Sulphur Dioxide

ACCORDING TO EC-REGULATIONS 1907/2006 (REACH), 1272/2008 (CLP) & 2015/830

1. SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1 Product identifier

Product Name	Sulphur dioxide
CAS No.	7446-09-5.
EC No.	231-195-2.
REACH Registration No.	01-2119485028-34-XXXX.

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

Identified Use(s)	Industrial and professional uses.
Uses Advised Against	For full details of identified uses see Annex.

1.3 Details of the supplier of the safety data sheet

Company Identification	Blended Products Ltd.
Address of Manufacturer	Elsham Wold Industrial Estate, Brigg, North Lincolnshire.
Postal code	DN20 0SP.
Telephone:	+44 (0)1652 680555
E-mail	technical@blendedproducts.com

1.4 Emergency telephone number

Emergency Phone No.	+44(0)1652 680555 Please use ‘Option 4’ for 24hr chemical / stock emergency assistance

2. SECTION 2: HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture

Regulation (EC) No. 1272/2008 (CLP)	Acute Tox. 3 :Toxic if inhaled. Press. Gas (Liq.) :Contains gas under pressure; may explode if heated. Skin Corr. 1B :Causes severe skin burns and eye damage.

2.2 Label elements

According to Regulation (EC) No. 1272/2008 (CLP)

Product Name: Sulphur dioxide

Hazard Pictogram(s)

GHS06

GHS05

Sulphur Dioxide

Signal Word(s)	Danger
Hazard Statement(s)	H280: Contains gas under pressure; may explode if heated. H314: Causes severe skin burns and eye damage. H331: Toxic if inhaled.
Precautionary Statement(s)	P260: Do not breathe gas. P280: Wear protective gloves/protective clothing/eye protection/face protection/hearing protection. 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. P410+P403: Protect from sunlight. Store in a well-ventilated place. P501: Dispose of this material and its container to hazardous or special waste collection point.

2.3 Other hazards

None known.

2.4 Additional Information

For full text of H/P Statements see section 16.

3. SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

3.1 Substances

HAZARDOUS INGREDIENT(S)	CAS No.	EC No. / REACH Registration No.	%W/W	Hazard Statement(s)	Hazard Pictogram(s)
sulphur dioxide	7446-09-5	231-195-2	100	Liquefied. Gas H280 Skin Corr. 1B H314 Acute Tox. 3 H331	GHS04 GHS06 GHS05

3.2 Mixtures

Not applicable.

4. SECTION 4: FIRST AID MEASURES

4.1 Description of first aid measures

Inhalation — Immediately call a POISON CENTER/doctor. Remove patient from exposure, keep

	warm and at rest. Administer oxygen if necessary. Apply artificial respiration if breathing has ceased or shows signs of failing.
Skin Contact	Take off immediately all contaminated clothing. Rinse skin with water. Wash contaminated clothing before reuse. Immediately call a POISON CENTER/doctor.
Eye Contact	Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER/doctor.
Ingestion	Rinse mouth. Do NOT induce vomiting. Immediately call a POISON CENTER/doctor. Provided the patient is conscious, wash out mouth with water and give 200-300 ml (half a pint) of water to drink.

4.2 Most important symptoms and effects, both acute and delayed

Gas is irritant to the respiratory tract. Causes severe skin burns and eye damage. Fluid build up on the lung (pulmonary oedema) may occur up to 48 hours after exposure and could prove fatal. Some individuals with asthma may be particularly sensitive to the inhalation of low atmospheric concentrations of Sulphur dioxide.

4.3 Indication of any immediate medical attention and special treatment needed

Immediately call a POISON CENTER/doctor. Treat symptomatically. Following exposure the patient should be kept under medical review for at least 48 hours as delayed pulmonary oedema may develop.

5. SECTION 5: FIREFIGHTING MEASURES

5.1 Extinguishing media

Suitable Extinguishing media	As appropriate for surrounding fire.
Unsuitable extinguishing media	None.

5.2 Special hazards arising from the substance or mixture

Contains gas under pressure; may explode if heated. Explosion risk. Fire water contaminated with this material must be contained and prevented from being discharged and disposed of appropriately.

5.3 Advice for firefighters

Fire fighters should wear complete protective clothing including self-contained breathing apparatus.

6. SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Provide adequate ventilation. Wear appropriate personal protective equipment, avoid direct contact.

6.2 Environmental precautions

Avoid release to the environment. Spillages or uncontrolled discharges into watercourses must be alerted to the appropriate regulatory body.

6.3 Methods and material for containment and cleaning up

Allow small spillages to evaporate provided there is adequate ventilation. Large spillages should be contained by covering with plastic sheeting. Recondensed Sulphur dioxide, contained under sheeting, should be pumped away into containers for disposal.

6.4 Reference to other sections

Sulphur Dioxide

See Also Section 8, 13.

7. SECTION 7: HANDLING AND STORAGE

7.1 Precautions for safe handling

Do not breathe gas. Avoid contact between the liquid and skin and eyes. Use only outdoors or in a well-ventilated area. Wash hands and exposed skin thoroughly after handling. Wear protective gloves/protective clothing/eye protection/face protection/hearing protection.

7.2 Conditions for safe storage, including any incompatibilities

Protect from sunlight. Store in a well-ventilated place. Keep container tightly closed. Store locked up.

Storage temperature	Ambient.
Storage life	Stable under normal conditions.
Incompatible materials	None known.

7.3 Specific end use(s)

Not known.

8. SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1 Control parameters

8.1.1 Occupational Exposure Limits

Hazardous Ingredients	Cas No.	LTEL 8 hr TWA ppm	LTEL 8 hr TWA mg/m³	STEL ppm	STEL mg/m³	Note
Sulphur dioxide	7446-09-5	1	2.7	1	2.7	HSE GV

sulphur dioxide			
DNEL / DMEL	Oral	Inhalation	Dermal
Industry - Long Term - Local effects	-	1.3 mg/m³ (0.5 ppm)	-
Industry - Long Term - Systemic effects	-	-	-
Industry - Short term - Local effects	-	2.7 mg/m³ (1 ppm)	-
Industry - Short term - Systemic effects	-	-	-
Consumer - Long Term - Local effects	-	0.53 mg/m³ (0.2 ppm)	-
Consumer - Long Term - Systemic effects	-	-	-
Consumer - Short term - Local effects	-	-	-
Consumer - Short term - Systemic effects	-	-	-

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sulphur dioxide	
Environment	PNEC
Aquatic Compartment (including sediment)	-
Terrestrial Compartment	-
Atmospheric Compartment	-

8.2 Exposure controls

8.2.1. Appropriate engineering controls — Use with ventilation, local exhaust ventilation or breathing protection. A washing facility/water for eye and skin cleaning purposes should be present.

