* SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Trade name/designation	Hydrogen bromide
Art-Nr(n).	2000, 2005, 70200
Substance name	hydrogen bromide
Index No	035-002-00-0
EC No	233-113-0
REACH No.	01-2119479072-39
CAS No	10035-10-6

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

Sector of uses [SU]
SU8 Manufacture of bulk, large scale chemicals (including petroleum products)
SU10 Formulation [mixing] of preparations and/or re-packaging (excluding alloys)
SU16 Manufacture of computer, electronic and optical products, electrical equipment

Process categories [PROC]
PROC1 Use in closed process, no likelihood of exposure
PROC2 Use in closed, continuous process with occasional controlled exposure
PROC3 Use in closed batch process (synthesis or formulation)

Environmental release categories [ERC]
ERC1 Manufacture of substances
ERC2 Formulation into mixture
ERC4 Industrial use of processing aids in processes and products, not becoming part of articles
ERC6a Industrial use resulting in manufacture of another substance (use of intermediates)
ERC6b Industrial use of reactive processing aids

Product Categories [PC]
PC2 Adsorbents
PC19 Intermediate (precursor)
PC33 Semiconductors

1.3 Details of the supplier of the safety data sheet

Supplier
GHC Gerling, Holz & Co. Handels GmbH
Ruhrstraße 113
D-22761 Hamburg
Telephone +49 40 853 123 0
E-mail hamburg@ghc.de
Website www.ghc.com

Department responsible for information:
GHC Gerling, Holz & Co. Handels GmbH
Telephone +49 40 853 123 0

E-mail (competent person):
msds@ghc.de

* 1.4 Emergency telephone number

EN: Poison Information Center Mainz +49 6131 19240

* SECTION 2: Hazards identification

* 2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008 [CLP]	Classification procedure
Press. Gas (Liq.), H280	
Acute Tox. 3, H331	

Classification according to Regulation (EC) No 1272/2008 [CLP]	Classification procedure
Skin Corr. 1A, H314	
Eye Dam. 1, H318	
STOT SE 3, H335	

Hazard statements for physical hazards
H280 Contains gas under pressure; may explode if heated.

Hazard statements for health hazards
H314 Causes severe skin burns and eye damage.
H318 Causes serious eye damage.
H331 Toxic if inhaled.
H335 May cause respiratory irritation.

* **2.2 Label elements**

* **Labelling according to Regulation (EC) No 1272/2008 [CLP]**

Hazard pictograms

GHS05

GHS06

Signal word
Danger

Hazard statements
H280 Contains gas under pressure; may explode if heated.
H314 Causes severe skin burns and eye damage.
H331 Toxic if inhaled.

* **Precautionary statements**
P260 Do not breathe gas/vapours.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P303 + P361 + P353 IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water or shower.
P304 + P340 IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P315 Get immediate medical advice/attention.
P403 Store in a well-ventilated place.
P405 Store locked up.

* **Supplemental hazard information**
EUH071 Corrosive to the respiratory tract.
Please return container with residual pressure.

* **2.3 Other hazards**

* **Adverse human health effects and symptoms**
Gas/vapour heavier than air. May accumulate in confined spaces, particularly at or below ground level.
Contact with liquid may cause cold burns/frostbite.

* **Other adverse effects**
The substance/mixture does not contain components identified as having endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated Regulation (EU) 2017/2100 or Commission Delegated Regulation (EU) 2018/605 in quantities of 0.1% or more.

* **Results of PBT and vPvB assessment**
The substance/mixture does not contain components meeting the PBT/vPvB criteria of the Reach Regulation, Annex XIII, at levels of 0.1% or higher.

SECTION 3: Composition / information on ingredients

3.1 Substances

Substance name	hydrogen bromide
Index No	035-002-00-0
EC No	233-113-0
REACH No.	01-2119479072-39
CAS No	10035-10-6

Additional information
Content: >= 99,8 %

3.2 Mixtures

not applicable

* SECTION 4: First aid measures

* 4.1 Description of first aid measures

* **General information**
Remove contaminated, saturated clothing immediately.
Call a physician immediately.
First aider: Pay attention to self-protection!

* **Following inhalation**
Remove casualty to fresh air and keep warm and at rest.
In case of respiratory standstill give artificial respiration by respiratory bag (Ambu bag) or respirator. Obtain medical assistance.

* **Following skin contact**
In case of skin contact rinse with warm water.
In case of frostbite, wash with plenty of water; do not remove clothing.
In case of frostbite rinse with lukewarm (not hot) water for at least 15 minutes. Do not remove clothing frozen to the skin.
Thaw with lukewarm water. Apply a sterile dressing. Obtain medical assistance.

After eye contact
Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Obtain medical assistance.

Following ingestion
Ingestion is not considered a potential route of exposure.

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

* **Symptoms**
Respiratory tract irritation
Corrosion
Cough
Dyspnoea

Effects
Pulmonary oedema

4.3 Indication of any immediate medical attention and special treatment needed

Notes for the doctor
Treat symptomatically.
Pulmonary oedema prophylaxis.
To supervise the blood circulation.

* SECTION 5: Firefighting measures

* 5.1 Extinguishing media

* **Suitable extinguishing media**
The product itself does not burn. The product itself does not burn. Match extinguishing measures to surrounding fire.
Foam
Dry extinguishing powder
Carbon dioxide (CO2)
Water spray jet

Unsuitable extinguishing media
Full water jet

* 5.2 Special hazards arising from the substance or mixture

* **Hazardous combustion products**
In case of fire formation of dangerous gases possible.
Bromine
Hydrogen

* 5.3 Advice for firefighters

* **Special protective equipment for firefighters**
Wear a self-contained breathing apparatus and chemical protective clothing.

*** Additional information**
If possible, shut off gas valves and move containers to a safe location.
Use water spray jet to protect personnel and to cool endangered containers.
Exposure to fire may cause rupture / explosion of the containers.
Dispose of fire residues and contaminated extinguishing water in accordance with local, official regulations.

