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

Prioritization of new and emerging chemical risks for workers and follow- up actions

RIVM report 2015-0091

N.G.M. Palmen | K.J.M. Verbist

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Colophon

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This investigation has been performed by order and for the account of the Ministry of Social Affairs and Employment, within the framework of the prioritization of emerging risks.

Published by:
National Institute for Public Health and the Environment
P.O. Box 1 | 3720 BA Bilthoven
The Netherlands
www.rivm.nl/en

Publiekssamenvatting

Prioritering en follow-up acties voor nieuwe en toenemende arborisico's van stoffen

Regelmatig blijkt weinig bekend te zijn over de schadelijke effecten van stoffen op de werkvloer. Dat komt onder andere doordat de risicobeoordeling van de meeste stoffen wordt gebaseerd op tests waarbij de stof wordt ingeslikt. Voor werknemers is echter het contact met een stof via de luchtwegen (inademen) of huid juist relevant. Ondanks alle wet- en regelgeving zijn er dan ook regelmatig meldingen van nieuwe en toenemende risico's die worden veroorzaakt doordat medewerkers aan stoffen blootstaan.

Om te voorkomen dat mensen ziek worden door deze 'nieuwe en toenemende risico's', pleit het RIVM ervoor dergelijke risico's zo snel mogelijk op te pikken. In 2013 is hiervoor een systeem ontwikkeld en is een overzicht gemaakt van 43 'nieuwe en toenemende' stoffen die via inhalatie of contact met de huid gezondheidsklachten veroorzaken. In het onderliggende onderzoek is deze lijst aangevuld tot 49 'nieuwe en toenemende' stoffen en is aangegeven welke van deze stoffen de meeste aandacht verdienen.

Om de prioritering te kunnen aanbrengen, is eerst inzicht verkregen in het mogelijke risico van de stoffen en is uitgezocht in hoeverre ze in Nederland worden gebruikt. Op basis daarvan zijn drie categorieën opgesteld. Als een stof in de eerste categorie valt, dient er direct onderzocht te worden of er een oorzakelijk verband is tussen het gezondheidseffect van een stof en de blootstelling, om zo nodig direct maatregelen te nemen. In de tweede categorie is actie noodzakelijk, maar niet meteen. In de derde categorie is minimale actie vereist.

Daarnaast is geïnventariseerd in welke mate de 49 stoffen al zijn gereguleerd binnen de Europese stoffenwetgeving REACH of andere wetgeving. Op basis hiervan kan Bureau REACH in samenwerking met de ministeries (SZW, VWS en I&M) en de inspecties (Inspectie SZW, NVWA en ILT) nagaan of op de hoogst geprioriteerde stoffen inmiddels voldoende actie wordt ondernomen en of aanvullende maatregelen noodzakelijk zijn.

Kernwoorden: medewerkers, gevaarlijke stoffen, prioritering, nieuwe risico's, toenemende risico's

Synopsis

Prioritization of new and emerging chemical risks for workers and follow-up actions

It happens quite often that there is little or no knowledge of the harmful effects of substances that are used by workers. One of the reasons for this is the fact that the risk assessment is usually based on toxicological tests following oral exposure, while workers are exposed via the airways and the skin. New and emerging risks (NERCs) continue to be reported despite existing laws and regulations put in place to limit the risks of dangerous substances at work.

To prevent workers from falling ill because of these NERCs, RIVM is arguing for a system that identifies NERCs as soon as possible. In 2013, RIVM published a list of 43 NERCs that may have adverse effects on health after inhalation or dermal exposure. In this report, this list was extended to 49 NERCs and subsequently prioritized to address those substances that deserve the most attention.

The NERCs were prioritized by mapping both the potential risk and the use of the substance in the Netherlands. Three categories were identified based on specific information: for a substance of the first category there is an urgent need to investigate a possible causal relationship between the exposure and the effect on health, and to take risk reduction measures if needed. The second category requires action to be taken, but not immediately. The third category requires minimal action.

In addition to this, an inventory was made showing the extent to which these 49 substances are already being regulated by the European chemicals legislation REACH or other legislation. Based on this information, the Netherlands' Bureau REACH, together with the Ministries (SZW, VWS and I&M) and the Inspectorates (Inspectorates of SZW, NVWA and ILT) can decide whether or not sufficient measures have already been taken for the substances with the highest priorities, and whether additional measures are needed.

Keywords: workers, dangerous substances, prioritization, new risks, emerging risks

Contents

Summary

A prioritization of new and emerging risks (NERCs) was asked for by the Ministry of Social Affairs and Employment following the RIVM report "Detecting emerging risks for workers and follow-up actions" (2013). The list of NERCs was updated until December 2014 and risk scores were calculated using a simplification of the ANSES impact analysis method (ANSES, 2014). Since it is important for risk management purposes to know whether a substance is used in the Netherlands, information on manufacturing and/or the use of the substance or mixture was combined with the risk score, leading to a priority class.

Substances with **very high priority**, indicating that 'direct action is necessary', are: formaldehyde, vinyl chloride, diacetyl-containing flavourings, 4,4-methylene-bismorpholine, beryllium, pesticides – methyl bromide and phosphine residual gases, hexamethylene diisocyanate, methylene diphenyl diisocyanate (MDI), methyl-methacrylate, ethyl methacrylate, trichloroethylene (TCE), lead, cobalt, triglycidyl isocyanurate (TGIC), tremolite-free chrysotile (= white asbestos) and crystalline silica.
Substances with **high priority**, meaning 'action is necessary' are: perchloroethylene (tetrachloroethylene), indium tin oxide, synthetic polymeric fibres, impregnation sprays containing fluoro carbons, aerosolized ribavirin, talc, tricresyl phosphate, fibreglass with styrene resins, corian dust, tropenol ester, chloracetal C5, humidifier disinfectants, 1-bromopropane, styrene, PVC, cleaning spray, potassium aluminium tetrafluoride fluxes, rhodium salts, 5-aminosalicylic acid.
Substances with **low priority**, meaning 'minimal action is needed', are: ready-to-use mixtures of powdered plant extracts, metal fumes or dust, epoxy resins/fragrances and thiazoles, trifluoroacetic acid, chlorhexidine diacetate/digluconate, trichloramine, multiple pesticides (containing carbendazim, 2,4-dichlorophenoxyacetic acid, glyphosate, ioxynil, linuron, trifluralin and vinclozolin), disulfiram, ultrafine particles, glyphosate, dipentene and pine oil, trimethyl benzene, epoxy resin, fluorohydrocarbons.

Information in EU databases regarding the availability of an occupational exposure limit, registration in REACH, classification according to CLP, inclusion in the community rolling action plan (CoRAP), substance of very high concern (SVHC), authorization or restriction in REACH or presence on other lists was gathered for all substances or mixtures mentioned above. With this information, it is possible to decide which action(s) is/are needed to control the new and/or emerging risk (NERC). An overview of possible actions is given in Chapter 4, but the actual steps to be taken for every individual substance or mixture has yet to be decided by mutual agreement with the concerned Ministries.

RIVM intends to continuously update and prioritize the list of NERCs.

1 Introduction

Identifying work-related new and undesirable side effects on health is a complementary approach to performing a risk assessment to manage the risks brought about by new technologies. In society, the need to identify new health risks more quickly and more effectively has grown, particularly over the past decade. It is continually emphasized that identifying new risks is a process that involves many uncertainties and many actors, in which a balance must be struck between a dynamic approach and a well-considered approach. The challenge is to prevent any occupational damage to human health without creating unnecessary concern (EC, 2013).

The European Agency for Safety and Health at Work (EU-OSHA) defines emerging risks as both "new and increasing" risks[1] (EU OSHA, 2009). This definition was also used in the RIVM report by Palmen et al. (2013). Since then, the acronym NERCs was introduced by RIVM, which means "new and emerging risks of chemicals". EU-OSHA states that the identification of NERCs in occupational safety and health is one of the strategic objectives to provide a basis on which to set priorities for OSH research and actions, and to improve the timeliness and effectiveness of preventive measures: ***Strategic objective 1:*** "***The provision of credible and good-quality data on new and emerging risks that meet the needs of policy-makers and researchers and allow them to take timely and effective action".*** (EU-OSHA, 2013)

A substance may become a NERC on the basis of new information on health complaints, exposure and work processes. In the report by Palmen et al. (2013), complementary methods were used to identify NERCs, such as case studies, epidemiological research, cluster analysis and health surveillance. An overview of 42 potential NERCs was prepared based on literature reports or reports written by experts during the last decennium. This list was supplemented with 7 potential NERCs that were reported in 2014 (until October). The degree of causality between the exposure to the substance and the reported health effect differs considerably between the reported potential NERCs and often needs further research. RIVM was asked by the Ministry of Social Affairs and Employment to make a priority list of the reported potential NERCs with the intention of taking further action concerning the substances with the highest priority.

[1] Emerging risks are defined as both "new and increasing" risks:
"New risks:
- the issue is new and caused by new types of substances, new processes, new technologies, new types of workplaces, or social or organizational change; or
- a longstanding issue is newly considered as a risk due to a change in social or public perceptions (e.g. stress, bullying); or
- new scientific knowledge allows a longstanding issue to be identified as a risk (e.g. repetitive strain injury (RSI), cases of which have existed for decades without being identified as RSI because of a lack of scientific evidence).

Increasing risks:
- the number of hazards leading to the risk is growing; or
- the likelihood of exposure to the hazard that leads to the risk is increasing, (exposure degree and/or the number of people exposed); or
- the effect of the hazard on the workers' health is getting worse."

The methods of risk score calculation, the prioritization of potential NERCs and information gathering from EU databases are explained in Chapter 2. In Chapter 3, the risk scores of the 49 NERCs are calculated, prioritized and information on every individual NERC in EU databases is presented. In Chapter 4, possible actions that may be taken to control the risk are discussed.

2 Methods

2.1 Collection of information on potential NERCs

The information necessary to calculate the risk score and to prioritize the potential NERC for further action was gathered by searching different sources and is summarized below:

- Literature review – first of all, the article in which the potential NERC was mentioned – to review information on the identified health effects, the substance considered responsible for the effect and the exposure level. The methods used to find literature on potential NERCs is presented in Palmen et al. (2013);
- Browsing the Internet to obtain information on the use of the substance in the Netherlands, irrespective of whether the substance is manufactured in the Netherlands or only used by downstream users. When possible, use of the substance in processes and occupations is described;
- Databases on occupational exposure limits: DGUV (IFA GESTIS), SER-database;
- REACH / CLP database for information on the classification of the substance, as this indicates the potential hazard of the substance.

Risk score and prioritization of potential NERCs:
There are many methods used to calculate risk scores. In industrial hygiene and safety, a modified version of the method of Fine and Kinney (1976) is often used. This is based on the severity of health complaints, the likelihood of their occurrence and rather extensive information on exposure. In this study, we used the 'impact analysis' method, since information on exposure is often scarce for potential NERCs. This method is based on the severity of the effect on health (impact) and the evidence of occurrence (likelihood). By multiplying these two variables, a risk score is derived (see Figure 1). Next, the risk score is classified under 4 groups (red, orange, yellow or green). A critical risk score is coloured red; a high or major risk score orange; a medium risk score yellow and a low score risk green. A more extensive version of the impact analysis method is being used by ANSES to classify reports in their system (ANSES, 2014). We used the simpler impact analyses because, in most instances, there is not enough information on the number of cases to use the more elaborate method.

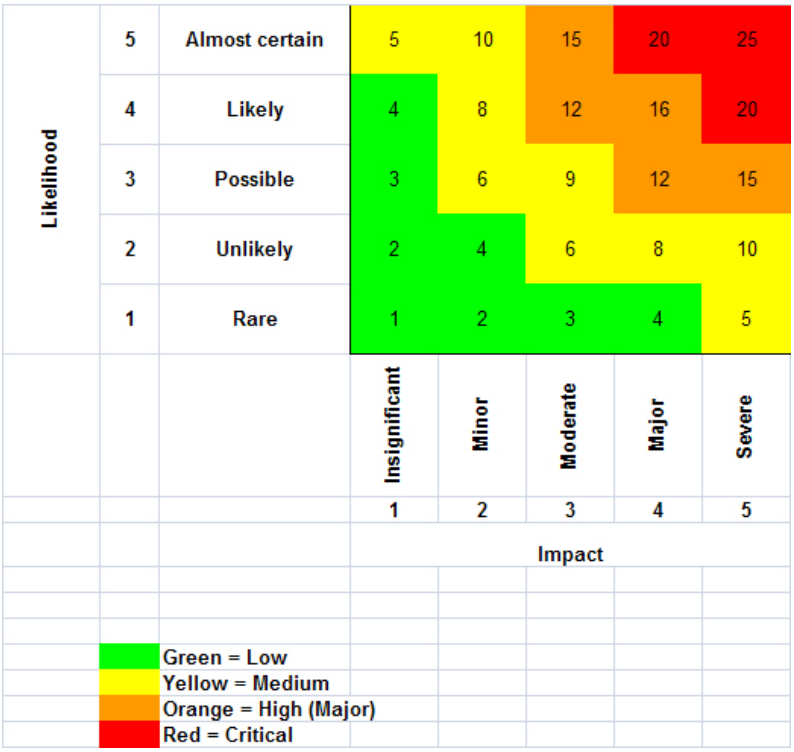

Figure 1: Impact analysis to calculate the risk score.
A method to calculate the risks of potential NERCs based on two variables: the impact and the likelihood of occurrence. Both variables are divided into 5 levels and multiplied, leading to a risk score that is further categorized under 4 levels (red, orange, yellow, green). A further operationalization of the 5 levels of both variables is given in Appendix A.

Besides the risk score of a potential NERC, the actual manufacture and/or use of the potential NERC in Dutch companies is also important to know for the Dutch government in order to be able to prioritize potential NERCs for further research or actions to be taken.
The risk prioritization score takes into account both the magnitude of the risk score and the actual manufacture and/or use of the substance in the Netherlands, resulting in a three-level final risk prioritization:

1. direct action required;
2. action required and
3. minimum action required (see Table 1).

Table 1: Prioritization of a potential NERC depends on both the impact analysis risk score and the manufacturing and/or use of the substance in the Netherlands. Three categories are presented: 1) direct action required, 2) action required and 3) minimum action required.

Impact analysis Risk score human health	Manufacturing/use in the Netherlands	Risk priority
20 – 25: Red	Yes	1: red
20 – 25: Red	Limited in the past for this use, but possibly elsewhere strongly reduced	2: orange
20 – 25: Red	No	3: green
12 – 16: Orange	Yes	2: orange
12 – 16: Orange	Not likely but possible	2: orange
12 – 16: Orange	No	3: green
5 – 11: Yellow	Yes	3: green
5 – 11: Yellow	No	3: green
1 – 4: Green	Yes	3: green
1 – 4: Green	No	3: green

2.2 Information in EU databases

Since a potential NERC may already have been studied in one of the REACH or CLP processes, this information was also gathered. If a substance has already been studied by an EU Member State or institution (e.g. SCOEL), less or no (direct) action is required by the Netherlands. Many potential NERCs are individual substances with a known CAS-number. This CAS-number makes it possible and easy to search the REACH database and learn what information on this chemical is already available, e.g. on classification or ongoing actions such as the inclusion on the SVHC list. The known CAS-numbers for these potential NERCs were therefore entered into the REACH database.