8.2.2. Personal protection equipment

Eye Protection — Goggles giving complete protection to the eyes.

Skin protection — Wear suitable protective clothing and gloves. Check with protective equipment manufacturer's data.

Respiratory protection — Wear suitable protective equipment if exposure to levels above the occupational exposure limit is likely. A self-contained breathing apparatus may be appropriate. Check with the protective equipment manufacturer's data. Where a cartridge/canister respirator is suitable use: Type E.

Thermal hazards — Wear thermal insulating gloves when handling liquefied gases.

8.2.3. Environmental Exposure Controls — Avoid release to the environment.

9. SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1 Information on basic physical and chemical properties

Appearance	Gas. Colour : colourless.
Odour	pungent.
Odour threshold	Not known.
Melting point	-75.5 °C.
Boiling point	-10.05 °C.
Flash Point	Not applicable.
Vapour pressure	327100 Pa at 20 °C.
Density (g/ml)	1.43 at 0 °C.
Solubility(ies)	Solubility (Water) : soluble (114 g/l at 20 °C). Solubility (Other) : soluble in Ethanol, Methanol, Acetic acid, Chloroform, Diethylether, polar solvents.
Vapour density (Air=1)	2.3

9.2 Other information

None.

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10. SECTION 10: STABILITY AND REACTIVITY

10.1 Reactivity

None anticipated.

10.2 Chemical Stability

Stable under normal conditions.

10.3 Possibility of hazardous reactions

May react violently with: Acrolein, Ammonia, Amines, Acetylene, Alkali metals, Chlorine, Butadiene, Ethylene oxide.

10.4 Conditions to avoid

Keep away from moisture. Keep away from heat and direct sunlight.

10.5 Incompatible materials

Reacts with water to produce sulphurous acid. Sulphur dioxide can corrode Zinc and most common metals if water is present.

10.6 Hazardous decomposition products

Oxides of sulphur.

11. SECTION 11: TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects

Acute toxicity - Ingestion	Not classified.
Acute toxicity - Skin Contact	Not classified.
Acute toxicity - Inhalation	Toxic if inhaled. LC50 (inhalation) 2528.5 mg/m^3
Skin corrosion/irritation	Causes severe skin burns and eye damage.
	Liquid splashes or spray may cause freeze burns to skin and eyes.
Serious eye damage/irritation	Causes serious eye damage.
Skin sensitization data	Not classified.
Respiratory sensitization data	Not classified.
Germ cell mutagenicity	Not classified.
Carcinogenicity	Not classified.
Reproductive toxicity	Not classified.
Lactation	Not classified.
STOT - single exposure	Not classified.
STOT - repeated exposure	Not classified.
Aspiration hazard	Not classified.

11.2 Other information

Not known.

12. SECTION 12: ECOLOGICAL INFORMATION

12.1 Toxicity

Toxicity - Aquatic invertebrates	Low toxicity to invertebrates.
Toxicity - Fish	Low toxicity to fish.

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Toxicity - Algae	Low toxicity to algae.
Toxicity - Sediment Compartment	Not classified.
Toxicity - Terrestrial Compartment	Not classified.

12.2 Persistence and Degradation

Not known.

12.3 Bioaccumulative potential

Not known.

12.4 Mobility in soil

Not known.

12.5 Results of PBT and vPvB assessment

Not known.

12.6 Other adverse effects

Not known.

13. SECTION 13: DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods

Dispose of this material and its container to hazardous or special waste collection point. Send to a licensed recycler, reclaimer or incinerator. Normal disposal is via incineration operated by an accredited disposal contractor.

13.2 Additional Information

Disposal should be in accordance with local, state or national legislation.

14. SECTION 14: TRANSPORT INFORMATION

14.1 UN number

UN No.	1079

14.2 UN proper shipping name

UN proper shipping name	SULPHUR DIOXIDE

14.3 Transport hazard class(es)

ADR/RID	
ADR/RID Class	2
ADR Classification Code	2TC
Special Provisions	Not applicable
Limited Quantities	0
Excepted Quantities	E0
Emergency Action Code	2RE
Mixed Packing Instructions for Packages	P200
Special Packing Provisions for Packages	Not applicable
Mixed Packing Instructions for Packages	MP9
Packing Instructions for Portable Tanks	(M) T50
Special Provisions for Portable Tanks	TP19
Tank Code for Tanks	PxDH(M)
Special Provisions for Tanks	TA4 TT9 TT10
Vehicle for Tank Carriage	AT

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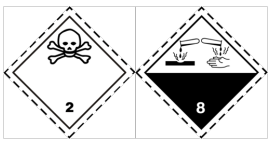
ADR Transport Category	1
Tunnel Restriction Code	C/D
Special Provisions for Carriage - Packages	Not applicable
Special Provisions for Carriage - Bulk	Not applicable
Special Provisions for Carriage - Loading, Unloading and Handling	CV9 CV10 CV36
Special Provisions for Carriage - Operation	S14
ADR HIN	268
IMDG	
IMDG Class	2
Special Provisions	Not applicable
Limited Quantities	0
Excepted Quantities	E0
Mixed Packing Instructions for Packages	P200
Special Packing Provisions for Packages	Not applicable
Packing Instructions for Portable Tanks	(M) T50
Special Provisions for Portable Tanks	TP19
IMDG EMS	Not applicable
Stowage and Handling	Not applicable
Segregation	Not determined
ICAO/IATA	
Excepted Quantities	Not applicable
Passenger and Cargo Aircraft Limited Quantities Packing Instructions	Forbidden for transport by air.
Passenger and Cargo Aircraft Limited Quantities Max net Qty	Forbidden for transport by air.
Passenger and Cargo Aircraft Packing Instructions	Forbidden for transport by air.
Passenger and Cargo Aircraft Max net Qty	Forbidden for transport by air.
Cargo Aircraft Packing Instructions	Forbidden for transport by air.
Cargo Aircraft Max net Qty	Forbidden for transport by air.
Special Provisions	A2
Emergency Response Guidebook (ERG) Code	2CP
Labels	
Labels	2.3 +8



14.4 Packing group

Packing group	Not applicable

14.5 Environmental hazards

Environmental hazards	Not classified as a Marine Pollutant.

Sulphur Dioxide

14.6 Special precautions for user

Special precautions for user	Not known.

14.7 Transport in bulk according to Annex II of Marpol and the IBC Code

Not anticipated to be transported in bulk.