* SECTION 6: Accidental release measures

* 6.1 Personal precautions, protective equipment and emergency procedures

* **For non-emergency personnel**
Use personal protection equipment.
Leave the danger area.
Keep people away and stay on the upwind side.

For emergency responders
Personal protection by wearing close-fitting protective clothing and breathing apparatus.
Pay attention to extension of gas especially at ground (heavier than air) and in direction of the wind.
Remove persons to safety.

* 6.2 Environmental precautions

If possible, stop flow of product.
Do not allow to enter into soil/subsoil.
Do not allow to enter into surface water or drains.

* 6.3 Methods and material for containment and cleaning up

* **For containment**
If necessary, secure leaky pressure receptacles using a salvage container.
Prevent the liquid from spreading over a wide area (set up barriers, cover sewage systems).
Limit expansion of the gas (water spray jet).

* **For cleaning up**
Leave to vapourize.
Provide adequate ventilation.

6.4 Reference to other sections

Disposal: see section 13
Personal protection equipment: see section 8

* SECTION 7: Handling and storage

* 7.1 Precautions for safe handling

*

Protective measures
Use only in well-ventilated areas.
Transfer and handle product only in closed systems.
Usual measures for fire prevention.
Containers' temperature should not be increased above 50 °C.
The working pressure in the receptacle must not exceed the saturation vapour pressure of the pure product resulting at a temperature of 50 °C.
Prevent cylinders from falling over.
Ensure valve protection device is correctly fitted.
Ensure valve outlet cap nut or plug (where provided) is correctly fitted.
Open valve slowly to avoid pressure shock.
Do not allow backflow into the container.
Entering of water into the container must be prevented.
No water to valves, flanges and other fittings.
Purging of pipes and valves with inert gases - to avoid: water, solvents.

*

Advices on general occupational hygiene
When using do not eat, drink, smoke, sniff.
Wash hands before breaks and after work.
Remove contaminated clothing and protective equipment before entering eating areas.

* 7.2 Conditions for safe storage, including any incompatibilities

*

Requirements for storage rooms and vessels
All regulations and local requirements for the storage of containers have to be respected.
Keep container tightly closed and in a well-ventilated place.
Containers' temperature should not be increased above 50 °C.
Prevent cylinders from falling over.
Only use containers specifically approved for the substance/product.
Information on suitable materials for receptacles and valves see ISO 11114.

*

Materials to avoid
Do not store together with explosives.
Do not store together with flammable liquids.
Do not store together with flammable solids.
Do not store together with pyrophoric and self-heating substances.
Do not store together with oxidizing liquids or oxidizing solids.
Do not store together with toxic liquids or toxic solids.
Do not store together with infectious substances.
Do not store together with radioactive material.
Do not store together with food or feed.

7.3 Specific end use(s)

Recommendation
Exposure scenarios (ES) see annex to this safety data sheet.

* SECTION 8: Exposure controls/personal protection

* 8.1 Control parameters

*

Occupational exposure limit values

CAS No	EC No	Substance name	occupational exposure limit value
10035-10-6	233-113-0	Hydrogen bromide	Short-term(ml/m³) 2 (1) Short-term(mg/m³) 6,6 (1) (1) 15 minutes reference period (IE)

DNEL worker

CAS No	Substance name	DNEL value	DNEL type	Remark
10035-10-6	hydrogen bromide	6.7 mg/m³	acute inhalative (local)	
10035-10-6	hydrogen bromide	6.7 mg/m³	acute inhalative (systemic)	
10035-10-6	hydrogen bromide	6.7 mg/m³	long-term inhalative (local)	
10035-10-6	hydrogen bromide	6.7 mg/m³	long-term inhalative (systemic)	

PNEC

CAS No	Substance name	PNEC Value	PNEC type	Remark
10035-10-6	hydrogen bromide	0.019 mg/L	aquatic, freshwater	Assessment factor 1000, assessment factor.

* 8.2 Exposure controls

Appropriate engineering controls

Technical measures to prevent exposure
Transfer and handle only in enclosed systems.

*** Personal protection equipment**

Eye/face protection
Protective goggles according to EN 166, in case of increased risk add protective face shield.

Hand protection
Safety gloves according to EN 374:
Glove material specification [make/type, thickness, permeation time/life]: FKM; 0,4 mm; >= 480 min

Body protection:
Safety shoes with steel toecap.
Body covering work clothing or chemical resistant suit at increased risk.

*** Respiratory protection**
Keep self contained breathing apparatus readily available for emergency use.
Respiratory protection necessary at:
high concentrations
Respiratory protection complying with EN 137.
Short term: filter apparatus, filter E
In case of rescue and maintenance activities in storage containers use environment-independent breathing apparatus because of risk of suffocation due to displacement of oxygen.

*** Thermal hazards**
Use cold-resistant protective equipment.

*** Remark**
Prevent release to the environment.

* SECTION 9: Physical and chemical properties

* 9.1 Information on basic physical and chemical properties

Physical state
Refrigerated liquefied gas

Colour
colourless

Odour
stinging

Safety relevant basis data

	Value	Method	Source, Remark
Odour threshold:			not determined
Melting point/freezing point			not applicable
Boiling point or initial boiling point and boiling range	-66.8 °C		
flammability			The product itself does not burn.
Lower and upper explosion limit			not determined
Flash point			not applicable
Auto-ignition temperature			not determined

	Value	Method	Source, Remark
Decomposition temperature			No decomposition if used as directed.
pH			not applicable
Viscosity			not applicable
Solubility(ies)	Water solubility 665 g/L (25°C)		
Partition coefficient n-octanol/water (log value)			not determined
Vapour pressure	20900 hPa (20°C)		
Density and/or relative density			not applicable
Relative vapour density	2.82		air = 1
particle characteristics	not determined		

* **9.2 Other information**

* **Information with regard to physical hazard classes**

* **Gases under pressure**

Safety characteristics

	Value	Method, Result	Source, Remark
Critical temperature	89.9 °C		

* **Other information**
Vapours are heavier than air.

* SECTION 10: Stability and reactivity

10.1 Reactivity

See section "Possibility of hazardous reactions".

* 10.2 Chemical stability

The substance is chemically stable under recommended conditions of storage, use and temperature.

