, BBP, DBP and DIBP*.

DIBP was mainly present as a co-plasticizer in small concentrations together with mainly DIHP. However, in a single sample DIBP was used as the dominant plasticizer with mainly DIHP as a co-plasticizer. It has been suggested that for the European Union producers of PVC flooring and wall coverings, the movement away from DIBP will continue.

- PVC Wire and Cable - DIBP is not reported used in wire and cable, probably due to its high volatility. Cables are heated during use and this increases the volatilization.
- PVC Plastic Bags - in a survey from the Danish Environmental Protection Agency from 2007, school bags and toy bags were analyzed for the migration of certain substances to artificial sweat. This showed that six of the seven analyzed bags migrated DEHP, DIBP or DBP to artificial sweat, indicating that these phthalates are used as plasticizers in part of the bags. A separate study from the Danish Environmental Protection Agency in 2010 measured phthalate concentrations in 10 plastic bags for children. The bags were limited to handbags, shoulder bags, sponge bags, rucksacks, trolleys and plastic bags for consoles, and the analyzed bags did not include school bags. The concentration of DIBP was below 0.1% in all of the bags.
- PVC Textiles – The Danish Environmental Protection Agency analyzed 12 oilcloths and dinner mats, which determined that the concentration of DIBP was below 0.1% in all of the analyzed products. The Danish Environmental Protection Agency also analyzed 8 carpet tiles for DIBP. None of the analyzed tiles contained DIBP in concentrations above 0.1%. Only in one of the carpet tiles was DIBP detected above the detection limit, but in low concentrations (0.016%).
- PVC Air Mattresses – The Danish Environmental Protection Agency analyzed 13 air mattresses for the content of DIBP. DIBP was detected in one of the mattresses in concentrations below 0.1%.
- PVC Wallpaper/Wall Coverings - according to major European producers, they do not use DIBP in wallpaper. In the Danish Environmental Protection Agency survey from 2010, 15 wallpapers were analyzed for the content of DIBP. The analyses showed all wallpapers having a DIBP content of below 0.1%.
- PVC Recreational Equipment – The Danish Environmental Protection Agency analyzed 10 fitness balls in 2010 for DIBP content. The analyses showed that two of the analyzed balls contained DIBP in concentrations above 1%.
- PVC Food Contact Materials - An analysis of the migration of phthalates in infant food packed in recycled paperboard was conducted and this study showed that phthalates and especially DIBP can still be found in infant food collected in the beginning of 2009. However the concentrations are considered low. It should be noted the DIBP is not allowed in plastic for food contact materials in the European Union.
- Other PVC Products – information indicates that DIBP may be used as a plasticizer in plastic sandals. DIBP was also found in 2% of children's toys/childcare articles in separate surveys in: (i) the Netherlands; and (ii) Germany, Austria and Switzerland.

There is a decreasing trend in the consumption of DIBP in Europe between 2000 and 2010. Substitution of the four phthalates (including DIBP) with other plasticizers is expected to continue due to information requirements (triggered by the fact that the four phthalates have been identified as substances of very high concern (SVHCs) under the REACH Regulation – see below).[72]

DIBP has been identified as a SVHC and is included in REACH Annex XIV and thus subject to the authorization process (with a sunset date of February 21st, 2015).[73] The authorization process, however, does not cover placing on the market of articles containing DIBP and therefore does not cover imported articles. Furthermore, DIBP has been classified as toxic under reproduction category 1B, and from July 2013, it is restricted under the *Toy Safety Directive* (2009/48/EC) in concentrations above the specific limit for classification. The use of DIBP is also not allowed in plastic for food contact materials. [74]

Denmark had proposed to restrict the use of four lower molecular weight phthalates (DEHP, DBP, BBP and DIBP) in certain consumer articles, but this proposal was determined not to be justified by the European Chemicals Agency. Denmark had proposed a ban on the use of these four plasticizers in articles used indoors or that come into contact with the skin. It was noted that these four phthalate were the subject of a steady decline in use over the last decade. This trend was expected to continue, and the authorization requirement for the four phthalates is expected to further impact this downward trend.[75]

4.5 Dimethyl Phthalate (DMP) (CAS 131-11-3)

In general, DMP is manufactured commercially in a closed system by catalytically esterifying phthalic anhydride with methanol. As with other phthalates, the unreacted alcohols are recovered and reused, and the DMP mixture is purified by vacuum distillation or activated charcoal. The purity of DMP can achieve 99% or greater using current manufacturing processes. The remaining fraction of the DMP commercial mixture can contain a maximum of 0.05-0.1% water.[76]

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[72] European Chemicals Agency – Committee for Socio-Economic Analysis (SEAC) (June, 2012), *Opinion on an Annex XV Dossier Proposing Restrictions on Four Phthalates.*

[73] European Chemicals Agency, *Committee for Risk Assessment (RAC), Committee for Socio-economic Analysis (SEAC) (July, 2012), Background Document to the Opinion on the Annex XV Dossier Proposing Restrictions for Four Phthalates.*

[74] Ibid.

[75] Plasticisers and Flexible PVC Information Centre (June 19, 2012), *"Not Justified" - ECHA Committee for Risk Assessment (RAC) Opinion on Danish Restriction Proposal for DEHP, DBP, DIBP and BBP.*

[76] Versar Inc. & SRC Inc. (July, 2011), *Toxicity Review for Dimethyl Phthalate (DMP, CASRN 131-11-3).*

Table 28: Identification of the Substance - DMP

Relevant CAS Numbers	131-11-3; 64441-70-9
Chemical Name	1,2-Benzenedicarboxylic acid, dimethyl ester
Identified Product Names	Uniplex 110; Palatinol® M, DMP

Based on available information, DMP has been marketed by BASF (Palatinol® M), Eastman Chemical Company (DMP), and Unitex Chemical Corporation (Uniplex 110).[77] However information on the BASF website indicates that Palatinol® M is likely only produced in Europe and no current information on Eastman Chemical's DMP product can be located on their website. Therefore there is a potential that Unitex Chemical Corporation is the only manufacturer of DMP in the U.S. (and likely no production in Canada).

Table 29: Identified North American and European Manufacturers of DMP

Manufacturer	Location	Product Name
Unitex Chemical Corporation	Greensboro, NC	Uniplex 110
Eastman Chemical*	Kingsport, TN	DMP
BASF	Germany	Palatinol® M
DEZA, a. s.	Czech Republic	Dimethyl Phthalate

* the U.S. EPA's Inventory Update Rule lists Velsicol Chemical Corporation as manufacturing DMP in 2006 in Chestertown, MD. However, Eastman Chemical purchased Velsicol Chemical Corporation (which had been renamed Genovique Specialties Corporation) in 2010. There is no mention on Eastman Chemical's website of them still offering a DMP product. Eastman Chemical was also noted as producing DMP in 2006 in Kingsport, TN.

The U.S. production of DMP has remained consistent since the implementation of chemical tracking in 1975 (i.e. approximately 3,000-6,000 tonnes per year). Recently, production has declined slightly from 4,000 tonnes (2005) to 3,600 tonnes (2008). DMP's proportion of the total phthalate production market has remained static at approximately 0.6-0.7% over the past 5 years. In the past 20 years, U.S. consumption of DMP has been within a tonne or two less than production estimates, and currently, percentages of the total phthalate consumption market are similar to production. This suggests that most DMP produced in the U.S. is utilized locally.[78]

[77] Ibid.
[78] Ibid.

Uniplex 110 is a solvent and plasticizer for cellulose acetate - butyrate compositions. It is also widely used as a solvent for organic catalysts and is an excellent plasticizer and solvent for aerosol hair sprays.[79] Meanwhile BASF's Palatinol® M product is a light-stable plasticizer with very good solvent power for cellulose acetate and cellulose nitrate. It is also an auxiliary plasticizer for surface coatings and an inhibitor for peroxides.[80] BASF has also noted that Palatinol M is unsuitable for PVC, however it is important as a plasticizer for coatings and cellulose moulding compounds.[81]

The more general literature indicates that DMP is a minor use plasticizer found in a variety of consumer products. DMP is currently considered to belong to the Low Molecular Weight Phthalate Esters (LMWPE), which are used primarily as solvents or in cellulose acetate polymers rather than as plasticizers for PVC. The non-confidential industrial processing and uses reported in the 2006 Inventory Update Rule submission (to the U.S. EPA) for DMP included chemical, paint, and coating manufacturing. The non-confidential commercial and consumer use included paints, coatings, rubber, and plastic products. DMP has been used as a solvent and/or plasticizer in automotive parts, encapsulation of electrical wiring, mining and construction, fabrication of fiberglass, paints, nitrocellulose, cellulose acetates and rubber. Other uses include as a solvent or plasticizer for cosmetics, creams, perfumes, candles, hair sprays, and shampoos and formerly as an insect repellent. Lower molecular weight phthalates are also reported to be used as solvents in fragrance bases for household cleaning products.[82] Downstream products include explosives, printing inks, adhesives, paper coatings, putty hardeners, fabric treatment, paints and coatings, plastic articles and children's toys, DMP is also used in insecticides and insect repellents.[83]

More specific information on its use in personal care products indicates that DMP is used in cosmetics as a fragrance ingredient, solvent and plasticizer. DMP is an ingredient in hair sprays, hair conditioners and rinses, face powders and foundations, bath soaps and detergents, deodorants and aftershave lotions.[84]

The Cosmetic Ingredient Review Panel indicated that DMP is used as a plasticizer, solvent and fragrance ingredient in cosmetics. For instance, DMP is an ingredient in some hair care products, including aerosol fixatives. The reported maximum concentration of use of DMP in cosmetics is 2% in aerosol hair sprays. In fact, in 2001 the Cosmetic Ingredient Review Panel found DMP in 8 hair sprays (aerosol fixatives), 3 other hair

[79] Unitex Chemical Corporation (June, 2009), *Uniplex 110 Dimethyl Phthalate CAS NO. 131-11-3*.
[80] BASF, *Technical Information Palatinol® M*, December, 2011.
[81] BASF, *Plasticizers*, September, 2010.
[82] Versar Inc. & SRC Inc. (July, 2011), *Toxicity Review for Dimethyl Phthalate (DMP, CASRN 131-11-3).*
[83] Australian Government Department of Health and Ageing NICNAS (June, 2008), *Dimethyl Phthalate*.
[84] Ibid.

preparations and one aerosol hair colour spray, with no DMP located in all other cosmetic products (e.g. face powders, foundations, etc.).[85]

4.6 Dibenzyl Phthalate (DBenzP) (CAS 523-31-9)

Research during this study did not identify any definitive information indicating that dibenzyl phthalate is commercially produced as a plasticizer or for any other applications. There were no submissions for dibenzyl phthalate to the U.S. Environmental Protection Agency's Inventory Update Rule over the 1986-2006 time-period (in four-year increments).[86] In addition, dibenzyl phthalate was not reported by industry in the European Union as either a high production volume chemical or a low production volume chemical.[87] Dibenzyl phthalates were also not present on the "complete" list of commercial phthalates that is available on the website of the Plasticisers and Flexible PVC Information Centre.[88]

Table 30: Identification of the Substance - DBenzP

Relevant CAS Numbers	523-31-9
Chemical Name	1,2-Benzenedicarboxylic acid, bis(phenylmethyl) ester
Identified Product Names	None identified

Two references[89/90] have indicated that dibenzyl phthalate is contained as an impurity of less than 1% in commercial benzyl butyl phthalate formulations.

It should be noted that one scientific article[91] has made references to the commercial use of dibenzyl phthalate as a plasticizer. This paper has indicated that the most commonly used phthalates have been banned or restricted for use as plasticizers in toys in some countries because of their endocrine-disrupting properties. Dibenzyl phthalate has been

[85] CIR Panel (February, 2003), *Dibutyl Phthalate, Diethyl Phthalate, and Dimethyl Phthalate Re-Review Summary*.
[86] Accessed at the website of the U.S. Environmental Protection Agency's Inventory Update Rule (http://www.epa.gov/oppt/iur/).
[87] Accessed at the website of the European Inventory of Existing Commercial Chemical Substances (http://esis.jrc.ec.europa.eu/).
[88] Accessed at the website of the Plasticisers and Flexible PVC Information Centre (www.plasticisers.org/plasticisers/not-all-phthalates-are-the-same/phthalates-list).
[89] Australian Government (April, 2007), *Human Health Hazard Assessment – Butylbenzyl Phthalate (BBP)*.
[90] European Chemicals Agency (October, 2008), *Substance Name: Benzyl Butyl Phthalate EC Number: 201-622-7 CAS Number: 85-68-7 - Member State Committee Support Document for Identification of Benzyl Butyl Phthalate (BBP) As a Substance of Very High Concern*.
[91] Zhang, Zhaobin, et. al., (2011), *Estrogen Agonist/Antagonist Properties of Dibenzyl Phthalate (DBzP) Based on In Vitro and In Vivo Assays*, published in Toxicology Letters.

proposed as a possible alternative for the banned/restricted phthalates. The paper indicates that dibenzyl phthalate is used as a plasticizer. The article concluded that dibenzyl phthalate is more toxic than benzyl butyl phthalate and should not be used as an alternative plasticizer. While this article does make reference to the use of dibenzyl phthalate as a plasticizer, no evidence was provided such as identified manufacturers, commercial product names or exact applications it is used within. Therefore it is still expected that dibenzyl phthalate, if it is actually used in commercial applications, will be consumed in very small quantities. There is also a good probability that there is no commercial utilization of dibenzyl phthalate, at least in Canada and the U.S.

