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

1.1. Product identifier

Name of product	Hydrogen bromide Art-Nr(n).: 2000, 70200
Name of substance	Hydrogen bromide
Index No	035-002-00-0
EC No	233-113-0
REACH registration number	01-2119479072-39
CAS No	10035-10-6

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

Identified uses

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

Product categories [PC]
PC19 - Intermediate
PC2 - Adsorbents
PC33 - Semiconductors

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 of preparations (mixtures)
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

Recommended intended purpose(s)
Basic substance.
Reducing agent.
Catalyst.

1.3. Details of the supplier of the safety data sheet

Manufacturer/distributor	GHC Gerling, Holz & Co. Handels GmbH Ruhrstraße 113, D-22761 Hamburg Phone +49 40 853 123-0, Fax +49 40 853 123-66 E-Mail hamburg@ghc.de Internet www.ghc.com
Advice	GHC Gerling, Holz & Co. Handels GmbH Phone +49 40 853 123-0 Fax +49 40 853 123-66 E-mail (competent person): msds@ghc.de

1.4. Emergency telephone number

Emergency advice	Giftinformationszentrum (Poison Control Centre) Mainz Phone +49 6131 19240

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

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

Hazard classes and Hazard categories	Hazard Statements	Classification procedure
Liquef. Gas	**H280**	
Acute Tox. 3	**H331**	
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/GHS]

GHS05

GHS06

Signal word
Danger

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.**
H331 **Toxic if inhaled.**
H335 **May cause respiratory irritation.**

Precautionary Statements

Prevention

P260 Do not breathe gas/vapours.
P280 Wear protective gloves/protective clothing/eye protection/face protection.

Response

P303 + P361 + P353 IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304 + P340 IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310 Immediately call a POISON CENTER/doctor/... .
P315 Get immediate medical advice/attention.

Storage

P403 Store in a well-ventilated place.
P405 Store locked up.

2.3. Other hazards

Adverse human health effects and symptoms
Contact with liquid may cause cold burns/frostbite.

Information pertaining to special dangers for human and environment
Dangerous substances are released in case of decomposition.
Gas/vapour heavier than air. May accumulate in confined spaces, particularly at or below ground level.

Results of PBT and vPvB assessment
This substance does not meet the PBT/vPvB criteria of REACH, annex XIII.

! SECTION 3: Composition/ information on ingredients

3.1. Substances

! **Description**
Content: > 99 %

CAS No 10035-10-6 **Hydrogen bromide**
EC No 233-113-0
Index No 035-002-00-0
REACH registration number 01-2119479072-39

3.2. Mixtures

not applicable

! SECTION 4: First aid measures

4.1. Description of first aid measures

General information
Remove contaminated soaked clothing immediately.
Adhere to personal protective measures when giving first aid.
Seek medical advice immediately.

In case of inhalation
Remove the casualty into fresh air and keep him immobile.
In the event of pulmonary irritation treat initially with corticoid spray, e.g. Ventolair- or Pulmicort- metered-dose aerosol (Ventolair and Pulmicort are registrated trademarks).
In case of respiratory standstill give artifical respiration by respiratory bag (Ambu bag) or respirator. Send for a doctor.

! **In case of skin contact**
In case of contact with skin wash off immediately with plenty of water.
In case of frostbite rinse with plenty of water. Don`t remove clothing.
In case of frostbite spray with lukewarm (not hot) water for at least 15 minutes. Do not remove clothing frozen to the skin. Thaw it with lukewarm water. Apply a sterile dressing. Obtain medical assistance.

In case of eye contact
Eye rinsing with water carefully while protecting unhurt eye.
Call for a doctor immediately.
Remove contact lenses, if present and easy to do. Continue rinsing.

In case of ingestion
Ingestion is not considered a potential route of exposure.

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

Physician's information / possible symptoms
Coughing
Nosebleeds.
Tears.

Physician's information / possible dangers
Risk of pulmonary oedema

4.3. Indication of any immediate medical attention and special treatment needed
Treatment (Advice to doctor)
Continue to monitor for pneumonia and pulmonary oedema.
Monitor circulation.