* 10.3 Possibility of hazardous reactions

Reactions with numerous chemical compounds.
Reactions with oxidising agents.
Reactions with ammonia.
Reactions with amines.

* 10.4 Conditions to avoid

Heat sources / heat - risk of bursting.
Ignition sources, open flames, glowing metal surfaces, etc.
Humidity.
Must not be mixed with air or oxygen.

* 10.5 Incompatible materials

Alkali metals
Alkaline earth metal
Chlorine

* 10.6 Hazardous decomposition products

When handled and stored appropriately, no dangerous decomposition products are known.

* SECTION 11: Toxicological information

11.1 Information on hazard classes as defined in Regulation (EC) No 1272/2008

*** Acute toxicity**

*** Animal data**

	Effective dose	Method,Evaluation	Source, Remark
Acute oral toxicity			Study technically not feasible.
Acute dermal toxicity			Study technically not feasible.
Acute inhalation toxicity	Acute inhalation toxicity (gas) LC0: < 1.48 mg/L Species Rat Exposure time 4 h		

*** Assessment/classification**
Toxic if inhaled.

*** Skin corrosion/irritation**

Animal data

Result / Evaluation	Method	Source, Remark
Corrosive.		Practical experience/human evidence.

*** Assessment/classification**
Causes severe burns.

*** Serious eye damage/irritation**

Animal data

Result / Evaluation	Method	Source, Remark
strongly irritant.		experiences

*** Assessment/classification**
Causes serious eye damage.

*** Sensitisation to the respiratory tract**

*** Assessment/classification**
No data available

Skin sensitisation

Animal data

Result / Evaluation	Dose / Concentration	Method	Source, Remark
			Study scientifically not necessary.

*** Germ cell mutagenicity**

*** Assessment/classification**
Based on available data, the classification criteria are not met.

*** Carcinogenicity**

*** Assessment/classification**
Based on available data, the classification criteria are not met.

*** Reproductive toxicity**

*** Assessment/classification**
Study scientifically not necessary.

* **STOT-single exposure**

* **STOT SE 3**

* **Irritation to respiratory tract**

* **Assessment/classification**
May cause respiratory irritation.

* **STOT-repeated exposure**

* **Animal data**

	Effective dose	Method	Specific effects:	Organs affected:	Source, Remark
Inhalative specific target organ toxicity (repeated exposure)	NOAEL(C): 0.1 mg/l Species Rat				

* **Aspiration hazard**

* **Assessment/classification**
Study technically not feasible.

11.2 Information on other hazards

Other information

Risk of strong health injuries in case of long-term exposition.
Irritating to respiratory system.
Pulmonary dammage is possible.
Irritates mucous membranes.

* SECTION 12: Ecological information

* **12.1 Toxicity**

* **Aquatic toxicity**

	Effective dose	Method,Evaluation	Source, Remark
Acute (short-term) fish toxicity	LC50: 71 mg/L Species Pimephales promelas (fathead minnow) Test duration 96 h		
Chronic (long-term) fish toxicity	not determined		
Acute (short-term) toxicity to crustacea	EC50 19 mg/L Species Daphnia magna (Big water flea) Test duration 48 h		
Chronic (long-term) toxicity to aquatic invertebrate	not determined		
Acute (short-term) toxicity to algae and cyanobacteria	NOEC 32 mg/L Species Algae Test duration 72 h		
Chronic (long-term) toxicity to aquatic algae and cyanobacteria	not determined		
Toxicity to other aquatic plants/organisms	not determined		
Toxicity to microorganisms	not determined		

12.2 Persistence and degradability

	Value	Method	Source, Remark
Biodegradation			Inorganic product which is not eliminable from water through biological cleaning processes.

*** 12.3 Bioaccumulative potential**

No data available

*** 12.4 Mobility in soil**

No data available

*** 12.5 Results of PBT and vPvB assessment**

The substance/mixture does not contain components meeting the PBT/vPvB criteria of the Reach Regulation, Annex XIII, at levels of 0.1% or higher.

*** 12.6 Endocrine disrupting properties**

No data available

*** 12.7 Other adverse effects**

No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Waste codes/waste designations according to EWC/AVV

Waste code product	Waste name
160504 *	gases in pressure containers (including halons) containing hazardous substances

Appropriate disposal / Product
Waste disposal according to directive 2008/98/EC, covering waste and dangerous waste.

Appropriate disposal / Package
Transportable pressure equipment (empty, residual pressure): Return to supplier / manufacturer.

* SECTION 14: Transport information

	Land transport (ADR/RID)	Sea transport (IMDG)	Air transport (ICAO-TI / IATA-DGR)
14.1 UN number or ID number	UN 1048	UN 1048	UN 1048
14.2 UN proper shipping name	HYDROGEN BROMIDE, ANHYDROUS	HYDROGEN BROMIDE, ANHYDROUS	Hydrogen bromide, anhydrous
14.3 Transport hazard class(es)	2.3 (8)	2.3 (8)	2.3 (8)
14.4 Packing group	-	-	-
14.5 Environmental hazards	No	No	No

14.6 Special precautions for user

The protective measures listed in Sections 6, 7 and 8 of the Safety Data Sheet have to be considered.

14.7 Maritime transport in bulk according to IMO instruments

No carriage in bulk.

Land transport (ADR/RID)

UN number or ID number	UN 1048
UN proper shipping name	HYDROGEN BROMIDE, ANHYDROUS
Transport hazard class(es)	2.3 (8)
Hazard label(s)	2.3+8
Classification code	2TC
Packing group	-
Environmental hazards	No
Limited quantity (LQ)	0
Special provisions	-

Tunnel restriction code	C/D

* **Sea transport (IMDG)**

UN number or ID number	UN 1048
UN proper shipping name	HYDROGEN BROMIDE, ANHYDROUS
Transport hazard class(es)	2.3 (8)
Packing group	-
Environmental hazards	No
Limited quantity (LQ)	0
Marine pollutant	No
EmS	F-C, S-U

* **Air transport (ICAO-TI / IATA-DGR)**

UN number or ID number	UN 1048
UN proper shipping name	Hydrogen bromide, anhydrous
Transport hazard class(es)	2.3 (8)
Packing group	-
Environmental hazards	No

* SECTION 15: Regulatory information

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

* **EU legislation**

* **Restrictions of occupation**
Observe employment restrictions under the Maternity Protection Directive (92/85/EEC) for expectant or nursing mothers.
Observe restrictions to employment for juvenils according to the 'juvenile work protection guideline' (94/33/EC).