4.7 Diundecyl Phthalate (DUP) (CAS 3648-20-2)

DUP is comprised of a pair of 11-carbon esters linked to a benzene-dicarboxylic acid ring. The branched ester side chains are in an *ortho* configuration, in contrast to those found in isophthalates (*meta*) or terephthalates (*para*). DUP belongs to the High Molecular Weight Phthalate Esters (HMWPE) group.[92]

In general, DUP is manufactured commercially in a closed system by catalytically esterifying phthalic anhydride with undecanol. As with other phthalates, the unreacted alcohols are recovered and reused, and the DUP mixture is purified by vacuum distillation or activated charcoal. The purity of DUP can achieve 99% or greater using current manufacturing processes. DUP is also manufactured as a mixture of branched chain isomers. The remaining fraction of the DUP commercial mixture can contain 0.1-0.2% (by weight) of antioxidants such as 1,1,3-Tris (2-methyl-4-hydroxy-5-tert-butylphenyl) butane (Topanol CA) and a maximum of 0.1% water.[93]

Table 31: Identification of the Substance - DUP

Relevant CAS Numbers	3648-20-2; 85507-79-5[1]; 154766-25-3
Chemical Name	1,2-Benzenedicarboxylic acid, diundecyl ester
Identified Product Names	Jayflex® L11P; Jayflex® L11P-E, Palatinol® 111P-I (Topanol); Synplast™ DUP-E

[1] diundecyl phthalate, branched and linear

DUP is currently manufactured in the U.S. by BASF (Palatinol®111P-I) and ExxonMobil (Jayflex L11P, L11P-E).[94] Meanwhile in Canada, PolyOne is believed to manufacture DUP in either (or both) Orangeville, ON or St. Remi, QC. It should be noted that BASF

[92] Versar Inc. & SRC Inc. (June, 2011), *Toxicity Review for Diundecyl Phthalate (DUP, CASRN 3648-20-2)*.
[93] Ibid.
[94] Ibid.

and ExxonMobil Chemical refer to their DUP products with the CAS number 3648-20-2 (diundecyl phthalate), while PolyOne refers to their DUP product with the CAS number 85507-79-5 (diundecyl phthalate, branched and linear). BASF has indicated that diundecyl ester, branched and linear (CAS# 85507-79-5) was formerly Palatinol® 11PE and that all DUP in the U.S. is now sold under CAS# 3648-20-2 (Palatinol® 111P-I and others).[95] BASF further has indicated that CAS 3648-20-2 was formerly CAS 85507-79-5.[96]

Table 32: Identified North American and European Manufacturers of DUP

Manufacturer	Location	Product Name
ExxonMobil Chemical	Baton Rouge, LA	Jayflex™ L11P Jayflex™ L11P-E[1]
BASF	Pasadena, TX and/or Cornwall, ON	Palatinol®111P-I (Topanol)[1]
PolyOne	Orangeville, ON and/or St. Remi, QC	Synplast® DUP-E[1]
Polynt	Italy	Diplast L11 Diplast L11/ST

[1] contains an antioxidant at approximately 0.1% concentration.

It should be noted that in the past a mixed phthalate plasticizer has been sold under the "711P" designation and was comprised of an equal-parts mixture of six phthalate esters one of which was DUP (CAS 3648-20-2). Products comprising a mixture of those six phthalate esters include Ferro's Santicizer® 711 and BASF's Palatinol 711P.[97] However research into Ferro's and BASF's plasticizer offerings did not identify these plasticizers (note that the reference also noted a product offered by Dynatex International called Strip Aid, however it is very doubtful that Dynatex actually manufactured these phthalates).

U.S. production of DUP has been slowly increasing since the implementation of chemical tracking in 1982 (8,000 tonnes to 18,000-20,000 tonnes in the mid 2000's). Currently, U.S. production of DUP is reported at 18,000 tonnes (2008) and is projected to increase to 20,200 tonnes (2013). DUP's proportion of the total phthalate production market (3.1%) is also projected to increase (to 3.6%) during the same period (+2.3% growth

[95] BASF (January, 2011), *Commercial Status of Other Phthalates – Comments to CPSC.*
[96] BASF (January, 2011), *Miscellaneous Phthalates – Status of Use In N. America.*
[97] U.S. Consumer Product Safety Commission, *CPSC Staff Toxicity Review of 17 Phthalates for Consideration by the Chronic Hazard Advisory Panel – 2010.*

rate). The 2008 estimate is slightly down from 20,000 tonnes reported for 2005 (3.3% of phthalate production market).[98]

U.S. consumption of DUP has paralleled production estimates. Current consumption of DUP has been reported at 17,500 tonnes (2008) and is projected to increase to 19,200 tonnes (2013). DUP's proportion of the total phthalate consumption market (2.9%) is also projected to increase (to 3.3%) during the same period (+1.9% growth rate). In the past 20 years, U.S. consumption of DUP has been within a metric ton or two less than production estimates, and currently, percentages of total phthalate consumption market are similar to production. This suggests that most DUP produced in the U.S. is utilized locally and a small amount may be exported.[99]

Palatinol® 111P-I (stabilized with 0.1% Topanol) is a primary plasticizer developed for wire and cable insulation compounds. Formulations made from Palatinol® 111P-I have low volatility and excellent oxidation resistance at high temperatures, and therefore, better retention of properties after oven aging. Palatinol® 111P-I can be blended with other linear phthalates or DPHP to improve performance, or with trimellitates for formulating lower cost 75°C, 90°C and 105°C wire insulation compounds. Palatinol® 111P-I is also recommended for vinyl compounds used in automotive applications requiring low fog performance and low temperature flexibility. The low viscosity of Palatinol® 111P-I provides the plastisol formulator with an option to improve part performance and maintain low plastisol viscosity.[100]

Jayflex™ L11P Plasticizer is a high molecular weight phthalate plasticizer used primarily in flexible PVC applications. Jayflex™ linear phthalate plasticizers (including DUP) are used when greater low-temperature flexibility or a specific end-use application requires unique processing where the performance requirements cannot be met with branched plasticizers.[101] Furthermore, ExxonChemical Mobil indicates that their Jayflex™ linear plasticizers have the following advantages: (i) strong low-temperature performance; (ii) improved resistance to UV light for increased resistance to outdoor weathering conditions; (iii) lower volatility for increased aging performance; (iv) low viscosity for easier and faster processing, faster dry-blending times; (v) lower plastisol and melt viscosities; and (vi) increased throughput.[102]

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[98] Versar Inc. & SRC Inc. (June, 2011), *Toxicity Review for Diundecyl Phthalate (DUP, CASRN 3648-20-2)*.
[99] Ibid.
[100] BASF (February, 2009), *Technical Data Sheet Palatinol® 111P- I Di-Undecyl Phthalate (stabilized with 0.1% Topanol CA)*.
[101] ExxonMobil Chemical (October, 2012), *Product Safety Summary – Jayflex™ L11P Plasticizer*.
[102] Accessed at the website of ExxonMobil Chemical (http://www.exxonmobilchemical.com/Chem-English/productsservices/jayflex-plasticizers.aspx).

PolyOne indicates that their Synplast™ DUP-E product is a linear C11 phthalate ester whose uses include automotive applications, automotive interior parts, cable jacketing, insulation and wire and cable applications.[103]

Meanwhile in Europe, it appears that the only registrant for CAS 3648-20-2 is Polynt in Italy, under the trade name Diplast L11 and Diplast L11/ST.[104] According to Polynt, Diplast® L11/ST is a plasticizer for PVC used in a wide range of applications such as medium-high temperature cables, anti fogging vinyl sheets for car interiors. The main characteristics of Diplast® L11 are low volatility, good efficiency and resistance both to high and low temperatures.[105]

More general information on the use of DUP indicates that it is a moderate use plasticizer found in a variety of consumer products. The high molecular weight phthalate esters (including DUP) are used primarily as industrial chemicals that are associated with polymers to impart flexibility in PVC resins. They are also used as synthetic base stocks for industrial lubricating oils. DUP is used for applications that require low fog and low temperature flexibility. Generally, this includes wiring and cable jacketing and insulation, furniture and automobile upholstery, floor mats, and seat covers, flooring, wall coverings, coil coatings, pool liners, water stops, roofing membranes, and coated fabrics. DUP has also been used in non-PVC polymers in thermoplastics (i.e. flame retardant nylon), rubbers, paints and adhesives and can be blended with trimellitate plasticizers.[106/107]

In Australia, DUP is imported for use in photographic paper dispersion coating, printing inks and flame-retardant polyurethane resins for construction.[108]

4.8 Cyclohexyl Isobutyl Phthalate (CHIBP) (CAS 5334-09-8)

Research during this study did not identify any information indicating that cyclohexyl isobutyl phthalate is commercially produced as a plasticizer or for any other applications. There were no submissions for cyclohexyl isobutyl phthalate to the U.S. Environmental Protection Agency's Inventory Update Rule over the 1986-2006 time-period (in four-year increments).[109] In addition, cyclohexyl isobutyl phthalate was not reported by industry in

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[103] PolyOne (December, 2011), *Technical Data Sheet – Synplast™ DUP-E – Di-undecyl Phthalate*.
[104] Accessed at the website of the European Chemicals Agency (http://www.echa.europa.eu/).
[105] Accessed at the website of Polynt SPA (www.polynt.com).
[106] Versar Inc. & SRC Inc. (June, 2011), *Toxicity Review for Diundecyl Phthalate (DUP, CASRN 3648-20-2)*.
[107] Australian Government Department of Health and Ageing NICNAS (June, 2008), *Existing Chemical Hazard Assessment Report, Diundecyl Phthalate*.
[108] Ibid.
[109] Accessed at the website of the U.S. Environmental Protection Agency's Inventory Update Rule (http://www.epa.gov/oppt/iur/).

the European Union as either a high production volume chemical or a low production volume chemical.[110] Cyclohexyl isobutyl phthalate was also not present on the "complete" list of commercial phthalates that is available on the website of the Plasticisers and Flexible PVC Information Centre.[111] Finally, a rather comprehensive Google® search was conducted, again yielding no information indicating that this phthalate is in industrial commerce.

Table 33: Identification of the Substance - CHIBP

Relevant CAS Numbers	5334-09-8
Chemical Name	1,2-Benzenedicarboxylic acid, cyclohexyl 2-methylpropyl ester
Identified Product Names	None

4.9 Texanol® Benzyl Phthalate (B84P) (CAS 16883-83-3)

This phthalate (often called by its original trade name Texanol® Benzyl Phthalate) is derived from 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate (CAS #25265-77-4), benzyl alcohol, and phthalic acid.[112]

Table 34: Identification of the Substance – B84P

Relevant CAS Numbers	16883-83-3
Chemical Name	1,2-Benzenedicarboxylic acid, 2,2-dimethyl-1-(1-methylethyl)-3-(2-methyl-1-oxopropoxy)propyl phenylmethyl ester
Identified Product Names	Santicizer® 278 (North American and European versions)

Monsanto were the original producers of Texanol® Benzyl Phthalate, however through various transactions (spin-off to Solutia and then purchase by Ferro) the Monsanto line of phthalate plasticizers is now produced by Ferro Corporation. Ferro now markets this

[110] Accessed at the website of the European Inventory of Existing Commercial Chemical Substances (http://esis.jrc.ec.europa.eu/).

[111] Accessed at the website of the Plasticisers and Flexible PVC Information Centre (www.plasticisers.org/plasticisers/not-all-phthalates-are-the-same/phthalates-list).

[112] U.S. Consumer Product Safety Commission, *CPSC Staff Toxicity Review of 17 Phthalates for Consideration by the Chronic Hazard Advisory Panel – 2010*.

phthalate under the product name Santicizer® 278.[113] Ferro Corporation is believed to be the only manufacturer of this phthalate and in the U.S. they are believed to manufacture it in Bridgeport, New Jersey. Ferro Corporation also appears to be the only company to have registered this phthalate (under the REACH initiative) to the European Chemicals Agency.[114] Ferro Corporation produces phthalate plasticizers in Antwerp, Belgium and it has been assumed that they also manufacture Santicizer® 278 at this location as well.