The database was specifically used to search for the following information:

- Information on registration. This was obtained via two routes:
  - The REACH database (ECHA) was searched for specific information on the manufacture and use of the substance by Dutch companies. This information was obtained for 14 substances;
  - In all other cases, ECHA's publically available REACH dossier was searched for information on registrants; both the overall number of registrants and the specific number of Dutch registrants (http://echa.europa.eu/web/guest/information-on-chemicals/registered-substances).
- Information on classification. This was obtained using the publically available information in the Classification and Labelling database (http://echa.europa.eu/information-on-chemicals/cl-inventory-database). When information was available, it was included as follows:
  - If the substance has a harmonized classification, this was directly included in Table 2 and highlighted. In addition, the classification notifications were reviewed to see if other (more hazardous) classifications have been submitted. If this was the

case, these classifications were added to the harmonized classification without highlighting;
    - If the substance did not have a harmonized classification, the different notifications were reviewed and a list of different notifications (hazard class and category codes) was included in Table 2;
    - The total number of aggregated notifications (indicating an identical notification) was included in Table 5. Each aggregated notification can be submitted by multiple notifiers. This means that the total number of submitted notifications can be much higher than the aggregated number.
- REACH Community Rolling Action Plan (CoRAP; http://echa.europa.eu/regulations/reach/evaluation/substance-evaluation/community-rolling-action-plan). If substances were included in the CoRAP, this was included in Table 5, as this specifies the substances that are to be evaluated in a substance evaluation (SEv) over a period of three years;
- REACH Substances of Very High Concern (SVHC). Substances included in the SVHC-list were included in Table 5. These substances will be added to the Candidate List for eventual inclusion in Annex XIV of REACH, i.e. the Authorization List (http://echa.europa.eu/web/guest/candidate-list-table);
- REACH Authorization and Restriction. If substances were subject to authorization (Annex XIV of REACH) or restriction (Annex XVII of REACH), this was also included in Table 5. Authorization ensures that risks from the use of such substances are either adequately controlled or outweighed by socio-economic benefits, having taken into account the available information on alternative substances or technologies. Restrictions limit or ban the manufacture, placing on the market or use of certain substances that pose an unacceptable risk to human health or the environment;
- Other information: besides the above-mentioned sources, information was obtained on the inclusion of the substance in other lists, included in Table 5 under 'other'. These lists include:
    - Biocidal Products Regulation - Potential Candidates for substitution (http://echa.europa.eu/regulations/biocidal-products-regulation/understanding-bpr);
    - Public Activities Coordination Tool (PACT; http://echa.europa.eu/addressing-chemicals-of-concern/substances-of-potential-concern/pact) lists the substances for which a Risk Management Option Analysis (RMOA) is either under development or has been completed since the implementation of the SVHC Roadmap commenced in February 2013 (http://echa.europa.eu/documents/10162/19126370/svhc_roadmap_implementation_plan_en.pdf);
    - Prior Informed Consent (PIC) list (http://echa.europa.eu/en/regulations/prior-informed-consent/understanding-pic). The PIC-regulation administers the import and export of certain hazardous chemicals and places obligations on companies who wish to export these chemicals to non-EU countries. Within the European Union, it implements the Rotterdam Convention on the prior informed

consent procedure for certain hazardous chemicals and pesticides in international trade. An import notification is part of this regulation;

- European Priority List and Risk Assessment (under the Existing Substances Regulation – ESR, 793/93/EC). This regulation (dates back before REACH) introduced a comprehensive framework for the evaluation and control of "existing substances" (substances on the market before 1982), regularly drawing up a list of priority substances that require immediate attention because of their potential effects on human health or the environment. Between 1994 and 2007 (the entry into force of REACH), four such priority lists were published, with a total of 141 substances (http://echa.europa.eu/in/information-on-chemicals/information-from-existing-substances-regulation).

3 Results

3.1 Risk score and prioritization of potential NERCs

The 42 potential NERCs presented in the study of Palmen et al. (2013) were supplemented with risks that have been newly identified since the publication of the report, resulting in a total of 49 potential NERCs. Table 2 presents the results of the impact analysis risk score and the final risk prioritization, including the following variables:

- Name of the substance or group of substances;
- CAS-number where appropriate;
- Classification where appropriate;
- Observed human health effect with explanation;
- Occupational setting;
- Impact analysis risk score based on severity and the likelihood of the effect;
- Current or previous manufacture and / or use in the Netherlands;
- Risk priority.

More information on the individual, potential NERCs concerning the above-mentioned variables is presented in Appendix B.

The impact analysis risk scores of the 49 potential NERCs classified are the critical risk score (red); high/major risk score (orange); medium risk score (yellow) and low risk score (green).

Since the risk priority depends on both the impact analysis risk score and the actual use/manufacture of the potential NERC in the Netherlands, the eventual risk priority may deviate from the risk score. The priority scores of the 49 potential NERCs classified are 'direct action is necessary' (red); 'action is necessary' (orange) and 'minimal action is needed' (green).

Table 2: Impact analysis risk scores and risk priorities of 49 identified substances (potential NERCs), as well as their CAS number, if available, CLP classification (harmonized classification in colour), observed health effect and occupation of the worker(s), and use of the substance in the Netherlands. Risk scores are calculated by multiplying the likelihood of occurrence by the impact of the health effect, resulting in four risk levels (red: critical risk; orange: high/major risk; yellow: medium risk; green: low risk). Risk priorities are calculated by combining the risk scores with the use of the potential NERC in the Netherlands, resulting in three priorities (red: direct action required; orange: action required and green: minimum action required.)

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
1	Formalde-hyde	50-00-0	Acute tox: 3 (inhaled, oral and skin) Skin. Corr.: 1B Skin. Sens.: 1 Carc. 2 Eye irrit. 2 Eye damage 1 Resp. sens. 1 STOT SE1 (dam. Org) STOT RE1 (dam. Org) STOT SE3 (resp. irr.) Carc 1A Muta 2 Met Corr 1	Irritation skin, eyes and respiratory tract, allergies. Nosebleeds following exposure to formaldehyde and other aldehydes during aluminium production.	Hairdressers - use of hair straightening products. Workers in aluminium production.	25	Yes	1

[2] Classification according to REGULATION (EC) No 1272/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 (http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R1272&from=EN)

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
2	Vinyl chloride	75-01-4	Flam Gas 1 Press Gas (comp gas) Carc 1A Muta 2 Aquatic Chronic 3	Angiosarcoma of the liver – historical exposure to vinylchloride in hairdressers	Hairdressers and barbers - use of hairspray	25	Yes	1
3	Diacetyl-containing flavourings	431-03-8	Flam. Liq. 2 Acute tox. 3: inhaled Acute tox. 4. swallowed, inhaled Skin Irritation 2 Skin Sensitivity 1 Eye Damage 1 Eye irritation 2 STOT RE 2 (damage to organs) STOT RE 3 (resp. irr.) Aquatic chronic 3	Bronchiolitis obliterans	Workers in flavouring production facility and workers that apply flavours (microwave popcorn production facility, cookie factory, coffee processing facility)	25	Yes	1
4	4,4-methylene-bismorpho-line	5625-90-1	Submitted CLH proposal Carc. 1B Muta. 2 Skin Corr. 1 Skin Sens. 1 STOT SE 3	Occupational asthma	Metal worker	25	Yes	1

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
5	Beryllium	7440-41-7	Acute Tox. 3 Skin Irrit. 2 Skin Sens. 1 Eye Irrit. 2 Acute Tox. 2 STOT SE 3 Carc. 1B STOT RE 1	Sensitization, Chronic Beryllium Disease (lung disease)	Workers with beryllium-containing materials (various industries)	25	Yes	1
6	Pesticides – methyl bromide and phosphine residual gases (fumigation of containers)	74-83-9 (methyl bromide)	Acute Tox. 3 Skin Irrit. 2 Eye Irrit. 2 Acute Tox. 3 STOT SE 3 Muta. 2 STOT RE 2 Aquatic Acute 1 Ozone 1 Acute Tox. 2	Respiratory disorders, neurotoxic symptoms, mild acute health effects	Dock workers - opening of containers	25	Yes	1
7	Hexa-methylene diisocyanate	822-06-0	Skin Irrit. 2 Skin Sens. 1 Eye Irrit. 2 Acute Tox. 3 Resp. Sens. 1 STOT SE 3	Acute life-threatening extrinsic allergic alveolitis (EAA)	Paint quality controller	20	Yes	1

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
8	Methylene diphenyl diisocyanate (MDI)	101-68-8	Skin Irrit. 2 Skin Sens. 1 Eye Irrit. 2 Acute Tox. 4 Resp. Sens. 1 STOT SE 3 Carc. 2 STOT RE 2	Occupational asthma Occupational asthma, death	Orthopaedic plaster casts workers Workers with spray-on truck bed liner applications	20	Yes	1
9	Methyl methacrylate	80-62-6	Flam. Liq. 2 Skin. Irrit. 2 Skin Sens. 1 STOT SE 3	Hypersensitivity pneumonitis (EAA)	Student dental technicians polishing and grinding prostheses	20	Yes	1
10	Ethyl methacrylate	97-63-2	Flam. Liq. 2 Skin. Irrit. 2 Skin Sens. 1 Eye Irrit. 2 STOT SE 3	Hypersensitivity pneumonitis (EAA)	Nail technician	20	Yes	1

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
11	Trichloro-ethylene (TCE)	79-01-6	Skin Irrit. 2 Eye Irrit. 2 STOT SE 3 Muta. 2 Carc. 1B Aquatic Chronic 3	Parkinson Disease Central nervous system effects, dementia	Industrial machinery repairer, industrial worker Production of microporous polyethylene battery separator material for lead-acid battery applications - extruder, winder, rover, utility, pelletizer, cut-to-fit, and maintenance Used in textile industry - authorization requested.	20	Yes	1

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
12	Lead	7439-92-1	Acute Tox. 4 Acute Tox. 4 Repr. 1A STOT RE 2 Aquatic Acute 1 Aquatic Chronic 1	Nausea, diarrhoea, vomiting, poor appetite, weight loss, anaemia, excess lethargy or hyperactivity, headaches, abdominal pain, and kidney problems.	Employees at firing ranges	20	Yes	1
13	Cobalt	7440-48-4	Skin Sens. 1 Resp. Sens. 1 Aquatic Chronic 4 Acute Tox. 1 Carc. 1B Repr. 1B	Hard metal lung disease and occupational asthma	Cemented tungsten carbide workers	20	Yes	1
14	Triglycidyl isocyanurate (TGIC)	2451-62-9	Acute Tox. 3 Skin Sens. 1 Eye Dam. 1 Acute Tox. 3 Muta. 1B STOT RE 2 Aquatic Chronic 3	Occupational asthma, Extrinsic allergic alveolitis (EAA)	Powder paint sprayers – bystanders, Painter using powder paint	20	Pro-bably	1
15	Tremolite-free chrysotile (= white asbestos)	77536-68-6	Carc. 1A STOT RE 1	Peritoneal mesothelioma	Mill worker from a tremolite free Canadian mine	25	Yes; removal	1

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
16	Crystalline silica (sand)	14808-60-7	Carc 1A or 1B Muta 2 STOT RE 1 or RE2 Acute Tox 4 Eye irrit 2 Skin irrit 2	Silicosis	Textile industry, sandblasting of textiles.	25	No sand-blasting, but exposure in con-structio n	1
17	Perchloro-ethylene (=tetrachloroethylene)	127-18-4	carc: 2 Aquatic chronic 2 Acute tox. 4 (inhaled) Acute tox. 5 (oral, skin) Asp Tox. 2 Skin irrit. 2 Eye irrit. 2, 2B Skin Sens. 1, 1B STOT SE 1 (organs) STOT SE2 (organs) STOT SE 3: may cause drowsiness or dizziness Carc 1B Aquatic Acute 2	Oesophageal squamous cell carcinoma	Workers in dry cleaning facilities	25	Yes - but reduced	2

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
18	Indium tin oxide	50926-11-9	Skin irrit: 2 Eye irrit: 2 STOT SE 3: may cause respiratory irritation	Pulmonary fibrosis, pulmonary alveolary proteinosis	Manufacture of flat-panel displays (LCD, plasma screen). Use at universities and laboratories, possibly also waste treatment (recycling).	25	Limited	2
19	Synthetic polymeric fibres	n.a.	n.a.	Interstitial lung disease (Flock worker's lung)	Textile workers from a nylon flocking plant	20	Yes	2

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
20	Impregnation sprays for leather impregnation spray containing fluorocarbons. Fluorocarbon Perfluoroalkyl resins in solvent Bromochlorodifluoromethane	n.a. 353-59-3	Ozone 1 Liq. Gas	Toxic alveolitis/ pneumonitis Interstitial pneumonia Reactive Airways Dysfunction Syndrome (RADS)	Consumers spraying leather Workers of a horse rug cleaning firm spraying the fluorocarbon Co exposure of worker waterproofing fabrics Workers using a fire extinguisher	20	Not likely, but possible	2

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
21	Aerosolized ribavirin	36791-04-5	Acute Tox. 4 Skin. Sens. 1 Eye Irrit. 2 STOT SE 3 Muta. 2 Repr. 1B Repr. 2 Carc. 2 STOT SE 3 STOT RE 2 Aquatic Chronic 3	Asthma	Health care workers	16	Yes	2
22	Talc	14807-96-6	Eye Irrit. 2 Acute Tox. 4 STOT RE 3 Carc. 1A STOT RE 1 Aquatic Chronic 4	Talcose	Workers in a chocolate factory, in a pancake roll factory and in production of floors.	16	Yes	2
23	Tricresyl phosphate	1330-78-5	Skin Sens. 1 Repr. 2 Aquatic Acute 1 STOT RE 2 Aquatic chronic 1 Aquatic chronic 2 Acute Tox 4 (inhaled, oral, skin) Skin Sens. 1B Eye Irrit 2	'Aerotoxic syndrome' (neurological symptoms)	Pilots and cabin crew	15	Yes	2

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
24	Fibreglass with styrene resins	N.a.	n.a.	Bronchiolitis obliterans	Yacht builders/ Work with glass reinforced plastics	15	Yes	2
25	Corian dust (solid-surface material composed of acrylic polymer and aluminium trihydrate)	n.a.	n.a.	Pulmonary fibrosis	Grinding, machining and drilling of Corian (single case – 16 years of exposure)	15	Yes	2
26	Tropenol ester Synonym: BA 679 Tropenolester	136310-66-2	Acute Tox. 3 Acute Tox. 3 Acute Tox. 3	Anticholinergic intoxication	(intermediate during production of medicines).	15	Probably	2
27	Chloracetal C5	105737-73-3	unknown	Renal cell cancer	Manufacturing vitamins and amino-acids	15	Not likely, but possible	2
28	humidifier disinfectants	n.a.	n.a.	Severe lung injury and respiratory distress (several lung transplants and deaths)	Exposure to pesticides used in home humidifiers	15	Not likely, but possible	2