15. SECTION 15: REGULATORY INFORMATION

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

European Regulations - Authorisations and/or Restrictions On Use

Candidate List of Substances of Very High Concern for Authorisation	Not listed
REACH: ANNEX XIV list of substances subject to authorisation	Not listed
REACH: Annex XVII Restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles	Not listed
Community Rolling Action Plan (CoRAP)	Not listed
Regulation (EC) N° 850/2004 of the European Parliament and of the Council on persistent organic pollutants	Not listed
Regulation (EC) N° 2037/2000 on substances that deplete the ozone layer	Not listed
Regulation (EU) N° 649/2012 of the European Parliament and of the Council concerning the export and import of hazardous chemicals	Not listed

National regulations

Other	Not known.

15.2 Chemical Safety Assessment

Please see Appendix.

16. SECTION 16: OTHER INFORMATION

The following sections contain revisions or new statements:

LEGEND

Hazard Pictogram(s)

GHS06

GHS05

GHS04: GHS: gas cylinder

Sulphur Dioxide

Hazard classification	Acute Tox. 3 : Acute toxicity, Category 3 Press. Gas : Gases under pressure Skin Corr. 1B : Skin corrosion/irritation, Category 1B
Hazard Statement(s)	H280: Contains gas under pressure; may explode if heated. H314: Causes severe skin burns and eye damage. H331: Toxic if inhaled
Precautionary Statement(s)	P260: Do not breathe gas. P261: Avoid breathing gas. P264: Wash hands and exposed skin thoroughly after handling. P271: Use only outdoors or in a well-ventilated area. P280: Wear protective gloves/protective clothing/eye protection/face protection/hearing protection. P301+P330+P331: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting. P303+P361+P353: IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water. 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. P311: Call a POISON CENTER/doctor. P321: Specific treatment (see on this label). P363: Wash contaminated clothing before reuse. P403+P233: Store in a well-ventilated place. Keep container tightly closed. P405: Store locked up. P410+P403: Protect from sunlight. Store in a well-ventilated place. P501: Dispose of this material and its container to hazardous or special waste collection point.
Acronyms	ADN : European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways ADR : European Agreement concerning the International Carriage of Dangerous Goods by Road CAS : Chemical Abstracts Service CLP : Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures DNEL : Derived No Effect Level EC : European Community EINECS : European Inventory of Existing Commercial Chemical Substances IATA : International Air Transport Association

IBC : Intermediate Bulk Container
ICAO : International Civil Aviation Organization
IMDG : International Maritime Dangerous Goods
LTEL : Long term exposure limit
PBT : Persistent, Bioaccumulative and Toxic
PNEC : Predicted No Effect Concentration
REACH : Registration, Evaluation, Authorisation and Restriction of Chemicals
RID : Regulations concerning the International Carriage of Dangerous Goods by Rail
STEL : Short term exposure limit
STOT : Specific Target Organ Toxicity
UN : United Nations
vPvB : very Persistent and very Bioaccumulative

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Sulphur Dioxide

Appendix: Exposure Scenarios

List of Exposure Scenarios.

1. Production of sulphur dioxide
2. Discharge and filling operations for trading and distribution purposes
3. Industrial use of Sulphur dioxide in the production of foundry cores (semi-closed process)
4. Industrial use of sulphur dioxide in closed or semi-closed processes
5. Professional use of sulphur dioxide in winemaking/refilling of refrigeration equipment

IU1: Production of sulfur dioxide

Exposure Scenario Format (1) addressing uses carried out by workers	
1. Title	
Free short title	Production of sulfur dioxide (SO_2)
Systematic title based on use descriptor	SU3 (Industrial uses), SU8, SU9 PC19 (appropriate PROCs and ERCs are given in Section 2 below)
Processes, tasks and/or activities covered	Processes, tasks and/or activities covered are described in Section 2 below.

2. Operational conditions and risk management measures

Workplace	Involved tasks	Involved PROCs
Unloading of waste sulfuric acid/sulfur	discharging of waste H_2SO_4/sulfur from road and rail tank cars into closed system	8b
Furnace operations	spraying for decomposition in rotary furnace, operations in the post-combustion chamber and/or burning of sulfur	22
Adsorption / Desorption	cooling, absorption, desorption, drying, compression, condensation	1
Filling of flasks/barrels	connecting and disconnecting operations	8b
Filling of road or rail tank cars	connecting and disconnecting operations	8b
ERC 1	Manufacture of substances	

2.1 Control of workers exposure

Product characteristic

According to the MEASE approach, the substance-intrinsic emission potential is one of the main exposure determinants. This is reflected by an assignment of a so-called fugacity class in the MEASE tool. For operations conducted with liquid or gaseous substances the fugacity is based on the vapour pressure of that substance.

Workplace	Use in preparation	Content in preparation	Physical form	Emission potential
Unloading of waste sulfuric acid/sulfur	not restricted		aqueous solution, liquid, massive	very low
Furnace operations			gaseous	high
Adsorption / Desorption			liquefied gas / gaseous	high
Filling of flasks/barrels			liquefied gas	high
Filling of road or rail tank cars			liquefied gas	high

Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario. Instead, the combination of the scale of operation (industrial vs. professional) and level of containment/automation (as reflected in the PROCs and technical conditions) is the main determinant of the process-intrinsic emission potential.

Frequency and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.

Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

Other given operational conditions affecting workers exposure

Workplace	Room volume	Outdoors or indoors	Process temperature	Process pressure
Unloading of waste sulfuric acid/sulfur	not considered relevant for occupational exposure assessment of the conducted processes	delivery and storage in roofed outdoor workplace	ambient	not considered relevant for occupational exposure assessment of the conducted processes
Furnace operations		not considered relevant for occupational exposure assessment of the conducted processes	< 1,500°C	
Adsorption / Desorption			up to 100°C	
Filling of flasks/barrels			ambient	3,000 – 4,000 hPa
Filling of road or rail			ambient	3,000 – 4,000 hPa

