Safety Data Sheet

According to Regulation (EU) 2015/830 of the Commission

Issue date	**05/07/2018**
Issue	**8**
Review date	***24/01/2020***
Review	***9***

Ammonia Solution (20 - < 25%)

SECTION 1	**Identification of the substance or mixture and of the company or undertaking**	
1.1	**Product identifier**	
	Product commercial name	Ammonia Solution
	Chemical name	Ammonia in solution (20 - <25% NH3)
	Other names	Ammoniacal liquor, ammonia water, aqueous ammonia
	Chemical formula	NH3+H2O
	EU index number	Not applicable
	CE No	Not applicable
	CAS No.	Not applicable
	REACH or National product registration number	Not applicable
1.2	**Relevant identified uses of the substance or mixture and uses advised against**	
	Identified uses	Fertilizer, wastewater treatment, laboratory chemical, building materials, processing aid in the food industry, processing aid in coatings, paints, solvents, ***cleaning products*** , etc.
	Uses advised against	***Any other use***
1.3	**Details of the supplier of the safety data sheet**	
	Company name	FERTIBERIA. S.A.
	Company address	Paseo de la Castellana, 259 D. Plantas 47 y 48 - 28046 Madrid
	Company telephone number	Central: 91.586.62.00; Aviles factory: 985.57.78.50; Puertollano factory: 926.44.93.00; Sagunto Factory: 962.69.90.04
	Company email for SDS	reachfertiberia@fertiberia.es
1.4	**Emergency telephone number**	Aviles factory: 985.57.78.50; Puertollano factory: 926.44.93.00; Sagunto Factory: 962.69.90.04

SECTION 2	**Hazards identification**				
2.1	**Classification of the substance or mixture***	According to Regulation EC 1272/2008 [CLP] Skin Corr. 1C; H314* Eye Dam. 1; H318 Acute Tox. 4; H302 STOT SE 3; H335 Aquatic Chronic 3; H412			
		* Note: The Skin corr. 1C corresponds to packing group III of the ADR of UN2672.			
2.2	**Label elements**	Pictograms	Signal word	Hazard statements	Precautionary Statements
			Hazard	H314 H302 H335 H412	P260 P303+P361+P353 P305+P351+P338 P310 P405 P501
2.3	**Other hazards**				
	PBT/vBvP Criteria	In accordance with appendix XIII of the Regulation (EC) no. 1907/2006, it is not PBT or vPvB since it is an inorganic substance.			
	Other hazards that do not involve product classification				
	Physical and chemical hazards	Ammonia may be released from the solution. In the open air the ammonia air mixture is generally outside flammability limits; so the risk of fire or explosion in these conditions is insignificant. In enclosed spaces the mixture may explode if in contact with a source of ignition. Containers containing the mixture may explode if subjected to fire or heating.			
	Health hazards	**Ingestion:** Ingestion will cause corrosion and damage in the gastrointestinal tract.			

*** To understand the full meaning of the hazard statements (H): see SECTION 16**

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SECTION 3	Composition/information on ingredients
3.1	***Substances*** ***Not applicable***
3.2	***Mixtures***

Name	% (w/w)	CAS No.	IUPAC name	Index No R.1272/2008	REACH Registration Number	Classification Regulation 1272/2008	Specific concentration limits
Anhydrous Ammonia	≥ 20% and < 25%	7664-41-7	Ammonia	007-001-00-5	01-2119488876-14-0038	Flam. Gas 2; H221 Press. Gas C; H280 Acute Tox. 3; H331 Skin Corr. 1B; H314 Aquatic Acute 1; H400 Aquatic Chronic 2; H411 EUH071	1.0≤C<5.0: Skin Irrit. 2; H315 C≥ 5.0: Skin Corr. 1B; H314; STOT Single Exp. 3; H335 2.5≤C<25.0: Aquatic Chronic 3; H412 C≥ 25.0: Aquatic Acute 1; H400; Aquatic Chronic 2; H411

SECTION 4	First aid measures	
4.1	Description of first aid measures	
	General	In the open air it is quite unlikely to find high concentrations of ammonia.
	Inhalation	In case of inhalation, remove casualty to fresh air and keep at rest. Victim to lie down in the recovery position, cover and keep him warm. Supply oxigen if necessary and qualified personal are present. Give artificial respiration if breathing has stopped or shows signs failure. Take victim immediately to hospital.
	Ingestion	Take victim immediately to hospital. DO NOT induce vomiting. If victim is conscious, rinse out the mouth and give two or three glasses of water or milk to drink. If victim is unconscious but breathing, oxygen or artificial respiration if needed.
	Contact with skin	Wash off with plenty of water. Take off contaminated clothing and shoes immediately and contunue to wash the affected areas. Take victim immediately to hospital.
	Contact with eyes	Rinse eyes immediately with eyewash solution or running water for at least 15 minutes. Keep eyelids open while washing,
4.2	Most important symptoms and effects, both acute and delayed	
		Eye damage effects may occur within a few days. Keep under medical observation if inhaled: pulmonary oedema or bronchial and tracheal problems may occur within 48 hours. Contaminated clothes can contain and release ammonia.
4.3	Indication of any immediate medical attention and special treatment needed	
		After sever exposure, the patient should be held under medical observation for at lest 48 hours. A pulmonary oedema may occur.

SECTION 5	Fire fighting measures	
5.1	Extinguishing media	
	Suitable extinguishing media Unsuitable extinguishing media	Suitable media may include water spray, CO2, fog or foam.
5.2	Special hazards arising from the substance or mixture	
	Special hazards	The solution is not flammable. Ammonia can be released from the solution but it is unlikely that the ammonia air mixture in the open air is within flammability limits. In confined spaces flammability limits can be reached. A closed vessel containing ammonia solution may explode if exposed to fire or heated.
	Thermal decomposition or product combustion hazards	Ammonia and nitrogen oxides can be produced.
5.3	Advice for fire fighters	
	Specific fire fighting methods	Cool containers, tanks and structures with water spray. Suppress gases/vapours/mists with a water jet spray. Avoid the inhalation of vapours or smoke coming from the fire. Approach from upwind. Keep from any possible contact with contaminated water. After the fire, proceed rapidly with cleaning of surfaces exposed to the fumes in order to limit equipment damage. Take the necessary measures so that water coming from the fire does not cause environmental damage.
	Special protective equipment for fire fighting	Wear self-contained breathing apparatus and protective suit. Fire fighter must wear fire resistant personal protective equipment. Wear chemical resistant oversuit.

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SECTION 6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Avoid contact with skin and eyes and the inhalation of vapours.
Personnel participating in a large release must wear a gas tight suit and self-contained breathing apparatus.
Approach from upwind.
Evacuate the area downstream and downwind from the point of emission whenever possible and whenever it is safe to do so. If not, stay within the area, close all windows and stop fans and electrical equipment.
Isolate the origin of the leaks and spills as rapidly as possible by trained personnel whenever it is safe to do so.
Ventilate the spill or leak area to disperse vapours.

6.2 Environmental precautions

Prevent it from reaching drainage networks and surface and deep waters, as large quantities can produce eutrophication.
Contain spills where it is possible and safe.
In case of accidental contamination of drainage networks or water courses, inform the local authorities immediately.

6.3 Methods and material for containment and cleaning up

Recover by pumping up the spill if possible.
If not, dilute with water or neutralize the spill before disposal.

6.4 Reference to other sections

See section 1 for contact data, section 8 for PPE and section 13 for waste disposal.

SECTION 7 Handling and storage

The information found in this section is generic. For each of the uses see the exposure scenarios.

7.1 Precautions for safe handling

Avoid contact with skin and eyes and the inhalation of vapours.
Provide adequate ventilation.
Use eye and hand protection when handling small quantities.
Wear protective clothing when there is a risk of splashing or spills.
Exercise caution when opening sealed containers (There may be a pressure release).

7.2 Conditions for safe storage, including any incompatibilities

Store in a cool, well ventilated area, avoiding heat sources, ignition sources and direct sunlight.
Keep away from incompatible substances (see section 10).
Protect containers from corrosion and physical damage.
Do not allow smoking in the storage area.

Recommended packaging materials: Suitable materials for containers are: carbon steel, stainless steel, polyethylene, polypropylene.

7.3 Specific end uses

See section 1.2 and appendices for exposure scenarios.

Note: stability and reactivity, see section 10

SECTION 8 Exposure controls/personal protection

8.1 Control parameters

Exposure limit values

Component	CAS	
Anhydrous ammonia	7664-41-7	ELV-DE (TWA): 8 hours exposure: 14 mg/m3 and 20 ppm ELV-ST (STEL): Short term: 36 mg/m3 and 50 ppm

Derived from the CSR

DNEL

		Worker		
	systemic	**industrial**	**professional**	**consumer**
oral	Short term long term	Not applicable	Not applicable	6.8 mg/kg bw/d
inhalation	Short term long term	47.6 mg/m3	47.6 mg/m3	23.8 mg/m3
dermal	Short term long term	6.8 mg/kg bw/d	6.8 mg/kg bw/d	68 mg/kg bw/d

PNEC

water	**air**	**soil**	**microbiological**	**sediment**	**oral**
Fresh water: 0.0011 mg/L (free ammonia) Sea water: 0.0011 mg/L Intermittent releases: 0,089 mg/L	Not available	Not required	Not required	Not required	Not required

8.2 Exposure controls

Appropriate engineering controls: Provide local exhaust ventilation where appropriate.
Safety showers and eye wash stations are provided at sites where there may be contact with eyes or skin.
Do not smoke or drink when handling.
Wash hands after handling the product and before eating, drinking or smoking.
Use the wash basin at the end of the work day.

Individual protection measures, such as personal protective equipment

Eyes	Wear chemical resistant goggles or homologated face-shield
Skin and body	Use chemical resistant protective clothing (EN 14605) and boots.
Hands	Chemical resistant gloves should always be worn when handling ammonia solution.
Respiratory	If the exposure levels exceed or may exceed the recommended exposure limits, wear adequate respiratory apparatus such as face shields equipped with K type filters, self-contained breathing apparatus, etc.
Thermal	

Environmental exposure controls: See section 6.

Advice relating to personal protection is valid for high exposure levels.
Choose personal protection equipment suitable to exposure risks.

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SECTION 9 Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance	Colourless liquid
Odour	Characteristic, pungent, suffocating.
Odour threshold	0.6 at 53 ppm, with a detected geometric average of 17 ppm.
pH	11.7 (conc. 1%)
Melting point/freezing point	-56 °C (25% NH3).
Initial boiling point and boiling range	38 °C at 101.3 kPa (25% NH3).
Flash-point	Not applicable.
Evaporation rate	Not available.
Flammability (solid, gas)	Flammability of ammonia vapours in the air is found between 16 - 26% (v/v) at room temperature ans pressure. Some ammonia solutions (e.g. 26% (w/w)) have a vapour pressure such that the equilibrium composition in the air can be within explosive limits.
Upper/lower flammability or explosive limits	For the mixture of air and dry ammonia vapours. 16 - 26 % v/v (ambient pressure and temperature) 13 - 34 % v/v (at 300 °C and atmospheric pressure) 11 - 37% v/v (at 400 °C and atmospheric pressure)
Vapour pressure at 20 °C	12 kPa (10% NH3) 48 kPa (25% NH3)
Vapour density	Not available
Liquid density	0.91 g/cm³ (25 % NH3)
Relative density	Soluble in all proportions
Partition coefficient n-octanol/water	Not applicable.
Auto-ignition temperature	651 °C (dry ammonia vapours)
Decomposition temperature	Not available
Viscosity	Not available
Explosive properties	Not explosive
Oxidising properties	Not oxidising

9.2 *Other information*

Miscibility	Alcohol, Chloroform, Ether

SECTION 10 Stability and reactivity

10.1	**Reactivity**	Thermally stable in reactive terms under designed storage conditions. Heat can cause liquid to vaporise.
10.2	**Chemical stability**	Thermally stable under normal storage conditions
10.3	**Possibility of hazardous reactions**	Under normal conditions of storage, handling and use, no hazarous reactions will be occur.
10.4	**Conditions that must be avoided**	Heat sources, direct sunlight and physical damage to the container.
10.5	**Incompatible materials**	Can react violently on contact with acid, strong oxidizers, halogens, acrolein, acrylic acid, dimethyl sulfate, silver nitrate, silver oxide, hypochlorite, mercury, etc. Ammonia solutions are corrosive to copper, zinc, aluminum and their alloys.
10.6	**Hazardous decomposition products**	If the solution is heated ammonia fumes will be given off. In case of fire, refer to section 5.

SECTION 11 Toxological information

11.1 Information on toxological effects

Acute toxicity

Component	CAS No.	Method	Species	Via	Result
Anhydrous ammonia	7664-41-7	OECD 401	rat rat rat	oral skin inhalation	LD50: 350 mg/kg bw. For an ammonia solution. LD50: Waived due to toxicity of the substance for the skin. LC50: male and female rat between 10 and 60 min: 28130 - ***13770*** mg/m3.

Skin corrosion or irritation

Component	CAS No.	Method	Species	Via	Result
Anhydrous ammonia	7664-41-7	***OECD 404***	Human	skin respiratory	Corrosive. Irritant

Severe eye damage or irritation to eyes

Component	CAS No.	Method	Species	Via	Result
Anhydrous ammonia	7664-41-7				Severe irritant. Highly corrosive to skin.

Respiratory or skin sensitisation

Component	CAS No.	Method	Species	Via	Result
Anhydrous ammonia	7664-41-7	***OECD 422***		skin respiratory	Non-sensitising. Non-sensitising.

Mutagenicity in germ cells

Component	CAS No.	Method	Species	Result
Anhydrous ammonia	7664-41-7	OECD 471 OECD 474	bacteria mammal cells	Negative. Non-mutagenic. Negative. Non-mutagenic.

Carcinogenicity

Component	CAS No.	Method	Species	Via	Result
Anhydrous ammonia	7664-41-7	OECD 453	rat	oral respiratory skin other vias	NOAEL: 67 mg/kg bw/d. Not carcinogenic. Data on the respiratory, skin and other vias is not available; research was carried out on oral vias and the carcinogenicity of the substance.

Toxicity for reproduction

Component	CAS No.	Method	Species	Via	Result
Anhydrous ammonia	7664-41-7	OECD 422	rat	oral oral respiratory	-Effects on fertility: NOAEL: 408 mg/kg bw/d. Non-toxic. -Toxicity for development: NOAEL: 100 mg/kg bw/d NOAEC: 25 mg/m3

Specific Target Organ Toxicity (STOT) - single and repeated exposure

Component	CAS No.	Method	Species	Via	Result
Anhydrous ammonia	7664-41-7				Conclusive data, but not sufficient for classification (unclassified): Sub-acute effect dose: 68 mg/kg bw/d; sub-chronic inhalative dose: 63 mg/m3

Aspiration hazards

Component	CAS No.	Method	Species	Via	Result
Anhydrous ammonia	7664-41-7				Conclusive data, but not sufficient for classification (unclassified)

SECTION 12 Ecological information

12.1 Toxicity

Water toxicity

Component	CAS No.		Fish (Oncorhyncus mykiss)	Crustaceans (Daphnia magna)	Algae (Chlorella vulgaris)
Anhydrous ammonia	7664-41-7	Short term	CL50(96h) = 0.89 mg/L of non-ionised ammonia.	CL50 (48h) = 110 mg/l	CL50 (18 days) = 2700 mg/L
		Long term	LOEC (73 days) = 0.022 mg/L	NOEC (96h) = 0.79 mg/L of non-ionised ammonia	Not available

Land Toxicity

Component	CAS No.	Macroorganisms	Microorganisms	Other organisms
Anhydrous ammonia	7664-41-7	Non-toxic	Non-toxic	Not required

Microbiological activity in waste water treatment plants

Component	CAS No.	Toxicity for aquatic microorganisms
Anhydrous ammonia	7664-41-7	Not required

12.2 Persistence and degradability

Component	CAS No.	
Anhydrous ammonia	7664-41-7	Not considered persistent and is rapidly biodegradable in aquatic systems. In abiotic environments, ammonia is assimilated by aquatic algae and macrophytes as a nitrogen source.

12.3 Bioaccumulative potential

Component	CAS No.	Octanol-water partition coefficient (Kow)	Bioconcentration factor (BCF)	Comments
Anhydrous ammonia	7664-41-7	Not applicable. Inorganic substance.	-	Ammonia is not expected to bioaccumulate. As a product of normal metabolism.

12.4 Mobility in soil

Component	CAS No.	Result
Anhydrous ammonia	7664-41-7	There is limited mobility in soil expected due to the strong absorption of ammonium ions to clay minerals and the bacterial oxidation to nitrate. Ammonia in soil is in dynamic equilibrium with nitrate and other substrates in the nitrate cycle.

12.5 Results of PBT and vPvB assessment

Not required. Inorganic substance.

12.6 Other adverse effects

No more information.

SECTION 13 Disposal considerations

13.1 Waste treatment methods

Depending on the level of contamination, eliminate as fertiliser or at an authorised waste facility. European List of Wastes: 06 02 03* Ammonium hydroxide.
Containers: Emtpy and wash. Manage as harmless waste.