* **Other regulations (EU)**

* **To follow:**
National and local regulations concerning chemicals shall be observed.
Directive 2012/18/EU on the control of major-accident hazards involving dangerous substances.

15.2 Chemical Safety Assessment

* **National regulations**

For this substance a chemical safety assessment has been carried out.

* SECTION 16: Other information

* **Abbreviations and acronyms**
Press. Gas (Comp.): Compressed gas (CG)
Press. Gas (Liq.): Liquefied gas (LG)
Skin Corr. 1A: Skin corrosion, Sub-category 1A
Eye Dam. 1: Serious eye damage, Category 1
STOT SE 3, H335: Specific target organ toxicity (single exposure), Category 3
Acute Tox. 3, H331: Acute Toxicity (inhalation), Category 3

Key literature references and sources for data
Information from our suppliers and data from the "GESTIS Substances Database" and the "Registered Substances" database of the European Chemicals Agency (ECHA) were used to create this safety data sheet.

* **Additional information**
The information contained herein is based on the state of our knowledge. It characterizes the product with regard to the appropriate safety precautions. It does not represent a guarantee of the properties of the product.

Relevant H- and EUH-phrases (Number and full text)

H280	Contains gas under pressure; may explode if heated.
H314	Causes severe skin burns and eye damage.
H335	May cause respiratory irritation.

Indication of changes
* Data changed compared with the previous version

Annex: Exposure scenarios

ES 1: Manufacture of Hydrogen bromide

1. Manufacture of hydrogen bromide

CS1. Environment	
Manufacture of substances	ERC 1
CS2. Worker	
Enclosed processes and no likelihood of exposure	PROC 1
Use in closed batch process (synthesis or formulation)	PROC 3

2. Condition of use affecting exposure

CS1. Control of environmental exposure: ERC 1

Product characteristics
Anhydrous hydrogen bromide (HBr): colourless gas Upon contact with water, HBr reacts rapidly to form hydrobromic acid which dissociates to hydrogen (H_3O^+) and bromide (Br^-) ions.
Amount used
In EU : ~ 7000 tons/year At manufacture site : ~ 6000 tons/year maximum
Frequency and duration of use
330 days a year
Environmental factors not influenced by risk management
Flow rate of the receiving surface water: 18,000 m^3/day (EUSES v2.1.1 (2008), default value); 73,440 m^3/day (value provided by the manufacturers)
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Risk management measures on site: * Waste gas may be passed through washing towers (with water and caustic soda) and subsequently through columns of active carbon to remove gaseous HBr. * Waste gases may be routed to a scrubber or incinerator unit. (Minor emissions via the untreated waste gas: 1 g/h of HBr) * A fraction of approximately 0.5% of the total tonnage of the manufactured hydrogen bromide may be released to wastewater. Upon contact with water, hydrogen bromide reacts rapidly to form hydrobromic acid. It has to be ensured that the pH of process wastewater is survey and, if necessary, regulated before wastewater is released to the environment. Hydrobromic acid can be neutralized with caustic soda to obtain bromides. On average an amount of 120-130 kg bromides per day may be lost through the wastewater. Remaining hydrogen bromide in the reaction vessels (gaseous and liquid part) is degraded into bromide (Br^-) and recovered into bromine (Br_2) in a recovery unit. The sewage sludge from wastewater treatment plants of units manufacturing hydrogen bromide is incinerated. Remark: The wastewater may be transferred to a recovery unit where bromine can be re-gained from the solutions.

Annex: Exposure scenarios

CS2. Control of worker exposure – PROC 1, PROC 3

Product characteristics
Anhydrous hydrogen bromide (HBr): colourless gas Solutions of HBr in water are clear liquids developing fumes that become brown on exposure to air and light.
Amounts used, Frequency and duration of use
8 hours per day
Technical and organizational conditions and measures
HBr is a corrosive substance. **General measures:** General ventilation at the point source of HBr releases. In indoor plant, Hydrogen bromide can be monitored using treated silica gel tube. Detector tubes are useful for determining the level of respiratory protection required during activities involving the use of HBr. Concentrations should not exceeds 6.7 mg/m^3. **Specific measures per contributing scenario issued by ECETOC TRA:**

Route of exposure	**Condition of use**				
	PROC	**Description**	**LEV**	**Respiratory protection**	**Indoors**
Inhalation	1	-High-integrity contained systems -Sampling done via closed-loop systems	no	no	yes
	3	- Use in closed batch process	90%	90%	yes
Route of exposure	**PROC**	**Description**	**LEV**	**Dermal protection**	**Indoors**
Dermal	1	-High-integrity contained systems -Sampling done via closed-loop systems	no	Yes, the substance is corrosive	yes
	3	- Use in closed batch process	no		yes

Remark: short-term exposure: Do not breach the IOELV value for a 15 minute inhalation exposure of 6.7 mg/m^3.
Conditions and measures related to personal protection, hygiene and health evaluation
HBr is a corrosive substance. Workers handling HBr must wear: * chemical resistant goggles, * face shields, * respiratory protection, * neoprene coveralls, * hardhat, * neoprene or nitrile rubber gloves, * neoprene boots. All protective clothing exposed to hydrogen bromide should be washed thoroughly with water before reuse. Safety showers and eye wash stations should be strategically located in areas where hydrogen bromide is used or stored.