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
29	1-bromopropane (1-BP)	106-94-5	Flam. Liq. 2 Skin Irrit. 2 Eye Irrit. 2 STOT SE 3 STOT SE 3 Repr. 1B STOT RE 2 Carc. 2	light-headedness	Dry cleaner - new use (conversion from perchloroethylene to 1-BP).	15	Unknown	2
30	Styrene	100-42-5	Flam. Liq. 3 Skin. Irrit. 2 Eye Irrit. 2 Acute Tox. 4 Carc.2 Muta. 2 Repr. 1B Repr. 2 STOT SE 3	Eosinophilic bronchitis	Panel beater	12	Yes	2
31	PVC (and Nickel)	n.a.	n.a. combination of substances	Occupational asthma	Wallpaper factory worker	12	Yes	2

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
32	Cleaning spray (including chlorine, bleach, disinfectants) - bleach, ammonia, decalcifiers, acids, solvents and stain removers	n.a.	n.a.	Occupational asthma	Professional cleaners	12	Yes	2
33	Potassium aluminium tetrafluoride fluxes	14484-69-6	Skin. Irrit. 2 Eye Irrit. 2 Acute Tox. 4 STOT SE 3 Lact. STOT RE 1 Aquatic Chronic 3	Bronchial hyperreactivity and occupational asthma, non-specific allergy reaction	Workers with potassium aluminium tetrafluoride, including the aluminium industry	12	Yes	2
34	Rhodium salts	14972-70-4	Acute Tox.4 Eye Irrit. 2	Occupational asthma, rhinitis	Operator of an electroplating plant	12	Probably	2
35	5-Aminosalicylic acid	89-57-6	Skin irrit. 2 Eye irrit. 2 STOS SE 3 (resp. irr.)	Occupational asthma	Drug manufacturing	12	Unlikely	2

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
36	Ready-to-use mixtures of powdered plant extracts: henna, guar gum, indigo, diphenylenediamine, and different plant materials.	n.a.	n.a.	Occupational asthma (re-emerging risk)	Hairdressers	12	Yes	3
37	Metal fumes or dust	n.a.	n.a.	Amyotrophic Lateral Sclerosis	Metal workers	10	Yes	3
38	Epoxy resins, fragrances and thiazoles	n.a.	n.a.	Allergic contact dermatitis	Biocide and cosmetic exposures	9	Yes	3
39	trifluoroacetic acid	76-05-1	Skin. Corr. 1A Acute Tox. 4 Aquatic Chronic 3 Acute Tox. 1	Contact dermatitis after exposure to vapours	Laboratory personnel	9	Yes	3

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
40	Chlorhexidine diacetate Chlorhexidine di gluconate	56-95-1 18472-51-0	Eye Dam. 1 Eye Irrit. 2 Toxic if swallowed Aquatic Acute 1 Aquatic Chronic 1 STOT SE 3 Skin Irrit. 2 Eye Dam. 1 STOT SE 3 Aquatic Acute 1 Aquatic Chronic 1	Allergic contact dermatitis	Health care workers	9	Yes	3
41	Trichloramine	10025-85-1	n.a.	Eye and respiratory irritation	Poultry processing employees and government food inspectors. Occurs as reaction product in swimming pools.	8	Yes	3

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
42	Multiple pesticides, including those that contain well-known endocrine disruptors such as carbendazim, 2,4-dichlorophenoxyacetic acid, glyphosate, ioxynil, linuron, trifluralin and vinclozolin	n.a.		Birth defects (congenital malformations).	Farmers – spraying of pesticides without protection.	8	Unknown	3
43	Disulfiram	97-77-8	Acute tox. 4 Skin Sens. 1 STOT RE 2 Aquatic acute 1 Aquatic chronic 1	Disulfiram alcohol reaction	Artist - painting involving solvents such as ethanol, methanol, toluene, acetone etc. Used for treatment of alcoholism.	8	No	3

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
44	Ultrafine particles	n.a.	n.a.	Health effects including headaches, irritation	Office workers close to laser printer	6	Yes	3
45	Glyphosate	1071-83-6	Eye Dam. 1 Aquatic Chronic 1	Rhabdomyolysis (acute muscular wasting syndrome)	Unknown	6	Yes	3
46	Dipentene and pine oil	138-86-3	Flam. Liq. 3 Skin irrit. 2 Skin sens. 1 Aquatic acute 1 Aquatic chronic 1 Skin corr. 1A Eye irrit. 2 Asp Tox. 1	Contact dermatitis	Automobile mechanics - use of home-made hand washing paste	6	Unknown	3
47	Trimethyl benzene	95-63-6	Flam. Liq. 3 Skin Irrit. 2 Eye Irrit. 2 Acute Tox. 4 STOT SE 3 Aquatic Chronic 2	Respiratory irritation, chemical burns, and headache chronic bronchitis and adverse effects on the blood and central nervous systems	Workers at a drum refurbishing plant	6	Unknown	3

No.	Substance name	CAS-number	Classification[2]	Observed health effect	Occupational setting	Risk score	Use in NL	Risk Priority
48	Epoxy resin (group of substances)	25068-38-6 (bisphenol-A)	n.a. (exposure to a group of substances)	Precancerous skin lesions	Epoxy resin applicator	5	Yes	3
49	Fluorohydrocarbons	308067-55-2	n.a.	Systemic scleroderma	Refrigeration technician	5	Not likely	3

In Table 3, an overview of the impact analysis risk scores of the 49 potential NERCs classified is given. There are 20 substances with a critical risk score, 16 substances with a high/major risk score, 13 substances with a medium risk score and zero substances with a low risk score.

Table 3: overview of NERCs classified by risk score.

Critical risk score	**High/major risk score**	**Medium risk score**	**Low risk score**
formaldehyde	aerosolized ribavirin	metal fumes or dust	
vinyl chloride	talc	epoxy resins/ fragrances and thiazoles	
diacetyl-containing flavourings	tricresyl phosphate	trifluoroacetic acid	
4,4-methylene-bismorpholine	fibreglass with styrene resins	chlorhexidine diacetate/digluconate	
Beryllium	corian dust	trichloramine	
Pesticides, methyl bromide and phosphine residual gases	tropenol ester	multiple pesticides (containing carbendazim, 2,4-dichlorophenoxy-acetic acid, glyphosate, ioxynil, linuron, trifluralin and vinclozolin)	
hexamethylene diisocyanate	chloracetal C5	disulfiram	
methylene diphenyl diisocyanate (MDI)	humidifier disinfectants	ultrafine particles	
methyl methacrylate	1-bromopropane	glyphosate	
ethyl methacrylate	styrene	dipentene and pine oil	
trichloroethylene (TCE)	PVC	trimethyl benzene	
lead	cleaning spray	epoxy resin	
cobalt	potassium alumi-nium tetra-fluoride fluxes	fluorohydrocarbons	
triglycidyl isocyanurate (TGIC)	rhodium salts		
perchloroethylene (tetrachloroethylene)	5-aminosalicylic acid		
indium tin oxide	ready-to-use mixtures of powdered plant extracts		
synthetic polymeric fibres			
impregnation sprays containing fluoro carbons			
crystalline silica			

Critical risk score	High/major risk score	Medium risk score	Low risk score
tremolite-free chrysotile (= white asbestos)			

Table 4 presents an overview of the risk priority of the 49 NERCs. It depends on both the impact analysis risk score and the actual use/manufacture of the potential NERC in the Netherlands. Priority scores are: 'direct action is necessary' (n=16); 'action is necessary' (n=19); 'minimal action is needed' (n=14).

Table 4: overview of NERCs classified by risk priority.

Direct action necessary	Action is necessary	Minimal action is needed
formaldehyde	perchloroethylene (tetrachloroethylene)	fluorohydrocarbons
vinyl chloride	indium tin oxide	ready-to-use mixtures of powdered plant extracts
diacetyl-containing flavourings	synthetic polymeric fibres	metal fumes or dust
4,4-methylene-bismorpholine	impregnation sprays containing fluoro carbons	epoxy resins/fragrances and thiazoles
beryllium	aerosolized ribavirin	trifluoroacetic acid
pesticides – methyl bromide and phosphine residual gases	talc	chlorhexidine diacetate/digluconate
hexamethylene diisocyanate	tricresyl phosphate	Trichloramine
methylene diphenyl diisocyanate (MDI)	fibreglass with styrene resins	multiple pesticides (containing carbendazim, 2,4-dichlorophenoxy-acetic acid, glyphosate, ioxynil, linuron, trifluralin and vinclozolin)
methyl methacrylate	corian dust	Disulfiram
ethyl methacrylate	tropenol ester	ultrafine particles
trichloroethylene (TCE)	chloracetal C5	Glyphosate
lead	humidifier disinfectants	dipentene and pine oil
cobalt	1-bromopropane	trimethyl benzene
triglycidyl isocyanurate (TGIC)	styrene	epoxy resin
tremolite-free chrysotile (= white asbestos)	PVC	
crystalline silica	cleaning spray	
	potassium aluminium tetrafluoride fluxes	
	rhodium salts	
	5-aminosalicylic acid	

3.2 Information in EU databases

Table 5 presents the information found on the potential NERCs in EU databases (December 2014), displaying the following variables:

- Name of the substance and CAS number;
- Information on the number of registrations in the REACH database, including the number of Dutch registrations;
- Number of CLP notifications (aggregated);
- Whether it concerns a harmonized CLP classification;
- Whether the potential NERC is on the Community Rolling Action Plan (CoRAP) for a substance evaluation (SEv);
- Whether the potential NERC is a substance of very high concern (SVHC) and on the candidate list for authorization;
- Whether there is a restriction (manufacturing/use) on the substance;
- Other information (e.g. biocidal product, subject to Risk Management Option Analysis (RMOA), PIC list, European Priority list of substances).

More information on the individual potential NERCs regarding the above-mentioned variables is presented in Appendix B.

No information in EU databases was found for mixtures and fibres without a CAS number (n=12). Fourteen substances are manufactured or used in the Netherlands according to the REACH database. This number does not contradict Table 2 since substances that are not in the REACH database, e.g. several mixtures or fibres, are manufactured or used in the Netherlands.

Nineteen substances have a harmonized classification according to CLP (see Table 5).

For eight substances, a substance evaluation (SEv) is ongoing:

- Formaldehyde
- Beryllium
- Methylene diphenyl diisocyanate (MDI)
- Methyl methacrylate
- Ethyl methacrylate
- Triglycidyl isocyanurate (TGIC)
- Perchloroethylene (=tetrachloorethylene)
- Tricresyl phosphate.

Five substances have been identified as SVHC:

- Beryllium
- Trichloroethylene (TCE)
- Lead
- Triglycidyl isocyanurate TGIC
- 1-bromopropane (1-BP)

For six substances, manufacture or use is restricted:

- Vinylchloride
- Hexamethylene diisocyanate
- Methylene diphenyl diisocyanate (MDI)
- Trichloroethylene (TCE)
- Lead
- Tremolite-free chrysotile (= white asbestos)

Table 5: Overview of potential NERCs in relation to the REACH regulation process

No.	Substance name	CAS-number	No of REACH registrations [manufacture & use NL]	Number of CLP notifications (aggregated)	CLP Harmo-nized clas-sification	CoRAP (SEv)	SVHC	Restric-tion	Other
1	Formaldehyde	50-00-0	130 [4]	65	Yes	Yes	No	No	-
2	Vinyl chloride	75-01-4	80 [4]	17	Yes	No	No	Yes	-
3	Diacetyl-containing flavourings	431-03-8	-	23	No	No	No	No	-
4	4,4-methylene-bismorpholine	5625-90-1	-	13	Proposed	No	No	No	Potential candidates for substi-tution (BPR)
5	Beryllium	7440-41-7	7 [0]	15	Yes	Yes	Yes	No	PACT-RMOA
6	Pesticides – methyl bromide and phosphine residual gases (fumigation of containers)	74-83-9 (methyl bromide)	2 [1] intermediate use	12	Yes	No	No	No	PIC-list
7	Hexamethylene diisocyanate	822-06-0	[1]	36	Yes	No	No	Yes	PACT-RMOA
8	Methylene diphenyl diisocyanate (MDI)	101-68-8	[10] 3 companies	42	Yes	Yes	No	Yes	-
9	Methyl methacrylate	80-62-6	53 [1]	49	Yes	Yes	No	No	-
10	Ethyl methacrylate	97-63-2	3 [1]	16	Yes	Yes	No	No	-

No.	Substance name	CAS-number	No of REACH registrations [manufacture & use NL]	Number of CLP notifications (aggregated)	CLP Harmo-nized clas-sification	CoRAP (SEv)	SVHC	Restric-tion	Other
11	Trichloro-ethylene (TCE)	79-01-6	6 [1]	21	Yes	No	Yes	Yes	
12	Lead	7439-92-1	95 [3]	51	Proposed	No	Yes	Yes	PACT-RMOA
13	Cobalt	7440-48-4	47 [2]	45	Yes	No	No	No	-
14	Triglycidyl isocyanurate (TGIC)	2451-62-9	2 [0]	15	Yes	Yes	Yes	No	-
15	Tremolite-free chrysotile (= white asbestos)	77536-68-6	-	-	Yes	No	No	Yes	PIC-list
16	Crystalline silica (sand)	14808-60-7	-	92	No	No	No	No	-
17	Perchloro-ethylene (=tetrachloor-ethylene)	127-18-4	4 [0]	19	Yes	Yes	No	No	Existing Substances Regulation
18	Indium tin oxide	50926-11-9	-	3	No	No	No	No	-
19	Synthetic polymeric fibres	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

No.	Substance name	CAS-number	No of REACH registrations [manufacture & use NL]	Number of CLP notifications (aggregated)	CLP Harmo-nized clas-sification	CoRAP (SEv)	SVHC	Restric-tion	Other
20	Impregnation sprays for leather impreg-nation, spray containing fluorocarbons. Fluorocarbon Perfluoroalkyl resins in solvent Bromochlorodi-fluoromethane	n.a. n.a. 353-59-3	n.a. n.a. n.a. -	n.a. n.a. n.a. 1	n.a. n.a. n.a. No	n.a. n.a. n.a. No	n.a. n.a. n.a. No	n.a. n.a. n.a. No	n.a. n.a. n.a. Import notification (PIC-list)
21	Aerosolized ribavirin	36791-04-5	-	9	No	No	No	No	-
22	Talc	14807-96-6	-	15	No	No	No	No	-
23	Tricresyl phosphate	1330-78-5	3	35	No	Yes	No	No	-
24	Fibreglass with styrene resins	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

No.	Substance name	CAS-number	No of REACH registrations [manufacture & use NL]	Number of CLP notifications (aggregated)	CLP Harmonized classification	CoRAP (SEv)	SVHC	Restriction	Other
25	Corian dust (solid-surface material composed of acrylic polymer and aluminium trihydrate)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
26	Tropenol ester Synonym: BA 679 Tropenolester	136310-66-2	-	1	No	No	No	No	-
27	Chloracetal C5	105737-73-3	-	-	No	No	No	No	-
28	Humidifier disinfectants	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
29	1-bromopropane (1-BP)	106-94-5	7 [2]	20	Yes		Yes Recommended for authorization	No	-
30	Styrene	100-42-5	170 [19]	47	Yes	No	No	No	PACT-RMOA Existing Substances Regulation
31	PVC (and Nickel)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

