National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

Cleaning Products Fact Sheet

Default parameters for estimating consumer exposure

Updated version 2018

This report contains an erratum d.d. 13-9-2018 on page 247

ConsExpo
consumer | exposure

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RIVM Report 2016-0179

Colophon

DOI 10.21945/RIVM-2016-0179

J.A.J. Meesters
M.M. Nijkamp
A.G. Schuur
J.D. te Biesebeek

Contact:
Gerlienke Schuur
VSP-CPV
consexpo@rivm.nl

This investigation has been performed by order and for the account of the ConsExpo 2015 project. This project is financed by:

Netherlands Food and Consumer Product Safety Authority
Ministry of Economic Affairs

Ministry of Health, Welfare and Sport

anses
Investigate, evaluate, protect

Health Canada
www.hc-sc.gc.ca

BfR
Bundesinstitut für Risikobewertung

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
Swiss Confederation
Federal Department of Home Affairs FDHA
Federal Office of Public Health FOPH

This is a publication of:
National Institute for Public Health and the Environment
P.O. Box 1 | 3720 BA Bilthoven
The Netherlands
www.rivm.nl

Synopsis

Cleaning Products Fact Sheet
Default parameters for estimating consumer exposure – Updated version 2018

Accurate estimation of consumer exposure is a necessity in assessing the potential risks of chemical substances in consumer products. RIVM has developed the computer program ConsExpo, for which recently an online version was launched (ConsExpo Web), to estimate such exposure. ConsExpo Web can be used to calculate indoor consumer exposure to substances during the use of for example paint, cleaning products and personal care products.

Fact Sheets that describe default models and default values for exposure parameters have been written for users of ConsExpo Web. Using these models and default values, the exposure assessment is performed in a standardised and transparent way. Several Fact Sheets are available. Following the update of the General Fact Sheet in 2014, the Cleaning Products Fact Sheet is now updated as well.

The Cleaning Products Fact Sheet describes default values useful in estimating exposure to substances in a cleaning product, such as for frequency of use and product amount. The updated version of the Cleaning Products Fact Sheet describes the latest data sources. This new information has been evaluated and the default values are adjusted when necessary.

The defaults in the ConsExpo database of amongst others laundry detergents, dishwashing products, all-purpose cleaners, abrasives, bathroom cleaners, floor, carpet and furniture cleaners and other cleaning products, will be renewed parallel to the publication of the revised Cleaning Products Fact Sheet.

Keywords: ConsExpo Web, Fact Sheet, standardisation, consumer exposure estimation, cleaning products.

Publiekssamenvatting

Schoonmaakmiddelen Factsheet
Standaard parameters voor de schatting van consumentenblootstelling - Herziene versie 2018.

Om mogelijke risico's van chemische stoffen in consumentenproducten te kunnen beoordelen, is een goede schatting nodig van de mate waarin mensen eraan blootstaan als zij het product gebruiken. Voor deze schatting heeft het RIVM het computerprogramma ConsExpo ontwikkeld, waarvoor recentelijk een webapplicatie is gemaakt (ConsExpo Web). Hiermee kan bijvoorbeeld de blootstelling van een bepaalde chemische stof binnenshuis tijdens het gebruik van bijvoorbeeld verf, schoonmaakmiddelen of cosmetica worden berekend.

Voor de gebruikers van ConsExpo Web zijn Factsheets geschreven waarin standaardmodellen en standaardwaarden (defaults) staan voorgeschreven. Door deze modellen en waarden te gebruiken, wordt de blootstellingsschatting op een transparante en gestandaardiseerde manier uitgevoerd. Er zijn meerdere Factsheets, waarvan, in navolging op de Factsheet Algemeen in 2014, nu de Schoonmaakmiddelen Factsheet is herzien.

In de Schoonmaakmiddelen Factsheet staan standaardwaarden die bruikbaar zijn om de blootstelling aan een stof in een schoonmaakmiddel te schatten. Voorbeelden van die waarden zijn de frequentie van het gebruik en hoeveelheden van het gebruikte product. In de herziene versie staan de nieuwste beschikbare databronnen beschreven, is de nieuwe informatie beoordeeld en waar nodig zijn de standaardwaarden aangepast.

Parallel aan de publicatie van de herziene Schoonmaakmiddelen Factsheet zullen ook de gepubliceerde standaardwaarden in de ConsExpo-database van onder meer wasmiddelen, afwasmiddelen, allesreinigers, schuurmiddelen, badkamerreinigers, vloer-, tapijt, -en meubelreinigingsmiddelen worden vernieuwd.

Kernwoorden: ConsExpo Web, Factsheet, standaardisering, consumentenblootstellingsschatting, schoonmaakmiddelen

Acknowledgements

Colleagues from ConsExpo2015-project partners ANSES, BfR, Health Canada and FOPH are acknowledged for critically reviewing versions of the revised Cleaning Products Fact Sheet, as well as for their contribution to general discussion points. Next to the partners, AISE, ACI/CCSPA and the Netherlands Food and Consumer Product Safety Authority are acknowledged for critically reviewing the draft version in the consultation round. Christiaan Delmaar is acknowledged for his contribution to discussions with regard to general discussion points and ConsExpo Web models. Susan Wijnhoven and Wouter ter Burg are acknowledged for critical reviewing several versions of the revised Cleaning Products Fact Sheet and delivering valuable feedback.

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Summary

The aim of the current report is to update the Cleaning Products Fact Sheet, an important document containing default values for the assessment of consumer exposure to substances in cleaning agents. The default values can be applied in the ConsExpo model, which is used to calculate consumer exposure to chemicals in consumer products via different exposure routes. The values given in the previous version of the Cleaning Products Fact Sheet were included in a database coupled to ConsExpo, which was developed by the RIVM in the early 1990s. The default values in the current Cleaning Products Fact Sheet replace those in the previous one. Recently an online version of ConsExpo (ConsExpo Web) was launched. ConsExpo is used by various (inter)national bodies and within different legal frameworks.

Product-specific default values are important for the consistent and harmonized estimation and assessment of consumer exposure to substances contained in consumer products. These are developed for different product categories and described in Fact Sheets, which provide consumer exposure scenarios for the use of cleaning products, cosmetics, paint products, pest control products, disinfectant products, do-it-yourself products and children's toys. In addition, the General Fact Sheet (of which the most recent update was published in 2014 by Te Biesebeek et al.) describes generic defaults for consumer exposure estimation such as body weight, surface areas of body parts, room sizes and ventilation rates.

The first version of the Cleaning Products Fact Sheet was written in 2006 (Prud'homme de Lodder et al., 2006a). In the current version, new data are taken into account and default values are adjusted when necessary. Although ConsExpo was originally developed for the Dutch consumer market, the parameter values assigned are now aimed at consumers in general. Therefore, in the absence of suitable Dutch data, information from outside the Netherlands has been considered. The data supporting the prescribed defaults are explained and their quality and reliability evaluated. At the time of publication of the updated Fact Sheet, the ConsExpo database will be updated with the new defaults.

The current Cleaning Products Fact Sheet gives more detailed information than the 2006 version. The scenarios explaining how consumer exposure is anticipated from intentional product use are more explicit. Standardized exposure estimation prescriptions are now given for every use activity from which consumer exposure is anticipated. From these, selected models and respective model parameter values are prescribed as defaults for the estimation of exposure to substances in laundry detergents, dishwash detergents, all-purpose cleaners, abrasives, bathroom cleaners, floor, carpet and furniture cleaners and other products. The quality of the supporting data is now ranked and a rationale is provided for all of the selected defaults. The current Fact Sheet also describes new data sources that have become available since 2006. Finally, all changes to exposure scenarios, selected ConsExpo models and default parameter values in comparison with the previous version, published in 2006, are shown in a single data table, so that they can easily be identified.

Samenvatting

Het huidige rapport is een herziening van de Reinigingsmiddelen Factsheet, een belangrijk document met standaardwaarden (defaults) voor het maken van een consumentenblootstellingschatting aan stoffen in schoonmaakproducten. Deze defaults zijn toepasbaar in het ConsExpo model, dat consumentenblootstelling aan chemische stoffen in consumentenproducten via de verschillende blootstellingsroutes kan berekenen. De waarden beschreven in de Reinigingsmiddelen Factsheet zijn gekoppeld aan een database behorende bij ConsExpo, een software model ontwikkeld in het begin van de jaren negentig. Recentelijk is een online versie beschikbaar gekomen (ConsExpo Web) waarin de standaardwaarden van de huidige Reinigingsmiddelen Factsheet die van de vorige versie vervangen. ConsExpo wordt gebruikt door diverse (inter)nationale organisaties en binnen verschillende wettelijke kaders.

Productspecifieke defaults zijn essentiële waarden voor een consistente en geharmoniseerde bepaling en beoordeling van de blootstelling aan stoffen in consumentenproducten bij het gebruik van ConsExpo. Deze defaults zijn ontwikkeld voor de verschillende productcategorieën en beschreven in de Factsheets met blootstellingscenario's voor productcategorieën zoals cosmetica, verfproducten, ongediertebestrijdingsmiddelen, speelgoed, desinfecterende middelen en doe-het- zelfproducten. Daarnaast staan defaults voor generieke parameters zoals lichaamsgewicht, lichaamsoppervlak, kamergrootte en ventilatievoud beschreven in de Factsheet Algemeen, waarvan de meeste recente versie in 2014 is verschenen (Te Biesebeek et al.).

De eerste versie van de Reinigingsmiddelen Factsheet dateert uit 2006 (Prud'homme de Lodder et al., 2006a). In de huidige versie zijn nieuwe beschikbare data beoordeeld en de defaults zijn waar nodig aangepast. De data en de defaults zijn zoveel mogelijk gebaseerd op de Nederlandse situatie. Bij afwezigheid van geschikte Nederlandse data is er gebruik gemaakt van informatie uit andere landen. De onderliggende data die gebruikt zijn voor het verkrijgen van de defaults worden uitgelegd en de betrouwbaarheid van de defaults wordt verantwoord met informatie over de kwaliteit van deze data. Parallel aan het publiceren van de herziene factsheet, zullen ook de waarden in de ConsExpo database vervangen worden door de nieuwe waarden.

In vergelijking met de vorige versie uit 2006, geeft de huidige Reinigingsmiddelen Factsheet meer gedetailleerde informatie. De consumentenscenario's voor de beschrijving van het productgebruik zijn nu meer expliciet beschreven. Voor elke mogelijke gebruikersactiviteit die kan leiden tot blootstelling zijn gestandaardiseerde waarden voorgeschreven. Dat houdt tevens in dat er meer specifieke modellen en defaults voor modelparameters staan voorgeschreven voor blootstellingsschatting voor stoffen in verschillende productgroepen; onder meer wasmiddelen, afwasmiddelen, allesreinigers, schuurmiddelen, badkamerreinigers, vloer-, tapijt, -en meubelreinigingsmiddelen. Alle defaults zijn nu ingedeeld op kwaliteitscore van de onderliggende data en van een rationale voorzien.

Daarnaast is er een samenvatting gegeven van nieuwe data die beschikbaar zijn gekomen na de publicatie van de vorige Reinigingsmiddelen Factsheet in 2006 en wordt de toepasbaarheid van deze bronnen besproken. Tot slot zijn alle veranderingen in blootstellingsscenarios, -modellen, default parameterwaarden en datakwaliteitsscores t.o.v. de versie uit 2006 samengevoegd in één tabel, zodat elke wijziging gemakkelijk te traceren is.

List of abbreviations

AISE	Association Internationale de la Savonnerie, de la Détergence et des Produits d'Entretien
ANSES	Agence Nationale de Sécurité Sanitaire de l'alimentation, de l'environnement et du travail
BfR	Bundesinstitut für Risikobewertung
BPR	Biocidal Product Regulation
C.V.	Coefficient of Variation
FOPH	Fédération des Offices Publics de l'Habitat
FS	Fact Sheet
HEAdhoc	Ad Hoc Working Group, Human Exposure (Biocides)Q-factor Quality Factor
NVWA	Nederlandse Voedsel- en Warenautoriteit
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RIVM	National Institute for Public Health and the Environment (Rijksinstituut voor Volksgezondheid en Milieu)
St. Dev	Standard Deviation

1 Introduction

1.1 Background

The ConsExpo software was developed in the early nineties at the request of the Keuringsdienst van Waren (currently Netherlands Food and Consumer Product Safety Authority; NVWA) and the Ministry of Health, Welfare and Sport (VWS) in The Netherlands to calculate human exposure to chemicals in non-food consumer products. ConsExpo was designed and is used to estimate consumer exposure via all exposure routes (inhalation and dermal and oral exposure). Over the years, the ConsExpo project has been extended by the development of Fact Sheets, which are incorporated into the ConsExpo software as a database.

The Fact Sheets are documents containing exposure scenario descriptions and default values for various product categories (Bremmer & Van Veen 2002; Bremmer et al., 2006a, b; Bremmer & Van Engelen 2007; Ter Burg et al., 2007; Prud'homme de Lodder et al., 2006a, b). In addition, there is a General Fact Sheet containing default values for parameters such as body weight, skin surface area, room volume, ventilation rate and activity patterns. The General Fact Sheet was updated in 2014 (Te Biesebeek et al., 2014). The defaults described in the various Fact Sheets ensure that exposure assessments are conducted in a harmonized and standardized way, providing reasonable worst-case estimates, and are fit for use in the ConsExpo Web software.

1.2 ConsExpo Web

In October 2016, ConsExpo Web was launched as an online web tool (www.consexpoweb.nl) for estimating exposure to substances in consumer products. ConsExpo Web is easily available via the internet and in principle similar to ConsExpo 4.1. The online tool is open for any future updates that improve the model. ConsExpo Web already allows the user to include multiple scenarios within a single assessment. A new model has been added to assess exposure to emissions from solid products (or articles), and a first-tier, screening-level model for estimating exposure to non-volatile substances in sprays has been added to the 'exposure to spray' model. Finally, the terminology for the outputs has been updated and the calculated exposure metrics have been adjusted. An updated manual describing how to use the ConsExpo Web version, as well as a description of the models available in the software, is available (Delmaar & Schuur, 2016).

The use of ConsExpo is recommended for consumer exposure assessment under REACH (EC, 2006) and the model is described in the updated REACH guidance (ECHA, 2016). It is also one of the models recommended for the assessment of consumer exposure to biocides (EU, 2012; ECHA, 2015a, b).

The RIVM developed ConsExpo Webas an online software tool for the assessment of exposure to substances in consumer products. For this purpose, the software contains a set of coherent general, mathematical models. Consumer exposure can be estimated by choosing the most suitable model and filling in the required parameters of the product, such as the amount used or concentration of the substance within a product, consistent with the scenario.

ConsExpo is constructed using data on the use of products contained in the Fact Sheets, which are then combined with mathematical models. The program is based on relatively simple exposure models. The starting point for these models is the route of exposure, i.e. inhalation or the dermal or oral route. The most appropriate exposure scenario and model is chosen for each route. Then, parameters needed for the exposure scenario and model, such as substance-specific data and the frequency and duration of use, are entered into the ConsExpo software for calculation of the exposure. Further details of the mathematics behind ConsExpo are described in the manual (Delmaar & Schuur, 2016).

ConsExpo can be used for a screening assessment (lower-tier, often used in regulatory frameworks) or for an advanced (higher-tier) assessment. For different exposure situations, different models are provided for calculating external exposure. ConsExpo also integrates the exposure via the different routes, resulting in a systemic dose. Different dosing regimens/exposure situations can be calculated (acute, daily, chronic). ConsExpo can also run calculations using distributed input parameters and perform sensitivity analyses. The models per route of exposure included in ConsExpo have different levels of detail and complexity.

The ConsExpo tool is publicly available via www.consexpoweb.nl. Default data are available via the database, which is an integral part of the online tool. The manual and the various Fact Sheets can be consulted by following links to the website of the National Institute for Public Health and the Environment in the Netherlands (RIVM; www.rivm.nl/consexpo).

1.3 Fact Sheets

Fact Sheets are documents that present key information for consistent and harmonized estimation and assessment of exposure to substances from consumer products when using ConsExpo. In the Fact Sheets, information about exposure to chemical substances is bundled into certain product or exposure categories, and default parameters are given. The main product categories, i.e. groupings of similar products, have been defined in the ConsExpo database. Examples of these categories are cleaning products, paint, cosmetics, toys and pest control products. Categories are structured in such a way that products to which consumer exposure is similar are covered by one scenario. The choice of main product categories and subcategories is based on the product classifications used under REACH, by the United States Environmental Protection Agency (US-EPA) and the Swedish Chemical Agency (KEMI), as described by the Organisation for Economic Co-operation and Development (OECD, 2012).

The Fact Sheets have been developed in order to characterize and standardize the exposure estimation in combination with the ConsExpo software, but they are also useful for any exposure estimation without the use of the software. For each product category the composition and use of the type of products included in that category are described. To estimate exposure, default models with default parameter values are determined for every product category. These are available via a database included in ConsExpo Web. Using these data, standardized calculations for consumer exposure to chemicals resulting from, for instance, the use of cleaning products can be performed. Fact Sheets for the product categories listed in Table 1 are currently available. In the near future, more Fact Sheets may be generated to cover other categories of consumer products.

Table 1: Main categories of consumer products, for which Fact Sheets are available.

Main categories of consumer products
Children's toys
Cleaning products
Cosmetics
Disinfectants
Do-it-yourself products
Paint
Pest control products

Main product categories are divided into subcategories. For example, the main product category Cosmetics includes the following product subcategories: shampoo, make-up, lipstick, toothpaste and deodorant. Composition and use are examined for every product subcategory and, to estimate consumer exposure to substances, default models with default parameter values are determined for every product subcategory.

Scoping literature reviews (Arksey & O'Malley, 2005) are performed in order to collect the most appropriate data available to include in the Fact Sheets. The Fact Sheets therefore provide general background information on exposure models. They also describe various exposure scenarios for the specific products and set defaults for relevant exposure parameters. The default values are presented as deterministic values, but the statistical information is also provided if possible. This can be used in distributions in probabilistic (aggregate) exposure assessments. In general, the following topics are dealt with in the Fact Sheets:

- Background information about the main category that is relevant to exposure calculations.
- Delimitation of the main category and description of the product subcategories.

The Fact Sheets contain:

- General description of the product category.
- Description of the composition of the products
- Description of the use of the products.
- Remarks about the products.
- Information on potentially problematic substances.
- Default scenarios and models.
- Default parameter values for the scenarios and models.
- Considerations that have been made in calculating the defaults.

The General Fact Sheet (Te Biesebeek et al., 2014) gives general information about the Fact Sheets and deals with overarching topics that are relevant to several main product categories, such as:

- The boundary conditions under which the defaults are estimated.
- The way in which the reliability of data is evaluated.
- Parameters such as ventilation rate and room size.
- Anthropometric parameters such as body weight and the surface area of the human body, or parts thereof, and inhalation rates and activity patterns.

The default values from the General Fact Sheet are used in the specific Fact Sheets unless there is more profound data to define individualized values for the separate scenarios.

2 Default setting and quality of the data

The underlying data used to estimate consumer exposure in the default scenarios described in the Fact Sheets are collected from scientific literature, product information, legislation documents, survey data on consumer habits, and experimental data on substance release from consumer products. Default exposure values are set according to the default exposure scenarios. The quality of the collected data is assessed in order to describe whether and where further improvements in consumer exposure estimation with ConsExpo can be achieved, i.e. by collecting more and better data. ConsExpo users are also informed about the uncertainty associated with the data underlying the default exposure parameter values and exposure estimates.

2.1 Default setting

Default parameter values are selected to represent a reasonable worst-case scenario, i.e. one that represents consumers who frequently use a certain product under unfavourable conditions. For example, in the case of cleaning products, parameter values are selected to represent a scenario in which, relative to ‘average’ use, use is frequent and the product is applied in a large amount and in a small room with low ventilation rate, in which the exposed person stays for a long duration.

Although ConsExpo was originally developed for the Dutch consumer market, the parameter values are now aimed at consumers in general. When information is available, and when relevant, differences will be described for the European and North American population.

The parameter values are chosen to generate a conservative or reasonable worst-case exposure estimate, i.e. in order of the magnitude of a 99th percentile of the population distribution. The reasonable worst-case aims to represent high-end users. To achieve this goal, the 75th or the 25th percentile is determined for each parameter. The 75th percentile is normally used for proportional parameters. However, a decrease in, for example, room volume or ventilation leads to an increase of the exposure estimate. In the case of such reverse proportional parameters, the 25th percentile is used. For a significant number of parameters, there are actually too few data to calculate the 75th or 25th percentile. In such cases, an estimate, corresponding to these percentiles, is made. Multiplication of two 75th percentile parameters results in an 89th percentile, whereas multiplication of three 75th percentile parameters results in a >99th percentile. The dermal, inhalation and oral exposure models included in ConsExpo all require at least three input parameters; most require more. Hence, a 75th percentile for those parameters would yield an approximate 99th percentile for the calculated exposure estimate. The result is a ‘reasonable worst-case’ estimate for consumers who use large amounts of a product under unfavourable circumstances (Figure 1).

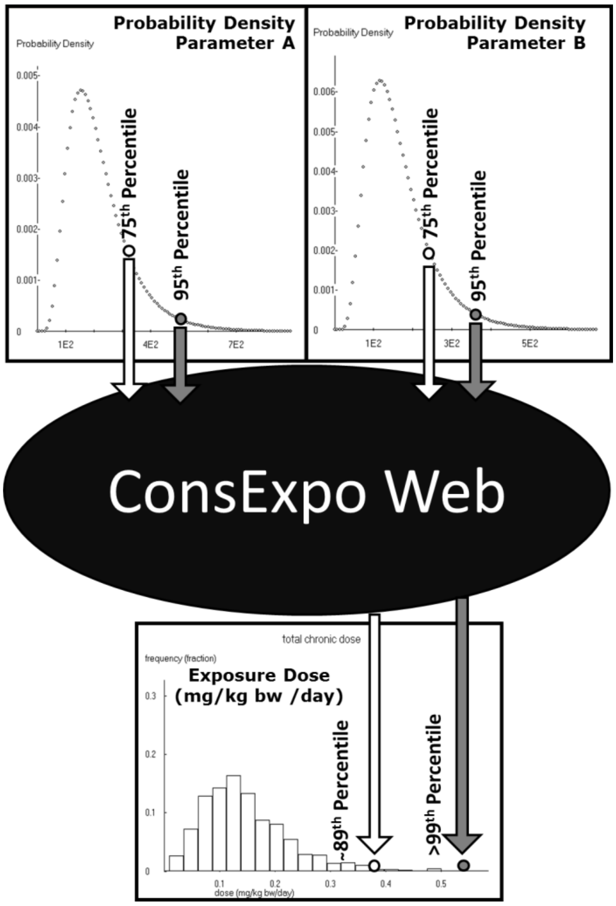

Figure 1: Illustration of the estimation of a 'reasonable worst-case' from variable data. Choosing a 75th percentile of the data for two uncorrelated parameters as input for a multiplicative model results in approximately a 95th percentile of the exposure distribution. Choosing higher percentiles for each of the input data, such as a 90th percentile, quickly leads to an unrealistic overestimation. The effect of this 'accumulation' of worst-case assumptions increases with the number of input parameters.

A probabilistic exposure assessment requires distributions of parameter values instead of deterministic point values. Such distributions were not reported in the previous version of the Fact Sheet (Prud'homme de Lodder et al., 2006a), but are, where available, provided in this update. If a distribution is not available, a reference may be provided.

2.2 Quality of the default

The availability of data is different for each exposure parameter. For a number of parameters there are insufficient data to derive a reliable default. To indicate the reliability of a default value, a quality factor (Q-factor) is used. The quality factor ranges from 1 (low quality) to 4 (high quality), see Table 2.

Low Q-factors (Q=1 or 2) indicate that the default value is based on data that are not directly compatible with the exposure scenario or data that come from a limited data source and/or are based on expert judgement only. If such a default is used in an exposure analysis, it should be used with caution. If more representative data are supplied by applicants or producers or are available from other sources, these data should be weighted higher than the default value.

High Q-factors (Q=3 or 4), on the other hand, indicate that the defaults are based on sufficient data. High-quality defaults are generally associated with less uncertainty than those with low Q-values. It is possible that some parameters will need to be adapted according to the exposure scenario. For example, if the exposure estimation is carried out for a room of a size that differs from the default scenario, the actual value should be weighted higher than the default value.

Table 2: Value of quality factor Q

Q-factor	Description
4	Good-quality relevant data, parameter value reliable
3	Extent and quality of data satisfactory, parameter value usable as default value
2	Parameter value based on single data source supplemented by expert judgement
1	Educated guess, no relevant data available, parameter value based only on expert judgement

3 About the Cleaning Products Fact Sheet

The first version of the Cleaning Products Fact Sheet was written in 2006 (Prud'homme de Lodder et al., 2006a). Since this version, new data have become available which have been evaluated and included, if appropriate, in this update. A summary table of updated defaults is presented in Annex I. The default values were initially selected to represent a European scenario. However, information from other countries, such as the USA and Canada, is used as well. ConsExpo is used within different legal frameworks, such as REACH (ECHA, 2016) and the Biocides Regulation (EU, 2012). Special attention is therefore given to default values taken from guidance documents for implementation of such legal frameworks.

3.1 Cleaning products

The Cleaning Products Fact Sheet covers the major sources of exposure due to the use of cleaning products by consumers. Products that are available on the consumer market to be used for cleaning are covered by this Fact Sheet, including products used to clean domestic surfaces, but also laundry detergents, dishwashing products, toilet cleaners and other products (Table 3). Products with an application that is comparable to cleaning products, like shoe polishes, are included as well. Therefore, no distinction is made within the exposure scenarios between exposure from the use of polishing and cleaning products.

Table 3: Cleaning products described in this Fact Sheet

Chapter	Cleaning Product Subcategory	Product Formats
6	Laundry products	Powder Liquid Single-unit dose packets Laundry pre-treatment products ▪ Liquid ▪ Spray ▪ Paste
7	Dishwashing products	Hand dishwashing liquids Machine dishwashing products ▪ Powder ▪ Liquid ▪ Tablet ▪ Salt
8	All-purpose cleaners	Liquid Spray Wet tissues (wipes)
9	Abrasives	Powder Liquid
10	Sanitary products	Bathroom cleaners ▪ Liquid ▪ Spray Toilet cleaners Toilet rim cleaners

Chapter	Cleaning Product Subcategory	Product Formats
11	Floor and furniture cleaning products	Floor products ▪ Liquid ▪ Wet tissues (mopping) ▪ Polishes ▪ Strippers ▪ Sealers Carpet products ▪ Powder ▪ Liquid ▪ Spray extraction machine ▪ Spray foams Furniture and leather products ▪ Furniture polish ▪ Leather furniture polish
12	Miscellaneous	Glass cleaners Oven cleaners Metal cleaners Drain openers Shoe polish products ▪ Spray ▪ Cream Pressure washers Electronic cleaners

This Fact Sheet principally aims to predict exposure arising from the use of products as a whole, independently of the substance of interest. The default values that are presented serve to characterize consumer use of cleaning products. Information about specific substances within the cleaning product, such as concentrations and physical-chemical properties, must be factored into the exposure assessment separately by the evaluator. Exposure routes that are not realistic, for example the inhalation of non-volatile substances in laundry tablets, are not considered in this Fact Sheet.

3.2 Ingredients in cleaning products

The major ingredients of cleaning products can be classified according to their function as surfactants, builders, solvents or anti-microbial compounds (ACI, 1994; NVZ, 2014; www.isditproductveilig.nl). Examples of other important ingredients are bleaching agents, enzymes and abrasives.

Surfactants

The most important group of detergent ingredients are surfactants, also called surface-active agents. These organic chemicals improve the wetting ability of water and emulsify, solubilize or suspend dirt in the detergent solution. Surfactants can be classified by their ionic properties in water as anionic, non-ionic, amphoteric or cationic surfactants (ACI, 1994).

- Anionic surfactants are used in laundry cleaning products, hand dishwashing detergents and household cleaners. They have excellent cleaning properties and produce great volumes of suds.

- Non-ionic surfactants produce low volumes of suds and are typically used in laundry, automatic dishwasher detergents and rinse aids. They are resistant to water hardness and are effective on most types of dirt.
- Amphoteric surfactants are applied in household cleaning products where mildness, suds production and stability are required.
- Cationic surfactants are used in fabric softeners (laundry detergents) or as disinfecting/sanitizing ingredients in household cleaners.

Mixtures of the above described surfactants are possible, since many cleaning products include two or more of them.

Builders
Builders improve the cleaning effectiveness of the surfactants by reducing water hardness through sequestration (i.e. holding hardness minerals in solution) or precipitation (forming an insoluble substance) or by ion exchange. Builders also supply and maintain alkalinity, which assists in the cleaning of acid types of dirt, prevents the redeposition of removed dirt during washing, and emulsifies oily and greasy types of dirt (ACI, 1994).

Solvents
Solvents are added to cleaning products to increase the cleaning effect of surfactants by dissolving oil and grease. They clean without leaving residues. Solvents used in cleaning products are water-soluble (ACI, 1994).

Anti-microbial compounds
Anti-microbial compounds exterminate or inhibit the growth of microorganisms that cause diseases and/or odour (ACI, 1994).

Miscellaneous
Other ingredients added to cleaning products include bleaching agents, enzymes, abrasives, acids, fragrances, dyes and preservatives. Short descriptions of these groups of ingredients are given below.

- Bleaching agents help whiten, brighten and remove stains. Oxygen bleach is used in laundry or automatic dishwasher detergents, toilet surface cleaning and sanitizing products. Chlorine bleaches are also disinfectants, which are used for hard surface cleaning and sanitizing.
- Enzymes aid in breaking down complex types of dirt into simpler forms, which can be removed by detergents. They are active against only one specific kind of dirt. Therefore, different types of enzymes are used in household products such as amylase for starch soils, lipase for fatty and oily types of dirt and protease for protein soils. Cellulase reduces the pilling and greying of fabrics containing cotton and helps remove particulate soils.
- Abrasives consist of small mineral particles for a smoothing, scrubbing and/or polishing action.

- Acids neutralize or adjust the alkalinity of other ingredients of household cleaning agents. Some cleaners need extra acidity to prevent mineral build-up.
- Alkalis neutralize or adjust the acidity of other ingredients and make surfactants and builders more efficient. High alkalinity is useful in removing acidic, fatty and oily types of dirt.
- Fragrances (blends) cover the odour of soils and mask the base odour of the other ingredients and packaging. They also give a particular identity to the product and leave a pleasant scent in clothes or rooms after washing and cleaning.
- Colorants, such as pigments and dyes, provide a particular identity to a product and provide a bluing action.
- Opacifiers reduce transparency or provide a special effect to the product.
- Preservatives protect against natural effects of product aging, decay, discoloration, oxidation and bacterial raid.
- Processing aids, such as clays, solvents and polymers, provide important physical characteristics such as flow, viscosity, solubility, stability and uniform density to cleaning agents.
- Suds control agents ensure the optimum foaming level for a particular product. Suds stabilizers and suds suppressors are added to maintain high sudsing when needed or to reduce suds production in case of interference with cleaning action.
- Hydrotropes prevent liquid products from separating into layers, so that product homogeneity is ensured (ACI, 1994).

4 Generic scenarios and models for cleaning products

The use of cleaning products results in dermal, inhalation or oral exposure to substance ingredients, or to a combination of these exposure routes. The exposure is determined by the type of product and the way the product is used. Because product formulation and use are often similar across different cleaning products, exposure can be comparable. Hence, the same models and scenarios can be applied to consumer exposure assessment for different products. Within this Cleaning Products Fact Sheet the generic scenarios describe the use of the product, exposure conditions and appropriate ConsExpo models to calculate exposure during the different stages of product use or residual exposures that occur after the product is used. The different stages of product use that are considered generic for cleaning products are:

- Mixing and loading (see 4.1)
  - Powder[1]
  - Liquid[2]
  - Product dilution with water
- Application (see 4.2)
  - Spray applications
  - Ready-to-use products
  - Surface treatment
- Post-application and secondary exposure (see 4.3)
  - Rubbing-off
  - Hand-to-mouth
  - Migration of residues from fabric
  - Ingestion of residues from dinner ware

The current chapter addresses only generic default parameters and scenarios that are applicable to several products covered by this Fact Sheet, such as the mixing and loading of powder products. Chapters 6 to 12 provide the default scenarios, models and parameter values to estimate exposure for relevant exposure routes for the product categories mentioned in Table 3 (including those included in this Chapter). The models themselves are described in the help file and the user manual of ConsExpo Web (Delmaar & Schuur, 2016).

4.1 Mixing and loading

Mixing and loading describes the steps required prior to application of the product, including the refilling of product containers between applications. Mixing and loading of cleaning products mainly involves the loading of powders and liquids. The use of powder products may lead to inhalation of solid aerosol particles or dermal exposure. The use of liquids may lead to exposure via inhalation of vapour from volatile chemical substances or aerosol or liquid particles and to dermal exposure. Dilution with water is considered to be a mixing step, where

[1] Tablets and salts also belong to the group solids, but powders are considered worst-case. Tablets and salts are addressed when necessary in the specific product type chapters
[2] Paste is considered to be a liquid, but powders are considered worst-case. Tablets and salts are addressed when necessary in the specific product type chapters

dermal exposure may occur from dipping the hands into the water. Inhalation may occur due to substances evaporating from the water. In the following paragraphs, the generic scenarios are described for the expected exposure routes. It is also explained for what type of products no exposure from mixing and loading is expected.

4.1.1 *Generic exposure scenario for loading powders*

Before they are used for cleaning purposes, powders are loaded into a machine reservoir, bucket or sink or directly loaded onto the surface that is to be treated, such as a kitchen top or carpet. The powders are handled either by pouring them straight from the package or by using a measuring cup or spoon. Both methods lead to the generation of aerosol solid particles that may be inhaled or deposited on the skin. Moreover, direct skin contact with the powder can occur during handling of the product.

Inhalation

The general scenario comprises the inhalation of product dust due to the loading of 200 g powder into a bucket or machine (Van de Plassche et al., 1999; AISE, 2002). No distinction is made between loading directly or through the use of a measuring cup or spoon, as it is not expected to result in a different exposure.

Within ConsExpo Web, the ***inhalation–exposure to spray–instantaneous release*** model (Delmaar & Schuur, 2016) is suggested to estimate exposure by inhalation of product particles during the loading of powders, in contrast to the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a), which prescribed the ***exposure to vapour–instantaneous release*** model for exposure calculation. The underlying algorithms for both models are the same (Delmaar & Schuur, 2016), but the physicochemical properties of powders have more in common with spray droplets than with vapours, e.g. particle shapes and occurrence as non-volatile substances. Although a powder is not typically a spray, the instantaneous release spray model best approximates exposure during the loading of powder. The release is expected to be very short-lived and therefore the instantaneous release model is preferred over the spraying model.

Exposure duration

Exposure duration is considered to be equal to the release duration. Prud'homme de Lodder et al. (2006a) describe a default of 0.25 min (15 s) for loading powders to a washing machine, based on the 75th percentile calculated from the data of Weegels (n=10, mean=11, St. Dev=3 s) (Weegels, 1997). The Q-factor is 3, because the underlying dataset is large but used generic.

Released mass

Little information is available about the fraction of powder that is released to indoor air during loading. Many literature sources erroneously refer to a released mass of 0.27 µg powder per cup (200 g) of product used for machine washing (HERA, 2002, 2003, 2005) including the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a). The original experiments and home observation studies were performed by Hendricks (1970). The author found 'that there is on average 0.27 µg detergent dust exposure per cup of product used'. Here the detergent dust exposure refers to the amount of laundry detergent inhaled while 'pouring the product from the carton into a measuring aid and then to the washing machine' (Hendricks, 1970; Burg et al., 1970; Van de Plassche et al., 1999). The misinterpretation of referring to 0.27 µg per cup as 'released mass' instead of 'inhaled mass' yields an underestimation of exposure. However, it is possible to recalculate the supposed released mass in the experiments of Hendricks (1970) based on the laboratory conditions described (sampling time of 2 min, distance to dust source within personal breathing zone (1 m), inhalation rate of 16.3 l/min), by assuming that ConsExpo's ***inhalation–exposure to spray–instantaneous release*** model (Delmaar & Schuur, 2016) is suitable for such a calculation and that the 2 min sampling time of the experiments is too short for the ventilation rate of 0.6–2.5 per hour (Te Biesebeek et al., 2014) to be effective. The supposed released amount per cup (8.3 µg) is calculated as follows:

$$Released\ Mass = \frac{Inhaled\ Mass}{(Inhalation\ Rate \times Sampling\ Time)/(Personal\ Breathing\ Zone\ Volume)} = \frac{0.27\mu g}{(0.00163\ m^3/\min \times 2\min)/1m^3} = 8.3\mu g$$

The generic default for released mass during the mixing and loading of powders is therefore set to 8.3 µg. The Q-factor is set to 1, because the data were not specifically collected to measure the released mass of detergent powder and it is unclear to what extent the physicochemical properties of laundry detergent powders in 1970 still represent the properties of detergent powders nowadays. Moreover, the following uncertain assumptions are made in the calculation: an instant release model is suitable for the calculation above, ventilation is negligible and the short distance from the analytical device to the loaded powder represents a personal breathing zone of 1 m^3. Therefore, it is recommended to, where possible, directly calculate inhalation exposure to detergent powder as a function of the inhaled mass of 0.27 µg per cup.

Room volume
Since the consumer is holding the container during the loading of powders, the powder is released into the personal breathing zone. Since only this small area around the user is relevant for inhalation exposure, room volume is interpreted as the personal breathing zone. Hence, the default for room volume is set equal to a personal breathing zone of 1 m^3. The Q-factor is considered to be 1, because the interpretation of the personal breathing zone is based solely on expert judgement.

Dermal
Within ConsExpo Web, the ***dermal–direct product contact–constant rate*** model is suggested to estimate dermal exposure to powder during loading.

Contact rate
The Guidance on the EU Biocidal Products Regulation (BPR) describes a dermal exposure study for the use of sprinkling/dusting powders to control dust mites (ECHA, 2015a). The subjects in the study applied crack and crevice powders in a kitchen, treating skirting boards, shelves and laminate surfaces. The dermal exposure by hands and forearms

ranged from 0.4 to 4.18 mg/min with a 75th percentile of 2.83 mg/min. The contact rate for dermal exposure for legs, feet and face ranged from 0.22 to 6.56 mg/min with a 75th percentile of 2.15 mg/min. A contact rate of ca. 5.0 mg/min (2.8 for hands and forearms + 2.15 for legs) probably overestimates exposure during the loading of cleaning powders, because it is unlikely that all these body parts are exposed simultaneously. This is in contrast to the reference source of BPR, which describes an estimate for exposure to substances in biocide products. Therefore, the default is set to 2.8 mg/min (the value for hands and forearms only). The Q-factor is considered to be 2, because the underlying data are of good quality but collected for another exposure scenario.

Release duration
The release duration is considered to be equal to the exposure duration for inhalation. The exposure duration for inhalation refers to the time in which the powder is airborne and thus subject to dermal deposition. Therefore, the release duration is set to 0.25 min with a Q-factor of 3, because it is supported by quantitative data that is used within a generic scenario.

4.1.2 Generic exposure scenario for loading undiluted liquids
Liquids are either poured straight from the bottle or loaded first into a measuring cup and then into a bowl or bucket. Volatiles evaporate from the open bottle (or measuring cup), leading to inhalation exposure, whereas dermal exposure could occur during pouring via spills and droplets.

Inhalation
During mixing and loading, substances evaporate through the opening of a bottle that contains the product of interest. In this scenario it is assumed that the product is in a one-litre bottle that has a circular opening of about 5 cm diameter and a surface area of 20 cm^2. To calculate inhalation exposure during mixing and loading within ConsExpo Web, the ***inhalation–exposure to vapour–evaporation–constant release area*** model is used.

Exposure duration
The first Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 0.75 min, based on the 75th percentile, for filling a dishwasher with a polish liquid. The consumer pours the product into a small box located at the front of the machine (Weegels, 1997). It is assumed that the duration of this activity is generic for loading liquids. The duration default value remains 0.75 min with a Q-factor of 3.

Product amount
In this scenario, product amount refers to the amount of product that is in the bottle from which substances may evaporate. The bottle containing the product will not be full during its entire service life. Rather, the bottle will be full at first use and empty at the end of its service life. On average, the bottle will therefore be half-full. Hence, the default for product amount is set at half of the content of the one-litre

bottle (density 1 g/cm^3), i.e. 500 g. The Q-factor is set to 2, because the description is generic but not supported by quantitative data.

Room volume
During the loading of liquids, the consumer is holding the bottle or measuring cup. The volatile substance from the liquid is then released into the personal breathing zone. Since only this small area around the user is relevant to inhalation exposure, room volume is interpreted as the personal breathing zone. Hence, the default for room volume is set equal to a personal breathing zone of 1 m^3. The Q-factor for this default value is set to 1, because the interpretation of the personal breathing zone is based solely on expert judgement.

Release area
The opening of the bottle is considered to be the release area for substances evaporating from a bottle, which is by default set at 20 cm^2, a conservative estimation. The Q-factor is set to 2, because the description is generic but not supported by quantitative data.

Emission duration
The emission duration is interpreted here as the duration of the activity of loading liquids. It is assumed that the duration of this activity is generic for loading liquids. The duration default value remains 0.3 min with a Q-factor of 3.

Mass transfer coefficient
The default mass transfer coefficient is set to 10 m/h with a Q-factor of 2. An explanation of the default and Q-factor is given in the generic exposure scenario for product surface application prior to cleaning (4.2.2.1).

Dermal
The generic exposure scenario for loading liquids considers two ways to do so: pouring the liquid product into the cap first or pouring the liquid directly from the bottle into a bucket, bowl or machine. Direct pouring can lead to dermal exposure through spatters, whereas pouring the product into the cap first can lead to dermal exposure through spills. To estimate the exposure within ConsExpo Web, the ***dermal–direct product contact–instant application*** model is used for both direct pouring and pouring via a cap. However, the default values for product amount and exposed area differ for the two ways of liquid loading.

Exposed area – direct pouring
It is assumed that the direct pouring of liquids leads to dermal exposure on one side of the hand, i.e. the side directing the bottle to the machine, bowl or bucket. The default for exposed area is set to be equal to one side of an adult hand: 225 cm^2, which is in accordance with the General Fact Sheet (Te Biesebeek et al., 2014). As the assumption for the exposed area is difficult to estimate (although the default for hand surface area is derived from a rich data source), the Q-factor is set to 2.

Product amount – direct pouring
The Biocides Human Health Exposure Methodology Document (ECHA, 2015a) describes dermal exposure of consumers to biocides when

dispersing a concentrate from a one-litre bottle and diluting it with water in a small vessel. The 75th percentile for dermal exposure during this mixing and loading event is 0.01 ml, irrespective of the amount poured (ECHA, 2015a). Assuming a liquid density of 1 g/cm^3, the default for product amount for direct pouring is set a 0.01 g. Because the data are quantitative but used in a generic scenario, the Q-factor is set to 3.

Exposed area – pouring via cap
It is assumed that the pouring of liquids via a cap leads to dermal exposure at the fingertips and phalanges holding the cap. The General Fact Sheet describes a default surface area of a hand of 450 cm^2. The surface area of fingers is then 225 cm^2 (half the surface area of the hand). The surface areas of one finger and one phalanx are assumed to be 45 cm^2 and 15 cm^2, respectively. The consumer holds the cap with the thumb and the top two phalanges of the forefinger and middle finger, which has a surface area of 105 cm^2 (thumb (45 cm^2) + two phalanges of forefinger: 2 x 15 cm^2 = 30cm^2 + two phalanges of middle finger: 2 x 15 cm^2 = 30 cm^2 = 45+30+30 = 105). Half of this surface area is pressed to the cap (52.5 cm^2), so that the other half is potentially exposed during a spill (52.5 cm^2). The default for exposed area is thus set to 53 cm^2, which is also in agreement with other exposure scenarios from handling products with the fingers. In the Guidance on the EU Biocidal Products Regulation (ECHA, 2015b), the exposed area of the fingers of one hand handling a wax block is estimated by expert judgement as 30 cm^2. The DIY Products Fact Sheet (Ter Burg et al., 2007) prescribes a default of 215 cm^2 for the entire exposed area of 10 fingers, so that one finger would have an exposed surface area of 21.5 cm^2, one phalanx 7.1 cm^2 and one thumb plus 4 phalanges therefore 50 cm^2. The Q-factor of the default of 53 cm^2 is set to 2, as the estimation for the exposed area is based on several assumptions, even if the default for hand surface area is derived from a rich data source.

Product amount – pouring via cap
The default product amount for dermal exposure while pouring liquids via a cap is calculated as the exposed area (53 cm^2) multiplied by the layer thickness (0.01 cm) and density (1 g/cm^3): 0.53 g.
The layer thickness applied here is taken from the Guidance on the EU Biocidal Products Regulation (BPR) (ECHA, 2015b), in which a general layer thickness for liquid runoffs is set at 0.01 cm. This value is supported by recent scientific literature. The US-EPA (2011) conducted a study resulting in a number of 74 values on thickness layer (mean each from 4 volunteers) showing that only one value was slightly higher than 0.01 cm (0.01187 cm). Weerdesteijn et al. (1999) performed an experiment involving the immersion of hands into a bucket of water and calculated, based on the surface area of male and female hands, a 75th percentile layer thickness of 0.009 and 0.007 cm, respectively. Based on ECHA (2015b), US-EPA (2011) and Weerdesteijn et al. (1999), it is assumed that a layer thickness of 0.01 cm is appropriate for calculating the product amount in the case of dermal exposure from loading liquids via caps. Therefore, the default product amount is set at 0.53 g with a Q-factor of 3, because it is supported by quantitative but generic (non-specific) data.

4.1.3 *Generic exposure scenario ready-to-use products*

Ready-to-use products are directly available for application once their packaging is removed. Removing the packaging can be regarded as a form of mixing and loading, but exposure during this activity will mostly be negligible. Examples of such activities are removing a plastic foil in the bottlenecks of trigger sprays or hand pumps. Other products do not even have packaging, so that there is no mixing and loading at all. Examples of such products are aerosol spray cans, impregnated tissues or cleaning tablets packed in soluble foils such as detergent pods. If a product is identified as a ready-to-use product, then it is assumed that exposure from mixing and loading is negligible compared with exposure during application and secondary exposure.

4.2 Application

The application of cleaning products involves tasks which can be considered generic for consumer exposure estimation. In this Fact Sheet the generic cleaning product applications are the use of spray applications (e.g. all-purpose, bathroom and kitchen cleaners) and surface cleaning (e.g. cleaning and polishing of floors and furniture). It is also important to determine whether the substance that is considered for evaluation by the ConsExpo user is a volatile or non-volatile substance. An arbitrary split for the vapour pressure of the substance of 0.01 Pa is considered to distinguish between (poorly) volatile substances (>0.01 Pa) and non-volatile substances (<0.01 Pa) in sprays (Prud'homme de Lodder et al., 2006a; Snippe et al., 2002). Prior to inhalation, non-volatile substances reside in the indoor air as aerosol droplets from which some of them are too large to inhale. Volatile substances in sprays, however, are all considered small enough for inhalation.

4.2.1 *Generic exposure scenario for spray applications*

Inhalation of non-volatile substances

A major pathway of exposure to spray applications is the inhalation of respirable aerosol particles generated during the use of aerosol spray cans or trigger sprays. Inhalation exposure to these aerosol particles is driven by a variety of exposure parameters such as the ventilation rate of the room, the duration of presence of the exposed person in the room during or after spraying, and the way the product is used.
The general exposure scenario for inhalation of substances from spray applications provides interpretation and/or defaults for parameters referring to spray duration, density of non-volatile substances and mass generation rate (i.e. the released mass per unit of time during spraying) for both aerosol spray cans and triggers sprays.

The ***exposure to spray–instantaneous release*** model is used to estimate the exposure to volatile substances from cleaning products available on the market as sprays (see 4.2.2.1).The ***exposure to spray–spraying*** model is used to estimate inhalation exposure to non-volatile substances when using cleaning products as sprays. The parameters of this spray model within ConsExpo Web are experimentally evaluated in the report of Delmaar & Bremmer (2009). Exposure duration, room volume, ventilation rate and initial particle size distribution are parameters that are not generic. Instead, defaults are specifically derived per scenario of consumer exposure. The other parameters in the ***exposure to spray–spraying*** model, describing either the derivation of a generic default value or at least a generic approach to such a derivation, are discussed below. These generic defaults and approaches are consistent with the manual of ConsExpo Web (Delmaar & Schuur, 2016), the set of experiments evaluating the critical parameters of the model (Delmaar & Bremmer, 2009), and the General Fact Sheet (Te Biesebeek et al., 2014). All consumer exposure scenarios described in the current Fact Sheet for substances in cleaning sprays do not consider the 'spraying toward person' option, because the intended use is to spray towards surfaces that are to be cleaned.

Spray duration
Spray duration is defined here as the net spraying time between the start and finish of spraying, not counting time between sprays (Delmaar & Schuur, 2016). The definition of spray duration is in contrast to that of the Cleaning Products Fact Sheet published in 2006 (Prud'homme de Lodder et al., 2006a), where spray duration is defined as the entire duration of the cleaning task (Annex I, Table A2), including non-spraying time in between multiple spraying activities. The manual of ConsExpo Web (Delmaar & Schuur, 2016), however, describes spray duration as the time that is spent in actual spraying during the spraying activity, thus excluding non-spraying time. A clear definition of 'spray duration' is important, because the amount of spray subject to inhalation is simulated in ConsExpo Web from the mass generation rate of the spray, the spray duration and ventilation (Delmaar & Schuur, 2016). Default values for spray durations, however, are derived per specific scenario for consumer exposure.

Room height
The default of room height is based on a standard room height of 2.5 m as explained in the General Fact Sheet (Te Biesebeek et al., 2014). The Q-factor is set to 4 in accordance with the General Fact Sheet.

Mass generation rate – aerosol spray cans
The definition of mass generation rate of sprays is in contrast to that of the Cleaning Products Fact Sheet published in 2006 (Prud'homme de Lodder et al., 2006a), where mass generation rate is defined as the *average mass released per unit of time over the entire duration of the cleaning task*. In the current Cleaning Products Fact Sheet, the mass generation rate of a spray product is defined as the *mass released per unit time of spraying*. In the study by Delmaar & Bremmer (2009) mass generation rates were experimentally determined for aerosol spray cans by spraying for 10 seconds and determining the weight loss in the spray can afterwards. To establish the variation of the mass generation rate during the lifetime of the product, the weight loss was measured when the spray container was still full and also when the container was nearly empty (Delmaar & Bremmer, 2009). In these experiments, performed on 17 aerosol spray cans, the mass generation rate ranged between 0.29 and 2.2 g/s. This is consistent with the data from a comparable series of experiments by Tuinman (2004, 2007), which show a 75th percentile of 1.2 g/s. The default mass generation rate for aerosol spray cans is therefore set at 1.2 g/s. The Q-factor is set to 3, because the underlying dataset is large but does not refer to a specific exposure scenario.

Mass generation rate – trigger sprays
Delmaar & Bremmer (2009) experimentally determined mass generation rates also for trigger sprays by squeezing 10 times (which approximately takes 6 seconds) and determining the weight loss in the spray can afterwards. The obtained mass generation rates of 6 different trigger sprays ranged between 1.0 and 1.5 g/s. This is consistent with data from a comparable series of experiments by Tuinman (2004, 2007), which show a 75th percentile of 1.6 g/s for trigger sprays. The default mass generation rate for trigger sprays is therefore set at 1.6 g/s. The Q-factor is set to 3, because the underlying dataset is large but does not refer to a specific exposure scenario.

Airborne fraction
The airborne fraction is defined as the fraction of the non-volatile product that becomes airborne as droplets after spraying. The airborne fraction will depend on the way in which the product is used as well as on the aerosol diameter distribution that has been specified. Cleaning sprays are used to clean surfaces and are therefore sprayed towards surfaces. In the series of experiments, Delmaar & Bremmer (2009) found that airborne fractions are relatively low for sprays that are used to treat a surface ranging from 0.006 to 0.18 (n=4) compared with spray applications directed towards persons or animals (0.2–0.9, n=5). The default airborne fraction for cleaning sprays is set to 0.2, which is a conservative value, consistent with the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a). The Q-factor is set to 2, because the surface sprays that were evaluated in the experiments of Delmaar & Bremmer (2009) included only four samples, of which only one was a cleaning product (all-purpose cleaner).

Inhalation cut-off diameter
The inhalation cut-off diameter is defined as the diameter below which the sprayed particles can be inhaled and reach the lower areas of the lungs, i.e. the alveolar region (Delmaar & Schuur, 2016). It is only an approximation of the complicated process of deposition of particles in the lung, but in practice its value is suggested to be set at 10–15 µm (Delmaar & Schuur, 2016). In order to be conservative, the default for inhalation cut-off diameter is set here at 15 µm. The Q-factor is considered to be 3, because the value is specifically but qualitatively derived for the parameter inhalation cut-off diameter.

Density – non-volatile substances
The density of the non-volatile substance is one of the parameters included in the spray model and is defined here as the density of the aerosol droplets that become airborne. Together with the droplet diameter, the aerosol density determines the time that the aerosol droplet is airborne and therefore subject to inhalation. Many ingredients in cleaning products are made of (very) large organic substances with densities between 1.0 and 1.5 g/cm^3. The density of salts generally varies between 1.5 and 3.0 g/cm^3. For a complex mixture of (organic) substances, the default density is set at 1.8 g/cm^3. The Q-factor is set to 3, because density is a physicochemical property that is generally known for most substances but is presented here on a generic level (Table 4).

Table 4: Default values for density of non-volatile substances (Prud'homme de Lodder et al., 2006a)

Main ingredient	Density (g/cm^3)	Q-factor
Large organic substances	1.5	3
Salts	3.0	3
Complex mixtures	1.8	3
Density data lacking (non-volatile)	1.8	3

Oral non-respirable material exposure
Non-respirable oral exposure is expected from materials in aerosol particles with a diameter larger than the inhalation cut-off. Particles of this size are deposited in the higher regions of the respiratory tract, so that they are taken up orally. ConsExpo offers the option to 'include oral non-respirable material exposure'. If this option is checked, ConsExpo adds an oral route model to the exposure scenario and accounts for the non-respirable fraction of the inhaled spray.
For cleaning sprays this option is not recommended and therefore not 'included' by default because the larger particles are most prone to deposit on the surface to which the spray is directed (although it can be included as a precaution).

Inhalation of volatiles
The inhalation exposure to volatile substances in cleaning sprays is estimated using the ***inhalation–exposure to spray–instantaneous release*** model. The defaults for the parameters exposure duration, room volume, ventilation and inhalation rate described for non-volatiles in sprays (see above) also apply to volatile substances.

Released mass
Released mass is interpreted here as the product amount that is sprayed out of the bottle or can. Therefore, the defaults for released mass (g) are simply calculated by multiplying the mass generation rate (g/s) by the spray duration (s), which are already described as defaults to estimate the inhalation exposure to non-volatile substances from spraying cleaning products. The Q-factor that is to be assigned for released mass is equal to the lowest Q-factor assigned to the respective mass generation rate or spray duration.

Dermal
In this general scenario of exposure to spray applications the ***dermal–direct product contact–constant rate*** model of ConsExpo Web is used to calculate dermal exposure from spray applications that are directed towards a surface. The selected model requires only 'contact rate' and 'release duration' as input parameters that are not specific to an ingredient or substance. For aerosol spray cans and trigger sprays, default values for contact rate are given below, in contrast to release duration, as this parameter depends on the use of the specific product. Nonetheless, the approach used to derive default release durations is generic and explained below.

Exposed area
Exposed area is interpreted here as the surface area of unprotected skin on which the sprayed aerosols can deposit, which are the hands and forearms of an adult. In the General Fact Sheet (Te Biesebeek et al.,

2014) default values for the surface area of the hands (900 cm^2) and forearms for adults (half surface area arms; 1300 cm^2) are described. Chapter R15 of the REACH guidance (ECHA, 2012) describes a skin area of the arms/forearms of adult males and females of 1851 cm^2 (derived from US-EPA, 1997). In the HEEG opinion on exposure assessments for biocidal products (HEEG 2013) a default of 1961 cm^2 is given. Here, the default value for the exposed area is set at 2200 cm^2 in agreement with the General Fact Sheet. The Q-factor is set to 3, because it is supported by quantitative data that do not refer to the specific use of spray cleaners.