Annex: Exposure scenarios

3. Exposure estimation and reference to its source

CS1. Environmental release and exposure – ERC 1

- **Aquatic compartment:** Hydrogen bromide may lower the pH of the wastewater. The toxic effect of hydrogen bromide to aquatic organisms seen in aquatic toxicity tests comes from the acidity of solutions containing hydrogen bromide. Therefore, the pH value of the wastewater from sites manufacturing hydrogen bromide has to be monitored and, if necessary, controlled by a neutralisation step before the wastewater is released to the environment. The potential risk to the environment due to manufacture of hydrogen bromide is controlled under the specified conditions of exposure.
- **Atmospheric compartment:** Negligible local atmospheric concentrations of hydrogen bromide are anticipated with the manufacture of hydrogen bromide. As soon as hydrogen bromide comes in contact with water in the atmosphere, it forms hydrobromic acid, which dissociates into hydrogen and bromide ions.

CS2. Worker exposure – PROC 1, PROC 3

Route of exposure and type of effects	PROC	Exposure estimate (mg/m^3)	DNEL (mg/m^3)	RCR
Inhalation, local, long-term	1	0.034	6.7	0.005
Inhalation, local, long-term	3	3.37	6.7	0.503
Dermal, local, long-term	1	HBr is corrosive – workers handling the substance must wear appropriate PPE. (see box 2)		
Dermal, local, long-term	3			

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Worker exposure
Exposure estimates for the inhalation route were determined using the model ECETOC TRA. For dermal exposure, the substance is corrosive. PPE as detailed in box2 must be worn in situations with a potential for direct dermal exposure to the airborne or dissolved substance in any cases.
Environmental exposure
Upon contact with water, HBr reacts rapidly to form hydrobromic acid which dissociates to hydrogen (H_3O^+) and bromide (Br^-) ions. In these circumstances, no exposure estimates were provided but appropriate risk management measures, as detailed in boxes 2 & 3, must be implemented on site to avoid any effect provoked by the dissociation of the substance.

Annex: Exposure scenarios

ES 2: Production of brominated intermediates (synthesis)

1. Production of brominated intermediates (synthesis)

CS1. Environment	
Manufacture of substances	ERC 1
Industrial use of processing aids in processes and products, not becoming part of articles	ERC 4
Industrial use resulting in manufacture of another substance (use of intermediates)	ERC 6a
Industrial use of reactive processing aids	ERC 6b
CS2. Worker	
Enclosed processes and no likelihood of exposure	PROC 1
Use in closed batch process (synthesis or formulation)	PROC 3

2. Condition of use affecting exposure

CS1. Control of environmental exposure: ERC 1, ERC 4, ERC 6a, ERC 6b

Product characteristics
Anhydrous hydrogen bromide (HBr): colourless gas Upon contact with water, HBr reacts rapidly to form hydrobromic acid which dissociates to hydrogen (H_3O^+) and bromide (Br^-) ions.
Amount used
At manufacture site : ~ 4500 tons/year maximum
Frequency and duration of use
330 days a year
Environmental factors not influenced by risk management
Flow rate of the receiving surface water: 18,000 m^3/day (EUSES v2.1.1 (2008), default value); 73,440 m^3/day (value provided by the downstream users)
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Risk management measures on site: * Waste gas may be passed through washing towers (with water and caustic soda) and subsequently through columns of active carbon to remove gaseous HBr. * Waste gases may be routed to a scrubber or incinerator unit. (Minor emissions via the untreated waste gas: 1 g/h of HBr) * A fraction of approximately 0.5% of the total tonnage of the manufactured hydrogen bromide may be released to wastewater. Upon contact with water, hydrogen bromide reacts rapidly to form hydrobromic acid. It has to be ensured that the pH of process wastewater is survey and, if necessary, regulated before wastewater is released to the environment. Hydrobromic acid can be neutralized with caustic soda to obtain bromides. On average an amount of 120-130 kg bromides per day may be lost through the wastewater. Remaining hydrogen bromide in the reaction vessels (gaseous and liquid part) is degraded into bromide (Br^-) and recovered into bromine (Br_2) in a recovery unit. The sewage sludge from wastewater treatment plants of units manufacturing hydrogen bromide is incinerated. Remark: The wastewater may be transferred to a recovery unit where bromine can be re-gained from

Annex: Exposure scenarios

the solutions.

CS2. Control of worker exposure – PROC 1, PROC 3

Product characteristics

Anhydrous hydrogen bromide (HBr): colourless gas
Solutions of HBr in water are clear liquids developing fumes that become brown on exposure to air and light.

Amounts used, Frequency and duration of use

8 hours per day

Technical and organizational conditions and measures

HBr is a corrosive substance.

General measures:

General ventilation at the point source of HBr releases.
In indoor plant, Hydrogen bromide can be monitored using treated silica gel tube. Detector tubes are useful for determining the level of respiratory protection required during activities involving the use of HBr. Concentrations should not exceeds 6.7 mg/m^3.

Specific measures per contributing scenario issued by ECETOC TRA:

Route of exposure	**Condition of use**				
	PROC	**Description**	**LEV**	**Respiratory protection**	**Indoors**
Inhalation	1	-High-integrity contained systems -Sampling done via closed-loop systems	no	no	yes
	3	- Use in closed batch process	90%	90%	yes
Route of exposure	**PROC**	**Description**	**LEV**	**Dermal protection**	**Indoors**
Dermal	1	-High-integrity contained systems -Sampling done via closed-loop systems	no	Yes, the substance is corrosive	yes
	3	- Use in closed batch process	no		yes

Remark: short-term exposure: Do not breach the IOELV value for a 15 minute inhalation exposure of 6.7 mg/m^3.

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

HBr is a corrosive substance.
Workers handling HBr must wear:
* chemical resistant goggles,
* face shields,
* respiratory protection,
* neoprene coveralls,
* hardhat,
* neoprene or nitrile rubber gloves,
* neoprene boots.

All protective clothing exposed to hydrogen bromide should be washed thoroughly with water before reuse. Safety showers and eye wash stations should be strategically located in areas where hydrogen bromide is used or stored.