No.	Substance name	CAS-number	No of REACH registrations [manufacture & use NL]	Number of CLP notifications (aggregated)	CLP Harmo-nized clas-sification	CoRAP (SEv)	SVHC	Restric-tion	Other
32	Cleaning spray (including chlo-rine, bleach, disinfectants) - bleach, ammonia, decalcifiers, acids, solvents and stain removers	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
33	Potassium aluminium tetrafluoride fluxes	14484-69-6	4 [1]	5	No	No	No	No	-
34	Rhodium salts	14972-70-4	-	3	No	No	No	No	-
35	5-Aminosali-cylic acid	89-57-6	1 [1 inactive]	5	No	No	No	No	-
36	Ready-to-use mixtures of powdered plants extracts: henna, guar gum, indigo, diphenylenediam ine, and different plant materials.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
37	Metal fumes or dust	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

No.	Substance name	CAS-number	No of REACH registrations [manufacture & use NL]	Number of CLP notifications (aggregated)	CLP Harmonized classification	CoRAP (SEv)	SVHC	Restriction	Other
38	Epoxy resins, fragrances and thiazoles	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
39	Trifluoroacetic acid	76-05-1	2 [0]	12	Yes	No	No	No	-
40	Chlorhexidine diacetate Chlorhexidinedigluconate	56-95-1 18472-51-0	- 2 [0]	9 16	No No	No No	No No	No No	- -
41	Trichloramine	10025-85-1	-	-	No	No	No	No	-
42	Multiple pesticides, including those that contain well-known endocrine disruptors such as carbendazim, 2,4-dichlorophenoxyacetic acid, glyphosate, ioxynil, linuron, trifluralin and vinclozolin	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
43	Disulfiram	97-77-8	1 [0]	16	Yes	No	No	No	-
44	Ultrafine particles	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
45	Glyphosate	1071-83-6	-	6	No	No	No	No	-

No.	Substance name	CAS-number	No of REACH registrations [manufacture & use NL]	Number of CLP notifications (aggregated)	CLP Harmonized classification	CoRAP (SEv)	SVHC	Restriction	Other
46	Dipentene and pine oil	138-86-3	-	43	Yes	No	No	No	-
47	Trimethyl benzene	95-63-6	2 [0]	52	Yes	No	No	No	-
48	Epoxy resin (group of substances)	25068-38-6 (bisphenol-A)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
49	Fluorohydro-carbons	308067-55-2	-	-	No	No	No	No	-

4 Discussion

4.1 Identification and prioritization of NERCs

The impairment of workers' health through exposure to hazardous substances is a known problem leading to occupational disease (1.2% in 2011 in the Netherlands) or death (1,850 deaths per year in the Netherlands) (NCOD, 2012; Baars et al., 2005). The exposure of workers to NERCs occurs regularly, which was shown by an overview of potential NERCs by Palmen et al. (2013). NERCs are defined by three variables: health complaints, exposure and work, and all three variables may still be unidentified.

The MODERNET[3] network is an international network of professionals who evaluate and discuss NERCs for workers and share knowledge with each other with the aim of rapidly exchanging information on possible new work-related diseases between European countries and introducing measures to reduce the risk. At the EU level, the identification of NERCs has a high priority (EU-OSHA, 2013). Also at the national level, the Ministry of Social Affairs and Employment (SZW) is interested in identifying potential NERCs. In July 2013, the Netherlands Centre for Occupational Disease launched SIGNAAL, together with KU Leuven and IDEWE (Belgium), which is an e-tool for occupational physicians to report health problems that might be due to workers' exposure to substances and which could turn out to be new and/or emerging risks. The tool already collected several potential NERCs; an overview is presented at https://www.signaal.info/content/overzicht-meldingen.

Since resources are limited, it is necessary to prioritize the potential NERCs for further action. This prioritization is based both on the potential NERCs risk score and its manufacture and/or use in the Netherlands. Substances with a high-risk score are given a lower priority when they are not manufactured and/or used in the Netherlands. Substances that are manufactured and/or used in the Netherlands have a higher priority compared to substances that are not. The number of exposed workers was not used in the prioritization since this information is not freely and readily available.

The substances with the highest priority are marked in red in Table 2, meaning that direct action is required. These are followed by substances for which action is required (marked orange), and minimum action is required (marked green). The actions that may be taken differ for every potential NERC and depend on the actions already taken at a national level or in EU context (see Table 5). In many cases, the causal relationship between the exposure and the health effects of potential NERCs is not clear and has to be studied. For that reason, RIVM and NCvB[4] established the Dutch Expert Group on NERCs in 2013. It consists of experts in the occupational sciences (i.e. occupational physicians, pulmonologists, dermatologists, toxicologists, industrial hygienists,

[3] MODERNET: Monitoring trends in Occupational Diseases and tracing new and Emerging Risks in a NETwork
[4] NCvB: Netherlands Center for Occupational Diseases

epidemiologists, etc…). The goal of this expert group is to strengthen the evidence of a first NERC signal by studying the potential NERC within the different disciplines and to canalize the communication on the NERC. Initializing new research may be one of the actions needed to study the causality of a potential NERC. The close cooperation of the Dutch Expert Group on NERCs with the international MODERNET network is necessary to detect and validate potential NERCs. Cases identified by the clinical watch system SIGNAAL or by a literature search may be strengthened by searching for similar cases in databases managed by MODERNET members (see also figure 2).

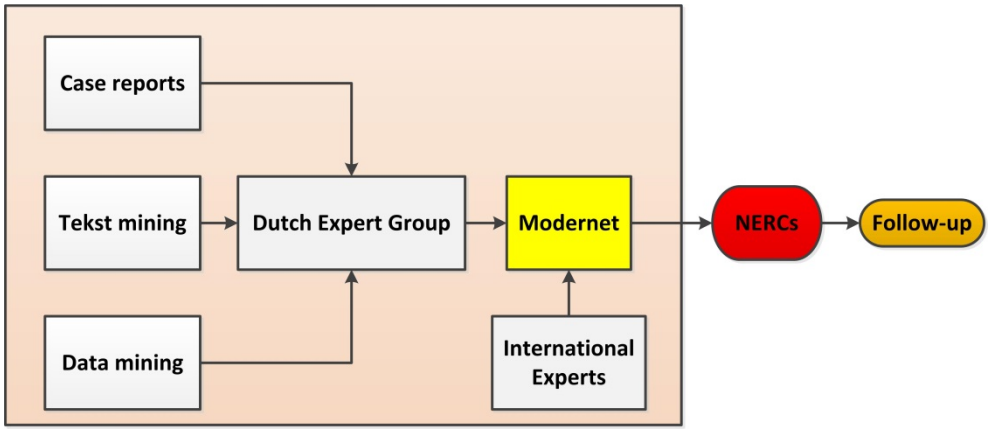

Figure 2: scheme methodology for workers

4.2 Possible actions that can be taken to control the risk

Several actions are possible if there is sufficient evidence for a potential NERC to become a verified NERC. If a substance is already regulated, the new risk will be reported to the relevant inspection department(s) of the Ministries of I&M, SZW and/or VWS so that measures can be taken. An example is when there is no compliance with a public OEL. Enforcement of the OEL should be enough to prevent further damage to human health. However, it is possible that health effects are reported below the level of the public OEL. In that case, further action must be taken, such as a request for re-evaluation of the public OEL.

Professional societies focused on occupational health and safety are an important first contact point for communicating a NERC, e.g. via an alert. Professionals such as industrial hygienists, safety engineers, occupational physicians, etc., should be informed as soon as possible about a NERC in order to check whether the NERC is used in the companies they advise. The ultimate aim is to take measures to reduce human exposure to the NERC at the earliest possible stage and thus prevent further health damage and/or start a preventive medical examination among workers in order to check for the first signs of health problems that may be caused by the NERC.

If a NERC is already on any of ECHA's lists of substances and is being evaluated by ECHA or one of the member states in one of the REACH processes, they will be informed about the information on the NERC. If a substance is not on any of ECHA's lists, a risk management options

analysis (RMOA) may be performed. This RMO analysis will reveal possible actions, such as:

- The need for deriving an Occupational Exposure Limit (OEL) by the Scientific Committee on Occupational Exposure Limits (SCOEL);
- The need to identify the substance as a substance of very high concern (SVHC) and for authorization under REACH;
- The need to generate additional information, which may be provided via the substance evaluation instrument (SEv) within REACH. This additional information on the hazard or the exposure of a substance may lead to:
- A proposal for a (change in) harmonized classification and labelling of a substance, which may subsequently have an effect on the REACH requirements and/or the requirements coming from worker safety legislation;
    - a proposal to restrict the use of the substance;
    - a proposal to identify the substance as an SVHC and for authorization; or
    - take away of the concern over the substance.
- Applying other legislation to prevent new cases (for example, legislation on medicine, cosmetics, biocides etc…)

NERCs will always be communicated to the Ministries of I&M, SZW and VWS. This is essential for taking responsibility for the provision for safe and healthy environmental, consumer and working conditions. Information on new risks at the earliest stage is essential to be able to take action as soon as possible in order to prevent further damage to human health.

Another possible action is to inform industry about the NERC. Industry is obliged to use the new information in their chemical safety report (CSR), which may lead to a re-evaluation of the risk management measures that are needed to work safely with the substance in question. The new information will then be communicated to downstream users by way of the safety data sheet (SDS) and the ECHA website.

Non-governmental organizations (NGOs) and court rulings are independent from authorities and may ask attention be given to a NERC once they are informed. This may lead to a higher priority to take action. For example, as a consequence of the court ruling that ordered KLM to measure TCP concentrations in airplanes, this NERC was chosen for evaluation in the Dutch Expert Group on NERCs.

Which of the actions mentioned above will be chosen to manage the risk for workers of a particular substance or mixture has to be considered and decided by mutual agreement with the concerned Ministries.

It may be concluded that the method described in this report is intended to gather and prioritize possible NERCs as soon as possible. Prioritization of possible NERCs for follow-up is necessary because of available resources. This report describes a method to prioritize possible NERCs. RIVM intends to continue searching and prioritizing possible NERCs. NERCs for which (direct) action is needed will be followed-up on a regular basis according to the possible actions described above. It is of

utmost importance to keep this process going since it is expected that possible NERCs will be found on a regular basis.

5 Literature

Abou-Donia, M. B., Abou-Donia, M. M., ElMasry, E. M., Monro, J. A. & Mulder, M. F. (2013) Autoantibodies to nervous system-specific proteins are elevated in sera of flight crew members: biomarkers for nervous system injury. Journal of Toxicology and Environmental Health. Part A 76: 363-80.

Akgun, M., Araz, O., Akkurt, I., Eroglu, A., Alper, F., Saglam, L., Mirici, A., Gorguner, M. & Nemery, B. (2008) An epidemic of silicosis among former denim sandblasters. The European Respiratory Journal: official journal of the European Society for Clinical Respiratory Physiology 32: 1295-303.

Akgun, M., Gorguner, M., Meral, M., Turkyilmaz, A., Erdogan, F., Saglam, L. & Mirici, A. (2005) Silicosis caused by sandblasting of jeans in Turkey: a report of two concomitant cases. Journal of Occupational Health 47: 346-9.

Akpinar-Elci, M., Travis, W. D., Lynch, D. A. & Kreiss, K. (2004) Bronchiolitis obliterans syndrome in popcorn production plant workers. The European Respiratory Journal: official journal of the European Society for Clinical Respiratory Physiology 24: 298-302.

AFSSAPS (2010) Opinion of the French Agency for the Safety of Health Products on the health risks of exposure to formaldehyde in cosmetic hair smoothing products [Avis de l'Agence française de sécurité sanitaire des produits de santé relatif aux risques sanitaires d'exposition au formaldéhyde contenu dans certains produits cosmétiques de lissage capillaire (in French)]. Saisine 2010BCT0065. Saint-Denis, French Agency for the Safety of Health Products.

Anees, W., Moore, V. C., Croft, J. S., Robertson, A. S. & Burge, P. S. (2011) Occupational asthma caused by heated triglycidyl isocyanurate. Occupational Medicine (Oxford, England) 61: 65-7.

ANSES (2014) Rapport du Réseau National de Vigilance et de Prévention des Pathologies Professionnelles rnv3p, Méthodes de détection et d'expertise des suspicions de nouvelles pathologies professionnelles (« pathologies émergentes »), rapport scientifique, ANSES, France.

Arochena, L., Fernández-Nieto, M., Aguado, E., García del Potro, M. & Sastre, J. (2014) Eosinophilic Bronchitis Caused by Styrene. Journal of Investigational Allergology and Clinical Immunology 24: 68-9.

Baars, A. J., Pelgrom, S. M. G. J., Hoeymans, F. H. G. M. & van Raaij, M. T. M. (2005) Health effects and burden of disease due to exposure to chemicals at the workplace – an exploratory study [Dutch: Gezondheidseffecten en ziektelast door blootstelling aan stoffen op de werkplek – een verkennend onderzoek]. RIVM report 320100001/2005. National Institute for Public Health and the Environment.

Babiker, M., Dillon, M. F., Bass, G. & Walsh, T. N. (2012) Oesophageal carcinoma in a married couple following long-term exposure to dry cleaning agents. Occupational and Environmental Medicine 69: 525.

Bieler, G., Thorn, D., Huynh, C. K., Tomicic, C., Steiner, U. C., Yawalkar, N. & Danuser, B. (2011) Acute life-threatening extrinsic allergic alveolitis in a paint controller. Occupational Medicine (Oxford, England) 61: 440-2.

BfR (2007) Container fumigation using methyl bromide. Cases of Poisoning Reported by Physicians. Berlin, Federal Institute for Risk Assessment.

BfR (2010) Assessment of formaldehyde-containing hair straighteners. BfR Opinion, Nr. 045/2010. Berlin, Federal Institute for Risk Assessment.

Bonneterre, V., Faisandier, L., Bicout, D., Bernardet, C., Piollat, J., Ameille, J., de Claviere, C., Aptel, M., Lasfargues, G. & de Gaudemaris, R. (2010) Programmed health surveillance and detection of emerging diseases in occupational health: contribution of the French National Occupational Disease Surveillance and Prevention Network (RNV3P). Occupational and Environmental Medicine 67: 178-86.

Bonte, F., Rudolphus, A., Tan, K. Y. & Aerts, J. G. J. V. (2003) Severe respiratory symptoms following the use of waterproofing sprays. Ernstige respiratoire verschijnselen na het gebruik van impregneersprays 147: 1185- 1188.

Bradberry, S. M., Watt, B. E., Proudfoot, A. T. & Vale, J. A. (2000) Mechanisms of toxicity, clinical features, and management of acute chlorophenoxy herbicide poisoning: a review. Journal of Toxicology. Clinical Toxicology 38: 111-22.