Contact rate – aerosol spray cans
ECHA (2015a) provides data for consumer spray products available as pressurized aerosol spray cans and hand-held trigger sprays, c.f. consumer product spraying and dusting model developed by the UK Health Safety Laboratory (HSL) in 2001. This non-professional surface spraying model for indoor surfaces describes the use of pre-pressurized aerosol spray cans, e.g. for skirting, shelves and horizontal/vertical laminate surfaces. The model calculates a 75th percentile of 64.7 mg/min for dermal exposure on hands and forearms and a 75th percentile of 35.7 mg/min for legs/feet and face, so that the total contact rate for the use of aerosol spray cans is 100 mg/min. Hence, the default for contact rate – aerosol spray cans is set at 100 mg/min. The Q-factor is 3, because the underlying dataset is large but does not refer to a specific exposure scenario.

Contact rate – trigger sprays
For the use of hand-held trigger sprays, ECHA (2015a) describes a non-professional surface spraying model for spraying indoors in small rooms, i.e. sofa skirting, dining chairs and carpets. The 75th percentile for contact rate after dermal exposure on hands and forearms is 36.1 mg/min and for legs/feet and face is 9.7 mg/min, yielding a total contact rate for trigger sprays of 46 mg/min. Hence, the default for contact rate for trigger sprays is set at 46 mg/min. The Q-factor is 3 because the underlying dataset is large but does not refer to a specific exposure scenario.

Release duration
Dermal exposure during a spraying activity is anticipated from sprayed product amounts that deposit onto the skin of the consumer. The duration in which substances can deposit is expected to include both the actual spraying events and the time between spraying events. The default release duration is therefore not equal to the nett spray duration described in the scenarios for inhalation of spray products. Instead it is assumed that the released duration is twice the net spray duration, which is referred to in the previous Cleaning Products Fact Sheet as the ‘intermittent spray duration’ (Prud’homme de Lodder et al., 2006a).

4.2.2 Generic exposure scenario for surface cleaning
Many different consumer products are used to clean surfaces. For example, there are products for cleaning specific surfaces, such as kitchen, oven, bathroom, and toilet cleaners. In addition to cleaning products, there are surface-specific waxes and polishes. Although all of these products are developed to treat different surfaces, the activities the consumer needs to perform to treat these surfaces are quite similar:

1. Applying the product to the surface
2. Leaving the product on the surface to soak
3. Removing the product from the surface.

Exposure should then be calculated as the sum of the exposures resulting from these three activities. Inhalation exposure to volatile substances in sprays is the exception here, because it is assumed that these substances are instantaneously and fully airborne during the spray application. Hence, the instantaneous release also covers the evaporation during the leave-on period. Consequently, in this case, adding airborne substances from evaporation during leave-on to the sum of inhalation exposure would yield an overestimation.

4.2.2.1 Surface application

Four different ways of applying a product onto a surface are considered: with a spray (4.2.1), with a wet (impregnated) tissue (wipe), and with a cloth or mop. Cloths and mops are used to clean medium to large areas. They absorb liquids, gels, creams and diluted products, whereas ready-to-use products (such as wet wipes) are impregnated with such products.

Two methods are considered for the application of a product to a surface with a cloth: the cloth itself can be wetted and then rubbed over the surface, or the surface can be wetted and then a dry cloth is used to spread the product over the surface.

The generic exposure scenario for surface application comprises the pouring and spreading-out of the product over the surface. The scenario defaults as described in the sections below are used to predict inhalation and dermal exposure.

Inhalation – wet cloths, mops and tissues

In contrast to the 2006 version of the Cleaning Products Fact Sheet (Prud'homme de Lodder, et al., 2006a), the ***exposure to vapour–evaporation–increasing release*** model is now used to estimate inhalation exposure for surface application with cloths, mops and wet tissues, as the surface area increases during application of the cleaning agent. Parameter values, however, are not generic, because they depend on the type of surface that is being treated, which can be product-dependent. The exposure duration for this phase is limited to the application duration, as the remainder of the exposure is covered by a subsequent leave-on period.

Mass transfer coefficient

The mass transfer coefficient determines the transport of an evaporating substance from a product's surface to indoor air. Moreover, the mass transfer coefficient accounts for the fact that emission from a product is limited by the presence of a stagnant layer of air over the product's surface through which the substance diffuses to reach indoor air. The mass transfer coefficient depends on a number of factors, including the diffusivity of the substance through air (dependent on molecular weight), the air flow over the product and the surface roughness of the product.

In ConsExpo version 4.1, two models were provided to estimate the mass transfer coefficient, referred to as 'Langmuir's' and 'Thibodeaux's' methods. These methods, however, are also suitable for outdoor conditions and give large over-predictions for indoor conditions. Typical estimated values are 500,000 m/h for Langmuir and 29 m/h for Thibodeaux (for a substance with a molecular weight of 20 g/mol and at 20 °C). Estimation methods of mass transfer coefficients that are more representative of indoor conditions are presented below. Based on these methods a generic default value is suggested.

Several models have been developed and used to estimate mass transfer in indoor environments. Weschler and Nazaroff (2008) use a particle deposition model to derive typical mass transfer rates for semi-volatile organic compounds (SVOCs) from flat surfaces indoors to indoor air. This model uses information on the range of typical diffusivities of substances in air indoors to describe the mass transfer. They conclude that for the substances they considered, the mass transfer coefficient ranged from 2.5 to 3.9 m/h. The US-EPA Consumer Exposure Model (CEM) user's guide (US-EPA, 2016) proposes a method to estimate the mass transfer coefficient as:

$$h_m = 46.8 \times \frac{3.3}{(2.5 + MW^{1/3})^2}$$

Here, h_m is the mass transfer coefficient in m/h and MW is the molecular weight in g/mol. This model takes only substance diffusivity (which depends on the molecular weight (MW)) into consideration. Using this model, based on variation in the molecular weight, a range of mass transfer coefficients can be estimated (see Table 5).

Table 5: Calculated mass transfer coefficient per molecular weight of substance

Molecular weight (g/mol)	**Mass transfer coefficient (m/h)**
20	5.7
100	3.0
300	1.8
600	1.3

Delmaar (2010) reviewed a number of models to estimate the mass transfer coefficient for a flat surface. This review shows that the different models predict the mass transfer coefficient to be between 2 and 16 m/h depending on the model used, the diffusivity of the substance in air (thus molecular weight) and the air flow over the surface. The different methods and models applied in the literature indicate that the mass transfer coefficient is in the order of 1 to 10 m/h, where the previously used default methods (the models of Langmuir and Thibodeaux) result in much higher estimates.
Therefore, a generic default value for the mass transfer coefficient of 10 m/h is proposed. This generic default is usable for a situation where the specific properties of the substance, the product and the indoor environment are not of influence. The Q-factor is set to 2, because of the generic character of the calculation from which the default is derived.

The ***inhalation–exposure to spray–instantaneous release*** model is used to estimate exposure to volatile substances from cleaning products available as sprays. The application duration is set equal to the exact spraying time, whereas the exposure duration is set at the duration a person remains in the room. The exposure duration is therefore dependent on the type of product. As this approach overestimates exposure to vapours considerably, it may be assumed that the instantaneous release also covers the evaporation during the leave-on period (4.2.2.2). Upon application it is assumed that all the substance is released to the air. Hence, it is redundant to add the substance evaporating from the surface, as this would lead to an overestimation.

Dermal

Dermal exposure from surface cleaning differs for the use of sprays, wet wipes or cloths and mops. Dermal contact from sprays is expected only from deposition of airborne aerosols onto the skin (4.2.1) and when a cloth is used to spread out the product. Treating the surface with wet wipes leads to dermal exposure via contact between the hands and the wipe. Dermal exposure to hands and forearms may also occur while dipping the cloth or mop it into a bucket with diluted product. Such dermal exposure from dipping the cloth or mop in a bucket is described in the generic exposure scenario of dilution of products (4.2.3). Hand contact with a wet cloth itself when the product is applied to the surface may also lead to dermal exposure. The ***direct product contact–instant application*** model is used to estimate dermal exposure from hand contact with wet cloths and wipes. Generic interpretations or default parameter values for dermal exposure from surface application with cloths, mops and wipes are discussed.

Product amount – wet cloth

The product amount that is subject to dermal exposure from a wet cloth is derived using the following calculation. The product amount applied to the surface is diluted by wetting the surface with the wet cloth. In a small experiment it was observed that a wet surface holds 40 ml water per m^2. The total volume of water on the treated surface can thus be calculated by multiplying the surface area (m^2) by 40 ml/m^2. The concentration of the product in the water is equal to the applied product amount (g) divided by the calculated total volume of water (ml). The volume of water that ends up on the hand palm of the consumer (2.25 ml) touching the wet cloth is calculated by multiplying the exposed area of one hand palm (225 cm^2) by a layer thickness of 0.01 cm (ECHA, 2015a). It is assumed that the product concentration in the water lying on the treated surface is equal to the concentration in the volume of water that is in contact with the hand palm, so that:

$$\frac{g_{product\ on\ surface}}{ml_{water\ on\ surface}} = \frac{g_{product\ on\ hand}}{ml_{water\ on\ hand}} = \frac{g_{product\ on\ surface}}{40\ ml \times surface\ area(m^2)} = \frac{g_{product\ on\ hand}}{2.25\ ml}$$

The default product amount subject to dermal exposure by touching a wet cloth is then calculated by rearranging the equation above into:

$$g_{product\ on\ hand} = \frac{g_{product\ on\ surface}}{surface\ area(m^2)} \times \frac{2.25\ ml}{40\ ml}$$

The Q-factor for the defaults derived with this equation is set to 2, because the underlying data for the calculation are limited.

Exposed area – mops
When the consumer uses a mop, it is also assumed that there will be dermal contact with the diluted product when dipping the hands and forearms in the mop bucket. In the General Fact Sheet (Te Biesebeek et al., 2014) default values for the surface area of the hands (900 cm^2) and forearms for adults (half surface area arms; 1300 cm^2) are described. The exposed area is therefore 2200 cm^2 (Te Biesebeek et al., 2014). The Q-factor for exposed area is set to 3, because the underlying dataset is large, but the quality is compromised by assuming that the surface area of a forearm is half the surface area of a full arm.

Product amount – mops
A volume of water of 22 ml that is in dermal contact upon dipping is then calculated by multiplying the exposed area (2200 cm^2, see above) by a layer thickness of 0.01 cm. The layer thickness applied here is taken from the Guidance on the EU Biocidal Product Regulation (ECHA, 2015a), in which a general layer thickness for liquid runoffs is set at 0.01 cm (4.1.2). The product amount is then calculated by multiplying the concentration of product in the mop bucket by the contacted water volume of 22 ml. The Q-factor for such a calculated parameter value is maximally 2, because that is the lowest Q-factor of the variables from which product amount is calculated (layer thickness).

Product amount – wet wipes
The product amount for wet wipes is interpreted as the amount of the liquid cleaning product that migrates from the wet tissues to the skin of the consumer that touches the tissue firmly during the cleaning task. It is derived by multiplying the amount of product migrating from the use of one tissue by the number of tissues used in the cleaning task. The number of tissues used is based on the EPHECT survey (2015, Annex II), where the 75^{th} percentiles are 3.2 for all-purpose wipes, 3.4 for bathroom wipes, 3.6 for kitchen wipes, and 3.8 for glass cleaner wipes. The amount of product migrating from a wet tissue is evaluated by Weerdesteijn et al. (1999) and Hossain et al. (2015). Weerdesteijn weighed wet tissues and determined that a mean amount of 0.044 g (St. Dev=0.004 g, n=5) remained on the surface of the hand after firmly touching the tissue. Hossain et al. (2015) estimated dermal contact for a commercially available baby wipe to be 0.5% of the weight of the total weight of the wipe (rounded mean weight 7.7 g and wiped amount 0.04 g per wipe). In the previous version of the Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) a 75^{th} percentile of 0.047 g was described as 1.4% of the weight of liquid product in the wipe. Based on a small experiment conducted internally, it is determined that 60% of the weight of a wet tissue comprises the liquid cleaning product and 40% of the weight is the dry weight of the tissue. Multiplying the 75^{th} percentiles for the number of wipes in Annex II by the fraction of 0.5% of liquid product that ends up on the skin (Hossain et al., 2015) and the 60% of the wipe that represents the liquid product fraction in the tissue, results in a range of 0.048–0.057 g for product amount in a wet wipe. This is consistent with the default in the previous version of the Cleaning Products Fact Sheet; the default product amount for dermal exposure therefore remains at 0.05 g with a Q-factor of 3, because the underlying dataset is large but does not refer to a specific exposure scenario.

4.2.2.2 Surface leave-on

After the cleaning product is applied to the surface, the consumer may leave the product on the surface for a period of time to soak. This activity of surface leave-on is not entirely independent from the way it has been applied (spray, wet tissue, cloth or mop), which may affect the amount of product on the treated surface and the time required for it to soak in. Therefore, the default scenarios for surface leave-on are not overarching for all products. Rather, it is considered generic for this mode of application. During leave-on, inhalation exposure from substances evaporating from the surface is to be expected, whereas dermal exposure is not.

Inhalation

Inhalation exposure to substances evaporating from the surface is calculated using the ***exposure to vapour–evaporation–constant release*** model.

Product amount – wet wipes

The product amount for wet wipes is interpreted here as the amount of product that is subject to inhalation exposure, which in this scenario is the product amount that is left on the surface. Wet tissues or wipes are generally used for small cleaning jobs on all washable surfaces. Nonetheless, analysis of the EPHECT data (2015; Annex II) shows a 75th percentile for the number of wipes of 3.3 for all-purpose wipes, bathroom wipes, kitchen wipes and glass-cleaning wipes. Weerdesteijn et al. (1999) measured the total weight of one wet wipe to range between 5.5 and 5.8 g. The dry weight of such a wipe ranges, however, between 2.2 and 2.3 g, so that the weight of the wet product in the wipe is between 3.3 and 3.5 g. The total amount of wet product used (11.5 g) is thus calculated as the number of wipes (3.3) multiplied by the wet product amount in one wipe (3.5 g). The default product amount for inhalation exposure is based on this total amount of wet product used, and is set at 11.5 g. The Q-factor is set to 3, because it is supported by quantitative but generic data, as different types of wet wipes are included.

4.2.2.3 Surface cleaning

It is assumed that the surface is cleaned with a (wet) cloth. Dermal exposure is considered equal to that of surface application with a cloth (4.2.4.1). In cases where the substance is applied with a wet wipe or mop, it is assumed that there is no removal step.

4.2.3 Generic exposure scenario–application of diluted products

Many consumer products require dilution with water prior to application. This mixing process is especially necessary for the application of certain cleaning products such as dishwashing, hand-laundry and floor-cleaning products. During the application of these products, dermal contact with the water in a bucket, sink, bowl or flask is possible. Moreover, diluting the product with hot water may increase the evaporation and subsequent inhalation of volatile substances.

Inhalation

Inhalation of water-diluted products is calculated using the ***inhalation–exposure to vapour–evaporation*** model of ConsExpo Web (Delmaar

& Schuur, 2016). In order to follow the generic exposure scenario for product dilution with water, some interpretation and defaults are required for the parameters release area, product amount and dilution times.

Release area – buckets, sinks and wash bowls
The release areas depends on the container in which the product is diluted. Here the release areas of buckets, sinks and wash bowls are derived from their dimensions. It is assumed that most consumers use a bucket that is 50 cm long x 27 cm wide, so that its surface area equals 1350 cm^2.
Weerdesteijn et al. (1999) calculated a 75^{th} percentile of 1453 cm^2 for the surface area of sinks (n=18). Today's rinse units of sinks are usually 41 cm long x 36 cm wide, so that their surface area also equals 1453 cm^2. Prud'homme de Lodder et al. (2006a) set the default at 1500 cm^2. Because of the minimal variation in the numbers, the default for release area resulting from sinks, buckets and wash bowls remains at 1500 cm^2. The Q-factor is set to 3, because the description is generic and supported by quantitative data only for sinks.

Dilution (times)
For products that are diluted with water it is necessary to correct for dilution in order to correctly simulate the evaporation of substances (Delmaar & Schuur, 2016). Such correction is done with a dilution expressed in 'times' that will be presented as a new feature in the ConsExpo Web tool in 2017. The equation to calculate the dilution times is derived as:

$$\mathrm{dilution_{times}} = \frac{\mathrm{solvent_{amount}} + \mathrm{product_{amount}}}{\mathrm{product_{amount}}}$$

Technically, the dilution times are calculated as the inverse of the weight fraction of the product amount into the *amount of solution used*. For example, a squeeze of dishwasher detergent of 7 g is diluted in 5 l water in a bowl. The product amount then equals the squeeze of dishwasher detergent (7 g). The solvent is the water in the bowl, which has a density of 1000 g/l, a volume of 5 l and thus an amount of 5000 g. The *amount of solution used* represents the sum of the *solvent amount* and the *product amount*, which is in the example 5000 g + 7 g = 5007 g. The weight fraction of the *product amount* in the *amount of solution used* is then 7 g / 5007 g = 0.0014. The number of *dilution times* is the inverse of this weight fraction, 1/0.0014 = 715 times. Consequently, the dishwasher detergent in the example is diluted in water 715 times.

Dermal
The ***dermal–direct product contact–instant application*** model is used to calculate dermal exposure from dipping hands and forearms into a water container (e.g. bucket or sink) with the diluted product.
Exposed area
The exposed area is interpreted as the skin surface of the hands and forearms.. Here, the default value for the exposed area is set at 2200 cm^2 in agreement with the General Fact Sheet and section 4.2.1 . The Q-factor is set to 3, because it is supported by quantitative data that do not refer to the specific use of cleaning products.

Product amount

The default product amount on the skin is calculated from the concentration of the product after dilution in a container such as a bucket, bowl or sink. This concentration is calculated by dividing the amount of product inserted in the container by the volume of water in the container. The volume of water in the container is 15 l, which is equal to the surface area (1500 cm^2, see release areas of buckets, sinks and wash bowls) multiplied by a water depth of 10 cm. The volume of water that comes into contact with the skin is 22 ml, since the surface area of the exposed skin (2200 cm^2) multiplied by the layer thickness of liquid film (0.01 cm; see 4.1.2) equals 22 ml. The product amount that comes into contact with the skin is then calculated by multiplying the concentration of the product in the water by the volume of water that comes into contact with the skin, calculated as follows:

$$g_{product\ on\ skin} = \frac{g_{product\ in\ container}}{l_{water\ in\ container}} \times l_{water\ on\ skin} = g_{product\ in\ container} \times \frac{0.022}{15}$$

The Q-factor for such a calculated parameter value is maximally 2, because that is the lowest Q-factor of the variables from which product amount is calculated (layer thickness).

Dilution

The *dilution* for estimating dermal exposure will be presented as an additional parameter in the new feature of ConsExpo Web. It refers to the number of times the product is diluted in a solvent, which is most often water, and can be derived using the same approach as described above for estimating inhalation exposure. In the current fact sheet, dilution times for dermal exposure are not explicitly presented. All external dermal exposure estimations are either done with the **dermal–direct product contact instant application** or **dermal–direct product contact constant rate** model, where dilution is not a parameter. However, the current Fact Sheet does describe consumer exposure scenarios that include dermal exposure from applications of diluted products. In these scenarios dilution is accounted for nonetheless by calculating the product amount that is in contact with the skin by multiplying the concentration of the product in the water by the volume of water that is on the skin of the consumer (see above). Please note that it is necessary to correct substance properties such as diffusion and permeability coefficients for the properties of water upon contact with diluted products when using dermal exposure models other than those prescribed in the current Fact Sheet, e.g. diffusion models.

4.3 Post-application and secondary exposure

Post-application exposure is interpreted in this Fact Sheet as exposure to a substance in a cleaning product while the person being exposed is not actively performing a cleaning task. Dermal and oral post-application exposure routes are a result of residues of the product left behind after application. Such exposure may be to the person who used the product or to other persons. There are four general relevant post-application exposure routes to be considered:

- Rubbing-off.
- Hand-to-mouth exposure.

- Migration from fabric.
- Ingestion from table ware.

Secondary inhalation exposure may occur as well in cases where other persons are present in the room during the cleaning task. However, the air concentrations to which the second person is exposed will not be higher than those of the first person performing the cleaning task. Therefore, the estimation of the inhalation exposure for the consumer performing the cleaning task also suffices for secondary external inhalation exposure. This is not necessarily true for internal exposure, as the second person exposed can be a child. The internal dose for children can be higher because their body weight is lower than that of adults. Such internal doses can be estimated from the defaults for children's bodies in the General Fact Sheet (Te Biesebeek et al., 2014) and the defaults for the calculation of air concentrations described in the current Fact Sheet.

4.3.1 *Generic exposure scenario for rubbing-off*

Rubbing-off occurs when there is dermal contact with a surface (work top, floor) that has been treated with a product, resulting in exposure to the substance. In this post-application phase, young children are relatively highly exposed, due to their specific time-activity pattern (crawling on treated surfaces, hand-to-mouth contact) and relatively low body weight. Within ConsExpo Web, dermal exposure from rubbing-off is estimated using the ***dermal–direct product contact–rubbing-off*** model. Explanation, interpretation and defaults are given for the parameters: dislodgeable amount, transfer coefficient, contact time, contacted surface and exposed area.

Exposed area

Dermal exposure (of a child) to a substance via rubbing-off can take place on any uncovered part of the skin, e.g. head, arms and hands, and legs and feet. The exposed area is based on a one-year-old child wearing T-shirt and shorts, a nappy and no socks or shoes. The covered skin area (trunk) is 35.7 % (Te Biesebeek et al., 2014), so that the exposed area can be calculated as an uncovered fraction of the total body surface of a one-year-old child: 64.3% x 0.45 m^2 = 0.3 m^2 (Te Biesebeek et al., 2014). The default for exposed area is therefore set at 0.3 m^2 with a Q-factor of 4, because the default specifically refers to the unprotected skin area of a child derived from a large dataset.

Transfer coefficient (TC)

The transfer coefficient (TC) was described by the US-EPA (1997, 2012) as 'a measure of surface-to-skin residue transfer dependent on factors such as surface type and contact intensity'. Another definition is 'the ratio of exposure, measured in mass of chemical per time (e.g. μg/hr), to residue, measured in mass of chemical per surface area (e.g. μg/cm^2), with resulting units cm^2/hr'. In the previous version of the Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a), a default of 0.6 (m^2/hr) was used based on US-EPA (1997) documentation. US-EPA updated their transfer coefficient to 0.18 m^2/hr in 2012. This correction was based on the fact that the default was obtained by correcting the adult TC value with a factor for total body surface area differences between adults and children. The Ad hoc Working Group on Human

Exposure to Biocides (HEAdhoc) recommended using US-EPA's 75th percentiles of 0.78 m^2/hr for an adult, but to apply a correction for infants of 6–12 months old. After all, as mentioned in the EU BPR, infants are typically considered to be the target population in rubbing-off scenarios. This resulted in a TC of 0.2 m^2/hr for children (HEAdhoc, 2016). In the current document the recommendations of HEAdhoc are taken into account, resulting in transfer coefficient values of 0.2 m^2/hr for children and 0.78 m^2/hr for adults. The corresponding Q-factor is set to 3, because it is supported by quantitative but generic (non-specific) data.

Dislodgeable amount and dislodgeable fraction ($F_{dislodge}$)
The dislodgeable amount is the amount of product applied to a contacted surface area that is potentially rubbed off per unit of surface area (g/m^2; see below). ECHA (2015b) gives an overview of transfer efficiencies for different types of surfaces. To calculate this amount, the dislodgeable fraction is needed, which is defined as the fraction of product on the surface that is potentially rubbed off. A pilot study conducted by the Health Safety Laboratory (HSL) on aerosols -cited in the Biocides Steering Group's report (1998)- describes a 10% value for the dislodgeable fraction from treated carpets. Based on the data of the more general HSL pilot study, the default fraction of product that is dislodgeable is set at 30% (the average of the 1–60% range). The dislodgeable amount is then by default calculated by multiplying this fraction by the product amount (g) per contacted surface area (g/m^2):

$$F_{dislodge} = 0.3\ \frac{product\ amount}{contacted\ surface}$$

The Q-factors for dislodgeable fraction and dislodgeable amount are set at 3, because the underlying dataset is large but does not refer to a specific exposure scenario.

Contact time (t)
Contact time is to be interpreted as the amount of time a treated surface is rubbed by the exposed individual.

Contacted surface (S_{area})
This is the area of the treated surface that can potentially be rubbed. In some cases the rubbed surface may be smaller than the treated surface, for example, when the treated surface is not entirely accessible. This is dependent of the product use, and will be discussed in Chapters 6 to 12.

4.3.2 Generic scenario for hand-to-mouth exposure
The ***oral–direct product contact–direct oral intake*** model is used to calculate oral exposure from hand-to-mouth behaviour. The hands are the part of the body for which the highest exposure per cm^2 is expected, because the hands are most likely to touch the substance upon secondary exposure. They form about 20% of the total uncovered skin. If it is assumed that 50% of the product that ended up on the hands is taken in orally due to hand-to-mouth contact, this means that 10% of the external dermal exposure is ingested via hand-mouth contact (Bremmer et al., 2006b) leaving 90% of the total external dose subject to dermal uptake. The ingested amount via hand-to-mouth contact is calculated by taking 10% of the total external dermal dose; see 4.3.1 (exposed area).

4.3.3 *Generic exposure scenario for migration from fabric (adults)*

After washing, residues of laundry products may remain on clothing. While these clothes are being worn, residues can migrate from fabric to skin, leading to dermal exposure. For estimating such secondary exposure the ***dermal–direct product contact–migration*** model is used (Delmaar & Schuur, 2016). The amount of residue depends on the composition of the detergent, the substance and the type of fabric.

Exposed area

The default for exposed area is set at 1.7 m^2, which equals the entire surface area of an adult human body minus head and hands (Te Biesebeek et al., 2014). It is not necessary to correct for the parts of the human body that are not covered with fabric, because this is already done in the derivation of the skin contact factor described below. The Q-factor is set to 4 based on the quantitative data in the General Fact Sheet (Te Biesebeek et al., 2014).

Product amount – clothes

In a small experiment (Prud'homme de Lodder et al., 2006a), individuals were asked to weigh their clothes (except shoes). Winter clothes worn simultaneously weigh 1382 g. Summer garments were estimated at 932 g (by excluding the sweater that is worn over a t-shirt during winter times). The default product amount for adults is set at 1000 g. The Q-factor is set to 2, because the supporting data are limited.

Skin-contact factor

The skin-contact factor (F_{skin}) is the fraction of the product that is actually in contact with bare skin. For the calculation of F_{skin}, it is assumed that half of the clothes are in constant contact with the skin (F_{skin}=1) and half has intermittent contact with the skin (F_{skin}=0.6). Overall, the skin-contact factor becomes 0.5 x 1 + 0.5 x 0.6 = 0.8 (Prud'homme de Lodder et al., 2006a). The default is set to 0.8. The Q-factor is set to 1, because the calculation depends largely on expert judgement.

4.3.4 *Generic exposure scenario for ingestion of residues from table ware*

Oral exposure can occur due to residues left on washed dishes and cutlery. According to Weerdesteijn et al. (1999) the residue quantity increases with the detergent concentration or with the dishwater temperature. Larger amounts of residue are expected if the table ware is air-dried. The ***oral–direct product contact–direct oral intake*** model parametrization described below assumes that all table ware is air-dried (Delmaar & Schuur, 2016).

Frequency

It is assumed that table ware is used every day for food and drinks. The default for frequency of use equals 365 times per year. The Q-factor is 4, because it is safe to assume that the table ware is used on a daily basis.

Amount ingested

The amount ingested is calculated by multiplying the amount of water left on the table ware by the concentration of product in the water. According to AISE (2002), the amount of regular dishwashing liquid used is between 3 and 10 g, whereas concentrated detergent is between 2 and 5 g (both per 5 l of water). Ramirez-Martinez et al. (2014) reported an average value of dishwashing liquid of 5.6 g (St. Dev=5.7 g) in 8 l. The 75th percentile of 7 g per 5 l water found by Weegels (1997) remains the default value for liquid, which is supported by the data from AISE (2002) and Ramirez-Martinez et al. (2014). This gives a product concentration of 1.4 g/l. The Q-factor for the product amount is set to 4, because the supporting data are specifically collected to assess the amount of product applied to dishwashing. According to Schmitz (1973, adopted by HERA, 2005) the amount of water left on table ware is $5.5x10^{-5}$ ml/cm^2 and the area of table ware in daily contact with food is 5400 cm^2 according to O.J. France (1990). The ingested product amount is then $5.5x10^{-5}$ ml/cm^2 x 5400 cm^2 x 1.4 mg/ml = 0.42 mg. ECHA (2015a) also uses the above-mentioned defaults and calculations. The default for amount ingested remains at 0.42 mg. The Q-factor for ingested amount is set to 2, because the data supporting the daily contact with table ware are limited.

4.4 User population

The default values in the Fact Sheets have been derived for consumers (private or non-professional users). They are not aimed at describing exposure for people who professionally work with cleaning products, such as in hospitals and in public services. This Fact Sheet therefore describes only cleaning products which are available to the consumer for private use.

Using the models in ConsExpo and the default values for consumers presented here as background data, it is nonetheless possible to calculate the exposure and uptake of cleaning products by professional users. Of course, the differences in products and product use between the consumer and those using cleaning products professionally must be taken into account.

Groups to consider

Two groups can be distinguished in the exposure assessment for consumers: the group experiencing the highest exposure during use (in most cases the user) and the group exposed after application (post-application; see 4.3). The person applying the product (the user) is the one actually using the cleaning product and, if necessary, diluting it to the required concentration (‘mixing and loading’). It is expected that the user will be exposed to high levels during mixing and loading and during application.
As both men and women use cleaning products, the default values for body weight and surface areas of body parts are given for adults. For men and women, values for body weight and surface area are used as presented in the General Fact Sheet (Te Biesebeek et al., 2014).

The defaults for anthropometric parameters such as body weight, inhalation rate and surface areas of body parts in the current Fact Sheet are taken from the defaults given in the General Fact Sheet (Te Biesebeek et al., 2014).

Body weight – adults

The default body weight is set to 68.8 kg with a Q-factor of 4 (Te Biesebeek et al., 2014).

Inhalation rate – adults
The performance of a cleaning task is interpreted as a 'light exercise activity', so that the default inhalation rate is set to 1.49 m^3/h (25 l/min). The Q-factor is set at 3, since the default does not refer to actually measured inhalation rates, but to an inhalation rate calculated from the body weight of the consumer (Te Biesebeek et al., 2014).

Body weight – crawling children
The current Fact Sheet refers to exposure scenarios in which a child crawls over a cleaned surface such a floor or carpet. The exposure calculations are then based on a 6–12-month-old child (the age at which children crawl). The default body weight for this age group is set to 8 kg with a Q-factor of 4 explained in the General Fact Sheet (Te Biesebeek et al., 2014).

5 New information since 2006

By means of a scoping review, new information was collected from scientific literature, product information labels, industrial and government reports and surveys in order to reconsider the defaults of the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a). Important sources of new information published since 2006 leading to reconsideration of the defaults are discussed below.

5.1 EPHECT Survey

The EPHECT project (Emissions, Exposure Patterns and Health Effects of Consumer Products in the EU) is a European collaborative project, co-funded by the European Union, in which important information has been gathered about the use of cleaning products by European consumers (EPHECT, 2015). The EPHECT survey was performed in 2012 (EPHECT, 2012) and published in 2015 (Dimitroulopoulou et al., 2015a, b; Trantallidi et al., 2015). It was designed to collect household use data for 16 consumer products across 4 geographical regions of Europe. A total of 4335 people from 10 European countries (Czech Republic, Germany, Denmark, Spain, France, Hungary, Italy, Poland, the UK and Sweden) were interviewed. Eight of the 16 products considered were cleaning products, namely all-purpose cleaners, kitchen cleaners, floor cleaners, glass and window cleaners, bathroom cleaners, furniture and floor polish products, and coating products for leather and fabrics. Raw data for the use frequency (per year) and the amount of product used per event (g) was provided by the EPHECT team (2015). For the purpose of this Fact Sheet, the raw data were analysed with a Monte Carlo simulation in order to derive probabilistic distributions for use frequency and product amount. In Table A3 (Annex) the conversion of the data to product amount has been described. For more information see Annex II. The Q-factor for the EPHECT data was in general set at 4, given the high number of survey participants from different EU countries and recentness of the study.

5.2 AISE surveys

The International Association for Soaps, Detergents and Maintenance Products (AISE) and the Committee of the European Chemical Industry Council (CEFIC) conducted a survey in 2002 in order to collect data on the habits and practices of European consumers in using cleaning agents. The data delivered by AISE refer to the use of laundry detergents, fabric conditioners, laundry additives, dishwashing agents, surface cleaners and toilet cleaners. Summary results of the survey are reported as minimal, maximal and typical frequencies, used amounts and task durations within the HERA (Human and Environmental Risk Assessment) Project in 2002 and published in 2005 (HERA, 2005). Defaults in the previous version of the Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) that refer to the AISE table of habits and practices (AISE, 2002) are used again in this version if more appropriate information has not become available since.

Additional data were collected by AISE in 2009 for laundry aids, insecticides, water softeners, maintenance products, wipes, drain granules, high-pressure washers/cleaners and air-fresheners. The summary results for these products are available on the website of AISE (AISE, 2009, 2014) and are used in this Fact Sheet to derive new defaults. Besides the quantitative information collected in 2002 and 2009, AISE has also performed a qualitative survey every three years since 2008 (AISE, 2015). In this survey it is questioned whether consumer awareness of environmental sustainability leads to adapted behaviour in the use of cleaning agents. However, the data from this survey are not presented in quantitative way (AISE, 2015) and are therefore less suitable for deriving new defaults referring to habits and practices of European consumers in using cleaning agents.

5.3 Consumer information websites

In addition to data from recent projects as mentioned above, new and relevant information was taken from the official consumer information websites of industrial and governmental organizations.
Product information such as the ingredients and compositions of laundry and dishwashing detergents, as well as surface cleaning agents was collected from www.isditproductveilig.nl. This website is an initiative of the Dutch Association of Soap Manufacturers (NVZ) to inform consumers about the safe use of cleaning products.
The website www.cleanright.eu also shares ingredient and composition information of laundry, dish and household cleaning and maintenance products. Cleanright (2016) is a service provided to consumers to help them understand the broad range of cleaning and maintenance products available on the consumer market. The website is an initiative of the two European industry associations AISE and CEFIC.
The American Cleaning Institute's website www.cleaninginstitute.org provides composition and ingredient information on cleaning products as well as relevant contextual information about the function and chemical structures of these ingredients (ACI, 1994).

5.4 Experimental evaluation of critical parameters of the ConsExpo spray model

A series of experiments on propellants and trigger sprays was performed in 2009 in order to validate and calibrate the spray models included in ConsExpo (Delmaar & Bremmer, 2009). Two critical exposure parameters for spray products are the mass generation rate of the product, and the size distribution of the generated particles. These parameters have been experimentally determined for 23 spray cans and trigger sprays. Mass generation rates were determined by spraying for 10 seconds (spray cans) or squeezing 10 times (trigger spray; squeezing 10 times takes approximately 6 seconds in total) and determining the weight loss of the spray.

Particle size distributions were determined by light scattering experiments using the Mastersizer S (Delmaar & Bremmer, 2009). The study included products from different product groups including pest-control products, personal care products, cleaning products and paints. Information from the experiments is used to derive defaults for mass generation rates and particle size distributions (mean diameters and

their standard deviations) for aerosol spray cans and trigger sprays for the different product categories.
The default mass generation rates described in the Fact Sheets generated in 2006 were updated in 2010 in ConsExpo 4.1, based on the experimental measurements of Delmaar & Bremmer (2009).

In the previous version of the Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) mass generation rates of sprays are defined as the mean mass generation rate over the total time span of the spraying task. These 'total time span mass generation rates' were updated in 2010 by averaging the mass generation rates of Delmaar & Bremmer (2009) over the total time span of the spraying task (RIVM, 2010). In the current version of the Cleaning Products Fact Sheet a different approach is adopted: 'total time span mass generation rates' are replaced by 'net mass generation rates'. In contrast to the 2006 Cleaning Products Fact Sheet, the mass generation rate is now defined as the mass generated during the net spraying time. Using this definition, the (net) mass generation corresponds directly to the generation rates determined in the experiments described in Delmaar & Bremmer (2009) (Annex I Table A2).

5.5 The ETH survey on the use of different consumer products

The Federal Technical University (ETH) of Zürich conducted a survey in Switzerland to assess consumer usage patterns (Garcia-Hidalgo et al., 2017). The use-patterns of 12 household care products, 5 laundry products, and 22 personal care products were collected among the Swiss population (n =759; ages 0–91) by postal questionnaire. The survey was designed to collect data with respect to the use frequency, quantity, duration, habits, and co-uses of household and personal care products. Based on the summary data of this study, 75th percentiles are derived and used in the current Fact Sheet for the frequency and duration of consumer use of various products. Examples are hand-wash laundry and dishwashing detergents, as well as all-purpose, toilet, kitchen, bathroom, carpet, glass, floor and furniture cleaners. The 75th percentiles are derived from the data tables that express the percentages of the multiple choice answer per sex and age group. The number of respondents for each subgroup is also given, which enables the recalculation of the percentage and thus percentiles for the adults of the survey population (n=611). The 75th percentiles derived for the current fact sheet should be interpreted as the multiple choice answer that the respondent reflecting the 75th percentile would declare. For some products it is clear that there is a distinction between respondents that never use the product (non-users) and respondents that use the product regularly. For these products (kitchen, bathroom and glass cleaners) the non-users are excluded in the calculation of the 75th percentile.

5.6 Other

Information from other sources leading to reconsideration of specific defaults is discussed above the respective tables presenting the default values, where applicable.

6 Laundry products

Laundry products are detergents for cleaning fabrics. The products can be distinguished on the basis of their function, e.g. all-purpose or light-duty detergents. All-purpose detergents are suitable for all washable fabrics, while light-duty detergents are designed for lightly soiled items and delicate fabrics. Many detergents are concentrated and are available in much smaller packages, as less detergent is needed for the same cleaning process.

Laundry detergents are available as powders/granules, liquids (including single unit dose liquid laundry detergent packets), tablets, gels, sticks, aerosol sprays and pump sprays. Exposure to substances in laundry products can occur through:

- Inhalation of detergent dust, aerosols or inhalation of volatile compounds.
- Direct dermal contact with undiluted or diluted laundry products.
- Indirect dermal contact via release of chemicals from fabric to the skin.

Laundry detergent powders
Detergent powders are used to facilitate the manual or mechanical washing of clothing with water. Loading a washing machine (or bucket) with laundry powder is executed either by pouring straight from the package or by using a measuring spoon. Both methods lead to the generation of dust particles and consequentially to both inhalation and dermal exposure. Table 6.1 gives an overview of the general composition of laundry detergent powders.

Table 6.1: General composition of laundry detergent powders (www.isditproductveilig.nl)

Laundry detergent powders	All-purpose % (w/w)	Colour % (w/w)	Delicate % (w/w)
Surfactants			
Anionic	5–10	5–15	10–20
Non-ionic	±5	5–10	1–10
Amphoteric	–	–	0–2
Builders			
Alkalis			
- Sodium carbonate	5–30	5–25	10–50
- Sodium silicate	<10	5–10	<5
Ion exchangers			
- Zeolite	25–35	20–40	15–60
- Polycarboxylate	0–5	0–5	1–5
Complexing agents			
- Citric acid / citrate	0–5	0–10	0–10
- Phosphonates	0–0.5	0–0.5	–
Bleaching agents			
Sodium perborate/percabonate	5–15	–	–
TAED	2–6	–	–
Additives			

Laundry detergent powders	**All-purpose % (w/w)**	**Colour % (w/w)**	**Delicate % (w/w)**
Optical brighteners	0.1–0.2	–	–
Dye transfer inhibitors	–	0.5–2	0.5–2
Sodium sulphate	<5	<5	2–40
Enzymes	<2	<2	0–2
Anti-redeposition agents	0–2	0–2	0–2
Foam inhibitors	0–0.1	0–0.1	0–0.1
Fragrances	0–1	0–1	0–1
Dyes	0–0.1	0–0.1	0–0.1

Laundry detergent liquids
Like powders, detergent liquids are used to facilitate the manual or mechanical washing of clothing with water. Loading a washing machine/bucket/sink with a laundry liquid is executed either by pouring straight from the bottle or by using a measuring cup. During loading with laundry liquids, spills may occur that may lead to dermal exposure and inhalation exposure of volatile substances. Table 6.2 gives an overview of the general composition of laundry detergent liquids.

Table 6.2: General composition of laundry detergent liquids (www.isditproductveilig.nl ; P&G, 2014)

Laundry products liquids	**All-purpose % (w/w)**	**Colour % (w/w)**	**Delicate % (w/w)**	**Single unit - dose packets % (w/w)**
Surfactants				
Anionic	5–25	5–25	0–25	>30 %
Soap	5–25	5–25	0–5	5–15%
Non-ionic	5–30	5–30	10–20	5–15 %
Builders				
Alkalis				
- Sodium carbonate	0–1	0–1	–	
Ion exchangers				
- Polycarboxylate	–	–	0–5	
Complexing agents				
- Citric acid / citrate	3–5	3–5	0–1	
- Phosphonates	0–1	0–1	–	<5%
Solvents				
Alcohol	1.5–10	1.5–10	0–15	
Additives				
Optical brighteners	0–0.1	–	–	<5%
Dye transfer inhibitor	–	0–1	0–1	
Enzymes	<2	<2	0–2	<5%
Preservatives	0.1	0.1	<1	
Thickening agents	–	1–5	1–5	
Foam inhibitors	0.1	0.1	–	
Fragrances	0–1	0–1	0–1	<5%
Dyes	0–0.1	0–0.1	0–0.1	
Water	rest	rest	rest	rest

Single unit -dose packets
The latest development in laundry detergents is single-dose liquid laundry detergent packets, tablets and capsules. They are designed for one machine wash and need to be placed in the dishwashing machine. Dermal exposure may occur during the removal of the foil wrapped around the tablet. Plastic wrapping foils must sometimes be removed, but most foils are water-soluble. Exposure from tablet/capsule use during mixing and loading is therefore considered negligible, because it is a ready-to-use product (see 4.1.3). Furthermore, no exposure is expected during the application phase, because the product is in an enclosed machine, whereas secondary exposure from migration to fabric is considered generic (see 4.3.3). Therefore, specific exposure from laundry detergent tablet/capsules is not further discussed in this chapter.

Conditioners
Fabric conditioners are used to soften fabrics after washing. In addition, they prevent synthetic fabrics from becoming statically charged and ease ironing. They often give a pleasant scent to the washed fabric. Fabric conditioners can be purchased as ready-to-use liquids or as wet wipes. Laundry detergents with built-in conditioners (two-in-one products) are also available. The softening substances most commonly used are bentonite and cellulase. Exposure is considered similar to exposure to substances in laundry liquids used in washing machines. Table 6.3 gives an overview of the general composition of fabric conditioners.

Table 6.3 General composition of fabric conditioners (www.isditproductveilig.nl)

Fabric conditioners	% (w/w)
Surfactants	
- Cationic	<25
- Non-ionic	0-4
Solvents	
- Alcohol	0–2.5
Additives	
Preservatives	<1
Dyes	0–0.1
Fragrances	<1
Water	Rest

6.1 Washing machine detergents

Scenarios for consumer exposure

The exposure scenarios of laundry detergent powders and liquids deviate from each other only with respect to the loading of the product in the washing machine (4.1.1. vs. 4.1.2). Filling the washing machine with laundry powder may lead to the generation of inhalable aerosols that may also deposit on the skin (4.1.1). Upon loading the washing machine with a liquid detergent, the consumer pours the liquid directly into the machine or fills a measuring cup, which is then placed or emptied into the machine. Inhalation exposure is expected during the opening of the bottle containing the liquid, since volatile substance may evaporate into the consumer’s breathing zone. Additionally, in the case of the pouring of liquids, spills (droplets) end up on the back of the hand directing the bottle to the machine (4.1.2). Further, the exposure scenarios for liquid and powder laundry detergents are considered to be similar, with respect to their use frequency and location of exposure. Exposure during the application phase is assumed to be negligible for machine washing, because the product powder or liquid is in an enclosed machine. After washing, the consumer hangs the laundry up to dry. The consumer is then dermally exposed by touching wet clothes that contain residues of the laundry product. Volatile substance may evaporate from the wet clothes as well, leading to inhalation exposure. Once the clothes are dry, there is still residue left on the clothes. Secondary exposure is expected for adults and children through wearing machine-washed clothes with laundry product residues that migrate from the fabric to the skin.

6.1.1 *Mixing and loading: concentrated and regular machine-washing powder*

The aerosol exposures from loading laundry detergent powders are estimated using the ***inhalation–exposure to spray–instantaneous release*** model and the ***dermal direct product contact–constant rate loading*** model (4.1.1). Defaults for the parameters: exposure duration, release duration, product amount for inhalation exposure, room volume and dermal contact rate are according to the generic scenario for loading powders (4.1.1).

Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 365 times per year. Data from the US-EPA (1989) indicates a frequency of 0.22 to 1.90 times per day (weighted mean of 1.32 per day) based on their national human exposure assessment survey. AISE (2015) indicates that the estimate derived from survey data in 2002 (AISE, 2002) matches more recent information on the typical frequency of washing machine as 5 times per week (range between 1 and 21 times per week). Kruschwitz et al. (2014) present a detailed graph for washing frequencies for German households consisting of 1 to 5 persons and more than 5 persons. The average frequencies for the two groups were 5.3 and 6.8 times per week, respectively. Laitala et al. (2012) present washing frequencies for Norwegian households with an average of 8.3 per week for a 4-person household.
A default value of once a day seems to represent a reasonable estimate that agrees with all of the different data sources. Therefore the default of 365 per year remains unaltered.
A Q-factor of 4 is set because the default is based on underlying data from multiple sources that are extensive and specifically refer to the frequency of laundry tasks.

Released mass

According to section 4.1.1, the inhalation default for powder dust is 8.3 µg per 200 g used. According to AISE (2002), the amount of washing powder per wash event varies between 20 and 290 g, whereas the typical amount used for regular laundry powder is 150 g (75 g for concentrated powder). Kruschwitz et al. (2014) present averages ranging from 64 to 74 g of powder. A higher amount of 150 g per task, however, is more conservative but still reasonable. The default released mass for regular powders is therefore adjusted to 6.2 µg based on a loading of 150 g, whereas the default for concentrated powders is adjusted to 3.2 µg based on a loading of 75 g. The Q-factor is set to 1, because the different data sources do not agree with each other.

Table 6.4: Default values for estimating consumer exposure to regular and concentrated machine-washing powder from mixing and loading

Default value		Q-factor	Source
General			
Frequency	365 per year	4	AISE, 2002, 2015; Kruschwitz et al., 2014; Laitala et al., 2012; US-EPA, 1989
Inhalation–exposure to spray–instantaneous release			
Exposure duration	0.25 min	3	Section 4.1.1
Released mass			
- Regular powder	6.2 µg	1	See above
- Conc. powder	3.1 µg	1	See above
Room volume	1 m^3	1	Section 4.1.1
Ventilation rate	0.6 per hour	3	Unspecified room (Te Biesebeek et al., 2014)
Dermal–direct product contact–constant rate loading			
Exposed area	225 cm^2	3	One palm (Te Biesebeek et al., 2014)
Contact rate	2.8 mg/min	2	Section 4.1.1
Release duration	0.25 min	3	Section 4.1.1

6.1.2 *Mixing and loading: concentrated and regular machine-washing liquid detergents*

For exposure estimation during the loading of liquids for machine washing the ConsExpo ***inhalation–exposure to vapour–evaporation–constant release area*** model and the ***dermal–direct product contact–instant application loading*** model are used (4.1.2). Defaults for the parameters: product amount for inhalation and dermal exposure, room volume, release area, exposed area and mass transfer coefficient are according to the generic scenario for loading liquids (4.1.2). As described in the scenario, the use frequency of laundry detergent liquids is considered equal to that of powders. The defaults derived below refer to the loading of laundry detergent liquids and apply to regular as well as concentrated liquids.

Emission duration

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 0.27 min, based on the 75th percentile for filling a dishwashing machine with a polishing liquid (Weegels, 1997). During this activity, the consumer pours the product into a small box located inside the machine. Filling a cup with liquid laundry detergent is considered to be a similar activity. The default application duration is therefore set at 0.3 min. The Q-factor is 3, because it is derived from quantitative data that are not specific to loading liquids in a washing machine.

Exposure duration

Exposure duration is considered here to be the time required to fill a cup with laundry detergent liquid and to empty the cup into the machine. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 0.75 min as the maximal exposure duration for filling a dishwasher, based on Weegels (1997). AISE (2002) presents the task as ‘less than 1 minute’, which seems be in agreement with the previous. The default remains 0.75 min. The Q-factor is 3, because it is derived from quantitative data that are not specific to loading liquids in a washing machine.

Molecular weight matrix
In the previous Cleaning Products Fact Sheet (Prud’homme de Lodder et al., 2006a) the fraction of water in the liquid is estimated to be 20%. No new data were found (Table 6.2), so the default for molecular weight matrix remains at 18 / 0.2 = 90 (g/mol). The Q-factor is set to 2, because the supporting data are limited.

Table 6.5: Default values for estimating consumer exposure to regular and concentrated machine-washing liquid detergents from mixing and loading

Default value		**Q-factor**	**Source**
General			
Frequency	365 per year	4	Section 6.1.1
Inhalation–exposure to vapour–evaporation–constant release area			
Exposure duration	0.75 min	3	Weegels, 1997
Product amount	500 g	2	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	0.6 per hour	1	Unspecified room (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Emission duration	0.3 min	3	Section 4.1.2
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2.1
Molecular weight matrix	90 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area			
- Direct pouring	225 cm^2	2	Section 4.1.2
- Pouring with caps	53 cm^2	2	Section 4.1.2
Product amount			
- Direct pouring	0.01 g	3	Section 4.1.2
- Pouring with caps	0.53 g	3	Section 4.1.2

6.1.3 *Application: hanging machine-washed laundry*
Exposure to laundry products from hanging machine-washed laundry is estimated using the ***dermal–direct product contact–instant application*** model and the ***inhalation–exposure to vapour–evaporation–increasing release area*** model. Note that the evaluation of inhalation exposure here is relevant only to volatile substances.

Application duration
The application duration is considered here to be the time required to hang the laundry out. A typical wash load consists of 17 items (Menon & Porteous, 2011). The default application duration is set to 17 min,

assuming it takes 1 min to hang up 1 item. The Q-factor is set to 1, because the default is largely based on expert judgement.

Exposure duration
The results of a Scottish survey indicated that in ‘almost all social housing types there is a lack of dedicated drying spaces, utility rooms or other potentially suitable spaces in which to dry clothes passively (Menon & Porteous, 2011).’ From this statement it is derived that it is plausible for a consumer to reside in an unspecified room where laundry is passively drying. Therefore, the default exposure duration is set to 240 min (4 hours). The Q-factor is set to 1, because the residence time of the consumer in the room is based on expert judgement.

Amount of solution used and dilution times
The amount of solution used that is subject to evaporation is calculated as the amount of solvent and product that is in the wet laundry after washing. This calculation is performed with the amount of laundry product inserted in the washing machine, the volume of water in wet laundry as well as the volume of water a washing machine uses per wash event. A standard washing machine uses approximately 50 l water per wash event (Milieu Centraal, 2017). A wash event with a machine consists of 3 cycles (2 wash and 1 rinsing), so that about 17 l is used per cycle (Miele, 2016). During each cycle, about 5 l of the water remains in the fabric. This 5 l is estimated from the dimensions of the condenser drawer in a tumble dryer (Parts.nl, 2017). Consequently, 12 l water remains in the machine per cycle. The concentration of product in the water held in the wet fabric is equal to the concentration of product in the washing water, so that:

$$\frac{g_{product\ (wm)}}{l_{water(wm)}} = \frac{g_{product(tex)}}{l_{water(tex)}}\text{ , and } g_{product(tex)} = g_{product\ (wm)}\frac{l_{water(tex)}}{l_{water(wm)}}$$

The amount of laundry detergent product in the wet fabric ($g_{product(tex)}$) is thus calculated as the amount of laundry product inserted in the washing machine ($g_{product(wm)}$) multiplied by the ratio between the volume (*l*) of water in the wet fabric ($l_{water(tex)}$) and the volume of water (*l*) used in the washing machine ($l_{water(wm)}$). Using the equation above to calculate the product amount that remains in the fabric after 3 cycles gives 3.8 g for regular powder (Table 6.6).

Table 6.6: Calculation of laundry detergent amount in fabric and machine-washing water per cycle

Cycle	Product amount (total)	Concentration in machine water	Product amount in machine water	Product amount in fabric
1	150 g	150 g/17 l =8.82 g/l	12 l x 8.82 g/l = 106 g	5 l x 8.82 g/l = 44 g
2	44 g	44 g/17 l = 2.59 g/l	12 l x 2.59 g/l = 31 g	5 l x 2.59 g/l = 13 g
3	13 g	13 g/17 l =0.77 g/l	12 l x 0.77 g/l = 9.2 g	5 l x 0.77 g/l = 3.8 g

The residual amount of product in the fabric after a machine wash calculated in Table 6.6 refers to a use amount of 150 g of regular powder. The residual product amounts for the different types of laundry detergents are calculated with the same approach and summarized in table 6.7. These residual amounts are not greater than 1% of the solvent amount, which is in this case the 5 l of water in the wet fabric. Therefore, the default amount of solution used is set equal to the solvent amount of 5 kg. Furthermore, dilution refers to the number of times the product is diluted in water (4.2.3). In this scenario the product amount refers to the residual amount of laundry detergent after the third cycle in the washing machine. The number of dilution times is then calculated by dividing the amount of solution used by this residual product amount (Table 6.7).

Table 6.7: Calculation of the amount of solution used and dilution times for different laundry detergent types

Laundry detergent type	Amount inserted in washing machine	Residual amount after machine wash	Dilution (times)
Regular powder	150 g	3.8 g	1300
Concentrated powder	75 g	1.9 g	2600
Regular liquid	150 g	3.8 g	1300
Concentrated liquid	90 g	2.3 g	2200
Tablet[1]	75 g	1.9 g	2600
Capsule[2]	90 g	2.3 g	2200

1: Assumed equal to concentrated powder
2: Assumed equal to concentrated liquid

All Q-factors for the derived defaults for amount of solution used and dilution are set to 2, because the supporting quantitative data are limited.

Release area
A typical wash load contains 5 kg of laundry (Menon & Porteous, 2011). The specific surface area of cotton is about 20 cm^2 per g, so that 1 m^2 of fabric weighs about 0.5 kg (Corea et al., 2006) and the area of 5 kg laundry is about 10 m^2. The specific surface area includes both sides of the fabric, from which volatile substances may evaporate while hanging to dry. Hence, the default release area is calculated to be 10 m^2. The Q-factor 2 is, because the data underlying the calculation are limited to cotton.

Exposed area
Both hands of the consumer are in full contact with the wet laundry. The exposed area is thus calculated as 2 x 450 cm^2 (Te Biesebeek et al., 2014), which is equal to 900 cm^2. The Q-factor is set to 3, because the dataset provides sufficient quantitative data for the estimation of the size of one palm.

Product amount dermal
The product amount subject to dermal exposure is calculated by multiplying the concentration of detergent in the water sorbed by the textile (0.77 g/l, see Table 6.6) by the volume of water that ends up on the hands of the consumer. The volume of water on the hands is 9 ml, which is calculated by multiplying the exposed area of both hands (900 cm^2) by a layer thickness of 0.01 cm (4.1.2). The calculated product amount that is subject to dermal exposure for different types of laundry detergents is summarized in Table 6.8.

Table 6.8: Calculated product amount subject to dermal exposure for different laundry detergents

Laundry detergent	Amount inserted in washing machine	Product amount subject to dermal exposure
Regular powder	150 g	6.9 mg
Concentrated powder	75 g	3.5 mg
Regular liquid	150 g	6.9 mg
Concentrated liquid	90 g	4.2 mg
Tablet[1]	75 g	3.5 mg
Capsule[2]	90 g	4.2 mg

1: Assumed equal to concentrated powder
2: Assumed equal to concentrated liquid

The Q-factors are set to 2, because the supporting quantitative data are limited.