Table 35: Identified North American and European Manufacturers of B84P

Manufacturer	Location	Product Name
Ferro Corporation	Bridgeport, New Jersey	Santicizer® 278
Ferro Corporation	Antwerp, Belgium	Santicizer® 278

Documents from BASF also indicate that this phthalate is only produced by Ferro Corporation[115] and that it is a specialty plasticizer.[116]

In 1998, Texanol® Benzyl Phthalate was listed on the U.S. EPA's HPV Chemicals list with an annual domestic production of between 3,060-4,045 tonnes.[117] The most recent information on this phthalate under the U.S. Environmental Protection Agency's Inventory Update Rule indicates production of between 450-4,550 tonnes in 2006 in the U.S. Ferro Corporation was the only company listed as either a manufacturer or importer for this phthalate in 2006 (they were listed as a manufacturer).[118] The market for Santicizer® 278 in Europe appears to be in the 1,000-10,000 tonne per year range.[119]

Ferro Corporation markets two different products called Santicizer® 278 – a North American version and a European version, however it is believed that they are both the same phthalate. In terms of the North American version, Santicizer® 278 plasticizer is a high molecular weight benzyl phthalate that offers very low volatility and good permanence, yet retains the aggressive solvating characteristics of the benzyl phthalates. High compatibility and low volatility give good processing and permanence that compares with polymeric plasticizers. This combination makes it a versatile plasticizer for use in many different resin systems. In PVC, Santicizer® 278 shows low flexibilizing

[113] Ibid.
[114] Accessed at the website of the European Chemicals Agency (http://www.echa.europa.eu/).
[115] BASF (January, 2011), *Commercial Status of Other Phthalates - Comments to CPSC*.
[116] BASF (January, 2011), *Miscellaneous Phthalates – Status of Use in North America*.
[117] U.S. Consumer Product Safety Commission, *CPSC Staff Toxicity Review of 17 Phthalates for Consideration by the Chronic Hazard Advisory Panel – 2010*.
[118] Accessed at the website of the U.S. Environmental Protection Agency's Inventory Update Rule (http://www.epa.gov/oppt/iur/).
[119] Accessed at the website of the European Chemicals Agency (http://www.echa.europa.eu/).

efficiency, yet formulations are fast processing. The end product will be highly resistant to staining and dirt pick-up and will retain its properties well even when exposed to high temperatures, extractants - such as solvents, oils, grease - and other severe-use conditions. Santicizer® 278 has been found to be especially effective in vinyl systems that require extremely good migration resistance. Typical of this effect is the use of Santicizer® 278 in automotive sealants. Santicizer® 278 provides excellent paintability with "Hi-solids" automotive enamels and resists migration into the paint.[120]

In paints and coatings, Santicizer® 278 helps develop high-performance products. In acrylic coatings, Santicizer® 278 promotes excellent resistance to water spotting, greater toughness and excellent adhesion.[121]

In polyurethanes, Santicizer® 278 shows excellent compatibility and is recommended for urethane fabric coatings and free film. Its excellent permanence allows it to be used without detracting seriously from the high performance that warrants the use of urethane for the application. Santicizer® 278 is an excellent plasticizer for use in caulks and sealants that are based on chlorinated rubber, butyl rubber, polysulphides or polyurethane.[122]

In polyurethane sealant applications, Santicizer® 278 offers excellent permanence, low free-hydroxyl content and outstanding "body" in the sealant. Its low-moisture content and low acidity do not interfere with the chemistry of the curing system. In caulks and sealants for automotive applications, for example, its low volatility, anti-fogging and migration resistance characteristics are unique.[123]

Additional information of relevance that was provided for the European version of Santicizer® 278 is as follows:[124]

- Santicizer® 278 is a monomeric phthalic acid ester capable of reproducing the properties of polymeric plasticizers. It has a very low volatility, and mechanical properties such as attainable modulus and tensile strength are similar to those of high molecular weight polymeric plasticizers.
- Santicizer® 278 has an unusual combination of properties: (i) extremely low volatility; (ii) fast fusion characteristics; (iii) very low efficiency; and (iv) outstanding stain resistance.
- One advantage of Santicizer® 278 over a polymeric plasticizer is that Santicizer® 278 has excellent fusion. Santicizer® 278 matches polymeric plasticizers in

[120] Accessed at the website of Ferro Corporation (www.ferro.com).
[121] Ibid.
[122] Ibid.
[123] Ibid.
[124] Ibid.

producing rigid end-products so that the preparation of calendered semi-rigid PVC foams is another possible application.

- Santicizer® 278 is an excellent plasticizer candidate for sealant applications in which polysulphide rubbers are used. This is particularly true in the case of sealants for glass insulation units when the very low vapour pressure of Santicizer® 278 eliminates the possibility of mist formation and fogging.

The general literature indicates that Texanol Benzyl Phthalate (i.e. Santicizer® 278) is used as a plasticizer in vinyl systems to which it imparts migration resistance, durability, adhesion, and resistance to water spotting. Specific applications include paints, coatings, automotive sealants, and in caulks and sealants that are based on chlorinated rubber, butyl rubber, polysulphides, water-blown methylene diisocyanate (MDI)-based polyurethane foams, PVC-containing conductive fillers, and electromagnetic shields. It is also used as a yellowing inhibitor for thermoplastic polycarbonate resins exposed to gamma radiation, as a fade-resistance solvent for pressure-sensitive copying paper and for interlayers of sandwich glass for cars and buildings.[125]

4.10 Diisodecyl Phthalate (DIDP) (CAS 26761-40-0)

DIDP is a complex mixture containing mainly C10-branched isomers. DIDP is marketed under two CAS numbers, as outlined in the table below. No data on the differences between the types of DIDP has been identified and the European Union risk assessment report for DIDP does not distinguish between the different forms.[126]

DIDP is prepared from propylene and butenes through an oligomerization process forming hydrocarbons with 8 to 15 carbon atoms. After distillation (in view of obtaining nonene), oxonation forms aldehydes with one more carbon atom ("isodecanal"). The latter are hydrogenated and distilled to form monohydric alcohols (mainly C10). These are reacted with phthalic anhydride (PA). The first reaction step, alcoholysis of PA to give the monoester, is rapid and goes to completion. By charging in excess alcohol and by removing the water that is formed, the equilibrium can be shifted almost completely towards the products side. The reaction rate is accelerated by using a catalyst and high temperature. Depending on the used catalyst the temperature range is between 140°C and 250°C. For an acid catalyst, neutralization with aqueous caustic soda or sodium carbonate is necessary. However, traces of alkali remain in the organic phase, and therefore a washing step is included. After distillation of remaining water and alcohol the catalyst is

[125] U.S. Consumer Product Safety Commission, *CPSC Staff Toxicity Review of 17 Phthalates for Consideration by the Chronic Hazard Advisory Panel – 2010*.

[126] COWI, IOM and AMEC (March, 2012), *Evaluation of the New Scientific Evidence Concerning the Restrictions on DINP and DIDP Contained in Entry 52 of Annex XVII to Regulation (EC) No. 1907/2006 (REACH) – Final Report – Volumes on DINP and DIDP*.

removed by filtration. In order to minimize the emissions into the different compartments the reaction water is used in the neutralization step and the distilled alcohol is recycled.[127]

Table 36: Identification of the Substance – DIDP

Relevant CAS Numbers	26761-40-0; 68515-49-1; 105009-98-1, 1341-39-5, 148384-02-5
Chemical Name	1,2-Benzenedicarboxylic acid, diisodecyl ester
Identified Product Names	Jayflex™ DIDP; Jayflex™ DIDP-E; Synplast DIDP Normal; Synplast DIDP Electrical; Diplast R

At present, there is believed to be only two U.S. or Canadian producers of DIDP, specifically ExxonMobil Chemical in Baton Rouge, LA and PolyOne in Orangeville, ON and/or St.-Remi, QC. In addition, there are believed to be two main European producers of DIDP, specifically ExxonMobil Chemical in the Netherlands and Polynt in Italy,[128] however the apparent DIDP product from Polynt (i.e. Diplast R), cannot be located on their website. As such, Polynt may have ceased to manufacture DIDP.

Table 37: Identified North American and European Manufacturers of DIDP

Manufacturer	Location	Product Name
ExxonMobil Chemical	Baton Rouge, LA Rotterdam, Netherlands	Jayflex™ DIDP-E Jayflex™ DIDP
PolyOne	Orangeville, ON and/or St. Remi, QC	Synplast DIDP Electrical Synplast DIDP Normal
Polynt	Italy	Diplast R

Note: the difference between the electrical and normal grades of DIDP (for ExxonMobil and PolyOne) is that a small amount (e.g. around 0.1% concentration) of an antioxidant is added to the electrical grade.

DIDP is a large volume general purpose plasticizer. For instance according to the European Council for Plasticisers and Intermediates, the consumption of DINP, DIDP and DPHP (di-2-propylheptyl phthalate), has increased from representing about 50% of total phthalate sales in Europe in 2001 to approximately 83% of the total sales in 2010.[129]

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[127] European Chemicals Bureau (2003), *European Union Risk Assessment Report – CAS Nos: 68515-49-1, 26761-40-0, 1,2-benzenedicarboxylic acid, di-C9-11-branched alkyl esters, C10-rich and di-"isodecyl" phthalate (DIDP).*

[128] Accessed at the website of the DIDP Information Centre (www.didp-facts.com).

[129] COWI, IOM and AMEC (March, 2012), *Evaluation of the New Scientific Evidence Concerning the Restrictions on DINP and DIDP Contained in Entry 52 of Annex XVII to Regulation (EC) No. 1907/2006 (REACH) – Final Report – Volumes on DINP and DIDP.*

Meanwhile in the U.S., the most recent information indicates that production of DIDP in the U.S. in 2006 was between 45,000-230,000 tonnes[130], however one of the two production facilities in 2006 has ceased producing DIDP (i.e. Sunoco in Neville Island, PA).

The current European Union consumption for DIDP has been reported to be approximately the same as was reported in the European Union Risk Assessment Report for this substance for the year 1994. The European Union Risk Assessment Report indicates the consumption of DIDP in Western Europe in 1994 to be in the range of 193,000- 220,000 tonnes/year and applies a mean value of 200,000 tonnes/year. The export of DIDP on its own was 38,000 tonnes/year and the substance was not reported as being imported on its own. Consequently, the manufacturing of DIDP in Western Europe in 1994 was in the range of 235,000-258,000 tonnes. Additional information indicates that DIDP consumption has corresponded to 22% of the total European phthalate consumption used as plasticizers.[131]

With respect to specific DIDP products, Jayflex™ DIDP is one of the largest-volume general-purpose high-molecular-weight plasticizers for the wire and cable industry. It is used in flexible PVC products that require resistance to degradation due to high temperatures (such as wire and cable) or call for low fogging (automotive interior trim). Flexible PVC products that demand high performance and good outdoor weathering (such as roofing membranes and tarpaulins) also benefit from its use. Jayflex™ DIDP is an excellent substitute for Di (2-ethylhexyl) phthalate (DOP) in most flexible PVC applications. The listed advantages of Jayflex™ DIDP are as follows:[132]

- higher permanency for better resistance to aging, increasing product life;
- lower density and efficiency for volume advantages compared to DOP;
- low volatility for reduced process emissions and improved working conditions;
- increased PVC compound electrical resistivity for better insulation properties;
- low fogging for reduced car interior emissions;
- sustained flexibility in cold conditions;
- better lubrication than DOP for lower energy consumption with higher extrusion outputs; and
- REACH readiness.

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[130] Accessed at the website of the U.S. Environmental Protection Agency's Inventory Update Rule (http://www.epa.gov/oppt/iur/).

[131] European Chemicals Bureau (2003), *European Union Risk Assessment Report – CAS Nos: 68515-49-1, 26761-40-0, 1,2-benzenedicarboxylic acid, di-C9-11-branched alkyl esters, C10-rich and di-"isodecyl" phthalate (DIDP).*

[132] Accessed at the website of ExxonMobil Chemical (http://www.exxonmobilchemical.com/Chem-English/productsservices/jayflex-plasticizers.aspx).

Jayflex DIDP can also be of benefit when used with other non-PVC polymers such as polyurethanes or polyacrylates used in coatings, sealants and mastic applications.[133]

In terms of the general literature on DIDP, the low vapour pressure of DIDP and its higher permanency makes it the preferred plasticizer for applications such as wire and cable formulations where heat aging resistance is required and in areas where emissions of volatile components into the atmosphere during processing is subject to restriction or where good outdoor weathering resistance is required. In accordance with this, the European Council for Plastisicers and Intermediates indicates that, due to DIDP's properties of volatility resistance, heat stability and electric insulation, it is typically used as a plasticizer for heat-resistant electrical cords, leather for car interiors, and PVC flooring. DIDP is preferentially used in car interior trims meeting the low fogging thresholds set by car manufacturers, which are usually not met by using DINP or low molecular weight phthalates. It has been estimated that (according to a major manufacturer of cables and wires), DIDP represents 80% of the phthalates used for this application area. Besides the uses in cables, industry indicates that DIDP is preferably used in extruded and calendered articles (such as profiles, roofing sheets, ponds liners, etc.); however, similarly to DINP, DIDP can also be blended into a paste (so-called "plastisol") for coating (such as tarpaulins, synthetic leather, flooring, wall covering, etc.).[134]

DPHP is often used as an alternative to DIDP because only minor compound changes are needed to adapt for example wire formulations to DPHP. It similarly matches DIDP performance in automotive applications.[135]

Non-PVC applications for DIDP are reportedly relatively small, but include use in anti-corrosion and antifouling paints, sealing compounds and textile inks.[136] Other non-PVC applications for DIDP include other vinyl resins besides PVC, cellulose ester plastics and other polymer containing products, such as pressure sensitive adhesives and printing inks.[137] Outlined in the table below is the most recent information available on the market for DIDP in Europe.

