

**SAFETY DATA SHEET****Acrylonitrile****SECTION 1: Identification of the substance/mixture and of the company/undertaking****1.1 Product identifier**

**Product name** : Acrylonitrile  
**Internal code** : WW12159  
**Chemical product name** : Acrylonitrile  
**Synonyms** : Acrylonitrile; Vinyl cyanide; 2-Propenitrile; 2-Propenenitrile  
**BG Name** : ACN  
**Chemical formula** : C<sub>3</sub>H<sub>3</sub>N  
**Index number** : 608-003-00-4  
**EC number** : 203-466-5  
**REACH Registration number** : 01-2119474195-34-0002

**1.2 Relevant identified uses of the substance or mixture and uses advised against****Identified uses**

Monomer for the production of acrylic and modacrylic textile fibres (>60% of total usage).  
 Monomer for the production of acrylonitrile-butadiene-styrene (ABS) and styrene-acrylonitrile (SAN) plastics. (20% of total usage).  
 Monomer for the production of nitrile rubbers.  
 Intermediate for the manufacture of bulk chemicals, used in closed processes.  
 Intermediate resin system.  
 Use as laboratory reagent  
 Manufacture of substance

**Recommended use** : Monomer for the production of acrylic and modacrylic textile fibres (>60% of total usage). Monomer for the production of acrylonitrile-butadiene-styrene (ABS) and styrene-acrylonitrile (SAN) plastics. (20% of total usage). Monomer for the production of nitrile rubbers. Intermediate for adiponitrile and acrylamide synthesis. Intermediate for the manufacture of bulk chemicals, used in closed processes. Laboratory chemical.

**1.3 Details of the supplier of the safety data sheet**

**Supplier** : DSM Acrylonitrile B.V.  
 P.O. Box 43  
 6130 AA Sittard  
 The Netherlands  
**e-mail address of person responsible for this SDS** : Info.Worldwide@dsm.com

**1.4 Emergency telephone number**

**Emergency telephone number** : Netherlands: +31 46 476 55 55  
 Fax: +31 46 476 64 40

**SECTION 2: Hazards identification****2.1 Classification of the substance or mixture**

**Product definition** : Substance

**Classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]**

Flam. Liq. 2, H225  
 Acute Tox. 3, H301  
 Acute Tox. 3, H311  
 Acute Tox. 3, H331  
 Skin Irrit. 2, H315  
 Eye Dam. 1, H318  
 Skin Sens. 1, H317  
 Carc. 1B, H350  
 Repr. 2, H361fd  
 STOT SE 3, H335  
 Aquatic Chronic 2, H411

See Section 16 for the full text of the H statements declared above.

**Classification according to Directive 67/548/EEC [DSD]**

F; R11  
 Carc. Cat. 2; R45  
 T; R23/24/25  
 Xi; R41, R37/38  
 R43  
 N; R51/53

**Remarks** : Acrylonitrile, stabilised . May polymerise violently unless stabilised.

See section 16 for the full text of the R-phrases declared above

## 2.2 Label elements

## Hazard pictograms



## Signal word

: Danger

## Hazard statements

: H225 - Highly flammable liquid and vapour.  
 H301 - Toxic if swallowed.  
 H311 - Toxic in contact with skin.  
 H331 - Toxic if inhaled.  
 H315 - Causes skin irritation.  
 H318 - Causes serious eye damage.  
 H317 - May cause an allergic skin reaction.  
 H350 - May cause cancer.  
 H361fd - Suspected of damaging fertility or the unborn child.  
 H335 - May cause respiratory irritation.  
 H411 - Toxic to aquatic life with long lasting effects.

Precautionary statements

## Prevention

: Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Use personal protective equipment as required. Wear protective gloves: >8 hours (breakthrough time): Butyl rubber. Wear eye or face protection. Wear protective clothing. Keep away from heat, sparks, open flames and hot surfaces. - No smoking. Use explosion-proof electrical, ventilating, lighting and all material-handling equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Keep container tightly closed. Use only outdoors or in a well-ventilated area. Avoid release to the environment. Avoid breathing vapour. Do not eat, drink or smoke when using this product. Wash hands thoroughly after handling. Contaminated work clothing should not be allowed out of the workplace.

## Response

: Collect spillage.

IF exposed or concerned: Get medical attention.

IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or physician.

IF SWALLOWED: Immediately call a POISON CENTER or physician. Rinse mouth.

IF ON SKIN (or hair): Take off immediately all contaminated clothing. Wash with plenty of soap and water. Call a POISON CENTER or physician if you feel unwell. Wash contaminated clothing before reuse.

If skin irritation or rash occurs: Get medical attention.

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER or physician.

## Storage

: Store locked up. Store in a well-ventilated place. Keep cool.

## Disposal

: Dispose of contents and container in accordance with all local, regional, national and international regulations.

## 2.3 Other hazards

Substance meets the criteria for PBT according to Regulation (EC) No. 1207/2006, Annex XIII

: No.  
 P: No. B: Not available. T: Yes.

Substance meets the criteria for vPvB according to Regulation (EC) No. 1207/2006, Annex XIII

: No.  
 vP: No. vB: Not available.

Other hazards which do not result in classification

: Gas/vapour is heavier than air and may travel along the floor to a source of ignition and flash back.

**SECTION 3: Composition/information on ingredients**

Substance/mixture : Substance

Product/ingredient name	Identifiers	%	Classification	
			67/548/EEC	Regulation (EC) No. 1272/2008 [CLP]

acrylonitrile	RRN: 01-2119474195-34 EC: 203-466-5 CAS: 107-13-1 Index: 608-003-00-4	100	F; R11 Carc. Cat. 2; R45 T; R23/24/25 Xi; R41, R37/38 R43 N; R51/53	Flam. Liq. 2, H225 Acute Tox. 3, H301 Acute Tox. 3, H311 Acute Tox. 3, H331 Skin Irrit. 2, H315 Eye Dam. 1, H318 Skin Sens. 1, H317 Carc. 1B, H350 Repr. 2, H361fd STOT SE 3, H335 Aquatic Chronic 2, H411
			<b>See section 16 for the full text of the R-phrases declared above</b>	<b>See Section 16 for the full text of the H statements declared above.</b>

There are no additional ingredients present which, within the current knowledge of the supplier, are classified and contribute to the classification of the substance and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

## SECTION 4: First aid measures

### 4.1 Description of first aid measures

- Remarks** : Specific first aid and treatment are necessary. The needed resources and their instructions for use must be present. Do not apply mouth-to-mouth resuscitation. Upon exposure always get medical aid as soon as possible. Immediately call for assistance ("buddy"). If the patient is unconscious or has stopped breathing and has no pulse (in all probability cyanide poisoning), then have immediately administered antidote by a trained first aid assistant or physician. Keep the patient under medical observation (for about 24 hours). Also in these later stages, symptoms of CN poisoning may occur. Let the victim rest in half upright position and administer oxygen (preferably 100%).
- Eye contact** : Get medical attention immediately. Call a poison center or physician. Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Chemical burns must be treated promptly by a physician.
- Inhalation** : Get medical attention immediately. Call a poison center or physician. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.
- Skin contact** : Get medical attention immediately. Call a poison center or physician. Wash with plenty of soap and water. Remove contaminated clothing and shoes. Wash contaminated clothing thoroughly with water before removing it, or wear gloves. Continue to rinse for at least 10 minutes. Chemical burns must be treated promptly by a physician. In the event of any complaints or symptoms, avoid further exposure. Wash clothing before reuse. Clean shoes thoroughly before reuse.
- Ingestion** : Get medical attention immediately. Call a poison center or physician. Wash out mouth with water. Remove dentures if any. Remove victim to fresh air and keep at rest in a position comfortable for breathing. Stop if the exposed person feels sick as vomiting may be dangerous. Do not induce vomiting unless directed to do so by medical personnel. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Chemical burns must be treated promptly by a physician. Never give anything by mouth to an unconscious person. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband.
- Protection of first-aiders** : No action shall be taken involving any personal risk or without suitable training. If it is suspected that fumes are still present, the rescuer should wear an appropriate mask or self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Wash contaminated clothing thoroughly with water before removing it, or wear gloves.

### 4.2 Most important symptoms and effects, both acute and delayed

#### Potential acute health effects

- Eye contact** : Causes serious eye damage.
- Inhalation** : Toxic if inhaled. May cause respiratory irritation. Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.
- Skin contact** : Toxic in contact with skin. Causes skin irritation. May cause an allergic skin reaction.
- Ingestion** : Toxic if swallowed. May cause burns to mouth, throat and stomach.

#### Over-exposure signs/symptoms

- Eye contact** : Adverse symptoms may include the following:  
pain  
watering  
redness

- Inhalation** : Adverse symptoms may include the following:  
respiratory tract irritation  
coughing  
reduced foetal weight  
increase in foetal deaths  
skeletal malformations
- Skin contact** : Adverse symptoms may include the following:  
pain or irritation  
redness  
blistering may occur  
reduced foetal weight  
increase in foetal deaths  
skeletal malformations
- Ingestion** : Adverse symptoms may include the following:  
stomach pains  
reduced foetal weight  
increase in foetal deaths  
skeletal malformations

#### 4.3 Indication of any immediate medical attention and special treatment needed

- Notes to physician** : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.
- Specific treatments** : No specific treatment.

## SECTION 5: Firefighting measures

### 5.1 Extinguishing media

#### Small fire

- Suitable** : Use dry chemical powder, CO<sub>2</sub> or alcohol-resistant foam.
- Not suitable** : Do not use water jet.