Table 6.9: Default values for estimating consumer exposure to laundry detergents from hanging out machine-washed laundry

Default value		Q-factor	Source
General			
Frequency	365 per year	4	Section 6.1.1
Inhalation–exposure to vapour–evaporation–increasing release area			
Exposure duration	240 min	1	See above
Amount of solution used	5000 g	2	See above
Dilution (times)			
- Regular powder	1300	2	See above
- Concentrated powder	2600	2	See above
- Regular liquid	1300	2	See above
- Concentrated liquid	2200	2	See above
- Tablet	2600	2	See above
- Capsule	2200	2	See above
Room volume	20 m^3	4	Unspecified room (Te Biesebeek et al., 2014)
Ventilation rate	0.6 per hour	3	Unspecified room (Te Biesebeek et al., 2014)
Release area	10 m^2	2	See above
Application duration	17 min	1	See above
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water
Dermal–direct product contact–instant application loading model			
Exposed area	900 cm^2	3	Both hands (Te Biesebeek et al., 2014)
Product amount			
- Regular powder	6.9 mg	2	See above
- Concentrated powder	3.5 mg	2	See above
- Regular liquid	6.9 mg	2	See above
- Concentrated liquid	4.2 mg	2	See above
- Tablet	3.5 mg	2	See above
- Capsule	4.2 mg	2	See above

6.1.4 *Post-application: migration from fabric*

For estimating secondary exposure the ConsExpo ***dermal–direct product contact–migration*** model is used (Delmaar & Schuur, 2016). Defaults for the parameters: product amount and skin contact factor are according to the generic scenario for migration of residues from fabric (4.3.3). The leachable fraction is discussed below. Note that the evaluation of secondary exposure is not relevant to (non-encapsulated) volatile substances, because these would have evaporated by the time the fabric was hung out to dry.

Product amount – children by age group

Product amount is interpreted here as the weight of the clothes worn by the exposed individual (4.3.3). In order to account for the body size of different age groups it is assumed that the weight of the clothes worn is proportional to the area of fabric that is in contact with the skin, i.e. the exposed area (see below). The exposed area of an adult is 1.71 m^2 and product amount 1 kg, so that the specific product amount per surface area is 0.58 kg/m^2. Therefore, the default product amounts per age group are calculated by multiplying the exposed areas per age group (see below) by 0.58 kg/m^2 (Table 6.10). The Q-factors are set to 1, because the quality of the original data is compromised by the rather crude assumption of linearity between exposed area and product amount.

Table 6.10: Exposed area and derived product amount of clothes worn in different age groups

Age group	Exposed area	Product amount
3–6 months	0.26 m^2	153 g
6–12 months	0.30 m^2	178 g
12–18 months	0.36 m^2	212 g
1.5–3 years	0.37 m^2	221 g
3–6 years	0.57 m^2	336 g
6–9 years	0.69 m^2	403 g
9–14 years	1.11 m^2	647 g
15–18 years	1.41 m^2	830 g

Leachable fraction

The leachable fraction is interpreted here as the fraction of a substance in a laundry product that is able to leach from clothes to the skin of the person wearing them. The leachable fraction is calculated by multiplying the residual amount in clothes by the fraction of the product that is liable to migrate to the skin. The residual amount is equal here to the amount of product in the clothes at the moment they are taken out of the washing machine. In the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) it was assumed that 50% of the residual amount in clothes is liable to migrate to the skin of the person wearing them. Corea et al. (2006), however, deduced as a worst-case estimate, on the basis of their personal communications with laundry detergent producers, that 10% of the residues on a washed fabric can migrate from clothes to skin. Since the source of their data was accepted for publication in scientific literature, it is applied in the calculation of a new default for the leachable fraction. Hence, the calculation of the leachable fraction for regular powders is:

$$FR_{leach(regular\ powders)} = \frac{g_{product(tex)}}{kg_{textile}} FR_{migration} \times W_f$$
$$= \frac{3.8}{5} \times 10\% = 0.076\, g/kg \ \times W_f$$

Note that this 0.076 g/kg refers to the leachable fraction of the entire laundry product. Hence, for evaluation of one substance in the product, the leachable fraction should be multiplied by the weight fraction of the substance in the product. Table 6.10 gives an overview of the leachable fractions of all types of laundry detergents derived with the above approach. The Q-factors are set to 1, since they strongly depend on expert opinion of migration rates, even though these were directly communicated by laundry detergent producers to Corea et al. (2006).

Table 6.11: Leachable fraction per type of machine-washing laundry detergent

Detergent	Amount used per machine wash	Residual amount in textile	Leachable Fraction
Regular powder	150 g	3.8 g	0.076 g/kg x W_f
Concentrated powder	75 g	1.9 g	0.038 g/kg x W_f
Regular liquid	150 g	3.8 g	0.076 g/kg x W_f
Concentrated liquid	90 g	2.3 g	0.045 g/kg x W_f
Tablet[1]	75 g	1.9 g	0.038 g/kg x W_f
Capsule[2]	90 g	2.3 g	0.045 g/kg x W_f

1: Assumed equal to concentrated powder
2: Assumed equal to concentrated liquid

Exposed area – adults
The exposed area is 1.7 m^2, which equals the entire surface area of an adult human body minus head and hands (Te Biesebeek et al., 2014). It is not necessary to correct the value for the parts of the human body that are not covered with clothes, because this is already done in the derivation of the skin contact factor (4.3.3). The Q-factor is set to 4 based on the quantitative data in the General Fact Sheet (Te Biesebeek et al., 2014).

Exposed area – children by age group
The exposed area for children in different age groups is calculated from the default body areas minus the areas of hands and head presented in the General Fact Sheet (Te Biesebeek et al., 2014). The Q-factors are set to 3 in accordance with the General Fact Sheet.

Table 6.12: Default values for estimating consumer exposure to machine-washing laundry detergents for post-application migration of residues from fabric

Default value		**Q-factor**	**Source**
General			
Frequency	365 per year	4	Every day
Dermal–direct product contact–migration			
Exposed area			
- Adults	1.7 m^2	4	See above
- 3–6-month-olds[1]	0.26 m^2	3	See above
Product amount			
- Adults	1 kg	2	Section 4.3.3
- 3–6-month-olds[1]	153 g	1	See above
Leachable fraction			
- Regular powder	7.6 x 10^{-5} x Wf	1	0.076 g/kg x Wf (See above)
- Conc. powder	3.8 x 10^{-5} x Wf	1	0.038 g/kg x Wf (See above)
- Regular liquid	7.6 x 10^{-5} x Wf	1	0.076 g/kg x Wf (See above)
- Conc. liquid	4.5 x 10^{-5} x Wf	1	0.045 g/kg x Wf (See above)
- Tablet	3.8 x 10^{-5} x Wf	1	0.038 g/kg x Wf (See above)
- Capsule	4.5 x 10^{-5} x Wf	1	0.045 g/kg x Wf (See above)
Skin contact factor	0.8	1	Section 4.3.3

1: The defaults for 3–6-month-olds are included here, because this is the age group for which dermal exposure from migration is anticipated to be the highest; they are calculated by relating their exposed area (0.26 m^2) and body weight (6.1 kg) to the product amount (153 g).

6.2 Hand-washing laundry detergents

Scenarios for consumer exposure

Hand washing is performed for clothes that are too delicate for machine washing. Therefore, it is done less frequently than machine washing. The exposure scenario starts with loading the liquid or powder detergent into a container. The scenarios for estimating the exposure while loading these powders or liquids are in accordance with the respective generic scenarios (4.1.1 and 4.1.2). After the detergent is added to warm water (40° C), clothes are immersed in the washing water that contains the diluted product. The exposure that the consumer is subjected to during this application phase is in accordance with the generic scenario for application of diluted products (4.2.3). After washing, the consumer wrings the wet clothes and hangs them out to dry. It is assumed that the consumer stays in the room while the clothes are drying. Furthermore, it is expected that dermal exposure from wringing the clothes is negligible compared with the dermal exposure from that occurs while washing. Any exposure from wringing and drying the clothes is thus not further considered in the exposure scenario. Secondary exposure from wearing the clothes is expected as substances may migrate from the clothes to the skin of the consumer. Such secondary exposure is in accordance with the generic scenario for migration from textile (4.3.3).

Frequency
Hand washing is mostly performed for clothes too delicate to be washed with the machine and is done less frequently than machine washing. Results from the Norwegian survey by Laitala et al. (2012) show that a 75^{th} percentile matches ‘1–2 cycles per month’ for washing delicate

laundry that requires either a hand wash programme in the washing machine or an actual hand wash. The survey by Garcia-Hidalgo et al. (2017) shows a 75th percentile of ‘every week’ among respondents asked how often they performed a hand wash. Hence, the surveys of Garcia-Hidalgo et al. (2017) and Laitala et al. (2012) do not match each other. Nonetheless, a new default of 52 times per year is selected based on the data of Garcia-Hidalgo et al., which comprise a higher number of respondents and is therefore the conservative choice. The Q-factor is set to 4, because the default is based on large datasets specifically set up to measure the frequency of performing a hand wash.

6.2.1 *Mixing and loading: concentrated and regular hand-washing powder*

The exposure estimation for loading powders during hand washing is in accordance with the generic scenario described in section 4.1.1. Hence, inhalation exposure is estimated using the ConsExpo ***inhalation–exposure to spray–instantaneous release*** model, and the ***dermal direct product contact–constant rate loading*** model is used to estimate dermal exposure. Defaults for the parameters: exposure duration, release duration, product amount (inhalation), room volume and dermal contact rate are according to the generic scenario for loading powders (4.1.1). Defaults for the parameters: product amount (dermal) and ventilation are assumed to be the same as for machine washing (6.1.1).

Table 6.13: Default values for estimating consumer exposure to concentrated and regular hand-washing powder from mixing and loading

Default value		**Q-factor**	**Source**
General			
Frequency	52 per year	4	Garcia-Hidalgo et al., 2017
Inhalation–exposure to spray–instantaneous release			
Exposure duration	0.25 min	3	Section 4.1.1
Released mass			
- Regular powder	6.2 µg	1	Section 6.1.1
- Conc. powder	3.1 µg	1	Section 6.1.1
Room volume	1 m^3	1	Section 4.1.1
Ventilation rate	0.6 per hour	1	Unspecified room (Te Biesebeek et al., 2014)
Dermal–direct product contact–constant rate loading			
Exposed area	225 cm^2	3	Section 6.1.1
Contact rate	2.8 mg/min	2	Section 4.1.1
Release duration	0.25 min	3	Section 4.1.1

6.2.2 *Mixing and loading: concentrated and regular hand-washing liquid*

The exposure estimation for loading liquids for hand washing is in accordance with the generic scenario described in section 4.1.2. Hence, inhalation exposure is estimated using the ***inhalation–exposure to vapour–evaporation–constant release area*** model, and the ***dermal–direct product contact–instant application loading*** model is used to estimate dermal exposure. Defaults for the parameters: product amount for inhalation and dermal exposure, room volume, release area and exposed area are according to the generic scenario for loading liquids (4.1.2). Defaults for the parameters: product amount (dermal), ventilation rate, exposure duration and molecular weight matrix are assumed to be the same as for machine washing (6.1.2). Furthermore, the derived defaults apply to the mixing and loading of both concentrated and regular hand-washing detergent liquids.

Table 6.14: Default values for estimating consumer exposure to concentrated and regular hand-washing liquids from mixing and loading

Default value		**Q-factor**	**Source**
General			
Frequency	52 per year	4	Garcia-Hidalgo et al., 2017
Inhalation–exposure to vapour–evaporation–constant release area			
Exposure duration	0.75 min	3	Section 6.1.2
Product amount	500 g	3	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	0.6 per hour	1	Unspecified room (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Emission duration	0.3 min	3	Section 4.1.2
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	90 g/mol	2	Section 6.1.2
Dermal–direct product contact–instant application loading			
Exposed area			
- Direct pouring	225 cm^2	2	Section 4.1.2
- Pouring via cap	53 cm^2	2	Section 4.1.2
Product amount			
- Direct pouring	0.01 g	3	Section 4.1.2
- Pouring via cap	0.53 g	2	Section 4.1.2

6.2.3 *Application: hand washing laundry*

During the hand washing of clothes, the hands and forearms are submerged in water, and volatiles evaporate from the water. The expected dermal and inhalation exposure is estimated in accordance with the generic scenario for application of diluted products (4.2.3). Hence, the ConsExpo ***inhalation–exposure to vapour–evaporation–constant release*** model and the ***dermal–direct product contact–instant application loading*** model are used. Defaults for the parameters: release area, product amount for inhalation and dermal exposure, weight fraction and exposed area are according to the generic scenario for application of diluted product (4.2.3).

Emission and exposure duration

The duration of a laundry hand wash is 10 minutes, according to AISE (2002). The survey by Garcia-Hidalgo et al. (2017) shows a 75th percentile of ‘10 minutes’ for the duration of performing a hand wash task. After the hand wash, the laundry is left to dry and the consumer will empty the bucket. Consequently, the exposure duration is set equal to the emission duration. The default is set at 10 minutes. The Q-factor is set to 4, because the underlying datasets are large and the data were collected specifically to determine the duration of a hand wash.

Amount of solution used

The amount of solution used is defined as the sum of the solvent amount and the product amount. Here, the solvent amount refers to the amount of water that is in the container used to wash the clothes (15 kg). The amount of hand-washing detergent inserted in the bucket is not greater than 1% of the solvent amount. Therefore, the default amount of solution used is set equal to the solvent amount. The Q-factor is set to 2, because the calculations lack supporting by quantitative data.

Dilution (times)

The dilution in number of times is calculated as the inverse of the product concentrations of laundry detergent in the water in the container (Table 6.15). According to these concentrations, 8.8 g of regular powder is diluted in 1 l of water. Therefore, about 1 kg of solution contains about 8.8 g product, so that the dilution in times is 1000 g / 8.8 g = 110 times for regular powder. The default dilution of regular powders, concentrated powders, regular liquids and concentrated liquids are then calculated to be 110 times, 230 times, 110 times and 190 times, respectively (Table 6.15). The Q-factors are set to 2, because the calculation is not supported by quantitative data.

Product amount – dermal exposure

The product amount that is subject to dermal exposure is calculated by multiplying the product concentration in the water in the container by the volume of water that is in contact with exposed skin. The volume of water ending up on the exposed skin upon immersing the hands and forearms in the water is 22 ml (4.2.3). The concentration of product in the water in the container used for hand washing is assumed to be equal to the concentration in the water used for machine washing during the first cycle (Table 6.6). The volume of water in the container is 15 l (4.2.3) and the volume of water for machine washing per cycle is 17 l (6.1.3). According to AISE (2002, 2009), the weight fraction of hand-washing detergent in solution is 0.1–1% which is equal to a concentration of 1–10 g/l. This range is in agreement with the calculated concentrations (Table 6.15). Therefore, these concentrations are used to calculate the default product amounts that are subject to dermal exposure. All are assigned a Q-factor of 3, because they are supported by quantitative data with a margin of uncertainty of one order of magnitude.

Table 6.15: Calculated product amounts available for dermal exposure and dilution in number of times from concentrations of laundry hand wash detergent in the washing water

Detergent	Amount per wash (6.1.2) (g)	Concentration in washing water (g/l)	Product amount dermal (mg)	Dilution (times)
Regular powder	150	8.8	194	110
Concentrated powder	75	4.4	97	230
Regular liquid	150	8.8	194	110
Concentrated liquid	90	5.3	116	190

Table 6.16: Default values for estimating consumer exposure to hand-washing detergents during application

Default value		**Q-factor**	**Source**
General			
Frequency	52 per year	4	Garcia-Hidalgo et al., 2017
Inhalation–exposure to vapour evaporation–constant release			
Exposure duration	10 min	4	See above
Amount of solution used	15 kg	2	See above
Dilution (times)			
- Regular powder	110	2	See above
- Concentrated powder	230	2	See above
- Regular liquid-	110	2	See above
- Concentrated liquid	190	2	See above
Room volume	20 m^3	4	Unspecified room (Te Biesebeek et al., 2014)
Ventilation rate	0.6 per hour	3	Unspecified room (Te Biesebeek et al., 2014)
Release area	1500 cm^2	3	Section 4.2.3
Emission duration	10 min	4	See above
Application temperature[1]	40° C	3	Washing water
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water
Dermal–direct product contact–instant application loading			
Exposed area	2200 cm^2	3	Section 4.2.2
Product amount			
- Regular powder	0.194 g	3	See above
- Concentrated powder	0.097 g	3	See above
- Regular liquid	0.194 g	3	See above
- Concentrated liquid	0.116 g	3	See above

1: The vapour pressure of the substance should be adjusted to the application temperature of 40 °C.

6.2.4 *Application: hanging hand-washed laundry*

Exposure to laundry products from hanging out laundry is estimated using the ***dermal–direct product contact–instant application*** model and the ***inhalation–exposure to vapour–evaporation–increasing release area*** model. Note that the estimation of inhalation exposure is relevant only to volatile substances.

Product amount – dermal

The product amount subject to dermal exposure is calculated by multiplying the concentration of detergent in the hand-washing water by the volume of water that ends up on the hands of the consumer. The volume of water on the hands is 9 ml, which is calculated by multiplying the exposed area of both hands (900 cm^2) by a layer thickness of 0.01 cm (4.1.2). The calculated product amounts that are subject to dermal exposure are summarized for different types of laundry detergents in Table 6.17. The Q-factors are set to 2, because the data used in the calculations are limited.

Table 6.17: Calculated product amounts for dermal exposure

Detergent	Concentration in washing water (g/l)	Product amount – dermal (mg)
Regular powder	8.8	79
Concentrated powder	4.4	40
Regular liquid	8.8	79
Concentrated liquid	5.3	48

Table 6.18: Default values for estimating consumer exposure to laundry detergents during hanging-out of hand-washed laundry

Default value		Q-factor	Source
General			
Frequency	52 per year	4	Garcia-Hidalgo et al., 2017
Inhalation–exposure to vapour–evaporation–increasing release area			
Exposure duration	240 min	1	Section 6.1.3
Amount of solution used	5 kg	2	Section 6.1.3
Dilution (times)			
- Regular powder	110	2	Section 6.2.3
- Concentrated powder	230	2	Section 6.2.3
- Regular liquid	110	2	Section 6.2.3
- Concentrated liquid	190	2	Section 6.2.3
Room volume	20 m^3	3	Unspecified room (Te Biesebeek et al., 2014)
Ventilation rate	0.6 per hour	3	Unspecified room (Te Biesebeek et al., 2014)
Release area	10 m^2	2	Section 6.1.3
Application duration	17 min	1	Section 6.1.3
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water
Dermal–direct product contact–instant application loading			
Exposed area	900 cm^2	3	Both hands (Te Biesebeek et al., 2014)
Product amount			
- Regular powder	79 mg	2	See above
- Concentrated powder	40 mg	2	See above
- Regular liquid	79 mg	2	See above
- Concentrated liquid	48 mg	2	See above

6.2.5 *Post-application: migration from fabric*

The scenario for secondary exposure from migration of residues from hand-washed fabrics is expected to be similar to the secondary exposure to concentrated products used for machine washing of (6.1.2). For estimating secondary exposure the ConsExpo ***dermal–direct product contact–migration*** model is used (Delmaar & Schuur, 2016). The defaults for the parameters: frequency and exposed area are also similar to those in the scenario for secondary exposure from machine-washing laundry detergents (6.1.4).

Leachable fraction

It is assumed that the 5 l water absorbed by the fabric (6.1.3) and the 10% that represents the fraction of the product that is prone to migrate to the skin (Corea et al., 2006) are similar for hand and machine washing. The leachable fractions are therefore calculated with the same equation as for machine-washed clothes (6.1.4):

$$FR_{leach} = \frac{g_{product(tex)}}{kg_{textile}} FR_{migration} \times W_f$$

The resulting defaults are calculated as 0.00088, 0.00044, 0.00088 and 0.00053 x W_f for regular powder, concentrated powder, regular liquid and concentrated liquid, respectively. The Q-factors are set to 1, since they strongly depend on expert opinion of migration rates, even though these were directly communicated by laundry detergent producers to Corea et al. (2006).

Table 6.19: Default values for estimating consumer exposure to hand-washing laundry detergents from post-application migration of residues from fabric

Default value		**Q-factor**	**Source**
General			
Frequency	52 per year	4	Garcia-Hidalgo et al., 2017
Dermal–direct product contact–migration			
Exposed area			
- Adults	1.7 m^2	4	Section 4.3.3
- 3–6-month-olds	0.26 m^2	3	Section 6.1.4
Product amount			
- Adults	1 kg	2	Section 4.3.3
- 3–6-month-olds	153 g	1	Section 6.1.4
Leachable fraction			
- Regular powder	0.00088 x W_f	1	See above
- Conc. powder	0.00044 x W_f	1	See above
- Regular liquid	0.00088 x W_f	1	See above
- Conc. liquid	0.00053 x W_f	1	See above
Skin contact factor	0.8	1	Section 4.3.3

6.3 Pre-treatment

Besides detergents, certain laundry aids are used to improve washing (Smulders & Sung, 2012; www.isditproductveilig.nl). Laundry aids can be categorized as follows:

- Pre-treatment aids:
  - Laundry or water softeners with mainly builders such as polycarboxylates (10–15%) and zeolite (40–60%).
  - Pre-soaking products containing surfactants (10–15%), soap (10-15%) and enzymes (<5%).
  - Pre-wash soil and stain removers with solvents (3–80%), surfactants (0–15%) and enzymes (<5%).
- Boosters containing bleaching agents, e.g. sodium percarbonate (0-80%) or hydrogen peroxide (3–15%);
- After-treatment aids:
  - Fabric conditioners (see Section 3.3).
  - Starches, e.g. potato, rice, wheat, corn, and stiffeners for synthetic polymers.
  - Fabric formers, e.g. stiffeners based on a copolymer of polyvinylacetate (10–30%) with an unsaturated organic acid and additives such as polywax.
- Laundry dryer aids: sheets impregnated with conditioner.

In this section only spot removers are discussed. Spot removers are products with high surfactant content that are applied to soiled areas prior to washing. They are supplied as a liquid, as granules or in a spray application (Smulders & Sung, 2012).

Scenarios for consumer exposure

A consumer applies spot remover to the fabric to treat a stain. The spot remover is considered to be a ready-to-use product, so that no exposure from mixing and loading is expected (4.1.3). In the case of liquid and spray spot removers, the clothes are assumed not to be wetted before application. In the case of granule spot removers, however, the clothes are assumed to be pre-wetted with water. Next, the fabric that has been treated is rubbed between the palms of the hands to impregnate the dirt with spot remover, leading to direct skin contact with the product. In the case of spray spot removers, inhalation exposure is also expected from the spraying itself. While the treated fabric is left to soak, no exposure is expected because the consumer is assumed to leave the room. Afterwards the treated fabric is washed with other clothes in the washing machine or by hand.

Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default for the use of spot removers of 128 times per year, based on a survey by the US-EPA (1989). They give frequency values for laundry boosters (pre-soaking and pre-wash) that range from 22 to 300 times per year, with a weighted mean of 128 times per year. It is assumed that spot removers are used with a similar frequency to laundry boosters. The default is kept at 128 per year. The Q-factor is set to 2, because the original data of US-EPA (1989) are not recent and refer to laundry boosters instead of spot removers.

6.3.1 Application: treatment with spot remover granules and liquid

The ConsExpo ***dermal–direct product contact–instant application loading*** model is used to estimate dermal exposure to spot remover granules and liquid.

Product amount – spot remover liquid

For liquid spot removers, the product amount used for treating the fabric is 1.3 g (US-EPA, 1989). It is assumed that 50% of the product is absorbed by the treated fabric. The remaining 50% is caught between the surface of the fabric and the surface of the rubbing hand. The next assumption is that the product is equally distributed over the two surfaces. Hence, it is deduced that there is dermal exposure to 25% of the product. Liquid spot removers are used undiluted, so the product amount to which there is dermal exposure is 25% of 1.3 g = 0.325 g. The Q-factor is 1, because the default depends strongly on assumptions based on expert judgement only.

Table 6.20: Default values for estimating consumer exposure to spot remover liquid during application

	Default value	Q-factor	Source
General			
Frequency	128 per year	2	US-EPA, 1989
Dermal–direct product contact–instant application loading			
Exposed area Product amount	450 cm^2 0.325 g	3 1	Hand palms (Te Biesebeek et al., 2014) See above

Product amount – spot remover granules
It is assumed that the amount of spot remover granules used to treat fabric is equal to that of liquid spot remover. For the use of granules is assumed that the fabric area with the stain is pre-wetted with a water:granules ratio of 1:1 (HERA, 2002). It is further assumed that 0.325 g of water ends up on the hand palms of the consumer as weel 0.325 g of product. The product amount available for dermal exposure is thus 0.325 g. The Q-factor is 1, because the default depends strongly on assumptions based on expert judgement only.

Table 6.21: Default values for estimating consumer exposure to spot remover granules during application

Default value		Q-factor	Source
General			
Frequency	128 per year	2	US-EPA 1989
Dermal–direct product contact–instant application loading			
Exposed area Product amount	450 cm^2 0.325 g	3 1	Hand palms(Te Biesebeek et al., 2014) See above

6.3.2 *Application: treatment with spot remover spray*

Applying spray spot removers consists of two phases: spraying and rubbing (soaking) the treated fabric between the palms of the hands. Inhalation exposure is expected from the spraying event. Dermal exposure from spraying is not considered, because it is assumed to be negligible compared with the dermal exposure resulting from rubbing the product into the fabric. The ConsExpo ***inhalation–exposure to spray–spraying*** model is used to estimate inhalation exposure from spraying the non-volatile fraction of substances in the spot treatment sprays, whereas inhalation exposure to the volatile substances is estimated using ***the inhalation–exposure to spray–instantaneous release*** model. The defaults for the parameters exposure duration, room volume, ventilation and inhalation rate described for non-volatiles in sprays are used in both the exposure estimation of volatile and non-volatile substances. Defaults for the mass generation rate and the density of non-volatiles in the product are applicable only to the non-volatile substances and are according to the generic scenario for spray application (4.2.1). The ***dermal–direct product contact–instant application loading*** model is used to estimate dermal exposure from rubbing (6.3.1).

Spray duration
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 0.05 min, which is based on a sprayed product amount of 3.9 g (US-EPA, 1989) and a mass generation rate of 1.6 g/s for trigger sprays (4.2.1). Hence, 2.4 s (0.04 min) is needed to generate the required amount of product. The default value remains 0.05 min with a Q-factor of 3, because it is supported by sufficient quantitative data.

Exposure duration
According to AISE (2014), laundry pre-treatment takes 10 minutes per task. The default for exposure duration is therefore set to 10 minutes. The Q-factor is set to 3, because the original data source specifically refers to laundry pre-treatment but on a qualitative level.

Initial particle distribution
In the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) the default particle size distribution of spray spot removers was characterized as a lognormal distribution with a median of 100 µm and C.V. of 0.6. This old default actually refers to a generically derived particle size distribution for trigger sprays. However, since then, no data of higher quality to characterize the particle size distribution of spray spot removers have become available. Therefore, the default initial particle size distribution remains unaltered. The Q-factor is set to 3, because the supporting data are of sufficient size but only on a generic level.

Released mass
Released mass is interpreted here as the product amount that is sprayed out of the bottle or can. According to the US-EPA (1989), the product amount for spray spot cleaners is 3.9 g. The default product amount is set accordingly, with a Q-factor of 3, because it is supported with data that are not recent but specifically refer to used amounts of spray spot cleaners.

Product amount – dermal exposure
For spray spot removers the amount used is 3.9 g and the product is used undiluted. It is assumed that 50% of the product is absorbed by the treated fabric. The remaining 50% is caught between the surface of the fabric and the surface of the rubbing hand. The next assumption is that the product is equally distributed over the two surfaces. Hence, it is deduced that there is dermal exposure to 25% of the product. Spray spot removers are used undiluted, so that the product amount to which there is dermal exposure is 25%. The default for the product amount is set at 25% of 3.9 g = 1 g. The Q-factor is 1, because the default depends strongly on assumptions based on expert judgement only.

Table 6.22: Default values for estimating consumer exposure to spot remover spray during application

	Default value	Q-factor	Source
General			
Frequency	128 per year	2	US-EPA, 1989
Inhalation–exposure to spray–spraying			
Spray duration[1]	0.05 min	3	See above
Exposure duration[2]	10 min	3	AISE, 2014
Room volume[2]	10 m^3	4	Bathroom (Te Biesebeek et al., 2014)
Room height[1]	2.5 m	4	Section 4.2.1
Ventilation rate[2]	2 per hour	3	Bathroom (Te Biesebeek et al., 2014)
Mass generation rate[1]	1.6 g/s	3	Section 4.2.1
Airborne fraction[1]	0.2	2	Section 4.2.1
Density non-volatile[1]	1.8 g/cm^3	3	Section 4.2.1
Initial particle distribution Median[1] (C.V.)[1]	100 µm (0.6)	3	Prud'homme de Lodder et al., 2006a
Inhalation cut-off diameter[1]	15 µm	3	Delmaar & Schuur, 2016
Inhalation–exposure to spray–instantaneous release			
Released mass[3]	3.9 g	3	US-EPA, 1989
Dermal–direct product contact–instant application loading			
Exposed area	450 cm^2	3	Hand palms (Te Biesebeek et al., 2014)
Product amount	1 g	1	See above

1: Applies to non-volatile substances only
2: Applies to both volatile and non-volatile substances
3: Applies to volatile substances only

6.3.3 *Post-application: migration from fabric*

Secondary exposure to spot removers resulting from migration of residues while wearing the treated clothes is estimated using the same approach as for washed clothes. Hence, the ***dermal–direct product contact–migration*** model is used for spot removers as well. Default parameters for product amount, skin contact factor and exposed area are set equal to those derived for machine washing (6.1.2).

Leachable fraction

The leachable fraction is interpreted here as the fraction of a substance in the spot remover that is able to leach from worn clothes to the skin of the person wearing them. The leachable fraction ($FR_{leach(spotremover)}$) is calculated as:

$$FR_{leach(spot\ remover)} = \frac{g_{product(tex)}}{kg_{textile}} FR_{migration} \times W_f$$

The scenario describes that the item treated with spot remover is washed with other clothes in a washing machine or by hand. It is assumed that during the washing event the spot remover desorbs from the treated item to the washing water. Prior to machine or hand washing, the amount of spray spot remover in the item is calculated to be 3 g, because upon pre-treatment (6.3.2) it is assumed that 50% of the 3.9 g used ends up sorbed by the textile into the item (2 g) and 25% of the 3.9 used ends up on the surface of the textile (1 g). Calculating the amount of liquid spot remover in the treated item in the same way (50% + 25% x 1.3 g) gives an amount of 0.975 g. Calculating the amount of spot remover that remains in clothing after a machine wash with the same method as for laundry detergents (6.1.3) gives an amount of 0.076 g still in the fabric ($g_{product(tex)}$). For hand washing this residual amount is calculated to be 1 g; prior to the hand wash 3 g is diluted in a container with 15 l water, of which 5 l is absorbed by the fabric, so that (3 g /15 l) x 5 l = 1 g. Hence, the residual amount of liquid spot remover is calculated to be 0.0033 g for machine washing and 0.325 g for hand washing (Table 6.23). Furthermore, it is assumed that the fraction of spot remover that is able to migrate ($FR_{migration}$) from the fabric is set to 10%, just as for machine washing detergents (6.1.4). Finally, the default leachable fractions for hand and machine washing for liquid and spray spot removers are derived with the equation above: (0.0015 g/kg) x W_f for spray spot remover in machine washing, (0.0065 g/kg) x W_f for spray spot remover in hand washing, ($5\ 10^{-4}$ g/kg x W_f) for liquid spot remover in machine washing and (0.0022 g/kg x W_f) for liquid spot remover in hand washing (Table 6.23). The respective Q-factors are set to 2, because the supporting data are limited.

Table 6.23: Calculated leachable fraction of spot remover liquid and spray

Spot remover	Initial amount applied	After spot treatment [1]	After machine washing [2]	After hand washing [3]	Leachable fraction machine washing	Leachable fraction hand washing
Spray	3.9 g	3 g	0.076 g	1 g	0.0015 g/kg x W_f	*0.0065 g/kg x W_f*
Liquid	1.3 g	0.975 g	0.033 g	0.325 g	$5\ 10^{-4}$ g/kg x W_f	0.0022 g/kg x W_f

1: 75% of initial amount
2: See section 6.1.3 ($g_{producttex}$)
3: $g_{producttex}$ = (amount after spot treatment /15 l) x 5 l
4: $FR_{leach(spot\ remover)}$

Table 6.24: Default values for estimating consumer exposure to spot treatment laundry detergents from post-application migration of residues from fabric

Default value		**Q-factor**	**Source**
General			
Frequency - After machine wash - After hand wash	 128 per year 52 per year	 2 4	 US-EPA, 1989 Garcia-Hidalgo et al., 2017
Dermal–direct product contact–migration			
Exposed area			
- Adults	1.7 m^2	4	Section 4.3.3
- 3–6-month-olds	0.26 m^2	3	Section 6.1.4
Product amount			
- Adults	1 kg	2	Section 4.3.3
- 3–6-month-olds	153 g	1	Section 6.1.4
Skin contact factor	0.8	1	
Leachable fraction			
- Machine wash			
Liquid product	$1.5\ 10^{-6} \times W_f$	2	See above
Spray product	$6.6\ 10^{-6} \times W_f$	2	See above
- Hand wash			
Liquid product	$5\ 10^{-7} \times W_f$	2	See above
Spray product	$2.2\ 10^{-6} \times W_f$	2	See above

7 Dishwashing products

7.1 Machine dishwashing detergents

Machine dishwashing detergents are used for cleaning cook ware and table ware (cutlery, crockery, glasses, pans, etc.) (henceforth 'table ware') in a dishwasher. The cycling stages of machine dishwashing consist of: a pre-wash cycle, during which food residues are removed by pure water: a wash cycle, when the dishwashing detergent is added; one or two intermittent rinse steps; and a final rinse cycle, in which rinse aid is often added. After that, the cleaned dishes are dried at high temperature (65 ºC). At the end of the dishwashing programme the dishes should be free of residues, rinse aids and detergents (Prud'homme de Lodder et al., 2006a; Falbe, 1987).
A range of liquid, powder and tablet products exists, including dishwashing detergents, glass corrosion inhibitors, rinse aids and salts, as well as pre-treatment products and products to clean or deodorize the dishwashing machine itself (Cleanright, 2016). Rinse aids and salts are necessary for pre-softening of hard water. Multifunctional products combine several of these functions, e.g. 3-in-1 or all-in-one products.

Table 7.1: General composition of machine dishwashing detergent (www.isditproductveilig.nl; www.cleanright.eu; Prud'homme de Lodder et al., 2006a; Reward Distribution, 2015; Rahman et al., 2013)

Machine dishwashing detergent	Powder % (w/w)	Tablet % (w/w)	All-in-one % (w/w)	Liquid % (w/w)
Surfactants				
Non-ionic surfactants	1–5	<5	<5	5–10
Builders				
Alkalis				
- Sodium carbonate	45–70	0–40	0–35	3–10
- Sodium silicate	5–>30	0–15	0–15	
Ion exchangers				
- Polycarboxylate		<5	<5	
Complexing agents				
- Phosphates		0–45	0–70	
- Phosphonates		<5	<5	
Bleaching agents				
Sodium perborate/percarbonate	5–10	15–40	5–15	10–30
TAED	1–2		0–5	
Additives				
Sodium sulphate	1		0–40	20–50
Enzymes	1–3	0–10	0–5	<10
Dyes	<1	<1	<1	<10
Perfume	<1	<1	<1	
Water				30–60

Scenarios for consumer exposure

The consumer loads the dishwasher with a powder, liquid or tablet detergent. Filling the machine with powders may generate inhalable aerosols, which may end up on the back of the hand holding the measuring cup. Consequential inhalation and dermal exposure are estimated according to the generic scenario for loading powders (4.1.1).

When using a liquid detergent the consumer removes the cap from the bottle and pours the liquid detergent into the reservoir of the machine. Volatiles may evaporate from the bottle and dermal exposure may occur as splatters end up on the back of the hand. Inhalation and dermal exposure are estimated according to the generic scenario for loading liquids (4.1.2).

No exposure is expected upon loading the dishwasher with a tablet, because that is considered to be a ready-to-use product (4.1.3).

No exposure is expected while the dishwasher is running, because the product is in an enclosed machine during this application phase. Secondary exposure from ingestion of product residues on the dishes is considered negligible in comparison with hand dishwashing (see Prud'homme et al., 2006a; Falbe, 1987). This form of oral exposure is thus not further described for machine dishwashing.

Frequency
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 252 times per year, based on data of Weegels (1997). AISE (2002) gives a frequency of 3–7 times per week, with a typical frequency of 5 times. Berkholz et al. (2010) performed a study on consumer dishwashing habits in the UK, which showed that the percentage of owners using the dishwasher at least once a day is 56%. The new default is set at 365 per year in accordance to Berkholz et al. (2010) with a Q-factor of 3, because it is well supported by quantitative data.

7.1.1 Mixing and loading: dishwashing machine powder
To add powder to a dishwashing machine, the consumer first pours powder into a measuring cup and then pours the powder into the machine. In accordance with the generic scenario for loading powder, inhalation exposure is estimated using the ***inhalation–exposure to spray–instantaneous release*** model, whereas dermal exposure is estimated using the ConsExpo ***dermal–direct product contact–constant rate loading*** model (4.1.1). Defaults for the parameters: room volume, exposure duration, contact rate and release duration are taken from the generic scenario (4.1.1).

Released mass
According to the generic scenario for loading powders (4.1.1), the released mass that is subject to inhalation is 8.3 µg per 200 g of the total product amount used. According to AISE (2014), the amount of dishwashing powder varies between 20 and 46 g per task for regular powders and from 20 to 40 g per task for concentrated powders. The new default for released mass of dishwashing detergent powder is set to 2.5 µg, which is based on the highest value for the amount of powder used (46 g per task). The Q-factor is considered to be 1, because of the conservative approach to the amount used and the assumption that the generic scenario is fit for loading dishwashing powders.

Table 7.2: Default values for estimating consumer exposure to machine dishwashing powder during mixing and loading

Default value		**Q-factor**	**Source**
General			
Frequency	365 per year	3	Scenario
Inhalation–exposure to spray–instantaneous release			
Exposure duration Released mass Room volume Ventilation rate	0.25 min 2.5 µg 1 m^3 2.5 per hour	3 1 1 1	Section 4.1.1 See above Section 4.1.1 Kitchen (Te Biesebeek et al., 2014)
Dermal–direct product contact–constant rate loading			
Contact rate Release duration Exposed area	2.8 mg/min 0.25 min 225 cm^2	2 3 3	Section 4.1.1 Section 4.1.1 Back of hand (Te Biesebeek et al., 2014)

7.1.2 *Mixing and loading: dishwashing machine liquid*

A consumer removes the cap from the bottle and pours the liquid detergent into the reservoir of the machine. To estimate exposure the ConsExpo ***inhalation–exposure to vapour–evaporation–constant release area*** model and the ***dermal–direct product contact–instant application loading*** model are used, as described in the generic scenario for loading liquids (4.1.2). Defaults for the parameters: product amount (inhalation), room volume, application duration, exposure duration, product amount (dermal) and mass transfer coefficient are taken from the generic scenario (4.1.2).

Molecular weight matrix

The fraction of water in liquid dishwashing machine detergent ranges between 0.3 and 0.6 (Table 7.1). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.3), which yields 60 g/mol. The Q-factor is 2, because the supporting quantitative data are limited.

Table 7.3: Default values for estimating consumer exposure to dishwashing machine liquid during mixing and loading

Default value		**Q-factor**	**Source**
General			
Frequency	365 per year	3	Scenario
Inhalation–exposure to vapour–evaporation–constant release area			
Exposure duration Product amount Room volume Ventilation rate Release area Emission duration Application temperature Mass transfer coefficient	0.75 min 500 g 1 m^3 2.5 per hour 20 cm^2 0.3 min 20 °C 10 m/h 60 g/mol	3 2 1 3 2 3 4 2 2	Section 4.1.2 Section 4.1.2 Section 4.1.2 Kitchen (Te Biesebeek et al., 2014) Section 4.1.2 Section 4.1.2 Room temperature Section 4.2.2 See above

Default value		Q-factor	Source
Molecular weight matrix			
Dermal–direct product contact–instant application loading			
Exposed area Product amount	225 cm^2 0.01 g	3 3	Back of hand (Te Biesebeek et al., 2014) Section 4.1.2

7.2 Machine dishwashing rinse aid

Rinse aids reduce the surface tension between the washed dishes and water during the final rinse cycle. Rinse aids allow good drying and prevent glass spots, stains and streaks.

Table 7.4: General composition of dishwashing machine rinse aids (www.isditproductveilig.nl and www.cleanright.eu)

Dishwashing machine rinse aids	liquid %
Surfactants - Non-ionic surfactants	 5–15
Builders - Citric acid	 0–15
Hydrotopes (solubilizes)	5–15
Additives - Solvents - Preservatives - Dyes - Perfume - Water	 5–15 <1 <0.5 <1 50–65

Scenarios for consumer exposure

The consumer removes the cap from the bottle and pours the liquid rinse aid into the reservoir of the machine. Volatiles may evaporate from the bottle and dermal exposure may occur as splatters end up on the back of the hand. Such inhalation and dermal exposure are estimated according to the generic scenario for loading liquids (4.1.2). No exposure is expected while the dishwasher is running, because the product is in an enclosed machine during this phase. Oral exposure can occur due to residues left on the washed dishes. According to Weerdesteijn et al. (1999), the residue quantity increases with the detergent concentration and with dishwashing water temperature. The secondary exposure to rinse aid resulting from ingestion of residues on table ware is estimated as described in the respective generic scenario (4.3.4).

Frequency

Based on information of Weegels (1997), the default value for frequency of filling the machine with rinse aid is set at 2 times per 3 weeks, i.e. 35 times per year. The Q-factor is set to 3, because the underlying dataset is neither large nor recent, but was collected specifically for filling a dishwashing machine with rinse aid.

7.2.1 *Mixing and loading*

To estimate exposure, the ConsExpo ***inhalation–exposure to vapour evaporation–constant release area*** model and the ***dermal–direct product contact–instant application loading*** model are used (4.1.2). Defaults for the parameters: product amount (inhalation), room volume, application duration, exposure duration, mass transfer coefficient and product amount (dermal) are taken from the generic scenario (4.1.2). The default for the parameter: exposed area is considered equal to that in the scenario for loading liquid dishwashing detergents into a machine (7.1.2).

Molecular weight matrix

The fraction of water in the product ranges between 0.5 and 0.65 (see Table 7.4). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.5), which yields 36 g/mol. The Q-factor is 2, because the supporting quantitative data are limited.

Table 7.5: Default values for estimating consumer exposure to dishwashing machine rinse aid during mixing and loading

Default value		**Q-factor**	**Source**
General			
Frequency	35 per year	3	Weegels, 1997
Inhalation–exposure to vapour–evaporation–constant release area			
Exposure duration	0.75 min	3	Section 7.1.2
Product amount	500 g	3	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	2.5 per hour	1	Kitchen (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Emission duration	0.3 min	3	Section 4.1.2
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	36 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Section 7.1.2
Product amount	0.01 g	3	Section 4.1.2

7.2.2 *Post-application: residues on table ware*

A dishwashing machine cleans the dishes in four cleaning phases – rinsing, cleaning with detergents and hot water, rinsing with cold water, rinsing with hot water – plus drying. In total, a dishwashing machine uses about 14 to 20 l water, so that per cleaning phase the machine uses about 4 l water (Consumenten Bond, 2016). Rinse aids are added at the start of phase 4, the rinsing-with-hot-water phase (Miele, 2016). According to the default factory setting, 30 ml of rinse aid is used. The resulting secondary exposure to the rinse aid that ends up on the cleaned dishes is estimated using the ***oral-direct oral contact–direct oral intake*** model.

Frequency
The frequency of secondary exposure to rinse aid from oral contact with cleaned table ware is interpreted here as the use frequency of rinse aid: 35 times per year, with a Q-factor of 3 (see above).

Amount ingested
According to the generic scenario (4.3.4), the amount of water left on dishes is 5.5 x 10^{-5} ml/cm^2 and the area of table ware in daily contact with food is 5400 cm^2. The concentration of rinse aid is 7.5 g/l, as the scenario describes a use of 30 ml per 4 l (assuming a liquid density of 1 g/ml). This leads to an ingested product amount of 5.5 x10^{-5} ml/cm^2 x 5400 cm^2 x 7.5 mg/ml = 2.25 x 10^{-3} g. The Q-factor is 1, because it is unclear to what extent the rinse aid is washed off after rinsing with hot water.

Table 7.6: Default values for estimating consumer exposure to dishwashing machine rinse aid from residues on table ware

Default value		**Q-factor**	**Source**
General			
Frequency	35 per year	3	Weegels, 1997
Oral–direct oral contact–direct oral intake			
Amount ingested	2.25 mg	1	See above

7.3 Manual dishwashing

Food residues on table ware are removed by washing them in water with dishwashing detergent. Mostly, dirt is removed by a brush, cloth or sponge. A scourer is used for hard-to-remove food residues. The clean items are dried either with a drying-up cloth (tea towel) or by placing them in a drainer to air-dry. The cleaning ability of manual dishwashing products is based on surfactants, solvents and additives (Table 7.7).

Table 7.7: General composition of liquid hand dishwashing detergents – regular and concentrated products (www.isditproductveilig.nl and cleanright.eu)

Manual dishwashing detergent ingredient	**Regular product % (w/w)**	**Concentrated product % (w/w)**
Surfactants		
Anionic surfactants	10–20	10–30
Non-ionic surfactants	0–10	0–20
Amphoteric surfactants	0–3	0–5
Solvents		
Alcohol	0–3	0–10
Additives		
Preservatives	0–1	0–1
Dyes	<0.1	<0.1
Hydrotropes	0–1	0–0.5
Perfume	<0.5	<0.5
Viscosity-controlling agents	0–0.5	0–0.5
Water	45–80	45–80

Scenarios for consumer exposure
The consumer does not perform a mixing and loading activity with the dishwashing liquid, but directly pours the dishwashing liquid into a sink

or a bowl filled with water by squeezing the bottle. Then the consumer manually cleans the table ware with a brush. In the process (‘doing the dishes’), there is dermal contact of hands and forearms with the diluted dishwashing liquid. Inhalation exposure to volatiles also occurs due to substances that evaporate from the dishwashing water. The exposure from doing the dishes is described in the generic scenario for application of diluted products (4.2.3). Secondary exposure is accounted for by considering the ingestion of dishwashing detergent residues on table ware. The generic scenario for ingestion of residues from table ware (4.3.4) is used to estimate such oral exposure.

Frequency
The previous Cleaning Products Fact Sheet (Prud’homme de Lodder et al., 2006a) prescribes a default for hand dishwashing of 426 per year, based on Weegels (1997). AISE (2014) gives a range of 3–21 times a week, with a typical frequency of 14 times a week. Berkholz et al. (2010) performed a study in the UK on consumer habits in hand washing a full set of dishes. The frequency of dishwashing by hand was estimated to be at least once per day for 68–88% of the respondents. Garcia-Hidalgo et al. (2017) present summary data from their survey (n=611), from which it can be derived that over half of the respondents did a dish wash ‘more than once a day’, which is also the answer of the respondent representing the 75th percentile. The frequency data indicate that the previous default is still within range and considered representative today. Therefore, the default is set at 426 per year. The Q-factor is set to 4, because the underlying datasets are large and the data were collected specifically to calclate the frequency of performing manual dishwashing.

7.3.1 *Application: manual dishwashing*
When doing the dishes, there is dermal contact of hands and forearms with the diluted dishwashing liquid. Inhalation exposure to volatiles occurs due to substances that evaporate from the dishwashing water. The generic scenario for application with diluted products is used to estimate exposure, so that the ConsExpo ***inhalation–exposure to vapour–evaporation–constant release area*** model and the ***dermal–direct product contact–instant application loading*** model are used (4.2.2). Defaults for the parameters: product amount (inhalation), release area, exposed area and product amount (dermal) are taken from the generic scenario (4.2.3).

Emission duration
Weegels (1997) reports a mean duration of dermal contact with dishwashing water of 11 min (St. Dev=7 min, n=592) and a 75th percentile of 16 min. Andra et al. (2015) present a median duration for hand dishwashing of 15 min, whereas Kalyvas et al. (2014) present a 75th of 12 min. Garcia-Hidalgo et al. (2017) present summary data from their survey (n=611), from which it can be derived that the respondent representing the 75th percentile would report spending between 10 and 30 minutes on a manual dishwashing task. The default of 16 min prescribed in the previous Cleaning Products Fact Sheet (Prud’homme de Lodder et al., 2006a) seems to agree with this quantitative data as a realistic but conservative estimate. The Q-factor is set to 4, because the

underlying datasets are large and the data are collected specifically to ascertain the duration of performing manual dishwashing.

Exposure duration
The estimated exposure duration is considered the duration of the dishwashing itself plus the tasks after dishwashing (e.g. emptying the sink or bowl and rinsing the kitchen top with water). This duration is estimated by AISE (2014) to range between 10 and 45 minutes, with a typical duration of 30 minutes. The default is set at 45 min. The Q-factor is 3, because the default may be over-conservative as it is the maximum of a range based on quantitative data.

Application temperature
Initially the temperature of dishwater is high, approximately 60 °C, and it decreases during dishwashing. Ramirez-Martinez et al. (2014) recorded an average water temperature of 36 °C (St. Dev=7.1 ºC), which is lower than the 40–45 °C reported by Falbe (1987). The default value for water temperature is kept at 45 °C, representing a more conservative input. The Q-factor is therefore 3, because the default is the maximum of a relatively narrow range.

Amount of solution used
The amount of solution used refers to the sum of the product amount and the solvent amount. Weegels (1997) derived the 75th percentile for volume of 5 l water in the sink or bowl. The solvent amount here is the 5 l of water that is in the sink or bowl. The product amount refers to the amount of manual dishwashing liquid, which is less than 1% in weight compared with the solvent amount (see below). Therefore, the amount of solution used is set equal to the solvent amount, which is 5 l of water and thus 5000 g. The Q-factor is set to 3, because the data specifically refers to the volume of water in a sink or bowl but the number of samples is limited.

Dilution (times)
The dilution in number times is calculated based on the product amount of 7 g and the 5 l volume of water in which it is diluted (see above). According to AISE (2014), the amount of regular dishwashing liquid used is between 3 and 10 g, whereas the amount of concentrated detergents ranges between 2 and 5 g, both per 5 l of water. Ramirez-Martinez (2014) reported an average value of dishwashing liquid of 5.6 g (St. Dev=5.7 g) per 8 l of water for regular dishwashing detergents. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a use of 7 g per 5 l water based on the 75th percentile found in the study by Weegels (1997). A concentration of 1.4 g/l reasonably agrees with the data from AISE and Ramirez-Martinez (2014). In order to be consistent, the product amount in the water is thus calculated as 1.4 g/l x 5 l = 7 g. The default dilution in number of times is calculated as (5000 g) / 7 g ≈ 700. The Q-factor is set to 3, because the calculation is based on data that specifically refer to the concentration of dishwasher detergent in the water for manual cleaning.

Product amount – dermal
The volume of water ending up on the exposed skin as a result of dipping the hands and forearms into the water is 22 ml (4.2.3). The

concentration of dishwashing liquid in the water is 1.4 g/l. The product amount that is subject to dermal exposure is thus calculated as 1.4 g/l x 22 ml = 31 mg. The Q-factor is set to 3, because the concentration data are of high quality but the supporting data for the volume of water that is in contact with the skin are limited.

Table 7.8: Default values for estimating consumer exposure to dishwashing liquid during the application phase of manual dishwashing

Default value		**Q-factor**	**Source**
General			
Frequency	426 per year	4	Garcia-Hidalgo et al., 2017
Inhalation–exposure to vapour–evaporation–constant release area			
Exposure duration	45 min	3	AISE, 2014
Amount of solution used	5000 g	3	Weegels, 1997
Dilution (times)	700	3	See above
Room volume	15 m^3	4	Kitchen (Te Biesebeek et al., 2014)
Ventilation rate	2.5 per hour	3	Kitchen (Te Biesebeek et al., 2014)
Release area	1500 cm^2	3	Section 4.2.3
Emission duration	16 min	4	Prud'homme de Lodder et al., 2006a
Application temperature[1]	45 °C	3	Temperature of hot water (Prud'homme de Lodder et al., 2006a)
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water
Dermal–direct product contact–instant application			
Exposed area	2200 cm^2	3	Hands + forearms (Te Biesebeek et al., 2014)
Product amount	31 mg	3	See above

1: The vapour pressure of the substance should be adjusted to the application temperature of 40 °C

7.3.2 *Post-application: residues on table ware*

It is assumed (as worst-case scenario) that all table ware is air-dried and not rinsed with pure water, so that residues on the table ware are proportional to the concentration of dishwasher detergent in the water in which the table ware was manually cleaned. The generic scenario for ingestion of residues from table ware is used to estimate oral exposure. Hence, the ConsExpo ***oral–direct oral contact–direct oral intake*** model is used.

Frequency

It is assumed that clean table ware is used every day for food and drinks, which equals a frequency of 365 times per year. The Q-factor is set to 4, because daily exposure is considered obvious in this case.

Amount ingested

According to the generic scenario (4.3.4), the amount of water left on table ware is 5.5 x 10^{-5} ml/cm^2 and the area of table ware in daily contact with food is 5400 cm^2. The concentration of the dishwashing detergent in water is 1.4 g/l (see above), which leads to an ingested product amount of 5.5×10^{-5} ml/cm^2 x 5400 cm^2 x 1.4 g/l = 0.42 mg.

The default remains at 0.42 mg. The Q-factor is 2, because the supporting data are limited.

Table 7.9: Default values for estimating consumer exposure to manual dishwashing liquid from post-application residues on table ware

Default value		**Q-factor**	**Source**
General			
Frequency	365	4	See above
Oral–direct oral contact–direct oral intake			
Amount ingested	0.42 mg	2	See above

8 All-purpose cleaners

All-purpose cleaners can be used for different cleaning tasks in and around the house, such as cleaning floors, windows and mirrors. They are suitable for light cleaning activities. Consumers place high demands on all-purpose cleaners (Falbe, 1997):

- High cleaning performance.
- Surface protection.
- Residue-free drying of clean surface.
- Good skin compatibility.
- Easy handling/dosage.
- Appropriate foaming behaviour.
- Pleasant scent during and after cleaning.

All-purpose cleaners are available as liquids, in spray form or as wipes (wet tissues). The all-purpose wipes considered in the current chapter are those used for small cleaning jobs.

Table 8.1: General composition of all-purpose cleaners (www.isditproductveilig.nl and www.cleanright.eu)

All-purpose cleaner ingredient	**Liquid % (w/w)**	**Spray % (w/w)**	**Wet tissue % (w/w)**
Surfactants		0–15	<10
Anionic	1–10		
Non-ionic	1–10		
Soap	1–5		
Builders		0–5	
Sodium carbonate	0–10		
Polycarboxylate	0–2		
Citric acid / citrate	0–10		
Hydrotropes & solvents	0–15		<10
Solvents	0–10	2–15	
Hydrotropes	0–5		
Additives			
Dyes	<0.1	<1	
Fragrances	<1	<1	<1
Preservatives	<0.5	<1	<1
Skin protecting agents	<2		
Water	75–85	85–95	70–95

According to the EPHECT (2012) report, all-purpose cleaners are mostly used in the kitchen (84%) and bathroom (76%) across European countries. The cleaners are less frequently used in the bedroom (31%) and storage rooms (18%). Furthermore, the EPHECT study results show that consumers use all-purpose cleaners in order to clean floors (67%), sinks (57%) or toilets (52%). Most consumers use the product in liquid form (80%). When looking at individual countries (or European zones), different use patterns are visible. Specific information for different EU countries is available from the EPHECT study.

8.1 All-purpose cleaning liquid

Scenarios for consumer exposure

Liquid all-purpose cleaners are used for cleaning floors, furniture, toilets, bathrooms and kitchens. For manual cleaning of surfaces with a liquid cleaner, a sponge, cloth or mop is used. Generally the cleaner is diluted, but the cleaner can also be used undiluted (for persistent soil). This scenario describes the cleaning of a tiled living room floor (22 m^2) and furniture surfaces, e.g. the tables, cupboards and other flat surfaces (10 m^2). It is thus assumed in this scenario that the consumer cleans 32 m^2 in total. The consumer remains in the living room afterwards for four hours. During mixing and loading, the user pours the cleaning product straight into a bucket (no use of a measuring cup). During this process, inhalation and dermal exposure to the pure product due to spills can occur. Next, the consumer cleans the furniture and the floor. For cleaning, the consumer uses either a mop for the floor and a cloth for the furniture. The cloth is dipped into the cleaning water and wrung out. During cleaning, there is intermittent dermal contact with the cleaning dilution throughout the task. After cleaning, the consumer does not wipe the surface dry. Secondary exposure can be expected for children crawling on the treated floor.