[133] Ibid.
[134] COWI, IOM and AMEC (March, 2012), *Evaluation of the New Scientific Evidence Concerning the Restrictions on DINP and DIDP Contained in Entry 52 of Annex XVII to Regulation (EC) No. 1907/2006 (REACH) – Final Report – Volumes on DINP and DIDP.*
[135] Ibid.
[136] Ibid.
[137] European Chemicals Bureau (2003), *European Union Risk Assessment Report – CAS Nos: 68515-49-1, 26761-40-0, 1,2-benzenedicarboxylic acid, di-C9-11-branched alkyl esters, C10-rich and di-"isodecyl" phthalate (DIDP).*

Table 38: Projected Market for DIDP in Europe, by End-Use Application (2015)

(tonnes)

Process	Application Area	Consumption	Percentage of Consumption
Calendering	Film, sheet and coated products	52,140	22.0%
	Flooring, roofing, wall covering	16,590	7.0%
Extrusion	Hose and profile	11,850	5.0%
	Wire and cable	113,760	48.0%
	Clear, medical, film	9,480	4.0%
Injection moulding	Footwear and miscellaneous	9,480	4.0%
Plastisol spread coating	Flooring	4,740	2.0%
	General (coated fabric, wall covering, etc.)	2,370	1.0%
Other plastisol applications	Car undercoating and sealants	2,370	1.0%
	Slush/rotational moulding, etc.	2,370	1.0%
Mixture Formulation	Non-PVC applications	11,850	5.0%
Total		237,000	100%

Source: COWI, IOM and AMEC (March, 2012), *Evaluation of the New Scientific Evidence Concerning the Restrictions on DINP and DIDP Contained in Entry 52 of Annex XVII to Regulation (EC) No. 1907/2006 (REACH) – Final Report – Volumes on DINP and DIDP*.

Meanwhile, estimates from the U.S. indicate that annual consumption for DIDP was in the range of 135,000 tonnes annually, although this information was for 1998.

Table 39: Consumption of DIDP in the U.S. (1998)

(tonnes)

End Use Area	Application	Subtotal	Total
Film and Sheet			20,000
	Skins-Unsupported	7,000	
	Pool Lining	9,000	
	Other	4,000	
Artificial Leather			20,000
Coated Fabrics			1,000
Dip Coating/Slush Method			4,000
	Toys	2,000	
	Traffic Cones	<2,000	
	Other	≈1,000	
Tubings			9,000
Wire and Cable			45,000
Underbody Coating			36,000
Total			135,000

Source: U.S. Department of Health and Human Services – National Toxicology Program (October, 2000), *NTP-CERHR Expert Panel Report on Di-isodecyl Phthalate*.

The typical content of DIDP in flexible PVC products is between 25 and 50% (by weight).[138] Typical plasticizer concentrations in PVC wire and cable insulation are reported at 20-30%.[139]

Under the *Consumer Product Safety Improvement Act* in the U.S., there is an interim prohibition on DINP and DIDP above 0.1% by weight (one thousand parts per million) in toys intended for children age 12 and under that can be placed in a child's mouth and child care articles for children age 3 and under. In the state of Washington, DINP and DIDP (along with some other phthalates not part of the Substance Groupings Initiative), individually or in combination, are not permitted in children's products at more than 0.1% by weight.[140] In October 2007, California State passed a law (which became effective January 1, 2008) prohibiting the manufacture, sale, and distribution of child care products

[138] Accessed at the website of the DIDP Information Centre (www.didp-facts.com).
[139] COWI, IOM and AMEC (March, 2012), *Evaluation of the New Scientific Evidence Concerning the Restrictions on DINP and DIDP Contained in Entry 52 of Annex XVII to Regulation (EC) No. 1907/2006 (REACH) – Final Report – Volumes on DINP and DIDP*.
[140] Esso Imperial Oil (September, 2012), *Material Safety Data Sheet - Jayflex DIDP Plasticizer*.

that contain DINP or DIDP (along with some other phthalates not part of the Substance Groupings Initiative) in concentrations higher than 0.1%.[141]

The European Union banned the use of DINP and DIDP (along with some other phthalates not part of the Substance Groupings Initiative) in children's articles which can be put in the mouth, effective on January 16, 2007.[142]

In Brazil, DINP and DIDP are permitted only for toys and child care articles that cannot be placed in the mouth. In Argentina and Japan, DINP and DIDP are permitted only for toys not intended to be placed in the mouth. [143]

4.11 Benzyl Isooctyl Phthalate (BIOP) (CAS 27215-22-1)

Research during this study did not identify any information indicating that benzyl isooctyl phthalate is commercially produced as a plasticizer or for any other applications. There were no submissions for benzyl isooctyl phthalate to the U.S. Environmental Protection Agency's Inventory Update Rule over the 1986-2006 time-period (in four-year increments).[144] In addition, benzyl isooctyl phthalate was not reported by industry in the European Union as either a high production volume chemical or a low production volume chemical.[145] Benzyl isooctyl phthalate was also not present on the "complete" list of commercial phthalates that is available on the website of the Plasticisers and Flexible PVC Information Centre.[146] Finally a rather comprehensive Google® search was conducted, again yielding no information indicating that this phthalate is in industrial commerce.

Table 40: Identification of the Substance – BIOP

Relevant CAS Numbers	27215-22-1; 30138-75-1
Chemical Name	1,2-Benzenedicarboxylic acid, isooctyl phenylmethyl ester
Identified Product Names	None

[141] Nexant Inc. (2009), *PERP Program – Developments in Non-Phthalate Plasticizers*.
[142] Ibid.
[143] Esso Imperial Oil (September, 2012), *Material Safety Data Sheet - Jayflex DIDP Plasticizer*.
[144] Accessed at the website of the U.S. Environmental Protection Agency's Inventory Update Rule (http://www.epa.gov/oppt/iur/).
[145] Accessed at the website of the European Inventory of Existing Commercial Chemical Substances (http://esis.jrc.ec.europa.eu/).
[146] Accessed at the website of the Plasticisers and Flexible PVC Information Centre (www.plasticisers.org/plasticisers/not-all-phthalates-are-the-same/phthalates-list).

It should be noted that a few references indicated that Ferro Corporation's Santicizer® 261 is actually isooctyl benzyl phthalate, including the Handbook of Plasticizers[147]. However Ferro Corporation indicates that the CAS number for Santicizer® 261 is CAS 68515-40-2, which is Benzyl Octyl Phthalate. There are no references indicating that CAS 68515-40-2 is the same substance as those CAS numbers listed in the table above. Therefore it is suspected that the attribution of benzyl isooctyl phthalate to Santicizer 261 is a mistake.

4.12 Dimethyl Cyclohexyl Phthalate (DMCHP) (CAS 27987-25-3)

DMCHP appears to be a very low volume plasticizer, with only one identified global manufacturer. There were no submissions for DMCHP to the U.S. Environmental Protection Agency's Inventory Update Rule over the 1986-2006 time-period (in four-year increments).[148] DMCHP was also not present on the "complete" list of commercial phthalates that is available on the website of the Plasticisers and Flexible PVC Information Centre.[149] However, DMCHP has been identified by industry in Europe to be a low production volume chemical.[150]

Table 41: Identification of the Substance – DMCHP

Relevant CAS Numbers	27987-25-3
Chemical Name	1,2-Benzenedicarboxylic acid, bis(methylcyclohexyl) ester
Identified Product Names	Edenol® 344

Emery Oleochemicals has been identified as a manufacturer of DMCHP and specifically their Edenol® 344 product. Emery Oleochemicals produces natural-source oleochemical basestocks. The company offers fatty acids, glycerin and triacetin, ozone acids, plastic additives, and ester-based oilfield chemicals. The company was formerly known as Cognis Oleochemicals LLC and changed its name to Emery Oleochemicals LLC in May, 2009.[151] Emery Oleochemicals is headquartered in Malaysia with production sites in Malaysia, Germany, the U.S. and Canada (Toronto).[152] It should be noted that the former

[147] Wypych, George (2004), *Handbook of Plasticizers*, published by ChemTec publishing.
[148] Accessed at the website of the U.S. Environmental Protection Agency's Inventory Update Rule (http://www.epa.gov/oppt/iur/).
[149] Accessed at the website of the Plasticisers and Flexible PVC Information Centre (www.plasticisers.org/plasticisers/not-all-phthalates-are-the-same/phthalates-list).
[150] Accessed at the website of the European Inventory of Existing Commercial Chemical Substances (http://esis.jrc.ec.europa.eu/).
[151] Accessed at http://investing.businessweek.com/research/stocks/private/snapshot.asp?privcapId=30644367
[152] Accessed at the website of Emery Oleochemicals (www. http://www.emeryoleo.com/).

name for Edenol® 344 was Dehysol® 344. Edenol® 344 potentially obtained its new name when the name of the company was changed (from Cognis to Emery). Furthermore, apart from being listed under CAS 27987-25-3, Edenol® 344 has also been listed under CAS 174493-24-4.

Table 42: Identified Manufacturers of DMCHP

Manufacturer	Location	Product Name
Emery Oleochemicals	Unknown (but likely in Malaysia)	Edenol® 344

According to Emery Oleochemicals, Edenol® 344 is a highly viscous migration-resistant plasticizer for PVC plastics, coatings, including cellophane and aluminum coatings, printing inks and related applications. Edenol® 344 is compatible with vinyl resins (PVC, polyvinyl acetate, their copolymers, polyvinyl acetal, polyvinyl butyral) ethylcellulose, cellulose nitrate, cellulose acetate butyrate, polystyrene, polymethyl methacrylate, chlorinated rubber and shellac. Edenol® 344 also has good compatibility in compounds with alkyd resins, phenol resins and urea-formaldehyde resins. Some of the most popular applications for Edenol® 344 are: (i) high quality furniture coatings; (ii) paper coatings and printing inks based on cellulose nitrate and vinyl chloride copolymers; (iii) leather coatings; (iv) printing inks; (v) organosols and plastisols; (vi) aluminum and cellophane coatings; (vii) ceramic paints; (viii) underbody sealants for motor vehicles; (ix) hot dip coating compounds; (x) strip coatings; and (xi) PVC plastics. Edenol® 344 is not compatible with cellulose acetate.[153]

Edenol® 344 is miscible in all proportions with almost all aliphatic, cycloaliphatic and aromatic hydrocarbons normally used in the processing of plastics and surface coating resins. It offers the following advantages:[154]

- low volatility;
- high solvating power;
- gives coatings good ageing resistance;
- low migration tendency;
- good resistance to water and oil;
- excellent dielectric behaviour; and
- very good compatibility.

[153] Emery Oleochemicals (March, 2006), *Edenol® 344*.
[154] Ibid.

The only other reference to DMCHP that was located during the study was a statement that it is a specialty plasticizer for underbody automotive coating.[155]

4.13 Diisononyl Phthalate (DINP) (CAS 28553-12-0)

DINP is a class of dialkyl phthalate esters that represents a complex of branched, predominantly C-9 isomers.[156] DINP is produced by esterification of phthalic anhydride with isononyl alcohol in a closed system. Isononyl alcohol used in the synthesis of DINP is produced via either the dimerization of butene or the oligomerization of propylene/butene. The reaction rate is accelerated by elevated temperatures (140-250°C) and a catalyst. Following virtually complete esterification, excess alcohol is removed under reduced pressure and the product is then typically neutralized, water washed and filtered.[157]

DINP is assigned different CAS numbers based on the method of manufacture. CAS number 68515-48-0 (i.e. DINP-1) is manufactured (by the "Polygas" process[158]) from octene that is converted to alcohol moieties consisting mainly of 3,4-, 4,6-, 3,6-, 3,5-, 4,5-, and 5,6-dimethyl-heptanol-1. CAS number 28553-12-0 (DINP-2) is produced from n-butene that is converted primarily to methyloctanols and dimethylheptanols. CAS number 28553-12-0 also represents DINP-3, which is produced from n-butene and isobutene that are converted to alcohols, with 60% consisting of methylethyl hexanols.[159]

Table 43: Identification of the Substance – DINP

Relevant CAS Numbers	28553-12-0; 68515-48-0; 33703-08-1
Chemical Name	1,2-Benzenedicarboxylic acid, diisononyl ester
Identified Product Names[1]	Jayflex™ DINP; Palatinol® N; Synplast DINP; Vestinol® 9; Diplast® NS

[1] there are several variations on the identified product names that are still DINP – see the next table.