#### Large fire

- Suitable** : Alcohol-resistant foam.
- Not suitable** : Do not use water jet.

### 5.2 Special hazards arising from the substance or mixture

- Hazards from the substance or mixture** : Highly flammable liquid and vapour. In a fire or if heated, a pressure increase will occur and the container may burst, with the risk of a subsequent explosion. The vapour/gas is heavier than air and will spread along the ground. Vapours may accumulate in low or confined areas or travel a considerable distance to a source of ignition and flash back. Runoff to sewer may create fire or explosion hazard. This material is toxic to aquatic life with long lasting effects. Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain. Liquid will float and may reignite on surface of water. Vapour is explosive in air at temperatures higher than the flash point.
- Hazardous combustion products** : Decomposition products may include the following materials:  
carbon dioxide  
carbon monoxide  
nitrogen oxides  
Hydrogen cyanide -Carbon monoxide. Ammonia Amines

### 5.3 Advice for firefighters

- Special precautions for fire-fighters** : Fire water contaminated with this material must be contained and prevented from being discharged to any waterway, sewer or drain.
- Special protective equipment for fire-fighters** : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode. Clothing for fire-fighters (including helmets, protective boots and gloves) conforming to European standard EN 469 will provide a basic level of protection for chemical incidents.

- Remarks** : Use water spray to keep fire-exposed containers cool.

## SECTION 6: Accidental release measures

### 6.1 Personal precautions, protective equipment and emergency procedures

- For non-emergency personnel** : No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilt material. Shut off all ignition sources. No flares, smoking or flames in hazard area. Do not breathe vapour or mist. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.
- For emergency responders** : If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

**6.2 Environmental precautions** : Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air). Water polluting material. May be harmful to the environment if released in large quantities. Collect spillage.

### 6.3 Methods and materials for containment and cleaning up

**Small spill** : Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor.

**Large spill** : Stop leak if without risk. Move containers from spill area. Approach the release from upwind. Prevent entry into sewers, water courses, basements or confined areas. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations. Use spark-proof tools and explosion-proof equipment. Dispose of via a licensed waste disposal contractor. Contaminated absorbent material may pose the same hazard as the spilt product.

**6.4 Reference to other sections** : See Section 1 for emergency contact information.  
See Section 8 for information on appropriate personal protective equipment.  
See Section 13 for additional waste treatment information.

**Remarks** : Immediately call for assistance ("buddy"). Initiate company's spill response procedures immediately. Evacuate area. Use full chemical-resistant suit and approved/certified self-contained breathing apparatus worn by authorised persons.

## SECTION 7: Handling and storage

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

### 7.1 Precautions for safe handling

**Protective measures** : Put on appropriate personal protective equipment (see Section 8). Persons with a history of skin sensitization problems should not be employed in any process in which this product is used. Avoid exposure - obtain special instructions before use. Avoid exposure during pregnancy. Do not handle until all safety precautions have been read and understood. Do not get in eyes or on skin or clothing. Do not breathe vapour or mist. Do not ingest. Avoid release to the environment. Use only with adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Do not enter storage areas and confined spaces unless adequately ventilated. Keep in the original container or an approved alternative made from a compatible material, kept tightly closed when not in use. Store and use away from heat, sparks, open flame or any other ignition source. Use explosion-proof electrical (ventilating, lighting and material handling) equipment. Use only non-sparking tools. Take precautionary measures against electrostatic discharges. Empty containers retain product residue and can be hazardous. Do not reuse container.

**Advice on general occupational hygiene** : Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

**7.2 Conditions for safe storage, including any incompatibilities** : Store in accordance with local regulations. Store in a segregated and approved area. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see section 10) and food and drink. Store locked up. Eliminate all ignition sources. Separate from oxidizing materials. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabelled containers. Use appropriate containment to avoid environmental contamination. Ventilation required along the floor.  
Protect from (sun)light.

### Packaging materials

**Suitable** : aluminium Steel.  
**Not suitable** : copper - copper alloys

### 7.3 Specific end use(s)

**Recommendations** : Not available.  
**Industrial sector specific solutions** : Not available.

**Remarks** : Avoid any personal exposure to vapour or liquid.

## SECTION 8: Exposure controls/personal protection

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

### 8.1 Control parameters

#### Occupational exposure limits

Product/ingredient name	Exposure limit values
acrylonitrile	<b>ACGIH TLV (United States, 2/2010). Absorbed through skin.</b> TWA: 2 ppm 8 hour(s). TWA: 4.3 mg/m <sup>3</sup> 8 hour(s).
<b>In-house limit value</b> acrylonitrile	<b>DSM limit values EHS AC 2004 118 FLL (IH, 9/2004). Absorbed through skin.</b> TWA: 2 ppm 8 hour(s). TWA: 4.3 mg/m <sup>3</sup> 8 hour(s).

**Recommended monitoring procedures** : If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment. Reference should be made to European Standard EN 689 for methods for the assessment of exposure by inhalation to chemical agents and national guidance documents for methods for the determination of hazardous substances.

#### Derived effect levels

Product/ingredient name	Type	Exposure	Value	Population
acrylonitrile	DNEL	Short term Inhalation	3.3 mg/m <sup>3</sup>	Consumers
	DNEL	Long term Dermal	0.009 mg/kg bw/day	Consumers
	DNEL	Long term Inhalation	0.1 mg/m <sup>3</sup>	Consumers
	DNEL	Long term Oral	0.009 mg/kg bw/day	Consumers
	DNEL	Long term Dermal	1.4 mg/kg bw/day	Workers
	DNEL	Long term Inhalation	2.7 mg/m <sup>3</sup>	Workers

#### Predicted effect concentrations

Product/ingredient name	Type	Compartment Detail	Value	Method Detail
acrylonitrile	PNEC	Fresh water	17 µg/l	Assessment Factors

### 8.2 Exposure controls

**Appropriate engineering controls** : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation or other engineering controls to keep worker exposure to airborne contaminants below any recommended or statutory limits. The engineering controls also need to keep gas, vapour or dust concentrations below any lower explosive limits. Use explosion-proof ventilation equipment.

#### Individual protection measures

**Hygiene measures** : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Contaminated work clothing should not be allowed out of the workplace. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

**Eye/face protection** : Full-face mask

**Hand protection** : >8 hours (breakthrough time): Butyl rubber

**Skin and body** : Chemical-resistant protective suit.

**Respiratory protection** : Self-contained breathing apparatus. (airhood, air fed respirator).

**Environmental exposure controls** : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

**Remarks** : Skin absorption may be a significant route for exposure. Gloves made of the following materials are not suitable: Natural rubber, neoprene, nitrile rubber, polyethylene, polyvinyl alcohol, PVC, Viton (these materials may degrade).

**Advice on personal protection is applicable for high exposure levels. Select proper personal protection based on a risk assessment of the actual exposure situation.**

## SECTION 9: Physical and chemical properties

### 9.1 Information on basic physical and chemical properties

<b>Physical state</b>	: Liquid.
<b>Colour</b>	: Clear. [ Colourless. ]
<b>Odour</b>	: Pungent. [Slight]
<b>Odour threshold</b>	: Not available.
<b>pH</b>	: 5.5 to 7.5
<b>Melting point</b>	: -83.5 °C
<b>Initial boiling point and boiling range</b>	: 77.3 °C
<b>Softening range</b>	: Not available.
<b>Flash point</b>	: 0 °C Open cup -0.15 °C Closed cup
<b>Evaporation rate</b>	: 3.31 (compared with butyl acetate)

Flammability (solid, gas)	: Not available.
Burning time	: Not applicable.
Burning rate	: Not applicable.
Upper/lower flammability or explosive limits	: Lower: 2% Upper: 28%
Vapour pressure	: 11.5 kPa
Vapour density	: 1.8 (Air = 1)
Relative density	: 0.807 (Water = 1)
Density ( g/cm <sup>3</sup> )	: 0.806 g/cm <sup>3</sup> (20°C)
Bulk density	: Not available.
Solubility	: Partially soluble in the following materials: cold water.
Solubility in water	: 7.35 g/100 ml
Solubility at room temperature	: Not available.
Partition coefficient: n-octanol/water	: -0.37
Auto-ignition temperature	: 481 °C
Decomposition temperature	: Not available.
Viscosity	: Dynamic: 0.4 mPa·s (0.4 cP)
Explosive properties	: Not available.
Oxidising properties	: Not available.

## 9.2 Other information

Molecular weight	: 53.06 g/mole
Critical temperature	: 263 °C
Remarks	: Not available.

## SECTION 10: Stability and reactivity

10.1 Reactivity	: No specific test data related to reactivity available for this product or its ingredients.
10.2 Chemical stability	: The product may not be stable under certain conditions of storage or use. See "Possibility of Hazardous Reactions" for further information. stabilizer: Hydroquinone monomethyl- ether ( 35-45 ppm ) , water ( 0.2 - 0.5 % ) .
10.3 Possibility of hazardous reactions	: Hazardous reactions or instability may occur under certain conditions of storage or use.
10.4 Conditions to avoid	: Avoid all possible sources of ignition (spark or flame). Do not pressurise, cut, weld, braze, solder, drill, grind or expose containers to heat or sources of ignition. Do not allow vapor to accumulate in low or confined areas. Exposure to (sun)light.
10.5 Incompatible materials	: Reactive or incompatible with the following materials: oxidizing materials ammonia - copper - copper alloys - bromine . May react violently with acids, alkalis or peroxides.
10.6 Hazardous decomposition products	: Hydrogen cyanide (HCN). ; carbon monoxide

## SECTION 11: Toxicological information

### 11.1 Information on toxicological effects

#### Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
acrylonitrile	LD50 Dermal	Rat	>200 mg/kg	-
	LD50 Oral	Rat	81 mg/kg	-
	LC50 Inhalation Vapour	Rat	2050 mg/m <sup>3</sup>	4 hours
	LC50 Inhalation Vapour	Rat	946 ppm	4 hours
	LC50 Inhalation Vapour	Rat	946 ppm	4 hours

Conclusion/Summary : Not available.