Frequency

In the previous version of the Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) a default for use frequency of 104 times per year is described. According to AISE (2014), surface cleaners are used 1 to 7 times per week with a typical frequency of 2 times per week (104 per year). Weegels (1997) reports a 75th percentile of 320 per year, but that includes cleaning of different surfaces in different rooms, so that exposure cannot be estimated with a single scenario. According to EPHECT (2012), most people that use all-purpose cleaners do so at least once a week (82%). Analysis of the EPHECT data (n=1153) results in a 75th percentile use frequency of 0.53 per day (197 per year) (Annex II). Garcia-Hidalgo et al. (2017) present summary data from their survey (n=611), from which it can be derived that the respondent representing the 75th percentile of consumers that use all-purpose cleaners (n=410) does so for 31–40 min per day. The exposure scenario describes the cleaning task for all-purpose cleaners as cleaning a living room floor and furniture. According to the summary data of Garcia-Hidalgo et al. (2017), the 75th percentile for the duration of cleaning furniture is '10 to 30 min' and the 75th percentile for the duration of cleaning a floor is also represented as '10 to 30 min'. The conservative estimate for the duration of performing both tasks is then 60 min. Performing the cleaning task 197 times per year (Annex II) would yield an exposure frequency of 32 min/day. Moreover, from the summary data of Garcia-Hidalgo et al. (2017) it can be derived that the 75th percentile for the frequency of cleaning floors is 'twice per week', and cleaning furniture 'once per week'. Hence, the scenario of cleaning both the furniture and the floor with all-purpose cleaner for 197 per year (3.8 per week) is consistent with the survey data of Garcia-Hidalgo et al. The default frequency for the use of all-purpose cleaner is thus set to 197 per year. The Q-factors is set to 4, because the underlying datasets are large, complement each other, and are consistent with each other.

8.1.1 *Mixing and loading*

During opening of the bottle and pouring of liquid all-purpose cleaners into a bucket, volatiles evaporate from the bottle into the personal breathing zone of the consumer. Meanwhile, spills (droplets) end up on the back of the pouring (directing) hand. To estimate exposure, the ***inhalation–exposure to vapour–evaporation–constant release area*** model and ***dermal–direct product contact–instant application loading*** model are used (see section 4.1.2). Defaults for the parameters: product amount (inhalation), exposure duration, room volume, release area, application duration, mass transfer coefficient, exposed area and product amount (dermal) are described in the generic scenario (4.1.2).

Molecular weight matrix

The fraction of water in the liquid cleaning product is estimated at 0.8 (Table 8.1). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.8) which yields 22 g/mol. The Q-factor is 2, because the supporting quantitative data are limited.

Table 8.2: Default values for estimating consumer exposure to all-purpose cleaner liquid during mixing and loading

Default value		**Q-factor**	**Source**
General			
Frequency	197 per year	4	Section 8.1
Inhalation–exposure to vapour–evaporation–constant release area			
Exposure duration	0.75 min	3	Section 4.1.2
Product amount	500 g	2	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	0.5 per hour	1	Living room (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Emission duration	0.3 min	3	Section 4.1.2
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	22 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Section 4.1.2
Product amount	0.01 g	3	Section 4.1.2

8.1.2 *Application: cleaning*

During cleaning, the hands and forearms come into contact with the diluted solution when using a cloth or dipping the mop in the bucket, and volatile substances may evaporate from the treated surface during cleaning. To estimate exposure during cleaning, the ***inhalation–exposure to vapour–evaporation–increasing release area*** model and the ***dermal–direct product contact–instant application loading*** model are used. Please note that the default scenario combines the dermal exposure from using a cloth and the inhalation exposure from using a mop in one cleaning task. Defaults for the parameters: mass transfer coefficient (4.2.2), product amount for dermal exposure and exposed area are described in the generic scenario for application of diluted products (4.2.3).

Application duration
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 20 min. According to AISE (2014), the duration of the cleaning task is 10 to 20 minutes. Weegels (1997) found an average duration of all-purpose cleaning of 20 minutes. Andra et al. (2015) present a median of 16 min for mopping floors and Kalyvas et al. (2014) present a 75th percentile of 15 min for mopping floors. The default value of 20 min thus agrees with different sources. Therefore, the default value remains at 20 min with a Q-factor of 3.

Exposure duration
According to the scenario, the exposure duration is 240 min (4 hours). The Q-factor is 1, because it is based on expert judgement.

Amount of solution used
The amount of solution used is defined as the sum of the solvent and product amount. The solvent amount is interpreted here as the amount of water applied to the floor and furniture. In a small experiment it was determined that a wet surface area holds 40 ml of water per m^2 (Prud'homme de Lodder et al., 2006a). A volume of 1.28 l is thus needed to wet the surface area of 32 m^2 described in the scenario, so that the solvent amount is 1280 g. The concentration of all-purpose cleaning liquid in the water is estimated to be 13 g/l (see below), so that a product amount of 17 g is in the solution applied to floor and furniture. The amount of solution used is then calculated as 1280 g + 17 g ≈1300 g. The Q-factors is set to 2, because the supporting quantitative data are limited.

Dilution
The dilution in number of times (4.2.3) is calculated by dividing the amount of all-purpose cleaner poured into the bucket (65 g, see above) by 5 l, the volume of water in which it is diluted. According to AISE (2002), the consumer typically uses an amount of 60 g liquid cleaner with a range of 30 to 110 g for the entire cleaning task. Data of EPHECT (2012) show a 75th percentile of 65 g. The data are consistent with the older data sources of Falbe (1987), which describes a use of 25 to 100 g, and Weegels (1997), reporting 1 to 63 g. The EPHECT data are the most recent and comprise the most respondents (n=1170). Therefore, it is proposed that 65 g of cleaner is diluted in a half-empty bucket containing 5 l water. The concentration of all-purpose cleaner in solution is thus 13 g/l, whereas the dilution in number of times is calculated as (65 g+5000 g) / 65 g = 78. The Q-factor is set to 2, because the calculation is supported by quantitative data only for the product amount loaded into the bucket and not for the amount of water in the bucket.

Release area
The release area is interpreted here as the surface area that is being cleaned. According to the scenario, the consumer uses the all-purpose cleaner to clean the floor and furniture. The General Fact Sheet describes a default living room floor of 22 m^2 (Te Biesebeek et al., 2014). By expert judgement it is determined that the consumer also uses the all-purpose

cleaner to clean another 10 m^2 of flat surfaces, such as furniture, cupboards and tables. The default release area is thus 32m^2. The Q-factor is set to 1, because the default largely depends on expert judgement.

Product amount – dermal
The product amount that is subject to dermal exposure is calculated from the product concentration in the water of the bucket multiplied by the volume of water in contact with the consumer's skin. The volume of water ending up on the exposed skin as a result of dipping the hands and forearms in the water is 22 ml (4.2.3). The concentration of all-purpose cleaner in the bucket is 13 g/l. The product amount that is subject to dermal exposure is thus calculated as 13 g/l x 22 ml = 286 mg. The Q-factor is set to 2, because the supporting quantitative data are limited.

Table 8.3: Default values for estimating consumer exposure to all-purpose cleaner liquid during application

Default value		**Q-factor**	**Source**
General			
Frequency	197 per year	4	Section 8.1
Inhalation–exposure to vapour–evaporation–increasing release area			
Exposure duration	240 min	1	According to scenario
Amount of solution used	1300 g	2	See above
Dilution (times)	78	2	See above
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	32 m^2	1	See above
Application duration	20 min	3	Weegels, 1997
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water
Dermal–direct product contact–instant application loading			
Exposed area	2200 cm^2	3	Section 4.1.3
Product amount	286 mg	2	See above

8.1.3 *Post-application: rubbing-off*

Post-application exposure to liquid all-purpose cleaners is only expected in treated surfaces that are accessible to small children. The floor that is treated with the all-purpose cleaner is such an accessible surface; therefore, exposure may occur by 'rubbing off' the product. This form of secondary exposure is estimated using the ***dermal–direct product contact–rubbing-off loading*** model according to the generic scenario for rubbing-off (4.3.1). The ***oral–direct product contact–direct oral intake*** model is used to calculate oral exposure from hand-to-mouth behaviour (4.3.2).

Contacted surface
The contacted surface (S_{area}) is the area of the treated surface that can potentially be rubbed, which is in this scenario the floor of a living room 22 m^2 (Te Biesebeek et al., 2014). The default is thus set to 22 m^2 and the Q-factor is set to 4 in accordance to the General Fact Sheet (Te Biesebeek et al., 2014).

Dislodgeable amount
As described in the generic scenario (4.3.1), the dislodgeable amount ($F_{dislodge}$) is calculated by multiplying a fraction of 0.3 by the product amount (g) used per m^2 of floor. The amount used for cleaning is estimated to be 40 ml diluted product per m^2 with a density of 1 g/ml (Prud'homme de Lodder et al., 2006a), so that the dislodgeable amount is 12 g/m^2. The Q-factor is set to 2, because the supporting data are limited.

Transfer coefficient
The default transfer coefficient for children is 0.2 m^2/hr (4.3.1).

Contact time
It is assumed that a child of 6–12 months crawls over a cleaned floor for 1 hour a day. The default is therefore set at 60 min with a Q-factor of 1 as it is derived from expert judgement (Prud'homme de Lodder et al., 2006a).

Exposed area
The default for exposed skin surface area for children is 0.3 m^2 (4.3.1).

Ingested amount
The ingested amount via hand-to-mouth contact can be calculated by taking 10% of the total external dose (4.3.2).

Table 8.4: Default values for estimating consumer exposure to all-purpose cleaner liquid from post-application rubbing-off

Default value		**Q-factor**	**Source**
General			
Frequency Body weight	197 per year 8.0 kg	4 4	Section 8.1 4.4
Dermal–direct product contact–rubbing-off			
Contacted surface Dislodgeable amount Transfer coefficient Contact time Exposed area	22 m^2 12 g/m^2 0.2 m^2/hr 60 min 0.3 m^2	4 2 3 1 4	Te Biesebeek et al., 2014 See above Section 4.3.1 Prud'homme de Lodder et al., 2006a Section 4.3.1
Oral–direct product contact–direct oral intake			
Ingested amount	10% of the total external dose	1	Section 4.3.2

8.2 All-purpose cleaning spray

Scenarios for consumer exposure

All-purpose cleaners are mostly used in the kitchen (EPHECT, 2012). Therefore, the scenario is based on cleaning a kitchen work top. Since all-purpose cleaning sprays are considered to be ready-to-use products, exposure from mixing and loading is not expected (4.1.3). Consumer exposure to substances in sprays depends not only on the way the product is used, but also on the substance considered. The indoor fate of volatile substances in sprays differs from that of non-volatile substances. Volatile substance are expected to remain in the indoor air after spraying, whereas non-volatile substances occur as spray particles, of which a fraction deposits to the surface and a fraction is emitted to the indoor air. In order to assess consumer exposure to non-volatile substances, three phases can be distinguished during cleaning with a spray product. First, the product is sprayed onto the surface with a trigger spray, then it is left to soak (leave-on) for several minutes and finally, the surface is rinsed or wiped with a wet cloth. Exposure during leave-on is, however, not calculated, because inhalation exposure to non-volatile substances is not expected as they do not evaporate from the surface. Dermal exposure is also not expected during leave-on, because the consumer will not touch the treated surface until it is rinsed or wiped. Upon wiping the surface, dermal exposure is expected from hand contact with the cloth. The treated surface is assumed not to be within the reach of small children, so that secondary exposure is not expected.

Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 365 times per year. The exposure scenario describes the task of cleaning a kitchen work top with all-purpose spray. Hence, the use of kitchen spray refers to a similar scenario. Analysis of the data from the EPHECT study (Annex II) shows a 75th percentile for use frequency for kitchen cleaning sprays of 153 per year (n=800) and for all-purpose sprays of 190 per year (n=679). AISE (2014) does not report frequencies for the use of cleaning sprays. The survey performed by Garcia-Hidalgo et al. (2017) includes the frequency of performing the task of cleaning the kitchen, which fully reflects the exposure scenario described above. By including non-users, it can be derived that the respondent representing the 75th percentile claims to clean the kitchen 'twice per week (104 per year), whereas excluding non-users yields a 75th percentile of 'daily'. The default is set to 365 per year based on the data of Garcia-Hidalgo, which specifically refer to the exposure scenario of cleaning the kitchen, excluding the non-user. The Q-factor is set to 4, because the underlying dataset is large and the data were collected specifically to measure the task of cleaning a kitchen, as described in the scenario of consumer exposure.

8.2.1 Application: spraying

Inhalation exposure to non-volatile substances occurring as sprayed particles is estimated using the ***inhalation–exposure to spray–spraying release*** model. Dermal exposure is estimated using the ***dermal–direct product contact–constant rate loading*** model (4.2.1). The defaults for the parameters: mass generation rate, airborne fraction, density non-volatiles and contact rate area are in accordance with the generic scenario (4.2.1). Inhalation exposure to volatile substances in all-purpose cleaning sprays is estimated using the ***inhalation–exposure to spray–instantaneous release*** model. The defaults for the parameters: exposure duration, room volume, ventilation and inhalation rate described for non-volatiles in all-purpose cleaning sprays also apply to volatile substances.

Spray duration
The spray duration is calculated from the amount of product that needs to be applied to the surface. The kitchen work top (including kitchen sink) has an area of 2 m^2 (Weerdesteijn et al., 1999), and 11.1 g of sprayed product is required per m^2, according to the 75th percentile derived from experiments by Weerdesteijn et al. (1999). The sprayed amount is thus 22.2 g. Delmaar & Bremmer (2009) describe a default mass generation rate of 1.6 g/s for all-purpose cleaners, so that the default spray duration here is set to 14 s (0.23 min). A Q-factor of 3 is given, because of the availability of quantitative but generic data.

Exposure duration
It is assumed that consumers stay in the kitchen after the cleaning task for at least one hour, so the default for exposure duration is set at 60 min. Since this default is based on expert judgement only, the Q-factor is set to 1.

Mass generation rate
As described above, Delmaar & Bremmer (2009) give a default mass generation rate of 1.6 g/s for all-purpose cleaners based on their own experimental data and that of Tuinman (2004, 2007). The default mass generation rate is set to 1.6 g/s. The Q-factor is set to 4, because the data were generated specifically to determine the mass generation rate of all-purpose cleaners. Moreover, the number of samples is large and the datasets of Delmaar & Bremmer (2009) and Tuinman (2004, 2007) are consistent with each other.

Airborne fraction
Delmaar & Bremmer (2009) experimentally determined an airborne fraction of 0.1 for all-purpose cleaner trigger sprays by spraying 10 times with the nozzle pointed towards the wall 30 cm from the surface. The default airborne fraction is thus set to 0.1. The Q-factor is set to 3, because the data were generated specifically to determe the airborne fraction of all-purpose cleaners, but the number of samples is limited.

Density non-volatile
Delmaar & Bremmer (2009) estimated the density of the non-volatile compounds in all-purpose cleaners to be 1 g/cm^3 based on the elemental composition of the ingredients. The default is thus set to 1 g/cm^3. The Q-factor is 3, because the collected data specifically describe the density of non-volatile compounds in all-purpose cleaning sprays, but the number of samples is limited.

Initial particle distribution
Delmaar & Bremmer (2009) experimentally derived a median particle size for bathroom cleaner sprays of 2.4 µm with a C.V. of 0.37. The default initial particle distribution is set accordingly. The Q-factor is set to 3, because the experimental data specifically describe the particle

size distribution of all-purpose cleaner sprays, but the number of samples is limited.

Released mass
Released mass is interpreted here as the product amount that is sprayed out of the bottle or can, which is already estimated to be 22 g (8.2.1: spray duration) based on the data of Weerdesteijn et al. (1999). The Q-factor is set to 2, because the supporting data specifically refer to spray cleaners in general but the number of samples is limited (Weerdesteijn et al., 1999).

Table 8.5: Default values for estimating consumer exposure to all-purpose cleaner spray during application

Default value		**Q-factor**	**Source**
General			
Frequency	365 per year	4	Garcia-Hidalgo et al., 2017
Inhalation–exposure to spray–spraying[1]			
Spray duration[1]	0.23 min	3	See above
Exposure duration[2]	60 min	1	See above
Room volume[2]	15 m^3	4	Kitchen (Te Biesebeek et al., 2014)
Room height[1]	2.5 m	4	Kitchen (Te Biesebeek et al., 2014)
Ventilation rate[1]	2.5 per hour	3	Kitchen (Te Biesebeek et al., 2014)
Mass generation rate[1]	1.6 g/s	4	Delmaar & Bremmer, 2009
Airborne fraction[1]	0.1	3	Delmaar & Bremmer, 2009
Density non-volatile[1]	1 g/cm^3	3	Delmaar & Bremmer, 2009
Initial particle distribution Median[1] (C.V.)[1]	2.4 µm (0.37)	3	Delmaar & Bremmer, 2009
Inhalation cut-off diameter[1]	15 µm	3	Delmaar & Schuur, 2016
Inhalation–exposure to spray–instantaneous release			
Released mass[3]	22 g	2	Weerdesteijn et al., 1999
Dermal–direct product contact–constant rate loading			
Exposed area	2200 cm^2	3	Section 4.2.1
Contact rate	46 mg/min	3	Section 4.2.1
Release duration	28 s	3	Twice the spray duration (4.2.1)

1: Applies to non-volatile substances only
2: Applies to both volatile and non-volatile substances
3: Applies to volatile substances only

8.2.2 *Application: rinsing*
The consumer rinses off the sprayed work top with a wet cloth. Inhalation exposure during this task is already covered by the inhalation estimated from spraying. In this phase only dermal exposure is relevant from hand contact with the wet cloth. The expected exposure is estimated using the ***dermal–direct product contact–instant application loading*** model (4.2.2.3).

Product amount – dermal
The spray product is removed with a wet cloth. The surface is thus treated with water. In a small experiment it was observed that the surface is fully wet at 40 ml water per m^2 (Prud'homme de Lodder et al., 2006a). The surface is 2 m^2, so that the amount of water required to wet it is 80 ml. The product amount of 11.1 g applied on the surface (see 8.2.1) is thus diluted with 80 ml water, so that the concentration of product in the water is 11.g / 80 ml = 0.14 g/ml. The volume of water that ends up on the inside of the hand by touching the wet cloth is calculated by multiplying a layer thickness of 0.01 cm (ECHA, 2015a, b) by the exposed area of 225 cm^2, resulting in 2.25 ml. The product amount that is subject to dermal exposure is calculated as 0.14 g/ml x 2.25 ml = 0.31 g. The Q-factor is set to 2, because the data supporting the calculation are limited.

Table 8.6: Default values for estimating consumer exposure to all-purpose cleaner spray during rinsing

Default value		**Q-factor**	**Source**
General			
Frequency	365 per year	4	Garcia-Hidalgo et al., 2017
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Inside hand (Te Biesebeek et al., 2014)
Product amount	0.31 g	2	See above

8.3 All-purpose cleaner wet tissue

Scenarios for consumer exposure
Wet tissues or wipes are used for small cleaning jobs on all washable surfaces. They are solid, moist, ready-to-use cleaning products in a package and are suitable for single use, after which they are thrown away. Since wet tissues are considered ready-to-use products, exposure from mixing and loading is not expected (4.1.3). The EPHECT (2012) study reports that consumers use all-purpose floor, glass, kitchen and bathroom cleaning wipes. The location of use, however, is not reported. Therefore, the scenario for wet tissues describes use in a non-specified room (Te Biesebeek et al., 2014). A wet tissue is used to clean a small surface such a table, window or kitchen top. Upon cleaning there is dermal contact with the hand of the consumer. It is not necessary to rinse the surface afterwards. Therefore, exposure from surface removal is not expected (4.2.2.3). Nonetheless, the product is left on the surface to dry out so that inhalation exposure of evaporating substances during this leave-on phase is expected (4.2.2.2). Moreover, the leave-on period starts right at the beginning of the cleaning task, so that inhalation exposure covers the surface application phase as well. It is assumed that the consumer stays in the room for 4 hours after the cleaning task. The treated surface is assumed not to be in reach of small children, so that secondary exposure is not considered.

8.3.1 Application: cleaning

Consumer exposure from the application of wet tissues is considered here for surface application (4.2.2.1) and leave-on (4.2.2.2). To estimate the expected exposure the ***inhalation–exposure to vapour–evaporation–increasing release* area** model and the ***dermal–direct***

product contact–instant application loading model are used. The defaults for the parameters: product amount (inhalation), product amount (dermal) and exposed area are in accordance with the generic scenario (4.2.2).

Frequency
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default frequency of 365 per year. According to AISE (2014), the frequency of use for kitchen wipes is 3.5 times per week. For bathroom wipes the typical frequency is 7 times per week. Analysis of the EPHECT data (Annex II) shows a 75th percentile frequency of 88 per year for all-purpose wipes. Since quantitative data that are specific to all-purpose wipes are available from the analysis of the EPHECT study, the new default is set at 88 per year with a Q-factor of 4.

Application duration
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default duration of 2 min (Q-factor of 2). According to AISE (2014), wiping surfaces typically takes 5 minutes and ranges between 1 and 10 minutes. Based on this quantitative but generic data, the new default is set at 5 min with a Q-factor of 3.

Exposure duration
According to the scenario, the exposure duration is the duration of the leave-on phase. It is assumed that the consumer stays in the room for at least 4 hours, which is set as the default. This default is based on expert judgement only. Therefore, the Q-factor is set to 1.

Molecular weight matrix
It is assumed here that the molecular weight matrix of the substance in a wet tissue is equal to that of a diluted liquid all-purpose cleaning product. The fraction of water in the liquid fraction of the wipe is 0.8 and thus the molecular weight matrix is 18 g/mol / 0.8 = 22 g/mol (8.1.1). The default remains 22 g/mol. The Q-factor is set to 2, because the supporting quantitative data are limited.

Table 8.7: Default values for estimating consumer exposure to substances in all-purpose cleaner wet tissues during application

Default value		**Q-factor**	**Source**
General			
Frequency	88 per year	4	Annex II
Inhalation–exposure to vapour–evaporation–increasing release			
Exposure duration	240 min	1	Section 8.1
Product amount	11.2 g	4	Section 4.2.2.2
Room volume	20 m^3	4	Unspecified room (Te Biesebeek et al., 2014)
Ventilation rate	0.6 per hour	3	Unspecified room (Te Biesebeek et al., 2014)
Release area	2 m^2	2	Kitchen top (Weerdesteijn et al., 1999)
Application duration	5 min	3	AISE, 2014
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	22 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Section 4.2.2
Product amount	0.05 g	3	Section 4.2.2

9 Abrasives

Abrasives are cleaners containing small mineral particles, which create a scouring effect that removes dirt firmly attached to a surface. According to AISE (2014) and EPHECT (2012), abrasive powders are still used, but abrasives are nowadays mostly on the market as (creamy) liquids and ready-to-use scouring pads. Scouring pads consist of a ball of fine steel wire and may contain a cleaning mixture of soap. The pad then provides the scouring action and the soap the cleaning action. This Fact Sheet however only describes the abrasive products that are applied to a surface both to be scoured and to clean.

Table 9.1: General composition of abrasives (www.isditproductveilig.nl and www.cleanright.eu)

Abrasive cleaner ingredients	Powder % (w/w)	Liquid % (w/w)
Surfactants		
Anionic	1–5	1–5
Non-ionic		1–5
Soap	0–1	0–1
Abrasives		
Calcium carbonate	90–95	20–50
Sodium carbonate	0–5	1–10
Builders		
Polycarboxylate		0–2
Additives		
Dyes	0–0.1	0–0.1
Fragrances	<0.5	0.1–2
Preservatives		<0.5
Water		40–60

9.1 Abrasive powder

The use of powders such as abrasive powders can lead to inhalation of and oral exposure to airborne particles. There is currently no model available that is specific to the use of powders. Exposure to powders can be calculated with the help of the ‘spray model’, which has been developed for the spraying of (liquid) aerosols. The spray model describes the behaviour of a cloud of aerosol particles, but it can also be used to describe a cloud of solid particles, which is in this case a scattered powder.

Scenarios for consumer exposure

Abrasive powder is considered to be a ready-to-use product, since the consumer directly scatters the powder from the packaging to the surface that is to be cleaned. Therefore, there is no exposure considered from mixing and loading (4.1.3). Prud’homme de Lodder et al. (2006a) describes the cleaning of kitchen (gas) stoves, sinks and work tops, corresponding to a combined surface area of 0.5 m^2 (approximately 0.16 m^2 kitchen sink and 0.36 m^2 gas stove). Directly after scattering, the consumer suspends the powder with some water and rubs the surfaces with a wet cloth. Dermal exposure is expected during rubbing via hand contact with the wet cloth. It is assumed that the consumer stays in the kitchen afterwards for at least 1 hour. Secondary exposure is not expected, because the treated surface is rubbed clean and dried afterwards and it is assumed not to be within the reach of small children.

Frequency
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a frequency default of 104 times per year, which was based on the 75^{th} percentile derived in a study of Weegels (1997). However, new information has been collected (Table 9.2). A new default of 91 times per year is set specifically for the use of abrasive powders in the kitchen, as described in the consumer exposure scenario. The respective data collected from EPHECT and recalculated in Annex II provide a sufficient number of data points (144) to set the Q-factor to 4.

Table 9.2: Overview of frequencies given for the use of abrasive powders according to different references

Frequency (per year)	Quantified as	Cleaned surface	n	Reference
104	Default (2006)	Kitchen	n.a.	Prud'homme de Lodder et al., 2006a
295	75^{th} percentile	Multiple	12	Weegels, 1997
104	Typical	Undefined	n.a.	AISE, 2014
91	75^{th} percentile	Kitchen	144	EPHECT, 2012; Annex II
62	75^{th} percentile	Multiple	142	EPHECT, 2012; Annex II
97	75^{th} percentile	Bathroom	97	EPHECT, 2012; Annex II
55	75^{th} percentile	Floor	67	EPHECT, 2012; Annex II
44	75^{th} percentile	Glass	20	EPHECT, 2012; Annex II

9.1.1 *Application: scattering*

ConsExpo Web does not possess a specific model to simulate exposure from scattering powders (Delmaar & Schuur, 2016). Nonetheless, the ***inhalation–exposure to spray–spraying release*** model is parameterized in such a way that it can be adapted to assess inhalation exposure to non-volatile substances in abrasive powders as well. For the estimation of dermal exposure the ***dermal–direct product contact–constant rate loading*** model is used. The ***inhalation–exposure to spray–instantaneous release*** model is used to estimate inhalation exposure to volatile substances.

Spray duration
Spray duration is set equivalent to the duration of scattering the powder. From expert judgement sink and gas stove. The default is set to 1 min, but with a Q-factor of 1, because it is based on expert judgement.

Mass generation rate
Mass generation rate (g/s) is set equivalent to the amount of product (g) used for the cleaning task divided by the scatter duration (s). The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 36.9 g per min, which was calculated from the 75^{th} percentile 36.9 g amount of powder used per cleaning task

from a study by Weegels (1997). The scatter duration is 1 min (see above). Hence, 36.9 g powder per 60 s is being scattered, so that the previous default mass generation rate was set to 0.62 g/s. However, according to the new information collected from EPHECT and recalculated in Annex II, the 75^{th} percentile of product amount required to clean a kitchen is 35 g. The new default for mass generation rate is therefore set to 0.58 g/s (note that the mass generation rate is derived from the amount used and the spray duration; if a longer or shorter duration of 'spraying' is used, change the mass generation rate accordingly). The Q-factor is 4, because of the availability of quantitative data (n=144) specifically collected for the amount of powder used in the kitchen.

Airborne fraction
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 0.2, which refers to a surface spray with a particle size distribution for which the median diameter is ≥ 50 µm. No new data has become available for abrasive powders, so that the default remains unchanged at 0.2. The Q-factor is set to 1, as the default originally depended on expert judgement only.

Density – non-volatile
Abrasive powder products consist of 90–95% calcium carbonates (Table 9.1), which have a density of 2.93 g/cm^3. The default therefore remains at 3 g/cm^3 The Q-factor is 4, because the density of calcium carbonate is considered to be evident.

Initial particle distribution
No information is available on the particle size distributions of powders used to clean kitchens. However, the composition of powders that consist of fine talc and lime is quite similar to or the same as that of crack and crevice powders used as biocides against fleas and ants (ECHA, 2015a). The median particle diameter of crack and crevice powder is characterized as 'less than 75 µm'. The default particle size distribution for abrasive kitchen powders in the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) was also derived from particle sizes of comparable biocidal powders (EC, 2002). Because more convincing data have not became available since the publication of the previous Cleaning Products Fact Sheet, in 2006, the particle size of powders remains characterized as a lognormal distribution with a median of 75 µm and a C.V. of 0.6. Given the limited data, the Q-factor is 1.

Released mass
Released mass is interpreted here as the amount of abrasive powder scattered over the kitchen sink and gas stove. This has already been estimated at 35 g (mass generation rate). Therefore, the default released mass set to 35 g. The Q-factor is set to 4 accordingly.

Table 9.3: Default values for estimating consumer exposure to abrasive powder during scattering

Default value		**Q-factor**	**Source**
General			
Frequency	91 per year	4	Annex II
Inhalation–exposure to spray–spraying			
Spray duration[1]	1 min	1	See above
Exposure duration[2]	60 min	1	Scenario
Room volume[1]	15 m^3	4	Kitchen (Te Biesebeek et al., 2014)
Room height[1]	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate[2]	2.5 per hour	3	Kitchen (Te Biesebeek et al., 2014)
Mass generation rate[1,4]	0.58 g/s	4	See above
Airborne fraction[1]	0.2	1	Prud'homme de Lodder et al., 2006a
Density non-volatile[1]	3 g/cm^3	4	Calcium carbonate
Initial particle distribution Median[1] (C.V.)[1]	75 µm (0.6)	1	Prud'homme de Lodder et al., 2006a
Inhalation cut-off diameter[1]	15 µm	3	Delmaar & Schuur, 2016
Inhalation–exposure to spray–instantaneous release			
Released mass[3]	35 g	4	Annex II
Dermal–direct product contact–constant rate loading			
Exposed area	225 cm^2	3	Inside of hand (Te Biesebeek et al., 2014)
Contact rate	2.8 mg/min	2	Section 4.1.1
Release duration	1 min	1	'Spray duration' set equivalent to scattering duration

1: Applies to non-volatile substances only
2: Applies to both volatile and non-volatile substances
3: Applies to volatile substances only
4: The mass generation rate is derived from the amount used and the spray duration; if a longer or shorter duration of 'spraying' is used, change the mass generation rate accordingly

9.1.2 *Application: rubbing*

The expected dermal exposure from rubbing a wetted surface with abrasive powder and a wet cloth is estimated as described in the generic scenario for surface treatment (4.2.2). Hence, the ***dermal–direct product contact–instant application loading*** model is used.

Product amount

In Annex II it is presented that to clean a kitchen with abrasive powder an amount of 35 g is used. The abrasive powder is rubbed in with a wet cloth. The surface is thus treated with water. In a small experiment it was observed that the surface is fully wet at 40 ml water per m^2 (Prud'homme de Lodder et al., 2006a). The surface is 0.5 m^2, so that the amount of water required to wet it is 20 ml. A product amount of 35 g is applied to the surface, so that the concentration of product in the water is 35 g / 20 ml = 1.75 g/ml. The volume of water that ends up on the inside of the hand by touching the wet cloth is calculated by multiplying a layer thickness 0.01 cm (ECHA, 2015a) by the exposed area of 225 cm^2: 2.25 ml. The product amount that is subject to dermal exposure is calculated as 1.75 g/ml x 2.25 ml = 3.9 g. The default for the product amount available for dermal exposure is therefore 3.94 g. The Q-factor is set to 2, because the supporting quantitative data are limited.

Table 9.4: Default values for estimating consumer exposure to abrasive powders during rubbing

Default value		**Q-factor**	**Source**
General			
Frequency	91 per year	4	Annex II
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Inside hand (Te Biesebeek et al., 2014)
Product amount	3.9 g	2	See above

9.2 Abrasive liquids

Abrasive liquids are suspensions of solid abrasive particles in a viscous, (creamy) liquid matrix. The ingredients of general-purpose abrasive liquids are similar to those of abrasive powders with water added (Table 9.1), the mineral composition of such liquids also being mainly calcium carbonates.

Scenarios for consumer exposure

Abrasive liquids are considered to be a ready-to-use product, since the consumer directly applies the liquid to the surface to be cleaned by squeezing the bottle. Therefore, there is no exposure considered from mixing and loading (4.1.3). The surface to be cleaned is a kitchen sink and gas stove of 0.5 m^2 (approximately 0.16 m^2 kitchen sink and 0.36 m^2 gas stove). Directly after application, the consumer starts to rub the surfaces with a wet cloth. Dermal exposure is expected during rubbing via hand contact with the wet cloth. Inhalation exposure is anticipated as well, since volatile substances may evaporate from the treated surface. It is assumed that the consumer stays in the kitchen afterwards for at least 1 hour. Secondary exposure is not expected, because the treated surface is cleaned and dried afterwards and it is assumed not to be within the reach of small children.

Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 156 times per year. According to AISE (2014), respondents clean between 1 to 7 times per week, with a typical use frequency of 2 times per week. Weegels (1997) reports a 75^{th} percentile frequency for the use of abrasives (powder and liquids) of 295 per year. Analysis of the EPHECT survey data (2012) shows a 75^{th} percentile use frequency of abrasive liquids for kitchens of 135 per year, for bathrooms of 88 per year, for general purpose of 84 per year, for glass of 62 per year and for floors of 55 per year. Based on the more recent data and number of data points (n=144) in this scenario, the new default is set at 135 times per year. The Q-factor is 4, because the underlying datasets are large and the data were collected specifically to measure the use of abrasive liquids to clean the kitchen.

9.2.1 *Application: rubbing*

The expected exposure from rubbing a kitchen sink and stove with abrasive liquid is estimated as described in the generic scenario for surface treatment (4.2.2). Therefore, inhalation exposure is estimated using the ***inhalation–exposure to vapour–evaporation–increasing release area*** model, whereas for dermal exposure the ***dermal–direct product contact–instant application loading*** model is used.

Application duration

According to AISE (2014), the task duration of surface cleaning is 10–20 minutes. The new default value for cleaning the sink and gas stove with abrasives liquid is set at 20 min with a Q-factor of 3.

Product amount – inhalation

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 37 g. AISE (2002) gives a range of 30–110 g (typical 60 g) for liquid surface cleaners. Weegels (1997) reports a 75th percentile of 36.9 g of abrasive per event. Analysis of EPHECT (2012) survey data shows 75th and 95th percentile use amounts of kitchen abrasive liquids of 32 and 76 g, respectively (Annex II). A new default of 32 g is set specifically for the use of abrasive liquids in the kitchen as described in the consumer exposure scenario. The respective data collected from EPHECT and recalculated in Annex II provide a sufficient number of data points (144) to set the Q-factor to 4.

Molecular weight matrix

According to the composition of abrasive liquids (Table 9.1), the water fraction is 0.4. Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.4), which yields 45 g/mol. The Q-factor is 2, because the supporting quantitative data are limited. The molecular weight matrix is calculated as 18 g/mol / 0.4 = 45 g/mol. The default is set at 45 g/mol with a Q-factor of 2.

Product amount – dermal

The abrasive liquid is rubbed with a wet cloth. The surface is thus treated with water. In a small experiment it was observed that the surface is fully wet at 40 ml water per m^2 (Prud'homme de Lodder et al., 2006a). The surface is 0.5 m^2, so that the amount of water required to wet it is 20 ml. The product amount applied on the surface is thus diluted with 20 ml water. The concentration in the water can then be calculated as 32 g / 20 ml = 1.6 g/ml. The volume of water that ends up on the inside of the hand by touching the wet cloth is calculated by multiplying a layer thickness of 0.01 cm (ECHA, 2015a) by the exposed area of 225 cm^2: 2.25 ml. The product amount that is subject to dermal exposure is calculated as 1.6 g/ml x 2.25 ml = 3.6 g. The new default is set to 3.6 g. The Q-factor is set to 2, because the data supporting the calculation are limited.

Table 9.5: Default values for estimating consumer exposure to abrasive liquid during rubbing

	Default value	Q-factor	Source
General			
Frequency	135 per year	4	Annex II
Inhalation–exposure to vapour–evaporation–increasing release area			
Exposure duration	60 min	1	Scenario
Product amount	32 g	4	Annex II
Room volume	15 m^3	4	Kitchen (Te Biesebeek et al., 2014)
Ventilation rate	2.5 per hour	3	Kitchen (Te Biesebeek et al., 2014)
Release area	0.5 m^2	3	Section 9.1.2
Application duration	20 min	3	See above
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	45 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Inside hand (Te Biesebeek et al., 2014)
Product amount	3.6 g	2	See above

10 Bathroom and toilet cleaning products

Various bathroom and toilet cleaning products are available for specific purposes, such as the removal of normal organic and inorganic soils as well as limescale and rust deposits from water. Generally, bathroom and toilet cleaning products are liquid acidic products and are therefore more often used undiluted than other cleaning products. Bathroom cleaners are usually liquids and are available in bottles, spray bottles and as aerosol foams. This chapter describes the use of liquid bathroom cleaning products, spray bathroom cleaners, toilet cleaners and toilet rim cleaners.

10.1 Bathroom cleaners

Bathroom cleaners are products specially designed for cleaning surfaces in bathrooms, such as bathtubs, sinks, taps and shower cabins. Bathroom cleaners are used by a large fraction of the European population according to EPHECT (2012), as 77% of their respondents reported using them. Furthermore, the EPHECT survey shows that bathroom cleaners are used, as intended, mainly in bathrooms (96%) and toilets (64%), where they are used for cleaning toilets (80%), showers (73%), bathtubs (71%), sinks (61%), walls (29%), floors (28%) and mirrors (21%). Most respondents prefer to use bathroom cleaners in liquid form (67%). Spray products are the second most popular form (51%).

Table 10.1: General composition of bathroom cleaners

Bathroom cleaner ingredients	Liquid % (w/w)	Liquid strong[1] % (w/w)	Spray[2] % (w/w)
Surfactants			1–5
Anionic	1–5	0–5	
Non-ionic	1–5	1–5	
Cationic		5–15	
Builders			0–10
Polycarboxylate, NTA or Trisodium methylglycine Diacetate	0–2	5–30	
Acids			
Citric acid	1–5		0–5
Sulfonic, lactic, formic acid			
Solvents			
Isopropanol	0–15		0–5
Additives			
Thickening agents	<1	<1	<1
Preservatives	<0.5	<1	<1
Dyes	<0.02	<1	<1
Fragrance	<1	<1	<1
Water	50–90	65–95	70–95

1: Composition adopted from Prud'homme de Lodder et al. (2006a)
2: Non-foam sprays, based on information from NVZ 2014

10.1.1 *Bathroom cleaning liquid*

Scenario for consumer exposure

During mixing and loading, the user pours the bathroom cleaner straight into a bucket (no use of a measuring cup). By doing this, inhalation exposure from evaporation and dermal exposure to the pure product due to spills can occur. Next, the consumer cleans a shower cubicle (Prud'homme de Lodder et al., 2006a) with 4 walls of 2 m^2 and a shower floor of 1 m^2, making a total surface of 3 m^2. While cleaning the surface, the user is exposed dermally to diluted substance from dipping the cloth into the bucket. Inhalation exposure to volatile substances is expected from evaporation of the substance from the treated surface. It is assumed that the consumer will leave the bathroom 5 minutes after the cleaning task. Secondary exposure is not anticipated, since the treated surfaces will not be within the reach of small children during or directly after the cleaning task.

Frequency

According to AISE (2014), the use frequency of bathroom surface cleaning is 1–7 times per week. According to EPHECT (2012), most consumers use bathroom cleaners weekly (71%), i.e. at least once a week (80%). According to EPHECT, the 75th percentile of the use frequency of bathroom cleaners is 'several times a week' (EPHECT, 2012; table Q *53*). Analysis of the EPHECT survey data shows a probabilistically simulated 75th percentile for the use frequency of 2.7 per week (Annex II). Garcia-Hidalgo et al. (2017) present summary data, from which it can be derived that '3–6 times per week' represents the 75th percentile for the frequency of cleaning the bathroom excluding the respondents that claim never to clean the bathroom. The summary data presented by Garcia-Hidalgo et al. (2017) proves to be internally consistent, as their 75th percentile for the use frequency of liquid bathroom cleaner expressed in min/day (11-20 min/day) divided by their 75th percentile for duration of the cleaning task (10–30 min) yields a range of 2.6–14 times per week. The 75th percentile of 3–6 times per week falls within this range. A default frequency of 3 times per week, 156 per year, agrees with the use frequency of liquid bathroom cleaner according to EPHECT (EPHECT, 2012; Annex II) and Garcia-Hidalgo et al. (2017) as well as for the frequency of the task of cleaning the bathroom (Garcia-Hidalgo et al., 2017). The number of samples is high, the data from the different sets are consistent with each other and specifically collected for the use of bathroom cleaner. Therefore, the Q-factor of the default frequency is set to 4.

10.1.1.1 Mixing and loading

During the opening of the bottle and pouring of liquid bathroom cleaner into a bucket, volatiles evaporate from the bottle into the personal breathing zone of the consumer. Meanwhile, spills (droplets) end up on the back of the pouring (directing) hand. To estimate the expected exposure the ***inhalation–exposure to vapour–evaporation–constant release area*** model and the ***dermal–direct product contact–instant application loading*** model are used (see Section 4.1.2). Defaults for the parameters: product amount (inhalation), exposure duration, room volume, release area, application duration, exposed area and product amount (dermal) are described in the generic scenario (4.1.2).

Molecular weight matrix
According to their general composition, the fraction of water in liquid bathroom cleaners is 0.5 (Table 10.1). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.5) which yields 36 g/mol. The Q-factor is 2, because the supporting data are limited.

Table 10.2: Default values for estimating consumer exposure to bathroom cleaner liquid during mixing and loading

Default value		**Q-factor**	**Source**
General			
Frequency	156 per year	4	EPHECT, 2012; Garcia-Hidalgo et al., 2017
Inhalation–exposure to vapour evaporation–constant release area			
Exposure duration	0.75 min	3	Section 4.1.2
Product amount	500 g	3	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	2 per hour	1	Bathroom (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Emission duration	0.3 min	3	Section 4.1.2
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	36 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Section 4.1.2
Product amount	0.01 g	3	Section 4.1.2

10.1.1.2 Application: cleaning
During cleaning, the hands and forearms come into contact with the diluted product and volatile substances evaporate from the treated surface. To estimate exposure during cleaning the ***inhalation–exposure to vapour–evaporation–increasing release area*** model and the ***dermal–direct product contact–instant application loading*** model are used. Defaults for the parameters: product amount for dermal exposure and exposed area are described in the generic scenario for the application of diluted products (4.2.3).

Amount of solution used
Amount of solution used is defined as the sum of the solvent and product amount subject to inhalation. The solvent amount subject to inhalation is considered to be the amount of water applied to the shower cubicle walls and floor. Based on a small experiment it was determined that 40 ml water wets 1 m^2 of surface (Prud'homme de Lodder et al., 2006a). The surface area of the shower cubicle is 9 m^2, so that 360 ml of water is required to clean it. Therefore, the solvent amount is 360 g. The product amount refers to the amount of bathroom cleaner diluted in the water that is applied to the surface of the shower cubicle. The concentration of bathroom cleaner in the water is 13.4 g/l (see below),

so that the amount of bathroom cleaner applied to the surface of the shower cubicle is 5 g. The amount of solution used is thus calculated to be 360 g + 5 g = 365 g. Q-factor is set to 2, because the calculation is not entirely based on expert judgement but lacks supporting by quantitative data.

Dilution (times)
The dilution in number of times (4.2.3) is calculated on the basis of the amount of bathroom cleaner liquid in the 5 l volume of water in which it is diluted. Analysis of the EPHECT (2012) study shows a 75th percentile of 67 g for the amount of liquid bathroom cleaner used for the entire cleaning task (Annex II). Therefore, the amount of solution in the bucket is 67 g + 5000 g = 5067 g and the concentration of product in the solution is 67 g / 5l = 13.4 g/l. The dilution in number of times is calculated by dividing the amount of solution by the product amount, so that 5067 g / 67 g = 76 times. The Q-factor is set to 3, because the assumption of 5 l in the half-empty bucket compromises the quality of the EPHECT data.

Application duration
According to the AISE survey (2014), the duration of cleaning the bathroom is 10–20 minutes. Andra et al. (2015) present a median duration of 15 min, whereas Kalyvas et al. (2014) present a 75th percentile of 19 min for consumers cleaning the shower. Garcia-Hidalgo et al. (2017) present summary data, from which it can be derived that the 75th percentile is between 10 and 30 min. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 20 min, which reasonably agrees with these different data sources. The default value therefore remains at 20 minutes. The Q-factor is set to 4, because the underlying datasets are large and specifically refer to the duration of cleaning the shower cubicle.

Exposure duration
The user is expected to remain in the bathroom after cleaning for 5 minutes. Therefore, the default remains 25 min. The Q-factor is 3, because the high-quality data referring to the application duration is compromised by the assumption that the consumer stays in the room for 5 min after the cleaning task.

Product amount – dermal
The product amount that is subject to dermal exposure is calculated from the product concentration in the water of the bucket multiplied by the volume of water that is in contact with the consumer's skin. The volume of water ending up on the exposed skin when the hands and forearms are dipped in the water is 22 ml (4.2.3). The concentration of bathroom cleaner in the bucket is 13.4 g/l. The product amount that is subject to dermal exposure is thus calculated as 13.4 g/l x 22 ml = 0.3 g. The Q-factor is set to 2, because the supporting quantitative data are limited.

Table 10.3: Default values for estimating consumer exposure to bathroom cleaner liquid during cleaning[1]

Default value		**Q-factor**	**Source**
General			
Frequency	156 per year	4	EPHECT, 2012; Garcia-Hidalgo et al., 2017
Inhalation–exposure to vapour–evaporation–increasing release area			
Exposure duration	25 min	3	See above
Amount of solution used	365 g	2	See above
Dilution (times)	76	3	See above
Room volume	10 m^3	4	Bathroom (Te Biesebeek et al., 2014)
Ventilation rate	2 per hour	3	Bathroom (Te Biesebeek et al., 2014)
Release area	9 m^2	3	Prud'homme de Lodder et al., 2006a
Application duration	20 min	4	AISE, 2014
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water
Dermal–direct product contact–instant application loading			
Exposed area	2200 cm^2	3	Section 4.2.3
Product amount	0.3 g	2	See above

1: In the scenario description above, the expected use of diluted bathroom liquids is assessed. Some consumers, however, use undiluted liquid by directly applying it to a cloth or sponge, and then cleaning the tiles or shower cabins. For this situation, it is advised to calculate dermal exposure using the dermal–direct product contact–instant application loading model, assuming a contact area of one hand. For inhalation exposure, the exposure to vapour–evaporation–increasing release model can be used. The latter model needs adjustment for duration and amounts by the assessor (case by case).

10.1.2 *Bathroom cleaner spray*

Scenario for consumer exposure

The consumer treats a shower cubicle with 4 walls of 2 m^2 and a floor of 1 m^2 with a trigger spray. Since spray bathroom cleaners are ready-to-use products, mixing and loading is not required before application. The product is first sprayed onto the surface (application). At this moment inhalation exposure is expected from aerosols generated by the trigger spray, whereas dermal exposure is also expected from sprayed aerosols depositing on the unprotected skin of the consumer. Once the cleaning product has been sprayed onto the surface of the walls it is left to soak (leave-on) for several minutes. Finally, the surface is rinsed or wiped with a wet cloth. Exposure during leave-on is, however, not calculated, because inhalation exposure to volatile substances in sprays is already covered by exposure during spray application (4.2.2). Dermal exposure is also not expected during leave-on, because the consumer will not touch the treated surface until it is rinsed or wiped. Upon wiping the surface, dermal exposure is expected from hand contact with the cloth. Such dermal exposure is considered equal to that of cleaning the bathroom with liquid cleaner. The treated surface is assumed not to be within reach of small children and the consumer will leave the shower cubicle after the cleaning task, so that secondary exposure is not expected.

Frequency
Analysis of EPHECT (2012) data gives a 75th percentile of the use frequency of bathroom spraying products of 120 per year (n=740) (Annex II), whereas Westat (1987) gives a 75th percentile of 52 times per year. A 75th percentile of '1–10 min/day' is derived from the summary data (n=611) of Garcia-Hidalgo et al. (2017). The task duration of cleaning the bathroom with spray cleaner is set to 10 min based on the data of AISE (2009, see below). Assuming that the task takes 10 min, the use frequency derived from the summary data of Garcia-Hidalgo et al. (2017) of 1–10 min per day can be recalculated into a frequency of 37–365 per year. Nonetheless, it is not certain to what extent this frequency (expressed in min/day) is due to the duration of the task (min) or how often the task is performed (per day). Therefore the EPHECT data (Annex II) are more appropriate for deriving the default frequency. Still, the summary data of Garcia-Hidalgo et al. (2017) indicate that their frequency expressed in min/day is consistent with the frequency expressed as per day by EPHECT (2012). The 75th percentile derived from Westat (1987) is considerably smaller. The data of EPHECT (2012) and Garcia-Hidalgo et al. (2017) are preferred over those of Westat (1987) because they are more recent and are consistent with each other. The default frequency is thus set to 120 per year. The Q-factor is set to 4, because the underlying datasets are large, consistent and specifically collected to calculate the use frequency of bathroom spray cleaner.

10.1.2.1 Application: spraying

Inhalation exposure to non-volatile substances in sprayed aerosols is estimated using the ***inhalation–exposure to spray–spraying*** model. Dermal exposure is estimated using the ***dermal–direct product contact–constant rate loading*** model. The defaults for the parameters: mass generation rate, density non-volatiles and contact rate area are in accordance with the generic scenario (4.2.1). Inhalation exposure to volatile substances in bathroom cleaner sprays is estimated using the ***inhalation–exposure to spray–instantaneous release*** model. The defaults for the parameters: exposure duration, room volume, ventilation and inhalation rate for non-volatiles in bathroom cleaner sprays also apply to volatile substances.

Spray duration
According to Weerdesteijn et al. (1999), the 75th percentile for the amount of product required to clean surfaces is 11.1 g per m^2. The shower cubicle consists of 4 walls of 2 m^2 and a floor 1 m^2, so that the surface area to be cleaned is 9 m^2, resulting in a sprayed amount of 100 g. Delmaar & Bremmer (2009) found a bathroom trigger spray to generate 1.25 g/s, so that the spray duration is calculated as 100 divided by 1.25 is 80 s. The new default value is set to 80 s. The Q-factor is set to 2, because the supporting data refer to spray cleaners in general and the number of samples is limited (Weerdesteijn et al., 1999).

Exposure duration
The exposure duration is interpreted here as the sum of the duration of the cleaning task itself and the time spent in the bathroom afterwards.

According to AISE (2014), the cleaning task duration is a maximum of 10 min, whereas Kalyvas et al. (2014) present a 75th percentile of 19 min for consumers cleaning the shower. The AISE data are based on 5249 respondents in 23 different European countries, whereas Kalyvas collected data from 224 respondents in Nicosia, Cyprus. From the survey data of Garcia-Hidalgo et al. (2017) it is derived that the respondent representing the 75th percentile would report taking 10–30 min to clean the bathroom, which agrees with the 19 min derived by Kalyvas et al. (2014). The scenario describes that the consumer remains in the bathroom for 5 min after the task is finished. Therefore, the new default is set at 24 min. The Q-factor is set to 3, because the duration of the cleaning task is represented by high-quality data (high number of samples and specifically collected to measure bathroom cleaning), but these are compromised by the assumption that the consumer stays for 5 min in the bathroom afterwards.

Airborne fraction
Since the spray is meant for cleaning surfaces only, a small part becomes (unintentionally) airborne. Hence, the generic default airborne fraction of 0.2 based on the experiments of Delmaar & Bremmer (2009) is used as the default for bathroom sprays. The Q-factor is 2, because the experiments of Delmaar & Bremmer comprise only a small number of samples and the data refer generically to surface sprays rather than specifically to bathroom sprays.

Initial particle distribution
Delmaar & Bremmer experimentally derived a median particle size for bathroom cleaner sprays of 3.6 µm with a C.V. of 0.52. The default initial particle distribution is set accordingly. The Q-factor is set to 3, because the experimental data specifically describe the particle size distribution of bathroom sprays, but the number of samples is limited.

Released mass
Released mass is interpreted here as the product amount that is sprayed out of the bottle or can, which has already been estimated to be 100 g (spray duration, see above) based on the data of Weerdesteijn et al. (1999). The Q-factor is set to 2, because the supporting data refer to spray cleaners in general and the number of samples is limited (Weerdesteijn et al., 1999).

Table 10.4: Default values for estimating consumer exposure to bathroom cleaner spray during application

Default value		**Q-factor**	**Source**
General			
Frequency	120 per year	4	EPHECT, 2012; Garcia-Hidalgo et al., 2017
Inhalation–exposure to spray–spraying			
Spray duration[1]	80 s	2	See above
Exposure duration[2]	24 min	3	See above
Room volume[2]	10 m^3	4	Bathroom (Te Biesebeek et al., 2014)
Room height[1]	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate[2]	2 per hour	3	Bathroom (Te Biesebeek et al., 2014)
Mass generation rate[1]	1.25 g/s	3	Delmaar & Bremmer, 2009
Airborne fraction[1]	0.2	2	Delmaar & Bremmer, 2009
Density non-volatile[1]	1.8 g/cm^3	3	Section 4.2.1
Initial particle distribution Median[1] (C.V.) [1]	3.6 µm (0.52)	3	Delmaar & Bremmer, 2009
Inhalation cut-off diameter[1]	15 µm	3	Delmaar & Schuur, 2016
Inhalation–exposure to spray–instantaneous release			
Released mass[3]	100 g	2	See above
Dermal–direct product contact–constant rate loading			
Exposed area	2200 cm^2	3	Section 4.2.1
Contact rate	46 mg/min	3	Section 4.2.1
Release duration	160 s	2	Twice the spray duration (4.2.1)

1: Applies to non-volatile substances only
2: Applies to both volatile and non-volatile substances
3: Applies to volatile substances only

10.1.2.2 Application: rinsing

Dermal exposure to bathroom spray during the rinsing task is expected, as the consumer touches a wet cloth that contains the sprayed product. According to the generic exposure scenario for cleaning with a wet cloth (4.2.2), dermal exposure is estimated using the ***dermal–direct product contact–instant application loading***.

Product amount

The product amount is calculated from the concentration of bathroom spray product in the water that is absorbed by the wet cloth. This concentration is equal to the amount of product sprayed onto the shower cubicle divided by the volume of water applied to the shower cubicle surface. According to the scenario, the consumer cleans a shower cubicle with a surface of 9 m^2. In a small experiment it was determined that 40-ml of water wets 1 m^2 of surface, so that it is derived that the volume of water on the shower cubicle surface is 360 ml. The amount of sprayed product is 100 g (see ‘spray duration’ in section 10.1.2.1). The concentration in of product in the cleaning water is thus 100 g / 360 ml =

0.2775 g/ml. The consumer is in dermal contact with 2.25 ml water by touching the wet cloth (4.2.2), so that the product amount that is subject to dermal exposure is 2.25 ml x 0.2775 g/ml = 0.62 g. The default product amount is thus set to 0.62 g. The Q-factor is set to 2, because the supporting data are limited.

Table 10.5: Default values for estimating consumer exposure to bathroom cleaner spray derived for the application of cleaning

Default value		**Q-factor**	**Source**
General			
Frequency	120 per year	4	EPHECT, 2012; Garcia-Hidalgo et al., 2017
Dermal–direct product contact–instant application loading			
Exposed area Product amount	225 cm^2 0.62 g	3 2	Section 4.2.2 See above

10.2 Toilet cleaner

Toilet cleaners are divided in two product types: cleaners containing acids for removing calcium or metal salts; and cleaners containing a bleaching system, which can be hydrogen peroxide or hypochlorite. In this section both types of toilet cleaners are described.

Table 10.6: General composition of toilet cleaners

Toilet cleaner ingredients	**Liquid, acid[A,B] % (w/w)**	**Liquid, bleaching[B,C] % (w/w)**
Surfactants Anionic surfactants Non-ionic surfactants Cationic surfactants	 0–10 1–15 0–15	 0–10 2–10
Acids Sulfonic, citric, lactic, formic phosphoric and sulfamic acid	0–10	
Salts, acids, bases		2–10
Bleaching agents[1] Active hydrogen peroxide Active hypochlorite		1–5
Additives Polymers Builders Dyes Perfume	 0–5 <1 <1	 0–5 0–2 <1 <1
Water	85–90	85–90

A: Vollebregt et al., 1994
B: Vollebregt & Van Broekhuizen, 1994
C: Unilever Nederland, 2006
1: Bleaching products with active oxygen can be acid or alkaline, whereas products containing hypochlorite are always alkaline.