Byun, J. Y., Woo, J. Y., Choi, Y. W. & Choi, H. Y. (2013) Occupational airborne contact dermatitis caused by trifluoroacetic acid in an organic chemistry laboratory. Contact Dermatitis 70: 63–66.

Cavalcanti Zdo, R., Albuquerque Filho, A. P., Pereira, C. A. & Coletta, E. N. (2012) Bronchiolitis in workers at a cookie factory in Brazil associated with exposure to artificial butter flavouring. Jornal brasileiro de pneumologi: publicacao oficial da Sociedade Brasileira de Pneumologia e Tisilogia 38: 395-9.

CDC (2002) Fixed Obstructive Lung Disease in Workers at a Microwave Popcorn Factory. Morbidity and Mortality Weekly Report, Vol. 51, No. 16. Atlant, USA, Centers for Disease Control and Prevention.

CDC (2013) Obliterative Bronchiolitis in Workers in a Coffee-Processing Facility - Texas, 2008–2012. Morbidity and Mortality Weekly Report, Vol. 62, No. 16.Atlant, USA, Centers for Disease Control and Prevention.

CIR Expert panel (2002) Amended final report on the safety assessment of ethyl methacrylate. International Journal of Toxicology 21 Suppl. 1: 63-79.

Cullinan, P., McGavin, C. R., Kreiss, K., Nicholson, A. G., Maher, T. M., Howell, T., Banks, J., Newman Taylor, A. J., Chen, C. H., Tsai, P. J., Shih, T. S. & Burge, P. S. (2013) Obliterative bronchiolitis in fibreglass workers: a new occupational disease? Occupational and Environmental Medicine 70: 357-9.

Cummings, K. J., Donat, W. E., Ettensohn, D. B., Roggli, V. L., Ingram, P. & Kreiss, K. (2010) Pulmonary alveolar proteinosis in workers at an indium processing facility. American Journal of Respiratory and Critical Care Medicine 181: 458-64.

Cummings, K.J., Suarthana, E., Day, G.A., Stanton, M.L., Kreiss, K. (2012) An evaluation of preventive measures at an indium-tin oxide production facility, Health Hazard Evaluation Report HETA 2009-0214-3153

D'Erme, A. M., Francalanci, S., Milanesi, N., Ricci, L. & Gola, M. (2012) Contact dermatitis due to dipentene and pine oil in an automobile mechanic. Occupational and Environmental Medicine 69: 452.

DGUV (IFA GESTIS) webpage. Available: http://www.dguv.de/dguv/ifa/Gefahrstoffdatenbanken/GESTIS-Internationale-Grenzwerte-für-chemische-Substanzen-limit-values-for-chemical-agents/index.jsp

Dimich-Ward, H., Wymer, M. L. & Chan-Yeung, M. (2004) Respiratory health survey of respiratory therapists. Chest 126: 1048-53.

EC (2013) Report on the current situation in relation to occupational diseases' systems in EU Member States and EFTA/EEA countries, in particular relative to Commission Recommendation 2003/670/EC concerning the European Schedule of Occupational Diseases and gathering of data on relevant related aspects. European Commission.

ECSA (2011a) Health Profile on Perchloroethylene. Brussels, European Chlorinated Solvent Association.

ECSA (2011b) Health Profile on Trichloroethylene. Brussels, European Chlorinated Solvent Association.

ECSA (2012a) Product Safety Summary on Perchloroethylene. Brussels, European Chlorinated Solvent Association.

ECSA (2012b) Product Safety Summary on Trichloroethylene. Brussels, European Chlorinated Solvent Association.

Egilman, D. & Menendez, L. M. (2011) A case of occupational peritoneal mesothelioma from exposure to tremolite-free chrysotile in Quebec,

Canada: A black swan case. American Journal of Industrial Medicine 54: 153-6.

Ehrlich, R. I., Woolf, D. C. & Kibel, D. A. (2012) Disulfiram reaction in an artist exposed to solvents. Occupational Medicine (Oxford, England) 62: 64-6.

Eschenbacher, W. L., Kreiss, K., Lougheed, M. D., Pransky, G. S., Day, B. & Castellan, R. M. (1999) Nylon flock-associated interstitial lung disease. American Journal of Respiratory and Critical Care Medicine 159: 2003-8.

EU-OSHA (2013) EU-OSHA MULTI-ANNUAL STRATEGIC PROGRAMME (MSP) 2014-2020. European Agency for Safety and Health at Work.

Goldman, S. M., Quinlan, P. J., Ross, G. W., Marras, C., Meng, C., Bhudhikanok, G. S., Comyns, K., Korell, M., Chade, A. R., Kasten, M., Priestley, B., Chou, K. L., Fernandez, H. H., Cambi, F., Langston, J. W. & Tanner, C. M. (2012) Solvent exposures and Parkinson disease risk in twins. Annals of Neurology 71: 776-84.

He, C., Morawska, L. & Taplin, L. (2007) Particle emission characteristics of office printers. Environmental Science & Technology 41: 6039-45.

Hjortsberg, U. (1999) Association between exposure to potassium aluminium tetrafluoride and bronchial hyperreactivity and asthma. Scandinavian Journal of Work, Environment & Health 25: 457.

Homma, S., Miyamoto, A., Sakamoto, S., Kishi, K., Motoi, N. & Yoshimura, K. (2005) Pulmonary fibrosis in an individual occupationally exposed to inhaled indium-tin oxide. The European Respiratory Journal: official journal of the European Society for Clinical Respiratory Physiology 25: 200-4.

Hong, S-B., Kim, H. J., Huh, J. W., Kyung-Hyun, D., Jang, S. J., Song, J. S., Choi, S-J., Heo, Y., Kim, Y-B., Lim, C-M.,
Chae, E. J., Lee, H., Jung, M., Lee, K., Lee, M-S. & Koh, Y. (2014)
A cluster of lung injury associated with home humidifier use: clinical, radiological and pathological description of a new syndrome. Thorax 69: 694–702.

Kanwal, R., Kullman, G., Piacitelli, C., Boylstein, R., Sahakian, N., Martin, S., Fedan, K. & Kreiss, K. (2006) Evaluation of flavourings-related lung disease risk at six microwave popcorn plants. Journal of Occupational and Environmental Medicine / American College of Occupational and Environmental Medicine 48: 149-57.

Kern, D. G., Crausman, R. S., Durand, K. T., Nayer, A. & Kuhn, C., 3rd (1998) Flock worker's lung: chronic interstitial lung disease in the nylon flocking industry. Annals of Internal Medicine 129: 261-72.

Kern, D. G., Kuhn, C., 3rd, Ely, E. W., Pransky, G. S., Mello, C. J., Fraire, A. E. & Muller, J. (2000) Flock worker's lung: broadening the

spectrum of clinicopathology, narrowing the spectrum of suspected etiologies. Chest 117: 251-9.

Kinney G, Wiruth A. Practical risk analysis for safety management. 1976 [cited 2013 Jul 26];(June). Available from: http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA027189.

Kirby, J. 2010. Alert over link between cleaning sprays and asthma. Irish Examiner, June 7 2010, http://www.irishexaminer.com/archives/2010/0607/sport/alert-over-linkbetween-cleaning-sprays-and-asthma-121774.html.

Kreiss, K. (2007) Flavouring-related bronchiolitis obliterans. Current opinion in allergy and clinical immunology 7: 162-7.

Kreiss, K., Gomaa, A., Kullman, G., Fedan, K., Simoes, E. J. & Enright, P. L. (2002) Clinical bronchiolitis obliterans in workers at a microwave-popcorn plant. The New England Journal of Medicine 347: 330-8.

Kullman, G., Boylstein, R., Jones, W., Piacitelli, C., Pendergrass, S. & Kreiss, K. (2005) Characterization of respiratory exposures at a microwave popcorn plant with cases of bronchiolitis obliterans. Journal of Occupational and Environmental Hygiene 2: 169-78.

Lee, C. W. & Hsu, D. J. (2007) Measurements of fine and ultrafine particles formation in photocopy centres in Taiwan. Atmospheric Environment 41: 6598–6609.

Linn, W. S., Gong, H., Jr., Anderson, K. R., Clark, K. W. & Shamoo, D. A. (1995) Exposures of health-care workers to ribavirin aerosol: a pharmacokinetic study. Archives of Environmental Health 50: 445-51.

Lison, D., Carbonnelle, P., Mollo, L., Lauwerys, R. & Fubini, B. (1995) Physicochemical mechanism of the interaction between cobalt metal and carbide particles to generate toxic activated oxygen species. Chemical Research in Toxicology 8: 600-6.

Lougheed, M. D., Roos, J. O., Waddell, W. R. & Munt, P. W. (1995) Desquamative interstitial pneumonitis and diffuse alveolar damage in textile workers. Potential role of mycotoxins. Chest 108: 1196-200.

Matrat, M., Laurence, M. F., Iwatsubo, Y., Hubert, C., Joly, N., Legrand-Cattan, K., L'Huillier, J. P., Villemain, C. & Pairon, J. C. (2004) Reactive airways dysfunction syndrome caused by bromochlorodifluoromethane from fire extinguishers. Occupational and Environmental Medicine 61: 712-4.

Medina-Ramon, M., Zock, J. P., Kogevinas, M., Sunyer, J., Torralba, Y., Borrell, A., Burgos, F. & Anto, J. M. (2005) Asthma, chronic bronchitis and exposure to irritant agents in occupational domestic cleaning: a nested case-control study. Occupational and Environmental Medicine 62: 598-606.

Merget, R., Sander, I., van Kampen, V., Raulf-Heimsoth, M., Ulmer, H. M., Kulzer, R. & Bruening, T. (2010) Occupational immediate-type asthma and rhinitis due to rhodium salts. American Journal of Industrial Medicine 53: 42-6.

Mesnage, R., Clair, E., Spiroux de Vendomois, J. & Seralini, G. E. (2010) Two cases of birth defects overlapping Stratton-Parker syndrome after multiple pesticide exposure. Occupational and Environmental Medicine 67: 359.

Meulenbelt, J., Zwaveling, J. H., van Zoonen, P. & Notermans, N. C. (1988) Acute MCPP intoxication: report of two cases. Human Toxicology 7: 289-92.

MODERNET webpage. Available: http://www.costmodernet.org/.

Montgomery, M. R., Wier, G. T., Zieve, F. J. & Anders, M. W. (1977) Human intoxication following inhalation exposure to synthetic jet lubricating oil. Clinical Toxicology 11: 423-6.

Morawska, L., He, C., Johnson, G., Jayaratne, R., Salthammer, T., Wang, H., Uhde, E., Bostrom, T., Modini, R., Ayoko, G., McGarry, P. & Wensing, M. (2009) An investigation into the characteristics and formation mechanisms of particles originating from the operation of laser printers. Environmental Science & Technology 43: 1015-22.

Muttray, A., Schneider, M. & Letzel, S. (2012) Intoxication with a tropenol ester. Occupational Medicine (Oxford, England) 62: 305-7.

NCOD (2012) Beroepsziekten in cijfers. Netherlands Center for Occupational Diseases (NCOD).

NCOD webpage. Available: http://www.occupationaldiseases.nl/.

Nielsen, J. & Bach, E. (1999) Work-related eye symptoms and respiratory symptoms in female cleaners. Occupational Medicine (Oxford, England) 49: 291-7.

NIOSH Alert (2003) Preventing Lung Disease in Workers Who Use or Make Flavorings. Publication Number 2004–110. Cincinnati, USA, National Institute for Occupational Safety and Health.

NIOSH Alert (2006) Preventing Asthma and Death from MDI Exposure During Spray-on Truck Bed Liner and Related Applications. Publication No. 2006–149. Cincinnati, USA, National Institute for Occupational Safety and Health.

NIOSH Alert (2009) Preventing Occupational Exposures to Lead and Noise at Indoor Firing Ranges. Publication Number 2009–136. Cincinnati, USA, National Institute for Occupational Safety and Health.

NIOSH Alert (2011) Preventing Sensitization and Disease from Beryllium Exposure. Publication Number 2011–107. Cincinnati, USA, National Institute for Occupational Safety and Health.

NIOSH HHE (2008) Evaluation of Neurological Dysfunction among Workers Exposed to Trichloroethylene. Health Hazard Evaluation Report, HETA 2004- 0372-3054. Lebanon, USA, National Institute for Occupational Safety and Health.

NIOSH HHE (2009a) Report on an Investigation of Buttermilk Flavoring Exposures and Respiratory Health at a Bakery Mix Production Facility. Health Hazard Evaluation Report, HETA 2008-0230-3096. Los Angeles, USA, National Institute for Occupational Safety and Health.

NIOSH HHE (2009b) Report on Respiratory Symptoms and Disease among Cemented Tungsten Carbide Workers. Health Hazard Evaluation Report, HETA 2003-0257-3088. Huntsville, Gurley, and Grant, Alabama, National Institute for Occupational Safety and Health.

NIOSH HHE (2010) Evaluation of 1-Bromopropane Use in Four New Jersey Commercial Dry Cleaning Facilities. Health Hazard Evaluation Report, HETA 2008-0175-3111. New Jersey, National Institute for Occupational Safety and Health.

NIOSH HHE (2011a) Evaluation of Chemical Hazards and Noise Exposures at a Drum Refurbishing Plant – Indiana. Health Hazard Evaluation Report, HETA 2010-0031-3130. National Institute for Occupational Safety and Health.

NIOSH HHE (2011b) Formaldehyde Exposures During Brazilian Blowout Hair Smoothing Treatment at a Hair Salon – Ohio. Health Hazard Evaluation Report, HETA 2011-0014-3147. Cincinnati, USA, National Institute for Occupational Safety and Health.

NIOSH HHE (2012a) Evaluation of Eye and Respiratory Symptoms at a Poultry Processing Facility – Oklahoma. Health Hazard Evaluation Report, HETA 2007- 0284 & 2007-0317-3155. National Institute for Occupational Safety and Health.

NIOSH HHE (2012b) An evaluation of preventive measures at an indium-tin oxide production facility. Health Hazard Evaluation Report, HETA 2009-0214- 3153. National Institute for Occupational Safety and Health.

OHSP (1997) Worker Exposures to Dusts and Vapors in Nail Salons. SENSOR Occupational Lung Disease Bulletin. Boston, Occupational Health Surveillance Program (OHSP) Massachusetts Department of Public Health.

Palmen et al. (2013) Detecting emerging risks for workers and follow-up actions RIVM report 601353004/2013

Parmet, A. J. & Von Essen, S. (2002) Rapidly progressive, fixed airway obstructive disease in popcorn workers: a new occupational pulmonary illness? Journal of Occupational and Environmental Medicine / American College of Occupational and Environmental Medicine 44: 216-8.

Quirce, S., Fernandez-Nieto, M., Gorgolas, M., Renedo, G., Carnes, J. & Sastre, J. (2004) Hypersensitivity pneumonitis caused by triglycidyl isocyanurate. Allergy 59: 1128.

Raghu, G., Collins, B. F., Xia, D., Schmidt, R. & Abraham, J. L. (2014) The New England Journal of Medicine 370: 2154-7.
Rayman, R. B. & McNaughton, G. B. (1983) Smoke/fumes in the cockpit. Aviation, Space, and Environmental Medicine 54: 738-40.