#### Irritation/Corrosion

Conclusion/Summary

Skin : Irritating.

**Eyes** : Irritating.

**Respiratory** : Irritating.

**Sensitiser**

**Conclusion/Summary**

**Skin** : Sensitising

**Respiratory** : Not sensitizing

**Mutagenicity**

**Conclusion/Summary** : No indications for mutagenicity.

**Carcinogenicity**

**Conclusion/Summary** : May cause cancer.

**Reproductive toxicity**

**Conclusion/Summary** : No indications for reproduction toxicity.

**Teratogenicity**

**Conclusion/Summary** : Not available.

**Specific target organ toxicity (single exposure)**

Product/ingredient name	Category	Route of exposure	Target organs
acrylonitrile	Category 3	Not determined	Respiratory tract irritation

**Specific target organ toxicity (repeated exposure)**

Not available.

**Aspiration hazard**

Not available.

**Potential acute health effects**

**Inhalation** : Toxic if inhaled. May cause respiratory irritation. Exposure to decomposition products may cause a health hazard. Serious effects may be delayed following exposure.

**Ingestion** : Toxic if swallowed. May cause burns to mouth, throat and stomach.

**Skin contact** : Toxic in contact with skin. Causes skin irritation. May cause an allergic skin reaction.

**Eye contact** : Causes serious eye damage.

**Symptoms related to the physical, chemical and toxicological characteristics**

**Inhalation** : Adverse symptoms may include the following:  
respiratory tract irritation  
coughing  
reduced foetal weight  
increase in foetal deaths  
skeletal malformations

**Ingestion** : Adverse symptoms may include the following:  
stomach pains  
reduced foetal weight  
increase in foetal deaths  
skeletal malformations

**Skin contact** : Adverse symptoms may include the following:  
pain or irritation  
redness  
blistering may occur  
reduced foetal weight  
increase in foetal deaths  
skeletal malformations

**Eye contact** : Adverse symptoms may include the following:  
pain  
watering  
redness

**General** : Once sensitized, a severe allergic reaction may occur when subsequently exposed to very low levels.

**Carcinogenicity** : May cause cancer. Risk of cancer depends on duration and level of exposure.

**Mutagenicity** : No known significant effects or critical hazards.

**Teratogenicity** : Suspected of damaging the unborn child.

**Developmental effects** : No known significant effects or critical hazards.

**Fertility effects** : Suspected of damaging fertility.

**Classification**

Product/ingredient name	ACGIH	IARC	EPA	NIOSH	NTP	OSHA
acrylonitrile	A3	2B	-	+	Possible	+

**Remarks** : May cause adverse effects in target organs after long-term exposure.

## SECTION 12: Ecological information

### 12.1 Toxicity

Product/ingredient name	Result	Species	Exposure	Effects
acrylonitrile	Acute EC50 7380 ug/L Fresh water	Daphnia - Water flea - Daphnia magna - Neonate - <24 hours	48 hours	Intoxication
	Acute LC50 10 mg/L Fresh water	Fish - Bluegill - Lepomis macrochirus - Young of the year - 0.32 to 1.2 g	96 hours	Mortality
	Acute LC50 8.6 mg/l	Fish	96 hours	-
	Acute LC50 11800 ug/L Fresh water	Fish - Bluegill - Lepomis macrochirus - 1.5 to 3.8 cm - 2 g	96 hours	Mortality
	Chronic NOEC 780 ug/L Fresh water	Daphnia - Water flea - Daphnia magna - <=24 hours	48 hours	Mortality

**Conclusion/Summary** : Not available.

### 12.2 Persistence and degradability

Product/ingredient name	Test	Result	Dose	Inoculum
acrylonitrile	-	51.8 % - Inherent - 5 days	-	-

**Conclusion/Summary** : Not available.

Product/ingredient name	Aquatic half-life	Photolysis	Biodegradability
acrylonitrile	Fresh water <28 days	< 28 day(s)	Inherent

### 12.3 Bioaccumulative potential

Product/ingredient name	LogP <sub>ow</sub>	BCF	Potential
acrylonitrile	-0.37	-	low

### 12.4 Mobility in soil

**Soil/water partition coefficient (K<sub>oc</sub>)** : 9

**Mobility** : Not available.

### 12.5 Results of PBT and vPvB assessment

**PBT** : No.  
P: No. B: Not available. T: Yes.

**vPvB** : No.  
vP: No. vB: Not available.

**12.6 Other adverse effects** : No known significant effects or critical hazards.

**Remarks** : This substance undergoes rapid photodegradation. Simulation tests show that this substance degrades rapidly in adapted wastewater treatment plants.

## SECTION 13: Disposal considerations

The information in this section contains generic advice and guidance. The list of Identified Uses in Section 1 should be consulted for any available use-specific information provided in the Exposure Scenario(s).

### 13.1 Waste treatment methods

#### Product

**Methods of disposal** : The generation of waste should be avoided or minimised wherever possible. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe way. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.













**Hazardous waste** : The classification of the product may meet the criteria for a hazardous waste.

#### Packaging

**Methods of disposal** : The generation of waste should be avoided or minimised wherever possible. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible.

**Special precautions** : This material and its container must be disposed of in a safe way. Care should be taken when handling emptied containers that have not been cleaned or rinsed out. Empty containers or liners may retain some product residues. Vapor from product residues may create a highly flammable or explosive atmosphere inside the container. Do not cut, weld or grind used containers unless they have been cleaned thoroughly internally. Avoid dispersal of spilt material and runoff and contact with soil, waterways, drains and sewers.

**SECTION 14: Transport information**

	ADR/RID	ADN/ADNR	IMDG	IATA
14.1 UN number	UN1093	UN1093	UN1093	UN1093
14.2 UN proper shipping name	ACRYLONITRILE, STABILIZED	ACRYLONITRILE, STABILIZED	ACRYLONITRILE, STABILIZED. Marine pollutant (Acrylonitrile)	Acrylonitrile, stabilized
14.3 Transport hazard class(es)	3 (6.1)   	3 (6.1)   	3 (6.1)   	3 (6.1)   
14.4 Packing group	I	I	I	I
14.5 Environmental hazards	Yes.	Yes.	Yes.	Yes.
14.6 Special precautions for user	Not available.	Not available.	Not available.	Not available.
Additional information	<b>Hazard identification number</b> 336 <b>Limited quantity</b> LQ0 <b>Tunnel code</b> (C/E)	-	<b>Emergency schedules (EmS)</b> F-E, S-D	<b>Passenger and Cargo Aircraft</b> Quantity limitation: Forbidden Packaging instructions: Forbidden <b>Cargo Aircraft Only</b> Quantity limitation: 30 L Packaging instructions: 303 <b>Limited Quantities - Passenger Aircraft</b> Quantity limitation: Forbidden Packaging instructions: Forbidden <b>Remarks</b> Forbidden

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

**SECTION 15: Regulatory information**

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

EU Regulation (EC) No. 1907/2006 (REACH)

Annex XIV - List of substances subject to authorisation

Substances of very high concern

None of the components are listed.

Annex XVII - Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles

Restricted to professional users.

**Other EU regulations**

Product/ingredient name	Carcinogenic effects	Mutagenic effects	Developmental effects	Fertility effects
acrylonitrile	Carc. 1B, H350	-	Repr. 2, H361d	Repr. 2, H361f

15.2 Chemical Safety Assessment : Complete.

## SECTION 16: Other information

Procedure used to derive the classification according to Regulation (EC) No. 1272/2008 [CLP/GHS]

Classification	Justification
Flam. Liq. 2, H225	Expert judgment
Acute Tox. 3, H301	Expert judgment
Acute Tox. 3, H311	Expert judgment
Acute Tox. 3, H331	On basis of test data
Skin Irrit. 2, H315	Expert judgment
Eye Dam. 1, H318	Expert judgment
Skin Sens. 1, H317	Expert judgment
Carc. 1B, H350	Expert judgment
Repr. 2, H361fd	Expert judgment
STOT SE 3, H335	Expert judgment
Aquatic Chronic 2, H411	Expert judgment