Scenarios for consumer exposure

The consumer cleans the interior of the toilet (also referred to as the toilet bowl). Toilet cleaners are considered to be ready-to-use products, so that exposure from mixing and loading is not anticipated (4.1.3). Rather, the product is directly applied with by squeezing the bottle under the rim of the toilet bowl. Then the toilet cleaner is left to soak (leave-on) for several minutes. After this leave-on period, the toilet bowl is brushed. During brushing, dermal contact with the toilet cleaner may occur. The consumer may also inhale volatile substances that evaporate from the cleaning product. The consumer washes their hands after brushing and flushes the toilet. Secondary exposure after flushing the toilet is thus not considered, because it will be negligible compared with the exposure during the cleaning task. Hence, exposure is expected only during the cleaning task itself.

10.2.1 Application - cleaning

The ***inhalation–exposure to vapour evaporation–constant release area*** model is used to estimate inhalation exposure during the task of cleaning the toilet, whereas the ***dermal–direct product contact–constant rate loading*** model is used to estimate dermal exposure.

Frequency
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default frequency of 260 per year based on Weegels (1997). These authors investigated the use of toilet cleaners and derived a mean frequency of 2 times per week (St. Dev=4.2, n=10) and a 75th percentile of 5 times per week (Weegels, 1997). According to the AISE survey (2014), the maximum use frequency is 2 times a week. According to the summary data of Garcia-Hidalgo et al. (2017), the 75th percentile value for the frequency of cleaning the toilet corresponds to '3–6 times per week', the duration '1–10 min per task' or '1–10 min per day'. Hence, the summary data presented by Garcia-Hidalgo et al. (2017) prove to be internally consistent. The default frequency is set to 156 per year (3 times per week) in accordance with the different data sources. The Q-factor is set to 4, because the underlying dataset is large and was collected specifically to measure the task of cleaning the toilet.

Emission duration
According to AISE (2014), it takes 'less than 1 min' to clean the toilet bowl. Weegels (1997) found a mean value of 72 s (St. Dev=41 s) and a 75th percentile of 100 s (total range 10–150 s). According to the summary data of Garcia-Hidalgo et al. (2017), the 75th percentile for application duration would be '1–10 min per task' or '1–10 min per day' for a frequency of '3–6 times per week'. The default value remains 2 min, because this duration agrees with the data of Weegels (1997) and of Garcia-Hidalgo et al. (2017) for task duration (1–10 min per task) and frequencies (1–10 min a day; 3–6 times a week). The Q-factor is set to 4, because the data of Weegels (1997) and Garcia-Hidalgo et al. (2017) are consistent, and the dataset of Garcia-Hidalgo et al. (2017) is large and specifically collected to measure the duration of cleaning a toilet bowl.

Exposure duration
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 3 min. Recent studies by Andra et al. (2015) and Kalyvas et al. (2014), however, show that 3 min is an underestimation of the exposure duration. Rather, the questionnaire data of Andra et al. show a median duration for the entire cleaning task of

8 min (n=57), whereas the questionnaire data of Kalyvas et al. presents a 75^{th} percentile of 7 min (n=224). A new default is set at 7 min, based on the data of Kalyvas et al. (2014), which comprises the largest number of investigated individuals. The Q-factor is 4, because the underlying dataset is large and specifically collected to measure the task of cleaning a toilet.

Room volume
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 2.5 m^3.This is a worst-case approach, as it is assumed that the toilet is in a separate room and the door is closed. The default remains at 2.5 m^3, but the Q-factor is lowered to 2 as the underlying data and assumptions are based on a combination of expert judgment and data on toilet volumes from the General Fact Sheet.

Release area
The release area is equal to the surface that needs to be cleaned, which is the inside of the toilet bowl. This surface area is calculated as that of a truncated cone plus the bottom of the toilet bowl. The radius of the rim of a standard toilet is about 20 cm and the radius of the bottom about 5 cm. The depth of the toilet is about 20 cm and the rim about 5 cm (Kohler, 2017a, b; Parisi Bathware 2016). The toilet rim is not considered to be part of the bowl, so that the depth of the surface to treat is 20 - 5 = 15 cm. The area of the truncated cone is calculated as:

$$S_{toilet} = \pi(r_{upside} + r_{bottom})\sqrt{(r_{upside} - r_{bottom})^2 + depth_{pan}{}^2} + \pi r_{bottom}{}^2$$

$$S_{toilet} = \pi(20+5)\sqrt{(20-5)^2 + 15^2} + \pi 5^2 \approx 1750cm^2$$

The default release area is thus set at 1750 cm^2. The Q-factor is 2, because the data supporting the calculation are limited.

Product amount – inhalation
The toilet is cleaned with an undiluted cleaning product. The product amount depends on the type of toilet cleaner: acid- or bleach-based. According to Weegels (1997), the average amount bleach agents used is 55 g and the 75^{th} percentile is 80 g (St. Dev=37 g, n=9). For acid agents Weegels found an average amount of 40 g and a 75^{th} percentile of 55 g (St. Dev=22g, n=12). AISE only gives 30 g as a typical amount for liquid toilet cleaners, whereas for gel toilet cleaners the typical amount is set as 25 g with a range from 20 to 35 g (AISE, 2014). Therefore, the default product amounts for inhalation are still based on Weegels' 75^{th} percentiles: 80 g for bleach and 55 g for acids. The Q-factor is 3, because the number of data points is limited (n=9 for bleach, n=12 for acids) but the data were specifically collected to measure the cleaning of toilet bowls.

Molecular weight matrix
The fraction of water in both toilet cleaner types (acid and bleach) is estimated as 0.85 (Table 10.6). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.85), which yields 21 g/mol. The Q-factor is 2, because the supporting quantitative data are limited.

Exposed area
It is assumed that dermal exposure can be estimated using the same approach as the rough brushing application of biocides (ECHA, 2015b). The Guidance on the Biocidal Products Regulation indicates that during 'rough brushing' the hands and forearms of the person holding the brush are subject to dermal exposure. However, during toilet cleaning with a liquid toilet cleaner, only one hand is in the bowl. The default exposed area is thus set to 450 cm^2 with a Q-factor of 3, which is consistent with the default and Q factor presented in the General Fact Sheet (Te Biesebeek et al., 2014).

Contact rate
The consumer is dermally exposed through splatters of undiluted product from roughly brushing the toilet pan. It is assumed that dermal exposure can be estimated using the same approach as the rough brushing application of biocides (ECHA, 2015b), which describes a 75th percentile contact rate of 193 mg/min. The default is thus set to 193 mg/min. The Q-factor is set to 2, because the original dataset (HSL, 2001) is large but refers to painting rough wooden joints. Hence, the quality of the data is compromised by assuming they are suitable for estimating dermal exposure from brushing a toilet.

Table 10.7: Default values for estimating consumer exposure to toilet cleaner (acid and bleach) during brushing

Default value		**Q-factor**	**Source**
General			
Frequency	156 per year	4	Weegels, 1997; Garcia-Hidalgo et al., 2017
Inhalation–exposure to vapour–evaporation–constant release area			
Exposure duration	7 min	3	Kalyvas et al., 2014
Product amount			
- Acid toilet cleaner	55 g	3	Weegels, 1997
- Bleach toilet cleaner	80 g	3	Weegels, 1997
Room volume	2.5 m^3	4	Toilet (Te Biesebeek et al., 2014)
Ventilation rate	2 per hour	3	Toilet (Te Biesebeek et al., 2014)
Release area	0.175 m^2	2	See above
Emission duration	2 min	4	Weegels, 1997
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	21 g/mol	2	See above
Dermal–direct product contact–constant rate loading			
Exposed area	450 cm^2	3	See above
Contact rate	193 mg/min	2	ECHA, 2015b
Release duration	2 min	4	Emission duration

10.3 Toilet rim blocks

Toilet rim blocks are fixed to the inner ring of the toilet bowl. They release active ingredients into the bowl at each flush of the toilet, so that the toilet bowl is cleaned automatically and a nice fresh smell is released. There are two main types of rim blocks: solid and liquid.

Table 10.8: General composition of toilet rim cleaners (NVZ 2004)

Toilet rim cleaners	Liquid %	Solid %
Surfactants		
Anionic surfactants	10–30	30–50
Non-ionic surfactants	2–10	1–10
Filler		
Sodium sulphate		40–60
Additives		
Perfume	5–10	3–10
Water	rest	

Scenario for consumer exposure

The toilet rim block is considered to be a ready-to-use product, so that there is no exposure expected from mixing and loading (4.1.3). Toilet rim blocks are designed to constantly provide a fresh smell in the room. Hence, it is assumed that the amount of product that is in the air is constant over time. The consumer will experience inhalation exposure to this steady air concentration during toilet visits.

10.3.1 Application - toilet visit

The ***inhalation–exposure to vapour–instant release*** model is used to calculate the expected inhalation exposure from the steady-state air concentration.

Product amount

The product amount that is subject to inhalation is interpreted as the amount of product that is in the air. The air concentration is constant over time, which means there is a steady-state situation. For such a steady-state situation the amount of product in the air can be calculated from a mass balance equation (Mackay, 2001): $m = E/k$, where m is the amount of product in the air, E is the emission rate of the product to the air and k is the removal rate by means of ventilation. The ventilation rate in a toilet room is 2 room air changes per hour (Te Biesebeek et al., 2014). The emission rate is calculated as the mass of the rim block divided by service life time of the product. In the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) the default mass of a solid rim block is given as 30 g and its service life 30 days, whereas a liquid rim block contains 70 g of substance and has a service life of 60 days. Hence, the steady-state amount of product in the air is 0.021 g for solid blocks and 0.024 g for liquid blocks. The Q-factor remains 2, because the supporting data are limited.

Ventilation rate

For this specific calculation the ventilation rate is set to zero to avoid double calculation of the amount of substance removed. Ventilation is the process that removes the product from the air in the toilet room.

However, this removal process is already included in the calculation of the steady-state product amount. The Q-factor is set to 3, referring to the default ventilation rate of a toilet in the General Fact Sheet (Te Biesebeek et al. 2014) used above to calculate the steady-state product amount.

Exposure duration
Exposure duration reflects the duration of a toilet visit by the consumer. It is considered healthy behaviour for a person to go to the toilet 10 times a day for 5 min (Heaton et al., 1992; B&B Community, 2017), so that the daily time spent on the toilet is about 50 min. The default exposure duration is therefore set to 50 min. The Q-factor for this default is 2, because the supporting data are limited.

Table 10.9: Default values for estimating consumer exposure to toilet rim blocks from total daily toilet visits

Default value		**Q-factor**	**Source**
General			
Frequency	365 per year	4	Exposure duration refers to time spent on the toilet daily, see above
Inhalation–exposure to vapour–instant release			
Exposure duration	50 min	2	See above
Product amount			
- Solid rim blocks	0.21 g	2	See above
- Liquid rim blocks	0.24 g	2	See above
Room volume	2.5 m^3	4	Toilet (Te Biesebeek et al., 2014)
Ventilation rate	0 per hour	3	See above

11 Floor, carpet and furniture products

The floor, carpet and furniture products described in this Fact Sheet combine cleaning, polishing and protecting aspects where applicable. Depending on their intended function, the products contain either more cleaning or more protecting compounds. Default values are given for floor cleaners and polishers (Section 11.1), carpet cleaners (Section 11.2) and furniture and leather cleaning products (Section 11.3).

In practice, consumers can also choose from additional cleaning products to suit their specific floor surface, e.g. stone, parquet, laminate and wood. These products will not be covered in detail, but the scenarios described in this chapter can be used to estimate the exposure to all these types of products.

11.1 Floor products

Floor products can be divided into floor cleaners, floor polishes, combined cleaners and polishers, sealing products and stripping products. For floor sealing and stripping products only general information is given (Table 11.1).

Combined cleaning and polishing products (two-in-one products) remove dirt and grease and, once dried, give a lasting shine to floors and leave a thin layer of wax to protect against new stains (www.cleanright.eu; EPHECT, 2012).

Table 11.1: General composition of floor cleaning and protecting products

Floor product ingredients	**Cleaner liquid[A] % (w/w)**	**Polisher[B] % (w/w)**	**Combined product[A,B] % (w/w)**	**Sealer[A] % (w/w)**	**Stripper A[A,C] % (w/w)**	**Stripper B[A,C] % (w/w)**
Surfactants		0–5				
Anionic	5–15		1–10		0–15	
Soap	1–30		1–5		0–5	
Non-ionic	5–15		1–10		0–5	
Builders	<5				3–8	
NTA, phosphates,			0–2			
Phosphonates			0–0.5			
Citric acid			1–10			
Alkalis					3–10	
Sodium (bi)carbonate			0–10			
Solvents	0–15					
Alcohols			5–25			
Glycols/glycolethers		0–5	1–5	0–5	0–15	0–20
2-butoxyethanol						10–50
Nonoxynol					3–15	2–5
Monoethanolamine						10–30
Hydrotropes					0–5	
Cumeensulphonate			0–0.5			

Floor product ingredients	**Cleaner liquid[A] % (w/w)**	**Polisher[B] % (w/w)**	**Combined product[A,B] % (w/w)**	**Sealer[A] % (w/w)**	**Stripper A[A,C] % (w/w)**	**Stripper B[A,C] % (w/w)**
Waxes		1–5	1–10	0–5		
Resins and polyacrylates		10–25	1–10	10–80		
Plasticizers		1–10	0–5	0–5		
Additives Preservatives Colorants Fragrances Water	 <1 <1 >50	 <1 <1 80	 <0.5 0–0.1 <1 50–70	 <1 <1 70–85	 <1 <1 60–80	

A: Composition adopted from Prud'homme de Lodder et al. (2006a)
B: www.cleanright.eu
C: Household Product Database (NLM, 2017)

Among those who use floor cleaners, almost two-thirds (60%) use the product on a weekly basis (once or more a week), and nearly a quarter (23%) on a monthly basis. Very few respondents use floor cleaners daily (8%) (EPHECT, 2012). With respect to the most used application types, 91% of the consumers prefer floor cleaners in liquid form; only 15% prefer sprays and even fewer, wipes and other types. Analysis of the EPHECT study resulted in 75th percentiles of use frequencies of liquid (161 per year), foams (74 per year), gels (73 per year), sprays (73 per year), wipes (66 per year), creams (47 per year), powders (47 per year) and tablets (30 per year). Floor cleaners are used on floors in the kitchen (83%), bathroom (75%), living room (67%), hallway (62%), toilet (57%), bedroom (51%) and to a lesser extent in storage rooms (22%) or other rooms in the house (16%).

11.1.1 *Floor cleaning liquid*

Scenarios for consumer exposure

The cleaning task is to clean the largest floor in the house, which is the living room, with an area of 22 m^2. First, the consumer opens the bottle containing floor cleaning liquid and pours it into a bucket containing 5 l water. When the bottle is opened and the liquid agent is poured into the bucket, volatiles evaporate from the product into the personal breathing zone of the consumer, resulting in exposure through the inhalation route, and dermal exposure is anticipated from loading the liquid through spilled droplets that end up on the back of the hand. Then the diluted product is applied to the floor surface with a mop. During application, dermal exposure to the hands and forearms is anticipated from dipping the mop into the bucket containing the diluted product. Inhalation exposure is anticipated at this moment as well, since volatile substances evaporate from the treated surface. Afterwards, the consumer allows the treated surface to air-dry and remains in the living room. Secondary exposure can be expected for children crawling on the treated floor.

Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 104 times per year. According to AISE (2014), surface cleaners are used 1 to 7 times per week with a typical frequency of 2 times per week (104 per year). The 75th percentile of 320 per year as reported by Weegels (1997) also includes cleaning the bathroom and other cleaning tasks. Analysis of the EPHECT study (2012) results in a 75th percentile use frequency for liquid of 161 times per year (Annex II). A 75th percentile of 'twice per week' is derived from the summary data of Garcia-Hidalgo et al. (2017) and the 75th percentile for the duration of cleaning the floor is estimated to be 11–30 min. The frequency (in min/day) for this task, however, is not included in their data. Consequently, it is not possible to verify whether task duration (min) and frequency (per day) are consistently collected. Therefore, the EPHECT study is chosen here as the data source for deriving a new default, because the data are recent, with a large sample size (n=1333), and were collected specifically to measure the task of cleaning floors. The new default is thus set at 161 times per year with a Q-factor of 4.

11.1.1.1 Mixing and loading

The expected exposure from loading floor cleaning liquid into a bucket is similar to that described in the generic scenario for loading liquids (4.1.2). Hence, to estimate exposure during this mixing and loading event the ***inhalation–exposure to vapour–evaporation–constant release area*** model and the ***dermal–direct product contact–instant application loading*** model are used. Defaults for the parameters: product amount (inhalation), exposure duration, application duration, room volume, ventilation rate, release area, product amount (dermal) and exposed area are described in the generic scenario (4.1.2).

Molecular weight matrix

The fraction of water in the undiluted liquid cleaning product is estimated at 0.5 (Table 11.1). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.5), which yields 36 g/mol. The Q-factor is 2, because the supporting quantitative data are limited.

Table 11.2: Default values for estimating consumer exposure to floor cleaner liquid during mixing and loading

Default value		**Q-factor**	**Source**
General			
Frequency	161 per year	4	Section 11.1.1
Inhalation–exposure to vapour–evaporation–constant release area			
Exposure duration	0.75 min	3	Section 4.1.2
Product amount	500 g	2	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	0.5 per hour	1	Living room (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Emission duration	0.3 min	3	Section 4.1.2
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	36 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Section 4.1.2
Product amount	0.01 g	3	Section 4.1.2

11.1.1.2 Application: cleaning

The scenario of cleaning a floor is in accordance with the generic scenario for surface treatment (4.2.2). Hence, to estimate the expected exposure the ***inhalation–exposure to vapour–evaporation–increasing release*** model and the ***dermal–direct product contact–instant application loading*** model are used. Default parameter values for exposed area and product amount (dermal) are described in the generic scenario for application of diluted product (4.2.3).

Application duration

Application duration is interpreted here as the duration of the cleaning task. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 30 min. According to AISE (2014), the cleaning task takes 10 to 20 min. Weegels (1997) found an average duration of all-purpose cleaning of 20 min. Andra et al. (2015) present a median of 16 min for mopping floor, whereas Kalyvas et al. (2014) present a 75th percentile of 15 min. A new default value is set at 20 min, because this duration most closely agrees with the different data sources. The Q-factor is 4, because the data are recent, quantitative and specifically collected to measure the duration of the task of cleaning floors.

Exposure duration

It is assumed that the consumer will stay in the room after the cleaning the task. Therefore, the default exposure duration is set to 240 min (4 hours). The Q-factor is set to 1, because the time the consumer remains in the room is based on expert judgement.

Amount of solution used

Amount of solution used is defined as the sum of the solvent and product amount subject to inhalation. The solvent amount subject to inhalation is considered to be the amount of water applied to the floor. Based on a small experiment, it was determined that 40 ml water wets 1 m^2 of surface (Prud'homme de Lodder et al., 2006a). The surface area of the floor is 22 m^2, so that 880 ml water is required to clean it. Therefore, the solvent amount is 880 g. The product amount refers to the amount of floor cleaner diluted in the water that is applied on the floor. The concentration of floor cleaner in the water is 16.4 g/l (see below), so that the amount of floor cleaner applied to the surface of the floor is 14 g. The amount of solution used is thus calculated to be 880 g + 14 g ≈ 900 g. The Q-factor is set to 2, because the calculation is not entirely based on expert judgement but lacks support by quantitative data.

Dilution (times)

The dilution in number of times (4.2.3) is calculated on the basis of the amount of floor cleaning liquid in the 5 l volume of water in which it is diluted. According to the survey by AISE (2014), the amount of floor cleaning liquid that is loaded can range between 30 and 110 g. Analysis of the EPHECT data (2012) shows a 75th percentile of 82 g. Therefore, the amount of solution used in the bucket is 82 g + 5000 g = 5082 g and the concentration of product in the solution is 82 g / 5 l = 16.4 g/l. The dilution in number of times is calculated by dividing the amount of solution used by the product amount, so that 5082 g / 82 g = 62 times.

The Q-factor is set to 3, because the assumption of 5 l of water in the bucket compromises the quality of the EPHECT data.

Release area
The release area in the scenario is a living room floor, which is according with the General Fact Sheet (Te Biesebeek et al., 2014), i.e. 22 m^2. The Q-factor is set to 4 in accordance with General Fact Sheet (Te Biesebeek et al., 2014).

Product amount – dermal
The product amount that is subject to dermal exposure is calculated from the volume of water that is in contact with the skin and the concentration of the floor cleaning product in the water. According to the generic scenario for the application of diluted products, the volume of water left on the skin after dipping the hands and forearms in the water is 22 ml (4.2.3). The concentration in the water is calculated as 16.4 g/l (see above). Hence, the product amount subject to dermal exposure is 16.4 g/l x 22 ml = 0.36 g.

Table 11.3: Default values for estimating consumer exposure to floor cleaner liquid during application

Default value		**Q-factor**	**Source**
General			
Frequency	161 per year	4	Section 11.1
Inhalation–exposure to vapour–evaporation–increasing release			
Exposure duration	240 min	1	See above
Amount of solution used	900 g	2	See above
Dilution (times)	62	2	See above
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	22 m^2	4	Living room floor (Te Biesebeek et al., 2014)
Application duration	20 min	4	AISE, 2014; Andra et al., 2015; Kalyvas et al., 2014; Weegels, 1997
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water
Dermal–direct product contact–instant application loading			
Exposed area	2200 cm^2	3	Section 4.2.3
Product amount	0.36 g	2	See above

11.1.1.3 Post-application: rubbing off

Post-application exposure to liquid floor cleaners is expected, since the treated floor is accessible to small children. This form of secondary exposure is estimated using the ***dermal–direct product contact–rubbing off*** model according to the generic scenario for rubbing off (4.3.1). The ***oral–direct product contact–direct oral intake*** model is used to calculate oral exposure from hand-to-mouth behaviour (4.3.2).

Contacted surface
The contacted surface (S_{area}) is the area of the treated surface that can be rubbed, which is in this scenario the floor of a living room 22 m^2 (Te Biesebeek et al., 2014). The default is thus set to 22 m^2 and the Q-factor is set to 4 in accordance with the General Fact Sheet (Te Biesebeek et al., 2014).

Dislodgeable amount
As described in the generic scenario (4.3.1), the dislodgeable amount ($F_{dislodge}$) is calculated by multiplying a fraction of 0.3 by the used product amount (g) per m^2 of floor, which is in this scenario equal to 0.2 g/m^2 (0.3 x 14.4 g / 22 m^2, see 11.1.1). The Q-factor is set to 2, because the supporting data are limited.

Contact time
It is assumed that a child of 12 months crawls over a cleaned floor for 1 hour a day. The default contact time (t) is therefore set at 60 min with a Q-factor of 1 as it is derived from expert judgement (Prud'homme de Lodder et al., 2006a).

Ingested amount
The ingested amount via hand-to-mouth contact can be calculated by taking 10% of the total external dose (4.3.2).

Table 11.4: Default values for estimating consumer exposure to floor cleaning liquid by rubbing off

Default value		**Q-factor**	**Source**
General			
Frequency	161 per year	4	Section 8.1
Body weight	8.0 kg	4	Section 4.4
Dermal–direct product contact–rubbing off loading model			
Contacted surface	22 m^2	3	Scenario
Dislodgeable amount	0.2 g/m^2	2	See above
Transfer coefficient	0.2 m^2/hr	3	Section 4.3.1
Contact time	60 min	2	Prud'homme de Lodder et al., 2006a
Exposed Area	0.3 m^2	4	Section 4.3.1
Oral–direct product contact–direct oral intake model			
Ingested amount	10% of total external dose	1	Section 4.3.2

11.1.2 *Floor stripping and sealing products*

Floor stripping and sealing products are not considered to be traditional cleaning products by definition, in that they do not remove dirt and sanitize surfaces. However, their application is comparable to traditional cleaning products and they are developed to help keep in-house surfaces clean. Floor sealers are applied before using a new floor. They seal floors such as linoleum, to prevent dirt, water and grease from getting into the pores of the floor easily. This effect can be strengthened by adding a floor polish that comprises a polymeric or wax layer. Old protective layers can be removed with floor-strippers, which are often strong alkalines. The alkaline concentration used depends on the age of the layer and on the difficulty of removing that layer. Floor stripping and sealing products are discussed below as a single group of products, because of their complementary actions in preventing the floor from becoming contaminated with dirt and their commonalities in the way they are applied to the floor.

Scenarios for consumer exposure
The consumer first applies the stripping product to the floor of a living room with an area of 22 m^2. Floor stripping products require dilution with water before they are applied. First, the consumer opens the bottle containing the liquid product and pours it into a bucket containing 5 l water. During the opening of the bottle and the pouring of the liquid agent into the bucket, volatiles evaporate from the bottle into the personal breathing zone of the consumer, while dermal exposure is anticipated from spills (droplets) that end up on the back of the hand. The diluted product is then applied to the floor surface with a mop. During this application dermal exposure to the hands and forearms is anticipated from demounting the mop from the stick, dipping the mop into the bucket containing the diluted product and then mounting the mop back to the stick. Inhalation exposure is anticipated at this moment as well, since volatile substances evaporate from the treated surface. Afterwards, the consumer leaves the treated surface to air-dry before treating it with the floor sealer. The floor sealer is a ready-to-use product that is used undiluted. Exposure from mixing and loading is thus not considered. Instead, the floor sealer is directly applied to the floor with a squeeze bottle and spread over the floor with a mop. Dermal exposure may occur at this moment if the consumer accidentally touches the treated surface. Inhalation exposure to volatile substances evaporating from the treated surface is anticipated as well. It is assumed that the consumer leaves the room directly after the task is finished.

Frequency
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default by expert judgement of once per 10 years for floor strippers and once a year for sealers. No new data have become available since. However, floor stripping and sealing products are assumed here to be used complementarily. Following a worst-case approach, the default frequency is therefore 1 per year for both products. The Q-factor remains 1, because it depends on expert judgement only.

11.1.2.1 Mixing and loading
Loading liquid floor stripping products into a bucket is in accordance with the generic scenario for loading liquids (4.1.2). Hence, to estimate exposure during mixing and loading, the ***inhalation–exposure to vapour–evaporation–constant release area*** model and the ***dermal–direct product contact–instant application loading*** model are used. Defaults for the parameters: product amount (inhalation), exposure duration, application duration, room volume, release area, product amount (dermal) and exposed area are described in the generic scenario (4.1.2).

Molecular weight matrix
The fraction of water in the floor stripping product is estimated at 0.6 (Table 11.1). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.6), which yields 30 g/mol. The Q-factor is 2, because the supporting quantitative data are limited.

Table 11.5: Default values for estimating consumer exposure to floor stripper liquid during mixing and loading

Default value		**Q-factor**	**Source**
General			
Frequency	1 per year	1	See above
Inhalation–exposure to vapour–evaporation–constant release area			
Exposure duration	0.75 min	3	Section 4.1.2
Product amount	500 g	2	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	0.5 per hour	1	Living room (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Emission duration	0.3 min	3	Section 4.1.2
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	30 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Section 4.1.2
Product amount	0.01 g	3	Section 4.1.2

11.1.2.2 Application: floor stripping
The scenario of treating a floor with stripping product is in accordance with the generic scenario for surface treatment (4.2.2). Hence, to estimate expected exposure, the ***inhalation–exposure to vapour–evaporation–increasing release*** model and the ***dermal–direct product contact–instant application loading*** model are used. Default parameter values for exposed area and product amount (dermal) are described in the generic scenario for application of diluted product (4.2.3).

Application duration
Application duration is interpreted here as the time required to apply the floor stripping product to the floor. It is assumed that such an activity is similar to applying liquid polish products to a floor. The default application duration is thus 90 min (Section 11.1.3). The Q-factor is 2, because the supporting data are not recent and were not collected specifically in relation to treating a floor with stripping products.

Amount of solution used
Amount of solution used is defined as the sum of the solvent and product amount subject to inhalation. The solvent amount subject to inhalation is considered to be the amount of water applied to the floor. On the basis of a small experiment, it was determined that 40 ml water wets 1 m^2 of surface (Prud'homme de Lodder et al., 2006a). The surface area of the floor is 22 m^2, so that 880 ml water is required to clean it. Therefore, the solvent amount is 880 g. The product amount refers to the amount of floor stripping liquid diluted in the water that is applied to the floor. The concentration of floor stripper in the water is 20 g/l (see below), so that the amount of floor stripper applied to the surface of the floor is 18 g. The amount of solution used is thus calculated to be 880 g + 18 g ≈ 900 g. The Q-factor is set to 2, because the calculation is not entirely based on expert judgement but lacks support by quantitative data.

Dilution (times)
Product label information advises a dilution of 100–200 g per 10 l water (Palmann, 2016). From a worst-case perspective, it is assumed that the consumer uses 200g per 10 l (20 g/l). Therefore, the dilution in number of times is calculated as (200 g + 10,000g) / 200 g = 51. The Q-factor is 2, because the supporting data are limited.

Product amount – dermal
The product amount that is subject to dermal exposure is calculated from the volume of water that is in contact with the skin and the concentration of the floor stripping product in the water. According to the generic scenario for the application of diluted products, the volume of water left on the skin after dipping the hands and forearms in the water is 22 ml (4.2.3). The concentration in the water is calculated as 20 g/l (see above). Hence, the default product amount subject to dermal exposure is 20 g/l x 22 ml = 0.44 g. The Q-factor is 2, because of the limited data on product use that are incorporated in this calculation.

Table 11.6: Default values for estimating consumer exposure to floor stripping liquid during application

Default value		**Q-factor**	**Source**
General			
Frequency	1 per year	1	Section 11.1.2.1
Inhalation–exposure to vapour–evaporation–increasing release area			
Exposure duration	90 min	1	Application duration
Amount of solution used	900 g	2	See above
Dilution (times)	51	2	See above
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	22 m^2	4	Living room floor (Te Biesebeek et al., 2014)
Application duration	90 min	2	Section 11.1.3.1.1
Application temperature	20 °C	4	Room temperature

Default value		Q-factor	Source
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water after dilution
Dermal–direct product contact–instant application loading			
Exposed area	2200 cm^2	3	Section 4.2.3
Product amount	0.44 g	2	See above

11.1.2.3 Application: floor sealing

The scenario for inhalation exposure from treating a floor with sealing products is in accordance with the generic scenario for surface treatment (4.2.2). Hence, to estimate the expected inhalation exposure, the ***inhalation–exposure to vapour–evaporation–increasing release area*** model is used. The scenario for dermal exposure, however, is not in accordance with the generic scenario, because the product is used in undiluted form and is touched accidentally. Here, the ***dermal–direct product contact–instant application loading*** model is used.

Application duration

Application duration is interpreted here as the time required to apply the floor sealing product to the floor. It is assumed that such an activity is similar to applying liquid polish products to a floor. The default application duration is thus 90 min (Section 11.1.3). The Q-factor is 2, because the supporting data are not recent and were not collected specifically in relation to treating a floor with stripping products.

Product amount – inhalation

The product amount that is subject to inhalation is interpreted as the amount of floor sealing product that is applied to the floor. Product information indicates that the amount required is about 0.04–0.1 l per m^2 (Tile & Floor Care, 2016) depending on the porosity of the floor. Floor sealing products are either polyacrylate or water based (Table 11.1). The density of polyacrylate (1220 g/l) is higher than that of water (1000 g/l), so that the maximum amount required to seal a floor of 22 m^2 with polyacrylate-based sealer is calculated as 1220 g/l x 0.1 l/m^2 x 22 m^2 = 2684 g and for water-based sealer 2200 g. The default product is set to 2.7 kg and 2.2 kg for polyacrylate- and water-based floor sealing products, respectively. The Q-factor is 2, because the supporting data are limited.

Molecular weight matrix

The fraction of water in polyacrylate floor sealing product is estimated at 0.2 (Table 11.1). The molecular weight of polyacrylate, however, is variable. The molecular weight matrix is thus calculated from its weight fraction of water. Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.2), which yields 90 g/mol. For water-based floor sealing products the molecular weight matrix is calculated as 18 g/mol divided by 0.8 (Table 11.1), which yields 22 g/mol. The Q-factor is set to 2, because the supporting data are limited.

Product amount – dermal
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a calculation for dermal exposure to undiluted products applied in surface treatment. It was assumed that 1% of the total amount that is applied ends up on the palms of the consumer. However, assuming a surface area equivalent to two palms, the product amount would be a clear overestimation for this specific scenario. Instead it is assumed that the consumer accidentally touches the treated floor with one palm (225 cm^2). In order to be conservative, it is assumed that the consumer is dermally exposed to the entire amount of product that is in the interface between the surface of the floor and that of the palm. Hence, the amount of product per m^2 applied to the floor is equal to the amount per m^2 on the palm of the hand of the consumer. For polyacrylate-based sealer the default product amount subject to dermal exposure is thus calculated as 225 cm^2 x 0.1 l/m^2 x 1220 g/l ≈ 3 g and for water-based sealer the amount is calculated to be 2 g. The Q-factor is set to 1, because of the assumption that the product amount per m^2 on the treated surface is equal to the amount per m^2 on the exposed palm.

Table 11.7: Default values for estimating consumer exposure to floor sealing liquid during application

Default value		**Q-factor**	**Source**
General			
Frequency	1 per year	1	Section 11.1.2.1
Inhalation–exposure to vapour–evaporation–increasing release area			
Exposure duration	90 min	2	Scenario
Product amount			
- Polyacrylate-based sealer	2.7 kg	2	See above
- Water-based sealer	2.2 kg	2	See above
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	22 m^2	4	Living room floor(Te Biesebeek et al., 2014)
Application duration	90 min	2	Section 11.1.3
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix			
- Polyacrylate-based sealer	90 g/mol	2	See above
- Water-based sealer	22 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	One palm (Te Biesebeek et al., 2014)
Product amount			
- Polyacrylate-based sealer	3 g	1	See above
- Water-based sealer	2 g	1	See above

11.1.3 Floor polishes

Floor polish is used to protect the floor. A durable wax coating is applied to keep the floor in a good state. Less cleaning is required and it can be performed more easily. The coating is applied in an undiluted form by waxing the floor and after drying, as a result of which a gleaming film is formed. Floor polish contains ingredients such as wax and polymers in various ratios. A longer polishing activity is required for polishes that contain relatively more wax.

The EPHECT (2012) survey shows that only a minor fraction of the European consumer population buys floor polishing products. Floor polish is used by only 14% of the survey respondents. Most consumers that buy floor polish use it weekly (41% use it once or twice a week); 29% use it or once or twice a month and 18% use the product less often than once a month. Few people use the product daily (7%). Floor polishes are most used for living room floors (68%) and for the floor in the hallway (51%). Consumers in Italy, however, most often use the product in bedrooms (72%). Most users prefer the product in liquid form (79%), in comparison with wipes.

11.1.3.1 Floor polishing liquid

Scenarios for consumer exposure

Floor polishing liquids are ready-to-use products in that they are used undiluted. Exposure from mixing and loading is thus not considered (4.1.3). Instead, the polish is directly applied to the floor with a squeeze bottle and spread over the floor with a mop. Dermal exposure is anticipated at this moment from spills ending up on the back of the hand of the consumer, whereas inhalation exposure to volatile substances evaporating from the treated surface is anticipated as well. It is assumed that the consumer leaves the room directly after the floor has been treated with floor polishing liquid.

Frequency

The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of twice a year. Versar (1992) estimated the frequency at 2 times in 6 months, while Westat (1987) gives a 75th percentile of 6 times per year for wood floor cleaners. However, EPHECT (2012) shows that 46% of the consumers that use floor polish do so weekly. Based on the recent and rich data of EPHECT specifically collected to measure the use of floor polish, the new default is set at 52 times per year with a Q-factor of 4.

11.1.3.1.1 Application: polishing

The scenario of inhalation exposure from treating a floor with liquid polish products is in accordance with the generic scenario for surface treatment (4.2.2). Hence, to estimate expected inhalation exposure, the ***inhalation–exposure to vapour–evaporation–increasing release*** model is used. The scenario for dermal exposure, however, is not in accordance with the generic scenario, because the product is used in undiluted form and applied to the floor with a squeeze bottle. Here, the ***dermal–direct product contact–instant application loading*** model is used.

Application duration
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 90 min, based on the 75th percentile of Westat (1987). Data of higher quality have not since become available. Therefore, the default application duration remains at 90 min with a Q-factor of 3.

Exposure duration
Product information advises the consumer to leave the room once the floor polishing liquid has been applied. The default for exposure duration is thus set equal to the application duration (Prud'homme de Lodder et al., 2006a). The default remains 90 min. The Q-factor, however, is set to 2, because the quality of the data is compromised by the assumption that the consumer leaves the room directly after the polishing task.

Product amount – inhalation
Product information prescribes a use of 17–25 g per m^2 (Antiquax, 2017; Bona, 2016; Cemcrete, 2014; RigoStep, 2012). The surface area of the floor is 22 m^2, so the maximum product amount required is 550 g, which is in accordance with the default in the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a). The default thus remains at 550 g. The Q-factor, however, is lowered to 2, because the supporting data (from product information) are limited.

Molecular weight matrix
The water fraction in liquid floor polish is about 0.8 (Table 11.1). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.8), which yields 22 g/mol. The Q-factor is 2, because the supporting quantitative data are limited.

Product amount – dermal
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a calculation for dermal exposure to undiluted products applied in surface treatment. It was assumed that 1% of the total amount that is applied ends up on the palm of the consumer. However, assuming a surface area equivalent to two palms, the product amount would be a clear overestimation for this specific scenario. Instead it is assumed that the consumer accidentally touches the treated floor with one palm (225 cm^2). In order to be conservative, it is assumed that the consumer is dermally exposed to the entire product amount that is on the interface between the surface of the floor and that of one palm. Hence, the amount per m^2 applied to the floor is equal to the amount per m^2 on the palm of the hand of the consumer. For floor polish the default product amount subject to dermal exposure is thus calculated as 225 cm^2 x 25 g/m^2 = 0.55 g. The Q-factor is set to 1, because of the assumption that the product amount per m^2 on the treated surface is equal to the amount per m^2 on the exposed palm.

Table 11.8: Default values for estimating consumer exposure to floor polishing liquid during application

Default value		**Q-factor**	**Source**
General			
Frequency	52 per year	4	EPHECT 2012
Inhalation–exposure to vapour–evaporation–increasing release area			
Exposure duration	90 min	2	See above
Product amount	550 g	2	See above
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room Te Biesebeek et al., 2014)
Release area	22 m^2	4	Living room floor (Te Biesebeek et al., 2014)
Application duration	90 min	3	Westat 1987
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	22 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Palm (Te Biesebeek et al., 2014)
Product amount	0.55 g	1	See above

11.1.3.2 Floor polish spray

Scenarios for consumer exposure

Floor polish sprays are ready-to-use products marketed as trigger sprays. Therefore, they are used undiluted. Exposure from mixing and loading is thus not considered (4.1.3). Floor polish sprays can be applied to an entire floor or to spots such as dirt or heel marks. When treating the entire floor, the consumer ‘lightly’ sprays the polish over an area of about 2 m^2 and then rubs this area with a cloth. The activities of spraying and rubbing 2 m^2 are then repeated until the entire floor is polished. During this spray treatment inhalation exposure is anticipated from the spray cloud and dermal exposure is anticipated from deposition of the spray cloud to the consumer’s skin. In the case of volatile substances, evaporation from the treated surface during rubbing is not considered, because inhalation exposure to the volatile substance in the spray is already covered in the instantaneous exposure estimate for the spraying activity (4.2.2). Additional dermal exposure is expected where the polish spray is used to treat a dirt or heel mark. For such local treatment, the consumer intensively sprays the mark and uses a cloth to rub it off. Dermal exposure is anticipated from accidental hand contact with the treated surface. Once the floor has been polished, the consumer is expected to leave the room and children are kept out of reach of the treated surface. Post-application or secondary exposure is therefore not considered.

11.1.3.2.1 Application: spraying

Inhalation exposure to non-volatile substances present as sprayed particles is estimated using the ***inhalation–exposure to spray–spraying release*** model. Dermal exposure is estimated using the ***dermal–direct product contact–constant rate loading*** model (4.2.1). The defaults for the parameters: mass generation rate, airborne fraction, density non-volatiles and contact rate area are in accordance with the generic scenario (4.2.1). Inhalation exposure to volatile substances in floor polish sprays is estimated using the ***inhalation–exposure to spray–instantaneous release*** model. The defaults for the parameters: exposure duration, room volume, ventilation and inhalation rate described for non-volatiles in floor polish sprays also apply to the volatile substances.

Spray duration

The spray duration is derived from the use pattern to treat an entire floor as described in the scenario. Product information suggests to 'lightly' mist an area of about 2 m^2 before rubbing the polish in with a cloth (Stromberg, 2017). Lightly misting an area of 2 m^2 is interpreted here as a spray event, which is assumed to be comparable with the spray events to treat furniture as described in the EPHECT survey. Therefore, the 75^{th} percentile for a floor spray event is '5 sprayings' (EPHECT, 2012). Pulling a trigger spray 10 times takes 6 s according to Delmaar & Bremmer (2009), so that 5 sprayings require 3 s. The floor that is treated is a living room floor with an area of 22 m^2, so that the pattern of lightly misting an area of 2 m^2 is repeated 11 times. Therefore, the spray duration required to treat the entire floor is 11 x 3 s = 33 s. The default spray duration is set to 33 s. The Q-factor is set to 2, because the data supporting the calculation are limited.

Exposure duration

Exposure duration is interpreted here as the duration of the polishing task. It is assumed that the duration of polishing a floor with spray is the same as that of polishing a floor with liquid: 90 min (11.1.3.1.1). The default exposure duration is thus set to 90 min and the Q-factor is set to 2 in accordance with the exposure duration when treating the floor with polishing liquid (11.1.3.1.1).

Mass generation rate

The floor polish is applied with a trigger spray, which generically has a mass generation rate of 1.6 g/s (4.2.1). The Q-factor is set to 3, because the supporting quantitative data were generically collected in relation to the use of trigger sprays and not specifically for floor polish sprays.

Initial particle distribution

Delmaar & Bremmer (2009) experimentally derived the particle size distribution of droplets released by a spray can containing furniture polish. They found a lognormal distribution with a median diameter of 10.8 µm and a C.V. of 0.81. The default initial particle distribution is set accordingly for floor polishes. The Q-factor is set to 2, because the data were collected specifically for furniture polish but are limited to 5 measurements on 2 samples.

Released mass
Released mass is interpreted here as the product amount that is sprayed out of the bottle or can. The default released mass is calculated to be 53 g by multiplying the spray duration (33 s) by the mass generation rate (1.6 g/s). The Q-factor is set to 2, because that is the lowest Q-factor assigned to the elements of the calculation, i.e. to spray duration (see above).

Table 11.9: Default values for estimating consumer exposure to floor polish spray during application to the entire floor area

Default value		Q-factor	Source
General			
Frequency	52 per year	4	EPHECT, 2012
Inhalation–exposure to spray–spraying			
Spray duration[1]	33 s	2	See above
Exposure duration[2]	90 min	2	See above
Room volume[2]	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Room height[1]	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate[2]	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Mass generation rate[1]	1.6 g/s	3	Section 4.2.1
Airborne fraction[1]	0.2	3	Section 4.2.1
Density non-volatile[1]	1.8 g/cm^3	3	Section 4.2.1
Initial particle distribution Median[1] (C.V.)[1]	10.8 µm (0.81)	3	Delmaar & Bremmer, 2009
Inhalation cut-off diameter[1]	15 µm	3	Delmaar & Schuur, 2016
Inhalation–exposure to spray–instantaneous release			
Release mass[3]	53 g	2	See above
Dermal–direct product contact–constant rate			
Exposed area	2200 cm^2	3	Section 4.2.1
Contact rate	46 mg/min	3	Section 4.2.1 (trigger sprays)
Release duration	66 s	2	Twice the spray duration (4.2.1)

1: Applies to non-volatile substances only
2: Applies to both volatile and non-volatile substances
3: Applies to volatile substances only

11.1.3.2.2 Application: spot polishing
In addition to the dermal exposure from deposition of sprayed aerosols to the skin of the consumer, dermal exposure by hand contact while rubbing the surface is expected during the treatment of local dirt or heel marks. Polishing the surface is in accordance with the generic scenario for surface treatment (4.2.2). Therefore, the ***dermal–direct product contact–instant application loading*** model is used to estimate dermal exposure via hand contact while rubbing the surface. For volatile substances, evaporation from the treated surface during the rubbing activity is not considered, because inhalation exposure to volatile substances in the spray is already covered in the exposure estimate for the spraying activity (4.2.2).

Product amount – dermal
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a calculation for dermal exposure to undiluted products applied in surface treatment. It was assumed that 1% of the total amount that is applied ends up on the palms of the consumer. However, assuming a surface area equivalent two palms would be a clear overestimation for this specific scenario. Instead it is assumed that the amount per m^2 applied to the floor is equal to the amount per m^2 on the palm of one hand of the consumer. For local treatment the consumer sprays more intensively than for treatment of the entire floor, so that a greater amount of product per unit of area is applied. Here it is assumed that the spot is treated with a similar amount per m^2 as described for the application of floor polishing liquid. Therefore, the amount of product applied is 25 g/m^2 (11.1.3.2). The default product amount subject to dermal exposure is then calculated as 225 cm^2 x 25 g/m^2 = 0.55 g (11.1.3.2). The Q-factor is set to 1, because of the assumption that the product amount per m^2 on the treated surface is equal to the amount per m^2 on the exposed surface.

Table 11.10: Default values for estimating consumer exposure to floor polishing spray during application to spots

Default value		**Q-factor**	**Source**
General			
Frequency	52 per year	4	EPHECT, 2012
Dermal–direct product contact–instant application loading			
Exposed area Product amount	225 cm^2 0.55 g	3 1	One palm (Te Biesebeek et al., 2014) See above

11.1.4 *Floor cleaning wipes*

Scenarios for consumer exposure
Floor cleaning wipes are taken from the package and mounted on a mop head. Dermal exposure is expected from mounting the wipe via contact with the inside of the consumer's hand. Once the wipe is mounted, the consumer starts to clean the floor of the living room. At this moment inhalation exposure is anticipated as volatile substances evaporate from the floor surface. Afterwards, the consumer allows the treated surface to air-dry and remains in the living room. Secondary exposure can be expected for children crawling on the treated floor.

Frequency
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 104 times per year, based on the typical AISE (2002) value for cleaning furniture. Analysis of EPHECT data (2012) shows a 75th percentile of 66 times per year for cleaning a floor with wipes (Annex II). The new default is based on the data of EPHECT, which are recent, rich and specifically collected to measure floor cleaning with wipes. Hence, the Q-factor is 4.

11.1.4.1 Application: mounting and cleaning

Dermal exposure is anticipated during hand contact with the wipe upon mounting the wipe on the mop head. Inhalation exposure is estimated during cleaning of the surface. The ***dermal–direct product contact–***

instant application loading model is used to estimate dermal exposure, whereas inhalation exposure is estimated using the ***inhalation–exposure to vapour-evaporation–increasing release area*** model.

Application duration
According to AISE (2014), the duration of a cleaning task with floor wipes is 2–10 minutes, with a typical duration of 5 min. The new default value is therefore set at 10 min. The Q-factor is 2. Although the data were specifically collected in relation to the use of floor wipes, important context data such as the treated surface area are not given. (For example, a larger surface area takes longer to clean, which will affect the application duration.)

Exposure duration
It is assumed that the consumer stays in the room for 4 hours after the cleaning task. Therefore, the default exposure duration is set to 240 min (4 hours). The Q-factor is set to 1, because the time the consumer stays in the room is based on expert judgement.

Product amount – inhalation
The product amount that is subject to inhalation is interpreted here as the amount that is applied to the floor. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 25 g. AISE (2014) presents a typical amount of 26 g per task. Analysis of the EPHECT data (2012) shows a 75th percentile value of 19 g (Annex II). The new default is set at 20 g based on the data of EPHECT, which are recent, rich and specifically collected in relation to floor cleaning with wipes. However, important context data such as the treated surface area are not given. Therefore, the Q-factor is set to 2.

Molecular weight matrix
According to the general composition of floor wipes, the fraction of water in the liquid is 0.5. Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.5), which yields 36 g/mol. The Q-factor is 2, because the supporting quantitative data are limited.

Table 11.11: Default values for estimating consumer exposure to floor cleaning wipes during loading and application

Default value		**Q-factor**	**Source**
General			
Frequency	66 per year	4	EPHECT, 2012
Inhalation–exposure to vapour–evaporation–increasing release area			
Exposure duration	240 min	1	Scenario
Product amount	20 g	2	Annex II
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	22 m^2	4	Living room floor (Te Biesebeek et al., 2014)
Application duration	10 min	2	AISE, 2014
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	36 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Hand palms (Te Biesebeek et al., 2014)
Product amount	0.05 g	3	Section 4.2.2.1

11.1.4.2 Post-application: rubbing-off

Secondary exposure to substances in floor wipes is expected, since the treated floor is accessible to small children. This form of secondary exposure is estimated using the ConsExpo ***dermal–direct product contact–rubbing-off*** model in accordance with the generic scenario for rubbing-off (4.3.1). The ***oral–direct product contact–direct oral intake*** model is used to calculate oral exposure from hand-to-mouth behaviour (4.3.2).

Contacted surface

The contacted surface (S_{area}) is the area of the treated surface that can be rubbed, which is in this scenario the floor of a living room 22 m^2 (Te Biesebeek et al., 2014). The default is thus set to 22 m^2 and the Q-factor is set to 4 in accordance with the General Fact Sheet (Te Biesebeek et al., 2014).

Dislodgeable amount

As described in the generic scenario (4.3.1), the dislodgeable amount ($F_{dislodge}$) is calculated by multiplying a fraction of 0.3 by the used product amount (g) per m^2, which is in this scenario equal to 0.27 g/m^2 (0.3 x 20 g/22 m^2). The Q-factor is set to 2, because the supporting data are limited.

Contact time

It is assumed that a child of 12 months crawls over a cleaned floor for 1 hour a day. The contact time (t) default is therefore set at 60 min with a Q-factor of 1 as it is derived from expert judgement (Prud'homme de Lodder et al., 2006a).

Ingested amount
The ingested amount via hand-to-mouth contact can be calculated by taking 10% of the total external dose (4.3.2).

Table 11.12: Default values for estimating consumer exposure to floor cleaning wipes by rubbing-off

Default value		**Q-factor**	**Source**
General			
Frequency Body weight	66 per year 8.0 kg	4 4	EPHECT, 2012 4.3.1
Dermal–direct product contact–rubbing-off			
Contacted surface Dislodgeable amount Transfer coefficient Contact time Exposed Area	22 m^2 0.27 g /m^2 0.2 m^2/hr 60 min 0.3 m^2	4 2 3 1 4	Living room floor (Te Biesebeek et al., 2014) See above Section 4.3.1 Prud'homme de Lodder et al., 2006a Section 4.3.1
Oral–direct product contact–direct oral intake			
Ingested amount	10% of total external dose	1	Section 4.3.2

11.1.5 *Floor cleaning liquid cartridge*

Scenario
Some mop systems for cleaning floors have cleaning pads and refillable cartridges. Inhalation and dermal exposure is anticipated while (re)filling the cartridge, which is considered to be in accordance with the generic exposure scenario for mixing and loading liquids (4.1.2). Once the cartridge is full, the consumer mounts it onto the mop. Exposure is not anticipated at this mounting stage, because the cleaning product is in the enclosed reservoir of the mop system. Next, the consumer starts to clean to floor of the living room. The cleaning product is released from the reservoir onto the floor by pulling a trigger on the mop handle. The consumer applies the cleaning product over the entire floor area by repeatedly pulling the trigger and continuously mopping the product. Once the floor has been cleaned, the cleaning pad is removed from the mop system. Dermal exposure is anticipated at this moment via contact with the inside of the consumer's hand. Afterwards, the consumer allows the treated surface to air-dry and remains in the living room. Secondary exposure can be expected for children crawling on the treated floor.

Frequency
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 104 times per year. According to AISE (2014), surface cleaners are used 1 to 7 times per week, with a typical frequency of 2 times per week (104 per year). Weegels (1997) reports a 75^{th} percentile of 320 per year but this also includes the cleaning of other rooms. Analysis of the EPHECT (2012) data results in a 75^{th} percentile for the use frequency of floor cleaning liquids of 161 times per year. The new default is set at 161 times per year based on the data of

EPHECT, which are recent and rich (1333 data points) but not specifically collected to measure floor cleaning with cartridge systems. Hence, the Q-factor is 3.

11.1.5.1 Mixing and loading

During the opening of the bottle and the pouring of floor cleaner into the empty cartridge, volatiles evaporate from the bottle into the personal breathing zone of the consumer. Meanwhile, spills (droplets) end up on the back of the pouring (directing) hand. To estimate exposure, the ***inhalation–exposure to vapour–evaporation–constant release area*** model and ***dermal–direct product contact–instant application loading*** model are used (see section 4.1.2). Defaults for the parameters: product amount (inhalation), exposure duration, room volume, release area, application duration, mass transfer coefficient, exposed area and product amount (dermal) are described in the generic scenario (4.1.2).

Molecular weight matrix

The ratio of water to other substances in cartridge floor cleaning liquids is about 2 to 1, so that the fraction of water is about 66% (Bona, 2016). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.66) which yields 27 g/mol. The Q-factor is 2, because the supporting quantitative data are limited.

Table 11.13: Default values for estimating consumer exposure to floor cleaning liquid in cartridges during mixing and loading

Default value		**Q-factor**	**Source**
General			
Frequency	161 per year	4	Section 11.1.1
Inhalation–exposure to vapour–evaporation–constant release area			
Exposure duration	0.75 min	3	Section 4.1.2
Product amount	500 g	2	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	0.5 per hour	1	Living room (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Emission duration	0.3 min	3	Section 4.1.2
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	27 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Section 4.1.2
Product amount	0.01 g	3	Section 4.1.2

11.1.5.2 Application: cleaning

Once the product has been applied to the floor, inhalation exposure to floor cleaning liquid in a cartridge mop system becomes similar to the expected inhalation exposure to regular floor cleaning liquids (11.1.1). This is not the case for dermal exposure, however. Dermal exposure to regular floor cleaning liquids occurs via dipping the hands and forearms in water that contains the cleaning liquid, whereas dermal exposure when using the cartridge system is expected only during removal of the pad. Exposure is thus estimated using the ***inhalation–exposure to vapour- evaporation–increasing release*** model (11.1.1) and the ***dermal–direct product contact–instant application loading*** model.

Product amount – inhalation
It is assumed that the amount of active cleaning ingredients that is applied to the floor with a floor mop cartridge system is equal to the amount of active cleaning ingredients that is applied to the floor when using a regular floor cleaning liquid. Comparing the ingredient composition of cartridge floor cleaners and regular floor cleaning liquids shows that the weight fractions of active ingredients are about the same (Bona, 2017). Therefore, it is assumed that the product amount of 14 g relating to regular floor cleaning products (11.1.1) is also applicable to cartridge floor cleaning products. The default product amount is thus set to 14 g. The Q-factor is set to 1, because the assumption that the product amounts for cartridge and regular floor cleaning liquids are similar compromises the initial Q-factor of 2 (11.1.1)

Product amount – dermal
Dermal exposure is anticipated for the consumer when touching the mop pad with the palm of the hand. The cartridge floor cleaning liquid is used undiluted, but it is assumed that it comprises a sufficient amount of water for the product amount on the palm to be calculated using the layer thickness model (4.2.2). Assuming a density of 1g/cm^3, the product amount that is subject to dermal exposure is calculated as 225 cm^2 x 0.01 cm x 1g/cm^3 = 2.25g. The default product amount is thus set to 2.25 g. The Q-factor is set to 1, given the number of assumptions in the calculation.

Table 11.14: Default values for estimating consumer exposure to floor cleaning liquid in cartridges during application

Default value		**Q-factor**	**Source**
General			
Frequency	161 per year	4	Section 11.1.1
Inhalation–exposure to vapour–evaporation–increasing release area			
Exposure duration	240 min	1	Section 11.1.1
Product amount	14 g	1	See above
Room volume	58 m^3	4	Section 11.1.1
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	22 m^2	4	Living room (Te Biesebeek et al., 2014)
Application duration	20 min	4	Section 11.1.1
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	27 g/mol	2	Section 11.1.5.1
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Palm (Te Biesebeek et al., 2014)
Product amount	2.25 g	1	See above

11.1.5.3 Post-application: rubbing-off

Post-application exposure to substances in floor cleaning liquids in cartridges is expected, since the treated floor is accessible to small children. This form of secondary exposure is estimated using the ***dermal–direct product contact–rubbing-off*** model according to the generic scenario for rubbing-off (4.3.1). The ***oral–direct product contact–direct oral intake*** model is used to calculate oral exposure from hand-to-mouth behaviour (4.3.2).