Sastre, J., Garcia del Potro, M., Aguado, E. & Fernandez-Nieto, M. (2010) Occupational asthma due to 5-aminosalicylic acid. Occupational and Environmental Medicine 67: 798-9.

Scherpereel, A., Tillie-Leblond, I., Pommier de Santi, P. & Tonnel, A. B. (2004) Exposure to methyl methacrylate and hypersensitivity pneumonitis in dental technicians. Allergy 59: 890-2.

SER-database webpage. Available: https://www.ser.nl/nl/themas/grenswaarden/overzicht%20van%20stoffen.aspx

Smit AA, V. d. H. M., Roos C, Van der Zee JS (2004) Inhalation of impregnation spray for leather as a cause of toxic alveolitis [Dutch: Inhalatie van leerimpregnatiespray als oorzaak van toxische alveolitis]. Nederlands Tijdschrift voor Allergie 5: 188-192.

Song, G-W., Ban, G-Y., Nam, Y-H., Park, H-S. & Ye, Y-M. (2013) Case Report of Occupational Asthma Induced by Polyvinyl Chloride and Nickel. Journal of Korean Medical Science 28: 1540-1542.

Sparks, P. J., Simon, G. E., Katon, W. J., Altman, L. C., Ayars, G. H. & Johnson, R. L. (1990) An outbreak of illness among aerospace workers. The Western Journal of Medicine 153: 28-33.

Spencer, A. B., Estill, C. F., McCammon, J. B., Mickelsen, R. L. & Johnston, O. E. (1997) Control of ethyl methacrylate exposures during the application of artificial fingernails. American Industrial Hygiene Association Journal 58: 214-8.

Suojalehto, H., Linstrom, I., Henriks-Eckerman, M. L., Jungewelter, S. & Suuronen, K. (2011) Occupational asthma related to low levels of airborne methylene diphenyl diisocyanate (MDI) in orthopedic casting work. American Journal of Industrial Medicine 54: 906-10.

Tashkin, D. P., Coulson, A. H., Simmons, M. S. & Spivey, G. H. (1983) Respiratory symptoms of flight attendants during high-altitude flight: possible relation to cabin ozone exposure. International Archives of Occupational and Environmental Health 52: 117-37.

Toholka, R. & Nixon, R (2013) Allergic contact dermatitis to chlorhexidine. Australasian Journal of Dermatology 54: 303–306.

Van Netten, C. (1998) Air quality and health effects associated with the operation of BAe 146- 200 aircraft. Applied Occupational and Environmental Hygiene 13: 733-739.

van Rooy, F. G., Rooyackers, J. M., Prokop, M., Houba, R., Smit, L. A. & Heederik, D. J. (2007) Bronchiolitis obliterans syndrome in chemical workers producing diacetyl for food flavorings. American Journal of Respiratory and Critical Care Medicine 176: 498-504.

Wallace, G. M. & Brown, P. H. (2005) Horse rug lung: toxic pneumonitis due to fluorocarbon inhalation. Occupational and Environmental Medicine 62: 414-6.

Walters, G. I., Moore, V. C., Robertson, A. S. & McGrath, E. E. (2013) European Respiratory Journal 42: 1137 – 1139.

Weng, S. F., Hung, D. Z., Hu, S. Y., Tsan, Y. T. & Wang, L. M. (2008) Rhabdomyolysis from an intramuscular injection of glyphosate-surfactant herbicide. Clinical Toxicology (Philadelphia, Pa.) 46: 890-1.

Winder, C. (2006) Hazardous chemicals on jet aircraft: case study – jet engine oils and aerotoxic syndrome. Current Topics in Toxicology 3: 65-88.

Winder, C., Fonteyn, P. & Balouet, J. C. (2002) Aerotoxic syndrome: A descriptive epidemiological survey of aircrew exposed to in-cabin airborne contaminants. Journal of Occupational Health and Safety - Australia and New Zealand 18: 321-338.

Zock, J. P., Kogevinas, M., Sunyer, J., Almar, E., Muniozguren, N., Payo, F., Sanchez, J. L. & Anto, J. M. (2001) Asthma risk, cleaning activities and use of specific cleaning products among Spanish indoor cleaners. Scandinavian Journal of Work, Environment & Health 27: 76-81.

Zock, J. P., Plana, E., Jarvis, D., Anto, J. M., Kromhout, H., Kennedy, S. M., Kunzli, N., Villani, S., Olivieri, M., Toren, K., Radon, K., Sunyer, J., Dahlman-Hoglund, A., Norback, D. & Kogevinas, M. (2007) The use of household cleaning sprays and adult asthma: an international longitudinal study. American Journal of Respiratory and Critical Care Medicine 176: 735-41.

6 Appendix A: Operationalization of the Impact Analysis variables

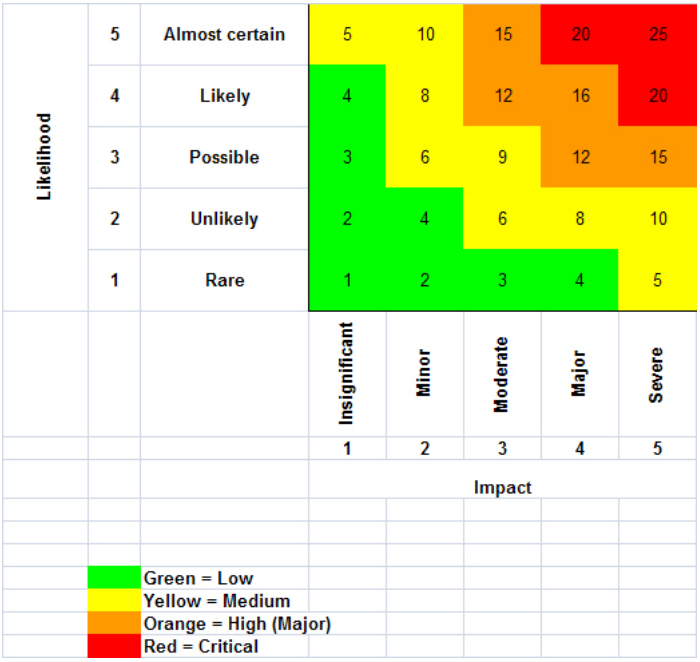

Figure 1: Impact analysis to calculate the risk score.
A method to calculate the risks of potential NERCs based on two variables: the impact and the likelihood of occurrence. Both variables are divided into 5 levels and multiplied, leading to a risk score that is further categorized under 4 levels (red, orange, yellow, green). A further operationalization of the 5 levels of both variables is given in Appendix A.

Likelihood

1. Rare: this means that the occurrence of this NERC is classified as unlikely.
2. Unlikely: the occurrence is unlikely, but possible. For example a (case) study that has to be elaborated further; health effects caused by mixtures.
3. Possible: the occurrence is possible, but there is little information on exposure; category for elaborate case studies.
4. Likely: the occurrence is likely; there are several studies that claim a causal relationship between the exposure and health effect, but discussions are still ongoing. This category is also used for epidemiological studies with little exposure information.
5. Almost certain: this category is used when there is consensus among scientists on the causal relationship between the exposure and the health effect.

Impact

1. Insignificant: health effect causing discomfort or nuisance; e.g. dermal irritation.
2. Minor: health effect causing discomfort or nuisance; e.g. airway irritation.

3. Moderate: health effect leading to functionality interference
4. Major: health effect with the probability of disability to work; e.g. sensitization of airways, possible carcinogen.
5. Severe: health effect which is possibly health threatening; e.g. proven carcinogen, lifelong invalidity or death.

7 Appendix B: More elaborate information on the possible NERCs

Appendix B gives more information on the reported health effects, exposure information and use by sector of the NERC. In addition, possible production or use in the Netherlands was gathered from the Internet. In the last column, both Dutch public / legal occupational exposure levels (OEL) and SCOEL OELs are reported.

7.1 Formaldehyde (CAS 50-00-0)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Nose bleeding in aluminium workers caused by formaldehyde exposure BfR (2010), AFSSAPS (2010), NIOSH HHE (2011b)	Nose bleeding in several men (ages 30-45) after work in an aluminium company (operation and quality control). The aluminium was treated with anti-corrosives. Reported exposures: formaldehyde (0.09-0.11 mg/m3), acetaldehyde (0.02-0.04 mg/mg3), acrolein (0.06-0.07 mg/m3).	Aluminium production	Formaldehyde-based synthetic resins No information on the specific use of anti-corrosives	NL: 0.15 mg/m3 (TWA[5] 8 h) NL: 0.5 mg/m3 (TWA 15 min) SCOEL[6]: 0.2 ppm[7] (TWA 8 h) Skin sensitizer SCOEL: 0.4 ppm (TWA 15 min) Skin sensitizer

[5] TWA: Time weighted average
[6] SCOEL: ongoing recommendation
[7] Formaldehyde 1 ppm ≈ 1.23 mg/m3

7.2 Vinyl chloride (CAS 75-01-4)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Vinylchloride is a human carcinogen, causing liver angiosarcoma Infante et al. (2009)	Historical exposure: Exposure was modelled in 2 reported cases of hair dressers: 129 -1234 ppm (TWA 15 min) 70-1037 ppm (TWA 8 h)	Hair dressers: Historical exposure to vinylchloride in hairspray	Production of vinylchloride in Botlek region	NL: 7.77 mg/m3 (TWA 8 h)[8]
				SCOEL: no OELs derived. Risk values were calculated because of non-threshold genotoxic carcinogen (additional cancer risk of 1 ppm[9] = $3x10^{-4}$)

[8] Concentration counts for vinylchloride monomer
[9] Vinylchloride: 1 ppm = 2.59 mg/m3

7.3 Diacetyl-containing flavourings (CAS 431-03-8)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Inhalation exposure to diacetyl vapours may lead to bronchiolitis obliterans, a very serious airway disorder that may lead to lung transplantation or death. Because bronchiolitis obliterans is a rare disease, some workers exposed to diacetyl may have been potentially misdiagnosed with asthma, bronchitis, emphysema and/or pneumonia Oral exposure to diacetyl, which is a butter flavouring, is not toxic. Kreiss et al.(2002) Akpinar-Elci et al.(2004) Kanwal et al.(2006) Cavalcanti Zdo et al. (2012)	Exposure is widespread in the food manufacturing industries in which workers handle diacetyl in the liquid form and are potentially exposed to diacetyl as vapours, fumes or adsorb them on particles, in the manufacturing process or at various stages of production. Even short-term peak flavouring exposures were reported to present a risk of lung damage, and average 8-hour diacetyl exposures as low as 0.02 ppm were measured in a work area where bronchiolitis obliterans occurred in workers mixing butter flavourings with heated oil. In this case, peak exposures exceeded 80 ppm. During flavour manufacture, the compounding of powder	Food manufacturing industry	Diacetyl production Use of diacetyl in Food industry (e.g. popcorn industry)	NL: no public OEL SCOEL: 0.1 ppm (TGG 8 h) SCOEL recommendation June 2014: - 0.02 ppm[10] (TGG 8 h) - 0.1 ppm / (TGG 15 min)

[10] Diacetyl 1 ppm = 3.58 mg/m3

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
NIOSH Alert (2003) NIOSH HHE (2009a) CDC (2013) CDC (2002) Kreiss (2007) Kullman et al.(2005) Parmet et al.(2002) van Rooy et al. (2007)	and liquid products caused the highest exposure levels. NIOSH Method 2557 underestimates the diacetyl exposure concentration. OSHA then developed the PV 2118 method to improve storage stability performances, which was subsequently replaced by the fully validated OSHA methods 1012 and 1013 (OSHA 2008a,b). Method 1013 is streamlined for monitoring low ppm levels, and method 1012 is optimized for ppb levels. At low concentrations, it appears that the average underestimation is by a factor of 20 for concentrations below the LOD with a range from 4.2 to 295			

7.4 4,4-methylene-bismorpholine (CAS 5625-90-1)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Occupational asthma after exposure to new metal working fluid containing 4,4-methylene-bismorpholine (a biocide). 4,4-methylene-bismorpholine has a high asthma hazard index (maximum 1.0) using the Manchester Occupational Asthma Hazard Programme. A challenge test with 4,4-methylene-bismorpholine showed that this substance was responsible for the occupational asthma. (Walters et al., 2013)	No information on exposure concentration is available. There was a visible mist at a 3 m distance from the machine containing the metal working fluid.	Metal industry	Authorized substance of Lubrizol Deutschland Gmbh by Ctgb)	NL: no public OEL SCOEL: no OEL

7.5 Beryllium (CAS 7440-41-7)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Chronic beryllium disease occurs when a sensitized worker's lungs react with beryllium that has been inhaled, producing lung granulomas and scarring. Chronic beryllium disease usually has a slow onset of symptoms. It can be so mild at the time of diagnosis that the affected worker has no suspicion that he or she has a lung disease. However, when chronic beryllium disease progresses, the widespread granulomas and associated lung damage cause chronic chest symptoms such as coughing and shortness of breath on exertion. Significantly elevated risks of lung cancer have been reported for workers exposed to beryllium. NIOSH Alert (2011)	Cases of beryllium sensitization and chronic beryllium disease have been reported in which exposures were below the current Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) of 2.0 µg/m3 of air and the current NIOSH Recommended Exposure Limit (REL) of 0.5 µg/m3	• Metal, • Aerospace, Biomedical, Energy and electric (NIOSH report)	Use in metal industry (e.g. copper finger strips and springs)	NL: No public OEL SCOEL: at this moment an OEL is going to be derived

7.6 Pesticides – methyl bromide and phosphine residual gases (fumigation of containers) (CAS 74-83-9: methyl bromide)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Respiratory disorders, neurotoxic symptoms, mild acute health effects. BfR (2007) T. Knol - de Vos (RIVM, 2002) See presentation of I-SZW at Contact Group of health and Chemistry	No exposure information reported in the reported case of BfR. Exposure information in the Netherlands: In 21% of 303 containers, methyl bromide, formaldehyde or phosphine was found. 5% Of the containers were considered to be a risk due to concentrations of methyl bromide or formaldehyde, or the presence of phosphine-forming pesticides.	Containers	• Added gas for pest control and quality preservation • Evaporation of gas from products	NL: no public OEL available for methyl bromide SCOEL: an OEL for methyl bromide could not be derived (non-threshold genotoxic carcinogen). Additional risk was not calculated.