[155] Murphy, J. (2001), *Additives for Plastics Handbook (Second Edition)*.
[156] U.S. Consumer Product Safety Commission (June, 2001), *Report to the U.S. Consumer Product Safety Commission by the Chronic Hazard Advisory Panel on Diisononyl Phthalate (DINP)*.
[157] European Chemicals Bureau (2003), *European Union Risk Assessment Report – CAS Nos: 68515-48-0, 28553-12-0, 1,2-benzenedicarboxylic acid, di-C8-10-branched alkyl esters, C9-rich and di-"isononyl" phthalate (DINP)*.
[158] COWI, IOM and AMEC (March, 2012), *Evaluation of the New Scientific Evidence Concerning the Restrictions on DINP and DIDP Contained in Entry 52 of Annex XVII to Regulation (EC) No. 1907/2006 (REACH) – Final Report – Volumes on DINP and DIDP*.
[159] U.S. Consumer Product Safety Commission (June, 2001), *Report to the U.S. Consumer Product Safety Commission by the Chronic Hazard Advisory Panel on Diisononyl Phthalate (DINP)*.

DINP-1 is also known by the tradename Jayflex® DINP while DINP-2 is also known by the tradename Palatinol® N. DINP 3 has been discontinued,[160] with production reportedly stopped in 1995.[161]

There are believed to be three DINP manufacturers located in the U.S. and Canada and five in the European Union (although there may be additional unidentified manufacturers in Europe). ExxonMobil Chemical and BASF appear to manufacture DINP in both North America and Europe while the third manufacturer in North America is PolyOne, which is believed to be producing DINP in Canada. The three additional DINP manufacturers in Europe are Evonik Industries (Germany), Polynt (Italy) and Deza (Czech Republic). ExxonMobil Chemical is believed to be the largest producer of DINP and has been producing DINP (and DIDP) for more than 40 years.[162]

Table 44: Identified North American and European Manufacturers of DINP

Manufacturer	Location	Product Name
ExxonMobil	Baton Rouge, LA Rotterdam, Netherlands	Jayflex™ DINP
BASF	Pasadena, TX and/or Cornwall, ON Ludwigshafen, Germany	Palatinol® N Palatinol® N-I[1] Palatinol® N-E[1]
PolyOne	Orangeville, ON and/or St. Remi, QC	Synplast DINP E[1] Synplast DINP N Synplast Mixed Phthalate[2]
Evonik Industries	Ruhr, Germany	Vestinol® 9
Polynt	San Giovanni Valdarno, Italy	Diplast® NS
Deza	Czech Republic	DINP

[1] electrical grade product, thereby containing an antioxidant.
[2] mixed phthalates including DINP.

According to data provided by manufacturers, the total production volume of DINP in the European Union was estimated at 185,200 tonnes in 1994. An estimated import volume of 5,400 tonnes and exports of 83,400 tonnes resulted in an estimated market for DINP of

[160] COWI, IOM and AMEC (March, 2012), *Evaluation of the New Scientific Evidence Concerning the Restrictions on DINP and DIDP Contained in Entry 52 of Annex XVII to Regulation (EC) No. 1907/2006 (REACH) – Final Report – Volumes on DINP and DIDP*.
[161] European Chemicals Bureau (2003), *European Union Risk Assessment Report – CAS Nos: 68515-48-0, 28553-12-0, 1,2-benzenedicarboxylic acid, di-C8-10-branched alkyl esters, C9-rich and di-"isononyl" phthalate (DINP)*.
[162] ExxonMobil (July 16, 2009), *Plasticizers and the CPSIA*, presented to the U.S. Consumer Product Safety Commission.

107,200 tonnes in 1994 in the European Union. The estimated mean consumption of DINP in Western Europe from 1990-1995 was approximately 121,000 tonnes per year.[163]

More recent information specifically on DINP from Europe is not available. The current manufacture of DINP and DPHP (di-2-propylheptyl phthalate), combined, has been estimated to be approximately 580,000 tonnes per year in the European Union while consumption of DINP, DIDP and DPHP in the European Union in 2010 has been estimated to be approximately 670,000 tonnes. The consumption of DINP, DIDP and DPHP has increased from representing about 50% of total phthalate sales in Europe in 2001 to approximately 83% of total sales in 2010.[164]

The most recent information from the U.S. indicates that DINP production was between 45,000-230,000 tonnes for both relevant CAS numbers (i.e. CAS 28553-12-0 and 68515-48-0) in 2006. If production was aggregated for these two CAS numbers, then total production of DINP in the U.S. in 2006 was between 90,000-460,000 tonnes.[165]

In terms of information from DINP manufacturers, ExxonMobil Chemical indicates that Jayflex™ DINP is the largest-volume and preferred general-purpose high-molecular-weight plasticizer for PVC. It is a substitute for Di (2-ethylhexyl) phthalate (DOP) in most flexible PVC applications. Advantages of Jayflex™ DINP are as follows:[166]

- better resistance to aging, increasing product life;
- easier plastisol coating, spraying and dipping;
- higher permanency and improved resistance for cold outdoor conditions;
- compatibility with secondary plasticizers for further cost savings;
- low volatility for reduced process emissions and improved working conditions;
- lower density and lower energy consumption with higher extrusion outputs compared to DOP; and
- REACH readiness.

BASF stated that Palatinol® N is a primary plasticizer that imparts beneficial application properties to plasticized vinyl articles. Palatinol® N in vinyl compounds provides good low temperature performance coupled with excellent rheological properties in plastisols.

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[163] European Chemicals Bureau (2003), *European Union Risk Assessment Report – CAS Nos: 68515-48-0, 28553-12-0, 1,2-benzenedicarboxylic acid, di-C8-10-branched alkyl esters, C9-rich and di-"isononyl" phthalate (DINP)*.

[164] COWI, IOM and AMEC (March, 2012), *Evaluation of the New Scientific Evidence Concerning the Restrictions on DINP and DIDP Contained in Entry 52 of Annex XVII to Regulation (EC) No. 1907/2006 (REACH) – Final Report – Volumes on DINP and DIDP*.

[165] Accessed at the website of the U.S. Environmental Protection Agency's Inventory Update Rule (http://www.epa.gov/oppt/iur/).

[166] Accessed at the website of ExxonMobil Chemical (http://www.exxonmobilchemical.com/Chem-English/productsservices/jayflex-plasticizers.aspx).

The unique nature of this ester results in lower volatility, improved processibility and better low temperature performance. The excellent resistance to water and outdoor exposure by vinyl plasticized with Palatinol® N is an advantage in the manufacture of film for the housing and construction markets. By virtue of its contribution to low viscosity and good viscosity stability, Palatinol® N is suitable for plastisols including spray coating, dipping, casting, or slush molding.[167]

From Europe, Evonik Industries indicates that DINP is mainly used as a plasticizer in polymer formulations, especially together with PVC, polyalkyl methacrylate and polyvinyl butyryl. The advantageous properties of DINP are apparent in every method of thermoplastics processing and also in the processing of plastisols, as well as in the performance of all kinds of the finished products. DINP is also used in other technical products, for instance in adhesives. DINP is used as a plasticizer for polymers, as a phlegmatizer (for organic peroxides), in construction chemicals, for the manufacture of coatings, inks and colours, for the production of lubricants and the production of adhesives. Its predominant use is as a plasticizer for PVC in a wide variety of (soft) PVC products especially flooring applications, wallpapers, coated fabrics, roofing membranes, hoses, profiles, artificial leather and wire & cable applications.[168]

In terms of the general literature on DINP, heat resistance, low temperature resistance and volatility resistance are some of the main properties of DINP that make it suitable for a wide range of applications.[169] It has been estimated that approximately 95% of DINP is used in PVC applications used for construction and industrial applications, and durable goods (wire and cable, film and sheet, flooring, industrial hoses and tubing, footwear, toys, food contact plastics).[170] The remaining 5% of DINP is used in non-PVC applications.[171] The price of DIDP (in the US.) is about 5% higher than the price of DINP. Therefore it would be expected that DIDP is mainly used in applications where the substance has some technical advantages compared to DINP. For applications where either could be applied (as is often the case) it would be expected that the least expensive of the substances (i.e. DINP) would be used.[172]

With respect to PVC applications, DINP can be blended into a paste (so-called "plastisol"), which makes it particularly fitted for coating (such as tarpaulins, synthetic leather, flooring, wall covering, etc.) and rotational moulding (such as some toys and

[167] BASF (February, 2009), *Technical Data Sheet - Palatinol® N - Diisononyl Phthalate*.
[168] Evonik Industries (November, 2011), *Technical Information – GPS Safety Summary – Diisononylphthalate*.
[169] Accessed at the website of the DINP Information Centre (www.dinp-facts.com).
[170] Ibid.
[171] COWI, IOM and AMEC (March, 2012), *Evaluation of the New Scientific Evidence Concerning the Restrictions on DINP and DIDP Contained in Entry 52 of Annex XVII to Regulation (EC) No. 1907/2006 (REACH) – Final Report – Volumes on DINP and DIDP*.
[172] Ibid.

sporting articles) applications. DINP is the major plasticizer for plastisol applications, in particular for the production of flooring products. Plasticizer concentrations vary quite extensively depending on flooring type. An estimated 10-20% plasticizer content, depending on product type, has been reported for products for the professional market, while higher concentrations (25-30%) are reported for low-price cushioned PVC flooring for the private market. According to European Council for Plasticisers and Intermediates, vinyl floors produced nowadays are based on DINP as the general purpose plasticizer and use a secondary fast fusing plasticizer, often esters of benzoic acid. Additional information on the use of DINP in PVC products is as follows:[173]

- DINP is the main plasticizer used in wallpaper/wall covering. According to major producers of PVC wallpaper, typical plasticizer concentrations are 25-30%.
- DINP is also used in air mattresses (20-30% concentration) and swimming pool liners made of flexible PVC typically contain 20-30% DINP.
- DINP is used in bathing equipment (20-30% concentration), although DEHP is the preferred plasticizer.
- DINP is rarely used for PVC wire and cable.

More than half of the DINP used in non-PVC applications involves polymer related-uses (e.g. rubbers). The remaining DINP is used in non-polymer applications including inks, pigments and dyestuffs, adhesives/glues, sealants, paints and lacquers and lubricants. Among the 450 tonnes of DINP in preparations in the Danish market in 1996, most were included in adhesives and printing inks.[174]

Outlined in the two tables below are estimates of DINP usage in the European Union and the U.S. for the mid to late 1990s, by application. Estimated annual consumption was in the same range in these two regions (i.e. between 100,000-200,000 tonnes per year).

[173] Ibid.
[174] European Chemicals Bureau (2003), *European Union Risk Assessment Report – CAS Nos: 68515-48-0, 28553-12-0, 1,2-benzenedicarboxylic acid, di-C8-10-branched alkyl esters, C9-rich and di-"isononyl" phthalate (DINP)*.

Table 45: Use of DINP in PVC and Non-PVC Applications in the European Union (1994)

(tonnes)

Application	Consumption Sub-Total	Total
Calendering		19,488
Film, sheet and coated products	15,936	
Flooring, roofing, wall covering	3,552	
Extrusion		41,524
Hose and profile	5,379	
Wire and cable	29,020	
Clear, medical, film	7,125	
Injection Moulding		8,313
Footwear and miscellaneous	8,313	
Plastisol Spread Coating		22,230
Flooring	10,658	
General (coated fabric, wall covering, etc.)	11,571	
Other Plastisol Applications		9,643
Car undercoating and sealants	7,714	
Slush/rotational moulding	1,929	
Total PVC		101,500
Non-PVC[1]		5,500
Total		107,000

[1] non-PVC applications include: (i) 2,750 tonnes in polymer related applications; and (ii) 2,750 tonnes in non-polymer related applications, which was evenly split among: (a) adhesives, glues and sealing compounds; (b) inks; and (c) paints.

Source: European Chemicals Bureau (2003), *European Union Risk Assessment Report – CAS Nos: 68515-48-0, 28553-12-0, 1,2-benzenedicarboxylic acid, di-C8-10-branched alkyl esters, C9-rich and di-"isononyl" phthalate (DINP).*

Table 46: Estimated U.S. End-Uses of DINP Produced in 1998

(tonnes)

End-Use	Sub-Total	Total
Film and Sheet		13,000
Stationary and Wood Veneer	6,000	
Pool Liners	1,000	
Other	6,000	
Flooring		48,000
Tiles	23,000	
Sheets	25,000	
Artificial Leather		3,000
Coated Fabrics		21,000
Tarps	16,000	
Conveyer Belts	1,000	
Other	4,000	
Dip Coating/Slush Molded		30,000
Gloves	15,000	
Toys	6,000	
Traffic Cones	<1,000	
Other	≈9,000	
Tubings and Profiles		7,000
Profiles	5,000	
Garden Hoses	2,000	
Wire and Cables		32,000
Shoes/Shoe Soles		9,000
Underbody Coating		7,000
Sealants (carpet backing)		8,000
Total		178,000

Source: U.S. Consumer Product Safety Commission (June, 2001), *Report to the U.S. Consumer Product Safety Commission by the Chronic Hazard Advisory Panel on Diisononyl Phthalate (DINP*).

The available literature has indicated that the production and usage of DINP has been increasing as it substitutes for other phthalates that have come under increasing scrutiny from government agencies. This increase in usage can be seen in the projected consumption of DINP in the European Union for 2015 of just under 500,000 tonnes. This represents a significant increase in consumption from the approximately 100,000 tonnes estimated consumed in 1994.