Contacted surface

The contacted surface (S_{area}) is the area of the treated surface that can be rubbed, which is in this scenario the floor of a living room: 22 m^2 (Te Biesebeek et al., 2014). The default is thus set to 22 m^2 and the Q-factor is set to 4 in accordance with the General Fact Sheet (Te Biesebeek et al., 2014).

Dislodgeable amount

As described in the generic scenario (4.3.1), the dislodgeable amount ($F_{dislodge}$) is calculated by multiplying a fraction of 0.3 by the used product amount (g) per m^2, which is in this scenario equal to 0.2 g/m^2 (0.3 x 14.4 g/22 m^2). The Q-factor is set to 1, because of the low Q-factor assigned to the product amount (11.1.5.2).

Contact time

It is assumed that a child of 12 months crawls over a cleaned floor for 1 hour a day. The default contact time (t) is therefore set at 60 min, with a Q-factor of 1 as it is derived from expert judgement (Prud'homme de Lodder et al., 2006a).

Ingested amount

The ingested amount via hand-to-mouth contact can be calculated by taking 10% of the total external dose (4.3.2).

Table 11.15: Default values for estimating consumer exposure to floor cleaning liquid in cartridge during rubbing-off

Default value		**Q-factor**	**Source**
General			
Frequency Body weight	161 per year 8.0 kg	4 4	Section 11.1.1 4.3.1
Dermal –direct product contact–rubbing-off loading			
Contacted surface Dislodgeable amount Transfer coefficient Contact time Exposed Area	22 m^2 0.2 g/m^2 0.2 m^2/hr 60 min 0.3 m^2	4 2 3 2 4	Living room floor (Te Biesebeek et al., 2014) See above Section 4.3.1 Prud'homme de Lodder et al., 2006a Section 4.3.1
Oral–direct product contact–direct oral intake			
Ingested amount	10% of total external dose	1	Section 4.3.2

11.2 Carpet products

Carpet cleaners are used for cleaning all kinds of carpets, rugs and upholstery. They dissolve oily and greasy soils. The cleaning solution or foam loosens the dirt from the fibres, coats the dirt particles for easy removal and keeps the carpets cleaner for a longer time. A wide variety of carpet cleaning products exists, including liquids, ready-to-use sprays, powders and aerosols. Carpet cleaning products can be applied manually or with a cleaning machine.

Table 11.16: General composition of carpet cleaners

Carpet cleaner ingredients	Liquid[A] % (w/w)	Powder[A] % w/w)	Shampoo[B] % (w/w)	Spot remover liquid[A] % (w/w)
Surfactants				0–>30
Anionic	0–15	1–5	1–5	
Non-ionic	0–15			
Builders	0–5			
polycarboxylates			0–2	
Solvents & hydrotropes				
Ethanol/ isopropylalochol	0–>30	7–14		30–40
Glycols/glycolethers				0–15
Additives				
Polymers				
Foam stabilizers				
Preservatives	<1			
Colorants	<1	<1	<0.02	
Fragrances		15–60	<1	
Carriers				
Propellants				
Water	60–90	40–80	90	

A: Composition adopted from Prud'homme de Lodder et al. (2006a)
B: www.cleanright.eu

11.2.1 *Carpet cleaning liquid*

Scenarios for consumer exposure

Carpet cleaning liquids are diluted with water before they are applied to the carpet either manually or with a machine. The anticipated exposure for loading a machine or a bucket for manual cleaning is considered to be similar, because both activities are in accordance with the generic scenario for loading liquids (4.1.2). Once the carpet cleaning liquid has been diluted, the consumer starts to treat the carpet. Manual treatment is performed by rubbing the product into the carpet with a brush or sponge. Machine cleaning is done with a machine that continuously sprays and vacuums the cleaning dilution back into the solution reservoir. Cleaning the carpet with a machine requires less time and leaves lower amounts of residue. Except for the application and exposure duration, however, inhalation and dermal exposure are estimated to be similar for manual and machine cleaning. Dermal exposure is estimated from the concentration of product in the water that ends up on the hands of the consumer. This volume of water is estimated from the exposed skin area and a water layer thickness of 0.01 cm (ECHA, 2015a, b). With manual cleaning the hands and forearms are dipped into the water in the bucket, whereas with machine cleaning the hands and forearms come in contact to thewater in the machine reservoir. The consumer stays in the room after cleaning the carpet. Furthermore, the carpet that is treated with the carpet cleaning liquid is an accessible surface for small children. Therefore, secondary dermal exposure may occur by rubbing off the product (4.3.1) and oral exposure from hand-to-mouth behaviour (4.3.2).

Frequency
Garcia-Hidalgo et al. (2017) present summary data, from which it is derived that the respondent representing the 75th percentile would report cleaning a rug or carpet once a week. It would take the respondent ‘10–30 min per task’ or ‘1–10 min per day’. Hence, the summary data of Garcia-Hidalgo prove to be consistent with respect to the frequency and duration of cleaning a carpet or rug. Data other than product information recommending cleaning the carpet at least once a year are not available. The default frequency is therefore based on the survey of Garcia-Hidalgo et al. (2017) and set to 52 per year. The Q-factor is set to 4, because the underlying dataset is large, internally consistent and specifically collected to measure the frequency of cleaning a carpet.

11.2.1.1.1 Mixing and loading

During the opening of the bottle and the pouring of carpet cleaning liquid into a bucket or machine reservoir, volatiles evaporate from the bottle into the personal breathing zone of the consumer. Meanwhile, spilled droplets end up on the back of the pouring hand. To estimate exposure, the ***inhalation–exposure to vapour–evaporation–constant release area*** model and ***dermal–direct product contact–instant application loading*** model are used (see Section 4.1.2). Defaults for the parameters: product amount (inhalation), exposure duration, room volume, release area, application duration, exposed area and product amount (dermal) are described in the generic scenario (4.1.2).

Molecular weight matrix
The fraction of water in the carpet cleaning liquid is estimated at 0.6 (Table 11.13). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.6), which yields 30 g/mol. The Q-factor is 2, because the supporting quantitative data are limited.

Table 11.17: Default values for estimating consumer exposure to carpet cleaning liquid during mixing and loading

Default value		**Q-factor**	**Source**
General			
Frequency	52 per year	4	Garcia-Hidalgo et al., 2017
Inhalation–exposure to vapour–evaporation–constant release area			
Exposure duration	0.75 min	3	Section 4.1.2
Product amount	500 g	2	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	0.5 per hour	1	Living room (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Emission duration	0.3 min	3	Section 4.1.2
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	30 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Section 4.1.2
Product amount	0.01 g	3	Section 4.1.2

11.2.1.1.2 Application: manual and machine cleaning

Inhalation and dermal exposure are estimated to be similar for manual and machine cleaning, except for the application and exposure duration. Exposure is estimated using the ***inhalation–exposure to vapour–evaporation–increasing release area*** model and the ***dermal instant–direct product contact–instant application loading*** model.

Application duration

Application duration is interpreted here as the duration of cleaning the carpet. According to the summary data of Garcia-Hidalgo et al. (2017), the 75th percentile for the duration of the cleaning task is 'up to 30 min'. However, important context information, such as the area of the carpet that is treated and whether the treatment is manual or with a machine, is missing. The default emission duration for cleaning the carpet by machine is therefore set to 30 min. The Q-factor is set to 2, because of the missing context information. For manual treatment, the default is set to 60 min, assuming it takes twice as long to clean a carpet manually as to clean it with a machine. Because of this assumption, the Q-factor is lowered to 1 for manual treatment.

Exposure duration

It is assumed that the consumer stays in the room for four hours after the cleaning task. Therefore, the default exposure duration is set to 240 min (4 hours). The Q-factor is set to 1, because the time the consumer remains in the room is based on expert judgement.

Amount of solution used

The amount of solution used is defined as the sum of the solvent and product amount subject to evaporation. The solvent amount subject to evaporation is considered to be the amount of water applied to the carpet, which is estimated to be 10 l, based on the volume of the solution reservoir of a carpet-cleaning machine. Product information on carpet-cleaning machines explains that there are small carpet cleaners with a reservoir of 0.35 to 1.4-10 l (SteamInsider, 2017) and large carpet cleaners with a reservoir of 30–45 l (Kärcher, 2017a, b). Here, it is assumed that a volume of 10 l is representative of both small and large machine reservoirs, as well as the volume of water in a bucket for manual cleaning. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a product use of 0.025–0.03 l per m^2, which is in accordance with the recommended use amount described in recent product information: 1 l of carpet cleaning liquid cleans about 37.5 m^2 (Rug Doctor, 2016). It can be assumed that the density of carpet cleaning liquid is 1000 g/l, since it mainly consists of water (Table 11.13). The amount of carpet cleaning liquid applied on the carpet is thus calculated as 0.03 l/m^2 x 22 m^2 x 1000 g/l = 660 g. The default amount of solution used is calculated to be 10,000 g + 660 g ≈ 11 kg. The Q-factor is set to 2, because the supporting data collected from product information are limited.

Dilution (times)

The carpet cleaning liquid is diluted in the water in the reservoir of the carpet cleaner, which is estimated to be 10 l in volume and thus 10 kg in mass, see above. Hence, the dilution of the product amount (660 g) is calculated as 11 kg / 660 g = 16. The Q-factor is set to 2, because the calculation is not entirely based on expert judgement but lacks support by quantitative data.

Product amount – dermal

The product amount that is subject to dermal exposure is interpreted here as the product amount that is in contact with the hands and forearms of the consumer. However, the carpet cleaning liquid is diluted with water prior to the application stage. The product amount that is subject to dermal exposure is therefore calculated from the volume of water that is in contact with the skin and the concentration of the carpet cleaning liquid in the water. The concentration is calculated by dividing the used product amount of 660 g (see above) with the volume of water it is diluted in. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a dilution with 10 l water for both manual and machine cleaning. The concentration in the water is thus calculated to be 66 g/l, i.e. 660 g/10 l. According to the generic scenario for the application of diluted products, the volume of water left on the skin from contact with hands and forearms to the water is 22 ml (4.2.3). The product amount that is subject to dermal exposure is therefore calculated as 66 g/l x 22 ml = 1.45 g. The Q-factor is 2, because the calculation of the default product amount for dermal exposure can be improved by further specification of the solution reservoir.

Table 11.18: Default values for estimating consumer exposure to carpet cleaning liquid during application (manual and machine cleaning)

Default value		Q-factor	Source
General			
Frequency	52 per year	4	Garcia-Hidalgo et al. (2017)
Inhalation–exposure to vapour–evaporation–increasing release area			
Exposure duration	240 min	1	See above
Amount of solution used	11 kg	2	See above
Dilution (times)	16	2	See above
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	22 m^2	4	Living room (Te Biesebeek et al., 2014)
Application duration			
- Manual cleaning	60 min	1	See above
- Machine cleaning	30 min	2	Garcia-Hidalgo et al., 2017
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	18 g/mol	4	Matrix is water
Dermal–direct product contact–instant application loading			
Exposed area	2200 cm^2	3	Section 4.2.3
Product amount	1.5 g	2	See above

11.2.1.2 Post-application exposure: rubbing-off

Post-application exposure for small children crawling over the treated carpet is estimated according to the generic scenario for rubbing-off (4.3.1). Hence, the ***dermal–direct product contact–rubbing-off loading*** model is used to estimate dermal exposure and the ***oral–direct product contact–direct oral intake*** model is used to estimate oral exposure from hand-to-mouth behaviour (4.3.2).

Contacted surface

The contacted surface (S_{area}) is the area of the treated surface that can be rubbed, which is in this scenario the floor of a living room: 22 m^2 (Te Biesebeek et al., 2014). The default is thus set to 22 m^2 and the Q-factor is set to 4 in accordance to the General Fact Sheet (Te Biesebeek et al., 2014).

Dislodgeable amount

As described in the generic scenario (4.3.1), the dislodgeable amount ($F_{dislodge}$) is calculated by multiplying a fraction of 0.3 by the used product amount (g) per m^2. The dislodgeable amount is thus calculated as 0.3 x 660 g/22 m^2 = 9 g/m^2. The Q-factor is set to 2, because the supporting quantitative data are limited.

Table 11.19: Default values for estimating consumer exposure to carpet cleaning liquid from rubbing-off

Default value		**Q-factor**	**Source**
General			
Frequency	52 per year	4	Garcia-Hidalgo et al., 2017
Body weight	8.0 kg	4	4.3.1
Dermal–direct product contact –rubbing-off loading			
Contacted surface	22 m^2	4	Living room floor (Te Biesebeek et al., 2014)
Dislodgeable amount	9 g/m^2	2	See above
Transfer coefficient	0.2 m^2/hr	3	Section 4.3.1
Contact time	60 min	1	Section 4.3.1
Exposed area	0.3 m^2	4	Section 4.3.1
Oral–direct product contact–direct oral intake			
Ingested amount	10% of total external dose	1	Section 4.3.2

11.2.2 Carpet powders
Carpet cleaners are also available as moist powders that contain water, solvents and surfactants to emulsify dirt. Product residues are removed with a vacuum cleaner once the dirt is absorbed into the powder and the carpet is dry.

Scenarios for consumer exposure
Carpet powder is considered to be a ready-to-use product, since the consumer directly scatters the powder from the packaging to the surface that is to be cleaned. Therefore, there is no exposure considered from mixing and loading (4.1.3). The powder is scattered over a carpeted area of 22 m^2 in the living room. Directly after scattering, the consumer brushes the powder into the carpet's fibre structure. Dermal exposure is expected during brushing via hand contact. Next, the powder is left on the carpet for a period of 20 min in order for the product to absorb and emulsify dirt. Inhalation exposure is anticipated during leave-on, because volatile substances in the moist powder evaporate from the carpet. After leave-on, the powder is removed with a vacuum cleaner. Secondary exposure is anticipated nonetheless, because the treated carpet is accessible to small children and residues may still be present after vacuum cleaning.

Frequency
The frequency of cleaning a carpet is estimated from the summary data of Garcia-Hidalgo et al. (2017) to be 52 per year (11.2.1).

11.2.2.1 Application: scattering
ConsExpo Web does not possess a specific model to simulate exposure from scattering powders (Delmaar & Schuur, 2016). In contrast to abrasive powders used in the kitchen (9.1.1), carpet powders mainly consist of volatile substances (Table 11.11). Therefore, the ***inhalation–exposure to vapour–evaporation–increasing release area*** model is used to estimate inhalation exposure to carpet powders. For the estimation of dermal exposure the ***dermal–direct product contact–constant rate loading*** model is used.

Application duration
Application duration is interpreted here as the time required for the consumer to scatter and brush the powder into the carpet's fibre structure. It is assumed that scattering a powder over and brushing it into a carpet is comparable to scattering a powder on a kitchen surface (9.1.1). Hence, in 1 min powder is scattered over 2 m^2 of surface (9.1.2). The carpet is 22 m^2, so that it takes 11 min to scatter powder over it. The default is thus set to 11 min. The Q-factor is 2, because the supporting data are limited.

Exposure duration
Exposure duration is interpreted here as the time required for the consumer to scatter the powder over the carpet plus a leave-on period of 20 min (Vanish, 2017). It is assumed that the consumer brushes the carpet during leave-on, so that no additional exposure duration from a brushing task is considered. Hence, the default exposure duration is set to 30 min. The Q-factor is 2, because the supporting data are limited.

Product amount – inhalation
The product amount that is subject to inhalation is calculated as the amount of powder that is scattered over the carpet. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 50–100 g per m^2, which is still in accordance with recent product information (Vanish, 2017). The carpet is 22 m^2, so that 2200 g of powder is scattered. The default product amount that is subject to inhalation is thus 2.2 kg. The Q-factor is 2, because the supporting data are limited.

Molecular weight matrix
The fraction of water in the carpet powder is estimated at 0.4 (Table 11.13). Following the conservative approach, the default molecular weight matrix is calculated as the molecular weight of water (18 g/mol) divided by the fraction of water in the product (0.4), which yields 45 g/mol. The Q-factor is 2, because the supporting quantitative data are limited.

Contact rate
It is assumed that the contact rate of 2.8 mg/min derived in the generic scenario for loading powders also applies to scattering powders over a carpet. The default is set to 2.8 mg/min. The Q factor is 1, because it is unclear whether dermal contact from the loading of powders is comparable to dermal contact from the brushing of scattered powders.

Table 11.20: Default values for estimating consumer exposure to carpet cleaning powder during application

Default value		**Q-factor**	**Source**
General			
Frequency	52 per year	4	Garcia-Hidalgo et al. (2017)
Inhalation–exposure to vapour–evaporation–increasing release area			
Exposure duration	30 min	2	See above
Product amount	2.2 kg	2	Prud'homme de Lodder et al., 2006a
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Application duration	11 min	2	See above
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	45 g/mol	2	See above
Dermal–direct product contact–constant rate			
Exposed area	225 cm^2	3	Hand palms (Te Biesebeek et al., 2014)
Release duration	11 min	2	Application duration
Contact rate	2.8 mg/min	1	Section 4.1.1

11.2.2.2 Post-application: rubbing-off

The carpet that is treated with carpet powder is an accessible surface for small children, who may be dermally exposed by rubbing off the product from the carpet. This form of secondary exposure is estimated using the ***dermal–direct product contact–rubbing-off loading*** model according to the generic scenario for rubbing-off (4.3.1). The ***oral–direct product contact–direct oral intake*** model is used to calculate oral exposure from hand-to-mouth behaviour (4.3.2).

Contacted surface

The contacted surface (S_{area}) is the area of treated surface that can be rubbed, which is in this scenario the floor of a living room: 22 m^2 (Te Biesebeek et al., 2014). The default is thus set to 22 m^2 and the Q-factor is set to 4 in accordance with the General Fact Sheet (Te Biesebeek et al., 2014).

Dislodgeable amount

As described in the generic scenario (4.3.1), the dislodgeable amount ($F_{dislodge}$) is calculated by multiplying a fraction of 0.3 by the product amount (g) per m^2. The carpet is vacuum cleaned after treatment with carpet powder. There are no data available about the amount of residue that remains on the carpet. It is thus conservatively assumed that 10% of the product amount is still on the carpet after vacuum cleaning. Hence, the dislodgeable amount is 0.3 x (2200g / 22 m^2) x 10% = 3 g/m^2. The Q-factor is set to 1, because the assumption of 10% residue after vacuum cleaning is based on expert judgement only.

Contact time
It is assumed that a child of 12 months crawls over a cleaned floor for 1 hour a day. The default contact time (t) is therefore 60 min, with a Q-factor of 2 (Prud'homme de Lodder et al., 2006a).

Table 11.21: Default values for estimating consumer exposure to carpet cleaning powder from rubbing-off

Default value		**Q-factor**	**Source**
General			
Frequency	52 per year	2	Garcia-Hidalgo et al., 2017
Body weight	8.0 kg	4	Section 4.3.1
Dermal–direct product contact–rubbing-off loading model			
Contacted surface	22 m^2	4	Living room floor (Te Biesebeek et al., 2014)
Dislodgeable amount	3 g/m^2	1	See above
Transfer coefficient	0.2 m^2/hr	3	Section 4.3.1
Contact time	60 min	2	Prud'homme de Lodder et al., 2006a
Exposed area	0.3 m^2	4	Section 4.3.1
Oral–direct product contact–direct oral intake model			
Ingested amount	10% of total external dose		Section 4.3.2

11.2.3 *Carpet spot remover*
Carpet spot removers eliminate small stains and dirt from carpets and upholstery.

Scenarios for consumer exposure
The consumer uses a spray can that contains a foam spot remover to treat the carpet in the living room. The spray can is a ready-to-use product, so that exposure from mixing and loading is not considered (4.1.3). The user sprays the spot remover on an area of 0.1 m^2. The foam is left on the stain to soak for 5 min. Inhalation exposure is anticipated during leave-on, as volatile substances may evaporate from the stain. Next, the dirt is absorbed with (paper) towels and the surface is patted dry. Dermal exposure is expected from rubbing the carpet/upholstery with towels.

Frequency
Westat (1987) investigated spot removers in a national survey and presents a 75^{th} percentile value for use frequency of 10 times a year. The default remains 10 per year with a Q-factor of 3.

11.2.3.1 Application: removing spots
Inhalation exposure during leave-on is estimated using the ***inhalation–exposure to vapour–evaporation–constant release area*** model. Dermal exposure from patting with towels is estimated using the ***dermal–direct product contact–instant application loading*** model.
Release area
The release area is interpreted here as the surface area of the carpet stain that is to be treated. In accordance with the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a), the default

release area is set to 0.1 m^2. The Q-factor is set to 1, because the default is based on expert judgement only.

Product amount – inhalation
The product amount that is subject to inhalation is interpreted here as the amount that is needed to treat the stain. Product information recommends an amount of 40 to 77 g per m^2(Vanish, 2017). A stain of 0.1 m^2 thus requires 8 g of product, and the default is set at 8 g accordingly. The Q-factor is 2, because the supporting data (product information) are limited.

Emission duration
Emission duration is interpreted here as the time during which the spot remover is left on the stain to soak. Product information recommends that the stain needs to be soaked for 1–5 min (Vanish, 2017). The default is set at 5 min to include the maximal duration of recommended use. The Q-factor is set to 2, because the data (product information) are limited.

Exposure duration
Exposure duration is interpreted here as the leave-on time plus the time the consumer needs to remove the spot with a cloth or towel. It is assumed that the duration for spot treatment for laundry products also applies to carpet products. According to AISE (2014), laundry pre-treatment takes 10 min per task (6.3.2). The default for exposure duration is therefore set to 15 min. The Q-factor is set to 1, because the product information supporting the leave-on time is limited and it is not clear to what extent the duration of spot treatment for laundry can be extrapolated to carpet products.

Molecular weight matrix
The fraction of ethanol in the spot remover is estimated at 0.4 (Table 11.13). The molecular weight matrix is thus calculated as 46 g/mol divided by 0.4 = 115 g/mol. The Q-factor is set to 2.

Product amount – dermal
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a calculation for dermal exposure to undiluted products applied in surface treatment. It was assumed that 1% of the total amount that is applied ends up on the palms of the consumer. However, it is unclear whether this assumption is plausible for this specific scenario. Instead it is conservatively assumed that the amount per m^2 applied to the stain is equal to the amount per m^2 on the exposed skin area of the consumer. The exposed skin area is calculated as five finger tips, because the rest of the hand is protected by the cloth or towel. For spot remover the default product amount subject to dermal exposure is thus calculated as (77g/m^2) x 75 cm^2 = 0.6 g. The Q-factor is 1, because of the assumption that the amount per m^2 applied to the stain is equal to the amount per m^2 on the exposed skin.

Exposed area
The exposed area is considered to be the top phalanges of all five fingers of one hand. The General Fact Sheet describes a default surface area of a hand to be 450 cm^2 (Te Biesebeek et al., 2014). The surface area of fingers is thus 225 cm^2, assuming they represents half the

surface area of the hand. The surface area of one finger is then 45 cm^2 and one phalanx 15 cm^2 and five phalanges 75 cm^2. The default is thus set to 75 cm^2. The Q-factor is set to 3, because the underlying data described in the General Fact Sheet (Te Biesebeek et al., 2014) are of high quality but are compromised by the calculation described.

Table 11.22: Default values for estimating consumer exposure to carpet spot remover during application

Default value		**Q-factor**	**Source**
General			
Frequency	10 per year	3	Westat, 1987
Inhalation–exposure to vapour–evaporation–constant release area			
Exposure duration	15 min	1	Product information
Product amount	8 g	2	Product information
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Release area	0.1 m^2	1	See above
Application temperature	20 °C	4	Room temperature
Emission duration	5 min	2	See above
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	115 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area	75 cm^2	3	See above
Product amount	0.6 g	1	See above

11.3 Furniture and leather products

Furniture and leather products are intended to remove dust and stains, to protect various items of furniture, leather clothes and shoes and to produce a shine afterwards. There are products containing wax, oil or varnish. The products are available as liquids, sprays or pastes.

Table 11.23: General composition of furniture and leather products

Cleaning and care product ingredients	**Furniture liquid[A] % (w/w)**	**Furniture spray[A] % (w/w)**	**Wood liquid[B] % (w/w)**	**Wood spray[B] % (w/w)**	**Leather foam[B] % (w/w)**
Surfactants					
Anionic					5–20
Non-ionic			1–10	0–2	1–5
Soap			1–5		
Waxes	51			0–2	1–5
Oil, turpentine oil, mineral oil	22	<10			
Solvents			1–5	10–15	0–1
Naphtha, petroleum distillate	20	<20			

Cleaning and care product ingredients	Furniture liquid[A] % (w / w)	Furniture spray[A] % (w / w)	Wood liquid[B] % (w / w)	Wood spray[B] % (w / w)	Leather foam[B] % (w / w)
Additives					
Silicones				0.5–2	
Colorants			0–0.1		
Fragrances			<1	0–1	
Preservatives			<0.5	0–1	
Hydrotropes			0–0.5		
Polymers					<5[A*]
Glycerine					1–5[A*]
Stearic acid	7				
Propellants		<18		10–20	10–20
Water		55–65	80	55–65	60–80

A: Composition adopted from Prud'homme de Lodder et al. (2006a)
B: www.cleanright.eu
[*] Liquid products

11.3.1 *Furniture polish spray*

Furniture polish sprays are available as aerosol cans and trigger sprays.

Scenarios for consumer exposure
The consumer treats a cupboard with a total area of 8 m^2 with a spray can containing furniture polish. The sprays are ready-to-use products that are used undiluted. Exposure from mixing and loading is thus not considered (4.1.3). First, the product is sprayed onto the cupboard. During spraying, inhalation exposure is anticipated as airborne droplets entering the breathing zone, while dermal exposure is expected from droplets depositing onto the unprotected skin of the consumer. Next, the polish is rubbed over the cupboard with a cloth. In the case of volatile substances, evaporation from the treated surface during the rubbing activity is not considered, because inhalation exposure to the volatile substances in spray is already covered in the instantaneous exposure estimate for the spraying activity (4.2.2). However, during rubbing dermal exposure is also expected via hand contact with a wetted cloth and due to spills. The treated surface is not accessible to small children, so that secondary exposure is not expected.

Frequency
Furniture polish can be used for maintenance and care or for protection of recently purchased wooden furniture. The frequency for these two uses differs, because polish used for maintenance and care is used in small amounts to treat scratches and other damage, whereas protection requires treatment of the entire piece of furniture. The EPHECT (2012) survey reports sufficient summary data to estimate the 75^{th} percentile for the frequency of using small amounts of furniture polish (5 sprayings). Using the EPHECT data to cumulatively derive a 75^{th} percentile indicates a frequency of 'once a week'. This is in contrast to the summary data of Garcia-Hidalgo et al. (2017), from which a 75^{th} percentile of 'once per year' can be derived. The 75^{th} percentile of Garcia-Hidalgo et al. (2017) typically reflects the use frequency of protection products prescribed by product information (Onderhouders.nl, 2017. The exposure scenario describes the treatment of the entire cupboard. Hence, the summary data

of Garcia-Hidalgo et al. (2017) most closely match the described exposure scenario. Therefore, the default frequency is set to once per year. The Q-factor is set to 4, because the dataset of Garcia-Hidalgo is large (n=723) and matches the scenario of consumer exposure.

11.3.1.1 Application: spraying

It is assumed that the application of waxes and polishes to the surface of a floor is similar to that of a cupboard. The model and defaults in section 11.1.3.2 derived for floor spray polishes are therefore also used to estimate the exposures from furniture spray. Inhalation exposure to sprayed particles is estimated using the ***inhalation–exposure to spray–spraying*** model. Dermal exposure is estimated using the ***dermal–direct product contact–constant rate loading*** model (4.2.1). The defaults for the parameters: mass generation rate, airborne fraction, density non-volatiles and contact rate area are in accordance with the generic scenario (4.2.1). Inhalation exposure to volatile substances in furniture polish sprays is estimated using the ***inhalation–exposure to spray–instantaneous release*** model. The defaults for the parameters: exposure duration, room volume, ventilation and inhalation rate described for non-volatiles in furniture polish sprays also apply to volatile substances.

Exposure duration
It is assumed that the consumer will stay in the room after the polishing task. Therefore, the default exposure duration is set to 240 min (4 hours). The Q-factor is set to 1, because the time the consumer remains in the room is based on expert judgement.

Spray duration
The spray duration is calculated from the amount of product that needs to be applied to the surface. It is assumed that the cupboard needs to be treated intensively, so that required product amount per unit of area is equal to that of removing dirt spots or heel marks from wooden floors (11.1.3.2.2). It was assumed that the intensive treatment of a wooden floor (11.1.3.2.2) requires a product amount per unit of area similar to the use of liquid floor polish (11.1.3.2.1). The cupboard is 8 m^2 and the product amount of polish liquid per m^2 is 20–25 g (11.1.3.1.1), so that a product amount of 200 g spray polish is estimated. The mass generation rate of a furniture polish spray can is 1.8 g/s (see below). Hence, 111 s ≈ 2 min are needed to spray the entire cupboard. The default spray duration is thus set to 2 min. The Q-factor is 2, because the supporting data are limited.

Mass generation rate
Delmaar & Bremmer (2009) experimentally derived the mass generation rate for a spray can with furniture polish. They found a released amount of 18 g from spraying for 10 s. Hence, the mass generation rate is set at 1.8 g/s. The Q-factor is set to 3, because the data were collected specifically in relation to furniture polish but are limited to 5 measurements on 2 samples.

Initial particle distribution
Delmaar & Bremmer (2009) experimentally derived the particle size distribution of droplets released by a spray can containing furniture

polish. They found a lognormal distribution with a median of 10.8 µm and a C.V. of 0.81. The default initial particle distribution is set accordingly. The Q-factor is set to 3, because the data were collected specifically in relation to furniture polish but are limited to 5 measurements on 2 samples.

Released mass
Released mass is interpreted here as the product amount that is sprayed out of the bottle or can, which has already been estimated to be 200 g (spray duration, see above). The Q-factor is set to 2, because the supporting data are limited.

Table 11.24: Default values for estimating consumer exposure to furniture polish spray during application

Default value		**Q-factor**	**Source**
General			
Frequency	1 per year	4	Garcia-Hidalgo et al., 2017
Inhalation–exposure to spray–spraying			
Spray duration[1]	2 min	2	See above
Exposure duration[2]	240 min	1	See above
Room volume[2]	20 m^3	4	Unspecified room (Te Biesebeek et al., 2014)
Room height[1]	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate[2]	0.6 per hour	3	Unspecified room (Te Biesebeek et al., 2014)
Mass generation rate[1]	1.8 g/s	3	Delmaar & Bremmer, 2009
Airborne fraction [1]	0.2	3	Section 4.2.1
Density non-volatile[1]	1.8 g/cm^3	3	Section 4.2.1
Initial particle distribution Median[1] (C.V.) [1]	10.8 µm (0.81)	3	Delmaar & Bremmer, 2009
Inhalation cut-off diameter[1]	15 µm	3	Delmaar & Schuur, 2016
Inhalation–exposure to spray–instantaneous release			
Released mass[3]	200 g	2	See above
Dermal–direct product contact–constant rate loading			
Exposed area	2200 cm^2	3	Section 4.2.1
Contact rate	46 mg/min	3	Section 4.2.1
Release duration	4 min	1	Twice the spray duration (4.2.1)

1: Applies to non-volatile substances only
2: Applies to both volatile and non-volatile substances
3: Applies to volatile substances only

11.3.1.2 Application: polishing
In addition to dermal exposure from the deposition of sprayed aerosols to the skin of the consumer, dermal exposure by hand contact while rubbing the surface is expected. The ***dermal–direct product contact–instant application loading*** model is used to estimate dermal exposure via hand contact.

Product amount – dermal
It is assumed that the consumer accidentally touches the treated furniture with one palm (225 cm^2). In order to be conservative it is assumed that dermal exposure is to the entire amount of product that is on the interface between the surface of the furniture and that of the consumer's hand. Hence, the amount of product per m^2 applied to the furniture is equal to the amount per m^2 on the palm of the hand of the consumer. For furniture polish spray the default product amount subject to dermal exposure is thus calculated as 25 g/m^2 x 225 cm^2 = 0.56 g. The Q-factor is set to 1, because of the assumption that the product amount per m^2 of treated surface is equal to the amount per m^2 of exposed area.

Table 11.25: Default values for estimating consumer exposure to furniture polish spray during rubbing

Default value		**Q-factor**	**Source**
General			
Frequency	1 per year	4	Garcia-Hidalgo et al., 2017
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Palm (Te Biesebeek et al., 2014)
Product amount	0.56 g	1	See above

11.3.2 *Furniture polishing liquid*

Scenarios for consumer exposure
The consumer treats a large cupboard with a total area of 22 m^2 with undiluted liquid furniture polish in the living room. First, the product is applied to a cloth and then it is rubbed on the cupboard. Inhalation exposure is anticipated as volatile substances evaporate from the treated surface. Dermal exposure is expected due to spills and via hand contact while rubbing with a wetted cloth. The treated surface is not accessible to small children, so that secondary exposure is not expected.

11.3.2.1 Application: polishing

It is assumed that surface treatment with liquid furniture polish is comparable to surface treatment with liquid floor polish (11.1.3.1). The molecular weight matrix is the exception here, as it is product-specific and differs from floor polishes. The scenario of inhalation exposure from treating a floor or item of furniture with liquid polish products is in accordance with the generic scenario for surface treatment (4.2.2). Hence, to estimate the expected inhalation exposure the ***inhalation–exposure to vapour–evaporation–increasing release area*** model is used. The scenario for dermal exposure, however, differs from the generic scenario, because the product is used in undiluted form and applied to the floor with a squeeze bottle. Here, the ***dermal–direct product contact–instant application loading*** model is used (11.1.3.1).

Exposure duration
It is assumed that the consumer will stay in the room after the cleaning task. Therefore, the default exposure duration is set to 240 min (4 hours). The Q-factor is set to 1, because the time the consumer remains in the room is based on expert judgement.

Molecular weight matrix
The most commonly used liquid solvent in liquid furniture polish is turpentine (Table 11.23). Assuming that the other solvents have a molecular weight comparable to that of turpentine (136 g/mol) the weight fraction of solvents in the product is characterized as 0.51 (Table 11.23). The molecular weight matrix of furniture polish is then calculated as 136 / 0.5 = 272 g/mol. The Q-factor is set to 2, because the data supporting the calculation are limited.

Table 11.26: Default values for estimating consumer exposure to furniture polishing liquid during polishing

Default value		**Q-factor**	**Source**
General			
Frequency	1 per year	4	Garcia-Hidalgo et al., 2017
Inhalation–exposure to vapour–evaporation–increasing release area			
Exposure duration	240 min	1	See above
Product amount	550 g	2	Section 11.1.3.1
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Ventilation rate	0.5 per hr	3	Living room (Te Biesebeek et al., 2014)
Release area	22 m^2	1	Scenario
Application duration	90 min	2	11.3.1.1
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix	272 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Hand palms (Te Biesebeek et al., 2014)
Product amount	0.55 g	1	Section 11.1.3.1

11.3.3 *Leather maintenance spray*
Leather products are used to protect and clean leather surfaces in furniture and fabrics. EPHECT (2012) data show that just over one-third (35%) of the European population uses leather and textile coatings less than once a month, while 27% use them once or twice a month, 24% use them once or more a week, and 5% use them daily. The products are mostly used in the living room (56%) and 45% is for use on leather furniture and interior decorations. The most often used formats for leather maintenance products are sprays (45%) and cream (33%).

Scenarios for consumer exposure
The consumer uses a spray can to treat a leather sofa (5.5 m^2) in the living room. Spray cans are ready-to-use products that are used undiluted. Exposure from mixing and loading is thus not considered (4.1.3). First, the product is sprayed onto the sofa. During spraying, inhalation exposure is anticipated as airborne droplets enter the breathing zone, while dermal exposure is expected from droplets depositing onto the unprotected skin of the consumer. After spraying, the consumer leaves the furniture spray to

dry and stays in the room. Evaporation from the treated surface during the rubbing activity is not considered, because inhalation exposure to the volatile substance in spray is already covered in the exposure estimate for the spraying activity (4.2.2). Additional dermal exposure can be expected, if the consumer is accidentally touches the treated sofa. It is expected that the consumer keeps small children away from the treated surface, so that secondary exposure is not considered.

Frequency
Maintenance sprays are used 1 to 3 times a week according to AISE (2009). However, product information for maintenance of leather advises to spray the product every 2 to 3 months for intensive use parts such as seats and elbow rests (HG, 2005). Based on the product information, the default is set at 5 times per year. The Q-factor is 1, because the supporting data (product information) are limited.

11.3.3.1 Application: spraying

The scenario of spraying a sofa with leather maintenance spray is in accordance with the generic scenario for spray applications (4.2.1). The ***inhalation–exposure to spray–spraying*** model estimates the inhalation exposure and the ***dermal–direct product contact–constant rate*** model estimates the dermal exposure. Inhalation exposure to volatile substances in furniture polish sprays is estimated using the ***inhalation–exposure to spray–instantaneous release*** model. The defaults for the parameters: exposure duration, room volume, ventilation and inhalation rate described for non-volatiles in leather maintenance sprays also apply to volatile substances.

Exposure duration
It is assumed that the consumer will stay in the room after the cleaning task. Therefore, the default exposure duration is set to 240 min (4 hours). The Q-factor is set to 1, because the time of consumer spends in the room is based on expert judgement.

Mass generation rate
Leather maintenance sprays are available as trigger sprays and aerosol spray cans. The respective generic mass generation rates are 1.6 and 1.2 g/s. The defaults are thus set accordingly. The Q-factor is 3, because the supporting quantitative data were not specifically collected in relation to leather maintenance sprays. Rather, the data were generically collected in relation to trigger sprays and aerosol spray cans.

Spray duration
The spray duration is calculated from the mass generation rate and the amount of leather maintenance spray that is required to treat the sofa. According to product information, a spray can of 300 ml will treat 10-15 m^2, and the density of a leather maintenance spray is 0.66 g/ml (HG, 2016). The amount of product required to treat a sofa of 5.5 m^2 is thus (5.5 m^2 / 10 m^2) x (300 ml x 0.66 g/ml) = 109 g. A trigger spray generates 1.6 g/s, so that the time required to spray 109 g is 68 s; for an aerosol spray can this is 90 s. The default spray durations are set accordingly. The Q-factor is 2, because the supporting data (based on product information) are limited.

Release duration
Release duration refers to the amount of time during which the skin is into contact with deposited aerosols. It is interpreted here as the gross spraying duration, which is equal to the duration of the spraying task including breaks between spraying activity. The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a release duration of 3 min, assuming that half of the time the consumer is actually spraying and half of the time the consumer takes a break to prepare for spraying. The default for release duration remains 3 min. The Q-factor is 2, because the default partially depends on quantitative data but these are compromised by the expert judgement assumption that the consumer takes a break for half of the time.

Initial particle distribution
It is assumed that the particle size distribution of a leather maintenance spray is comparable to that of furniture polish. Therefore, the default median particle diameter is set to 10.8 µm with a C.V. of 0.81 based on the report of Delmaar & Bremmer (2009). The Q-factor is set to 2, because the data informing the particle distribution comprise only one sample that was not specifically leather maintenance spray but furniture polish.

Released mass
Released mass is interpreted here as the product amount that is sprayed from the bottle or can, which has already been estimated to be 109 g (see above, spray duration). The Q-factor is set to 2, because the supporting data are limited.

Table 11.27: Default values for estimating consumer exposure to leather maintenance spray during application

Default value		**Q-factor**	**Source**
General			
Frequency	5 per year	2	Product information
Inhalation–exposure to spray–spraying			
Spray duration			
- Trigger spray[1]	68 s	3	See above
- Aerosol spray can[1]	90 s	3	See above
Exposure duration[2]	240 min	1	See above
Room volume[2]	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Room height[1]	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate[2]	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Mass generation rate			
- Trigger spray[1]	1.6 g/s	3	Section 4.2.1
- Aerosol spray can[1]	1.2 g/s	3	Section 4.2.1
Airborne fraction[1]	0.2	3	Section 4.2.1
Density non-volatile[1]	1.8 g/cm^3	3	Section 4.2.1
Initial particle	10.8 µm	2	Delmaar & Bremmer, 2009

Default value		Q-factor	Source
distribution Median[1] (C.V.)[1] Inhalation cut-off diameter[1]	 (0.81) 15 µm	 3	 Delmaar & Schuur, 2016
Inhalation–exposure to spray- instantaneous release			
Released mass[3]	109 g	2	See above
Dermal–direct product contact–constant rate loading			
Exposed area Contact rate - Trigger spray - Aerosol spray can Release duration	$2200\ cm^2$ 46 mg/min 100 mg/min 3 min	3 3 3 2	Section 4.2.1 Section 4.2.1 Section 4.2.1 See above

1: Applies to non-volatile substances only
2: Applies to both volatile and non-volatile substances
3: Applies to volatile substances only

11.3.3.2 Application: rubbing-in

While rubbing the leather maintenance spray into the sofa, the consumer may experience dermal exposure by touching the treated surface with the inside of the hand. The ***dermal–direct product contact–instant application loading*** model is used to estimate the dermal exposure via hand contact.

Product amount

It is assumed that the consumer accidentally touches the treated sofa with one palm ($225\ cm^2$). In order to be conservative, it is assumed that exposure is to the entire amount of product that is on the interface between surface of the sofa and that of the consumer's hand. Hence, the amount of product per m^2 applied to the furniture is equal to the amount per m^2 on the palm of the hand of the consumer. It was explained earlier (11.3.3.1) that it takes 109 g to treat a sofa of $5.5\ m^2$, so that the product amount per unit of area is $19.8\ g/m^2$. The product amount subject to dermal exposure is then calculated as $19.8\ g/m^2$ x $225\ cm^2$ = 0.45 g. The default product amount is set to 0.45 g. The Q-factor is set to 1, because of the assumption that the product amount per m^2 on the treated surface is equal to the amount per m^2 on the exposed skin.

Table 11.28: Default values for estimating consumer exposure to leather maintenance spray during rubbing-in

Default value		Q-factor	Source
General			
Frequency	5 per year	2	Product information
Dermal–direct product contact–instant application loading			
Exposed area Product amount	$225\ cm^2$ 0.45 g	3 1	Hand palms (Te Biesebeek et al., 2014) See above

12 Miscellaneous

Certain surfaces require specific cleaning products. This chapter describes the estimation of consumer exposure to glass cleaners, oven cleaners, metal cleaners, drain cleaners and shoe polish.

12.1 Glass cleaners

Glass cleaners loosen and dissolve oily marks from various glass surfaces such as windows, mirrors, glass cases and tables. Glass cleaners contain surfactants, solvents and alkalis that adhere to the glass surface and lift away dirt and grime. They clean the surface without leaving stripes and dry quickly. Mostly, they are applied undiluted with a trigger spray, but there are also glass cleaners available as liquids (mostly for cars), foams and wipes. Liquid cleaners and wipes have already been discussed in Chapter 8. Glass cleaner trigger sprays are discussed below. The scenarios for modelling exposure when using a glass cleaner vary among the different use phases, because glass cleaner spray contains both volatile and non-volatile substances

Table 12.1: General composition of glass cleaners

Glass cleaner ingredients	Liquid spray[A] % (w/w)
Surfactants	
Anionic	0–1
Non-ionic	0–1
Bases	0–5[B]
Ammonia	
Solvents	
Ethanol	5–20
Isopropyl alcohol	5–20
Additives	
Preservatives	<1
Fragrances	<1
Colorants	0–0.2
Water	75–90

A:www.cleanright.eu

The EPHECT survey (2012) shows that most people use glass and window cleaners once or twice a month (39%). Slightly fewer consumers use such products weekly (34%), and only 4% use them on a daily basis. The cleaners are most often used in living rooms (79%), bathrooms (71%), kitchens (70%) and bedrooms (67%).

Scenarios for consumer exposure

The consumer uses a trigger spray glass cleaner to clean the windows (12 m^2) in the living room. Trigger sprays are ready-to-use products that are used undiluted. Exposure from mixing and loading is thus not considered (4.1.3). During spraying, inhalation exposure is anticipated as airborne droplets enter the breathing zone, while dermal exposure is expected from droplets depositing onto the unprotected skin of the consumer. The consumer cleans the glass windows with a dry cloth directly after a leave-on period of several minutes, during which the glass cleaner is left on the surface to soak. In the case of volatile substances, evaporation from the treated surface during the leave-on period is not considered, because inhalation exposure to the volatile substance in spray should be covered by the ***inhalation–exposure to spray–spraying release*** model during the spraying activity (4.2.2). Additional dermal exposure is expected during cleaning via hand contact with the surface that is cleaned. Finally, the glass cleaner is removed with a dry cloth, so that secondary exposure is not expected.

Frequency
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 365 per year. AISE (2009) presents information for surface cleaners, but not specifically for glass surfaces. Analysis of the EPHECT data (Annex II) results in a 75th percentile of 66 per year for the use of glass spray cleaners. The summary data of Garcia-Hidalgo et al. (2017) present only a frequency expressed in min/day and are thus not applicable here. Based on the recent data of EPHECT and number of data points (n=981), the new default is set at 66 per year with a Q-factor of 4.

12.1.1 Application: spraying
Inhalation exposure to sprayed particles is estimated using the ***inhalation–exposure to spray–spraying*** model. Dermal exposure is estimated using the ***dermal–direct product contact–constant rate loading*** model (4.2.1). The defaults for the parameters: mass generation rate, airborne fraction, density non-volatiles and contact rate area are in accordance with the generic scenario (4.2.1). Inhalation exposure to volatile substances in glass sprays is estimated using the ***inhalation–exposure to spray–instantaneous release*** model. The defaults for the parameters: exposure duration, room volume, ventilation and inhalation rate described for non-volatile glass sprays also apply to volatile substances.

Spray duration
Spray duration is interpreted here as the time in which the consumer is actually spraying. Glass sprays are available as trigger sprays. The spray duration is calculated from the number of trigger movements required to clean the windows. According to the EPHECT survey, the 75th percentile is '5 sprayings per event' for cleaning windows. However, important context information is missing, such as the surface area of the windows and a clear definition of 'spraying(s) per event'. Therefore, it is assumed that '5 sprayings per event' relates to cleaning a surface area of 2 m^2. The underlying rationale for this assumption is explained in section 11.1.3.2.1. According to the EPHECT (2012) survey, glass spray cleaners are mostly used to clean the windows of the living room. Therefore, the surface area is 12 m^2. Here, it is assumed that the area of a living room (22 m^2 according to General Fact Sheet of Te Biesebeek et al., 2014) is 4 m x 5.5 m. The height of the room is 2.5 m. Next it is assumed that the windows are in the walls on one short side of the room (4 m) and one long side (5.5 m) and that half of the surface area of the walls is a glass window. The surface area is then (½ x 4m x 2.5 m) + (½ x 5.5 m x 2.5 m) = 12 m^2. Since it is assumed that 2 m^2 requires 5 trigger pulls, 12 m^2 requires 30 trigger pulls. According to Delmaar & Bremmer (2009),

it takes 6 s to perform 10 trigger pulls, so that it would take 18 s to perform 30 trigger pulls. The default spray duration is thus set to 18 s. The Q-factor is set to 1, given the number of assumptions included in the calculation.

Exposure duration
It is assumed that the consumer will stay in the room after the cleaning task. Therefore, the default exposure duration is set to 240 min (4 hours). The Q-factor is set to 1, because the time of consumer remains in the room is based on expert judgement.

Mass generation rate
Glass cleaners are available as trigger sprays. The default mass generation is set according to the generic mass generation rate for trigger sprays, which is 1.6 g/s (4.2.1). The Q-factor is 3, because the supporting data are quantitatively sufficient but not specifically collected in relation to glass cleaner sprays.

Initial particle distribution
It is assumed that the particle size distribution of glass cleaner spray is comparable to that of all-purpose cleaner spray. Therefore, the default median particle diameter is set to 2.4 µm with a C.V. of 0.37 based on the report of Delmaar & Bremmer (2009). The Q-factor is set to 2, because the data referring the particle distribution comprise only one sample, which was not glass cleaner spray but all-purpose cleaner spray.

Released mass
Released mass is interpreted here as the product amount that is sprayed out of the bottle or can. The default released mass is estimated to be 29 g by multiplying the spray duration (18 s) by the mass generation rate (1.6 g/s). The Q-factor is set to 1, because of the low Q-factor assigned to the spray duration.

Table 12.2: Default values for estimating consumer exposure to glass cleaner spray during application

	Default value	**Q-factor**	**Source**
General			
Frequency	66 per year	4	Annex II
Inhalation–exposure to spray–spraying			
Spray duration[1]	18 s	1	See above
Exposure duration[2]	240 min	1	See above
Room volume[2]	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Room height[1]	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate[2]	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Mass generation rate[1]	1.6 g/s	3	Section 4.2.1
Airborne fraction[1]	0.2	2	Section 4.2.1
Density non-volatile[1]	1.8 g/cm^3	3	Section 4.2.1

	Default value	Q-factor	Source
Initial particle distribution Median[1] (C.V.)[1]	2.4 µm (0.37)	3	See above
Inhalation cut-off diameter[1]	15 µm	3	Section 4.2.1
Inhalation–exposure to spray–instantaneous release			
Released mass[3]	29 g	1	See above
Dermal–direct product contact–constant rate loading			
Exposed area	2200 cm^2	3	Section 4.2.1
Contact rate	46 mg/min	3	Section 4.2.1
Release duration	36 s	1	Twice the spray duration (4.2.1)

1: Applies to non-volatile substances only
2: Applies to both volatile and non-volatile substances
3: Applies to volatile substances only

12.1.2 *Application: cleaning*

The consumer cleans the windows with a dry cloth. Dermal exposure is estimated using the ***dermal–direct product contact–instant application loading*** model.

Product amount – dermal
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a calculation for dermal exposure to undiluted products applied in surface treatment. It was assumed that 1% of the total amount that is applied ends up on the palms of the consumer. However, it is unclear whether this assumption is plausible for this specific scenario. Since glass cleaner consists mainly of water (Table 12.1), it is assumed that the amount of product that ends up on the skin of the consumer can be calculated by multiplying the exposed area by a layer thickness of 0.01 cm (4.2.3). The exposed skin area is calculated as five phalanges (75 cm^2), because the rest of the hand is protected by the dry cloth. The amount of product on the fingers is then 75 cm^2 x 0.01 cm = 0.75 ml. The density of the product is estimated to be 1 g/ml, because it consists mainly of water. The default product amount that is subject to exposure is thus set to 0.75 g. The Q-factor is set to 2, because the data supporting the calculation are limited.

Table 12.3: Default values for estimating consumer exposure to glass cleaner spray during cleaning

Default value		Q-factor	Source
General			
Frequency	66 per year	4	Annex II
Dermal–direct product contact–instant application loading			
Exposed area	75 cm^2	3	Section 11.2.3.1
Product amount	0.75 g	2	See above

12.2 Metal cleaners

Metal cleaners are designed to remove marks from and restore shine to all kinds of metals, including chrome, copper, brass, aluminium and stainless steel. They make surfaces gleam and slow down the re-tarnishing process. There are two types of metal cleaners: water-based products and solvent-based products. Exposure to volatile substances in metal cleaners is discussed below.

Table 12.4: General composition metal cleaners

Metal cleaners	**Liquid – water-based**[A] **% (w/w)**	**Liquid – solvent-based**[A] **% (w/w)**	**Stainless steel**[B] **% (w/w)**
Surfactants			
Anionic			0–4
Non-ionic			0–4
Solvents			
Naphtha	31	60–70	
Oleic acid	0.5		
Alkanolamine	0.2		
Bases or salts	0.5	2–3	
Additives			
Abrasives			0–6
Phosphoric acid			10–20
Polishing agents, e.g. quartz	3.5	9–12	
Water	64		75

A: www.cleanright.eu
B: Prud'homme de Lodder et al., 2006a

Scenarios for consumer exposure
The consumer applies metal cleaner to a wet cloth and starts to clean a kitchen work top of 2 m^2 (Weerdesteijn et al., 1999). The metal cleaner is used directly, so that exposure from mixing and loading is not considered (4.1.3). The kitchen top to which the product is applied is then wetted with a cloth, so that the product becomes diluted with water. The consumer then starts to polish the surface. Inhalation exposure is anticipated as volatile substances evaporate from the treated surface, while dermal exposure is anticipated via hand contact with the product. The consumer stays for 1 hour in the kitchen after the cleaning task.

Frequency
From expert judgement it is assumed that a kitchen top is cleaned every two months with a metal cleaner (Prud'homme de Lodder et al., 2006a). The default is set at 6 per year. The Q-factor is 1, because the default depends on expert judgement only.

12.2.1 Application: cleaning
The anticipated exposure to metal cleaners during surface treatment is estimated in accordance with the generic scenario for surface cleaning (4.2.2). Inhalation exposure to volatile substances is thus estimated using the ***inhalation–exposure to vapour–evaporation–increasing release area*** model and dermal exposure is estimated using the ***direct product contact–instant application loading*** model.

Amount of solution used
The amount of solution used that is subject to evaporation is interpreted here as the sum of the solvent amount and product amount that is applied on the kitchen work top. Product information recommends a mixture of water and metal cleaner in a ratio 1:1 (Swissvax, 2016). Hence, it is assumed that wetting the kitchen work top results in a

mixture that comprises 0.5 ml water and 0.5 ml metal cleaner. From a small experiment (Prud'homme de Lodder et al., 2006a), it is assumed that a wet surface comprises 40 ml liquid per m^2. The volume of the mixture on a wet kitchen work top of 2 m^2 is thus estimated to be 80 ml.

Metal cleaners are either naphtha- (1.14 g/ml) or water- (1 g/ml) based. Therefore, a mixture of water and water-based metal cleaner applied to the surface comprises 40 g water plus 40 g cleaner, so that the amount of solution used is 80 g. The amount of solution used for naphtha-based metal cleaners is calculated to be 86 g as it consists of 40 g water plus 1.14 g/ml x 40 ml = 45.6 g naphtha-based metal cleaner. The default amount of solution used is set to 86 g and 80 g for naphtha- and water-based metal cleaner, respectively. The Q-factor is set to 2, because the supporting data are limited.

Dilution (times)
The dilution factor refers to the ratio of the product amount and the total mass of the substance in which it is diluted (4.2.3). Here, the dilution in number of times is calculated separately for naphtha- and water-based metal cleaners based on the ratios used to calculate the product amount subject to inhalation. For naphtha-based metal cleaner this is 86 g / 46g = 1.9, whereas for water-based metal cleaner this is 80 g / 40 g = 2. The Q-factors are set to 2, because the calculations are not entirely based on expert judgement but lack supporting quantitative data.

Product amount – dermal
The product amount that is subject to dermal exposure is interpreted here as the amount that ends up on the hand of the consumer from touching the wet cloth. According to the generic scenario for surface treatment with a wet cloth (4.2.2), the product amount subject to dermal exposure for naphtha-based metal cleaners is calculated as (46 g / 2 m^2) x (2.25 ml / 40 ml) = 1.3 g and for water-based cleaner as (40 g /2 m^2) x (2.25 ml / 40 ml) = 1.1 g.

Application duration
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default of 10 min based on expert judgement only. AISE (2014) presents a maximal task duration for cleaning surfaces with gel products of 20 minutes, which is also used as the default application duration for cleaning a kitchen top with abrasive liquids (9.2.1). The task of polishing a kitchen top with abrasive liquid is comparable to the task of polishing a kitchen work top with metal cleaner. Therefore, the default is set to 20 min. The Q-factor is set to 3, because the supporting data are generic for polishing surfaces and not specifically for polishing a kitchen work top with metal cleaner.

Molecular weight matrix
The matrix from which substance evaporates is interpreted here as the mixture that is applied to the kitchen work top. The fraction of water in the mixture is calculated to range between 0.8 and 0.9 for water-based metal cleaners, since they consist of 25–36% substances other than water, which are diluted in a ratio of 1:1. The default molecular weight matrix for water-based metal cleaners is thus calculated as 18 g/mol

divided by 0.9 = 20 g/mol. The fraction of naphtha, which has a molecular weight of 128 g/mol, in naphtha-based metal cleaners ranges between 0.6 and 0.7 (Table 12.4). As explained above (see, dilution), yhis fraction is diluted in the mixture to 0.3–0.35. The weight fraction of water in the naphtha mixture is 0.47, because 1.07 g mixture comprises 0.57 g metal cleaner and 0.5 g water (0.5 g / 1.07 g = 0.47). The default molecular weight matrix of naphtha-based metal cleaners is then calculated as 1 / (0.47/18 + 0.3/128) = 35 g/mol. The Q-factors are set to 2, because the supporting data are limited.