tank cars				
Technical conditions and measures at process level (source) to prevent release				
Workplace	**Level of containment**		**Level of segregation**	
Unloading of waste sulfuric acid/sulfur	tight fitting connections		segregation of the emission source is generally not required in the processes	
Furnace operations	closed system (furnace)			
Adsorption / Desorption	closed system			
Filling of flasks/barrels	extracted (< 100 mbar) and tight fitting connections		For pre-cautionary reasons, it is suggested that workers leave the workplace after connecting/disconnecting if appropriate according the mode of operation. As far as technically feasible, use should be made of automated filling stations.	
Filling of road or rail tank cars	extracted (< 100 mbar) and tight fitting connections			
Technical conditions and measures to control dispersion from source towards the worker				
Workplace	**Level of separation**	**Localised controls (LC)**	**Specification of LC**	**Further information**
Unloading of waste sulfuric acid/sulfur	separation of workers is generally not required in the processes	not required	na	-
Furnace operations		furnace extraction device	10 mbar	
Adsorption / Desorption		not required	na	
Filling of flasks/barrels		integrated extraction devices	< 100 mbar	
Filling of road or rail tank cars		integrated extraction devices	< 100 mbar	
Organisational measures to prevent /limit releases, dispersion and exposure				
Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal hygiene practices, no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes. It is noted that this exposure scenario does exclusively cover exposure to sulfur dioxide. However, during raw material handling, exposure to sulfuric acid may occur. Any existing occupational exposure level has to be maintained in parallel to this exposure scenario.				
Conditions and measures related to personal protection, hygiene and health evaluation				
Eye protection equipment (e.g. goggles or visors) must be worn, unless potential contact with the eye can be excluded by the nature and type of application (i.e. closed process). Additionally, face protection, protective clothing and safety shoes are required to be worn as appropriate. Since sulfur dioxide has corrosive properties, the use of protective gloves is mandatory for all process steps. Respiratory equipment is only required if workers may be exposed to sulfur dioxide during “Filling of road or rail tank cars”. For such situations an ABEK1 mask offering an assigned protection factor of 30 is required. Reference is given to the section “Selection of appropriate respiratory equipment” for a more detailed description of the requirements of personal protective equipment.				
2.2 Control of environmental exposure				
Product characteristics				
Gas				
Amounts used				
80,000 tonnes/year maximum local downstream use volume (local worst-case tonnage is set equal to regional tonnage) regional tonnage sites using SO2 are numerous and wide-spread throughout the EU				
Frequency and duration of use				
365 days				
Technical conditions and measures at process level (source) to prevent release				
All processes are strictly closed.				
Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil				
None if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (e.g. wet or dry scrubber…) No emissions to water. In case of emissions to water, pH impact on the receiving water should be avoided, e.g. by neutralizing the effluent.				
Conditions and measures related to municipal sewage treatment plant				
Not applicable				

Conditions and measures related to external treatment of waste for disposal

No solid waste

Conditions and measures related to external recovery of waste

No solid waste

3. Exposure estimation and reference to its source

Occupational exposure

For the assessment of inhalation exposure, measured data from the production of SO_2 and the exposure estimated from the MEASE tool were used. The risk characterisation ratio (RCR) is the quotient of the refined exposure estimate and the respective DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on the DNEL for sulfur dioxide of 0.5 ppm (1.3 mg/m³).

Workplace	Method used for inhalation exposure assessment	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)
Unloading of waste sulfuric acid/sulfur	not assessed as sulfur dioxide is not yet produced		Since sulfur dioxide has corrosive properties, dermal exposure has to be minimised as far as technically feasible. A DNEL for dermal effects has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.	
Furnace operations	measured data	0.2 ppm (0.4)		
Adsorption / Desorption	MEASE	0.01 ppm (0.02)		
Filling of flasks/barrels	measured data	0.2 ppm (0.4)		
Filling of road or rail tank cars	measured data	0.03 ppm (0.07)		

Environmental emissions

The predicted no effect concentration PNEC of SO_2 in air is 6.65 µg/m3.
Following a PECregional air of 1.035 µg/m3 and a maximum RCR of 0.95, 7 tonnes/year (PEC 5.28 µg/m3) is the maximum amount of SO2 that can be released.
Consequently safe use can be demonstrated when emissions to air of SO_2 do not exceed 7 tonnes/year.

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

Occupational exposure

The downstream user (DU) works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the DU can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation and dermal exposure to a level below the respective DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. It is noted that any given RPE and corresponding APFs in MEASE are related to their efficiency for protection against particles. Thus, for the current scenarios, the specific protection factor of an ABEK1 respiratory mask of 30 has to be applied manually by the user.

$DNEL_{inhalation}$: 0.5 ppm (1.3 mg/m3)
Important note: The DU has to be aware of the fact that apart from the long-term DNEL given above, a DNEL for acute effects exists at a level of 1 ppm (2.7 mg/m³). By demonstrating a safe use when comparing exposure estimates with the long-term DNEL, the acute DNEL is therefore also covered (according to R.14 guidance, acute exposure levels can be derived by multiplying long-term exposure estimates by a factor of 2). When using MEASE for the derivation of exposure estimates, it is noted that the exposure duration may not be reduced.

Environmental emissions

The downstream user (DU) works inside the boundaries set by the ES if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (wet or dry scrubber…).

Sulphur Dioxide

IU2: Discharging and filling operations for trading and distributing purposes

Exposure Scenario Format (1) addressing uses carried out by workers				
1. Title				
Free short title	Discharging and filling operations for trading and distributing purposes of sulfur dioxide (SO_2)			
Systematic title based on use descriptor	SU3 (Industrial uses), SU10 PC19, PC21 (appropriate PROCs and ERCs are given in Section 2 below)			
Processes, tasks and/or activities covered	Processes, tasks and/or activities covered are described in Section 2 below.			
2. Operational conditions and risk management measures				
Workplace	**Involved tasks**		**Involved PROCs**	
Connecting and disconnecting of flasks/barrels	discharging and filling operations (including 1, 8a, 8b, 9 formulation steps in closed systems)			
Discharging and filling of road/rail tank cars	discharging and filling operations (including 1, 8a, 8b, 9 formulation steps in closed systems)			
ERC 2	Formulation of preparations			
2.1 Control of workers exposure				
Product characteristic				
According to the MEASE approach, the substance-intrinsic emission potential is one of the main exposure determinants. This is reflected by an assignment of a so-called fugacity class in the MEASE tool. For operations conducted with liquid or gaseous substances the fugacity is based on the vapour pressure of that substance.				
Workplace	**Use in preparation**	**Content in preparation**	**Physical form**	**Emission potential**
All relevant workplaces	not restricted		liquefied gas	high
Amounts used				
The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario. Instead, the combination of the scale of operation (industrial vs. professional) and level of containment/automation (as reflected in the PROCs and technical conditions) is the main determinant of the process-intrinsic emission potential.				
Frequency and duration of use/exposure				
The exposure duration is not restricted for all applicable processes in this scenario.				
Human factors not influenced by risk management				
The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.				
Other given operational conditions affecting workers exposure				
Workplace	**Room volume**	**Outdoors or indoors**	**Process temperature**	**Process pressure**
All relevant workplaces	not considered relevant for occupational exposure assessment of the conducted processes		ambient	< 4,000 hPa
Technical conditions and measures at process level (source) to prevent release				
Workplace	**Level of containment**		**Level of segregation**	
All relevant workplaces	extracted (< 100 mbar) and tight fitting connections, closed system		For pre-cautionary reasons, it is suggested that workers leave the workplace after connecting/disconnecting if appropriate according the mode of operation. As far as technically feasible, use should be made of automated discharging respectively filling stations.	
Technical conditions and measures to control dispersion from source towards the worker				
Workplace	**Level of separation**	**Localised controls (LC)**	**Specification of LC**	**Further information**
All relevant workplaces	separation of workers is generally not required in the processes	integrated extraction devices	< 100 mbar	-

Organisational measures to prevent /limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal hygiene practices, no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes.