7.7 Hexamethylene diisocyanate (CAS 822-06-0)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Acute life-threatening extrinsic allergic alveolitis (EAA) in paint controller. In EAA there is diffuse, granulomatous inflammation of the lung parenchyma and airways in people who have been sensitized. Bieler et al. (2011)	Stationary measurements: not-detectable - 0.00425 ppm Personal measurements: all undetectable <0.00005 ppm Urinary concentration <1.0-15.4 ug/g creatinine Dermal absorption may contribute to the exposure	Paint industry	Paint industry	NL: no public OEL SCOEL: no OEL

7.8 Methylene diphenyl diisocyanate (MDI) (CAS 101-68-8)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Orthopaedic plaster casts containing MDI leading to occupational asthma Suojalehto et al. (2011) Painting of pick-up trucks (truck bed liner) (NIOSH, 2006).	Exposure during casting activities ranged from 0.00002 - 0.0025 mg NCO/m3 (Suojalehtto, 2011) Spray enclosure at low temperature, low pressure GM MDI monomer concentration of 0.99 mg/m3; Spray enclosure at high temperature, high-pressure GM MDI monomer concentration of 0.78 mg/m3. Post-spraying samples inside enclosure range from non-detectable to 0.08 mg/m3. Truck preparation area: in 8 of 12 samples exposure was non-detectable, 4 samples ranged from 0.0057-0.022 mg/m3. Exhaust area: in 6 samples exposure was non-detectable, highest concentration of 0.41 mg/m3	Polyurethane industry	bandage products Bedliner coating	NL: No public OEL SCOEL: no OEL

7.9 Methyl methacrylate (CAS 80-62-6)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Hypersensitivity pneumonitis (= extrinsic allergic alveolitis (EAA)). In EAA there is diffuse, granulomatous inflammation of the lung parenchyma and airways in people who have been sensitized. Scherpereel et al. (2004)	Exposure of dental technicians to MMA during polishing and grinding of prostheses. No worker exposure information described in article of Scherpereel (2004)	Dental technicians	• No specific examples found for dental industry • Also used in artificial nails	NL: 205 mg/m3 (TWA 8 h) NL: 410 mg/m3 (TWA 15 min)
				SCOEL: 50 ppm[11] (TWA 8 h) SCOEL: 100 ppm (TWA 15 min)

[11] Methylmethacrylate: 1 ppm = 4,10 mg/m³ at 25°C

7.10 Ethyl methacrylate (CAS 97-63-2)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Occupational asthma in cosmetologists working with artificial fingernails. (Spencer) Case report in France (RNV3P database) of extrinsic allergic alveolitis (EAA) after exposure to ethyl methacrylate. In EAA there is diffuse, granulomatous inflammation of the lung parenchyma and airways in people who have been sensitized. OHSP (1997) Spencer et al. (1997) CIR Expert panel (2002)	Exposure in the personal breathing zone when using the modified table was 0.6 ppm; exposure using the conventional unventilated table was 8.7 ppm. No exposure information in the French case report.	Artificial nails	Ethyl methacrylate is a substitute for methyl methacrylate in artificial nails.	NL: No public OEL SCOEL: no OEL

7.11 Trichloroethylene (CAS 79-01-6)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Case study: Parkinson's disease (Goldman et al, 2012) neurological effects and dementia (NIOSH HHE, 2008) 48% of Entek International workers reported feeling high or lightheaded while at work in the last 30 days, compared to 19% of non-TCE-exposed workers at an adjacent facility, Entek Manufacturing ECSA (2011b) ECSA (2012b)	No exposure data available in the Goldman study. It concerns an epidemiological study: ever exposed to trichloroethylene has a higher risk of dementia compared with never exposed. However, based on historical data collected by Entek International, airborne TCE concentrations have ranged from approximately 20 to 40 ppm near the workstations of the employees involved in battery separator manufacturing.	• Formulation • Surface cleaning (closed and enclosed systems) • Heat transfer fluid (mainly in closed systems) • Process chemical (e.g. in purification) • Textile scouring • Adhesives • Laboratory chemical • (ECHA, 2011)	• Production of garment • surface cleaning • filtration and separation	NL: no public OEL SCOEL: 10 ppm[12] (TWA 8 h) SCOEL: 30 ppm (TWA 15 min) Skin notation Biological Limit Value: 20 mg TCA (trichloroacetic acid) / litre urine (Sampling time: end of the last shift of a workweek or a shift period)

[12] Trichloroethylene: 1 ppm = 5,47 mg/m3

7.12 Lead (CAS 7439-92-1)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Nausea, diarrhoea, vomiting, poor appetite, weight loss, anaemia, excess lethargy or hyperactivity, headaches, abdominal pain, and kidney problems. NIOSH Alert (2009)	Lead exposure at indoor firing ranges (NIOSH, 2009) Pre-training mean values: 6.5 ug/dL blood Post-training mean values: 50.4 ug/dL Mean airborne lead concentration: >2 mg/m3 After adjusting the ventilation system: below detection level	Firing ranges	Firing range Tilburg (1996): 57% > 0.2 mg/L blood (20 ug/dL)	NL: lead in blood: 70 µg/100 ml Article 4.19a Arbeidsomstandighedenregeling (Regulations on Working Conditions)
				SCOEL: Biological limit value, lead in blood (PbB): 30 µg/100 ml

7.13 Cobalt (CAS 7440-48-4)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Hard metal lung disease and occupational asthma. Hard metal lung disease is a type of pneumoconiosis (lung fibrosis). Combined exposure of cobalt and tungsten probably leads to a potentiation of the lung disease. NIOSH HHE (2009b) Lison et al. (1995)	Hard metal is an alloy containing Cobalt and Tungsten. Cobalt concentrations were (NIOSH, 2009)): • Powder mixing area: 0.574 mg/m3 • Reprocessing: 0.427 mg/m3 • Powder mixing: 0.414 mg/m3	Hard metal industry	No information regarding combined exposure of cobalt and tungsten, but exposure via grinding of hard metal tools.	NL: 0.02 mg/m3 (TWA 8 h) No information on combined exposure with tungsten
				SCOEL: ongoing but not yet available

7.14 Triglycidyl isocyanurate (TGIC) (CAS 2451-62-9)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Bystanders of powder spraying TGIC developed asthma. A painter applying TGIC containing paint contracted EAA (Extrinsic allergic alveolitis). Anees et al. (2011) Quirce et al. (2004)	No information on exposure of bystanders was given. No exposure information available.	Polyester powder paints are extensively used in metal painting.	production of powder paints containing TGIC	NL: No public OEL SCOEL: no OEL

7.15 Tremolite-free crysotile (CAS 77536-68-6)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Peritoneal mesothelioma in a mill worker from a tremolite-free Canadian mine. Egilman et al. (2011)	Tremolite contamination has been proposed as the cause of mesothelioma in workers exposed to commercial chrysotile. This study shows that chrysotile without tremolite can cause peritoneal mesothelioma.	Mining Construction Asbestos removal	• No production or use • Removal of asbestos	NL: 2.000 fibres/m3 (TWA 8 h) SCOEL: ongoing but not yet available

7.16 Crystalline silica (sand) (CAS 14808-60-7)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Case reports of silicosis in textile workers. Silicosis is a fibrotic lung disease caused by inhalation of crystalline silica. Akgun et al.(2005), Akgun et al. (2008)	Sandblasting of jeans. Sandblasting involves forcefully projecting a stream of abrasive particles onto a surface, usually with compressed air or steam. Exposure period varied from several months to 5 years; exposure concentrations were high (no values given).	Construction	No sandblasting, but exposure in construction	NL: 0.075 mg/m3 (TWA 8 h) respirable dust
				SCOEL: OEL should lie below 0.05 mg/m3 (TWA 8 h) of respirable silica dust

7.17 Perchloroethylene (=tetrachloroethylene) (CAS 127-18-4)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Oesophageal squamous cell carcinoma 30 years after exposure to perchloroethylene. Babiker et al. (2012) ECSA (2011a) ECSA (2012a)	Historical exposure during dry cleaning; no further exposure information available.	• Manufacture and packaging • Recycling used tetrachloroethylene • Dry-cleaning • Metal degreasing Since 2005, only 4 manufacturers have produced tetrachloroethylene. ECSA website: perchloroethylene is produced by Dow Europe (Ger), Solvay (Fr, It) and Spolchemie (CZ)	• Metal degreasing • Stain removal • Degreasing electronics	NL: no public OEL SCOEL: 20 ppm[13] (TWA 8 h) SCOEL: 40 ppm (TWA 15 min) Skin notation 0.4 mg tetrachloroethylene per litre of blood [sampling time: prior to the last shift of a workweek]. 3 ppm [0.435 mg/m3] tetrachloroethylene in end-exhaled air

[13] Perchloroethylene: 1 ppm= 6.89 mg/m3

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
				[sampling time: prior to the last shift of a work-week]. Non-genotoxic carcinogen with threshold**.**

7.18 Indium tin oxide (CAS 50926-11-9)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Indium tin oxide may cause pulmonary alveolar proteinosis, which eventually may lead to lung fibrosis, emphysema and, potentially, death. Pulmonary alveolar proteinosis is a rare disease. Homma et al.(2005), Cummings et al. (2010), Cummings et al. (2012), NIOSH HHE (2012b)	Hydrogen furnace operator: no exposure concentrations available, but fumes and dust were coming out of the kiln, no respiratory protection used during regular work, exposure to intense and irritating fumes during opening of kiln. Crushing area: exceeding the NIOSH REL (Indium compounds TWA 0,1 mg/m3)	Many uses, e.g.: Lighting LED production Solar panel Laboratories	• coating on light bulb • production of organic LEDs • Chip-on-glass LCD Driver Technology • Atomic Layer Deposition for nanowire devices • ITO-coated glass slides as a substrate for cell culture • Thin film PV production • Production of optical discs and PV cells and modules Possibly • Solar Cells • production LCD screens	NL: no public OEL SCOEL: no OEL

7.19 Synthetic polymeric fibres (CAS not applicable)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Exposure to synthetic polymeric fibres (not only nylon) may lead to chronic interstitial pneumonitis (Flock worker's lung). This is an interstitial lung disease. Lougheed et al.(1995), Kern et al.(1998), Eschenbacher et al. (1999), Kern et al. (2000)	Exposure was below 10 mg/m3 (OEL of inhalable dust). Flock consists of short fibres that are cut from long filaments and glued to backing material such as cloth to provide a fuzzy, carpet-like surface texture. They are usually prepared from synthetic materials such as nylon, rayon or polypropylene. The cutting process results in formation of airborne particles or fibres in the respirable range. Inhalation of flock dust has been associated with an interstitial lung disease called flock workers' lung.	Clothing industry Automotive	• Garment industry • Automotive industry	NL: no public OEL SCOEL: no OEL

7.20 Impregnation sprays for leather; impregnation sprays containing fluorocarbons (CAS not applicable)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Acute shortness of breath as a consequence of toxic alveolitis after spraying anti rain (containing fluorocarbons) (Smit ea, 2004). If not treated this leads to lung fibrosis (Bonte, 2003). Chronic and acute alveolitis after spraying fluorocarbons (Wallace ea, 2005). Reactive airway dysfunction syndrome and occupational asthma after exposure to bromochlorodifluoromethane (Matrat, 2004). Desquamative interstitial pneumonia because of exposure to aerosols of perfluoroalkyl resins in a solvent (Algranti, 2014).	The aerosols were < 5 um, so they could reach the alveoli; No information on the exposure concentration available in the Smit study. No exposure information in the Bonte study. During spraying of horse blankets in a spay booth, people were exposed and fell ill. No further exposure information available (Wallace ea, 2005). No exposure information No exposure information	Spray application of fluorocarbon containing solvents Fire extinguishers	No information	NL: no public OEL SCOEL: no OEL

7.21 Aerolized ribavirin (CAS 36791-04-5)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Asthma in health care workers - aerosolized ribavirin Dimich-Ward et al. (2004) Linn et al. (1995)	No exposure information in the studies that reported the NERC. Other exposure information: Of the 12 workers evaluated, the six nurses and two respiratory therapists providing direct care to patients who received ribavirin through an oxygen tent were exposed to the highest air levels over the work shift (mean ribavirin concentration in personal air samples: 161ug/m3, range: 69-316 ug/m3). The three nurses attending patients that received ribavirin through a ventilator were exposed to the lowest air concentrations (range: less than 1 to 6 ug/m3), and one nurse providing care for a patient that received ribavirin through a mist mask was exposed to a mean concentration of 62 ug/m3. Bedside area samples, collected continuously in the ribavirin-delivery areas, showed generally higher ribavirin concentrations than the corresponding personal samples, averaging 317 ug/m3 during administration through an oxygen tent (CDC)	Health care	Treatment of hepatitis C patients (UMC Utrecht)	NL: no public OEL SCOEL: no OEL

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
	NL: Exposure concentrations between 20-600 (max 1000) ug/m3 ribavirin. (Dutch hospitals)			

7.22 Talc (CAS 14807-96-6)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Talcosis caused by the inhalation of talc; prolonged exposure may result in pulmonary fibrosis Presentation NECORD[14] NVVA congress	No exposure information available	Food industry Floor industry	• workers in a chocolate factory • workers in a pancake roll factory • worker in production of floors	NL: 0.25 mg/m3 (TWA 8 h) as respirable dust SCOEL: no OEL

[14] Netherlands Expertise Centre for Occupational Respiratory Disorders (NECORD)

7.23 Tricresyl phosphate (CAS 1330-78-5)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Neuropsychological effects reported by cabin crew and pilots. Tri-ortho TCP is a proven neurotoxic substance. Other isomers may also be neurotoxic. Montgomery et al. (1977), Rayman et al. (1983), Tashkin et al. (1983), Sparks et al. (1990), Abou-Donia et al.(2013), Van Netten (1998), Winder et al.(2002), Winder(2006)	Tri-ortho TCP in cabin air was found: mean 0.24 ug/m3; max 22.8 ug/m3)(Crump et al, 2011) NL: No Tri-ortho TCP found (TNO, 2014). See also TCP's in cabinelucht van vliegtuigen Voortgangsrapportage voorjaar 2014 (RIVM, 2014)	Bleed air and fume events in aeroplanes Exposure to exhaust from turbine engines (electrical power plants, submarines, drilling platform)	• No production • Airplanes and technical services • Constituent of oils used in turbine engines	NL: no public OEL SCOEL: no OEL

7.24 Fibreglass with styrene resins (CAS not applicable)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Bronchiolitis obliterans reported by yacht builders (application of glass-reinforced plastics) Bronchiolitis obliterans is a rare and very serious airway disease, which may lead to lung transplant or death. Cullinan et al.(2013)	Suspected substances: • MEKPO (methyl ethyl keton peroxide) • Dimethylftalate • Styrene No further exposure information available	Yacht building Other workers in glass-reinforced plastics • Caravan industry • Silo's • Car industry (bumper)	Yacht building in NL, but no bronchiolitis obliterans reported	NL: no public OEL for the mixture SCOEL: no OEL for the mixture

7.25 Corian dust (CAS not applicable)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Case study: idiopathic pulmonary fibrosis leading to death (Raghu et al., 2014)	Corian is a solid-surface material composed of acrylic polymer and aluminium trihydrate. Work: grounding, machining, drilling, and sanding for sixteen years. No further exposure information available.	Corian is the brand name for a solid surface material created by E. I. du Pont de Nemours and Company (DuPont). Its primary use is as a countertop / bench-top surface, though it has many other applications.	Many applications (e.g. in designing, bath rooms, kitchens, construction, etc…).	NL: no public OEL for the mixture SCOEL: no OEL for the mixture