Table 12.5: Default values for estimating consumer exposure to metal cleaner during cleaning

Default value		**Q-factor**	**Source**
General			
Frequency	6 per year	1	Product information
Inhalation–exposure to vapour–evaporation–increasing release area			
Exposure duration	60 min	1	Scenario
Amount of solution used			
- Water-based	80 g	2	See above
- Naphtha-based	86 g	2	See above
Dilution (times)			
- Water-based	2	2	See above
- Naphtha-based	1.9	2	See above
Room volume	15 m^3	4	Kitchen (Te Biesebeek et al., 2014)
Ventilation rate	2.5 per hour	3	Kitchen (Te Biesebeek et al., 2014)
Release area	2 m^2	3	Section 9.1
Application duration	20 min	3	Section 9.1
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix			
- Water-based	20 g/mol	2	See above
- Naphtha-based	35 g/mol	2	See above
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Hand palms (Te Biesebeek et al., 2014)
Product amount			
- Water-based	1.1 g	2	See above
- Naphtha-based	1.3 g	2	See above

12.3 Drain cleaners

Drain cleaners unclog and help prevent clogging in kitchen sinks, toilets and bathroom drains by dissolving and loosening grease and organic waste. Drain cleaners are available in liquid and solid (granular) form. They can be based on hypochlorite in combination with sodium or potassium hydroxide or sulphuric acid, or be biological enzyme- or bacteria-based. Chemical drain cleaners are corrosive.

Aided by the heat of hot water, drain cleaners chemically break down fats, hair and other deposits. Usually they are poured undiluted into drains. Drain cleaners containing bacteria or enzymes that clear the drains by breaking down the organic material first into small, simple pieces and afterwards into the two basic components: carbon dioxide and water. Exposure to volatiles is discussed below.

Table 12.6: General composition of drain cleaners

Drain cleaner Ingredient	**Sulphuric liquid[A] % (w/w)**	**Water-based liquid[B] % (w/w)**	**Solid[A] % (w/w)**
Alkaline Sodium or potassium hydroxide		20–40	100
Acid Sulphuric acid	98		
Surfactants Viscosity controlling agents Bleach Aluminium Water	 <2	1–2 0–1 0–5 60–80	 <1

A: Prud'homme de Lodder et al., 2006a
B: www.cleanright.eu

Scenarios for consumer exposure
Drain cleaners are available as granules and liquids. They are ready-to-use products that are poured directly into the sink that is to be treated. Exposure from mixing and loading is thus not considered (4.1.3). Instead, dermal exposure is expected while pouring the granules or liquids to spilled droplets ending up on the consumer's hands. Note that hands and eyes should be protected since drain cleaners contain corrosive substances. However, it is assumed that not all consumers follow the instructions, so that no gloves and glasses are considered to be used while cleaning. Inhalation exposure is anticipated as well, as volatile substances evaporate from the bottle into the breathing zone of the consumer. Once the drain cleaner is in the drain, it is left there to soak for several minutes. It is assumed that 0.25 l water is added to the granule drain cleaner in order to dissolve the granules. Inhalation exposure is expected during this period of leave-on from volatile substances that evaporate out of the drain. After leave-on, the product is flushed away with an abundant volume of water flowing out of the tap.

Frequency
The previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a) prescribes a default for use frequency of 4 per year, which is based on Versar (1992), who reports a 75th percentile of 2 times per 6 months. According to AISE (2014), the maximum frequency is once a week (typically less than once a week). Product information recommends a use of 2 times a month to avoid unpleasant odours (HG, 2016), which is in accordance with the typical frequency reported by AISE. Therefore, the frequency reported by AISE is selected as the default frequency of 24 per year. The Q-factor is 2, because the supporting data are limited.

12.3.1 *Application: pouring*

Dermal exposure from pouring the liquid or granules is estimated using the ***dermal–direct product contact–constant rate loading*** model (4.1.1). Inhalation exposure from volatile substances evaporating out of the bottle upon pouring is estimated using the ***inhalation–exposure to vapour–evaporation–constant release area*** model.

Molecular weight matrix
The molecular weight matrix depends on the composition of the drain cleaner. Liquid drain cleaners are either water-based or acid-based. Acid-based drain cleaners comprise a fraction of 0.98 sulphuric acid, which has a molecular weight of 98 g/mol. Hence, the default molecular weight matrix for acid-based drain cleaners is set to 98 g/mol.
The water-based liquid drain cleaner comprises a fraction of 0.2–0.4 sodium, which has a molecular weight of 23 g/mol, and a fraction of 0.6–0.8 water. The default molecular weight matrix for water-based drain cleaners is thus calculated as 1 / (0.8/18 + 0.2/23) = 19 g/mol.
Granular drain cleaners consist entirely of sodium, so that the molecular weight is 23 g/mol.

Product amount – dermal
The product that is subject to dermal exposure to sulphuric and water based drain cleaners is 0.01 g according to the generic scenario for pouring liquids (4.1.2). For granules the product amount (0.7 mg) is calculated by multiplying the release duration (0.25 min) and contact rate (2.8 mg/min) given in the generic scenario for pouring powders (4.1.1). The Q-factors are set in accordance with the generic exposure scenarios as well: a Q-factor of 3 for the liquid water- and sulphuric-based drain cleaners and a Q-factor of 2 for the granules.

Table 12.7: Default values for estimating consumer exposure to drain cleaner during application

Default value		**Q-factor**	**Source**
General			
Frequency	24 per year	2	AISE, 2014
Inhalation–exposure to vapour–evaporation-constant release area			
Exposure duration	0.75 min	3	Section 4.1.2
Product amount	500 g	2	Section 4.1.2
Room volume	1 m^3	1	Section 4.1.2
Ventilation rate	2.5 per hour	1	Kitchen (Te Biesebeek et al., 2014)
Release area	20 cm^2	2	Section 4.1.2
Emission duration	0.3 min	3	Section 4.1.2
Application temperature	20 °C	4	Room temperature
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix			
- Sulphuric acid	98 g/mol	2	See above
- Water-based	19 g/mol	2	See above
- Granules	23 g/mol	2	See above

Default value		Q-factor	Source
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Section 4.1.2
Product amount			
- Sulphuric acid	0.01 g	3	Section 4.1.2
- Water-based	0.01 g	3	Section 4.1.2
- Granules	0.7 mg	2	Section 4.1.2

12.3.2 *Application: leave-on*

The ***inhalation–exposure to vapour–evaporation–constant release area*** model is used to estimate inhalation exposure to volatile substances evaporating from the drain during the leave-on period.

Application temperature
Hot water is added to granular drain cleaner. It is assumed that the consumer uses a kettle to boil the water, but the water is cooled to a temperature of 95 °C once it is poured into the drain. The Q-factor is set to 2, because the supporting data are limited.

Molecular weight matrix
The molecular weight of granular drain cleaner is altered once the hot water is added. The product amount of 500 g is diluted with 250 g hot water. The weight fraction of granules in the mixture is thus 500 g / (250 g + 500 g) = 0.67 and the weight fraction of water in the mixture is 250 g / (250 g + 500 g) = 0.33. The default molecular weight matrix for granular drain cleaner is calculated as 1 / (0.67/23 + 0.33/18) = 21 g/mol. The Q-factor is set to 2, because the supporting data are limited.

Product amount
The product amount that is subject to inhalation is interpreted here as the amount that is poured into the drain. For granules the default product amount is set to 70 g per task (AISE, 2014). Product information recommends the use of 300 ml for liquid drain cleaners (HG, 2016). Hence, the default product amount for water–based drain cleaners is 300 g. The density of sulphuric acid is 1.84 g/ml, so that the default product amount is calculated as 300 ml x 1.84 g/ml = 550 g. The Q-factors are set to 2, because the supporting data are limited.

Application duration
Application duration is interpreted here as the soaking time of the drain cleaner. According to AISE (2014), the typical soaking time is 10 min (range 5–15 min). Product information, however, recommends a soaking period of 30 min for liquid drain cleaners (HG, 2016). The default is set at 15 min for granules and 30 min for liquid drain cleaners. The Q-factor is set to 2, because the soaking periods strongly depend on the extent of the clogging that needs to be dissolved. For example, heavy clogging in kitchen sinks requires a soaking period of 6–8 hours (HG, 2016).

Exposure duration
The exposure duration is set equal to the application duration, because the drain cleaner is flushed away after the soaking period.

Table 12.8: Default values for estimating consumer exposure to drain cleaner during leave-on (soaking)

Default value		**Q-factor**	**Source**
General			
Frequency	24 per year	2	AISE, 2014
Inhalation–exposure to vapour–evaporation–constant release area			
Exposure duration			
- Sulphuric acid	30 min	2	See above
- Water-based	30 min	2	See above
- Granules	15 min	2	See above
Product amount			
- Sulphuric acid	550 g	2	See above
- Water-based	300 g	2	Product information
- Granules	70 g	2	AISE, 2014
Room volume	15 m^3	4	Kitchen (Te Biesebeek et al., 2014)
Ventilation rate	2.5 per hour	3	Kitchen (Te Biesebeek et al., 2014)
Release area	20 cm^2	1	Drain
Emission duration			
- Sulphuric acid	30 min	2	Product information
- Water-based	30 min	2	Product information
- Granules	15 min	2	AISE, 2014
Application temperature			
- Sulphuric acid	20 °C	4	Room temperature
- Water-based	20 °C	4	Room temperature
- Granules[1]	95 °C	2	See above
Mass transfer coefficient	10 m/h	2	Section 4.2.2
Molecular weight matrix			
- Sulphuric acid	98 g/mol	2	Section 12.3.1
- Water-based	19 g/mol	2	Section 12.3.1
- Granules	21 g/mol	2	See above

1: The vapour pressure of the substance should be adjusted to the application temperature of 95 °C

12.4 Shoe polish products

Shoe polish products are available as polishes, sprays (Section 11.5.1), wipes and ‘instant-shine’ liquids and creams (Section 11.5.2). The ingredients are selected to protect and nourish different types of shoes, such as leather, suede and nubuck. Exposure to non-volatile substances is considered below.

Table 12.9: General composition of shoe polish products

Shoe polish ingredients	**Polish[A,B] % (w/w)**
Waxes and paraffins	20–40
Solvents	>50
Additives	
- Dyes	0.1–0.3
- Propellants	<18[A*]
- Water	+

A: Prud’homme de Lodder et al., 2006a
B: www.cleanright.eu

The EPHECT survey data (2012) show for leather and fabric coatings that just over one-third of respondents (35%) use such products less than once a month, while 27% use them once or twice a month, 24% use them once or more a week, and 5% use them daily. Thy are mostly used in the living room (56%). The products are most often used on leather accessories such as shoes and handbags (52%). The most often used formats for these products are sprays (45%) and creams (33%). The most often coated surfaces are those of clothing accessories (including shoes) (EPHECT, 2012).

12.4.1 Shoe polish spray

Scenarios for consumer exposure

Polish sprays are ready-to-use products, so that exposure during mixing and loading is not relevant (4.1.3). According to their product information, shoes must be sprayed with several light coatings from a minimal distance of 20 cm. The user sprays 4 pairs of shoes in the living room with several light coatings. It is further assumed the consumer does not rub the shoes with a cloth after spraying, but allows the polish to dry between each application. The shoes are also not polished at the end of the spraying. Inhalation exposure is estimated using the ***inhalation–exposure to spray–spraying*** model, and the ***dermal–direct product contact–instant application*** model is used to estimate dermal exposure. Inhalation exposure to volatile substances in shoe polish sprays is estimated using the ***inhalation–exposure to spray–instantaneous release*** model. The defaults for the parameters: exposure duration, room volume, ventilation and inhalation rate described for non-volatiles in shoe polish sprays also apply to volatile substances.

Frequency

Prud'homme de Lodder et al. (2006a) use a default of 8 times per year, based on the 75th percentile from Westat (1987). The EPHECT survey (2012) shows that 56% of their respondents use leather and textile products at least once a month. According to AISE (2014), maintenance products for furniture, shoes and leather are used 1 to 3 times per week (typically once a week). According to Garcia-Hidalgo et al. (2017), the 75th value for frequency of use of shoe care products is 'every month'. The data of Garcia-Hidalgo et al. are preferred over those of AISE and EPHECT, because they were collected specifically to measure the use of shoe care products and do not refer to other leather products as well. The default frequency is therefore set to 12 times per year. The Q-factor is set to 4, because the underlying dataset is large and specifically collected in relation to shoe care products.

12.4.1.1 Application: spraying

Spray duration

Spray duration is calculated from the amount of product required to treat the shoes and the mass generation rate of the spray. The generic mass generation rate of aerosol spray cans is 1.2 g/s (4.2.1), and the mass generation rate of furniture polish sprays is experimentally determined to be 1.8 g/s (Delmaar & Bremmer, 2009). AISE (2014) gives a typical amount of 30 g per task (range between 2 and 60 g) for maintenance sprays in general. The specific product amount required to polish a shoe, however, is unclear. Product information for oil, grease, water and grime repellents for leather objects such as prescribes a treatment of 58 g per m^2 (HG, 2008). According to the General Factsheet, the default surface area of an adult foot is 0.06 m^2 (Te Biesebeek et al., 2014). It can thus be calculated that one shoe requires 3.4 g (0.06 m^2 x 58 g/m^2 = 3.4 g) of leather maintenance product, assuming that the surface area of an adult foot is representative of that of a shoe. According to the scenario, the consumer treats four pairs of shoes, so that 28 g of product amount is used in total. The spray duration is then calculated to be 16 s (28 g / 1.8 g/s = 16 s) assuming that the mass generation rate of furniture polish is representative of that of shoe polish sprays. The Q-Factor is set to 1, because the data supporting the calculation are limited and the calculation is based on a number of assumptions.

Exposure duration
The consumer stays in the room for 4 hours after spraying the shoes. The Q-factor is set to 1 because the defaults is based on expert judgement only.

Mass generation rate
It is assumed that the mass generation of furniture polish is also representative of shoe polish sprays. Based on the experimental data of Delmaar & Bremmer (2009), the default mass generation is set to 1.8 g/s. The Q-factor is 2, because the data are quantitatively poor and do not directly refer to shoe polish sprays.

Airborne fraction
Shoe polish is sprayed towards a surface. The data of Delmaar & Bremmer (2009) show the airborne fraction for sprays directed at surfaces is 0.3 at the highest. The default airborne fraction is set to 0.3. The Q-factor is 2, because the supporting data are quantitatively poor and not specifically collected for shoe polish sprays.

Initial particle distribution
It is assumed that the particle size distribution of furniture polish is also representative of shoe polish sprays. Therefore, the default median particle diameter is set to 10.8 µm with a C.V. of 0.81 based on the data of Delmaar & Bremmer (2009). The Q-factor is set to 2, because the data referring the particle distribution comprise only one sample, which was not shoe polish spray.

Product amount – dermal
Prud'homme de Lodder et al. (2006a) prescribe a contact rate model to estimate dermal exposure to substances in shoe polish sprays. This prescription, however, is not considered not here, because airspace spraying does not account for spraying towards the user. During spraying the consumer holds up the shoe with one hand; thus the spray is also directed at the hand holding the shoe. Bremmer et al. (2006a) provide a default for dermal exposure due to spraying with hair spray, assuming that 90% of the spray ends up on the head (hair + skin), whereas 10% misses the hair and ends op on the scalp. Adopting a similar approach for spraying towards a hand holding a shoe yields a product amount subject to dermal exposure of 2.8 g. The new default is thus set to 2.8 g. The Q-factor is set to 1, because of the crude assumptions in the calculation.

Released mass
Released mass is interpreted here as the product amount that is sprayed out of the bottle or can, which has already been estimated to be 28 g (spray duration, see above). The Q-factor is set to 1, because of the low Q-factor assigned to the spray duration.

Table 12.10: Default values for estimating consumer exposure to shoe polish spray during application

Default value		**Q-factor**	**Source**
General			
Frequency	12 per year	4	Garcia-Hidalgo et al., 2017
Inhalation–exposure to spray–spraying			
Spray duration[1]	16 s	2	See above
Exposure duration[2]	240 min	1	See above
Room volume	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Room height[1]	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate[2]	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Mass generation rate[1]	1.8 g/s	2	See above
Airborne fraction[1]	0.3	2	Delmaar & Bremmer, 2009
Initial particle distribution Median[1] (C.V.)[1]	10.8 µm (0.81)	2	Delmaar & Bremmer, 2009
Inhalation cut-off diameter[1]	15 µm	3	Delmaar & Schuur, 2016
Inhalation–exposure to spray–instantaneous release			
Released mass[3]	28 g	1	See above
Dermal–direct product contact–instant application loading			
Exposed area	450 cm^2	3	Full hand (Te Biesebeek et al., 2014)
Product amount	2.8 g	1	See above, 10% of released mass

1: Applies to non-volatile substances only
2: Applies to both volatile and non-volatile substances
3: Applies to volatile substances only

12.4.2 *Shoe polish cream*

Scenarios for consumer exposure
Shoe polish cream is considered to be a ready-to-use product, so that consumer exposure during mixing and loading is not considered to be relevant (4.1.3). The consumer directly applies the shoe polish cream with a brush or soft cloth to 4 pairs of shoes. After drying, the shoes are brushed and then polished with a cloth.

Frequency
Prud'homme de Lodder et al. (2006a) set the default on the basis of the 90th percentile use frequency of polish spray from Westat (1987). The EPHECT survey data (2012) show that 56% of respondents use leather and textile products at least once a month. From the summary data of Garcia-Hidalgo et al. (2017) it is derived that the respondent representing the 75th percentile would report using shoe care products 'every month'. Hence, the data of Garcia-Hidalgo et al. (2017) are consistent with those

of EPHECT (2012). Moreover, the data of Garcia-Hidalgo et al. (2017) were specifically collected in relation to shoe care products and do not refer to other leather products as well. The default frequency is therefore set to 12 per year. The Q-factor is set to 4, because the underlying dataset is large and specifically collected in relation to shoe care products.

12.4.2.1 Application: polishing

The ***dermal–direct product contact–instant application loading*** model is used to estimate dermal exposure for polishing shoes with cream (4.2.4).

Product amount – dermal
Product information for oil, grease, water and grime repellents for leather objects prescribes a treatment of 58 g per m^2 (HG, 2008). According to the General Factsheet, the default surface area of one adult foot is 0.06 m^2 (Te Biesebeek et al., 2014). It is assumed that the amount of product per m^2 that ends up on the skin of the consumer is equal to the amount of product per m^2 applied to the shoes. The exposed area is considered to be that of one palm, which according to the General Fact Sheet is 225 cm^2. Hence, the product amount subject to dermal exposure is calculated to be 225 cm^2 x 58 g/m^2 = 1.3 g. The Q-factor is set to 1, because the calculation is based on crude assumptions.

Table 12.11: Default values for estimating consumer exposure to shoe polish cream during application

Default value		**Q-factor**	**Source**
General			
Frequency	12 per year	4	Garcia-Hidalgo et al., 2017; EPHECT, 2012
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Hand palms (Te Biesebeek et al., 2014)
Product amount	1.3 g	1	See above

12.5 Oven cleaners

Oven cleaners are strong degreasers and usually contain strong alkali and solvents to break down burnt-on fats and other deposits. They are available in liquid and spray (trigger or foam) form, so that otherwise inaccessible places can be reached. Liquid cleaners and wipes are discussed in chapter 6.2 and chapter 6.3, respectively. Trigger sprays are discussed below and suggestions are made for the use of foam (sprays).

Oven cleaners contain surfactants, solvents and additives. The scenarios for modelling consumer exposure when using oven spray cleaners vary among the different use phases, because the spray contains both volatile and non-volatile substances.

Table 12.12: General composition of oven cleaners

Oven cleaner ingredients	Liquid[A] % (w/w)	Aerosol[A] % (w/w)	General[B] % (w/w)
Surfactants			
Anionic and non-ionic surfactants	0–10	0–10	1–5
Solvents	0–10	0–10	0–33
Additives			
Monoethanolamine	0–5	0–5	
Potassium carbonate	0–10	0–10	1–5
Sodium metasilicate	0–5	0–5	
Sodium hydroxide	0–0.5	0–0.5	1–5
Aluminium oxide			25–50
Propellants		10–20	1–5
Wax			20–50
Fragrance			1–5
Water	Up to 100	Up to 100	Up to 100

A: www.cleanright.eu
B: DEPA, 2010

EPHECT (2012) reports kitchen cleaners as products used for cleaning and/or degreasing different surfaces in the kitchen, i.e. oven cleaners, water softeners, stainless steel cleaners, etc. Kitchen cleaners are mostly used on sinks (71%) and electrical kitchen appliances (70%). Almost half of consumers use special oven cleaners (48%).
Exposure to oven and stove-top cleaners mainly occurs via skin contact when using liquid, cream and gel products, and via inhalation when using spray products. Some oven cleaners are used at very high oven temperatures, which results in increased evaporation and thus increased risk of inhalation, e.g. for bases and solvents. As oven cleaning mostly requires thorough cleaning, oven cleaners are potentially more hazardous to human health than other cleaning products (DEPA, 2010). Oven cleaners that work in a cold oven are even stronger than those designed to work in a heated oven (cleaninginsitute.org). Note that although product information recommends the wearing of rubber gloves and avoidance of contact with skin and eyes, not all consumers will follow the instructions – despite the fact that, given the aggressive nature of oven cleaners, it is unlikely that consumers do not protect themselves. It is assumed nonetheless that no gloves are worn while cleaning.

Scenarios for consumer exposure
Trigger spray oven cleaners are ready-to-use products, so that consumer exposure during mixing and loading is not considered relevant (4.1.3). To conduct the cleaning task, the consumer sprays the oven cleaner spray/foam directly into a cold oven with dimensions of 60 x 40 x 40 cm. Inhalation and dermal exposure during spraying are considered, because the consumer sprays within a confined space. According to the DEPA (2010), for products in aerosol cans with a propellant, 60% of the product stays in the air and 10% of it deposits onto the skin. After spraying, the oven door is closed and the product is left to soak. During this phase the dirt and grime is absorbed. During the leave-on phase there is no inhalation or dermal exposure because the oven is closed and the bulk of the particles will then be inside the oven space. Here they will deposit so that they are no longer airborne

after the leave-on phase. Hence, the bulk of inhalation exposure will be during the spraying phase. Next the oven needs to be wiped clean with a wet cloth or sponge, so that dermal contact with the product is expected to occur again.

Frequency
Prud'homme de Lodder et al. (2006a) uses a default of 25 events per year. The DEPA (2010) assumes that the product is used once a week for cleaning the oven as an expression of a worst-case approach. Analysis of the EPHECT data shows a 75th percentile for the use frequency of kitchen spray cleaners is 190 per year and for kitchen cleaner foam 99 per year. From the summary data of Garcia-Hidalgo et al. (2017) it is derived that the 75th percentile for oven cleaner use is 2–5 times per year. The data of Garcia-Hidalgo et al. (2017) are preferred to the worst-case expressionof the DEPA (2010) and the EPHECT (2012) data, because the underlying dataset of Garcia-Hidalgo et al. (2017) is large and specifically collected to measure use of oven cleaners. The default frequency is therefore set to 5 per year with a Q-factor of 4.

12.5.1 *Application: spraying*
The substances considered in relation to exposure during the spraying phase are (associated with) non-volatile aerosol particles. The ***inhalation–exposure to spray–spraying*** model is used to estimate inhalation exposure (4.2.1) and the ***dermal–direct product contact–instant application*** model estimates dermal exposure.

Spray duration
The spray duration is calculated by dividing the amount of product used by the mass generation rate of the oven cleaner spray. Prud'homme de Lodder et al. (2006a) specified a sprayed amount of 24 g, which was derived from a study by Weerdesteijn et al. (1999), in which people were asked to clean a surface with a spray. The 24 g was twice the maximum amount of product used in the study. The 75th percentiles derived from the EPHECT (2012) data for kitchen sprays are 11 g for foam sprays and 6.1 g for trigger sprays. The DEPA (2010) describes a product amount of 8 g in an assessment of exposure to substances in oven cleaner, but the underlying calculation for this value is not made explicit. Straightforward and explicit data for characterizing the amount of oven cleaner product used are thus not available. In the absence of such data and in order to be consistent with the EPHECT (2012) data for kitchen sprays (which includes oven sprays) and the maximum amount found by Weerdesteijn et al. (1999), it is assumed that 12 g of product is used. According to the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a), the mass generation rate of an oven spray cleaner is 0.8 g/s. However, this mass generation rate actually refers to the intermittent spray duration divided from the observation studies of Weerdesteijn et al. (1999). Therefore, the generic mass generation rates for trigger sprays (1.6 g/s) and aerosol spray cans (1.2 g/s) are used for calculating the spray duration. A product amount of 12 g divided by these mass generation rates yield spray durations of 7.5 s and 10 s, respectively. The defaults are set accordingly with a Q-factor of 1 to account for the lack of data supporting the calculation of both the used product amount and mass generation rate.

Exposure duration
Prud'homme de Lodder et al. (2006a) describe a default exposure duration of 60 min, which is based on the residence time in a kitchen. General consumer practice, however, would be to close the oven after spraying. In that case the exposure duration can be derived as the intermittent spray duration mentioned above. According to Weerdesteijn et al. (1999), intermittent spraying of oven cleaner yields 0.8 g/s. The exposure duration for a product amount of 12 g is then calculated to be 15 s. The Q-factor is set to 1, because the supporting data are limited and the calculation does not discriminate between trigger sprays and aerosol spray cans.

Room volume
Spraying inside an oven releases substances within the breathing zone of the consumer holding the spray can or trigger spray. The room volume is therefore set to the default volume of an oven of 1 m^3 (4.2.1), with a Q-factor of 1, because it is derived with expert judgement only.

Room height
Room height refers here to the height of the personal breathing zone, i.e. the inside of the oven, which is set to 1 m. The Q-factor is 1 in accordance with the low Q-factor for the volume of the personal breathing zone.

Ventilation rate
The oven is assumed to be located in the kitchen. The default ventilation rate for a kitchen is set to 2.5 per hour in accordance with the General Fact Sheet (Te Biesebeek et al., 2014). The Q-factor is set to 1, because the personal breathing zone is subject to air flows other than just the ventilation of the room, e.g. diffusion and convection. These air flows are not accounted for in the default and hence the Q-factor is set to 1.

Initial particle distribution
Since the publication of the previous Cleaning Products Fact Sheet (Prud'homme de Lodder et al., 2006a), no data have become available that adequately describe the particle size distribution of oven cleaners. Therefore, the old default remains: a median particle size of 100 µm with a C.V. of 0.6. The Q-factor is set to 1, because the data were generically collected to measure large particulates and not specifically particles in oven cleaning sprays. Moreover, the default does not discriminate between aerosol spray cans and trigger sprays.

Product amount – dermal
In this specific situation the consumer sprays into an oven, which is a confined space, leading to dermal exposure. According to the DEPA (2010), the fraction subject to dermal exposure could be up to 6% of the sprayed amount (0.66 g). The new default is thus conservatively set to 0.7 g. The Q-factor is set to 1, because the default is originally derived from expert judgement.

Released mass
Released mass is interpreted here as the product amount that is sprayed out of the bottle or can, which has already been estimated to be 12 g.

The Q-factor is set to 2, because the supporting data are lacking some contextual information.

Table 12.13: Default values for estimating consumer exposure to oven cleaner spray during application (spraying)

Default value		**Q-factor**	**Source**
General			
Frequency	5 per year	4	Garcia-Hidalgo et al., 2017
Inhalation–exposure to spray–spraying release			
Spray duration - Trigger spray[1] - Aerosol spray can[1] Exposure duration[2] Room volume[2] Room height[1] Ventilation rate Mass generation rate - Trigger spray[1] - Aerosol spray can[1] Airborne fraction[1] Initial particle distribution Median[1] (C.V.)[1] Inhalation cut-off diameter[1]	 7.5 s 10 s 15 s $1\ m^3$ 1 m 2.5 per hour 1.6 g/s 1.2 g/s 0.2 100 µm (0.6) 15 µm	 1 1 1 1 1 1 3 3 2 1 3	 See above See above See above Section 4.2.1 Personal breathing zone Kitchen (Te Biesebeek et al., 2014) See above Section 4.2.1 Section 4.2.1 Section 4.2.1 Prud'homme de Lodder et al., 2006a Delmaar & Schuur, 2016
Inhalation–exposure to spray–instantaneous release			
Released mass[3]	12 g	2	See above
Dermal exposure -instant application			
Exposed area Product amount	$450\ cm^2$ 0.7 g	3 1	Hand (Te Biesebeek et al., 2014) DEPA, 2010

1: Applies to non-volatile substances only
2: Applies to both volatile and non-volatile substances
3: Applies to volatile substances only

12.5.2 *Application: cleaning*

When cleaning, the user wipes off the oven cleaner with a wet cloth. Dermal exposure is estimated using the ***dermal–direct product contact–instant application loading*** model (4.2.2).

Product amount – dermal
Prud'homme de Lodder et al. (2006a) prescribe 0.2 g as the default (as a fraction of an amount used of 24 g). During the application phase, 11 g is the product amount generated (EPHECT, 2012). The oven is cleaned with a wet cloth. According to the dimensions of the oven, the surface that needs to be cleaned is $1.1\ m^2$. In a small experiment (Prud'homme de Lodder et al. 2006a) it was observed that a surface is fully wet at 40 ml water per m^2, so that the volume of water needed to clean the oven is 44 ml. The concentration of oven cleaner in the water is then 12 g / 44ml = 0.27 g/ml. The volume of water that is in contact

with the skin from touching the wet cloth is 2.25 ml (see Section 4.2.2), so that the product amount that is subject to dermal exposure is calculated to be 2.25 ml x 0.27 g/ml = 0.6 g. The default product amount subject to dermal exposure is thus set to 0.6 g. The Q-factor is set to 1, because the supporting data are limited.

Table 12.14: Default values for estimating consumer exposure to oven cleaner spray during cleaning

Default value		**Q-factor**	**Source**
General			
Frequency	5 per year	4	Garcia-Hidalgo et al., 2017
Dermal–direct product contact–instant application loading			
Exposed area	225 cm^2	3	Hand palms (Te Biesebeek et al., 2014)
Product amount	0.6 g	1	See above

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Annex I Cleaning Products Fact Sheet 2018 compared with 2006

All Cleaning Products Fact Sheet data for exposure scenarios, selected ConsExpo models and default parameter values reported in the current Fact Sheet and that of 2006 are presented in one table below (Table A1). Changes compared with 2006 are highlighted yellow.

Table A1: All Cleaning Products Fact Sheet data for exposure scenarios, selected ConsExpo models and default parameter values published in 2006 and 2018

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
Mixing and loading - machine washing powder (6.1.1 ~ 3.1.1)	General	Frequency	365	per year	4	365	per year	3
	Inhalation– exposure to spray– instantaneous release[1]	Exposure duration	0.25	min	3	0.25	min	3
		Released mass – regular powder	6.2	µg	1	0.27	µg	1
		Released mass – concentrated powder	3.1	µg	1	Not included in FS 2006		
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	0.6	per hour	1	2	per hour	1
	Dermal– direct product contact– constant rate loading	Contact rate	2.8	mg/ min	2	Not included in FS 2006		
		Release duration	0.25	min	3			
		Exposed area	225	cm^2	3			
Mixing and loading - machine washing liquid (6.1.2 ~ 3.2.1)	General	Frequency	365	per year	4	365	per year	3
	Inhalation– exposure to vapour–	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	2	500	g	3
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	0.6	per hour	1	2	per hour	1
		Release area	20	cm^2	2	20	cm^2	2

Scenario (Section FS 2018 - Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
	evaporation –constant release area	Emission duration	0.3	min	3	0.3	min	3
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	90	g/mol	2	90	g/mol	2
	Dermal–direct product contact–instant application loading model	Exposed area – direct pouring	225	cm^2	2	215	cm^2	3
		Exposed area – pouring via cap	53	cm^2	2	Not included in FS 2006		
		Product amount – direct pouring	0.01	g	3	0.01	g	3
		Product amount – pouring via cap	0.53	g	2	Not included in FS 2006		
Hanging machine-washed laundry (6.1.3)	General	Frequency	365	per year	4	Not included in FS 2006		
	Inhalation–exposure to vapour–evaporation –increasing release area	Exposure duration	240	min	1			
		Amount of solution used	5000	g	2			
		Dilution – regular powder	1300	times	2			
		Dilution – concentrated powder	2600	times	2			
		Dilution – regular liquid	1300	times	2			
		Dilution – concentrated liquid	2200	times	2			
		Dilution – tablet	2600	times	2			
		Dilution – capsule	2200	times	2			
		Room volume	20	m^3	4			

Scenario (Section FS 2018 – Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
		Ventilation rate	0.6	per hour	3			
		Release area	10	m^2	2			
		Application duration	17	min	1			
		Application temperature	20	°C	4			
		Mass transfer coefficient	10	m/h	2			
		Molecular weight matrix	18	g/mol	4			
	Dermal–direct product contact – instant application loading	Exposed area	900	cm^2	3			
		Product amount – regular powder	6.9	mg	2			
		Product amount – concentrated powder	3.5	mg	2			
		Product amount – regular liquid	6.9	mg	2			
		Product amount – concentrated liquid	4.2	mg	2			
		Product amount – tablet	3.5	mg	2			
		Product amount – capsule	4.2	mg	2			
Post-application - migration from machine-washed fabric	Dermal–direct product contact–migration	Frequency	365	per year	4	365	per year	3
		Product amount – adults	1	kg	2	1	kg	3
		Product amount – 3–6-month-olds	153	g	1	Not included in FS 2006		

Scenario (Section FS 2018 - Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
(6.1.4 - 3.1.3)		Exposed area – adults	1.7	m^2	4			
		Exposed area – 3–6-month-olds	0.26	m^2	3			
		Leachable fraction – regular powder	0.000076	X Wf	1	0.003	X Wf	1
		Leachable fraction – concentrated powder	0.000038	X Wf	1	Not included in FS 2006		
		Leachable fraction – regular liquid	0.000076	X Wf	1			
		Leachable fraction – concentrated liquid	0.000045	X Wf	1			
		Leachable fraction – tablet	0.000038	X Wf	1			
		Leachable fraction – capsule	0.000045	X Wf	1			
		Skin contact factor	0.8	(-)	1	0.8	(-)	2
Mixing and loading – hand-washing powder (6.2.1)	General	Frequency	52	per year	4	Not included in FS 2006		
	Inhalation– exposure to spray– instantaneous release	Exposure duration	0.25	min	3			
		Released mass – regular powder	6.2	µg	1			
		Released mass – concentrated powder	3.1	µg	1			
		Room volume	1	m^3	1			
		Ventilation rate	0.6	per hour	1			

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
	Dermal– direct product contact– constant rate	Contact rate	2.8	mg/min	2			
		Release duration	0.25	min	3			
		Exposed area	225	cm^2	3			
Mixing and loading – hand-washing liquid (6.2.2)	General	Frequency	52	per year	4	Not included in FS 2006		
	Inhalation– exposure to vapour evaporation –constant release area	Exposure duration	0.75	min	3			
		Product amount	500	g	3			
		Room volume	1	m^3	1			
		Ventilation rate	0.6	per hour	1			
		Release area	20	cm^2	2			
		Emission duration	0.3	min	3			
		Application temperature	20	°C	4			
		Mass transfer coefficient	10	m/h	2			
		Molecular weight matrix	90	g/mol	2			
	Dermal– direct product contact– instant application loading	Exposed area – direct pouring	225	cm^2	2			
		Exposed area – pouring via cap	53	cm^2	2			
		Product amount – direct pouring	0.01	g	3			
		Product amount – pouring via cap	0.53	g	2			
Application – hand-washing laundry (6.2.3 ~ 3.1.2)	General	Frequency	52	per year	4	104	per year	3
	Inhalation– exposure to vapour evaporation –constant	Exposure duration	10	min	4	Not included in FS 2006		
		Amount of solution used	15	kg	2			

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
	release area	Dilution – regular powder	110	times	2			
		Dilution factor – regular liquid	110	times	2			
		Dilution factor – concentrated powder	230	times	2			
		Dilution factor – concentrated liquid	190	times	2			
		Room volume	20	m^3	4			
		Ventilation rate	0.6	per hour	3			
		Release area	1500	cm^2	3			
		Emission duration	10	min	4			
		Application temperature	40	°C	3			
		Mass transfer coefficient	10	m/h	2			
		Molecular weight matrix	18	g/mol	4			
	Dermal– direct product contact– instant application loading	Exposed area	2200	cm^2	3	1900	cm^2	3
		Product amount – regular powder	0.194	g	3	Not included in FS 2006		
		Product amount – regular liquid	0.194	g	3	0.19	g	X
		Product amount – concentrated powder	0.097	g	3	Not included in FS 2006		
		Product amount – concentrated liquid	0.116	g	3			
		Product amount – paste	Not included in FS 2018			0.19	g	X

Scenario (Section FS 2018 - Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
Hanging hand washed laundry (6.2.3)	General	Frequency	52	per year	4	Not included in FS 2006		
	Inhalation–exposure to vapour–evaporation –increasing release area	Exposure duration	240	min	1			
		Amount of solution used	5000	g	2			
		Dilution – regular powder	110	times	2			
		Dilution – concentrated powder	230	times	2			
		Dilution – regular liquid	110	times	2			
		Dilution – concentrated liquid	190	times	2			
		Room volume	20	m^3	3			
		Ventilation rate	0.6	per hour	3			
		Release area	10	m^2	2			
		Application duration	17	min	1			
		Application temperature	20	°C	4			
		Mass transfer coefficient	10	m/h	2			
		Molecular weight matrix	18	g/mol	4			
	Dermal–direct product contact–instant application loading	Exposed area	900	cm^2	3			
		Product amount–regular powder	79	mg	2			
		Product amount–concentrated powder	40	mg	2			
		Product amount–regular liquid	79	mg	2			
		Product amount–concentrated liquid	48	mg	2			

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
Post-application migration from hand washed textile (6.2.4)	Dermal–direct product contact–migration	Frequency	52	per year	4	Not included in FS 2006		
		Product amount – adults	1	kg	2			
		Product amount – 3–6-month-olds	153	g	1			
		Exposed area – adults	1.7	m^2	4			
		Exposed area – 3–6-month-olds	0.26	m^2	3			
		Leachable fraction – regular powder	0.00088	X Wf	1			
		Leachable fraction – concentrated powder	0.00044	X Wf	1			
		Leachable fraction – regular liquid	0.00088	X Wf	1			
		Leachable fraction – concentrated liquid	0.00053	X Wf	1			
		Skin contact factor	0.8	(-)	1			
Application – treatment with spot remover spray (6.3.2 ~ 3.4.2)	General	Frequency	128	per year	3	128	per year	3
	Inhalation–exposure to spray–spraying	Spray duration	0.05	min	3	0.05	min	3
		Exposure duration	10	min	3	10	min	3
		Room volume	10	m^3	3	10	m^3	3
		Room height	2.5	m	4	2.5	m	4
		Ventilation rate	2	per hour	3	2	per hour	3
		Mass generation rate	1.6	g/s	3	1.5	g/s	3
		Airborne fraction	0.2	(-)	2	0.2	(-)	2

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Parameter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
		Weight fraction non-volatile	Not included in FS 2017			0.1	g/g	2
		Density non-volatile	1.8	g/cm^3	3	1.8	g/cm^3	3
		Initial particle distribution (median)	100	µm	3	100	µm	3
		Initial particle distribution (C.V.)	0.6	µm	3	0.6	µm	3
		Inhalation cut-off diameter	15	µm	3	15	µm	3
	Inhalation–exposure to spray–instantaneous release	Released mass	3.9	g	3	Not included in FS 2006		
	Dermal–direct product contact–instant application loading	Exposed area	450	cm^2	3	430	cm^2	3
		Product amount	1	g	1	0.2	g	1
Application-treatment with spot remover liquid or granules (6.3.1 ~ 3.4.3)	General	Frequency	128	per year	2	128	per year	3
	Dermal-direct product contact-instant application loading	Exposed area	450	cm^2	3	430	cm^2	3
		Product amount	0.325	g	1	Not included in FS 2006		
Post-application - wearing spot treated fabric (6.3.3)	General	Frequency – machine wash	128	per year	3	Not included in FS 2006		
		Frequency – hand wash	52	per year	4			
	Dermal–direct product contact–migration	Exposed area – adults	1.7	m^2	4			
		Exposed area – 3–6-month-olds	0.26	m^2	3			

Scenario (Section FS 2018 – Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
		Product amount – adults	1	kg	2			
		Product amount – 3–6-month-olds	153	g	1			
		Skin contact factor	0.8	(-)	1			
		Leachable fraction – machine wash liquid spot remover	1.5×10^{-6}	X Wf	2			
		Leachable fraction – machine wash spray spot remover	6.6×10^{-6}	X Wf	2			
		Leachable fraction – hand wash liquid spot remover	5×10^{-7}	X Wf	2			
		Leachable fraction – hand wash spray spot remover	2.2×10^{-6}	X Wf	2			
Mixing and loading – machine dishwashing powder (7.1.1 – 4.2.2)	General	Frequency	365	per year	3	252	per year	3
	Inhalation– exposure to spray– instantaneous release	Exposure duration	0.25	min	3	0.25	min	3
		Released mass	2.5	µg	1	0.27	µg	1
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	2.5	per hour	1	2.5	per hour	3
	Dermal– direct product contact– constant rate loading	Contact rate	2.8	mg/ min	2	Not included in FS 2006		
		Release duration	0.25	min	3			
		Exposed area	225	cm^2	3			

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
Mixing and loading – machine dishwashing liquid (7.1.2)	General	Frequency	365	per year	3	426	per year	3
	Inhalation–evaporation–constant release area	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	2	500	g	3
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	2.5	per hour	1	2.5	per hour	3
		Release area	20	cm^2	2	20	cm^2	2
		Emission duration	0.3	min	3	0.3	min	3
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	60	g/mol	2	36	g/mol	2
	Dermal–direct product contact–instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.01	g	3	0.01	g	3
Mixing and loading – machine dishwashing rinse aid (7.2.1 ~ 4.2.3)	General	Frequency	35	per year	3	35	per year	3
	Inhalation–Evaporation constant release area	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	3	500	g	3
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	2.5	per hour	1	2.5	per hour	1
		Release area	20	cm^2	2	20	cm^2	2
		Emission duration	0.3	min	3	0.3	min	3
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	36	g/mol	2	60	g/mol	2

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
	Dermal–direct product contact–instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.01	g	3	0.01	g	3
Post-application - residues on machine-washed table ware (7.2.2)	General	Frequency	35	per year	3	Not included in FS 2006		
	Oral–direct oral contact–direct oral intake loading	Amount ingested	2.25	mg	1			
Application - manual dish-washing liquid (7.3.1 ~ 4.1.3)	General	Frequency	426	per year	4	426	per year	3
	Inhalation–exposure to vapour evaporation – constant release area	Exposure duration	45	min	3	60	min	3
		Amount of solution used	5000	g	3	Not included in FS 2006		
		Dilution	700	times	3	15	l	3
		Room volume	15	m^3	4	15	m^3	4
		Ventilation rate	2.5	per hour	4	2.5	per hour	3
		Release area	1500	cm^2	3	1500	cm^2	3
		Emission duration	16	min	4	16	min	3
		Application temperature	45	°C	3	45	°C	3
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	18	g/mol	4	18	g/mol	4
	Dermal–Exposure instant application–	Exposed area	2200	cm^2	3	860	cm^2	3
		Product amount	31	mg	3	12	mg	1
Post-application - residues on hand-washed table ware (7.3.2 ~ 4.1.4)	General	Frequency	365	per year	4	365	per year	4
	Oral–direct oral contact–direct oral intake	Amount ingested	0.42	mg	2	0.42	mg	2

Scenario (Section FS 2018 - Section FS 2006)	Selected exposure model	Parameter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
Mixing and loading - all-purpose cleaning liquid (8.1.1 - 5.2)	General	Frequency	197	per year	4	104	per year	3
	Inhalation–evaporation–constant release area	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	2	500	g	3
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	0.5	per hour	1	0.5	per hour	1
		Release area	20	cm^2	2	20	cm^2	2
		Emission duration	0.3	min	3	0.3	min	3
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	22	g/mol	2	22	g/mol	2
	Dermal–direct product contact–instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.01	g	3	0.01	g	3
Application - cleaning with liquid all-purpose cleaning liquid (8.1.2 - 5.2)	General	Frequency	197	per year	4	104	per year	3
	Inhalation–exposure to vapour evaporation–increasing release	Exposure duration	240	min	1	240	min	3
		Amount of solution used	1300	g	2	Not included in FS 2006		
		Dilution	78	times	2			
		Room volume	58	m^3	4	58	m^3	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	32	m^2	1	10	m^2	2
		Application duration	20	min	3	20	min	3
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	18	g/mol	4	18	g/mol	4

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
	Dermal–direct product contact–instant application loading	Exposed area	2200	cm^2	3	1900	cm^2	3
		Product amount	286	mg	2	237.5	mg	1
Post-application - rubbing-off all-purpose cleaning liquid (8.1.3)	General	Frequency	197	per year	4	Not included in FS 2006		
	General	Body weight	8.0	kg	4			
	Dermal–direct product contact–rubbing-off loading	Contacted surface	22	m^2	4			
		Dislodgeable amount	12	g/m^2	2			
		Transfer coefficient	0.2	m^2/hr	3			
		Contact time	60	min	1			
		Exposed area	0.3	m^2	4			
	Oral–direct product contact–direct oral intake	Ingested amount	10	% of the total external dose	1			
Application – spraying all-purpose cleaning spray (8.2.1 ~ 5.3)	General	Frequency	365	per year	4	365	per year	2
	Inhalation–exposure to spray–spraying	Spray duration	0.23	min	3	0.41	min	3
		Exposure duration	60	min	1	60	min	3
		Room volume	15	m^3	4	15	m^3	4
		Room height	2.5	m	4	2.5	m	4
		Ventilation rate	2.5	per hour	3	2.5	per hour	3
		Mass generation rate	1.6	g/s	4	0.78	g/s	3
		Airborne fraction	0.1	(-)	3	0.2	(-)	2
		Density non-volatile	1	g/cm^3	3	1.8	g/cm^3	2
		Initial particle distribution (median)	2.4	µm	3	100	µm	3

Scenario (Section FS 2018 - Section FS 2006)	Selected exposure model	Parameter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
		Initial particle distribution (C.V.)	0.37	µm	3	0.6	µm	3
		Inhalation cut-off diameter	15	µm	3	15	µm	0
	Inhalation–exposure to spray–instantaneous release	Released mass	22	g	2	Not included in FS 2006		
	Dermal–direct product contact–constant rate loading	Exposed area	2200	cm^2	3			
		Contact rate	46	mg/min	3	46	mg/min	3
		Release duration	28	s	3	25	s	3
Application - rinsing all-purpose cleaning spray (8.2.2 - 5.3)	General	Frequency	365	per year	4	365	per year	2
	Dermal–direct product contact–instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.31	g	2	0.16	g	1
Application - cleaning surfaces with all-purpose cleaner wet tissue (8.3.1 - 5.4)	General	Frequency	88	per year	4	365	per year	2
	Inhalation–exposure to vapour–evaporation–increasing release	Exposure duration	240	min	1	60	min	3
		Product amount	11.2	g	4	3.42	g	3
		Room volume	20	m^3	4	20	m^3	3
		Ventilation rate	0.6	per hour	3	0.6	per hour	3
		Release area	2	m^2	2	2	m^2	2
		Application duration	5	min	3	2	min	2
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	22	g/mol	2	22	g/mol	2

Scenario (Section FS 2018 – Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
	Dermal– direct product contact– instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.05	g	3	0.047	g	3
Application - scattering abrasive powder (9.1.1–6.2)	General	Frequency	91	per year	4	104	per year	3
	Inhalation– exposure to spray– spraying	Spray duration	1	min	2	1	min	2
		Exposure duration	60	min	3	60	min	3
		Room volume	15	m^3	4	15	m^3	4
		Room height	2.5	m	4	2.5	m	4
		Ventilation rate	2.5	per hour	3	2.5	per hour	3
		Mass generation rate	0.58	g/s	4	0.62	g/s	2
		Airborne fraction	0.2	(-)	1	0.2	(-)	1
		Density non-volatile	3	g/cm^3	4	3	g/cm^3	3
		Initial particle distribution (median)	75	µm	1	75	µm	1
		Initial particle distribution (C.V.)	0.6	µm	1	0.6	µm	1
		Inhalation cut-off diameter	15	µm	3	15	µm	0
	Inhalation– exposure to spray– instantaneous release	Released mass	35	g	4	Not included in FS 2006		
	Dermal– direct product contact– constant rate loading	Exposed area	225	cm^2	3			
		Contact rate	2.8	mg/min	2	5	mg/min	1
		Release duration	1	min	1	1	min	2

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
Application - rubbing abrasive powder (9.1.2)	General	Frequency	91	per year	4	Not included in FS 2006		
	Dermal–direct product contact–instant application loading	Exposed area	225	cm^2	3			
		Product amount	3.9	g	2			
Application - rubbing abrasive liquid (9.2.1 ~ 6.1)	General	Frequency	135	per year	4	156	per year	3
	Inhalation–exposure to vapour–evaporation–increasing release	Exposure duration	60	min	3	10	min	2
		Product amount	32	g	4	37	g	3
		Room volume	15	m^3	4	2.5	m^3	3
		Ventilation rate	2.5	per hour	3	2	per hour	3
		Release area	0.5	m^2	3	4	m^2	2
		Application duration	20	min	3	7.6	min	3
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	45	g/mol	2	45	g/mol	2
	Dermal–direct product contact–instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	3.6	g	2	0.37	g	1
Mixing and loading - bathroom cleaning liquid (10.1.1.1 ~ 7.1.2)	General	Frequency	156	per year	4	4	per year	2
	Inhalation–exposure to vapour evaporation–constant release area	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	3	500	g	3
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	2	per hour	1	2	per hour	1
		Release area	20	cm^2	2	20	cm^2	2
		Emission duration	0.3	min	3	0.3	min	3

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	36	g/mol	2	26	g/mol	2
	Dermal– direct product contact– instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.01	g	3	0.01	g	3
Application - cleaning with bathroom cleaning liquid (10.1.2 ~ 7.1.2)	General	Frequency	156	per year	4	4	per year	2
	Inhalation– exposure to vapour– evaporation increasing release	Exposure duration	25	min	3	25	min	2
		Amount of solution used	365	g	2	Not included in FS 2006		
		Dilution	76	times	3			
		Room volume	10	m^3	4	10	m^3	3
		Ventilation rate	2	per hour	3	2	per hour	3
		Release area	9	m^2	3	6.4	m^2	3
		Application duration	20	min	4	20	min	2
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	18	g/mol	4	18	g/mol	4
	Dermal– direct product contact– instant application loading	Exposed area	2200	cm^2	3	1900	cm^2	3
		Product amount	0.3	g	2	422	mg	3
	General	Frequency	120	per year	4	52	per year	3
	Inhalation– exposure to spray– spraying	Spray duration	80	s	2	1.5	min	3
		Exposure duration	24	min	3	25	min	2
		Room volume	10	m^3	4	10	m^3	3

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
Application – spraying bathroom cleaning spray (10.1.2.1 ~ 7.1.1)		Room height	2.5	m	4	2.5	m	4
		Ventilation rate	2	per hour	3	2	per hour	3
		Mass generation rate	1.25	g/s	3	0.39	g/s	3
		Airborne fraction	0.2	(-)	2	0.2	(-)	2
		Density non-volatile	1.8	g/cm^3	3	1.8	g/cm^3	2
		Initial particle distribution (median)	3.6	µm	3	100	µm	3
		Initial particle distribution (C.V.)	0.52	µm	3	0.6	µm	3
		Inhalation cut-off diameter	15	µm	3	15	µm	3
	Inhalation–exposure to spray–instantaneous release	Released mass	100	g	2	Not included in FS 2006		
	Dermal–direct product contact – constant rate loading model	Exposed area	2200	cm^2	3			
		Contact rate	46	mg/min	3	46	mg/min	3
		Release duration	160	s	2	1.5	min	3
Application - cleaning with bathroom cleaning spray (10.1.2.2 ~ 7.1.1)	General	Frequency	120	per year	4	52	per year	3
	Dermal–direct product contact–instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.62	g	2	0.3	g	1
Application - cleaning a toilet bowl (10.2 ~ 7.2)	General	Frequency	156	per year	4	Not included in FS 2006		
		Frequency – acid toilet cleaner	Not included in FS 2018			260	per year	3

Scenario (Section FS 2018 – Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
		Frequency – bleach toilet cleaner				120	per year	3
	Inhalation–exposure to vapour–evaporation –constant release area	Exposure duration	7	min	3	3	min	3
		Product amount –acid toilet cleaner	55	g	3	56	g	2
		Product amount – leach toilet cleaner	80	g	3	83	g	2
		Room volume	2.5	m^3	4	2.5	m^3	3
		Ventilation rate	2	per hour	3	2	per hour	3
		Release area	0.17 5	m^2	2	0.07 5	m^2	3
		Emission duration	2	min	4	2	min	3
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
	Dermal– direct product contact– constant rate loading	Exposed area	450	cm^2	3	215	cm^2	3
		Contact rate	193	mg/ min	2	Not included in FS 2006		
		Release duration	2	min	4			
Applicatio n - inhalation from toilet rim blocks (10.3 – 7.3)	General	Frequency	365	per year	4	365	per year	3
	Inhalation–exposure to vapour–instantaneo us release[2]	Exposure duration	50	min	2	1440	min	1
		Product amount–solid rim blocks	0.21	g	2	0.21	g	2
		Product amount–liquid rim blocks	0.24	g	2	0.24	g	2
		Room volume	2.5	m^3	4	2.5	m^3	4
		Ventilation rate[2]	0	per hour	3	0	per hour	2

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
Mixing and loading - floor cleaning liquid (11.1.1.1 ~ 8.1.1)	General	Frequency	161	per year	4	104	per year	3
	Inhalation– exposure to vapour– evaporation –constant release area	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	2	500	g	3
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	0.5	per hour	1	0.5	per hour	1
		Release area	20	cm^2	2	20	cm^2	2
		Emission duration	0.3	min	3	0.3	min	3
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	36	g/mo l	2	22	g/mo l	2
	Dermal– direct product contact– instant application loading model	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.01	g	3	0.01	g	3
Applicatio n – floor cleaning liquid (11.1.1.2 ~ 8.1.1)	General	Frequency	161	per year	4	104	per year	3
	Inhalation– exposure to vapour– evaporation –increasing release	Exposure duration	240	min	1	Not included in FS 2006		
		Amount of solution used	900	g	2			
		Dilution	62	times	2	0.05	(-)	3
		Room volume	58	m^3	4	58	m^3	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m^2	4	22	m^2	4
		Application duration	20	min	4	30	min	2
		Application temperature	20	°C	4	20	°C	2
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	18	g/mo l	4	18	g/mo l	4

Scenario (Section FS 2018 - Section FS 2006)	Selected exposure model	Parameter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
	Dermal–direct product contact–instant application loading	Exposed area	2200	cm^2	3	1900	cm^2	3
		Product amount	0.36	g	2	0.95	g	1
Post-application - rubbing off floor cleaning liquid (11.1.1.3)	General	Frequency	161	per year	4	Not included in FS 2006		
		Body weight	8.0	kg	4			
	Dermal–direct product contact–rubbing-off loading model	Contacted surface	22	m^2	3			
		Dislodgeable amount	0.2	g/m^2	2			
		Transfer coefficient	0.2	m^2/hr	3			
		Contact time	60	min	2			
		Exposed Area	0.3	m^2	4			
	Oral–direct product contact–direct oral intake model	Frequency	10	% of the total external dose	1			
Mixing and loading - floor stripper liquid (11.1.2.1)	General	Frequency	1	per year	1	Not included in FS 2006		
	Inhalation–exposure to vapour–evaporation –constant release area	Exposure duration	0.75	min	3			
		Product amount	500	g	2			
		Room volume	1	m^3	1			
		Ventilation rate	0.5	per hour	1			
		Release area	20	cm^2	2			
		Emission duration	0.3	min	3			
		Application temperature	20	°C	4			
		Mass transfer coefficient	10	m/h	2			
		Molecular weight matrix	30	g/mol	2			