Table 47: Projected Market for DINP in Europe, by End-Use Application (2015)

(tonnes)

Process	Application Area	Consumption	Percentage of Consumption
Calendering	Film, sheet and coated products	57,018	11.5%
	Flooring, roofing, wall covering	7,739	1.6%
Extrusion	Hose and profile	25,006	5.1%
	Wire and cable	85,761	17.3%
	Clear, medical, film	39,901	8.1%
Injection moulding	Footwear and miscellaneous	48,249	9.7%
Plastisol spread coating	Flooring	68,299	13.8%
	General (coated fabric, wall covering, etc.)	76,933	15.5%
Other plastisol applications	Car undercoating and sealants	50,498	10.2%
	Slush/rotational moulding, etc.	10,845	2.2%
Mixture Formulation	Non-PVC applications	24,750	5.0%
Total		495,000	100%

Source: COWI, IOM and AMEC (March, 2012), *Evaluation of the New Scientific Evidence Concerning the Restrictions on DINP and DIDP Contained in Entry 52 of Annex XVII to Regulation (EC) No. 1907/2006 (REACH) – Final Report – Volumes on DINP and DIDP*.

According to Annex XVII of REACH, as of January 16, 2007 DINP and DIDP cannot be used as substances or as constituents of preparations, at concentrations higher than 0.1% by mass of the plasticized material, in toys and childcare articles which can be placed in the mouth by children.[175]

In the U.S., there is an interim prohibition on DINP and DIDP above 0.1% by weight in toys intended for children age 12 and under that can be placed in a child's mouth and child care articles for children age 3 and under. In October 2007, California passed a law (which became effective January 1, 2008) prohibiting the manufacture, sale, and distribution of child care products that contain DINP or DIDP (along with some other phthalates not part of the Substance Groupings Initiative) in concentrations higher than 0.1%.[176] In the state of Washington, DINP and DIDP (along with some other phthalates not part of the Substance Groupings Initiative), individually or in combination, are not permitted in children's products at more than 0.1% by weight.

[175] COWI, IOM and AMEC (March, 2012), *Evaluation of the New Scientific Evidence Concerning the Restrictions on DINP and DIDP Contained in Entry 52 of Annex XVII to Regulation (EC) No. 1907/2006 (REACH) – Final Report – Volumes on DINP and DIDP*.

[176] Nexant Inc. (2009), *PERP Program – Developments in Non-Phthalate Plasticizers*.

In Argentina and Japan, DINP and DIDP are permitted only for toys not intended to be placed in the mouth.

4.14 Benzyl Octyl Phthalate (B79P) (CAS 68515-40-2)

The only identified commercial product for benzyl octyl phthalate (i.e. Santicizer® 261) is a mixture comprising benzyl chloride, C7 alcohols, C9 alcohols, benzyl chloride, toluene, and 1,2-benzenedicarboxylic acid, benzyl, C7-9 branched and linear alkyl esters in an unknown ratio.[177]

Table 48: Identification of the Substance – B79P

Relevant CAS Numbers	68515-40-2
Chemical Name	1,2-Benzenedicarboxylic acid, benzyl C7-9-branched and linear alkyl esters
Identified Product Names	Santicizer® 261

There is only one identified manufacturer of benzyl octyl phthalate in North America or Europe, specifically Ferro Corporation with production occurring in Bridgeport, New Jersey. It should be noted that in recent documentation concerning the review of phthalates by the Consumer Product Safety Commission, BASF indicated that contact was needed with Ferro Corporation to determine if their product (i.e. Santicizer® 261 was discontinued.[178] Available information from the U.S. Environmental Protection Agency Inventory Update Rule indicates that between 450 and 4,550 tonnes of this phthalate was produced by Ferro Corporation in 2006.[179]

[177] U.S. Consumer Product Safety Commissions, *CPSC Staff Toxicity Review of 17 Phthalates for Consideration by the Chronic Hazard Advisory Panel – 2010*.
[178] BASF (January, 2011), *Commercial Status of Other Phthalates – Comments to CPSC*.
[179] Accessed at the website of the U.S. Environmental Protection Agency's Inventory Update Rule (http://www.epa.gov/oppt/iur/).

Table 49: Identified North American and European Manufacturers of B79P

Manufacturer	Location	Product Name
Ferro Corporation	Bridgeport, NJ	Santicizer® 261 (North American and European versions)

Santicizer® 261 plasticizer is a monomeric plasticizer that finds application in polyurethane and polysulphide caulks and sealants, film and sheeting, coated fabrics, plastisols, organosols, vinyl foams and acrylic lacquers.[180]

In polyurethane, Santicizer® 261 has excellent compatibility, provides good viscosity control and, due to its low volatility, excellent permanence. High filler loadings are possible because of the excellent wet-out characteristics of Santicizer® 261. In acrylic coatings, Santicizer® 261 imparts excellent durability, anti-fogging properties, better adhesion to metal undercoats, improved weatherability and good solvent-craze resistance. It imparts excellent gloss, resists water spotting, provides good flow characteristics and flexibility without brittleness for a long coating life. The low volatility and greater permanence makes it the preferred modifier for acrylic coatings that must have a long service life and/or must endure under high-temperature exposure.[181]

In vinyl plastisols and organosols, Santicizer® 261 provides relatively low initial viscosity and adequate viscosity stability. It offers fast fusion at normal temperatures, low volatility and permanence in finished vinyl products. In calendering and extrusions, Santicizer® 261 combines the efficiency of monomeric esters with permanence approaching that of low molecular weight polymerics, and offers excellent processing characteristics. With Santicizer® 261, vinyl compounders can obtain oil, kerosene and gasoline resistance that is better than that obtainable with low molecular weight polymerics or high molecular weight monomerics.[182]

In vinyl foams, Santicizer® 261 provides a good combination of fusion and rheology properties that produce excellent cell structure. Its low volatility helps maintain a permanent, dimensionally stable foam.[183]

[180] Information on North American Santicizer® 261, accessed at the website of Ferro Corporation (www.ferro.com).
[181] Ibid.
[182] Ibid.
[183] Ibid.

Ferro Corporation also provides information on European Santicizer® 261, although they do not identify the CAS number of the phthalate plasticizer. It is assumed that it is the same product as North American Santicizer® 261, which was described above. Unique information provided for European Santicizer® 261 is as follows:[184]

- it is a fast fusing phthalate plasticizer with high permanence, somewhat comparable to low molecular weight polymeric plasticizers. It provides the easy processing conditions characteristic of monomeric plasticizers.
- the fields of application for Santicizer® 261 include : (i) calendered and extruded PVC for its low volatility and extraction resistance; (ii) expanded flooring and leathercloth for its fusion, low volatility and good cell structure; (iii) acrylic varnishes, polyvinyl acetate adhesives, paints, polysulphide and castable polyurethanes sealants for its low volatility and good compatibility with a wide variety of recipes.
- Santicizer® is also used in plastisols, which take advantage of its: (i) excellent resistance to extraction by soapy water, oil, petrol, kerosene and hexane; (ii) provision of rapid fusion under normal operating temperature; and (iii) low volatility. Plastisols have low initial viscosity, good shelf life and present flow properties, which are not attainable with polymeric plasticizers. The pastes can be fused at lower temperatures and shorter processing times, representing an advantage of Santicizer® 261 over polymeric plasticizers, which fuse slowly.
- Santicizer® 261 is used in nitrile rubber to reduce the hardness of the vulcanisate, and also in polyurethane sealants, helping the rapid build up of thixotropy and long-term retention of performances. Compatibility with polyurethane resins depends upon formulations, crosslinking density and polyurethane type.

Additional noted uses for Santicizer® 261 include slush molding, inks, elastomers as well as wire and cable.[185]

4.15 Diisoheptyl Phthalate (DiHepP) (CAS 71888-89-6)

DiHepP is manufactured commercially in a closed system by catalytically esterifying phthalic anhydride with various alcohols (isoheptyl or heptanol mixtures). As with other phthalates, the unreacted alcohols are recovered and reused, and the DiHepP mixture is purified by vacuum distillation or activated charcoal. The purity of DiHepP can achieve 99% or greater using existing manufacturing processes. The remaining fraction of the DiHepP commercial mixture can also contain impurities such as isoheptyl alcohol (0.03% by weight), diisoheptyl ether and isoheptyl benzoate (0.07% by weight), and a maximum of 0.1% water.[186] DiHepP possesses 2 branched ester side chains each with a backbone of

[184] Information on European Santicizer® 261, accessed at the website of Ferro Corporation (www.ferro.com).
[185] U.S. Consumer Product Safety Commissions, *CPSC Staff Toxicity Review of 17 Phthalates for Consideration by the Chronic Hazard Advisory Panel – 2010*.
[186] Versar Inc. & SRC Inc. (July, 2011), *Toxicity Review for Diisoheptyl Phthalate (DIHP, CASRN 71888-89-6)*, prepared for U.S. Consumer Product Safety Commission.

predominantly 6 carbons (C6). DiHepP is considered to belong to a group of 'transitional' phthalates defined as those produced from alcohols with straight-chain carbon backbones of C4-6.[187]

Table 50: Identification of the Substance - DIHepP

Relevant CAS Numbers	71888-89-6
Chemical Name	1,2-Benzenedicarboxylic acid, di-C6-8-branched alkyl esters, C7 rich
Identified Product Names	Jayflex® 77 (Historical – no longer produced)

Historically, global annual DiHepP production volume was between 20,000 and 200,000 tonnes, with one production site located in Europe and one in the U.S.[188] However available information indicates that DiHepP is not longer produced in North America or the European Union. DiHepP was previously manufactured by ExxonMobil Chemical in the U.S. (in Baton Rouge, La) under the brand name Jayflex® 77.[189] According to information from ExxonMobil Chemical, their manufacturing of Jayflex® 77 stopped by the end of 2010 and stocks were due to be consumed within a three month period.[190]

DIHepP had previously been manufactured by at least one company in the European Union. However, it is understood that manufacture has ceased as of the end of 2010. According to the European Council for Plasticisers and Intermediates (ECPI), none of the Council's member companies currently produce DIHP. The European Commission also sent questionnaires to all companies that were identified as manufacturers of phthalates in the European Union but which are not members of ECPI (in total seven manufacturers). Six of the seven manufacturers indicated that they do not manufacture or import the substance, whilst one manufacturer in Eastern Europe did not provide any response. The European Chemicals Agency has also not received a registration dossier (under REACH) from industry for DIHepP, indicating that it is not manufactured or imported into the European Union as a substance on its own. Therefore, the number of manufacturing sites in the European Union is considered to be zero on the basis of the available information. According to a former manufacturer in the European Union, the main reason for the cessation of production is that DIHepP has been classified as toxic to reproduction by an amendment to the *Classification, Labelling and Packaging Regulation* in 2009. Based on European Chemical Agency discussions with industry it is understood that, due to the

[187] Australian Government – Department of Health and Ageing NICNAS (June, 2008), *Diisoheptyl Phthalate*.
[188] Ibid.
[189] Versar Inc. & SRC Inc. (July, 2011), *Toxicity Review for Diisoheptyl Phthalate (DIHP, CASRN 71888-89-6)*, prepared for U.S. Consumer Product Safety Commission.
[190] European Chemicals Agency (February, 2011), *Proposal for Identification of a Substance as a Category 1A or 1B CMR, PBT, vPvB or a Substance of an Equivalent Level of Concern – Substance Name – 1,2-Benzenedicarboxylic Acid, di-C6-8-Branched Alkyl Esters , C7-Rich (DIHP)*.

classification of DIHepP and the availability of suitable alternatives, it is unlikely that DIHepP will be reintroduced.[191]

Production of DiHepP was also reported to cease in Japan in 2000, following the discontinuation of isoheptyl alcohol production.[192] According to the European Chemicals Agency, the former manufacturer of DIHepP has indicated that DiHepP is not manufactured in Asia.[193]

This elimination of DiHepP production is corroborated by two different publications[194/195] from BASF which has indicated that DiHepP is no longer a commercial product, has been discontinued and as such is not currently available.