SECTION 14 Transport Information

	Regulatory Information	ADR/RID	ADNR	IMDG	IATA
14.1	UN number	UN 2672			
14.2	UN proper shipping name	Ammonia solution			
14.3	Transport hazard class(es)	8			
14.4	Packing group	III			
14.5	Environmental hazards	NO			
14.6	Special precautions for user	Hazard 80 Identification Number See ADR/RID		Emergency procedures (EmS): F-A, S-B	See ICAO regulation for quantity limitation
	Label				

14,7 ***Transport in bulk according to Annex II of Marpol and the IBC Code:*** *Not applicable*

Ammonia Solution (20 - < 25%)

SECTION 15	**Regulatory information**	
15.1	**Safety, health and environmental regulations and legislation specific for the substance or mixture**	
	Regulation 2003/2003 (fertilisers) Regulation 1907/2006 (REACH) Regulation 1272/2008 (CLP) MIE-APQ 006 (Storage of corrosive liquids) R.D. 374/2001 (Chemical agents) R.D. 506/2013 (fertilizers)	
15.2	**Chemical Safety Assessment**	
	A chemical safety assessment for ammonium nitrate has been conducted	
SECTION 16	**Other information**	
	Hazard statements	H221: Flammable gas. H280: Contains gas under pressure; may explode if heated. ***H302: Harmful if swallowed.*** H314: Causes severe skin burns and eye damage. H331: Toxic if inhaled. H335: ***May cause respiratory irritation.*** H400: Very toxic to aquatic life. H411: Toxic to aquatic life with long lasting effects. ***H412: Harmful to aquatic life with long lasting effects.*** EUH071: Corrosive to the respiratory tract.
	Precautionary statements	P102: Keep out of reach of children. P210: ***Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking*** . P260: ***Do not breathe vapours*** . P273: Avoid release to the environment. P280: ***Wear protective gloves/ protective clothing/eye protection/face protection*** . P303+P361+P353: ***IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower].*** P304+P340: ***IF INHALED: Remove person to fresh air and keep comfortable for breathing.*** P305+P351+P338: IF IN EYES: Rinse continuously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing. P310: Immediately call a POISON CENTRE or doctor P377: Leaking gas fire: Do not extinguish, unless leak can be stopped safely. P403+P233: ***Store in a well-ventilated place. Keep container tightly closed.*** P405: Store locked up. P410+P403: Protect from sunlight. Store in a well ventilated place. P501: Dispose of contents/container by authorised manager.
	Bibliographical references and data sources	Anhydrous ammonia chemical safety assessment. Guidance documents EFMA/FERTILIZER EUROPE; Data for TFI HPV; NOTOX
	Abbreviations and acronyms	ELV-DE: Environmental limit value (daily exposure) ELV-ST Environmental limit value (short term) NOAEL: No observable adverse effect level LD50: Lethal dose 50% LC50: Lethal concentration 50% DNEL: Derived no effect level PNEC: Predicted no effect concentration LOEC: Lowest observed effect concentration NOEC: No observed effect concentration NOAEC: No observed adverse effect concentration
	Adequate training for workers	Obligatory training in occupational risk prevention
	Date of prior SDS	***Version 8 dated 05.07.18***
	Modifications made to present revision	***See texts with bold + italics + underline***
	Exposure scenarios 4, 5 and 6 are attached	

The information contained in this Safety Data Sheet is given in good faith. It is accurate to the best of our knowledge and belief and represents the most up to date information about the product at the time of publication. The information given in this data sheet does not constitute or replace the user's own assessment of workplace risks as required by other health and safety legislation.

Safety Data Sheet Appendices
Exposure Scenario 4

1	**Title of Exposure Scenario**
	Industrial use of anhydrous and aqueous ammonia as a processing additive, functional additive and auxiliary agent
2	**Description of activities or processes covered by the exposure scenario**

Sector of Use (SU)	SU4, SU5, SU6a, SU6b, SU8, SU9, SU13, SU15, SU16, SU 23
Product Category (PC)	PC 1, PC 9a, PC 14, PC 15, PC 16, PC 20, PC 26, PC 29, PC 30, PC 34, PC 35, PC 37, PC 39, PC 40
Process Category (PROC)	PROC 1: Use in closed processes, no likelihood of exposure PROC 2: Use in closed, continuous processes with occasional controlled exposure PROC 3: Use in closed batch processes (synthesis or formulation) PROC 4: Use in batch and other processes (synthesis) where opportunity for exposure arises PROC 5: Mixing or blending in batch processes (multistage and/or significant contact) PROC 7: Industrial spraying PROC 8b: Transfer of substances or preparations (charging/discharging) from or to vessels or large containers at non-dedicated facilities PROC 9: Transfer of substances or preparations into small containers (dedicated filling line, including weighing) PROC 10: Roller or brushing application PROC 13: Treatment of articles by dipping and pouring PROC 19: Hand mixing with intimate contact and only PPE available
Article Category (AC)	
Environmental Release Category (ERC)	ERC 4: Industrial use of processing aids in processes and products, not becoming part of articles ERC 5: Industrial use resulting in inclusion into or onto a matrix ERC 6b: Industrial use of reactive processing aids ERC 7: Industrial use of substances in closed systems

Liquid anhydrous ammonia and aqueous ammonia solutions are used in a large number of applications in various industrial sectors. Among these are end uses such as a processing aids, non-processing aids in continuous or batch processes, as well as an auxiliary agent or as a substance in a closed system. Common industrial uses of ammonia are shown in the following table:

Industrial Use	Type of use					Description of use
	Processing aid	Functional aid	Reactive processing aid	Auxiliary agent	Use in closed system	
Use as a developing agent in	X					Ammonia is used as a developing agent in photochemical processes such as printing in white or blue and the diazo copying process.
Use in cooling systems		X			X	Liquid anhydrous ammonia is used as a coolant in domestic, commercial and industrial systems due to its heat of vaporisation and its relative ease of liquefaction.
Insulating products		X				
Ink and toners	X	X				Ammonia vapours are used as a reagent in the treatment of writing and ink marks.
Coatings, thinners, paint removers	X	X				
Processing aid in the chemical industry			X			
Use as an extraction agent			X			Ammonia is used as an extraction agent in the mining industry to obtain metals such as copper, nickel and molybdenum from their ores.
Gas treatment (reduction of NOx and SOx)			X		X	Ammonia is used in emission control systems to neutralise sulphur oxides that result from burning fuels with a sulphur content, as an NOx control method in catalytic and non catalytic applications to improve the effectiveness of electrostatic precipitators for particulate control.
Processing aid			X		X	The food industry uses the ammonia as a source of nitrogen for raising and microorganisms.
Use as a neutralising agent			X		X	Ammonia is used in the petrochemical industry to neutralise acids in the crude and to protect equipment from corrosion.
Textile dyes			X			
Water treatment	X		X			Aqueous ammonia is used in water and wastewater treatment to control the pH, to regenerate ammonia exchange resins and as a neutralising agent in the treatment of boiled water. For water disinfection, aqueous ammonia is added to

						water with chlorine to produce chloramine disinfectant.
Use as a cleaning and hygiene agent	X		X			Weak ammonia solutions are extensively used in the sector by professionals and consumers as a commercial and domestic cleaner and as a detergent. Commercial ammonia cleaning products contain up to 30 percent of the substance, while domestic cleaning products contain between 5 - 10%.
Treatment of fabrics		X	X			Liquid ammonia is used to increase the quality of fabrics.
Treatment of pulp and paper		X	X			Ammonia is used in the paper industry for pulping wood and as a casein dispersant for recovering paper.
Leather treatment		X	X			Ammonia is used as a treatment in the leather industry, and as a preservative against mildew and mucus in tanning liquids, and to protect stored leather and skins.
Wood treatment	X		X			Anhydrous ammonia fumes are used to darken wood in a process called "vaporisation with ammonia".
Treatment of medical surfaces	X		X			Ammonia is used in metal treatment processes, such as nitration, carbonitriding, bright annealing, forge welding, sintering, deoxidisation with sodium hydride, welding with atomic hydrogen, and other applications in which protected environments are needed.
Treatment of rubber or latex		X	X			Concentrated aqueous ammonia is used in the rubber industry as a natural and synthetic latex preservative due to its antibacterial and alkaline properties and as a stabiliser to prevent premature coagulation ("ammoniation") of natural rubber latex.
Manufacture of semiconductors and				X		Ammonia is used in the electronics industry for the manufacture of semiconductor chips.
Adhesives, sealants	X			X		
Polymer preparations	X			X		
Air treatment products					X	
Preservatives		X				Ammonia is used as a preservative for the storage of high moisture corn.

2.1 Contributing scenario (1) controlling environmental exposure for ES 4 (Exposure Scenario 4)

Environmental exposure due to industrial uses of anhydrous and aqueous ammonia.

Section 2.1 describes environmental releases that may occur during industrial uses of anhydrous and aqueous ammonia. These releases may be in the form of wastewater or emissions to the atmosphere. If the emissions in wastewater occur at the site itself, an industrial wastewater treatment plant will be required to prevent downstream contamination.

In fact, ammonia removal in a wastewater treatment plants is highly efficient, first it is removed by nitrification to nitrate followed by denitrification and the release of nitrogen gas. If these processes are used it is considered that all the ammonia is removed from the wastewater. Emissions to the atmosphere should not exceed concentrations of 30.5 mg/m3.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a typical purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Industrial plants can use up to 25,000 tonnes a year, with a total of around 354,000 tons used in the European Union. According to the Agency's risk assessment guidance document, the default number of emission days per year for this tonnage band is 330/360.

Frequency and duration of use

Workers work standard 8-hour shifts per day and work 220 days per year. Potential exposure to ammonia during its end industrial use is generally considered to be short and limited.

Environmental factors not influenced by risk management

Flow rate of receiving water at least 18,000 m3 per day. Dilution for any wastewater treatment plant discharge to receiving waters: at least ten fold.

Other operational conditions that have an impact on environmental exposure

Workers are fully trained in the safe use of appropriate systems to prevent accidental release. Closed systems are used to prevent unintended releases.

Technical conditions and measures at process level (source) to prevent release

Transport and transfer pipelines must be sealed. There must be a wastewater treatment plant at the industrial facilities in order to prevent any environmental emissions through contaminated wastewater.

Technical on-site conditions and measures to reduce or limit emissions into water, atmosphere or soil

Wastewater must pass through the wastewater treatment plant in the plant itself for specialised removal. Emissions to air resulting from the industrial processes or from the water treatment plant should not exceed a concentration of 19.9 mg/m3 of air. This is approximately equivalent to a total loss to air of 70,000 kg/day. Sludge from the treatment plant should not be dumped on the land. Any solid waste should be sent to a landfill site, incinerator or recycling plant.

Organisational measures to prevent or limit emissions from the facility

Workers are fully trained to prevent accidental releases and exposure may be monitored to ensure that airborne concentrations are within acceptable limits.

Conditions and measures for the municipal sewage treatment plant

There must be no direct emissions to the municipal sewage treatment plant.

Conditions and measures for external treatment of waste for its disposal

Waste may be sent to an external waste treatment plant, be treated on-site or recycled by returning it to the industrial process. Sludge from the on-site treatment plant should be recycled, incinerated or sent to a landfill.

Conditions and measures for external waste recovery

No external waste recovery is planned. Waste sludge is reduced and incinerated and emissions to atmosphere are not collected.

2.2 Contributing scenario (2) controlling worker exposure for daily use in closed processes with no likelihood of exposure.

Worker exposure due to daily use in closed processes with no likelihood of exposure during industrial use.

Section 2.2 describes the potential exposure to workers during industrial use of ammonia in closed systems. Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the

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Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a normal purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Industrial plants can use up to 25000 tonnes a year, with a total of around 354,000 tons used in the European Union. According to the Agency's risk assessment guidance document, the default number of emission days per year for this tonnage band is 330.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its industrial end use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained to prevent accidental release. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Industrial end uses of the anhydrous and aqueous forms of ammonia require special equipment and high integrity containment systems that prevent the possibility of worker exposure. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for industrial workers to be exposed to ammonia during these processes is negligible, as they are located in a separate control room.

Workers may potentially be exposed to ammonia during the performance of tasks in the field (e.g. during the installation of valves, pumps or tanks, etc.). All activities are carried out in a closed system. Pipelines and vessels are sealed and isolated, and samples are taken with a closed circuit sampler. At openings and points where there may be emissions, exhaust ventilation systems are provided. Ammonia is stored in sealed tanks and containers and is transferred in contained conditions.
All technological devices have their own quality certification and are regularly controlled and maintained in order to prevent uncontrolled releases of ammonia, and points where emissions may occur are provided with exhaust ventilation. Anhydrous ammonia is stored in special tanks and containers. Ammonia is transferred under contained conditions. During maintenance tasks, a good standard of general or controlled ventilation is ensured. Protective clothing must be worn (e.g.: face and eye protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

Good practice as regards work hygiene and exposure control measures are in place to minimise the potential for worker exposure. Workers involved in the industrial end use of ammonia are well trained in these procedures and in the use of appropriate protective equipment.

2.3	**Contributing scenario (3) controlling worker exposure for daily use of the product in closed continuous processes with occasional exposure (such as sampling)**

Worker exposure due to the daily use of the product in continuous closed processes with occasional exposure (such as sampling).

Section 2.3 describes the potential exposure to workers during the industrial use of preparations of ammonia in closed systems with the potential for occasional exposure during tasks such as sampling, cleaning and maintenance. Exposure may be due to working with industrial use equipment, as well as related machinery and during sampling, routine cleaning and occasional maintenance tasks.

Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the risk of exposure to workers who carry out these tasks. The prepared solutions are stored and transported as a pressurised liquid by road, rail or sea in special, approved containers (such as tanks and tanker lorries licensed to carry ammonia).

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a typical purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Industrial plants can use up to 25,000 tonnes a year, with a total of approximately 354,000 tons used in the European Union. According to the Agency's risk assessment guidance document, the default number of emission days per year for this tonnage band is 330.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its industrial end use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained to prevent accidental release. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Industrial end uses of the anhydrous and aqueous forms of ammonia require special equipment and high integrity containment systems that prevent the possibility of worker exposure. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for industrial workers to be exposed to ammonia during these processes is negligible, as they are located in a separate control room.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, pumps or tanks, etc.). All activities are carried out in a closed system. Pipelines and vessels are sealed and isolated, samples are taken with a closed circuit sampler. At openings and points where there may be emissions, exhaust ventilation is provided. Anhydrous ammonia is stored in special tanks and containers. Ammonia is transferred under contained conditions. During maintenance tasks, a good standard of general or controlled ventilation is ensured. Protective clothing must be worn (e.g.: face and eye protection,
face and eye protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled releases of ammonia.

Good work hygiene and exposure control measures are put into practice to minimise potential worker exposure. Workers involved in the industrial use of ammonia have good training on the required procedures and the use of appropriate protective equipment.

2.4	**Contributing scenario (4) for controlling worker exposure for daily use in batch and other processes (synthesis) with some potential for exposure (such as sampling, cleaning or maintenance)**

Worker exposure due to daily use in batch and other processes (synthesis) with some potential for exposure (such as sampling, cleaning or maintenance).

Section 2.4 describes potential exposure to workers during daily use of industrial machinery, distribution pipelines and storage vessels. Potential exposure may occur during daily use, however it is more likely to occur during tasks related to its use during manufacturing by batch or other processes (synthesis), such as sampling of the intermediaries produced, charging, cleaning and routine maintenance.

Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task. Ammonia solutions are stored and transported as a pressurised liquid by road, rail or sea in special, approved containers (such as tanks and tanker lorries licensed to carry ammonia).

This contributing scenario takes into consideration potential exposure in batch and other processes and, although there is a certain exposure potential, generally the systems are in place to control any unintended ammonia releases or emissions
in the industrial facilities.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a typical purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Industrial plants can use up to 25,000 tonnes a year, with a total of approximately 354,000 tons used in the European Union. According to the Agency's risk assessment guidance document, the default number of emission days per year for this tonnage band is 330.

Ammonia Solution (20 - < 25%)

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its industrial end use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained to prevent accidental release. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Industrial end uses of the anhydrous and aqueous forms of ammonia require special equipment and high integrity containment systems that prevent the possibility of worker exposure. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for industrial workers to be exposed to ammonia during these processes is negligible, as they are located in a separate control room.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, pumps or tanks, etc.). All activities are carried out in a closed system. Pipelines and vessels are sealed and isolated, samples are taken with a closed circuit sampler. At openings and points where there may be emissions, exhaust ventilation systems are provided. Anhydrous ammonia is stored in special tanks and containers. Ammonia is transferred under contained conditions. During maintenance tasks, a good standard of general or controlled ventilation is ensured. Protective clothing must be worn (e.g.:
face and eye protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled releases of ammonia.

Good work hygiene and exposure control measures are put into practice to minimise potential worker exposure. Workers involved in the industrial use of ammonia have good training on the required procedures and the use of appropriate protective equipment.

2.5	Contributing scenario (5) controlling worker exposure for mixing and blending

Worker exposure due to mixing and blending work in batch processes during industrial use

Section 2.5 describes the potential exposure to workers during mixing and blending of ammonia compounds. Potential exposure can occur during daily use of machinery and technology associated with the mixing and blending process as part of the professional end use of ammonia.

Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task. Stock ammonia is stored and transported as a pressurised liquid by road, rail or sea in special, approved containers (such as tanks and tanker lorries licensed to carry ammonia).

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a typical purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Industrial plants can use up to 25,000 tonnes a year, with a total of approximately 354,000 tons used in the European Union. According to the Agency's risk assessment guidance document, the default number of emission days per year for this tonnage band is 330.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its industrial end use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained to prevent accidental release. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Industrial end uses of the anhydrous and aqueous forms of ammonia require special equipment and high integrity containment systems that prevent the possibility of worker exposure. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for industrial workers to be exposed to ammonia during these processes is negligible, as they are located in a separate control room.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, pumps or tanks, etc.). All activities are carried out in a closed system. Pipelines and vessels are sealed and isolated, samples are taken with a closed circuit sampler. At openings and points where there may be emissions, exhaust ventilation systems are provided. Anhydrous ammonia is stored in special tanks and containers. Ammonia is transferred under contained conditions. During maintenance tasks, a good standard of general or controlled ventilation is ensured. Protective clothing must be worn (e.g.:
protective coat or overalls) when there is any possibility that contact could occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled releases of ammonia.

Good work hygiene and exposure control measures are put into practice to minimise potential worker exposure. Workers involved in the industrial use of ammonia have good training on the required procedures and the use of appropriate protective equipment.

2.6	Contributing scenario (6) controlling worker exposure for industrial spraying

Worker exposure due to industrial spraying and air dispersion techniques.

Section 2.6 describes potential exposure to workers during industrial end use of the ammonia in spraying of ammonia or solutions with ammonia. Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a typical purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Industrial plants can use up to 25,000 tonnes a year, with a total of approximately 354,000 tons used in the European Union. According to the Agency's risk assessment guidance document, the default number of emission days per year for this tonnage band is 330.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its industrial end use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained to prevent accidental release. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed. Workers should not be directly exposed to solutions during industrial spraying.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Industrial end uses of sprayed ammonia during air dispersion techniques require special equipment and high integrity containment systems.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, pumps or tanks, etc.). Protective clothing must be worn (e.g.: face and eye protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled releases of ammonia.

Good work hygiene and exposure control measures are put into practice to minimise potential worker exposure. Workers involved in the industrial use of ammonia have good training on the required procedures and the use of appropriate protective equipment.

2.7 Contributing scenario (7) controlling worker exposure during transfer from or to vessels or large containers

Worker exposure due to the transfer of ammonia from or to vessels or large containers

Section 2.7 describes the potential exposure to workers during the filling and loading to and from vessels or large containers in dedicated and non-dedicated facilities. Exposure is most likely to occur during tasks related to the filling of the containers themselves.

Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task. Formulated aqueous ammonia is then stored and transported as a liquid in the large containers.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a typical purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Industrial plants can use up to 25,000 tonnes a year, with a total of approximately 354,000 tons used in the European Union. According to the Agency's risk assessment guidance document, the default number of emission days per year for this tonnage band is 330.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its industrial end use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained to prevent accidental release. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Industrial end uses of the anhydrous and aqueous forms of ammonia require special equipment and high integrity containment systems that prevent the possibility of worker exposure. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for industrial workers to be exposed to ammonia during these processes is negligible, as they are located in a separate control room.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, pumps or tanks, etc.). All activities are carried out in a closed system. Pipelines and vessels are sealed and isolated, samples are taken with a closed circuit sampler. At openings and points where there may be emissions, exhaust ventilation systems are provided. Anhydrous ammonia is stored in special tanks and containers. Ammonia is transferred under contained conditions. During maintenance tasks, a good standard of general or controlled ventilation is ensured. Protective clothing must be worn (e.g.: face and eye protection, safety helmet,
gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled releases of ammonia.

Good work hygiene and exposure control measures are put into practice to minimise potential worker exposure. Workers involved in the industrial use of ammonia have good training on the required procedures and the use of appropriate protective equipment.

2.8 Worker exposure during transfer in small containers

Worker exposure due to transfer in small containers in dedicated filling lines

Section 2.8 describes the potential exposure to workers during the filling of small containers in dedicated filling lines.

Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task. Formulated liquid ammonia is stored and transported as a liquid in the small containers.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a typical purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Industrial plants can use up to 25,000 tonnes a year, with a total of approximately 354,000 tons used in the European Union. According to the Agency's risk assessment guidance document, the default number of emission days per year for this tonnage band is 330.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its industrial end use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained to prevent accidental release. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Industrial end uses of the anhydrous and aqueous forms of ammonia require special equipment and high integrity containment systems that prevent the possibility of worker exposure. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for industrial workers to be exposed to ammonia during these processes is negligible, as they are located in a separate control room.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, pumps or tanks, etc.). All activities are carried out in a closed system. Pipelines and vessels are sealed and isolated, samples are taken with a closed circuit sampler. At openings and points where there may be emissions, exhaust ventilation systems are provided. Anhydrous ammonia is stored in special tanks and containers. Ammonia is transferred under contained conditions. During maintenance tasks, a good standard of
general or controlled ventilation is insured. Protective clothing must be worn (e.g.: face and eye protection, safety helmet,
gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled releases of ammonia.

Good work hygiene and exposure control measures are put into practice to minimise potential worker exposure. Workers involved in the industrial use of ammonia have good training on the required procedures and the use of appropriate protective equipment.

2.9	Contributing scenario (8) controlling worker exposure during the application of coatings by roller or brushing

Worker exposure due to the application of coatings by roller or brushing.

Section 2.9 describes the potential exposure to workers during the industrial end use of ammonia in the roller or brushing application of ammonia or of solutions with ammonia on the coating surfaces. Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a typical purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Industrial plants can use up to 25,000 tonnes a year, with a total of approximately 354,000 tons used in the European Union. According to the Agency's risk assessment guidance document, the default number of emission days per year for this tonnage band is 330.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its industrial end use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained to prevent accidental release. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Industrial end uses for ammonia by roller application or brushing require special equipment and high integrity containment systems with little or no exposure potential for workers. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for exposure to ammonia of industrial workers during these processes is negligible, as they are located in a separate control room.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, pumps or tanks, etc.). All activities are carried out in a closed system. Pipelines and vessels are sealed and isolated, samples are taken with a closed circuit sampler. At openings and points where there may be emissions, exhaust ventilation systems are provided. Anhydrous ammonia is stored in special tanks and containers. Ammonia is transferred under contained conditions. During maintenance
tasks, a good standard of general or controlled ventilation is ensured. Protective clothing must be worn (e.g.: face and eye protection,
safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled releases of ammonia.

Good work hygiene and exposure control measures are put into practice to minimise potential worker exposure. Workers involved in the industrial use of ammonia have good training on the required procedures and the use of appropriate protective equipment.

2.10	Contributory scenario (9) controlling worker exposure for treatment of articles by dipping and pouring

Worker exposure due to treatment of articles by dipping and pouring

Section 2.10 describes potential exposure to workers in the industrial end use of ammonia during the treatment of articles by dipping and pouring using ammonia or solutions with ammonia. Personal protection equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a typical purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Industrial plants can use up to 25,000 tonnes a year, with a total of approximately 354,000 tons used in the European Union. According to the Agency's risk assessment guidance document, the default number of emission days per year for this tonnage band is 330.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its industrial end use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained to prevent accidental release. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Industrial end uses of ammonia for the treatment of articles by dipping and pouring using ammonia or solutions with ammonia require special equipment and high integrity containment systems with little or no exposure potential for the workers. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for exposure to ammonia of industrial workers during these processes is negligible, as they are located in a separate control room.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, pumps or tanks, etc.). All activities are carried out in a closed system. Pipelines and vessels are sealed and isolated, samples are taken with a closed circuit sampler. At openings and points where there may be emissions, exhaust ventilation systems are provided. Anhydrous ammonia is stored in special tanks and containers. Ammonia is transferred under contained conditions. During maintenance tasks, a good standard of
general or controlled ventilation is ensured. Protective clothing must be worn (e.g.: face and eye protection, safety helmet, gloves, boots and a protective coat or overalls)
when there is any possibility that contact could occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled releases of ammonia.

Good work hygiene and exposure control measures are put into practice to minimise potential worker exposure. Workers involved in the industrial use of ammonia have good training on the required procedures and the use of appropriate protective equipment.

2.11	**Contributing scenario (11) controlling worker exposure for hand mixing with intimate contact and only PPE available.**

Worker exposure due to hand mixing with intimate contact and only PPE available.

Section 2.11 describes the potential exposure to workers during industrial use of ammonia during hand mixing of formulations (with intimate contact and using only PPE) using ammonia and ammonia solutions. Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a typical purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Industrial plants can use up to 25,000 tonnes a year, with a total of approximately 354,000 tons used in the European Union. According to the Agency's risk assessment guidance document, the default number of emission days per year for this tonnage band is 330.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its industrial end use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained to prevent accidental release. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Workers must not be directly exposed to solutions in the workplace without PPE. Generally, an exhaust ventilation system is not required.

Technical conditions and measures for controlling dispersion of the source to workers

No specific measures are required other than good industrial practice

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of mixing machinery related on the appropriate use of personal protective equipment (PPE) to avoid accidental releases or involuntary exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Hand mixing of ammonia at an industrial level is generally carried out using low consumption methods and in vessels that reduce the potential for unintended releases. The potential of industrial workers to be exposed to ammonia during these phases is, therefore, negligible, as they use personal protective equipment and low emission methods.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled releases of ammonia.

Good work hygiene and exposure control measures are put into practice to minimise potential worker exposure. Workers involved in hand mixing of ammonia and ammonia solutions have good training on the necessary procedures and the use of appropriate protective equipment.

3	**Estimation of exposure and reference to its source**

The assessment of worker exposure to anhydrous and aqueous ammonia used as an intermediate substance in chemical synthesis (ES4) was carried out for the processes relevant to this scenario and identified by the PROC codes in point 1 of this scenario and that are repeated below: Use in closed processes, no likelihood of exposure (PROC 1), use in closed, continuous processes with occasional controlled exposure (PROC 2), formulation using closed batch processes (PROC 3), use in batch or other processes with some risk of exposure (PROC 4), mixing and blending in batch processes (PROC 5), industrial spraying (PROC 7), transfer (PROC 8b), transfer of ammonia into small containers (PROC 9), brush and roller applications (PROC 10), treatment of articles by dipping and pouring (PROC 13), sample analysis (PROC 15) and hand mixing with intimate contact and using only PPE (PROC 19).

An estimate of exposure for level 1 workers was carried out using the ECETOC TRA model: ECETOC tool for risk assessment (Targeted Risk Assessment).

ECETOC TRA is used to estimate dermal exposure (expressed as a daily systemic dose in mg/kg of body weight) and exposure concentrations due to inhalation (expressed as an airborne concentration in mg/m3) associated with each process defined by PROC codes.

Exposure to workers was assessed taking into account the different work conditions that may be associated with the formulation of aqueous ammonia solutions and ammonia distribution in anhydrous form and in solution, and the impact of the various exposure control measures. Exposures were determined for tasks of 1 to 4 hours duration or more than 4 hours and assuming that the processes are carried out outdoors or indoors without the use of local exhaust ventilation (LEV) systems or indoors with the use of a local exhaust ventilation system (LEV). To reflect the use of personal protective equipment (PPE), dermal exposures were determined assuming use without gloves or with gloves affording 90% protection. To reflect the use of respiratory protective equipment (RPE), inhalation exposure concentrations were determined assuming use without respiratory protective equipment or with respiratory protective equipment affording 95% protection.

The ECETOC TRA model uses a simple algorithm to determine dermal exposure that does not take into account the physical-chemical properties of a substance. The same dermal exposures were therefore estimated for the anhydrous and aqueous forms of ammonia. The parameters used in the ECETOC TRA model to assess exposure by inhalation were: molecular weight (35 g.mol-1 and 17 g.mol-1 for the aqueous and anhydrous forms respectively), and vapour pressure (the vapour pressure for the anhydrous form of ammonia is 8.6 x 105 Pa at 20°C, while vapour pressure of a aqueous ammonia solution between 5 - < 25% by weight varies between 5 x 103 Pa and 4 x 104 Pa at 20°C). Systemic dermal exposures have been determined for a worker with a body weight of 70 kg.

For environmental emissions, to quantify the exposure values that are shown below (PEC), their complete removal was considered to take place in the plant's own wastewater treatment system.

Information for contributing scenario 1 (environmental exposure):

The following PEC values (predicted environmental concentration) are calculated using the European Computer program for environmental risk assessment of chemical substances: EUSES 2.1.

ERC	PEC - Compartment	Values
ERCs 4, 5, 6b and 7	PEC in effluent of sewage treatment works	0 (due to complete elimination)
ERCs 4, 5, 6b and 7	PEC in the aquatic compartment Fresh water	 ERC 4: 2.82 x 10- ^{3} ERC 5: 1.46 x 10- ^{3} ERC 6b: 4.54 x 10- ^{5} ERC 7: 1.46 x 10- ^{4}
	Sea water	 ERC 4: 6.06 x 10- ^{4} ERC 5: 3.17 x 10- ^{4} ERC 6b: 5.19 x 10- ^{6} ERC 7: 3.17 x 10- ^{5}
ERCs 4, 5, 6b and 7	PEC in sediments (mg/kg): Sediments in inland surface water	 ERC 4: 3.05 x 10- ^{3} ERC 5: 1.58 x 10- ^{3} ERC 6b: 4.91 x 10- ^{5} ERC 7: 1.58 x 10- ^{4}
	Marine sediments	 ERC 4: 6.56 x 10- ^{4} ERC 5: 3.43 x 10- ^{4} ERC 6b: 5.62 x 10- ^{6} ERC 7: 3.43 x 10- ^{5}
ERCs 4, 5, 6b and 7	PEC on land and groundwater	When ammonia comes into contact with the land, actinomycete bacteria and fungi convert it into ammonium (NH_4^+) through the ammonification or mineralisation process. Then, the ammonium quickly converts to nitrate. Plants absorb and use the nitrate or it returns to the atmosphere after denitrification, the metabolic reduction of nitrate to nitrogen or in nitrous oxide gas (N20). The most likely is that the ammonia ions in the earth convert to nitrates through nitrification. Therefore, it is not very likely for large quantities of ammonia to accumulate in the earth or groundwater.
ERCs 4, 5, 6b and 7	PEC in the air: annual average (mg/m^3)	ERC 4: 18 ERC 5: 9,45 ERC 6b: 0,0189 ERC 7: 0,945

The following risk characterisation ratios were obtained (RCR = PEC/PNEC):

Compartment	PEC	PNEC	PEC/PNEC	Debate
ERC 4 Fresh water (level 1)	468 mg/L (Total ammonia) 17.88 mg/L (Free ammonia)	0.0011 mg/L (Free ammonia)	16252	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)
ERC 4 Sea water (level 1)	46.8 mg/L (Total ammonia) 17.88 mg/L (Free ammonia)	0.0011 mg/L (Free ammonia)	1625	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)
ERC 4 Fresh water (level 2)	2.82 x 10^{-3} mg/L (Total ammonia) 1.08 x 10^{-4} mg/L (Free ammonia)	0.0011 mg/L (Free ammonia)	0.098	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)
ERC 4 Sea water (level 2)	6.06 x 10^{-4} mg/L (Total ammonia) 2.31 mg/L (Free ammonia)	0.0011 mg/L (Free ammonia)	0.021	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)
ERC 5 Fresh water (level 1)	234 mg/L (Total ammonia) 8.939 x 10^{-5} mg/L (Free ammonia)	0.0011 mg/L (Free ammonia)	8126	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)
ERC 5 Sea water (level 1)	23.4 mg/L (Total ammonia) 0.8939 mg/L (Free ammonia)	0.0011 mg/L (Free ammonia)	813	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)
ERC 5 Fresh water (level 2)	1.46 x 10^{-3} mg/L (Total ammonia) 5.58 x 10^{-5} mg/L (Free ammonia)	0.0011 mg/L (Free ammonia)	0.051	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)
ERC 5 Sea water (level 2)	3.17 x 10^{-4} mg/L (Total ammonia) 1.21 x 10^{-5} mg/L (Free ammonia)	0.0011 mg/L (free ammonia)	0.011	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)

ERC 6b Fresh water (level 1)	23.4 mg/L (Total ammonia) 0.8939 mg/L (Free ammonia)	0.0011 mg/L (Free ammonia)	812.6	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)
ERC 6b Sea water (level 1)	23.4 mg/L (Total ammonia) 0.8939 mg/L (Free ammonia)	0.0011 mg/L (Free ammonia)	81.262	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)
ERC 6b Fresh water (level 2)	4.54×10^{-5} mg/L (Total ammonia) 1.73×10^{-6} mg/L (Free ammonia)	0.0011 mg/L (Free ammonia)	1.58×10^{-3}	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)
ERC 6b Sea water (level 2)	5.19×10^{-6} mg/L (Total ammonia) 1.98×10^{-7} mg/L (Free ammonia)	0.0011 mg/L (Free ammonia)	1.80×10^{-4}	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)
ERC 7 Fresh water (level 1)	23.4 mg/L (Total ammonia) 0.8939 mg/L (Free ammonia)	0.0011 mg/L (Free ammonia)	812.6	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)
ERC 7 Sea water (level 1)	2.34 mg/L (Total ammonia) 0.0894 mg/L (Free ammonia)	0.0011 mg/L (Free ammonia)	81.268	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)
ERC 7 Fresh water (level 2)	1.46×10^{-4} mg/L (Total ammonia) 5.58×10^{-6} mg/L (Free ammonia)	0.0011 mg/L (Free ammonia)	5.07×10^{-3}	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)
ERC 7 Sea water (level 2)	3.17×10^{-5} mg/L (Total ammonia) 1.21×10^{-6} mg/L (Free ammonia)	0.0011 mg/L (Free ammonia)	1.10×10^{-3}	Conversion of Total ammonia to Free ammonia based on a fraction of 3.82% for a pH of 8 and 25 °C. (Reference data given in a table in EPA document EPA-600/3-79-091)

The following values for worker exposure were obtained using ECETOC TRA

Dermal exposure estimated using the ECETOC TRA model

Description of the activity	**PROC**	**Exposure assumptions**		**Estimated exposure mg/kg body weight/day**	
		Duration	**Use of ventilation**	**Without gloves**	**With gloves (90% reduction)**
Information for contributing scenario 2:					
Use in a closed process with no likelihood of exposure: storage (closed or bulk container)	PROC 1	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	**0.34**	**0.03**
Information for contributing scenario 3:					
Use in a closed continuous process with occasional controlled exposure (e.g. sampling)	PROC 2	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	1.37	0.14
			Indoors with LEV	0.14	0.01
Information for contributing scenario 4:					
Use in closed batch processes (synthesis or formulation)	PROC 3	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	0.34	0.03
		1-4 hrs or > 4 hrs	Indoors with LEV	0.03	< 0.01
Use in batch processes (synthesis) where there is a chance of exposure	PROC 4	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	6.86	0.69
		1-4 hrs or > 4 hrs	Indoors with LEV	0.69	0.07
Information for contributing scenario 5:					
Mixing in batch processes	PROC 5	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	13.71	1.37
		1-4 hrs or > 4 hrs	Indoors with LEV	0.07	0.01
Information for contributing scenario 6:					
Industrial spraying	PROC 7	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	42.86	4.29
		1-4 hrs or > 4 hrs	Indoors with LEV	2.14	0.21
Information for contributing scenario 7:					
Transfer (charging/discharging) between vessels or large containers in dedicated facilities	PROC 8b	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	6.86	0.69
			Indoors with LEV	0.69	0.07
Information for contributing scenario 8:					
Transfer to small containers	PROC 9	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	6.86	0.69
		1-4 hrs or > 4 hrs	Indoors with LEV	0.69	0.07
Information for contributing scenario 9:					
Application with roller or brush	PROC 10	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	27.43	0.14
		1-4 hrs or > 4 hrs	Indoors with LEV	1.37	10.71
Information for contributing scenario 10:					
Treatment of articles by dipping or pouring	PROC 13	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	13.71	1.37
		1-4 hrs or > 4 hrs	Indoors with LEV	0.69	0.07
Information for contributing scenario 11:					
Hand mixing with intimate contact and PPE only	PROC 19	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	141.73	14.13