SECTION 5: Firefighting measures

5.1. Extinguishing media
Suitable extinguishing media
Product does not burn, fire-extinguishing activities according to surrounding.
Foam
Dry fire-extinguishing substance
Carbon dioxide
Water spray jet

Unsuitable extinguishing media
Full water jet

5.2. Special hazards arising from the substance or mixture
In the event of fire the following can be released:
Hydrogen (on contact with firefighting water).
Explosion hazard.

5.3. Advice for firefighters
Special protective equipment for fire-fighters
Use breathing apparatus with independent air supply (isolated).
Wear full protective clothing.

Additional information
Cool endangered containers with water spray jet.
Exposure to fire may cause containers to rupture / explode.
Fire residues and contaminated firefighting water must be disposed of in accordance with the local regulations.
Collect contaminated firefighting water separately, must not be discharged into the drains.

! SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures
! **For non-emergency personnel**
See section 8.
Evacuate area.
Keep people away and stay on the upwind side.

! **For emergency responders**
Remove persons to safety.
Personal protection by wearing close-fitting protective clothing and breathing apparatus.
Eliminate all ignition sources if safe to do so.

6.2. Environmental precautions
Collect contaminated water / firefighting water separately.
If possible, stop flow of product.
Do not discharge into the drains/surface waters/groundwater.
Prevent spread over a wide area (e.g. by containment or oil barriers).
If necessary, secure leaky pressure receptacles in a salvage packaging.
Suppress gases/vapours/mists with water spray jet
Do not discharge into the subsoil/soil.

6.3. Methods and material for containment and cleaning up
Ensure adequate air ventilation.
Clean contaminated objects and floor thoroughly under consideration of environment regulations.
Dispose of contaminated material in accordance with regulations.

6.4. Reference to other sections
Safe handling: see section 7
Disposal: see section 13
Personal protection equipment: see section 8

! SECTION 7: Handling and storage

7.1. Precautions for safe handling
! **Advice on safe handling**
Use only in thoroughly ventilated areas.
Transfer and handle only in enclosed systems.
Containers' temperature may not be increased above 50 °C.
Do not heat with open flames.
The working pressure in the receptacle must not exceed the saturation vapour pressure of the pure product resulting at a temperature of 50 °C.
The working pressure in the receptacle must not exceed 2/3 of the test pressure of the pressure receptacle.
Provide good room ventilation even at ground level (vapours are heavier than air).
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.
Use only properly specified equipment which is suitable for this product, its supply pressure and temperature.
Do not allow backfeed into the container.
Suck back 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.

General protective measures
Do not inhale gases/vapours/aerosols.

Hygiene measures
At work do not eat, drink, smoke or take drugs.
Wash hands before breaks and after work.

! **Advice on protection against fire and explosion**
The product is not flammable in air under ambient conditions of temperature and pressure.
Pay attention to general rules of internal fire prevention.

7.2. Conditions for safe storage, including any incompatibilities
! **Requirements for storage rooms and vessels**
Keep in closed original container.
Ventilate store-rooms thoroughly.
Only use containers that are approved specifically for the substance/product.
Suitable materials: Normalised carbon steel, tempered alloy steel, austenitic stainless steels.
Other material details see ISO 11114.
All regulations and local requirements for the storage of containers have to be respected.
Unsuitable materials: Aluminium alloys, brass, copper alloys.

Advice on storage compatibility
Do not store with spontaneously flammable materials.
Do not store together with combustible liquids or combustible solids.
Do not store together with animal feedstuffs.
Do not store together with explosives.
Do not store together with infectious substances.

Do not store together with radioactive material.
Do not store together with toxic liquids or toxic solids.
Do not store together with food.
Do not store together with oxidizing liquids or oxidizing solids.

Further information on storage conditions
Store only in original container at temperature of 50 °C maximum (=122 °F).
Keep container tightly closed and store at cool and aired place.
Prevent cylinders from falling over.
Protect of heat.
Recommended storage temperature: =< 25 °C.

7.3. Specific end use(s)
! **Recommendation(s) for intended use**
Exposure scenarios (ES) see annex to this safety data sheet.