- Full text of abbreviated H statements** : H225 Highly flammable liquid and vapour.  
H301 Toxic if swallowed.  
H311 Toxic in contact with skin.  
H315 Causes skin irritation.  
H317 May cause an allergic skin reaction.  
H318 Causes serious eye damage.  
H331 Toxic if inhaled.  
H335 May cause respiratory irritation.  
H350 May cause cancer.  
H361fd Suspected of damaging fertility. Suspected of damaging the unborn child.  
H411 Toxic to aquatic life with long lasting effects.
- Full text of classifications [CLP/GHS]** : Acute Tox. 3, H301 ACUTE TOXICITY: ORAL - Category 3  
Acute Tox. 3, H311 ACUTE TOXICITY: SKIN - Category 3  
Acute Tox. 3, H331 ACUTE TOXICITY: INHALATION - Category 3  
Aquatic Chronic 2, H411 AQUATIC TOXICITY (CHRONIC) - Category 2  
Carc. 1B, H350 CARCINOGENICITY - Category 1B  
Eye Dam. 1, H318 SERIOUS EYE DAMAGE/ EYE IRRITATION - Category 1  
Flam. Liq. 2, H225 FLAMMABLE LIQUIDS - Category 2  
Repr. 2, H361fd TOXIC TO REPRODUCTION [Fertility and Unborn child] - Category 2  
Skin Irrit. 2, H315 SKIN CORROSION/IRRITATION - Category 2  
Skin Sens. 1, H317 SKIN SENSITIZATION - Category 1  
STOT SE 3, H335 SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) [Respiratory tract irritation] - Category 3
- Full text of abbreviated R phrases** : R11- Highly flammable.  
R45- May cause cancer.  
R23/24/25- Also toxic by inhalation, in contact with skin and if swallowed.  
R41- Risk of serious damage to eyes.  
R37/38- Irritating to respiratory system and skin.  
R43- May cause sensitisation by skin contact.  
R51/53- Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
- Full text of classifications [DSD/DPD]** : F - Highly flammable  
Carc. Cat. 2 - Carcinogen category 2  
T - Toxic  
Xi - Irritant  
N - Dangerous for the environment
- Alterations compared to the previous version** : Alterations compared to the previous version are marked with a little (blue) triangle.
- Abbreviations and acronyms** : ATE = Acute Toxicity Estimate  
CLP = Classification, Labelling and Packaging Regulation [Regulation (EC) No. 1272/2008]  
DNEL = Derived No Effect Level  
EUH statement = CLP-specific Hazard statement  
PNEC = Predicted No Effect Concentration  
RRN = REACH Registration Number
- Sources of key data** : Literature data and/or investigation reports are available through the manufacturer.
- Internal code** : WW12159
- Training advice** : Handling of this substance or preparation is restricted to skilled personnel only.
- Notice to reader**  
The information contained in the Safety Data Sheet is based on our data available on the date of publication. The information is intended to aid the user in controlling the handling risks; it is not to be construed as a warranty or specification of the product quality. The information may not be or may not altogether be applicable to combinations of the product with other substances or to particular applications.  
The user is responsible for ensuring that appropriate precautions are taken and for satisfying themselves that the data are suitable and sufficient for the product's intended purpose. In case of any unclarity we advise consulting the supplier or an expert.
- History**  
**Date of printing** : 30 November 2010.  
**Date of issue** : 30 November 2010

Version : 7.04

## Annex to the extended Safety Data Sheet (eSDS)

Industrial

### Identification of the substance or mixture

**Product definition** : Mono-constituent substance  
**Code** : WW12159  
**Product name** : Acrylonitrile DFI

### Section 1 - Title

**Short title of the exposure scenario** : Acrylonitrile\_107-13-1\_ES1

**List of use descriptors** : **Identified use name:** Monomer for the production of acrylic and modacrylic textile fibres (>60% of total usage).  
**Process Category:** PROC01, PROC02, PROC03, PROC04, PROC08b, PROC09  
**Substance supplied to that use in form of:** As such  
**Sector of end use:** SU05  
**Subsequent service life relevant for that use:** Yes.  
**Environmental Release Category:** ERC06c  
**Market sector by type of chemical product:** PC32  
**Article category related to subsequent service life:** AC05

**Environmental contributing scenarios** : **Industrial use of monomers for manufacture of thermoplastics - ERC06c**

**Health Contributing scenarios** : **Use in closed process, no likelihood of exposure - PROC01**  
**Use in closed, continuous process with occasional controlled exposure - PROC02**  
**Use in closed batch process (synthesis or formulation) - PROC03**  
**Use in batch and other process (synthesis) where opportunity for exposure arises - PROC04**  
**Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities - PROC08b**  
**Transfer of substance or preparation into small containers (dedicated filling line, including weighing) - PROC09**

**Number of the ES** : 1

### Section 2 - Exposure controls

#### Contributing exposure scenario controlling environmental exposure for 0: Industrial use of monomers for manufacture of thermoplastics

**Frequency and duration of use** : Emission Days (days/year): 300

**Technical conditions and measures at process level (source) to prevent release** : Size of industrial sewage treatment plant (m3/d) 2000

**Technical on-site conditions and measures to reduce or limit discharges, air emissions and releases to soil** : On-site wastewater treatment required.  
 Release fraction to wastewater from process (initial release prior to RMM): Maximum substance input (kg/day): 7.9  
 Typical on-site wastewater treatment technology provides removal efficiency of (%): 95

#### Contributing exposure scenario controlling worker exposure for 0: Use in closed process, no likelihood of exposure

**Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%

**Physical state** : liquid 40 - 70°C

**Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
 Exposure duration per year: 220 days

**Engineering controls** : Use complete process isolation technology.  
 Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
 Handle substance within a closed system.

**Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
 Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

#### Conditions and measures related to personal protection, hygiene and health evaluation

**Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
 Wear suitable gloves tested to EN374. butyl rubber  
 Wear rubber boots. neoprene

**Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 1: Use in closed, continuous process with occasional controlled exposure**

- Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%
- Physical state** : liquid 40 - 70°C
- Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
Exposure duration per year:220 days
- Engineering controls** : Use complete process isolation technology.  
Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
Handle substance within a closed system.
- Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

**Conditions and measures related to personal protection, hygiene and health evaluation**

- Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
Wear suitable gloves tested to EN374. butyl rubber  
Wear rubber boots. neoprene
- Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 2: Use in closed batch process (synthesis or formulation)**

- Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%
- Physical state** : liquid 40 - 70°C
- Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
Exposure duration per year:220 days
- Engineering controls** : Use complete process isolation technology.  
Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
Handle substance within a closed system.
- Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

**Conditions and measures related to personal protection, hygiene and health evaluation**

- Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
Wear suitable gloves tested to EN374. butyl rubber  
Wear rubber boots. neoprene
- Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 3: Use in batch and other process (synthesis) where opportunity for exposure arises**

- Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%
- Physical state** : liquid 40 - 70°C
- Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
Exposure duration per year:220 days
- Technical conditions and measures to control dispersion from source towards the worker** : with local exhaust ventilation
- Engineering controls** : Use complete process isolation technology.  
Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
Handle substance within a closed system.
- Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

**Conditions and measures related to personal protection, hygiene and health evaluation**

- Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
Wear suitable gloves tested to EN374. butyl rubber  
Wear rubber boots. neoprene

**Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 4: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities**

**Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%

**Physical state** : liquid 40 - 70°C

**Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
Exposure duration per year:220 days

**Technical conditions and measures to control dispersion from source towards the worker** : with local exhaust ventilation

**Engineering controls** : Use complete process isolation technology.  
Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
Handle substance within a closed system.

**Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

**Conditions and measures related to personal protection, hygiene and health evaluation**

**Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
Wear suitable gloves tested to EN374. butyl rubber  
Wear rubber boots. neoprene

**Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 5: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)**

**Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%

**Physical state** : liquid 40 - 70°C

**Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
Exposure duration per year:220 days

**Technical conditions and measures to control dispersion from source towards the worker** : with local exhaust ventilation

**Engineering controls** : Use complete process isolation technology.  
Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
Handle substance within a closed system.

**Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

**Conditions and measures related to personal protection, hygiene and health evaluation**

**Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
Wear suitable gloves tested to EN374. butyl rubber  
Wear rubber boots. neoprene

**Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Section 3 - Exposure estimation and reference to its source**

**Website:** : Not applicable.

**Exposure estimation and reference to its source - Environment: 0: Industrial use of monomers for manufacture of thermoplastics**

**Exposure assessment (environment):** : Used EUSES model.

**Exposure estimation** : PEC Environment, water, continuous: Fresh water 0.0169 mg/l. Risk characterisation ratio (PEC/PNEC): = 0.99  
PEC Environment, water, continuous: Marine water 0.00169 mg/l. Risk characterisation ratio (PEC/PNEC): = 0.099

**Exposure estimation and reference to its source - Workers: 1: Use in closed process, no likelihood of exposure**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.343 mg/kg bw/day  
 Short term exposure - Inhalation 0.1376 mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.343 mg/kg bw/day  
 Long term exposure - Inhalation 0.0688 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 2: Use in closed, continuous process with occasional controlled exposure**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.137 mg/kg bw/day  
 Short term exposure - Inhalation 0.688 mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.137 mg/kg bw/day  
 Long term exposure - Inhalation 0.344 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 3: Use in closed batch process (synthesis or formulation)**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.0343 mg/kg bw/day  
 Short term exposure - Inhalation 1.72 mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.0343mg/kg bw/day  
 Long term exposure - Inhalation 0.860 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 4: Use in batch and other process (synthesis) where opportunity for exposure arises**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.686 mg/kg bw/day  
 Short term exposure - Inhalation 1.376 mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.686 mg/kg bw/day  
 Long term exposure - Inhalation 0.688 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 5: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.686 mg/kg bw/day  
 Short term exposure - Inhalation 1.032mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.686 mg/kg bw/day  
 Long term exposure - Inhalation 0.516 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 6: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.686 mg/kg bw/day. Risk characterisation ratio = < 1  
 Short term exposure - Inhalation 1.08 mg/m<sup>3</sup>. Risk characterisation ratio = 0.108  
 Long term exposure - Dermal 0.686 mg/kg bw/day. Risk characterisation ratio = 0.49  
 Long term exposure - Inhalation 1.08 mg/m<sup>3</sup>. Risk characterisation ratio = 0.6