Annex: Exposure scenarios

3. Exposure estimation and reference to its source

CS1. Environmental release and exposure – ERC 1, ERC 4, ERC 6a, ERC 6b

- **Aquatic compartment:** Hydrogen bromide may lower the pH of the wastewater. The toxic effect of hydrogen bromide to aquatic organisms seen in aquatic toxicity tests comes from the acidity of solutions containing hydrogen bromide. Therefore, the pH value of the wastewater from sites processing hydrogen bromide has to be monitored and, if necessary, controlled by a neutralisation step before the wastewater is released to the environment. The potential risk to the environment due to the use of hydrogen bromide in the production of brominated intermediates is controlled under the specified conditions of exposure.
- **Atmospheric compartment:** Negligible local atmospheric concentrations of hydrogen bromide are anticipated with the manufacture of brominated compounds from hydrogen bromine. As soon as hydrogen bromide comes in contact with water in the atmosphere, it forms hydrobromic acid, which dissociates into hydrogen and bromide ions.

CS2. Worker exposure – PROC 1, PROC 3

Route of exposure and type of effects	PROC	Exposure estimate (mg/m^3)	DNEL (mg/m^3)	RCR
Inhalation, local, long-term	1	0.034	6.7	0.005
Inhalation, local, long-term	3	3.37	6.7	0.503
Dermal, local, long-term	1	HBr is corrosive – workers handling the substance must wear appropriate PPE. (see box 2)		
Dermal, local, long-term	3			

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Worker exposure
Exposure estimates for the inhalation route were determined using the model ECETOC TRA. For dermal exposure, the substance is corrosive. PPE as detailed in box 2 must be worn in situations with a potential for direct dermal exposure to the airborne or dissolved substance in any cases.
Environmental exposure
Upon contact with water, HBr reacts rapidly to form hydrobromic acid which dissociates to hydrogen (H_3O^+) and bromide (Br^-) ions. In these circumstances, no exposure estimates were provided but appropriate risk management measures, as detailed in boxes 2 & 3, must be implemented on site to avoid any effect provoked by the dissociation of the substance.

Annex: Exposure scenarios

ES 3: Use as a process aid in chemical manufacture

1. Use as a process aid in chemical manufacture

CS1. Environment	
Formulation of preparations	ERC 2
CS2. Worker	
Use in closed, continuous process with occasional controlled exposure	PROC 2

2. Condition of use affecting exposure

CS1. Control of environmental exposure: ERC 2

Product characteristics
Anhydrous hydrogen bromide (HBr): colourless gas Upon contact with water, HBr reacts rapidly to form hydrobromic acid which dissociates to hydrogen (H_3O^+) and bromide (Br^-) ions.
Amount used
In EU : ~ 7000 tons/year
Frequency and duration of use
330 days a year
Environmental factors not influenced by risk management
Flow rate of the receiving surface water: 18,000 m^3/day (EUSES v2.1.1 (2008), default value); 73,440 m^3/day (value provided by the downstream users)
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Risk management measures on site: * Waste gas may be passed through washing towers (with water and caustic soda) and subsequently through columns of active carbon to remove gaseous HBr. * Waste gases may be routed to a scrubber or incinerator unit. (Minor emissions via the untreated waste gas may occur) * A small part of the total tonnage of hydrogen bromide used in the process may be released to wastewater. Upon contact with water, hydrogen bromide reacts rapidly to form hydrobromic acid. It has to be ensured that the pH of process wastewater is survey and, if necessary, regulated before wastewater is released to the environment. Hydrobromic acid can be neutralized with caustic soda to obtain bromides. Remaining hydrogen bromide in the reaction vessels (gaseous and liquid part) is degraded into bromide (Br^-) and recovered into bromine (Br_2) in a recovery unit. The sewage sludge from wastewater treatment plants of units processing hydrogen bromide is incinerated. Remark: The wastewater may be transferred to a recovery unit where bromine can be re-gained from the solutions.

Annex: Exposure scenarios

CS2. Control of worker exposure – PROC 2

Product characteristics

Anhydrous hydrogen bromide (HBr): colourless gas
Solutions of HBr in water are clear liquids developing fumes that become brown on exposure to air and light.

Amounts used, Frequency and duration of use

8 hours per day

Technical and organizational conditions and measures

HBr is a corrosive substance.

General measures:

General ventilation at the point source of HBr releases.
In indoor plant, Hydrogen bromide can be monitored using treated silica gel tube. Detector tubes are useful for determining the level of respiratory protection required during activities involving the use of HBr. Concentrations should not exceeds 6.7 mg/m^3.

Specific measures per contributing scenario issued by ECETOC TRA:

Route of exposure	**Condition of use**				
	PROC	**Description**	**LEV**	**Respiratory protection**	**Indoors**
Inhalation	2	Use in closed, continuous process with occasional controlled exposure	90%	90%	yes
Route of exposure	**PROC**	**Description**	**LEV**	**Dermal protection**	**Indoors**
Dermal	2	Use in closed, continuous process with occasional controlled exposure	no	Yes, the substance is corrosive	yes

Remark: short-term exposure: Do not breach the IOELV value for a 15 minute inhalation exposure of 6.7 mg/m^3.

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

HBr is a corrosive substance.
Workers handling HBr must wear:
* chemical resistant goggles,
* face shields,
* respiratory protection,
* neoprene coveralls,
* hardhat,
* neoprene or nitrile rubber gloves,
* neoprene boots.

All protective clothing exposed to hydrogen bromide should be washed thoroughly with water before reuse. Safety showers and eye wash stations should be strategically located in areas where hydrogen bromide is used or stored.

Annex: Exposure scenarios

3. Exposure estimation and reference to its source

CS1. Environmental release and exposure – ERC 2

- **Aquatic compartment:** Hydrogen bromide may lower the pH of the wastewater. The toxic effect of hydrogen bromide to aquatic organisms seen in aquatic toxicity tests comes from the acidity of solutions containing hydrogen bromide. Therefore, the pH value of the wastewater from sites processing hydrogen bromide has to be monitored and, if necessary, controlled by a neutralisation step before the wastewater is released to the environment. The potential risk to the environment due to the use of hydrogen bromide as a process aid is controlled under the specified conditions of exposure.
- **Atmospheric compartment:** Negligible local atmospheric concentrations of hydrogen bromide are anticipated with the use of hydrogen bromine as a process aid. As soon as hydrogen bromide comes in contact with water in the atmosphere, it forms hydrobromic acid, which dissociates into hydrogen and bromide ions.