! SECTION 8: Exposure controls/personal protection

8.1. Control parameters
! Ingredients with occupational exposure limits to be monitored

CAS No	Name	Code	[mg/m3]	[ppm]		Remark
10035-10-6	hydrogen bromide	8 hours	6,7	2	1(I)	DFG, EU, 13
10035-10-6	Hydrogen bromide	WEL, 8 hours Short-term	 10	 3		EH40/2007/ UK

Indicative occupational exposure limit values (91/322/EEC, 2000/39/EC, 2004/37/EC, 2006/15/EC or 2009/161/EU)

CAS No	Name	Code	[mg/m3]	[ppm]	Remark
10035-10-6	hydrogen bromide	Short-term	6,7	2	

DNEL-/PNEC-values
DNEL worker

CAS No	Substance name	Value	Code	Remark
10035-10-6	Hydrogen bromide	6,7 mg/m3	DNEL acute inhalative (local)	
		6,7 mg/m3	DNEL long-term inhalative (local)	
		6,7 mg/m3	DNEL long-term inhalative (systemic)	
		6,7 mg/m3	DNEL acute inhalative (systemic)	

PNEC

CAS No	Substance name	Value	Code	Remark
10035-10-6	Hydrogen bromide	0,019 mg/l	PNEC aquatic, freshwater	Assessment factor 1000

8.2. Exposure controls
Respiratory protection
Short term: filter apparatus, filter E
Short term: filter apparatus, combination filter E-P2
Breathing apparatus in the event of high concentrations.
Keep self contained breathing apparatus readily available for emergency use.
In case of rescue and maintenance activities in storage containers use environment-independent breathing apparatus because of risk of suffocation by edging out of air oxygen

Hand protection
chemical-resistant gloves
Leather gloves
Glove material specification [make/type, thickness, permeation time/life]: FKM; 0,4 mm; >= 480 min
Glove material specification [make/type, thickness, permeation time/life]: NBR; 0,4 mm; >= 480 min
Glove material specification [make/type, thickness, permeation time/life]: CR; 0,5 mm; >= 480 min
Glove material specification [make/type, thickness, permeation time/life]: IIR, >= 0,5 mm, >= 480 min
Glove material specification [make/type, thickness, permeation time/life]: NR, >= 0,5 mm, >= 480 min
Glove material specification [make/type, thickness, permeation time/life]: PVC, >= 0,5 mm, >= 480 min

Eye protection
Safety goggles complying with EN 166, in case of increased risk add protective face shield
Safety goggles with side protection complying with EN 166.

! **Other protection measures**
Safety shoes with steel toe.
Body covering work clothing, or chemical resistant suit at increased risk.

! **Limitation and surveillance of the environment**
See section 7.

Appropriate engineering controls
Transfer and handle only in enclosed systems.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Appearance	**Colour**	**Odour**
compressed liquified gas	colourless	pungent

Odour threshold
6,7 mg/m³

Important health, safety and environmental information

	Value	Temperature	at	Method	Remark
pH value	not applicable				
Acid number	not applicable				
boiling point	-66,4 °C		1013 hPa		
melting point	-86,9 °C				
Flash point	no				
Vapourisation rate	not determined				
Flammable (solid)	not applicable				
Flammability (gas)	no				
Ignition temperature	no				

	Value	Temperature	at	Method	Remark
Self ignition temperature	no				
Lower explosion limit	no				
Upper explosion limit	no				
Vapour pressure	20003 hPa	20 °C			
Relative density	2,203 g/cm3	-66,4 °C			liquid phase
Bulk density	not applicable				
Vapour density	2,71				air = 1
Solubility in water	700 g/l	20 °C			
Solubility/other					Soluble in ethanol
Partition coefficient n-octanol/water (log P O/W)	0,6287				Calculated
Decomposition temperature	not determined				
Viscosity dynamic	0,01819 mPa*s	25 °C			vapour phase
Viscosity dynamic	0,61 mPa*s	20 °C			liquid phase
Solvent content	not applicable				

Oxidising properties
no

Explosive properties
no

9.2. 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
Stable under recommended conditions of use and storage (see section 7).

10.3. Possibility of hazardous reactions
Reactions with oxidizing agents.
Reactions with alkali metals.
Reactions with earth alkali metals.
Reactions with alkalies.
Reactions with amines.

10.4. Conditions to avoid
Heat sources / heat - risk of bursting.
Humidity.

10.5. Incompatible materials
Substances to avoid
Alkali (lye)
Alkali metals
Amines
Ammonia
nitric acid
Oxidants.
Metallic salts.
Earth alkali metals.

10.6. Hazardous decomposition products
Hydrogen
Bromine

Thermal decomposition

Remark No decomposition if used as directed.