Inhalation exposure estimated using the ECETOC TRA model

Description of the activity	PROC	Exposure assumptions		Anhydrous ammonia		Aqueous ammonia (5 - 25% by weight)	
				Estimated exposure concentration mg/m3			
		Duration	Use of ventilation	Without respiratory protective equipment	With respiratory protective equipment (95% reduction)	Without respiratory protective equipment	With respiratory protective equipment (95% reduction)
Information for scenario 2:							
Use in a closed process with no likelihood of exposure: storage (closed or bulk container)	PROC1	1-4 hrs or > 4 hrs	Outdoors	0	NA	0.01	NA
		1-4 hrs or > 4 hrs	Indoors without LEV	0.01	NA	0.01	NA
Information for scenario 3:							
Use in a closed continuous process with occasional controlled exposure (e.g. sampling)	PROC2	> 4 hrs	Outdoors	24.79	1.24	30.63	1.53
		> 4 hrs	Indoors without LEV	35.42	1.77	43.75	2.19
		> 4 hrs	Indoors with LEV	3.53	0.18	438	0.22
		1-4 hrs	Outdoors	14.81	0.74	18.31	0.92
		1-4 hrs	Indoors without LEV	22.25	1.06	26.25	1.31
		1-4 hrs	Indoors with LEV	2.13	0.11	2.63	0.13
Information for scenario 4:							
Use in closed batch processes (synthesis or formulation)	PROC3	> 4 hrs	Outdoors	49.51	2.48	61.23	3.06
		> 4 hrs	Indoors without LEV	70.83	3.54	87.5	4.38
		> 4 hrs	Indoors with LEV	7.08	0.35	8.75	0.44
		1-4 hrs	Outdoors	29.73	1.45	36.73	1.84
		1-4 hrs	Indoors without LEV	42.5	2.13	52.5	2.63
		1-4 hrs	Indoors with LEV	4.25	0.21	5.25	0.26
Use in batch processes (synthesis) where there is a chance of exposure	PROC4	> 4 hrs	Outdoors	49.51	2.48	61.23	3.06
		> 4 hrs	Indoors without LEV	70.83	3.54	87.5	4.38
		> 4 hrs	Indoors with LEV	7.08	0.35	8.75	0.44
		1-4 hrs	Outdoors	29.73	1.49	36.73	1.84
		1-4 hrs	Indoors without LEV	42.5	2.13	52.5	2.63
		1-4 hrs	Indoors with LEV	4.25	0.21	5.25	0.26
Information for scenario 5:							
Mixing in batch processes	PROC5	> 4 hrs	Outdoors	123.9	6.2	153.1	7.66
		> 4 hrs	Indoors without LEV	177.08	8.85	218.75	10.94
		> 4 hrs	Indoors with LEV	17.71	0.85	21.88	1.09
		1-4 hrs	Outdoors	74.31	3.72	91.81	4.55
		1-4 hrs	Indoors without LEV	106.2	5.31	131.25	6.56
		1-4 hrs	Indoors with LEV	10.63	0.53	13.13	0.66
Information for scenario 6:							
Industrial spraying	PROC7	> 4 hrs	Outdoors	NA	NA	306.2	15.3
		> 4 hrs	Indoors without LEV	NA	NA	437.5	21.88
		> 4 hrs	Indoors with LEV	NA	NA	21.88	1.09
		1-4 hrs	Outdoors	NA	NA	183.7	9.19
		1-4 hrs	Indoors without LEV	NA	NA	262.5	13.13
		1-4 hrs	Indoors with LEV	NA	NA	13.13	0.66
Information for scenario 7:							
Transfer of ammonia (charging/discharging) between vessels or large containers in dedicated facilities	PROC8b	> 4 hrs	Outdoors				
		> 4 hrs	Indoors without LEV	106.25	5.31	131.25	6.56
		> 4 hrs	Indoors with LEV	3.19	0.16	3.94	0.2
		1-4 hrs	Outdoors	44.63	2.23	55.13	2.76
		1-4 hrs	Indoors without LEV	63.75	3.19	78.75	3.94
		1-4 hrs	Indoors with LEV	1.91	0.1	236	0.12
Information for scenario 8:							
Transfer to small containers	PROC9	> 4 hrs	Outdoors	99.1	4.96	122.3	6.13
		> 4 hrs	Indoors without LEV	141.67	7.08	175	8.75
		> 4 hrs	Indoors with LEV	14.17	0.71	17.5	0.88
		1-4 hrs	Outdoors	59.5	2.98	73.5	3.68
		1-4 hrs	Indoors without LEV	85	4.25	105	5.25
		1-4 hrs	Indoors with LEV	8.5	0.43	10.5	0.53
Information for scenario 9:							
Application with roller or brush	PROC10	> 4 hrs	Outdoors	123.96	6.2	153.1	7.66
		> 4 hrs	Indoors without LEV	177.08	8.85	218.75	1094
		> 4 hrs	Indoors with LEV	17.71	0.89	21.88	1.09
		1-4 hrs	Outdoors	74.38	3.72	91.81	4.55
		1-4 hrs	Indoors without LEV	106.25	5.31	131.25	6.56
		1-4 hrs	Outdoors	10.63	0.53	13.13	0.66
Information for scenario 10:							
Treatment of articles by dipping or pouring	PROC13	> 4 hrs	Outdoors	NA	NA	153.1	7.66
		> 4 hrs	Indoors without LEV	NA	NA	218.75	1094
		> 4 hrs	Indoors with LEV	NA	NA	21.88	1.09
		1-4 hrs	Outdoors	NA	NA	91.81	4.55
		1-4 hrs	Indoors without LEV	NA	NA	131.25	6.56
		1-4 hrs	Outdoors	NA	NA	13.13	0.66
Information for scenario 11:							
Hand mixing with intimate contact and PPE only	PROC19	> 4 hrs	Outdoors	--	--	153.1	7.66
		> 4 hrs	Indoors without LEV	--	--	218.75	10.94
		1-4 hrs	Outdoors	--	--	91.83	4.59
		1-4 hrs	Indoors without LEV	--	--	131.25	6.56

Quantitative risk characterisation of dermal exposure to anhydrous or aqueous ammonia for industrial workers (in mixtures of between 5 - < 25% by weight) (ES 4: Industrial use

PROC Code	Exposure assumptions		ES 4: Exposure concentrations (EC0 mg/kg body weight/day		Acute systemic effects/ at DNEL = 6.8 mg/kg weight Risk characterisation ratio	
	Duration	Use of ventilation	Without gloves	With gloves (90% reduction)	Without gloves	With gloves (90% reduction)
Information for contributing scenario 2:						
PROC 1	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	0.34	0.03	0.05	0.01
Information for contributing scenario 3:						
PROC 2	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	1.37	0.14	0.2	0.02
		Indoors with LEV	0.14	0.01	0.02	< 0.01
Information for contributing scenario 4:						
PROC 3	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	0.34	0.03	0.05	0.01
		Indoors with LEV	0.03	< 0.01	0.01	< 0.01
PROC 4	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	6.86	0.69	1.01	0.1
		Indoors with LEV	0.69	0.07	0.1	0.01
Information for contributing scenario 5:						
PROC 5	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	13.71	1.37	2.02	0.2
		Indoors with LEV	0.07	0.01	0.01	< 0.01
Information for contributing scenario 6:						
PROC 7	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	42.86	4.29	6.3	0.63
		Indoors with LEV	2.14	0.21	0.32	0.03
Information for contributing scenario 7:						
PROC 8b	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	6.86	0.69	1.01	0.1
		Indoors with LEV	0.69	0.07	0.1	0.01
Information for contributing scenario 8:						
PROC 9	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	6.86	0.69	1.01	0.1
		Indoors with LEV	0.69	0.07	0.1	0.01
Information for contributing scenario 9:						
PROC 10	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	27.43	2.74	4.03	0.4
		Indoors with LEV	1.37	0.14	0.2	0.02
Information for contributing scenario 10:						
PROC 13	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	13.71	1.37	2.02	0.2
		Indoors with LEV	0.69	0.07	0.1	0.01
Information for contributing scenario 10:						
PROC 15	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	0.34	0.03	0.05	0.01
		Indoors with LEV	0.03	< 0.01	0.01	< 0.01
Information for contributing scenario 11:						
PROC 19	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	141.73	14.14	20.8	2.08 *
* An adjustment for a dermal exposure of 10% gives a dermal exposure of 1.41 mg/kg body weight/day, assuming that gloves are worn that afford 90% protection and the RCR = 0.2.						

Quantitative risk characterisation due to inhalation of anhydrous ammonia concentrations to which industrial workers are exposed (ES4 - industrial use)

Description of the activity	PROC	Exposure assumptions		Anhydrous ammonia Estimated exposure concentration mg/m3		Ammoniacal solutions (5-25% w/w) Estimated exposure concentration mg/m3	
		Duration	Use of ventilation	No RPE	RPE (95% reduction)	No RPE	RPE (95% reduction)
Use in closed processes, no likelihood of exposure	PROC 1	1-4 hrs or >4 hrs	Outdoor	0.00	NA	0.01	0.00
		1-4 hrs or >4 hrs	Indoor without LEV	0.01	NA	0.01	0.00
Use in closed, continuous processes with occasional controlled exposure	PROC 2	>4 hrs	Outdoor	24.79	1.24	30.63	1.53
		>4 hrs	Indoor without LEV	35.42	1.77	43.75	2.19
		>4 hrs	Indoor with LEV	3.53	0.18	4.38	0.22
		1-4 hrs	Outdoor	14.88	0.74	18.38	0.92
		1-4 hrs	Indoor without LEV	22.25	1.06	26.25	1.31
		1-4 hrs	Indoor with LEV	2.13	0.11	2.63	0.13
Use in closed batch processes (synthesis or formulation)	PROC 3	>4 hrs	Outdoor	49.58	2.48	61.25	3.06
		>4 hrs	Indoor without LEV	70.83	3.54	87.5	4.38
		>4 hrs	Indoor with LEV	7.08	0.35	8.75	0.44
		1-4 hrs	Outdoor	29.75	1.49	36.75	1.84
		1-4 hrs	Indoor without LEV	42.5	2.13	52.50	2.63
		1-4 hrs	Indoor with LEV	4.25	0.21	5.25	0.26
Use in batch and other processes (synthesis) where opportunity for exposure arises	PROC 4	>4 hrs	Outdoor	49.58	2.48	61.25	3.06
		>4 hrs	Indoor without LEV	70.83	3.54	87.5	4.38
		>4 hrs	Indoor with LEV	7.08	0.35	8.75	0.44
		1-4 hrs	Outdoor	29.75	1.49	36.75	1.84
		1-4 hrs	Indoor without LEV	42.5	2.13	52.5	2.63
		1-4 hrs	Indoor with LEV	4.25	0.21	5.25	0.26
Mixing or blending in batch processes (multistage and/or significant contact)	PROC 5	>4 hrs	Outdoor	123.96	6.20	153.13	7.66
		>4 hrs	Indoor without LEV	177.08	8.85	218.75	10.94
		>4 hrs	Indoor with LEV	17.71	0.89	21.88	1.09
		1-4 hrs	Outdoor	74.38	3.72	91.88	4.59
		1-4 hrs	Indoor without LEV	106.25	5.31	131.25	6.56
		1-4 hrs	Indoor with LEV	10.63	0.53	13.13	0.66
Transfer of substances or preparations (charging/discharging)	PROC 8a	>4 hrs	Outdoor	123.96	6.20	153.13	7.66
		>4 hrs	Indoor without LEV	177.08	8.85	218.75	10.94
		>4 hrs	Indoor with LEV	17.71	0.89	21.88	1.09

from or to vessels or large containers at non-dedicated facilities		1-4 hrs	Outdoor	74.38	3.72	91.88	4.59
		1-4 hrs	Indoor without LEV	106.25	5.31	131.25	6.56
		1-4 hrs	Indoor with LEV	10.63	0.53	13.13	0.66
Transfer of substances or preparations (charging/discharging) from or to vessels or large containers at non-dedicated facilities	PROC 8b	>4 hrs	Outdoor	74.38	3.72	91.88	4.59
		>4 hrs	Indoor without LEV	106.25	5.31	131.25	6.56
		>4 hrs	Indoor with LEV	3.19	0.16	3.94	0.20
		1-4 hrs	Outdoor	44.63	2.23	55.13	2.76
		1-4 hrs	Indoor without LEV	63.75	3.19	78.75	3.94
		1-4 hrs	Indoor with LEV	1.91	0.1	2.36	0.12
Transfer of substances or preparations into small containers (dedicated filling line, including weighing)	PROC 9	>4 hrs	Outdoor	99.17	4.96	122.50	6.13
		>4 hrs	Indoor without LEV	141.67	7.08	175.00	8.75
		>4 hrs	Indoor with LEV	14.17	0.71	17.50	0.88
		1-4 hrs	Outdoor	59.50	2.98	73.50	3.68
		1-4 hrs	Indoor without LEV	85.00	4.25	105.00	5.25
		1-4 hrs	Indoor with LEV	8.5	0.43	10.50	0.53
Application using roller or brush	PROC 10	>4 hrs	Outdoor	NA	NA	153.13	7.66
		>4 hrs	Indoor without LEV	NA	NA	218.75	10.94
		>4 hrs	Indoor with LEV	NA	NA	21.88	1.09
		1-4 hrs	Outdoor	NA	NA	91.88	4.59
		1-4 hrs	Indoor without LEV	NA	NA	131.25	6.56
		>4 hrs	Outdoor	NA	NA	13.13	0.66
Non-industrial spraying	PROC 11	>4 hrs	Outdoor	NA	NA	613.20	30.66
		>4 hrs	Indoor without LEV	NA	NA	876.00	43.80
		>4 hrs	Indoor with LEV	NA	NA	175.20	8.76
		1-4 hrs	Outdoor	NA	NA	367.92	18.40
		1-4 hrs	Indoor without LEV	NA	NA	525.60	26.28
		>4 hrs	Outdoor	NA	NA	105.12	5.26
Treatment of articles by dipping and pouring	PROC 13	>4 hrs	Outdoor	123.96	6.20	153.13	7.66
		>4 hrs	Indoor without LEV	177.08	8.85	218.75	10.94
		>4 hrs	Indoor with LEV	17.71	0.89	21.88	1.09
		1-4 hrs	Outdoor	74.38	3.72	91.88	4.59
		1-4 hrs	Indoor without LEV	106.25	5.31	131.25	6.56
		1-4 hrs	Indoor with LEV	10.63	0.53	13.13	0.66
Use as laboratory reagents	PROC 15	>4 hrs	Indoor without LEV	35.42	1.77	43.75	2.19
		>4 hrs	Indoor with LEV	3.54	0.18	4.38	0.22
		1-4 hrs	Indoor without LEV	21.25	1.06	26.25	1.31
		1-4 hrs	Indoor with LEV	2.13	0.11	2.63	0.13
Hand mixing with intimate contact and only PPE available	PROC 19	<4 hrs	Outdoor	NA	NA	153.13	7.66
		<4 hrs	Indoor without LEV	NA	NA	218.75	10.94
		1-4 hrs	Outdoor	NA	NA	91.88	4.59
		1-4 hrs	Indoor without LEV	NA	NA	131.25	6.56
Heat and pressure transfer fluids in dispersive but closed systems; professional use	PROC 20	>4 hrs	Outdoor	24.79	1.24	30.63	1.53
		>4 hrs	Indoor without LEV	35.42	1.77	43.75	2.19
		>4 hrs	Indoor with LEV	7.08	0.35	8.75	0.44
		1-4 hrs	Outdoor	14.88	0.74	18.38	0.92
		1-4 hrs	Indoor without LEV	21.25	1.06	26.25	1.31
		1-4 hrs	Indoor with LEV	4.25	0.21	5.25	0.26

Quantitative risk characterisation due to inhalation of aqueous ammonia concentrations (in mixtures of 5- < 25% by weight) to which industrial workers are exposed (ES4 - industrial use)

PROC Code	Exposure assumptions		ES 4: Exposure concentrations (EC) mg/m³		Acute systemic effects/long term DNEL = 47.6 mg/m3		Acute local effects DNEL = 36 mg/m3		Long term local effects DNEL = 14 mg/m3	
					RCR		RCR		RCR	
	Duration	Use of ventilation	No RPE	RPE (95% reduction)	No RPE	RPE (95% reduction)	No RPE	RPE (95% reduction)	No RPE	RPE (95% reduction)
PROC 1	1-4 hrs or > 4 hrs	Outdoors	0	NA	< 0.01	NA	< 0.01	NA	< 0.01	NA
		Indoors without LEV	0.01	NA	< 0.01	NA	< 0.01	NA	< 0.01	NA
PROC 2	> 4 hrs	Outdoors	30.63	1.53	0.64	0.03	0.85	0.04	2.19	0.11
		Indoors without LEV	43.75	2.19	0.92	0.05	1.22	0.06	3.13	0.16
		Indoors with LEV	4.38	0.22	0.09	0	0.12	0.01	0.31	0.02
	1-4 hrs	Outdoors	18.38	0.92	0.39	0.02	0.51	0.03	1.31	0.07
		Indoors without LEV	26.25	1.31	0.55	0.03	0.73	0.04	1.88	0.09
		Indoors with LEV	2.63	0.13	0.06	0	0.07	< 0.01	0.19	0.01
PROC 3	> 4 hrs	Outdoors	61.21	3.06	1.29	0.06	1.7	0.09	4.38	0.22
		Indoors without LEV	87.5	4.38	1.84	0.09	2.43	0.12	6.25	0.31
		Indoors with LEV	8.75	0.44	0.18	0.01	0.24	0.01	0.63	0.03
	1-4 hrs	Outdoors	36.75	1.84	0.77	0.04	1.02	0.05	2.63	0.13
		Indoors without LEV	52.5	2.63	1.1	0.06	1.46	0.07	3.75	0.19
		Indoors with LEV	5.25	0.26	0.11	0.01	0.15	0.01	0.38	0.02
PROC 4	> 4 hrs	Outdoors	61.25	3.06	1.29	0.06	1.7	0.09	4.38	0.22
		Indoors without LEV	87.5	4.38	1.84	0.09	2.43	0.12	6.25	0.31
		Indoors with LEV	8.75	0.44	0.18	0.01	0.24	0.01	0.63	0.03
	1-4 hrs	Outdoors	36.75	1.84	0.77	0.04	1.02	0.05	2.63	0.13
		Indoors without LEV	52.5	2.63	1.1	0.06	1.46	0.07	3.75	0.19
		Indoors with LEV	5.25	0.26	0.11	0.01	0.15	0.01	0.38	0.02
PROC 5	> 4 hrs	Outdoors	153.13	7.66	3.22	0.16	4.25	0.21	10.94	0.55
		Indoors without LEV	218.75	10.94	4.6	0.23	6.08	0.3	15.63	0.78
		Indoors with LEV	21.88	1.09	0.46	0.02	0.61	0.03	156	0.08
	1-4 hrs	Outdoors	91.88	4.59	1.93	0.1	2.55	0.13	6.56	0.33
		Indoors without LEV	131.25	6.56	2.76	0.14	3.65	0.18	9.38	0.47
		Indoors with LEV	13.13	0.66	0.28	0.01	0.36	0.02	0.94	0.05
PROC 7	> 4 hrs	Outdoors	306.25	15.31	6.43	0.32	8.51	0.43	21.88	1.09
		Indoors without LEV	437.5	21.88	9.19	0.46	12.15	0.61	31.25	1.56
		Indoors with LEV	21.88	1.09	0.46	0.02	0.61	0.03	1.56	0.08
	1-4 hrs	Outdoors	183.75	9.19	3.86	0.19	5.1	0.26	13.13	0.66