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

Eye protection equipment (e.g. goggles or visors) must be worn, unless potential contact with the eye can be excluded by the nature and type of application (i.e. closed process). Additionally, face protection, protective clothing and safety shoes are required to be worn as appropriate. Since sulfur dioxide has corrosive properties, the use of protective gloves is mandatory for all process steps. Respiratory equipment is only required if workers may be exposed to sulfur dioxide during “Discharging and filling of road/rail tank cars”. For such situations an ABEK1 mask offering an assigned protection factor of 30 is required. Reference is given to the section “Selection of appropriate respiratory equipment” for a more detailed description of the requirements of personal protective equipment.

2.2 Control of environmental exposure

Product characteristics

Gas

Amounts used

80,000 tonnes/year maximum local downstream use volume (local worst-case tonnage is set equal to regional tonnage) regional tonnage sites using SO2 are numerous and wide-spread throughout the EU

Frequency and duration of use

365 days

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

All processes are strictly closed.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

None if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (e.g. wet or dry scrubber…)
No emissions to water. In case of emissions to water, pH impact on the receiving water should be avoided, e.g. by neutralizing the effluent.

Conditions and measures related to municipal sewage treatment plant

Not applicable

Conditions and measures related to external treatment of waste for disposal

No solid waste

Conditions and measures related to external recovery of waste

No solid waste

3. Exposure estimation and reference to its source

Occupational exposure

For the assessment of inhalation exposure, analogous data from the production of SO_2 were used. The risk characterisation ratio (RCR) is the quotient of the refined exposure estimate and the respective DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on the DNEL for sulfur dioxide of 0.5 ppm (1.3 mg/m³).

Workplace	Method used for inhalation exposure assessment	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)
Connecting and disconnecting of flasks/barrels	analogous data	0.2 ppm (0.4)	Since sulfur dioxide has corrosive properties, dermal exposure has to be minimised as far as technically feasible. A DNEL for dermal effects has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.	
Discharging and filling of road/rail tank cars	analogous data	0.03 ppm (0.07)		

Environmental emissions

The predicted no effect concentration PNEC of SO_2 in air is 6.65 µg/m3.
Following a PECregional air of 1.035 µg/m3 and a maximum RCR of 0.95, 7 tonnes/year (PEC 5.28 µg/m3) is the maximum amount of SO2 that can be released.
Consequently safe use can be demonstrated when emissions to air of SO_2 do not exceed 7 tonnes/year.

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

Occupational exposure

The downstream user (DU) works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the DU can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation and dermal exposure to a level below the respective DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. It is noted that any given RPE and corresponding APFs in MEASE are related to their efficiency for protection against particles. Thus, for the current scenarios, the specific protection factor of an ABEK1 respiratory mask of 30 has to be applied manually by the user.

DNEL $_{inhalation}$: 0.5 ppm (1.3 mg/m3)

Important note: The DU has to be aware of the fact that apart from the long-term DNEL given above, a DNEL for acute effects exists at a level of 1 ppm (2.7 mg/m³). By demonstrating a safe use when comparing exposure estimates with the long-term DNEL, the acute DNEL is therefore also covered (according to R.14 guidance, acute exposure levels can be derived by multiplying long-term exposure estimates by a factor of 2). When using MEASE for the derivation of exposure estimates, it is noted that the exposure duration may not be reduced.

Environmental emissions

The downstream user (DU) works inside the boundaries set by the ES if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (wet or dry scrubber…)

IU3: Industrial use of sulfur dioxide in the production of foundry cores (semi-closed process)

Exposure Scenario Format (1) addressing uses carried out by workers	
1. Title	
Free short title	Industrial use of sulfur dioxide (SO_2) in the production of foundry cores (semi-closed process)
Systematic title based on use descriptor	SU3 (Industrial uses), SU14 PC19 (appropriate PROCs and ERCs are given in Section 2 below)
Processes, tasks and/or activities covered	Processes, tasks and/or activities covered are described in Section 2 below.

2. Operational conditions and risk management measures		
Workplace	**Involved tasks**	**Involved PROCs**
Connecting and disconnecting of flasks/barrels	discharging operations (including formulation and processing steps in closed systems)	1, 8a, 8b, 9
Discharging of road/rail tank cars	discharging operations (including formulation and processing steps in closed systems)	1, 8a, 8b, 9
Manufacture of foundry cores (semi-closed process)	manual operations at core shooting machines, and finishing of foundry cores	2, 3, 8b
ERC 2	Formulation of preparation	
ERC 6d	Industrial use of process regulators for polymerisation processes in produc-tion of resins, rubbers, polymers	

2.1 Control of workers exposure

Product characteristic

According to the MEASE approach, the substance-intrinsic emission potential is one of the main exposure determinants. This is reflected by an assignment of a so-called fugacity class in the MEASE tool. For operations conducted with liquid or gaseous substances the fugacity is based on the vapour pressure of that substance.

Workplace	**Use in preparation**	**Content in preparation**	**Physical form**	**Emission potential**
Connecting and disconnecting of flasks/barrels	not restricted		liquefied gas	high
Discharging of road/rail tank cars			liquefied gas	
Manufacture of foundry cores (semi-closed process)			liquefied gas / gaseous	

Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario. Instead, the combination of the scale of operation (industrial vs. professional) and level of containment/automation (as reflected in the PROCs and technical conditions) is the main determinant of the process-intrinsic emission potential.

Frequency and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.

Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

Other given operational conditions affecting workers exposure

Workplace	**Room volume**	**Outdoors or indoors**	**Process temperature**	**Process pressure**
Connecting and disconnecting of flasks/barrels	not considered relevant for occupational exposure assessment of the conducted processes		ambient	< 4,000 hPa
Discharging of road/rail tank cars			ambient	< 4,000 hPa
Manufacture of foundry cores (semi-closed process)			not restricted	ambient

Sulphur Dioxide

Technical conditions and measures at process level (source) to prevent release		
Workplace	**Level of containment**	**Level of segregation**
Connecting and disconnecting of flasks/barrels	extracted (< 100 mbar) and tight fitting connections, closed system	For pre-cautionary reasons, it is suggested that workers leave the workplace after connecting/disconnecting if appropriate according the mode of operation. As far as technically feasible, use should be made of automated discharging respectively filling stations.
Discharging of road/rail tank cars		
Manufacture of foundry cores (semi-closed process)	not required	segregation of the emission source is not required at this workplace

Technical conditions and measures to control dispersion from source towards the worker				
Workplace	**Level of separation**	**Localised controls (LC)**	**Specification / Efficiency of LC**	**Further information**
Connecting and disconnecting of flasks/barrels	separation of workers is generally not required in the processes	integrated extraction devices	< 100 mbar	-
Discharging of road/rail tank cars		integrated extraction devices	< 100 mbar	
Manufacture of foundry cores (semi-closed process)		local exhaust ventilation	90 % (ECETOC efficiency for PROC 2 & PROC 3)	

Organisational measures to prevent /limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal hygiene practices, no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes.