**Section 4 - Guidance to Downstream User to evaluate if he works inside the boundaries set by the ES**

**Environment** : Not available.

**Health** : Not available.

**Additional good practice advice beyond the REACH CSA**

**Environment** : Not available.

**Health** : Not available.

## Annex to the extended Safety Data Sheet (eSDS)

Industrial

### Identification of the substance or mixture

**Product definition** : Mono-constituent substance  
**Code** : WW12159  
**Product name** : Acrylonitrile DFI

### Section 1 - Title

**Short title of the exposure scenario** : Acrylonitrile\_107-13-1\_ES2

**List of use descriptors** : **Identified use name:** Monomer for the production of acrylonitrile-butadiene-styrene (ABS) and styrene-acrylonitrile (SAN) plastics. (20% of total usage).  
**Process Category:** PROC01, PROC02, PROC03, PROC04, PROC08b, PROC09  
**Substance supplied to that use in form of:** As such  
**Sector of end use:** SU11, SU12  
**Subsequent service life relevant for that use:** Yes.  
**Environmental Release Category:** ERC06c  
**Market sector by type of chemical product:** PC32  
**Article category related to subsequent service life:** AC01, AC02, AC03, AC13

**Environmental contributing scenarios** : **Industrial use of monomers for manufacture of thermoplastics - ERC06c**

**Health Contributing scenarios** : **Use in closed process, no likelihood of exposure - PROC01**  
**Use in closed, continuous process with occasional controlled exposure - PROC02**  
**Use in closed batch process (synthesis or formulation) - PROC03**  
**Use in batch and other process (synthesis) where opportunity for exposure arises - PROC04**  
**Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities - PROC08b**  
**Transfer of substance or preparation into small containers (dedicated filling line, including weighing) - PROC09**

**Number of the ES** : 2

### Section 2 - Exposure controls

#### Contributing exposure scenario controlling environmental exposure for 0: Industrial use of monomers for manufacture of thermoplastics

**Frequency and duration of use** : Emission Days (days/year): 365 days.

**Technical conditions and measures at process level (source) to prevent release** : Size of industrial sewage treatment plant (m3/d) 2000

**Technical on-site conditions and measures to reduce or limit discharges, air emissions and releases to soil** : On-site wastewater treatment required.  
 Release fraction to wastewater from process (initial release prior to RMM): Maximum substance input (kg/day): 7.9  
 Typical on-site wastewater treatment technology provides removal efficiency of (%): 95

#### Contributing exposure scenario controlling worker exposure for 0: Use in closed process, no likelihood of exposure

**Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%

**Physical state** : liquid 80 - 180°C

**Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
 Exposure duration per year: 220 days

**Engineering controls** : Use complete process isolation technology.  
 Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
 Handle substance within a closed system.

**Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
 Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

#### Conditions and measures related to personal protection, hygiene and health evaluation

**Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
 Wear suitable gloves tested to EN374. butyl rubber  
 Wear rubber boots. neoprene

**Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 1: Use in closed, continuous process with occasional controlled exposure**

<b>Concentration of substance in mixture or article</b>	: Covers percentage substance in the product up to 100%
<b>Physical state</b>	: liquid 80 - 180°C
<b>Frequency and duration of use</b>	: Exposure duration per day: 8 h (full shift). Exposure duration per year:220 days
<b>Engineering controls</b>	: Use complete process isolation technology. Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits. Handle substance within a closed system.
<b>Organisational measures to prevent/limit releases, dispersion and exposure</b>	: Only allow access to authorised staff. Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

**Conditions and measures related to personal protection, hygiene and health evaluation**

<b>Personal protection</b>	: Wear suitable coveralls capable of preventing significant penetration of the substance - PVC Wear suitable gloves tested to EN374. butyl rubber Wear rubber boots. neoprene
<b>Respiratory protection</b>	: Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 2: Use in closed batch process (synthesis or formulation)**

<b>Concentration of substance in mixture or article</b>	: Covers percentage substance in the product up to 100%
<b>Physical state</b>	: liquid 80 - 180°C
<b>Frequency and duration of use</b>	: Exposure duration per day: 8 h (full shift). Exposure duration per year:220 days
<b>Engineering controls</b>	: Use complete process isolation technology. Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits. Handle substance within a closed system.
<b>Organisational measures to prevent/limit releases, dispersion and exposure</b>	: Only allow access to authorised staff. Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

**Conditions and measures related to personal protection, hygiene and health evaluation**

<b>Personal protection</b>	: Wear suitable coveralls capable of preventing significant penetration of the substance - PVC Wear suitable gloves tested to EN374. butyl rubber Wear rubber boots. neoprene
<b>Respiratory protection</b>	: Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 3: Use in batch and other process (synthesis) where opportunity for exposure arises**

<b>Concentration of substance in mixture or article</b>	: Covers percentage substance in the product up to 100%
<b>Physical state</b>	: liquid 80 - 180°C
<b>Frequency and duration of use</b>	: Exposure duration per day: 8 h (full shift). Exposure duration per year:220 days
<b>Technical conditions and measures to control dispersion from source towards the worker</b>	: with local exhaust ventilation
<b>Engineering controls</b>	: Use complete process isolation technology. Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits. Handle substance within a closed system.
<b>Organisational measures to prevent/limit releases, dispersion and exposure</b>	: Only allow access to authorised staff. Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

**Conditions and measures related to personal protection, hygiene and health evaluation**

<b>Personal protection</b>	: Wear suitable coveralls capable of preventing significant penetration of the substance - PVC Wear suitable gloves tested to EN374. butyl rubber Wear rubber boots. neoprene
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**Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 4: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities**

**Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%

**Physical state** : liquid 80 - 180°C

**Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
Exposure duration per year:220 days

**Technical conditions and measures to control dispersion from source towards the worker** : with local exhaust ventilation

**Engineering controls** : Use complete process isolation technology.  
Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
Handle substance within a closed system.

**Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

**Conditions and measures related to personal protection, hygiene and health evaluation**

**Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
Wear suitable gloves tested to EN374. butyl rubber  
Wear rubber boots. neoprene

**Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 5: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)**

**Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%

**Physical state** : liquid 80 - 180°C

**Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
Exposure duration per year:220 days

**Technical conditions and measures to control dispersion from source towards the worker** : with local exhaust ventilation

**Engineering controls** : Use complete process isolation technology.  
Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
Handle substance within a closed system.

**Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

**Conditions and measures related to personal protection, hygiene and health evaluation**

**Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
Wear suitable gloves tested to EN374. butyl rubber  
Wear rubber boots. neoprene

**Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Section 3 - Exposure estimation and reference to its source**

**Website:** : Not applicable.

**Exposure estimation and reference to its source - Environment: 0: Industrial use of monomers for manufacture of thermoplastics**

**Exposure assessment (environment):** : Used EUSES model.

**Exposure estimation** : PEC Environment, water, continuous: Fresh water 0.0169 mg/l. Risk characterisation ratio (PEC/PNEC): = 0.99  
PEC Environment, water, continuous: Marine water 0.00169 mg/l. Risk characterisation ratio (PEC/PNEC): = 0.099

**Exposure estimation and reference to its source - Workers: 1: Use in closed process, no likelihood of exposure**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.343 mg/kg bw/day  
 Short term exposure - Inhalation 0.1376 mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.343 mg/kg bw/day  
 Long term exposure - Inhalation 0.0688 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 2: Use in closed, continuous process with occasional controlled exposure**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.137 mg/kg bw/day  
 Short term exposure - Inhalation 0.688 mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.137 mg/kg bw/day  
 Long term exposure - Inhalation 0.344 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 3: Use in closed batch process (synthesis or formulation)**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.0343 mg/kg bw/day  
 Short term exposure - Inhalation 1.72 mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.0343mg/kg bw/day  
 Long term exposure - Inhalation 0.860 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 4: Use in batch and other process (synthesis) where opportunity for exposure arises**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.686 mg/kg bw/day  
 Short term exposure - Inhalation 1.376 mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.686 mg/kg bw/day  
 Long term exposure - Inhalation 0.688 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 5: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.686 mg/kg bw/day  
 Short term exposure - Inhalation 1.032mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.686 mg/kg bw/day  
 Long term exposure - Inhalation 0.516 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 6: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.686 mg/kg bw/day. Risk characterisation ratio = < 1  
 Short term exposure - Inhalation 3.44 mg/m<sup>3</sup>. Risk characterisation ratio = 0.344  
 Long term exposure - Dermal 0.686 mg/kg bw/day. Risk characterisation ratio = 0.49  
 Long term exposure - Inhalation 1.72 mg/m<sup>3</sup>. Risk characterisation ratio = 0.96

**Section 4 - Guidance to Downstream User to evaluate if he works inside the boundaries set by the ES**

**Environment** : Not available.

**Health** : Not available.

**Additional good practice advice beyond the REACH CSA**

**Environment** : Not available.

**Health** : Not available.

## Annex to the extended Safety Data Sheet (eSDS)

Industrial

### Identification of the substance or mixture

**Product definition** : Mono-constituent substance  
**Code** : WW12159  
**Product name** : Acrylonitrile DFI

### Section 1 - Title

**Short title of the exposure scenario** : Acrylonitrile\_107-13-1\_ES3

**List of use descriptors** : **Identified use name:** Monomer for the production of nitrile rubbers.  
**Process Category:** PROC01, PROC02, PROC03, PROC08b, PROC09  
**Substance supplied to that use in form of:** As such  
**Sector of end use:** SU11  
**Subsequent service life relevant for that use:** Yes.  
**Environmental Release Category:** ERC06c  
**Market sector by type of chemical product:** PC32  
**Article category related to subsequent service life:** AC10

**Environmental contributing scenarios** : **Industrial use of monomers for manufacture of thermoplastics - ERC06c**

**Health Contributing scenarios** : **Use in closed process, no likelihood of exposure - PROC01**  
**Use in closed, continuous process with occasional controlled exposure - PROC02**  
**Use in closed batch process (synthesis or formulation) - PROC03**  
**Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities - PROC08b**  
**Transfer of substance or preparation into small containers (dedicated filling line, including weighing) - PROC09**

**Number of the ES** : 3

### Section 2 - Exposure controls

#### Contributing exposure scenario controlling environmental exposure for 0: Industrial use of monomers for manufacture of thermoplastics

**Frequency and duration of use** : Emission Days (days/year): 365 days.

**Technical conditions and measures at process level (source) to prevent release** : Size of industrial sewage treatment plant (m3/d) 2000

**Technical on-site conditions and measures to reduce or limit discharges, air emissions and releases to soil** : On-site wastewater treatment required.  
 Release fraction to wastewater from process (initial release prior to RMM): Maximum substance input (kg/day): 7.9  
 Typical on-site wastewater treatment technology provides removal efficiency of (%): 95

#### Contributing exposure scenario controlling worker exposure for 0: Use in closed process, no likelihood of exposure

**Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%

**Physical state** : liquid 35°C

**Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
 Exposure duration per year: 220 days

**Engineering controls** : Use complete process isolation technology.  
 Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
 Handle substance within a closed system.

**Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
 Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

#### Conditions and measures related to personal protection, hygiene and health evaluation

**Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
 Wear suitable gloves tested to EN374. butyl rubber  
 Wear rubber boots. neoprene

**Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 1: Use in closed, continuous process with occasional controlled exposure**

<b>Concentration of substance in mixture or article</b>	: Covers percentage substance in the product up to 100%
<b>Physical state</b>	: liquid 35°C
<b>Frequency and duration of use</b>	: Exposure duration per day: 8 h (full shift). Exposure duration per year:220 days
<b>Engineering controls</b>	: Use complete process isolation technology. Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits. Handle substance within a closed system.
<b>Organisational measures to prevent/limit releases, dispersion and exposure</b>	: Only allow access to authorised staff. Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
<b>Personal protection</b>	: Wear suitable coveralls capable of preventing significant penetration of the substance - PVC Wear suitable gloves tested to EN374. butyl rubber Wear rubber boots. neoprene
<b>Respiratory protection</b>	: Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 2: Use in closed batch process (synthesis or formulation)**

<b>Concentration of substance in mixture or article</b>	: Covers percentage substance in the product up to 100%
<b>Physical state</b>	: liquid 35°C
<b>Frequency and duration of use</b>	: Exposure duration per day: 8 h (full shift). Exposure duration per year:220 days
<b>Engineering controls</b>	: Use complete process isolation technology. Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits. Handle substance within a closed system.
<b>Organisational measures to prevent/limit releases, dispersion and exposure</b>	: Only allow access to authorised staff. Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
<b>Personal protection</b>	: Wear suitable coveralls capable of preventing significant penetration of the substance - PVC Wear suitable gloves tested to EN374. butyl rubber Wear rubber boots. neoprene
<b>Respiratory protection</b>	: Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 3: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities**

<b>Concentration of substance in mixture or article</b>	: Covers percentage substance in the product up to 100%
<b>Physical state</b>	: liquid 35°C
<b>Frequency and duration of use</b>	: Exposure duration per day: 8 h (full shift). Exposure duration per year:220 days
<b>Technical conditions and measures to control dispersion from source towards the worker</b>	: with local exhaust ventilation
<b>Engineering controls</b>	: Use complete process isolation technology. Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits. Handle substance within a closed system.
<b>Organisational measures to prevent/limit releases, dispersion and exposure</b>	: Only allow access to authorised staff. Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	

<b>Personal protection</b>	: Wear suitable coveralls capable of preventing significant penetration of the substance - PVC Wear suitable gloves tested to EN374. butyl rubber Wear rubber boots. neoprene
<b>Respiratory protection</b>	: Wear special protective clothing and positive pressure, self-contained breathing apparatus.

#### Contributing exposure scenario controlling worker exposure for 4: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)

<b>Concentration of substance in mixture or article</b>	: Covers percentage substance in the product up to 100%
<b>Physical state</b>	: liquid 35°C
<b>Frequency and duration of use</b>	: Exposure duration per day: 8 h (full shift). Exposure duration per year: 220 days
<b>Technical conditions and measures to control dispersion from source towards the worker</b>	: with local exhaust ventilation
<b>Engineering controls</b>	: Use complete process isolation technology. Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits. Handle substance within a closed system.
<b>Organisational measures to prevent/limit releases, dispersion and exposure</b>	: Only allow access to authorised staff. Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
<b>Personal protection</b>	: Wear suitable coveralls capable of preventing significant penetration of the substance - PVC Wear suitable gloves tested to EN374. butyl rubber Wear rubber boots. neoprene
<b>Respiratory protection</b>	: Wear special protective clothing and positive pressure, self-contained breathing apparatus.

### Section 3 - Exposure estimation and reference to its source

**Website:** : Not applicable.

#### Exposure estimation and reference to its source - Environment: 0: Industrial use of monomers for manufacture of thermoplastics

<b>Exposure assessment (environment):</b>	: Used EUSES model.
<b>Exposure estimation</b>	: PEC Environment, water, continuous: Fresh water 0.0169 mg/l. Risk characterisation ratio (PEC/PNEC): = 0.99 PEC Environment, water, continuous: Marine water 0.00169 mg/l. Risk characterisation ratio (PEC/PNEC): = 0.099

#### Exposure estimation and reference to its source - Workers: 1: Use in closed process, no likelihood of exposure

<b>Exposure assessment (human):</b>	: Used ECETOC TRA model.
<b>Exposure estimation</b>	: Short term exposure - Dermal 0.343 mg/kg bw/day Short term exposure - Inhalation 0.1376 mg/m <sup>3</sup> Long term exposure - Dermal 0.343 mg/kg bw/day Long term exposure - Inhalation 0.0688 mg/m <sup>3</sup>

#### Exposure estimation and reference to its source - Workers: 2: Use in closed, continuous process with occasional controlled exposure

<b>Exposure assessment (human):</b>	: Used ECETOC TRA model.
<b>Exposure estimation</b>	: Short term exposure - Dermal 0.137 mg/kg bw/day Short term exposure - Inhalation 0.688 mg/m <sup>3</sup> Long term exposure - Dermal 0.137 mg/kg bw/day Long term exposure - Inhalation 0.344 mg/m <sup>3</sup>

#### Exposure estimation and reference to its source - Workers: 3: Use in closed batch process (synthesis or formulation)

<b>Exposure assessment (human):</b>	: Used ECETOC TRA model.
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**Exposure estimation** : Short term exposure - Dermal 0.0343 mg/kg bw/day  
 Short term exposure - Inhalation 1.72 mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.0343mg/kg bw/day  
 Long term exposure - Inhalation 0.860 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 4: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.686 mg/kg bw/day  
 Short term exposure - Inhalation 1.032mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.686 mg/kg bw/day  
 Long term exposure - Inhalation 0.516 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 5: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.686 mg/kg bw/day. Risk characterisation ratio = < 1  
 Short term exposure - Inhalation 3.44 mg/m<sup>3</sup>. Risk characterisation ratio = 0.344  
 Long term exposure - Dermal 0.686 mg/kg bw/day. Risk characterisation ratio = 0.49  
 Long term exposure - Inhalation 1.72 mg/m<sup>3</sup>. Risk characterisation ratio = 0.96

**Section 4 - Guidance to Downstream User to evaluate if he works inside the boundaries set by the ES**

**Environment** : Not available.

**Health** : Not available.

**Additional good practice advice beyond the REACH CSA**

**Environment** : Not available.

**Health** : Not available.

## Annex to the extended Safety Data Sheet (eSDS)

Industrial

### Identification of the substance or mixture

**Product definition** : Mono-constituent substance  
**Code** : WW12159  
**Product name** : Acrylonitrile DFI

### Section 1 - Title

**Short title of the exposure scenario** : Acrylonitrile\_107-13-1\_ES4

**List of use descriptors** : **Identified use name:** Intermediate for the manufacture of bulk chemicals, used in closed processes.  
 Intermediate resin system.  
**Process Category:** PROC01, PROC02, PROC03, PROC08b, PROC09  
**Substance supplied to that use in form of:** As such  
**Sector of end use:** SU08, SU12  
**Subsequent service life relevant for that use:** No.  
**Environmental Release Category:** ERC06c, ERC06a, ERC06d  
**Market sector by type of chemical product:** PC32, PC19  
**Article category related to subsequent service life:** Not applicable.