	1-4 hrs	Outdoors	183.75	9.19	3.86	0.19	5.1	0.26	13.13	0.66
		Indoors without LEV	262.5	13.13	5.51	0.28	7.29	0.36	18.75	0.94
		Indoors with LEV	13.13	0.66	0.28	0.01	0.36	0.02	0.94	0.05
PRO C 8b	> 4 hrs	Outdoors	91.88	4.59	1.93	0.1	2.55	0.13	6.56	0.33
		Indoors without LEV	131.25	6.56	2.76	0.14	3.65	0.18	9.38	0.47
		Indoors with LEV	3.94	0.2	0.08	0	0.11	0.01	0.28	0.01
	1-4 hrs	Outdoors	55.13	2.76	1.16	0.06	1.53	0.08	3.94	0.2
		Indoors without LEV	78.75	3.94	1.65	0.08	2.19	0.11	5.63	0.28
		Indoors with LEV	2.36	0.12	0.05	0	0.07	< 0.01	0.17	0.01
PRO C 9	> 4 hrs	Outdoors	122.5	6.13	2.57	0.13	3.4	0.17	8.75	0.44
		Indoors without LEV	175	8.75	3.68	0.18	4.86	0.24	12.5	0.63
		Indoors with LEV	17.5	0.88	0.37	0.02	0.49	0.02	1.25	0.06
	1-4 hrs	Outdoors	73.5	3.68	1.54	0.08	2.04	0.1	5.25	0.26
		Indoors without LEV	105	5.25	2.21	0.11	2.92	0.15	7.5	0.38
		Indoors with LEV	10.5	0.53	0.22	0.01	0.29	0.01	0.75	0.04
PRO C 10	> 4 hrs	Outdoors	153.13	7.66	3.22	0.16	4.25	0.21	10.94	0.55
		Indoors without LEV	218.75	10.94	4.6	0.23	6.08	0.3	15.63	0.78
		Indoors with LEV	21.88	1.09	0.46	0.02	0.61	0.03	1.56	0.08
	1-4 hrs	Outdoors	91.88	4.59	1.93	0.1	2.55	0.13	6.56	0.33
		Indoors without LEV	131.25	6.56	2.76	0.14	3.65	0.18	9.38	0.47
		Indoors with LEV	13.13	0.66	0.28	0.01	0.36	0.02	0.94	0.05
PRO C 13	> 4 hrs	Outdoors	153.13	7.66	3.22	0.16	4.25	0.21	10.94	0.55
		Indoors without LEV	218.75	10.94	4.6	0.23	6.08	0.3	15.63	0.78
		Indoors with LEV	21.88	1.09	0.46	0.02	0.61	0.03	1.56	0.08
	1-4 hrs	Outdoors	91.88	4.59	1.93	0.1	2.55	0.13	6.56	0.33
		Indoors without LEV	131.25	6.56	2.76	0.14	3.65	0.18	9.38	0.47
		Indoors with LEV	13.13	0.66	0.28	0.01	0.36	0.02	0.94	0.05
PRO C 19	> 4 hrs	Outdoors	153.13	7.66	3.22	0.16	4.25	0.21	10.94	0.55
		Indoors without LEV	218.75	10.94	4.6	0.23	6.08	0.3	15.63	0.78
	1-4 hrs	Outdoors	91.88	4.59	1.93	0.1	2.55	0.13	6.56	0.33
		Indoors without LEV	131.25	6.56	2.76	0.14	3.65	0.18	9.38	0.47

4 Guidance for intermediate users to assess if they working within the limits set by the ES

Emissions into the environment:

To work within the exposure scenario limits (ES), the following conditions must be complied with:

- Local emissions to the atmosphere lower than 70,000 kg/day.
- When a wastewater treatment system is used in the plant, the resulting sludge should not be spread on soil.
- Emissions should be completely removed from wastewater.
- The waste may be treated externally, in the treatment plant or may be recycled in the industrial process.
- It must be ensured that measured emissions result in concentrations in the environment that are lower that the relevant PNEC.
- Laboratory wastewater must not be discharged to municipal sewage plants.

Worker exposure:

To work within the exposure scenario limits (ES), the following conditions must be complied with:

- When natural ventilation is inadequate indoors, a local exhaust ventilation (LEV) system must be installed.
- When there is a dermal exposure risk, gloves with a minimum efficiency of 90% and respiratory protective equipment with an efficiency of 95% must be used.
- Regular medical monitoring should be carried out in order to determine potential exposure levels.
- Protective clothing must be worn (e.g.: face and eye protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.
- All technological devices must have a proper quality certification, and be regularly controlled and maintained to avoid the uncontrolled release of ammonia.
- Workers must be fully trained.
- Any measurement of worker exposure must be confirmed as being lower than the relevant DNEL, as stated in section 3.

Safety Data Sheet Appendices
Exposure Scenario 5

1	**Title of Exposure Scenario**	
	Wide, dispersive professional use of anhydrous ammonia and aqueous ammonia	
2	**Description of activities or processes covered by the exposure scenario**	
	Sector of Use (SU)	SU1, SU4, SU5, SU6a, SU8, SU9, SU10, SU11, SU12, SU15, SU16, SU23, SU24
	Product Category (PC)	PC 9a, PC 12, PC 14, PC 15, PC 16, PC 19, PC 20, PC 21, PC 29, PC 30, PC 37, PC 40
	Process Category (PROC)	PROC 1: Use in closed processes, no likelihood of exposure PROC 2: Use in closed, continuous processes with occasional controlled exposure PROC 3: Use in closed batch processes (synthesis or formulation) PROC 4: Use in batch and other processes (synthesis) where opportunity for exposure arises PROC 5: Mixing or blending in batch processes (multistage and/or significant contact) PROC 8a: Transfer of substances or preparations (charging/discharging) from or to vessels or large containers at non-dedicated facilities PROC 8b: Transfer of substances or preparations (charging/discharging) from or to vessels or large containers at non-dedicated facilities PROC 9: Transfer of substances or preparations into small containers (dedicated filling line, including weighing) PROC 10: Roller or brushing application PROC 11: Non industrial spraying PROC 13: Treatment of articles by dipping and pouring PROC 15: Use as laboratory reagents PROC 19: Hand mixing with intimate contact and only PPE available PROC 20: Heat and pressure transfer fluids in dispersive but closed systems for professional use
	Article Category (AC)	
	Environmental Release Category (ERC)	ERC 8b: Wide dispersive indoor use of reactive substances in open systems ERC 8e: Wide dispersive outdoor use of reactive substances in open systems ERC 8f: Wide dispersive outdoor use resulting in inclusion into or onto a matrix ERC 9a: Wide dispersive indoor use of substances in closed systems ERC 9b: Wide dispersive outdoor use of substances in closed systems
	Professionals use liquid anhydrous ammonia (> 95.5% by weight) and aqueous ammonia solution (5 - < 25% by weight) in a very wide range of applications. The most common applications of ammonia are as follows: use as a laboratory chemical, a refrigerant in cooling systems, a water treatment chemical, fertiliser, a coating, paint thinner or remover, a photochemical, cleaning products, a product for treating leather or other surfaces, a pH regulator or neutralisation agent and a processing aid in the food industry. Typical activities associated with professional uses of ammonia where exposure may occur include: working with equipment that contains ammonia (such as opening and shut-off valves), transferring ammonia between storage vessels using pipelines or hoses, maintaining equipment and applying ammonia-based products (fertilisers, cleaning or surface treatment products). Operating conditions of the various professional use scenarios of anhydrous ammonia and aqueous forms of ammonia vary considerably from one application to another. Therefore, in this exposure scenario it is impossible to carry out a complete characterisation of the frequency and duration of the tasks. In order to estimate worker exposure, operating conditions have been represented in a general way assuming that the tasks may last from 1 to 4 hours or more than 4 hours and that the processes may be carried out outdoors, or indoors with or without exhaust ventilation. These assumptions cover the broad range of tasks associated with the professional uses of ammonia.	
2,1	**Contributing scenario (1) controlling environmental exposure for ES 5 (Exposure Scenario 5)**	

Environmental exposure due to wide dispersive professional uses of anhydrous and aqueous ammonia.

Section 2.1 describes environmental releases that may occur during wide dispersive professional uses of anhydrous and aqueous ammonia. These releases may be in the form of wastewater or emissions to the atmosphere. Due to the wide dispersive nature of these uses, it is expected that emissions from local sources will be low and significant concentrations in the environment are not expected.

Low-level emissions may be outdoor or indoor and may be directed to the atmosphere or to the municipal sewage treatment plant. In fact, removing ammonia in municipal sewage treatment plants is very efficient as ammonia solutions are readily biodegradable.

The majority of ammonia in the environment comes from natural sources, particularly decomposing organic material.
The wide, dispersive professional uses of ammonia are diverse and widespread. The resulting environmental exposure is not expected to add significantly to existing levels of ammonia in the environment. Therefore, an additional assessment of environmental exposure has not been given in section 3.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a normal purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

A very small amount used at a local level is expected for professional use, with use very widespread throughout the EU.

Frequency and duration of use

Variable low-level use.

Environmental factors not influenced by risk management

Large regional dilution and wide dispersive pattern of use.

Other operational conditions that have an impact on environmental exposure

Professional workers must be informed to prevent accidental release. Close systems are used in articles (for example fridges) to prevent unintended emissions.

Technical conditions and measures at process level (source) to prevent release

Closed articles for long life use

Technical on-site conditions and measures to reduce or limit emissions into water, atmosphere or soil

Nothing more specific is required than the standard good practice of professionals.

Organisational measures to prevent or limit emissions from the facility

Workers are fully trained to prevent accidental releases.

Conditions and measures for the municipal sewage treatment plant

Small local and low-level emissions can be sent to the municipal sewage treatment plant, where its removal tends to be efficient, due to the readily biodegradable nature of low concentration ammonia solutions.

Conditions and measures for external treatment of waste for its disposal

Any waste (such as empty bottles or old fridges and cooling systems) should be sent to a landfill site or to specialised disposal facilities.

Conditions and measures for external waste recovery

No external ammonia waste re-use is envisaged.

2.2	Contributing scenario (2) controlling worker exposure for daily use in closed processes with no likelihood of exposure.

Worker exposure due to daily use in closed processes with no likelihood of exposure during professional use processes.

Section 2.2 describes the potential exposure to workers during professional use of ammonia as an intermediate substance in closed systems. Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a normal purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Small quantities are expected to be used in professional businesses each year. Significant tonnages are not expected for professional use, as use is wide and dispersive.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its professional use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when natural ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for professional end use and on the appropriate use of personal protective equipment (PPE) to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Professional end uses of anhydrous and aqueous forms of ammonia are diverse, generally they should be carried out using specific containment systems with little or no potential for worker exposure. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for exposure of professionals to ammonia during these processes is negligible, as they are located in a separate control room.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, spraying equipment, pumps or tanks, or during mixing). At openings and points where there may be emissions, exhaust ventilation systems are provided. Anhydrous ammonia is stored in special tanks and containers. During maintenance tasks, a good standard of general or controlled ventilation is ensured. Protective clothing must be worn
(e.g.: face and eye protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled
ammonia.

Good practice as regards work hygiene and exposure control measures are in place to minimise the potential for worker
exposure. Workers involved in the wide dispersive professional uses of ammonia are well trained in these procedures and in the use of appropriate
protective equipment.

2.3	Contributing scenario (3) controlling worker exposure for the daily use of the product in closed continuous processes with occasional exposure (such as sampling)

Worker exposure due to the daily use of the product in continuous closed processes with occasional exposure (such as sampling).

Section 2.3 describes the potential exposure to workers during the professional use of preparations of ammonia from the operation of closed systems with the potential for occasional exposure during tasks such as sampling, cleaning and maintenance. Exposure may be due to working with professional use equipment, as well as related machinery and during sampling and routine cleaning and occasional maintenance tasks.

Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the risk of exposure to workers who carry out these tasks. The prepared solutions are stored and transported as a pressurised liquid by road, rail or sea in special, approved containers (such as tanks and tanker lorries licensed to carry ammonia).

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a normal purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Small quantities are expected to be used in professional businesses each year. Significant tonnages are not expected for professional use, as use is wide and dispersive.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its professional use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for professional end use and on the appropriate use of personal protective equipment (PPE) to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Professional end uses of anhydrous and aqueous forms of ammonia are diverse, generally they should be carried out using specific containment systems with little or no potential for worker exposure. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for exposure of professionals to ammonia during these processes is negligible, as they are located in a separate control room.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, spraying equipment, pumps or tanks, or during mixing). At openings and points where there may be emissions, exhaust ventilation systems are provided. Anhydrous ammonia is stored in special tanks and containers. During maintenance tasks, a good standard of general or controlled ventilation is ensured. Protective clothing must be worn (e.g.: face and eye protection, safety helmet, gloves, boots and a protective coat or overalls)
when there is any possibility that contact could occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled
ammonia.

Good practice as regards work hygiene and exposure control measures are in place to minimise the potential for worker
exposure. Workers involved in the wide dispersive professional uses of ammonia are well trained in these procedures and in the use of appropriate
protective equipment.

2.4	**Contributing scenario (4) for controlling worker exposure for daily use in batch and other processes (synthesis) with some potential for exposure (such as sampling, cleaning or maintenance)**

Worker exposure due to daily use in batch and other processes (synthesis) with some potential for exposure (such as sampling, cleaning or maintenance).

Section 2.4 describes potential exposure to workers during daily use of professional machinery, distribution pipelines and storage vessels. Exposure may occur during daily use, although it is more likely to occur during tasks related to batch or other processes, such as cleaning and routine maintenance.

Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task. Ammonia solutions are stored and transported as a pressurised liquid by road, rail or sea in special, approved containers (such as tanks and tanker lorries licensed to carry ammonia).

This contributing scenario takes into consideration potential exposure in batch and other processes and, although there is a certain exposure potential, generally the systems are in place to control any unintended ammonia releases or emissions in industrial facilities.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a normal purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Small quantities are expected to be used in professional businesses each year. Significant tonnages are not expected for professional use, as use is wide and dispersive.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its professional use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for professional end use and on the appropriate use of personal protective equipment (PPE) to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Professional end uses of anhydrous and aqueous forms of ammonia are diverse, generally they should be carried out using specific containment systems with little or no potential for worker exposure. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for exposure of professionals to ammonia during these processes is negligible, as they are located in a separate control room.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, spraying equipment, pumps or tanks, or during mixing). At openings and points where there may be emissions, exhaust ventilation systems are provided. Anhydrous ammonia is stored in special tanks and containers. During maintenance tasks, a good standard of general or controlled ventilation is ensured. Protective clothing must be worn
(e.g.: face and eye protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled
ammonia.

Good practice as regards work hygiene and exposure control measures are in place to minimise the potential for worker
exposure. Workers involved in the wide dispersive professional uses of ammonia are well trained in these procedures and in the use of appropriate
protective equipment.

2.5	**Contributing scenario (5) controlling worker exposure for mixing and blending**

Worker exposure due to mixing and blending work in batch processes during professional use

Section 2.5 describes the potential exposure to workers during mixing and blending of ammonia compounds. Potential exposure can occur during daily use of machinery and technology associated with the mixing and blending process as part of the professional end use of ammonia.

Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task. Stock ammonia is stored and transported as a pressurised liquid by road, rail or sea in special, approved containers (such as tanks and tanker lorries licensed to carry ammonia).

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a normal purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Small quantities are expected to be used in professional businesses each year. Significant tonnages are not expected for professional use, as use is wide and dispersive.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its professional use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for professional end use and on the appropriate use of personal protective equipment (PPE) to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Professional end uses of anhydrous and aqueous forms of ammonia are diverse, generally they should be carried out using specific containment systems with little or no potential for worker exposure. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for exposure of professionals to ammonia during these processes is negligible, as they are located in a separate control room.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, spraying equipment, pumps or tanks, or during mixing). At openings and points where there may be emissions, exhaust ventilation systems are provided. Anhydrous ammonia is stored in special tanks and containers. During maintenance tasks, a good standard of general or controlled ventilation is ensured. Protective clothing must be worn
(e.g.: face and eye protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled
ammonia.

Good practice as regards work hygiene and exposure control measures are in place to minimise the potential for worker
exposure. Workers involved in the wide dispersive professional uses of ammonia are well trained in these procedures and in the use of appropriate
protective equipment.

2.6	Contributing scenario (6) controlling worker exposure during transfer from or to vessels or large containers

Worker exposure due to the transfer of ammonia from or to vessels or large containers

Section 2.6 describes the potential exposure to workers during the filling and charging between containers or large vessels using dedicated and non dedicated pipelines. Exposure is most likely to occur during tasks related to the filling of the containers or vessels themselves.

Personal protection equipment (PPE) is available and control parameters are in place to reduce the exposure risk to workers that carry out this task.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a normal purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Small quantities are expected to be used in professional businesses each year. Significant tonnages are not expected for professional use, as use is wide and dispersive.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its professional use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for professional end use and on the appropriate use of personal protective equipment (PPE) to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Professional end uses of anhydrous and aqueous forms of ammonia are diverse, generally they should be carried out using specific containment systems with little or no potential for worker exposure. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for exposure of professionals to ammonia during these processes is negligible, as they are located in a separate control room.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, spraying equipment, pumps or tanks, or during mixing). At openings and points where there may be emissions, exhaust ventilation systems are provided. Anhydrous ammonia is stored in special tanks and containers. During maintenance tasks, a good standard of general or controlled ventilation is ensured. Protective clothing must be worn
(e.g.: face and eye protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled
ammonia.

Good practice as regards work hygiene and exposure control measures are in place to minimise the potential for worker
exposure. Workers involved in the wide dispersive professional uses of ammonia are well trained in these procedures and in the use of appropriate
protective equipment.

2.7	Contributing scenario (7) controlling worker exposure during transfer in small containers

Worker exposure due to transfer in small containers in dedicated filling lines

Section 2.7 describes the potential exposure to workers during the filling of small containers in dedicated filling lines.

Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a normal purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Ammonia Solution (20 - < 25%)

Small quantities are expected to be used in professional businesses each year. Significant tonnages are not expected for professional use, as use is wide and dispersive.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its professional use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for professional end use and on the appropriate use of personal protective equipment (PPE) to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Professional end uses of anhydrous and aqueous forms of ammonia are diverse, generally they should be carried out using specific containment systems with little or no potential for worker exposure. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for exposure of professionals to ammonia during these processes is negligible, as they are located in a separate control room.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, spraying equipment, pumps or tanks, or during mixing). At openings and points where there may be emissions, exhaust ventilation systems are provided. Anhydrous ammonia is stored in special tanks and containers. During maintenance tasks, a good standard of general or controlled ventilation is ensured. Protective clothing must be worn
(e.g.: face and eye protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled
ammonia.

Good practice as regards work hygiene and exposure control measures are in place to minimise the potential for worker
exposure. Workers involved in the wide dispersive professional uses of ammonia are well trained in these procedures and in the use of appropriate
protective equipment.

2.8	Contributing scenario (8) controlling worker exposure during the application of coatings by roller or brushing

Worker exposure due to the application of coatings by roller or brush.