Additional information
May decompose in the presence of a catalyst.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity/Irritation/Sensitization

	Value/Validation	Species	Method	Remark
LD50 acute oral	not applicable			
LD50 acute dermal	not applicable			
LC50 acute inhalation	2858 ppm (1 h)	rat		
Skin irritation	corrosive			experiences
Eye irritation	strong irritant			experiences
Skin sensitization	Not known.			
Sensitization respiratory system	Not known.			

Subacute Toxicity - Carcinogenicity

	Value	Species	Method	Validation
Chronic Toxicity	Inhalation			Inflammatory changes in the mucosa of the upper respiratory tract, indigestion, slight change of reflexes and decreased amount of erythrocytes.
Mutagenicity				No experimental information on genotoxicity in vitro and in vivo available.
Reproduction-Toxicity				No information available.
Carcinogenicity				No information available.

Specific target organ toxicity (single exposure)
No data available

Specific target organ toxicity (repeated exposure)
No data available

Aspiration hazard
not applicable

Experiences made from practice
Risk of strong health injuries in case of long-term exposition.
Irritates respiratory tract.
Pulmonary dammage is possible.
Irritates mucous membranes.

! SECTION 12: Ecological information

12.1. Toxicity

Ecotoxicological effects

	Value	Species	Method	Validation
Fish	LC50 64,05 mg/l	freshwater fish		
Daphnia	EC50 ca. 19 mg/l (48 h)	Daphnia magna	EU Method C.2 (Acute Toxicity for Daphnia).	
Algae	NOEC 32 mg/l	Algae		

12.2. Persistence and degradability

	Elimination rate	Method of analysis	Method	Validation
Physico-chemical degradability				not determined

	Elimination rate	Method of analysis	Method	Validation
Biological degradability	Inorganic product, cannot be eliminated from the water by biological purification processes.			
Biological eliminability	Inorganic product, cannot be eliminated from the water by biological purification processes.			

12.3. Bioaccumulative potential
Because of the n-octanol/water distribution coefficient (log K o/w) accumulation in organisms is not expected.

12.4. Mobility in soil
No data available

12.5. Results of PBT and vPvB assessment
This substance does not meet the PBT/vPvB criteria of REACH, annex XIII.

12.6. Other adverse effects
No information available.

General regulation
Avoid release to the environment.
Product is not allowed to be discharged into the ground water or aquatic environment.
Product is not allowed to be discharged into aquatic environment, drains or sewage treatment plants.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste code No.	**Name of waste**
16 05 04*	gases in pressure containers (including halons) containing hazardous substances

Wastes marked with an asterisk are considered to be hazardous waste pursuant to Directive 2008/98/EC on hazardous waste.

Recommendations for the product
Dispose of as hazardous waste.
Return to manufacturer.

Recommendations for packaging
Transportable pressure equipment (empty, residual pressure): Return to supplier / manufacturer.

SECTION 14: Transport information

	ADR/RID	**IMDG**	**IATA-DGR**
14.1. UN number	1048	1048	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. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code
not applicable
No transport as bulk according IBC - Code.

Land and inland navigation transport ADR/RID
Hazard label(s) 2.3+8
tunnel restriction code C/D
Classification code 2TC

Air transport ICAO/IATA-DGR
FORBIDDEN

! SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture
! **Other regulations (EU)**
Directive 2012/18/EU on the control of major-accident hazards involving dangerous substances.

15.2. Chemical Safety Assessment
For this substance a chemical safety assessment has been carried out.
Exposure scenarios (ES) see annex to this safety data sheet.

! SECTION 16: Other information

Recommended uses and restrictions
National and local regulations concerning chemicals shall be observed.

Further information
All declarations of safety-data-sheet refer to pure substance.
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.

Indication of changes: "!" = Data changed compared with the previous version. Previous version: 10.3
! **Sources of key data used**
For the preparation of this safety data sheet, information from our suppliers as well as data from the "database of registered substances" of the European Chemicals Agency (ECHA) were used.

ES FOR COMMUNICATION

ES FOR COMMUNICATION

Substance Name: Hydrogen bromide

EC Number: 233-113-0

CAS Number: 10035-10-6

Date of Generation/Revision: 10/02/2014

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.

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.

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.

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

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.