CS2. Worker exposure – PROC 2

Route of exposure and type of effects	PROC	Exposure estimate (mg/m^3)	DNEL (mg/m^3)	RCR
Inhalation, local, long-term	2	1.69	6.7	0.25
Dermal, local, long-term	2	HBr is corrosive – workers handling the substance must wear appropriate PPE. (see box 2)		

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Worker exposure
Exposure estimates for the inhalation route were determined using the model ECETOC TRA. For dermal exposure, the substance is corrosive. PPE as detailed in box 2 must be worn in situations with a potential for direct dermal exposure to the airborne or dissolved substance in any cases.
Environmental exposure
Upon contact with water, HBr reacts rapidly to form hydrobromic acid which dissociates to hydrogen (H_3O^+) and bromide (Br^-) ions. In these circumstances, no exposure estimates were provided but appropriate risk management measures, as detailed in box 2 & 3, must be implemented on site to avoid any effect provoked by the dissociation of the substance.

Annex: Exposure scenarios

ES 4: Formulation of mixtures with gas in pressure receptacles

1. Formulation of mixtures with gas in pressure receptacles

CS1. Environment	
Industrial use resulting in manufacture of another substance (use of intermediates)	ERC 6a
CS2. Worker	
Use in closed process, no likelihood of exposure	PROC 1

2. Condition of use affecting exposure

CS1. Control of environmental exposure: ERC 6a

Product characteristics
Anhydrous hydrogen bromide (HBr): colourless gas Upon contact with water, HBr reacts rapidly to form hydrobromic acid which dissociates to hydrogen (H_3O^+) and bromide (Br^-) ions.
Amount used
In EU : ~ 7000 tons/year
Frequency and duration of use
330 days a year
Environmental factors not influenced by risk management
Flow rate of the receiving surface water: 18,000 m^3/day (EUSES v2.1.1 (2008), default value); 73,440 m^3/day (value provided by the downstream users)
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Risk management measures on site: * Waste gas may be passed through washing towers (with water and caustic soda) and subsequently through columns of active carbon to remove gaseous HBr. * Waste gases may be routed to a scrubber or incinerator unit. (Minor emissions via the untreated waste gas may occur) * A small part of the total tonnage of hydrogen bromide used in the process may be released to wastewater. Upon contact with water, hydrogen bromide reacts rapidly to form hydrobromic acid. It has to be ensured that the pH of process wastewater is survey and, if necessary, regulated before wastewater is released to the environment. Hydrobromic acid can be neutralized with caustic soda to obtain bromides. Remaining hydrogen bromide in the reaction vessels (gaseous and liquid part) is degraded into bromide (Br^-) and recovered into bromine (Br_2) in a recovery unit. The sewage sludge from wastewater treatment plants of units processing hydrogen bromide is incinerated. Remark: The wastewater may be transferred to a recovery unit where bromine can be re-gained from the solutions.

Annex: Exposure scenarios

CS2. Control of worker exposure – PROC 1

Product characteristics
Anhydrous hydrogen bromide (HBr): colourless gas Solutions of HBr in water are clear liquids developing fumes that become brown on exposure to air and light.
Amounts used, Frequency and duration of use
8 hours per day
Technical and organizational conditions and measures
HBr is a corrosive substance. **General measures:** General ventilation at the point source of HBr releases. In indoor plant, Hydrogen bromide can be monitored using treated silica gel tube. Detector tubes are useful for determining the level of respiratory protection required during activities involving the use of HBr. Concentrations should not exceeds 6.7 mg/m^3. **Specific measures per contributing scenario issued by ECETOC TRA:**

Route of exposure	**Condition of use**				
	PROC	**Description**	**LEV**	**Respiratory protection**	**Indoors**
Inhalation	1	Use in closed process, no likelihood of exposure	no	no	yes
Route of exposure	**PROC**	**Description**	**LEV**	**Dermal protection**	**Indoors**
Dermal	1	Use in closed process, no likelihood of exposure	no	Yes, the substance is corrosive	yes

Remark: short-term exposure: Do not breach the IOELV value for a 15 minute inhalation exposure of 6.7 mg/m^3.

Conditions and measures related to personal protection, hygiene and health evaluation
HBr is a corrosive substance. Workers handling HBr must wear: * chemical resistant goggles, * face shields, * respiratory protection, * neoprene coveralls, * hardhat, * neoprene or nitrile rubber gloves, * neoprene boots. All protective clothing exposed to hydrogen bromide should be washed thoroughly with water before reuse. Safety showers and eye wash stations should be strategically located in areas where hydrogen bromide is used or stored.

Annex: Exposure scenarios

3. Exposure estimation and reference to its source

CS1. Environmental release and exposure – ERC 6a

- **Aquatic compartment:** Hydrogen bromide may lower the pH of the wastewater. The toxic effect of hydrogen bromide to aquatic organisms seen in aquatic toxicity tests comes from the acidity of solutions containing hydrogen bromide. Therefore, the pH value of the wastewater from sites processing hydrogen bromide has to be monitored and, if necessary, controlled by a neutralisation step before the wastewater is released to the environment. The potential risk to the environment due to the use of hydrogen bromide in the formulation of gas mixtures is controlled under the specified conditions of exposure.
- **Atmospheric compartment:** Negligible local atmospheric concentrations of hydrogen bromide are anticipated with the manufacture of brominated compounds from hydrogen bromine. As soon as hydrogen bromide comes in contact with water in the atmosphere, it forms hydrobromic acid, which dissociates into hydrogen and bromide ions.