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

Eye protection equipment (e.g. goggles or visors) must be worn, unless potential contact with the eye can be excluded by the nature and type of application (i.e. closed process). Additionally, face protection, protective clothing and safety shoes are required to be worn as appropriate. Since sulfur dioxide has corrosive properties, the use of protective gloves is mandatory for all process steps. Respiratory equipment is required if workers may be exposed to sulfur dioxide during “Discharging of road/rail tank cars” and “Manufacture of foundry cores (semi-closed process)”. For such situations an ABEK1 mask offering an assigned protection factor of 30 is required. Reference is given to the section “Selection of appropriate respiratory equipment” for a more detailed description of the requirements of personal protective equipment.

2.2 Control of environmental exposure

Product characteristics

Gas

Amounts used

80,000 tonnes/year maximum local downstream use volume (local worst-case tonnage is set equal to regional tonnage) regional tonnage sites using SO2 are numerous and wide-spread throughout the EU

Frequency and duration of use

365 days

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

All processes are strictly closed.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

None if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (e.g. wet or dry scrubber…)
No emissions to water. In case of emissions to water, pH impact on the receiving water should be avoided, e.g. by neutralizing the effluent.

Conditions and measures related to municipal sewage treatment plant

Not applicable

Conditions and measures related to external treatment of waste for disposal

No solid waste

Conditions and measures related to external recovery of waste

No solid waste

3. Exposure estimation and reference to its source

Occupational exposure

For the assessment of inhalation exposure, measured data from the manufacture of foundry cores (semi-closed process) and analogous data from the production of SO_2 were used. The risk characterisation ratio (RCR) is the quotient of the refined exposure estimate and the respective DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on the DNEL for sulfur dioxide of 0.5 ppm (1.3 mg/m³).

Workplace	Method used for inhalation exposure assessment	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)
Connecting and disconnecting of flasks/barrels	analogous data	0.2 ppm (0.4)	Since sulfur dioxide has corrosive properties, dermal exposure has to be minimised as far as technically feasible. A DNEL for dermal effects has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.	
Discharging of road/rail tank cars	analogous data	0.03 ppm (0.07)		
Manufacture of foundry cores (semi-closed process)	measured data	0.41 ppm (0.82)		

Environmental emissions

The predicted no effect concentration PNEC of SO_2 in air is 6.65 µg/m3.

Following a PECregional air of 1.035 µg/m3 and a maximum RCR of 0.95, 7 tonnes/year (PEC 5.28 µg/m3) is the maximum amount of SO2 that can be released.

Consequently safe use can be demonstrated when emissions to air of SO_2 do not exceed 7 tonnes/year.

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

Occupational exposure

The downstream user (DU) works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the DU can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation and dermal exposure to a level below the respective DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. It is noted that any given RPE and corresponding APFs in MEASE are related to their efficiency for protection against particles. Thus, for the current scenarios, the specific protection factor of an ABEK1 respiratory mask of 30 has to be applied manually by the user.

$DNEL_{inhalation}$: 0.5 ppm (1.3 mg/m3)

Important note: The DU has to be aware of the fact that apart from the long-term DNEL given above, a DNEL for acute effects exists at a level of 1 ppm (2.7 mg/m³). By demonstrating a safe use when comparing exposure estimates with the long-term DNEL, the acute DNEL is therefore also covered (according to R.14 guidance, acute exposure levels can be derived by multiplying long-term exposure estimates by a factor of 2). When using MEASE for the derivation of exposure estimates, it is noted that the exposure duration may not be reduced.

Environmental emissions

The downstream user (DU) works inside the boundaries set by the ES if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (wet or dry scrubber…)

IU4-IU9: Industrial use of sulfur dioxide in closed or semi-closed processes

Exposure Scenario Format (1) addressing uses carried out by workers	
1. Title	
	Industrial use of sulfur dioxide (SO_2) in the paper, sugar and starch industry, the production of pharmaceutical products, in industrial water treatment, glass coating/lubricate rollers in glass manufacture, in metal casting/mining/purification and as refrigerant agent
Systematic title based on use descriptor	SU3 (Industrial uses), SU4, SU6b, SU8, SU9, SU10, SU13, SU14, SU15 PC14, PC15, PC19, PC20, PC26, PC29, PC37 (appropriate PROCs and ERCs are given in Section 2 below)
Processes, tasks and/or activities	Processes, tasks and/or activities covered are described in Section 2 below. **covered**

2. Operational conditions and risk management measures

Workplace	Involved tasks	Involved PROCs
Connecting and disconnecting of flasks/barrels	discharging operations	1, 8a, 8b, 9
Discharging of road/rail tank cars	discharging operations	1, 8a, 8b, 9
Use of sulfur dioxide in closed processes	maintenance and supervision activities at closed systems	1
Use of sulfur dioxide in semi-closed processes	such as: manual operations (e.g. sampling, additional dosing of fine chemicals), maintenance and use of sulfur dioxide as inert gas in metal alloy production and casting	2, 3, 4, 5, 8b, 22, 23
ERC 2 **ERC 4** **ERC 6a** **ERC 6b**	Formulation of preparation Industrial use of processing aids in processes and products, not becoming part of articles Industrial use resulting in manufacture of another substance (use of intermediates) Industrial use of reactive processing aids	

2.1 Control of workers exposure

Product characteristic

According to the MEASE approach, the substance-intrinsic emission potential is one of the main exposure determinants. This is reflected by an assignment of a so-called fugacity class in the MEASE tool. For operations conducted with liquid or gaseous substances the fugacity is based on the vapour pressure of that substance.

Workplace	Use in preparation	Content in preparation	Physical form	Emission potential
Connecting and disconnecting of flasks/barrels	not restricted		liquefied gas	high
Discharging of road/rail tank cars			liquefied gas	
Use of sulfur dioxide in closed processes			liquefied gas / gaseous	
Use of sulfur dioxide in semi-closed processes			liquefied gas / gaseous	

Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario. Instead, the combination of the scale of operation (industrial vs. professional) and level of containment/automation (as reflected in the PROCs and technical conditions) is the main determinant of the process-intrinsic emission potential.

Frequency and duration of use/exposure

The exposure duration is not restricted for all applicable processes in this scenario.

Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m³/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

Sulphur Dioxide

Other given operational conditions affecting workers exposure				
Workplace	**Room volume**	**Outdoors or indoors**	**Process temperature**	**Process pressure**
Connecting and disconnecting of flasks/barrels	not considered relevant for occupational exposure assessment of the conducted processes		ambient	< 4,000 hPa
Discharging of road/rail tank cars			ambient	< 4,000 hPa
Use of sulfur dioxide in closed processes			not restricted	not restricted
Use of sulfur dioxide in semi-closed processes			not restricted	ambient

Technical conditions and measures at process level (source) to prevent release		
Workplace	**Level of containment**	**Level of segregation**
Connecting and disconnecting of flasks/barrels	extracted (< 100 mbar) and tight fitting connections	For pre-cautionary reasons, it is suggested that workers leave the workplace after connecting/disconnecting if appropriate according the mode of operation. As far as technically feasible, use should be made of automated discharging respectively filling stations.
Discharging of road/rail tank cars		
Use of sulfur dioxide in closed processes	closed system	not required
Use of sulfur dioxide in semi-closed processes	not required	not required

Technical conditions and measures to control dispersion from source towards the worker				
Workplace	**Level of separation**	**Localised controls (LC)**	**Specification / Efficiency of LC**	**Further information**
Connecting and disconnecting of flasks/barrels	separation of workers is generally not required in the processes	integrated extraction devices	< 100 mbar	-
Discharging of road/rail tank cars		integrated extraction devices	< 100 mbar	
Use of sulfur dioxide in closed processes		not required	na	
Use of sulfur dioxide in semi-closed processes		local exhaust ventilation	90 % (ECETOC efficiency for PROC 2 & PROC 3)	

Organisational measures to prevent /limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal hygiene practices, no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes.

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

Eye protection equipment (e.g. goggles or visors) must be worn, unless potential contact with the eye can be excluded by the nature and type of application (i.e. closed process). Additionally, face protection, protective clothing and safety shoes are required to be worn as appropriate. Since sulfur dioxide has corrosive properties, the use of protective gloves is mandatory for all process steps. Respiratory equipment is required if workers may be exposed to sulfur dioxide during “Discharging of road/rail tank cars” and “Use of sulfur dioxide in semi-closed processes”. For such situations an ABEK1 mask offering an assigned protection factor of 30 is required. Reference is given to the section “Selection of appropriate respiratory equipment” for a more detailed description of the requirements of personal protective equipment.

2.2 Control of environmental exposure

Product characteristics

Gas, aqueous solution

Amounts used

80,000 tonnes/year maximum local downstream use volume (local worst-case tonnage is set equal to regional tonnage) regional tonnage sites using SO2 are numerous and wide-spread throughout the EU

Frequency and duration of use

365 days

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

All processes are strictly closed.

Sulphur Dioxide

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

None if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (e.g. wet or dry scrubber…)
No emissions to water. In case of emissions to water, pH impact on the receiving water should be avoided, e.g. by neutralizing the effluent.

Conditions and measures related to municipal sewage treatment plant

Not applicable

Conditions and measures related to external treatment of waste for disposal

No solid waste

Conditions and measures related to external recovery of waste

No solid waste

3. Exposure estimation and reference to its source

Occupational exposure

For the assessment of inhalation exposure, analogous data from the manufacture of foundry cores (semi-closed process), analogous data from the production of SO_2, and MEASE were used. The risk characterisation ratio (RCR) is the quotient of the refined exposure estimate and the respective DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on the DNEL for sulfur dioxide of 0.5 ppm (1.3 mg/m³).

Workplace	Method used for inhalation exposure assessment	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)
Connecting and disconnecting of flasks/barrels	analogous data	0.2 ppm (0.4)	Since sulfur dioxide has corrosive properties, dermal exposure has to be minimised as far as technically feasible. A DNEL for dermal effects has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.	
Discharging of road/rail tank cars	analogous data	0.03 ppm (0.07)		
Use of sulfur dioxide in closed processes	MEASE	0.01 ppm (0.02)		
Use of sulfur dioxide in semi-closed processes	analogous data	0.41 ppm (0.82)		

Environmental emissions

The predicted no effect concentration PNEC of SO_2 in air is 6.65 µg/m3.
Following a PECregional air of 1.035 µg/m3 and a maximum RCR of 0.95, 7 tonnes/year (PEC 5.28 µg/m3) is the maximum amount of SO2 that can be released.
Consequently safe use can be demonstrated when emissions to air of SO_2 do not exceed 7 tonnes/year.

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

Occupational exposure

The downstream user (DU) works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the DU can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation and dermal exposure to a level below the respective DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. It is noted that any given RPE and corresponding APFs in MEASE are related to their efficiency for protection against particles. Thus, for the current scenarios, the specific protection factor of an ABEK1 respiratory mask of 30 has to be applied manually by the user.

DNEL inhalation: 0.5 ppm (1.3 mg/m3)
Important note: The DU has to be aware of the fact that apart from the long-term DNEL given above, a DNEL for acute effects exists at a level of 1 ppm (2.7 mg/m³). By demonstrating a safe use when comparing exposure estimates with the long-term DNEL, the acute DNEL is therefore also covered (according to R.14 guidance, acute exposure levels can be derived by multiplying long-term exposure estimates by a factor of 2). When using MEASE for the derivation of exposure estimates, it is noted that the exposure duration may not be reduced.

Environmental emissions

The downstream user (DU) works inside the boundaries set by the ES if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (wet or dry scrubber…)

Professional IU1 & IU2: Professional use of sulfur dioxide in winemaking/refilling of refrigeration equipment

Exposure Scenario Format (1) addressing uses carried out by workers	
1. Title	
Free short title	Professional use of sulfur dioxide (SO_2) in winemaking/refilling of refrigeration equipment
Systematic title based on use descriptor	SU22 (Professional uses) PC16, PC19 (appropriate PROCs and ERCs are given in Section 2 below)
Processes, tasks and/or activities covered	Processes, tasks and/or activities covered are described in Section 2 below.

2. Operational conditions and risk management measures	
Workplace/Involved tasks	**Involved PROCs**
Connecting and disconnecting of flasks/barrels	8a, 8b, 9
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration equipment	8a, 8b, 9, 19 (dosing by the use of special sulfur dioxide dosing tools)
ERC 6a **ERC 7**	Industrial use resulting in manufacture of another substance (use of intermediates) Industrial use of substances in closed systems

2.1 Control of workers exposure

Product characteristic

According to the MEASE approach, the substance-intrinsic emission potential is one of the main exposure determinants. This is reflected by an assignment of a so-called fugacity class in the MEASE tool. For operations conducted with liquid or gaseous substances the fugacity is based on the vapour pressure of that substance.