**Environmental contributing scenarios** : **Industrial use resulting in manufacture of another substance (use of intermediates)** - ERC06a  
**Industrial use of monomers for manufacture of thermoplastics** - ERC06c  
**Industrial use of process regulators for polymerisation processes in production of resins, rubbers, polymers** - ERC06d

**Health Contributing scenarios** : **Use in closed process, no likelihood of exposure** - PROC01  
**Use in closed, continuous process with occasional controlled exposure** - PROC02  
**Use in closed batch process (synthesis or formulation)** - PROC03  
**Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities** - PROC08b  
**Transfer of substance or preparation into small containers (dedicated filling line, including weighing)** - PROC09

**Number of the ES** : 4

### Section 2 - Exposure controls

#### Contributing exposure scenario controlling environmental exposure for 0: Industrial use resulting in manufacture of another substance (use of intermediates)

**Frequency and duration of use** : Emission Days (days/year): 365 days.

**Technical conditions and measures at process level (source) to prevent release** : Size of industrial sewage treatment plant (m3/d) 2000

**Technical on-site conditions and measures to reduce or limit discharges, air emissions and releases to soil** : On-site wastewater treatment required.  
 Release fraction to wastewater from process (initial release prior to RMM): Maximum substance input (kg/day): 7.9  
 Typical on-site wastewater treatment technology provides removal efficiency of (%): 95

#### Contributing exposure scenario controlling environmental exposure for 1: Industrial use of monomers for manufacture of thermoplastics

**Frequency and duration of use** : Emission Days (days/year): 365 days.

**Technical conditions and measures at process level (source) to prevent release** : Size of industrial sewage treatment plant (m3/d) 2000

**Technical on-site conditions and measures to reduce or limit discharges, air emissions and releases to soil** : On-site wastewater treatment required.  
 Release fraction to wastewater from process (initial release prior to RMM): Maximum substance input (kg/day): 7.9  
 Typical on-site wastewater treatment technology provides removal efficiency of (%): 95

#### Contributing exposure scenario controlling environmental exposure for 2: Industrial use of process regulators for polymerisation processes in production of resins, rubbers, polymers

**Frequency and duration of use** : Emission Days (days/year): 365 days.

**Technical conditions and measures at process level (source) to prevent release** : Size of industrial sewage treatment plant (m3/d) 2000

**Technical on-site conditions and measures to reduce or limit discharges, air emissions and releases to soil** : On-site wastewater treatment required.  
 Release fraction to wastewater from process (initial release prior to RMM):Maximum substance input (kg/day):7.9  
 Typical on-site wastewater treatment technology provides removal efficiency of (%):95

**Contributing exposure scenario controlling worker exposure for 0: Use in closed process, no likelihood of exposure**

**Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%

**Physical state** : liquid

**Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
Exposure duration per year:220 days

**Engineering controls** : Use complete process isolation technology.  
Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
Handle substance within a closed system.

**Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

**Conditions and measures related to personal protection, hygiene and health evaluation**

**Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
Wear suitable gloves tested to EN374. butyl rubber  
Wear rubber boots. neoprene

**Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 1: Use in closed, continuous process with occasional controlled exposure**

**Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%

**Physical state** : liquid

**Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
Exposure duration per year:220 days

**Engineering controls** : Use complete process isolation technology.  
Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
Handle substance within a closed system.

**Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

**Conditions and measures related to personal protection, hygiene and health evaluation**

**Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
Wear suitable gloves tested to EN374. butyl rubber  
Wear rubber boots. neoprene

**Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 2: Use in closed batch process (synthesis or formulation)**

**Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%

**Physical state** : liquid

**Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
Exposure duration per year:220 days

**Engineering controls** : Use complete process isolation technology.  
Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
Handle substance within a closed system.

**Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

**Conditions and measures related to personal protection, hygiene and health evaluation**

**Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
Wear suitable gloves tested to EN374. butyl rubber  
Wear rubber boots. neoprene

**Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 3: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities**

**Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%

**Physical state** : liquid

**Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
Exposure duration per year:220 days

**Technical conditions and measures to control dispersion from source towards the worker** : with local exhaust ventilation

**Engineering controls** : Use complete process isolation technology.  
Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
Handle substance within a closed system.

**Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

**Conditions and measures related to personal protection, hygiene and health evaluation**

**Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
Wear suitable gloves tested to EN374. butyl rubber  
Wear rubber boots. neoprene

**Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 4: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)**

**Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%

**Physical state** : liquid

**Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
Exposure duration per year:220 days

**Technical conditions and measures to control dispersion from source towards the worker** : with local exhaust ventilation

**Engineering controls** : Use complete process isolation technology.  
Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
Handle substance within a closed system.

**Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

**Conditions and measures related to personal protection, hygiene and health evaluation**

**Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
Wear suitable gloves tested to EN374. butyl rubber  
Wear rubber boots. neoprene

**Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Section 3 - Exposure estimation and reference to its source**

**Website:** : Not applicable.

**Exposure estimation and reference to its source - Environment: 0: Industrial use resulting in manufacture of another substance (use of intermediates)**

**Exposure assessment (environment):** : Used EUSES model.

**Exposure estimation** : PEC Environment, water, continuous: Fresh water 0.0169 mg/l. Risk characterisation ratio (PEC/PNEC): = 0.99  
PEC Environment, water, continuous: Marine water 0.00169 mg/l. Risk characterisation ratio (PEC/PNEC): = 0.099

**Exposure estimation and reference to its source - Environment: 1: Industrial use of monomers for manufacture of thermoplastics**

**Exposure assessment (environment):** : Used EUSES model.

**Exposure estimation** : PEC Environment, water, continuous: Fresh water 0.0169 mg/l. Risk characterisation ratio (PEC/PNEC): = 0.99  
 PEC Environment, water, continuous: Marine water 0.00169 mg/l. Risk characterisation ratio (PEC/PNEC): = 0.099

**Exposure estimation and reference to its source - Environment: 2: Industrial use of process regulators for polymerisation processes in production of resins, rubbers, polymers**

**Exposure assessment (environment):** : Used EUSES model.

**Exposure estimation** : PEC Environment, water, continuous: Fresh water 0.0169 mg/l. Risk characterisation ratio (PEC/PNEC): = 0.99  
 PEC Environment, water, continuous: Marine water 0.00169 mg/l. Risk characterisation ratio (PEC/PNEC): = 0.099

**Exposure estimation and reference to its source - Workers: 3: Use in closed process, no likelihood of exposure**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.343 mg/kg bw/day  
 Short term exposure - Inhalation 0.1376 mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.343 mg/kg bw/day  
 Long term exposure - Inhalation 0.0688 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 4: Use in closed, continuous process with occasional controlled exposure**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.137 mg/kg bw/day  
 Short term exposure - Inhalation 0.688 mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.137 mg/kg bw/day  
 Long term exposure - Inhalation 0.344 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 5: Use in closed batch process (synthesis or formulation)**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.0343 mg/kg bw/day  
 Short term exposure - Inhalation 1.72 mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.0343 mg/kg bw/day  
 Long term exposure - Inhalation 0.860 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 6: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.686 mg/kg bw/day  
 Short term exposure - Inhalation 1.032 mg/m<sup>3</sup>  
 Long term exposure - Dermal 0.686 mg/kg bw/day  
 Long term exposure - Inhalation 1.032 mg/m<sup>3</sup>

**Exposure estimation and reference to its source - Workers: 7: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.686 mg/kg bw/day. Risk characterisation ratio = < 1  
 Short term exposure - Inhalation 3.44 mg/m<sup>3</sup>. Risk characterisation ratio = 0.344  
 Long term exposure - Dermal 0.686 mg/kg bw/day. Risk characterisation ratio = 0.49  
 Long term exposure - Inhalation 1.72 mg/m<sup>3</sup>. Risk characterisation ratio = 0.96

**Section 4 - Guidance to Downstream User to evaluate if he works inside the boundaries set by the ES**

**Environment** : Not available.

**Health** : Not available.

**Additional good practice advice beyond the REACH CSA**

**Environment** : Not available.

**Health** : Not available.

## Annex to the extended Safety Data Sheet (eSDS)

Industrial

### Identification of the substance or mixture

Product definition : Mono-constituent substance  
 Code : WW12159  
 Product name : Acrylonitrile DFI

### Section 1 - Title

Short title of the exposure scenario : Acrylonitrile\_107-13-1\_ES5  
 List of use descriptors : **Identified use name:** Use as laboratory reagent  
**Process Category:** PROC15  
**Substance supplied to that use in form of:** As such  
**Sector of end use:** SU22  
**Subsequent service life relevant for that use:** No.  
**Environmental Release Category:** ERC06a  
**Market sector by type of chemical product:** PC19  
**Article category related to subsequent service life:** Not applicable.  
 Environmental contributing scenarios : **Industrial use resulting in manufacture of another substance (use of intermediates) - ERC06a**  
 Health Contributing scenarios : **Use as laboratory reagent - PROC15**

Number of the ES : 5

### Section 2 - Exposure controls

#### Contributing exposure scenario controlling environmental exposure for 0: Industrial use resulting in manufacture of another substance (use of intermediates)

Frequency and duration of use : Emission Days (days/year): 365 days.  
 Technical conditions and measures at process level (source) to prevent release : Size of industrial sewage treatment plant (m3/d) 2000  
 Technical on-site conditions and measures to reduce or limit discharges, air emissions and releases to soil : Release fraction to wastewater from process (initial release prior to RMM):Maximum substance input (kg/day):0  
 Wastewater emission controls are not applicable as there is no direct release to wastewater.

#### Contributing exposure scenario controlling worker exposure for 0: Use as laboratory reagent

Concentration of substance in mixture or article : Covers percentage substance in the product up to 100%  
 Physical state : liquid  
 Frequency and duration of use : Exposure duration per day: 8 h (full shift).  
 Exposure duration per year:220 days  
 Engineering controls : Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
 All handling must be performed in a glove box or other totally enclosed system.  
 Organisational measures to prevent/limit releases, dispersion and exposure : Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.  
 Conditions and measures related to personal protection, hygiene and health evaluation  
 Personal protection : Lab coat.  
 Wear suitable gloves tested to EN374.butyl rubber  
 Wear tightly-sealed safety glasses.

### Section 3 - Exposure estimation and reference to its source

Website: : Not applicable.