CS2. Worker exposure – PROC 1

Route of exposure and type of effects	PROC	Exposure estimate (mg/m^3)	DNEL (mg/m^3)	RCR
Inhalation, local, long-term	1	0.034	6.7	0.005
Dermal, local, long-term	1	HBr is corrosive – workers handling the substance must wear appropriate PPE. (see box 2)		

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Worker exposure
Exposure estimates for the inhalation route were determined using the model ECETOC TRA. For dermal exposure, the substance is corrosive. PPE as detailed in box 2 must be worn in situations with a potential for direct dermal exposure to the airborne or dissolved substance in any cases.
Environmental exposure
Upon contact with water, HBr reacts rapidly to form hydrobromic acid which dissociates to hydrogen (H_3O^+) and bromide (Br^-) ions. In these circumstances, no exposure estimates were provided but appropriate risk management measures, as detailed in boxes 2 & 3, must be implemented on site to avoid any effect provoked by the dissociation of the substance.

Annex: Exposure scenarios

ES 5: Use for electronic component manufacture

1. Use for electronic component manufacture

CS1. Environment	
Industrial use resulting in manufacture of another substance (use of intermediates)	ERC 6a
CS2. Worker	
Use in closed process, no likelihood of exposure	PROC 1

2. Condition of use affecting exposure

CS1. Control of environmental exposure: ERC 6a

Product characteristics
Anhydrous hydrogen bromide (HBr): colourless gas Upon contact with water, HBr reacts rapidly to form hydrobromic acid which dissociates to hydrogen (H_3O^+) and bromide (Br^-) ions.
Amount used
In EU : ~ 10 tons/year
Frequency and duration of use
330 days a year
Environmental factors not influenced by risk management
Flow rate of the receiving surface water: 18,000 m^3/day (EUSES v2.1.1 (2008), default value); 73,440 m^3/day (value provided by the downstream users)
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil
Risk management measures on site: * Waste gas may be passed through washing towers (with water and caustic soda) and subsequently through columns of active carbon to remove gaseous HBr. * Waste gases may be routed to a scrubber or incinerator unit. (Minor emissions via the untreated waste gas may occur) * A small part of the total tonnage of hydrogen bromide used in the process may be released to wastewater. Upon contact with water, hydrogen bromide reacts rapidly to form hydrobromic acid. It has to be ensured that the pH of process wastewater is survey and, if necessary, regulated before wastewater is released to the environment. Hydrobromic acid can be neutralized with caustic soda to obtain bromides. Remaining hydrogen bromide in the reaction vessels (gaseous and liquid part) is degraded into bromide (Br^-) and recovered into bromine (Br_2) in a recovery unit. The sewage sludge from wastewater treatment plants of units processing hydrogen bromide is incinerated. Remark: The wastewater may be transferred to a recovery unit where bromine can be re-gained from the solutions.

Annex: Exposure scenarios

CS2. Control of worker exposure – PROC 1

Product characteristics
Anhydrous hydrogen bromide (HBr): colourless gas Solutions of HBr in water are clear liquids developing fumes that become brown on exposure to air and light.
Amounts used, Frequency and duration of use
8 hours per day
Technical and organizational conditions and measures
HBr is a corrosive substance. **General measures:** General ventilation at the point source of HBr releases. In indoor plant, Hydrogen bromide can be monitored using treated silica gel tube. Detector tubes are useful for determining the level of respiratory protection required during activities involving the use of HBr. Concentrations should not exceeds 6.7 mg/m^3. **Specific measures per contributing scenario issued by ECETOC TRA:**

Route of exposure	**Condition of use**				
	PROC	**Description**	**LEV**	**Respiratory protection**	**Indoors**
Inhalation	1	Use in closed process, no likelihood of exposure	no	no	yes
Route of exposure	**PROC**	**Description**	**LEV**	**Dermal protection**	**Indoors**
Dermal	1	Use in closed process, no likelihood of exposure	no	Yes, the substance is corrosive	yes

Remark: short-term exposure: Do not breach the IOELV value for a 15 minute inhalation exposure of 6.7 mg/m^3.

Conditions and measures related to personal protection, hygiene and health evaluation
HBr is a corrosive substance. Workers handling HBr must wear: * chemical resistant goggles, * face shields, * respiratory protection, * neoprene coveralls, * hardhat, * neoprene or nitrile rubber gloves, * neoprene boots. All protective clothing exposed to hydrogen bromide should be washed thoroughly with water before reuse. Safety showers and eye wash stations should be strategically located in areas where hydrogen bromide is used or stored.

Annex: Exposure scenarios

3. Exposure estimation and reference to its source

CS1. Environmental release and exposure – ERC 6a

- **Aquatic compartment:** Hydrogen bromide may lower the pH of the wastewater. The toxic effect of hydrogen bromide to aquatic organisms seen in aquatic toxicity tests comes from the acidity of solutions containing hydrogen bromide. Therefore, the pH value of the wastewater from sites processing hydrogen bromide has to be monitored and, if necessary, controlled by a neutralisation step before the wastewater is released to the environment. The potential risk to the environment due to the use of hydrogen bromide in the manufacture of electronic components is controlled under the specified conditions of exposure.
- **Atmospheric compartment:** Negligible local atmospheric concentrations of hydrogen bromide are anticipated with the use of hydrogen bromine as an etchant in the manufacture of electronic components. As soon as hydrogen bromide comes in contact with water in the atmosphere, it forms hydrobromic acid, which dissociates into hydrogen and bromide ions.

CS2. Worker exposure – PROC 1

Route of exposure and type of effects	PROC	Exposure estimate (mg/m^3)	DNEL (mg/m^3)	RCR
Inhalation, local, long-term	1	0.034	6.7	0.005
Dermal, local, long-term	1	HBr is corrosive – workers handling the substance must wear appropriate PPE. (see box 2)		

4. Guidance to DU to evaluate whether he works inside the boundaries set by the ES

Worker exposure
Exposure estimates for the inhalation route were determined using the model ECETOC TRA. For dermal exposure, the substance is corrosive. PPE as detailed in box 2 must be worn in situations with a potential for direct dermal exposure to the airborne or dissolved substance in any cases.
Environmental exposure
Upon contact with water, HBr reacts rapidly to form hydrobromic acid which dissociates to hydrogen (H_3O^+) and bromide (Br^-) ions. In these circumstances, no exposure estimates were provided but appropriate risk management measures, as detailed in boxes 2 & 3, must be implemented on site to avoid any effect provoked by the dissociation of the substance.