Production of DiHepP peaked in the U.S. in the mid/late-1990's at 48,000 tonnes and then subsequently declined. Recently, U.S. production of DiHepP decreased from 26,000 tonnes (2005) to 22,700 tonnes (2008) and was projected to decrease further to negligible levels (2013). DiHepP's proportion of the total phthalate production market (3.9%) was also projected to decrease to negligible levels during the same period. The U.S. Environmental Protection Agency's Inventory Update Rule reported that aggregated national production volume for DiHepP in the U.S. was between 22,700-45,500 tonnes in 2006.[196]

Estimated U.S. consumption of DiHepP paralleled production estimates. Consumption of DiHepP was reported at 22,000 tonnes in 2008 and was projected to decrease to negligible amounts by 2013. DiHepP's proportion of the total phthalate consumption market (3.7%) was also projected to decrease to negligible amounts in the U.S. In the past 20 years, U.S. consumption of DiHepP has been within a tonne or two less than production estimates, suggesting that most DiHepP produced in the U.S. was utilized locally.[197]

According to ExxonMobil Chemical, Jayflex® 77 was an excellent general purpose, strongly solvating, highly compatible phthalate plasticizer with applications in: (i) vinyl flooring, tile, and carpet backing; and (ii) molding and coating of plastisols. Jayflex® 77 was used as a partial replacement for higher molecular weight phthalate plasticizers in

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[191] Ibid.
[192] Versar Inc. & SRC Inc. (July, 2011), *Toxicity Review for Diisoheptyl Phthalate (DIHP, CASRN 71888-89-6)*, prepared for U.S. Consumer Product Safety Commission.
[193] European Chemicals Agency (February, 2011), *Proposal for Identification of a Substance as a Category 1A or 1B CMR, PBT, vPvB or a Substance of an Equivalent Level of Concern – Substance Name – 1,2-Benzenedicarboxylic Acid, di-C6-8-Branched Alkyl Esters , C7-Rich (DIHP*).
[194] BASF Corporation, *Commercial Status of Other Phthalates – Comments to CPSC 1-25-2011.*
[195] BASF Corporation (January, 2011), *Miscellaneous Phthalates – Status of Use in North America.*
[196] Versar Inc. & SRC Inc. (July, 2011), *Toxicity Review for Diisoheptyl Phthalate (DIHP, CASRN 71888-89-6)*, prepared for U.S. Consumer Product Safety Commission.
[197] Ibid.

extrusion, injection molding and calendering applications requiring improved processability.[198] The main reported uses of DIHepP were as a plasticizer in PVC and as a plasticizer in sealants and printing inks.[199]

The main former use of DIHepP in the European Union was as a plasticizer in PVC. According to the OECD, DIHepP was mainly used as a plasticizer to impart flexibility to PVC resins, which in turn were largely used in the manufacture of flooring products. PVC flooring typically consists of several layers on top of each other. DIHepP was recommended for use in the top wear layer and the chemical foam layer.[200]

DIHepP was also used in a range of marketed sealants and coatings according to material safety data sheets provided on the websites of manufacturers and suppliers in December 2010. The sealants were of different kinds including two-component systems, one-component polyurethanes and acrylics. DIHepP was present in the products in concentrations in the range of 1-10%. There was also some evidence to indicate that DiHepP was also used in adhesive formulations.[201]

For the period 2003-2008, a stable consumption of 0.2-0.4 tonnes of DIHepP for printing inks based on organic thinner was registered in the Norwegian Product Register.[202] In Australia, DiHepP was imported for use as a specialist plasticizer in screen printing inks.[203]

DIHepP has also been used as an oil additive for engine oils. One product from Wynn's was marketed as an additive to improve the viscosity index. According to the Material Safety Data Sheet, the concentration of DIHepP was in the range of 2.5-5.0%. Wynn's also listed DiHepP in the same concentration range in an oil additive marketed as an additive to stop leaks in oil systems without the need to dismantle the system. According to Wynn's, DIHepP has recently been replaced by DINP. It was also noted that DIHepP was located in Material Safety Data Sheets for oil additives from manufacturers in the U.S.[204]

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[198] ExxonMobil Chemical (August, 2003), *JayFlex® Plasticizers – Jayflex 77 Diisoheptyl Phthalate*.
[199] European Chemicals Agency (February, 2011), *Proposal for Identification of a Substance as a Category 1A or 1B CMR, PBT, vPvB or a Substance of an Equivalent Level of Concern – Substance Name – 1,2-Benzenedicarboxylic Acid, di-C6-8-Branched Alkyl Esters , C7-Rich (DIHP*).
[200] Ibid.
[201] Ibid.
[202] Ibid.
[203] Australian Government – Department of Health and Ageing NICNAS (June, 2008), *Diisoheptyl Phthalate*.
[204] European Chemicals Agency (February, 2011), *Proposal for Identification of a Substance as a Category 1A or 1B CMR, PBT, vPvB or a Substance of an Equivalent Level of Concern – Substance Name – 1,2-Benzenedicarboxylic Acid, di-C6-8-Branched Alkyl Esters , C7-Rich (DIHP*).

5. Identified Information Gaps

5.1 Manufacture

Information on the manufacturers of phthalates is rather robust and considered of good quality/reliability. Most of the Canadian imports of phthalates originate from the U.S., east Asia and Germany. Therefore understanding the manufacturers from these locations is considered to be important. Rather comprehensive information is provided in the report on the U.S. and German manufacturers and some limited information on Asian manufacturers is outlined. However it is expected that there are many more phthalate manufacturers in Asia than has been outlined in this report.

There are only three plasticizer manufacturing facilities in Canada, however it is unknown which specific (if any) phthalates are manufactured at these facilities. Educated guesses can be made with respect to the phthalates manufactured by PolyOne in Canada as it is believed that they only produce phthalates in Canada and they are transparent about what phthalates they offer for sale. Overall this is not that important an information gap, as Environment Canada can ensure that both PolyOne (2 facilities) and BASF (1 facility) is aware of the section 71 notice. Both of these companies will then report in their section 71 response in terms of their Canadian production of the specific phthalates of interest.

There are four phthalates that no information could be located during the study indicating that they are in fact currently commercial substances. It is believed that these four substances are not in commercial use at present. Therefore this may not be an information gap but simply a reality of the current market for phthalate plasticizers.

5.2 Import and Distribution

Import data for 2012 is available for categories of phthalates as well as for two individual phthalates, one of which is a CMP II substance (i.e. DINP). The HS codes were recently modified so that less detail is available on the imports of individual phthalates. In 2011 and historically, individual import data is available for two CMP II phthalates, specifically DINP and DIDP. Therefore an information gap is the annual importation data for 12 of the 14 phthalates. It is expected that DINP and DIDP will be the CMP II phthalates consumed in the largest quantities in Canada. Therefore it is advantageous that individual import data exist for these two phthalates. Alternatively, some of the other phthalates will likely be used in small quantities in Canada, in niche applications and by only a handful of companies. If certain companies distributing or consuming these low-volume phthalates are not aware or do not respond to the section 71 notice, then a

significant percentage of the Canadian market for that phthalate is missed. Having import data for that phthalate from Statistics Canada would assist in ensuring that the major quantities are not missed through the section 71 response. However unfortunately that option is not available to Environment Canada.

Caution is also raised with respect to relying on Statistics Canada import data. We have observed several instances in the past (with respect to our chemical-related studies for the federal government) where the import data from Statistics Canada was considered incorrect (or could not be explained). Therefore while these data should be obtained where it is considered informative, the data from section 71 responses (if comprehensive) should be considered more accurate. It is recommended that the DINP and DIDP imports as determined through the section 71 response be compared to the Statistics Canada import data to see if the two numbers are in somewhat agreement. If they are not, then there could be problems with either information set.

There is limited information on the current distribution of the phthalate plasticizers in Canada. The manufacturers are well known (at least in North America, Europe and to some extent Asia), however how these phthalates are distributed in Canada is unknown. This has important implications with respect to collecting relevant information through the section 71 notice to accurately define consumption in Canada as well as the end-use pattern. There are many different chemical distributors in Canada and without contacting each of the major phthalate manufacturers directly it is difficult to ascertain exactly whom they utilize as distributors in Canada. This is particularly important with respect to the Asian phthalate manufacturers that are supplying the Canadian market since they would likely rely to a greater extent on chemical distributors in Canada versus supplying their phthalates directly to end-users in Canada (as is often the case for North American manufacturers of various chemicals). Since China, South Korea and Taiwan represent almost 20% of the imports of phthalates into Canada, understanding who the distributors are of these phthalates is important to ensure that comprehensive information is obtained through the section 71 responses.

5.3 Use

It is expected that the vast majority of the total consumption of all 14 phthalates combined will be in the PVC sector. A good overview of the various segments of the PVC sector that will be consuming phthalates was provided earlier in this report. What is unknown is to what extent these phthalates are consumed outside of the PVC sector. Gathering this information will be more difficult for Environment Canada because of the expected large number of potential end-users across a range of diverse sectors and the expected small volumes that are consumed by individual facilities. This issue is more problematic for certain phthalates that are primarily consumed outside of the PVC sector.

For instance, DMP and DIBP are expected to have large percentages of their consumption potentially occurring outside of PVC. Gathering information on end-users within the PVC sector is more straightforward given that it is only one "sector" with not an exhaustive amount of potential end-users in the key segments (e.g. wire and cable, flooring, etc.) and it is also represented by an active industry association (i.e. the Canadian Plastics Industry Association).

5.4 Other Notes

It is important to note that certain information that is typically required in order to inform risk management instrument development was not specifically researched during the study. For instance information on releases to the environment or technologies/substitutes to reduce the use/release of phthalates were not specifically researched during the study. Therefore comments with respect to information gaps related to these issues cannot be made. Please note that Cheminfo is in the process of completing a study[205] that has identified release factors for the 14 phthalate plasticizers from the use and end-of-life of plastic products. This report may be of assistance to risk assessors at Environment Canada in the future.

[205] Cheminfo Services Inc. (March, 2013), *Plastic Product Study (Review of the Potential for Releases of CMP II Substances and Organotins from Plastic Products*, prepared for Environment Canada.

6. Potential Challenges for Collection of Data on Substances

6.1 Introduction

Outlined in this chapter is the identification of challenges for the collection of data on phthalates through the section 71 notice as well as recommendations to reduce the risk of major reporting issues for potential section 71 notices, including areas of non-compliance.

6.2 Communication with Relevant Organizations to Ensure Responses to the Section 71 Notice

The particular structure of the phthalate industry provides both advantages and challenges for the collection of information through the section 71 notice in the *Canada Gazette*. One of the particular advantages are that upwards of 70-90% of the market for phthalates in Canada is supplied by Canadian and U.S. manufacturers of phthalates. This particular percentage will differ for each of the individual fourteen phthalates under consideration and there is no information available to indicate how the Canadian market is being supplied for the individual phthalates under the Substance Groupings Initiative. However in general, Canadian and U.S. manufacturers supply an estimated 70-90% of the market for phthalates and likely for the 14 phthalates (combined).

In addition, there are less than ten identified manufacturers of phthalates in Canada and the U.S. This report has identified all known Canadian and U.S. manufacturers of phthalates, which combined likely represent 90-100% of phthalate production in these two countries. Therefore it will not be difficult or time-consuming to communicate with these manufacturers to make them aware of the section 71 notice on phthalates so that they will respond with the required information. It is recommended that Environment Canada communicate with these Canadian and U.S. manufacturers of phthalates to make them aware that the section 71 notice has been published in the *Canada Gazette* or arrange to have the section 71 notice distributed to them directly. The Phthalate Esters Panel of the American Chemistry Council could assist in this regard, however they do not represent all of the relevant phthalate manufacturers in Canada and the U.S.

Many of these Canadian and U.S. phthalate manufacturers will have established supply arrangements with chemical distributors in Canada. Since some of these phthalate manufacturers are relatively small, not all of them will be supplying the Canadian market. However, the majority of them will. These Canadian distributors are important as they

often supply many, small volume accounts that the phthalate manufactures do not even know about. Therefore to obtain a complete understanding of the supply and use of phthalates in Canada, it is important that these phthalate distributors in Canada respond to the section 71 notice. As a result, it is recommended that Environment Canada:

- Identify the Canadian chemical distributors for each of the Canadian and U.S. phthalate manufacturers and inform them of the section 71 notice for phthalates or forward the actual section 71 notice to these distributors directly. Note that this could be accomplished as well by allowing the phthalate manufacturers to inform their Canadian distributors of the section 71 notice for phthalates (this is the less preferable option as it takes the management of this information flow away from Environment Canada); and
- Arrange for the Canadian Association of Chemical Distributors to inform their members of the phthalate section 71 notice.

The most challenging aspect of the process of informing relevant phthalate manufacturers/distributors of the section 71 notice is the supply of phthalates from Asian sources. Based on import data for phthalates, it appears that approximately 10-20% of the market for phthalates in Canada is supplied by Asian phthalate manufacturers. These manufacturers would typically rely to a greater extent on chemical distributors to sell their products versus supplying end-users directly themselves. In past studies, Cheminfo has identified relatively obscure Canadian chemical distributors that have aligned themselves with Chinese chemical manufacturers to supply plastic additives to the market in Canada. Therefore the challenge for Environment Canada is to ensure that the supply of these phthalates manufactured in Asia are being reported comprehensively through the section 71 notice. To reduce the risk that these Asian imports are unaccounted for through the section 71 responses, Environment Canada could undertake the following:

- Conduct research to identify the major manufacturers of phthalates in China, South Korea and Taiwan (some of which were identified in this report) and determine if/who they have established as their Canadian distributors;
- Contact the Canadian Border Services Agency to determine if Environment Canada could get access to information on the origin and destination company for imported phthalates from Asia;
- Based on the above two actions, communicate directly with the identified Canadian distributors (for Asian manufactured phthalates) informing them of the section 71 notice on phthalates; and
- Arrange for the Canadian Association of Chemical Distributors to inform their members of the phthalate section 71 notice.