Section 2.8 describes the potential exposure to workers during the professional end use of ammonia in the roller or brushing application of ammonia or of solutions with ammonia on the coating surfaces. Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a normal purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Small quantities are expected to be used in professional businesses each year. Significant tonnages are not expected for professional use, as use is wide and dispersive.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its professional use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for professional end use and on the appropriate use of personal protective equipment (PPE) to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Professional end uses involving ammonia application on coatings by roller or brushing require special equipment and high integrity containment systems that prevent the possibility of worker exposure. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for exposure of professionals to ammonia during these processes is negligible, as they are located in a separate control room.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, spraying equipment, pumps or tanks, or during mixing). At openings and points where there may be emissions, exhaust ventilation systems are provided. Anhydrous ammonia is stored in special tanks and containers. During maintenance tasks, a good standard of general or controlled ventilation is ensured. Protective clothing must be worn
(e.g.: face and eye protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled
ammonia.

Good practice as regards work hygiene and exposure control measures are in place to minimise the potential for worker
exposure. Workers involved in the wide dispersive professional uses of ammonia are well trained in these procedures and in the use of appropriate
protective equipment.

2.9	Contributing scenario (9) controlling worker exposure during professional spraying

Worker exposure due to professional spraying and air dispersion techniques.

Section 2.9 describes potential worker exposure during professional end use of ammonia in spraying of ammonia or solutions with ammonia. Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a typical purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Small quantities are expected to be used in professional businesses each year. Significant tonnages are not expected in the workplace, as use is wide and dispersive.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its industrial end use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained to prevent accidental release. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed. Workers should not be directly exposed to solutions during professional spraying.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for professional use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Professional end uses of sprayed ammonia using air dispersion techniques require special equipment and high integrity containment systems.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, pumps or tanks, etc.). Protective clothing must be worn (e.g.: face and eye protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled releases of ammonia.

Good work hygiene and exposure control measures are put into practice to minimise potential worker exposure. Workers involved in the industrial use of ammonia have good training on the required procedures and the use of appropriate protective equipment.

2.10	**Contributory scenario (10) controlling worker exposure for treatment of articles by dipping and pouring**

Worker exposure due to treatment of articles by dipping and pouring

Section 2.10 describes potential exposure to workers in the professional end use of ammonia during the treatment of articles by dipping and pouring using ammonia or solutions with ammonia. Personal protection equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a normal purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Small quantities are expected to be used in professional businesses each year. Significant tonnages are not expected for professional use, as use is wide and dispersive.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its professional use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.
Workers should not be directly exposed to solutions for article treatment.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for professional end use and on the appropriate use of personal protective equipment (PPE) to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Professional end uses of ammonia for treatment of articles by dipping or pouring require special equipment and high integrity containment systems that prevent the possibility of worker exposure. Facilities may be located outdoors with workers isolated in separate control rooms with no direct contact with the chemical processing units. The potential for exposure of professionals to ammonia during these processes is negligible, as they are located in a separate control room.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, spraying equipment, pumps or tanks, or during mixing). At openings and points where there may be emissions, exhaust ventilation systems are provided. Anhydrous ammonia is stored in special tanks and containers. During maintenance tasks, a good standard of general or controlled ventilation is ensured. Protective clothing must be worn
(e.g.: face and eye protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled
ammonia.

Good practice as regards work hygiene and exposure control measures are in place to minimise the potential for worker
exposure. Workers involved in the wide dispersive professional uses of ammonia are well trained in these procedures and in the use of appropriate
protective equipment.

2.11	**Contributing scenario (11) controlling worker exposure in the laboratory**

Worker exposure due to ammonia use in laboratories (on a small-scale, not industrial).

Section 2.11 describes the potential exposure to workers during the use of ammonia in the laboratory, especially during the filling of small flasks and vessels using non-dedicated filling lines or small-scale transfer methods.

For dedicated small-scale laboratories, personal protection equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a normal purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: verified values for solubility in water are between 48200 - 53100 mg/L. Anhydrous ammonium is considered flammable.

During laboratory use, aqueous ammonium solutions with concentrations of 5 - < 25% are the most likely to be encountered. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable. This aqueous ammonia is the most likely to cause potential exposure in this scenario.

Quantities used

The quantities used in the professional settings are normally small, less than 1 litre or 1 kilogram at each site. According to the Agency's risk assessment guidance document, the default number of emission days per year for this tonnage band is 330, although the actual emission of ammonia is usually lower in practice.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its industrial end use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

For indoor laboratory use of ammonia, exhaust ventilation must be installed. Personal protective equipment is also used to minimise the potential for dermal exposure during the transfer process. Respiratory protective equipment is provided when required.

Technical conditions and measures at process level (source) to prevent release

During laboratory use, there may or may not be a local exhaust ventilation system in place (see section 3 for relevant exposure levels in these cases).
All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled releases of ammonia.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system must be in place during indoor operations when natural ventilation is inadequate or in enclosed areas.

Organisational measures to prevent or limit releases, dispersion and exposure

Laboratory workers must trained in the safe use of chemical compounds in general and in the use of personal protective equipment suitable for preventing accidental releases or exposure.

Conditions and measures for personal protection, hygiene and health evaluation

Workers may be exposed to ammonia during laboratory use when filling vessels or during transfers. At openings and points where there may be emissions, an exhaust ventilation system is provided.

Good work hygiene and exposure control measures are put into practice to minimise potential worker exposure. Workers are well trained in these procedures and in use of appropriate protective equipment.

When natural ventilation is not adequate, general mechanical ventilation or local exhaust ventilation is provided. Protective clothing must be worn (e.g.: face, eye and ear protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

Level A clothing (fully encapsulating suit with incorporated breathing apparatus) is used when dealing with large liquid spills or vapour clouds. Impervious clothing and a rubber gloves are used for small liquid spills and normal charging and discharging operations. Safety shower or eye wash facilities are provided in areas where ammonia is handled or stored. If there is an accidental release
of ammonia, a full face mask with filter must be worn.

2.12	**Contributing scenario (12) controlling worker exposure for hand mixing with intimate contact and only PPE available.**

Worker exposure due to hand mixing with intimate contact and only PPE available.

Section 2.12 describes the potential exposure to workers during professional use of ammonia during hand mixing of formulations (with intimate contact and using PPE only) using ammonia and ammonia solutions. Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a normal purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Small quantities are expected to be used in professional businesses each year. Significant tonnages are not expected for professional use, as use is wide and dispersive.

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. The potential for exposure to ammonia during its professional use is generally considered to be short and limited.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained in the safe use of machinery for industrial use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Workers must not be directly exposed to solutions in the workplace without PPE. Generally, an exhaust ventilation system is not required.

Technical conditions and measures for controlling dispersion of the source to workers

No specific measures are required other than good industrial practice

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of mixing machinery related on the appropriate use of personal protective equipment (PPE) to avoid accidental releases or involuntary exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Hand mixing of ammonia at a professional level is generally carried out indoors using low consumption methods and in vessels that reduce the potential for unintended releases. The potential of industrial workers to be exposed to ammonia during these phases is, therefore, negligible, as they use personal protective equipment and low emission methods.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled releases of ammonia.

Good work hygiene and exposure control measures are put into practice to minimise potential worker exposure. Workers involved in hand mixing of ammonia and ammonia solutions have good training on the necessary procedures and the use of appropriate protective equipment.

2.13	**Contributing scenario (13) controlling worker exposure for its use in heat and pressure transfer fluids in dispersive but closed systems for professional use.**

Worker exposure due to its use in heat and pressure transfer fluids in dispersive but closed systems for professional use.

Section 2.2 describes potential exposure to workers during professional end use of ammonia in heat and pressure transfer fluids of solutions based on ammonia in dispersive but closed systems. Personal protective equipment (PPE) is available and control parameters are in place in the workplace to reduce the exposure risk to workers that carry out this task.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a typical purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Small quantities are expected to be used in professional businesses each year. Significant tonnages are not expected in the workplace, as use is wide and dispersive.

Ammonia Solution (20 - < 25%)

Frequency and duration of use or exposure

Workers work standard 8-hour shifts per day and work 220 days per year. Worker exposure to ammonia during its use in heat and pressure transfer fluids is usually limited and of short duration.

Human factors not influenced by risk management

Respiration volume during use: 10 m3/d
Area of skin contact with the substance during use: 480 cm2 (default value used by the ECETOC assessment tool).

Other operational conditions that have an impact on worker exposure

Workers are fully trained to prevent accidental release. Health effects are frequently monitored through medical monitoring programmes.

Technical conditions and measures at process level (source) to prevent release

Systems and distribution pipelines must be closed and sealed. If processes are carried out indoors or when ventilation is inadequate, a local exhaust ventilation system should be fitted. Processes carried out outdoors do not usually require an exhaust ventilation system, but a closed system should be installed.
Workers should not be directly exposed to treatment solutions.

Technical conditions and measures for controlling dispersion of the source to workers

A local exhaust ventilation system should be in place during indoor operations when natural ventilation is inadequate. Reactors and pipelines should be closed and sealed systems.

Organisational measures to prevent or limit releases, dispersion and exposure

Workers are fully trained in the safe use of machinery for professional use and on the appropriate use of personal protective equipment to prevent accidental releases or unintended exposure. Health effects are frequently monitored through medical monitoring programmes.

Conditions and measures for personal protection, hygiene and health evaluation

Professional end uses of ammonia lubricants for heat and pressure transfer fluid applications require special equipment and high integrity specialised systems.

Workers may be potentially exposed to ammonia during the performance of tasks in the field (e.g. for the installation of valves, pumps or tanks, etc.). Protective clothing must be worn (e.g.: face and eye protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.

All technological devices have their own quality certification and are regularly controlled and maintained to prevent uncontrolled releases of ammonia.

Good work hygiene and exposure control measures are put into practice to minimise potential worker exposure. Workers involved in the industrial use of ammonia have good training on the required procedures and the use of appropriate protective equipment.

3	**Estimation of exposure and reference to its source**

The assessment of worker exposure to anhydrous and aqueous ammonia used as an intermediate substance in chemical synthesis (ES5) was carried out for process categories relevant to this scenario and identified by the PROC codes in point 1 of this scenario and that are repeated below: use in closed processes, no likelihood of exposure (PROC 1), use in continuous, closed processes with occasional controlled exposure (PROC 2), formulation in closed batch processes (PROC 3), use in batch or other processes with some risk of exposure (PROC 4), maintenance and cleaning (PROC 8a), transfer (PROC 8b), transfer of ammonia to small containers (PROC 9), applications by roller or brushing (PROC 10), spraying (PROC 11), treatment of articles by dipping or pouring (PROC 13), sample analysis (PROC 15) and hand mixing with intimate contact using only PPE (PROC 19) and heat and pressure transfer fluids in dispersive but closed systems for professional use (PROC 20).

An estimate of exposure for level 1 workers was carried out using the ECETOC TRA model: ECETOC tool for risk assessment (Targeted Risk Assessment).

ECETOC TRA is used to estimate dermal exposure (expressed as a daily systemic dose in mg/kg of body weight) and exposure concentrations due to inhalation (expressed as an airborne concentration in mg/m3) associated with each process defined by PROC codes.

Exposure to workers was assessed taking into account the different work conditions that may be associated with the formulation of aqueous ammonia solutions and ammonia distribution in anhydrous form and in solution, and the impact of the various exposure control measures. Exposures were determined for tasks of 1 to 4 hours duration or more than 4 hours and assuming that the processes are carried out outdoors or indoors without the use of local exhaust ventilation (LEV) systems or indoors with the use of a local exhaust ventilation system (LEV). To reflect the use of personal protective equipment (PPE), dermal exposures were determined assuming use without gloves or with gloves affording 90% protection. To reflect the use of respiratory protective equipment (RPE), inhalation exposure concentrations were determined assuming use without respiratory protective equipment or with respiratory protective equipment affording 95% protection.

The ECETOC TRA model uses a simple algorithm to determine dermal exposure that does not take into account the physical-chemical properties of a substance. The same dermal exposures were therefore estimated for the anhydrous and aqueous forms of ammonia. The parameters used in the ECETOC TRA model to assess exposure by inhalation were: molecular weight (35 g.mol-1 and 17 g.mol-1 for the aqueous and anhydrous forms respectively), and vapour pressure (the vapour pressure for the anhydrous form of ammonia is 8.6 x 105 Pa at 20°C, while vapour pressure of a aqueous ammonia solution between 5 - < 25% by weight varies between 5 x 103 Pa and 4 x 104 Pa at 20°C). Systemic dermal exposures have been determined for a worker with a body weight of 70 kg.

Information for contributing scenario 1 (environmental exposure):

The majority of ammonia in the environment comes from natural sources, mainly decomposing organic material.

The dispersive professional uses of ammonia are diverse and widespread. The resulting exposure to the environment is not expected to increase the existing level significantly.

An environmental assessment has not been made.

Ammonia Solution (20 - < 25%)

The following values for worker exposure were obtained using ECETOC TRA

Dermal exposure estimated using the ECETOC TRA model

Description of the activity	PROC	Exposure assumptions		Estimated exposure mg/kg body weight/day	
		Duration	Use of ventilation	Without gloves	With gloves (90% reduction)
Use in a closed process with no likelihood of exposure: storage (closed or bulk container)	PROC 1	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	0.34	0.03
Use in a closed continuous process with occasional controlled exposure (e.g. sampling)	PROC 2	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	1.37	0.14
			Indoors with LEV	0.14	0.01
Use in closed batch processes (synthesis or formulation)	PROC 3	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	0.34	0.03
		1-4 hrs or > 4 hrs	Indoors with LEV	0.03	< 0.01
Use in batch processes (synthesis) where there is a chance of exposure	PROC 4	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	6.86	0.69
		1-4 hrs or > 4 hrs	Indoors with LEV	0.69	0.07
Mixing in batch processes	PROC 5	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	13.71	1.37
		1-4 hrs or > 4 hrs	Indoors with LEV	0.07	0.01
Transfer (charging/discharging) between vessels or large containers in non dedicated facilities	PROC 8a	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	13.71	1.37
			Indoors with LEV	0.14	0.01
Transfer (charging/discharging) between vessels or large containers in dedicated facilities	PROC 8b	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	6.86	0.69
			Indoors with LEV	0.69	0.07
Transfer to small containers	PROC 9	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	6.86	0.69
		1-4 hrs or > 4 hrs	Indoors with LEV	0.69	0.07
Application with roller or brush	PROC 10	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	27.43	0.14
		1-4 hrs or > 4 hrs	Indoors with LEV	1.37	10.71
Non industrial spraying	PROC 11	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	107	10.71
		1-4 hrs or > 4 hrs	Indoors with LEV	2.14	0.21
Treatment of articles by dipping or pouring	PROC 13	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	13.71	1.37
		1-4 hrs or > 4 hrs	Indoors with LEV	0.69	0.07
Use in the laboratory quality control in a laboratory	PROC 15	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	0.34	0.03
		1-4 hrs or > 4 hrs	Indoors with LEV	0.03	< 0.01
Hand mixing with intimate contact and PPE only	PROC 19	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	141.73	14.13
Heat and pressure transfer fluids in dispersive use but in closed systems	PROC 20	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	1.71	0.17
		1-4 hrs or > 4 hrs	Indoors with LEV	0.14	0.01

Inhalation exposure estimated using the ECETOC TRA model

Description of the activity	PROC	Exposure assumptions		Anhydrous ammonia		Ammoniacal solutions (5-25% w/w)	
				Estimated exposure concentration mg/m3		Estimated exposure concentration mg/m3	
		Duration	Use of ventilation	No RPE	RPE (95% reduction)	No RPE	RPE (95% reduction)
Use in closed processes, no likelihood of exposure	PROC 1	1-4 hrs or > 4 hrs	Outdoor	0	NA	0.01	0
		1-4 hrs or > 4 hrs	Indoor without LEV	0.01	NA	0.01	0
Use in closed, continuous processes with occasional controlled exposure	PROC 2	> 4 hrs	Outdoor	24.79	1.24	30.63	1.53
		> 4 hrs	Indoor without LEV	35.42	1.77	43.75	2.19
		> 4 hrs	Indoor with LEV	3.53	0.18	4.38	0.22
		1-4 hrs	Outdoor	14.88	0.74	18.38	0.92
		1-4 hrs	Indoor without LEV	22.25	1.06	26.25	1.31
		1-4 hrs	Indoor with LEV	2.13	0.11	2.63	0.13
Use in closed batch processes (synthesis or formulation)	PROC 3	> 4 hrs	Outdoor	49.58	2.48	61.25	3.06
		> 4 hrs	Indoor without LEV	70.83	3.54	87.5	4.38
		> 4 hrs	Indoor with LEV	7.08	0.35	8.75	0.44
		1-4 hrs	Outdoor	29.75	1.49	36.75	1.84
		1-4 hrs	Indoor without LEV	42.5	2.13	52.5	2.63
		1-4 hrs	Indoor with LEV	4.25	0.21	5.25	0.26
Use in batch and other processes (synthesis) where	PROC 4	> 4 hrs	Outdoor	49.58	2.48	61.25	3.06
		> 4 hrs	Indoor without LEV	70.83	3.54	87.5	4.38
		> 4 hrs	Indoor with LEV	7.08	0.35	8.75	0.44

opportunity for exposure arises	PROC 4	1-4 hrs	Outdoor	29.75	1.49	36.75	1.84
		1-4 hrs	Indoor without LEV	42.5	2.13	52.5	2.63
		1-4 hrs	Indoor with LEV	4.25	0.21	5.25	0.26
Mixing or blending in batch processes (multistage and/or significant contact)	PROC 5	> 4 hrs	Outdoor	123.96	6.2	153.13	7.66
		> 4 hrs	Indoor without LEV	177.08	8.85	218.75	10.94
		> 4 hrs	Indoor with LEV	17.71	0.89	21.88	1.09
		1-4 hrs	Outdoor	74.38	3.72	91.88	4.59
		1-4 hrs	Indoor without LEV	106.25	5.31	131.25	6.56
		1-4 hrs	Indoor with LEV	10.63	0.53	13.13	0.66
Transfer of substances or preparations (charging/discharging) from or to vessels or large containers at non-dedicated facilities	PROC 8a	> 4 hrs	Outdoor	123.96	6.2	153.13	7.66
		> 4 hrs	Indoor without LEV	177.08	8.85	218.75	10.94
		> 4 hrs	Indoor with LEV	17.71	0.89	21.88	1.09
		1-4 hrs	Outdoor	74.38	3.72	91.88	4.59
		1-4 hrs	Indoor without LEV	106.25	5.31	131.25	6.56
		1-4 hrs	Indoor with LEV	10.63	0.53	13.13	0.66
Transfer of substances or preparations (charging/discharging) from or to vessels or large containers at non-dedicated facilities	PROC 8b	> 4 hrs	Outdoor	74.38	3.72	91.88	4.59
		> 4 hrs	Indoor without LEV	106.25	5.31	131.25	6.56
		> 4 hrs	Indoor with LEV	3.19	0.16	3.94	0.2
		1-4 hrs	Outdoor	44.63	2.23	55.13	2.76
		1-4 hrs	Indoor without LEV	63.75	3.19	78.75	3.94
		1-4 hrs	Indoor with LEV	1.91	0.1	2.36	0.12
Transfer of substances or preparations into small containers (dedicated filling line, including weighing)	PROC 9	> 4 hrs	Outdoor	99.17	4.96	122.5	6.13
		> 4 hrs	Indoor without LEV	141.67	7.08	175	8.75
		> 4 hrs	Indoor with LEV	14.17	0.71	17.5	0.88
		1-4 hrs	Outdoor	59.5	2.98	73.5	3.68
		1-4 hrs	Indoor without LEV	85	4.25	105	5.25
		1-4 hrs	Indoor with LEV	8.5	0.43	10.5	0.53
Application using roller or brush	PROC 10	> 4 hrs	Outdoor	NA	NA	153.13	7.66
		> 4 hrs	Indoor without LEV	NA	NA	218.75	10.94
		> 4 hrs	Indoor with LEV	NA	NA	21.88	1.09
		1-4 hrs	Outdoor	NA	NA	91.88	4.59
		1-4 hrs	Indoor without LEV	NA	NA	131.25	6.56
		> 4 hrs	Outdoor	NA	NA	13.13	0.66
Non-industrial spraying	PROC 11	> 4 hrs	Outdoor	NA	NA	613.2	30.66
		> 4 hrs	Indoor without LEV	NA	NA	876	43.8
		> 4 hrs	Indoor with LEV	NA	NA	175.2	8.76
		1-4 hrs	Outdoor	NA	NA	367.92	18.4
		1-4 hrs	Indoor without LEV	NA	NA	525.6	26.28
		> 4 hrs	Outdoor	NA	NA	105.12	5.26
Treatment of articles by dipping and pouring	PROC 13	> 4 hrs	Outdoor	123.96	6.2	153.13	7.66
		> 4 hrs	Indoor without LEV	177.08	8.85	218.75	10.94
		> 4 hrs	Indoor with LEV	17.71	0.89	21.88	1.09
		1-4 hrs	Outdoor	74.38	3.72	91.88	4.59
		1-4 hrs	Indoor without LEV	106.25	5.31	131.25	6.56