7.26 Tropenol ester (Synonym: BA 679 tropenolester) (CAS 136310-66-2)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Anticholinergic symptoms (enlarged eye pupil, dry mouth, abnormal coordination, attaque). The patient was treated at the intensive care unit. Muttray et al. (2012)	Tropenol ester is used in drug manufacturing and is a precursor of tiotropium bromide, a bronchodilatator. Exposure to the tertiary amine tropenol ester caused the effects. This substance penetrates the blood-brain barrier easily. The urine samples contained tropenol ester, an intermediary of the tropenol production. The worker spilled his clothes with a brush and was probably contaminated when removing his clothes.	Production of drugs	Production of spirivia	NL: no public OEL SCOEL: no OEL

7.27 Cloracetal C5 (CAS 105737-73-3)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Renal cell cancer Case reports in France (InVS), correlation is possible but not confirmed. French Institute for Public Health Surveillance (InVS) in MODERNET	Cloracetal C5 is used in the production of vitamin A. No further exposure information.	Production of medicine	Production of food supplements	NL: no public OEL SCOEL: no OEL

7.28 Humidifier disinfectants (CAS not applicable)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Cluster of severe lung injury and respiratory distress (several lung transplants and deaths). (Hong et al., 2014)	Exposure to disinfectants used in home humidifiers. No further information on the composition and exposure concentration.	Consumers	No specific information	NL: no public OEL for the mixture
				SCOEL: no OEL for the mixture

7.29 1-bromopropane (1-BP) (CAS 106-94-5)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Light headedness NIOSH HHE (2010)	New use in dry cleaning (conversion from perchloroethylene to 1-BP). Insufficient protection. Task concentrations (personal measurements) ranging from 1.5 ppm to 160 ppm (7.5 - 800 mg/m3) High area measurements: 36-103 ppm (180-515 mg/m3) (NIOSH, 2010)	Propyl bromide (n-PB) is used as an intermediate inorganic synthesis and in the manufacture of agrochemicals and pharmaceuticals. n-PB is also used as an organic cleaning solvent for degreasing, precision cleaning, electronics and metal cleaning applications. Used in dry cleaning.	• Production • Dry cleaning facilities	NL: no public OEL SCOEL: no OEL

7.30 Styrene (CAS 100-42-5)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Case study: eosinophilic bronchitis leading to chronic cough and shortness of breath. No complaints during the weekends. (Arochena et al., 2014)	Panel beater working with styrene. The hardener was composed of 10-20% styrene. No exposure measurements available.	Used in the production of polystyrene, ABS, styrene-butadiene (SBR) rubber, styrene-butadiene latex, SIS (styrene-isoprene-styrene), S-EB-S (styrene-ethylene/butylene-styrene), styrene-divinylbenzene (S-DVB), styrene-acrylonitrile resin (SAN), and unsaturated polyesters used in resins and thermosetting compounds. These materials are used in rubber, plastic, insulation, fibreglass, pipes, automobile and boat parts, food containers, and carpet backing.	Production	NL: no public OEL SCOEL: ongoing but not yet available

7.31 PVC (CAS not applicable)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Case study; occupational asthma in a wall paper factory worker (Song et al., 2013)	Exposure to PVC and Ni dust. The mechanisms behind the effect are different for PVC and Ni. The authors conclude that PVC dust without Ni may be able to cause occupational asthma. No exposure measurements available.	One of the most used plastic materials Wall paper production	PVC production	NL: no public OEL (OELs for particles not otherwise specified are applicable)
				SCOEL: no OEL

7.32 Cleaning spray (CAS not applicable)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Occupational asthma (irritant) in cleaners using spraying applications. Nielsen et al.(1999) Zock et al. (2001) Medina-Ramon et al. (2005) Zock et al. (2007) Kirby (2010)	Cleaning spray (including chlorine, bleach, disinfectants) - bleach, ammonia, decalcifiers, acids, solvents and stain removers. Risks were predominantly found for the commonly used glass-cleaning, furniture, and air-refreshing sprays. Cleaning products not applied in spray form were not associated with asthma. (Zock, 2007) Airborne exposure levels of both chlorine and ammonia were detectable (that is, >0.1 ppm) during domestic cleaning work in all 10 measurement sessions. Chlorine exposures up to 0.7 ppm have been measured. Ammonia exposures up to 50 ppm have been measured (Medina-Ramon et.al, 2005)	Cleaning	Cleaning	NL: no public OEL for the mixture SCOEL: no OEL for the mixture

7.33 Potassium aluminium tetrafluoride fluxes (CAS 14484-69-6)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Bronchial hyperreactivity and occupational asthma, nonspecific allergy reaction (Hjortsberg, 1999) Workers with potassium aluminium tetrafluoride, including the aluminium industry. Correlation between asthma and fluorides is known, but with potassium aluminium tetrafluoride (fluxes) not. Effects at lower concentrations than fluorides.	Exposure to potassium aluminium tetrafluoride dust (respirable fraction) was applied when putting together aluminium shields (Hjortsberg, 1999) Fluoride may be only irritating to the airways, but the exposure levels of potassium aluminium tetrafluoride (fluxes) that causes bronchial hyperactivity or asthma is lower than that causing airway irritation through fluoride exposure (Hjortsberg, 1999).	Metal industry Glass production	• Controlled atmospheric brazing • Production of cooling systems	NL: no public OEL SCOEL: no OEL

7.34 Rhodium salts (CAS 14972-70-4)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Occupational asthma, rhinitis in an operator of an electroplating plant. Merget et al. (2010)	Work: Preparation of the electrolysis baths containing rhodium salts (sulphates, phosphates, chlorides and others), as well as gold salts. No information on workplace exposure concentrations (inhalation / dermal) described in the paper (Merget, 2010).	Metal industry Car industry (catalyzer)	• Precious metal treatment • Goldsmithery	NL: no public OEL SCOEL: no OEL

7.35 5-Aminosalicylic acid (CAS 89-57-6)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Case study: occupational asthma during drug manufacturing. Challenge test was done. Sastre et al. (2010)	No exposure measurements available. Worker used dermal and respiratory protection.	Production of medicines	• Supplied but unclear whether it is produced in the Netherlands • In medicines also named Mesalazine	NL: no public OEL SCOEL: no OEL

7.36 Ready to use mixtures of powdered plant extracts: henna, guar gum, indigo, diphenylenediamine and different plant materials (CAS not applicable)

Reported health effect(s)	Exposure information	(Sector of) Use/	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Case of asthma caused by natural hair dyes (ready-to-use mixtures of powdered plant extracts: henna, guar gum, indigo, diphenylenediamine, and different plant materials). The only positive prick tests were black henna and red henna. (RNV3P database) in MODERNET	Hairdressers applying natural hair dyes. No further exposure information available.	Hair dressers	Hair dressers	NL: no public OEL for the mixture SCOEL: no OEL for the mixture

7.37 Metal fumes or dust (CAS not applicable)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Amyotrophic Lateral Sclerosis (ALS) Two clusters of ALS in France (RNV3P database). Occupational & Environmental Diseases Centre, Grenoble, France. Further studies are needed. Occupational & Environmental Diseases Centre, Grenoble, France in MODERNET.	Exposure to metal fumes or dust. No exposure information available.	Metal industry	Metal industry	NL: no public OEL for the mixture If welding fumes: 1 mg/m3 (TWA 8 h) SCOEL: no OEL for the mixture

7.38 Epoxy resins, fragrances and thiazoles (CAS not applicable)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Work-related allergic contact dermatitis increased significantly, especially those related to biocide and cosmetic exposures, as well as epoxy resins, perfumes, thiazoles (RNV3P database) I MODERNET.	No further exposure information available..	Cosmetics	Cosmetics	NL: no public OEL for the mixture SCOEL: no OEL for the mixture

7.39 Trifluoroacetic acid (CAS 76-05-1)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Case study: allergic contact dermatitis as a consequence of exposure to vapours of trifluoroacetic acid (TFA). Patch tests confirmed that TFA caused the health effect. (Byun et al, 2013)	Exposure to vapours can lead to allergic contact dermatitis. No further exposure information available.	Production of laboratory chemicals. Laboratories	• Laboratories • Laboratory chemicals	NL: no public OEL SCOEL: no OEL

7.40 Chlorhexidine diacetate (CAS 56-95-1) and chlorhexidine digluconate (CAS 18472-51-0)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Allergic contact dermatitis in health care workers. Higher prevalence than expected after chlorhexidine exposure. (Toholka and Nixon, 2013)	No exposure information available.	Health care (disinfection)	Health care	NL: no public OEL available SCOEL: no OEL available

7.41 Trichloramine (CAS 10025-85-1)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Eye and respiratory irritation for employees in poultry processing and government food inspectors (NIOSH HHE, 2012a). Besides trichloramine, also other chemicals (soluble chlorine, quaternary ammonium compound) present. NIOSH HHE (2012a)	Trichloramine is a reaction product of chlorine and urine. It is a known reaction product in swimming pools. Exposure concentration during poultry processing (NIOHS HHE 2012a): 142 samples from personal breathing zone: • 18% <MDC[15] of 15 ug/m3 • 75% MDC-MQC[16] of 15-48 ug/m3 • 1% (1 sample) > MQC of 48 ug/m3 • Geometric mean of 17.2 ug/m3. Data from indoor swimming pools: • 500 ug/m3 described as concentration at which people begin exhibiting symptoms (NIOSH HHE 2012a, based on research from Hery et.al. 1995). • 370 ug/m3 described as concentration at which teenage swimmers began exhibiting health symptoms (NIOSH HHE 2012a, based on research from Levesque et. Al. 2006).	Reaction product of chlorine and urine	Reaction product in swimming pools	NL: no public OEL SCOEL: no OEL

[15] MDC: minimum detectable concentration
[16] MQC: minimum quantifiable concentration

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
	• The World Health Organization recommends using an air trichloramine concentration of 500 µg/m3 as a provisional value to prevent symptom occurrence [WHO 2006]. Remark WHO provisional value was specified for indoor aquatic environments.			

7.42 Multiple pesticides, including well-known endocrine disrupters such as carbendazim, 2,4-dichlorophenoxyacetic acid, glyphosate, ioxynil, linuron, trifluralin and vinclozolin (CAS not applicable)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Birth defects in 2 out of 3 children of one family. The defect, Stratton Parker syndrome (congenital malformation), is rare. The family was not genetically predisposed. Mesnage et al. (2010)	Intensified exposure (mixture of chemicals resulting in synergy) Father: spraying without protection during his wives pregnancy (1.3 tonnes pesticides/y plus 300 l/y herbicides containing glyphosate). Family: close contact to father, consumption of own products from garden, pigs and poultry. Pesticide levels unknown.	Agriculture	Agriculture	NL: no public OEL for the mixture SCOEL: no OEL for the mixture

7.43 Disulfiram (CAS 97-77-8)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Disulfiram alcohol reaction (antabuse effect). Ethanol intake while on disulfiram results in accumulation of acetaldehyde, believed to contribute to the symptoms of nausea, fatigue, headache, facial flushing and palpitations. In this case, an Artist - painter using solvents such as ethanol, methanol, toluene, acetone, etc., showed the effects. Learnt from this case: caution in the use of disulfiram in conditions involving occupational exposure to solvents. Ehrlich et al. (2012)	The painter was exposed to solvents such as ethanol, methanol, toluene, acetone, etc. and showed the effects thereof. No further exposure concentrations available.	Painting while using organic solvents	No production or use	NL: no public OEL SCOEL: no OEL

7.44 Ultrafine particles (CAS not applicable)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Office workers close to laser printer showed signs of effects on health, including headaches and irritation. He et al. (2007) Morawska et al. (2009) Lee et al. (2007)	This study investigated particle numbers and PM2.5 emissions from printers. It was found that approximately 60% of the investigated printers did not emit submicrometer particles and, out of the 40% that did emit particles, 27% were high particle emitters (He et al, 2007). We have also shown, for the first time, that the particles were volatile and were of a secondary nature, being formed in the air from VOC that originated from both the paper and hot toner (Morawska, 2009). Average background-corrected eight-hour PM2.5 in the 12 photocopy centres ranged from 10 to 83 ug/m3 with an average of 40 ug/m3. (Lee et al, 2007)	Offices	Offices	NL: no specific OEL (OELs for particles not otherwise specified are applicable) SCOEL: no OEL

7.45 Glyphosate (CAS 1071-83-6)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Rhabdomyolysis (acute muscular wasting syndrome) Also cases showing a correlation between rhabdomyolysis and other pesticides (phenoxyacid herbicides and organophosphorous insecticides). Meulenbelt et al. (1988) Bradberry et al. (2000) Weng et al. (2008)	Information on inhalation and dermal exposure is minimal.	Agriculture	Use of round-up possible	NL: no public OEL SCOEL: no OEL

7.46 Dipentene and pine oil (CAS 138-86-3)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Case of contact dermatitis in an automotive mechanic who used home-made hand washing paste. He tested positive in a skin prick test with dipentene (5% in pet.) and pine oil. D'Erme et al. (2012)	Use of home-made hand washing paste containing dipentene and pine oil. No further exposure information.	Mechanics	unknown	NL: no public OEL SCOEL: no OEL

7.47 Trimethyl benzene (CAS 95-63-6)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Respiratory irritation, chemical burns and headaches, chronic bronchitis and adverse effects on the blood and central nervous systems in a drum refurbishing plant (NIOSH, HHE, 2011a)	14 samples, ranging from 2.3-150 mg/m3. One sample (150 mg/m3).	Drum refurbishing (=opknappen van vaten)	unknown	NL: 100 mg/m3 (TWA 8 h) NL: 200 mg/m3 (TWA 15 min)
				SCOEL[17]: 20 ppm (TWA 8 h)

[17] Trimethylbenzene: 1 ppm = 5,00 mg/m3

7.48 Epoxy resin (group of substances, eg bisphenol A) (CAS bisphenol A 25068-38-6)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Case study: precancerous skin lesions in an epoxy resin applicator. This case was studied among MODERNET members. The conclusion was that there is no causal relationship between exposure to epoxy resins and the precancerous skin lesions. (RNV3P, in MODERNET)	Very frequent exposure of the skin to epoxy resins during the preparation of floors.	Construction	epoxy floor coating	NL: no public OEL for the mixture
				SCOEL: no OEL for the mixture

7.49 Fluorohydrocarbons (CAS 308067-55-2)

Reported health effect(s)	Exposure information	(Sector of) Use	Production/use in the Netherlands	Occupational Exposure Limits (OELs)
Systemic scleroderma in a refrigeration technician (RNV3P, France). Systemic scleroderma, an autoimmune or connective tissue disease, characterized by thickening of the skin due to the accumulation of collagen and by injuries to the smallest arteries. There are two overlapping forms: limited cutaneous scleroderma, limited to the skin on the face, hands and feet. Diffuse cutaneous scleroderma covers more of the skin and entails the risk of progressing to the kidneys, heart, lungs and gastrointestinal tract. MODERNET members concluded: there is no causal relationship between exposure to fluorohydrocarbons and systemic scleroderma. Bonneterre et al. (2010)	Worker was exposed to fluorohydrocarbons after dismantling a fridge.	Refrigeration technician	Not likely	NL: no public OEL for the mixture SCOEL: no OEL for the mixture

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