In terms of end-users, again the particular nature of the phthalate market provides both advantages and challenges for Environment Canada. The majority of the phthalates will

be consumed within the PVC sector in Canada, which is not that large. This report has identified several of the companies in the range of PVC processing sectors that would be the likely candidates for consuming phthalates. Environment Canada could work with the Canadian Plastics Industry Association – CPIA (which represents the PVC sector in Canada) to communicate with their PVC members informing them of the upcoming phthalate section 71 notice or have the CPIA distribute the notice to these members directly. In addition, the CPIA could assist Environment Canada in taking the list of companies provided in this report (e.g. PVC wire and cable, flooring, plastisols, etc.) and identifying any additional companies that are not members of the CPIA and whom Environment Canada may want to communicate with directly. Even though these companies may not be members of the CPIA, the CPIA may be aware of their existence.

The more challenging aspect of communicating with phthalate end-users will be the non-PVC end-users of phthalates in Canada. These non-PVC end-users are distributed across several sectors and include hundreds (potentially thousands) of potential end-users. The problem is exacerbated by the fact that usage of phthalates in these sectors is likely restricted to a small percentage of the companies and that these companies will generally consume small quantities of phthalates. To assist in maximizing responses from relevant end-users in these non-PVC sectors, it is recommended that Environment Canada undertake the following:

- Arrange for the respective industry associations to inform their members of the phthalate section 71 notice and how to obtain it. These associations include the Canadian Cosmetic, Toiletry and Fragrance Association, Canadian Paints and Coatings Association, Rubber Association of Canada, Canadian Printing Ink Manufacturer's Association and the Adhesives and Sealants Manufacturers Association of Canada; and
- The contacts that Environment Canada established with the distributors of phthalates in Canada can also be beneficial in communicating with phthalate end-users. These distributors could be asked to communicate with their customers informing them of the phthalate section 71 notice and that they should review the notice to see if they meet the thresholds for submitting data to the federal government.

6.2.1 Phthalates with No/Low Expected Responses Under the Section 71 Notice

There are four CMP II phthalates that, based on available information, do not appear to be in commerce at present. These four phthalates are as follows: (i) dibenzyl phthalate; (ii) cyclohexyl isobutyl phthalate; (iii) benzyl isooctyl phthalate; and (iv) diisoheptyl phthalate. Therefore based on research conducted during this study, Environment Canada should expect that few (and likely no) section 71 responses will be received for these particular phthalates.

Reference was made to one of these phthalates (i.e. dibenzyl phthalate) being present only as a residual (of less than 1%) in benzyl butyl phthalate formulations. There are no specific recommendations for modifying the current draft section 71 notice for phthalates based on this information (since the percentage concentration triggering a response is already so low in the draft section 71 notice). However the purpose of this section was to draw Environment Canada's attention to this issue.

There are other phthalates that while in commerce are still expected to generate few responses and/or low reported volumes to the section 71 notice, for instance dicyclohexyl phthalate, butyl cyclohexyl phthalate, Texanol® benzyl phthalate, dimethyl cyclohexyl phthalate and benzyl octyl phthalate.

The issue with the phthalates discussed in this section is that if they are consumed in Canada, it is likely by a small number of end-users. As such, it is necessary to effectively communicate the existence of the phthalate section 71 notice in order to increase the likelihood that those few companies that may be consuming these phthalates actually respond to the section 71 notice.

6.2.2 Intermediate and Finished Products that Contain Phthalates

Phthalates will also be contained in various intermediate and finished products that are imported into Canada. For instance in terms of finished products, phthalates will be contained in PVC textiles, PVC wallcoverings, automobiles, adhesives and sealants, personal care products, etc. that are imported into Canada. There are also several intermediate PVC products that are imported into Canada annually that will contain phthalates. Examples of some HS Code for these intermediate products are as follows:

- HS Code 390422 – Plasticized PVC Resin
- HS Code 391810 – PVC Floor Coverings
- HS Code 392043 – PVC Plates, Sheet, Film, Foil and Strip Containing (By Weight) Not Less than 6% Plasticizers

As written, the section 71 notice will capture the import of these intermediate (and many finished) PVC products as the phthalate concentrations in these PVC products will be above that specified in the draft section 71 notice. In reality, there could be numerous actual importers of these products into Canada that should respond to the section 71 notice however could be unaware of its existence.

There are no actions that we recommend with respect to Environment Canada communicating with the importers/end-users of these products. This is attributed to the fact that there will be many thousands of potential companies to contact. In addition, the phthalates will be contained within the intermediate/final product with less of an opportunity for being released to the environment versus pure phthalates being

imported/used. It is suggested that Environment Canada's resources would be better allocated to ensuring that responses from manufacturers, importers/distributors and end-users of pure phthalates is maximized.

6.3 Recommendations for the Draft Section 71 Notice on Phthalates

The thresholds specified in the draft section 71 notice for phthalates appear reasonable. When used in PVC, phthalates are generally added in concentrations ranging from 1-30%, while in personal care products they are often added at concentrations of around 2%.

There are not expected to be that many importers (or end-users) of pure phthalates in Canada, which is confirmed by the modest number of companies representing 80% of phthalate imports within the Canadian Importers Database. However, there may be many more importers of finished products containing 100 kilograms of specific phthalates. Since phthalates can be contained in relatively high concentrations in PVC (e.g. 30%), it would only take the importation of approximately 333 kilograms of a PVC product with 30% phthalate concentration to trigger reporting under section 71. As an example, HS Code 391810 is "Floor, Wall And Ceiling Coverings (In Rolls Or Tiles) - Polymers Of Vinyl Chloride", of which 31 individual companies in Canada represented 80% of the imports of this HS Code in 2011 (according to the Canadian Importers Database). Therefore there is the potential for receiving quite a few submissions from importers of finished products containing more than 100 kilograms of individual phthalates. However given that there is likely to be a large number of non-responsive companies in this category (since these importers generally won't even know what phthalates are contained in the PVC flooring), we only raise this issue to highlight the potential problem, without suggesting that any changes be made to the current thresholds.

Outlined below are specific recommendations that we have established as it pertains to the current draft section 71 notice for phthalates.

6.3.1 Nomenclature Issues with the CMP II Phthalates

There may be a mistake in the current draft section 71 notice. The Part 1 Substances only contains 12 of the 14 substances that were the subject of this study. It was expected that all 14 substances analyzed in this study would be included under the Part 1 Substances. Based on this hypothesis, it is recommended that Environment Canada check to determine whether CAS 68515-40-2 and CAS 71888-89-6 should be added to the Part 1 Substances list (and removed from the Part 2 Substances list). Consequently if this is required, then CAS 68515-49-1 and CAS 68515-48-0 may have to be removed from the

Part 1 Substances list (i.e. there are two CAS numbers in the Part 1 Substances list that refer to DINP).

One of the issues with collecting information on specific chemical substances is one of nomenclature and it is no different with the fourteen phthalates identified under the Substance Groupings Initiative. The nomenclature issues relate to different CAS numbers and/or common names being used for the same substance. In the case of the phthalates under consideration, the issue of nomenclature primarily relates to multiple CAS numbers. However there are issues with the common names as well.

The draft phthalate section 71 notice identifies some of the additional CAS numbers that apply to specific phthalates. This is particularly of concern for DINP and DIDP which are the large volume phthalates on the list and each has a separate CAS number that appears to be potentially still in use. However there are some additional CAS numbers that were identified during this study for some of the 14 phthalates that are not outlined in the current draft section 71 notice. It is recommended that Environment Canada confirm that these are also possible CAS numbers describing these phthalates and if they are, then they be added to the section 71 notice to properly define the substances in question. The additional CAS numbers that were identified during this study have been provided in each of the individual phthalate profiles in Chapter 4.

There were also instances where more than one common name was identified for a particular phthalate and it was (and remains) uncertain whether the different common names actually referred to one phthalate or totally different phthalates. The one particular instance where there was the most confusion and where potential section 71 respondents may be confused was with diundecyl phthalate and whether diisoundecyl phthalate is a totally different phthalate or just another common name for diundecyl phthalate.

It should be noted that information on common names for several of the fourteen phthalates is not provided on the website for the Chemicals Management Plan and in the Terms of Reference for this study. The actual common name for these phthalates was identified during the study and provided in their respective profiles in chapter 4.

It is recommended that Environment Canada be as transparent as possible in the section 71 notice in terms of describing each of the fourteen phthalates. This would include multiple CAS numbers and multiple common names if relevant for specific substances as well as identifying the acronym that is likely the most commonly used identifier for the various phthalates.

6.3.2 Require All Canadian Phthalate Distributors to Report

It is recommended that Environment Canada consider requiring all distributors of phthalates to respond to the section 71 notice with relevant information. Distributors are

important links in the movement of phthalates from manufacturers to end-users and often are key to understanding the complete picture with respect to consumption of specific substances in Canada. Not all chemical distributors are importers and therefore they would not be subject to the section 71 notice, for instance:

- There are three Canadian manufacturing facilities for phthalates. From past projects we know that these manufacturers use chemical distributors in Canada to move some of their products to end-user sites. Therefore these Canadian distributors who obtain their phthalates from Canadian phthalate manufactures are currently not required to respond to the section 71 notice since they do not manufacture, import or use the phthalates.
- U.S. (or international) manufacturers of phthalates may use their Canadian arm as the importer of record. As a hypothetical, Eastman Chemical in the U.S. could use Eastman Chemical Canada as the importer of record for their phthalates. Eastman Chemical Canada could then use the services of Canadian chemical distributors to sell their phthalates. These Canadian chemical distributors would not be required under the current section 71 notice to report since they are not a manufacturer, importer or end-user of phthalates.
- In the past Cheminfo has identified the presence of sub-distributors for various chemicals. In other words, there are some companies that obtain their chemicals from a distributor and then distribute to various end-users in Canada. As an example, a Canadian importer/distributor of phthalates that received their phthalates from a U.S. manufacturer could then sell some of this phthalate quantity to another distributor (i.e. a sub-distributor). This sub-distributor would then sell the phthalates to various end-users in Canada. This sub-distributor would not currently be required to report under the section 71 notice since they are not a manufacturer, importer or user of the phthalates. The original distributor would be required to report (since they are importing phthalates), but not the sub-distributor.

From our experience in working with section 71 responses and summaries, this lack of complete information on distributors (and their customers) has posed problems in the past since it is difficult to develop an accurate supply/demand balance without understanding how the entire quantity of specific substances moves within the Canadian economy. If all companies that are supposed to respond to the section 71 notice do actually respond then requiring all distributors to respond is less important. This is attributed to the fact that all relevant users should be responding. However it is suspected that this is not normally the case and that there are end-users in Canada that should be responding to section 71 notices but are not. Requiring all distributors (and sub-distributors) to respond to section 71 notices with their customer lists (e.g. top 20 customers as indicated in the section 71 notice) ensures that a much more accurate accounting of the flow and end-use of phthalates will be developed. Obtaining customer lists from all distributors will allow Environment Canada to identify specific end-users that did not respond to the section 71 notice, but should have. At present, this can only be accomplished with the customer lists

provided by phthalate manufactures and some of the Canadian distributors (i.e. those that import).

Requiring all distributors to respond to the section 71 notice also reduces the likelihood of double or even triple-counting of quantities when analyzing the results. The rationale for this is that the phthalates can be tracked all the way from manufacture to end-use. At present in the draft section 71 notice, there is a potential for a gap in the flow of phthalates, where certain distributors will not be required to respond. This results in uncertainties and increases the likelihood of double-counting volumes. For instance, a Canadian manufacturer of phthalates and an end-user of phthalates would both be required to respond to the section 71 notice, reporting the same quantity of phthalates (if that phthalate quantity manufactured was eventually consumed by that end-user). However if the Canadian phthalate manufacturer first sold the phthalate to a Canadian distributor and then that Canadian distributor sold it to the end-user, it would be difficult to determine (from the current section 71 notice) that it is actually the same quantity of phthalates. The difficulty is exacerbated if sub-distributors are involved. Having all distributors respond allows Environment Canada to track phthalates from manufacture to end-use and would reduce the likelihood for double-counting.

6.3.3 Identify Product/Brand Names

It is recommended that Environment Canada consider requiring that the actual product or brand names be collected through the section 71 response. For instance, this would require importers and end-users to explicitly indicate that they are importing/using Jayflex™ DINP instead of just DINP. The current section 71 notice only requires that the "common or generic name…." of the substance be reported. It is unclear whether this means that "Jayflex® DINP" or just "DINP" would be reported. Attaching product/brand names to the manufacture, importation and end-use facilitates the tracking of the flow of phthalates from manufacture to end-use, since ExxonMobil's DINP product (Jayflex™ DINP) can be distinguished from BASF's DINP product (e.g. Palatinol® N) or PolyOne's DINP product (e.g. Synplast® DINP-N). If only DINP is reported by importers, distributors or end-users, it can be unclear which manufacturer produced the phthalate. Again this assists in understanding the flow of phthalates from manufacture to end-use.

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