		1-4 hrs	Indoor with LEV	10.63	0.53	13.13	0.66
Use as laboratory reagents	PROC 15	> 4 hrs	Indoor without LEV	35.42	1.77	43.75	2.19
		> 4 hrs	Indoor with LEV	3.54	0.18	4.38	0.22
		1-4 hrs	Indoor without LEV	21.25	1.06	26.25	1.31
		1-4 hrs	Indoor with LEV	2.13	0.11	2.63	0.13
Hand mixing with intimate contact and only PPE available	PROC 19	<4 hrs	Outdoor	NA	NA	153.13	7.66
		<4 hrs	Indoor without LEV	NA	NA	218.75	10.94
		1-4 hrs	Outdoor	NA	NA	91.88	4.59
		1-4 hrs	Indoor without LEV	NA	NA	131.25	6.56
Heat and pressure transfer fluids in dispersive but closed systems; professional use	PROC 20	> 4 hrs	Outdoor	24.79	1.24	30.63	1.53
		> 4 hrs	Indoor without LEV	35.42	1.77	43.75	2.19
		> 4 hrs	Indoor with LEV	7.08	0.35	8.75	0.44
		1-4 hrs	Outdoor	14.88	0.74	18.38	0.92
		1-4 hrs	Indoor without LEV	21.25	1.06	26.25	1.31
		1-4 hrs	Indoor with LEV	4.25	0.21	5.25	0.26

The following RCR values were obtained using ECETOC TRA and relevant DNELs.

Quantitative risk characterisation of dermal exposure to anhydrous or aqueous ammonia (in mixtures of 5 - < 25% by weight) for professional workers (ES 5: professional use)

PROC Code	Exposure assumptions		ES 5: Exposure concentrations (EC0 mg/kg body weight/day		Acute systemic effects/long term DNEL = 6.8 mg/kg weight Risk characterisation ratio	
	Duration	Use of ventilation	Without gloves	With gloves (90% reduction)	Without gloves	With gloves (90% reduction)
PROC 1	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	0.34	0.03	0.05	0.01
PROC 2	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	1.37	0.14	0.2	0.02
		Indoors with LEV	0.14	0.01	0.02	< 0.01
PROC 3	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	0.34	0.03	0.05	0.01
		Indoors with LEV	0.03	< 0.01	0.01	< 0.01
PROC 4	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	6.86	0.69	1.01	0.1
		Indoors with LEV	0.69	0.07	0.1	0.01
PROC 5	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	13.71	1.37	2.02	0.2
		Indoors with LEV	0.07	0.01	0.01	< 0.01
PROC 8a	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	13.71	1.37	2.02	0.2
		Indoors with LEV	0.14	0.01	0.02	< 0.01
PROC 8b	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	6.86	0.69	1.01	0.1
		Indoors with LEV	0.69	0.07	0.1	0.01
PROC 9	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	6.86	0.69	1.01	0.1
		Indoors with LEV	0.69	0.07	0.1	0.01
PROC 10	1-4 hrs or >4 hrs	Outdoors/Indoors without LEV	27.43	2.74	4.03	0.40
		Indoors with LEV	1.37	0.14	0.20	0.02
PROC 11	1-4 hrs or >4 hrs	Outdoors/Indoors without LEV	107.14	10.71	15.76	1.58
		Indoors with LEV	2.14	0.21	0.32	0.03
PROC 13	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	13.71	1.37	2.02	0.2
		Indoors with LEV	0.69	0.07	0.1	0.01
PROC 15	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	0.34	0.03	0.05	0.01
		Indoors with LEV	0.03	< 0.01	0.01	< 0.01
PROC 19	1-4 hrs or >4 hrs	Outdoors/Indoors without LEV	141.73	14.14	20.80	2.08 *
PROC 20	1-4 hrs or > 4 hrs	Outdoors/Indoors without LEV	1.71	0.17	0.25	0.03
		Indoors with LEV	0.14	0.01	0.02	< 0.01
* Adjusted for 10% dermal absorption gives a value of 1.41, if it assumed that gloves are worn with 90% protection, this RCR = 0.2						

Quantitative risk characterisation of inhalation of anhydrous ammonia concentrations to which professional workers are exposed (ES5 - professional use)

PROC Code	Exposure assumptions		ES 5- exposure concentrations (EC) mg/m^3		Acute/long-term systemic effects DNEL = 47.6 mg/m3		Acute local effects DNEL = 36 mg/m3		Long-term local effects DNEL = 14 mg/m3	
					RCR		RCR		RCR	
	Duration	Use of ventilation	No RPE	RPE – 95% reduction	No RPE	RPE – 95% reduction	No RPE	RPE – 95% reduction	No RPE	RPE – 95% reduction
PROC 1	1-4 hrs or > 4 hrs	Outdoor	0	NA	< 0.01	NA	< 0.01	NA	< 0.01	NA
		Indoor without LEV	0.01	NA	< 0.01	NA	< 0.01	NA	< 0.01	NA
		Outdoor	24.79	1.24	0.52	0.03	0.69	0.03	1.77	0.09

Ammonia Solution (20 - < 25%)										
PROC 2	> 4 hrs	Indoor without LEV	35.42	1.77	0.74	0.04	0.98	0.05	2.53	0.13
		Indoor with LEV	3.54	0.18	0.07	0	0.1	< 0.01	0.25	0.01
	1-4 hrs	Outdoor	14.88	0.74	0.31	0.02	0.41	0.02	1.06	0.05
		Indoor without LEV	22.25	1.06	0.47	0.02	0.59	0.03	1.52	0.08
		Indoor with LEV	2.13	0.11	0.04	0	0.06	< 0.01	0.15	0.01
PROC 3	> 4 hrs	Outdoor	49.58	2.48	1.04	0.05	1.38	0.07	3.54	0.18
		Indoor without LEV	70.83	3.54	1.49	0.07	1.97	0.1	5.06	0.25
		Indoor with LEV	7.08	0.35	0.15	0.01	0.2	0.01	0.51	0.03
	1-4 hrs	Outdoor	29.75	1.49	0.63	0.03	0.83	0.04	2.13	0.11
		Indoor without LEV	42.5	2.13	0.89	0.04	1.18	0.06	3.04	0.15
		Indoor with LEV	4.25	0.21	0.09	0	0.12	0.01	0.3	0.02
PROC 4	> 4 hrs	Outdoor	49.58	2.48	1.04	0.05	1.38	0.07	3.54	0.18
		Indoor without LEV	70.83	3.54	1.49	0.07	1.97	0.1	5.06	0.25
		Indoor with LEV	7.08	0.35	0.15	0.01	0.2	0.01	0.51	0.03
	1-4 hrs	Outdoor	29.75	1.49	0.63	0.03	0.83	0.04	2.13	0.11
		Indoor without LEV	42.5	2.13	0.89	0.04	1.18	0.06	3.04	0.15
		Indoor with LEV	4.25	0.21	0.09	0	0.12	0.01	0.3	0.02
PROC 5	> 4 hrs	Outdoor	123.96	6.2	2.6	0.13	3.44	0.17	8.85	0.44
		Indoor without LEV	177.08	8.85	3.72	0.19	4.92	0.25	12.65	0.63
		Indoor with LEV	17.71	0.89	0.37	0.02	0.49	0.02	1.26	0.06
	1-4 hrs	Outdoor	74.38	3.72	1.56	0.08	2.07	0.1	5.31	0.27
		Indoor without LEV	106.25	5.31	2.23	0.11	2.95	0.15	7.59	0.38
		Indoor with LEV	10.63	0.53	0.22	0.01	0.3	0.01	0.76	0.04
PROC 8a	> 4 hrs	Outdoor	123.96	6.2	2.6	0.13	3.44	0.17	8.85	0.44
		Indoor without LEV	177.08	8.85	3.72	0.19	4.92	0.25	12.65	0.63
		Indoor with LEV	17.71	0.89	0.37	0.02	0.49	0.02	1.26	0.06
	1-4 hrs	Outdoor	74.38	3.72	1.56	0.08	2.07	0.1	5.31	0.27
		Indoor without LEV	106.25	5.31	2.23	0.11	2.95	0.15	7.59	0.38
		Indoor with LEV	10.63	0.53	0.22	0.01	0.3	0.01	0.76	0.04
PROC 8b	> 4 hrs	Outdoor	74.38	3.72	1.56	0.08	2.07	0.1	5.31	0.27
		Indoor without LEV	106.25	5.31	2.23	0.11	2.95	0.15	7.59	0.38
		Indoor with LEV	3.19	0.16	0.07	0	0.09	< 0.01	0.23	0.01
	1-4 hrs	Outdoor	44.63	2.23	0.94	0.05	1.24	0.06	3.19	0.16
		Indoor without LEV	63.75	3.19	1.34	0.07	1.77	0.09	4.55	0.23
		Indoor with LEV	1.91	0.1	0.04	0	0.05	< 0.01	0.14	0.01
PROC 9	> 4 hrs	Outdoor	99.17	4.96	2.08	0.1	2.75	0.14	7.08	0.35
		Indoor without LEV	141.67	7.08	2.98	0.15	3.94	0.2	10.12	0.51
		Indoor with LEV	14.17	0.71	0.3	0.01	0.39	0.02	1.01	0.05
	1-4 hrs	Outdoor	59.5	2.98	1.25	0.06	1.65	0.08	4.25	0.21
		Indoor without LEV	85	4.25	1.79	0.09	2.36	0.12	6.07	0.3
		Indoor with LEV	8.5	0.43	0.18	0.01	0.24	0.01	0.61	0.03
PROC 13	> 4 hrs	Outdoor	123.96	6.2	2.6	0.13	3.44	0.17	8.85	0.44
		Indoor without LEV	177.08	8.85	3.72	0.19	4.92	0.25	12.65	0.63
		Indoor with LEV	17.71	0.89	0.37	0.02	0.49	0.02	1.26	0.06

Ammonia Solution (20 - < 25%)

	1-4 hrs	Outdoor	74.38	3.72	1.56	0.08	2.07	0.1	5.31	0.27
		Indoor without LEV	106.25	5.31	2.23	0.11	2.95	0.15	7.59	0.38
		Indoor with LEV	10.63	0.53	0.22	0.01	0.3	0.01	0.76	0.04
PROC 15	> 4 hrs	Indoor without LEV	35.42	1.77	0.74	0.04	0.98	0.05	2.53	0.13
		Indoor with LEV	3.54	0.18	0.07	0	0.1	< 0.01	0.25	0.01
	1-4 hrs	Indoor without LEV	21.25	1.06	0.45	0.02	0.59	0.03	1.52	0.08
		Indoor with LEV	2.13	0.11	0.04	0	0.06	< 0.01	0.15	0.01
PROC 20	> 4 hrs	Outdoor	24.79	1.24	0.52	0.03	0.69	0.03	1.77	0.09
		Indoor without LEV	35.42	1.77	0.74	0.04	0.98	0.05	2.53	0.13
		Indoor with LEV	7.08	0.35	0.15	0.01	0.2	0.01	0.51	0.03
	1-4 hrs	Outdoor	14.88	0.74	0.31	0.02	0.41	0.02	1.06	0.05
		Indoor without LEV	21.25	1.06	0.45	0.02	0.59	0.03	1.52	0.08
		Indoor with LEV	4.25	0.21	0.09	0	0.12	0.01	0.3	0.02

Quantitative risk characterisation of inhalation of aqueous ammonia concentrations (in mixtures of 5 - < 25% by weight) to which the professional workers are exposed (ES 5: professional use)

PROC Code	Exposure assumptions		ES 5- exposure concentrations (EC) mg/m^3		Acute/long-term systemic effects DNEL = 47.6 mg/m3		Acute – local effects DNEL = 36 mg/m3		Long-term local effects DNEL = 14 mg/m3	
					RCR		RCR		RCR	
	Duration	Use of ventilation	No RPE	RPE (95% reduction)	No RPE	RPE – 95% reduction	No RPE	RPE – 95% reduction	No RPE	RPE – 95% reduction
PROC 1	1-4 hrs or > 4 hrs	Outdoor	0	NA	NA	NA	NA	NA	NA	NA
		Indoor without LEV	0.01	NA	NA	NA	NA	NA	NA	NA
PROC 2	> 4 hrs	Outdoor	30.63	1.53	0.64	0.03	0.85	0.04	2.19	0.11
		Indoor without LEV	43.75	2.19	0.92	0.05	1.22	0.06	3.13	0.16
		Indoor with LEV	4.38	0.22	0.09	0	0.12	0.01	0.31	0.02
	1-4 hrs	Outdoor	18.38	0.92	0.39	0.02	0.51	0.03	1.31	0.07
		Indoor without LEV	26.25	1.31	0.55	0.03	0.73	0.04	1.88	0.09
		Indoor with LEV	2.63	0.13	0.06	0	0.07	< 0.01	0.19	0.01
PROC 3	> 4 hrs	Outdoor	61.25	3.06	1.29	0.06	1.7	0.09	4.38	0.22
		Indoor without LEV	87.5	4.38	1.84	0.09	2.43	0.12	6.25	0.31
		Indoor with LEV	8.75	0.44	0.18	0.01	0.24	0.01	0.63	0.03
	1-4 hrs	Outdoor	36.75	1.84	0.77	0.04	1.02	0.05	2.63	0.13
		Indoor without LEV	52.5	2.63	1.1	0.06	1.46	0.07	3.75	0.19
		Indoor with LEV	5.25	0.26	0.11	0.01	0.15	0.01	0.38	0.02
PROC 4	> 4 hrs	Outdoor	61.25	3.06	1.29	0.06	1.7	0.09	4.38	0.22
		Indoor without LEV	87.5	4.38	1.84	0.09	2.43	0.12	6.25	0.31
		Indoor with LEV	8.75	0.44	0.18	0.01	0.24	0.01	0.63	0.03
	1-4 hrs	Outdoor	36.75	1.84	0.77	0.04	1.02	0.05	2.63	0.13
		Indoor without LEV	52.5	2.63	1.1	0.06	1.46	0.07	3.75	0.19
		Indoor with LEV	5.25	0.26	0.11	0.01	0.15	0.01	0.38	0.02
PROC 5	> 4 hrs	Outdoor	153.13	7.66	3.22	0.16	4.25	0.21	10.94	0.55
		Indoor without LEV	218.75	10.94	4.6	0.23	6.08	0.3	15.63	0.78
		Indoor with LEV	21.88	1.09	0.46	0.02	0.61	0.03	1.56	0.08