Workplace/Involved tasks	**Use in preparation**	**Content in preparation**	**Physical form**	**Emission potential**
All relevant workplaces	not restricted		liquefied gas	high

Amounts used

The actual tonnage handled per shift is not considered to influence the exposure as such for this scenario. Instead, the combination of the scale of operation (industrial vs. professional) and level of containment/automation (as reflected in the PROCs and technical conditions) is the main determinant of the process-intrinsic emission potential.

Frequency and duration of use/exposure

Workplace/Involved tasks	**Duration of exposure**
Connecting and disconnecting of flasks/barrels	480 minutes (not restricted)
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration equipment	< 15 minutes (not considered during exposure assessment because of existing acute effects of sulfur dioxide but pre-scribed for pre-cautionary reasons)

Human factors not influenced by risk management

The safe use of the substance has been demonstrated by assuming a standard breathing volume of 10 m^3/shift for workers. If doubts exist that the actual breathing volume exceeds this value on a regular basis, a refined exposure scenario may be required.

Other given operational conditions affecting workers exposure

Workplace/Involved tasks	**Room volume**	**Outdoors or indoors**	**Process temperature**	**Process pressure**
Connecting and disconnecting of flasks/barrels	not considered relevant for occupational exposure assessment of the conducted processes		ambient	< 4,000 hPa
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration equipment	wine cellars/refrigerating facilities	not restricted		

Sulphur Dioxide

Technical conditions and measures at process level (source) to prevent release		
Workplace/Involved tasks	**Level of containment**	**Level of segregation**
Connecting and disconnecting of flasks/barrels	extracted (< 100 mbar) and tight fitting connections	For pre-cautionary reasons, it is suggested that workers leave the workplace after connecting/disconnecting if appropriate according the mode of operation. As far as technically feasible, use should be made of automated discharging respectively filling stations.
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration equipment	not required	When not used, flasks should be safely stored (preferably in a separate room) according to manufacturer's instructions.

Technical conditions and measures to control dispersion from source towards the worker				
Workplace/Involved tasks	**Level of separation**	**Localised controls (LC)**	**Specification of LC**	**Further information**
Connecting and disconnecting of flasks/barrels	separation of workers is generally not required in the processes	integrated extraction devices	< 100 mbar	-
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration equipment		not required	na	

Organisational measures to prevent /limit releases, dispersion and exposure

Avoid inhalation or ingestion. General occupational hygiene measures are required to ensure a safe handling of the substance. These measures involve good personal hygiene practices, no eating and smoking at the workplace, unless otherwise stated below the wearing of standard working clothes and shoes.

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

Eye protection equipment (e.g. goggles or visors) must be worn, unless potential contact with the eye can be excluded by the nature and type of application (i.e. closed process). Additionally, face protection, protective clothing and safety shoes are required to be worn as appropriate. Since sulfur dioxide has corrosive properties, the use of protective gloves is mandatory for all process steps. Respiratory equipment is not required for the workplaces defined in this exposure scenario. Reference is given to the section "Selection of appropriate respiratory equipment" for a more detailed description of the requirements of personal protective equipment.

2.2 Control of environmental exposure

Product characteristics

Gas, aqueous solution

Amounts used

80,000 tonnes/year maximum local downstream use volume (local worst-case tonnage is set equal to regional tonnage) regional tonnage sites using SO2 are numerous and wide-spread throughout the EU

Frequency and duration of use

365 days

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

All processes are strictly closed.

Technical onsite conditions and measures to reduce or limit discharges, air emissions and releases to soil

None if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (e.g. wet or dry scrubber…)
No emissions to water. In case of emissions to water, pH impact on the receiving water should be avoided, e.g. by neutralizing the effluent.

Conditions and measures related to municipal sewage treatment plant

Not applicable

Conditions and measures related to external treatment of waste for disposal

No solid waste

Conditions and measures related to external recovery of waste

No solid waste

3. Exposure estimation and reference to its source

Occupational exposure

For the assessment of inhalation exposure, analogous data from the production of SO_2 were used and doubled for pre-cautionary reasons. The risk characterisation ratio (RCR) is the quotient of the refined exposure estimate and the respective DNEL (derived no-effect level) and has to be below 1 to demonstrate a safe use. For inhalation exposure, the RCR is based on the DNEL for sulfur dioxide of 0.5 ppm (1.3 mg/m³).

Workplace/Involved tasks	Method used for inhalation exposure assessment	Inhalation exposure estimate (RCR)	Method used for dermal exposure assessment	Dermal exposure estimate (RCR)
Connecting and disconnecting of flasks/barrels	analogous data	0.4 ppm (0.8)	Since sulfur dioxide has corrosive properties, dermal exposure has to be minimised as far as technically feasible. A DNEL for dermal effects has not been derived. Thus, dermal exposure is not assessed in this exposure scenario.	
Manual dosing of sulfur dioxide from flasks into wine casks/refrigeration equipment	analogous data	0.4 ppm (0.8)		

Environmental emissions

The predicted no effect concentration PNEC of SO_2 in air is 6.65 µg/m3.
Following a PECregional air of 1.035 µg/m3 and a maximum RCR of 0.95, 7 tonnes/year (PEC 5.28 µg/m3) is the maximum amount of SO2 that can be released.
Consequently safe use can be demonstrated when emissions to air of SO_2 do not exceed 7 tonnes/year.

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

Occupational exposure

The downstream user (DU) works inside the boundaries set by the ES if either the proposed risk management measures as described above are met or the DU can demonstrate on his own that his operational conditions and implemented risk management measures are adequate. This has to be done by showing that they limit the inhalation and dermal exposure to a level below the respective DNEL (given that the processes and activities in question are covered by the PROCs listed above) as given below. If measured data are not available, the DU may make use of an appropriate scaling tool such as MEASE (www.ebrc.de/mease.html) to estimate the associated exposure. It is noted that any given RPE and corresponding APFs in MEASE are related to their efficiency for protection against particles. Thus, for the current scenarios, the specific protection factor of an ABEK1 respiratory mask of 30 has to be applied manually by the user.

DNEL $_{inhalation}$: 0.5 ppm (1.3 mg/m3)
Important note: The DU has to be aware of the fact that apart from the long-term DNEL given above, a DNEL for acute effects exists at a level of 1 ppm (2.7 mg/m³). By demonstrating a safe use when comparing exposure estimates with the long-term DNEL, the acute DNEL is therefore also covered (according to R.14 guidance, acute exposure levels can be derived by multiplying long-term exposure estimates by a factor of 2). When using MEASE for the derivation of exposure estimates, it is noted that the exposure duration may not be reduced.

Environmental emissions

The downstream user (DU) works inside the boundaries set by the ES if emission to air < 7 tonnes/year. If emission to air > 7 tonnes/year, air emission abatement system should be used (wet or dry scrubber…)