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
	Dermal– direct product contact– instant application loading	Exposed area	225	cm^2	3			
		Product amount	0.01	g	3			
Application - floor stripper liquid (11.1.2.2.~ 8.1.3)	General	Frequency	1	per year	1	1	per year	1
	Inhalation– exposure to vapour evaporation –increasing release area	Exposure duration	90	min	2	90	min	3
		Amount of solution used	900	g	2	Not included in FS 2006		
		Dilution	51	times	2			
		Room volume	58	m^3	4	58	m^3	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m^2	4	22	m^2	4
		Application duration	90	min	2	90	min	3
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	18	g/mol	4	22	g/mol	4
	Dermal– direct product contact– instant application loading	Exposed area	2200	cm^2	3	430	cm^2	3
		Product amount	0.44	g	2	5.5	g	1
Application - floor sealing liquid (11.1.2.3~ 8.1.3)	General	Frequency	1	per year	1	0.1	per year	1
	Inhalation– exposure to vapour evaporation –increasing release area	Exposure duration	90	min	2	90	min	3
		Product amount– polyacrylate-based sealer	2.7	kg	2	1.5	kg	3
		Product amount– water-based sealer	2.2	kg	2	1.5	kg	3
		Room volume	58	m^3	4	58	m^3	4

Scenario (Section FS 2018 - Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m^2	4	22	m^2	4
		Application duration	90	min	2	90	min	3
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix – polyacrylate-based sealer	90	g/mol	2	22	g/mol	4
		Molecular weight matrix – water-based sealer	22	g/mol	2	22	g/mol	4
	Dermal–direct product contact–instant application loading	Exposed area	225	cm^2	3	430	cm^2	3
		Product amount – polyacrylate-based sealer	3	g	1	15	g	1
		Product amount – water-based sealer	2	g	1	15	g	1
Application - floor polish liquid (11.1.3.1 - 8.1.3)	General	Frequency	52	per year	4	2	per year	3
	Inhalation–exposure to vapour evaporation –increasing release	Exposure duration	90	min	2	90	min	3
		Product amount	550	g	2	550	g	3
		Room volume	58	m^3	4	58	m^3	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m^2	4	22	m^2	4
		Application duration	90	min	3	90	min	3
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X

Scenario (Section FS 2018 - Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
		Molecular weight matrix	22	g/mol	2	22	g/mol	4
	Dermal–direct product contact–instant application loading	Exposed area	225	cm^2	3	430	cm^2	3
		Product amount	0.55	g	1	5.5	g	1
Application – spraying floor polish spray (11.1.3.2.1)	General	Frequency	52	per year	4	Not included in FS 2006		
	Inhalation–exposure to spray–spraying	Spray duration	33	s	2			
		Exposure duration	20	min	2			
		Room volume	58	m^3	4			
		Room height	2.5	m	4			
		Ventilation rate	0.5	hour	3			
		Mass generation rate	1.6	g/s	3			
		Airborne fraction	0.2	(-)	3			
		Density non-volatile	1.8	g/cm^3	3			
		Initial particle distribution (median)	10.8	µm	3			
		Initial particle distribution (C.V.)	0.81	µm	3			
		Inhalation cut-off diameter	15	µm	3			
	Inhalation–exposure to spray–instantaneous	Released mass	53	g	2			
	Dermal–direct product contact–constant rate loading	Exposed area	2200	cm^2	3			
		Contact rate	46	mg/min	3			
		Release duration	66	s	2			

Scenario (Section FS 2018 - Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
Application - polishing floor spots with spray (11.1.3.2.2)	General	Frequency	52	per year	4	Not included in FS 2006		
	Dermal– direct product contact– instant application loading	Exposed area	225	cm^2	3			
		Product amount	0.55	g	1			
Application – floor cleaning wipes (11.1.4.1)	General	Frequency	66	per year	4	Not included in FS 2006		
	Inhalation– exposure to vapour– evaporation –increasing release	Exposure duration	240	min	1			
		Product amount	20	g	2			
		Room volume	58	m^3	4			
		Ventilation rate	0.5	per hour	3			
		Release area	22	m^2	4			
		Application duration	10	min	2			
		Application temperature	20	°C	4			
		Mass transfer coefficient	10	m/h	2			
		Molecular weight matrix	36	g/mol	2			
	Dermal– direct product contact– instant application loading	Exposed area	225	cm^2	3			
		Product amount	0.05	g	3			
Post-application - rubbing off floor cleaning wipe (11.1.4.2)	General	Frequency	66	per year	4	Not included in FS 2006		
		Body weight	8.0	kg	4			
	Dermal– direct product contact– rubbing-off loading model	Contacted surface	22	m^2	4			
		Dislodgeable amount	0.27	g/m^2	2			
		Transfer coefficient	0.2	m^2/hr	3			
		Contact time	60	min	1			
		Exposed area	0.3	m^2	4			

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
	Oral–direct product contact–direct oral intake	Frequency	10	% of the total external dose	1			
Mixing and loading - floor cleaning liquid cartridges (11.1.5.1)	General	Frequency	161	per year	4	Not included in FS 2006		
	Inhalation–exposure to vapour–evaporation –constant release area	Exposure duration	0.75	min	3			
		Product amount	500	g	2			
		Room volume	1	m^3	1			
		Ventilation rate	0.5	per hour	1			
		Release area	20	cm^2	2			
		Application duration	0.3	min	3			
		Application temperature	20	°C	4			
		Mass transfer coefficient	10	m/h	2			
		Molecular weight matrix	27	g/mol	2			
	Dermal–direct product contact–instant application loading	Exposed area	225	cm^2	3			
		Product amount	0.01	g	3			
Application - floor cleaning liquid cartridges (11.1.5.2 ~ 8.1.2)	General	Frequency	161	per year	4	104	per year	3
	Inhalation–exposure to vapour evaporation –increasing release area	Exposure duration	240	min	1	240	min	3
		Product amount	14	g	1	245	g	3
		Room volume	58	m^3	4	58	m^3	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m^2	4	22	m^2	4
		Application duration	20	min	4	30	min	2
		Application temperature	20	°C	2	20	°C	2

Scenario (Section FS 2018 - Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	27	g/mol	2	22	g/mol	4
	Dermal–direct product contact–instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	2.25	g	1	0.25	g	1
Post-application - rubbing off floor cleaning liquid cartridges (11.1.5.3)	General	Frequency	161	per year	4	Not included in FS 2006		
		Body weight	8.0	kg	4			
	Dermal–direct product contact–rubbing off loading	Contacted surface	22	m^2	4			
		Dislodgeable amount	0.2	g/ m^2	2			
		Transfer coefficient	0.2	m^2/hr	3			
		Contact time	60	min	2			
		Exposed area	0.3	m^2	4			
	Oral–direct product contact–direct oral intake	Frequency	10	% of the total external dose	1			
Mixing and loading - carpet cleaning liquid (11.2.1.1. 1 - 8.2.1)	General	Frequency	52	per year	4	0.5	per year	3
	Inhalation–exposure to vapour–evaporation–constant release	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	2	500	g	3
		Room volume	1	m^3	1	1	m^3	1
		Ventilation rate	0.5	per hour	1	0.5	per hour	1
		Release area	20	cm^2	2	20	cm^2	2
		Emission duration	0.3	min	3	0.3	min	3
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix	30	g/mol	2	36	g/mol	2

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Parameter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
	Dermal– direct product contact– instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	0.01	g	3	0.01	g	3
Application - carpet cleaning liquid (11.2.1.1.2 ~ 8.2.1)	General	Frequency	52	per year	4	0.5	per year	3
	Inhalation– exposure to vapour evaporation –increasing release area	Exposure duration – manual cleaning	240	min	1	110	min	3
		Amount of solution used	11	kg	2	Not included in FS 2006		
		Dilution factor	16	(-)	2			
		Room volume	58	m^3	4	58	m^3	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m^2	4	22	m^2	4
		Application duration – manual cleaning	60	min	1	110	min	3
		Application duration – machine cleaning	30	min	2	not included in FS 2006		
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	18	g/mol	4	18	g/mol	4
	Dermal– direct product contact– instant application loading	Exposed area	2200	cm^2	3	860	cm^2	3
		Product amount	1.5	g	2	0.01	g	3

Scenario (Section FS 2018 ‑ Section FS 2006)	Selected exposure model	Parameter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
Post-application - rubbing off carpet cleaning liquid (11.2.1.2)	General	Frequency	52	per year	4	Not included in FS 2006		
		Body weight	8.0	kg	4			
	Dermal–direct product contact–rubbing-off loading	Contacted surface	22	m^2	4			
		Dislodgeable amount	9	g/m^2	2			
		Transfer coefficient	0.2	m^2/hr	3			
		Contact time	60	min	1			
		Exposed area	0.3	m^2	4			
	Oral–direct product contact–direct oral intake	Ingested amount	10	% of the total external dose	1			
Application - scattering carpet powder (11.1.2.1 ‑ 8.2.3)	General	Frequency	52	per year	4	0.5	per year	3
	Inhalation–exposure to vapour–evaporation–increasing release area[3]	Exposure duration	30	min	2	22	min	2
		Product amount	2.2	kg	2	2244	g	2
		Room volume	58	m^3	4	58	m^3	3
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m^2	4	Not included in FS 2006		
		Application duration	11	min	2			
		Application temperature	20	°C	4			
		Mass transfer coefficient	10	m/h	2			
		Molecular weight matrix	45	g/mol	2			
	Dermal–direct product contact–constant release loading	Exposed area	225	cm^2	3			
		Release duration	11	min	2			
		Contact rate	2.8	mg/min	1	5	mg/min	2

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
Post-application – rubbing off carpet powder (11.2.2.2 ~ 8.2.3)	General	Frequency	52	per year	2	14	per year	3
		Body weight	8.0	kg	4	8.69	kg	4
	Dermal–direct product contact–rubbing-off loading	Contacted surface	22	m^2	4	22	m^2	4
		Dislodgeable amount	3	g/m^2	1	3	g/m^2	2
		Transfer coefficient	0.2	m^2/hr	3	0.6	m^2/hr	2
		Contact time	60	min	2	60	min	2
		Exposed area	0.3	m^2	4			
	Oral–direct product contact–direct oral intake	Ingested amount	10	% of the total external dose	1	10	% of the total external dose	1
Application - leave-on and rubbing in carpet spot remover (11.2.3.1 ~ 8.2.4)	General	Frequency	10	per year	3	10	per year	3
	Inhalation–exposure to vapour–evaporation–constant release area	Exposure duration	15	min	2	Not included in FS 2006		
		Product amount	8	g	2	Not included in FS 2006		
		Room volume	58	m^3	4	Not included in FS 2006		
		Ventilation rate	0.5	per hour	3	Not included in FS 2006		
		Application temperature	20	°C	4	Not included in FS 2006		
		Release area	1	m^2	1	Not included in FS 2006		
		Emission duration	5	min	2	Not included in FS 2006		
		Mass transfer coefficient	10	m/h	2	Not included in FS 2006		
		Molecular weight matrix	115	g/mol	2	Not included in FS 2006		
	Dermal–direct product contact–instant application loading	Exposed area	75	cm^2	3	215	cm^2	3
		Product amount	0.6	g	1	0.07	g	1

Scenario (Section FS 2018 - Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
Application – spraying furniture polish spray (11.3.1.1)	General	Frequency	1	per year	4	Not included in FS 2006		
	Inhalation– exposure to spray– spraying	Spray duration	2	min	2			
		Exposure duration	240	min	1			
		Room volume	20	m^3	3			
		Room height	2.5	m	4			
		Ventilation rate	0.6	per hour	4			
		Mass generation rate	1.8	g/s	3			
		Airborne fraction	0.2	(-)	3			
		Density non-volatile	1.8	g/cm^3	3			
		Initial particle distribution (median)	10.8	µm	3			
		Initial particle distribution (C.V.)	0.81	µm	3			
		Inhalation cut-off diameter	15	µm	3			
	Inhalation– exposure to spray– instantaneous release	Released mass	200	g	2			
	Dermal– direct product contact– constant rate loading	Exposed area	2200	cm^2	3			
		Contact rate	46	mg/min	3			
		Release duration	4	min	1			
Application - polishing sprayed furniture (11.3.1.2)	General	Frequency	1	per year	4	Not included in FS 2006		
	Dermal– direct product contact– instant application	Exposed area	225	cm^2	3			
		Product amount	0.56	g	1			

Scenario (Section FS 2018 - Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
Application - furniture polish liquid (11.3.2.1 - 8.3.1)	General	Frequency	1	per year	4	1	per year	2
	Inhalation–exposure to vapour–evaporation–increasing release area	Exposure duration	240	min	1	240	min	3
		Product amount	550	g	2	550	g	3
		Room volume	58	m^3	4	58	m^3	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Release area	22	m^2	1	22	m^2	4
		Application duration	90	min	2	90	min	3
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Langmuir	m/h	X
		Molecular weight matrix	272	g/mol	2	272	g/mol	1
	Dermal–direct product contact–instant application loading	Exposed area	225	cm^2	3	430	cm^2	3
		Product amount	0.55	g	1	5.5	g	1
Application – spraying leather mainten-ance spray (11.3.1.1 - 8.3.2)	General	Frequency	5	per year	2	1	per year	2
	Inhalation–exposure to spray–spraying	Spray duration – trigger spray	68	s	3	180	s	2
		Spray duration – aerosol spray can	90	s	3	180	s	2
		Exposure duration	240	min	1	240	min	3
		Room volume	58	m^3	4	58	m^3	4
		Room height	2.5	m	4	2.5	m	3
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Mass generation rate – trigger spray	1.6	g/s	3	0.75	g/s	3

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
		Mass generation rate – aerosol spray can	1.2	g/s	3	0.75	g/s	3
		Airborne fraction	0.2	(-)	3	1	(-)	2
		Density non-volatile	1.8	g/cm^3	3	1.8	g/cm^3	3
		Initial particle distribution (median)	10.8	µm	3	25	µm	3
		Initial particle distribution (C.V.)	0.81	µm	2	0.4	µm	3
		Inhalation cut-off diameter	15	µm	3	15	µm	3
	Inhalation–exposure to spray–instantaneous release	Released mass	109	g	2	Not included in FS 2006		
	Dermal–direct product contact–constant rate loading	Exposed area	2200	cm^2	3			
		Contact rate – trigger spray	46	mg/min	3			
		Contact rate –aerosol spray can	100	mg/min	3	100	mg/min	3
		Release duration	3	min	2	3	min	2
Application - rubbing in leather mainten-ance spray (11.3.3.2)	General	Frequency	5	per year	2	Not included in FS 2006		
	Dermal–direct product contact–instant application loading	Exposed area	225	cm^2	3			
		Product amount	0.45	g	1			
Application – spraying glass cleaner spray	General	Frequency	66	per year	4	365	per year	2
	Inhalation–exposure to spray–spraying	Spray duration	18	s	1	42	s	3
		Exposure duration	240	min	1	240	min	3
		Room volume	58	m^3	4	58	m^3	4

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Parameter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
(12.1.1 ~ 9.1)		Room height	2.5	m	4	2.5	m	4
		Ventilation rate	0.5	per hour	3	0.5	per hour	3
		Mass generation rate	1.6	g/s	3	0.78	g/s	3
		Airborne fraction	0.2	(-)	2	0.2	(-)	2
		Density non-volatile	1.8	g/cm^3	3	1.8	g/cm^3	3
		Initial particle distribution (median)	2.4	µm	3	100	µm	3
		Initial particle distribution (C.V.)	0.37	µm	3	0.6	µm	3
		Inhalation cut-off diameter	15	µm	3	15	µm	3
	Inhalation–exposure to spray–spraying instantaneous release	Released mass	29	g	1	Not included in FS 2006		
	Dermal–direct product contact–constant rate loading	Exposed area	2200	cm^2	3			
		Contact rate	46	mg/min	3	46	mg/min	3
		Release duration	36	s	1	43	s	3
Application - cleaning with glass cleaner spray (12.1.2 ~ 9.1)	General	Frequency	66	per year	4	365	per year	2
	Dermal–direct product contact–instant application loading	Exposed area	75	cm^2	3	215	cm^2	3
		Product amount	0.75	g	2	0.29	g	1
Application - metal cleaner (12.2.1 ~ 9.3)	Frequency	General	6	per year	1	6	per year	2
		Exposure duration	60	min	1	60	min	3

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
	Inhalation–exposure to vapour–evaporation –increasing release area	Amount of solution used – water-based	80	g	2	Not included in FS 2006		
		Amount of solution used – naphtha-based	86	g	2			
		Dilution – water-based	2	times	2			
		Dilution – naphtha-based	1.9	times	2			
		Room volume	15	m^3	4	15	m^3	4
		Ventilation rate	2.5	per hour	3	2.5	per hour	3
		Release area	2	m^2	3	1.71	m^2	3
		Application duration	20	min	3	10	min	2
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix – water-based	20	g/mo l	2	22	g/mo l	2
		Molecular weight matrix – naphtha-based	35	g/mo l	2	22	g/mo l	2
	Dermal–direct product contact–constant rate loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount – water-based	1.1	g	2	0.1	g	1
		Product amount – naphtha-based	1.3	g	2	0.1	g	1
Applicatio n - pouring drain opener (12.3.1 ~ 9.4)	General	Frequency	24	per year	2	4	per year	2
	Inhalation–exposure to vapour–evaporation –constant release area	Exposure duration	0.75	min	3	0.75	min	3
		Product amount	500	g	2	500	g	3
		Room volume	1	m^3	1	1	m^3	1

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
		Ventilation rate	2.5	per hour	1	0.5	per hour	1
		Release area	20	cm^2	2	20	cm^2	2
		Emission duration	0.3	min	3	0.3	min	3
		Application temperature	20	°C	4	20	°C	4
		Mass transfer coefficient	10	m/h	2	Lang muir	m/h	X
		Molecular weight matrix – sulphuric acid	98	g/mol	2	22	g/mol	2
		Molecular weight matrix – water-based	19	g/mol	2	22	g/mol	2
		Molecular weight matrix – granules	23	g/mol	2	22	g/mol	3
	Dermal–direct product contact–instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount – sulphuric acid	0.01	g	3	0.01	g	3
		Product amount – water-based	0.01	g	3	0.01	g	3
		Product amount – granules	0.7	mg	2	0.01	g	3
Application – leave on drain opener (12.3.2 ~ 9.4)	General	Frequency	24	per year	2	4	per year	2
	Inhalation–exposure to vapour–evaporation –constant release area	Exposure duration – sulphuric acid	30	min	2	Not included in Fact Sheet 2006		
		Exposure duration – water-based	30	min	2			
		Exposure duration – granules	15	min	2			
		Product amount – sulphuric acid	550	g	2	500	g	2
		Product amount – water-based	300	g	2	500	g	2

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
		Product amount – granules	70	g	2	500	g	2
		Room volume	15	m^3	4	Not included in FS 2006		
		Ventilation rate	2.5	per hour	3			
		Release area	20	cm^2	1			
		Emission duration – sulphuric acid	30	min	2			
		Emission duration – water-based	30	min	2			
		Emission duration – granules	15	min	2			
		Temperature – sulphuric acid	20	°C	4			
		Temperature – water-based	20	°C	4			
		Temperature – granules	95	°C	2			
		Mass transfer coefficient	10	m/h	2			
		Molecular weight matrix – sulphuric acid	98	g/mol	2			
		Molecular weight matrix – water-based	19	g/mol	2			
		Molecular weight matrix – granules	21	g/mol	2			
Application - spraying shoe polish (12.4.1.1 ~ 9.5.1)	General	Frequency	12	per year	4	8	per year	3
	Inhalation– exposure to spray– spraying	Spray duration	16	s	2	72	s	3
		Exposure duration	240	min	1	5	min	3
		Room volume	58	m^3	4	34	m^3	3
		Room height	2.5	m	4	2.5	m	4
		Ventilation rate	0.5	per hour	3	1.5	per hour	3

Scenario (Section FS 2018 - Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
		Mass generation rate	1.8	g/s	2	0.5	g/s	3
		Airborne fraction	0.3	(-)	2	1	(-)	2
		Initial particle distribution (median)	10.8	µm	2	25	µm	3
		Initial particle distribution (C.V.)	0.81	µm	2	0.4	µm	3
		Inhalation cut-off diameter	15	µm	3	15	µm	3
	Inhalation–exposure to spray–instantaneous release	Released mass	28	g	1	Not included in FS 2006		
	Dermal–direct product contact–instant application loading[4]	Exposed area	450	cm^2	3			
		Product amount	2.8	g	1	0.12	g	3
Application – shoe polish cream (12.4.2.1 - 9.5.2)	General	Frequency	12	per year	4	26	per year	3
	Dermal–direct product contact–instant application loading	Exposed area	225	cm^2	3	215	cm^2	3
		Product amount	1.3	g	1	0.1	g	1
Application - spraying oven cleaner (12.5.1. - 9.2)	General	Frequency	5	per year	4	26	per year	3
	Inhalation–exposure to spray–spraying	Spray duration – trigger spray	7.5	s	1	30	s	3
		Spray duration – aerosol spray can	10	s	1			
		Exposure duration	15	s	1	60	s	3
		Room volume	1	m^3	1	15	m^3	4

Scenario (Section FS 2018 ~ Section FS 2006)	Selected exposure model	Para meter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
		Room height	1	m	1	2.5	m	4
		Ventilation rate	2.5	per hour	1	2.5	per hour	3
		Mass generation rate – trigger spray	1.6	g/s	3	0.78	g/s	3
		Mass generation rate – aerosol spray can	1.2	g/s	3	Not included in FS 2006		
		Airborne fraction	0.2	(-)	2	0.2	(-)	2
		Initial particle distribution (median)	100	µm	1	100	µm	3
		Initial particle distribution (C.V.)	0.6	µm	1	0.6	µm	3
		Inhalation cut-off diameter	15	µm	3	15	µm	0
	Inhalation–exposure to spray–instantaneous release	Released mass	12	g	2	Not included in FS 2006		
	Dermal–direct product contact–instant application loading[5]	Exposed area	450	cm^2	3			
		Product amount	0.7	g	1	0.023	g	3
Application - oven cleaner (12.5.2 ~ 9.2)	General	Frequency	5	per year	4	26	per year	3
	Dermal–direct product contact–instant application	Exposed area	225	cm^2	3	430	cm^2	3
		Product amount	0.6	g	1	0.2	g	1

1: In FS 2006: Inhalation–exposure to vapour–instantaneous release
2: In FS 2006: Inhalation–exposure to vapour–constant rate
3: In FS 2006: Inhalation–exposure to spray–spraying
4: In FS 2006: Dermal–direct product contact–constant rate loading
5: In FS 2006: Dermal–direct product contact–constant rate loading

Table A2: Anthropometric data for exposure scenarios, selected ConsExpo models and default parameter values published in 2006 and 2017

	Cleaning Products Fact Sheet 2018		**Cleaning Products Fact Sheet 2006**	
Parameter	**Default value**	**Q-factor**	**Default value**	**Q-factor**
Adult				
Body weight	68.8 kg	4	65 kg	4
Inhalation rate	25 l/min	3	24.1 l/min	3
Child Body weight	8.0 kg (6–12 months)	4	8.67 kg (10.5 months)	4

Annex II EPHECT survey analysis

Annex II 1.1 EPHECT data simulation

The EPHECT (Emissions, Exposure Patterns and Health Effects of Consumer Products in the EU) project is a European collaborative action co-funded by the European Union (Executive Agency for Health and Consumers, EAHC; 2010–2013). The survey performed within the EPHECT project was designed to gain insight into the indoor use patterns of consumer products in the EU Member States (EPHECT, 2012). A total of 4335 respondents answered a questionnaire across 10 countries to reflect different use patterns of 16 cleaning products in Northern Europe (Sweden n=471, Denmark n=449), Western Europe (Germany n=358, France n=487, UK n=351), Southern Europe (Italy n=361, Spain n=578), and Eastern Europe (Poland n=350, Hungary n=565, Czech Republic n=365). Eight of the 16 products considered represent cleaning product categories covered by this Fact Sheet, namely all-purpose cleaners, kitchen cleaners, floor cleaners, glass and window cleaners, bathroom cleaners, furniture and floor polish products, and coating products for leather and textiles. For these products, questions included use frequency (e.g. daily, per week, per month, per year) and amount of product used per event. Summary data for use frequency and product amount are reported by Johnson and Lucica (EPHECT, 2012). For the purpose of this Fact Sheet, however, the raw data of the survey were kindly provided by EPHECT and analysed with a Monte Carlo (MC) simulation in order to derive probabilistic distributions for use frequency and product amount. Note that not all raw data of the EPHECT survey is reported in the summary of Johnson and Lucica (EPHECT, 2012).

Annex II 1.2 Data preparation

The first step in the preparation of the MC simulation is to convert the qualitative survey data on product amount into quantitative amounts (g). In Table 1 an overview is provided on the units that were used in the survey and the amounts that were linked to these units (by RIVM, last column).

Table A2: Quantitative conversion of qualitative product amount units in EPHECT respondent data per product category and product use format

Product category	Product use format	Qualitative amount unit EPHECT survey[1]	Quantified by RIVM as
All-purpose cleaner	Liquid	Number of caps	40 g/cap[2]
	Spray	Number of sprays	1–2 g per spray[3]
	Cream	Number of tablespoons	20 g per spoon[4]
	Powder	Number of table spoons	20 g per spoon[4]
	Wipes	Number of wipes	20 g per wipe[5]
Kitchen cleaner	Liquid	Number of caps	40 g/cap[2]
	Spray	Number of sprays	1–2 g per spray[3]
	Cream	Number of tablespoons	20 g per spoon[4]
	Powder	Number of tablespoons	20 g per spoon[4]
	Wipes	Number of wipes	5–6 g per wipe[5]
Floor cleaner	Liquid	Number of caps	40 g/cap[2]
	Spray	Number of sprays	1–2 g per spray[3]
	Wipes / Tissues	Number of wipes	5–6 g/wipe[5]
	Powder	Number of tablespoons	20 g per spoon[4]
Glass and window cleaner	Liquid	Number of caps	40 g/cap[2]
	Spray	Number of sprays	1–2 g per spray[3]
	Wipes / Tissues	Number of wipes	5 g/wipe[5]
Bathroom cleaner	Liquid	Number of caps	40 g/cap[2]
	Spray	Number of sprays	1–2 g per spray[3]
	Gel	Number of tablespoons	20 g per spoon[4]
	Powder	Number of tablespoons	20 g per spoon[4]
	Wipes	Number of wipes	5–6 g per wipe[5]
Furniture polish	Liquid	Number of caps	40 g/cap[2]
	Spray	Number of sprays	1–2 g per spray[3]
	Wipes / Tissues	Number of wipes	5 g/wipe[4]
Leather and textile coatings	Liquid	Number of caps	40 g/cap[2]
	Spray	Number of sprays	1–2 g per spray[3]
	Cream	Number of tablespoons	20 g per spoon[4]

1: EPHECT (2012)
2: Average of 2 measured all-purpose cleaner caps on the Dutch market. Assuming product density of 1 g/ml
3: Delmaar & Bremmer (2009)
4: Wikipedia: 20 ml, assuming a density of 1 g/ml
5: Weerdesteijn et al. (1999)

The second step in preparing the data is to assign probabilistic distributions to the ranges presented in the multiple choice questions of the original EPHECT questionnaire with respect to product amount per product format (Table A3) and use frequency per product category (Table A4).

Table A3: Assigned probabilistic distributions for ranges in multiple choice answers EPHECT related to product amounts per product format

Product format	EPHECT multiple choice answers: related product amount	Distribution U = uniform T = triangular	Assigned values U: minimum–maximum T: minimum–mode–maximum
Liquid	Less than 0.5 cap	T	0–20–20 g
	0.5 cap to less than 1 cap	U	20–40 g
	1 cap to less than 1.5 caps	U	40–60 g
	1.5 caps to less than 2 caps	U	60–80 g
	2 caps to less than 2.5 caps	U	80–100 g
	2.5 caps to less than 3 caps	U	100–120 g
	3 caps to less than 3.5 caps	U	120–140 g
	3.5 caps to less than 4 caps	U	140–160 g
	4 caps to less than 4.5 caps	U	160–180 g
	4.5 caps to less than 5 caps	U	180–200 g
	3 caps or more	T	120–120–240 g
	5 caps or more	U	200–220 g
Sprays	1 spraying	U	1–2 g
	2 sprayings	U	2–4 g
	3 sprayings	U	3–6 g
	4 sprayings	U	4–8 g
	5 sprayings	U	8–10 g
	More than 5 sprayings	T	6–6 –14 g
Creams, foams, gels and powders	Less than 0.5 tablespoon	T	0–10–10 g
	0.5 table spoon to less than 1 table spoon	U	10–20 g
	1 tablespoon to less than 1.5 tablespoons	U	20–30 g
	1.5 tablespoons to less than 2 tablespoons	U	30–40 g
	2 tablespoons to less than 2.5 tablespoons	U	40–50 g
	2.5 tablespoons to less than 3 tablespoons	U	50–60 g
	3 tablespoons or more	T	60–60–120 g
Wipes	1 wipe	U	5–6 g
	2 wipes	U	10–12 g
	3 wipes	U	15–18 g
	4 wipes	U	20–24 g
	5 wipes	U	25–30 g
	More than 5 wipes	T	30–30–72 g

Table A4: Assigned probabilistic distributions for ranges in multiple choice answers EPHECT related to use frequency

EPHECT multiple choice answers related to use frequency	Distribution P = point U = uniform	Assigned values P: point estimate U: minimum–maximum
At least once a day	P	365 per year
Several times a week	U	104–312 per year
Once a week	P	52 per year
Once per two weeks	P	26 per year
Once per month	P	12 per year
Less than once a month	U	1–12 per year

The raw data obtained from the EPHECT survey are then reorganized into a database structured per product used per individual respondent (Table A5). The use frequency per specific product format was not specified per respondent in the original questionnaire of EPHECT. It is therefore assumed the respondent uses the products in the category with an equal frequency, so that:

$$use\ frequency\ product\ format = \frac{use\ frequency\ product\ category}{number\ of\ product\ formats\ respondent\ uses\ in\ the\ category}$$

Table A5: Database structure

Product category and format and respective number of respondents	Respondent ID	Quantified probabilistic distribution for *product amount* per respondent	Quantified probabilistic distribution for *use frequency* per respondent
All-purpose cleaner cream	540	U: 20–730 g	P: 104 per year[1]
	698	U: 10–20 g	U: 35–104 per year[1]
	...	...	...
... n=235	92706	U: 0–10 g	P: 52 per year
All-purpose cleaner liquid	540	U: 80–100 g	P: 12 per year
	700	U: 20–40 g	U: 35–104 per year[1]
	...	...	...
... n=1170	92702	U: 40–60 g	P: 365 per year

Product category and format and respective number of respondents	Respondent ID	Quantified probabilistic distribution for *product amount* per respondent	Quantified probabilistic distribution for *use frequency* per respondent
All-purpose cleaner spray	540	U: 2–4 g	P: 12 per year
	689	U: 2–4 g	U: 35–104 per year[1]
	...	...	...
... n=686	92699	U: 4-8 g	26 per year
Bathroom cleaner liquid	701	U: 60–80 g	P: 52 per year
	707	U: 60–80 g	P: 182 per year[(1)]
	...	...	...
... n=1006	92761	U: 20–40 g	P: 52 per year
Bathroom cleaner wipes	834	U: 10–12 g	U: 52–153 per year[1]
	11008	U: 5-6g	P: 52 per year
	...	...	...
... n=72	92652	U: 25–30g	P: 26 per year
Etc... n total=11970	...	...	...

P = point estimate, U = uniform distribution
1: Respondent uses more than one form of the product. Frequency is corrected for the use of other product forms in the product category

Annex II 1.3 Data simulation

The database is subject to an MC simulation in which for each respondent–product combination a single value is randomly drawn from the corresponding amount distributions for product amount and use frequency. Based on these single amount and frequency values, population-wide amount and frequency distributions are estimated for each product separately. To estimate the amount and frequency distributions for European users, the individual values available are weighted for the number of inhabitants of each country. Weighting is necessary because the number of surveyed individuals per country is not representative of the entire European population. A total of 4335 interviews were conducted across the 10 countries. Sample sizes varied between the countries, with 368 to 578 interviews conducted in each, ensuring national representativeness of consumers of the selected product classes by age, gender and region.

Each country was assigned a weight (*w*) according to:

$$w_i = \frac{N_i/\sum_{i=1} N_i}{n_i/\sum_{i=1} n_i} \qquad (1)$$

where *i* is country, *N* is the total number of inhabitants (www.europa-nu.nl) and *n* is the number of surveyed individuals.

The product amount is assumed to be lognormally distributed for the entire European population. The lognormal amount distributions are characterized by their geometric mean (GM) and geometric standard deviation (GSD) or coefficient of variation (C.V.). The GM and GSD are the back-transformed mean and St. Dev of the log transformed raw (individual) data. The C.V. is derived using the following equation:

$$CV = \sqrt{e^{s^2} - 1} \qquad (2)$$

where s^2 is the variance of the log transformed amounts. The mean and variance on log scale are weighted for the number of inhabitants of each country using equations (3) and (4).

$$\bar{x} = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i} \qquad (3)$$

$$s^2 = \frac{1}{W_n - 1} \sum_{i=1}^{n} w_i (x_i - \bar{x})^2 \qquad (4)$$

where W_n is the sum of weights.

The frequency is described using a beta distribution, which is characterized by two parameters α and β. The values for these two parameters are derived according to:

$$\alpha = \bar{x}\left(\frac{\bar{x}(1-\bar{x})}{s^2} - 1\right) \qquad (5)$$

$$\beta = (1-\bar{x})\left(\frac{\bar{x}(1-\bar{x})}{s^2} - 1\right) \qquad (6)$$

where $\bar{x}$ and s^2 are derived from the reported frequencies without transformation according to equations (3) and (4).

Annex II 1.4 Simulation results

The MC simulation results are a probabilistic distribution of product amounts and use frequencies for the entire European population, from which 75th percentiles are extracted (Table A6).

Table A6: Probabilistically simulated 5th, 25th, 50th, 75th and 95th percentiles for product amount and use frequency for the entire European population derived from EPHECT survey data

Product Sub category and format	n	Percentiles Product amount (g)					Percentiles Frequency (per year)				
		5th	*25th*	*50th*	*75th*	*95th*	*5th*	*25th*	*50th*	*75th*	*95th*
All-purpose cleaner – cream	233	7.2	14.4	22.8	36.4	72.0	1	13	40	84	175
All-purpose cleaner – foam	63	6.8	13.6	21.6	34.4	68.0	1	7	22	51	120
All-purpose cleaner – gel	225	5.6	12.0	19.6	32.4	68.0	2	12	31	62	128
All-purpose cleaner – liquid	1153	9.4	21.0	37.0	65.0	150.0	1	18	80	197	325
All-purpose cleaner – powder	142	3.0	7.6	15.2	29.6	76.0	1	9	28	62	131
All-purpose cleaner – spray	679	1.5	2.5	3.6	5.1	8.6	1	17	66	153	285
All-purpose cleaner – tablets	48	3.8	6.0	8.2	11.0	18.0	1	9	23	47	99
All-purpose cleaner – wipes	229	4.2	7.4	11.0	16.0	29.0	1	11	37	88	186
Bathroom cleaner – cream	177	6.8	13.2	21.2	34.0	68.0	1	10	36	88	190
Bathroom cleaner – foam	59	6.4	15.2	27.2	48.0	116.0	2	17	51	110	212
Bathroom cleaner – gel	307	6.8	13.6	22.4	36.8	76.0	1	14	44	99	204
Bathroom cleaner – liquid	989	8.0	19.0	36.0	67.0	160.0	0	12	55	139	277
Bathroom cleaner – powder	97	6.0	12.0	19.2	30.8	60.0	4	20	47	88	164
Bathroom cleaner – spray	740	1.7	3.0	4.4	6.5	12.0	1	14	51	120	241
Bathroom cleaner – tablets	43	3.3	4.6	5.8	7.3	10.0	4	18	40	69	131
Bathroom cleaner – wipes	69	5.0	8.4	12.0	17.0	29.0	2	13	31	62	120
Floor cleaner – cream	77	11.2	20.8	32.0	48.0	92.0	2	11	27	55	110
Floor cleaner – foam	48	4.4	12.0	23.2	44.0	120.0	0	3	16	47	124
Floor cleaner – gel	120	6.4	14.0	24.0	40.0	88.0	0	6	26	73	175
Floor cleaner – liquid	1333	15.0	30.0	50.0	82.0	170.0	0	9	55	161	310
Floor cleaner – powder	67	10.8	20.4	31.2	48.0	88.0	0	4	20	55	139
Floor cleaner – spray	212	2	3	4	5	9	1	9	31	73	161
Floor cleaner – tablets	27	5	8	11	15	24	1	7	16	30	58
Floor cleaner – wipes	140	5	9	13	19	34	1	11	31	66	135

Product Sub category and format	n	Percentiles Product amount (g)					Percentiles Frequency (per year)				
		5th	*25th*	*50th*	*75th*	*95th*	*5th*	*25th*	*50th*	*75th*	*95th*
Glass cleaner – cream	27	8	16	26	44	84	0	3	18	62	172
Glass cleaner – foam	33	3	9	18	39	112	0	1	5	23	84
Glass cleaner – gel	36	4	9	16	29	64	1	7	23	55	124
Glass cleaner – liquid	617	5	14	30	63	180	0	1	13	66	215
Glass cleaner – powder	20	13	20	28	38	60	4	13	25	44	80
Glass cleaner – spray	981	2	3	4	7	12	0	1	13	66	215
Glass cleaner – tablets	12	6	10	13	18	28	0	2	9	23	58
Glass cleaner – wipes	95	5	9	13	19	34	0	2	20	73	204
Kitchen cleaner – cream	315	4	10	18	32	76	2	23	66	135	245
Kitchen cleaner – foam	93	5	12	23	44	104	3	21	51	99	186
Kitchen cleaner – gel	183	5	11	19	34	76	2	17	51	113	219
Kitchen cleaner – liquid	952	8	18	33	60	140	2	26	91	193	318
Kitchen cleaner – powder	144	5	12	20	35	80	3	20	47	91	172
Kitchen cleaner – spray	800	2	3	4	6	11	1	24	88	190	314
Kitchen cleaner – tablets	86	4	7	9	12	19	9	28	47	77	128
Kitchen cleaner – wipes	130	5	8	12	18	32	3	19	44	84	157

Erratum RIVM report 2016-0179

Report number: 2016-0179

Report title: Cleaning Products Fact Sheet: Default parameters for estimating consumer exposure-Updated version 2018

Mistakes: The derivation of ‘airborne fractions’ is not accurately assigned to the particle size distribution of some spray cleaners described in Cleaning Products Fact Sheet, which are all-purpose cleaner spray, bathroom cleaner spray, floor polish spray, furniture polish spray, leather maintenance spray, and glass cleaner spray.

Signature project leader for approval
Joke Herremans
17 september 2018

Cleaning Products Fact Sheet. Default parameters for estimating consumer exposure
Updated version 2018

Bilthoven September 13th , 2018

Erratum with regard to incorrect defaults for the airborne fraction for the products: all-purpose cleaner spray, bathroom cleaner spray, floor polish spray, furniture polish spray, leather maintenance spray, and glass cleaner spray

This erratum presents corrected values for the following sections and tables of RIVM report 2016-0179:

Erratum Table 1: Section and table with corrected values in RIVM report 2016-0179

Consumer exposure scenario	**Section**	**Table number**
Spraying all-purpose cleaner spray	8.2.1	8.5
Spraying bathroom cleaner spray	10.1.2.1	10.4
Spraying floor polish spray	11.1.3.2	11.9
Spraying furniture polish spray	11.3.1.1	11.24
Spraying leather maintenance spray	11.3.3.1	11.27
Spraying glass cleaner spray	12.1.1	12.2
All of the above	Annex I	Table A1

Introduction

In order to use ConsExpo Web's '***Inhalation–exposure to spray–spraying'*** model to simulate the inhalation exposure to non-volatile substances in sprays, it is required to insert input values that adequately represent the particle size distribution of spray droplets. More specifically, it is important that the particle sizes relevant for inhalation and oral exposure via secondary ingestion are represented. This means that the low particle size range should be properly described by the parameterization of the particle size distribution.
The measured initial particle size distributions in the experimental work on consumer spray products by Delmaar & Bremmer (2009) indicate that a lognormal distribution fitted for the entire initial particle size distribution of a spray may in fact result in a poor description of the smaller particles. For this reason, it was decided to fit the initial particle size distribution in the particle size range up to 22.5 µm. Consequently, the default initial particle size distributions of all-purpose cleaner spray, bathroom cleaner spray and furniture spray, as published in the previous version of the Cleaning products fact sheet in 2006, were adapted in 2010 using a separate fit for the size spectrum of the droplets up to 22.5 µm. The method to derive a separate fit for smaller particles is described in detail in Delmaar & Bremmer (2009). In 2010, these new derived defaults for the initial particle size distribution were included in the ConsExpo 4.1 software by updating the database.

By taking the new defaults from 2010 for initial particle size distribution as input in the ConsExpo's '***Inhalation–exposure to spray–spraying'*** model, a correction is required to account for the fraction of particles above the 22.5 µm cut-off. Otherwise, the exposure would be overestimated as the model would assume that all airborne particles are in the range up to 22.5 µm. It was therefore proposed to adjust the input value for the so-called 'airborne fraction' parameter in ConsExpo for the 22.5 µm cut-off. The 'airborne fraction' refers to the mass fraction of the product that actually becomes airborne upon spraying. The proposed scaling factor ($f_{scale<22.5\ \mu m}$) refers to the mass of all sprayed particles with a diameter < 22.5 µm as a fraction of the total mass sprayed of the product:

$$f_{scale<22.5\ \mu m} = \frac{g_{product\ sprayed<22.5\mu m}}{g_{total\ product\ sprayed}}$$

The scaling factor is then accommodated in a scaled airborne fraction that refers to the mass of the particles that are both airborne and smaller than22.5 µm as a fraction of the total mass sprayed:

$$airborne\ fraction_{(scaled\ <22.5\ \mu m)} = f_{scale<22.5\ \mu m} \times \frac{g_{airborne}}{g_{total\ product\ sprayed}}$$

It should be noted, that the default airborne fractions link specifically to the initial particle size distribution (in the range up to 22.5 µm) and must not be used when particle size distributions with other definitions are inserted by the user.

Incorrect defaults for airborne fraction

The scaled airborne fraction complementary to the initial particle size distributions fitted to represent particles up to 22.5 µm has not been correctly adopted in the updated Cleaning Products Fact Sheet published in January 2018, RIVM report 2016-0179.

The default airborne fractions in the consumer exposure scenarios that refer to the inhalation of non-volatile substances upon spraying of all-purpose cleaner spray, bathroom cleaner spray and furniture spray therefore need adjustment (Erratum Table 1).
The consumer exposure scenarios that refer to the inhalation of non-volatile substances upon spraying of floor polish spray, leather maintenance spray and shoe polish spray describe a default initial particle size distribution that is based on furniture spray, whereas the default initial particle size distribution of glass cleaner spray is based on all-purpose cleaner spray. As such, the default airborne fractions described in these consumer exposure scenarios for all spray products mentioned here need adjustment (Erratum Table 1). The defaults presented for shoe polish spray did not require a correction and can be used as presented in the main report.

Erratum Table 2: References to incorrectly updated default airborne fractions of spray products in the Cleaning Products Fact Sheet and the respective correctly updated default airborne fractions.

Consumer exposure scenario	**Section**	**Table number**	**Old default airborne fraction (2006)[1]**	**Incorrectly updated default airborne fraction(January, 2018)**	**Correctly updated default airborne fraction(Erratum September 2018)[2]**
Spraying all-purpose cleaner spray	8.2.1	8.5	0.2	0.1	0.006
Spraying bathroom cleaner spray	10.1.2.1	10.4	0.2	0.2	0.002
Spraying floor polish spray	11.1.3.2	11.9	-	0.2	0.3
Spraying furniture polish spray	11.3.1.1	11.24	-	0.2	0.3
Spraying leather maintenance spray	11.3.3.1	11.27	1	0.2	0.3
Spraying glass cleaner spray	12.1.1	12.2	0.2	0.2	0.006
All of the above	Annex I	Table A1	All of the above	All of the above	All of the above

1 Directly cited from Prud'homme de Lodder et al., 2006
2 The corrected default values for the scaled airborne fractions are directly cited from RIVM's document 'New default values for the spray model' (RIVM, 2010).

(1) Section 8.2 All-purpose cleaning spray
Section 8.2.1 Application: spraying

Airborne fraction
For all-purpose cleaner sprays an airborne fraction of 0.2 needs to be scaled with a factor 0.03 to be complementary to the initial particle size distributions fitted to represent particles up to 22.5 µm (Delmaar & Bremmer, 2009; RIVM, 2010). As such, a default airborne fraction of 0.006 is set. The Q-factor is set to 3, because the data were generated specifically to determine the airborne fraction of all-purpose cleaners, but the number of samples is limited.

Table 8.5: Default values for estimating consumer exposure to all-purpose cleaner spray during application

Default value		**Q-factor**	**Source**
General			
Frequency	365 per year	4	Garcia-Hidalgo et al., 2017
Inhalation–exposure to spray–spraying[1]			
Spray duration[1]	0.23 min	3	See above
Exposure duration[2]	60 min	1	See above
Room volume[2]	15 m^3	4	Kitchen (Te Biesebeek et al., 2014)
Room height[1]	2.5 m	4	Kitchen (Te Biesebeek et al., 2014)
Ventilation rate[1]	2.5 per hour	3	Kitchen (Te Biesebeek et al., 2014)
Mass generation rate[1]	1.6 g/s	4	Delmaar & Bremmer, 2009
Airborne fraction[1]	0.006	3	RIVM,2010
Density non-volatile[1]	1 g/cm^3	3	Delmaar & Bremmer, 2009
Initial particle Distribution Median[1] (C.V.)[1]	2.4 µm (0.37)	3	Delmaar & Bremmer, 2009
Inhalation cut-off diameter[1]	15 µm	3	Delmaar & Schuur, 2016
Inhalation–exposure to spray–instantaneous release			
Released mass[3]	22 g	2	Weerdesteijn et al., 1999
Dermal–direct product contact–constant rate loading			
Exposed area	2200 cm^2	3	Section 4.2.1
Contact rate	46 mg/min	3	Section 4.2.1
Release duration	28 s	3	Twice the spray duration (4.2.1)

1 Applies to non-volatile substances only
2 Applies to both volatile and non-volatile substances
3 Applies to volatile substances only

(2) *Section 10.1.2. Bathroom cleaner spray*
Section 10.1.2.1 Application: spraying

Airborne fraction
For bathroom cleaner sprays an airborne fraction of 0.2 needs to be scaled with a factor 0.009 to be complementary to the initial particle size distributions fitted to represent droplets up to 22.5 µm (Delmaar & Bremmer, 2009; RIVM, 2010). As such, a default airborne fraction of 0.002 is set. The Q-factor is 2, because the experiments of Delmaar & Bremmer comprise only a small number of samples and the data refer generically to surface sprays rather than specifically to bathroom sprays.

Table 10.4: Default values for estimating consumer exposure to bathroom cleaner spray during application

Default value		**Q-factor**	**Source**
General			
Frequency	120 per year	4	EPHECT, 2012; Garcia-Hidalgo et al., 2017
Inhalation–exposure to spray–spraying			
Spray duration[1]	80 s	2	See above
Exposure duration[2]	24 min	3	See above
Room volume[2]	10 m^3	4	Bathroom (Te Biesebeek et al., 2014)
Room height[1]	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate[2]	2 per hour	3	Bathroom (Te Biesebeek et al., 2014)
Mass generation rate[1]	1.25 g/s	3	Delmaar & Bremmer, 2009
Airborne fraction[1]	0.002	2	RIVM,2010
Density non-volatile[1]	1.8 g/cm^3	3	Section 4.2.1
Initial particle distribution Median[1] (C.V.) [1]	3.6 µm (0.52)	3	Delmaar & Bremmer, 2009
Inhalation cut-off diameter[1]	15 µm	3	Delmaar & Schuur, 2016
Inhalation–exposure to spray–instantaneous release			
Released mass[3]	100 g	2	See above
Dermal–direct product contact–constant rate loading			
Exposed area	2200 cm^2	3	Section 4.2.1
Contact rate	46 mg/min	3	Section 4.2.1
Release duration	160 s	2	Twice the spray duration (4.2.1)

1 Applies to non-volatile substances only
2 Applies to both volatile and non-volatile substances
3 Applies to volatile substances only

(3) Section 11.1.3.2 Floor polish spray
Section 11.1.3.2.1 Application: spraying

Table 11.9: Default values for estimating consumer exposure to floor polish spray during application to the entire floor area

Default value		**Q-factor**	**Source**
General			
Frequency	52 per year	4	EPHECT, 2012
Inhalation–exposure to spray–spraying			
Spray duration[1]	33 s	2	See above
Exposure duration[2]	90 min	2	See above
Room volume[2]	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Room height[1]	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate[2]	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Mass generation rate[1]	1.6 g/s	3	Section 4.2.1
Airborne fraction[1]	0.3	2	Section 11.3.1.1
Density non-volatile[1]	1.8 g/cm^3	3	Section 4.2.1
Initial particle distribution Median[1] (C.V.)[1]	10.8 µm (0.81)	3	Delmaar & Bremmer, 2009
Inhalation cut-off diameter[1]	15 µm	3	Delmaar & Schuur, 2016
Inhalation–exposure to spray–instantaneous release			
Release mass[3]	53 g	2	See above
Dermal–direct product contact–constant rate			
Exposed area	2200 cm^2	3	Section 4.2.1
Contact rate	46 mg/min	3	Section 4.2.1 (trigger sprays)
Release duration	66 s	2	Twice the spray duration (4.2.1)

1 Applies to non-volatile substances only
2 Applies to both volatile and non-volatile substances
3 Applies to volatile substances only

(4) Section 11.3.1. Furniture polish spray
Section 11.3.1.1. Application: spraying

Table 11.24: Default values for estimating consumer exposure to furniture polish spray during application

Default value		**Q-factor**	**Source**
General			
Frequency	1 per year	4	Garcia-Hidalgo et al., 2017
Inhalation–exposure to spray–spraying			
Spray duration[1]	2 min	2	See above
Exposure duration[2]	240 min	1	See above
Room volume[2]	20 m^3	4	Unspecified room (Te Biesebeek et al., 2014)
Room height[1]	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate[2]	0.6 per hour	3	Unspecified room (Te Biesebeek et al., 2014)
Mass generation rate[1]	1.8 g/s	3	Delmaar & Bremmer, 2009
Airborne fraction [1]	0.3	2	Section 4.2.1
Density non-volatile[1]	1.8 g/cm^3	3	Section 4.2.1
Initial particle distribution Median[1] (C.V.) [1]	10.8 µm (0.81)	3	Delmaar & Bremmer, 2009
Inhalation cut-off diameter[1]	15 µm	3	Delmaar & Schuur, 2016
Inhalation–exposure to spray–instantaneous release			
Released mass[3]	200 g	2	See above
Dermal–direct product contact–constant rate loading			
Exposed area	2200 cm^2	3	Section 4.2.1
Contact rate	46 mg/min	3	Section 4.2.1
Release duration	4 min	1	Twice the spray duration (4.2.1)

1 Applies to non-volatile substances only
2 Applies to both volatile and non-volatile substances
3 Applies to volatile substances only

(5) *Section 11.3.3. Leather maintenance spray*
Section 11.3.3.1. Application: spraying

Airborne fraction
For furniture sprays an airborne fraction of 1 needs to be scaled with a factor 0.3 to be complementary to the initial particle size distributions fitted to represent droplets up to 22.5 µm (Delmaar & Bremmer, 2009; RIVM, 2010). As such, a default airborne fraction of 0.3 is set. The Q-factor is 2, because the experiments of Delmaar & Bremmer comprise only a small number of samples.

Table 11.27: Default values for estimating consumer exposure to leather maintenance spray during application

Default value		**Q-factor**	**Source**
General			
Frequency	5 per year	2	Product information
Inhalation–exposure to spray–spraying			
Spray duration			
- Trigger spray[1]	68 s	3	See above
- Aerosol spray can[1]	90 s	3	See above
Exposure duration[2]	240 min	1	See above
Room volume[2]	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Room height[1]	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate[2]	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Mass generation rate			
- Trigger spray[1]	1.6 g/s	3	Section 4.2.1
- Aerosol spray can[1]	1.2 g/s	3	Section 4.2.1
Airborne fraction[1]	0.3	2	RIVM, 2010
Density non-volatile[1]	1.8 g/cm^3	3	Section 4.2.1
Initial particle distribution Median[1] (C.V.)[1]	10.8 µm (0.81)	2	Delmaar & Bremmer, 2009
Inhalation cut-off diameter[1]	15 µm	3	Delmaar & Schuur, 2016
Inhalation–exposure to spray- instantaneous release			
Released mass[3]	109 g	2	See above
Dermal–direct product contact–constant rate loading			
Exposed area	2200 cm^2	3	Section 4.2.1
Contact rate			
- Trigger spray	46 mg/min	3	Section 4.2.1
- Aerosol spray can	100 mg/min	3	Section 4.2.1
Release duration	3 min	2	See above

1 Applies to non-volatile substances only
2 Applies to both volatile and non-volatile substances
3 Applies to volatile substances only

(6) Section 12.1. Glass cleaners
Section 12.1.1. Application: spraying

Table 12.2: Default values for estimating consumer exposure to glass cleaner spray during application

Default value		**Q-factor**	**Source**
General			
Frequency	66 per year	4	Annex II
Inhalation–exposure to spray–spraying			
Spray duration[1]	18 s	1	See above
Exposure duration[2]	240 min	1	See above
Room volume[2]	58 m^3	4	Living room (Te Biesebeek et al., 2014)
Room height[1]	2.5 m	4	Standard room height (Te Biesebeek et al., 2014)
Ventilation rate[2]	0.5 per hour	3	Living room (Te Biesebeek et al., 2014)
Mass generation rate[1]	1.6 g/s	3	Section 4.2.1
Airborne fraction[1]	0.006	2	Section 8.2.1
Density non-volatile[1]	1.8 g/cm^3	3	Section 4.2.1
Initial particle distribution Median[1] (C.V.)[1]	2.4 µm (0.37)	3	See above
Inhalation cut-off diameter[1]	15 µm	3	Section 4.2.1
Inhalation–exposure to spray–instantaneous release			
Released mass[3]	29 g	1	See above
Dermal–direct product contact–constant rate loading			
Exposed area Contact rate Release duration	2200 cm^2 46 mg/min 36 s	3 3 1	Section 4.2.1 Section 4.2.1 Twice the spray duration (4.2.1)

1 Applies to non-volatile substances only
2 Applies to both volatile and non-volatile substances
3 Applies to volatile substances only

(7) Annex

Table A1: All Cleaning Products Fact Sheet data for exposure scenarios, selected ConsExpo models and default parameter values published in 2006 and 2018[1]

Scenario (Section FS 2018 - Section FS 2006)	Selected exposure model	Parameter	Cleaning Products Fact Sheet 2018			Cleaning Products Fact Sheet 2006		
			Default value	Unit	Q-factor	Default value	Unit	Q-factor
Application – spraying all-purpose cleaning spray (8.2.1 - 5.3)	Inhalation– exposure to spray– spraying	Airborne fraction	0.006	(-)	3	0.2	(-)	2
Application – spraying bathroom cleaning spray (10.1.2.1 - 7.1.1)	Inhalation– exposure to spray– spraying	Airborne fraction	0.002	(-)	2	0.2	(-)	2
Application – spraying floor polish spray (11.1.3.2.1)	Inhalation– exposure to spray– spraying	Airborne fraction	0.3	(-)	2	Not included in FS 2006		
Application – spraying furniture polish spray (11.3.1.1)	Inhalation– exposure to spray– spraying	Airborne fraction	0.3	(-)	2			
Application – spraying leather maintenance spray (11.3.3.1 - 8.3.2)	Inhalation– exposure to spray– spraying	Airborne fraction	0.3	(-)	2	1	(-)	2
Application – spraying glass cleaner spray(12.1.1 - 9.1)	Inhalation– exposure to spray– spraying	Airborne fraction	0.006	(-)	2	0.2	(-)	2

1 only the rows of Table A1 adjusted in the erratum are displayed here. Adjustment compared to the Cleaning Product Fact Sheet 2006 are highlighted yellow

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J.A.J. Meesters | M.M. Nijkamp | A.G. Schuur | J.D. te Biesebeek

RIVM Report 2016-0179

ConsExpo
consumer | exposure

Published by:

National Institute for Public Health and the Environment, RIVM
P.O. Box 1 | 3720 BA Bilthoven
The Netherlands
www.rivm.nl/en

januari 2018

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010217