Ammonia Solution (20 - < 25%)										
	1-4 hrs	Outdoor	91.88	4.59	1.93	0.1	2.55	0.13	6.56	0.33
		Indoor without LEV	131.25	6.56	2.76	0.14	3.65	0.18	9.38	0.47
		Indoor with LEV	13.13	0.66	0.28	0.01	0.36	0.02	0.94	0.05
PROC 8a	> 4 hrs	Outdoor	153.13	7.66	3.22	0.16	4.25	0.21	10.94	0.55
		Indoor without LEV	218.75	10.94	4.6	0.23	6.08	0.3	15.63	0.78
		Indoor with LEV	21.88	1.09	0.46	0.02	0.61	0.03	1.56	0.08
	1-4 hrs	Outdoor	91.88	4.59	1.93	0.1	2.55	0.13	6.56	0.33
		Indoor without LEV	131.25	6.56	2.76	0.14	3.65	0.18	9.38	0.47
		Indoor with LEV	13.13	0.66	0.28	0.01	0.36	0.02	0.94	0.05
PROC 8b	> 4 hrs	Outdoor	91.88	4.59	1.93	0.1	2.55	0.13	6.56	0.33
		Indoor without LEV	131.25	6.56	2.76	0.14	3.65	0.18	9.38	0.47
		Indoor with LEV	3.94	0.2	0.08	0	0.11	0.01	0.28	0.01
	1-4 hrs	Outdoor	55.13	2.76	1.16	0.06	1.53	0.08	3.94	0.2
		Indoor without LEV	78.75	3.94	1.65	0.08	2.19	0.11	5.63	0.28
		Indoor with LEV	2.36	0.12	0.05	0	0.07	< 0.01	0.17	0.01
PROC 9	> 4 hrs	Outdoor	122.5	6.13	2.57	0.13	3.4	0.17	8.75	0.44
		Indoor without LEV	175	8.75	3.68	0.18	4.86	0.24	12.5	0.63
		Indoor with LEV	17.5	0.88	0.37	0.02	0.49	0.02	1.25	0.06
	1-4 hrs	Outdoor	73.5	3.68	1.54	0.08	2.04	0.1	5.25	0.26
		Indoor without LEV	105	5.25	2.21	0.11	2.92	0.15	7.5	0.38
		Indoor with LEV	10.5	0.53	0.22	0.01	0.29	0.01	0.75	0.04
PROC 10	> 4 hrs	Outdoor	153.13	7.66	3.22	0.16	4.25	0.21	10.94	0.55
		Indoor without LEV	218.75	10.94	4.6	0.23	6.08	0.3	15.63	0.78
		Indoor with LEV	21.88	1.09	0.46	0.02	0.61	0.03	1.56	0.08
	1-4 hrs	Outdoor	91.88	4.59	1.93	0.1	2.55	0.13	6.56	0.33
		Indoor without LEV	131.25	6.56	2.76	0.14	3.65	0.18	9.38	0.47
		Indoor with LEV	13.13	0.66	0.28	0.01	0.36	0.02	0.94	0.05
PROC 11	> 4 hrs	Outdoor	613.2	30.66	12.88	0.64	17.03	0.85	43.8	2.19
		Indoor without LEV	876	43.8	18.4	0.92	24.33	1.22	62.57	3.13
		Indoor with LEV	175.2	8.76	3.68	0.18	4.87	0.24	12.51	0.63
	1-4 hrs	Outdoor	367.92	18.4	7.73	0.39	10.22	0.51	26.28	1.31
		Indoor without LEV	525.6	26.28	11.04	0.55	14.6	0.73	37.54	1.88
		Indoor with LEV	105.12	5.26	2.21	0.11	2.92	0.15	7.51	0.38
PROC 13	> 4 hrs	Outdoor	153.13	7.66	3.22	0.16	4.25	0.21	10.94	0.55
		Indoor without LEV	218.75	10.94	4.6	0.23	6.08	0.3	15.63	0.78
		Indoor with LEV	21.88	1.09	0.46	0.02	0.61	0.03	1.56	0.08
	1-4 hrs	Outdoor	91.88	4.59	1.93	0.1	2.55	0.13	6.56	0.33
		Indoor without LEV	131.25	6.56	2.76	0.14	3.65	0.18	9.38	0.47
		Indoor with LEV	13.13	0.66	0.28	0.01	0.36	0.02	0.94	0.05
PROC 15	> 4 hrs	Indoor without LEV	43.75	2.19	0.92	0.05	1.22	0.06	3.13	0.16
		Indoor with LEV	4.38	0.22	0.09	0	0.12	0.01	0.31	0.02
	1-4 hrs	Indoor without LEV	26.25	1.31	0.55	0.03	0.73	0.04	1.88	0.09
		Indoor with LEV	2.63	0.13	0.06	0	0.07	< 0.01	0.19	0.01
	> 4 hrs	Outdoor	153.13	7.66	3.22	0.16	4.25	0.21	10.94	0.55

Ammonia Solution (20 - < 25%)										
PROC 19	[illegible]	Indoor without LEV	218.75	10.94	4.6	0.23	6.08	0.3	15.63	0.78
	1-4 hrs	Outdoor	91.88	4.59	1.93	0.1	2.55	0.13	6.56	0.33
		Indoor without LEV	131.25	6.56	2.76	0.14	3.65	0.18	9.38	0.47
PROC 20	> 4 hrs	Outdoor	30.63	1.53	0.64	0.03	0.85	0.04	2.19	0.11
		Indoor without LEV	43.75	2.19	0.92	0.05	1.22	0.06	3.13	0.16
		Indoor with LEV	8.75	0.44	0.18	0.01	0.24	0.01	0.63	0.03
	1-4 hrs	Outdoor	18.38	0.92	0.39	0.02	0.51	0.03	1.31	0.07
		Indoor without LEV	26.25	1.31	0.55	0.03	0.73	0.04	1.88	0.09
		Indoor with LEV	5.25	0.26	0.11	0.01	0.15	0.01	0.38	0.02

4	Guidance for intermediate users to assess if they working within the limits set by the ES

Emissions into the environment:

• As there is no environmental exposure, there are no specific requirements other than good standard professional practice

Worker exposure:

To work within the exposure scenario limits (ES), the following conditions must be complied with:

• When natural ventilation is inadequate in indoor facilities, a local exhaust ventilation (LEV) system must be installed.
• When there is a dermal exposure risk, gloves with a minimum efficiency of 90% and respiratory protective equipment with 95% minimum efficiency must be used.
• Regular medical monitoring should be carried out in order to determine potential exposure levels.
• Protective clothing must be worn (e.g.: face and eye protection, safety helmet, gloves, boots and a protective coat or overalls) when there is any possibility that contact may occur.
• All technological devices should have appropriate quality certification and be regularly controlled and maintained to prevent uncontrolled releases of ammonia.
• Workers must be fully trained.
• Any measurement of worker exposure must be confirmed as being lower than the relevant DNEL, as stated in section 3.

Safety Data Sheet Appendices
Exposure Scenario 6

1	**Title of Exposure Scenario**	
	Wide and dispersive use of aqueous ammonia solution by consumers	
2	**Description of activities or processes covered by the exposure scenario**	
	Sector of Use (SU)	
	Product Category (PC)	PC 9a: Coatings and paints, thinners, paint removers PC16: Heat transfer fluids PC 35: Washing and cleaning products (including solvent based products) PC 39: Cosmetics, personal care products
	Process Category (PROC)	
	Article Category (AC)	
	Environmental Release Category (ERC)	ERC 8b, 8e, 9a, 9b
	Consumers may be exposed to an aqueous ammonia solution (with ammonia content of 0 - < 25%) when they use a large variety of products: common household products, including DIY products, such as: paints, thinners, paint removers, cleaning products, etc. Although there is no information available for other uses such as: PC 16: Heat transfer fluids, PC 18: dyes and toners, PC 20: processing aids used in the chemical industry, PC 23: Products for leather tanning, dyeing, finishing, impregnation and care, PC 37: Water treatment chemicals, PC0 - others: refrigerants. Exposures arising from these uses are not expected to be worse than those considered for the representative products selected in this exposure scenario (ES6)	
2.1	**Contributing scenario (1) controlling environmental exposure for ES 6 (Exposure Scenario 6)**	

Environmental exposure due to wide dispersive uses of anhydrous and aqueous ammonia by consumers.

Section 2.1 describes environmental releases that may occur during wide dispersive uses of anhydrous and aqueous ammonia by consumers. These releases may be in the form of wastewater or emissions to the atmosphere. Due to the wide dispersive nature of these uses, it is expected that emissions from local sources will be low and significant concentrations in the environment are not expected.

Low-level emissions may be outdoor or indoor and may be directed to the atmosphere or to the municipal sewage treatment plant. In fact, removing ammonia in municipal sewage treatment plants is very efficient as ammonia solutions are readily biodegradable.

The majority of ammonia in the environment comes from natural sources, particularly decomposing organic material.
The wide dispersive uses of ammonia in aqueous solution by consumers are very diverse and widespread. The resulting environmental exposure is not expected to add significantly to existing levels of ammonia in the environment. Therefore, an additional assessment of environmental exposure for these wide and dispersive uses has not been given in section 3.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a normal purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

Consumer use is expected to see small amounts used at a local level, with use very widespread throughout the EU.

Consumers use ammonia in aqueous solution (in concentrations between 0 - < 25% by weight of ammonia) in a large variety of common household products, including DIY products, products such as coatings and paints, thinners and paint removers, and fillers, putties, plaster and modelling clay, washing and cleaning products, cosmetic and personal care products and fertilisers.

The typical composition of these products contains 0.2% of aqueous ammonia solution (25% ammonia solution w/w). Therefore the final concentration in these products is: 0.05% w/w of ammonia.
Cleaning products normally contain an aqueous ammonia solution of 5 - 10% w/w of ammonia and are usually diluted with water prior to use.
Cosmetic products such as hair dyes contain a maximum concentration of 4% w/w of ammonia.

Frequency and duration of use

Variable low-level use.

Environmental factors not influenced by risk management

Large regional dilution and wide dispersive pattern of use.

Other operational conditions that have an impact on environmental exposure

The use of aqueous ammonia solution by consumers may be indoors or outdoors.

Conditions and measures for the municipal sewage treatment plant

Small local and low-level emissions can be directed to the municipal sewage treatment plant, where its removal tends to be efficient due to the readily biodegradable nature of low concentration ammonia solutions.

Conditions and measures for external treatment of waste for its disposal

Any waste (such as empty bottles or old fridges and cooling systems) should be sent to a landfill site or to specialised disposal facilities.

Conditions and measures for external waste recovery

No external ammonia waste re-use is envisaged.

2.2	**Contributing scenario (2) controlling consumer exposure for wide, dispersive use of aqueous ammonia solution by consumers**

Wide and dispersive use of aqueous ammonia solution by consumers

Consumer use is expected to see small amounts used at a local level, with use very widespread throughout the EU.

Consumers use ammonia in aqueous solution (in concentrations between 0 - < 25% by weight of ammonia) in a large variety of common household products, including DIY products, products such as coatings and paints, thinners and paint removers, and fillers, putties, plaster and modelling clay, washing and cleaning products, cosmetic and personal care products and fertilisers.

- The typical composition of these products is 0.2 and 0.4 % of aqueous ammonia solution (25% ammonia solution w/w). Therefore the final concentration in these products is: 0.05 and 1 % w/w of ammonia.
- Cleaning products normally contain an aqueous ammonia solution of 5 - 10% w/w of ammonia and are usually diluted with water prior to use.
- Cosmetic products such as hair dyes contain a maximum concentration of 4% w/w of ammonia.

Typical activities related to the use of aqueous ammonia solution by consumers have the following main exposure routes: dermal and inhalation. Consumers are not expected to ingest ammonia during normal use of the product.

Product characteristics

Anhydrous ammonia is a colourless gas at ambient pressure and temperature, with a normal purity of approximately 99.9%. The vapour pressure of anhydrous ammonia is reported to be 8611 hPa at 20 °C. Anhydrous ammonia is very soluble in water: 48,200 - 53100 mg/L. Anhydrous ammonia is considered to be flammable. Formulated aqueous ammonia has a vapour pressure of 287 hPa and is considered readily biodegradable.

Quantities used

The products selected for the risk assessment of this scenario, and in order to cover the full range of uses, have the following concentration and quantity in the representative products:

- Ammonia solution: 0 - < 25% of ammonia. It is usually added to various products up to 0.2%. Therefore the final ammonia concentration in these products is: 0.05% w/w.
- Cleaning products normally contain an aqueous ammonia solution of 5 - 10% w/w of ammonia and are usually diluted with water prior to use.
- Cosmetic products such as hair dyes contain a maximum concentration of 4% w/w of ammonia.

Frequency and duration of use or exposure

The duration of daily product use tends to vary depending on the application.

Ammonia Solution (20 - < 25%)

Human factors not influenced by risk management

Typical activities related to the use of aqueous ammonia solution by consumers have the following main exposure routes: dermal and inhalation. Consumers are not expected to ingest ammonia during normal use of the product.

Other operational conditions that have an impact on consumer exposure

Not relevant

Conditions and measures with information and recommendations for consumer conduct

It is recommended that instructions on the labels and safe use instructions of the products are followed.

Conditions and measures for personal protection and hygiene

It is recommended that instructions on the labels and safe use instructions of the products are followed: sometimes it is necessary to wear gloves, for example for the application of hair dye.

3	Estimation of exposure and reference to its source

The assessment of consumer exposure to aqueous ammonia solution (ES6) was carried out for the product categories that were chosen as relevant to this scenario and identified by the PC codes in point 1 of this scenario, these are repeated below: Coatings and paints, thinners, paint removers (PC 9a), Fillers, putties, plaster, modelling clay (PC 9b), Washing and cleaning products (including products that contain solvents) (PC 35), Cosmetic and personal care products (PC 39), Fertilisers (PC12)

An estimate of exposure for level 1 consumers was carried out using the ConsExpo tool, version 4.1: it includes a database with default values for a large number of products and uses. When a product is selected, the database offers scenarios and default parameter values for the models. For fertiliser use, the ECETOC TRA tool was used.

Consumer exposure is assessed for both the dermal and inhalation route. Considering the 2 dermal models of the ConsExpo 4.1 tool: instantaneous application and the migration model. While for the inhalation route - exposure to vapour or aerosols.
The worst case considered was: the use of a DIY product once a month. For cleaning products, all possible applications in the ConsExpo scenarios were considered for an ammonia solution of 10%, which is diluted 1:80 with water giving a final concentration of 0.125 and 1 % w/w of ammonia, and also considering daily use of the cleaning product. Lastly, for cosmetic products such as hair dye a use of once a month was considered.
It is assumed that dermal absorption of the product is 100% and that consumers do not always read the labels and follow recommendations for use, therefore the estimations were made considering that neither gloves nor any other type of protection was worn by the consumers. However, as the substance is corrosive, it is also considered advisable, in the case of hair dyes and fertilisers, to add a more realistic dermal absorption of 10% to the resulting quantification.

The following exposure values (dermal and inhalation) were obtained for consumers using ConsExpo 4.1 and ECETOC TRA

Description of use	Ammonia concentration (%)	Use frequency	Acute systemic exposure: dermal route (dose/times) mg/kg body weight/day 100% dermal absorption	Chronic systemic exposure: dermal route (average dose for 1 year) mg/kg body weight/day 100% dermal absorption	Exposure concentration by acute inhalation (once) mg/m3	Exposure concentration by chronic inhalation (annual average) mg/m3
PC9a Coatings and paint, thinners, paint removers (0.05% w/w ammonia)						
Application of plastic paints with brush or roller	0.05	Once a month	0.03	8.2×10^{-5}	7	0.0018
Paint spraying with air gun	0.05	Once a month	0.013	6.8×10^{-5}	0.67	5.1×10^{-5}
Application of coatings	0.05	Once a month	0.0021	1.9×10^{-6}	6.7	2.4×10^{-4}
Application of paint remover	0.05	Once a month	0.0042	1.1×10^{-5}	3.2	3.6×10^{-4}
PC35 Washing and cleaning products (1% w/w ammonia)						
Application of multi-purpose liquid cleaners / detergents	0.125	104 times/year	3.2	0.9	0,062	0,018
Application of multi-purpose sprays	1	1 time/day	0.0301	0.0301	0,198	0,198
PC 39 Cosmetic and personal care products (4% w/w ammonia)						
Application of hair dyes	4	Once a month	67	2.203	NA	NA

The following RCR values were obtained using ConsExpo, ECETOC TRA and the relevant DNELs.

Quantitative risk characterisation of dermal exposure to aqueous ammonia solution of consumers (in mixtures of 0 - < 25%) (ES 6: consumer use)

Description of use	Use frequency	Acute dermal systemic effects DNEL = 6.8 mg/kg bw/day				Chronic dermal systemic effects DNEL = 6.8 mg/kg bw/day			
		100% absorption		10% absorption		100% absorption		10% absorption	
		dose/times mg/kg body weight/day	Risk characterisation ratio (RCR)	dose/times mg/kg body weight/day	Risk characterisation ratio (RCR)	Annual average dose mg/kg	Risk characterisation ratio (RCR)	Annual average dose mg/kg	Risk characterisation ratio (RCR)
PC9a Coatings and paint, thinners, paint removers (0.05% w/w ammonia)									

PC9a Coatings and paint, thinners, paint removers (0.05% w/w ammonia)									
Application of plastic paints with brush or roller	Once a month	0.03	4.4 x 10 $^{-3}$	-	-	8.2 x 10 $^{-5}$	1.2 x 10 $^{-6}$	-	-
Paint spraying with air gun	Once a month	0.03	1.9 x 10 $^{-3}$	-	-	6.8 x 10 $^{-5}$	1.0 x 10 $^{-5}$	-	-
Application of coatings	Once a month	0.0021	3.1 x 10 $^{-3}$	-	-	1.9 x 10 $^{-4}$	1.8 x 10 $^{-7}$	-	-
Application of paint remover	Once a month	0.0042	6.2 x 10 $^{-3}$	-	-	1.1 x 10 $^{-5}$	1.6 x 10 $^{-6}$	-	-
PC9b Fillers, putties, plaster, modelling clay (0.05% w/w ammonia)									
Application of fillers	Once a month	4.2 x 10 $^{-4}$	6.2 x 10 $^{-5}$	-	-	3.4 x 10 $^{-6}$	5 x 10 $^{-7}$	-	-
PC35 Washing and cleaning products (0.125% w/w ammonia)									
Application of multi-purpose liquid cleaners / detergents	104 times/year	3.2	0.47	-	-	0.9	0.13	-	
Application of multi-purpose sprays	1 time/day	0.0301	4.43 x 10-3	-	-	0.031	4.43x10^{-3}		
PC 39 Cosmetic and personal care products (4% w/w ammonia)									
Application of hair dyes	Once a month	67	9.85	6.7	0.99	2.203	0.324	0.220	0.032

Ammonia Solution (20 - < 25%)

Quantitative risk characterisation of inhalation of aqueous ammonia solution concentrations by consumers (in mixtures of 0 - < 25%)
(ES 6: consumer use)

Description of use	Use frequency	Acute local effects DNEL = 7.2 mg/m3 100% absorption		Chronic local effects DNEL = 2.8 mg/m3 100% absorption		Systemic acute/chronic effects DNEL = 23.8 mg/m3 100% absorption	
		mg/m3	Risk characterisation ratio (RCR)	mg/m3	Risk characterisation ratio (RCR)	mg/m3	Risk characterisation ratio (RCR)
PC9a Coatings and paint, thinners, paint removers (0.05% w/w ammonia)							
Application of plastic paints with brush or roller	Once a month	7	0.97	0.0018	6.4×10^{-4}	0.0018	7.6×10^{-5}
Paint spraying with air gun	Once a month	0.67	0.09	5.1×10^{-5}	1.8×10^{-5}	5.1×10^{-5}	2.1×10^{-6}
Application of coatings	Once a month	6.7	0.93	2.4×10^{-4}	8.6×10^{-5}	2.4×10^{-4}	1.0×10^{-5}
Application of paint remover	Once a month	3.2	0.44	3.6×10^{-4}	1.3×10^{-4}	3.6×10^{-4}	1.5×10^{-5}
PC35 Washing and cleaning products (1% w/w ammonia)							
Application of multi-purpose liquid cleaners / detergents	104 times/year	-	-	-	-	0.036	1.51×10^{-3}
Application of multi-purpose sprays	1 time /day	-	-	-	-	0,116	4.87×10^{-3}

4	**Guidance for intermediate users to assess if they are working within the limits set by the ES**

Include on labels safe use recommendations for consumers