#### Exposure estimation and reference to its source - Environment: 0: Industrial use resulting in manufacture of another substance (use of intermediates)

Exposure assessment (environment): : Used EUSES model.  
 Exposure estimation : PEC Environment, water, continuous: Fresh water0 mg/l. Risk characterisation ratio (PEC/PNEC): =0.0022  
 PEC Environment, water, continuous: Marine water 0mg/l. Risk characterisation ratio (PEC/PNEC): =0.000177

**Exposure estimation and reference to its source - Workers: 1: Use as laboratory reagent**

**Exposure assessment (human):** : Used ECETOC TRA model.

**Exposure estimation** : Short term exposure - Dermal 0.343mg/kg bw/day. Risk characterisation ratio = < 1  
Short term exposure - Inhalation 0.688mg/m<sup>3</sup>. Risk characterisation ratio =0.688  
Long term exposure - Dermal 0.343mg/kg bw/day. Risk characterisation ratio = 0.49  
Long term exposure - Inhalation 0.344 mg/m<sup>3</sup>. Risk characterisation ratio =0.191

**Section 4 - Guidance to Downstream User to evaluate if he works inside the boundaries set by the ES**

**Environment** : Not available.

**Health** : Not available.

**Additional good practice advice beyond the REACH CSA**

**Environment** : Not available.

**Health** : Not available.

## Annex to the extended Safety Data Sheet (eSDS)

Industrial

### Identification of the substance or mixture

**Product definition** : Mono-constituent substance  
**Code** : WW12159  
**Product name** : Acrylonitrile DFI

### Section 1 - Title

**Short title of the exposure scenario** : Acrylonitrile\_107-13-1\_ES6

**List of use descriptors** : **Identified use name:** Manufacture of substance  
**Process Category:** PROC01, PROC02, PROC08b, PROC09  
**Substance supplied to that use in form of:** As such  
**Sector of end use:** SU08, SU09, SU10  
**Subsequent service life relevant for that use:** Yes.  
**Environmental Release Category:** ERC01  
**Market sector by type of chemical product:** Not applicable.  
**Article category related to subsequent service life:** Not applicable.

**Environmental contributing scenarios** : **Manufacture of substances - ERC01**

**Health Contributing scenarios** : **Use in closed process, no likelihood of exposure - PROC01**  
**Use in closed, continuous process with occasional controlled exposure - PROC02**  
**Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities - PROC08b**  
**Transfer of substance or preparation into small containers (dedicated filling line, including weighing) - PROC09**

**Number of the ES** : 6

### Section 2 - Exposure controls

#### Contributing exposure scenario controlling environmental exposure for 0: Manufacture of substances

**Frequency and duration of use** : Emission Days (days/year): 300

**Technical conditions and measures at process level (source) to prevent release** : Size of industrial sewage treatment plant (m3/d) 2000

**Technical on-site conditions and measures to reduce or limit discharges, air emissions and releases to soil** : On-site wastewater treatment required.  
 Release fraction to wastewater from process (initial release prior to RMM): Maximum substance input (kg/day): 7.9  
 Typical on-site wastewater treatment technology provides removal efficiency of (%): 95

#### Contributing exposure scenario controlling worker exposure for 0: Use in closed process, no likelihood of exposure

**Concentration of substance in mixture or article** : Covers percentage substance in the product up to 100%

**Physical state** : liquid 400 - 500°C

**Frequency and duration of use** : Exposure duration per day: 8 h (full shift).  
 Exposure duration per year: 220 days

**Engineering controls** : Use complete process isolation technology.  
 Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits.  
 Handle substance within a closed system.

**Organisational measures to prevent/limit releases, dispersion and exposure** : Only allow access to authorised staff.  
 Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.

#### Conditions and measures related to personal protection, hygiene and health evaluation

**Personal protection** : Wear suitable coveralls capable of preventing significant penetration of the substance - PVC  
 Wear suitable gloves tested to EN374. butyl rubber  
 Wear rubber boots. neoprene

**Respiratory protection** : Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 1: Use in closed, continuous process with occasional controlled exposure**

<b>Concentration of substance in mixture or article</b>	: Covers percentage substance in the product up to 100%
<b>Physical state</b>	: liquid 400 - 500°C
<b>Frequency and duration of use</b>	: Exposure duration per day: 8 h (full shift). Exposure duration per year:220 days
<b>Engineering controls</b>	: Use complete process isolation technology. Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits. Handle substance within a closed system.
<b>Organisational measures to prevent/limit releases, dispersion and exposure</b>	: Only allow access to authorised staff. Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
<b>Personal protection</b>	: Wear suitable coveralls capable of preventing significant penetration of the substance - PVC Wear suitable gloves tested to EN374. butyl rubber Wear rubber boots. neoprene
<b>Respiratory protection</b>	: Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 2: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities**

<b>Concentration of substance in mixture or article</b>	: Covers percentage substance in the product up to 100%
<b>Physical state</b>	: liquid 400 - 500°C
<b>Frequency and duration of use</b>	: Exposure duration per day: 8 h (full shift). Exposure duration per year:220 days
<b>Technical conditions and measures to control dispersion from source towards the worker</b>	: with local exhaust ventilation
<b>Engineering controls</b>	: Use complete process isolation technology. Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits. Handle substance within a closed system.
<b>Organisational measures to prevent/limit releases, dispersion and exposure</b>	: Only allow access to authorised staff. Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	
<b>Personal protection</b>	: Wear suitable coveralls capable of preventing significant penetration of the substance - PVC Wear suitable gloves tested to EN374. butyl rubber Wear rubber boots. neoprene
<b>Respiratory protection</b>	: Wear special protective clothing and positive pressure, self-contained breathing apparatus.

**Contributing exposure scenario controlling worker exposure for 3: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)**

<b>Concentration of substance in mixture or article</b>	: Covers percentage substance in the product up to 100%
<b>Physical state</b>	: liquid 400 - 500°C
<b>Frequency and duration of use</b>	: Exposure duration per day: 8 h (full shift). Exposure duration per year:220 days
<b>Technical conditions and measures to control dispersion from source towards the worker</b>	: with local exhaust ventilation
<b>Engineering controls</b>	: Use complete process isolation technology. Use process enclosures, local exhaust ventilation or other engineering controls to keep airborne levels below recommended exposure limits. Handle substance within a closed system.
<b>Organisational measures to prevent/limit releases, dispersion and exposure</b>	: Only allow access to authorised staff. Before handling this substance/preparation, the personnel involved should be instructed by means of this safety data sheet.
<b>Conditions and measures related to personal protection, hygiene and health evaluation</b>	

<b>Personal protection</b>	: Wear suitable coveralls capable of preventing significant penetration of the substance - PVC Wear suitable gloves tested to EN374. butyl rubber Wear rubber boots. neoprene
<b>Respiratory protection</b>	: Wear special protective clothing and positive pressure, self-contained breathing apparatus.

### Section 3 - Exposure estimation and reference to its source

<b>Website:</b>	: Not applicable.
<b>Exposure estimation and reference to its source - Environment: 0: Manufacture of substances</b>	
<b>Exposure assessment (environment):</b>	: Used EUSES model.
<b>Exposure estimation</b>	: PEC Environment, water, continuous: Fresh water 0.0169 mg/l. Risk characterisation ratio (PEC/PNEC): = 0.99 PEC Environment, water, continuous: Marine water 0.00169 mg/l. Risk characterisation ratio (PEC/PNEC): = 0.099
<b>Exposure estimation and reference to its source - Workers: 1: Use in closed process, no likelihood of exposure</b>	
<b>Exposure assessment (human):</b>	: Used ECETOC TRA model.
<b>Exposure estimation</b>	: Short term exposure - Dermal 0.343 mg/kg bw/day Short term exposure - Inhalation 0.1376 mg/m <sup>3</sup> Long term exposure - Dermal 0.343 mg/kg bw/day Long term exposure - Inhalation 0.0688 mg/m <sup>3</sup>
<b>Exposure estimation and reference to its source - Workers: 2: Use in closed, continuous process with occasional controlled exposure</b>	
<b>Exposure assessment (human):</b>	: Used ECETOC TRA model.
<b>Exposure estimation</b>	: Short term exposure - Dermal 0.137 mg/kg bw/day Short term exposure - Inhalation 0.688 mg/m <sup>3</sup> Long term exposure - Dermal 0.137 mg/kg bw/day Long term exposure - Inhalation 0.344 mg/m <sup>3</sup>
<b>Exposure estimation and reference to its source - Workers: 3: Transfer of substance or preparation (charging/discharging) from/to vessels/large containers at dedicated facilities</b>	
<b>Exposure assessment (human):</b>	: Used ECETOC TRA model.
<b>Exposure estimation</b>	: Short term exposure - Dermal 0.686 mg/kg bw/day Short term exposure - Inhalation 1.032mg/m <sup>3</sup> Long term exposure - Dermal 0.686 mg/kg bw/day Long term exposure - Inhalation 0.516 mg/m <sup>3</sup>
<b>Exposure estimation and reference to its source - Workers: 4: Transfer of substance or preparation into small containers (dedicated filling line, including weighing)</b>	
<b>Exposure assessment (human):</b>	: Used ECETOC TRA model.
<b>Exposure estimation</b>	: Short term exposure - Dermal 0.686 mg/kg bw/day. Risk characterisation ratio = < 1 Short term exposure - Inhalation 3.44 mg/m <sup>3</sup> . Risk characterisation ratio = 0.344 Long term exposure - Dermal 0.686 mg/kg bw/day. Risk characterisation ratio = 0.49 Long term exposure - Inhalation 1.72 mg/m <sup>3</sup> . Risk characterisation ratio = 0.96

### Section 4 - Guidance to Downstream User to evaluate if he works inside the boundaries set by the ES

<b>Environment</b>	: Not available.
<b>Health</b>	: Not available.

### Additional good practice advice beyond the REACH CSA

<b>Environment</b>	: Not available.
<b>Health</b>	: Not available.